LAND-ROVER **RANGE ROVER**

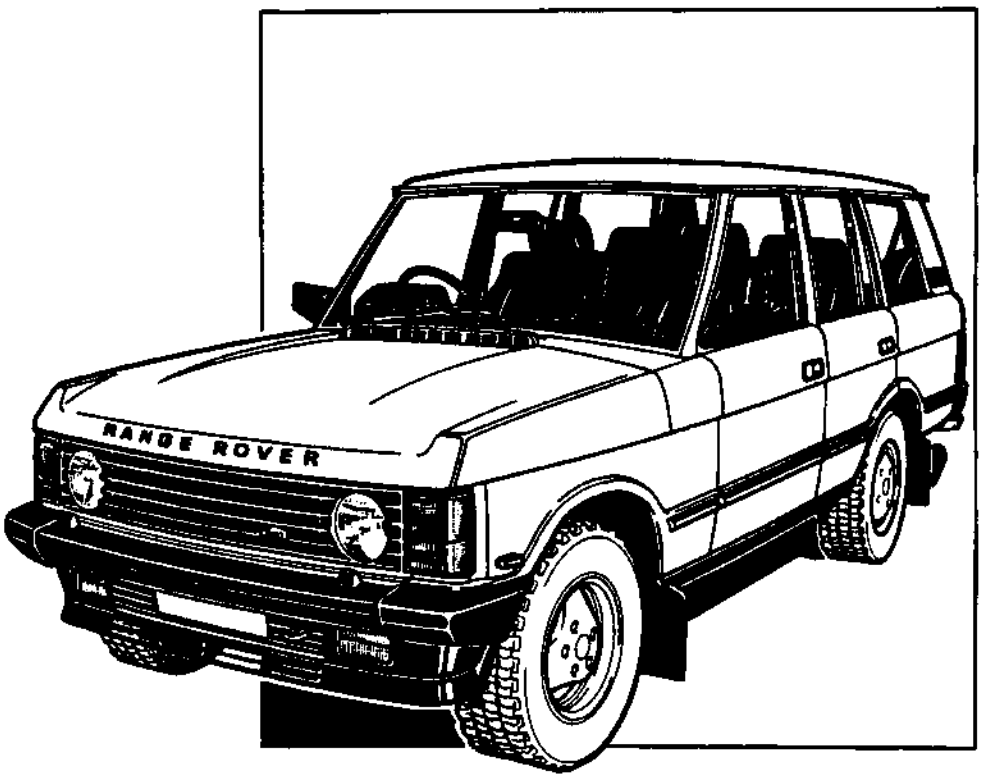


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1988 Model Year Supplement

Alternator Bulletin

Brake Bulletin

Vogue SE Bulletin

Sunshine Roof Bulletin

1989 Model Year Supplement

Concealed Door Hinges Bulletin

The following supplements and bulletins appear in Part Two of the manual

1990 Model Year Supplement

1991 Model Year Supplement

2.4 & 2.5 Turbo Diesel Engine Supplement

Power Steering Supplement

LT77S Gearbox Supplement

1992 Model Year Supplement

1993 Model Year Supplement

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INTRODUCTION

This Workshop Manual covers the Range Rover range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Range Rover vehicles.

WARNINGS and CAUTIONS are given throughout this manual in the following form:

WARNING: Procedures which must be followed precisely to avoid the possibility of personal injury.

CAUTION: This calls attention to procedures which must be followed to avoid damage to components.

NOTE: This calls attention to methods which make a job easier to perform.

REFERENCES

References to the left- or right-hand side in the manual are made when viewing the vehicle from the rear. With the engine and gearbox assembly removed , the water pump end of the engine is referred to as the front.
To reduce repetition, operations covered in this manual do not include reference to testing the vehicle after repair. It is essential that work is inspected and tested after completion and if necessary a road test of the vehicle is carried out particularly where safety related items are concerned.

DIMENSIONS

The dimensions quoted are to design engineering specification. Alternative unit equivalents, shown in brackets following the dimensions, have been converted from the original specification.
During the period of running-in from new, certain adjustments may vary from the specification figures given in this Manual. These adjustments will be re-set by the Distributor or Dealer at the After Sales Service, and thereafter should be maintained at the figures specified in the Manual.

REPAIRS AND REPLACEMENTS

When replacement parts are required it is essential that only Land Rover parts are used.
Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories:
Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque wrench setting figues given in the Repair Operation Manual must be strictly adhered to. Locking devices, where specified, must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed. Owners purchasing accessories while travelling abroad should ensure that the accessory and its fitted location on the vehicle conform to mandatory requirements existing in their country of origin. The terms of the Owners Service Statement may be invalidated by the fitting of other than Land Rover parts.
All Land Rover parts have the full backing of the Owners Service Statement.
Land Rover Distributors and Dealers are obliged to supply only Land Rover service parts.

POISONOUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should as far as possible be kept away from open wounds. These substances among others include antifreeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if petrol (gasoline) is to be handled safely. It also outlines the other areas of risk which must not be ignored.
This information is issued for basic guidance only, and in any case of doubt appropriate enquiries should be made of your local Fire Officer.

GENERAL

Petrol/gasoline vapour is highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially very dangerous.

Continued

Always have a fire extinguisher containing FOAM CO_2 GAS, or POWDER close at hand when handling or draining fuel, or when dismantling fuel systems and in areas where fuel containers are stored.
Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system.
Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

NO ONE SHOULD BE PERMITTED TO REPAIR COMPONENTS ASSOCIATED WITH PETROL/GASOLINE WITHOUT FIRST HAVING HAD SPECIALIST TRAINING.

FUEL TANK DRAINING

WARNING: PETROL/GASOLINE MUST NOT BE EXTRACTED OR DRAINED FROM ANY VEHICLE WHILST IT IS STANDING OVER A PIT.

Draining or extracting petrol/gasoline from vehicle fuel tank must be carried out in a well ventilated area.
The receptacle used to contain the petrol/gasoline must be more than adequate for the full amount of fuel to be extracted or drained. The receptacle should be clearly marked with its contents, and placed in a safe storage area which meets the requirements of local authority regulations.
WHEN PETROL/GASOLINE HAS BEEN EXTRACTED OR DRAINED FROM A FUEL TANK THE PRECAUTIONS GOVERNING NAKED LIGHTS AND IGNITION SOURCES SHOULD BE MAINTAINED.

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are released before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.
As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

Under no circumstances should a repair to any tank involving heat treatment be carried out without first rendering the tank SAFE, by using one of the following methods:

STEAMING: With the filler cap and tank unit removed, empty the tank. Steam the tank for at least two hours with low pressure steam. Position the tank so that condensation can drain away freely, ensuring that any sediment and sludge not volatised by the steam, is washed out during the steaming process.

BOILING: With the filler cap and tank unit removed, empty the tank. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling and also surrounding the tank for at least two hours.
After steaming or boiling a signed and dated label to this effect should be attached to the tank.

SPECIFICATION

Purchasers are advised that the specification details set out in this Manual apply to a range of vehicles and not to any one. For the specification of a particular vehicle, purchasers should consult their Distributor or Dealer.

The Manufacturers reserve the right to vary their specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer nor the Distributor or Dealer, by whom this Manual is supplied, shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

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Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which they save can be considerable.

Every special tool is designed with the close co-operation of Land Rover Ltd., and no tool is put into production which has not been tested and approved by us. New tools are only introduced where an operation cannot be satisfactorily carried out using existing tools or standard equipment. The user is therefore assured that the tool is necessary and that it will perform accurately, efficiently and safely.

Special tools bulletins will be issued periodically giving details of new tools as they are introduced.

All orders and enquiries from the United Kingdom should be sent direct to V. L. Churchill. Overseas orders should be placed with the local V. L. Churchill distributor, where one exists. Countries where there is no distributor may order direct from V. L. Churchill Limited.

The tools recommended in this Repair Operation Manual are listed in a multi-language, illustrated catalogue obtainable from Messrs. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address: Land Rover Limited, Service Department, Lode Lane, Solihull, West Midlands, England B92 8NW.

ABBREVIATIONS AND SYMBOLS USED IN THIS MANUAL

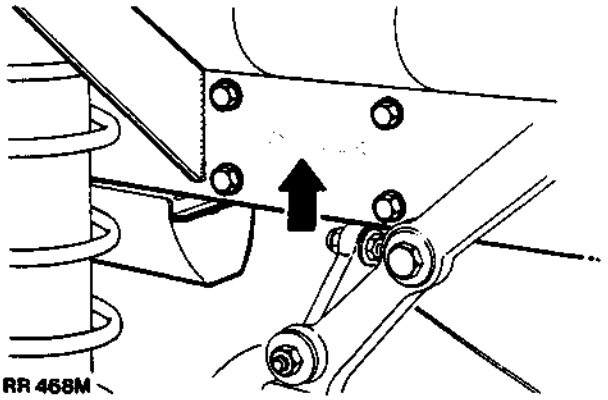
Across flats (bolt size)	AF
After bottom dead centre	ABDC
After top dead centre	ATDC
Alternating current	a.c.
Ampere	amp
Ampere-hour	amp hr
Atmospheres	Atm
Before bottom dead centre	BBDC
Before top dead centre	BTDC
Bottom dead centre	BDC
Brake mean effective pressure	BMEP
Brake horse power	bhp
British Standards	BS
Carbon monoxide	CO
Centimetre	cm
Centigrade (Celsius)	C
Cubic centimetre	cm^3
Cubic inch	in^3
Degree (angle)	deg or °
Degree (temperature)	deg or °
Diameter	dia.
Direct current	d.c.
Fahrenheit	F
Feet	ft
Feet per minute	ft/min
Fifth	5th
Figure (illustration)	Fig.
First	1st
Fourth	4th
Gramme (force)	gf
Gramme (mass)	g
Gallons	gal
Gallons (US)	US gal
High compression	h.c.
High tension (electrical)	H.T.
Hundredweight	cwt
Independent front suspension	i.f.s.
Internal diameter	i.dia.
Inches of mercury	in.Hg
Inches	in
Kilogramme (force)	kgf
Kilogramme (mass)	kg
Kilogramme centimetre (torque)	kgf.cm
Kilogramme per square centimetre	kg/cm^2
Kilogramme metres (torque)	kgf.m
Kilometres	km
Kilometres per hour	km/h
Kilovolts	kV
King pin inclination	k.p.i.
Left-hand steering	LHStg
Left-hand thread	LHThd
Litres	litre
Low compression	l.c.
Low tension	l.t.
Maximum	max.
Metre	m
Microfarad	mfd
Midget edison screw	MES
Millimetre	mm
Miles per gallon	mpg
Miles per hour	mph
Minimum	min
minute (angle)	'
Minus (of tolerance)	−
Negative (electrical)	−
Number	No.
Ohms	ohm
Ounces (force)	ozf
Ounces (mass)	oz
Ounce inch (torque)	ozf.in.
Outside diameter	o.dia.
Paragraphs	para.
Part number	Part No.
Percentage	%
Pints	pt
Pints (US)	US pt
Plus (tolerance)	+
Positive (electrical)	+
Pound (force)	lbf
Pounds feet (torque)	lbf.ft.
Pounds inches (torque)	lbf.in.
Pound (mass)	lb
Pounds per square inch	lb/in^2
Radius	r
Rate (frequency)	c/min
Ratio	:
Reference	ref.
Revolution per minute	rev/min
Right-hand	RH
Right-hand steering	RHStg
Second (angle)	"
Second (numerical order)	2nd
Single carburetter	SC
Specific gravity	sp.gr.
Square centimetres	cm^2
Square inches	in^2
Standard	std.
Standard wire gauge	s.w.g.
Synchroniser/synchromesh	synchro.
Third	3rd
Top dead centre	TDC
Twin carburetters	TC
United Kingdom	UK
Vehicle Identification Number	VIN
Volts	V
Watts	W

SCREW THREADS

American Standard Taper Pipe	NPTF
British Association	BA
British Standard Fine	BSF
British Standard Pipe	BSP
British Standard Whitworth	Whit.
Unified Coarse	UNC
Unified Fine	UNF

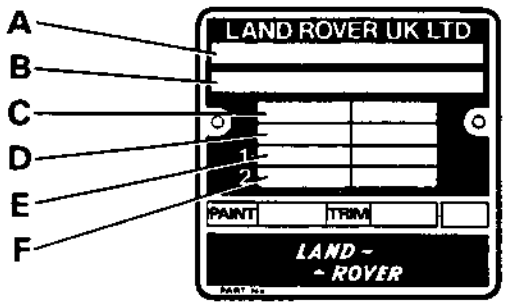
VEHICLE IDENTIFICATION NUMBER (VIN)

The Vehicle Identification Number and the recommended maximum vehicle weights are stamped on a plate located under the bonnet riveted to the top of the front grille at the front of the engine compartment.
The number is also stamped on the right side of the chassis forward of the spring mounting turret.


RR 468M

Key to Vehicle Identification Number Plate
(UK, Australia, R.O.W., Europe)

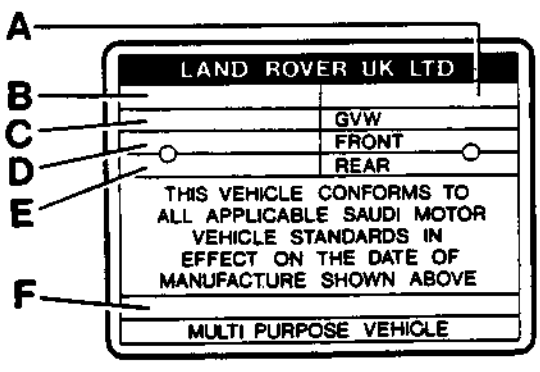
A. Type approval (UK only)
B. VIN (minimum of 17 digits)
C. Maximum permitted laden weight for vehicle
D. Maximum vehicle and trailer weight
E. Maximum road weight—front axle
F. Maximum road weight—rear axle



RR 381

Key to Vehicle Identification Number
(Saudi Arabia)

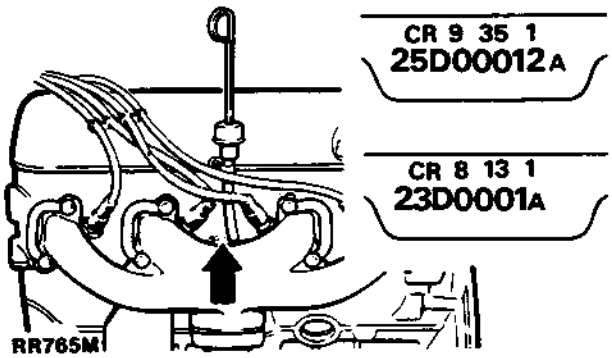
A. Year of manufacture
B. Month of manufacture
C. Maximum vehicle weight
D. Maximum road weight—front axle
E. Maximum road weight—rear axle
F. VIN (minimum of 17 digits)



RR 466M

ENGINE SERIAL NUMBER—V8 ENGINE

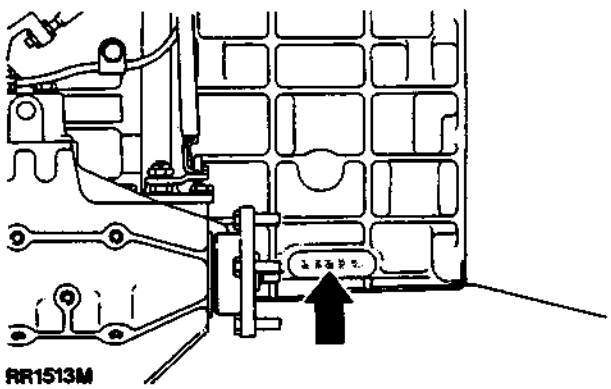
The V8 engine serial number is stamped on a cast pad on the cylinder block between numbers 3 and 5 cylinders.
NOTE: The appropriate engine compression ratio is stamped above the serial number.



RR765M

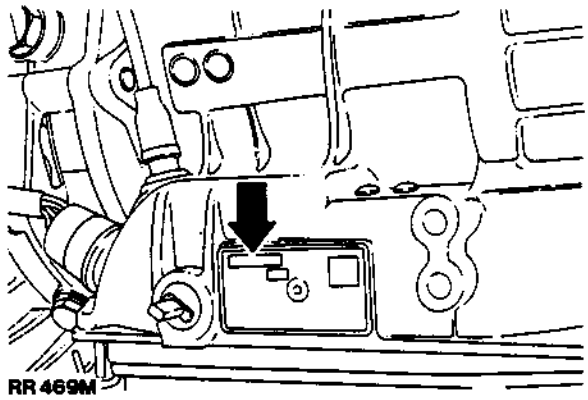
MAIN GEARBOX LT77—5 SPEED

The serial number is stamped on a cast pad on the bottom right-hand side of the gearbox.


RR1513M

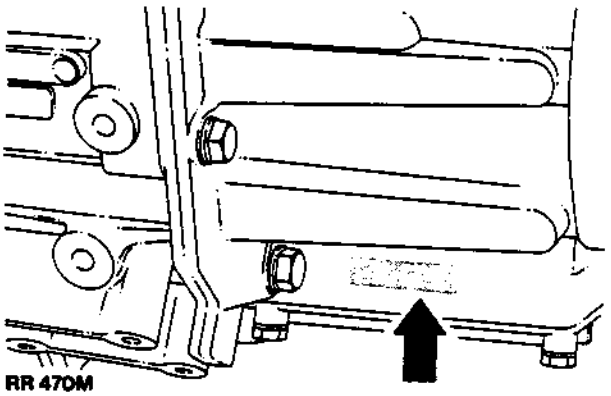
AUTOMATIC GEARBOX ZF4HP22

The serial number is stamped on a plate riveted to the bottom left-hand side of the gearbox casing.


RR 469M

TRANSFER GEARBOX LT230T

The serial number is stamped on the left-hand side of the gearbox casing below the mainshaft rear bearing housing adjacent to the bottom cover.


RR 470M

FRONT AXLE

The serial number is stamped on top of the left-hand axle tube.

REAR AXLE

The serial number is stamped on the left-hand rear axle tube.

GENERAL SPECIFICATION DATA

V8 ENGINE

ENGINE	
Type	V8
Number of cylinders	Eight, two banks of four
Bore	88.90 mm (3.500 in)
Stroke	71.12 mm (2.800 in)
Capacity	3528 cc (215 in³)
Valve operation	Overhead by push-rod
Fuel-injection models	
Maximum power—bhp—9.35 :1	165 at 4750 rev/min
Maximum power—bhp—8.13 :1	150 at 4750 rev/min
Maximum torque—9.35 :1	206 lbf.ft. (279 Nm) at 3200 rev/min
Maximum torque—8.13 :1	190 lbf.ft. (258 Nm) at 2500 rev/min
Carburetter models	
Maximum power—bhp—9.35 :1	127 at 4000 rev/min
Maximum power—bhp—8.13 :1	132 at 5000 rev/min
Maximum torque—9.35 :1	194 lbf.ft. (263 Nm) at 2500 rev/min
Maximum torque—8.13 :1	185 lbf.ft. (251 Nm) at 2500 rev/min
Main bearings	
Number and type	5 Vandervell shells
Material	Lead–indium
Connecting rods	
Type	Horizontally split big-end, plain small-end
Big-end bearings	
Number and type	8 Vandervell VP shells
Material	Lead–indium
Gudgeon pins	
Type	Press fit in connecting rod. Clearance on piston
Pistons	
Type	Aluminium alloy, concave crown
Camshaft	
Location	Central
Number of bearings	5
Bearings	Non-serviceable
Tappets	Hydraulic—self-adjusting
Lubrication	
System type	Wet sump, pressure fed
Oil pump type	Gear
Oil filter	Full flow, self-contained cartridge
Cooling system	
Type	Pressurised spill-return system with thermostat control, pump and fan assisted
Type of pump	Centrifugal

Fuel system—carburetter	
8.13 :1, 9.35 :1 Emission controlled	2 × Solex 175 CDSE
8.13 :1 Non emission	2 × Solex 175 CD3
Fuel pump	AC Delco—low pressure (electrical), immersed in the fuel tank
Fuel filter	AC Delco CD600, element ACD60
Fuel system—fuel injection	
Type	Lucas 'L' system electronically controlled
Fuel pump—make and type	AC Delco—high pressure (electrical), immersed in the fuel tank
Fuel filter—make and type	Bosch in-line filter, cannister type

TRANSMISSION

Clutch	
Make and type	Borg & Beck, diaphragm type
Clutch plate diameter	266.5 mm (10.5 in)
Gearbox	
Model	LT77 (manual)
Type	Five speed, single helical constant mesh with synchromesh on all forward gears
Gearbox	
Model	ZF 4HP22 (automatic)
Type	Automatic four speed and reverse, epicyclic gearbox with fluid torque converter and lock up
Transfer gearbox	
Model	LT230T
Type	Two-speed reduction on gearbox output, front and rear drive permanently engaged via a lockable differential
Propellor shafts	
Type	Open type 50.8 mm (2 in) diameter
Universal joints	03EHD standard shafts
Rear axle	
Type	Spiral bevel, fully floating shafts
Ratio	3.54 :1
Front axle	
Type	Spiral bevel enclosed constant velocity joints
Ratio	3.54 :1

SUSPENSION

Front	Coil springs, radius arms and panhard rod
Rear	Coil springs, radius arms, 'A' frame location arms with 'Boge' hydromat self-energising levelling device
Shock absorbers	
Type	Telescopic, double acting—non adjustable

STEERING

Power assisted type	Adwest varamatic

BRAKES

Foot Brake

Type	Disc
Operation	Hydraulic, servo assisted, self adjusting

Front Brake

Type	Outboard discs with four piston calipers
Pad wear indicator	Right-hand caliper, inboard pad

Rear Brake

Type	Outboard disc with two piston calipers
Pad wear indicator	Left-hand caliper, inboard pad

Transmission Brake

Type	Mechanical-cable operated drum brake on the rear of the transfer gearbox output shaft

WHEELS AND TYRES

Type and size	Steel 6.00 JK × 16 (tubed) Alloy 7.00 J × 16 (tubed or tubeless)
Tyre size	205 R16 or 215/75 R16

NOTE: Fuel injection vehicles must be fitted with 'S' rated high speed tyres.

ELECTRICAL EQUIPMENT

System	12 volt negative earth
Fuses	'Autofuse' (blade type) Blow ratings to suit individual circuits

Battery

Make	Chloride maintenance free
Type	9 plate 210/85/90 13 plate 380/120/90

Starter Motor

Make and type	Lucas 3M100 pre-engaged

Alternator

Make and type	Lucas 133/65

Wiper Motor

Make and type	Front—Lucas 28W 2-speed Rear—Lucas 14W PM

Horns

Make and type	Klamix (Mixo) TR99

Distributor

Make and type	Lucas 35DM8 electronic

Ignition Module	
Make and type	Lucas 2CE 12 volt electronic
Airflow Meter	
Make and type	Lucas 2AM
Serial number	73243A
Injectors	
Make and type	Lucas 6NJ
Serial number	73178A
Electronic Control Unit	
Make and type	Lucas 4CU
Serial number	84477A
Power Resistor Pack	
Make and type	2PR
Serial number	73184A
VEHICLE DIMENSIONS	
Overall length	4.45 m (175 in)
Overall width	1.82 m (71.6 in)
Overall height	1.90 m (74.8 in)
Wheelbase	2.54 m (100 in)
Track: front and rear	1.49 m (58.5 in)
Ground clearance: under differential	190 mm (7.5 in)
Turning circle	11.89 m (39 ft)
Loading height	686 mm (27 in)
Maximum cargo height	1.01 m (40 in)
Rear opening height	1.01 m (40 in)
Usable luggage capacity, rear seat folded	2.00 m^3 (70 ft^3)
Usable luggage capacity, rear seat in use:	
—four door vehicles	1.25 m^3 (44.14 ft^3)
—two door vehicles	1.17 m^3 (41.31 ft^3)
Maximum roof rack load	75 kg (165 lb)

VEHICLE WEIGHTS AND PAYLOAD

When loading a vehicle to its maximum (Gross Vehicle Weight), consideration must be taken of the unladen vehicle weight and the distribution of the payload to ensure that axle loadings do not exceed the permitted maximum values.
It is the customer's responsibility to limit the vehicle's payload in an appropriate manner such that neither maximum axle loads nor Gross Vehicle Weight are exceeded.

Range Rover						
	Manual			Automatic		
Model	Front Axle kg (lb)	Rear Axle kg (lb)	Total kg (lb)	Front kg (lb)	Rear kg (lb)	Total kg (lb)
2 DOOR Unladen Weight	893 (1969)	867 (1911)	1760 (3880)	920 (2028)	871 (1920)	1791 (3948)
EEC Kerb Weight	912 (2011)	983 (2167)	1895 (4178)	939 (2070)	987 (2176)	1926 (4246)
Gross Vehicle Weight	1100 (2425)	1510 (3329)	2510 (5534)	1100 (2425)	1510 (3329)	2510 (5534)
4 DOOR Unladen Weight	909 (2004)	883 (1947)	1792 (3951)	925 (2039)	911 (2008)	1836 (4048)
EEC Kerb Weight	928 (2046)	999 (2202)	1927 (4248)	944 (2081)	1027 (2264)	1971 (4345)
Gross Vehicle Weight	1100 (2425)	1510 (3329)	2510 (5534)	1100 (2425)	1510 (3329)	2510 (5534)

Note: UNLADEN WEIGHT is the minimum vehicle specification, excluding fuel and driver.
EEC KERB WEIGHT is the minimum vehicle specification, plus full fuel tank and 75 kg (165 lb) driver.
GROSS VEHICLE WEIGHT is the maximum all-up weight of the vehicle including driver, passengers, payload and equipment. This figure is liable to vary according to legal requirements in certain countries.

Maximum permissible towed weights

	On-road	Off-road
Trailers without brakes	750 kg 1650 lb	750 kg 1650 lb
Trailers with overrun brakes	3500 kg 7700 lb	1000 kg 2200 lb
4-wheel trailers with continuous or semi-continuous brakes, i.e. coupled brakes	4000 kg 8800 lb	1000 kg 2200 lb

NOTE: **It is the Owner's responsibility to ensure that all regulations with regard to towing are complied with. This applies also when towing abroad. All relevant information should be obtained from the appropriate motoring organisation.**

Tyre Pressures

Pressures: Check with tyres cold

Normal on- and off-road use. All speeds and loads			Off-road 'emergency' soft use maximum speed of 40 kph (25 mph)		
	Front	Rear		Front	Rear
bars	1,9	2,4	bars	1,1	1,6
lbf/in²	28	35	lbf/in²	16	23
kgf/cm²	2,0	2,5	kgf/cm²	1,1	1,6

For extra ride comfort rear tyre pressures may be reduced to 2,1 bars (31 lbf/in²) 2,2 kgf/cm² when the rear axle weight does not exceed 1250 kg (2755 lb).
These pressures may be increased for rough off-road usage where the risk of tyre cutting or penetration is more likely.
Pressures may also be increased for high speed motoring near the vehicle's maximum speed. Any such increase in pressures may be up to an absolute maximum pressure of 2,9 bars (42 lbf/in²) 3,0 kgf/cm².
Normal operating pressures should be restored as soon as reasonable road conditions or hard ground is reached.
After any usage off the road, tyres and wheels should be inspected for damage particularly if high cruising speeds are subsequently to be used.
Towing: When the vehicle is used for towing, the reduced rear tyre pressures for extra ride comfort are not applicable.

WARNING: Wheels and tyres. Unless both wheel rim and tyre are marked 'TUBELESS', an inner tube MUST be fitted.

ENGINE TUNING DATA

Type	V8 Cylinder
Firing order	1—8—4—3—6—5—7—2
Cylinder Numbers—Left bank	1—3—5—7
Right bank	2—4—6—8
No 1 Cylinder location	Pulley end of left bank
Timing marks	On crankshaft vibration damper
Spark plugs	
Make/type	Champion N9YC
Gap	0.70–0.80 mm (0.030–0.032 in)
Ignition module	
Make/type	Lucas 2CE 12 volt electronic
Distributor	
Make/type	Lucas 35DM8 electronic
Air gap	0.20–0.35 mm (0.008–0.014 in)

FUEL INJECTION MODELS

Engine	V8 Cylinder
Compression ratio	9.35:1 and 8.13:1
Fuel injection system	Lucas 'L' system electronically controlled

Valve Timing	**Inlet**	**Exhaust**
Opens	24° BTDC	62° BBDC
Closes	52° ABDC	14° ATDC
Duration	256°	256°
Valve peak	104° ATDC	114° BTDC

Idle Speed	700 to 800 rev/min
Ignition Timing at	600 rev/min
Ignition Timing	
Dynamic or static	TDC ± 1°
Exhaust Gas CO content at idle	0.5–1.0% max
Distributor	
Make/type	Lucas 35 DM8 electronic
Rotation	Clockwise
Air gap	0.20–0.35 mm (0.008–0.014 in)
Serial number	42608
Centrifugal Advance	
Decelerating check—vacuum pipe disconnected	
Distributor decelerating speeds—1600	Distributor advance 12° to 14°
1100	9° 30′ to 11° 30′
600	1° 30′ to 4°
No centrifugal advance below	600 rev/min
Fuel	96 octane—9.35:1
	93 octane—8.13:1

EUROPE—Emission Controlled

CARBURETTER MODELS

Engine	V8 Cylinder	
Compression ratio	9.35:1	
Valve timing	**Inlet**	**Exhaust**
Opens	36° BTDC	74° BBDC
Closes	64° ABDC	26° ATDC
Duration	280°	280°
Valve peak	99° ATDC	119° BTDC
Carburetters		
Type	2 × Solex 175 CDSE	
Solex specification number	4187	
Needle	B1GG	
Idle speed (engine hot)	650–750 rev/min	
Fast idle speed (engine hot)	1050–1150 rev/min	
Mixture setting—CO at idle	0.5%–2.5% pulsair connected	
Ignition		
Distributor make/type	Lucas 35DM8 electronic	
Direction of rotation	Clockwise	
Air gap	0.20–0.35 mm (0.008–0.014 in)	
Distributor serial number	41980	
Centrifugal advance		
Decelerating check with vacuum pipe disconnected		
Distributor decelerating speeds—2800	Distributor advance 5° 30′ to 9°	
1750	6° 30′ to 9°	
1000	2° 30′ to 4° 30′	
No advance below	250 rev/min	
Ignition timing		
Dynamic or static	6° BTDC at 650–750 rev/min (vacuum pipe disconnected)	
Fuel	96 octane	

GULF STATES—Emission Controlled

CARBURETTER MODELS

Engine	V8 Cylinder	
Compression ratio	8.13:1	
Valve timing	**Inlet**	**Exhaust**
Opens	30° BTDC	68° BBDC
Closes	75° ABDC	37° ATDC
Duration	285°	285°
Valve peak	106° ATDC	112° BTDC
Carburetters		
Type	2 × Solex 175 CDSE	
Solex specification number	4186	
Needle	B1FC	
Idle speed (engine hot)	650–750 rev/min	
Fast idle speed (engine hot)	1050–1150 rev/min	
Mixture setting—CO at idle	1.5%–3.5% pulsair connected	
Ignition		
Distributor make/type	Lucas 35DM8 electronic	
Direction of rotation	Clockwise	
Air gap	0.20–0.35 mm (0.008–0.014 in)	
Distributor serial number	42609	
Centrifugal advance	Vacuum pipe disconnected	
Distributor decelerating speeds—2300	Distributor advance 10° 30′ to 13° 30′	
1800	8° to 10°	
1200	3° 30′ to 5° 30′	
No advance below	450 rev/min	
Ignition timing		
Dynamic or static	6° BTDC at 600 rev/min (vacuum pipe disconnected)	
Fuel	90–93 octane	

REST OF THE WORLD—Non Emission

CARBURETTER MODELS

Engine	V8 Cylinder	
Compression ratio	8.13:1	
Valve timing	**Inlet**	**Exhaust**
Opens	30° BTDC	68° BBDC
Closes	75° ABDC	37° ATDC
Duration	285°	285°
Valve peak	106° ATDC	112° BTDC
Carburetters		
Type	2 × Solex 175 CD3	
Solex specification number	4185	
Needle	B1FF	
Idle speed (engine hot)	550—650 rev/min	
Fast idle speed (engine hot)	1050—1150 rev/min	
Ignition		
Distributor make/type	Lucas 35DM8 electronic	
Direction of rotation	Clockwise	
Air gap	0.20–0.35 mm (0.008–0.014 in)	
Distributor serial number	41981	
Centrifugal advance	Vacuum pipe disconnected	
Distributor decelerating speeds—2100	Distributor advance 11° 30′ to 13° 30′	
1500	8° to 10°	
1000	4° to 6°	
No advance below	450 rev/min	
Ignition timing		
Dynamic or static	6° BTDC at 650–750 rev/min (vacuum pipe disconnected)	
Fuel	90–93 octane	

GENERAL FITTING INSTRUCTIONS

PRECAUTIONS AGAINST DAMAGE

1. Always fit covers to protect wings before commencing work in engine compartment.
2. Cover seats and carpets, wear clean overalls and wash hands or wear gloves before working inside car.
3. Avoid spilling hydraulic fluid or battery acid on paint work. Wash off with water immediately if this occurs. Use Polythene sheets in boot to protect carpets.
4. Always use a recommended Service Tool, or a satisfactory equivalent, where specified.
5. Protect temporarily exposed screw threads by replacing nuts or fitting plastic caps.

SAFETY PRECAUTIONS

1. Whenever possible use a ramp or pit when working beneath vehicle, in preference to jacking. Chock wheels as well as applying hand brake.
2. Never rely on a jack alone to support vehicle. Use axle stands or blocks carefully placed at jacking points to provide rigid location.
3. Ensure that a suitable form of fire extinguisher is conveniently located.
4. Check that any lifting equipment used has adequate capacity and is fully serviceable.
5. Inspect power leads of any mains electrical equipment for damage and check that it is properly earthed.
6. Disconnect earth (grounded) terminal of vehicle battery.
7. Do not disconnect any pipes in air conditioning refrigeration system, if fitted, unless trained and instructed to do so. A refrigerant is used which can cause blindness if allowed to contact eyes.
8. Ensure that adequate ventilation is provided when volatile degreasing agents are being used.

   CAUTION: Fume extraction equipment must be in operation when trachloride, methylene chloride, chloroform or perchlorethylene are used for cleaning purposes.

9. Do not apply heat in an attempt to free stiff nuts or fittings; as well as causing damage to protective coatings, there is a risk of damage to electronic equipment and brake lines from stray heat.
10. Do not leave tools, equipment, spilt oil, etc., around or on work area.
11. Wear protective overalls and use barrier creams when necessary.

PREPARATION

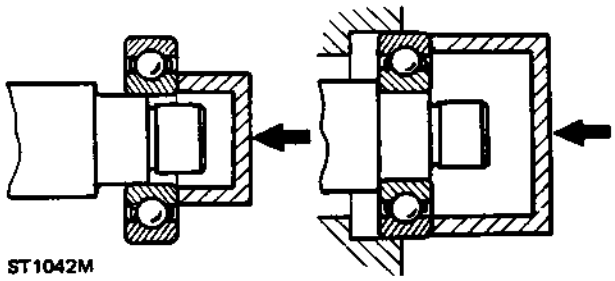
1. Before removing a component, clean it and its surrounding areas as thoroughly as possible.
2. Blank off any openings exposed by component removal, using greaseproof paper and masking tape.
3. Immediately seal fuel, oil or hydraulic lines when separated, using plastic caps or plugs, to prevent loss of fluid and entry of dirt.
4. Close open ends of oilways, exposed by component removal, with tapered hardwood plugs or readily visible plastic plugs.
5. Immediately a component is removed, place it in a suitable container; use a separate container for each component and its associated parts.
6. Before dismantling a component, clean it thoroughly with a recommended cleaning agent; check that agent is suitable for all materials of component.
7. Clean bench and provide marking materials, labels, containers and locking wire before dismantling a component.

DISMANTLING

1. Observe scrupulous cleanliness when dismantling components, particularly when brake, fuel or hydraulic system parts are being worked on. A particle of dirt or a cloth fragment could cause a dangerous malfunction if trapped in these systems.
2. Blow out all tapped holes, crevices, oilways and fluid passages with an air line. Ensure that any O-rings used for sealing are correctly replaced or renewed, if disturbed.
3. Mark mating parts to ensure that they are replaced as dismantled. Whenever possible use marking ink, which avoids possibilities of distortion or initiation of cracks, liable if centre punch or scriber are used.
4. Wire together mating parts where necessary to prevent accidental interchange (e.g. roller bearing components).
5. Wire labels on to all parts which are to be renewed, and to parts requiring further inspection before being passed for reassembly; place these parts in separate containers from those containing parts for rebuild.
6. Do not discard a part due for renewal until after comparing it with a new part, to ensure that its correct replacement has been obtained.

INSPECTION—GENERAL

1. Never inspect a component for wear or dimensional check unless it is absolutely clean; a slight smear of grease can conceal an incipient failure.
2. When a component is to be checked dimensionally against figures quoted for it, use correct equipment (surface plates, micrometers, dial gauges, etc.) in serviceable condition. Makeshift checking equipment can be dangerous.
3. Reject a component if its dimensions are outside limits quoted, or if damage is apparent. A part may, however, be refitted if its critical dimension is exactly limit size, and is otherwise satisfactory.
4. Use 'Plastigauge' 12 Type PG-1 for checking bearing surface clearances; directions for its use, and a scale giving bearing clearances in 0.0025 mm (0.0001 in) steps are provided with it.
9. When fitting bearing to shaft, apply force only to inner ring of bearing, and only to outer ring when fitting into housing.
10. In the case of grease-lubricated bearings (e.g. hub bearings) fill space between bearing and outer seal with recommended grade of grease before fitting seal.
11. Always mark components of separable bearings (e.g. taper roller bearings) in dismantling, to ensure correct reassembly. Never fit new rollers in a used cup.


ST1042M

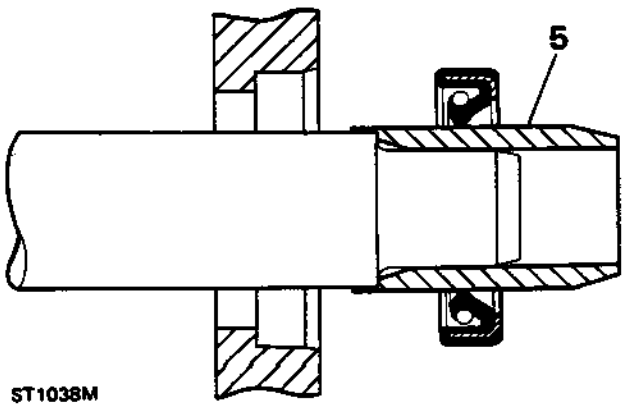
BALL AND ROLLER BEARINGS

NEVER REPLACE A BALL OR ROLLER BEARING WITHOUT FIRST ENSURING THAT IT IS IN AS-NEW CONDITION

1. Remove all traces of lubricant from bearing under inspection by washing in petrol or a suitable degreaser; maintain absolute cleanliness throughout operations.
2. Inspect visually for markings of any form on rolling elements, raceways, outer surface of outer rings or inner surface of inner rings. Reject any bearings found to be marked, since any marking in these areas indicates onset of wear.
3. Holding inner race between finger and thumb of one hand, spin outer race and check that it revolves absolutely smoothly. Repeat, holding outer race and spinning inner race.
4. Rotate outer ring gently with a reciprocating motion, while holding inner ring; feel for any check or obstruction to rotation, and reject bearing if action is not perfectly smooth.
5. Lubricate bearing generously with lubricant appropriate to installation.
6. Inspect shaft and bearing housing for discolouration or other marking suggesting that movement has taken place between bearing and seatings. (This is particularly to be expected if related markings were found in operation 2.) If markings are found, use 'Loctite' in installation of replacement bearing.
7. Ensure that shaft and housing are clean and free from burrs before fitting bearing.
8. If one bearing of a pair shows an imperfection it is generally advisable to renew both bearings: an exception could be made if the faulty bearing had covered a low mileage, and it could be established that damage was confined to it only.

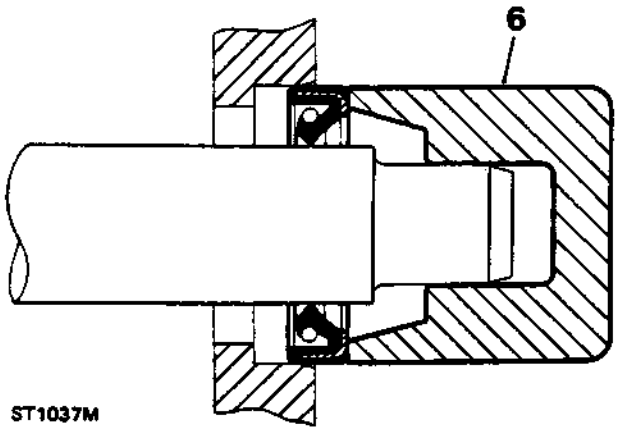
OIL SEALS

1. Always fit new oil seals when rebuilding an assembly. It is not physically possible to replace a seal exactly when it has bedded down.
2. Carefully examine seal before fitting to ensure that it is clean and undamaged.
3. Smear sealing lips with clean grease; pack dust excluder seals with grease, and heavily grease duplex seals in cavity between sealing lips.
4. Ensure that seal spring, if provided, is correctly fitted.
5. Place lip of seal towards fluid to be sealed and slide into position on shaft, using fitting sleeve when possible to protect sealing lip from damage by sharp corners, threads or splines. If fitting sleeve is not available, use plastic tube or adhesive tape to prevent damage to sealing lip.



ST1038M

6. Grease outside diameter of seal, place square to housing recess and press into position, using great care and if possible a 'bell piece' to ensure that seal is not tilted. (In some cases it may be preferable to fit seal to housing before fitting to shaft.) Never let weight of unsupported shaft rest in seal.



ST1037M

7. If correct service tool is not available, use a suitable drift approximately 0.4 mm (0.015 in) smaller than outside diameter of seal. Use a hammer VERY GENTLY on drift if a press is not suitable.
8. Press or drift seal in to depth of housing if housing is shouldered, or flush with face of housing where no shoulder is provided. Ensure that the seal does not enter the housing in a tilted position.

NOTE: Most cases of failure or leakage of oil seals are due to careless fitting, and resulting damage to both seals and sealing surfaces. Care in fitting is essential if good results are to be obtained.

JOINTS AND JOINT FACES

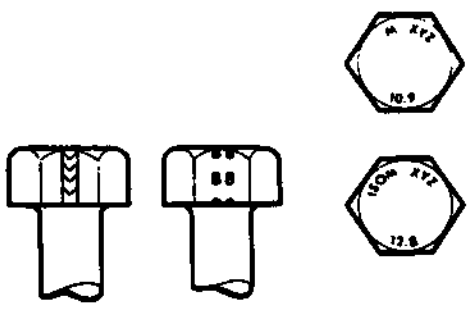
1. Always use correct gaskets where they are specified.
2. Use jointing compound only when recommended. Otherwise fit joints dry.
3. When jointing compound is used, apply in a thin uniform film to metal surfaces; take great care to prevent it from entering oilways, pipes or blind tapped holes.
4. Remove all traces of old jointing materials prior to reassembly. Do not use a tool which could damage joint faces.
5. Inspect joint faces for scratches or burrs and remove with a fine file or oil stone; do not allow swarf or dirt to enter tapped holes or enclosed parts.
6. Blow out any pipes, channels or crevices with compressed air, renewing any O-rings or seals displaced by air blast.

FLEXIBLE HYDRAULIC PIPES, HOSES

1. Before removing any brake or power steering hose, clean end fittings and area surrounding them as thoroughly as possible.
2. Obtain appropriate blanking caps before detaching hose end fittings, so that ports can be immediately covered to exclude dirt.
3. Clean hose externally and blow through with airline. Examine carefully for cracks, separation of plies, security of end fittings and external damage. Reject any hose found faulty.
4. When refitting hose, ensure that no unnecessary bends are introduced, and that hose is not twisted before or during tightening of union nuts.
5. Containers for hydraulic fluid must be kept absolutely clean.
6. Do not store hydraulic fluid in an unsealed container. It will absorb water, and fluid in this condition would be dangerous to use due to a lowering of its boiling point.
7. Do not allow hydraulic fluid to be contaminated with mineral oil, or use a container which has previously contained mineral oil.
8. Do not re-use fluid bled from system.
9. Always use clean brake fluid to clean hydraulic components.
10. Fit a blanking cap to a hydraulic union and a plug to its socket after removal to prevent ingress of dirt.
11. Absolute cleanliness must be observed with hydraulic components at all times.
12. After any work on hydraulic systems, inspect carefully for leaks underneath the vehicle while a second operator applies maximum pressure to the brakes (engine running) and operates the steering.

METRIC BOLT IDENTIFICATION

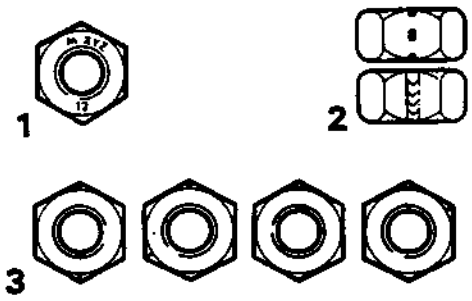
1. An ISO metric bolt or screw, made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the head.
2. In addition to marks to identify the manufacture, the head is also marked with symbols to indicate the strength grade, e.g. 8.8, 10.9, 12.9 or 14.9, where the first figure gives the minimum tensile strength of the bolt material in tens of kg/sq mm.
3. Zinc plated ISO metric bolts and nuts are chromate passivated, a greenish-khaki to gold-bronze colour.



ST1035M

METRIC NUT IDENTIFICATION

1. A nut with an ISO metric thread is marked on one face or on one of the flats of the hexagon with the strength grade symbol 8, 12 or 14. Some nuts with a strength 4, 5 or 6 are also marked and some have the metric symbol M on the flat opposite the strength grade marking.
2. A clock face system is used as an alternative method of indicating the strength grade. The external chamfers or a face of the nut is marked in a position relative to the appropriate hour mark on a clock face to indicate the strength grade.
3. A dot is used to locate the 12 o'clock position and a dash to indicate the strength grade. If the grade is above 12, two dots identify the 12 o'clock position.



ST1036M

KEYS AND KEYWAYS

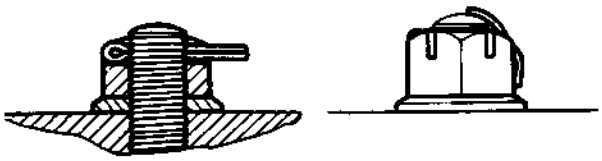
1. Remove burrs from edges of keyways with a fine file and clean thoroughly before attempting to refit key.
2. Clean and inspect key closely; keys are suitable for refitting only if indistinguishable from new, as any indentation may indicate the onset of wear.

TAB WASHERS

1. Fit new washers in all places where they are used. Always renew a used tab washer.
2. Ensure that the new tab washer is of the same design as that replaced.

SPLIT PINS

1. Fit new split pins throughout when replacing any unit.
2. Always fit split pins where split pins were originally used. Do not substitute spring washers: there is always a good reason for the use of a split pin.
3. All split pins should be fitted as shown unless otherwise stated.



ST1030M

NUTS

1. When tightening a slotted or castellated nut never slacken it back to insert split pin or locking wire except in those recommended cases where this forms part of an adjustment. If difficulty is experienced, alternative washers or nuts should be selected, or washer thickness reduced.
2. Where self-locking nuts have been removed it is advisable to replace them with new ones of the same type.

NOTE: Where bearing pre-load is involved nuts should be tightened in accordance with special instructions.

LOCKING WIRE

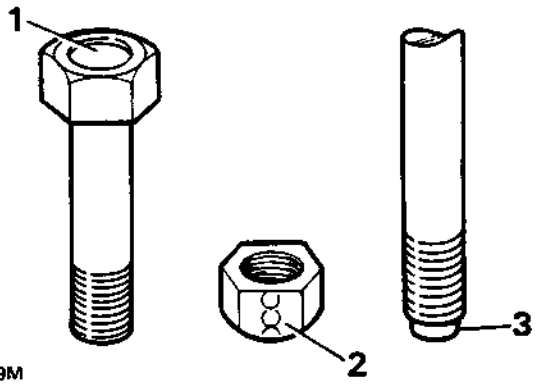
1. Fit new locking wire of the correct type for all assemblies incorporating it.
2. Arrange wire so that its tension tends to tighten the bolt heads, or nuts, to which it is fitted.

SCREW THREADS

1. Both UNF and Metric threads to ISO standards are used. See below for thread identification.
2. Damaged threads must always be discarded. Cleaning up threads with a die or tap impairs the strength and closeness of fit of the threads and is not recommended.
3. Always ensure that replacement bolts are at least equal in strength to those replaced.
4. Do not allow oil, grease or jointing compound to enter blind threaded holes. The hydraulic action on screwing in the bolt or stud could split the housing.
5. Always tighten a nut or bolt to the recommended torque figure. Damaged or corroded threads can affect the torque reading.
6. To check or re-tighten a bolt or screw to a specified torque figure, first slacken a quarter of a turn, then re-tighten to the correct figure.
7. Always oil thread lightly before tightening to ensure a free running thread, except in the case of self-locking nuts.

UNIFIED THREAD IDENTIFICATION

1. **Bolts**
   A circular recess is stamped in the upper surface of the bolt head.
2. **Nuts**
   A continuous line of circles is indented on one of the flats of the hexagon, parallel to the axis of the nut.
3. **Studs, Brake Rods, etc.**
   The component is reduced to the core diameter for a short length at its extremity.



ST1039M

RECOMMENDED LUBRICANTS, FLUIDS AND CAPACITIES

These recommendations apply to temperate climates where operational temperatures may vary between −10°C (14°F) and 35°C (95°F)

COMPONENTS	BP	CASTROL	DUCKHAMS	ESSO	MOBIL	PETROFINA	SHELL	TEXACO
Engine V8 Sump Dashpots (Carburetter models only)	BP Super Viscostatic (20/50) or BP VF7 (10W/30)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube (15W/40)	Mobil Super 10W/40 or Mobil 1 Rally Formula 5W/50	Fina Supergrade Motor Oil 15W/40 10W/40	Shell Super Motor Oil 15W/40 or 10W/40	Havoline Motor Oil 15W/40 or Eurotex HC (10W/30)
LT77—five-speed gearbox ZF4HP22 Automatic Gearbox	BP Autran DX2D	Castrol TQ Dexron IID	Duckhams Fleetmatic CD or Duckhams D-Matic	Esso ATF Dexron IID	Mobil ATF 220D	Fina Dexron IID	Shell ATF Dexron IID	Texamatic Fluid 9226
Front differential Rear differential Swivel pin housings and LT230T Transfer box*	BP Gear Oil SAE 90EP	Castrol Hypoy SAE 90EP	Duckhams Hypoid 90	Esso Gear Oil GX 85W/90	Mobil Mobilube HD90	Fina Pontonic MP SAE 80W/90	Shell Spirax 90 EP	Texaco Multigear Lubricant EP 85W/90
Brake and clutch reservoirs	Brake Fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT3 or DOT4							
Prop. shaft Front and rear	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi-purpose Grease H	Mobil-grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All purpose Grease
Power steering box and fluid reservoir as applicable	BP Autran DX2D	Castrol TQ Dexron IID	Duckhams Fleetmatic CD or Duckhams D-Matic	Esso ATF Dexron IID	Mobil ATF 220D	Fina Dexron II	Shell ATF Dexron IID	Texamatic Fluid 9226
Lubrication nipples (hubs, ball joints, etc.)	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi-purpose Grease H	Mobil-grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All purpose Grease
Ball joint assembly Top link	Dexragrease Super GP							
Seat slides Door lock striker	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi-purpose Grease H	Mobil Mobil-grease MP	Fina Marson HTL2	Shell Retinax A	Marfak All purpose Grease
Engine cooling system	Use an ethylene glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors suitable for use in aluminium engines to ensure the protection of the cooling system against frost and corrosion in all seasons Use one part anti-freeze to one part water for protection down to −36°C (−65°F) **IMPORTANT: Coolant solution must not fall below proportions one part anti-freeze to three parts water, i.e. minimum 25% anti-freeze in coolant otherwise damage to engine is liable to occur.** When anti-freeze is not required, the cooling system must be flushed out with clean water and refilled with a solution of one part Marstons SQ36 inhibitor to nine parts water, i.e. minimum 10% inhibitor in coolant							

* Engine oil or gearbox oil or a mixture of both may be used as an alternative to the gear oil specified for the transfer box.

RECOMMENDED LUBRICANTS AND FLUIDS SERVICE INSTRUCTIONS ALL MARKETS

COMPONENTS	BP	CASTROL	DUCKHAMS	ESSO	MOBIL	PETROFINA	SHELL	TEXACO	SPEC. REF. ALL BRANDS
Seat slides Door lock striker	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi-purpose Grease H	Mobil Mobil-grease MP	Fina Marson HTL2	Shell Retinax A	Marfak All purpose Grease	NGLI-2 Multi-purpose Lithium based Grease
Windscreen Washers	Screen Washer Fluid								
Bonnet pintle	Graphite Lock Grease Type 'B'								
Door locks (anti-burst) Inertia reels	DO NOT LUBRICATE. These components are 'life' lubricated at the manufacturing stage								
	NOTE: The above lubricants are considered to be suitable for ambient temperatures in the range of −40°C to +35°C. For extreme ambient temperatures, outside the above range, refer to local Distributor.								
Battery lugs Earthing surfaces Where paint has been removed	Petroleum jelly. NOTE: Do not use Silicone Grease								
Air Conditioning System Refrigerant Compressor Oil	METHYLCHLORIDE REFRIGERANTS MUST NOT BE USED Use only with refrigerant 12. This includes 'Freon 12' and 'Arcton 12' Shell Clavus 68 BP Energol LPT 68 Sunisco 4GS Texaco Capella E Wax Free 68								

RECOMMENDED LUBRICANTS AND FLUIDS SERVICE INSTRUCTIONS FOR AMBIENT CONDITIONS OUTSIDE TEMPERATE CLIMATE LIMITS OR FOR MARKETS WHERE THE PRODUCTS LISTED ARE NOT AVAILABLE

	Service Classification		Ambient Temperature °C
	Specification	SAE Classification	−30 −20 −10 0 10 20 30 40 50
Engine sump Dashpots (carburetter models only) oil can	Oils must meet BLS.22.OL.07 or	5W/30 5W/40 5W/50	
	CCMC G3 or API service levels SF	10W/30 10W/40 10W/50	
	Oils must meet BLS.22.OL.02	15W/40 15W/50	
	or CCMC G1 or G2	20W/40 20W/50	
	or API service levels SE or SF	25W/40 25W/50	
Main gearbox, manual or automatic	ATF Dexron IID		
Transfer gearbox Final drive units Swivel pin housings Steering box	API GL4 or GL5 MIL-L-2105 or MIL-L-2105B	90 EP 80W EP	
Power steering	ATF M2C 33 (F or G) ATF Dexron II D		
Brake and clutch reservoirs	Brake fluid must have a minimum boiling point of 260°C (500°F) and comply with FMVSS 116 DOT 3		
Lubrication nipples (bubs, ball joints, etc.)	NLGI-2 multipurpose lithium based grease		
Engine cooling system	Use an ethylene glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors suitable for use in aluminium engines to ensure the protection of the cooling system against frost and corrosion in all seasons. Use one part anti-freeze to one part water for protection down to −36°C (−65°F). IMPORTANT: Coolant solution must not fall below proportions one part anti-freeze to three parts water, i.e. minimum 25% anti-freeze in coolant otherwise damage to engine is liable to occur. When anti-freeze is not required, the cooling system must be flushed out with clean water and refilled with a solution of one part Marstons SQ36 inhibitor to nine parts water, i.e. minimum 10% inhibitor in coolant.		

ANTI-FREEZE

ENGINE	MIXTURE	PERCENTAGE CONCENTRATION	PROTECTION
V8 (aluminium)	One part anti-freeze One part water	50%	
Complete protection Vehicle may be driven away immediately from cold			−33°C −36°C
Safe limit protection Coolant in mushy state. Engine may be started and driven away after short warm-up period			−41°C −42°F
Lower protection Prevents frost damage to cylinder head, block and radiator. Thaw out before starting engine			−47°C −53°F

RECOMMENDED FUEL

With the exception of the 9.35:1 high compression (emission) engine which is designed to operate on 97 octane fuel (British 4-star rating) all other Range Rover engines are designed for fuel having a minimum octane rating of 91 to 93 (the British 2-star rating).

Where these fuels are not available and it is necessary to use fuels of lower or unknown rating, the ignition timing must be retarded from the specified setting, just sufficiently to prevent audible detonation (pinking) under all operating conditions, otherwise damage to the engine may occur. Use exhaust gas analysis equipment to check the final engine exhaust emissions after resetting. (See 'Engine Tuning' data).

The use of lower octane fuels will result in the loss of engine power and efficiency.

CAUTION: Do not use oxygenated fuels such as blends of methanol/gasolene or ethanol/gasolene (e.g. 'GASOHOL').

In the interests of public health, and to assist in keeping undesirable exhaust emissions as low as possible, fuels of an octane rating higher than that recommended should not be used.

NOTE: Vehicles fitted with 8.13 :1 low compression engines will operate on unleaded fuel with an octane rating of 91 octane without any engine tune adjustments.

Capacities (approx.)*	Litres	Imperial unit	US unit
Engine sump and filter from dry	5.66	10 pints	12.8 pints
Gearbox from dry—manual LT77	2.7	4.7 pints	5.9 pints
Gearbox from dry—automatic ZF	9.1	16 pints	20 pints
Transfer gearbox from dry	2.5	4.4 pints	5.5 pints
Front axle from dry	1.7	3.0 pints	3.75 pints
Front axle swivel pin housing (each)	0.35	0.6 pints	0.75 pints
Rear axle from dry	1.7	3.0 pints	3.75 pints
Power steering box and reservoir	2.9	5.0 pints	6.25 pints
Cooling system	11.4	20 pints	24 pints
Fuel tank	80.0	17.5 gallons	22 gallons

NOTE: * All levels must be checked by dipstick or level plugs as applicable.

When draining oil from the ZF automatic gearbox, oil will remain in the torque converter, refill to high level on dipstick only.

MAINTENANCE SCHEDULES

Efficient maintenance is one of the biggest factors in ensuring continuing reliability and efficiency. For this reason the following detailed schedules are included so that at the appropriate intervals owners and operators may know what is required. The Maintenance Schedules are based upon intervals of 10,000 km (6,000 miles) or 6 months unless otherwise stated.

A = 10,000 km (6,000 miles)
30,000 km (18,000 miles)
50,000 km (30,000 miles)
70,000 km (42,000 miles)

B = 20,000 km (12,000 miles)
40,000 km (24,000 miles)
60,000 km (36,000 miles)
80,000 km (48,000 miles)

CORRECT = ☑ INCORRECT = ☒

No.	A	B	Operations
1		☐	Check condition and security of seats, seat belt mountings, seat belts and buckles
2		☐	Check operation of footbrake and clutch with engine running; stop engine
3		☐	Check operation of; all lamps, horns, warning indicators
4		☐	Check operation of front/rear screen wipers and washers and condition of wiper blades
5	☐	☐	Check security and operation of hand brake; release fully after checking
6		☐	Check rear view mirrors for security, cracks and crazing
7	☐	☐	Remove road wheels
8	☐	☐	Check tyres for: compliance with manufacturers specification; visually for cuts, lumps, bulges, uneven tread wear and depth; tyre pressures (including spare) adjust if required—see Owners Manual
9	☐	☐	Inspect brake pads for wear, calipers for leaks and discs for condition
10	☐	☐	Check for oil/fluid leaks from steering and suspension systems
11		☐	Check condition and security of steering, joints and gaiters
12	☐	☐	Refit road wheels to original position
13		☐	Drain flywheel housing if drain plug is fitted for wading (refit)
14	☐		Check/top up engine oil
15		☐	Renew engine oil and filter
16	☐	☐	Check/top up automatic transmission fluid
17	40,000 km (24,000 miles)		Renew automatic transmission fluid and filter
18	☐	☐	Check/top up gearbox oil
19	40,000 km (24,000 miles)		Renew gearbox oil
20	☐	☐	Check/top up transfer box oil
21	40,000 km (24,000 miles)		Renew transfer box oil
22	☐	☐	Check/top up front axle oil
23	40,000 km (24,000 miles)		Renew front axle oil
24	☐	☐	Check/top up swivel pin housing oil
25	40,000 km (24,000 miles)		Renew swivel pin housing oil
26	☐	☐	Check/top up rear axle oil
27	40,000 km (24,000 miles)		Renew rear axle oil
28		☐	Check visually brake, fuel, clutch pipes/unions for chafing, leaks and corrosion
29	☐	☐	Check exhaust system for leakage and security
30		☐	Lubricate hand brake mechanical linkage and adjust to manufacturers instructions if required
31	☐	☐	Lubricate propeller shaft universal joints
32	40,000 km (24,000 miles)		Lubricate propeller shaft sliding joints
33		☐	Check tightness of propeller shaft coupling bolts
34		☐	Ensure front and rear axle breathers are free from obstruction
35		☐	Check security and condition of suspension fixings
36		☐	Check for oil leaks from engine and transmission
37	80,000 km (48,000 miles)		Clean fuel pump filter
38		☐	Check suspension self levelling unit for leaks
39	80,000 km (48,000 miles)		Renew fuel filter (EFi engines)
40		☐	Renew fuel filter element (carburetter engines)
41		☐	Renew air cleaner element(s)
42		☐	Check air cleaner dump valve, clean or renew
43	40,000 km (24,000 miles)		Renew engine breather filter
44		☐	Clean or renew engine flame trap(s)
45	☐	☐	Check condition of driving belts—adjust if required
46	80,000 km (48,000 miles)		Renew charcoal canister
47		☐	Check crankcase breathing system for leaks, hoses for security and condition
48	☐		Clean/adjust spark plugs
49		☐	Renew spark plugs
50	☐	☐	Top up carburetter piston dampers
51	☐	☐	Check/top up cooling system
52		☐	Check brake servo hose for security and condition
53		☐	Check ignition wiring and H.T. leads for fraying, chafing and deterioration
54		☐	Clean distributor cap, check for cracks and tracking
55	☐	☐	Check/adjust ignition timing (refer to the repair operation manual for details)
56		☐	Lubricate accelerator control linkages and pedal pivot

Continued

No.	A	B	Operations
57		☐	Check throttle operation
58	☐	☐	Lubricate all locks (not steering lock), hinges and door—check mechanisms
59		☐	Check operation of all doors, bonnet and tailgate locks
60	☐	☐	Check/adjust carburetter mixture settings, fuel injection idle air mixture and engine idle speed with engine at normal running temperature
61	☐	☐	Check operation of air intake temperature control system
62		☐	Check/adjust steering box
63	☐	☐	Check power steering system for leaks, hydraulic pipes and unions for chafing and corrosion
64	☐	☐	Check/top up fluid in power steering reservoir
65	☐	☐	Check/top up clutch fluid reservoir
66	☐	☐	Check/top up brake fluid reservoir
67	☐	☐	Check/top up windscreen washer reservoir
68		☐	Check cooling and heater system for leaks, hoses for security and condition
69		☐	Check/top up battery electrolyte
70		☐	Remove battery connections; clean and grease—refit
71		☐	Check/adjust headlamp alignment
72		☐	Check front wheel alignment
73	☐	☐	Road test—Check:
	☐	☐	And ensure automatic gearbox starter/isolator switch will only operate in 'P' and 'N'
	☐	☐	For excessive engine noise
	☐	☐	Clutch for slipping/judder/spinning
	☐	☐	Gear selection/noise—high and low range
	☐	☐	Automatic gear selection/shift speeds
	☐	☐	Steering for noise/abnormal effort required
	☐	☐	All instruments, pressure, fuel and temperature gauges, warning indicators
		☐	Heater and air conditioning systems
	☐	☐	Heated rear screen
	☐	☐	Shock absorbers (irregularities in ride)
	☐	☐	Footbrake, on emergency stop, pulling to one side, binding, pedal effort
	☐	☐	Handbrake efficiency
		☐	Fully extend seat belt, check for correct operation of retraction and latching. Inertia belts lock when snatched and when car is on slope
	☐	☐	Road wheel balance
	☐	☐	Transmission for vibrations
	☐	☐	For body noises (squeaks and rattles)
74	☐	☐	Endorse service record
75	☐	☐	Report any additional work required

It is recommended that:
At 30,000 km (18,000 mile) intervals or every 18 months, whichever is the sooner, the hydraulic brake fluid should be completely renewed.

At 60,000 km (36,000 mile) intervals or every 3 years, whichever is the sooner, all hydraulic brake fluid, seals and flexible hoses should be renewed, all working surfaces of the master cylinder, wheel cylinders and caliper cylinders should be examined and renewed where necessary.

At 60,000 km (36,000 mile) intervals remove all suspension dampers, test for correct operation, refit or renew as necessary.

MAINTENANCE SUMMARY

The following should be checked weekly or before a long journey.

Engine oil level	Windscreen/tailgate/headlamp washer. Reservoir level(s)	Operation of horn
Brake fluid level	Battery electrolyte level(s)	Operation of washers and wipers
Radiator coolant level	All tyres for pressure and condition	Operation of all lights

LUBRICATION

This first part of the maintenance section covers renewal of lubricating oils for the major units of the vehicle and other components that require lubrication, as detailed in the 'Maintenance Schedules'. Refer to the 'General Specification Data' for capacities and recommended lubricants.

Vehicles operating under severe conditions of dust, sand, mud and water should have the oils changed and lubrication carried out at more frequent intervals than that recommended in the maintenance schedules.

Draining of used oil should take place after a run when the oil is warm. Always clean the drain and filler-level plugs before removing. In the interests of safety disconnect the vehicle battery to prevent the engine being started and the vehicle moved inadvertently, while oil changing is taking place.

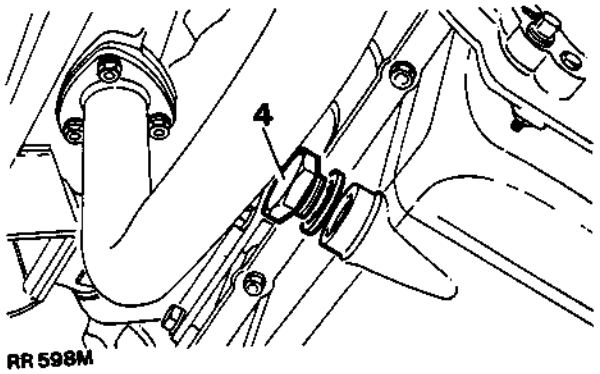
Allow as much time as possible for the oil to drain completely except where blown sand or dirt can enter the drain holes. In these conditions clean and refit the drain plugs immediately the main bulk of oil has drained.

Where possible, always refill with oil of the make and specification recommended in the lubrication charts and from sealed containers.

RENEW ENGINE OIL AND FILTER

DRAIN THE OIL

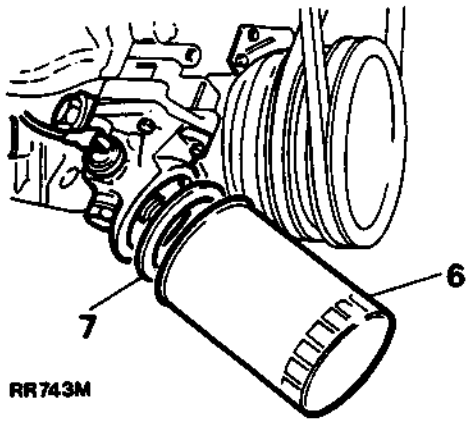
1. Drive vehicle to level ground.
2. Run the engine to warm the oil; switch off the ignition and disconnect the battery for safety.
3. Place an oil tray under the drain plug.
4. Remove the drain plug in the bottom of the sump at the left-hand side. Allow oil to drain away completely and replace the plug and tighten to the correct torque.



RR 598M

Renew oil filter

5. Place an oil tray under the engine.
6. Unscrew the filter anti-clockwise, using a strap spanner as necessary.
7. Smear a little clean engine oil on the rubber washer of the new filter, then screw the filter on clockwise until the rubber sealing ring touches the machined face, then tighten a further half turn by hand only. Do not overtighten.



RR743M

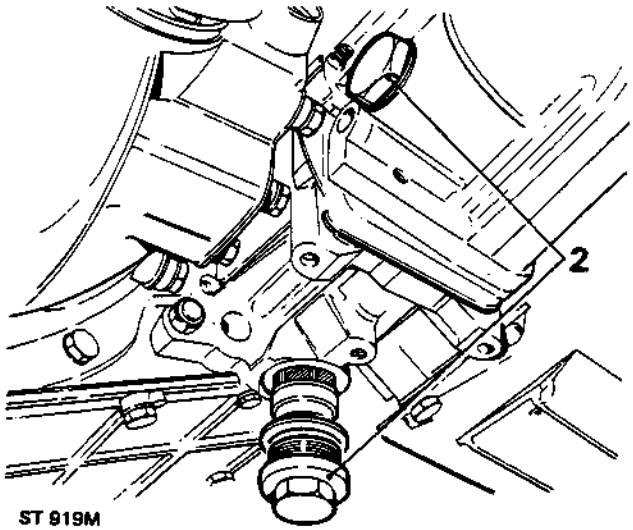
Refill sump with oil

8. Check that the drain plug is tight.
9. Clean the outside of the oil filler cap, remove it from the rocker cover or extension filler neck and clean the inside.
10. Pour in the correct quantity of new oil of the correct grade from a sealed container to the high mark on the dipstick and firmly replace the filler cap. **DO NOT FILL ABOVE 'HIGH' MARK.**
11. Run the engine and check for leaks from the filter. Stop the engine, allow the oil to run back into the sump for a few minutes, then check the oil level again and top up if necessary.

RENEW MAIN AND TRANSFER GEARBOX OILS

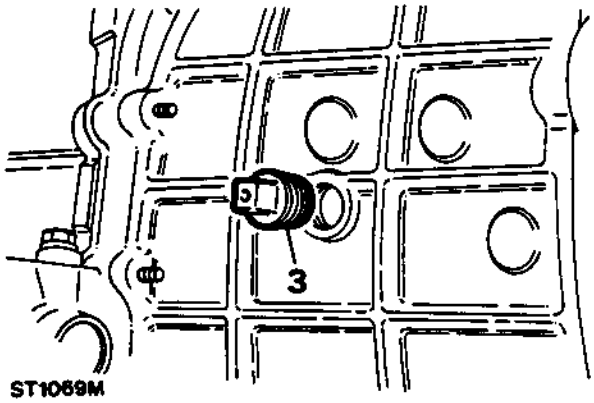
DRAIN AND REFILL 77 mm MAIN GEARBOX

1. Drive the vehicle to level ground and place a suitable container under the gearbox to catch the old oil.
2. Remove the gearbox and extension case drain plugs and allow the oil to drain completely. Wash the extension case filter in kerosene and refit the plugs using new washers, if necessary, and tighten to the correct torque.



ST 919M

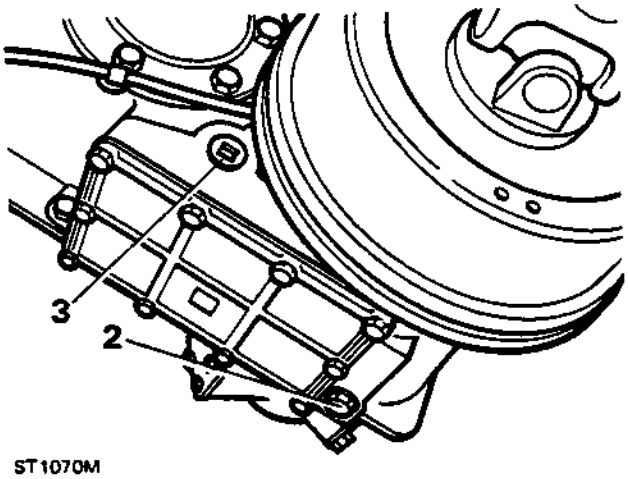
3. Remove the oil filler-level plug and inject the approximate quantity of new oil of the correct make and grade until it begins to run out of the filler-level hole. Fit the plug and tighten to the correct torque. Since the plug has a tapered thread it must not be overtightened. Wipe away any surplus oil.



ST1069M

DRAIN AND RENEW 230T TRANSFER GEARBOX

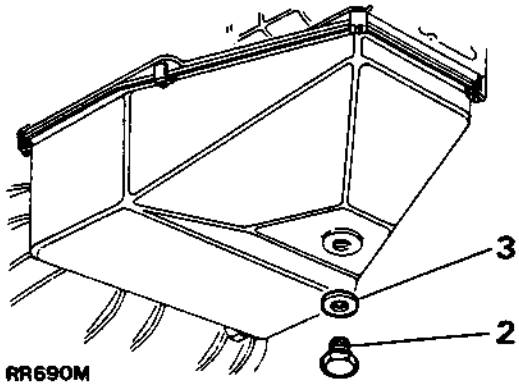
1. Drive the vehicle to level ground and place a container under the gearbox to catch the old oil.
2. Remove the drain plug and allow the oil to drain. Fit the plug using a new washer, if necessary, and tighten to the correct torque.
3. Remove the filler-level plug and inject the approximate quantity of the recommended oil until it begins to run from the plug hole. Fit the level plug and tighten only to the correct torque, do not overtighten, wipe away any surplus oil.



ST1070M

RENEW ZF AUTOMATIC GEARBOX FLUID

1. Drive the vehicle onto a suitable hydraulic ramp. Obtain a suitable container to drain the gearbox fluid into.
2. Remove the drain plug from the bottom of the sump and allow time for the fluid to drain.
3. Refit the plug using a new sealing washer and tighten to the correct torque.



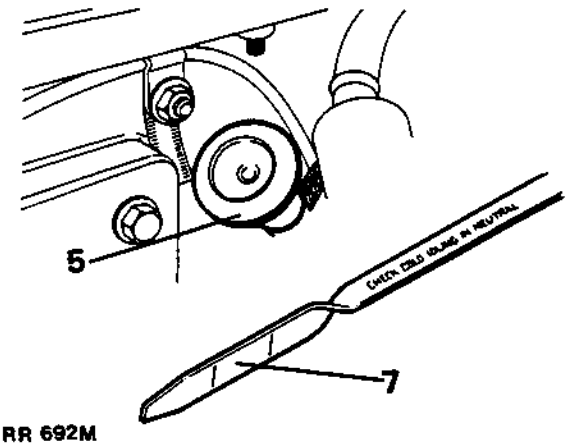
RR690M

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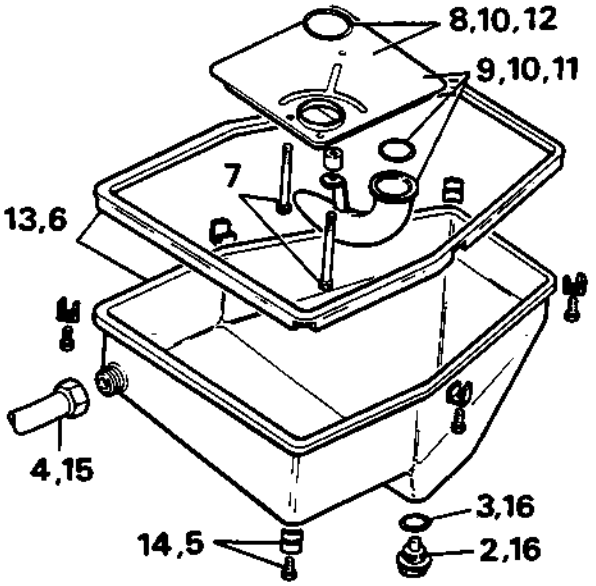
REFILL ZF AUTOMATIC GEARBOX AND CHECK FLUID LEVEL

NOTE: The fluid level in the ZF automatic gearbox is checked when the engine is at normal ambient temperature, and idling in neutral gear.

4. Ensure the vehicle is on level ground.
5. Lift the bonnet and remove the gearbox dipstick located at the rear of the right-hand rocker cover.
6. Refill or top-up the fluid with the correct quantity and grade of fluid (see 'Data' section).
7. Ensure that the fluid level registers between the minimum and maximum level markings on the dipstick.



RR 692M



RR691M

14. Secure using the six retaining plates and bolts (two straight and four corner plates), tighten to the specified torque.
15. Reconnect the oil level/filler tube.
16. Fit oil pan plug using a new seal.
17. Connect the battery leads.
18. Fill the gearbox with the correct oil through the filler/level tube located within the engine bay (see 'Data' section).
19. Ensuring the vehicle is on level ground with the handbrake applied, check oil level while engine is running at idle with neutral selected.

OIL SCREEN REPLACEMENT ZF AUTOMATIC GEARBOX

Removing

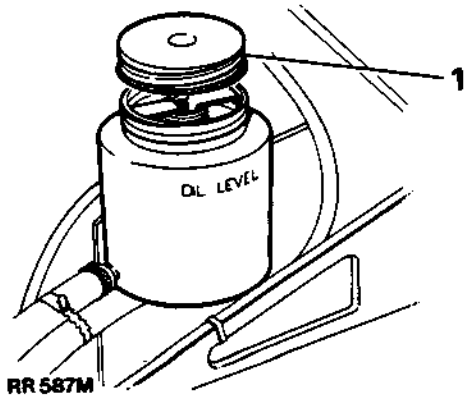
1. Place the vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle drain the gearbox using a suitable container.
3. Discard the oil pan plug seal ring.
4. Remove the filler/level tube from the oil pan.
5. Remove the six retaining plates and bolts.
6. Remove the oil pan and discard the gasket.
7. Using TX27 torx bit undo the three screws which hold the oil screen.
8. Remove the oil screen and discard the 'O' rings.
9. Separate the oil screen from the suction tube and discard the 'O' ring and oil screen.

Refitting

10. Fit two new 'O' rings to the oil screen using a light grease for ease of assembly.
11. Fit the suction tube to the oil screen.
12. Fit the oil screen to the control unit and secure with three bolts using TX27 torx bit tighten to the specified torque.
13. Refit the oil pan using a new gasket.

POWER STEERING—FLUID RESERVOIR

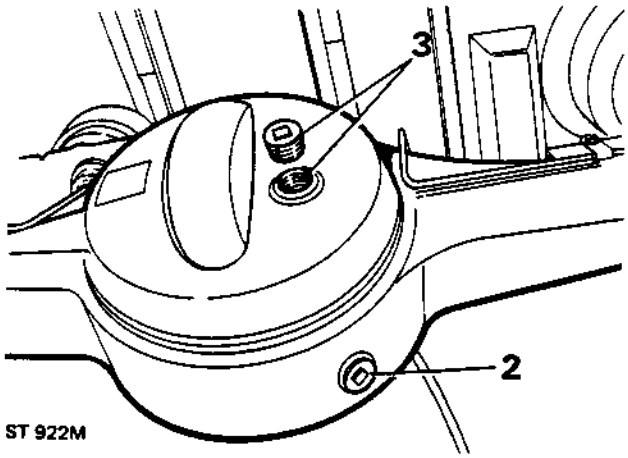
1. Clean and remove the reservoir cap, observe the fluid level in relation to the level mark on the side of the reservoir.
2. If necessary top-up with a recommended fluid (see 'Data' section), until the fluid is 12 mm (½ in) above the filter.
3. Refit the cap.



RR 587M

RENEW FRONT AND REAR AXLE OIL

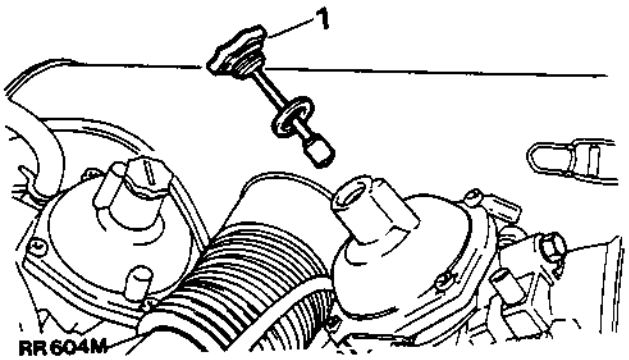
1. Drive the vehicle to level ground and place a container under the axle to be drained.
2. Using a spanner with a 13 mm (0.5 in) square drive remove the drain plug and allow the oil to drain completely. Clean and refit the drain plug.
3. Remove the oil filler-level plug and inject new oil of a recommended make and grade until it begins to run from the hole. Clean and fit the filler-level plug and wipe away any surplus oil.



ST 922M

CHECK/TOP UP CARBURETTER PISTON DAMPERS

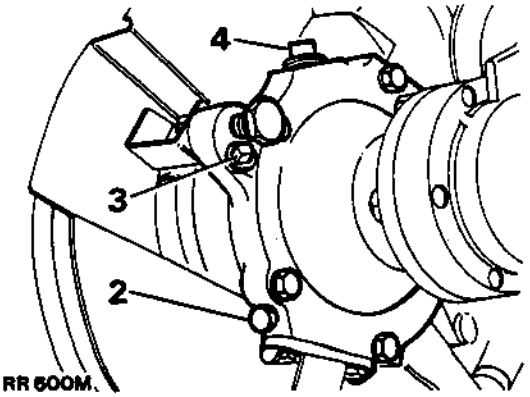
1. Unscrew and withdraw the plug and damper assembly from the top of each carburetter.
2. Top-up the damper chambers with the seasonal grade of engine oil.
3. The oil level is correct, when utilising the damper as a dipstick its threaded plug is 6 mm above the dash pots and resistance is felt.
4. Screw down the damper plugs.



RR 604M

RENEW SWIVEL PIN HOUSING OIL

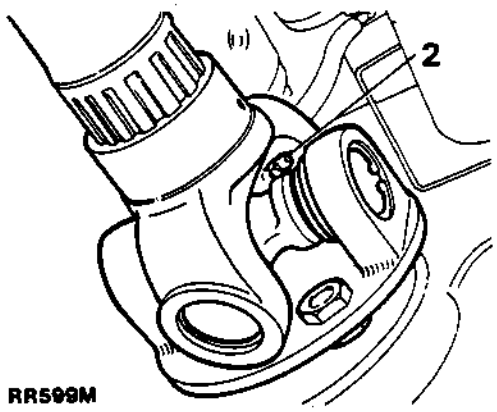
1. Drive the vehicle to level ground and place a container under each swivel housing to catch the old oil.
2. Remove the drain plug and allow the oil to drain completely, clean and refit the plug.
3. Remove the level plug.
4. Remove the filler plug and inject the recommended make and grade of oil until oil begins to run from the level hole.
5. Clean and refit the level and filler plugs, wipe away any surplus oil.



RR 600M

LUBRICATE PROPELLER SHAFTS

1. Clean all grease nipples on the front and rear propshaft universal joints and sliding portion of the rear shaft.
2. Charge a low pressure hand-grease gun with grease of a recommended make and grade and apply to the grease nipples.

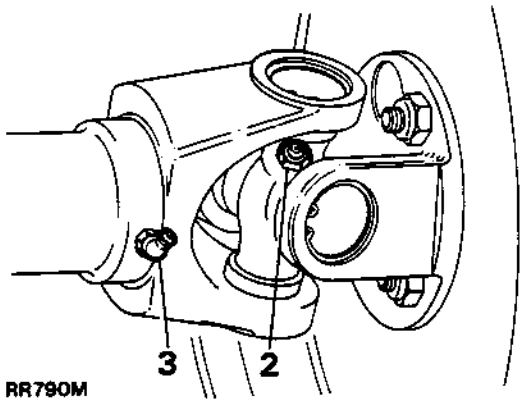


RR599M

Continued

Lubricate the propeller shaft sliding joint

3. Disconnect one end of the front propeller shaft and compress the sliding portion whilst applying grease. It is necessary to compress the shaft to prevent overfilling with grease. It should be noted that this sliding joint must only be lubricated at 40,000 km (24,000 mile) intervals.



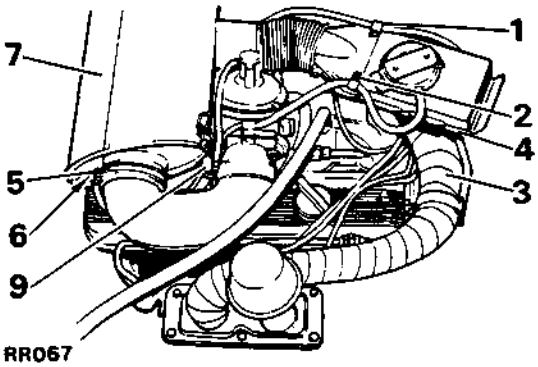
RR790M

GENERAL MAINTENANCE AND ADJUSTMENT

FILTERS

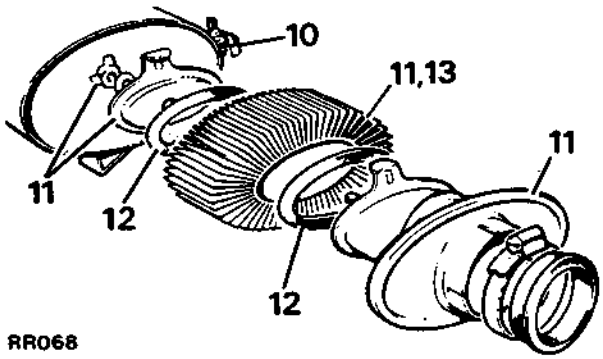
RENEW THE AIR CLEANER ELEMENT—carburetter type

1. Slacken the clip retaining the advance/retard vacuum pipes from the air intake and release pipes from intake.
2. Slacken the clip retaining hose air cleaner to temperature sensing device from air intake and remove pipe from flap valve on air intake.
3. Slacken the hose clip attaching warm air intake hose to air intake.
4. Withdraw air intake from steady post and hoses.
5. Slacken the clips and remove the air cleaner elbows.
6. Emission engines — slacken the clips and withdraw 'Pulsair' hoses.
7. Remove the air cleaner from the retaining posts by lifting and easing forward.
8. At the same time disconnect the hose engine breather filter to air cleaner. Place air cleaner to one side.



RR067

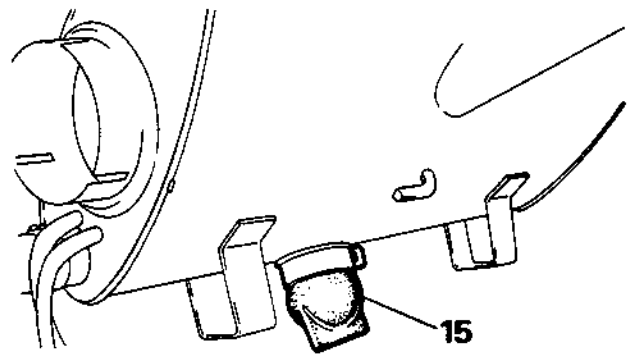
9. Remove hose with the non-return valve from the manifold.
   The air cleaner can now be completely removed.
10. Release the two clips at each side of air cleaner casing and withdraw the frames and elements.
11. Release wing nuts and withdraw plate and sealing washers, and discard old elements.
12. Discard any faulty rubber seals.
13. Assemble new elements to air cleaner frames and secure with seals, end plate and wing nuts.
14. Fit the carrier frames and elements into the air cleaner body and secure with clips.



RR068

Check air cleaner dump valve

15. Squeeze open the dump valve and check that the interior is clean. Also check that the rubber is flexible and in a good condition.
16. If necessary, remove the dump valve to clean the interior. Fit a new valve if the original is in a poor condition.



RR597M

Fit air cleaner

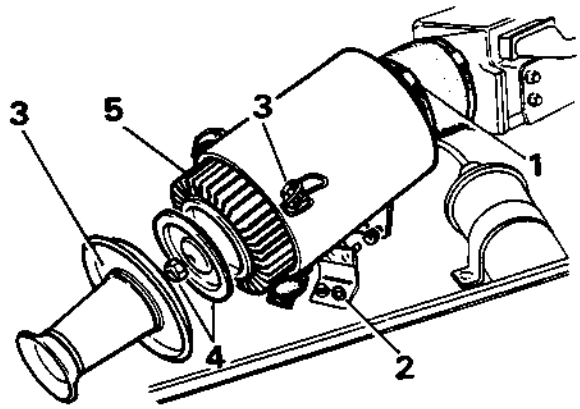
17. Reconnect hose with non-return valve to the manifold connection.
18. Place air cleaner on to the retaining posts.

Continued

19. At the same time reconnect the breather filter hose to the base of the air cleaner.
20. Emission engines — reconnect and secure 'Pulsair' hoses.
21. Refit the air cleaner elbows and tighten clips.
22. Replace air intake on to steady post and reconnect air cleaner and warm air intake hoses. Tighten clip.
23. Reconnect pipe, air cleaner to temperature sensor and vacuum advance/retard pipe to air intake. Position pipes in retaining clips on air intake and tighten clips.

RENEW THE AIR CLEANER ELEMENT—fuel injection type

1. Release the clip securing the hose to the rear of the air cleaner case.
2. Remove the two nuts and bolts securing the air cleaner retaining bracket to the left-hand valance. Remove air cleaner case from the hose, and remove from the vehicle.
3. Unclip the three catches securing the inlet tube to the air cleaner body and remove the inlet tube.
4. Remove the nut and end plate securing the air cleaner element in position.
5. Withdraw and discard the old element.



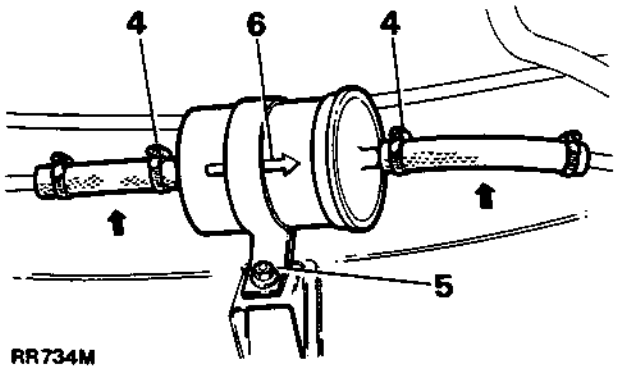
RR596M

6. Reverse the removal instructions 1 to 5 ensuring that all hose connections are secure.

RENEW FUEL LINE FILTER—fuel injection type

WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Depressurise the fuel system.
2. The fuel line filter is located on the right-hand chassis side member forward of the fuel tank filler neck. Access to the filter is gained through the right-hand rear wheel arch.
3. Clamp the inlet and outlet hoses to prevent the minimum of fuel spillage when disconnecting the hoses. (Denoted by the arrows.)
4. Slacken the two securing clip screws nearest the filter to enable the hoses to be removed from the filter canister.
5. Remove the filter from the chassis side member by releasing the securing bolt and bracket.



RR734M

Fit new filter

6. Fit a new filter observing the direction of flow arrows stamped on the canister.
7. Start the engine and inspect for fuel leaks around the hose connections.

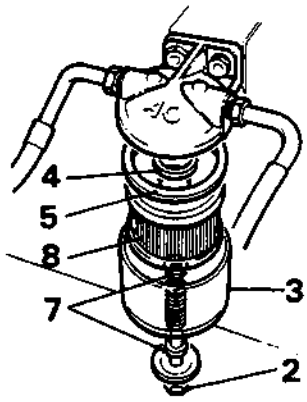
RENEW FUEL FILTER ELEMENT—carburetter type

Renew fuel filter element

The element provides a filter between the pump and carburetter and is located on the front LH wing.
Replace as follows:

1. Remove all dirt, grit, grease from around the filter body before dismantling.
2. Unscrew the centre bolt.
3. Withdraw the filter bowl.
4. Remove the small sealing ring and remove the element.
5. Withdraw the large sealing ring from the underside of the filter body.
6. Discard the old element and replace with a new unit.

Continued

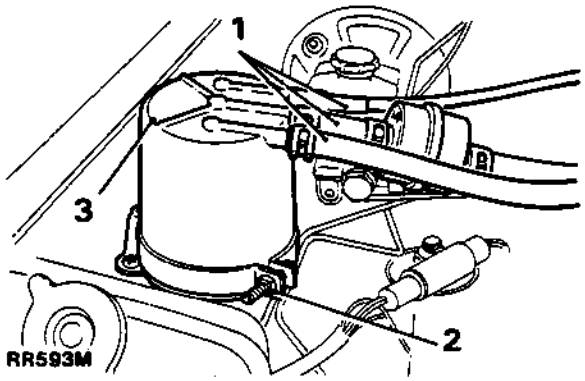


ST1075M

7. Ensure that the centre and top sealing rings are in good condition and replace as necessary.
8. Fit new element, small hole downwards.
9. Refit sealing rings (small and large).
10 Replace filter bowl and tighten the centre bolt.

RENEW ADSORPTION CANISTER

1. Disconnect from the canister:
   (i) Canister line to fuel tank.
   (ii) Canister purge line.
   (iii) Carburetter vent pipe (blanked off on 'fuel injection models').
2. Slacken the clamp nut screw.
3. Remove the canister.



RR593M

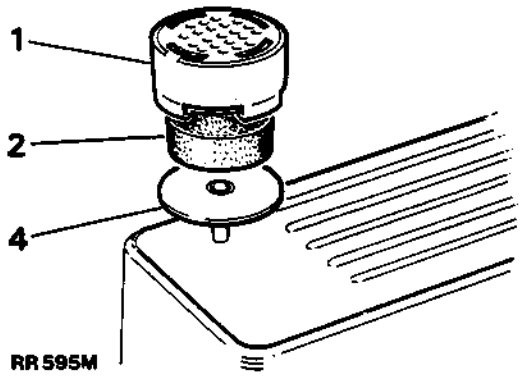
Fit new canister

4. Secure the canister in the clamp.
5 Reverse instructions 1 and 2 above.

WARNING: The use of compressed air to clean an adsorption canister or clear a blockage in the evaporative system is very dangerous. An explosive gas present in a fully saturated canister may be ignited by the heat generated when compressed air passes through the canister.

RENEW CRANKCASE AIR INTAKE FILTER—fuel injection type

1. Prise the filter holder upwards to release it from the rocker cover.



RR595M

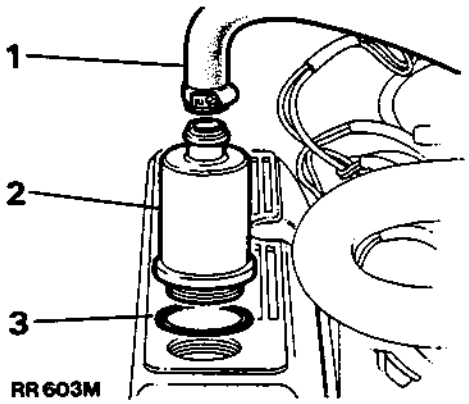
2. Discard the sponge filter.

Fit new filter

3. Insert a new filter into the plastic body.
4. Push filter holder onto the rocker cover until it clips firmly into place.

CLEAN CRANKCASE FLAME TRAP/BREATHER FILTER—fuel injection type

1. Release the hose clip and pull the hose off the canister.
2. Unscrew the canister and remove it from the rocker cover.
3. Remove the large 'O' ring from the screwed end of the canister.



4. Visually inspect the condition of the wire gauze within the canister, if in poor condition renew the whole assembly, if in an acceptable condition clean the gauze as follows:
5. Immerse canister in a small amount of petrol and allow time for the petrol to dissolve and loosen any engine fume debris within the canister.
6. Remove canister from petrol bath and allow to dry out in still air.

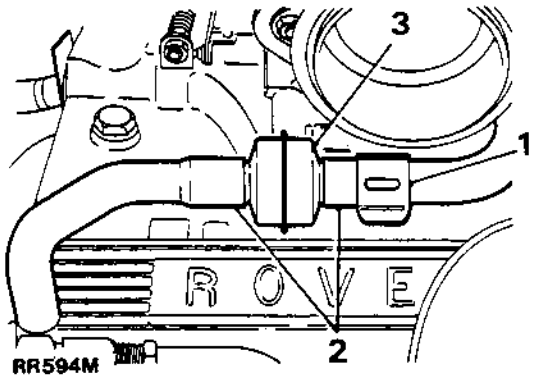
WARNING: Do not use a compressed air line to remove any remaining petrol or particles of debris within the canister as this could cause fire or personal injury.

Refitting the flame trap/breather

7. Fit a new rubber 'O' ring.
8. Screw the flame trap canister into the rocker cover, hand tight only.
9. Refit hose and tighten hose clip securely.

CLEAN OR RENEW ENGINE FLAME TRAP(S)—carburetter type

1. Pull the flame trap hoses out of the retaining clips.
2. Pull the hoses from the flame trap.
3. Withdraw the flame trap.



4. Visually inspect wire gauze inside the flame trap, if in poor condition renew the unit. If the gauze is in a satisfactory condition clean as follows:
5. Emerse flame traps in a small amount of petrol, allow time for the petrol to dissolve and loosen any debris within the flame trap.
6. Allow the flame traps to dry in still air.

WARNING: Do not use a compressed air line to dry or clean the flame traps as this could cause fire or personal injury.

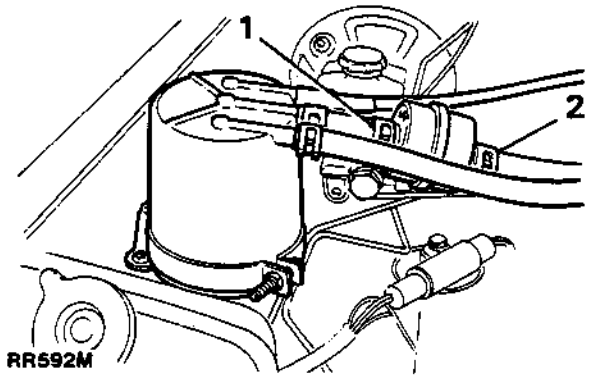
Fit engine flame traps

7. Push the hoses onto the flame trap and ensure that they are secure.
8. Locate the hoses in their respective retaining clips.

RENEW EVAPORATIVE LOSS FILTER—carburetter models

NOTE: Engine breather filters may have alternative locations according to engine build specification.

1. Squeeze the short centre hose retaining clip and pull the filter from the hose.
2. Squeeze the hose retaining clip on the opposite end of the filter and remove the hose.



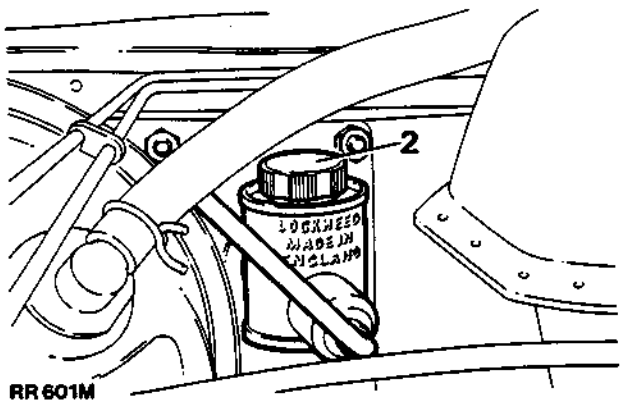
3. Fit a new filter, ensuring that the end of the filter marked 'IN' is fitted to the short hose from the adsorption cannister.

CHECK CLUTCH FLUID RESERVOIR

1. Check the fluid level in the reservoir mounted on the bulkhead adjacent to the brake servo.
2. Remove the cap, top-up if necessary to the bottom of the filler neck. (Use the correct fluid specified in the 'Data' section).

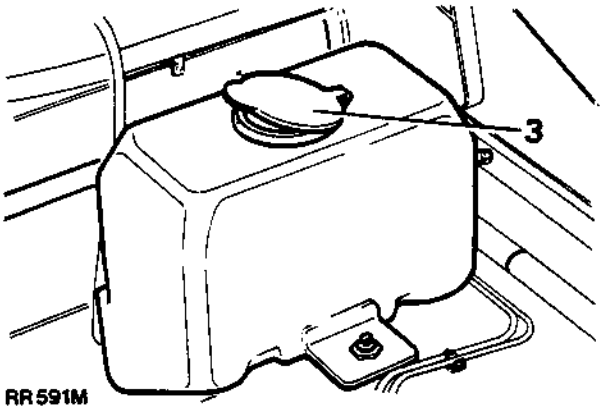
   NOTE: If significant topping-up is required check for leaks at master cylinder, slave cylinder and connecting pipes.

3. Check clutch pipes for chafing and corrosion.



CHECK/ADJUST OPERATION OF ALL WASHERS AND TOP-UP RESERVOIR

1. Check the operation of windscreen, tailgate and headlamp washers.
2. Adjust jets if necessary by inserting a needle or very fine sharp implement into the jet orifice and manoeuvring to alter the jet direction.
3. Unclip the reservoir cap.
4. Top up reservoir to within 25 mm (1 in) below the bottom of the filler neck.
   Use a screen washer solvent in the reservoir, this will assist in removing mud, flies and road film.
5. In cold weather to prevent freezing of the water add 'Isopropyl Alcohol' to the reservoir.



CHECK

Check ignition wiring and high tension leads for fraying, chafing and deterioration.

CHECK

Check/adjust ignition timing. (see engine tuning data/ procedure) using suitable electronic equipment.

FUEL SYSTEM (All models)

Check all hose connections for leaks and hose deterioration, renew hoses or tighten hose clips as necessary.

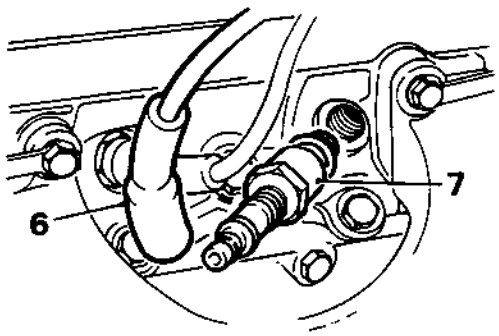
IGNITION

Clean/adjust or renew spark plugs

1. Use the special spark plug spanner and tommy bar supplied in the tool kit when removing or refitting spark plugs.
2. Take great care when fitting spark plugs not to cross-thread the plug, otherwise costly damage to the cylinder head will result.
3. Check or replace the spark plugs as applicable. If the plugs are in good condition, clean and reset the electrode gaps, refer to engine tuning data. At the same time file the end of the central electrode until bright metal can be seen.
4. It is important that only the correct type of spark plugs are used for replacements.
5. Incorrect grades of plugs may lead to piston overheating and engine failure.

To remove spark plugs proceed as follows:

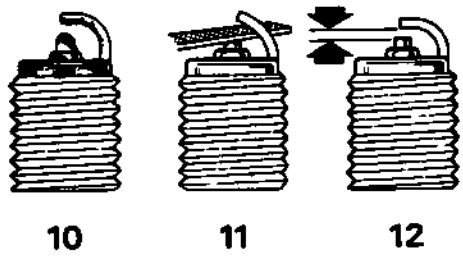
6. Remove the leads from the spark plugs.
7. Remove the plugs and washers.



RR474M

Clean the spark plugs

8. (a) Fit the plug into a 14 mm adaptor of an approved spark plug cleaning machine.
   (b) Wobble the plug in the adaptor with a circular motion for three or four seconds only with the abrasive blast in operation. Important: Excessive abrasive blasting will lead to severe erosion of the insulator nose. Continue to wobble the plug in its adaptor with air only, blasting the plug for a minimum of 30 seconds: this will remove abrasive grit from the plug cavity.
   (c) Wire-brush the plug threads; open the gap slightly, and vigorously file the electrode sparking surfaces using a point file. This operation is important to ensure correct plug operation by squaring the electrode sparking surfaces.
   (d) Wash new plugs in petrol to remove protective coating.
9. Set the electrode gap to the recommended clearance.
10. Shows dirty plug.
11. Filing plug electrodes.
12. Clean plug set to correct gap.

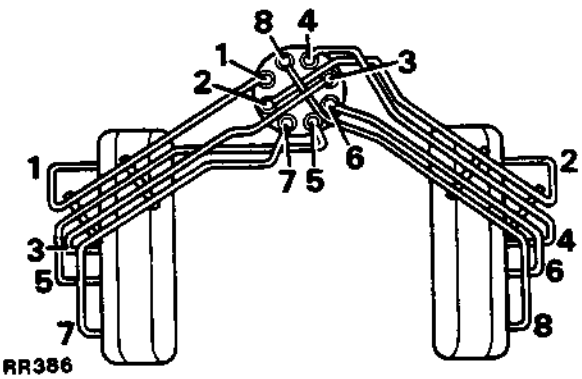


RR740M

13. Test the plugs in accordance with the plug cleaning machine manufacturers' recommendations.
14. If satisfactory the plugs can be refitted.
15. When pushing the leads onto the plugs, ensure that the shrouds are firmly seated on the plugs.

Fitting H.T. leads

16. Ensure that replacement H.T. leads are refitted in their spacing cleats in accordance with the correct layout illustrated.
    Failure to observe this instruction may result in cross-firing between two closely fitted leads which are consecutive in the firing order.



RR386

DISTRIBUTOR - LUCAS 35DM8

The electronic ignition employs a Lucas 35DM8 distributor.
The internal operating parts of the distributor are pre-set at the factory and should not normally require resetting.
Adjustments should only be made, if the unit is known to be faulty or damaged.
Maintenance of the distributor consists of the following items.

1. Clean outer surfaces of distributor cap to remove dirt, grease etc.
2. Unclip the cap, check cap for signs of cracking.
3. Wipe inside cap with nap free cloth.
4. Check rotor arm, cap and flash shield for signs of tracking.
5. Apply three drops of clean engine oil to the felt pad in the rotor shaft.
   DO NOT DISTURB the clear plastic insulating cover (flash shield) which protects the magnetic pick-up module.

CHECK AIR CONDITIONING SYSTEM (where fitted)

WARNING: Adjustments or rectification operations should be carried out by a Range Rover dealer or an approved automotive air conditioning specialist. Under no circumstances should non-qualified personnel attempt repair or servicing of air conditioning equipment.

The following items should be checked,

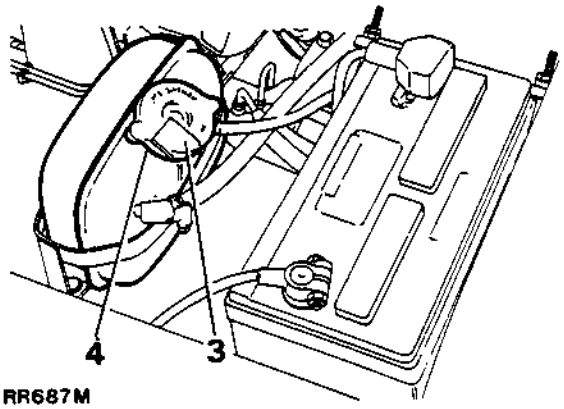
1. **Condenser:** Clean the exterior of the condenser matrix using a water hose or compressed air-line.
2. Check pipe connections for signs of fluid leakage.
3. **Evaporator:** Examine the pipe connections for signs of fluid leakage.
4. **Receiver/drier sight glass:** After running the engine for five minutes with the air conditioning system in operation, examine the sight glass, there should be no sign of bubbles.
5. Check pipe connections for signs of fluid leakage.
6. **Compressor:** Check the pipe connections for fluid leakage and the hoses for swellings.

CHECK/TOP UP COOLING SYSTEM

1. To prevent corrosion of the aluminium alloy engine parts it is imperative that the cooling system is filled with a solution of water and anti-freeze, winter or summer, or water and inhibitor during the summer only. Never fill or top up with plain water.
2. The expansion tank filler cap is under the bonnet.
3. With a cold engine, the correct coolant level should be up to the 'Water Level' plate situated inside the expansion tank below the filler neck.

WARNING: Do not remove the filler cap when engine is hot because the cooling system is pressurised and personal scalding could result.

4. When removing the filler cap, first turn it anti-clockwise a quarter of a turn and allow all pressure to escape, before turning further in the same direction to lift it off.

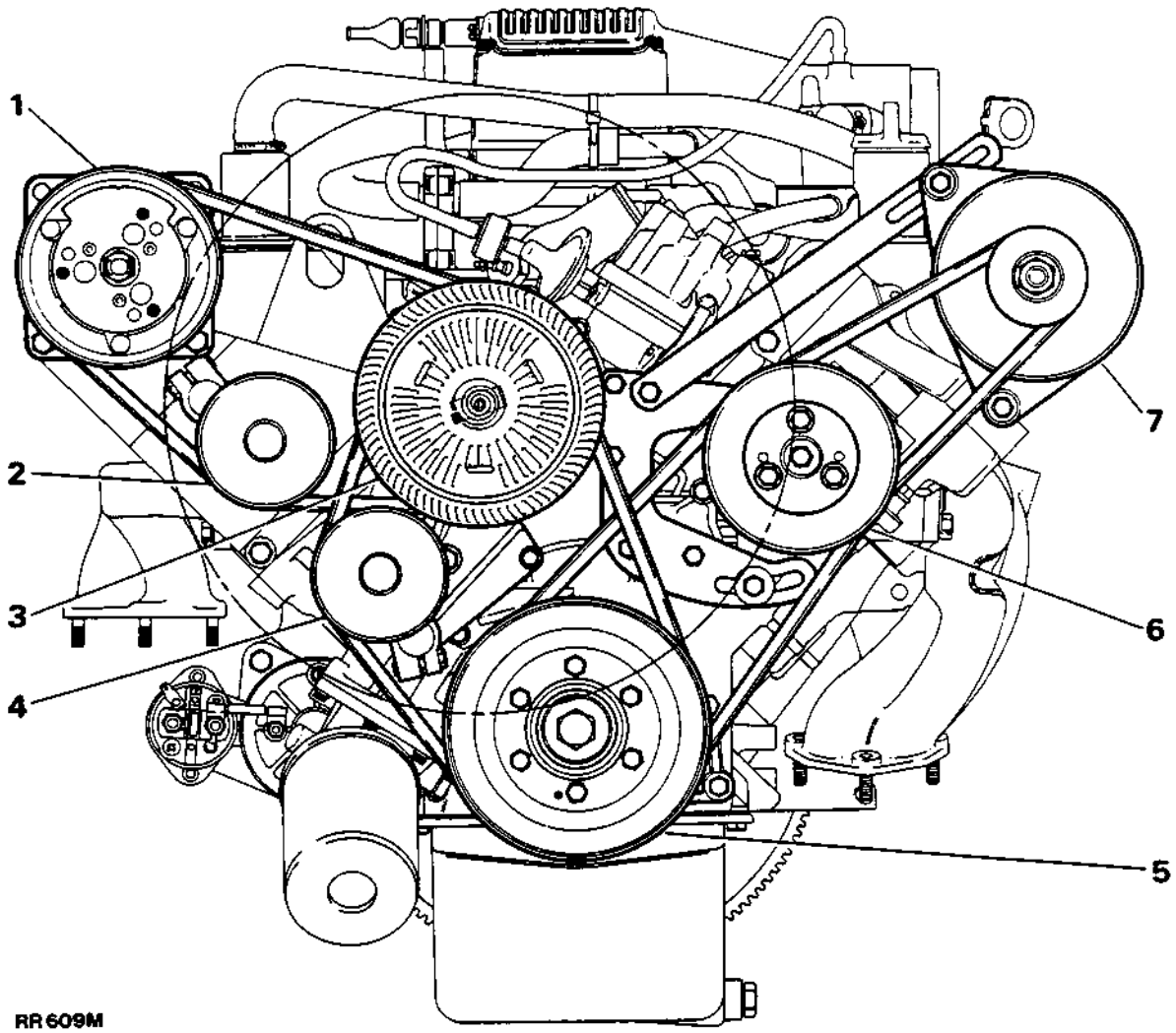


RR687M

5. When replacing the filler cap it is important that it is tightened down fully, not just to the first stop. Failure to tighten the filler cap properly may result in water loss, with possible damage to the engine through overheating. Use soft water whenever possible, if local water supply is hard, rainwater should be used.

Check cooling/heater systems for leaks and hoses for security and condition.

Cooling system hoses should be changed at the first signs of deterioration.



1. Air conditioning compressor
2. Jockey wheel
3. Viscous fan—water pump unit
4. Jockey wheel
5. Crankshaft
6. Power steering pump
7. Alternator

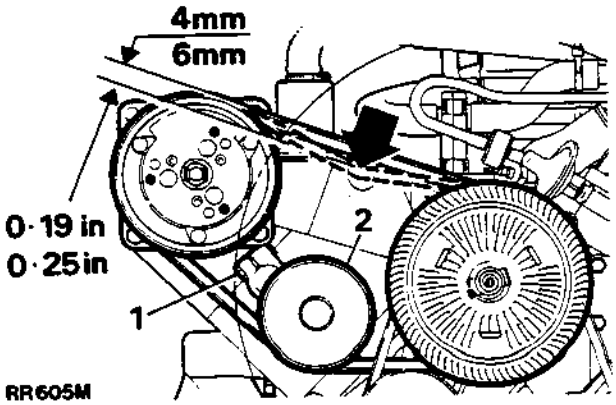
DRIVE BELTS—adjust or renew

COMPRESSOR DRIVE BELT

The belt must be tight with not more than 4 to 6 mm (0.19 to 0.25 in) total deflection when checked by hand midway between the pulleys on the longest run.

Where a belt has stretched beyond the limits, a noisy whine or knock will often be evident during operation, if necessary adjust as follows:

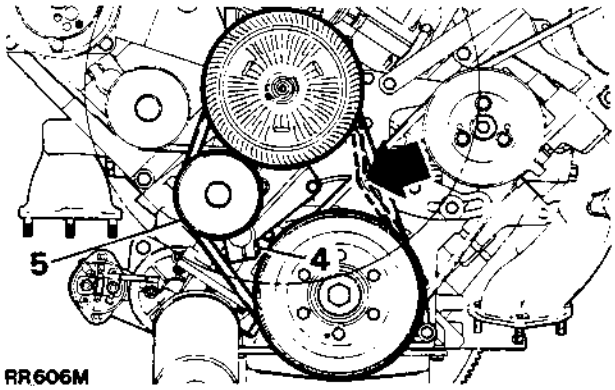
1. Slacken the jockey wheel securing bolt.
2. Adjust the position of the jockey wheel until the correct tension is obtained.
3. Tighten the securing bolt and re-check the belt tension.



Check driving belts, adjust or renew as necessary

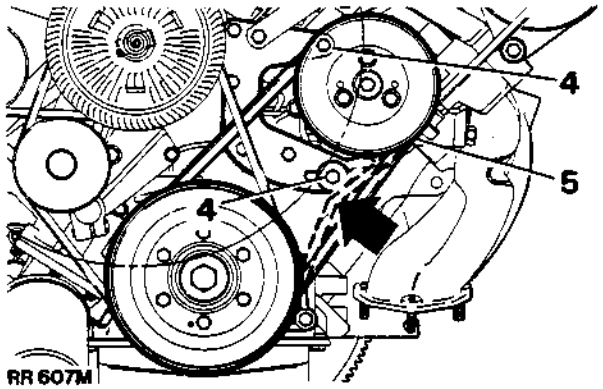
1. Examine the following belts for wear and condition and renew if necessary:
   (A) Crankshaft—Jockey Pulley—Water Pump
   (B) Crankshaft—Steering Pump
   (C) Steering Pump—Alternator

Illustration A



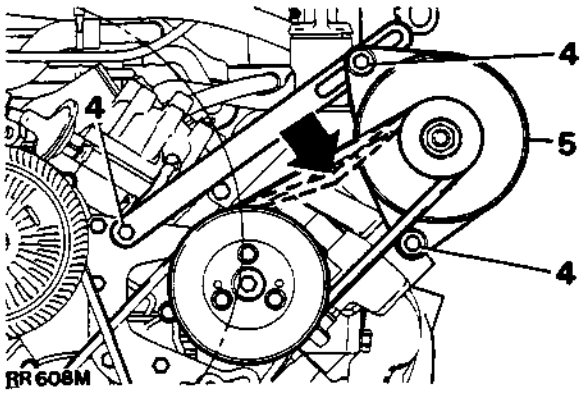
RR606M

Illustration B



RR607M

Illustration C



RR608M

2. Each belt should be sufficiently tight to drive the appropriate auxiliary without undue load on the bearings.
3. Slacken the bolts securing the unit to its mounting bracket.
4. Slacken the appropriate pivot bolt or jockey wheel and the fixing at the adjustment link where applicable.
5. Pivot the unit inwards or outwards as necessary and adjust until the correct belt tension is obtained.
6. Belt tension should be approximately 11 to 14 mm (0.437 to 0.562 in) at the points denoted by the bold arrows.
7. Tighten all unit adjusting bolts. Check adjustment again, when a new belt is fitted, after approximately 1,500 km (1,000 miles) running.

CHECK AIR INTAKE TEMPERATURE CONTROL SYSTEM—carburetter type

1. Check operation of the mixing flap valve in the air cleaner by starting the engine from cold and observing the flap valve as the engine temperature rises.
2. The valve should start to open slowly within a few minutes of starting and continue to open until a stabilised position is achieved. This position and the speed of operation will be entirely dependent on prevailing ambient conditions.
3. Failure to operate indicates failure of flap valve vacuum capsule or thermostatically controlled vacuum switch or both.
4. Check by connecting a pipe directly from the banjo on No. 8 point inlet manifold to the flap valves, thus by-passing the temperature sensor.
5. If movement of the flap valve is evident the temperature sensor is faulty. If no movement is detected, the vacuum capsule is faulty.
6. Fit new parts where necessary.

STEERING AND SUSPENSION

Check condition and security of steering unit, joints, relays and gaiters

Check steering box for oil/fluid leaks

Check shock absorbers for fluid leaks

Check power steering system for leaks, hydraulic pipes and unions for chafing and corrosion

Check security of suspension fixings

CHECK STEERING BALL JOINTS

Ball joints are lubricated for the normal life of ball joints during manufacture and require no further lubrication. This applies only if the rubber gaiter has not become dislodged or damaged. The joints should be checked at the specified mileage intervals but more frequently if the vehicle is used under arduous conditions.

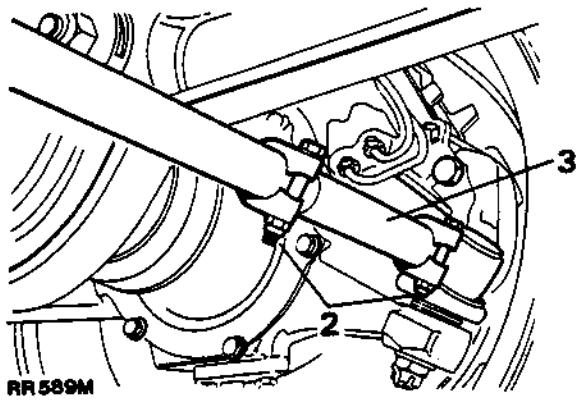
1. Check for wear in the joints by moving the ball joint up and down vigorously. If free movement is apparent renew the complete joint assembly.

Check/adjust front wheel alignment

Use recognised wheel alignment equipment to perform this check and adjustment.
See 'Data' section for the correct alignment.

To adjust

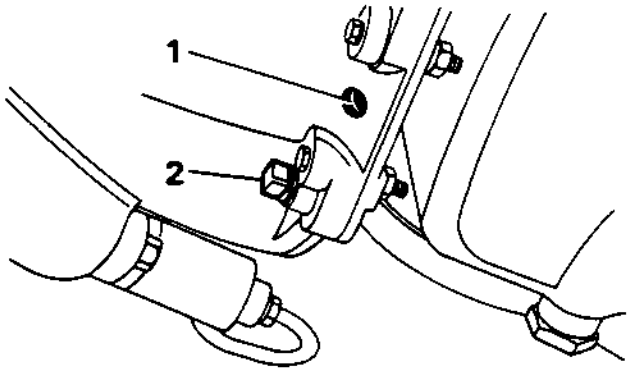
1. Set the vehicle on level ground, with the road wheels in the straightforward position, and push it forward a short distance.
2. Slacken the clamps securing the adjusting shaft to the track rod.
3. Turn the adjusting shaft to decrease or increase the effective length of the track rod, as necessary, until the toe-out is correct.
4. Re-tighten the clamps.
5. Push the vehicle rearwards, turning the steering wheel from side to side to settle the ball joints. Then with the road wheels in the straight ahead position, push the vehicle forward a short distance.
6. Re-check the toe-out. If necessary carry out further adjustment.



RR589M

Drain flywheel housing if drain plug is fitted for wading

1. The flywheel housing can be completely sealed to exclude mud and water under severe wading conditions, by means of a plug fitted in the bottom of the housing.
2. The plug is screwed into the housing adjacent to the drain hole, and should only be fitted when the vehicle is expected to do wading or very muddy work.
3. When the plug is in use it must be removed periodically and all oil allowed to drain off before the plug is replaced.



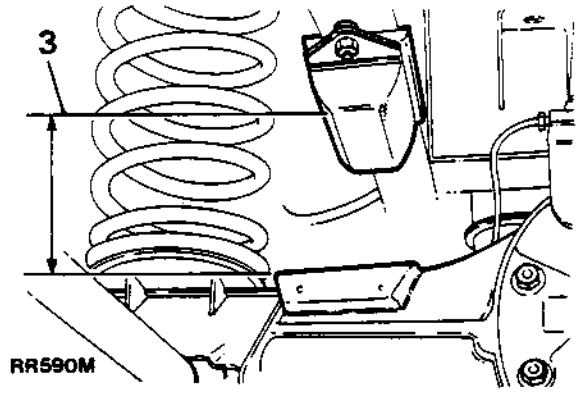
RR105M

CHECK ROAD SPRINGS

Verify that the vehicle is being operated within the specified maximum loading capabilities. Drive the vehicle onto level ground and remove all loads. Should the vehicle lean to one side it indicates a fault with the springs or shock absorbers, **not** the self-levelling unit. If the levelling unit is believed to be at fault, the procedure below should be followed:

1. Check the levelling unit for excessive oil leakage and if present the unit must be changed. Slight oil seepage is permissible.
2. Remove any excessive mud deposits and loose items from the rear seat and load area.
3. Measure the clearance between the rear axle bump pad and the bump stop rubber at the front outer corner on both sides of the vehicle. The average clearance should be in excess of 67 mm (2.8 in). If it is less than this figure remove the rear springs and check their free length against the 'Road Spring Data'. Replace any spring whose free length is more than 20 mm (0.787 in) shorter than the figure given. If after replacing a spring the average bump clearance is still less than 67 mm (2.8 in), replace the levelling unit.

Continued



4. With the rear seat upright, load 450 kg (992 lb) into the rear of the vehicle, distributing the load evenly over the floor area. Check the bump stop clearance, with the driving seat occupied.
5. Drive the vehicle for approximately 5 km (3 miles) over undulating roads or graded tracks. Bring the vehicle to rest by light brake application so as not to disturb the vehicle loading. With the driving seat occupied, check the bump stop clearance again.
6. If the change in clearance is less than 20 mm (0.787 in) the levelling unit must be replaced.

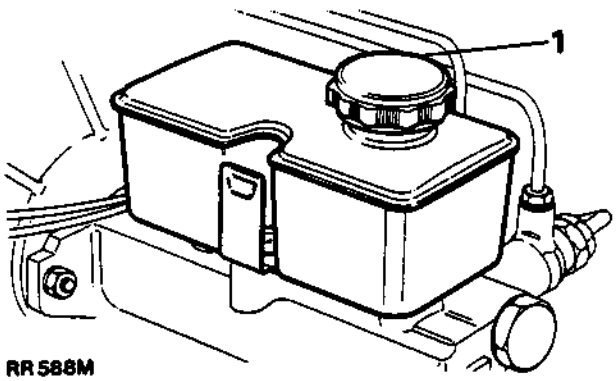
BRAKES

Check visually, hydraulic pipes and unions for chafing, leaks and corrosion.

Check/top up brake fluid reservoir

The tandem brake reservoir is integral with the servo unit and master cylinder.

1. Remove cap to check fluid level; top up if necessary until the fluid reaches the bottom of the filter neck. See 'Data' section for recommended fluids.
2. If significant topping up is required check master cylinder, brake disc cylinders and brake pipes and connections for leakage; any leakage must be rectified immediately.



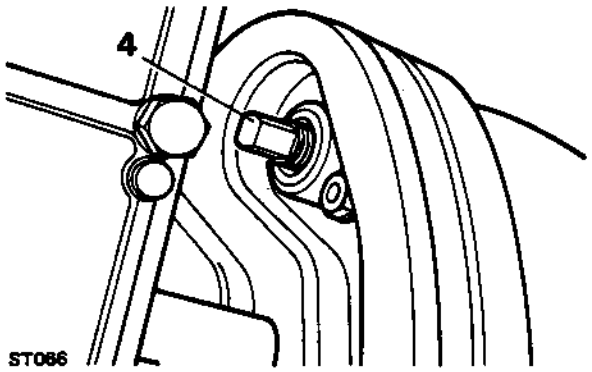
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CAUTION: When topping-up the reservoir, care should be taken to ensure that brake fluid does not come into contact with any paintwork on the vehicle.

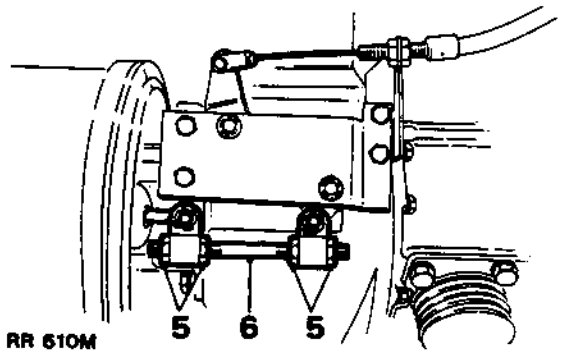
CHECK AND ADJUST TRANSMISSION BRAKE (Handbrake)

The handbrake lever acts on a transmission brake at the rear of the transfer box.

1. Set the vehicle on level ground.
2. Fully release the handbrake.
3. Disconnect the handbrake cable linkage at the transmission brake drum by removing the split pin, plain and spring washer and clevis pin.
4. Turn the adjuster on the back plate clockwise until the shoes are fully expanded against the drum.
5. Slacken the four locknuts on the handbrake adjustment link.



6. Rotate the link clockwise or anti-clockwise until the clevis pin holes in the link bracket and brake drum lever line up.
7. Fit the clevis pin, plain and spring washer and a **new** split pin, lightly grease the assembly.
8. Fully tighten the four link locknuts.



9. Slacken the brake drum adjuster, until the handbrake becomes fully operational on the third or fourth notch of the handbrake lever quadrant.

CAUTION: DO NOT over-adjust the handbrake, the drum must be free to rotate when the handbrake is released, otherwise serious damage will result.

CHECK FOOTBRAKE OPERATION

If the footbrake is 'spongy' bleed the brake system. Check all hoses and pipes for security, fractures and leaks. Renew as necessary.

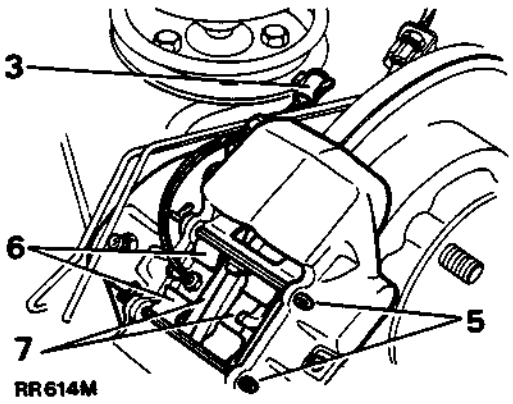
RENEW FRONT AND REAR BRAKE PADS

Brake pad wear is indicated by a pad wear warning light incorporated into the instrument binnacle. The warning lamp is illuminated when pad wear is reduced to approximately 3.0 mm (0.118 in). The system is operated by an electrical sensor incorporated into the front and rear right-hand side inboard brake pads.

When pad wear is sufficient in either front or rear pads allowing the sensor within the pads to complete a circuit to earth through the disc, thus illuminating the warning lamp in the instrument binnacle.

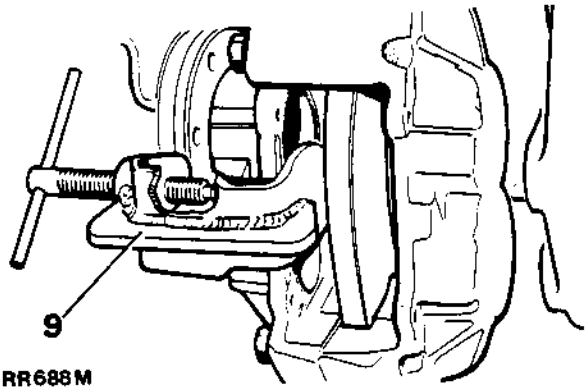
Renew front brake pads

1. Slacken both front wheel nuts, jack up the vehicle and lower onto axle stands.
2. Disconnect the battery.
3. Disconnect the two-pin electrical plug at the rear of the disc mudshield (front right-hand side only).
4. Clean the exterior of the calipers.
5. Remove the split pins from the brake caliper.
6. Remove the retaining springs.
7. Withdraw the brake pads.
8. Clean the exposed parts of the pistons, using new brake fluid.



RR614M

9. Using piston clamp 18G672 press each piston back into its bore, whilst ensuring that the displaced brake fluid does not overflow from the reservoir.
10. Smear the faces of the pistons with Lockheed disc brake lubricant taking care not to let any reach the lining material.



RR688M

11. Insert the new brake pads.
12. Place the brake pad retaining springs in position, fit new split pins and splay the ends.
13. Apply the footbrake several times to locate the pads.
14. Check the fluid reservoir and top-up if necessary.
15. Fit the road wheels, lower the vehicle and finally tighten the road wheels.

Renew rear brake pads

Jacking up the rear of the vehicle, follow the procedure as for front pads.

1. The two-pin electrical plug for rear brake pad wear indication is located on the rear left-hand inboard pad.

CHECK BRAKE SERVO HOSE(S)

Visually inspect all servo hoses and connections for condition and security.

RENEW BRAKE FLUID

Brake fluid absorbs water and in time the boiling point of the fluid will be lowered sufficiently to cause the fluid to be vapourised by the heat generated when the vehicle brakes are applied. This will result in loss of braking efficiency or in extreme cases brake failure.

Therefore, all fluid in the brake system should be changed every eighteen months or 30,000 km (18,000 miles), whichever is the sooner. It should also be changed before touring in mountainous areas if not done in the previous nine months.

Care must be taken always to observe the following points:
(a) At all times use the recommended brake fluid.
(b) Never leave fluid in unsealed containers. It absorbs moisture quickly and can be dangerous if used in the braking system in this condition.

Continued

(c) Fluid drained from the system or used for bleeding is best discarded.
(b) The necessity for absolute cleanliness throughout cannot be over emphasised.

CLEAN THE THROTTLE BUTTERFLY HOUSING—plenum chamber

Fuel injection

At regular service intervals it is recommended that any carbon/oil build up around the throttle butterfly seat (plenum chamber bore), should be removed using a suitable solvent.

1. Remove the inlet pipe from the plenum chamber inlet neck.
2. Open the throttle butterfly and remove any carbon/oil deposits around the butterfly seating.
3. Refit inlet pipe.
4. Check idle speed (see 'Engine Tuning Data').
5. Check and reset CO levels as necessary (see 'Engine Tuning Data').

BATTERY

A low maintenance battery is installed in the vehicle. Dependent upon climate conditions the electrolyte levels should be checked as follows:

Temperate climates every three years.
Hot climates every year.

The exterior of the battery should be occasionally wiped clean to remove any dirt or grease.

Periodically remove the battery terminals to clean and coat with petroleum jelly.

NOTE: If a new battery is fitted to the vehicle it should be the same type as fitted to the vehicle when new. Alternative batteries may vary in size and terminal positions and this could be a possible fire hazard if the terminals or leads come into contact with the battery clamp assembly. When fitting a new battery ensure that the terminals and leads are clear of the battery clamp assembly.

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GENERAL SPECIFICATION DATA

ENGINE

Crankshaft	
Main journal diameter	58.409–58.422 mm (2.2996–2.3001 in)
Minimum regrind diameter	57.393–57.406 mm (2.2596–2.2601 in)
Crankpin journal diameter	50.800–50.812 mm (2.0000–2.0005 in)
Minimum regrind diameter	49.784–49.797 mm (1.9600–1.9605 in)
Crankshaft end thrust	Taken on thrust washers of centre main bearing
Crankshaft end-float	0.10–0.20 mm (0.004–0.008 in)
Main bearings	
Number and type	5, Vandervell shells
Material	Lead–indium
Diametrical clearance	0.010–0.048 mm (0.0004–0.0019 in)
Undersizes	0.254 mm, 0.508 mm (0.010 in, 0.020 in)
Connecting rods	
Type	Horizontally split big-end, plain small-end
Length between centres	143.81–143.71 mm (5.662–5.658 in)
Big-end bearings	
Type and material	Vandervell VP lead–indium
Diametrical clearance	0.015–0.055 mm (0.006–0.0022 in)
End-float on crankpin	0.15–0.36 mm (0.006–0.014 in)
Undersizes	0.254 mm, 0.508 mm (0.010 in, 0.020 in)
Gudgeon pins	
Length	72.67–72.79 mm (2.861–2.866 in)
Diameter	22.215–22.220 mm (0.8746–0.8749 in)
Fit-in connecting rod	Press fit
Clearance in piston	0.002–0.007 mm (0.0001–0.0003 in)
Pistons	
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	0.018–0.033 mm (0.0007–0.0013 in)
Piston rings	
Number of compression	2
Number of oil	1
No. 1 compression ring	Chrome parallel faced
No. 2 compression ring	Stepped to 'L' shaped and marked 'T' or 'TOP'
Width of compression rings	1.56–1.59 mm (0.0615–0.0625 in)
Compression ring gap	0.44–0.57 mm (0.017–0.022 in)
Oil ring type	Perfect circle, type 98-6
Oil ring width	4.811 mm (0.1894 in) max
Oil ring gap	0.38–1.40 mm (0.015–0.055 in)
Camshaft	
Location	Central
Bearings	Non serviceable
Number of bearings	5
Drive	Chain 9.52 mm (0.375 in) pitch × 54 pitches

Tappets

Type	Hydraulic, non adjustable

Valves

Length:	
Inlet	116.59–117.35 mm (4.590–4.620 in)
Exhaust	116.59–117.35 mm (4.590–4.620 in)
Seat angle:	
Inlet	45°–45½°
Exhaust	45°–45½°
Head diameter:	
Inlet	39.75–40.00 mm (1.565–1.575 in)
Exhaust	34.226–34,480 mm (1.3475–1.3575 in)
Stem diameter:	
Inlet	8.664–8.679 mm (0.3411–0.3417 in)
Exhaust	8.651–8.666 mm (0.3406–0.3412 in)
Stem to guide clearance:	
Inlet	0.025–0.066 mm (0.0010–0.0026 in)
Exhaust	0.038–0.078 mm (0.0015–0.0031 in)
Valve lift (inlet and exhaust)	9.49 mm (0.374 in)
Valve spring length fitted	40.4 mm (1.590 in) at pressure of 29.5 kg (65 lb)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2400 rpm	2.1–2.8 kgf/cm² (30–40 lbf/in²)
Oil filter (external)	Full-flow, self-contained cartridge
Oil filter (internal)	Gauze. Pump intake filter
Oil pump type	Gear

Oil pressure relief valve

Type	Non adjustable
Relief valve spring:	
Free length	81.2 mm (3.200 in)
Compressed length at 4.2 kg (9.3 lb) load	45.7 mm (1.800 in)

Oil filter by-pass valve

Type	Non adjustable
By-pass valve spring:	
Free length	37.5 mm (1.48 in)
Compressed length at 0.34 kg (0.75 lb)	22.6 mm (0.89 in)

FUEL SYSTEM—carburetter

Carburetter type	See 'Engine Tuning Data', in Book I.
Fuel pump—make/type	AC Delco—low pressure (electrical) immersed in the fuel tank
Pump delivery pressure	0.28–0.42 kgf/cm² (4–6 lbf/in²)
Fuel filter	AC Delco CD600—element ACD60

FUEL SYSTEM—fuel injection

Fuel system type	See 'Engine Tuning Data', in Book I
Fuel pump—make/type	AC Delco—high pressure (electrical) immersed in the fuel tank
Pump delivery pressure	1.83–2.5 kgf/cm² (26–36 lbf/in²)
Fuel filter	Bosch in-line filter 'canister' type

COOLING SYSTEM

Type	Pressurized spill return system with thermostat control, pump and fan assisted
Thermostat	88°C
Type of pump	Centrifugal

CLUTCH

Type	Borg and Beck diaphragm spring
Centre plate diameter	267 mm (10.5 in)
Facing material	Raybestos 1488-05. Grooved
Damper spring colour	Light blue/dark blue
Release bearing	Ball journal
Number of damper springs	6

TORQUE WRENCH SETTINGS	Nm	lbf ft
ENGINE—V8 Petrol engine		
Air intake adaptor to carbs	24	17
Alternator mounting bracket to cylinder head	34	25
Alternator to mounting bracket	24	17
Alternator to adjusting link	24	17
Chainwheel to camshaft	54–61	40–45
Connecting rod bolt	47–54	35–40
Clutch attachment to flywheel	24–30	18–22
Cylinder head:		
Outer row	54–61	40–45*
Centre row	88–95	65–70*
Inner row	88–95	65–70*
Distributor clamp bolt	19–22	14–16
Exhaust manifold to cylinder heads	19–22	14–16
Fan to viscous unit	26–32	19–24
Flexible drive plate to crankshaft	74–81	55–60
Flywheel to crankshaft	74–81	55–60
Inlet manifold to cylinder heads	47–54	35–40
Lifting eye to cylinder heads	24	17
Main bearing cap bolts	68–75	50–55**
Main bearing cap rear bolts	88–95	65–70**
Manifold gasket clamp bolt	13.5–20	10–15
Oil pump cover to timing cover	11–14	8–10
Oil plug	24–30	18–22
Oil relief valve plug	40–47	30–35
Oil sump drain plug	40.6–47	30–35
Oil sump to cylinder block	8–11	5–8
Oil sump rear to cylinder block	17.6–20.3	13–15
Rocker cover to cylinder head	7	5
Rocker shaft bracket to cylinder head	34–40	25–30
Spark plug	13.8–16.2	10–12
Starter motor attachment	40.6–47.4	30–35
Damper to crankshaft	257–285	190–210
Timing cover to cylinder block	24–30	18–22***
Viscous unit to water pump hub	36–40	27–30
Water pump pulley to water pump hub	23	17***
Water pump timing cover to cylinder block	24–30	18–22
Water jacket to plenum chamber	10–14	8–10***
Plenum chamber to ram housing	20–24	15–18
Ram housing to intake manifold	20–24	15–18
Thermostat housing to intake manifold	24–30	18–22

Lubricants/sealants have been specified in certain applications for assembly purposes.

* These bolts must have threads coated with Loctite 572 prior to assembly. For this purpose it is necessary to use an approved dispenser to apply the sealant/lubricant to the first three threads of the bolts.

** These bolts must have threads coated in lubricant EXP16A (Marston Lubricants) prior to assembly.

*** These bolts must have threads coated in sealant Loctite 572 prior to assembly.

It is essential that all bolts are securely tightened and it is imperative that the correct torque is adhered to.

Charts below give torque settings for all screws and bolts used except for those that are specified otherwise

SIZE	METRIC		SIZE	UNC		UNF	
	Nm	lbf ft		Nm	lbf ft	Nm	lbf ft
M5	3.7–5.2	5–7	¼	6.8–9.5	5–7	8.1–12.2	6–9
M6	5.2–7.4	7–10	5/16	20.3–27.1	15–20	20.3–27.1	15–20
M8	16.2–20.7	22–28	3/8	35.2–43.4	26–32	35.2–43.4	26–32
M10	29.5–36.9	40–50	7/16	67.8–88.1	50–65	67.8–88.1	50–65
M12	59.0–73.8	80–100	½	81.3–101.7	60–75	81.3–101.7	60–75
M14	66.4–88.5	90–120	5/8	122.0–149.1	90–110	122.0–149.1	90–110
M16	118.0–147.5	160–200					

V8 CYLINDER ENGINE

The following V8 Engine overhaul is applicable to all Range Rovers.
Before removing the fuel injection engine from the vehicle, the following equipment and bracketry must be disconnected or removed.

Air conditioning compressor (if fitted, do not evacuate or disconnect any hoses. Release the compressor from its mounting and lay to one side)
Alternator
Radiator
Power steering pump (disconnect pipes and hoses)
Fan blades
Automatic transmission fluid pipes (from side of block)
Any electrical wiring or harnesses

For the removal procedure of the following items see the 'Fuel Injection' section of manual.

Air cleaner
Air flow meter
Throttle lever bracketry
Plenum chamber
Ram housing
Any electrical wiring or harnesses

DISMANTLE AND OVERHAUL

Remove the engine from the vehicle and clean the exterior. In the interests of safety and efficient working secure the engine to a recognised engine stand. Drain and discard the sump oil.

Special tools:
RO605351—Guide bolts
18G 537—Torque wrench
18G 79—Clutch centralising tool
18G 1150—Gudgeon pin remover/replacer—Basic tool
18G 1150E—Adaptor remover/replacer—gudgeon pin.
18G106A—Spring compressor
600959—Valve guide drift exhaust
MS76—Valve cutter handle set
MS150—8.5 Adjustable pilot
MS621—Valve seat cutter
RO605774—Distance piece for valve guide
RO274401—Drift for guide removal—inlet and exhaust
RO1014—Camshaft rear seal sleeve

REMOVE ANCILLARY EQUIPMENT

Before commencing, and whilst dismantling, make a careful note of the position of brackets, clips, harnesses, pipes, hoses, filters and other miscellaneous and non-standard items to facilitate reassembly.

1. Remove the following items of equipment:
   Starter motor.
   Alternator and mounting bracket.
   Power steering pump.
   Disconnect spark plug H.T. leads and remove the distributor.
   Clutch.
   Fan blades, pulley and drive belt.
   Remove pulse air rails from cylinder heads.
   Dipstick and engine mounting brackets.

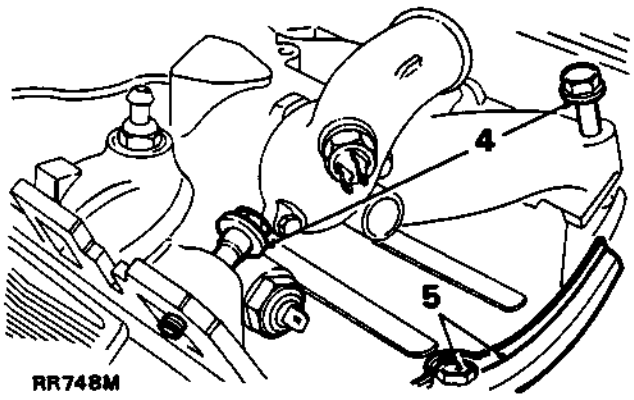
Remove exhaust manifolds

2. Bend back the lock tabs, and remove the eight bolts securing each manifold, and withdraw the manifolds.

Remove intake manifold—Carburetter versions only

NOTE: The removal procedure for the intake manifold on fuel injection models is incorporated in the 'Fuel Injection' section of the manual.

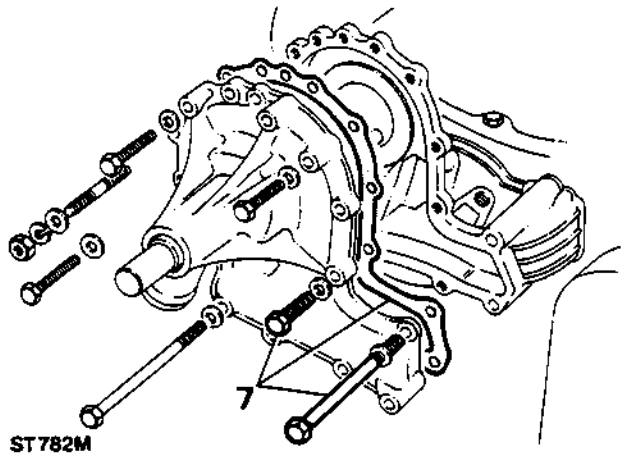
3. Disconnect miscellaneous pipes and hoses from the intake manifold and the carburetters.
4. Evenly slacken and remove the twelve bolts and lift off the intake manifold complete with carburetters.
5. Wipe away any surplus coolant lying on the manifold gasket and remove the gasket clamp bolts and remove the clamps.
6. Lift off the manifold gasket and seals.



Continued

Remove water pump

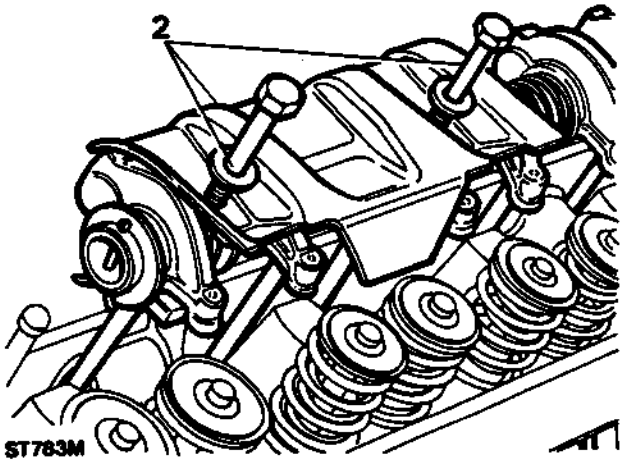
7. Remove the fifteen bolts and withdraw the water pump and joint washer.



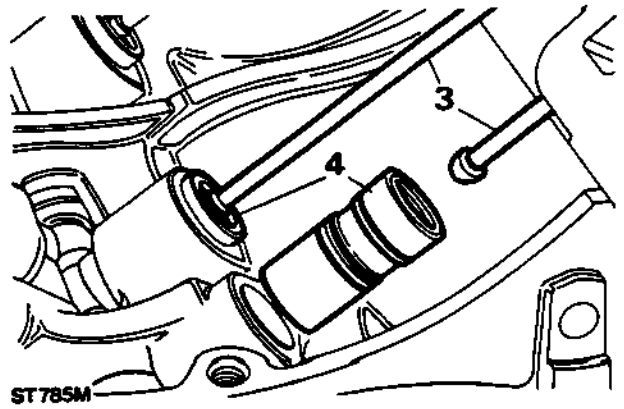
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REMOVE AND OVERHAUL ROCKER SHAFTS AND VALVE GEAR

1. Remove the four screws and lift off the rocker covers.
2. Remove the four rocker shaft retaining bolts and lift off the assembly complete with baffle plate.



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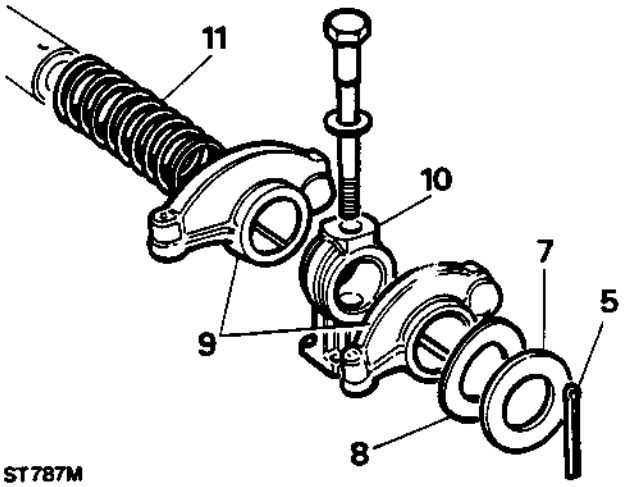


ST785M

3. Withdraw the pushrods and retain in the sequence removed.
4. Remove the hydraulic tappets and place to one side with their respective pushrods. If a tappet cannot be removed leave in position until the camshaft is removed.

Dismantle rocker shafts

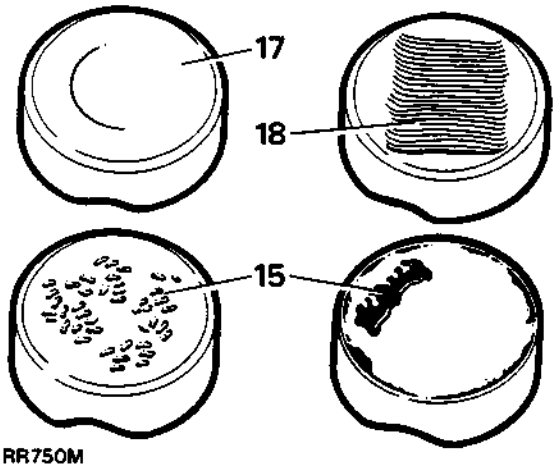
5. Remove the split pin from one end of the rocker shaft.
6. Withdraw the following components and retain them in the correct sequence for reassembly:
7. A plain washer.
8. A wave washer.
9. Rocker arms.
10. Brackets.
11. Springs.
12. Examine each component for wear, in particular the rockers and shafts. Discard weak or broken springs.



ST787M

Inspect tappets and pushrods

13. Hydraulic tappet: inspect inner and outer surfaces of body for blow holes and scoring. Replace hydraulic tappet if body is roughly scored or grooved, or has a blow hole extending through the wall in a position to permit oil leakage from lower chamber.
14. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored. It is caused by side thrust of the cam against the body while the tappet is moving vertically in its guide.
15. Inspect the cam contact surface of the tappets. Fit new tappets if the surface is excessively worn or damaged.
16. A hydraulic tappet body that has been rotating will have a round wear pattern and a non-rotating tappet body will have a square wear pattern with a very slight depression near the centre.
17. Tappets MUST rotate and a circular wear condition is normal. Tappets with this wear pattern can be refitted provided there are no other defects.
18. In the case of a non-rotating tappet, fit a new replacement and check camshaft lobes for wear; also ensure the new tappet rotates freely in the cylinder block.



RR750M

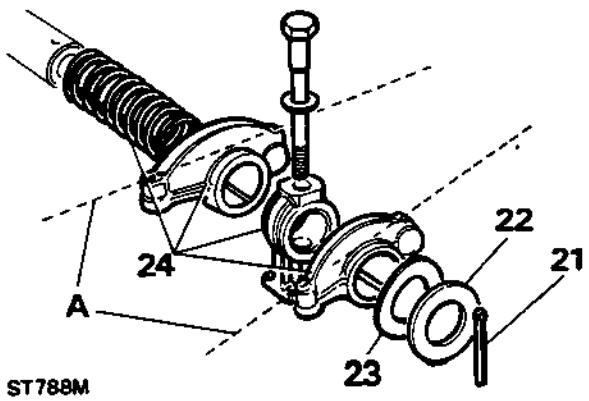
19. Fit a new hydraulic tappet if the area where the pushrod contacts is rough or otherwise damaged.
20. Renew any pushrod having a rough or damaged ball end or seat. Also bent rods must be renewed.

Assemble rocker shafts

21. Fit a split pin to one end of the rocker shaft.
22. Slide a plain washer over the long end of the shaft to abut the split pin.
23. Fit a wave washer to abut the plain washer.

NOTE: Two different rocker arms are used and must be fitted so that the valve ends of the arms slope away from the brackets, as indicated by the dotted lines 'A' on the illustration.

24. Assemble the rocker arms, brackets and springs to the rocker shaft.

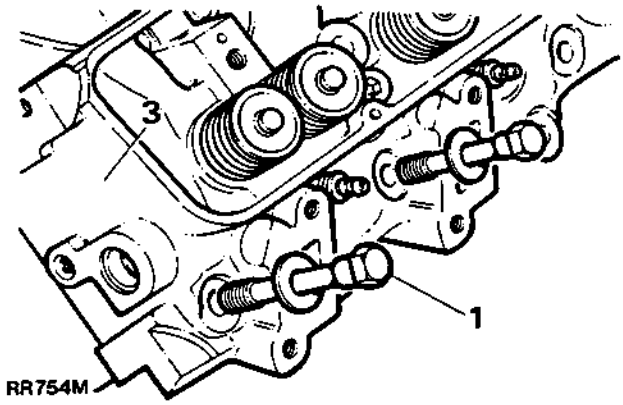


ST788M

25. Compress the springs, brackets and rockers, and fit a wave washer, plain washer and split pin to the end of the rocker shaft.
26. Locate the oil baffle plate in place over the rockers furthest from the notched end of the rocker shaft and fit the bolts through the brackets and place the assemblies to one side.

REMOVE AND OVERHAUL THE CYLINDER HEADS

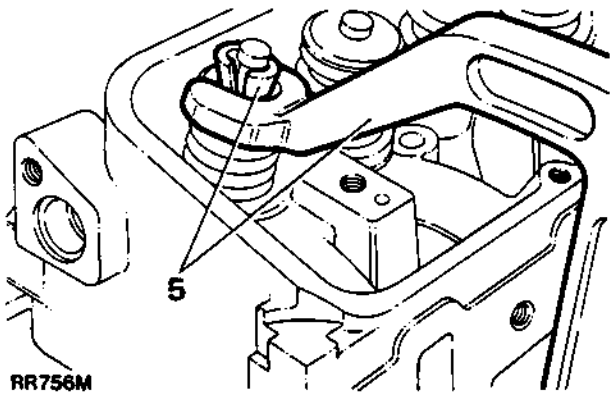
1. Evenly slacken the fourteen cylinder head bolts reversing the tightening order.
2. Before removing the heads mark them relative to the LH and RH side of the engine.
3. Lift off the cylinder heads and discard the gasket.



RR754M

Dismantle cylinder heads

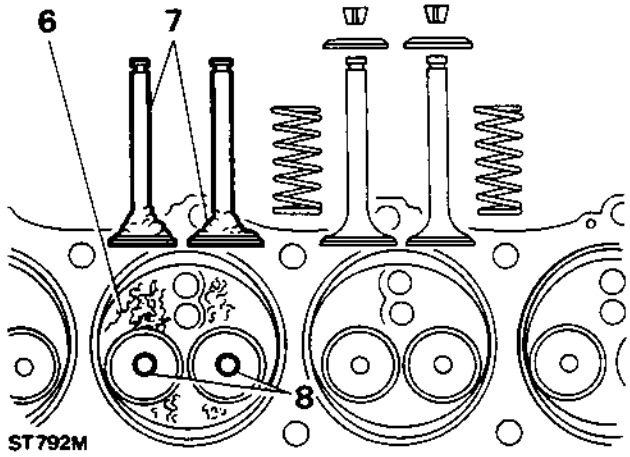
4. Remove the spark plugs.
5. Using the valve spring compressor 18G 106A or a suitable alternative, remove the valves and springs and retain in sequence for refitting.



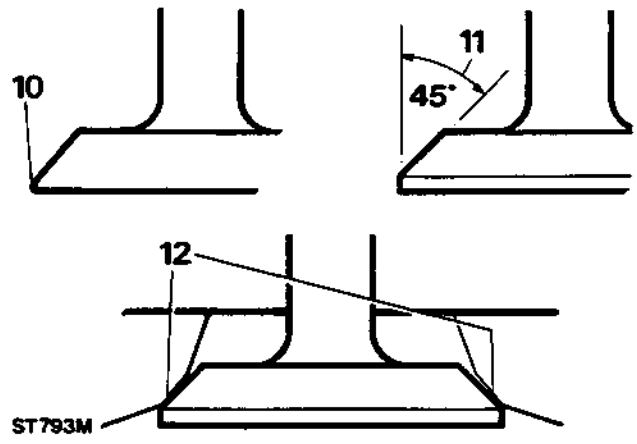
RR756M

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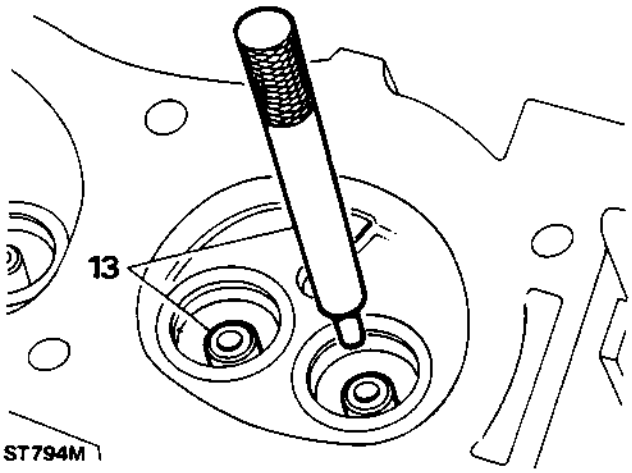
6. Clean the combustion chambers with a soft wire brush.
7. Clean the valves.
8. Clean the valve guide bores.



9. Regrind or fit new valves as necessary.
10. If a valve must be ground to a knife-edge to obtain a true seat, fit a new valve.
11. The correct angle for the valve face is 45 degrees.
12. The correct angle for the seat is 46 ± ¼ degrees and the seat witness should be towards the outer edge.



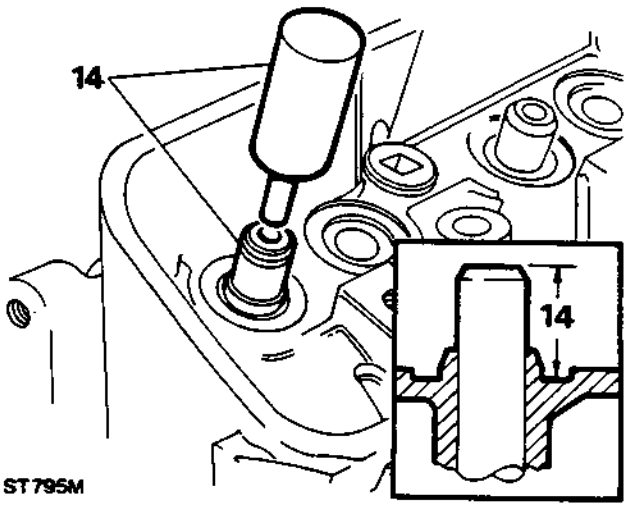
13. Check the valve guides and fit replacements as necessary. Using the valve guide remover 274401, drive out the old guides from the combustion chamber side.



Fit new valve guides

14. Lubricate the new valve guide and place in position. Using guide drift 600959 drive the guide into the cylinder head until it protrudes 19 mm (¾ in) above the valve spring recess in the head.

NOTE: Service valve guides are 0.02 mm (0.001 in) larger on the outside diameter than the original equipment to ensure interference fit.



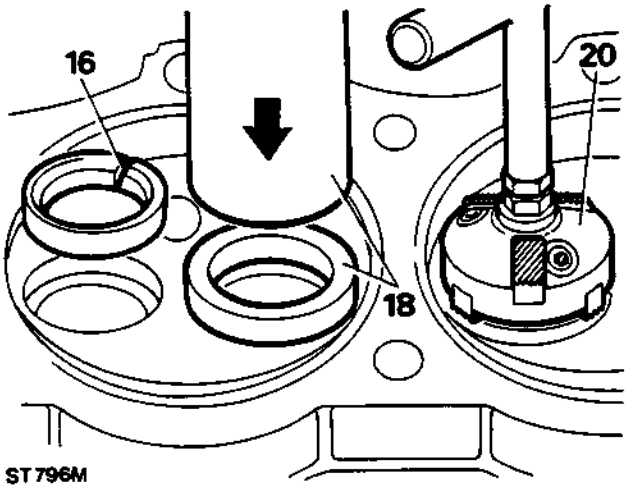
Examine and fit new valve seats

15. Check the valve seats for wear, pits and burning and renew the inserts if necessary.

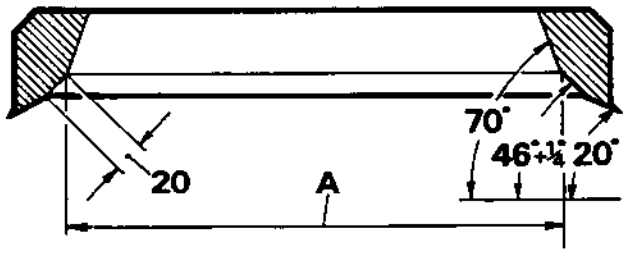
16. Remove the old seat inserts by grinding them away until they are thin enough to be cracked and prised out.
17. Heat the cylinder head evenly to approximately 65° C (150° F).
18. Press the new insert into the recess in the cylinder head.

NOTE: Service valve seat inserts are available in two over-sizes 0.25 and 0.50 mm (0.010 and 0.020 in) larger on the outside diameter to ensure interference fit.

19. If necessary, cut the valve seats to 46 ± ¼ degrees.
20. The nominal seat width is 1.5 mm (0.031 in). If the seat exceeds 2.0 mm (0.078 in) it should be reduced to the specified width by the use of 20° and 70° cutters.
21. The inlet valve seat diameter: 'A' is 37.03 mm (1.458 in) and the exhaust valve seat is 31.50 mm (1.240 in).

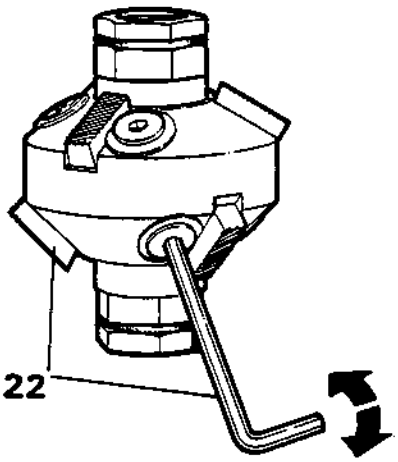


ST796M



ST797M

22. Ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated.
Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS76. Use light pressure and remove only the minimum material necessary.

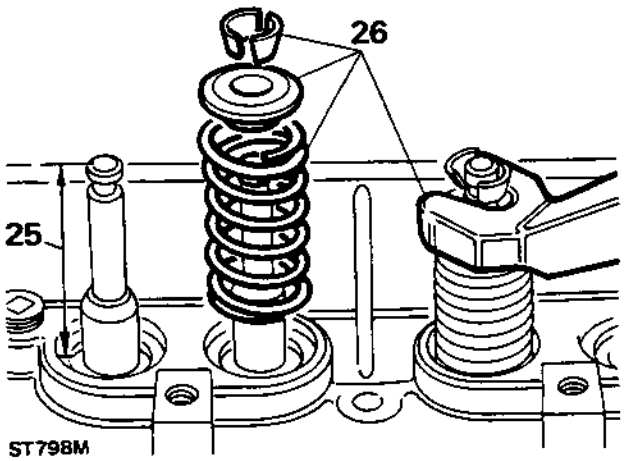


ST1024M

23. Smear a small quantity of engineers' blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a gap of not more than 12 mm it can be corrected by lapping.
24. Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag the seal is satisfactory in that spot. Repeat this in at least eight places. Lapping-in will correct a small open spot.

Assemble valves to cylinder head

25. Before fitting the valves and springs the height of each valve above the head must be checked. Insert each valve in turn in its guide and whilst holding the head firmly against the seat, measure the height of the stem above the valve spring seat surface. This dimension must not exceed 47.63 mm (1.875 in). If necessary renew the valve or grind the end of the valve stem.
26. Lubricate the valve stems and assemble the valves, springs and caps and secure with the collets using valve spring compressor 18G 106A.



ST798M

Continued

Reclaiming cylinder head threads

Damaged or stripped threads in the cylinder head can be salvaged by fitting Helicoils as follows:

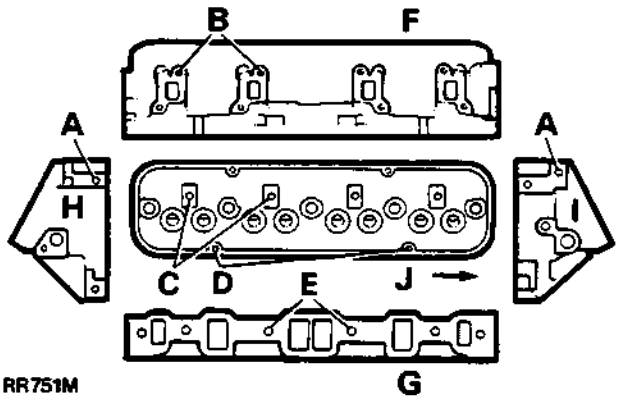
Holes A — These three holes may be drilled 0.3906 in dia. × 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS × 0.875 in (min) deep (⅜ UNC 1½D insert).

Holes B — These eight holes may be drilled 0.3906 in dia. × 0.812 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CBB 0.749 in (min) deep (⅜ UNC 1½D insert).

Holes C — These four holes may be drilled 0.3906 in dia. × 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS × 0.875 in (min) deep (⅜ UNC 1½D insert).

Holes D — These four holes may be drilled 0.261 in dia. × 0.675 + 0.040 in deep. Tapped with Helicoil Tap No. 4 CPB or 4CS × 0.625 in (min) deep (¼ UNC 1½D insert).

Holes E — These six holes may be drilled 0.3906 in dia. × 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS × 0.875 in (min) deep (⅜ UNC 1½D insert).



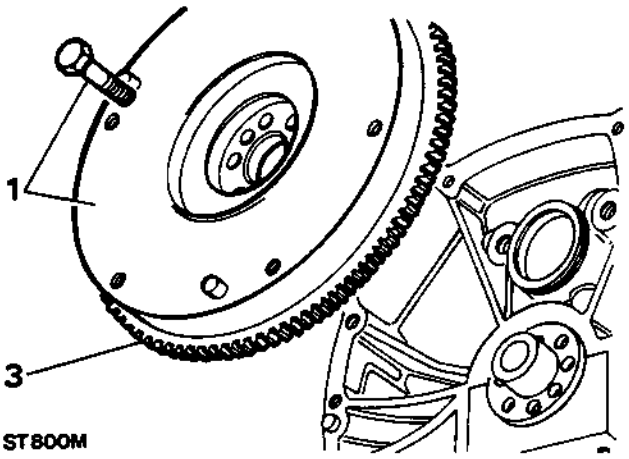
RR751M

NOTE: Right-hand cylinder head illustrated. American projection.

F Exhaust manifold face
G Inlet manifold face
H Front face
I Rear face
J Front of engine

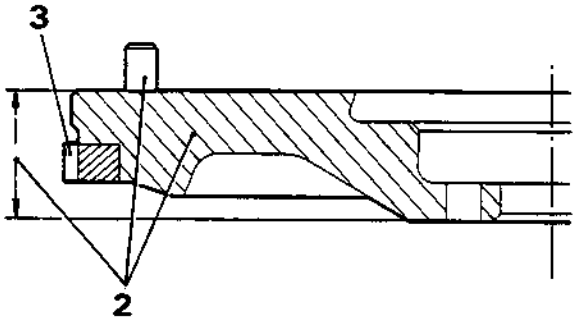
REMOVE AND OVERHAUL FLYWHEEL

1. Remove the retaining bolts and withdraw the flywheel from the crankshaft.



ST800M

2. Examine the flywheel clutch face for cracks, scores and overheating. If the overall thickness of the flywheel is in excess of the minimum thickness i.e. 39.93 mm (1.572 in) it can be refaced provided that after machining it will not be below the minimum thickness. Remove the three dowels before machining.
3. Examine the ring gear and if worn or the teeth are chipped and broken it can be renewed as follows:

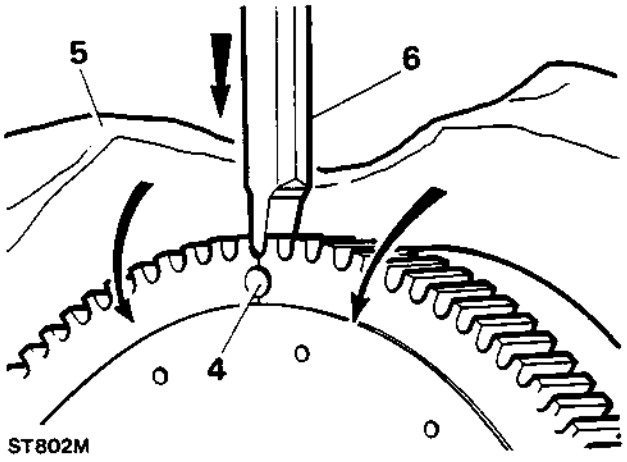


ST803M

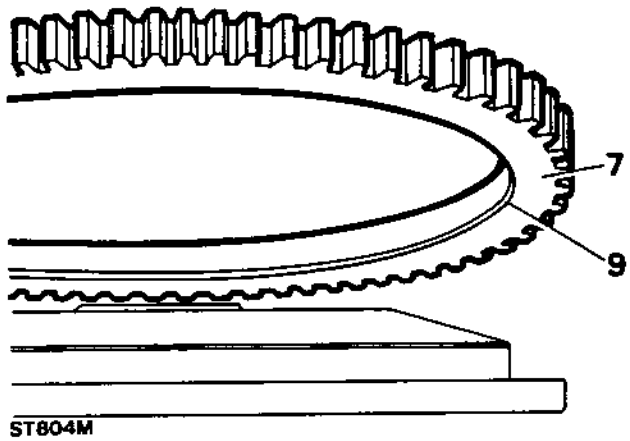
4. Drill a 10 mm (0.393 in) diameter hole axially between the root of any tooth and the inner diameter of the starter ring sufficiently deep to weaken the ring. Do NOT allow the drill to enter the flywheel.
5. Secure the flywheel in a vice fitted with soft jaws and place a cloth over the flywheel to protect the operator from flying fragments.

WARNING: Take adequate precautions against flying fragments when splitting the ring gear.

6. Place a chisel immediately above the drilled hole and strike it sharply to split the starter ring gear.

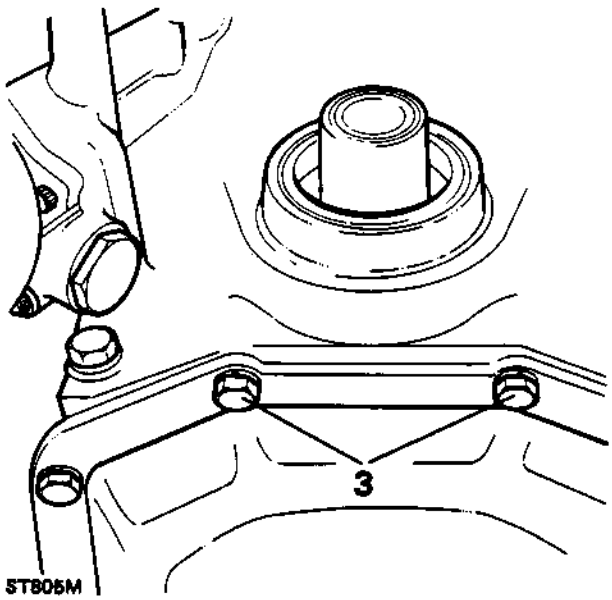


7. Heat the new ring gear uniformly to between 170° and 175° C (338° to 347° F) but do not exceed the higher temperature.
8. Place the flywheel, clutch side down, on a flat surface.
9. Locate the heated starter ring gear in position on the flywheel, with the chamfered inner diameter towards the flywheel flange. If the starter ring gear is chamfered both sides, it can be fitted either way round.
10. Press the starter ring gear firmly against the flange until the ring contracts sufficiently to grip the flywheel.
11. Allow the flywheel to cool gradually. Do NOT hasten cooling in any way or distorting may occur.
12. Fit new clutch assembly location dowels to the flywheel.

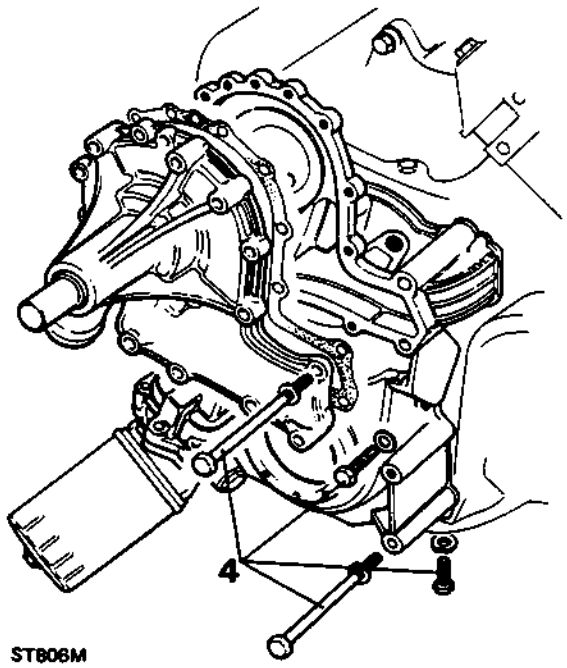


REMOVE TIMING GEAR COVER AND WATER PUMP

1. Place an oil drip-tray beneath the timing cover and remove the oil filter element.
2. Remove the crankshaft pulley bolt and special washer and withdraw the pulley.
3. Remove the two bolts securing the sump to the bottom of the timing cover.



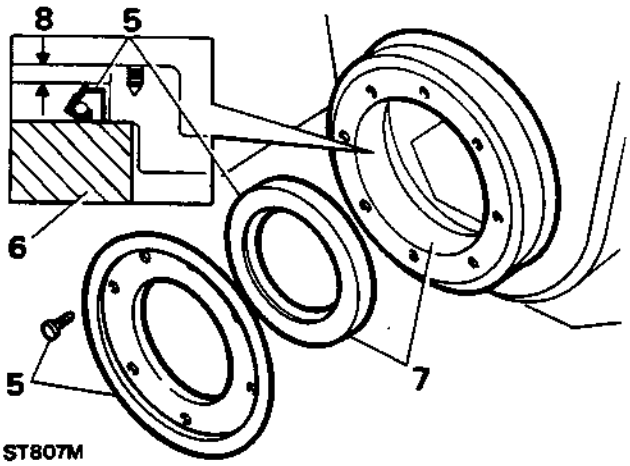
4. Remove the remaining timing cover retaining bolts and withdraw the cover complete with oil pump.



Continued

Renewing timing cover oil seal

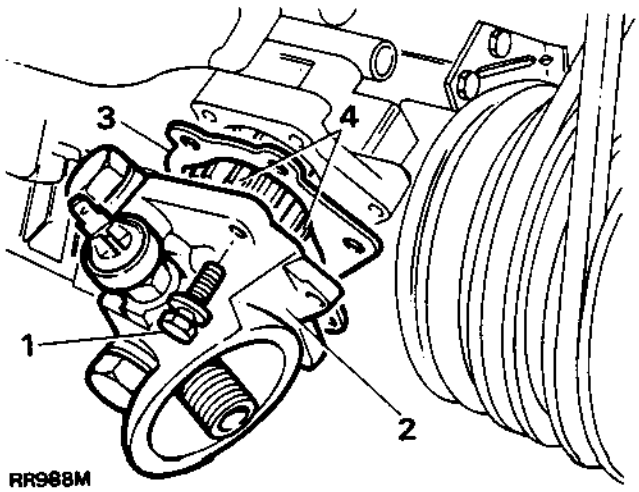
5. Remove the seven drive screws and withdraw the mud shield and the oil seal.
6. Position the gear cover with the front face uppermost and the underside supported across the oil seal housing bore on a suitable wooden block.
7. Enter the oil seal, lip side leading, into the housing bore.
8. Press in the oil seal until the plain face is 1.5 mm (0.062 in) approximately below the gear cover face.
9. Fit the mud shield and secure with the screws.



ST807M

REMOVE AND OVERHAUL THE OIL PUMP

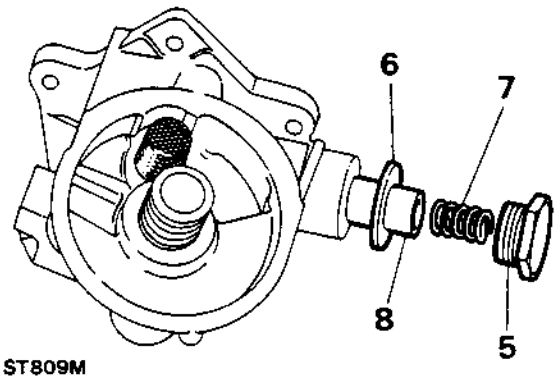
1. Remove the bolts from the oil pump cover.
2. Withdraw the oil pump cover.
3. Lift off the cover gasket.
4. Withdraw the oil pump gears.



RR968M

Dismantle pump

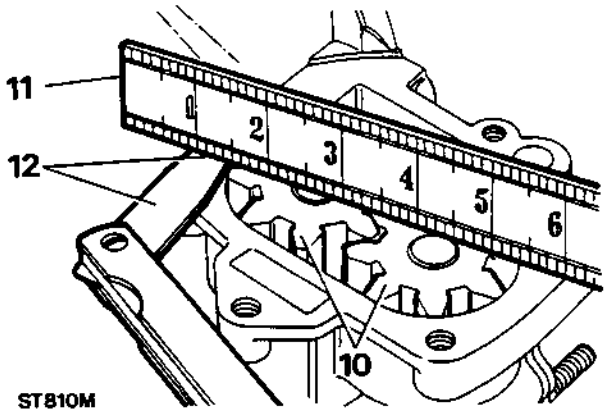
5. Unscrew the plug from the pressure relief valve.
6. Lift off the joint washer for the plug.
7. Withdraw the spring from the relief valve.
8. Withdraw the pressure relief valve.



ST809M

Examine pump

9. Check the oil pump gears for wear or scores.
10. Fit the oil pump gears and shaft into the front cover.
11. Place a straight-edge across the gears.
12. Check the clearance between the straight-edge and the front cover. If less than 0.05 mm (0.0018 in), check the front cover gear pocket for wear.



ST810M

13. Check the oil pressure relief valve for wear or scores.
14. Check the relief valve spring for wear at the sides or signs of collapse.
15. Clean the gauze filter for the relief valve.
16. Check the fit of the relief valve in its bore. The valve must be an easy slide fit with no perceptible side movement.

Assemble pump

17. Insert the relief valve spring.
18. Locate the sealing washer on to the relief valve plug.
19. Fit the relief valve plug and tighten to correct torque —see data section.
20. Fully pack the oil pump gear housing with petroleum jelly. Use only petroleum jelly; no other grease is suitable.
21. Fit the oil pump gears so that the petroleum jelly is forced into every cavity between the teeth of the gears.

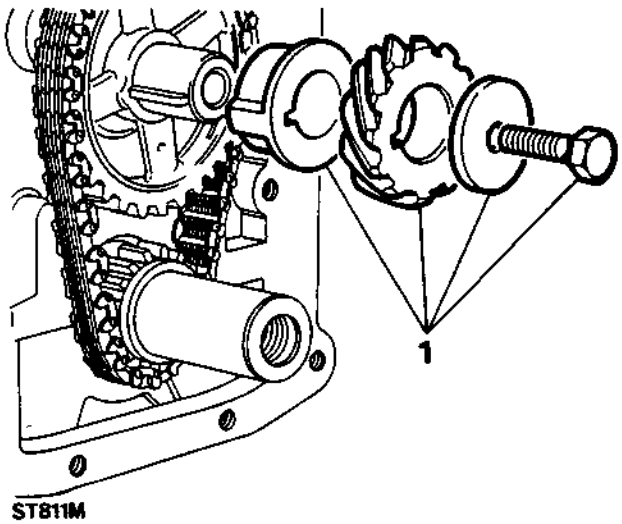
    IMPORTANT: Unless the pump is fully packed with petroleum jelly it may not prime itself when the engine is started.

22. Place a new gasket on the oil pump cover.
23. Locate the oil pump cover in position.
24. Fit the special fixing bolts and tighten alternately and evenly to the correct torque.

REMOVE TIMING CHAIN GEARS AND CAMSHAFT

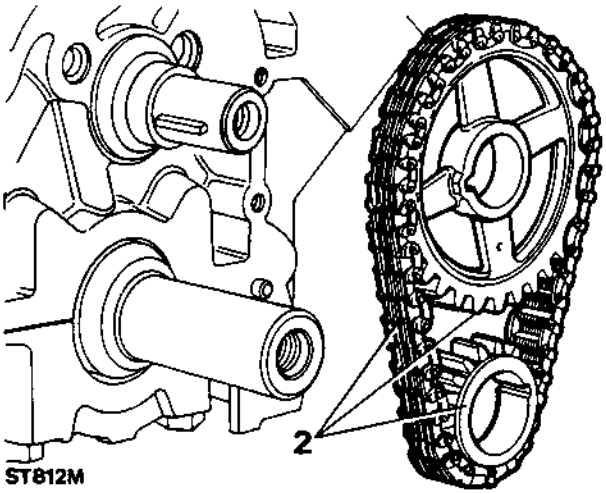
CAUTION: If this operation is carried out with cylinder heads and rocker shafts in position the engine must NOT be rotated once the timing chain has been removed otherwise the pistons and valves will be damaged.

1. Remove the retaining bolt and washer and withdraw the distributor drive gear and spacer.



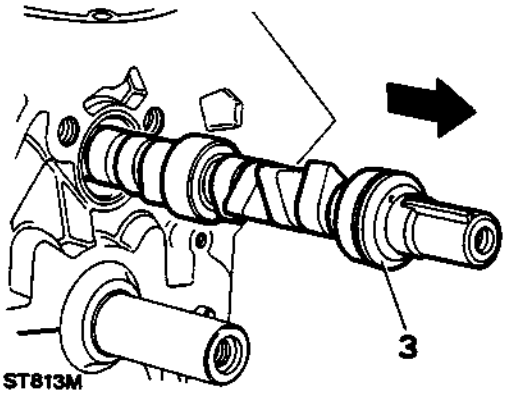
ST811M

2. Withdraw the chain wheels complete with timing chain.



ST812M

3. Withdraw the camshaft whilst taking particular care not to damage the bearings in the cylinder block.



ST813M

Examine components

4. Visually examine all parts for wear. Check the camshaft bearing journals and cams for wear, pits, scores and overheating. Should any of these conditions be present the shaft should be renewed.
5. Examine the links and pins of the timing chain for wear and compare its condition with that of a new chain. Similarly the teeth of the chain wheels should be inspected and if necessary the wheels should be renewed.

Continued

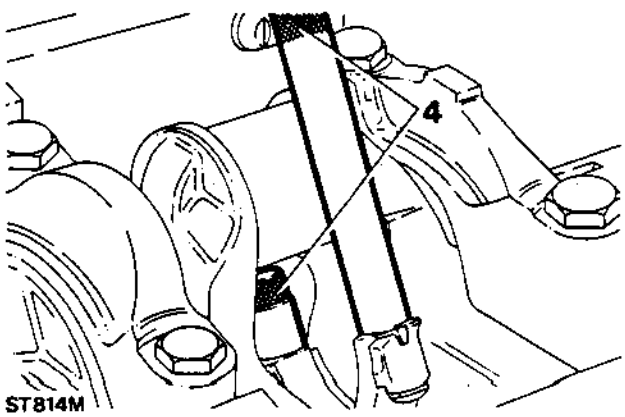
6. Measure the camshaft journals for overall wear, ovality and taper. The diameters of the five journals are as follows commencing from the front of the shaft:

   Number 1 journal 1.786 to 1.785 in
   Number 2 journal 1.750 to 1.755 in
   Number 3 journal 1.726 to 1.725 in
   Number 4 journal 1.696 to 1.095 in
   Number 5 journal 1.666 to 1.665 in.

7. To check the camshaft for bow, rest the two end journals i.e. numbers 1 and 5 on 'V' blocks and mount a dial gauge on the centre journal. Rotate the shaft and note the reading. If the run out is more than 0.05 mm (0.002 in) it should be renewed.

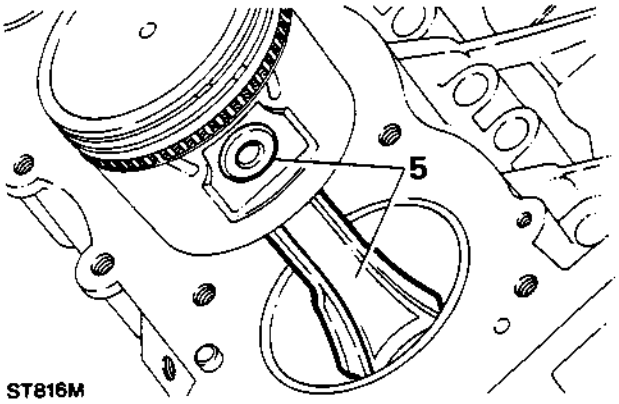
REMOVE AND OVERHAUL CONNECTING-RODS AND PISTONS

1. Withdraw the remaining bolts and remove the sump.
2. Remove the sump oil strainer.
3. Remove the connecting-rod caps and retain them in sequence for reassembly.
4. Screw the guide bolts 605351 onto the connecting-rods.



ST814M

5. Push the connecting-rod and piston assembly up the cylinder bore and withdraw it from the top. Retain the connecting-rod and piston assemblies in sequence with their respective caps.
6. Remove the guide bolts 605351 from the connecting-rod.

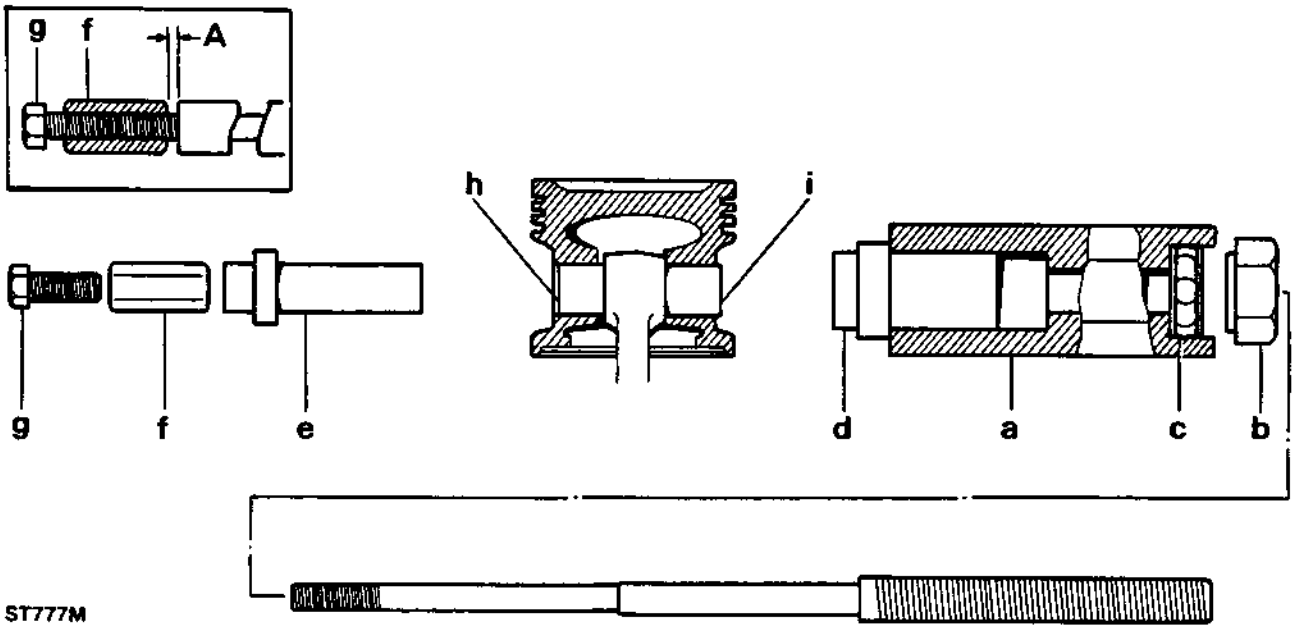


ST816M

Overhaul

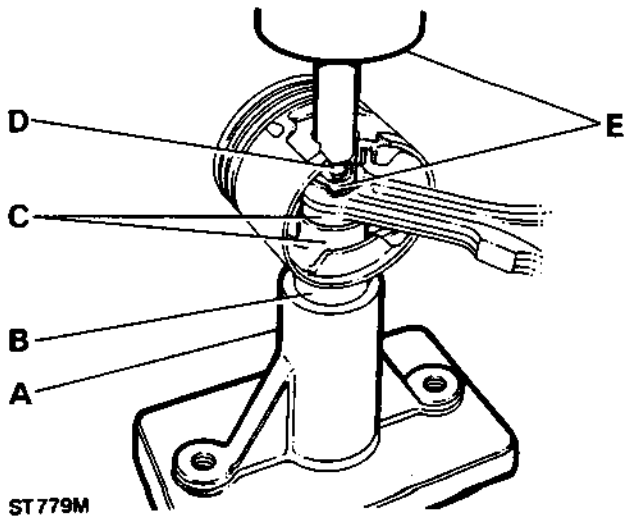
NOTE: The connecting-rods, caps and bearing shells must be retained in sets, and in the correct sequence. Remove the piston rings over the crown of the piston. If the same piston is to be refitted, mark it relative to its connecting-rod to ensure that the original assembly is maintained.

7. Withdraw the gudgeon pin, using tool 18G 1150 as follows:
   a. Clamp the hexagon body of 18G 1150 in a vice.
   b. Position the large nut flush with the end of the centre screw.
   c. Push the screw forward until the nut contacts the thrust race.
   d. Locate the piston adaptor 18G 1150 E with its long spigot inside the bore of the hexagon body.
   e. Fit the remover/replacer bush of 18G 1150 on the centre screw with the flanged end away from the gudgeon pin.
   f. Screw the stop-nut about half-way onto the smaller threaded end of the centre screw, leaving a gap 'A' of 3 mm (⅛ in) between this nut and the remover/replacer bush.
   g. Lock the stop-nut securely with the lock screw.
   h. Check that the remover/replacer bush is correctly positioned in the bore of the piston.
   i. Push the connecting-rod to the right to expose the end of the gudgeon pin, which must be located in the end of the adaptor 'd'.
   j. Screw the large nut up to the thrust race.
   k. Hold the lock screw and turn the large nut until the gudgeon pin has been withdrawn from the piston. Dismantle the tool.



ST777M

8. As an alternative to tool 18G 1150, press the gudgeon pin from the piston using an hydraulic press and the components which comprise tool 605350 as follows:
   A. Place the base of tool 605350 on the bed of an hydraulic press which has a capacity of 8 tons (8 tonnes).
   B. Fit the guide tube into the bore of the base with its countersunk face uppermost.
   C. Push the piston to one side so as to expose one end of the gudgeon pin and locate this end in the guide tube.
   D. Fit the spigot end of the small diameter mandrel into the gudgeon pin.
   E. Press out the gudgeon pin, using the hydraulic press.



ST779M

Original pistons

Remove the carbon deposits, particularly from the ring grooves.
Examine the pistons for signs of damage or excessive wear; refer to 'new pistons' for the method of checking the running clearance. Fit new pistons if necessary.

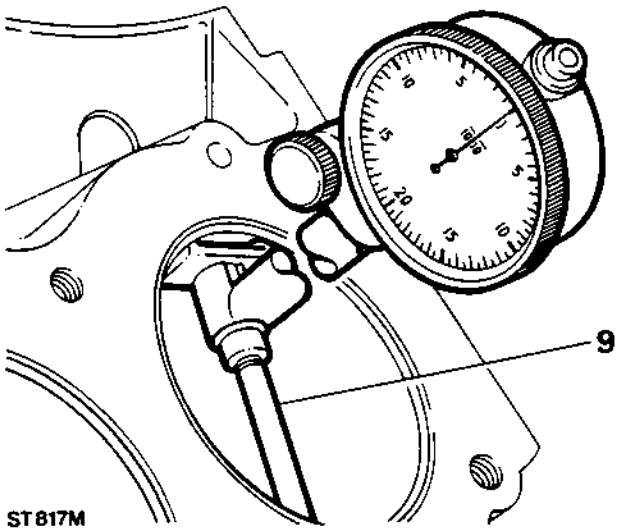
New pistons

Pistons are available in service standard size and in oversizes of 0.25 mm (0.010 in) and 0.50 mm (0.020 in). Service standard size pistons are supplied 0.0254 mm (0.001 in) oversize. When fitting new service standard size pistons to a cylinder block, check for correct piston to bore clearance, honing the bore if necessary. Bottom of piston skirt/bore clearance should be 0.018 to 0.033 mm (0.0007 to 0.0013 in).

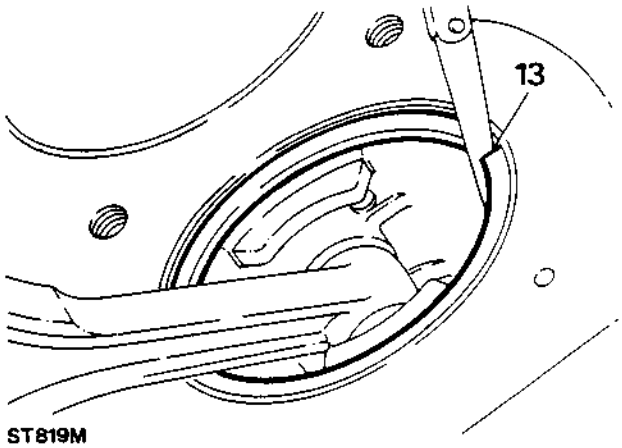
NOTE: The temperature of the piston and cylinder block must be the same to ensure accurate measurement. When reboring the cylinder block, the crankshaft main bearing caps must be fitted and tightened to the correct torque.

9. Check the cylinder bore dimension at right angles to the gudgeon pin, 40 to 50 mm (1½ to 2 in) from the top.

Continued

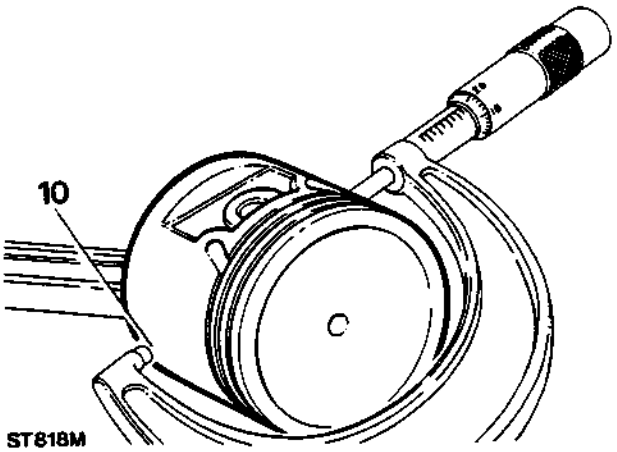


ST817M



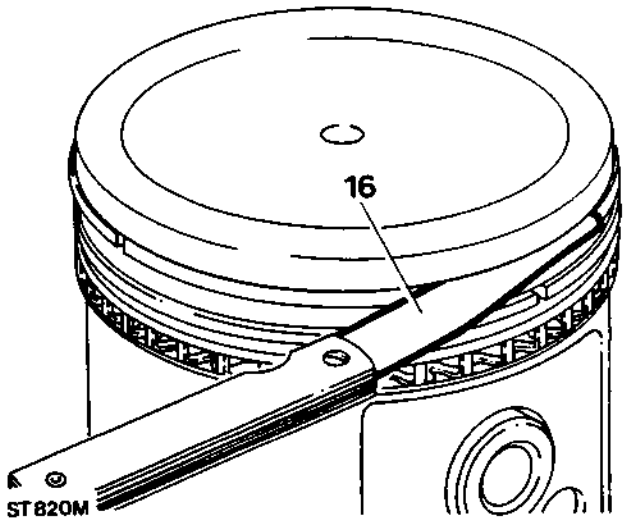
ST819M

10. Check the piston dimension at right angles to the gudgeon pin, at the bottom of the skirt.
11. The piston dimension must be 0.018 to 0.033 mm (0.0007 to 0.0013 in) smaller than the cylinder.
12. If new piston rings are to be fitted without reboring, deglaze the cylinder walls with a hone, without increasing the bore diameter to provide a cross-hatch finish.



ST818M

14. Temporarily fit the compression rings to the piston.
15. The ring marked 'TOP' must be fitted with the marking uppermost and into the second groove. The chrome ring is for the top groove and can be fitted either way round.
16. Check the compression ring clearance in the piston groove. Clearance limits: 0.05 to 0.10 mm (0.002 to 0.004 in).



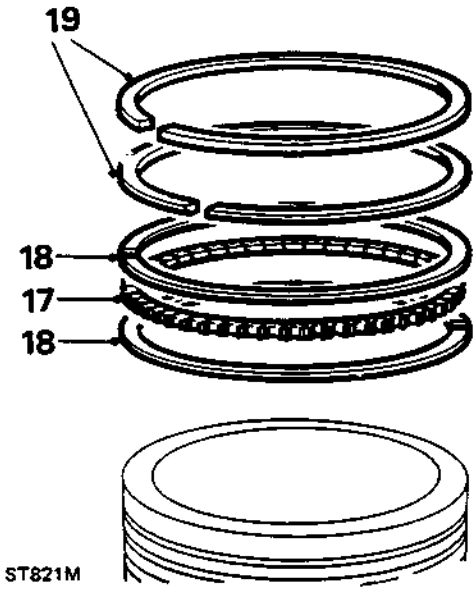
ST820M

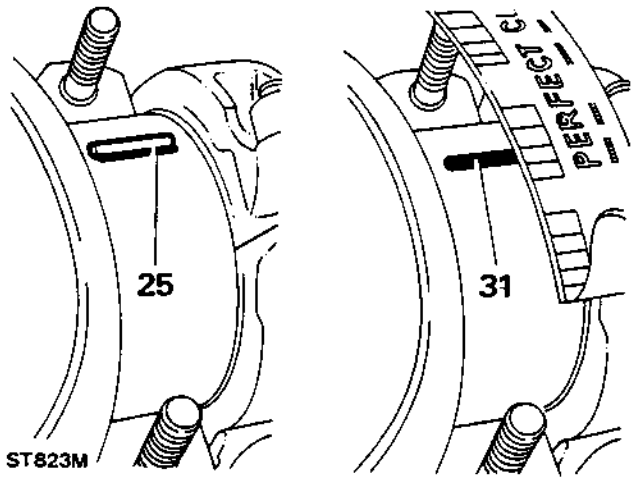
13. Check the compression ring gaps in the applicable cylinder, held square to the bore with the piston. Gap limits: 0.44 to 0.56 mm (0.017 to 0.022 in). Use a fine-cut flat file to increase the gap if required. Select a new piston ring if the gap exceeds the limit.

NOTE: Gapping does not apply to oil control rings.

Fit piston rings

17. Fit the expander ring into the bottom groove making sure that the ends butt and do not overlap.
18. Fit two ring rails to the bottom groove, one above and one below the expander ring.
19. Fit the second compression ring with the marking 'TOP' uppermost and the chrome compression ring in the top groove, either way round.



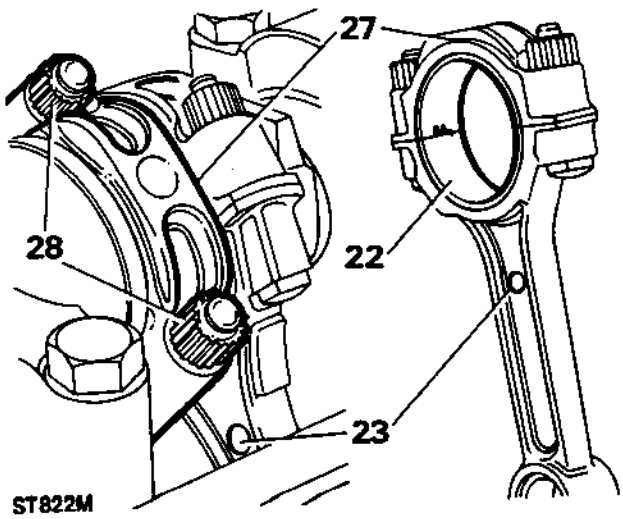


Examine connecting-rods

20. Check the alignment of the connecting-rod.
21. Check the connecting-rod small end, the gudgeon pin must be a press fit.

Check crankshaft bearings

22. Locate the bearing upper shell into the connecting-rod.
23. Locate the connecting-rod and bearing onto the applicable crankshaft journal, noting that the domed shape boss on the connecting-rod must face towards the front of the engine on the right-hand bank of cylinders and towards the rear on the left-hand bank.
24. When both connecting-rods are fitted, the bosses will face inwards towards each other.

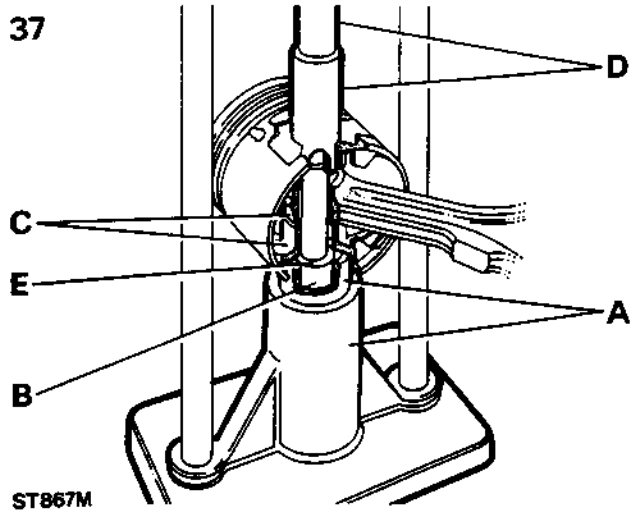


25. Place a piece of Plastigauge across the centre of the lower half of the crankshaft journal.
26. Locate the bearing lower shell into the connecting-rod cap.
27. Locate the cap and shell onto the connecting-rod. Note that the rib on the edge of the cap must be the same side as the domed shape boss on the connecting-rod.
28. Secure the connecting-rod cap. Tighten to the correct torque, see data section.
29. Do not rotate the crankshaft or connecting rod while the Plastigauge is in use.
30. Remove the connecting-rod cap and shell.
31. Using the scale printed on the Plastigauge packet, measure the flattened Plastigauge at its widest point.
32. The graduation that most closely corresponds to the width of the Plastigauge indicates the bearing clearance.
33. The correct bearing clearance with new or overhauled components is 0.013 to 0.06 mm (0.0006 to 0.0022 in).
34. If a bearing has been in service, it is advisable to fit a new bearing if the clearance exceeds 0.08 mm (0.003 in).
35. If a new bearing is being fitted, use selective assembly to obtain the correct clearance.
36. Wipe off the Plastigauge with an oily rag. DO NOT scrape it off.

IMPORTANT: The connecting-rods, caps and bearing shells must be retained in sets, and in the correct sequence.

Continued

37

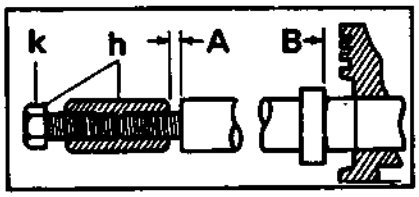


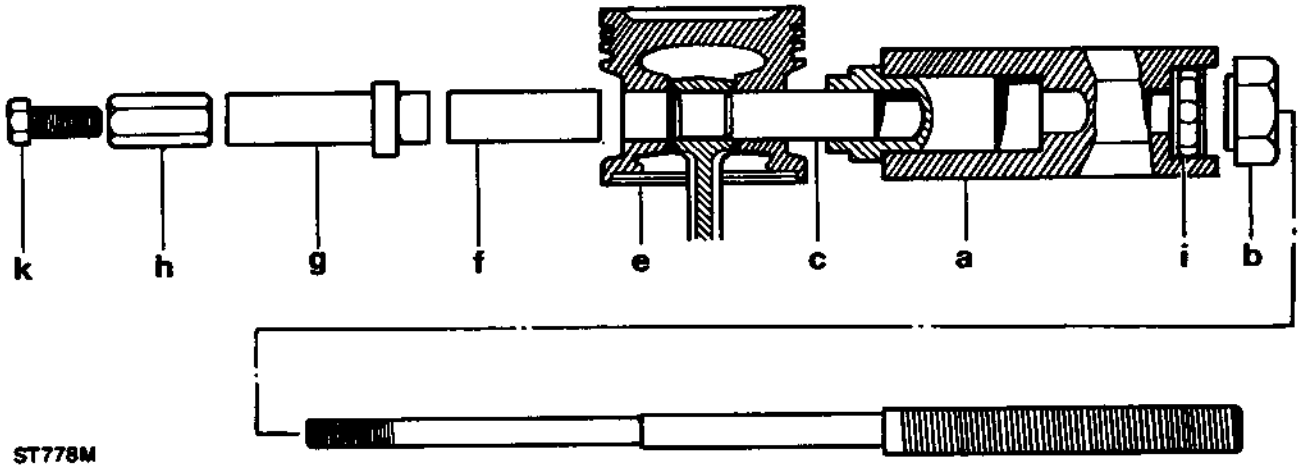
ST867M

Assembling pistons to connecting-rods

37. If an hydraulic press and tool 605350 was used for dismantling, refit each piston to its connecting-rod as follows:
    A. Check that the base of tool 605350 and the guide tube are fitted as follows:
    Place the base of tool 605350 on the bed of an hydraulic press which has a capacity of 8 tons (8 tonnes).
    Fit the guide tube into the bore of the base with its countersunk face uppermost.
    B. Fit the long mandrel inside the guide tube.
    C. Fit the connecting-rod into the piston with the markings together if the original pair are being used, then place the piston and connecting rod assembly over the long mandrel until the gudgeon pin boss rests on the guide tube.
    D. Fit the gudgeon pin into the piston up to the connecting-rod, and the spigot end of the small diameter mandrel into the gudgeon pin.
    E. Press in the gudgeon pin until it abuts the shoulder of the long mandrel.

38. If tool 18G 1150 was used for dismantling, refit each piston to its connecting-rod as follows:
    a. Clamp the hexagon body of 18G 1150 in a vice, with the adaptor 18G 1150 E positioned as in 7d.
    b. Remove the large nut of 18G 1150 and push the centre screw approximately 50 mm (2 in) into the body until the shoulder is exposed.
    c. Slide the parallel guide sleeve, grooved end last, onto the centre screw and up to the shoulder.
    d. Lubricate the gudgeon pin and bores of the connecting-rod and piston with graphited oil (Acheson's Colloids 'Oildag'). Also lubricate the ball race and centre screw of 18G 1150.
    e. Fit the connecting-rod and the piston together onto the tool with the markings together if the original pair are being used and with the connecting-rod around the sleeve up to the groove.
    f. Fit the gudgeon pin into the piston bore up to the connecting-rod.
    g. Fit the remover/replacer bush 18G 1150/3 with its flanged end towards the gudgeon pin.
    h. Screw the stop-nut onto the centre screw and adjust this nut to obtain a 1 mm ($\frac{1}{32}$ in) end-float 'A' on the whole assembly, and lock the nut securely with the screw.
    i. Slide the assembly back into the hexagon body and screw on the large nut up to the thrust race.





ST778M

j. Set the torque wrench 18G 537 to 12 lbf/ft. This represents the minimum load for an acceptable interference fit of the gudgeon pin in the connecting-rod.

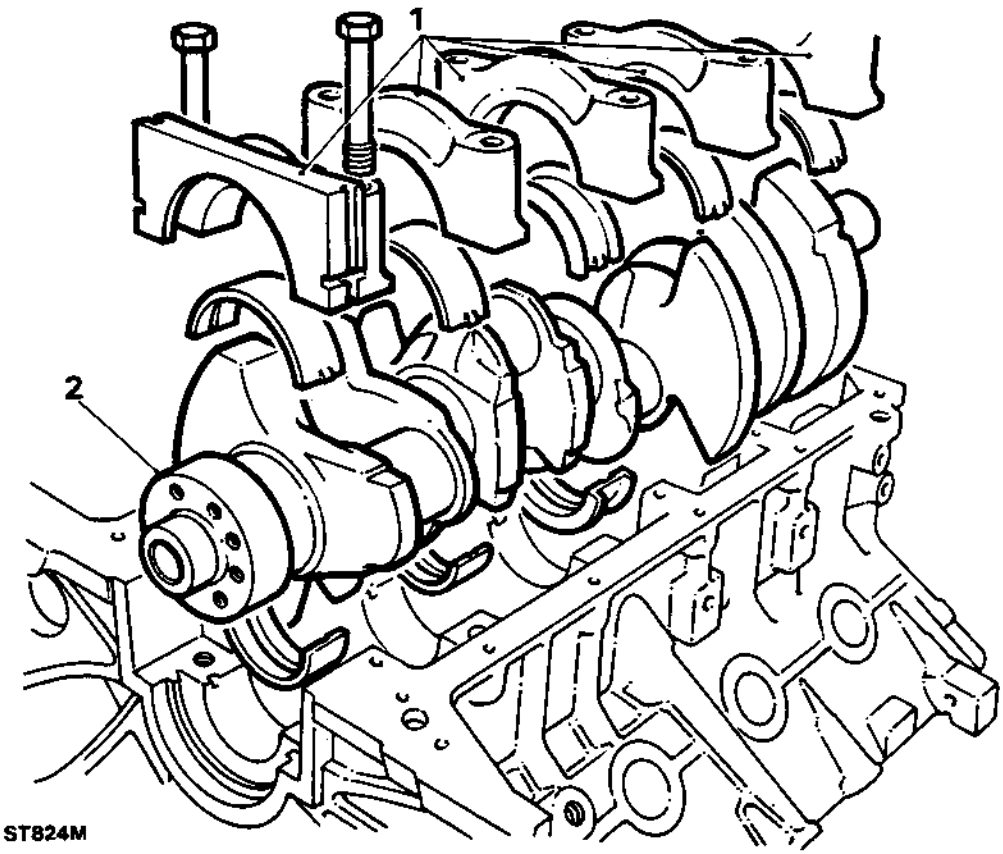
k. Using the torque wrench and socket 18G 587 on the large nut, and holding the lock screw, pull the gudgeon pin in until the flange of the remover/replacer bush is 4 mm (0.160 in) 'B' from the face of the piston. Under no circumstances must this flange be allowed to contact the piston.

CAUTION: If the torque wrench has not broken throughout the pull, the fit of the gudgeon pin to the connecting-pin is not acceptable and necessitates the renewal of components. The large nut and centre screw of the tool must be kept well-oiled.

39. Remove the tool and check that the piston moves freely on the gudgeon pin and that no damage has occurred during pressing.

REMOVE AND OVERHAUL CRANKSHAFT

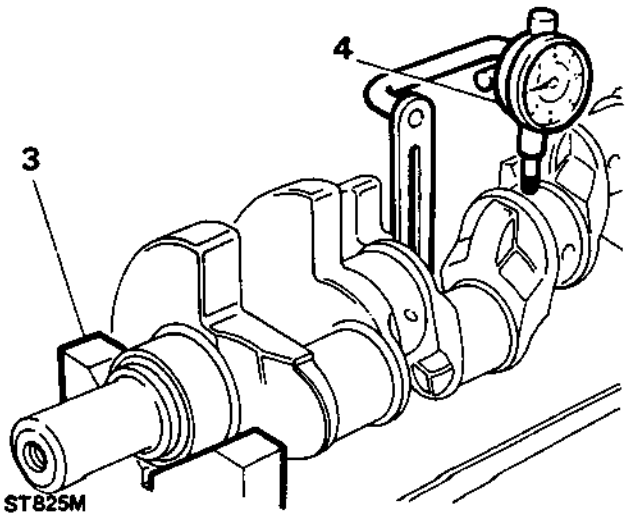
1. Remove the main bearing caps and lower bearing shells and retain in sequence. It is important to keep them in pairs and mark them with the number of the respective journal until it is decided if the bearing shells are to be refitted.
2. Lift out the crankshaft and rear oil seal.



ST824M

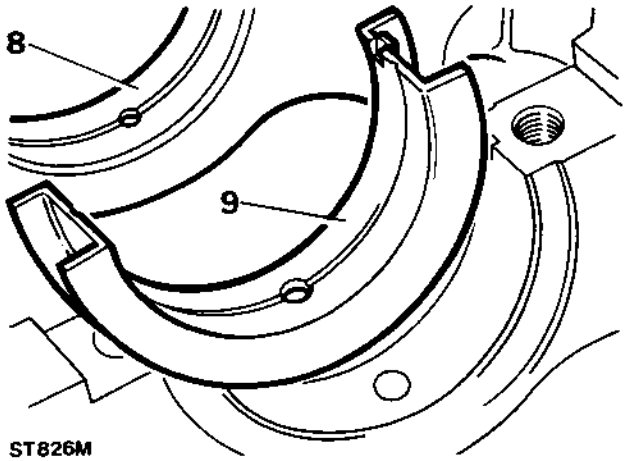
Inspect and overhaul crankshaft

3. Rest the crankshaft on vee-blocks at numbers one and five main bearing journals.
4. Using a dial test indicator, check the run-out at numbers two, three and four main bearing journals. The total indicator readings at each journal should not exceed 0.08 mm (0.003 in).
5. While checking the run-out at each journal, note the relation of maximum eccentricity on each journal to the others. The maximum on all journals should come at very near the same angular location.
6. If the crankshaft fails to meet the foregoing checks it is bent and is unsatisfactory for service.
7. Check each crankshaft journal for ovality. If ovality exceeds 0.040 mm (0.0015 in), a reground or new crankshaft should be fitted.



ST825M

8. Bearings for the crankshaft main journals and the connecting-rod journals are available in the following undersizes:
   0.25 mm (0.010 in)
   0.50 mm (0.020 in)
9. The centre main bearing shell, which controls crankshaft thrust, has the thrust faces increased in thickness when more than 0.25 mm (0.010 in) undersize, as shown on the following chart.



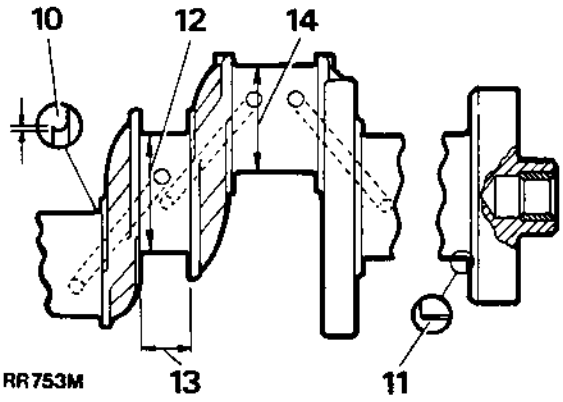
10. When a crankshaft is to be reground, the thrust faces on either side of the centre main journal must be machined in accordance with the dimensions on the following charts.

Main bearing journal size	Thrust face width
Standard	Standard
0.25 mm (0.010 in) undersize	Standard
0.50 mm (0.020 in) undersize	0.25 mm (0.010 in) oversize

11. For example: If a 0.50 mm (0.020 in) undersize bearing is to be fitted, then 0.12 mm (0.005 in) must be machined off each thrust face of the centre journal, maintaining the correct radius.

Crankshaft dimensions

12. The radius for all journals except the rear main bearing is 1.90 to 2.28 mm (0.075 to 0.090 in).
13. The radius for the rear main bearing journal is 3.04 mm (0.120 in).
14. Main bearing journal diameter, see the following charts.
15. Thrust face width, and connecting-rod journal diameter, see the following charts.



Crankshaft dimensions—millimetres

Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	58.400–58.413	26.975–27.026	50.800–50.812
0.254 U/S	58.146–58.158	26.975–27.026	50.546–50.559
0.508 U/S	57.892–57.904	27.229–27.280	50.292–50.305

Crankshaft dimensions—inches

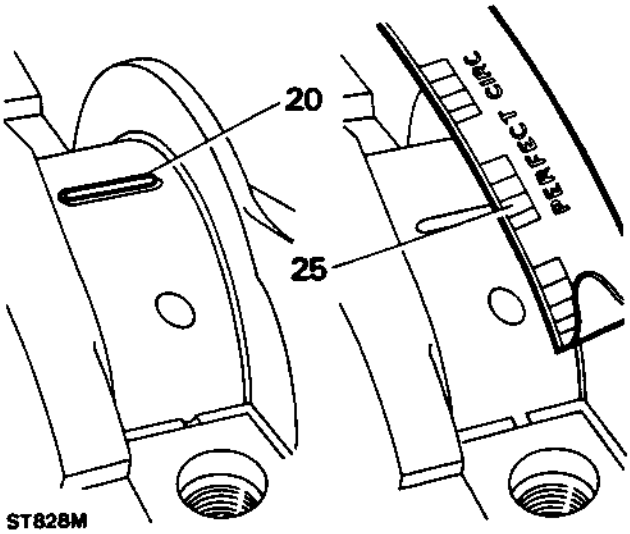
Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	2.2992–2.2997	1.062–1.064	2.0000–2.0005
0.010 U/S	2.2892–2.2897	1.062–1.064	1.9900–1.9905
0.020 U/S	2.2792–2.2797	1.072–1.074	1.9800–1.9805

Check main bearing clearance

16. Remove the oil seals from the cylinder block and the rear main bearing cap.
17. Locate the upper main bearing shells into the cylinder block. These must be the shells with the oil drilling and oil grooves.
18. Locate the flanged upper main bearing shell in the centre position.
19. Place the crankshaft in position on the bearings.

Continued

20. Place a piece of Plastigauge across the centre of the crankshaft main bearing journals.
21. Locate the bearing lower shell into the main bearing cap.
22. Fit numbers one to four main bearing caps and shells, tighten to the correct torque, see data section.
23. Fit the rear main bearing cap and shell and tighten to the correct torque, see data section. Do not allow the crankshaft to be rotated while the Plastigauge is in use.
24. Remove the main bearing caps and shells.
25. Using the scale printed on the Plastigauge packet, measure the flattened Plastigauge at its widest point.

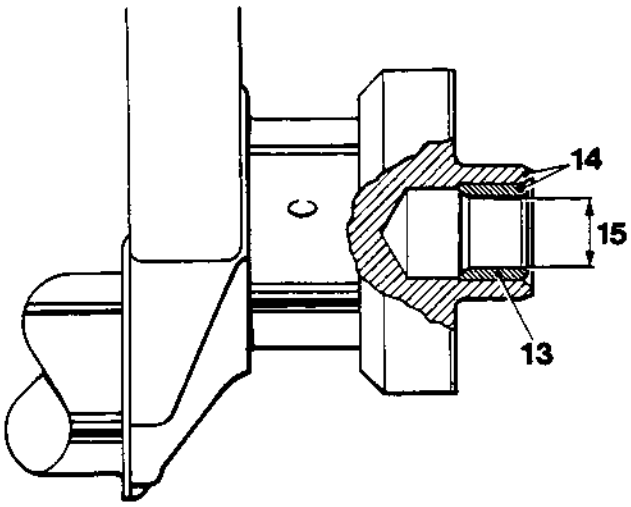


ST828M

26. The graduation that most closely corresponds to the width of the Plastigauge indicates the bearing clearance.
27. The correct bearing clearance with new or overhauled components is 0.023 to 0.065 mm (0.0009 to 0.0025 in).
28. If the correct clearance is not obtained initially, use selective bearing assembly.
29. Wipe off the Plastigauge with an oily rag. Do NOT scrape it off.
30. Maintain the bearing shells and caps in sets and in the correct sequence.

Renew spigot bearing

31. Carefully remove the old bearing.
32. Fit the spigot bearing flush with, or to a maximum of 1.6 mm (0.063 in) below the end face of the crankshaft.
33. Ream the spigot bearing to 19.177 + 0.025 mm (0.7504 + 0.001 in) inside diameter. Ensure all swarf is removed.

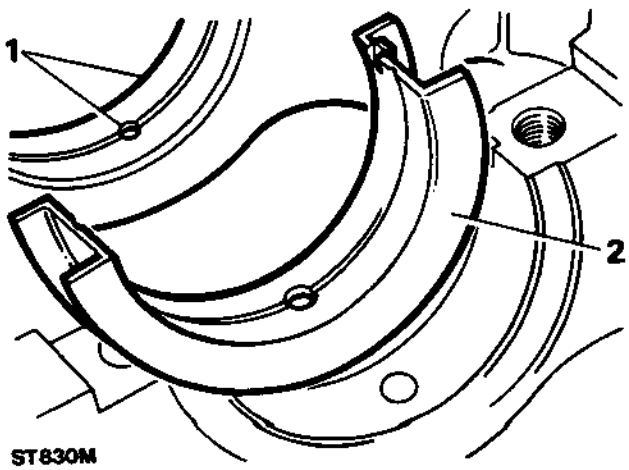


ST 829M

ASSEMBLING ENGINE

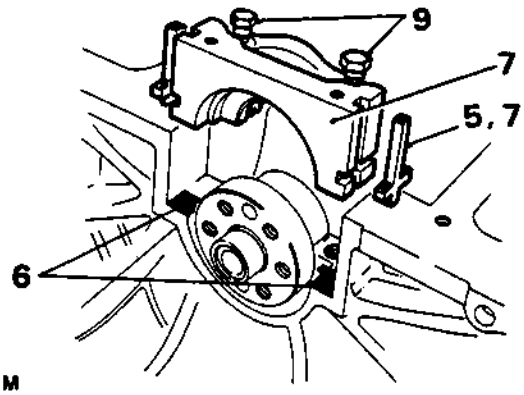
FIT CRANKSHAFT AND MAIN BEARINGS

1. Locate the upper main bearing shells into the cylinder block; these must be the shells with the oil drilling and oil grooves.
2. Locate the flanged upper main bearing shell in the centre position.
3. Lubricate the crankshaft main bearing journals and bearing shells with clean engine oil and lower the crankshaft into position.



ST830M

4. Lubricate the lower main bearing shells and fit numbers one to four main bearing caps and shells only, leaving the fixing bolts finger-tight at this stage.
5. Fit the cruciform side seals to the grooves each side of the rear main bearing cap. Do not cut the side seals to length, they must protrude 1.5 mm (0.062 in) approximately above the bearing cap parting face.
6. Apply Hylomar PL32M jointing compound to the rearmost half of the rear main bearing cap parting face or, if preferred, to the equivalent area on the cylinder block as illustrated.
7. Lubricate the bearing half and bearing cap side seals with clean engine oil.
8. Fit the bearing cap assembly to the engine. Do not tighten the fixings at this stage but ensure that the cap is fully home and squarely seated on the cylinder block.
9. Tension the cap bolts equally by one-quarter turn approximately, then back off one complete turn on each fixing bolt.



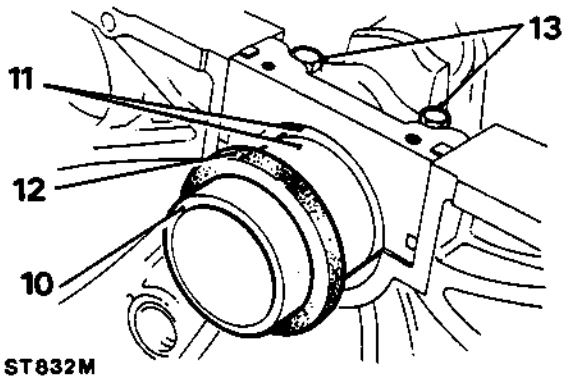
ST831M

CAUTION: Do not handle the seal lip, visually check that it is not damaged and ensure that the outside diameter remains clean and dry.

10. Position the seal guide RO 1014 on the crankshaft flange.
11. Ensure that the oil seal guide and the crankshaft journal are scrupulously clean, then coat the seal guide and oil seal journal with clean engine oil.

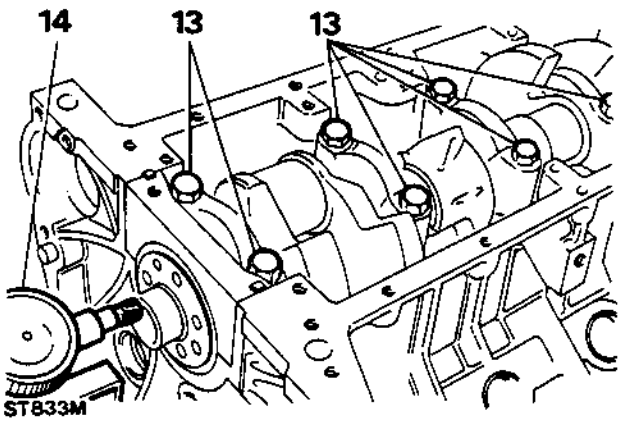
NOTE: The lubricant coating must cover the seal guide outer surface completely to ensure that the oil seal lip is not turned back during assembly.
Position the oil seal, lipped side towards the engine, onto the seal guide. The seal outside diameter must be clean and dry.

12. Push home the oil seal fully and squarely by hand into the recess formed in the cap and block until it abuts against the machined step in the recess.
Withdraw the seal guide.



ST832M

13. Tighten the main bearing cap bolts to the correct torque noting that the bolts for numbers one to four bearings have a different torque to number five bearing cap bolts.
14. Using a feeler gauge or a dial indicator check the crankshaft end-float, 0.10 to 0.20 mm (0.004 to 0.008 in).

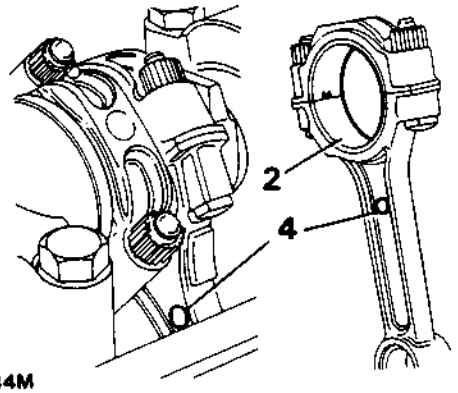


ST833M

CAUTION: Do not exceed 1,000 engine rev/min when first starting the engine, otherwise the crankshaft rear oil seal will be damaged.

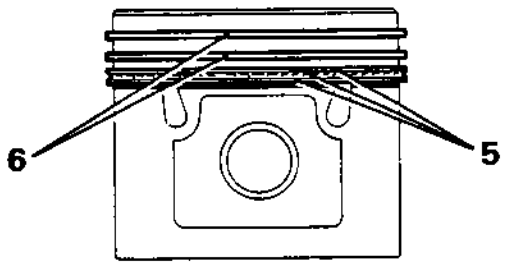
FIT CONNECTING-RODS AND PISTONS

1. Locate the applicable crankshaft journal at BDC.
2. Place the bearing upper shell in the connecting-rod.
3. Retain the upper shell by screwing the guide bolts 605351 onto the connecting-rods.
4. Insert the connecting-rod and piston assembly into its respective bore, noting that the domed shape boss on the connecting-rod must face towards the front of the engine on the right-hand bank of cylinders and towards the rear on the left-hand bank. When both connecting-rods are fitted, the bosses will face inwards towards each other.



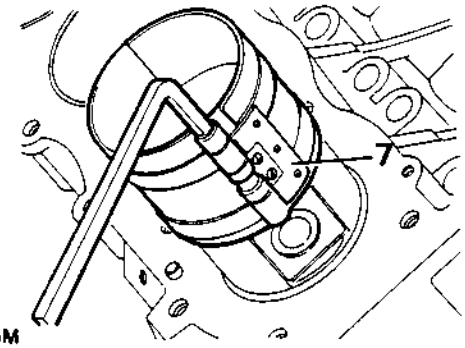
ST834M

5. Position the oil control piston rings so that the ring gaps are all at one side, between the gudgeon pin and piston thrust face. Space the gaps in the ring rails approximately 25 mm (1 in) each side of the expander ring joint.
6. Position the compression rings so that their gaps are on opposite sides of the piston between the gudgeon pin and piston thrust face.



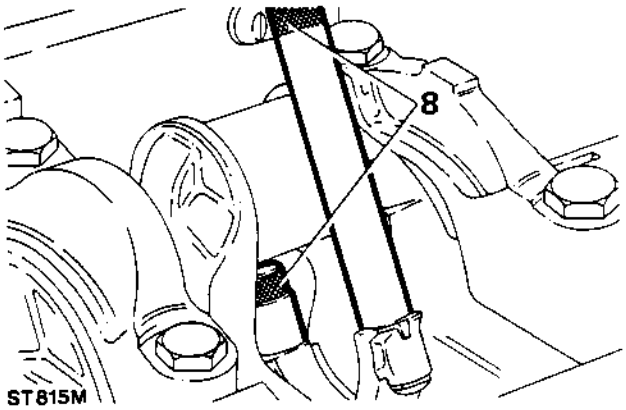
ST835M

7. Using a piston ring compressor, locate the piston into the cylinder bore, until the piston crown is just below the cylinder block top face.



ST836M

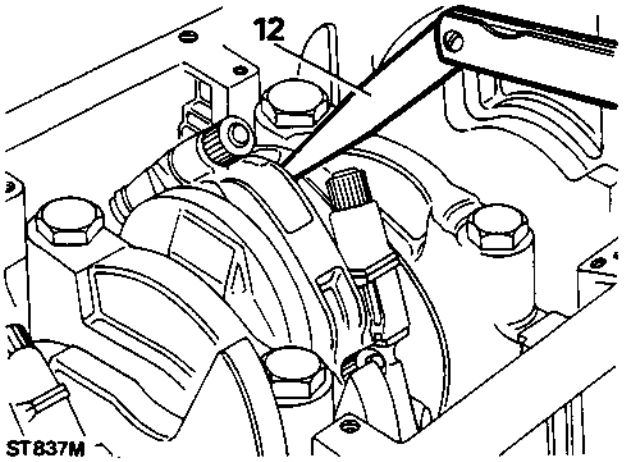
8. Pull the connecting rods on to the crankpins using the guide rods.



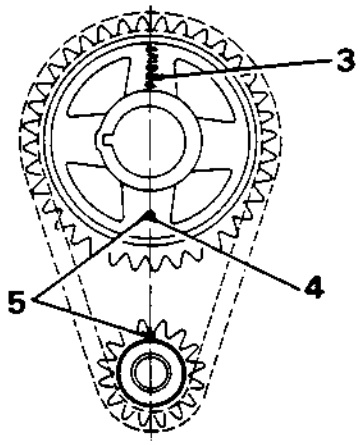
ST815M

9. Place the bearing lower shell in the connecting-rod cap.
10. Locate the cap and shell onto the connecting-rod, noting that the rib on the edge of the cap must be towards the front of the engine on the right-hand bank of cylinders and towards the rear on the left-hand bank.
11. Check that the connecting-rods move freely sideways on the crankshaft. Tightness indicates insufficient bearing clearance or a misaligned connecting-rod.

12. Check the end-float between the connecting-rods on each crankshaft journal. Clearance limits: 0.15 to 0.37 mm (0.006 to 0.014 in).
13. Tighten the connecting-rod nuts to the correct torque. Fit the oil strainer and joint washer.



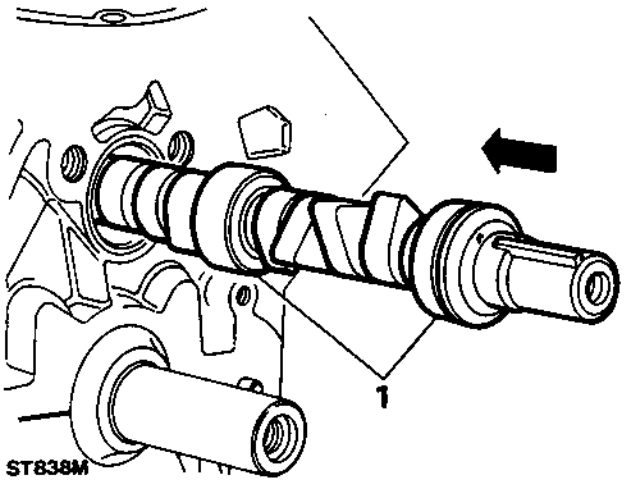
3. Temporarily fit the camshaft chain wheel with the marking 'FRONT' outward.
4. Turn the camshaft until the mark on the camshaft chain wheel is at the six o'clock position, then remove the chain wheel without disturbing the camshaft.
5. Encircle the chain wheels with the chain keeping the timing marks aligned.



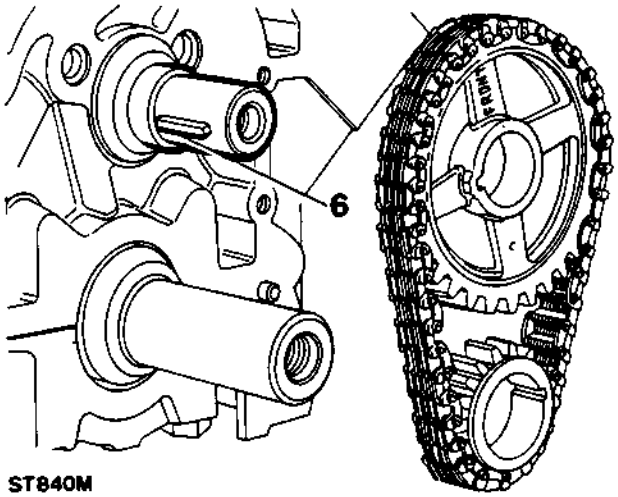
6. Engage the chain wheel assembly on the camshaft and crankshaft key locations and check that the camshaft key is parallel to the shaft axis to ensure adequate lubrication of the distributor drive gear.

FIT CAMSHAFT TIMING GEARS AND CHAIN

1. Lubricate the camshaft journals and carefully insert the camshaft into the cylinder block.

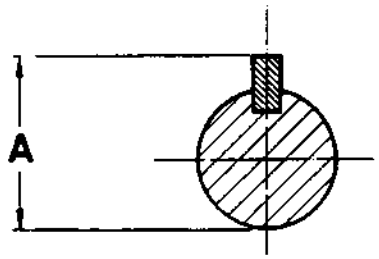


2. Turn the crankshaft to bring number one piston to TDC.



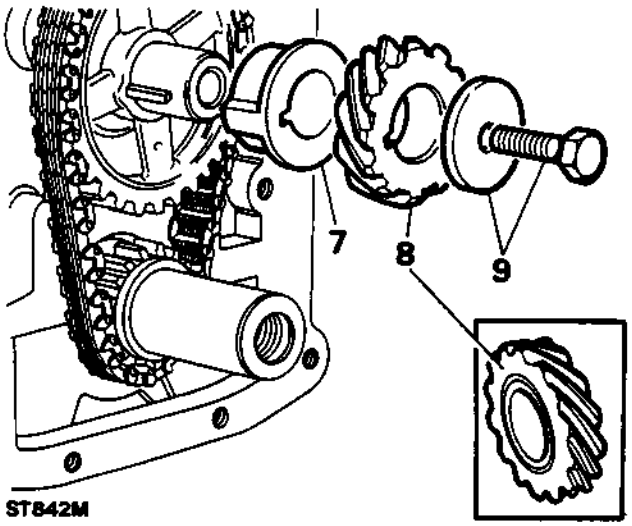
Continued

CAUTION: The space between the key and keyway acts as an oilway for lubrication of the drive gear. Ensure that the key is seated to the full depth of the keyway. The overall dimension of shaft and key must not exceed 30.15 mm (1.187 in). Dimension A below.



ST841M

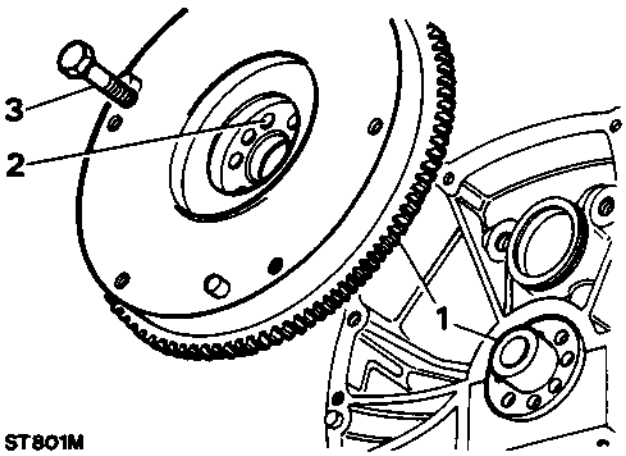
7. Check that the timing marks line-up and fit the spacer with the flange to the front.
8. Fit the distributor drive gear ensuring that the annular grooved side is fitted to the rear, that is towards the spacer.
9. Secure the drive gear and camshaft chain wheel assembly with the bolt and washer and tighten to the correct torque.



ST842M

FIT THE FLYWHEEL

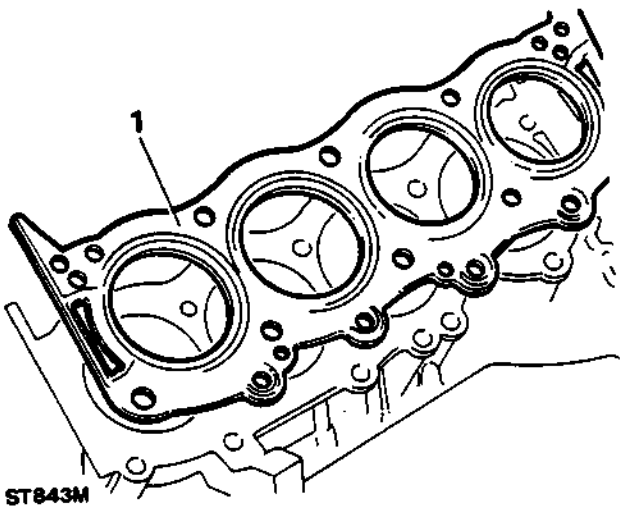
1. Locate the flywheel in position on the crankshaft spigot, with the ring gear towards the engine.
2. Align the flywheel fixing bolt holes which are off-set to prevent incorrect assembly.
3. Fit the flywheel fixing bolts and before finally tightening, take up any clearance by rotating the flywheel against the direction of engine rotation. Tighten the bolts evenly to the correct torque.



ST801M

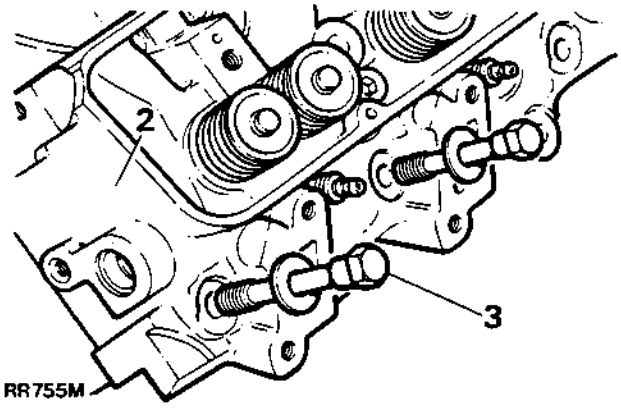
FIT CYLINDER HEADS

1. Fit new cylinder head gaskets with the word 'TOP' uppermost. Do NOT use sealant.



ST843M

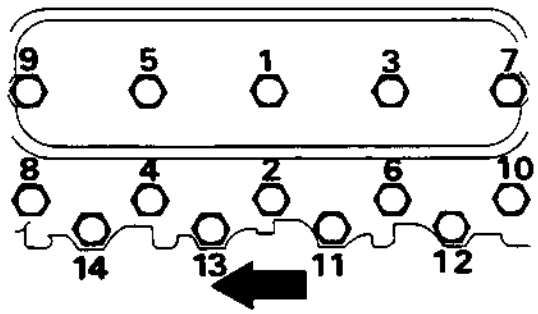
2. Locate the cylinder heads on the block dowel pins.
3. Clean the threads of the cylinder head bolts then coat them with Thread Lubricant-Sealant Loctite 572.



4. Locate the cylinder head bolts in position as illustrated and fit dipstick tube.

   Long bolts—1, 3 and 5.
   Medium bolts—2, 4, 6, 7, 8, 9 and 10.
   Short bolts—11, 12, 13 and 14.

5. Tighten the cylinder head bolts a little at a time in the sequence shown. See data for correct tightening torque.
6. When all bolts have been tightened, re-check the torque settings.

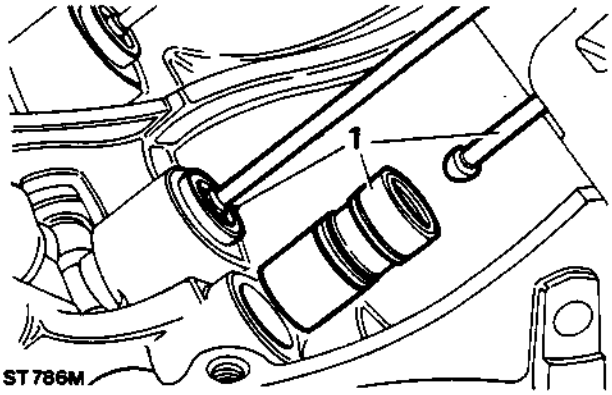


Note: Left-hand cylinder head illustrated. Arrow points to front of vehicle.

FIT TAPPETS, PUSH RODS AND ROCKER ASSEMBLIES

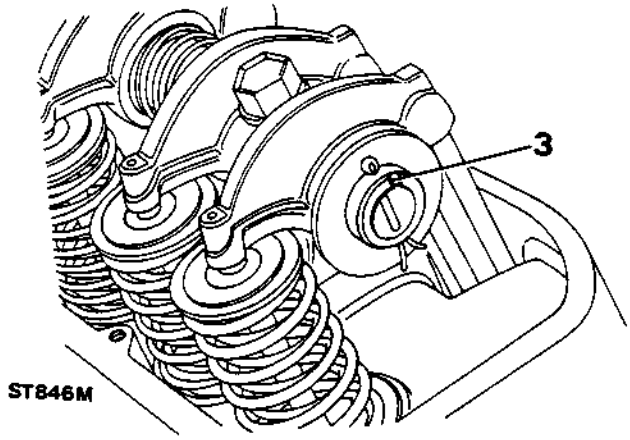
Fit tappets and push rods

1. Fit the tappets and push rods to their original locations. Ensure that the tappets move freely in their respective bores. Before fitting the tappets immerse them in clean engine oil to reduce tappet noise when the engine is first started after the overhaul.



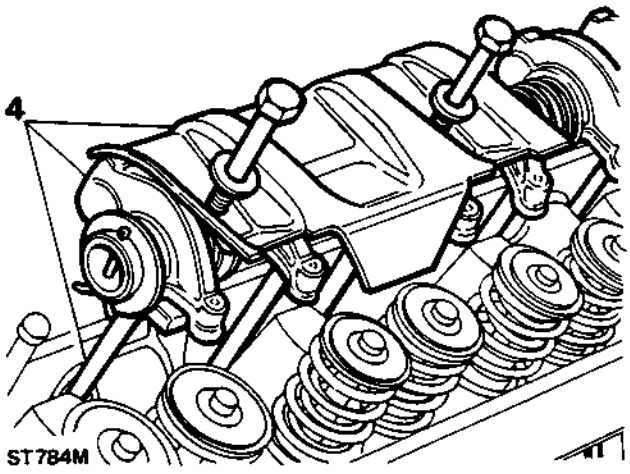
Fit the rocker assemblies

2. The rocker shafts are handed and must be fitted correctly to align the oilways.
3. Each rocker shaft is notched at one end and on one side only. The notch must be uppermost and towards the front of the engine on the right-hand side, and towards the rear on the left-hand side.



Continued

4. Fit the rocker shaft assemblies. Ensure that the push-rods engage the rocker cups and that the baffle plates are fitted to the front on the left-hand side, and to the rear on the right-hand side. Tighten the bolts.

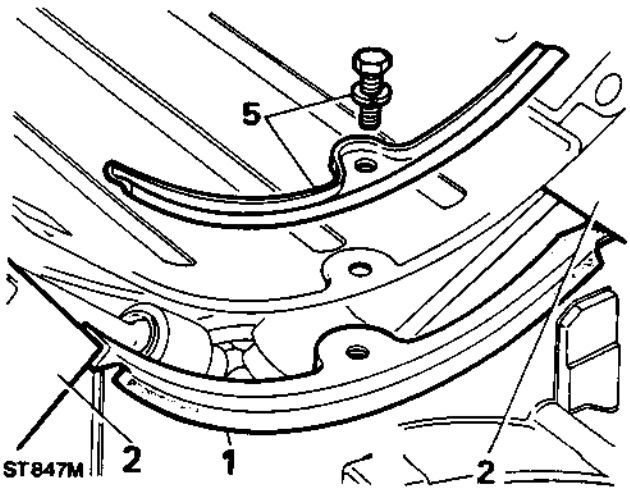


It should be noted that tappet noise can be expected on initial starting-up after an overhaul due to oil drainage from the tappet assemblies or indeed if the vehicle has been standing over a very long period. If excessive noise should be apparent after an overhaul, the engine should be run at approximately 2,500 rev/min for a few minutes (subject to the following caution), when the noise should be eliminated.

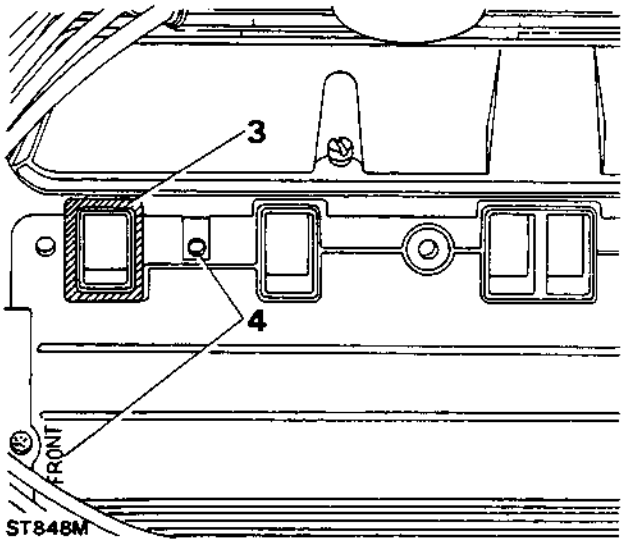
CAUTION: Do not exceed 1,000 engine rev/min when first starting the engine, otherwise the crankshaft rear oil seal will be damaged.

FIT THE INTAKE MANIFOLD

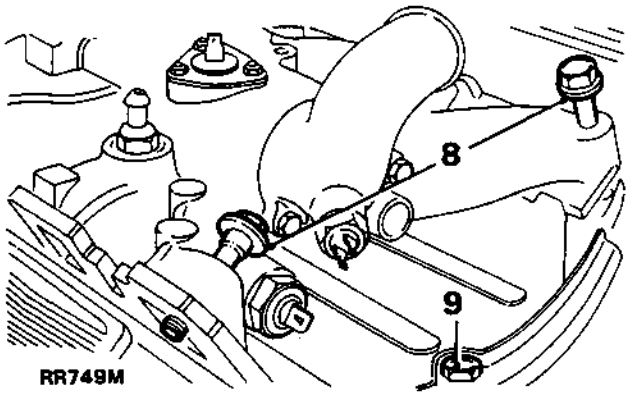
1. Coat both sides of new manifold gasket seals with silicon grease.
2. Locate the seals in position with their ends engaged in the notches formed between the cylinder head and block.



3. Apply 'Hylomar' sealing compound SQ32M on the corners of the cylinder head, manifold gasket and manifold, around the water passage joints.
4. Fit the manifold gasket with the word 'FRONT' to the front and the open bolt hole at the front R.H. side.
5. Fit the gasket clamps but do not fully tighten the bolts at this stage.

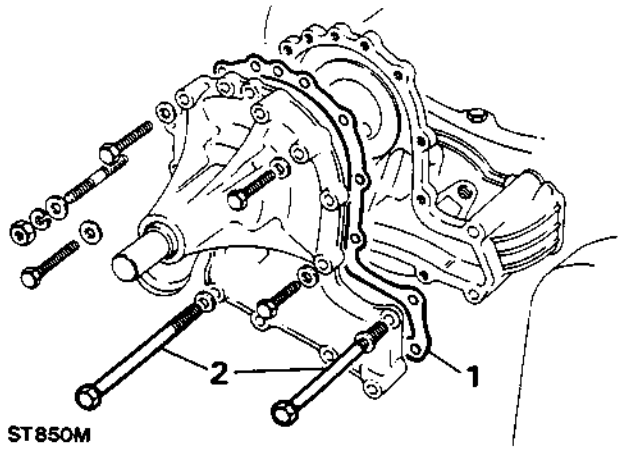


6. Locate the manifold onto the cylinder head.
7. Clean the threads of the manifold securing bolts.
8. Fit all the manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre to each end and finally tighten to the correct torque.
9. Tighten the gasket clamp bolts to the correct torque.

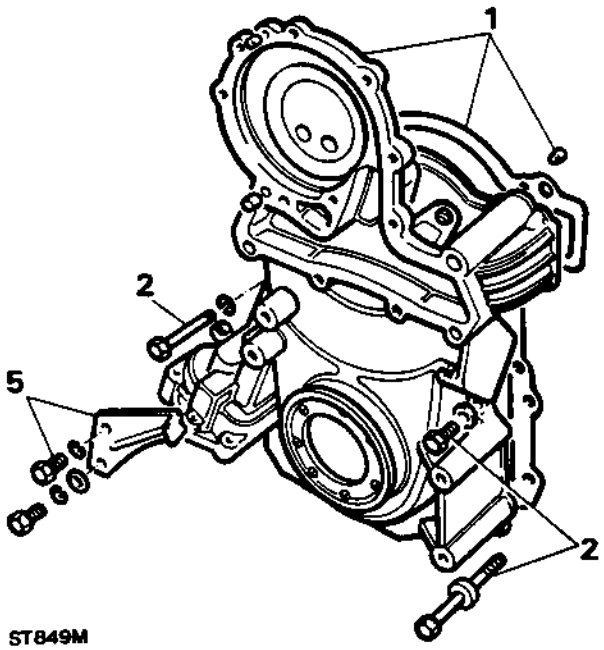


FIT THE TIMING COVER AND CRANKSHAFT PULLEY

1. Place a new timing cover joint washer in position and fit the timing cover locating it on the two dowels.
2. Clean the threads of the timing cover securing bolts, then coat them with Thread Lubricant-Sealant Loctite 572.
3. Fit and evenly tighten the timing cover bolts to the correct torque figure.
4. Fit the crankshaft pulley and tighten the retaining bolt to the correct torque.
5. Fit timing pointer.



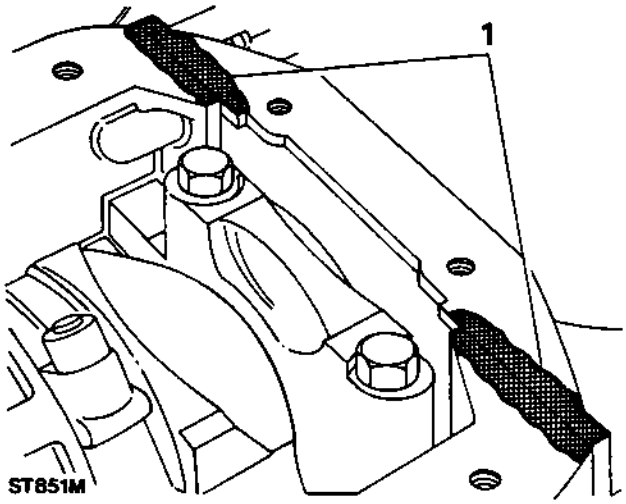
ST850M



ST849M

FIT THE SUMP

1. Clean the sump mating faces and at the joint between the timing cover and crankcase apply a coating of a universal jointing compound about 13 to 19 mm (½ to ¾ in) wide in the area illustrated.

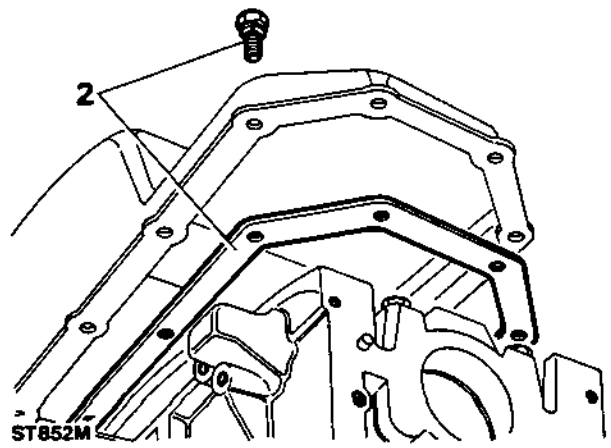


ST851M

2. Place the sump gasket in position, fit the sump and evenly tighten the retaining bolts to the correct torque.

FIT THE WATER PUMP

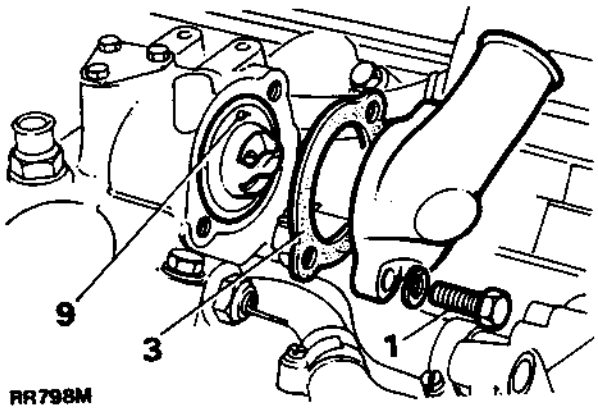
1. Lightly grease a new joint washer and place it in position on the timing cover.
2. Clean the threads of the four long bolts and smear them with Loctite 572 thread lubricant sealant. Locate the water pump in position.
3. Locate the alternator adjusting link on the water pump.
4. Leave the alternator adjusting link loose and tighten the remaining water pump housing bolts evenly and to the correct torque.



ST852M

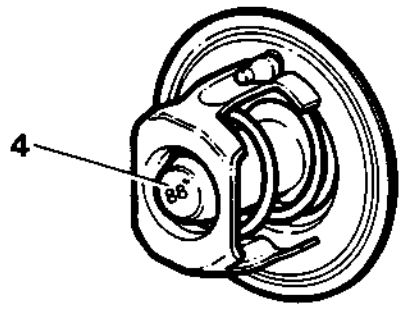
TEST AND FIT THERMOSTAT

1. Remove the two bolts securing the thermostat housing to the intake manifold.
2. Remove the housing gasket.
3. Withdraw the thermostat.



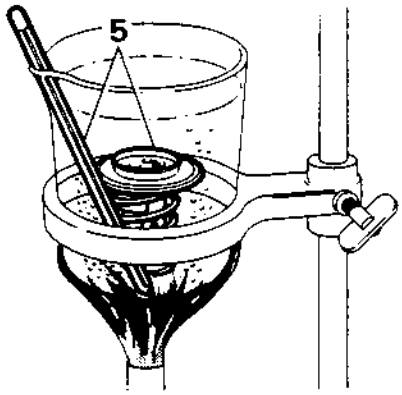
RR798M

4. Note the temperature stamped on the thermostat at which it should be fully open.



RR799M

5. Place the thermostat and a Centigrade thermometer in a laboratory beaker, or a suitable alternative, half full of water.
6. Heat the water and observe the temperature at which the thermostat opens.
7. If faulty discard the thermostat.

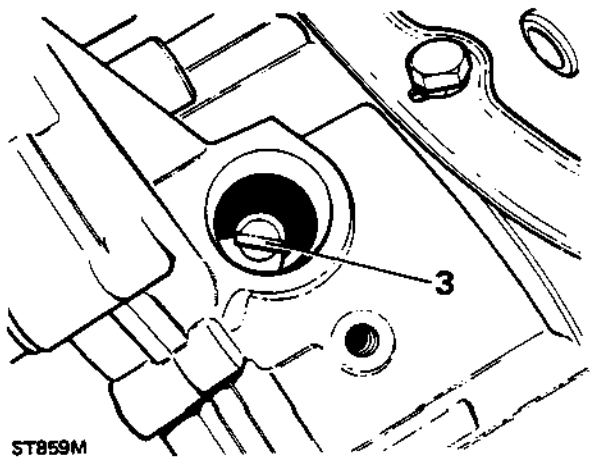


ST858M

8. Clean the intake manifold and thermostat housing mating faces.
9. Fit the thermostat with the jiggle pin uppermost at 12 o'clock.
10. Fit the housing using a new gasket, and tighten the two bolts to the correct torque, see 'data section'.

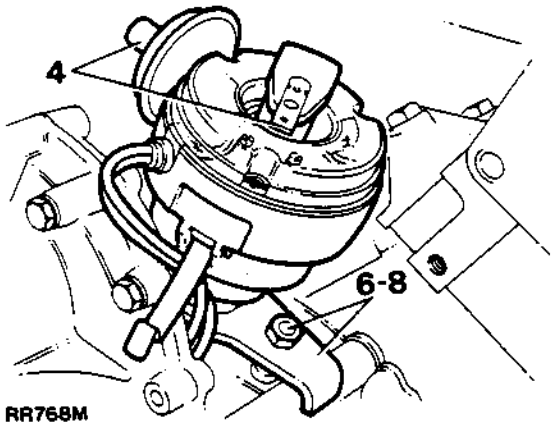
FIT THE DISTRIBUTOR

1. Turn the crankshaft to bring number one piston to TDC on the compression stroke (both valves closed number one cylinder).
2. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
3. Turn the oil pump and distributor common drive shaft so that the tongue is in the approximate position as illustrated.



ST859M

4. Fit distributor to engine and check that centre line of rotor arm is now in line with number one sparking plug lead in cap. Reposition distributor if necessary. The vacuum capsule should be at 90° to the camshaft.
5. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
6. Fit clamp and bolt leaving both loose at this stage.



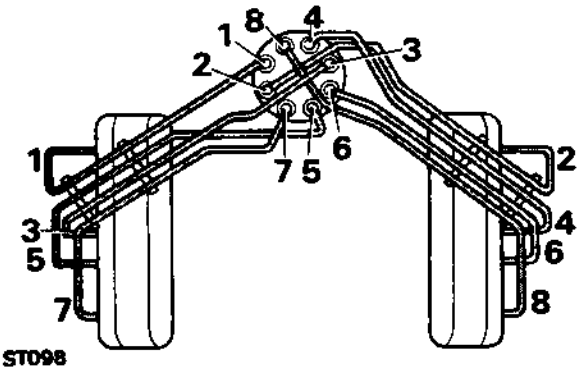
RR768M

7. Rotate distributor until the static timing is within 2–3° of TDC.

CAUTION: On no account must the engine be started before this operation is carried out.

8. Secure distributor in this position by tightening clamp bolt.
9. Fit the distributor cap and spark plugs and connect the H.T. leads in accordance with the illustration below.

NOTE: The above distributor setting is to enable the engine to be run so that the correct setting given in 'Engine Tuning Data' can be achieved once the engine is refitted to the vehicle.



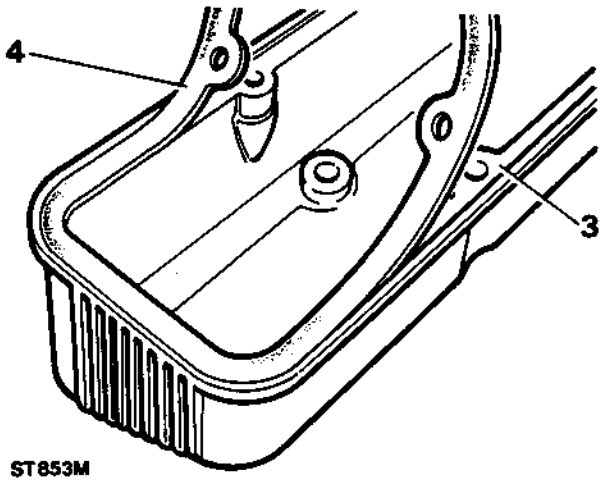
ST098

FIT ROCKER COVERS

1. Remove all traces of old gasket on the covers and cylinder heads.
2. Clean and dry the gasket mounting surface, using Bostik cleaner 6001.
3. Apply Bostik 1775 impact adhesive to the seal face and the gasket, using a brush to ensure an even film. Allow the adhesive to become touch-dry, approximately fifteen minutes.

NOTE: The gasket fits one way round only and must be fitted accurately first time; any subsequent movement would destroy the bond.

4. Place one end of the gasket into the cover recess with the edge firmly against the recess wall: at the same time hold the remainder of the gasket clear; then work around the cover, pressing the gasket into place ensuring that the outer edge firmly abuts the recess wall.

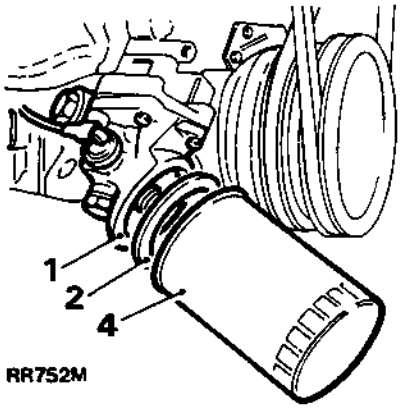


ST853M

5. Allow the cover to stand for thirty minutes before fitting it to the engine.
6. Secure the rocker covers to the engine with the four screws. Short screws—in board, long screws—out board.

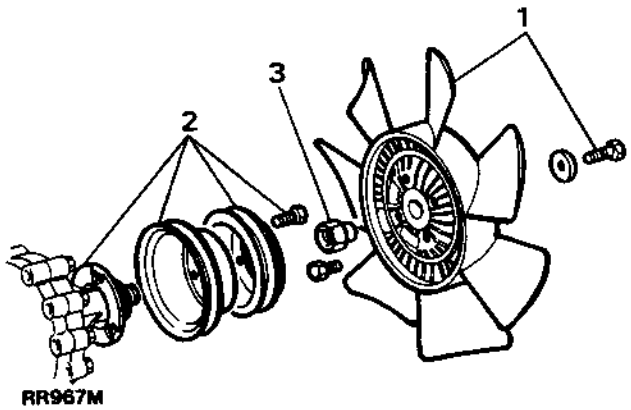
FIT ENGINE OIL FILTER

1. Clean oil pump mating face with filter.
2. Smear clean engine oil on the rubber washer of the new filter.
3. Fill the filter with new oil as far as possible, noting the angle at which the filter is to be fitted.
4. Screw on the filter until the sealing ring touches the oil pump cover face, then tighten it a further half turn by hand only. **Do not overtighten.**



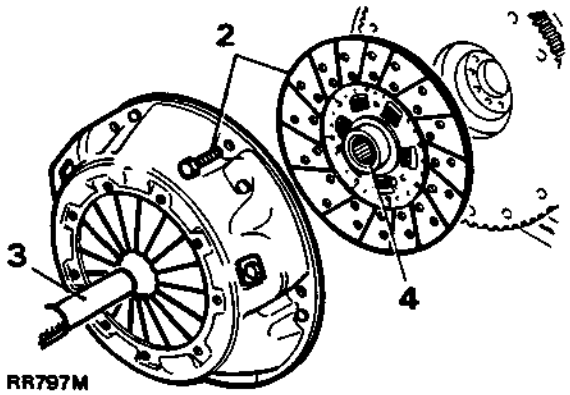
FIT THE FAN PULLEY, VISCOUS COUPLING AND FAN

1. Secure the fan to the viscous coupling with the four bolts and tighten evenly.
2. If removed, fit the pulley to hub assembly adaptor and secure with the three bolts and tighten to the correct torque.
3. Screw the viscous coupling onto the adaptor thread tighten to the correct torque—see data section.
4. Fit the fan belt and compressor belt if fitted.



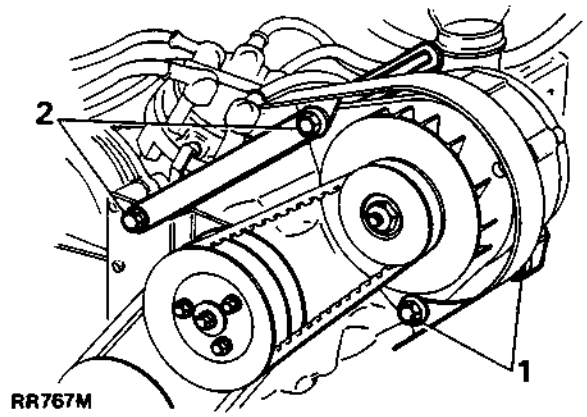
FIT THE CLUTCH

1. Clean the flywheel and clutch assembly pressure plate.
2. Fit the centre plate and the clutch assembly and loosely secure to the flywheel with the retaining bolts.
3. Insert centralising tool 18G 79 or a slave primary shaft and finally tighten the clutch assembly retaining bolts in a diagonal sequence, to the correct torque.
4. Smear the centre plate splines with Rocol MV3 or Rocol MTS 1000 grease.



FIT THE ALTERNATOR

1. Offer up the alternator to the mounting bracket and locate the pivot nuts and bolts noting that the fan guard is attached to the front nut and bolts.
2. Slacken the alternator adjustment bracket and attach alternator bracket. Note that the fan guard is attached to the adjustment bracket bolt.
3. Fit and tension the fan belt as follows:
   Pivot the alternator away from the engine but in doing so, do not apply any pressure to the slip ring end bracket. Tighten the pivot nuts and bolts and adjustment bolt. The tension is correct when, with thumb pressure, the belt deflection is approximately 11 to 14 mm (0.437 to 0.562 in) between alternator and the power steering pulley. Finally, tighten the fixings and connect the wiring plug to the alternator.



FIT THE CARBURETTERS

If removed, fit the carburetters to the induction manifold, using new joint washers in the correct sequence as illustrated.

Illustration A

1. Fit the liner.
2. Fit the two joint washers.
3. In between the washers fit the insulator.

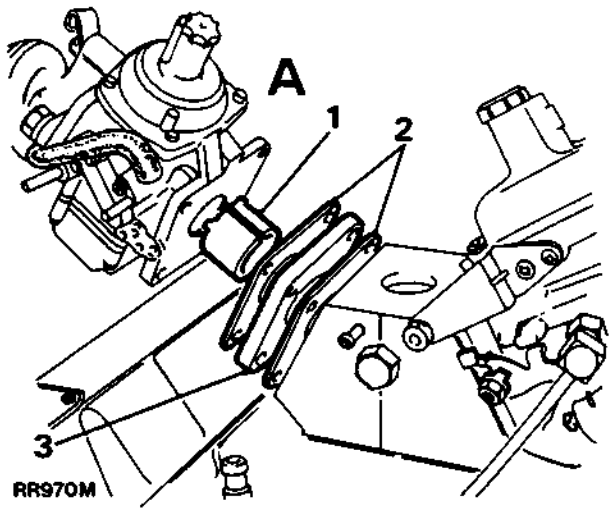
Illustration B

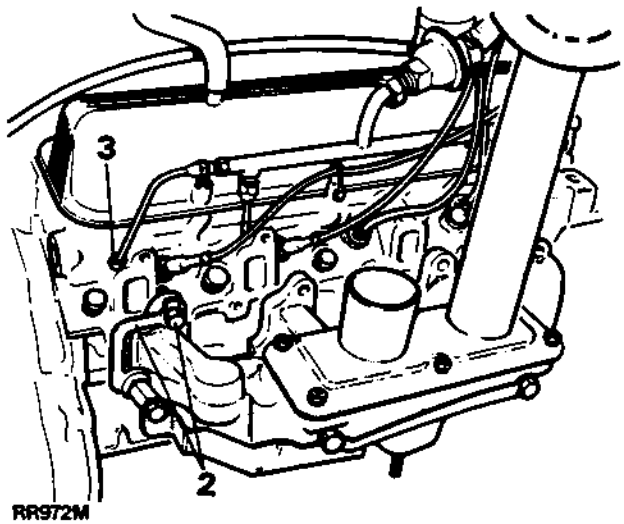
NOTE: Ensure the teeth are pointing towards the manifold penthouse when the deflector is refitted.

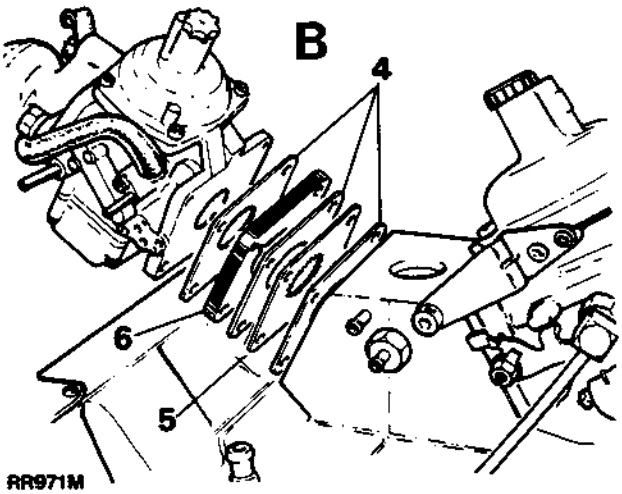
4. Fit the three joint washers.
5. Fit the saw toothed deflector.
6. Fit the insulator.

FIT EXHAUST MANIFOLD AND AIR RAILS

1. Ensure that the mating surfaces of the cylinder head and exhaust manifold are clean and smooth and coat the faces with 'Foliac J 166' or 'Moly Paul' anti-seize compound. 'Foliac J 166' is manufactured by Rocol Ltd., Rocol House, Swillington, Leed, England. 'Moly Paul' is manufactured by K.S. Paul Products Ltd., Nobel Road, London N18.
2. Place the manifold in position on the cylinder head and fit the securing bolts, lockplates and plain washers. The plain washers are fitted between the manifold and lockplates. Evenly tighten the manifold bolts to the correct torque figure and bend over the lock tabs.
3. Fit pulse-air rails to cylinder heads.







MISCELLANEOUS AND NON-STANDARD ITEMS

Fit any other items of equipment and miscellaneous hoses, pipes, filters, clips and brackets to the positions noted during dismantling.

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
ENGINE FAILS TO START	1. Incorrect starting procedure	See owners handbook
	2. Starter motor speed too slow	Check battery and connections
	3. Faulty ignition system	Check each component in system
	4. Water or dirt in fuel system	Flush out system with clean fuel
	5. Carburetter(s) flooding	Check float chamber needle valve
	6. Defective fuel pump	Remove, overhaul or renew
	7. Defective starter motor	Overhaul or renew
	8. Starter pinion not engaging	Remove starter motor and overhaul
ENGINE STALLS	1. Low idling speed	Adjust carburetter(s)
	2. Faulty sparking plugs	Clean and test; renew if necessary
	3. Faulty coil	Renew
	4. Faulty reluctor	Renew
	5. Incorrect mixture	Adjust carburetter(s)
	6. Foreign matter in fuel system	Investigate source of foreign matter and clean as necessary
LACK OF POWER	1. Poor compression	If the compression is appreciably less than the correct figure, the piston rings or valves are faulty. Low pressure in adjoining cylinders indicates a faulty cylinder head gasket
	2. Badly seating valves	Overhaul cylinder head(s)
	3. Faulty exhaust silencer	Renew
	4. Incorrect ignition timing	Check and adjust using electronic equipment
	5. Leaks or restriction in fuel system	Check through system
	6. Faulty sparking plugs	Clean, test and renew if necessary
	7. Excessive carbon deposit	Decarbonize
	8. Brakes binding	Adjust brakes or overhaul
	9. Faulty coil or battery	Determine which component and renew
ENGINE RUNS ERRATICALLY	1. Faulty electrical connections	Check security of all ignition connections
	2. Defective sparking plugs	Clean, test and renew if necessary
	3. Low battery charge	Recharge battery and test for condition
	4. Defective distributor	Remove and overhaul
	5. Foreign matter in fuel system	Determine source of dirt and clean system
	6. Faulty fuel pump	Remove and overhaul or renew
	7. Sticking valves	Overhaul cylinder head(s)
	8. Defective valve springs	Overhaul cylinder head(s)
	9. Incorrect ignition timing	Check timing with electronic equipment, if possible
	10. Worn valve guides or valves	Overhaul cylinder head(s)
	11. Faulty cylinder head gaskets	Renew gaskets
	12. Damaged exhaust system	Rectify or renew
	13. Vacuum pipes, disconnected at inlet manifold, distributor or gearbox	Refit pipes
ENGINE STARTS, BUT STOPS IMMEDIATELY	1. Faulty electrical connections	Check HT leads for cracked insulation, check low tension circuit
	2. Foreign matter in fuel system	Determine source of matter and clean system
	3. Faulty fuel pump	Remove, overhaul or renew
	4. Low fuel level in tank	Replenish
ENGINE FAILS TO IDLE	1. Incorrect carburetter setting	Adjust as necessary
	2. Faulty fuel pump	Remove, overhaul or renew
	3. Sticking valves	Overhaul cylinder head(s)
	4. Faulty cylinder head gasket(s)	Renew
ENGINE MISFIRES ON ACCELERATION	1. Distributor incorrectly set	Adjust
	2. Faulty coil	Renew
	3. Faulty sparking plugs	Clean, test or renew
	4. Faulty carburetter(s)	Overhaul
	5. Vacuum pipes disconnected at inlet manifold	Check all vacuum connections. Renew faulty pipes
ENGINE KNOCKS	1. Ignition timing advanced	Adjust using electronic equipment
	2. Excessive carbon deposit	Decarbonise
	3. Incorrect carburetter setting	Adjust
	4. Unsuitable fuel	Adjust ignition timing to suit octane rating
	5. Worn pistons or bearings	Overhaul engine
	6. Distributor advance mechanism faulty	Renew capsule and re-check
	7. Defective sparking plugs	Clean, test and renew if necessary
ENGINE BACKFIRES	1. Ignition defect	Check all ignition components and timing
	2. Carburetter defect	Overhaul carburetter(s)
	3. Sticking valve	Overhaul cylinder head
	4. Weak valve springs	
	5. Badly seating valves	
	6. Excessively worn valve stems and guides	
	7. Excessive carbon deposit	
	8. Incorrect sparking plug gap	Clean and reset
	9. Air leak in induction or exhaust systems	Renew faulty gaskets or components

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
BURNED VALVES	1. Sticking valves 2. Weak valve springs 3. Excessive deposit on valve seats 4. Distorted valves 5. Excessive mileage between overhauls	Overhaul cylinder head
NOISY VALVE MECHANISM	1. Excessive oil in sump, causing air bubbles in hydraulic tappets 2. Worn or scored parts in valve operating mechanism 3. Valves and seats cut down excessively, raising end of valve stem, 1.27 mm (0.050 in) above normal position 4. Sticking valves 5. Weak valve springs 6. Worn timing chain or chain wheels	Drain and refill to correct level on dipstick Replace faulty parts Grind off end of valve stem or replace parts Overhaul cylinder head Renew worn parts
NOISE FROM HYDRAULIC TAPPETS 1. Rapping noise only when engine is started 2. Intermittent rapping noise 3. Noise on idle and low speed 4. General noise at all speeds 5. Loud noise at normal operating temperature only	1. Oil too heavy for prevailing temperature Excessive varnish in tappet 2. Leakage at check ball 3. Excessive leak-down 4. High oil level in sump Leakage at check ball Worn tappet body Worn camshaft 5. Excessive leak-down rate or scored lifter plunger	Drain and refill with correct grade Replace tappet Replace tappet Replace tappet Drain and refill to correct level on dipstick Replace tappet Replace tappet Replace camshaft Replace tappet
MAIN BEARING RATTLE	1. Low oil level in sump 2. Low oil pressure 3. Excessive bearing clearance 4. Burnt-out bearings 5. Loose bearing caps	Replenish as necessary to high mark on dipstick Worn bearings Renew bearings; grind crankshaft Renew and investigate reason for failure Tighten to correct torque
LOW OIL PRESSURE WARNING LIGHT REMAINS ON, ENGINE RUNNING ON, ENGINE RUNNING	1. Thin or diluted oil 2. Low oil level 3. Choked pump strainer 4. Faulty release valve 5. Excessive bearing clearance 6. Oil pressure switch unserviceable 7. Electrical fault 8. Relief valve plunger sticking 9. Weak relief valve spring 10. Pump rotors excessively worn 11. Excessively worn bearings; main connecting rod, big end, camshaft, etc	Drain and refill with correct oil and renew filter Replenish to high mark on dipstick Clean Rectify Rectify Renew Check circuit Remove and ascertain cause Renew Overhaul oil pump Ascertain which bearings and rectify
RATTLE IN LUBRICATION SYSTEM	1. Oil pressure relief valve plunger sticking	Remove and clean
ENGINE OVERHEATING	1. Low coolant level 2. Faulty cooling system 3. Faulty thermostat 4. Incorrect timing 5. Defective lubrication system	Check for leaks. Check expansion tank level Check fan and belt, pump, radiator fins not blocked Test and renew if necessary Check and adjust using electronic equipment Renew filter. Check pump. Clean strainer. Check oil circulation
MECHANICAL NOISES: Medium low pitch knock Low pitch thud High pitch tap Intermittent thuds Continual slapping	Big end bearing slack or run Main bearing slack or run Worn gudgeon pins Loose flywheel or excessive crankshaft end-float Piston clearance excessive—more apparent when engine cold, may disappear when engine hot	

EMISSION AND EVAPORATIVE CONTROL

Range Rover—carburetter and electronic fuel injection models are fitted during manufacture with various items of emission and evaporative control equipment to meet individual territory requirements. Therefore, some operations in this section may not be applicable to all vehicles. Where possible, items have been territorised to help identify individual requirements.

Unauthorised replacement or modification of the emission or evaporative control equipment may contravene local territory legislation and render the vehicle user and/or repairer liable to legal penalties. Any repairs or adjustments to the systems must be undertaken by an approved dealer. Refer to 'Engine Tuning Data' for the appropriate CO levels applicable to the vehicle specification.

CRANKCASE BREATHING SYSTEM

Description

The 'blow-by' gases from the crankcase are vented into the combustion system to be burned with the fuel/air mixture. The system provides positive emission control under all conditions. During engine running, crankcase fumes which may collect in the crankcase are vented to the carburetter or plenum chamber via hoses and flame traps.

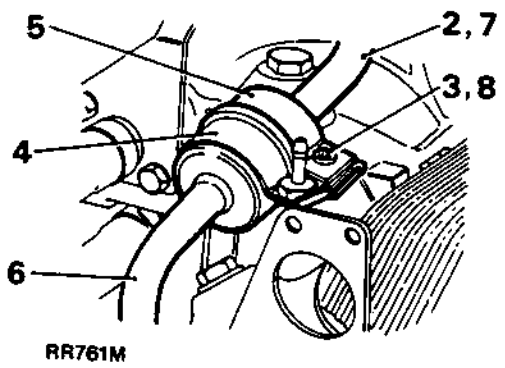
NOTE: Filters may have alternative locations according to engine build specification.

ENGINE BREATHER FILTER—carburetter models

Remove and refit

Removing

1. Remove the air cleaner.
2. Withdraw the filter top hose.
3. Slacken the filter clip.
4. Withdraw the filter from the bottom hose.



Refitting

5. Fit the filter with the end marked 'IN' facing forward.
6. Connect the filter bottom hose.
7. Connect the filter top hose.
8. Secure the filter retaining clip.
9. Fit the air cleaner.

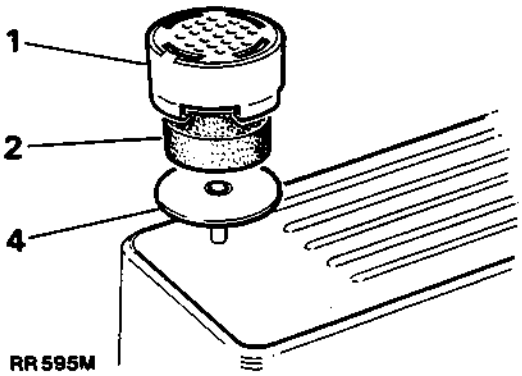
ENGINE BREATHER FILTER—fuel injection models

The engine breather filter is located at the rear of the left-hand rocker cover, beneath the throttle linkage bracketry.

Remove and refit

Removing

1. Prise the filter outer cover upwards to release it from its mounting.
2. Remove the sponge filter from the cover and discard the sponge.



Refitting

3. Insert a new filter into the filter cover.
4. Press the filter onto its mounting until it clips firmly into position.

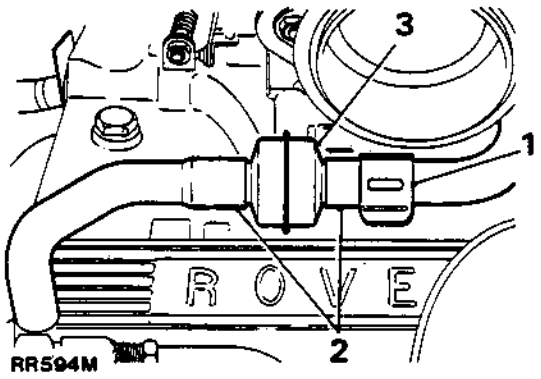
ENGINE FLAME TRAPS—carburetter models

NOTE: Flame traps may have alternative locations according to engine build specification.

Remove and refit

Removing

1. Pull the flame trap hoses out of the retaining clips.
2. Pull the hoses from the flame trap.
3. Withdraw the flame trap.



4. Visually inspect the wire gauze inside the flame trap, if in poor condition, renew the unit. If the unit is in a satisfactory condition, clean as follows:
5. Immerse the flame trap in a small amount of petrol, allow time for the petrol to dissolve and loosen any debris.
6. Remove the flame trap from the petrol bath and allow it to dry in still air.

WARNING: Do not use a compressed air line to dry or clean the flame traps as this could cause fire or personnel injury.

Refitting

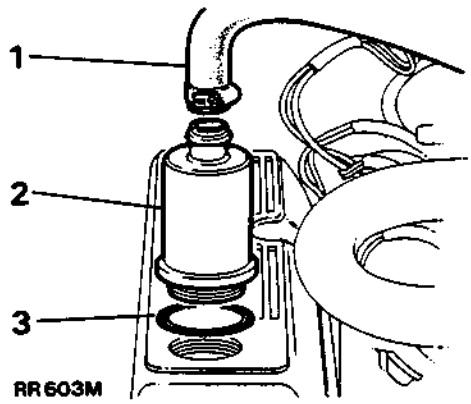
7. Push the hoses onto the flame trap and ensure that they are secure.
8. Locate the hoses in their respective retaining clips.

ENGINE FLAME TRAP—fuel injection models

Remove and refit

Removing

1. Release the hose clip and pull the hose off the canister.
2. Unscrew the canister and remove it from the rocker cover.
3. Remove the large rubber 'O' ring and inspect for deterioration.



4. Visually inspect the condition of the wire gauze within the canister, if in poor condition, renew the whole assembly, if the flame trap is in an acceptable condition, clean as follows:
5. Immerse the canister in a small amount of petrol and allow time for the petrol to dissolve or loosen any debris.
6. Remove the canister from the petrol bath and allow to dry in still air.

WARNING: Do not use a compressed air line to dry; clean or remove any remaining particles of debris within the canister as this could cause fire or personnel injury.

Refitting

7. If the original canister is being refitted, fit a new 'O' ring.
8. Screw the canister into the rocker cover securely—hand tight only.
9. Refit the hose and tighten the hose clip securely.

EVAPORATIVE LOSS CONTROL SYSTEM
(Saudi Arabia carburetter models only)

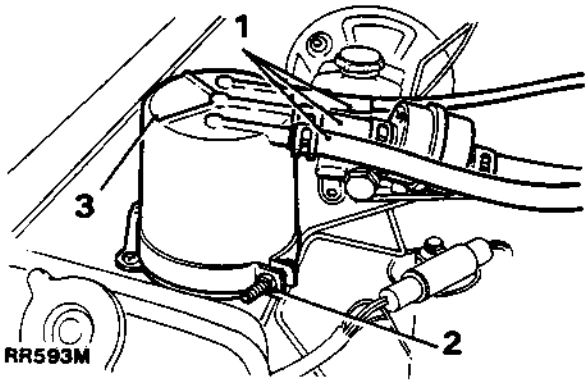
The evaporative loss control system reduces the amount of fuel vapour vented to the atmosphere. An adsorption canister receives vapour from the carburetter float chamber and from the fuel tank. The canister is purged of these vapours by inlet manifold or carburetter depression.

ADSORPTION CANISTER

Remove and refit

Removing

1. Disconnect from the canister:
   (i) Canister line to fuel tank.
   (ii) Canister purge line.
   (iii) Carburetter vent pipe.
2. Slacken the clamp nut screw.
3. Remove the canister.



Refitting

4. Secure the canister in the clamp.
5. Reverse instructions 1 and 2 above.

EVAPORATIVE LOSS CONTROL SYSTEM
(Australian and Saudi Arabia fuel injection models only)

The evaporative loss control system reduces the amount of fuel vapour vented to the atmosphere. An adsorption canister receives vapour from the fuel tank. The canister is purged of these vapours by plenum chamber depression.

The remove and refit of the canister is as described for carburetter models, noting that the carburetter vent pipe marked 'C' is blanked off.

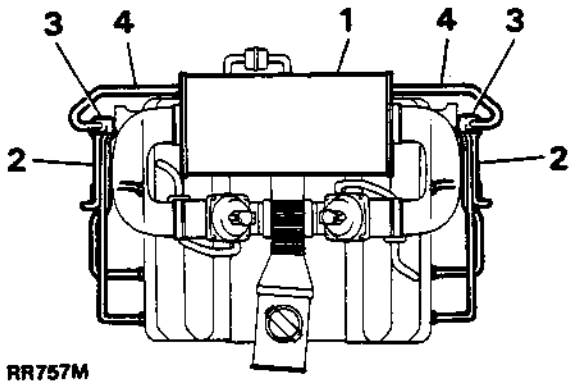
WARNING: The use of compressed air to clean an adsorption canister or clear a blockage in the evaporative system is very dangerous. An explosive gas present in a fully saturated canister may be ignited by the heat generated when compressed air passes through the canister.

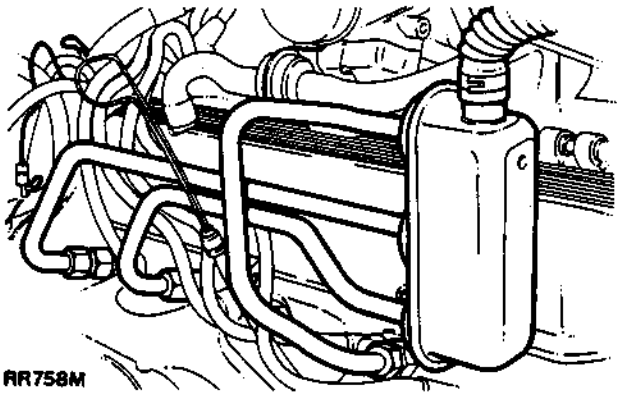
PULSAIR AIR INJECTION
(UK, Europe and Saudi Arabia carburetter models only)

'Pulsair' is a system of self-induced air injection. The induced air which is taken from the air cleaner (UK and Europe models) or from the air intake elbows (Saudi Arabia models) at high manifold depressions, passes through one-way valves and a configuration of pipes which inject clean air into the exhaust gases via the manifold, thereby reducing carbon monoxide emission to the atmosphere.

UK and Europe Version

1. Air cleaner.
2. Pulsair manifolds.
3. Check valve housings.
4. Connecting hoses.

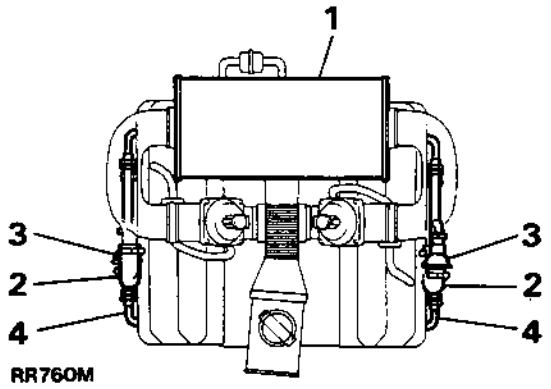




Continued

Saudi Arabia Version

1. Air cleaner.
2. Connecting pipes.
3. Connecting hoses.
4. Pulsair valves.
5. Air manifolds.

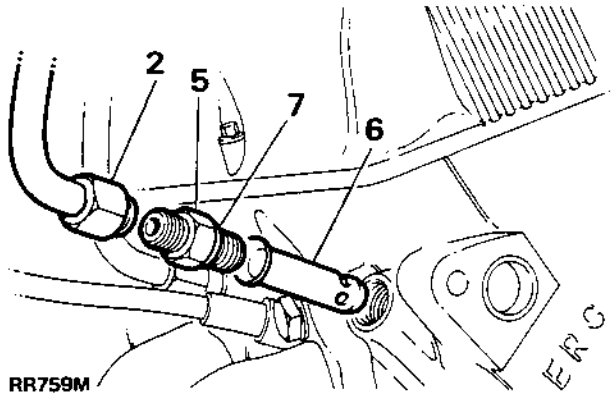


PULSAIR MANIFOLD (UK and Europe carburetter models)

Remove and refit

Removing

1. Release the clip securing the hose to the check valve housing.
2. Release the manifold from the cylinder head.
3. Release the single screw securing the check valve housing to the rocker cover.
4. Withdraw the manifold.
5. Remove the threaded inserts from the cylinder head.
6. Using a piece of bent wire, retrieve the spargas tube from the bottom of the insert bore.



Refitting

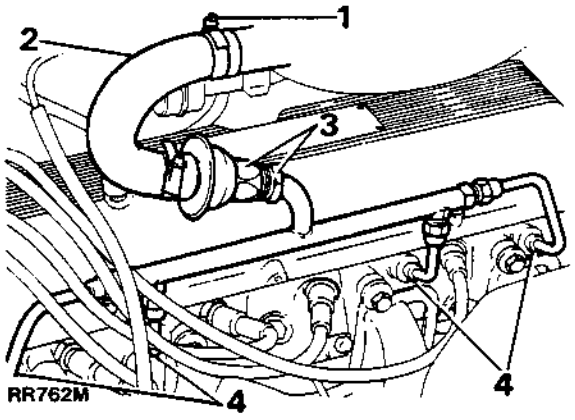
7. Reverse the removal procedure ensuring that the threaded double ended insert is fitted with the plain shank nearest the cylinder head.
8. Run the engine and check for air leaks at the manifold.

PULSAIR MANIFOLD (Saudi Arabia carburetter models)

Remove and refit

Removing

1. Release the hose clip securing the hose at the air intake elbow.
2. Pull the hose from the elbow.
3. Release the check valve from the manifold.
4. Release the manifold from the cylinder head.
5. Lift off the manifold.



Refitting

6. Reverse the removal procedure.
7. Run the engine and check for air leaks at the manifold.

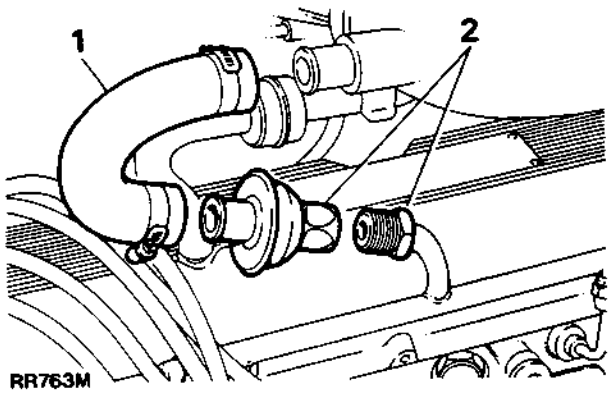
PULSAIR CHECK VALVE (Saudi Arabia carburetter models only)

Remove and refit

Removing

1. Disconnect the hose from the check valve/pulse air valve.
2. Using two open-ended spanners—one on the air distribution manifold hexagon, to support the manifold, and the other to remove the valve anti-clockwise.

   CAUTION: Do not impose any strain on the air manifold.



RR763M

Refitting

3. Reverse instructions 1 and 2.

   NOTE: The pulsair valve is identified by a pink paint spot and the part number 4974-196 on the face.

PULSAIR CHECK VALVE

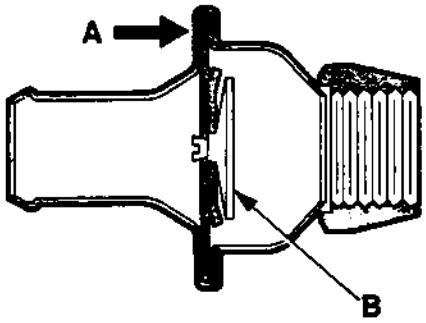
Test

The check valve is a one-way valve positioned to prevent the back-flow of exhaust gases.

Testing

CAUTION: Do not use a pressure air supply for this test.

1. Remove the check valve.
2. Blow through the valve orally in both directions in turn. Air should only pass through the valve when blown from the hose connection end. Should air pass through the valve when blown from the air manifold end, renew the valve.



RR764M

A. Direction of flow.
B. Valve diaphragm.

3. Refit the pulsair check valve.

PULSAIR CHECK VALVE (UK and Europe carburetter models only)

The pulsair check valves are an integral part of the pulsair manifold assembly and are located in the check valve housing. If a single valve within that housing fails it will be necessary to renew the complete pulsair manifold assembly.

To remove the pulsair assembly see pulsair manifold, remove and refit.

TEST

1. Remove the pulsair manifold.
2. Blow through the valve orally in both directions in turn. Air should only pass through the valve or valves when blown from the check valve housing. Should air pass through the valves when blown from the manifold end, renew the complete assembly.

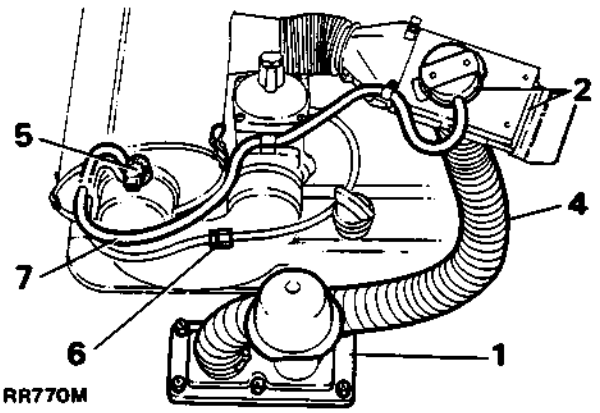
AIR INTAKE TEMPERATURE CONTROL SYSTEM
(UK, Europe and Saudi Arabia carburetter models only)

Description

To maintain an efficient air intake temperature, a sensor is incorporated in the air cleaner. The sensor allows inlet manifold vacuum to operate a flap in the air cleaner intake. The flap permits cold air, from forward of the radiator and/or hot air, from a scoop around the exhaust manifold, to mix in varying amounts to provide the required air temperature.

The specification comprises:

1. A hot box surrounding the exhaust manifold.
2. A vacuum operated thermostatically controlled flap valve in the air cleaner.
3. The flap valve controls the source of the intake air supply which may be warm air drawn entirely from the hot box or cold air drawn from the under bonnet area or a combination of both.
4. The hot box is connected via a hose to the flap valve in the air intake.
5. The temperature sensing device is situated in the air cleaner on the clean side of the element.
6. A pipe from the manifold is attached to the temperature sensing device via a non-return valve.
7. From the other side of the temperature sensing device is a pipe connecting the vacuum capsule operating the flap valve.



RR770M

CONTROL VALVE

Check operation

1. Check operation of the mixing flap valve in the air cleaner by starting the engine from cold and observing the flap valve as the engine temperature rises.
2. The valve should start to open slowly within a few minutes of starting and continue to open until a stabilised position is achieved. This position and the speed of operation will be entirely dependent on prevailing ambient conditions.
3. Failure to operate indicates failure of the flap valve vacuum capsule or the thermostatically controlled vacuum switch or both.
4. Check by connecting a pipe directly to the flap valve, thus by-passing the temperature sensor.
5. If movement of the flap valve is evident the temperature sensor is faulty. If no movement is detected, the vacuum capsule is faulty.
6. Fit new parts where necessary.

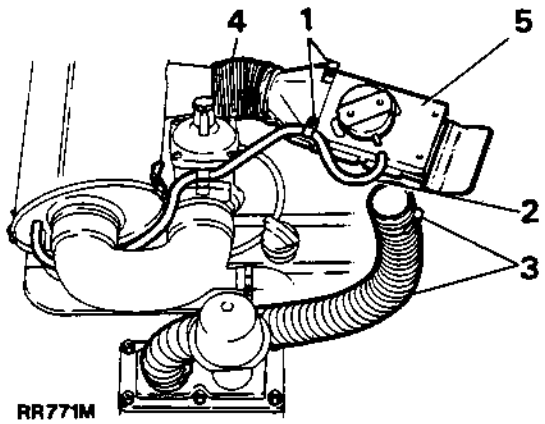
AIR INTAKE TEMPERATURE CONTROL VALVE

Remove and refit

NOTE: Alternative valves may be fitted according to engine build specifications.

Removing

1. Release the two clips securing the pipes at either side of the valve unit.
2. Pull the pipe from the vacuum capsule.
3. Release the hose clip and remove the hot box hose from the bottom of the valve unit.
4. Disconnect the hose between the valve unit and air cleaner.
5. Release the valve unit from its support and lift it from the engine compartment.



RR771M

Refitting

6. Reverse the removal procedure. Ensure that all hoses and pipes are fitted securely.

TEMPERATURE SENSOR

The temperature sensor is incorporated into the clean air side of the air cleaner case. The sensor is located in the right-hand end cover of the air cleaner. Access to the unit is gained as follows:

Remove and refit

Removing

1. Remove the right-hand air cleaner elbow.

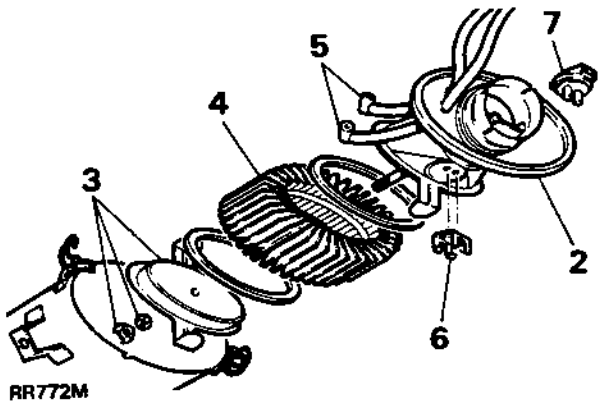
   NOTE: Saudi Arabia versions only—disconnect the hose from the check valve at the air cleaner elbow.

   Care should be taken not to damage any seals or 'O' rings when removing the elbows.

2. Remove the air cleaner right-hand end cover.

   NOTE: UK and Europe versions only—remove the hose from the pulsair manifold at the right-hand air cleaner end cover.

3. Remove the wing nut, fibre washer and end plate securing the air cleaner element.
4. Remove the element.
5. Pull the two pipes off the sensor, noting their position for re-assembly.
6. Prise the spring retaining clip of the sensor.
7. Manoeuvre the sensor and remove it from the end cover.



RR772M

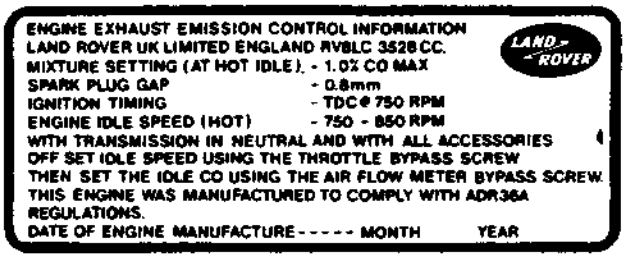
Refitting

8. Reverse the removal procedure.

   NOTE: When refitting the elbows coat the air cleaner seal and carburetter 'O' ring with petroleum jelly. Ensure that all hoses and connections are secure.

EMISSIONS LABEL (Australian and Saudi Arabian fuel injection models only)

An exhaust emission control information label is attached to the right-hand rocker cover. The label is fitted to comply with local territory emission requirements.


ENGINE EXHAUST EMISSION CONTROL INFORMATION
LAND ROVER UK LIMITED ENGLAND RVBLC 3528 CC.
MIXTURE SETTING (AT HOT IDLE). - 1.0% CO MAX
SPARK PLUG GAP - 0.8mm
IGNITION TIMING - TDC @ 750 RPM
ENGINE IDLE SPEED (HOT) - 750 - 850 RPM
WITH TRANSMISSION IN NEUTRAL AND WITH ALL ACCESSORIES OFF SET IDLE SPEED USING THE THROTTLE BYPASS SCREW
THEN SET THE IDLE CO USING THE AIR FLOW METER BYPASS SCREW.
THIS ENGINE WAS MANUFACTURED TO COMPLY WITH ADR36A REGULATIONS.
DATE OF ENGINE MANUFACTURE - - - - - MONTH YEAR

RR769M

VACUUM DELAY VALVE—all carburetter emission controlled models

The coloured end of the vacuum delay valve should always be fitted to the short hose from the distributor.

Test check valve air flow

1. Attach a 10.00 ± .250 in³ vacuum tank to the coloured side of the valve.
2. Expose the black side to atmospheric pressure.
3. **Expected result:** The time required for the vacuum to drop from minus 20 in Hg to minus 2 in Hg will be 0.5 seconds maximum.

Test

4. **Vacuum recovery air flow:** Attach a 22.75 ± .5 in³ vacuum tank to the black side of the valve.
5. Expose the coloured side to atmospheric pressure.
6. **Expected result:** The time required for the vacuum to drop from 16 in Hg to 8 in Hg will be 240 to 360 seconds.

Test: external leakage check

1. Seal the coloured side of the valve and attach a short flexible pipe to the other end.
2. Submerge the valve in water and orally blow through the valve.
3. If any external leakage is noticeable, renew the valve.

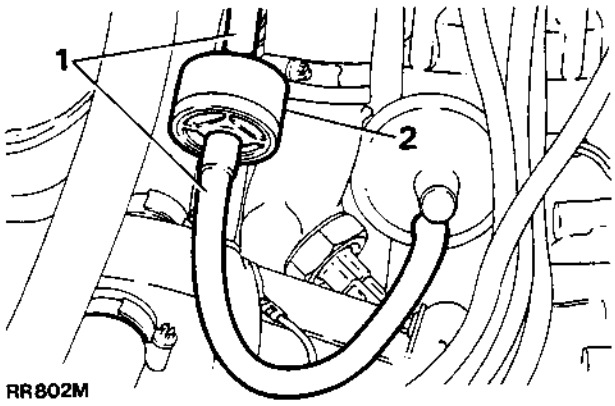
   If the delay valve does not comply with any of the test results, renew the unit.

Continued

Remove and refit

Removing

1. Pull the two flexible hoses from the delay unit.
2. Remove the unit from the engine compartment.

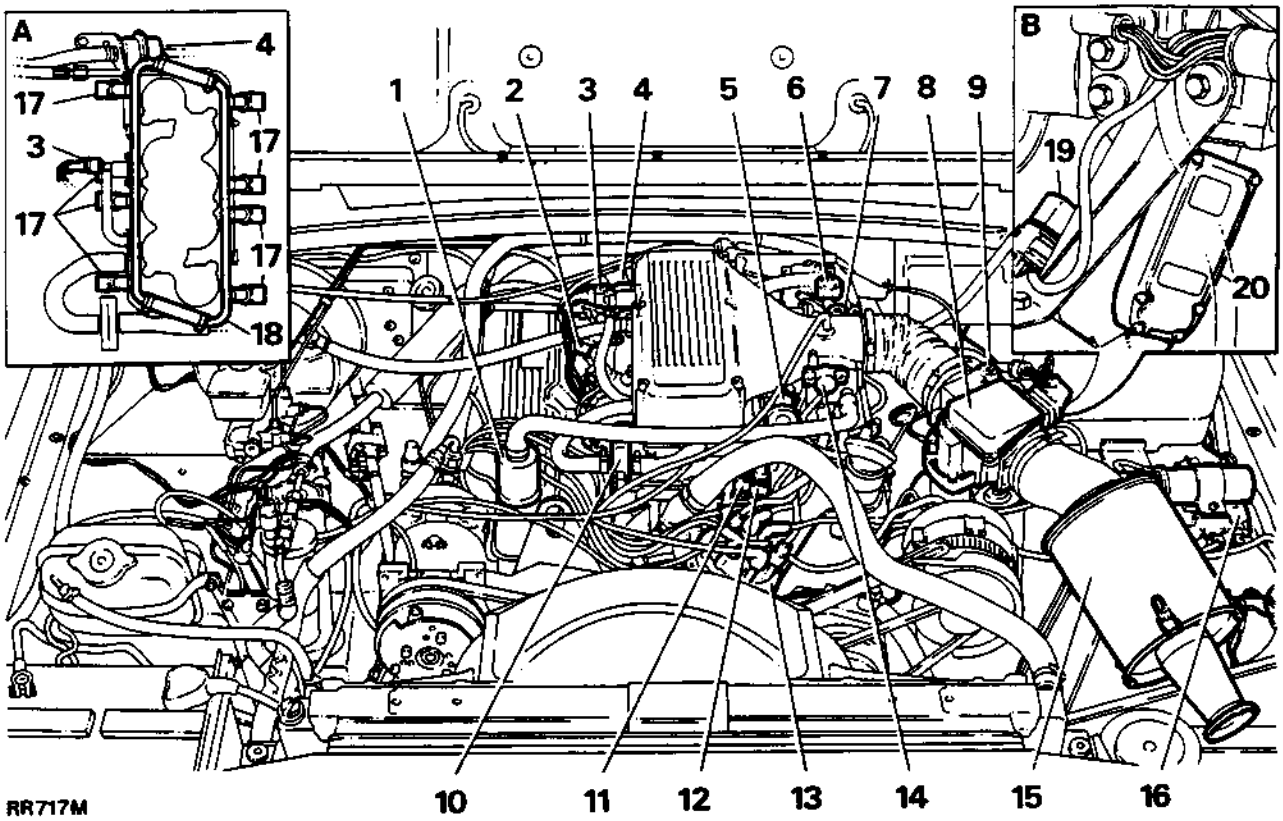


Refitting

3. Reverse the removal instructions ensuring that the coloured side of the valve is fitted to the short hose from the distributor.

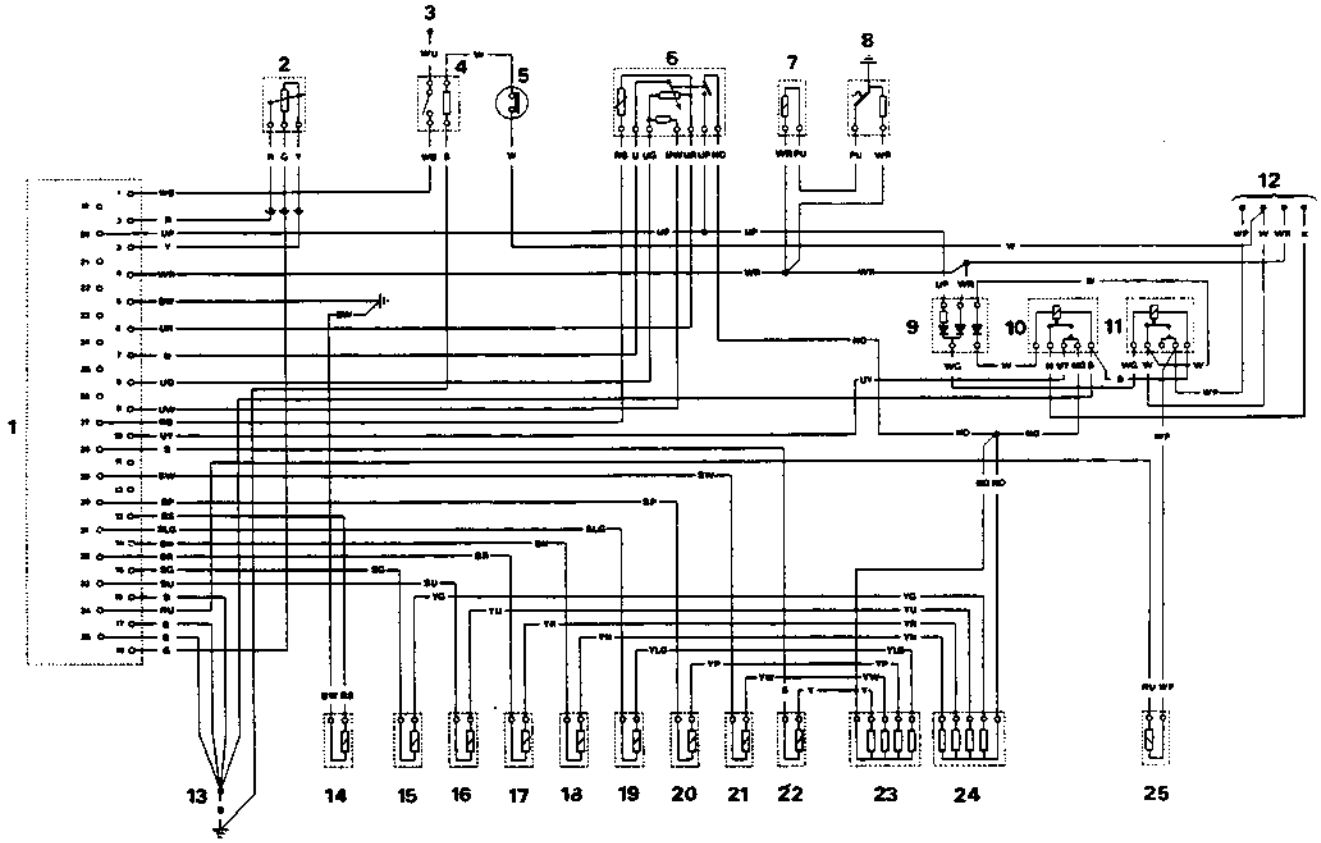
AIR INTAKE TEMPERATURE CONTROL — FAULT FINDING

SYMPTOM	POSSIBLE CAUSE	ACTION
Poor or erratic idle Hesitation or flat spot (cold engine) Excessive fuel consumption Lack of power Engine overheating	Hot air inlet hose loose, adrift or blocked	Check hot air inlet hose for condition and security. Renew if necessary.
Poor or erratic idle Hesitation or flat spot (cold engine) Excessive fuel consumption Lack of power Engine cuts out or stalls (at idle) Engine 'runs-on' Engine 'knocks or pinks' Rich running (excess CO)	Flap valve jammed	Check operation of flap valve. If fault cannot be rectified renew air cleaner outer cover which includes flap valve.
Poor or erratic idle Hesitation or flat spot (cold engine) Excessive fuel consumption Lack of engine power Engine cuts out or stalls (at idle) Engine misfires Lean running (low CO)	Vacuum pipes disconnected or leaking	Check the vacuum pipes for security and deterioration. Renew if necessary.
Hesitation or flat spot (cold engine) Excessive fuel consumption Lack of power Engine overheating Engine cuts out or stalls (at idle) Engine 'runs-on' Engine 'knocks or pinks' Rich running (excess CO)	One-way valve faulty	Blow through valve to check 'one-way' action. If the valve leaks fit a new valve.
Poor or erratic idle Hesitation or flat spot (cold engine) Excessive fuel consumption Lack of power Engine overheating Engine cuts out or stalls (at idle) Engine 'runs-on' Engine 'knocks or pinks' Rich running (excess CO)	Temperature sensor faulty, leaking or jammed	Check and renew if necessary.
Poor or erratic idle Hesitation or flat spot (cold engine) Excessive fuel consumption Lack of power Engine cuts out and stalls Rich running	Flap valve diaphragm leaking	Check with a distributor vacuum test unit. If leakage is apparent renew air cleaner outer cover which includes the servo motor.



FUEL INJECTION SYSTEM COMPONENTS — RANGE ROVER

1. Breather flame trap
2. Vacuum switch
3. Cold start injector
4. Fuel pressure regulator
5. Solenoid operated air valve (air conditioning versions only)
6. Engine crankcase breather
7. Idle speed adjustment screw
8. Airflow meter
9. Idle air mixture screw
10. Extra air valve
11. Coolant temperature switch
12. Thermotime switch
13. Electronic distributor
14. Throttle potentiometer
15. Air cleaner
16. Constant energy unit
    Inset 'A'
17. Injectors
18. Fuel feed rail
    Inset 'B'
19. Over run fuel shut-off relay
20. Power resistor pack



RR612M

FUEL INJECTION—Circuit Diagram

1. Electronic control unit (ECU)
2. Throttle potentiometer
3. Ignition pick-up point (142 on main circuit diagram)
4. Over-run fuel shut-off relay
5. Vacuum switch
6. Air flow meter
7. Cold start injector
8. Thermotime switch
9. Current steering module for fuel injection relays
10. Main relay
11. Fuel pump relay
12. Pick-up point fuel injection circuit (111 on main circuit diagram)
13. Clinch
14. Temperature sensor
15. Injector (No. 1 cylinder)
16. Injector (No. 3 cylinder)
17. Injector (No. 5 cylinder)
18. Injector (No. 7 cylinder)
19. Injector (No. 2 cylinder)
20. Injector (No. 4 cylinder)
21. Injector (No. 6 cylinder)
22. Injector (No. 8 cylinder)
23. Power resistors
24. Power resistors
25. Extra air valve

Key to cable colours

B – Black	G – Green
K – Pink	L – Light
N – Brown	O – Orange
P – Purple	R – Red
S – Slate	U – Blue
W – White	Y – Yellow

The last letter of a colour code denotes the tracer colour

Connectors via plug and socket

Snap connectors

Permanent in-line connections

Earth connections via cables B

Earth connections via fixing bolts

ELECTRONIC FUEL INJECTION

Description

Fuel Injection System

Fuel is drawn from the fuel tank by a high pressure electric pump located in the fuel tank. The fuel pump operates only when the pump relay and/or the starter motor circuits are energised. Fuel passes to the pressure regulator via an in-line filter. The pressure regulator varies pressure in direct proportion to manifold depression and thus varies injection pressure between 1.8 to 2.5 kgf/cm², 26 to 36 lbf/in². Excess fuel is returned to the fuel tank.

A fuel rail links the pressure regulator with the fuel injectors, one injector being fitted to each inlet manifold spur. The injectors are solenoid operated being pulse energised by the electronic control unit, ECU, completing a circuit to 'earth'. When 'open' the injectors spray fuel into the inlet manifold to be drawn into the engine cylinders at the next induction stroke of each piston.

Therefore there needs to be no fixed relationship between the injector timing and the engine ignition or valve timing.

The injectors are programmed to 'open' alternately in two banks of four, twice per engine operating cycle. The time that the injectors are 'open' governs the amount of fuel supplied to the engine and this 'open' time is computed by the ECU from the inputs it receives from the various sensors.

To assist cold starting, a separate cold start injector sprays a fine jet of fuel against the air stream entering the plenum chamber. The cold start injector is energised from the engine starter motor circuit and is in series with a thermotime switch which is dual activated by the engine coolant temperature (heat) and a heater coil around a bi-metal strip (time) the coil being energised from the starter motor circuit. The thermotime switch ensures that the cold start injector will not be energised when the engine is at normal operating temperature or during prolonged operation of the starter motor when the engine is below normal operating temperature. The switch will isolate the cold start injector after approximately 8 to 12 seconds at −20°C, −4°F, this time is decreased as the engine approaches its normal operating temperature.

Fuel Pump

The fuel pump is energised initially via a relay during operation of the starter motor solenoid and then by a switch operated by the air flow meter and is independent of the ECU.

Electronic Control Unit — ECU.

The ECU is a sealed unit and receives input signals from various sensors and computes from these an output signal to the fuel injector solenoid circuits. When activated the solenoids 'open' the injectors to spray fuel into the engine inlet manifold spurs, the injectors remaining open for between 1.5 and 10 milli-seconds depending on engine running requirements.

The ECU is protected by various devices: the diode pack protects against reversed battery connection. The main relay is controlled by the ignition switch and connects battery voltage directly to the ECU.

Engine Speed

Low tension circuit pulses from the ignition coil negative terminal, are passed to the ECU to be computed into an engine speed input.

Air Flow Meter

The air flow meter measures induction air flow mass. The plenum chamber absorbs any rapid fluctuations in air flow that might upset the air flow meter signals.

The movement of the measuring flap is dampened by a compensating flap which prevents flutter. The position of the flap is controlled by the air drawn into the engine and the action of a return spring. The mass of air drawn into the engine at any time is indicative of the engine load and a signal from a potentiometer, variable resistance, proportional to the flap position, is passed to the ECU. However, the air mass and air density is dependent upon air temperature. Therefore, an air temperature sensor is incorporated into the air flow meter and this sends a separate signal to the ECU.

Due to the action of the return spring, the measuring flap is almost closed when the engine is idling and an idle air by-pass channel is provided to assist the engine to breath at low speed. Air passing through the by-pass channel is not registered by the air flow meter measuring flap. The idle air mixture screw is fitted into the by-pass channel to regulate the air flow to adjust the air to fuel ratio CO content at idle speed.

Coolant Temperature Sensor

The sensor provides coolant temperature information to the ECU.

The sensor causes the ECU to lengthen slightly, the time that the main injectors are 'open' reducing this time as the engine warms up and cutting it off when normal engine operating temperature is reached.

Continued

Extra Air Valve

This valve is mounted above a water passage in the inlet manifold and registers engine coolant temperature. The valve provides the additional air required to maintain satisfactory cold start mixture until the engine reaches normal operating temperature. This air is taken after it has passed through the air flow meter, so that the air is registered by the ECU, and returned to the plenum chamber after the throttle butterfly.

The valve allows extra air to pass under cold start conditions, the extra air source is reduced and finally terminated as normal engine operating temperature is reached.

The valve is controlled by a bi-metal strip which is heated from two sources; the coolant and a heater coil around the strip. The heater coil is energised from the fuel pump circuit and comes into operation when the engine is under crank or running.

Throttle Potentiometer

The electrical signal from the potentiometer to the ECU depends upon the position of the throttle butterfly spindle and hence the accelerator pedal. By using the variable voltage output in conjunction with the information from the other sensors, the ECU adjusts fuel input to accommodate requirements for acceleration, deceleration and constant engine speed. When sudden acceleration is signalled to the ECU by the throttle potentiometer, all injectors are instantly pulsed to operate once simultaneously to ensure adequate engine response.

Over-run Fuel Cut-off — Vacuum Switch

The manifold depression switch senses manifold depression above 24 in Hg ± 1 in Hg. The switch operates the over-run relay which interrupts the ignition signal to the ECU.

Air Temperature Sensor

The air temperature sensor is an integral part of the air flow meter and cannot be replaced as a separate item.

The sensor sends a separate signal to the ECU, the ECU then alters the length of time the injectors remain open, correcting the air/fuel mixture.

FUEL INJECTION SYSTEM

CAUTION: The fuel system incorporates fine metering components that would be affected by any dirt in the system; therefore it is essential that working conditions are scrupulously clean.

If it is necessary to disconnect any part of the fuel injection system i.e. pipes, hoses, etc., these must be blocked off to prevent ingress of dirt.

ENGINE SETTING PROCEDURE — FUEL INJECTION

If a major overhaul has been undertaken on the fuel injection/engine system, the following check and adjustments must be carried out before attempting to start the engine.

A. **Throttle potentiometer setting** — see 'Throttle switch —potentiometer' setting procedure.

B. **Spark plug gaps**—see 'Data section'.

C. **Throttle levers**—see 'Throttle lever setting procedure'.

D. **Ignition timing—static**—see 'Engine tuning data'.

E. **By-pass idle screw**—see 'Engine tuning procedure'.

NOTE: If the previous checks and adjustments are satisfactory but the engine will not start the fuel injection electrical circuitory must be checked using the appropriate recommended equipment.

Recommended Equipment:

Lucas 'Electronic Ignition Analyser'
Lucas Part Number—TWB 119.

Lucas 'E.F.I. Throttle Potentiometer Adjustment Gauge'
Lucas Part Number—YWB 121.

Lucas 'Epitest' diagnostic system
Lucas Part Number—YWB 105.

Use in conjunction with the Lucas Operating Instruction Manuals.

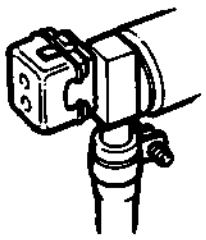
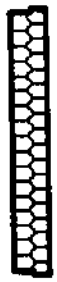
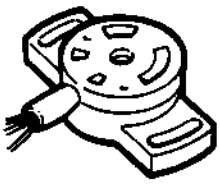
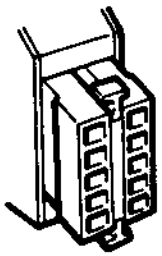
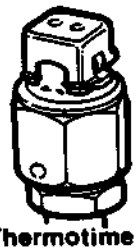
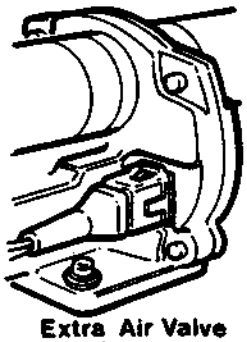
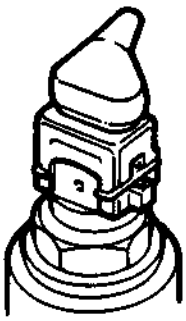
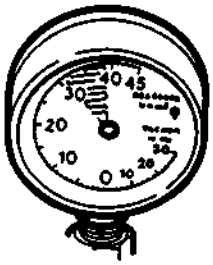
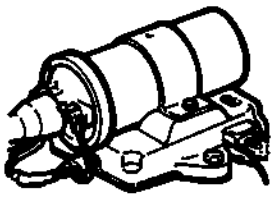
If the above equipment is unavailable the tests can be carried out using an AVO meter, following the instructions given in the charts.

CAUTION: Ensure the AVO is correctly set to volts or ohms, dependent upon which test is being undertaken.

CONTINUITY TESTS—Using an AVO meter

The following continuity tests are intended as a guide to identifying where a fault may occur within a circuit; reference should be made to the fuel injection circuit diagram for full circuit information.

Key to Symbols

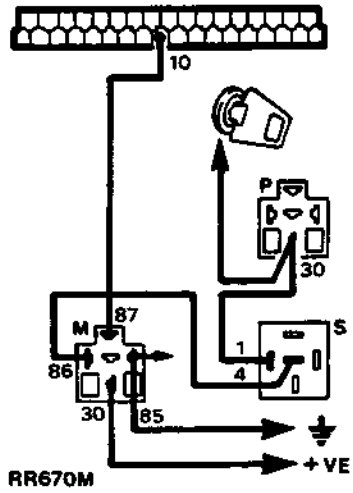
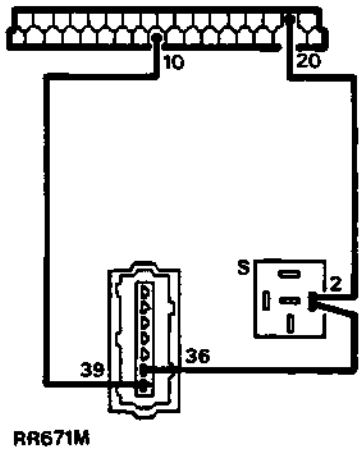
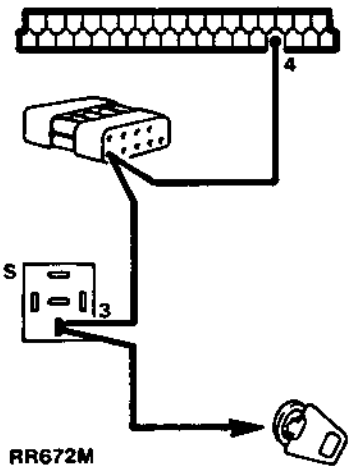
 Cold Start Injector	 35-Way Harness Multiplug	 P-Pump Relay M-Main Relay S-Steering Module	 Airflow Meter Harness Plug	 Throttle Switch (potentiometer type)
 Temporary Connection	 Resistor Box	 Injector	 Thermotime Switch	 Extra Air Valve
 Coolant Temp. Sensor	 Ignition	 Pressure Gauge	 Electrical Multiplug	 Constant Energy Unit

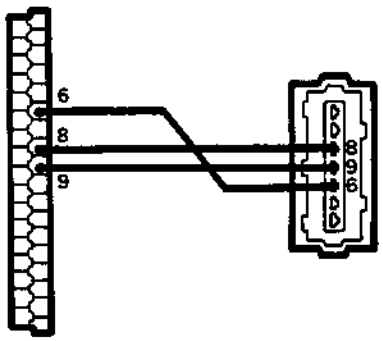
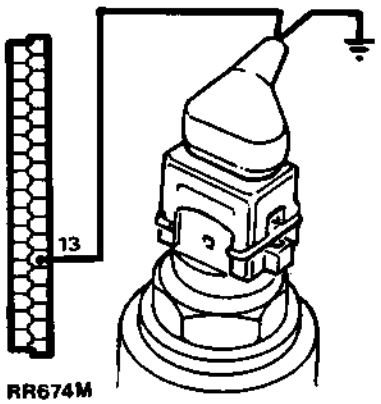
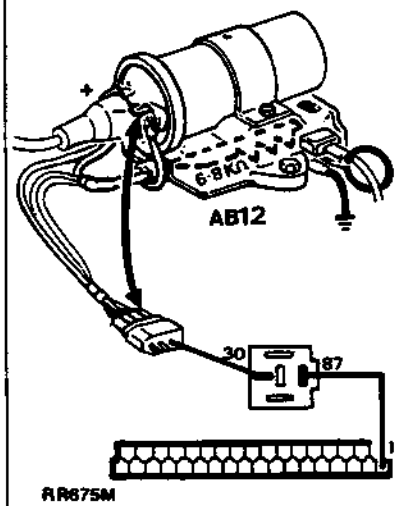
RR 716M

CONTINUITY TEST—Using an AVO meter

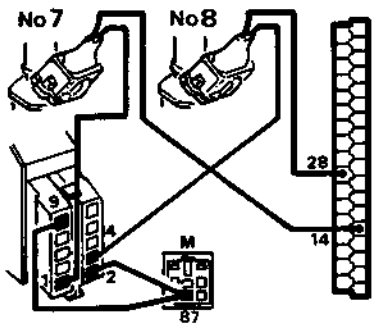
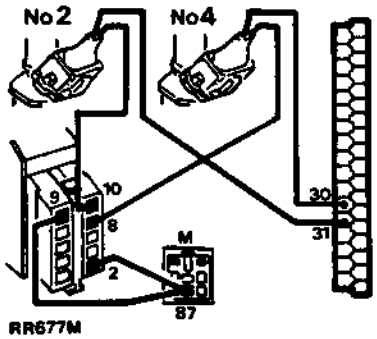
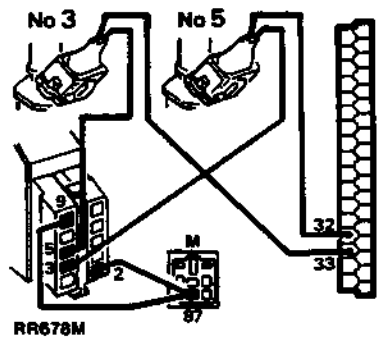
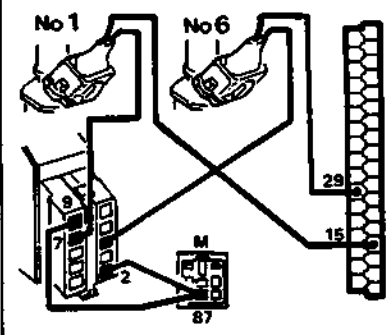
NOTE: All tests are carried out from the electronic control unit (ECU) harness multi-plug unless stated otherwise in the test procedure.

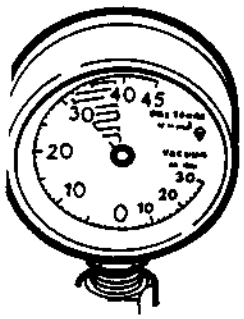
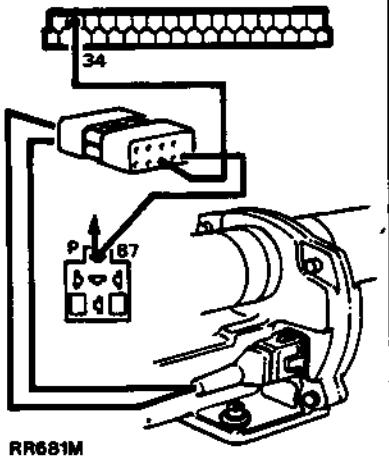
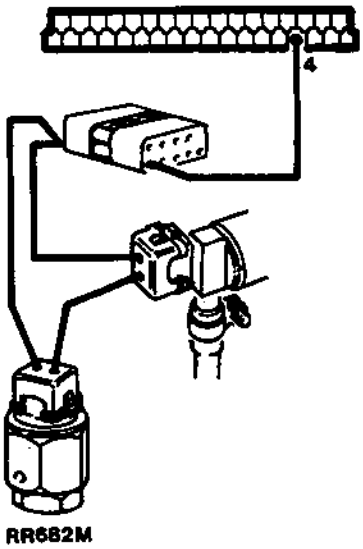
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TEST	CIRCUIT TESTING	EXPECTED RESULTS	POSSIBLE FAULTS AND REMEDIES
1. ECU SUPPLY Disconnect the mutli-plug from the ECU. Switch on the ignition. Connect a voltmeter between pin 10 and earth.		11–12.5 volts	No reading; check all wiring to main relay, check main relay by substitution. Below 11 volts; check battery. Check circuit for high resistance connection.
2. FUEL PUMP CONTACTS Switch on the ignition and connect a voltmeter between pin 20 and earth. Airflow meter flap closed.		0 volts	If reading registered, check airflow meter switch action.
Operate the flap in the airflow meter.		11–12.5 volts	No reading, check wiring from main relay to airflow meter. Check wiring from airflow meter to fuel pump relay. Check pump relay by substitution. Check fuel pump operation by connecting a direct supply to the pump terminals.
3. CRANKING SIGNAL Connect a voltmeter between pin 4 and earth. Crank the engine.		8–12 volts	No reading but starter motor operates; check wiring from starter relay to steering module and from steering module to ECU. No reading starter motor does not operate; check starter relay and starter motor. Below 8 volts check battery, check starter motor.

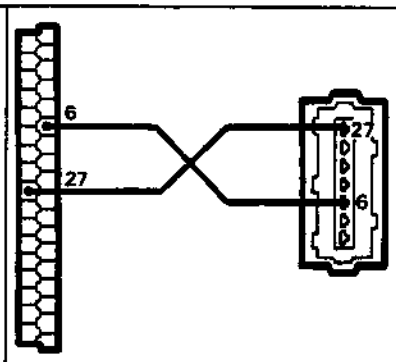
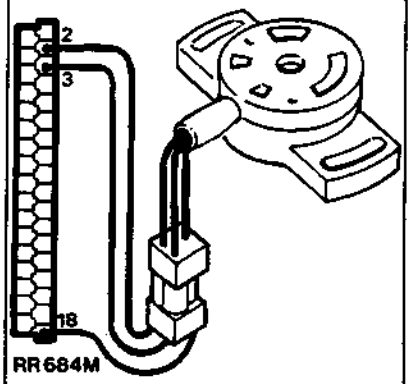
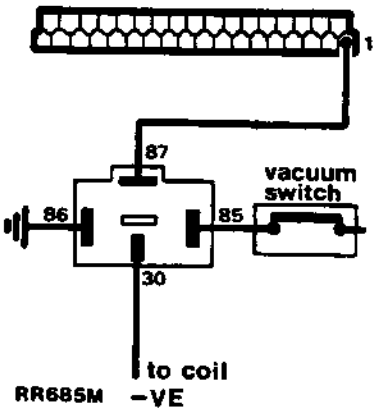
4. AIRFLOW METER Connect ohmmeter between pin 6 and 8. — — — — — — — — — — Connect ohmmeter between pins 6 and 9. — — — — — — — — — — Connect ohmmeter between pins 8 and 9.		360 ± 10 Ω — — — — — 560 ± 10 Ω — — — — — 200 ± 10 Ω	Should readings be different from expected results; check harness continuity between ECU plug and airflow meter plug, i.e. pins 6–6, 8–8, 9–9. Check variable resistor circuit in airflow meter with ohmmeter, check that meter flap is closed before substituting airflow meter.
5. WATER TEMPERATURE SENSOR Connect ohmmeter between pin 13 and earth.		Temp °C K Ω −10 ± 1 °C 7.0 to 11.6 +20 ± 1 °C 2.1 to 2.9 +80 ± 1 °C 0.27 to 0.39	Incorrect reading; check wiring and electrical plug, renew sensor if readings do not comply with results. **NOTE: Connect the AVO measuring leads to the sensor for short periods only, to minimise the effect of self heating due to the measuring current.**
6. SPEED SIGNAL **(Constant energy ignition)** Fit a jump lead between the negative terminal on the ignition coil and pin 1. Connect voltmeter between pin 1 and earth. Crank engine.		6–9 volts fluctuating	No reading; check harness connections between coil and ECU.

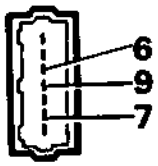
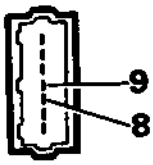
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TEST	CIRCUIT TESTING	EXPECTED RESULTS	POSSIBLE FAULTS AND REMEDIES
7. INJECTOR CHECK **Numbers 7 and 8** **Injector 7** Connect ohmmeter between pin 14 and 87 on main relay. **Injector 8** Connect ohmmeter between pin 28 and 87 on main relay.	 RR676M	7–10 KΩ 7–10 KΩ	If reading is below expected results, disconnect each injector in turn to find injector with '00' or low reading; renew injector. If winding resistance of injector is satisfactory, check wiring circuits and resistor pack for open circuit condition.
7A. INJECTOR CHECK **Numbers 2 and 4** **Injector 2** Connect ohmmeter between pin 31 and 87 on main relay. **Injector 4** Connect ohmmeter between pin 30 and 87 on main relay.	 RR677M	7–10 KΩ 7–10 KΩ	See injectors 7 and 8.
7B. INJECTOR CHECK **Numbers 3 and 5** **Injector 3** Connect ohmmeter between pin 15 and 87 on main relay. **Injector 5** Connect ohmmeter between pin 29 and 87 on main relay.	 RR678M	7–10 KΩ 7–10 KΩ	See injectors 7 and 8.
7C. INJECTOR CHECK **Numbers 1 and 6** **Injector 1** Connect ohmmeter between pin 33 and 87 on main relay. **Injector 6** Connect ohmmeter between pin 32 and 87 on main relay.	 RR679M	7–10 KΩ 7–10 KΩ	See injectors 7 and 8.

8. PRESSURISED FUEL RAIL Fit pressure gauge to cold start injector fuel hose. Switch the ignition on and operate the airflow meter spring return switch to energise the fuel pump.	 RR680M	2.4–2.6 kgf/cm² 34–37 lbf in²	No pressure build up; check fuel pump circuit with voltmeter. If a reading of 12 volts obtained, check fuel pump earth circuit, satisfactory. If earth circuit check pump. Check operation of fuel pump relay and main relay by substitution if pressure reading is zero. Fuel pressure above or below limits; check pipe work and regulator for blockages and falling pressure reading, check pipe work for leaks, check for leaking injectors, pressure regulator and fuel pump non-return valve.
9. EXTRA AIR VALVE Connect ohmmeter between pin 34 and 87 on fuel pump relay.	 RR681M	30–40 Ω	No reading; check wiring and connections between the pump relay, extra air valve and ECU. Check air valve for continuity with an ohmmeter.
10. COLD START INJECTOR Disconnect the thermotime switch. With each of the leads being connected to earth in turn. Connect ohmmeter between pin 4 and earth.	 RR682M	0–5.0 Ω	No reading; check wiring and connections between the ECU cold start injector and thermotime switch. Open circuit; check wiring and connections and cold start injector windings.

Continued

11. AIR TEMPERATURE SENSOR (Airflow meter) Connect ohmmeter between pin 6 and 27. **NOTE: Connect the AVO measuring leads to the sensor for short periods only, to minimise the effect of self heating due to the measuring current.**	 RR683M	Temp °C K Ω −10 ±0.5 °C 8.26 to 10.56 +20 ±0.5 °C 2.28 to 2.72 +50 ±0.5 0.76 to 0.91	If reading is infinity; disconnect airflow meter, bridge terminals 6 and 27. If ohmmeter reads zero air temperature, sensor is faulty. If after replacement ohmmeter shows infinity, check wiring and connections to the ECU.
12. THROTTLE POTENTIOMETER **CAUTION: Ensure the AVO is set to volts.** Reconnect the ECU switch ignition on. Measure voltage between green −VE lead and yellow +VE lead by inserting the meter probes into the rear of the multi plug.	 RR684M	4.3 ± 0.2 volts	No reading or low reading; check wiring and connections
With ECU connected insert meter −VE lead to green wire and meter +VE lead to red wire measure voltage.		0.3–0.36 volts	
ECU connected and with leads connected as above; open throttle voltage should steadily increase.		Smooth swing within 0.3 to 4.5 volt range	If meter reading drops and suddenly picks up through the voltage range—indicates faulty track—renew potentiometer.
13. OVER-RUN RELAY Disconnect the negative lead from coil to relay. Ignition off, connect ohmmeter between pin 1 and 30 on relay.	 RR685M	Infinity Ω	Reading other than infinity; check wiring and connections for security. Substitute relay.
Ignition on, connect ohmmeter between pin 1 and 30 on relay.		0 Ω	Readings other than zero; check wiring and connections, renew vacuum switch if necessary.
Disconnect the vacuum switch and repeat the above test.		Infinity Ω	Readings other than infinity; renew relay.

14. AIRFLOW METER (Potentiometer) Reconnect the ECU switch ignition on. Peel back rubber boot on plug. Insert +VE meter probe to pin 6 and −VE lead to pin 9 Connect −VE meter probe to pin 9 and +VE probe to pin 7 measure voltage With leads connected as above gradually open air flap. Voltage should decrease.	 RR714M	1.55 ± 0.1 volts 3.7 ± 0.1 volts 1.6 ± 0.1 volts	No reading or low reading; check wiring and connections Renew airflow meter if results are not within expected results.
15. AIRFLOW METER (Potentiometer) Disconnect the ECU. Switch ignition on. Peel back electrical plug rubber boot. Insert −VE meter probe to pin 9 and +VE probe to pin 8.	 RR715M	4.3 ± 0.2 volts	If actual results do not meet expected results, renew the airflow meter.

After completing the tests with either the 'Epitest' equipment or AVO meter, retest the vehicle to ensure the faults have been rectified.
If faults still persist, check the ECU by substitution.

FAULT DIAGNOSIS—FUEL INJECTION—HOT START

SYMPTOM	POSSIBLE CAUSE	CURE
A. Engine will not start.	1. Battery discharged.	1. Remove battery from vehicle and recharge.
	WARNING: BEFORE CARRYING OUT THE NEXT TWO OPERATIONS, ENSURE THAT THE RECOMMENDED INSULATED EQUIPMENT IS USED WHEN HANDLING THE HIGH TENSION LEAD.	
	2. Ignition—coil.	2. Remove HT lead from distributor, turn ignition on and check for spark at HT to earth—no spark—renew coil and amplifier.
	3. Ignition—distributor.	3. Remove HT lead from spark plug, turn ignition on and crank engine—no spark—rectify or renew distributor.
	4. Injectors failing to operate.	4. Turn ignition on and operate the throttle briskly; injectors should be heard to click. If no clicking audible, check throttle potentiometer connections.
	5. Fuel tank ventilation.	5. Check ventilation pipe work and that a non-vented petrol cap is fitted, rectify or renew.
	6. Cold start system operating.	6. Cold start system should be inoperative at coolant temperatures above 35°C. If the cold start injector is operating it will cause over-richness of fuel and the vehicle will not start. Disconnect cold start injector, if vehicle starts renew thermotime switch and or cold start injector if injector is leaking.
	7. Loss of fuel pressure.	7. Disconnect the high tension lead from the coil. Insert a pressure gauge between fuel pump and fuel rail (between fuel rail and cold start injector), crank engine to pressurise fuel system, pressure under cranking should be 2.5 kgf/cm² (36 lbf/in²). Pressure should not drop by more than 0.7 kgf/cm² (10 lbf/in²) in first hour, if greater check for fuel leaks in system. Clamp fuel pipe between gauge and fuel rail, if pressure drops renew fuel pump.
	8. Loss of pressure due to faulty fuel pressure regulator.	8. Insert a pressure gauge between fuel pump and fuel rail. (Between fuel rail and cold start injector). Crank engine to pressurise fuel system, and clamp fuel pipe between pressure regulator and fuel rail; if pressure still drops rectify or renew pressure regulator. If regulator leaking it may be due to ingress of dirt or grit lodged on the valve seat. It is possible to clear this by clamping fuel return pipe after the regulator, run engine for no more than two seconds; release the clamp quickly. The resultant fuel flow may be sufficient to move the dirt or grit off the valve seat. If valve still loses pressure after re-testing—renew the pressure regulator.
	9. Loss of fuel pressure due to leaking injectors.	9. Insert a pressure gauge between fuel pump and fuel rail; crank engine to pressurise fuel system. Clamp fuel pipe between pressure regulator and fuel rail; if pressure drops locate and renew a faulty injector or cold start injector.

FAULT DIAGNOSIS CHART—GENERAL—FUEL INJECTION

SYMPTOM	POSSIBLE CAUSE	CURE
1. Fuel/air mixture weak.	Air leaks (unmetered air entering engine).	Check engine for air leaks, renew 'O' rings and gaskets as necessary.
	Low fuel pressure.	See fault diagnosis 'Hot start' tests 7, 8, 9.
	Blocked fuel injectors.	Remove injectors from manifold; do not disconnect from fuel rail. Using Lucas 'Epitest' diagnostic equipment locate faulty injector and renew.
2. Fuel/air mixture rich.	Fuel pressure high.	See fault diagnosis 'Hot start' test 8. Check for faulty pressure regulator; check fuel return pipes for blockages.
	Cold start system operating continuously.	Disconnect cold start injector; if mixture returns to correct levels, renew the thermotime switch or cold start injector.
	Exhaust leaks.	Check all exhaust joints, pipes, silencers for security and leaks; retighten or renew as necessary.
	Leaking injector.	Locate and renew faulty injector.
3. Engine erratic (hesitating/ intermittent).	Engine compressions.	If pressure is considerably low, this indicates faulty valves or piston rings. Low pressure in other cylinders indicates faulty cylinder head gasket.
	Fuel injection electrical earth.	Check earth connection on rear of block, clean and check for security.
	Ignition system.	See fault diagnosis 'Hot start' test 2 and 3 for H.T. checks. Check low tension side of ignition using 'Lucas Electronic Ignition Analyser' Part number YWB 119.
	Electrical connections.	Check all connections for security.
	Air filter blocked.	Check filter—renew if necessary.
	Inadequate fuel pressure.	Insert pressure gauge into fuel system; check for correct operating pressure. If pressure low, investigate for blockages on fuel feed line.

ENGINE TUNING PROCEDURE

Before carrying out 'Engine Tuning' on fuel injection vehicles, it is important that all other engine related setting procedures are undertaken first; air meter and air cleaner correctly fitted, ignition and throttle potentiometer correctly set; all hoses correctly fitted and secured.

When the engine is running at its normal operating temperature; thermostat open, the following additional checks and adjustments can be made.

CHECK AND ADJUST IGNITION TIMING

1. Timing to be checked at not more than 600 rev/min from number 1 cylinder using a stroboscopic lamp.
2. If adjustment is necessary, slacken the distributor clamp bolt and rotate clockwise to retard or anti-clockwise to advance. When the required setting has been attained, tighten the clamp bolt and re-check the setting.

   NOTE: Timing must be checked with vacuum pipe disconnected.

CHECK AND ADJUST IDLE SPEED

1. Remove tamperproof plug from the plenum chamber.
2. Rotate the idle adjustment screw to set the engine idle speed at 700 to 800 rev/min.
   (Clockwise decreases speed — anti-clockwise increases speed.)

CHECK AND ADJUST IDLE CO LEVEL

The following measurements must be taken with the air cleaner connected, exhaust system correctly fitted and checked for leaks.

1. Remove the tamperproof blanking plug from the top of the air flow meter.
2. Adjust the screw until the CO level reading is to specification; 1% maximum.

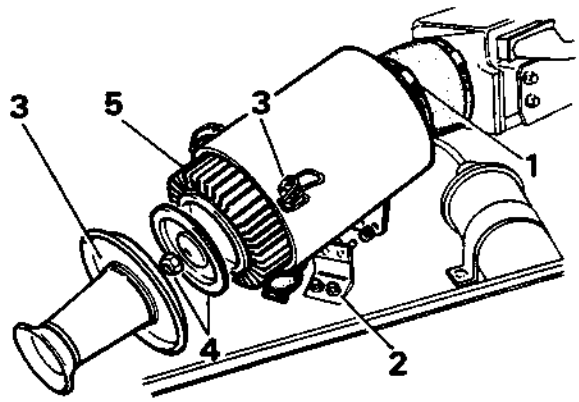
   NOTE: Do not allow the engine to idle for longer than 3 minutes when setting.

3. Give engine a 'clear out' burst of 30 seconds at 2000 rev/min light load or longer if necessary to maintain normal running temperature.
4. Re-check CO level and idle speed; adjust if necessary.
5. Fit new tamperproof plugs to air flow meter and idle adjustment screws.

AIR CLEANER

Remove

1. Release the hose clip securing the hose to the rear of the air cleaner canister.
2. Remove the two nuts and bolts securing the air cleaner to the left-hand valance. Pull the canister from the hose and remove the air filter canister from the engine compartment.
3. Unclip the three catches securing the inlet tube to the air cleaner canister and remove the inlet tube.
4. Remove the nut and end plate securing the air cleaner element in position.
5. Withdraw the air cleaner element and discard.



RR596M

Refit

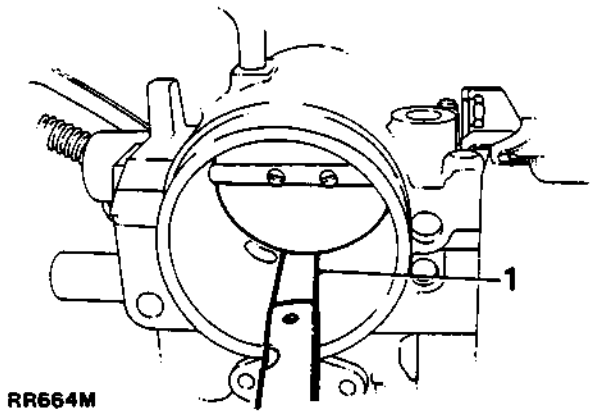
6. Fit new element and secure in position.
7. Refit the inlet tube to the air cleaner canister.
8. Refit the air cleaner to the mounting bracket and tighten the two nuts.
9. Fit the hose to the air cleaner outlet aperture and tighten the hose clip.

RESETTING THROTTLE LEVERS—fuel injection

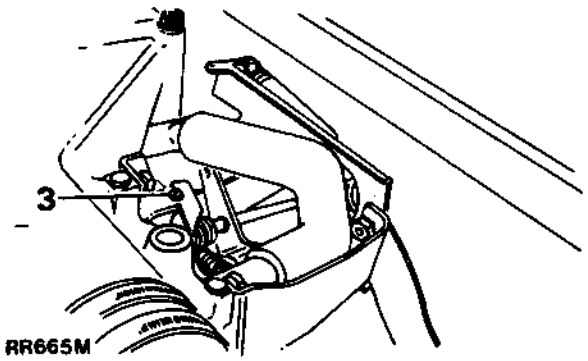
Manual/Automatic Transmission

NOTE: The setting procedure outlined is applicable at minimum throttle condition only.

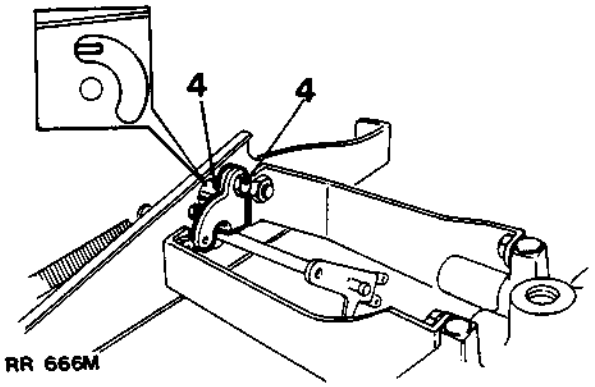
1. Set the throttle butterfly to a maximum of 0.05 mm (0.002 in) clearance, measured at the vertical centre line within ± 10°.



2. Ensuring that the butterfly is retained at its setting, remove the stop adjustment screw tamperproof cap (if fitted).
3. Rotate the screw until contact is made with the stop lever, refit the tamperproof cap (if fitted).



4. Release the throttle operating lever securing screw and adjust the lever until contact is made with the top end of the slot in the throttle lever mounting bracket; retaining the lever in this position re-tighten the screw.



NOTE: Re-check the throttle potentiometer setting after adjusting the throttle levers.

RENEW THE THROTTLE CABLE

Removing

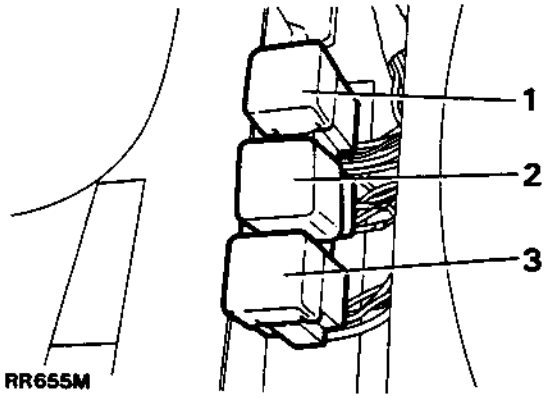
1. Remove the split pin, washer and clevis pin securing the throttle linkage end of the cable.
2. Carefully prise the throttle cable adjustment nut out of the linkage mounting bracket.
3. Withdraw the cable from the mounting bracket.
4. Release the outer cable from the retaining clips within the engine compartment.
5. Remove the lower fascia panel from beneath the steering column.
6. Disconnect the cable from the throttle pedal.
7. Feed the cable through the bulkhead grommet and into the engine compartment.

FIT NEW THROTTLE CABLE

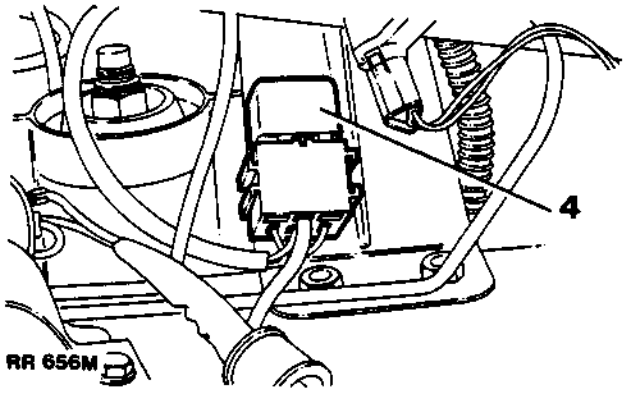
8. Feed the new cable from the engine compartment through the bulkhead grommet.
9. Connect the cable to the throttle pedal.
10. Connect the cable to the throttle linkage, fit a new split pin and secure in position.
11. Clip the outer cable adjustment nut into the mounting bracket.
12. Adjust the outer cable to give 1.57 mm (0.062 in) free play in the throttle cable and check the throttle operation.

ELECTRONIC FUEL INJECTION RELAYS

Incorporated into the fuel injection electrical circuits are three relays and a current steering diode pack. Two of the relays and the steering diode pack are located beneath the front right-hand seat protected by a black cover. The remaining relay is located in the engine compartment attached to the air flow meter mounting bracket.



Relays viewed from within the vehicle.



Relay viewed from engine compartment

1. Fuel pump relay (Item 11 on fuel injection circuit diagram).
2. Steering module (red case) (Item 9 on fuel injection circuit diagram).
3. Main relay (Item 10 on fuel injection circuit diagram).
4. Over-run fuel shut-off relay (Item 4 on fuel injection circuit diagram).

Removing

1. Disconnect the battery.
2. Remove the black protective cover (applicable only to the relays located under the right-hand seat).
3. Pull the relay(s) from the multi-plug(s).

Refitting

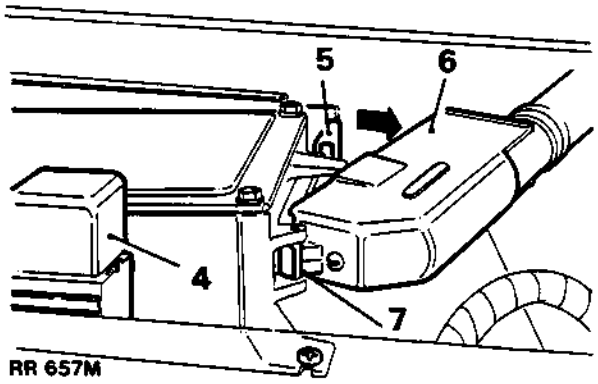
4. Reverse the removal procedure.

ELECTRONIC CONTROL UNIT—ECU

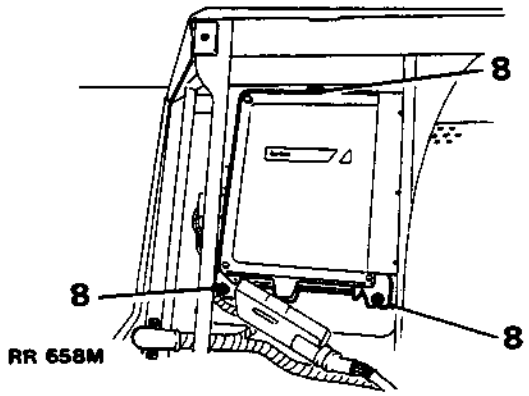
Remove and refit

Removing

1. Disconnect the battery.
2. The ECU is located under the front right-hand seat and is accessible through the front aperture of the seat plinth.
3. Release the quarter turn screw and lift off the black protection cover.
4. Remove the three relays, noting their position for re-assembly.
5. Pull the ECU multi-plug retaining clip towards the rear of the seat.
6. Pull the rear of the multi-plug out of the ECU.
7. Manoeuvre the rear of the plug towards the gearbox tunnel to release the hooked front end of the plug from the retaining peg.



8. Release the three screws securing the ECU to the mounting bracket.



9. Withdraw the ECU from beneath the seat.

NOTE: The ECU is not itself a serviceable item, in the event of a unit failure, the ECU must be renewed.

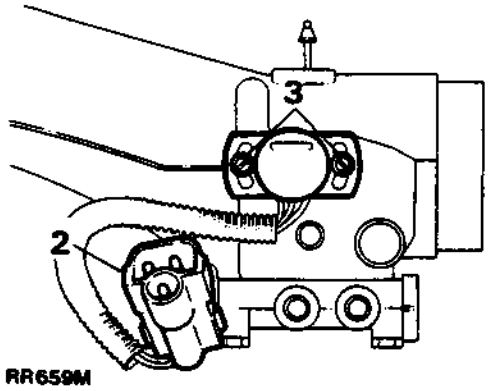
Refitting

10. Secure the ECU in position.
11. Push the multi-plug into the ECU until an audible click is heard denoting that the plug is fitted securely.
12. Refit the relays.
13. Refit the ECU protective cover.
14. Re-connect the battery.

THROTTLE POTENTIOMETER

Remove

1. Disconnect the battery.
2. Disconnect the electrical three pin plug.
3. Remove the two screws securing the switch to the plenum chamber and carefully pull the switch off the throttle butterfly spindle.



4. Remove the old gasket.

Refit

5. Fit a new gasket between the throttle switch and plenum chamber.
6. Align the switch and spindle flats; slide the switch onto the throttle spindle and secure the switch to the plenum chamber.
7. The throttle potentiometer must be reset using a potentiometer adjustment gauge.

Setting the potentiometer

Equipment required:—

Lucas electronic fuel injection throttle potentiometer adjustment gauge — **Lucas Part Number YWB 121.**

8. Slacken the potentiometer securing screws.
9. Disconnect the three-pin plug from the potentiometer electrical lead. Connect the adjustment gauge plug to the potentiometer.
10. Connect the two crocodile clips from the throttle potentiometer gauge to the appropriate battery terminals.
11. Rotate the potentiometer clockwise or anti-clockwise until the middle lamp of the three indication lamps remains illuminated.
12. Tighten the potentiometer securing screws.
13. Re-check the potentiometer setting.
14. Disconnect the adjustment gauge from the potentiometer and battery terminals.
15. Re-connect the harness three-pin plug to the potentiometer.

NOTE: If a potentiometer adjustment gauge is unavailable, the setting procedure can be carried out using a voltmeter.

IF AN AVO METER IS USED TO CARRY OUT THIS CHECK — ENSURE THE AVO IS SET TO VOLTS. AN AVO METER SETTING OTHER THAN VOLTS WILL RESULT IN DAMAGE TO THE POTENTIOMETER.

Setting the Potentiometer using a voltmeter

16. Slacken the potentiometer securing screws.
17. Switch on the ignition.
18. Connect a voltmeter between the red and green leads at the potentiometer electrical plug.
19. Rotate the potentiometer clockwise or anti-clockwise, until the volt meter reads 290 ± 20 Mv.
20. Tighten the potentiometer securing screws.
21. Re-check the voltmeter reading.

THERMOTIME SWITCH

Test

WARNING: When the cooling system is hot take care to avoid scalding.

1. Remove the pressure relief cap from the coolant expansion tank and remove the filler plug from the radiator. Use a thermometer and note the coolant temperature.
2. Disconnect the battery and pull the electrical connector from the thermotime switch.

   Note the rated value stamped on body of the switch.

3. Connect ohmmeter between switch terminal 'W' and earth:
   (a) Coolant temperature higher than the switch rated value; a very high resistance reading, (approximately 300 ohms at temperature greater than 40°C) open circuit, should be obtained. Renew the switch if a low resistance, short circuit, is shown.
   (b) Coolant temperature lower than the switch rated value; a very low resistance reading, closed circuit, (approximately zero ohms at temperature less than 40°C) should be obtained. Renew the switch if a high reading, open circuit, is shown.
4. Connect a 12v supply via an isolating switch to terminal 'G' of the thermotime switch.

   Use a stopwatch, check the time delay between making the isolating switch, and the ohmmeter showing the change from low to high resistance. The delay period must closely approximate to time, according to temperature:

Coolant Temperature °C	Delay in Seconds
−10	8
0	4.5
10	3.5
35	0

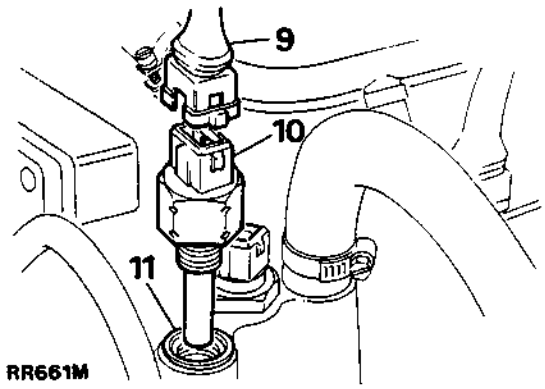
   Renew the thermotime switch if necessary.

5. Re-connect the plug to the switch and connect the battery.

Removing

WARNING: When the cooling system is hot take care to avoid scalding

6. Remove the pressure relief cap from the coolant expansion tank.
7. Remove the radiator bottom hose and partially drain the cooling system.
8. Disconnect the battery.
9. Remove the electrical plug from the switch.
10. Unscrew the switch and remove it from the inlet manifold.
11. Remove the copper seating washer.



Refitting

12. Fit a new copper washer.
13. Reverse the removal instructions ensuring that the switch is firmly screwed into position.
14. Re-connect the electrical plugs.
15. Visually inspect for water leaks.

COOLANT TEMPERATURE SENSOR

Test

NOTE: When using an AVO connect the measuring leads to the sensor for short periods of time only to minimise the effects of self heating due to the measuring current.

1. Disconnect the battery and remove the electrical plug from the temperature sensor.
2. Connect an ohmmeter between the sensor terminals and note the resistance reading, disconnect the ohmmeter.

   The reading should closely approximate the following according to temperature:

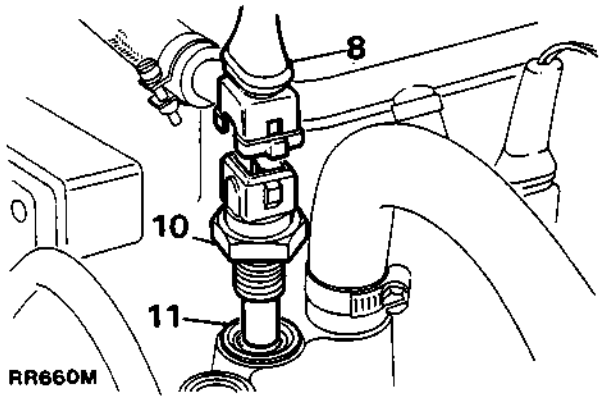
Coolant Temperature °C	Resistance Kilohms
−10	9.2
0	5.9
20	2.5
40	1.18
60	0.60
80	0.33

3. Check the resistance between each terminal in turn against the body of the sensor. A very high resistance reading, open circuit, must be obtained.
4. Re-connect the sensor and the battery.

Removing

WARNING: When the cooling system is hot take care to avoid scalding.

5. Remove the pressure relief cap from the coolant expansion tank.
6. Remove the radiator bottom hose and partially drain the cooling system.
7. Disconnect the battery.
8. Remove the electrical plugs from the coolant sensor and thermotime switch.
9. Unscrew the thermotime switch to give access to the coolant sensor.
10. Unscrew the coolant sensor and remove it from the inlet manifold.
11. Remove the copper washer from the manifold.



Refitting

12. Reverse the removal procedure ensuring that the switches are securely fitted. Fit new copper washers.
13. Re-connect the electrical plugs.
14. Visually inspect for water leaks.

AIR TEMPERATURE SENSOR

Test

NOTE: To prevent self heating of the sensor during the test procedure connect the measuring leads to the sensor for short periods of time only.

1. Disconnect the battery and the electrical multiplug from air flow meter.
2. Connect the ohmmeter between terminals 6 and 27 of the air flow meter and note the resistance reading. The reading should closely approximate the following, according to temperature:

Ambient air temperature (°C)	Resistance kilohms
−10	9.2
0	5.9
20	2.5
40	1.18
60	0.60

3. Disconnect the ohmmeter. Re-connect the multi-plug and the battery.

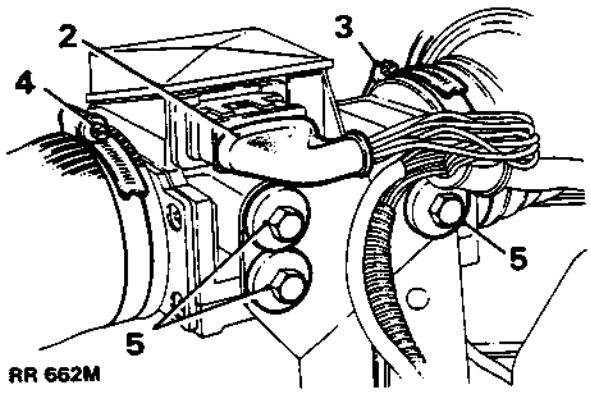
The air temperature sensor is not a serviceable item. If it does not meet the test requirements, the complete air flow meter must be renewed.

AIR FLOW METER

Remove and Refit

Removing

1. Disconnect the battery.
2. Disconnect the electrical multi-plug from the side of the air flow meter.
3. Release the hose clip and remove the plenum chamber hose from the rear of the meter.
4. Release the hose clip at the air intake side of the air flow meter.
5. Remove the three securing screws and plain washers retaining the meter to the mounting bracket.
6. Detach the air flow meter from the hose and withdraw it from the engine compartment.

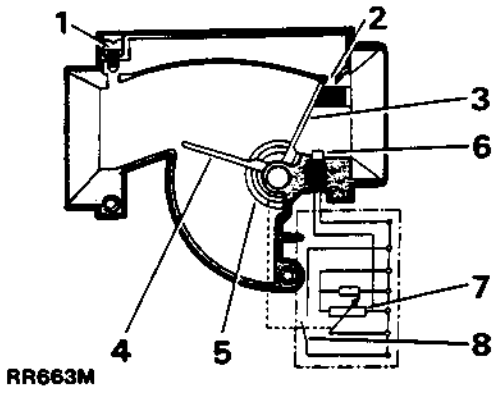


Refitting

7. Reverse the removal operations ensuring the multi-plug is firmly re-connected on re-assembly.

NOTE: The air flow meter is not a serviceable item. In the event of failure or damage the complete unit is to be renewed.

Continued



RR663M

1. Idle mixture adjustment screw
2. Air by-pass channel
3. Measuring flap
4. Compensating flap
5. Coil spring—flap return
6. Air temperature sensor
7. Potentiometer
8. Fuel pump switch

POWER RESISTOR RACK

The power resistor pack is located under the air flow meter attached to the meter mounting bracket.

The resistor pack is not a serviceable item, in the event of failure or damage the unit must be renewed.

Removing

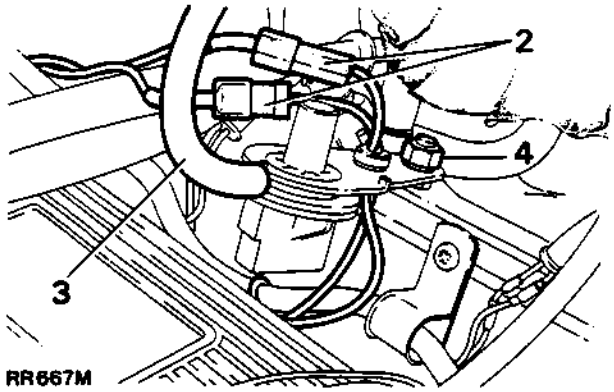
1. Disconnect the battery.
2. Disconnect the multi-plug from the bottom of the resistor pack.
3. Remove the two nuts, bolts and spring washers securing the resistor pack to the air flow meter mounting bracket.
4. Withdraw the resistor pack from the engine compartment.

Refitting

5. Reverse the removal instructions ensuring that the multi-plug is fitted securely.

OVER-RUN FUEL SHUT-OFF VALVE—VACUUM SWITCH

1. Disconnect the battery.
2. Disconnect the two electrical leads.
3. Remove the vacuum hose from the valve.
4. Remove the single nut and spring washer securing the valve to the injector retaining plate.
5. Withdraw the valve.



RR667M

NOTE: In the event of failure or damage the valve is not serviceable.

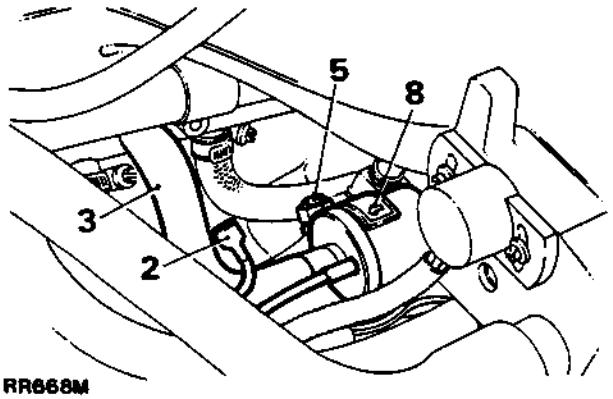
Refitting

6. Reverse the removal instructions.

SOLENOID OPERATED AIR VALVE

—fitted to vehicles with air conditioning only.

1. Disconnect the battery.
2. Disconnect the electrical lead.
3. Pull the front air valve pipe from the plenum chamber.
4. Pull the rear air valve pipe from the extra air valve air rail.
5. Remove the single nut and spring washer securing the valve to the injector retaining plate.
6. Withdraw the valve.
7. Remove the hoses from the valve.



RR668M

Refitting

8. Reverse the removal procedure, observing the direction of flow arrow on the air valve body. The direction of flow is from air rail to plenum chamber.

DEPRESSURISING THE FUEL SYSTEM

WARNING: Under normal operating conditions the fuel injection system is pressurised by a high pressure fuel pump, operating at 1.8 to 2.5 kgf/cm² (26 to 36 lbf/in²). When the engine is stationary this pressure is maintained within the system.
To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise the fuel injection system before any service operations are carried out.

1. Remove the ECU protective cover located under the front right hand seat.
2. Pull the fuel pump relay off its multi-plug (see Electronic fuel injection relays).
3. Start and run the engine.
4. When sufficient fuel has been used up causing the fuel line pressure to drop, the injectors will become inoperative, resulting in engine stall. Switch ignition off.

   NOTE: Fuel at low pressure will still remain in the system. This low pressure can be removed by releasing the cold start injector from the plenum chamber and them placing the injector with hose still attached into a suitable container. Release the hose clip and carefully remove the hose from the injector to release any remaining pressurised fuel.

5. Disconnect the battery.

Refitting

6. Refit the cold start injector.
7. Refit the fuel pump relay, re-connect the battery.
8. Crank the engine (engine will fire within approximately 6 to 8 seconds).

FUEL PRESSURE REGULATOR

Test

1. Depressurise the fuel system.
2. Release the clip and pull the cold start injector supply hose from the fuel rail. Connect a pressure gauge to the fuel rail.
3. Switch the ignition on and operate the flap in the air flow meter to energise the fuel pump.
4. Check that the pressure gauge reading is between 2.5 to 2.6 kgf/cm² (35 to 37 lbf/in²).
5. Switch off the ignition. The fuel pressure should be maintained between 2.1 to 2.6 kgf/in² (30 to 37 lbf/in²).

   NOTE: The pressure reading may slowly drop through either the regulator valve or the fuel pump non-return valve. A slow steady drop is permissable; a rapid fall must be investigated.

6. If the pressure reading is unsatisfactory renew the pressure regulator.

7. After fitting a new regulator re-test the system, if the pressure continues to drop off, the fuel injectors, fuel pump, non-return valve and fuel system pipework should be checked for leaks.
8. Depressurise the fuel system. Remove the gauge and connect the cold start injector supply hose.
9. Check for fuel leaks around the hose connection.

Remove and Refit

Removing

10. Depressurise the fuel system.
11. Disconnect the battery.
12. Pull the flexible rubber vacuum hose from the bottom of the regulator.
13. Release the spill return hose from the side of the regulator.
14. Release the clip and remove the spill return hose from the top of the regulator.
15. Release the single large nut securing the regulator to the regulator mounting bracket.
16. Withdraw the regulator.

Refitting

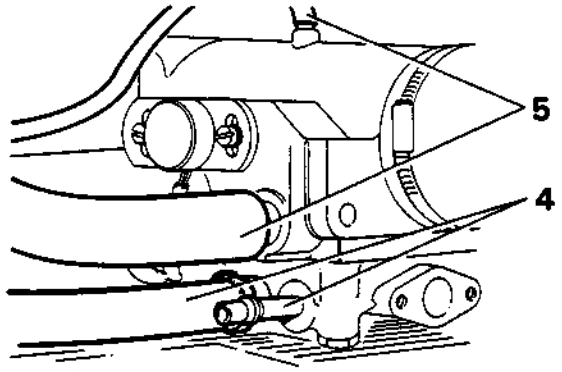
17. Reverse the removal instructions ensuring that all hose connections are secure.
18. Energise the fuel pump and visually inspect all hose connections for fuel leaks.

PLENUM CHAMBER

Remove and refit

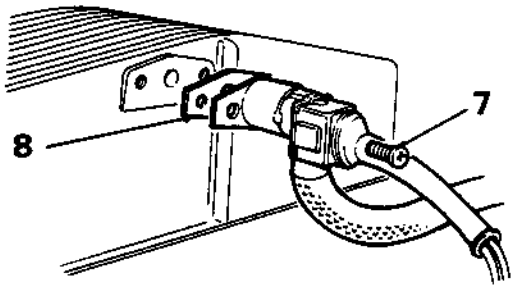
Removing

1. Disconnect the battery.
2. Release the hose clip at the rear of the air flow meter and remove the hose from its location.
3. Release the radiator bottom hose and partially drain the cooling system.
4. Release the two coolant hoses from the bottom of the plenum chamber inlet neck.
5. Disconnect the breather hose and vacuum pipe.



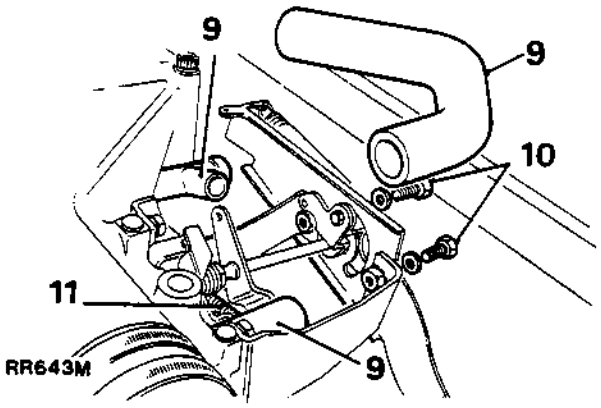
RR641M

6. Disconnect the throttle potentiometer electrical multi-plug.
7. Remove the two screws securing the cold start injector to the plenum chamber.
8. Withdraw the cold start injector and gasket.



RR642M

9. Disconnect the flexible rubber hose from the extra air valve rail and plenum chamber.
10. Remove the two bolts (with spring washers) securing the throttle cable anchor bracket to the throttle lever support bracket.
11. Unhook the small return spring from the throttle levers.



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12. Remove the small vacuum hose from the rear of the plenum chamber.
13. Remove the six socket head bolts securing the plenum chamber to the ram housing.
14. Manoeuvre the plenum chamber and lift it off the ram housing.

NOTE: To prevent dirt entering the ram tubes, place a protective cover over the ram tube apertures.

Refitting

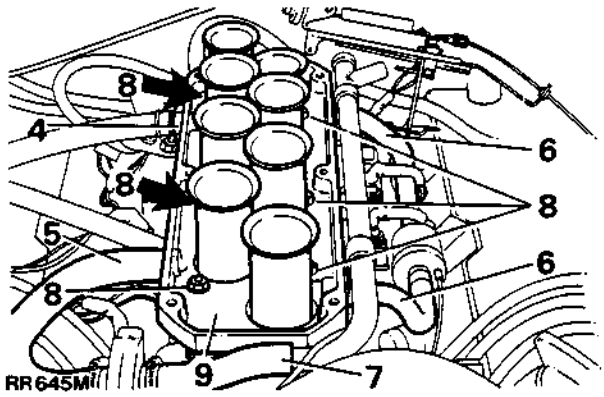
15. Ensure that all mating surfaces are free from any previous sealing compounds.
16. Smear the mating surfaces of the plenum chamber and ram housing with 'Hylomar' sealant.
17. Reverse the removal procedure.

RAM HOUSING

Remove and refit

Removing

1. Depressurise the fuel system.
2. Disconnect the battery.
3. Remove the plenum chamber (see plenum chamber remove and refit).
4. Release the brake servo hose from the ram housing.
5. Release the extra air valve hose at the ram housing.
6. Remove the solenoid operated air valve hoses from the front left-hand side of the ram housing and from the rear of the extra air valve rail.
7. Remove the extra air valve hose from the air valve rail.



8. Remove the six through bolts (with plain washers) securing the ram housing to the intake manifold.
9. Lift the ram housing off the intake manifold and remove it from the engine compartment.
10. Place a protective cover over the top of the intake manifold inlet bores to prevent ingress of dirt.

Refitting

11. Ensure that all mating faces are clean and free from dirt and any previous sealing compounds.
12. Apply 'Hylomar' sealant to the intake manifold face before refitting the ram housing.
13. Fit the ram housing and retighten the bolts, working from the two centre bolts, diagonally towards the outer four bolts.
14. See 'Data section' for correct tightening torque.

EXTRA AIR VALVE

Test

1. Disconnect the electrical multi-plug from the valve and connect a voltmeter across the terminals of the connector.
2. Operate the starter motor—battery voltage should be obtained on the voltmeter.

   No voltage—check wiring for continuity and condition; Battery voltage—check the resistance of the heating coils.

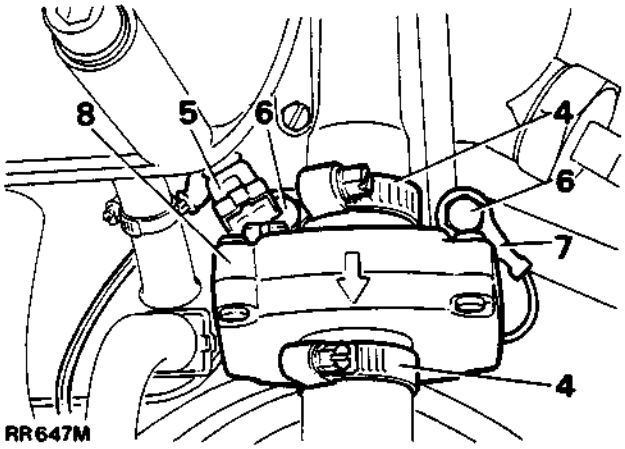
3. Connect an ohmmeter between the terminals of the air valve. A resistance of 33 ohm should be obtained.

   No resistance—renew the air valve.

Remove and refit

Removing

4. Release the two hose clips and detach the hoses from the air valve.
5. Disconnect the electrical multi-plug.
6. Remove the two bolts securing the air valve to the intake manifold.
7. Move the plug lead support bracket and earth lead aside.
8. Withdraw the air valve from the engine compartment.



Refitting

9. Refit the hoses securely.
10. Refit the plug lead support bracket and earth lead.
11. Reverse the removal operations.

FUEL RAILS

Remove

1. Depressurise the fuel system.
2. Remove the plenum chamber.
3. Remove the ram housing.
4. Disconnect the fuel feed pipe at the fuel rail.
5. Disconnect the spill return pipe from the pressure regulator at the fuel rail.
6. Release the eight injector hose clips at the fuel rail.
7. Remove the fuel rail from the hoses.

Refitting the fuel rails

8. Push the fuel rail outlet pipes onto the injector hoses.
9. Tighten the eight hose clips securely.
10. Re-connect the spill return and fuel feed pipes.
11. Refit the ram housing and plenum chamber, tighten bolts to correct torque. See 'Data section'.
12. Start the engine and visually check the fuel rails and connections for leaks.

INJECTORS—RH AND LH BANKS—COLD START INJECTOR

Test

1. Use an ohmmeter to measure resistance value of each injector winding, which should be 2.4 ohm at 20°C (68°F).
2. Check for short-circuit to earth on the winding, by connecting the ohmmeter probes between each injector terminal and injector body; meter should read infinity. Renew the injector if the winding is open circuit or short circuit.

Remove the injectors

1. Depressurise the fuel system.
2. Disconnect the battery.

Cold start injector

3. Disconnect the electrical plug from the injector.
4. Release the hose clip and remove the hose from the injector.
5. Remove the two screws (with spring washers) securing the injector to the plenum chamber.
6. Withdraw the cold start injector and remove the gasket.

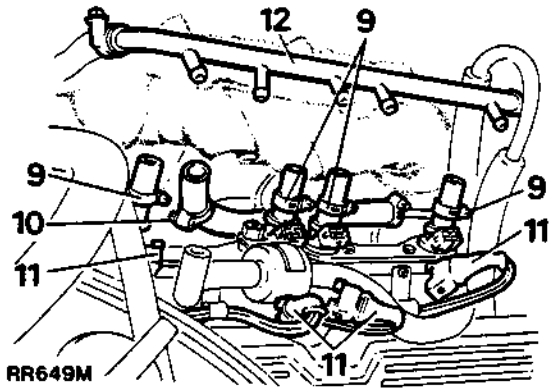
Manifold injectors—RH and LH

7. Remove the plenum chamber (see plenum chamber remove and refit).
8. Remove the ram housing (see ram housing remove and refit).

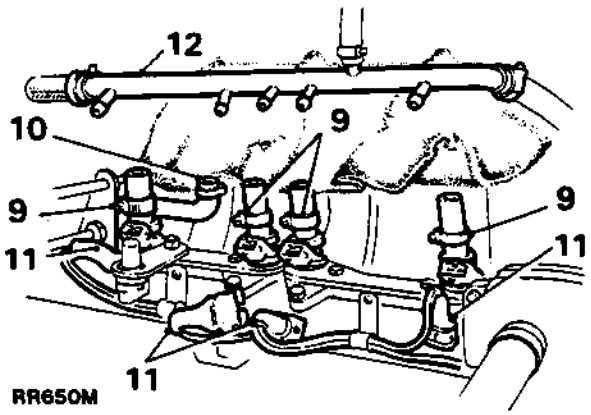
NOTE: To enable any pair of injectors to be released from their locations on either the left- or right-hand side of the intake manifold, it will be necessary to remove the fuel rail from all four injectors in that bank.

WARNING: Before releasing any hoses from the fuel rail, place a cloth around the hose connections to prevent any excess fuel which may be under pressure escaping.

9. Release the four clips securing the injector hoses to the fuel rail.
10. **Left-hand injectors**—release the clip and remove the fuel feed hose from the fuel rail.
    Right-hand injectors—release the clip and remove the spill return hose to the pressure regulator at the fuel rail.
11. Remove the electrical plugs from the injectors.
12. Carefully prise the fuel rail out of the injector hoses.



Left-hand injectors



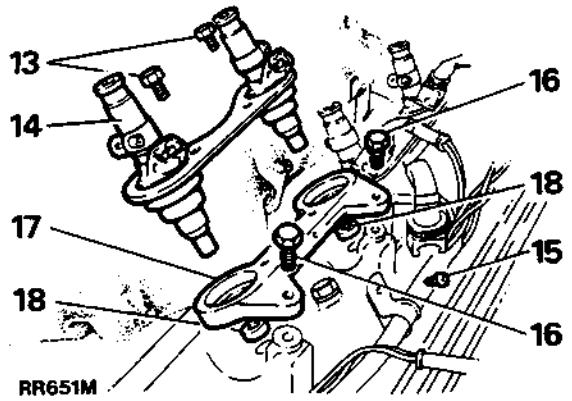
Right-hand injectors

13. Remove the two bolts securing the injector retaining plate.

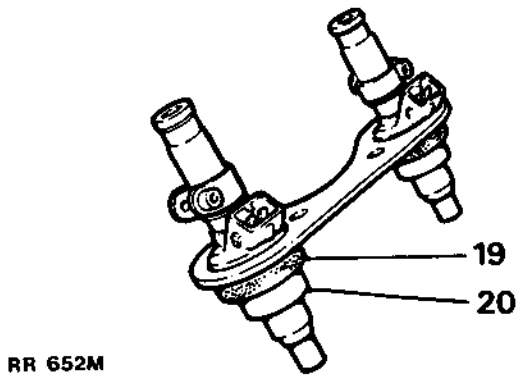
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NOTE: Left-hand front injectors—remove the single nut securing the solenoid operated air valve to the injector retaining plate, remove the air valve to give access to the retaining plate securing nut.
Right-hand rear injectors—remove the single nut securing the over-run fuel shut off valve to the injector retaining plate, remove the valve to give access to the retaining plate securing nut.

14. Withdraw the pair of injectors complete with retaining plate.
15. Remove the single screw securing the injector harness retaining clip to the injector location plate.
16. Remove the two bolts securing the location plate to the intake manifold.
17. Remove the location plate to give access to the small rubber seating washers located in the intake manifold injector bores.
18. Pull the rubber seats from the bore and discard.



19. Remove the injectors from the retaining plate by releasing the large rubber seating washers from their registers.
20. Withdraw the injector(s) from the retaining plate.



Refitting the injector(s)

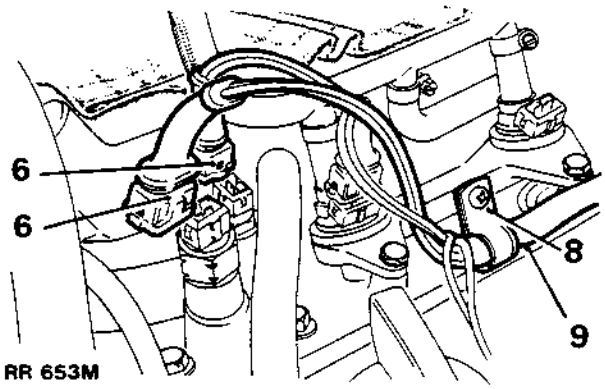
21. Fit **new** seating rubbers in the intake manifold before refitting the injectors.
22. Refit the injectors with the electrical plug connections facing away from the intake manifold.
23. Re-connect the fuel rail to the injector hoses ensuring that the rail is pushed firmly into position, tighten all hose clips securely.
24. Refit the ram housing and plenum chamber.
25. Refit all ancillary items.
26. Refit fuel pump relay and re-connect the battery.
27. Start the engine and visually inspect for fuel leaks around all hose connections.

INTAKE MANIFOLD

Removal and refit

Removing

1. Depressurise the fuel system.
2. Drain the cooling system.
3. Remove the plenum chamber and ram housing.
4. Remove the extra air valve.
5. Disconnect the electrical multi-plugs from the injectors.
6. Remove the multi-plugs from the thermotime switch and coolant sensor.



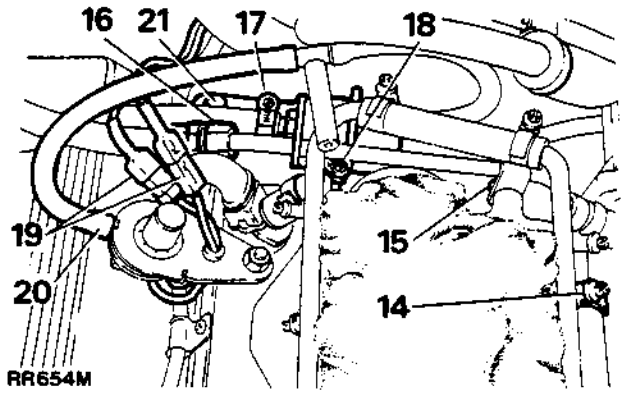
7. Disconnect the multi-plug from the cold start injector.
8. Release the four screws and clips securing the injector harness to the left- and right-hand side of the intake manifold.
9. Move the harness away from the intake manifold.
10. Disconnect the top hose from the thermostat housing.
11. Release the two flexible hoses from the rear of the water pump.
12. Disconnect the electrical lead from the water temperature sensor.

NOTE: If air conditioning is fitted, disconnect the two electrical leads from the sensor in the thermostat housing.

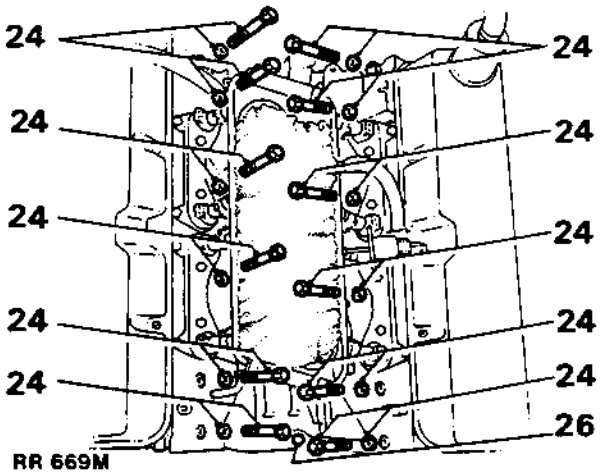
13. Release the two flexible heater hoses from the rear of the intake manifold.

NOTE: To enable the intake manifold rear right-hand securing bolt to be removed it is necessary to remove the fuel pressure regulator, this is removed as follows.

14. Release the clip securing the flexible hose to the rigid fuel supply pipe and remove the hose from the pipe.
15. Remove the single bolt securing the rigid fuel supply pipe to the rear of the intake manifold.
16. Release the nut securing the flexible fuel feed hose to the rigid fuel supply pipe.
17. Release the hose clip and remove the spill return hose at the pressure regulator.
18. Release the hose clip and remove the flexible spill return hose at the side of the pressure regulator.
19. Disconnect the two electrical leads at the vacuum switch.
20. Release the flexible hose from the vacuum switch.
21. Remove the single bolt and spring washer securing the pressure regulator mounting bracket to the rear right-hand side of the intake manifold.



22. Manoeuvre the regulator and mounting bracket, withdraw the assembly from the engine compartment.
23. Release the sparking plug leads from the two plastic retaining clips located at the front of the intake manifold.
24. Remove the twelve bolts and washers securing the intake manifold to the cylinder heads.



NOTE: The two bolts securing the front of the manifold are of a longer type. Ensure that these two bolts are fitted in the correct positions on re-assembly.

25. Lift off the intake manifold.
26. Remove the two gasket clamps from the top of the cylinder block.
27. Lift off the gasket.
28. Remove the gasket seals.

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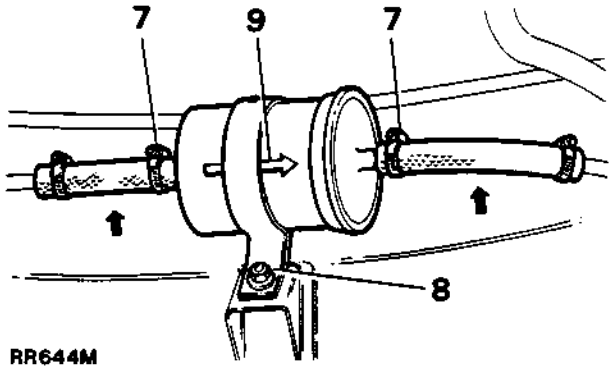
Refitting

29. Using new gasket seals, smear both sides of the seals with silicon grease.
30. Locate the seals in position with their ends engaged in the notches formed between the cylinder heads and block.
31. Apply 'Hylomar' sealant around the outside of the water passage apertures on the cylinder heads, manifold gasket and intake manifold.
32. Fit the manifold gasket with the word 'FRONT' to the front and the open bolt hole to the front right-hand side.
33. Fit the gasket clamps but DO NOT fully tighten the bolts at this stage.
34. Locate the intake manifold onto the cylinder heads, clean the threads of the manifold securing bolts and coat them with thread lubricant sealer 3M EC776.
35. Fit all manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre outwards.
36. Tighten to correct torque—see 'Data section'.
37. Tighten the gasket clamps to the correct torque—see 'Data section'.
38. Reverse removal procedure items 1–23.
39. Start the engine, check for water and fuel leaks.

RENEW FUEL LINE FILTER

WARNING: THE SPILLING OF FUEL IS UNAVOIDABLE DURING THIS OPERATION. ENSURE THAT ALL NECESSARY PRECAUTIONS ARE TAKEN TO PREVENT FIRE AND EXPLOSION.

1. Depressurise the fuel system.
2. The fuel line filter is located on right-hand chassis side member forward of the fuel tank filler neck.
   Access to the filter is gained through the right-hand rear wheel arch.
3. Chock the front road wheels.
4. Raise the rear of the vehicle and place on suitable axle stands.
5. Remove the right-hand rear road wheel.
6. Clamp the inlet and outlet hoses to the fuel filter (denoted by the two arrows).
7. Release the two hose clips and disconnect the hoses. Plug the open ends of the hoses to prevent ingress of dirt.
8. Release the filter clamp bolt and slide the filter out of the clamp.



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Refitting

9. Fit a new filter observing the direction of flow arrows stamped on the filter body.
10. Reverse the removal procedure. Start the engine and inspect all hose connections for leakage.

REMOVE FUEL PUMP

The high pressure fuel pump is located within the fuel tank, and is accessible by removing the tank from the vehicle. The removal of the fuel tank from the vehicle requires the assistance of a second person to support the tank when the fuel feed pipe and electrical terminals are disconnected from the fuel pump.

WARNING: Ensure all the necessary precautions are taken against handling and spillage of fuel.

NOTE: The electrical supply to the fuel pump is taken from the starter motor solenoid and the air flow meter switch via the diode pack and relays. The pump should therefore only operate when the engine is being turned by the starter motor or whilst air flow holds the switch closed.

1. Drive the vehicle onto a suitable hydraulic ramp.
2. Depressurise the fuel system.
3. Disconnect the battery.
4. Remove the drain plug from the bottom of the tank and drain fuel into a suitable container.
5. Remove the inlet pipe from the fuel filter and plug the hose.
6. Disconnect the breather pipe and plug the hose.
7. Release the two hose clips at the top and bottom of the filler tube, manoeuvre the hose up the filler tube to withdraw the hose off the tank filler neck.

   NOTE: If a tow bar is fitted the two tie bars from the towing plate to the chassis must be removed to allow the fuel tank to be removed from the vehicle.

Continued

8. Remove the four bolts securing the tank to the chassis.
9. With assistance, tilt the left-hand side of the tank downwards as far as the remaining connected fuel pipe will permit, giving access to the fuel feed pipe connection and electrical terminals at the fuel pump.
10. Disconnect the electrical leads from the fuel pump, place the fuel tank on a suitable workbench.

Remove the fuel pump

NOTE: Plug the ends of the fuel feed pipe and fuel pump outlet aperture to prevent ingress of dirt.

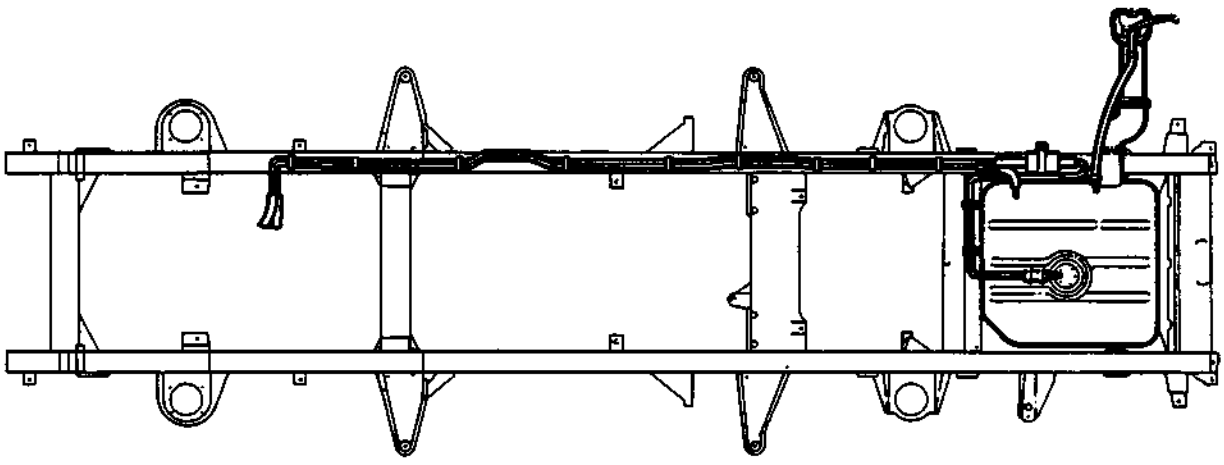
11. Remove the five screws securing the pump to the top of the tank.
12. Withdraw the fuel pump and pump seal from the tank.

Fit new fuel pump

13. Ensure sealing faces are free from dirt and grease.
14. Fit the fuel pump and a NEW seal to the tank.
15. Refit the fuel tank to the chassis, taking care to relocate the fuel feed pipe grommets between the fuel tank and chassis.
16. Re-connect all fuel pipes.
17. Re-connect the battery.
18. Refill the tank with fuel.
19. Refit fuel pump relay.
20. Start the engine and inspect for fuel leaks around the fuel pump and all hose connections.

FUEL PIPES—FUEL INJECTION SYSTEM

WARNING: Before disconnecting any part of the fuel pipe system ensure that all necessary precautions are taken against fuel spillage.

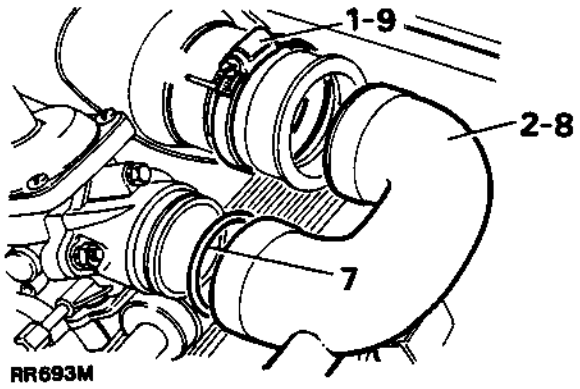


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FUEL SYSTEM—CARBURETTER

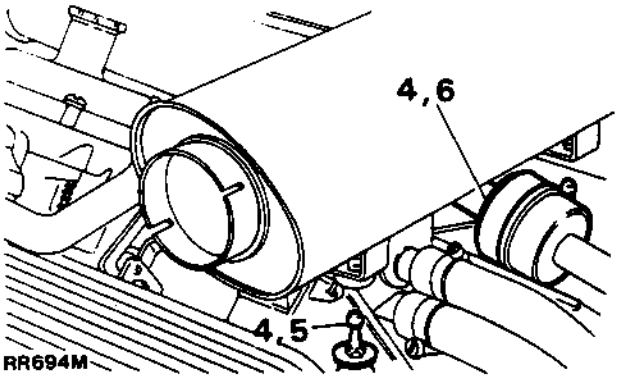
Remove the Air Filter

1. Release the hose clips each side of the air cleaner.
2. Withdraw the air cleaner elbows.



RR693M

3. Detach the choke cable from the clip on the air cleaner.
4. Withdraw the air cleaner from the retaining posts, at the same time disconnecting the hose from the engine breather filter.



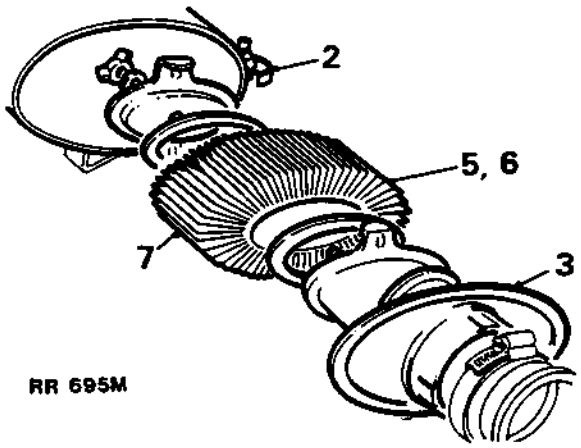
RR694M

Refitting

5. Fit the air cleaner, locating the rubber mountings over the retaining posts.
6. Connect the engine breather hose at the underside of the air cleaner.
7. Smear the 'O' rings at the carburetter intakes with MS4 grease.
8. Fit the air cleaner elbows.
9. Secure the hose clips.
10. Retain the choke cable in the clip at the front of the air cleaner.

RENEW THE AIR CLEANER ELEMENT

1. Remove the air cleaner.
2. Release the end plate clips.
3. Withdraw the end plates.
4. Remove the wing nut, washer and retaining plate.
5. Withdraw the air cleaner elements.
6. Fit new air cleaner elements.
7. Fit new sealing washers.



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8. Reverse 1 to 4.

CARBURETTERS

Description

Variations in carburetters may be fitted to meet local territory legislation.

Tamperproofing

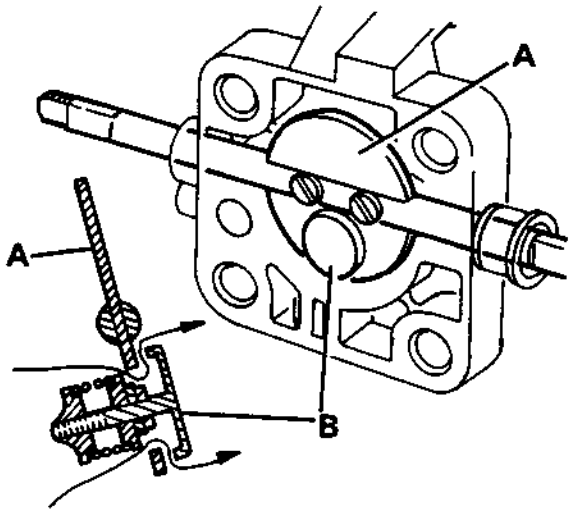
These carburetters may be externally identified by a tamperproof sealing tube fitted around the slow running adjustment screw.

The purpose of these carburetters is to more stringently control the air fuel mixture entering the engine combustion chambers and in consequence the exhaust gas emissions leaving the engine.

For this reason the only readily accessible external adjustment on these carburetters is to the throttle settings for fast idle speed and, on some later carburetters, this may require the use of a special tool to adjust the settings.

On all carburetters a deceleration (poppet) valve is incorporated in the throttle (butterfly) disc (A) and consists of a precisely set, spring-loaded plate valve (B). With low manifold depression, the valve remains closed. Under high induction manifold depression conditions, for instance during over-run with the throttle closed, the valve opens thereby slightly reducing the depression, allowing a correct quantity of fuel and air mixture to sustain engine running which improves the combustion of fuel during these conditions and helps to prevent high-value hydrocarbon emissions.

The deceleration valve is not adjustable (See fault diagnosis).



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ENGINE TUNING PROCEDURE—CARBURETTER

Before carrying out 'Engine Tuning' to carburetters it is important that all other engine related setting procedures are undertaken first, i.e. sparking plugs correctly set, hoses and air cleaner correctly fitted and secure. When the engine is running at its normal operating temperature i.e. thermostat open, the following additional checks can be made.

Check and adjust ignition timing

Equipment required:
Calibrated tachometer
Stroboscopic timing lamp

1. Couple stroboscopic timing lamp and tachometer to engine, following the manufacturers instructions.
2. Disconnect the vacuum pipe from the distributor.
3. Start engine, with no load and not exceeding 3000 rev/min run engine until normal operating temperature is reached. Check that normal idle speed falls within that specified (see 'Engine Tuning Data' for required idle speed dependent upon market).
4. Idle speed should not exceed 750 rev/min and this speed should be achieved by removing a breather hose. NOT by adjusting the carburetter idle screws.
5. If adjustment is necessary, slacken the distributor clamping bolt and rotate the distributor (clockwise to retard or anti-clockwise to advance) until the timing flash coincides with the timing pointer and correct timing mark on the torsional vibration clamper.
6. Re-tighten the distributor clamping bolt securely and re-check the timing setting.
7. Refit vacuum pipe (for vehicle specification see 'Engine Tuning Data' section).

ADJUSTMENT PROCEDURE—CARBURETTER

To comply with ECE exhaust emission regulations, all carburetters are tamperproofed on the idle adjustment screws. When mixture and idle settings have been finalised, the carburetter must be tamperproofed by fitting a cap to the nylon shroud on the idle adjusting screw.

Should, for any reason, the cap require removal, this can be affected by piercing the cap with a sharp pointed tool and prising out.

The following tools will be required to adjust idle speed, mixture and tamperproof carburetter.

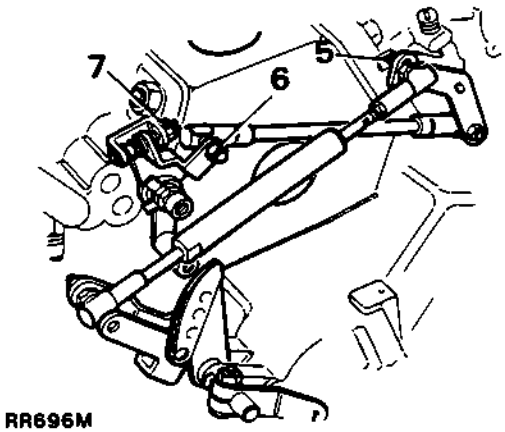
Carburetter adjusting wrench—MS 86
Carburetter jet adjusting tool—MS 80
Tamperproof cap fitting tool—ERC 3786

A numerical code exists for the tamperproofed cap and must be adhered to. Cap fitted by Land Rover Service Departments—ERC 3429.

SLOW RUNNING (IDLE) ADJUSTMENT—Manual and Automatic

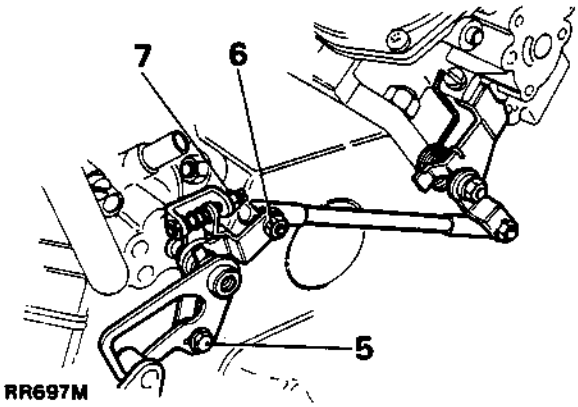
Assuming that mixture levels are correct

1. Check that the throttle control between the pedal and the carburetters is free and has no tendency to stick.
2. Check the throttle cable setting with the throttle pedal in the released position. The throttle linkage must not have commenced movement but commences with the minimum depression of the pedal.
3. Run the engine until it reaches normal operating temperature—thermostat open.
4. Turn ignition off and remove the air cleaner.
5. Slacken the nut which secures the kickdown cable to carburetter inter-connecting link at the right-hand carburetter lever (Automatic only).
   Slacken the screw securing the throttle cam to the left-hand carburetter lever (Manual only).



RR696M

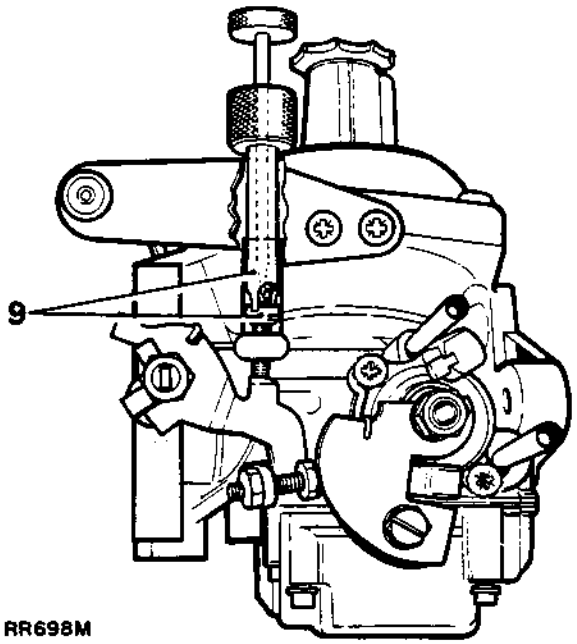
Automatic Version



RR697M

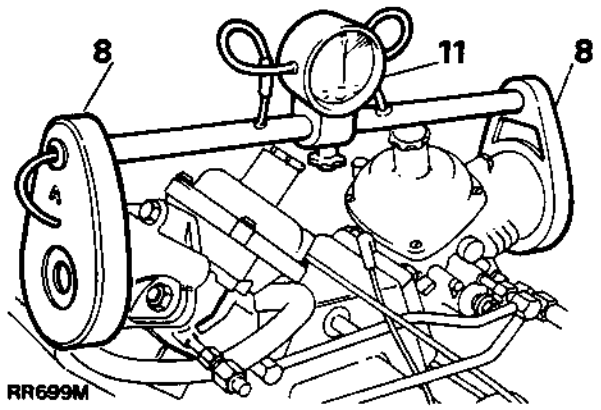
Manual Version

6. Disconnect the inter-connecting link between the carburetters, at the left-hand carburetter.
7. Slacken the locknut and release the lost motion adjusting screw on the left-hand carburetter, ensuring that the screw is well clear of the spring loaded pad.
8. Place suitable carburetter balancing equipment across the carburetter intake apertures.
9. Remove the tamperproof caps from the carburetter idle screws. Using idle screw adjustment tool MS 86 release the locknuts.



RR698M

10. Start the engine and check the idle speed using a reliable proprietary tachometer.
11. Check balancer gauge reading.

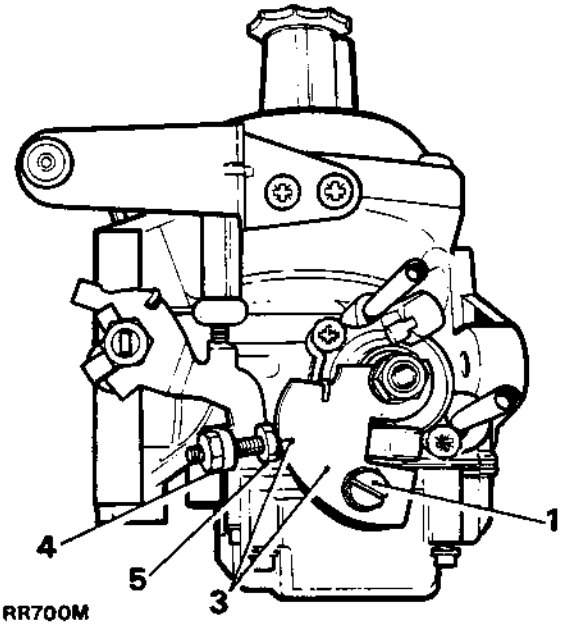


RR699M

12. If the gauge pointer is in the 'zero' sector no adjustment is required to balance carburetter.
13. If the gauge pointer moves to the right, decrease the air flow through the left-hand carburetter by unscrewing the left-hand idle adjustment screw or increase the air flow through the right-hand carburetter by turning the right-hand idle adjustment screw clockwise. Reverse the procedure if the pointer moves to the left.
14. If the engine idle speed rises too high or drops too low, re-adjust the idle screws on both carburetters ensuring that the pointer on the balancing gauge remains in the 'zero' sector.

Continued

15. When items 13 and 14 are satisfactory, tighten the idle screw locknuts.
16. Re-connect the inter-connecting link to the left-hand carburetter.
17. Hold the throttle lever against the throttle lever stop on the right-hand carburetter and adjust the lost motion screw until contact is made with the spring loaded pad and tighten the locknut.
18. Re-check idle speed and balance. Correct if necessary repeating checks 13 and 14.
19. Check idle CO level.
20. If all checks and adjustments are satisfactory; fit new tamperproof caps—part number ERC 3429 using tool—part number ERC 3786.
21. **Automatic version**—Ensuring that the right-hand carburetter countershaft lever is against the idle stop, tighten the inter-connecting link securing nut.
    Manual version—Ensure that the roller in the throttle cam on the left-hand carburetter is seated in the corner of the cam slot, tighten the cam lever securing screw.



RR700M

6. Push the choke control knob fully home and check that normal idle speed is regained.

FAST IDLE ADJUSTMENT—LH carburetter only

Automatic and Manual

Operation of the choke control from 'on' to 'off' should result in a fast idle speed of 1100 rev/min ± 50 when the choke control is approximately 12.7 mm (0.5 in) from the choke off position.

Check and adjust

1. Slacken choke cable clamping screw at the left-hand carburetter.
2. Pull the choke control knob out and push it into a distance of approximately 12.7 mm (0.5 in) and lock in position.
3. Rotate the fast idle cam allowing the choke cable to slide through the trunnion until the punched mark on the cam flank aligns with the centre of the domed screw on the throttle lever, tighten the choke cable clamping screw.
4. With the cam held in this position release the fast idle adjustment screw locknut.
5. Turn the adjustment screw until contact is made with the face of the fast idle cam, continue adjusting until the specified fast idle speed is achieved. Tighten the locknut.

IDLE MIXTURE ADJUSTMENT

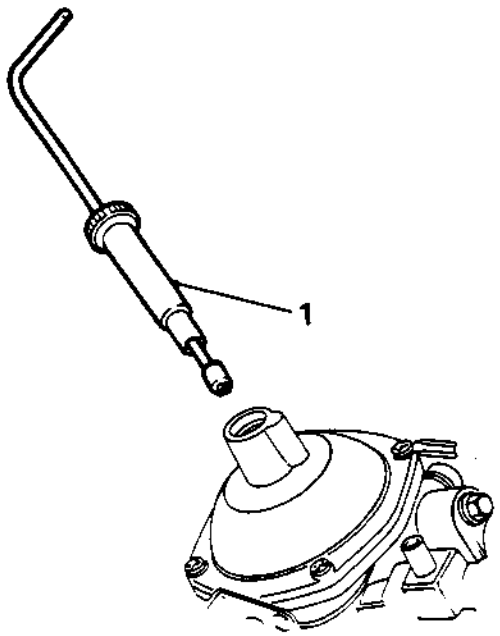
Automatic and Manual

Service Tools—MS 80 Mixture Adjustment Tool.
Carburetter Balancing Gauge.

Mixture adjustment should be carried out when the vehicle is up to normal operating temperature, i.e. warm air intake valve open.

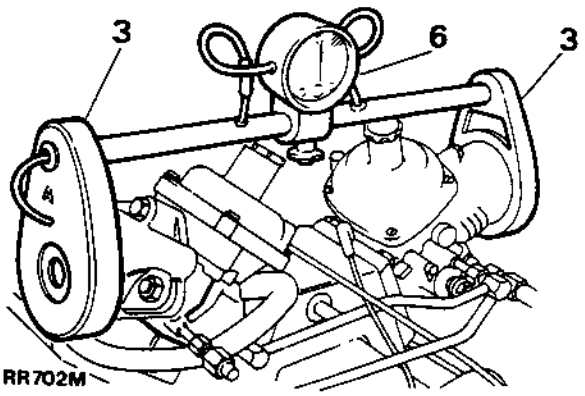
Check and adjust

1. Remove the piston damper plug, and using special tool MS 80 adjust the mixture. Locate the outer sleeve of the tool to engage a machined slot to prevent the air valve twisting. Turn the inner tool clockwise to enrich the mixture and anti-clockwise to weaken it. After every adjustment the tool should be removed from the carburetter to allow engine to stabilise. Run engine at 2000 rev/min to aid stabilisation.
2. When the mixture is correctly adjusted, the engine speed will remain constant or may fall slowly a small amount as the air valve is lifted.



RR 701M

3. Place balancer on the carburetter adaptors, ensuring that there are no air leaks. If the engine stalls or decreases considerably in speed, the mixture is too rich. If the engine speed increases, the mixture is too weak.
4. If necessary, remove balancer and re-adjust the mixture, then refit the tool.



RR702M

5. Check balancer gauge reading.
6. If the gauge pointer is in the 'zero' sector, no adjustment is required.
7. If the gauge pointer moves to the right, decrease the air flow through the left-hand carburetter by unscrewing the slow running screw or increase the air flow through the right-hand carburetter by turning clockwise the slow running screw. Reverse the procedure if the pointer moves to the left.
8. If the engine idle speed (slow running) rises too high or drops too low during balancing adjust to the correct idle speed, whilst maintaining the gauge pointer in the zero sector.
9. Remove balancer. With the mixture setting and carburetter balance correctly adjusted the difference in engine rev/min with the balancing tool on or off will be negligible, approximately ± 25 rev/min.
10. Check CO levels.

NOTE: The flow test of the carburetter may require the needle to be set within the limits of ± ½ turn of adjuster from a 'flush' condition. Before any needle component is changed the setting of the needle from 'flush' should be noted and reproduced when refitting. If difficulty is experienced with carburation the needle should be set with the shoulder flush with the face of the piston for investigation.

When using the adjusting tool a positive stop will be felt when the needle reaches full rich position. In the anti-clockwise direction there is no stop and it is possible to disengage the needle from the adjusting screw if more than two turns are made from the datum position. Should disengagement occur it can be rectified by applying light pressure, in an upwards direction to the shoulder of the needle at the piston face, whilst turning in a clockwise direction.

CHECK CO LEVEL

Use a proprietary non-dispersive infra-red exhaust gas analyser.

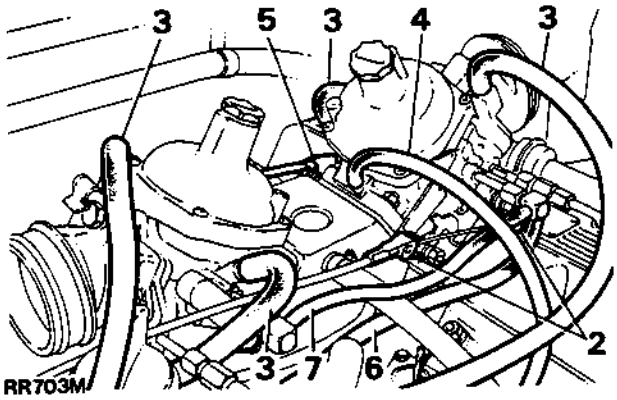
11. Insert the probe of the analyser as far as possible into the exhaust tail pipe, start the engine and allow a one to one and a half minute stabilisation period.
12. Check that the correct idle speed (slow running) is maintained and observe the CO reading against that given in the data section. If necessary re-adjust the mixture setting to achieve the correct CO level.

NOTE: For local territory emission level requirements see 'Engine Tuning Data' in specification section.

CARBURETTERS—Manual & Automatic

Removing

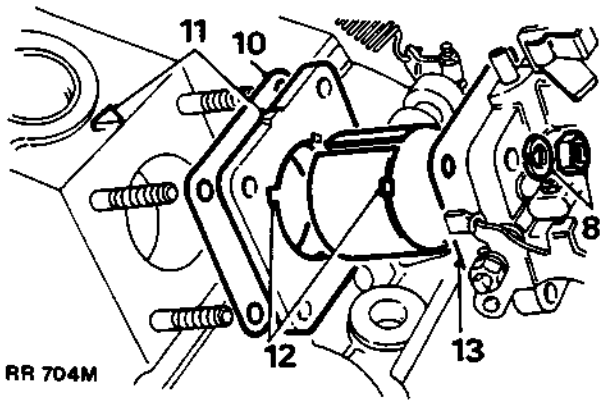
1. Remove the air cleaner.
2. Disconnect the choke cable.
3. Disconnect the emission control pipes.
4. Disconnect the distributor vacuum pipe.
5. Disconnect the throttle linkages.



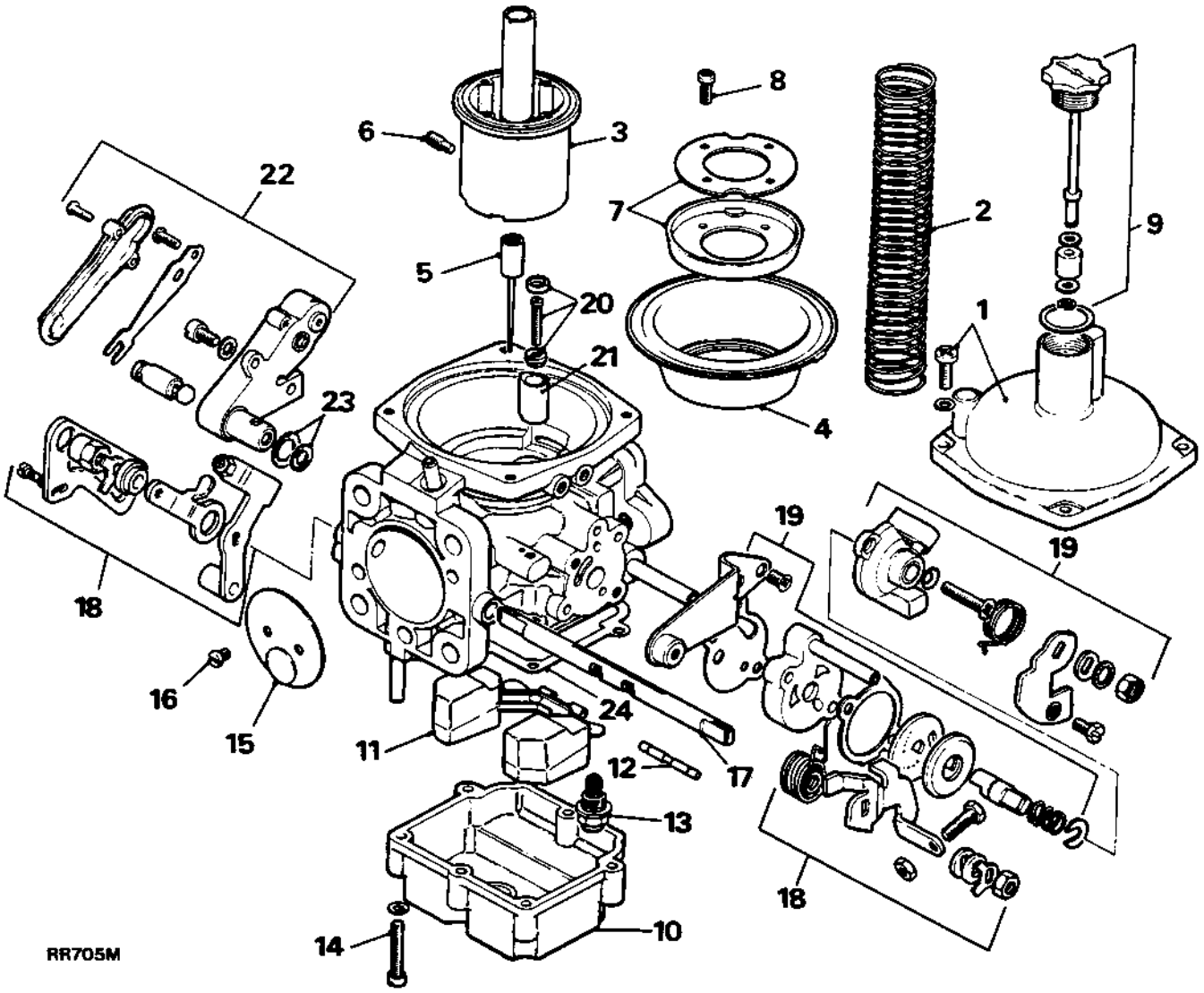
6. Disconnect the main fuel supply pipe.
7. Disconnect the choke fuel supply pipe.
8. Remove the eight retaining nuts and lift off the carburetters.
9. Withdraw the joint washers, insulator and liner.

Refitting

10. Locate a new joint washer on the inlet manifold.
11. Fit the insulator, aligning the arrows.
12. Fit the liner fully into the insulator, engaging the three tabs into the recesses.
13. Locate a joint washer on the insulator.



14. Reverse 1 to 8.
15. Fit the air cleaner.
16. Tune and adjust the carburetters.



KEY TO LH CARBURETTER

1. Top cover and retaining screws
2. Air valve return spring
3. Air valve
4. Diaphragm
5. Metering needle
6. Metering needle retaining screw
7. Diaphragm retaining ring and plate
8. Screw (4 off) retaining diaphragm to air valve
9. Damper assembly
10. Float chamber
11. Float assembly
12. Float assembly spindle
13. Needle valve
14. Float chamber retaining screws (6 off)
15. Butterfly
16. Butterfly retaining screws (2 off)
17. Butterfly (throttle) spindle
18. Throttle spindle lever assembly
19. Cold start assembly (left-hand carburetter only)
20. Slow running screw assembly
21. Tamper-proof sleeve
22. Temperature compensator assembly
23. Temperature compensator rubber seals (large and small)
24. Float chamber joint washer

CARBURETTER OVERHAUL

DISMANTLE

Remove the piston assembly

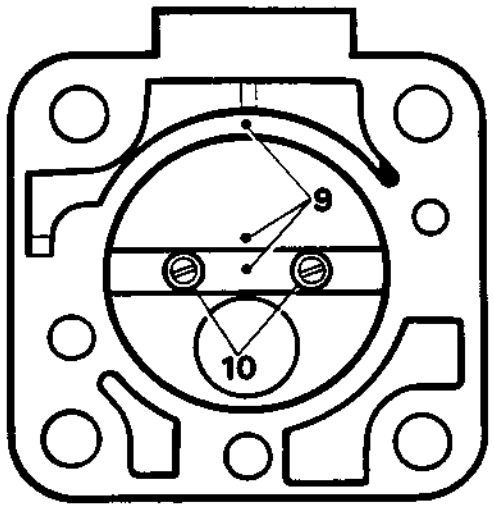
1. Remove the carburetters from the engine.
2. Release the four screws and withdraw the top cover and spring.
3. Withdraw the air valve, shaft and diaphragm assembly.
4. Remove the metering needle retained by a locking screw.
5. Release the four screws and separate the diaphragm from the air valve.

Remove the float chamber

6. Release the six screws and remove the float chamber and joint washer.
7. Release the float assembly and spindle from the two clips.
8. Unscrew the needle valve and washer from carburetter body.

Dismantle carburetter body

9. Make location marks, as illustrated, to assist correct assembly, on the throttle butterfly, spindle and carburetter body.
10. Right-hand carburetter. Release the two screws and remove the butterfly and withdraw the spindle.



ST1119M

11. Left-hand carburetter. Remove the left-hand lever assembly. Release the two screws, remove the butterfly and withdraw the spindle.
12. Left-hand carburetter. Release the two retaining screws and shake-proof washers and remove the cold start assembly and joint washers.
13. Dismantle the cold start assembly but DO NOT remove the discs from the spindle.
14. If necessary, dismantle the throttle spindle lever assemblies from both carburetters.

Slow running adjustment screws

Do not attempt to remove these screws or break the tamper-proof seals. See Cautionary note under 'Tune and Adjust'.

Remove temperature compensator

15. Release the two screws and withdraw the temperature compensator unit complete.
16. Remove the large and small rubber washers.

CLEANING AND INSPECTION

Cleaning

17. When cleaning fuel passages do not use metal tools (files, scrapers, drills etc.) which could cause dimensional changes in the drillings or jets. Cleaning of all components should be affected using clean fuel and, where necessary, a moisture-free air blast.

Joint washers and seals

18. New gaskets and seals should be used throughout carburetter rebuild. A complete set of gaskets is available for replacement purposes.
    Inspect metering needle; it is machined to very close limits and should be handled with care. Examine for wear, bend and twist; renew if necessary.
19. Examine the faces for deep scores which would lead to leakage taking place when assembled.

Diaphragm

20. Examine the diaphragm for deterioration, damage and punctures. Do not use any cleaning chemicals on the diaphragm only clean lint free rag.

Float assembly

21. Examine the two plastic floats and check for punctures and damage.
22. Check the spindle and retaining clips for wear.
23. Inspect the needle valve assembly for wear. Renew the valve if there is any tendency for the needle to stick.

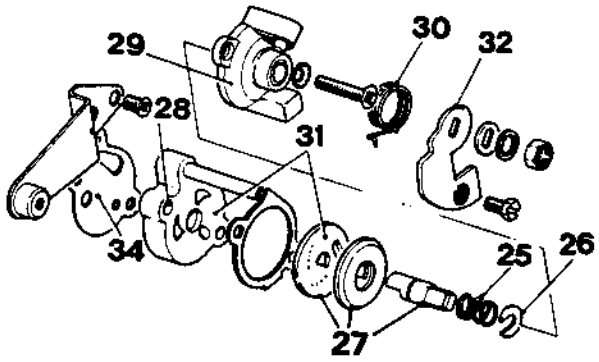
Cold start assembly

24. Examine all the cold start components for wear and corrosion and the machined faces for scores.

ASSEMBLE CARBURETTERS

Cold start—LH carburetter

25. Place the spring on the cold start spindle.
26. Fit the spring retaining clip.
27. Check that the discs slide easily on the spindle.
28. Place the cold start spindle on the starter face.
29. Place the starter cover in position.
30. Fit the return spring over the spindle.
31. Rotate the spindle until the oval port in the end disc is aligned with the oval port in the starter face.
32. Fit the cold start lever.
33. Engage the return spring over the lug on the starter cover and the back of the cold starter lever.
34. Place the cold start gasket onto the carburetter body.



ST1116M

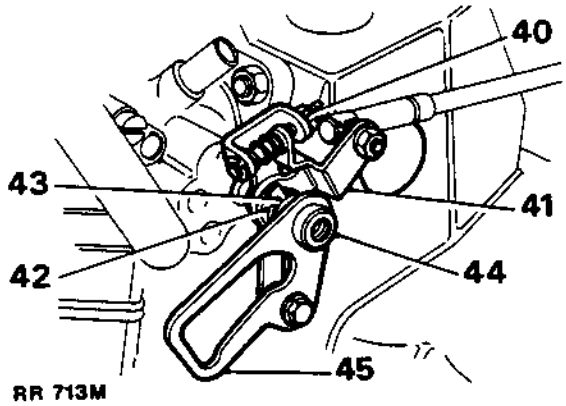
35. Fit the cold start assembly to the carburetter body, and check for ease of operation.

Throttle spindle, LH carburetter

36. Place the return spring over either end of the spindle.
37. Fit the throttle stop and fast idle lever and secure with spacers, tab washer and nut.
38. Insert the throttle spindle from the cold start side of the carburetter body and fit the throttle return spring on the fast idle adjustment lug. Tension the spring half a turn.

    NOTE: To enable the throttle butterfly to be centralised, remove the tamperproof cap (if fitted) from the idle adjustment screw, slacken the screw until the lever is free to move without restrictions.

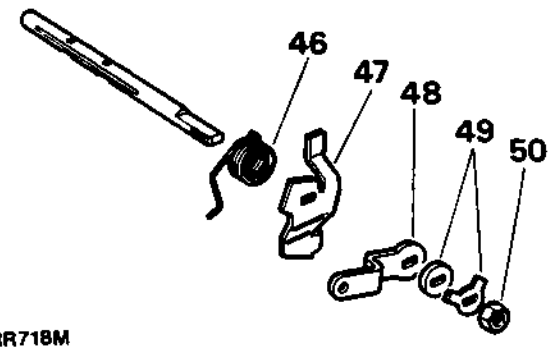
39. Fit the throttle butterfly, maintaining the previously marked alignment. Leave the retaining screws loose. Actuate the throttle several times to centralize the butterfly, then tighten the retaining screws and lock by peening ends.
40. Fit the lost motion lever to the opposite end of the spindle.
41. Fit the throttle lever locating the raised tab between the spring loaded pad and adjustment screw.
42. Place the spacer on the spindle.
43. Place the tab washer on the spindle.
44. Fit the sleeve nut, sleeve end first, and engage the tab washer.
45. Fit the throttle adjusting lever (automatic gearbox carburetter versions are not fitted with this lever).



RR 713M

Throttle spindle—RH carburetter

46. Place the return spring over the threaded end of the spindle.
47. Fit the throttle stop lever.
48. Fit the throttle lever.
49. Fit the spacer and tab washer.
50. Fit the retaining nut.

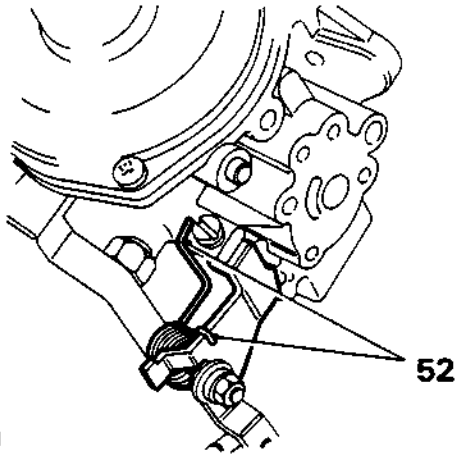


RR718M

51. Secure the assembly to the shaft with the tab washer.

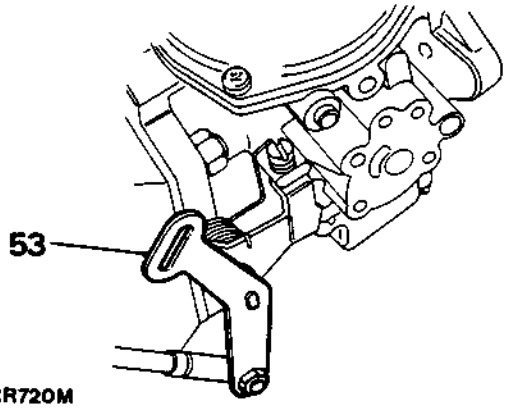
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52. Fit the spindle to the carburetter and assemble the throttle butterfly as described in instruction 39. (See note preceding instruction 39.) Anchor the return spring as illustrated.



RR 719M

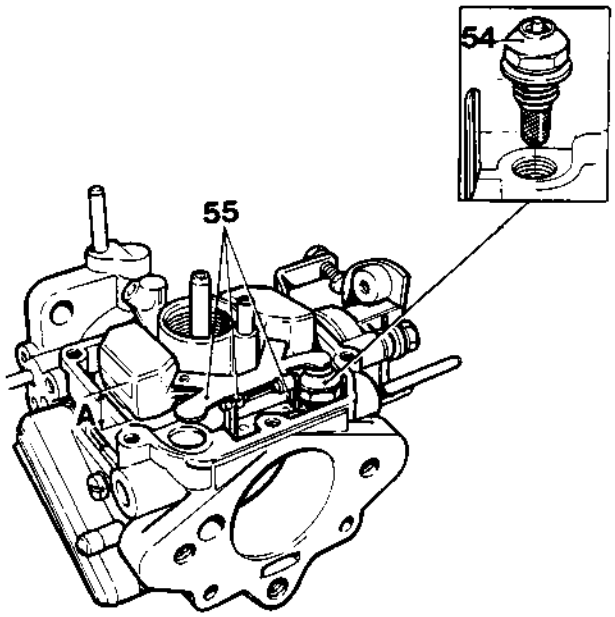
53. Fit the kick-down lever. (Automatic gearbox versions only.)



RR720M

Float chamber assembly

54. Fit the needle valve and new washer.
55. Locate the spindle in the float arm and fit the assembly into the retaining clips.

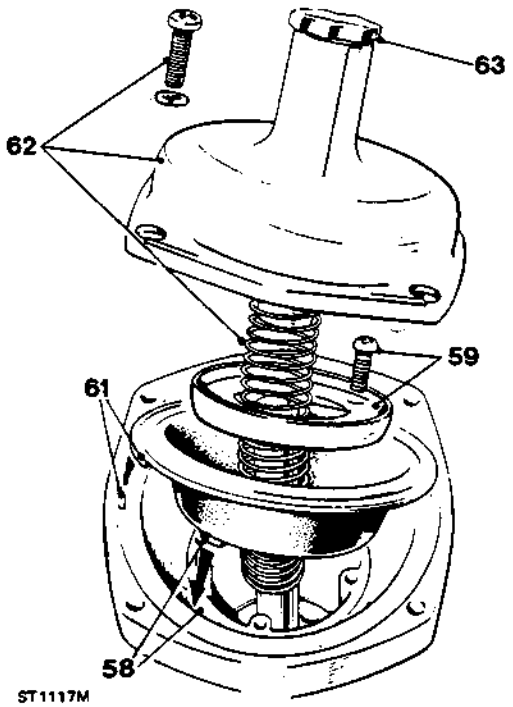


ST1123M

56. Invert the carburetter so that the needle is on its seating and the float tab is contacting the needle. Measure the dimension 'A' between the carburetter gasket face and the highest point on the floats. The correct measurement should be 17 to 18 mm (0.67 to 0.71 in). Adjust by bending the float tab. This dimension must be the same for both floats. The float carrier tab must be maintained at right angles to the needle in the closed position.
57. Fit the float chamber and new gasket and evenly tighten the retaining screws.

Air valve and diaphragm

58. Fit the diaphragm to the air valve with the inner tag locating in the air valve recess.
59. Fit the diaphragm retaining ring and secure with the four screws.
60. Fit the metering needle into the air valve and secure with the locking screw.
61. Insert the air valve and needle into the carburetter and locate the diaphragm outer tag into the recess in the carburetter body.
62. Fit the spring and top cover and secure with the four screws.
63. Fit the damper.



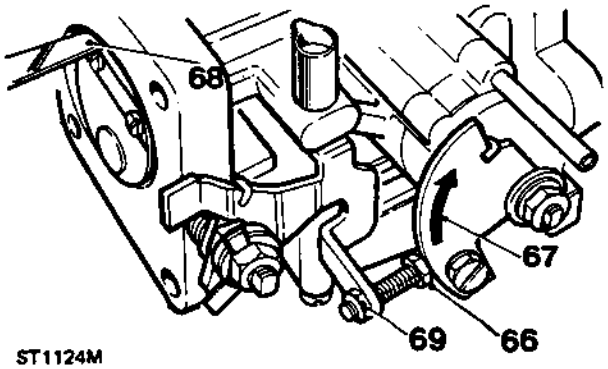
ST1117M

Temperature compensator

64. Clean the carburetter and compensator mating faces.
65. Fit a new inner and outer rubber washer and secure the temperature compensator with the two screws and shake-proof washers.

Fast idle adjustment—LH carburetter only

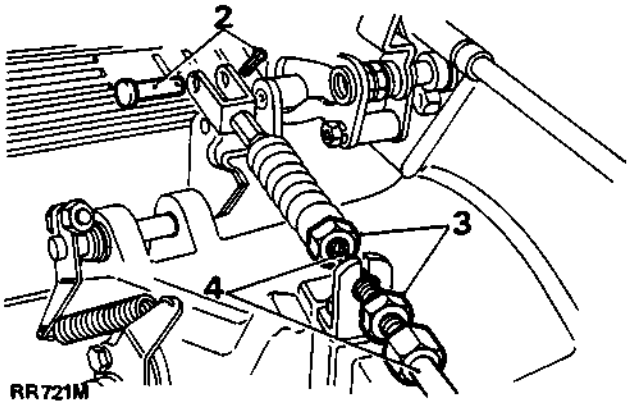
66. Slacken the fast idle adjusting screw.
67. Hold the cold start cam lever in the maximum position.
68. Adjust the fast idle adjusting screw against the cam lever until there is 0.61 to 0.66 mm (0.024 to 0.026 in) gap between the top edge of the throttle butterfly and the carburetter barrel wall. Use feeler gauges or a 0.65 mm diameter (No. 72) drill to measure the gap.
69. Secure the locknut on the fast idle adjusting screw without disturbing the adjustment.



ST1124M

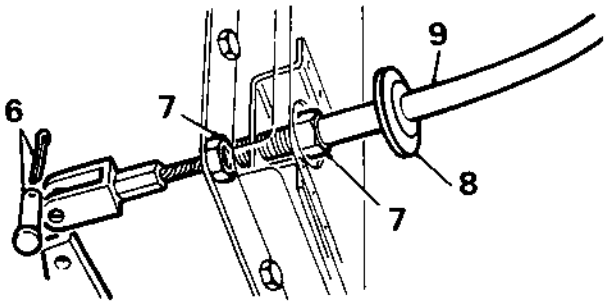
RENEW THE THROTTLE CABLE—manual gearbox

1. Remove the air cleaner.
2. Remove the split pin and clevis pin from the counter shaft lever.
3. Release the two locknuts securing the outer cable to the adjustment bracket.
4. Manoeuvre the inner and outer cable and remove from the adjustment bracket.



RR721M

5. Remove the six screws retaining the lower fascia within the vehicle. Disconnect the dimmer switch multi-plug to enable the fascia panel to be removed to give access to the throttle pedal linkage.
6. Remove the split pin and clevis pin from the top of the throttle pedal.
7. Release the two outer cable locknuts at the throttle cable retaining bracket on the inner bulkhead.
8. Prise out the rubber grommet accessible from the engine compartment.
9. Withdraw the throttle cable complete.



RR 722M

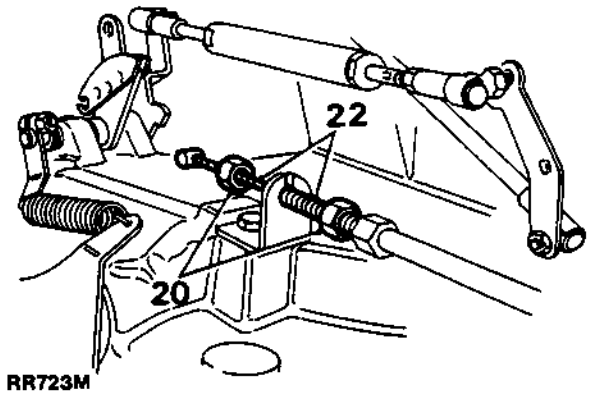
Fit new throttle cable

10. Fit new cable ensuring that new split pins are used.
11. Lightly grease linkage and clevis pins.
12. Adjustment of the cable should be undertaken with the throttle pedal in the fully released position.
13. Adjust the outer cable until the throttle levers operate with the minimum of throttle pedal pressure.
14. Refit the air cleaner and lower fascia panel.

Continued

Renew the throttle cable—Automatic gearbox

15. Remove the six screws securing the lower fascia within the vehicle, lower the fascia and disconnect the multi-plug at the dimmer switch to enable the fascia panel to be removed to give access to the top of the throttle pedal.
16. Remove the split pin and clevis pin from the throttle pedal.
17. Release the two outer cable locknuts at the throttle cable retaining bracket on the inner bulkhead panel.
18. Remove the air cleaner.
19. Prise the rubber grommet from the bulkhead to allow the cable to be manoeuvred into the engine compartment (see illustration RR722M).
20. Release the two outer cable locknuts from the adjustment bracket at the intake manifold.
21. Remove the nipple end of the cable from the cam lever and remove the complete cable assembly.
22. Manoeuvre the inner and outer cable to release it from the adjustment bracket.



RR723M

Fit new throttle cable

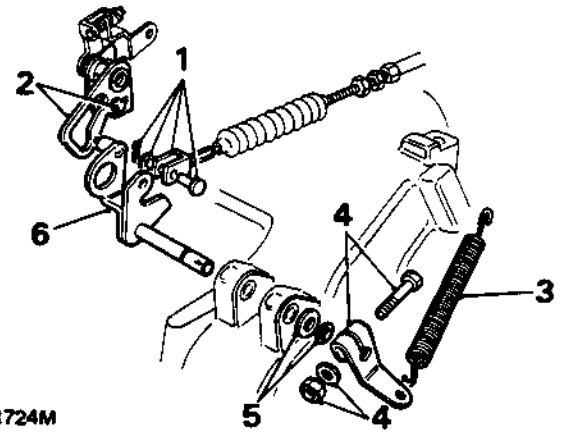
23. Fit new cable ensuring that a new split pin is used.
24. Lightly grease clevis pin and linkage at the throttle pedal.
25. Adjustment of the cable should be undertaken with the throttle pedal in the fully released position.
26. Adjust the outer throttle cable until the throttle levers operate with the minimum of throttle pedal pressure.
27. Refit air cleaner.
28. Refit the lower fascia panel.

THROTTLE LINKAGE—Manual gearbox version

Remove and refit

Removing

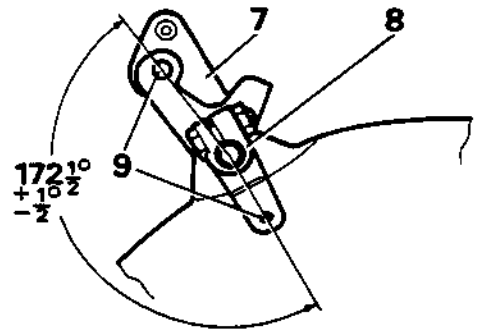
1. Release the throttle cable from the countershaft lever.
2. Remove the small bolt with spring washer securing the throttle adjustment lever to the left-hand carburetter spindle and remove the lever.
3. Disconnect the throttle return spring.
4. Release the nut and slide the return spring lever off the countershaft spindle.
5. Remove the circlip and plain washer from the countershaft lever.
6. Pull the countershaft spindle out of its location.



RR724M

Refitting

7. Fit the countershaft assembly and secure in position with the plain washer and circlip.
8. Fit the return spring lever to abut the circlip and lightly tighten the securing bolt.
9. Position the lever and countershaft lever so that the holes for the throttle cable and return spring connection are 172½° ± ½°, and tighten the securing bolt.



RR725M

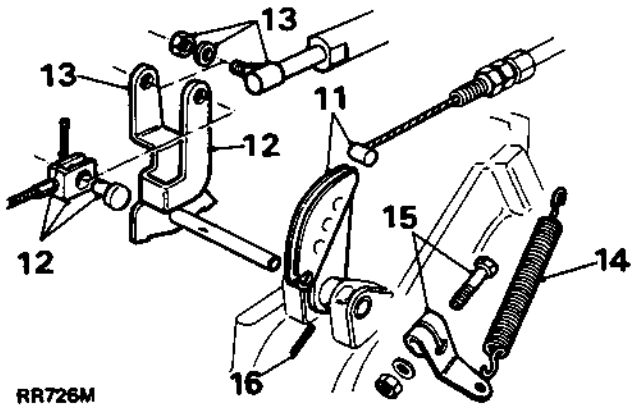
10. Reverse the remaining removal instructions 1 to 3.

THROTTLE LINKAGE—Automatic gearbox versions

Remove and refit

Removing

11. Disconnect the throttle cable from the cam lever.
12. Remove the split pin and clevis pin securing the kick-down cable to the countershaft lever.
13. Remove the nut (with spring washer) securing the carburetter inter-connecting link to the countershaft lever.
14. Disconnect the throttle return spring.
15. Release the spring return lever retaining bolt and remove the lever from the countershaft lever spindle.
16. Drift out the small roll pin securing the cam lever to the countershaft lever spindle.

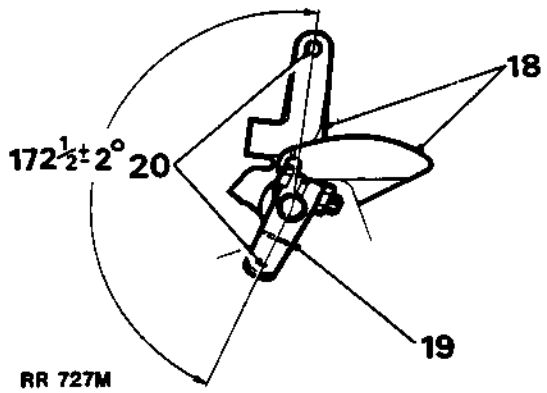


RR726M

17. Manoeuvre the countershaft lever and withdraw it from its location.

Refitting

18. Fit the countershaft lever and cam lever, secure the cam lever to the spindle using a **new** roll pin.
19. Fit the return spring lever and lightly tighten the securing bolt.
20. Position the return spring lever and countershaft lever so that the holes for the kickdown cable and return spring connection are 172½° ± 2°, and tighten the securing bolt.



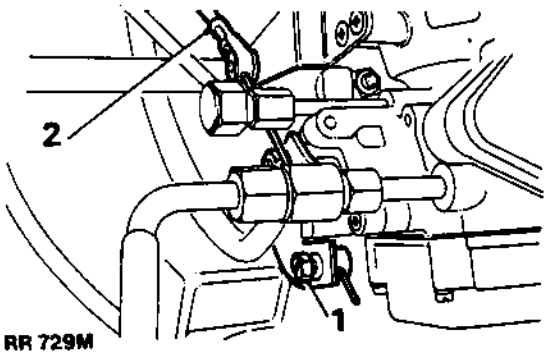
RR 727M

21. Reverse the remaining removal instructions 11 to 14.

RENEW CHOKE CONTROL CABLE—carburetter models only

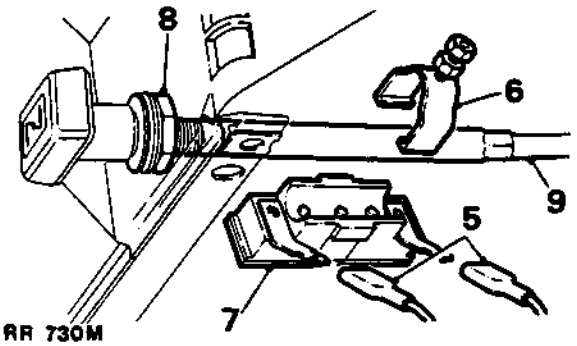
Manual and Automatic gearbox

1. Release the pinch screw and disconnect the choke cable from the left-hand carburetter fast idle cam.
2. Release the cable from the securing clip in the engine compartment.



RR 729M

3. To gain access to the rear of the choke control knob it is necessary to remove the lower fascia panel.
4. Remove the six lower fascia panel securing screws, lower the panel, disconnect the electrical multi-plug attached to the dimmer control switch and remove the fascia panel.
5. Disconnect the two electrical leads from the choke control switch.
6. Release the locknut and screw, slide the clamp off the switch.
7. Remove the switch from the cable.
8. Release the locknut at the rear of the choke control knob.
9. From within the vehicle, pull the cable assembly through the bulkhead and upper fascia panel.



RR 730M

Fit new choke cable

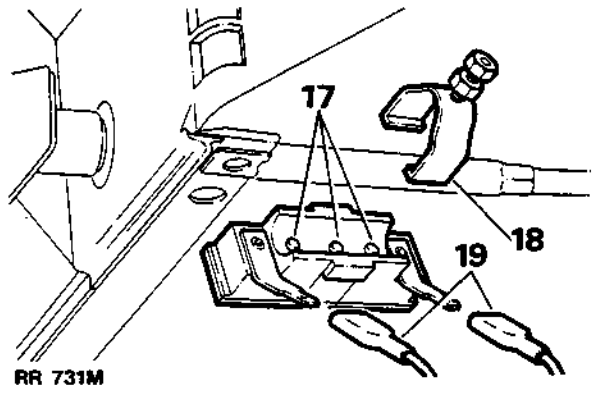
10. Feed the new choke cable through the upper fascia and slide the locknut over the cable.

Continued

11. Push cable through bulkhead grommet into the engine compartment.

    NOTE: Ensure that the grommet is secure in the bulkhead.

12. Tighten the locknut at the rear of the choke cable knob.
13. Feed the cable through the locking screw on the fast idle cam. Do not tighten the clamping screw at this stage.
14. Attach the outer choke cable to the securing clips.
15. Pull the choke control knob out approximately 12.7 mm (0.50 in), rotate the fast idle cam until the stamped mark on the cam flank aligns with the centre of the domed screw on the throttle lever, tighten the choke cable clamping screw.
16. Push the choke control knob in and check that the domed screw is not in contact with the fast idle cam.
17. Fit the choke warning light switch to the outer cable ensuring that the three small pegs on the switch locate with the indentations on the choke cable.
18. Slide the clamp over the switch and secure in position.

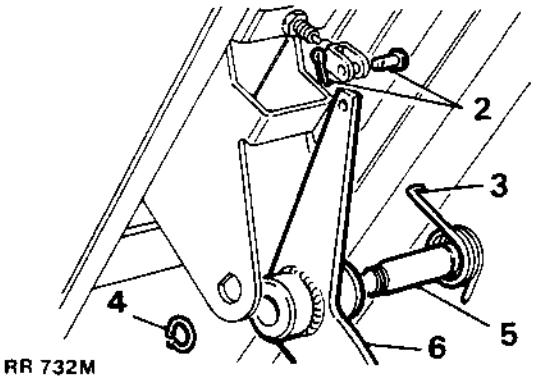


RR 731M

19. Re-connect the electrical leads to the switch.
20. Re-connect dimmer switch electrical leads and secure the lower fascia in position.

REMOVE THE THROTTLE PEDAL—all models

1. Release the six securing screws from the lower fascia panel, lower the panel and disconnect the two electrical leads from the dimmer switch, remove the panel from the vehicle.
2. Remove the split pin and clevis pin securing the throttle cable to the throttle pedal.
3. Release the tension from the pedal return spring.
4. Remove the circlip from the pedal pivot pin.
5. Withdraw the pivot pin.
6. Withdraw the throttle pedal.



RR 732M

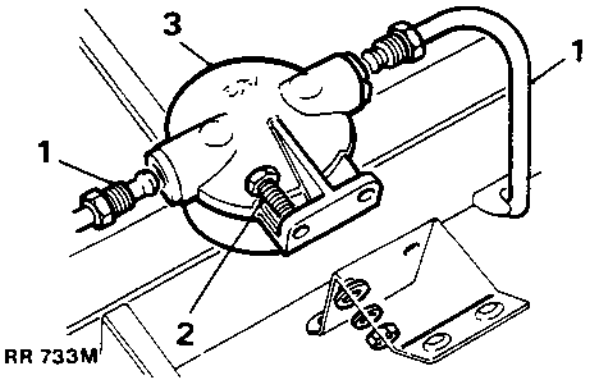
Fit throttle pedal

7. Lightly grease the pivot pin and clevis pin before re-assembly.
8. Fit a new split pin to the clevis pin.
9. Reverse the removal procedure.

REMOVE MAIN FUEL FILTER—carburetter versions only

WARNING: Ensure that all the necessary precautions are taken against the spillage of petrol when removing the filter assembly.

1. Release the two pipe unions securing the pipes to the filter. Plug the end of the pipes to prevent ingress of dirt.
2. Remove the two nuts, bolts and washers securing the filter to the inner wing mounting bracket.
3. Remove the filter assembly.



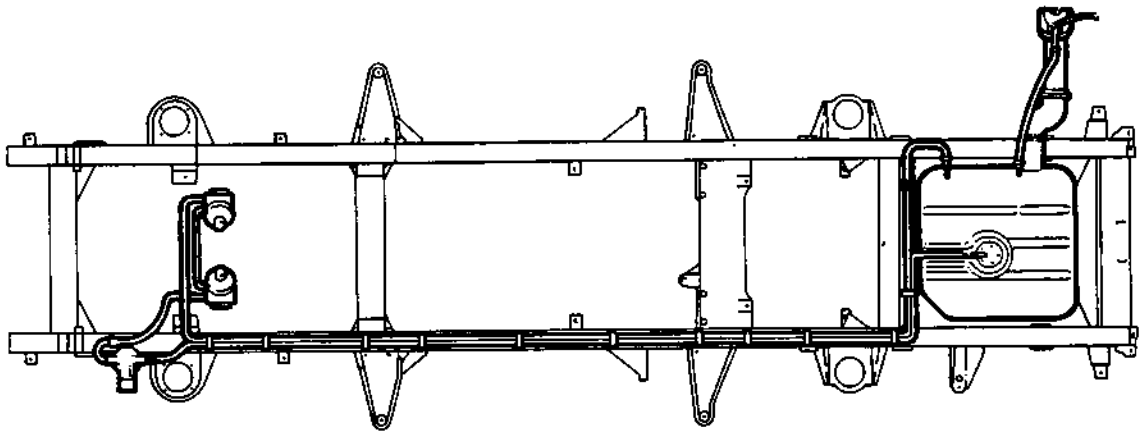
RR 733M

Refitting

4. Reverse the remove instructions 1 to 3, ensuring there are no fuel leaks around the pipe unions.

FUEL PIPES

WARNING: Before disconnecting any part of the fuel pipe system ensure that all necessary precautions are taken against fuel spillage.



RR686M

REMOVE THE FUEL TANK AND FUEL PUMP

NOTE: The removal of the fuel tank from the vehicle requires the assistance of a second person to support the tank when the fuel feed pipe is disconnected from the fuel pump.

The low pressure in-tank fuel pump is located on the top of the fuel tank, access to the pump is gained by removing the fuel tank from the vehicle.

WARNING: Ensure that all the necessary precautions are taken when draining the fuel from the tank.

Remove the fuel tank

1. Drive the vehicle onto a suitable ramp.
2. Disconnect the battery.
3. Remove the drain plug from the bottom of the fuel tank, drain the fuel into a suitable container. Refit the plug.
4. Disconnect the spill return pipe at the fuel tank, accessible through the rear right-hand wheel arch. Plug the end of the return pipe to prevent ingress of dirt.
5. Disconnect the flexible breather hose from the tank.
6. Release the two hose clips at the top and bottom of the filler tube. Manoeuvre the hose up the filler tube and withdraw the hose off the tank filler neck.

   NOTE: If a tow bar is fitted, the two tie-bars from the towing plate to the chassis must be removed allowing the tank to be removed from the vehicle.

7. From beneath the vehicle remove the four bolts, nuts, washers and spring washers securing the tank to the chassis frame.
8. Tilt the left-hand side of the tank downwards as far as the remaining connected fuel pipe will permit, to give access to the fuel feed pipe connection and electrical terminals at the fuel pump.
9. With assistance from someone supporting the tank, disconnect the fuel feed pipe and electrical leads.
10. Carefully lower the tank and place on a suitable workbench.
11. Plug the ends of the fuel feed pipe and fuel pump to prevent ingress of dirt.

Remove the fuel pump

12. Remove the five screws and washers securing the pump in the tank.
13. Withdraw the fuel pump and sealing washer from the tank.

Fit the fuel pump

14. Ensure the area around the fuel pump aperture in the tank is free from dirt and grease.
15. Fit the pump and a **NEW** sealing washer to the tank, secure the pump in position.

Fit fuel tank

16. With assistance offer up the fuel tank to the chassis, remove the plugs from the fuel pipes and re-connect the hose to the pump. Re-connect the electrical leads.
17. Secure the tank to the chassis and refit all hoses and pipes.
18. Connect the battery, turn ignition on and check for fuel leaks at all hose and pipe connections.

V8 ENGINE CARBURETTER

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
DIFFICULT STARTING WHEN COLD	Insufficient choke action	Check action of cold start unit to ensure that the choke is being applied fully—adjust choke cable. Check position of cold start adjuster—move outward.
	Fast idle adjustment incorrect	Check and adjust fast idle setting. Check linkage between choke and throttle for distortion.
	Float chamber level too low	Check needle valve for sticking—(closed). Check float level setting. Check inlet connection filter for blockage. Check external fuel system in accordance with fuel system fault diagnosis.
	Carburetter flooding	Check needle valve for sticking—(open). Float punctured. Fuel pump pressure too high. Float level too high.
	No fuel supply to carburetter	Check filters and pump for blockage. Check fuel tank breather and fuel lines for blockage. Remove fuel pump and check operation. Overhaul or fit new pump.
	No oil in damper or oil too thin	Check level of oil in damper, and fill to correct level with oil of a viscosity of S.A.E. 20.
DIFFICULT STARTING WHEN HOT	Choke sticking 'on'	Check to ensure choke is returning to fully 'off' position; reset as necessary.
	Blocked air cleaner	Fit new air cleaner elements.
	Float chamber level too high	Check float level setting. Check float arms for distortion. Check needle valve for sticking. Punctured float, fuel pump pressure too high.
LACK OF ENGINE POWER	No oil in damper or oil too thin	Check level of oil in damper, and fill to correct level with oil of a viscosity of S.A.E. 20.
	Air valve sticking	Check air valve assembly moves freely and returns under spring load—centre jet assembly. Check diaphragm for cracks or porosity.
	Water in fuel	If water is present in float chamber, the complete fuel system should be drained, fuel components should be dismantled, inspected for contamination, paying particular attention to filters.
ERRATIC SLOW RUNNING OR STALLING ON DECELERATION	Float level too low	Check float chamber level. Check for needle valve sticking.
	Incorrect jet setting	Check and reset jet settings in accordance with carburetter overhaul instructions.
	Carburetter air leaks	Check throttle spindle and bearings for wear.
	Manifold air leaks	Check inlet manifold gasket for leakage. Check inlet manifold for cracks and distortion of mating faces. Check gasket between carburetter and manifold. Check condition of vacuum advance pipe and connections. Check vacuum servo pipes and connections.
	Damper oil too thick. No oil in damper	Check and refill to correct level with oil specified.
	Air valve sticking	Check air valve assembly moves freely and returns under spring load—centre jet assembly. Check diaphragm for cracks or porosity.
EXCESSIVE FUEL CONSUMPTION	Blocked air cleaner	Fit new air cleaner elements.
	Damper oil too thick	Replace with correct grade.
	Incorrectly adjusted carburetter	Check and reset slow running in accordance with carburetter tune and adjust instructions.
	Float level too high	Check and reset float level.
	Incorrect needle	Check needle type.
	Worn jets and needle	Check and replace as necessary.
	Choke sticking 'on'	Check to ensure choke is returning to fully 'off' position, reset as necessary.
	Engine fault	See 'Engine Fault' diagnosis.

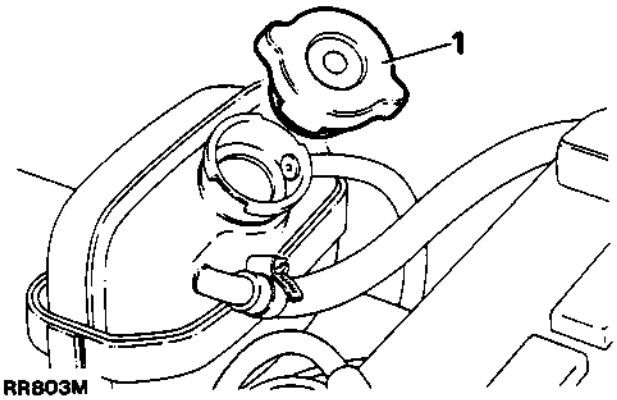
COOLANT

Drain and refill

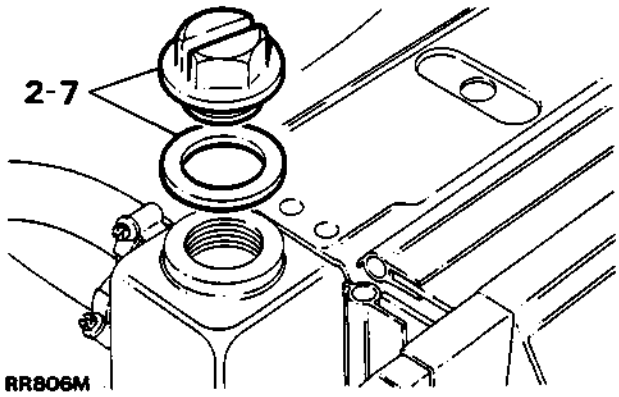
Draining

WARNING: Do not remove the expansion tank filler cap when the engine is hot because the cooling system is pressurised and personal scalding could result.

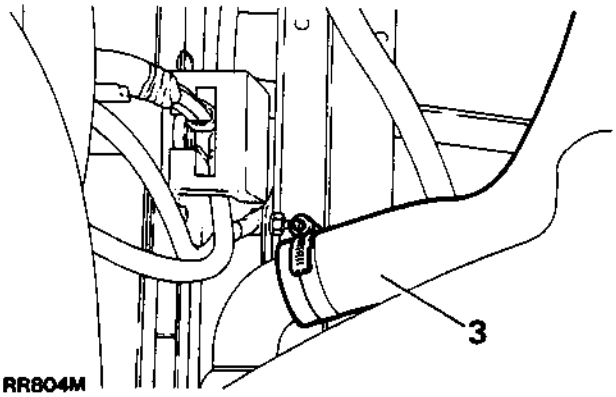
1. Remove the expansion tank filler cap by first turning it anti-clockwise a quarter of a turn to allow pressure to escape, then turn it further in the same direction and lift off.



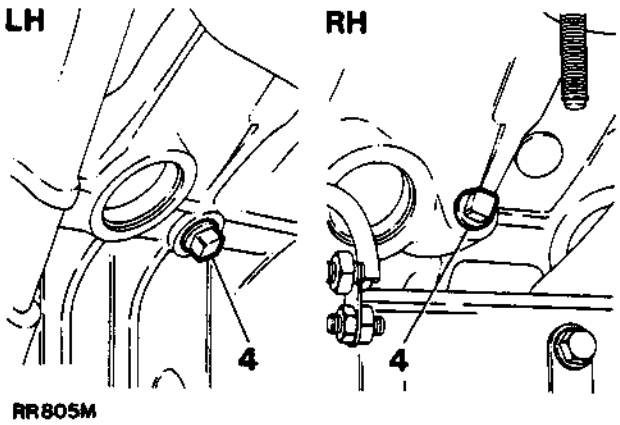
2. Remove the radiator filler plug and washer to assist drainage.



3. Disconnect the radiator bottom hose and allow the coolant to drain into a suitable container. Use a clean container if the coolant solution is to be reused. Re-connect the bottom hose after draining and tighten the hose clip.



4. Remove the engine drain plugs, one each side of the cylinder block, beneath the exhaust manifolds. Allow the coolant to drain and refit plugs.



See the following coolant requirements before refilling the system.

continued

Coolant requirements

Frost precautions and engine protection

The engine cooling system MUST ALWAYS be filled and topped-up with a solution of water and anti-freeze, winter and summer, or, where frost precautions are not required, water and inhibitor. NEVER use water alone as this may corrode the aluminium alloy.

CAUTION: Do not use salt water even with an inhibitor, otherwise corrosion will occur. In certain territories where the only available natural water supply has some salt content use only rain or distilled water.

Recommended solutions

Anti-freeze: Universal Anti-freeze or permanent type ethylene base, without methanol, with a suitable inhibitor for aluminium engines and engine parts.

Use one part of anti-freeze to one part of water.

Inhibitor: Marston Lubricants SQ36 inhibitor concentrate.

If frost precautions are not required use a 10% solution of inhibitor, i.e. one part inhibitor to nine parts of water. Inhibitor solution should be drained and flushed out and new inhibitor solution introduced every two years, or sooner where the purity of the water is questionable.

Anti-freeze can remain in the cooling system and will provide adequate protection for two years provided that the specific gravity of the coolant is checked before the onset of the second winter and topped-up with new anti-freeze as required.

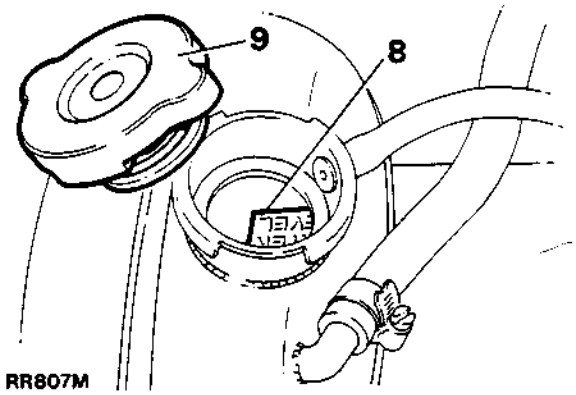
Vehicles leaving the factory have the cooling system filled with 50% of anti-freeze mixture. This gives protection against frost down to minus 47°C (minus 53°F). Vehicles so filled can be identified by a label affixed to the windscreen and radiator.

After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and renew defective hoses to make sure that the system is leakproof.

See the 'Recommended Lubricants, Fluids and Capacities' section for protection quantities.

Refilling

5. Pour 4.5 litre (1 gal) of water into the radiator.
6. Add the recommended quantity of anti-freeze or inhibitor.
7. Top-up the radiator with water, refit the radiator filler plug and washer and tighten.
8. Add water to the expansion tank, up to the 'WATER LEVEL' plate.



9. Fit the expansion tank filler cap.
10. Run the engine until normal operating temperature is attained, that is, thermostat open.
11. Allow the engine to cool, then check the coolant level and top-up if necessary.

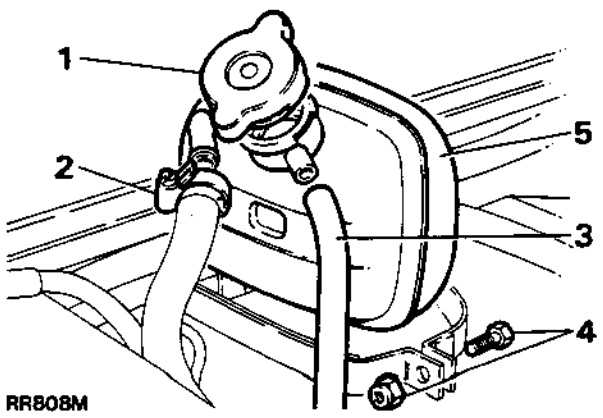
EXPANSION TANK

Remove and refit

Removing

WARNING: Do not remove the expansion tank filler cap when the engine is hot because the cooling system is pressurised and personal scalding could result.

1. Remove the expansion tank filler cap by first turning it anti-clockwise a quarter of a turn to allow pressure to escape, then turn it further in the same direction and lift off.



2. Disconnect the hose to the radiator.
3. Disconnect the overflow pipe.
4. Remove the pinch bolt.
5. Lift out the expansion tank.

Refitting

6. Reverse 2 to 5.
7. Replenish the cooling system.

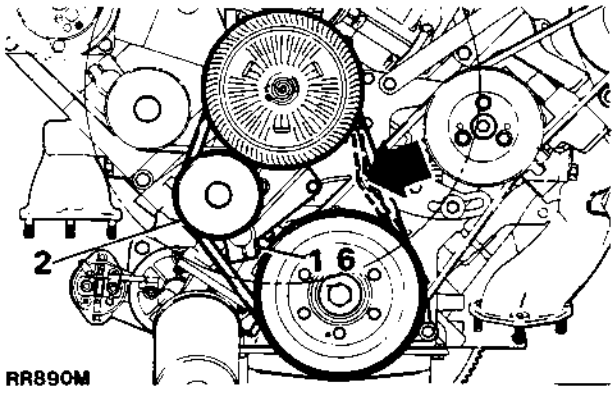
FAN BELT

Check and adjust tension, 1 and 5 to 6

Remove and refit, 1 to 6

Removing

1. Slacken the jockey pulley pivot bolt.
2. Pivot the jockey pulley inwards.
3. Lift off the fan belt.



RR890M

Refitting

4. Locate the fan belt on the pulleys.
5. Adjust the fan belt using the jockey pulley to give 11 to 14 mm (0.437 to 0.572 in) free movement when checked midway between the fan and crankshaft pulleys by hand.
6. Tighten the jockey pulley pivot bolt and check the adjustment.

NOTE: Re-check belt adjustment after approximately 1500 km (1,000 miles) running when a new belt has been fitted.

VISCOUS COUPLING, FAN BLADES, PULLEY AND FAN COWL

Viscous coupling—remove and refit 1 to 5

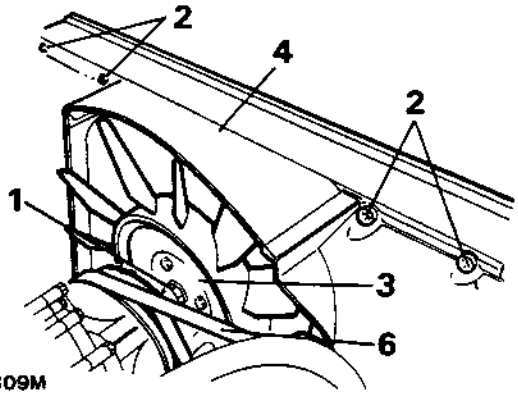
Fan blades—remove and refit 1 to 5 and 8

Fan cowl—remove and refit 1 to 4

Fan pulley—remove and refit 1 to 7

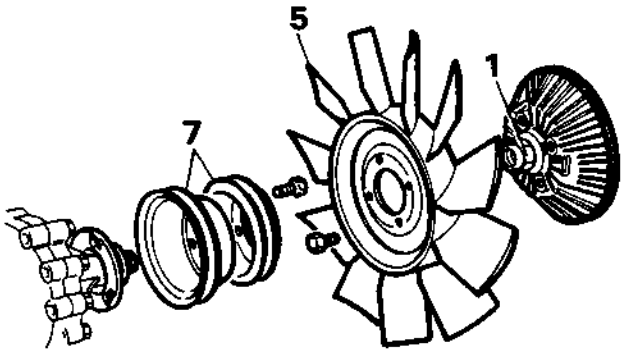
Removing

1. Slacken the nut securing the viscous coupling and fan blade assembly to the water pump spindle.
2. Remove the four fan cowl fixings and lift the cowl out of its lower mountings.



RR809M

3. Remove the viscous coupling securing nut and withdraw the assembly.
4. Remove the fan cowl, if required.

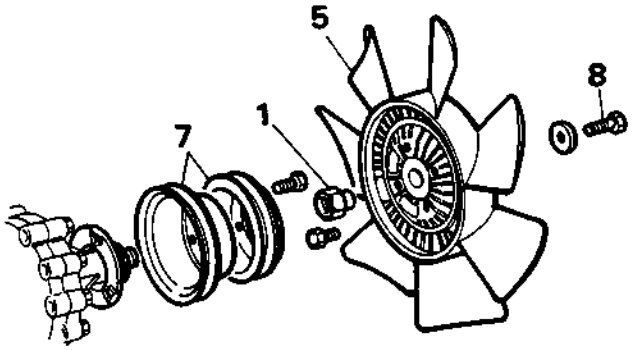


RR810M

5. Remove the fan blades from the viscous coupling, if required.
6. Remove the fan belt and, if fitted, the compressor belt.
7. Remove the pulley fixings and withdraw the pulley.

Continued

8. Vehicles having seven-bladed fans have a detachable boss securing the viscous coupling. Follow 1 to 5 above and remove the bolt to dismantle.



Refitting

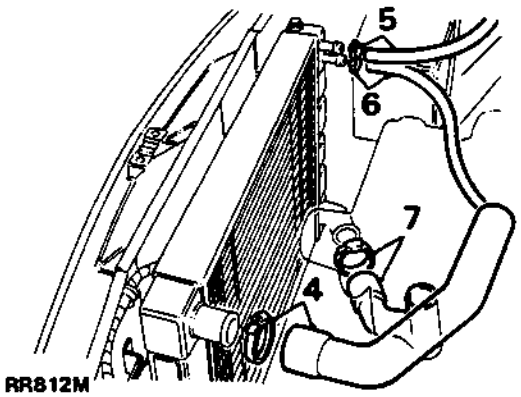
9. Reverse the above procedure, ensuring the fan blades are fitted correctly. Eleven-bladed fans are marked FRONT. Seven-bladed fans are fitted with the deeper dished side towards the viscous coupling. See 'Data' section for correct torque figures.
10. Adjust the fan belt and compressor belt.

RADIATOR

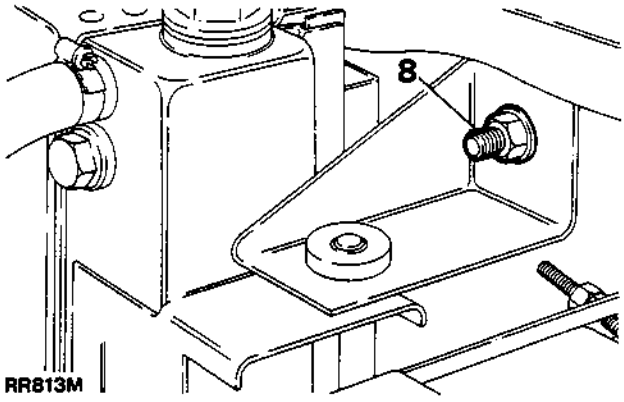
Remove and refit

Removing

1. Drain the cooling system.
2. Remove the fan blades.
3. Remove the fan cowl.
4. Disconnect the top hose from the radiator.



5. Disconnect the hose to the expansion tank.
6. Disconnect the hose to the induction manifold.
7. Disconnect the hose from the bottom of the radiator.
8. Remove the fixings from each side of the radiator.



9. Withdraw the radiator from the rubber-mounted spigots.

Refitting

10. Reverse 1 to 9 noting the assembly order of the radiator side fixings and ensuring that the radiator sealing strips are correctly located and secure.

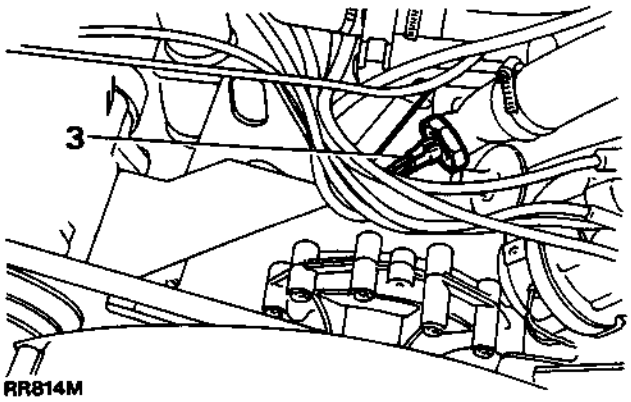
THERMOSTAT

Remove and refit

Test

Removing

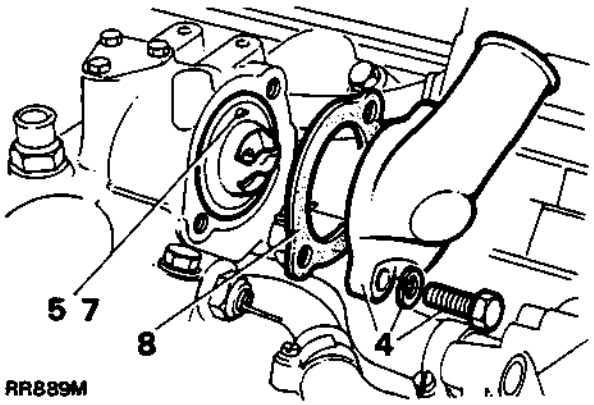
1. Drain the cooling system, sufficient to drain the induction manifold.
2. Disconnect the hose to the radiator.



3. Disconnect the electrical connections to the water temperature switch, if fitted.

Continued

4. Remove the outlet elbow.
5. Withdraw the thermostat.



Testing

6. Note that the rating of the thermostat is 88°C. Place the thermostat in a suitable container half full of water. Heat the water and observe the temperature at which the thermostat opens.

Refitting

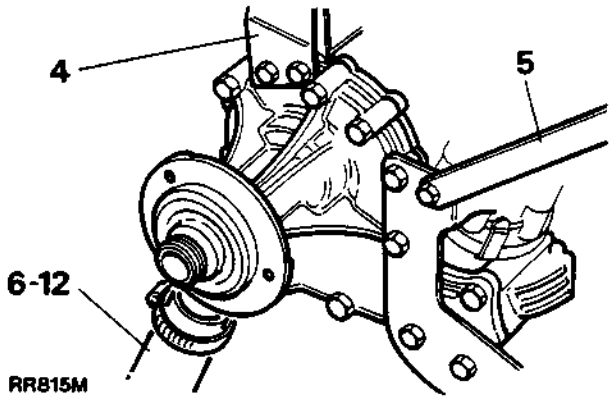
7. Insert the thermostat with the jiggle pin uppermost (12 o'clock).
8. Using a new joint washer, fit the outlet elbow and tighten to the correct torque, see 'Data' section.
9. Reverse 1 to 3.

WATER PUMP

Remove and refit

Removing

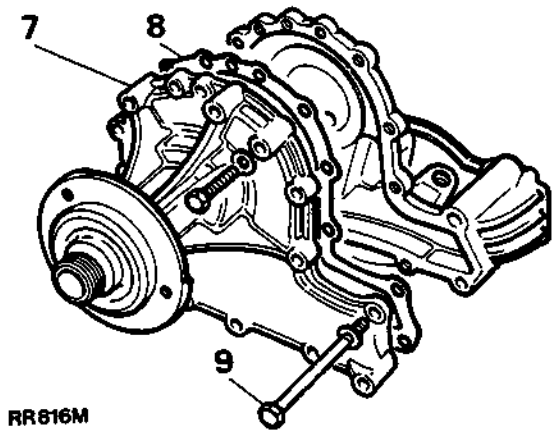
1. Drain the engine cooling system.
2. Remove the fan belt and, where fitted, the compressor belt.
3. Remove the fan blades and pulley.
4. Remove the air control valve from the support bracket (carburetter vehicles only).
5. Release the alternator adjusting link and the power-steering pump fixings.
6. Disconnect the inlet hose from the water pump.



7. Remove the water pump.

Refitting

8. Lightly grease a new joint washer and place it in position on the timing cover.



9. Clean the threads of the four long bolts and smear with Loctite 572 thread lubricant–sealant.
10. Locate the water pump in position.
11. Locate the alternator adjusting link and power-steering pump bracket.
12. Leave the alternator adjusting link loose and tighten the remaining water pump housing bolts evenly and to the correct torque, see 'Data' section.
13. Connect the inlet hose to the water pump.
14. Fit the fan pulley.
15. Fit the air-control valve to the support bracket.
16. Fit and adjust the fan belt, power-steering pump belt and, where applicable, the compressor belt.
17. Fit the fan blade assembly.
18. Refill the cooling system.

COOLING SYSTEM FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—EXTERNAL LEAKAGE	1. Loose hose clips	1. Tighten
	2. Defective rubber hose	2. Renew
	3. Damaged radiator seams	3. Rectify
	4. Excessive wear in the water pump	4. Renew
	5. Loose core plugs	5. Renew
	6. Damaged gaskets	6. Renew
	7. Leaks at the heater connections or plugs	7. Rectify
	8. Leak at the water temperature gauge plug	8. Tighten
B—INTERNAL LEAKAGE	1. Defective cylinder head gasket	1. Renew. Check engine oil for contamination and refill as necessary
	2. Cracked cylinder wall	2. Renew cylinder block
	3. Loose cylinder head bolts	3. Tighten. Check engine for oil contamination and refill as necessary
C—WATER LOSS	1. Boiling	1. Ascertain the cause of engine overheating and correct as necessary
	2. Internal or external leakage	2. See items A and B
	3. Restricted radiator or inoperative thermostat	3. Flush radiator or renew the thermostat as necessary
D—POOR CIRCULATION	1. Restriction in system	1. Check hoses for crimps, reverse-flush the radiator, and clear the system of rust and sludge
	2. Insufficient coolant	2. Replenish
	3. Inoperative water pump	3. Renew
	4. Loose fan belt	4. Adjust
	5. Inoperative thermostat	5. Renew
E—CORROSION	1. Excessive impurity in the water	1. Use only soft, clean water together with correct anti-freeze or inhibitor mixture
	2. Infrequent flushing and draining of system	2. The cooling system should be drained and flushed thoroughly at least once a year
	3. Incorrect anti-freeze mixtures	3. Certain anti-freeze solutions have a corrosive effect on parts of the cooling system. Only recommended solutions should be used
F—OVERHEATING	1. Poor circulation	1. See item D
	2. Dirty oil and sludge in engine	2. Refill
	3. Radiator fins choked with chaff, mud, etc.	3. Use air pressure from the engine side of the radiator and clean out passages thoroughly
	4. Incorrect ignition timing	4. Check using electronic equipment
	5. Insufficient coolant	5. See item D
	6. Low oil level	6. Replenish
	7. Tight engine	7. New engines are very tight during the 'running-in' period and moderate speeds should be maintained for the first 1,000 miles (1,500 km)
	8. Choked or damaged exhaust pipe or silencer	8. Rectify or renew
	9. Dragging brakes	9. Adjust brakes
	10. Overloading vehicle	10. In the hands of the operator
	11. Driving in heavy sand or mud	11. In the hands of the operator
	12. Engine labouring on gradients	12. In the hands of the operator
	13. Low gear work	13. In the hands of the operator
	14. Excessive engine idling	14. In the hands of the operator
	15. Inaccurate temperature gauge	15. Renew
	16. Defective thermostat	16. Renew
G—OVERCOOLING	1. Defective thermostat	1. Renew
	2. Inaccurate temperature gauge	2. Renew

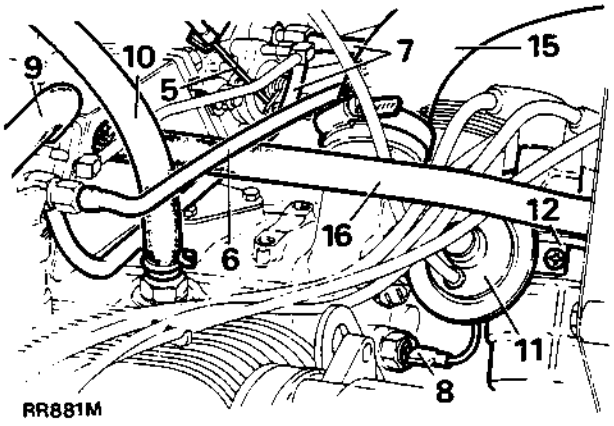
INDUCTION MANIFOLD

Remove and refit

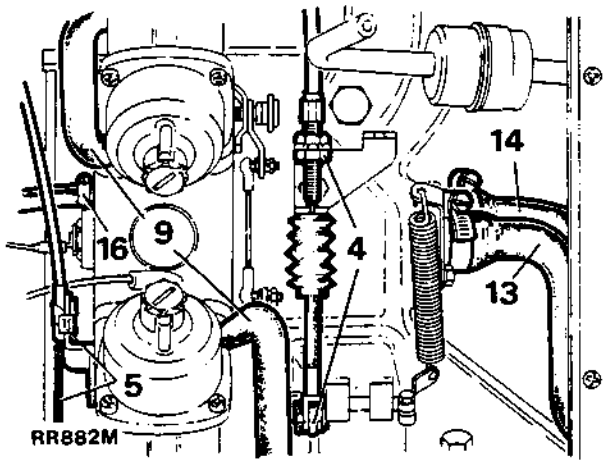
NOTE: Refer to electronic fuel injection, section 19, for remove and refit of EFI induction manifold.

Removing

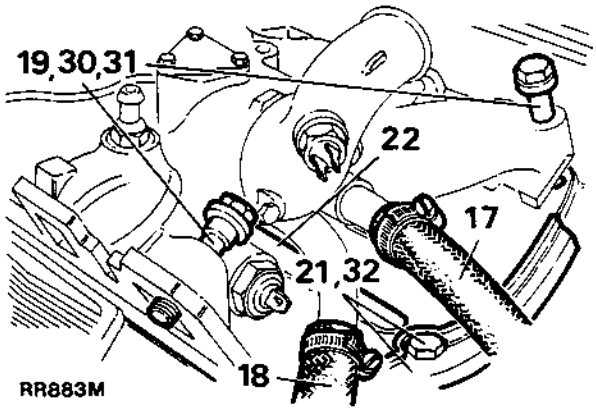
1. Drain the cooling system.
2. Remove the air cleaner.
3. Remove the engine breather filter.
4. Disconnect the throttle cable from the carburetter and manifold.



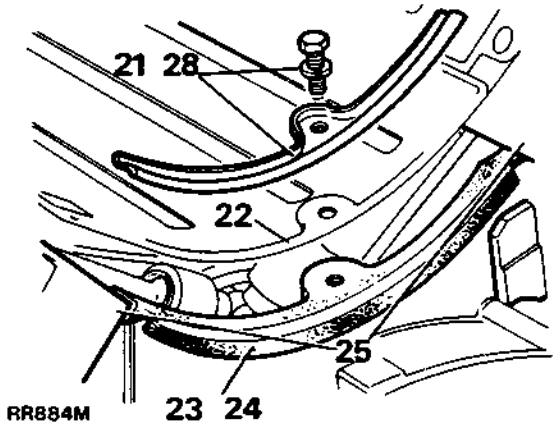
5. Disconnect the choke cable from the carburetter.
6. Disconnect the fuel spill return pipe from the RH carburetter.
7. Remove the fuel supply pipe from the carburetters.



8. Disconnect the lead from the water temperature transmitter.
9. Disconnect the flame trap hoses from the carburetters.
10. Disconnect the vacuum pipe for the brake servo.
11. Disconnect the vacuum pipe from the distributor.
12. Release the distributor cap.
13. Disconnect the inlet hose to the heater.
14. Disconnect the return hose from the heater.
15. Disconnect the return hose to the radiator.
16. Disconnect the return hose from the top of the induction manifold.



17. Disconnect the outlet hose from the manifold.
18. Disconnect the heater return hose from the manifold.
19. Evenly slacken and withdraw twelve bolts and remove the manifold.
20. Wipe away any coolant lying on the manifold gasket.
21. Remove the gasket clamps.
22. Lift off the gasket.
23. Withdraw the gasket seals.

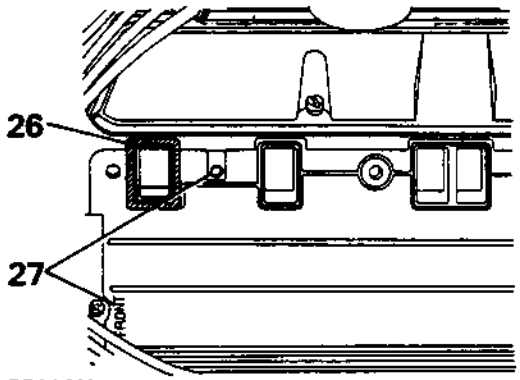


Refitting

24. Using new seals, smear them on both sides with silicon grease.
25. Locate the seals in position with their ends engaged in the notches formed between the cylinder head and block.
26. Apply 'Hylomar' sealing compound SQ32M on the corners of the cylinder head, manifold gasket and manifold, around the water passage joints.
27. Fit the manifold gasket with the word 'FRONT' to the front and the open bolt hole at the front RH side.

Continued

28. Fit the gasket clamps but do not fully tighten the bolts at this stage.
29. Locate the manifold onto the cylinder head.
30. Clean the threads of the manifold securing bolts and then coat them with Thread Lubricant-sealer 3M EC776.
31. Fit all the manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre to each end. Finally tighten to the correct torque, see Data section.



RR885M

32. Tighten the gasket clamp bolts to the correct torque, see Data section.
33. Reverse 1 to 18.
34. Run the engine and check for water leaks.

EXHAUST SYSTEM COMPLETE

Remove and refit, 1 to 11

Front pipe, left hand 1 to 3 and 12

Front pipe, right hand 1 to 3 and 12

Silencer 4, 7, 8 and 13

Intermediate pipe 1 to 6 and 14

Tail pipe 7, 9, 10 and 15

NOTE: Ensure that no exhaust leaks are evident in either a new or an old exhaust system, as this will affect vehicle performance.

Removing

Note that a gasket is fitted between manifold and down pipe on EFI models—see inset.

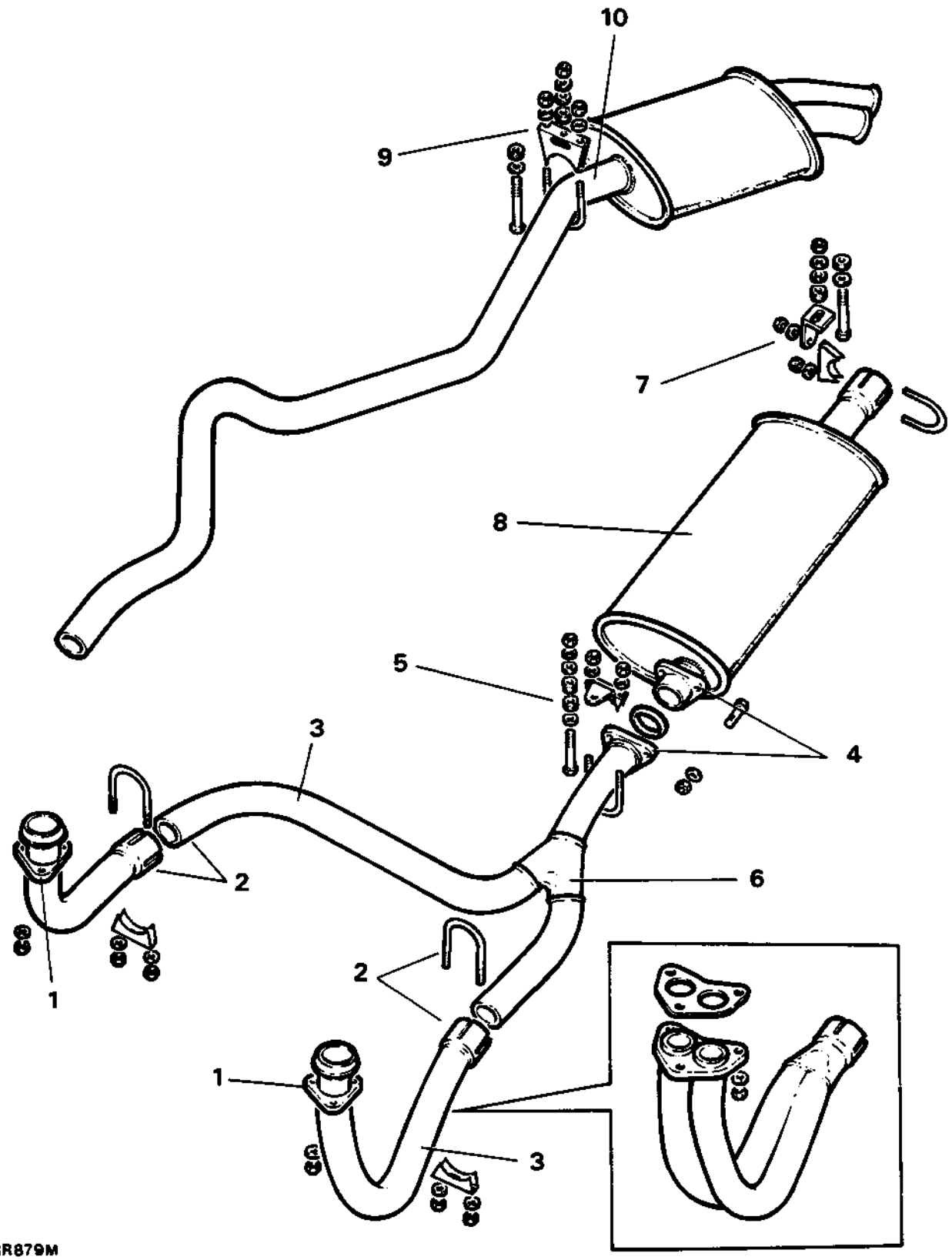
1. Disconnect the front pipe(s) from the manifold(s).
2. Slacken the U-bolts securing the front and intermediate pipes.
3. Withdraw the front pipe(s).
4. Remove three bolts securing the intermediate pipe to the main silencer and withdraw the olive.
5. Remove the U-bolt from the pipe mounting bracket.
6. Withdraw the intermediate pipe.
7. Remove the U-bolt from the pipe mounting bracket
8. Withdraw the silencer.
9. Remove the U-bolt from the tail pipe mounting bracket.
10. Withdraw the tail pipe.

Refitting

NOTE: Apply Firegum Putty, Part No 15608 to the joints between the downpipe and intermediate pipe and between the silencer and tailpipe.

11. Complete system, reverse 1 to 10.
12. Front pipe, reverse 1 to 3.
13. Silencer, reverse 4, 7 and 8.
14. Intermediate pipe, reverse 1 to 6.
15. Tail pipe, reverse 7, 9 and 10.

EXHAUST SYSTEM COMPLETE



RR879M

EXHAUST MANIFOLD

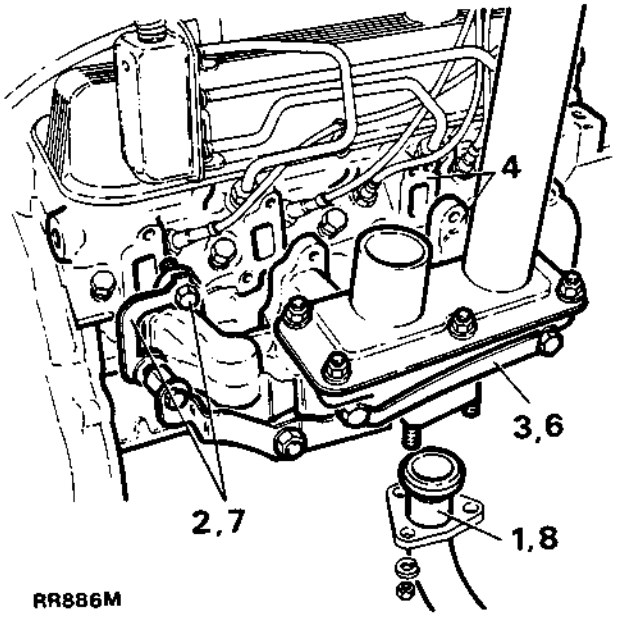
Remove and refit

Left hand

Right hand

Removing

1. Disconnect the front exhaust pipe from the manifold and (where fitted) remove the hot air box.
2. Tap back the bolt locking tabs and remove eight bolts with lock tabs and washers.
3. Remove the manifold.



Refitting

4. Ensure that the mating surfaces of the cylinder head and exhaust manifold are clean and smooth.
5. Coat the exhaust manifold (cylinder head mating faces) with 'Foliac J 166' or 'Moly Paul' anti-seize compound.
   'Foliac J 166' is manufactured by Rocol Ltd., Rocol House, Swillington, Leeds, England.
   'Moly Paul' is manufactured by K.S. Paul Products Ltd., Nobel Road, London N18.
6. Place the manifold in position on the cylinder head and fit the securing bolts, lockplates and plain washers. The plain washers are fitted between the manifold and lockplates.
7. Evenly tighten the manifold bolts to the correct torque, see Data section, and bend over the lockplate tabs.
8. Reconnect the front exhaust pipe.

CLUTCH ASSEMBLY

Overhaul

Clutch pressure plate

Renew the pressure plate if the diaphragm spring fingers are worn or if the pressure plate shows signs of wear, cracks or burning.

Clutch driven plate

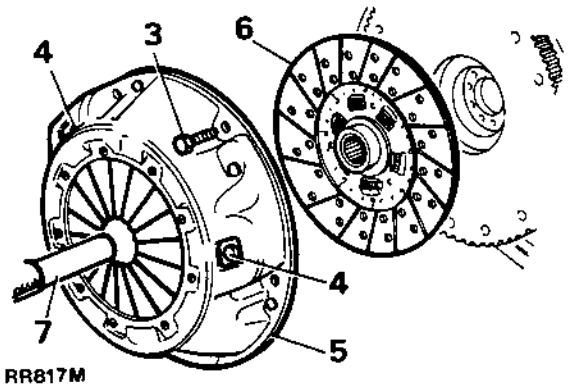
Renew the driven plate if the centre hub splines are worn or if the lining is contaminated, burned or unevenly worn.

Remove and refit

Service tool: 18G 79 clutch centralising tool

Removing

1. Remove the engine.
2. Mark the clutch cover fitted position relative to the flywheel.
3. Remove the clutch cover securing bolts, working evenly and diagonally.
4. Do not disturb the three bolts located in the apertures in the clutch cover.
5. Remove the clutch assembly.
6. Withdraw the clutch driven plate.



RR817M

Refitting

NOTE: As a precaution against the clutch plate sticking, lubricate the splines using Rocol MV 3 or Rocol MTS 1000 grease.

7. Reverse 5 and 6, aligning the assembly marks. Centralising tool 18G 79.
8. Secure the cover fixings evenly, working in a diagonal sequence. Finally tighten to the correct torque, see Data section.
9. Fit the engine.

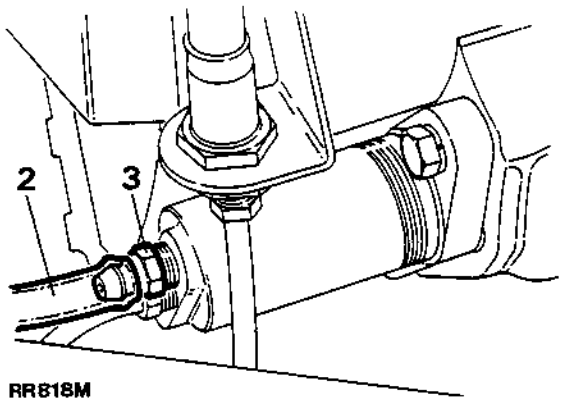
HYDRAULIC SYSTEM

Bleed

Procedure

NOTE: During the following procedure, keep the fluid reservoir topped up to avoid introducing air to the system. Use only the hydraulic fluid recommended in Section 09.

1. Attach a length of suitable tubing to the slave cylinder bleed screw.
2. Place the free end of the tube in a glass jar containing clutch fluid.
3. Slacken the bleed screw.



RR818M

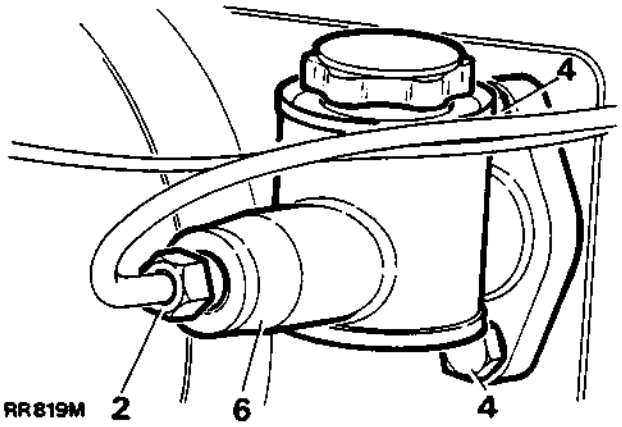
4. Pump the clutch pedal, pausing at the end of each stroke, until the fluid issuing from the tubing is free of air with the tube free end below the surface of the fluid in the container.
5. Hold the clutch pedal down. Keeping the free end of the tube below the fluid, tighten the bleed screw.

MASTER CYLINDER

Remove and refit

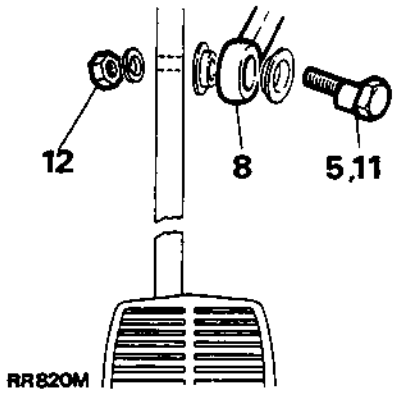
Removing

1. Evacuate the hydraulic fluid from the system.
2. Disconnect the fluid pipe at the master cylinder. Plug the master cylinder fluid port and seal the end of the hydraulic pipe to prevent ingress of foreign matter.
3. Remove the lower fascia panel.
4. Remove the master cylinder fixings at the dash panel.
5. Remove the pivot bolt and sleeves to free the push rod from the clutch pedal.
6. Withdraw the master cylinder.

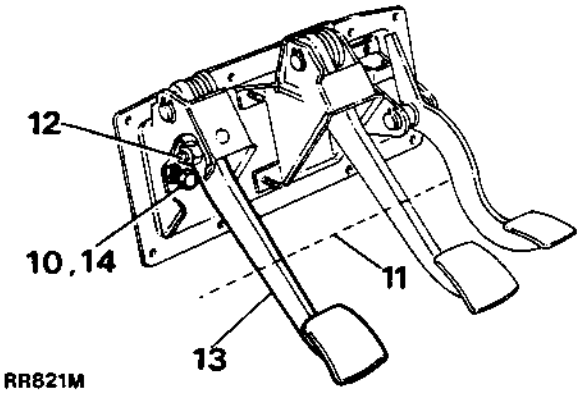


Refitting

7. Fit the master cylinder and dash fixings.
8. Fit the push-rod to the pedal. Do not tighten the pivot bolt nut at this stage.



9. Check the brake pedal setting.
10. Back off the lower stop bolt.
11. Align the clutch pedal to the same angle as the brake pedal by turning the pivot bolt and integral cam.
12. Tighten the pivot bolt securing nut.
13. Fully depress the pedal.
14. Adjust the lower stop bolt to touch the pedal then continue a further turn.



15. Fit the fluid pipe to the master cylinder.
16. Bleed and replenish the hydraulic system.
17. Fit the lower fascia panel.

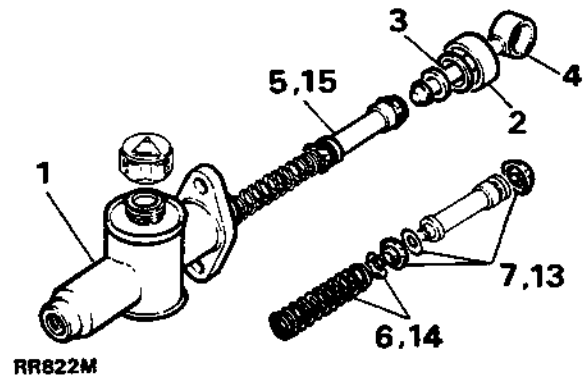
MASTER CYLINDER

Overhaul

1. Remove the master cylinder.

Dismantling

2. Pull back and remove the rubber sealing boot from the pushrod.
3. Depress the push-rod and extract the circlip.
4. Withdraw the push-rod assembly.
5. Withdraw the piston assembly.
6. Withdraw the retainer and spring.

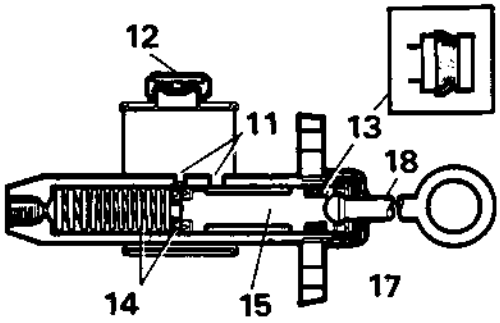


7. Remove the two piston seals and the piston washer.

Inspecting

8. Clean all the components thoroughly using new hydraulic fluid. Dry, using a lint-free cloth.

9. Examine the cylinder bore and piston, ensure that they are smooth to the touch with no corrosion, score marks or ridges. If there is any doubt, fit new replacements.
10. Replace the seals and rubber boot using new components. These items are all included in the master cylinder overhaul kit.
11. Ensure that the feed and by-pass ports are not obstructed.



RR823M

12. Ensure the reservoir cap vent is clear.

Assembling

NOTE: Scrupulous cleanliness is essential, ensure that the hands are free of grease or dirt. Lubricate the cylinder bore and rubber seals with new hydraulic fluid before assembling.

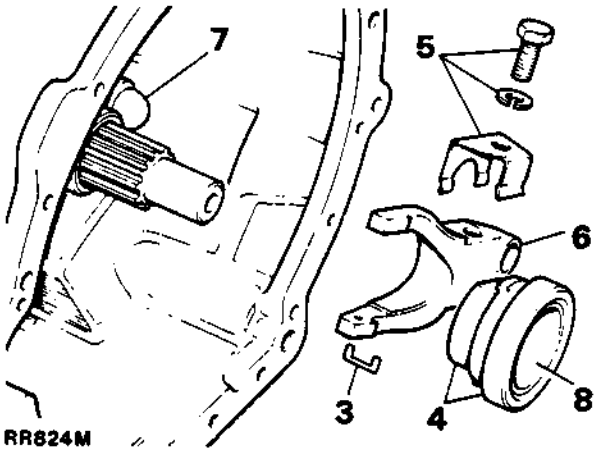
13. Fit a new piston washer and the thinner of the two piston seals, lip last, over the piston nose, up against the drilled piston head. Fit the thicker seal into the piston groove with the lip facing towards the seal at the opposite end.
14. Insert the spring and retainer into the master cylinder bore.
15. Insert the piston and seal assembly, ensuring that the seal lips do not bend back.
16. Reverse 3 and 4, correctly locating the circlip.
17. Gently stretch the new rubber boot over the push-rod, pack with rubber grease, and fit securely into its locating groove.
18. Operate the push-rod several times to ensure free movement of the internal components.
19. Fit the master cylinder.

RELEASE BEARING ASSEMBLY

Remove and refit

Removing

1. Remove the engine.
2. Remove the clutch slave cylinder.
3. Withdraw the retainer staple.



RR824M

4. Withdraw the bearing and sleeve. If required, press the bearing off the sleeve. Fit the replacement bearing with the domed face outwards from sleeve.
5. Remove the spring clip and fixings.
6. Withdraw the release lever assembly.

Refitting

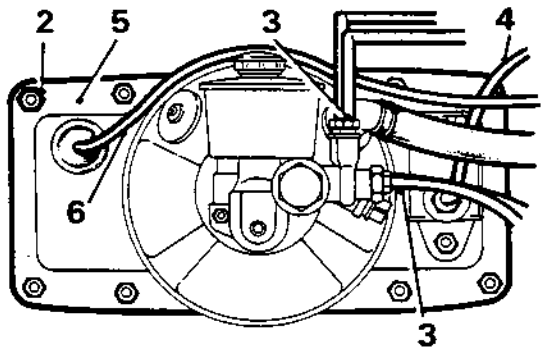
7. Smear the pivot with grease and fit the release lever and retain with the spring clip and bolt.
8. Smear the release bearing sleeve inner diameter with molybdenum disulphide base grease.
9. Reverse 1 to 4.

CLUTCH PEDAL

Remove and refit

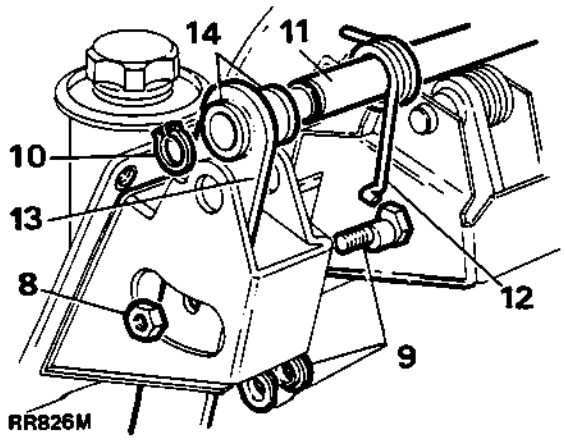
Removing

1. Remove the lower fascia panel.
2. Remove the pedal bracket fixings at the cab dash panel.
3. Disconnect the brake fluid pipes and electrical connection at the brake master cylinder.
4. Disconnect the fluid pipe at the clutch master cylinder.
5. Withdraw the pedal bracket assembly into the engine compartment.



RR825M

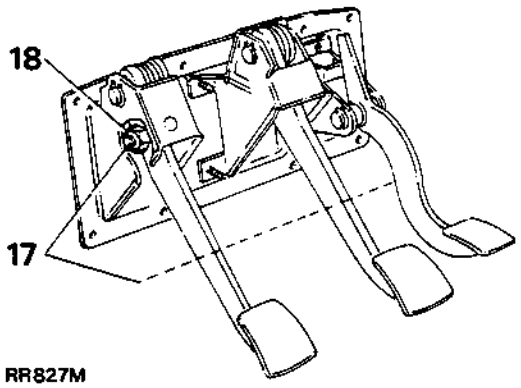
6. Disconnect the accelerator control cable at the pedal.
7. Withdraw the pedal bracket assembly from the vehicle.
8. Remove the pivot bolt nut.
9. Withdraw the pivot bolt and bearing sleeves which retain the master cylinder push-rod.
10. Remove the pedal spindle circlip.
11. Withdraw the spindle.
12. Lift out the return spring.
13. Withdraw the pedal.
14. If required, press out the spindle bushes. Press in replacements and lubricate.



RR826M

Refitting

15. Reverse 9 to 13.
16. Loosely fit the pivot bolt nut.
17. Align the clutch pedal to the same angle as the brake pedal by turning the pivot bolt and integral cam.
18. Tighten the pivot bolt securing nut.



RR827M

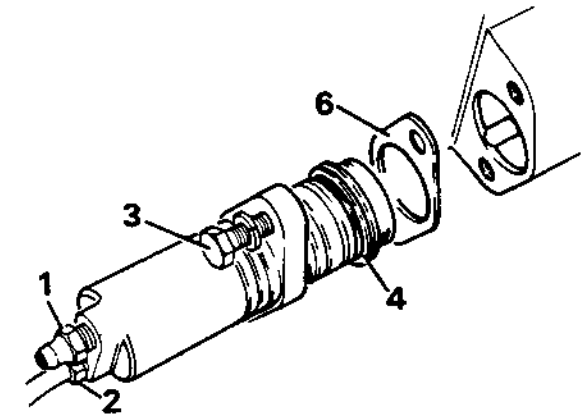
19. Fit the accelerator cable.
20. Offer the pedal bracket assembly and joint washer to the dash panel. Avoid damaging the brake light switch.
21. Reverse 1 to 4.
22. Bleed the brake system.
23. Bleed the clutch system.

SLAVE CYLINDER

Remove and refit

Removing

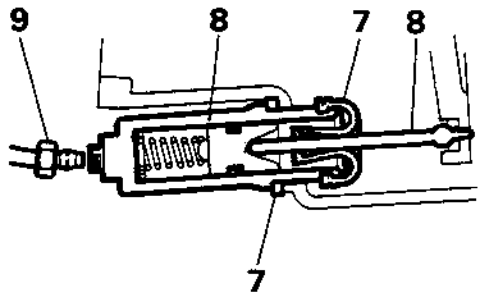
1. Evacuate the clutch system fluid at the slave cylinder bleed valve.
2. Disconnect the fluid pipe.
3. Remove the two securing bolts and withdraw the slave cylinder and backing plate.
4. If the dust cover is not withdrawn with the slave cylinder, withdraw it from the bell housing.



RR828M

Refitting

5. Withdraw the dust cover and backing plate from the slave cylinder.
6. Coat both sides of the backing plate with Hylomar P232M waterproof jointing compound.
7. Locate the backing plate and dust cover in position on the slave cylinder.
8. Fit the slave cylinder, engaging the push-rod through the centre of the dust cover and with the bleed screw uppermost.



RR829M

9. Reconnect the fluid pipe.
10. Replenish and bleed the clutch hydraulic system.
11. Check for fluid leaks with the pedal depressed and also with the system at rest.

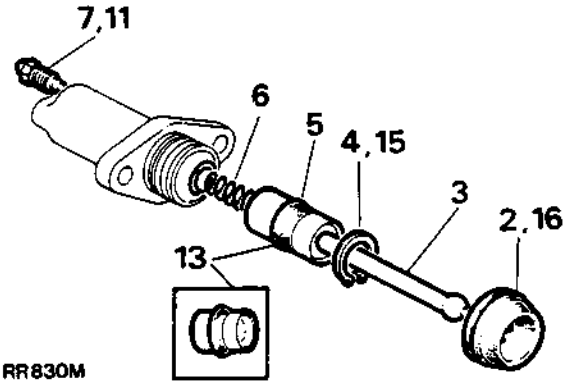
SLAVE CYLINDER

Overhaul

1. Remove the slave cylinder.

Dismantling

2. Withdraw the rubber boot.
3. Withdraw the push-rod.
4. Remove the circlip.
5. Extract the piston and seal assembly, applying low pressure air to the fluid inlet if necessary.
6. Withdraw the spring.
7. Remove the bleed valve.



RR830M

Inspecting

8. Clean all components thoroughly using new hydraulic fluid, and dry using lint-free cloth.
9. Examine the cylinder bore and piston which must be free from corrosion, scores and ridges.
10. Replace the seal and rubber boot using the appropriate repair kit.

Assembling

NOTE: Scrupulous cleanliness is essential, ensure that hands are free of grease or dirt.

11. Fit the bleed valve. Do not overtighten.
12. Lubricate the seals, piston and bore using new hydraulic fluid.
13. Fit the seal into the piston groove, the lip of the seal towards the fluid inlet end of the cylinder.
14. Enter the piston assembly, spring first, into the cylinder bore. Ensure that the seal lip does not fold back.
15. Secure with the circlip.
16. Fill the rubber boot with rubber grease.
17. Reverse 1 to 3.

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Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which they save can be considerable.

Every special tool is designed with the close co-operation of Land Rover Ltd., and no tool is put into production which has not been tested and approved by us. New tools are only introduced where an operation cannot be satisfactorily carried out using existing tools or standard equipment. The user is therefore assured that the tool is necessary and that it will perform accurately, efficiently and safely.

Special tools bulletins will be issued periodically giving details of new tools as they are introduced.

All orders and enquiries from the United Kingdom should be sent direct to V. L. Churchill. Overseas orders should be placed with the local V. L. Churchill distributor, where one exists. Countries where there is no distributor may order direct from V. L. Churchill Limited.

The tools recommended in this Repair Operation Manual are listed in a multi-language, illustrated catalogue obtainable from Messrs. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address: Land Rover Limited, Service Department, Lode Lane, Solihull, West Midlands, England B92 8NW.

ABBREVIATIONS AND SYMBOLS USED IN THIS MANUAL

Across flats (bolt size)	AF
After bottom dead centre	ABDC
After top dead centre	ATDC
Alternating current	a.c.
Ampere	amp
Ampere-hour	amp hr
Atmospheres	Atm
Before bottom dead centre	BBDC
Before top dead centre	BTDC
Bottom dead centre	BDC
Brake mean effective pressure	BMEP
Brake horse power	bhp
British Standards	BS
Carbon monoxide	CO
Centimetre	cm
Centigrade (Celsius)	C
Cubic centimetre	cm^3
Cubic inch	in^3
Degree (angle)	deg or °
Degree (temperature)	deg or °
Diameter	dia.
Direct current	d.c.
Fahrenheit	F
Feet	ft
Feet per minute	ft/min
Fifth	5th
Figure (illustration)	Fig.
First	1st
Fourth	4th
Gramme (force)	gf
Gramme (mass)	g
Gallons	gal
Gallons (US)	US gal
High compression	h.c.
High tension (electrical)	H.T.
Hundredweight	cwt
Independent front suspension	i.f.s.
Internal diameter	i.dia.
Inches of mercury	in.Hg
Inches	in
Kilogramme (force)	kgf
Kilogramme (mass)	kg
Kilogramme centimetre (torque)	kgf.cm
Kilogramme per square centimetre	kg/cm^2
Kilogramme metres (torque)	kgf.m
Kilometres	km
Kilometres per hour	km/h
Kilovolts	kV
King pin inclination	k.p.i.
Left-hand steering	LHStg
Left-hand thread	LHThd
Litres	litre
Low compression	l.c.
Low tension	l.t.
Maximum	max.
Metre	m
Microfarad	mfd
Midget edison screw	MES
Millimetre	mm
Miles per gallon	mpg
Miles per hour	mph
Minimum	min
minute (angle)	'
Minus (of tolerance)	−
Negative (electrical)	−
Number	No.
Ohms	ohm
Ounces (force)	ozf
Ounces (mass)	oz
Ounce inch (torque)	ozf.in.
Outside diameter	o.dia.
Paragraphs	para.
Part number	Part No.
Percentage	%
Pints	pt
Pints (US)	US pt
Plus (tolerance)	+
Positive (electrical)	+
Pound (force)	lbf
Pounds feet (torque)	lbf.ft.
Pounds inches (torque)	lbf.in.
Pound (mass)	lb
Pounds per square inch	lb/in^2
Radius	r
Rate (frequency)	c/min
Ratio	:
Reference	ref.
Revolution per minute	rev/min
Right-hand	RH
Right-hand steering	RHStg
Second (angle)	"
Second (numerical order)	2nd
Single carburetter	SC
Specific gravity	sp.gr.
Square centimetres	cm^2
Square inches	in^2
Standard	std.
Standard wire gauge	s.w.g.
Synchroniser/synchromesh	synchro.
Third	3rd
Top dead centre	TDC
Twin carburetters	TC
United Kingdom	UK
Vehicle Identification Number	VIN
Volts	V
Watts	W

SCREW THREADS

American Standard Taper Pipe	NPTF
British Association	BA
British Standard Fine	BSF
British Standard Pipe	BSP
British Standard Whitworth	Whit.
Unified Coarse	UNC
Unified Fine	UNF

TRANSMISSION

Main gearbox

Model ..... LT77 (manual)

Type ..... Five-speed, single helical constant mesh with synchromesh on all forward gears

Ratios .....

5th	0.770 :1
4th	1.000 :1
3rd	1.397 :1
2nd	2.132 :1
1st	3.321 :1
Reverse	3.429 :1

Transfer gearbox

Model LT230T

Type ..... Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential

Ratios .....

High	1.192 :1
Low	3.320 :1

Overall ratio (including final drive) .....

	High Transfer	Low Transfer
5th	3.25 :1	9.05 :1
4th	4.22 :1	11.75 :1
3rd	5.89 :1	16.41 :1
2nd	8.99 :1	25.04 :1
1st	14.01 :1	39.02 :1
Reverse	14.46 :1	40.27 :1

TRANSMISSION

Main gearbox

Model ..... ZF 4HP 22 (automatic)

Type ..... Automatic four-speed and reverse epicyclic gearbox with fluid torque converter and lock-up

Ratio .....

4th	0.728 :1
3rd	1.000 :1
2nd	1.480 :1
1st	2.480 :1
Reverse	2.086 :1

Transfer gearbox

Model LT230T

Type ..... Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential

Ratios .....

High	1.192 :1
Low	3.320 :1

Overall ratio (including final drive) .....

	High Transfer	Low Transfer
4th	3.08 :1	8.553 :1
3rd	4.218 :1	11.747 :1
2nd	6.240 :1	17.380 :1
1st	10.458 :1	29.127 :1
Reverse	8.797 :1	24.501 :1

SHIFT SPEED SPECIFICATION
Automatic ZF 4HP22 Gearbox

OPERATION	SELECTOR POSITION	VEHICLE SPEED APPROX.		ENGINE SPEED APPROX. (RPM)
		MPH	KPH	
		KICK DOWN		
KD 1–2	D	35–40	56–64	4600–5250
KD 2–3	D	61–67	97–107	4750–5200
KD 4–2	D	34–63	54–101	
KD 4–1	D	16–34	25–54	
KD 3–2	3	57–64	91–102	
		FULL THROTTLE		
FT 1–2	D	27–33	43–53	3600–4300
FT 2–3	D	55–61	88–98	4350–4800
FT 3–4	D	75–82	120–131	3980–4330
FT 4–3	D	61–68	98–109	
FT 3–2	3	40–47	64–75	
		ZERO THROTTLE		
ZT 4–3	D	19–26	30–42	
ZT 3–2	D	12–16	19–25	
ZT 2–1	D	6–7	10–12	
		PART THROTTLE		
PT 4–3	D	47–55	75–88	
PT 3–2		29–37	46–59	
PT 2–1		10–12	16–25	
		LIGHT THROTTLE		
LT 1–2	D	8–10	13–16	1180–1220
LT 2–3	D	18–23	29–37	1420–1820
LT 3–4	D	27–31	43–50	1430–1650
Lock Up	IN	40–44	64–70	1480–1620
	OUT	39–42	62–67	1430–1560

PROPELLER SHAFTS
Type ..... Open type 50.8 mm (2 in) diameter
Universal joints ..... 03EHD standard shafts

REAR AXLE
Type ..... Spiral bevel, fully floating shafts
Ratio ..... 3.54 :1

FRONT AXLE
Type ..... Spiral bevel enclosed constant velocity joint
Angularity of joint on full lock ..... 32°
Ratio ..... 3.54 :1

TORQUE WRENCH SETTINGS — TRANSFER GEARBOX LT230T

COMPONENT	DESCRIPTION	QUANTITY	Nm	lbf ft
Pinch bolt, operating arm	6 × 25,0 mm bolt	1	7 to 10	5 to 7
Gate plate to grommet plate	6 × 20,0 mm screw	4	7 to 10	5 to 7
End cover	6 × 20,0 mm screw	2	7 to 10	5 to 7
Speedometer cable retainer	6 mm nut	1	7 to 10	5 to 7
Rear output/speedometer housing	6 × 30,0 mm stud	1	See note	
Locating plate to gear change housing	5 mm self lock nut	2	5 to 7	4 to 5
Bottom cover to transfer case	8 × 30,0 mm bolt	10	22 to 28	16 to 21
Front output housing to transfer case	8 × 30,0 mm bolt	7	22 to 28	16 to 21
Front output housing to transfer case	8 × 90,0 mm bolt	1	22 to 28	16 to 21
Cross shaft housing to front output housing	8 × 55,0 mm bolt	6	22 to 28	16 to 21
Gear change housing	8 × 55,0 mm bolt	2	22 to 28	16 to 21
Pivot shaft	8 mm nut	1	22 to 28	16 to 21
Connecting rod	8 mm nut	2	22 to 28	16 to 21
Anti-rotation plate intermediate shaft	8 × 20,0 mm screw	1	22 to 28	16 to 21
Front output housing cover	8 × 25,0 mm screw	7	22 to 28	16 to 21
Gear change housing	8 × 25,0 mm screw	2	22 to 28	16 to 21
Bracket to extension housing	8 × 25,0 mm screw	2	22 to 28	16 to 21
Finger housing to front output housing	8 × 25,0 mm screw	3	22 to 28	16 to 21
Mainshaft bearing housing	8 × 25,0 mm screw	2	22 to 28	16 to 21
Brake drum	8 × 20,0 mm screw	2	22 to 28	16 to 21
Gearbox to transfer box	10 × 40,0 mm bolt	3	40 to 50	29 to 37
Gearbox to transfer box	10 × 45,0 mm bolt	1	40 to 50	29 to 37
Bearing housing to transfer gearbox	10 × 35,0 mm bolt	6	40 to 50	29 to 37
Speedometer housing to transfer gearbox	10 × 30,0 mm screw	5	40 to 50	29 to 37
Speedometer housing to transfer gearbox	10 × 45 mm screw	1	40 to 50	29 to 37
Selector finger to cross shaft high/low	10 mm grub screw	1	22 to 28	16 to 21
Selector fork, high/low to shaft	10 mm grub screw	1	22 to 28	16 to 21
Transmission brake	10 × 25,0 mm bolt	4	65 to 80	48 to 59
Intermediate shaft stake nut	20,0 mm nut	1	130 to 140	96 to 104
Gate plate to grommet plate (auto only)	6 × 20,0 mm screw	4	7 to 10	5 to 7
Gate plate to gear change housing (manual versions only)	6 × 16,0 mm countersunk screw	2	7 to 10	5 to 7

Continued

TORQUE WRENCH SETTINGS (Continued)

Gearbox to transfer case	10 mm nut	2	40 to 50	29 to 37
Gearbox to transfer case	10 mm studs	2	See note	
Oil drain plug	12 × 14 mm hexagon head	1	25 to 35	19 to 26
Differential case	10 × 60 mm bolt	8	55 to 64	40 to 47
Output flanges	20 mm self locking nut	2	146 to 179	108 to 132
Differential case rear	50 mm nut	1	66 to 80	50 to 60
Link arm and cross shaft lever to ball joint	¼ inch UNF self locking nut	2	8 to 12	6 to 9
Oil filler/level plug	¾ inch taper thread	1	25 to 35	19 to 26
Transfer breather	⅛ inch B.S.P.		14 to 16	10 to 12

NOTE: Studs to be assembled into casings with sufficient torque to wind them fully home, but this torque must not exceed the maximum figure quoted for the associated nut on final assembly.

ZF4HP22 AUTOMATIC GEARBOX

	Nm	lbf/ft.
Coupling shaft to mainshaft	36 to 48	26 to 34*
Filler tube to sump	35 to 42	25 to 30
Gear change lever to gearbox	22 to 28	16 to 21
Cooler pipe adaptor to gearbox	36 to 48	26 to 34
Securing screws—clutch.F	10	7
Securing screw—parking pawl	10	7
Securing screws—pump	10	7
Intermediate plate plugs (M20)	50	37
Intermediate plate plugs (M14)	40	29
Bell housing mounting bolts	46	34
Governor mounting screws	10	7
Extension housing bolts	23	17
Control unit mounting bolts	8	6
Sump plug	10	7
Mounting screws for sump	8	6
Drive plate to converter	35 to 42	25 to 30*
Gearbox to engine	36 to 48	26 to 34
Strut (nyloc nut end)	36 to 48	26 to 34
Bottom cover to converter housing	7 to 10	5 to 7
Cover—converter housing	7 to 10	5 to 7
Drive plates to crankshaft adaptor	35 to 46	25 to 33*
Adaptor to crankshaft	77 to 90	55 to 65

NOTE: * These bolts must have threads coated with Loctite 270 prior to assembly.

MAIN GEARBOX (FIVE-SPEED)

	Nm	lbf ft.
Bottom cover to clutch housing	7 to 10	5 to 7
Oil pump body to extension case	7 to 10	5 to 7
Clip to clutch release lever	7 to 10	5 to 7
Attachment plate to gearcase	7 to 10	5 to 7
Extension case to gearcase	22 to 28	16 to 21
Pivot—clutch lever to bell housing	22 to 28	16 to 21
Guide clutch release sleeve	22 to 28	16 to 21
Slave cylinder to clutch housing	22 to 28	16 to 21
Front cover to gearcase	22 to 28	16 to 21
5th support bracket	22 to 28	16 to 21
Clutch housing to gearbox	65 to 80	48 to 59
Plug—detent spring	22 to 28	16 to 21
Oil drain plug	40 to 47	30 to 35
Oil filter plug	65 to 80	48 to 59
Breather	14 to 16	10 to 12
Oil level plug	25 to 35	19 to 26
Upper gear lever to lower gear lever	22 to 28	16 to 21
5th gear retaining nut	204 to 231	150 to 170
Attachment plate to gear change housing	7 to 10	5 to 7
Gear change housing to extension case	22 to 28	16 to 21
Plunger housing to gear change housing	22 to 28	16 to 21
Adjustment plate to gearchange housing	22 to 28	16 to 21
Cover to gear change housing	7 to 10	5 to 7
Bell housing to cylinder block bolts	36 to 45	27 to 33
Pivot plate to bell housing	22 to 28	16 to 21
Yoke to selector shaft	22 to 28	16 to 21
Locknut—plus reverse knockout	22 to 28	16 to 21

FRONT AXLE

	Nm	lbf ft.
Hub driving shaft to hub	41 to 52	30 to 38
Brake disc to hub	65 to 80	48 to 59
Stub axle to swivel pin housing	60 to 70	44 to 52*
Brake caliper to swivel pin housing	75 to 88	55 to 65
Upper swivel pin to swivel pin housing	68 to 88	50 to 65*
Lower swivel pin to swivel pin housing	68 to 88	50 to 65*
Oil seal retainer to swivel pin housing	9 to 12	7 to 9
Swivel bearing housing to axle case	65 to 80	48 to 59*
Pinion housing to axle case	36 to 46	26 to 34
Crown wheel to differential housing	55 to 61	40 to 45
Differential bearing cap to pinion housing	80 to 100	59 to 74
Differential drive flange to propeller shaft	41 to 52	30 to 38
Mudshield to bracket lower swivel pin	9 to 12	7 to 9
Bevel pinion nut	95 to 163	70 to 120
Draglink to hub arm	40	30
Panhard rod to axle bracket	88	65
Radius arm to axle	190	140
Radius arm to chassis side member	190	140

* These bolts to be coated with Loctite 270 prior to assembly.

REAR AXLE

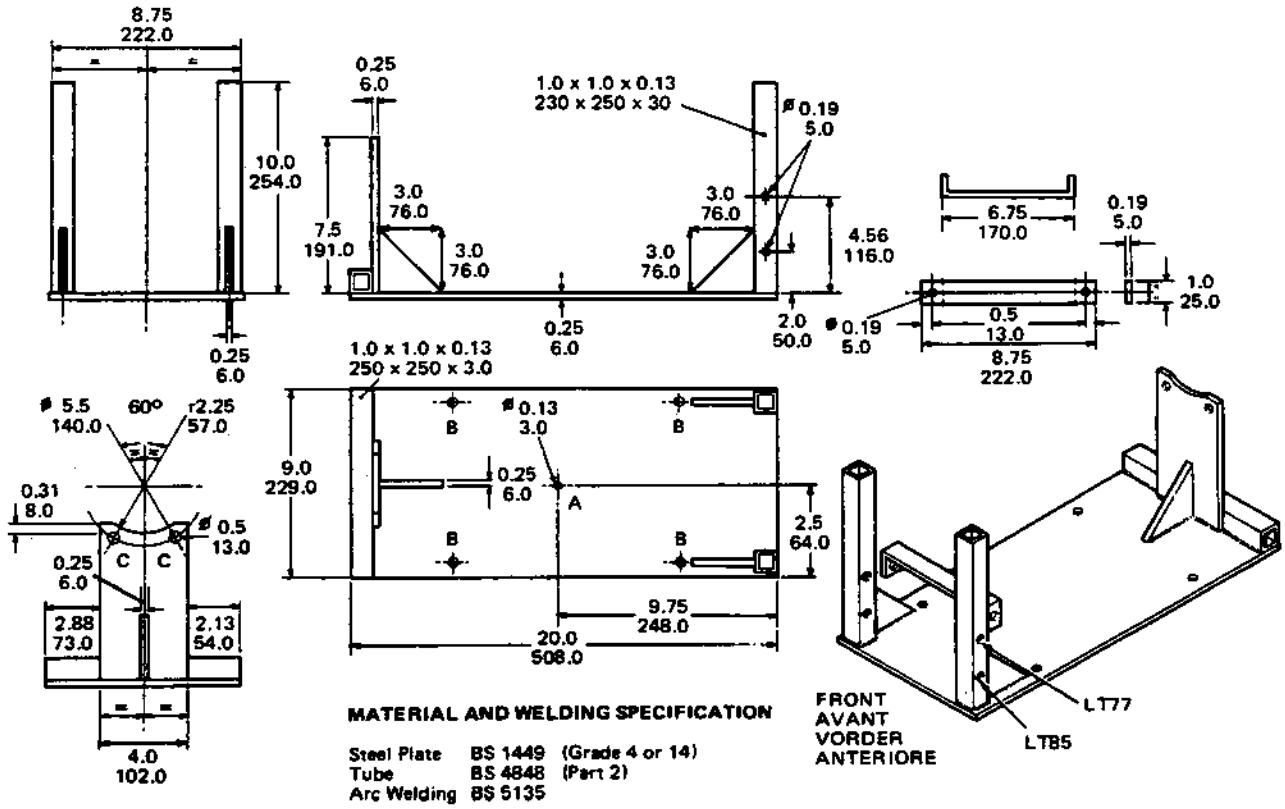
	Nm	lbf ft.
Axle shaft to hub	41 to 52	30 to 38
Brake disc to hub	65 to 80	48 to 59
Stub axle rear to axle case	60 to 70	44 to 52
Brake caliper to axle case	75 to 88	55 to 65
Pinion housing to axle case	36 to 46	26 to 34
Crown wheel to differential case	55 to 61	40 to 45
Differential bearing cap to pinion housing	80 to 100	59 to 74
Differential drive flange to propeller shaft	41 to 52	30 to 38
Mudshield to axle case	9 to 12	7 to 9
Bevel pinion nut	95 to 163	70 to 120
Lower link to axle	176	130
Pivot bracket ball joint to axle	176	130

CHARTS BELOW GIVE TORQUE SETTINGS FOR ALL SCREWS AND BOLTS USED EXCEPT FOR THOSE THAT ARE SPECIFIED OTHERWISE

SIZE	METRIC		SIZE	UNC		UNF	
	Nm	lbf ft		lbf ft	Nm	lbf ft	Nm
M5	5–7	3,7–5,2	¼	5–7	6,8–9,5	6–9	8,1–12,2
M6	7–10	5,2–7,4	5/16	15–20	20,3–27,1	15–20	20,3–27,1
M8	22–28	16,2–20,7	3/8	26–32	35,2–43,4	26–32	35,2–43,4
M10	40–50	29,5–36,9	7/16	50–65	67,8–88,1	50–65	67,8–88,1
M12	80–100	59,0–73,8	½	60–75	81,3–101,7	60–75	81,3–101,7
M14	90–120	66,4–88,5	5/8	90–110	122,0–149,1	122,0–149,1	90–110
M16	160–200	118,0–147,5					

LT77 FIVE SPEED GEARBOX AND LT230T TRANSFER BOX

1. Install the vehicle on a ramp and disconnect the battery.
2. Remove both main and transfer gear lever knobs.
3. Remove the cubby box liner, disconnect the window lift switches and release the handbrake inner cable from the handbrake lever. Release the console fixings and withdraw the console from the vehicle.
4. Remove the noise insulation pad to gain access to the gaiter. Release the four screws and drill out all the pop-rivets securing the gaiter to the top of the gearbox.
5. Disconnect the reverse light electrical leads and pull the leads through the tunnel aperture.
6. Remove the lower lock nut from the high/low operating rod.
7. Remove the spring clip from the clevis pin securing the differential lock lever to the high/low gear change housing.
8. Remove the two pan head screws securing the gear change housing top cover. Raise the cover to give access to one of the gear change housing to extension case securing bolts located by the reverse plunger assembly, and remove the bolt.
9. Remove the three remaining gear change housing to extension case securing bolts, remove the housing complete with transfer gear housing and gaiter.
10. Remove the nut securing the outer handbrake cable to the top of the tunnel and feed the inner and outer cable through its aperture to the underside of the vehicle.
11. Remove the nuts and bolts securing the fan cowl to the radiator. Move the cowling away from the radiator and hang it loosely around the fan blade assembly.
12. Release the transmission breather pipes, speedometer cable, and starter motor harness from the clips at the rear of the engine.
13. **Fuel injection models**—Disconnect the airflow meter to plenum chamber air intake hose.
14. Raise the ramp.
15. Remove the eight nuts and bolts securing the chassis cross member and using a suitable means of spreading the chassis, remove the cross member.
16. Place a suitable container under the transmission, remove the three drain plugs, allow the oil to drain and refit the plugs. Clean filter on the extension housing plug before refitting.
17. Remove the intermediate exhaust pipe and silencer section as follows:
    (a) Release the connection to the front pipe assembly at the flanges.
    (b) Release the connection to the rear section at the flange immediately behind the silencer.
    (c) Remove the 'U' bolt retaining the pipe to the bracket attached to the transfer box.
18. Mark the drive flanges for reassembly and disconnect the front propeller shaft from the transfer box.
19. Similarly, disconnect the rear propeller shaft.
20. Disconnect the speedometer cable from the rear of the transfer box.
21. Remove the two bolts and withdraw the clutch slave cylinder from the bell housing.

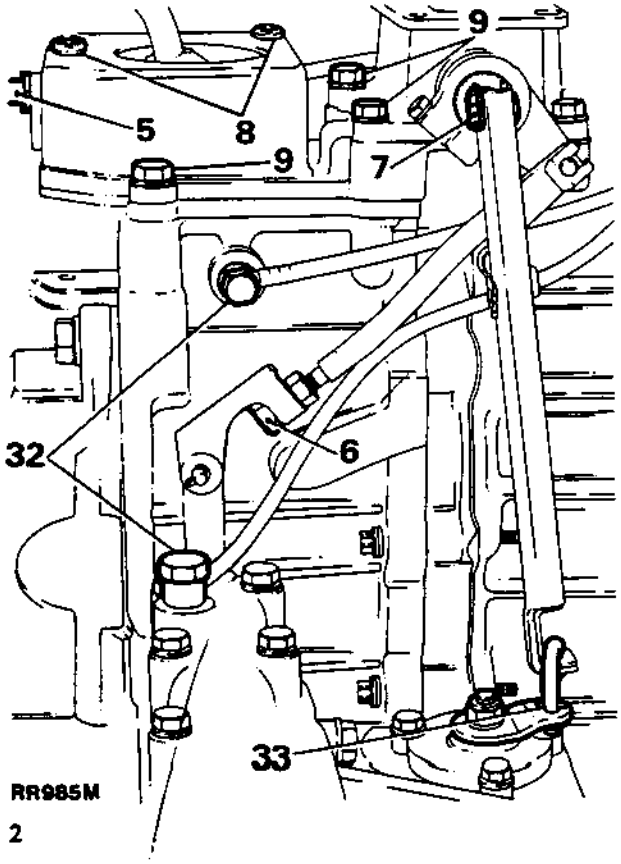


ST 538M

22. Manufacture a cradle to the dimensions given in the drawing and attach it to a transmission hoist. To achieve balance of the transmission unit when mounted on the transmission hoist, it is essential that point A is situated over the centre of the lifting hoist ram. Drill fixing holes B to suit hoist table. Secure the transmission unit to the lifting bracket at point C, by means of the lower bolts retaining the transfer gearbox rear cover.
23. Remove the bottom two bolts from the transfer box rear cover and use them to attach the rear end of the cradle to the transfer box. Ensure that the tube in the centre of the cradle locates over the extension housing drain plug.
24. Raise the hoist just enough to take the weight of the transmission.
25. Remove the three nuts and bolts securing the transfer box LH and RH mounting brackets to the chassis.
26. Remove the nuts retaining the brackets to the mounting rubbers and remove the brackets.
27. Lower the hoist sufficiently to allow the differential lock electrical leads to be disconnected from the transfer-box.
28. Support the engine under the sump with a jack, placing timber between the jack pad and sump.
29. Remove the bolts from the bell housing.
30. Withdraw the transmission whilst ensuring all connections to the engine and chassis are released.

Separating the transfer box from gearbox

31. Remove the transmission assembly from the hoist and cradle and install it safely on a bench.



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32. Remove the clip and withdraw the clevis pin securing the cross-over lever at the pivot point. Release the breather pipes from the clips at the pivot point.
NOTE: note the position of the breather pipes for re-assembly.
33. Disconnect the connecting link from the differential lock lever.
34. Place a sling round the transfer box and attach to a hoist.
35. Remove the two nuts and four bolts retaining the transfer box to the extension housing and withdraw the transfer box.

Assembling transfer box to main gearbox

36. Stand the gearbox vertically on the bell housing face on two pieces of wood to prevent damage to the primary pinnion which protrudes beyond the bell housing face. Lower the transfer gearbox onto the main gearbox, care should be taken to prevent any damage to seals. Secure the transfer gearbox to the main gearbox and tighten all bolts to the specified torque.
37. Refit the differential lock connecting link.
38. Refit the breather pipes and crossover lever.

Fitting main gearbox and transfer box to engine

39. Fit the cradle to the transmission hoist and the transmission to the cradle as described in instruction 23. Smear Hylomar on bell housing face mating with engine.
40. Locate the gear change housing temporarily on the gearbox and select any gear in the main gearbox to facilitate entry of the primary shaft, after selection remove the housing from the gearbox.
41. Position and raise the hoist to line up with the engine, feed the handbrake cable through the aperture in the tunnel, ensure that any pipes or electrical leads do not become trapped.
42. Secure the engine with seven of the eight bell housing bolts noting that the third bolt up on the left hand side is fitted with a harness clip.
43. Fit the differential lock indicator electrical leads to the transfer box.
44. Check that there are no obstructions and raise the transmission hoist until the gearbox mounting points are in line with the chassis fixing points.
45. Fit the transfer box LH and RH mounting brackets but only partially tighten the securing nuts and bolts.
46. Loosely fit the rubber mounting nuts and lower the transmission onto the mountings. Fully tighten all the securing nuts and bolts.
47. Remove the supporting jack from under the engine sump.
48. Remove the two bolts securing the cradle to the transfer box and remove the cradle and hoist.
49. Refit the two bolts using Loctite 290 on the threads and note that the LH bolt holds a clip for the speedometer cable.
50. Fit the slave cylinder using Hylosil on the gasket and tighten the two bolts evenly to the specified torque.
51. Connect the speedometer cable.

52. Check that the three drain plugs are tight and remove the main gearbox and transfer box filler level plugs. Fill the main gearbox with approximately 1,76 litres (3 pints) of a recommended oil or until it begins to run out of the filler level hole. Fit and tighten the filler plug. Similarly remove the transfer filler level plug and inject approximately 2,6 litres (4.5 pints) of recommended oil or until it runs out of the filler hole. Apply Hylosil to the threads and fit the plug and wipe away any surplus oil.
53. Line up the marks and fit the front and rear propeller shafts to the transfer box.
54. Fit the exhaust system, and evenly tighten the flange nuts and bolts. Fit the 'U' bolt and secure to the bracket.
55. Fit the bottom cover on the front of the gearbox and tighten the bolts to the specified torque.
56. Expand the chassis and fit the cross-member and secure in position with the eight bolts, lower the ramp.
57. Fit a NEW gasket to the top of the gearbox and refit the gear change housing. Coat the securing bolts with Hylomar PL32 or Loctite 290 and fit the bolts, tighten to the specified torque.
58. Reconnect the high/low operating rod and secure in position with the single lock nut.
59. Reconnect the differential lock lever to the transfer lever selector shaft, fit a NEW spring clip.
60. Refit the gear change housing top cover, apply Hylomar PL32 or loctite 290 to the forward screw tighten screws to the specified torque.
61. Re-connect the electrical leads to the reverse light switch.
62. Secure the gaiter in position using self tapping screws or pop rivets and position the insulation pad.
63. Refit the centre console, reconnect the handbrake cable using a NEW split pin. Secure the outer cable to the top of the tunnel.
64. Connect the electrical plugs to the window lift switches and refit the cubby box liner.
65. Refit the main and transfer gearbox knobs.
66. Refit the radiator cowl and reconnect the battery.
67. Re-clip the transmission breather pipes, speedometer cable and starter motor harness to the rear of the engine.
68. **Fuel Injection models**—Re-connect the plenum chamber to airflow meter air intake hose.

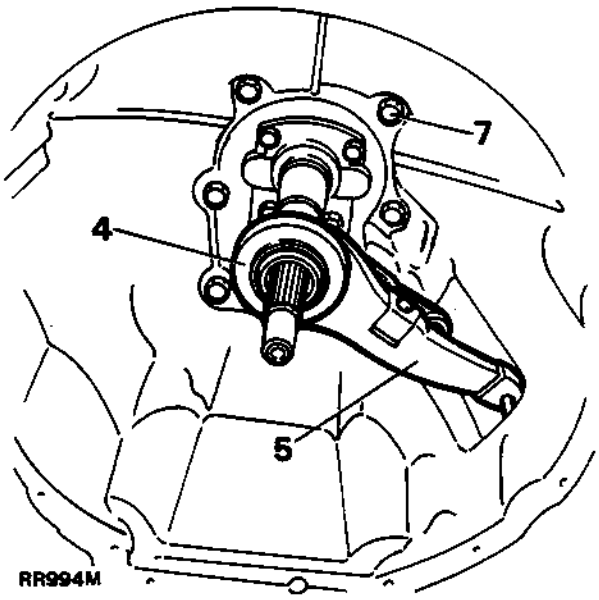
OVERHAUL LT77 FIVE SPEED GEARBOX

Service Tools:

18G705—Bearing remover
18G705-1A—Adaptor for mainshaft
18G705-5—Adaptor for layshaft
18G1400—Remover for synchromesh hub and gear cluster
18G1400-1—Adaptor mainshaft fifth gear
MS47—Hand press
18G47BA—Adaptor, layshaft bearing remover
18G47BAX—Conversion kit
18G284—Impulse extractor
18G284AAH—Adaptor for input shaft pilot bearing track
18G1422—Mainshaft rear oil seal replacer
18G1431—Mainshaft fifth gear and oil seal collar replacer

Dismantle

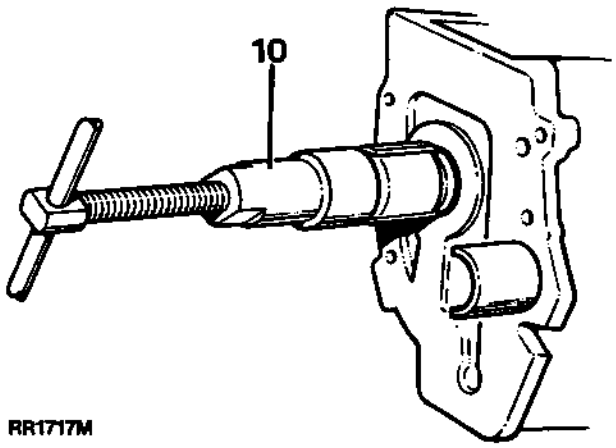
1. Place gearbox on a bench with the transfer gearbox removed, ensuring the oil is first drained.
2. Thoroughly clean the exterior of the gearbox case.
3. Remove the clutch release bearing carrier clip.
4. Remove the clutch release bearing.
5. Release the single bolt and remove the spring clip from the clutch release lever. Pull the lever off the clutch release pivot.
6. Remove the clutch release pivot and single bolt retaining the clutch release bearing guide. Withdraw the guide from the input shaft.



7. Remove the six bolts and washers securing the bell housing.

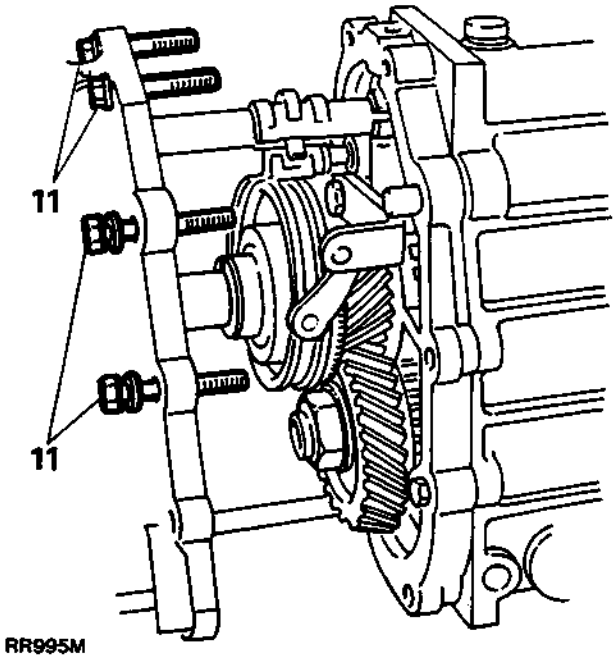
GEAR HOUSING

8. Carefully ease the bell housing off the dowels and withdraw it from the gearbox.
9. Remove the circlip which retains the mainshaft oil seal collar located at the rear of the gearbox.



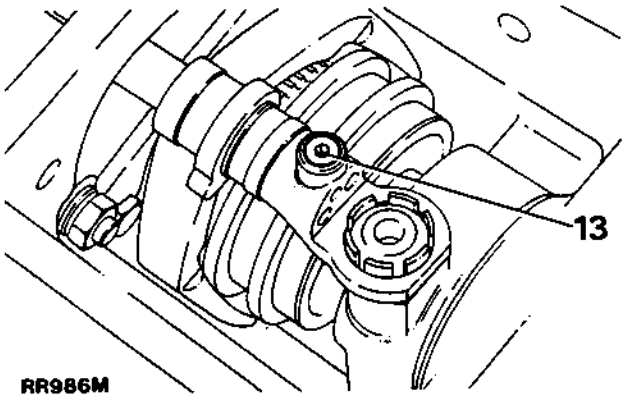
10. Using tools 18G705 and 18G705-1A remove the oil seal collar.

Continued



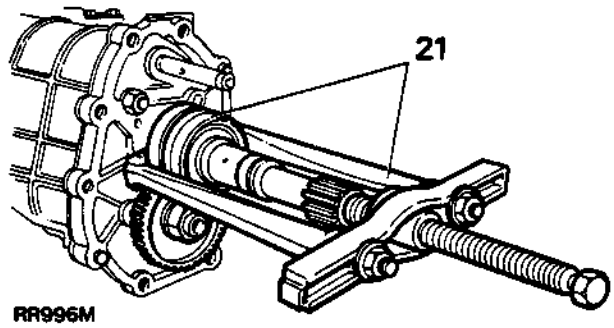
RR995M

11. Remove the ten bolts and spring washers securing the fifth gear extension case to the gearcase; withdraw the extension case and discard the gasket.
12. Fit two dummy bolts (8 × 35 mm) to the casing to retain the centre plate to the main case.
13. Select first or third gear and remove the grub screw securing the selector yoke to the selector shaft, manoeuvre the yoke and withdraw it from the shaft.



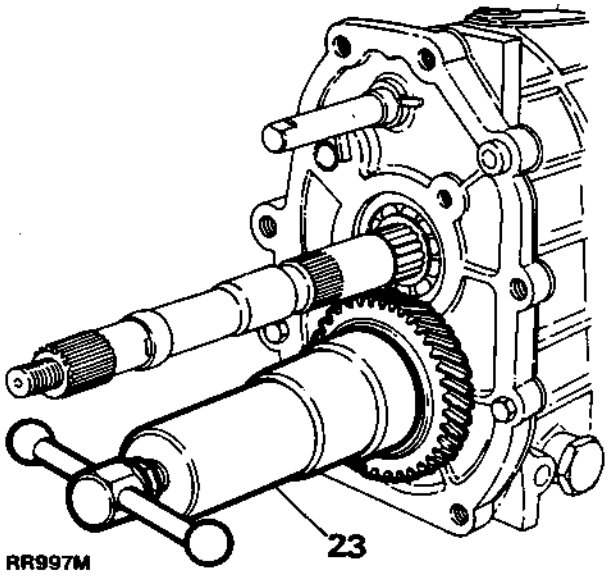
RR986M

14. Remove the oil seal collar 'O' ring from the mainshaft.
15. Withdraw the oil pump drive shaft.
16. Remove the two circlips retaining the 5th selector fork to its bracket and remove the fork and pads.
17. Withdraw the fifth gear selector spool.
18. Remove the two bolts and spring washers and withdraw the fifth gear selector fork and bracket.
19. Engage reverse gear by turning selector rail anti-clockwise and pulling rearwards. Move the fifth speed synchro hub into mesh with the fifth gear. De-stake the retaining nut securing the fifth gear layshaft and remove nut. Select neutral by pushing selector rail inwards and turning clockwise; and return fifth speed synchro hub to its out of mesh position.



RR996M

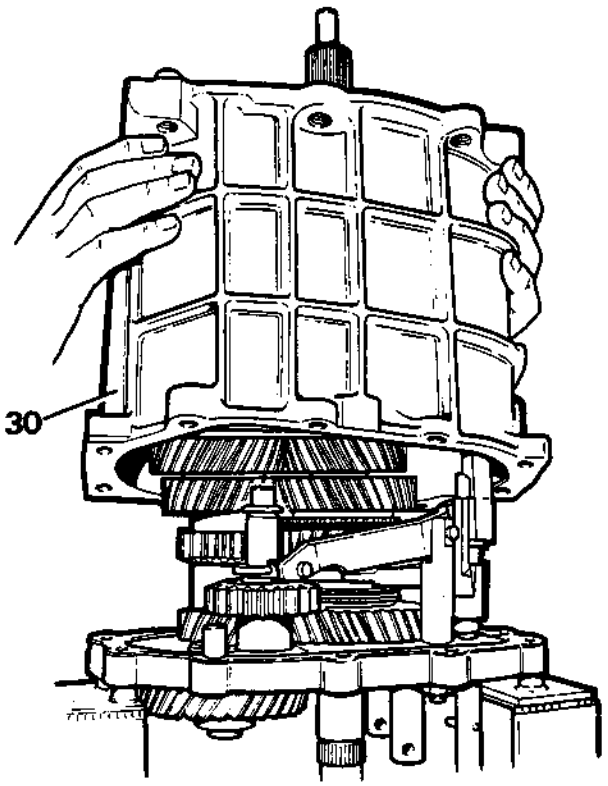
20. Release the circlip retaining the fifth gear synchromesh assembly to the mainshaft.
21. Using tools 18G1400-1 and 18G1400 withdraw the selective washer, fifth gear synchromesh hub and cone, fifth gear (driven) and spacer from the mainshaft.
22. Remove the split roller bearing assembly from the mainshaft.
23. Using tools 18G705 and 18G705-1A remove the layshaft fifth gear.



RR997M

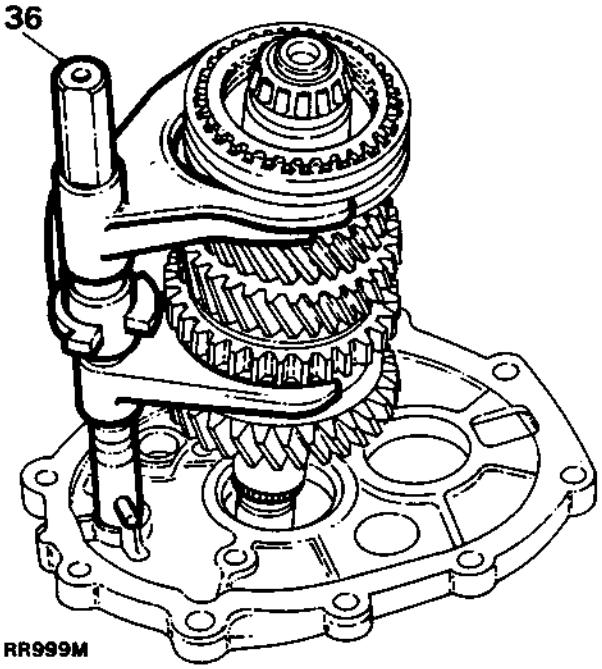
24. Fit suitable guide studs (measuring 8 × 60 mm) to the main gearbox case.
25. Locate the gearbox to a suitable stand.
26. Remove the six bolts and spring washers from the front cover, withdraw the cover and discard the gasket.
27. Remove the input shaft and layshaft selective washers from the gearcase.
28. Remove the two bolts and washers securing the locating boss for the selector shaft front spool, withdraw the locating boss.

29. Withdraw the selector plug, spring and detent ball from the centre plate.



RR998M

30. Remove the dummy bolts and carefully lift the gearcase, leaving the centre plate and gear assemblies in position. Discard gasket.
31. Insert two slave bolts and nuts to retain the centre plate to the stand; and remove the circlip, pivot pin, reverse lever and slipper pad.
32. Slide the reverse shaft rearwards and lift off the thrust washer, reverse gear and reverse gear spacer.
33. Lift off the layshaft cluster.
34. Remove the input shaft and fourth gear synchromesh cone.
35. Rotate the fifth gear selector shaft clockwise (viewed from above) to align the fifth gear selector pin with the slot in the centre plate.
36. Remove the mainshaft and selector fork assemblies from the centre plate together.
37. Detach the selector fork assembly from the mainshaft gear cluster.
38. Remove the slave bolts from the centre plate and lift the centre plate clear of the stand.



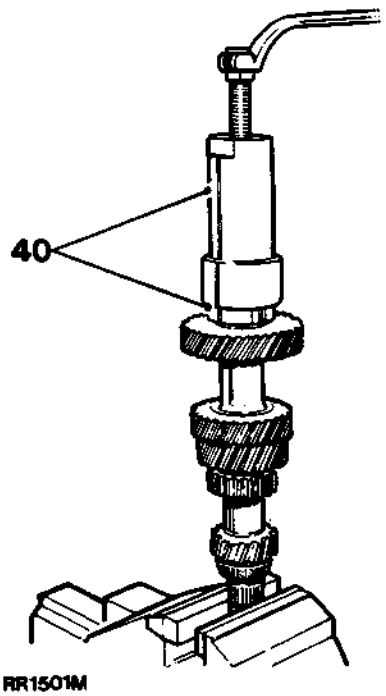
RR999M

Front cover

39. Remove and discard the oil seal from the front cover. Do not fit a new oil seal at this stage.

Layshaft

40. Using press 18G705 and tool 18G705-5 remove the layshaft bearings.

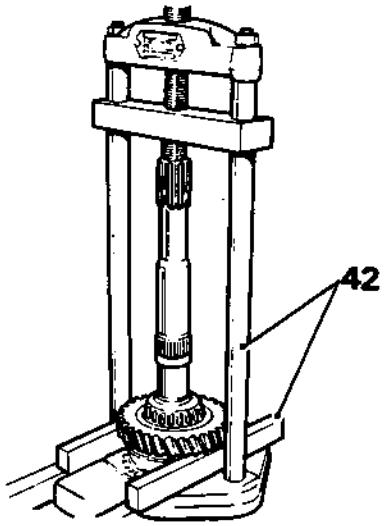


RR1501M

Continued

Mainshaft

41. Remove the centre bearing circlip
42. Using press MS47 and any suitable metal bars, remove the centre bearing, first gear bush, first gear and needle bearings and first gear synchromesh cone.



RR1502M

43. If a difficulty is experienced in removing the first and second gear synchromesh hub, locate underneath the second gear with a suitable tool; and extract the complete synchromesh hub and second gear assemblies using a suitable press.
44. Turn the mainshaft through 180° and using press MS47 and extension, with a support underneath the third speed gear, press the mainshaft through the pilot bearing spacer, third and fourth synchromesh hub, third gear synchromesh cone, third gear and third gear needle roller bearing.

First and second gear synchromesh assemblies

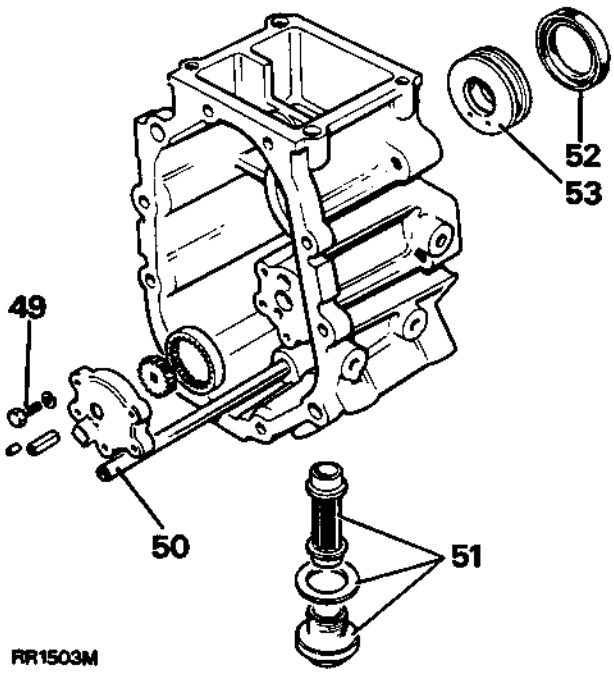
45. Mark the hub and sleeve to aid reassembly and remove the slipper springs from the front and rear of the first and second gear synchromesh assemblies.
46. Withdraw the slippers and hub from the sleeve.

Third and fourth gear synchromesh assemblies

47. Mark the hub and sleeve to aid reassembly and remove the slipper springs from the front and rear of the assembly.
48. Withdraw the slippers and hub from the sleeve.

Extension case

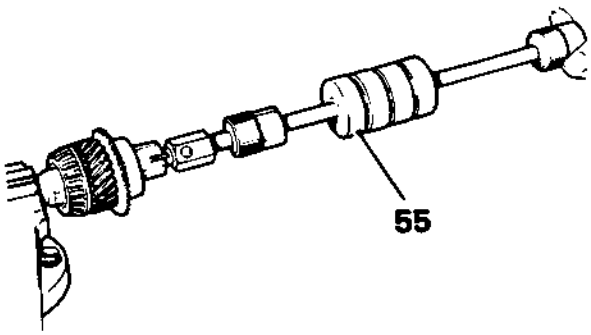
49. Remove the three oil pump housing bolts, spring washers and oil pump gears and housing.
50. Do not withdraw oil pick-up pipe.
51. Remove the plug, washer and filter.
52. Invert casing and extract the oil seal.
53. Press out the ferrobestos bush from the casing.



RR1503M

Input shaft

54. Using tools MS47 and 18G47BA, remove the input shaft bearing.
55. With the aid of tools 18G284AAH and 18G284, extract the pilot bearing track.



RR1504M

Reverse idler gear

56. Remove the circlip from the reverse idler gear.
57. Having noted their positions, remove both needle roller bearings and remaining circlip from the gear.

Fifth gear synchromesh assembly

58. Mark the hub and sleeve to aid reassembly and lever the backing plate off the fifth gear synchromesh assembly.
59. Remove the slipper springs from the front and rear of the assembly.
60. Release the slippers and slide the hub from the sleeve.

Centre plate

61. Remove the layshaft and mainshaft bearing tracks from the centre plate and reverse pivot post.

Main gearbox casing

62. Remove the mainshaft and layshaft bearing tracks from the main casing.
63. Remove the plastic oil trough from the front of the casing.

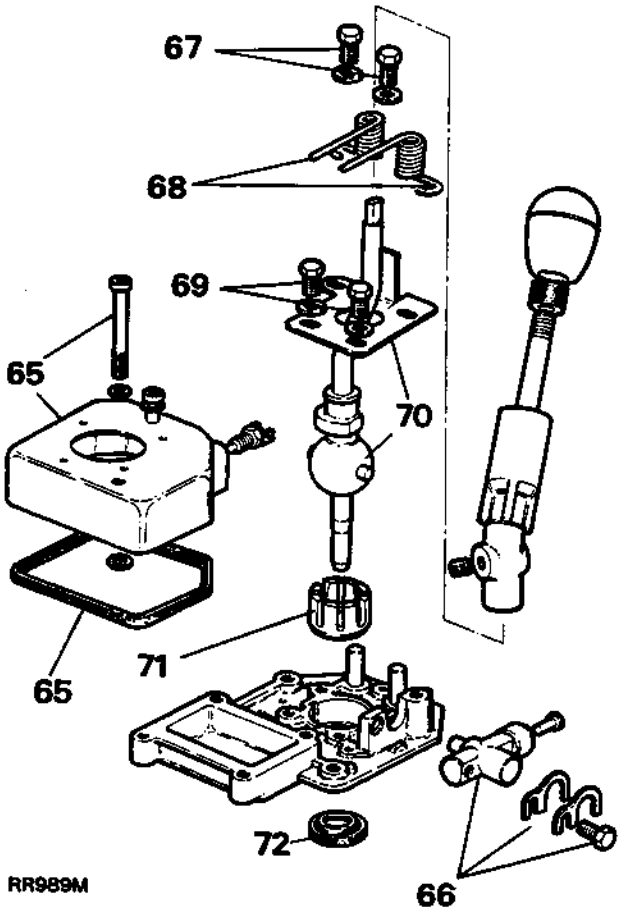
Selector rail

64. The selector rail is supplied complete with first and second selector fork, pin and fifth speed selector pin. If it is required to replace the first and second selector fork on its own, press out the fifth speed gear selector pin and remove the first and second selector fork from the selector rail.

Gear change housing

NOTE: The upper and lower gear levers are loctited together. If difficulty is experienced in separating these two components, a complete new assembly should be fitted.

65. Raise the gear lever top cover as far as the gaiter and upper gear lever will permit to gain access to the lower gear lever fixings.
66. Release the single bolt with plain washer securing the reverse plunger to the gear change housing, withdraw the plunger and shims if fitted
67. Remove the two bolts and washers anchoring the bias springs.
68. Release the springs from the register at the gear lever and remove them from the dowels.
69. Remove the remaining two bolts securing the bias adjustment plate to the housing.
70. Remove the lower gear lever and bias plate from the housing.
71. Remove the railko bush from the lower gear lever.
72. Prise the seal from the bottom of the gear change housing.

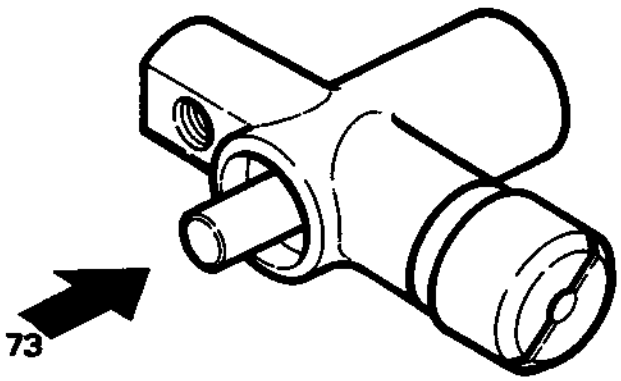


RR989M

Reverse gear plunger assembly

NOTE: The plunger assembly is not a serviceable item. To check that the unit is operating correctly proceed as follows.

73. Apply a load of between 50 to 60 kg (110 to 130 lb) to the plunger nose. If the plunger is operational within these limits the unit is satisfactory. If the plunger operates outside the limits renew the plunger assembly.



RR990M

Continued

Cleaning and inspection

74. Clean gearcase thoroughly using a suitable solvent. Inspect case for cracks, stripped threads in the various bolt holes, and machined mating surfaces for burrs, nicks or any condition that would render the gearcase unfit for further service. If threads are stripped, install Helicoil, or equivalent inserts.
75. Inspect all gear teeth for chipped or broken teeth, or showing signs of excessive wear. Inspect all spline teeth on the synchromesh assemblies. If there is evidence of chipping or excessive wear, install new parts on reassembly. Check all slippers and slipper springs for wear or breakage. Replace with new parts if necessary.
76. Inspect all circlip grooves for burred edges. If rough or burred, remove condition carefully using a fine file.
77. Ensure all oil outlets are clear of sludge or contamination especially the mainshaft oil ways. Clean with compressed air observing the necessary safety requirements.
78. During the rebuild operation, it is recommended that new roller and needle bearings are fitted.

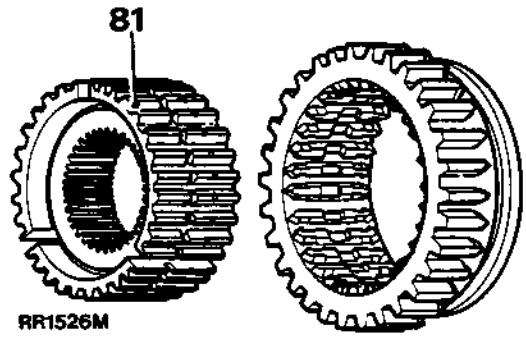
ASSEMBLY

Layshaft

79. Using tools MS47 and a suitable tube, fit new bearing cones to the layshaft.

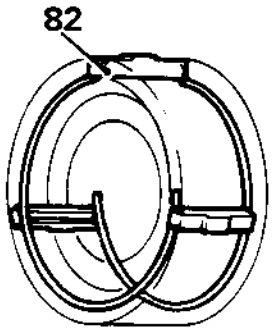
Synchromesh assemblies

80. With the outer sleeve held, a push-through load applied to the outer face of the synchromesh hub should register 8,2 to 10 kgf m (18 to 22 lbf ft) to overcome the spring detent in either direction.
81. Assemble the first and second synchromesh assembly by locating the shorter splined face towards the second gear.



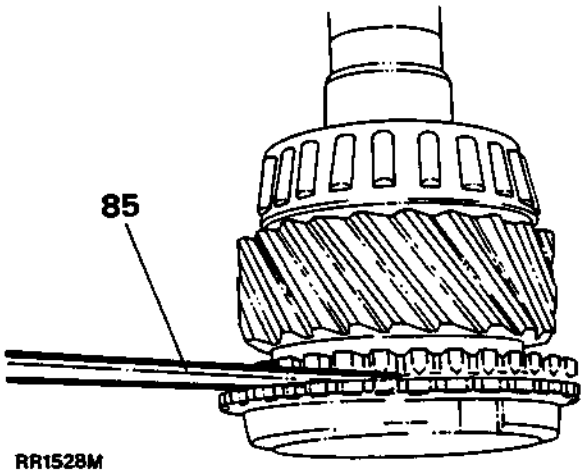
RR1526M

82. Refit the slippers and locate the slipper springs to each side of the assembly, ensuring that the hooked ends of both slipper springs are located in the same slipper; but running in opposite directions and finishing against the other two slippers.



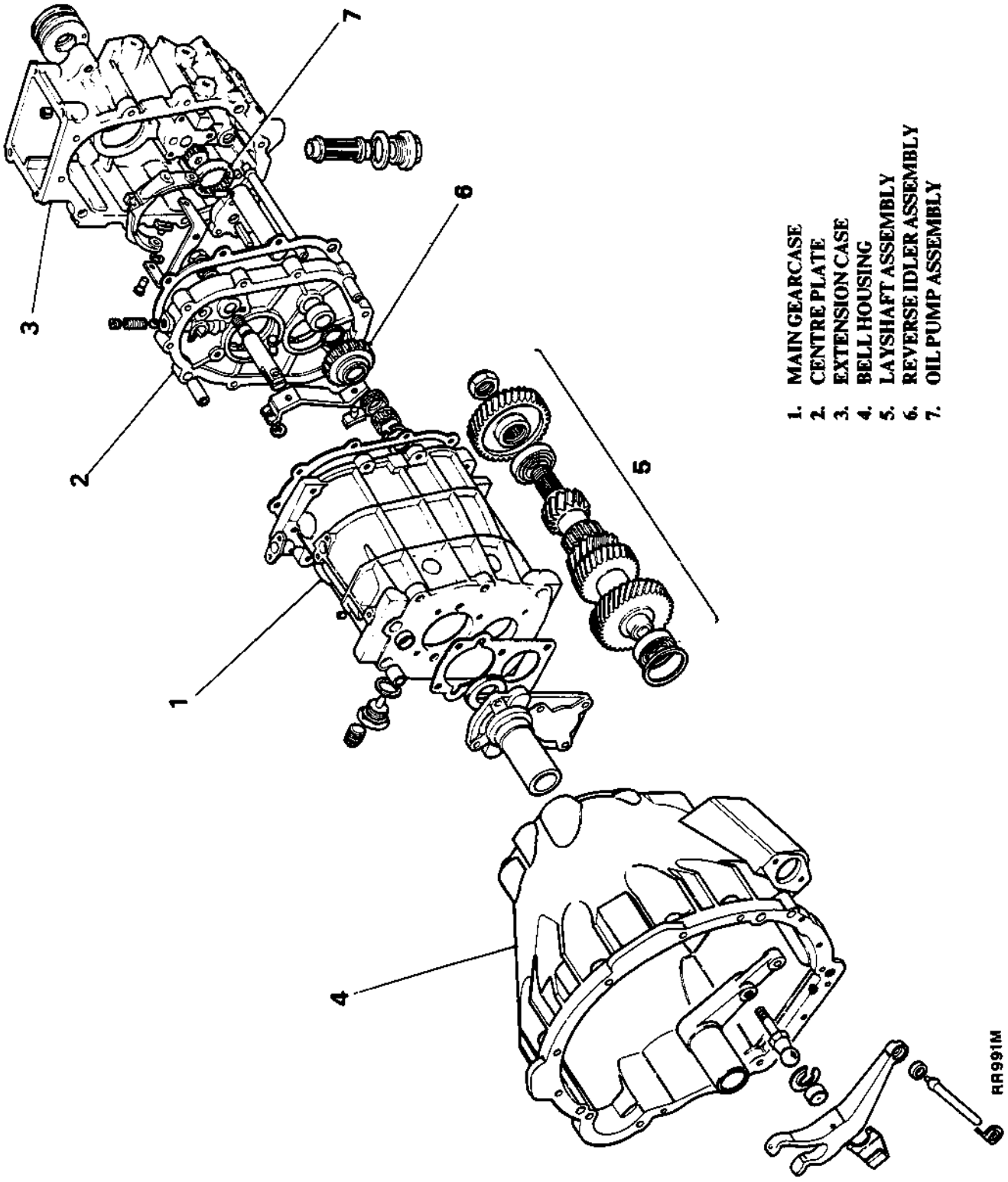
RR1527M

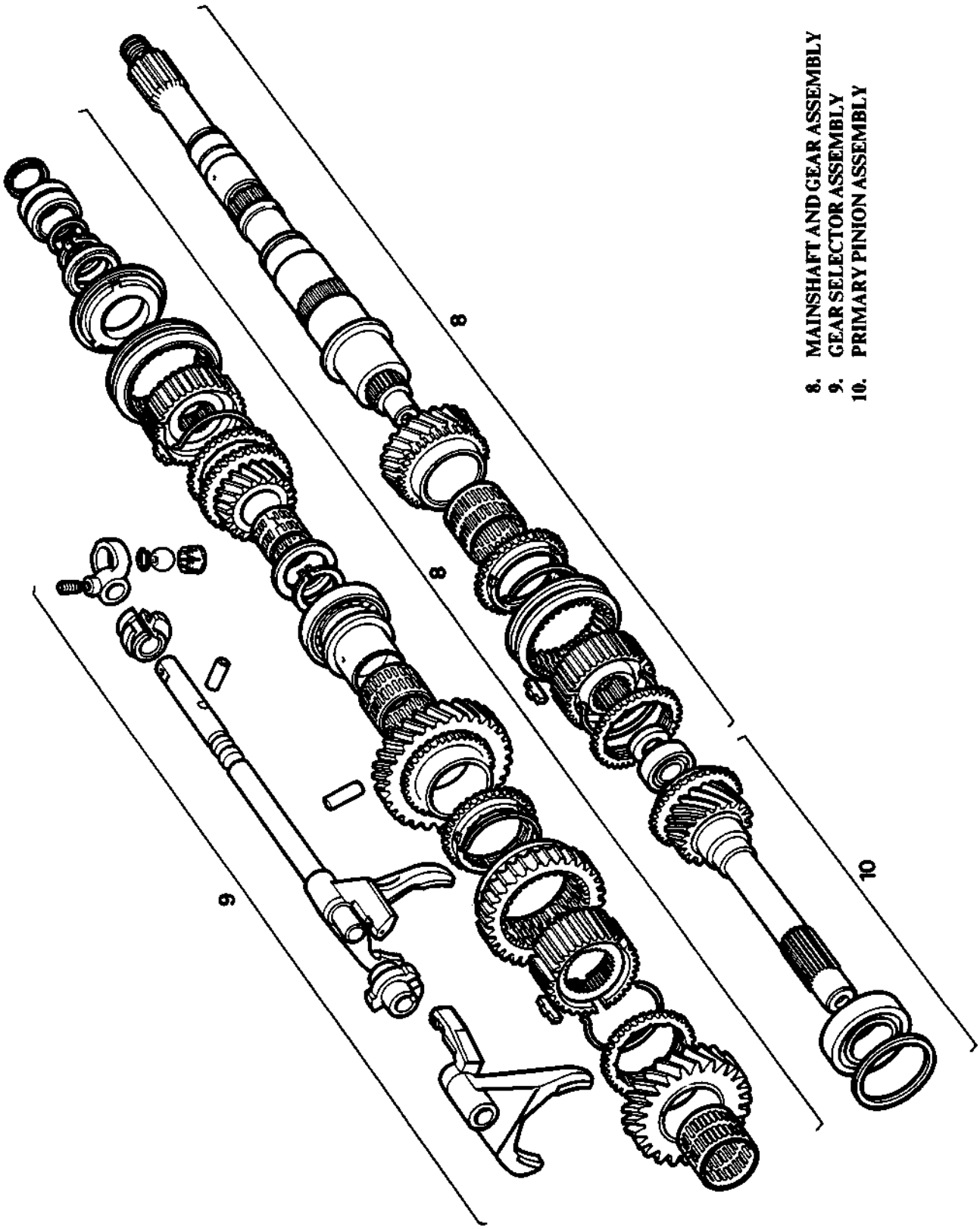
83. Assemble the third and fourth synchromesh assembly and ensure the hooked ends are located in the same slipper; and run in opposing directions and finally locate against the other two slippers.
84. Assemble the fifth synchromesh hub assembly again ensuring the hooked ends of the springs are located in the same slipper, but running in opposite directions. Fit the backplate onto the rear of the synchromesh hub assembly. Ensure the tag on the backplate locates in the slot on the hub.
85. Check the wear between all the synchromesh cones and gears by pushing the cone against the gear and measuring the gap between the gear and cone. The minimum clearance is 0,64 mm (0.025 in). If this clearance is not met, fit new synchromesh cones.



RR1528M

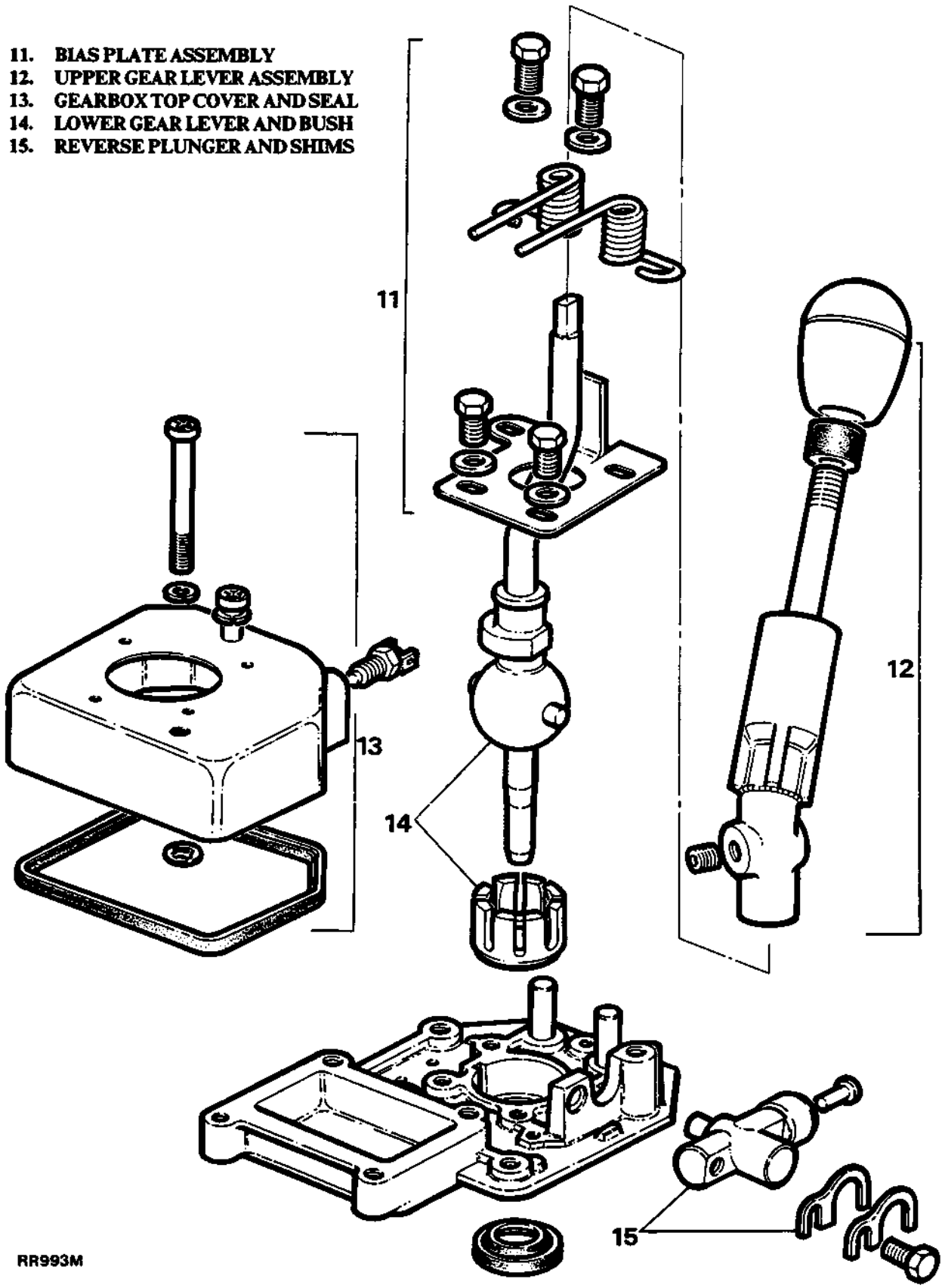
Continued


1. MAIN GEARCASE
2. CENTRE PLATE
3. EXTENSION CASE
4. BELL HOUSING
5. LAYSHAFT ASSEMBLY
6. REVERSE IDLER ASSEMBLY
7. OIL PUMP ASSEMBLY
RR991M



8. MAINSHAFT AND GEAR ASSEMBLY
9. GEAR SELECTOR ASSEMBLY
10. PRIMARY PINION ASSEMBLY

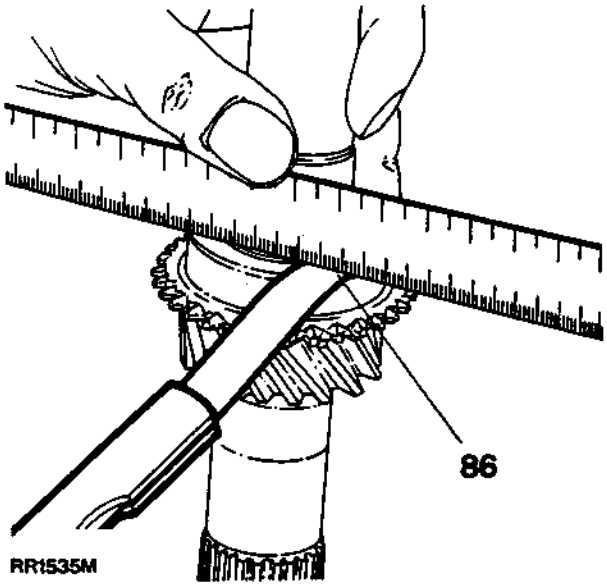
11. BIAS PLATE ASSEMBLY
12. UPPER GEAR LEVER ASSEMBLY
13. GEARBOX TOP COVER AND SEAL
14. LOWER GEAR LEVER AND BUSH
15. REVERSE PLUNGER AND SHIMS



RR993M

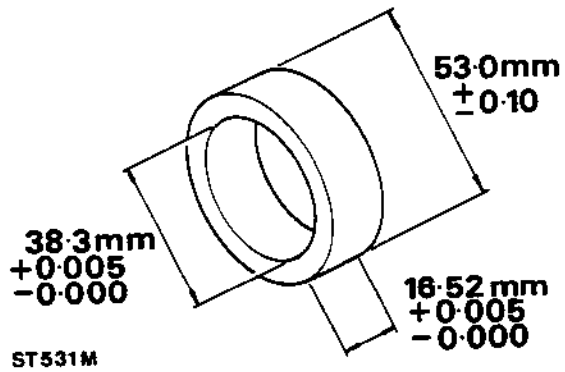
Fifth gear end-float

86. Fit the washer and fifth gear to the mainshaft, place a straight edge on the shoulder and using feeler gauges check the end-float between gear and shoulder. End float should not be in excess of 0,25 mm (0.010 in) maximum.
87. If end float is outside limit inspect the washer and gear faces for wear.

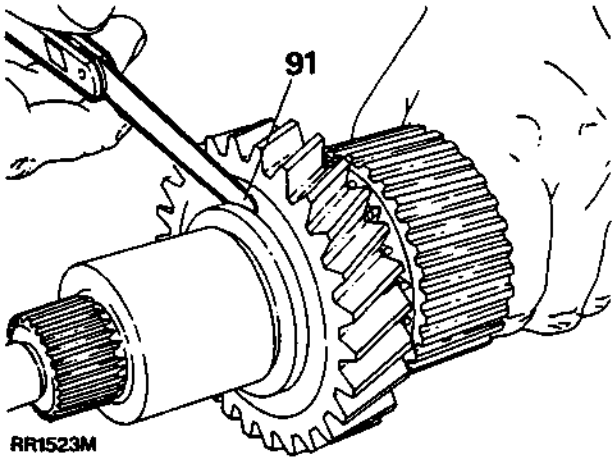


First gear bush end-float

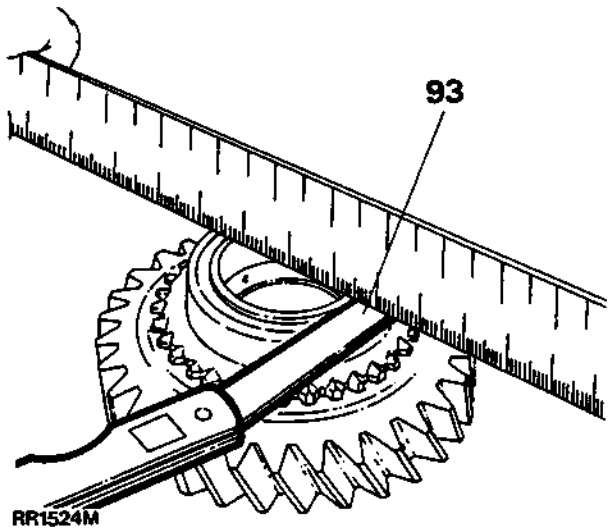
88. Manufacture a spacer to the dimensions provided in the illustration, this will represent a slave bearing.



89. Lubricate the second gear needle bearing with a light oil and fit the bearing, second gear and synchromesh cone to the mainshaft. It should be noted that the second gear synchromesh cone has larger slipper slots than the other synchromesh cones.
90. Fit the first and second synchromesh hub assembly with the selector fork groove to the rear of the mainshaft.
91. Holding the synchromesh hub firmly in position check the second gear end-float, between the gear and flange on the mainshaft, end-float should not be in excess of 0,25 mm (0.010 in) maximum. If end float is outside limits inspect the flange and gear faces for wear.



92. Fit the first gear bush to the first gear, place the gear and bush on a spacer so that the gear is sitting firmly on the shoulder of the bush.
93. Place a straight-edge across the bush and measure the clearance between bush and gear, this should not be in excess of 0,25 mm (0.010 in) maximum.

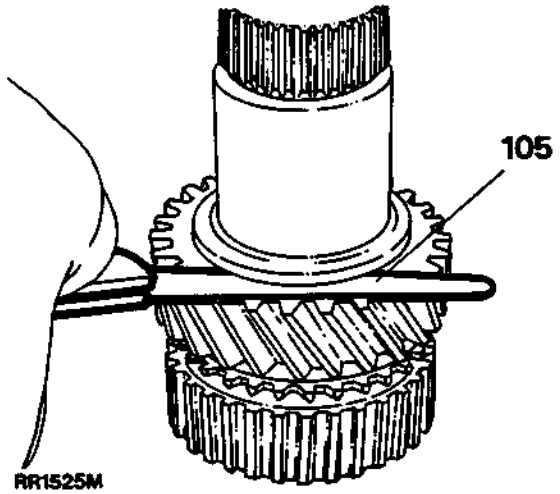


94. If the clearance is in excess of the maximum permissible limit, renew the bush. If after renewing the bush of a similar type, the end-float is still not within limit, inspect gear faces for wear.
95. Fit the first gear bush and slave bearing spacer and a new circlip to the mainshaft. When fitting the circlip, care must be taken to ensure it is not opened (stretched) beyond the minimum necessary to pass over the shaft.

96. Press the slave bearing spacer back against the circlip to allow the bush maximum end-float. Measure the clearance between the rear of the first gear bush and front face of the slave bearing spacer with a feeler gauge. The clearance should be within 0,05 mm (0.002 in) maximum. The first gear bush is available with collars of different thickness. Select a bush with a collar to give the required end-float. The bush must be free to rotate easily with the required end-float.
97. Remove the circlip, slave bearing spacer and first gear bush from the mainshaft.
98. First gear bushes are available in the following sizes:

Part No.	Thickness (mm)
FRC5243	40,16–40,21
FRC5244	40,21–40,26
FRC5245	40,26–40,31
FRC5246	40,31–40,36
FRC5247	40,36–40,41

99. Having selected a suitable first gear bush, lubricate the needle bearing and fit to the first gear.
100. Fit the selected bush to the first gear and place first gear synchromesh cone, followed by the first gear assembly to the mainshaft.
101. Using tools MS47, 18G47BA and 18G47BA-X refit the centre bearing and circlip to the mainshaft. After fitting the circlip, ensure the bearing, gear and circlip are in their rearmost position on the mainshaft, this can be achieved by placing two bars under the 1st gear and using press MS47 carefully press the assembly rearwards on the mainshaft.
102. Invert the mainshaft, lubricate the third gear needle roller bearing with light oil, fit to the front end of the mainshaft.
103. Fit the third gear to the mainshaft; and locate the third gear synchromesh cone to the third gear.
104. Fit the third/fourth synchromesh assembly (with the longer boss of the synchromesh hub to the front of the gearbox) to the mainshaft.



105. Holding the synchromesh assembly firmly in position, check third gear end-float between the gear face and mainshaft flange. The end-float should not be in excess of 0,25 mm (0.010 in) maximum.
If end float is outside specified limit check flange and gear faces for wear.
106. Fit the spacer and bearing to the front of the mainshaft.

Input shaft

107. Using tool MS47 and any suitable tube, refit a new pilot bearing track to the input shaft.
108. Fit the input shaft bearing using tools MS47, 18G47BA and 18G47BA-X.

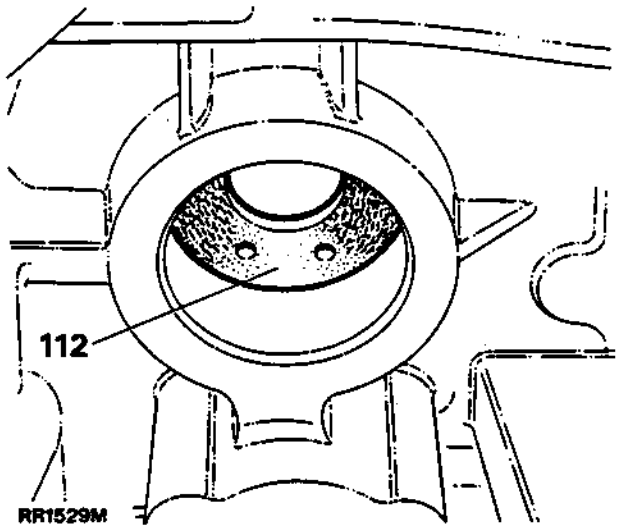
Reverse gear and shaft

109. Fit a new circlip to the rear of the reverse idler gear, ensuring that the circlip is not stretched beyond the minimum necessary to pass over the shaft.
110. Lubricate with light oil and fit both needle roller bearings. Fit the shorter needle bearing to the rear of the reverse idler gear.
111. Fit a new circlip to the front of the reverse idler gear.

Extension case

112. Using a suitable press, fit a new ferrobestos bush to the case, ensuring the two drain holes are towards the bottom of the case.

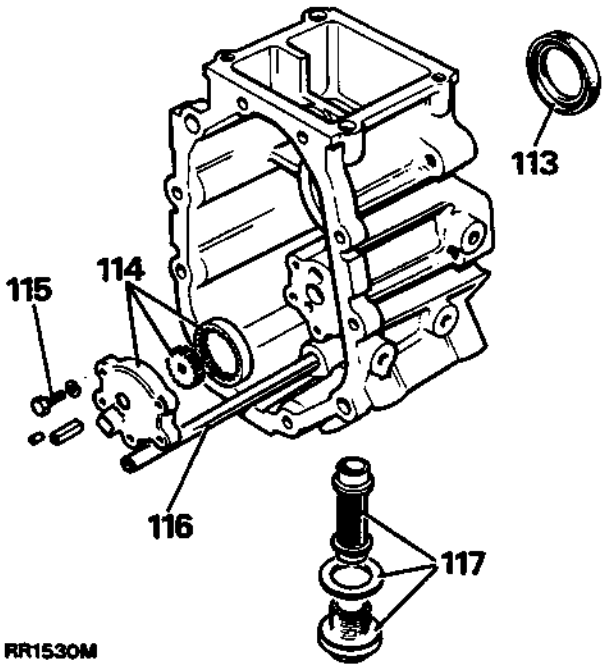
NOTE: If a new extension case is fitted, it is essential that a grub screw is securely fitted in the main oilway located in the rear of the case.



Continued

113. With the aid of tool 18G1422, fit a new oil seal to the rear of the extension case. Ensure the seal lips are towards the ferrobestos bush. Lubricate the seal lips with a suitable SAE 140 oil.
114. Assemble and fit the fibre oil pump gears to the oil pump cover, whilst ensuring the centre rotor squared drive faces the layshaft.

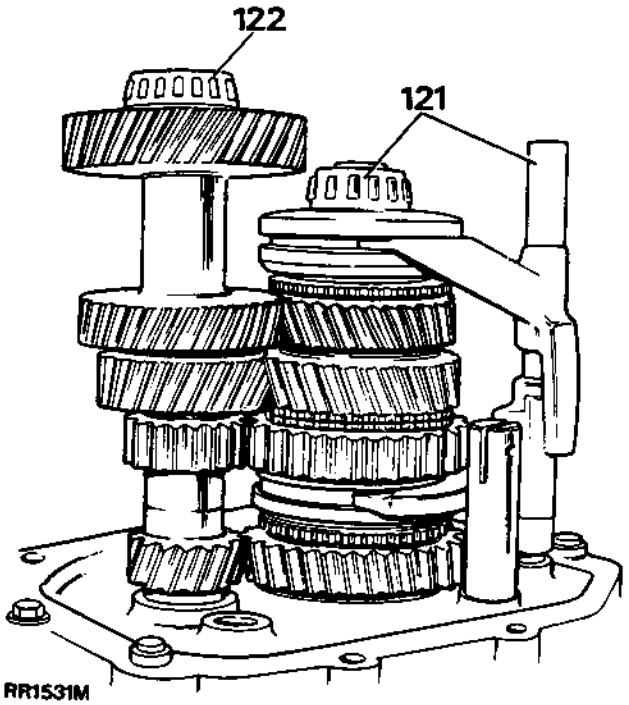
115. Fit the three bolts and spring washers to secure the oil pump cover; and tighten to the specified torque.
116. Ensure that the oil pick-up pipe is free of contamination or blockage.
117. Fit a new oil filter, fibre gasket and tighten plug to the specified torque.



RR1530M

Centre plate

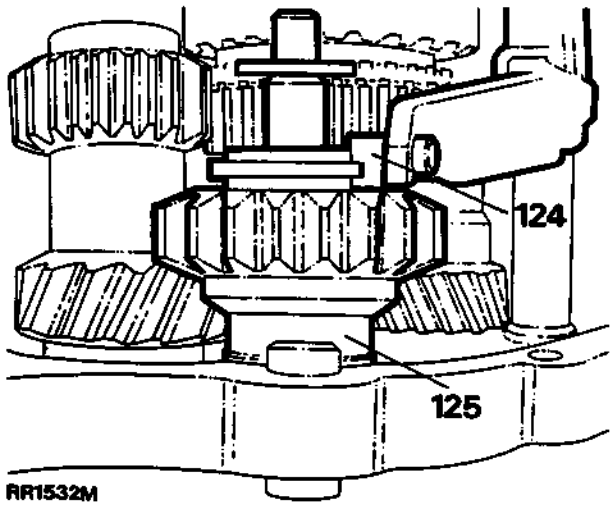
118. Fit the centre plate to a suitable stand and secure with two slave bolts.
119. Place the new mainshaft and layshaft bearing tracks to the centre plate.
120. Lightly lubricate the selector shaft with a light oil.
121. Take the selector shaft complete with the first and second selector fork, front spool and third and fourth selector fork; engage both selector forks in their respective synchromesh sleeves on the mainshaft, simultaneously engage the selector shaft and mainshaft assemblies in the centre plate, whilst rotating the fifth gear selector pin to align with the slot in the centre plate.
122. Fit the layshaft to the centre plate.



RR1531M

123. Rotate the selector shaft and spool to enable the reverse crossover lever forks to correctly align to the selector pin. Reposition the selector shaft and locate the lever into the slot of the reverse gear pivot shaft. Insert pivot pin and fit a new circlip, ensuring that it is not opened beyond the minimum necessary to pass over the shaft.

124. Fit the slipper pad to the reverse lever. If a new reverse lever pivot shaft has been fitted, it will be necessary to ascertain that its radial location is consistent with the reverse pad slipper engagement/clearance. The radial location is determined during initial assembly.

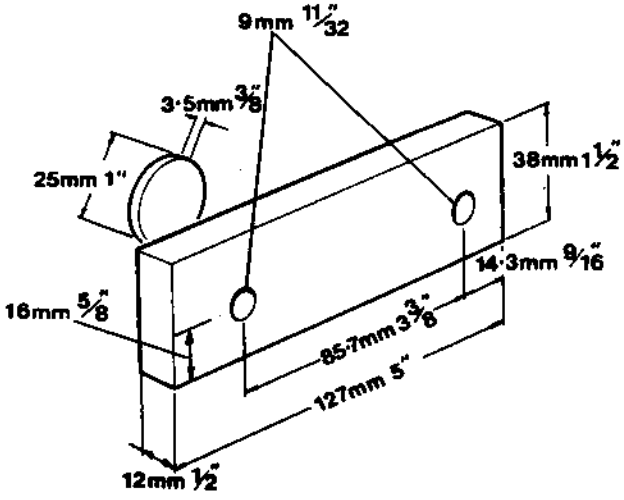


RR1532M

125. Fit the reverse gear spacer and reverse gear assembly, locating the slipper pad lip to the reverse gear groove. Engage the reverse gear shaft from the underside of the centre plate, ensuring the roll pin is aligned with the slot in the centre plate casing.
126. Prior to assembly lubricate the detent ball and spring with light oil, and fit to the top of centre plate. Smear Hylomar PL32 or Loctite 290 to the plug threads and screw the plug flush with the case. Stake the plug to prevent rotation using a suitable centre punch. Release the slave bolts.
127. Locate the fourth gear synchromesh cone to the third/fourth synchromesh assembly.
128. Fit the input shaft to the mainshaft.
129. Fit the reverse gear thrust washer to the reverse gear shaft.
130. Fit a new gasket to the centre plate.

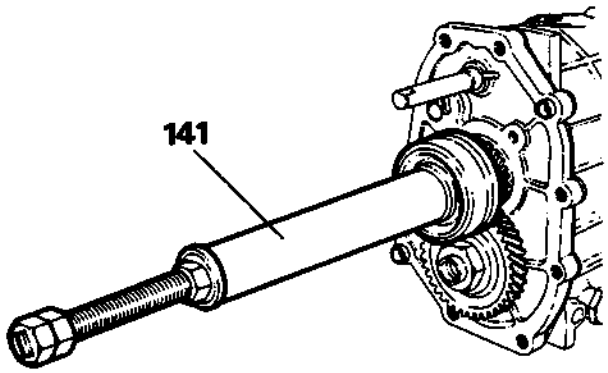
Main gearbox casing

131. Insert a new plastic oil trough to the back of the main gearbox casing, ensuring the open trough faces the top of the case.
132. Carefully lower the gearcase into position over the gear assemblies. DO NOT USE FORCE. This operation can be assisted by the use of two 8 × 100 mm guide studs. Ensure the centre plate dowels and selector shaft are engaged in their respective locations.
133. Fit the layshaft and input shaft bearing outer tracks.
134. Using 8 × 35 mm slave bolts and plain washers to prevent damaging the rear face of the centre plate, evenly draw the gearcase into position on the plate.
135. Fit the locating shaft front spool to the top of the gearcase using Hylomar PL32 to seal between the spool and gearcase. Smear Loctite 290 or Hylomar PL32 to the bolt threads, tighten bolts and spring washers to the specified torque.
136. Manufacture a layshaft support plate and plain washer to the dimensions provided in the illustration.



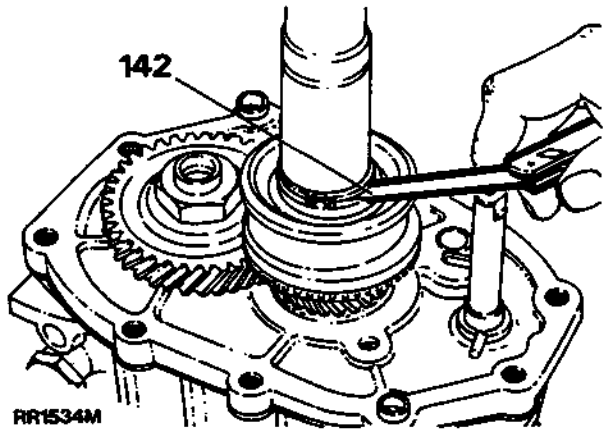
ST1118M

137. The layshaft support plate is fitted using two 8 × 25 mm bolts and washers to the front of the gearbox, with the plain washer situated between the support plate and layshaft. The plate also retains the input shaft bearing outer track.
138. Using a suitable press, fit the fifth gear to the layshaft, fit a new 22 mm stake nut and tighten sufficiently to retain.
139. Locate assembly horizontally in a vice or suitable jig.
140. Fit the fifth speed washer, roller bearing, gear and cone to the mainshaft.
141. Press fit fifth gear synchromesh hub assembly using tool 18G1431. Fit a dummy spacer with an oversize bore to ascertain the correct spacer to provide the specified clearance on the fifth gear. When the correct spacer has been determined, fit the spacer to the mainshaft and secure in position with a new circlip.



RR1533M

142. Measure the clearance between the front spacer and circlip, which should be between 0,055 and 0,005 mm, (0.002–0.0002 in) maximum. Select the appropriate spacer to provide the aforementioned clearance.



RR1534M

Continued

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FRC5284	5,10	FRC5294	5,40
FRC5286	5,16	FRC5296	5,46
FRC5288	5,22	FRC5298	5,52
FRC5290	5,28	FRC5300	5,58
FRC5292	5,34	FRC5302	5,64

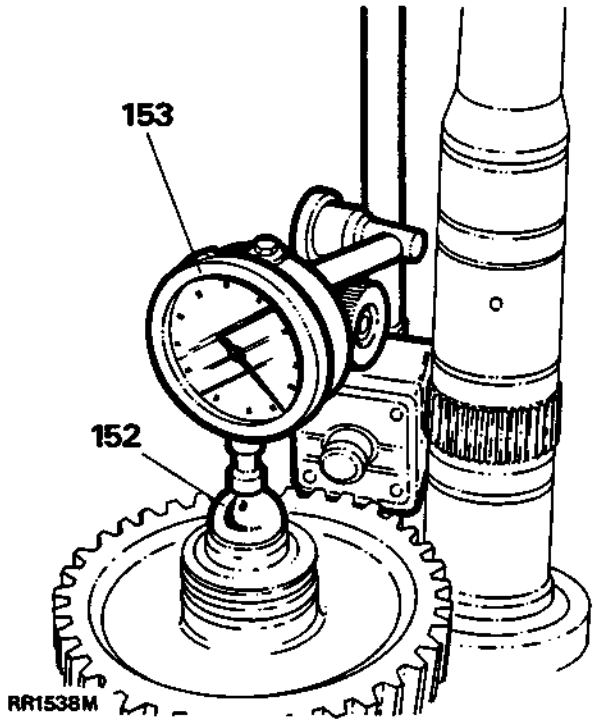
143. Fit the correct selective spacer and new circlip.

Mainshaft and layshaft end-float

144. Measure and adjust the mainshaft and layshaft end-float as necessary. Remove the layshaft support plate from the front of the gearbox.

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FRC4327	1,51	FRC4349	2,17
FRC4329	1,57	FRC4351	2,23
FRC4331	1,63	FRC4353	2,29
FRC4333	1,69	FRC4355	2,35
FRC4335	1,75	FRC4357	2,41
FRC4337	1,81	FRC4359	2,47
FRC4339	1,87	FRC4361	2,53
FRC4341	1,93	FRC4363	2,59
FRC4343	1,99	FRC4365	2,65
FRC4345	2,05	FRC4367	2,71
FRC4347	2,11	FRC4369	2,77

145. When ascertaining the mainshaft end-float care must be taken when checking the dial gauge readings to ensure that the end-float only, as distinct from side movement, is recorded. To overcome the difficulty in differentiating between end-float and side movement, wrap approximately ten turns of masking tape around the plain portion of the input shaft below the splines. Ascertain that the rise and fall of the input shaft is not restricted by the tape.
146. Place a mainshaft and layshaft spacer of nominal thickness 1,02 mm on the mainshaft and layshaft bearing tracks, fit the front cover and gasket, tighten bolts and spring washers to the specified torque.
147. Invert the gearbox on the stand. Rotate the mainshaft to correctly seat the bearing.
148. Place a suitable ball bearing in the mainshaft centre and mount the dial gauge on the gearcase with the stylus resting on the ball bearing centre. Zero the gauge.
149. Check the end-float by a 'push-pull' action to the mainshaft. The required mainshaft end-float measurement should be between 0,01 to 0,06 mm (0.0004 to 0.002 in) maximum with no preload.
150. Select the appropriate spacer to give the specified end float.
151. Rotate the layshaft to correctly seat the bearing.
152. Place a suitable ball bearing in the layshaft centre and mount the dial gauge on the gearcase, with the stylus resting on the ball bearing centre. Zero the gauge.



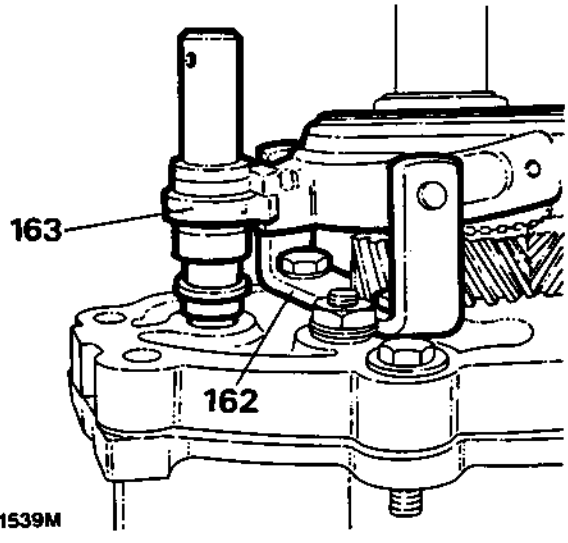
153. With the aid of levers approximately 23 cm long; to prevent component damage, check the end-float by a gentle 'push-lift' action to the layshaft. The required layshaft setting is:
0,025 mm end-float
0,025 mm preload.
Spacer thickness required equals; nominal thickness of spacer, plus end-float obtained. Remove the gauge and ball bearing.
154. Remove the front cover. Having ascertained the mainshaft and layshaft end-float, fit the mainshaft and layshaft spacers of the appropriate thickness to the mainshaft and layshaft bearing tracks. Selective spacers are available in a range of sizes to meet the aforementioned clearance limits.

Part No.	Thickness (mm)	Part No.	Thickness (mm)
TKC4633	1,69	TKC4649	2,17
TKC4635	1,75	TKC4651	2,23
TKC4637	1,81	TKC4653	2,29
TKC4639	1,87	TKC4655	2,35
TKC4641	1,93	TKC4657	2,41
TKC4643	1,99	TKC4659	2,47
TKC4645	2,05	TKC4661	2,53
TKC4647	2,11	TKC4663	2,59

155. Fit a new oil seal to the front cover, ensuring the seal lips face towards the gearbox. Lubricate the seal lips with SAE 140 gear oil.
156. Mask the splines with masking tape to protect the oil seal, refit the front cover and remove the spline masking tape.
157. Refit the bolts and spring washers having used Hylomar PL32 or Loctite 290 on the bolt threads. Tighten to the specified torque.
158. Remove gearbox from the stand and place suitably supported on the bench.
159. Remove the guide studs fitted to the centre plate.
160. Select reverse gear by turning the selector rail anti-clockwise and pulling rearwards. Move the fifth speed synchromesh hub into mesh with the fifth gear.
161. Tighten the staked nut onto the fifth gear layshaft to the specified torque. Stake the nut with a suitable punch to secure. Select neutral by pushing selector rail inwards and turning clockwise, thereby returning the fifth speed synchromesh hub to its out of mesh position.

Fifth gear selector fork assembly

162. Fit the fifth selector fork bracket to the centre plate with the bolts and spring washers and tighten to the specified torque.
163. Fit the fifth gear spool to the selector shaft. It should be noted that the longer shoulder of the spool is fitted towards the front of the gearbox.
164. Fit the bronze pads to the 5th gear selector fork (retain with vaseline), engage, the fork with the spool, bracket and synchromesh sleeve, insert the two dowel pins and secure in position with the two circlips.



RR1539M

165. Fit the selector yoke to the selector shaft and secure in position with a NEW 10 mm grub screw.

NOTE: The NEW grub screw is encapsulated with loctite during manufacture.

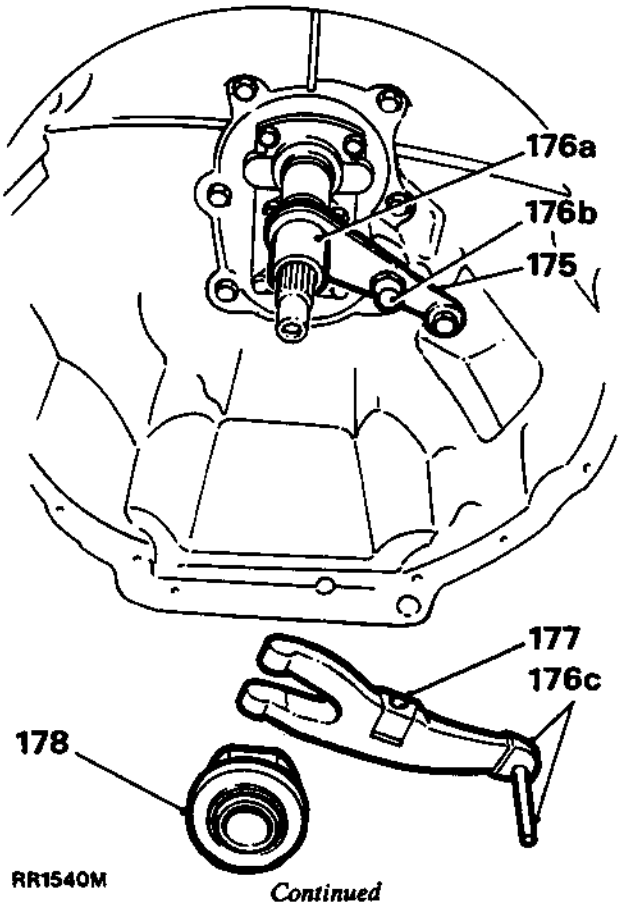
166. Remove the six dummy bolts securing the centre plate to the main casing.
167. Position the gearbox assembly horizontally and fit the oil pump shaft to the pump.

Extension case

168. Fit a new gasket to the centre plate.
169. Rotate the oil pump shaft to align with the layshaft.
170. Carefully fit the extension case ensuring that the oil pump shaft engages the layshaft.
171. Fit the extension case bolts and spring washers; tighten to specified torque.
172. Cover the mainshaft splines with masking tape and fit a new oil seal collar 'O' ring. Remove the masking tape.
173. Using tool 18G1431 fit a NEW oil seal collar to the mainshaft, ensuring the collar is NOT pushed too far on the shaft, fit only with sufficient clearance to allow the circlip to engage in its groove.

Bell housing

174. Locate the bell housing to the dowels and fit the two long bolts (12 × 45 mm) with spring and plain washers to the dowel positions. The remaining four bolts (12 × 30 mm) are fitted with spring washers only. Tighten to the specified torque.
175. Slide the release bearing guide over the input shaft, and secure in position with the single bolt and clutch release pivot, tighten to the specified torque.



RR1540M

Continued

176. Prior to assembly, lubricate the following items with a thin film of molybdenum disulphide grease.
   (a) Clutch release lever fulcrum pivot socket.
   (b) The outer diameter of the release bearing guide.
   (c) Ball ends of the clutch operating push rod.
177. Locate the clutch release bearing lever on the pivot ball and secure in position with the spring clip, tighten the clip securing bolt to the specified torque.
178. Slide the clutch release bearing over the bearing guide and locate the NEW nylon clutch release lever clip onto the bearing.

Gear change housing

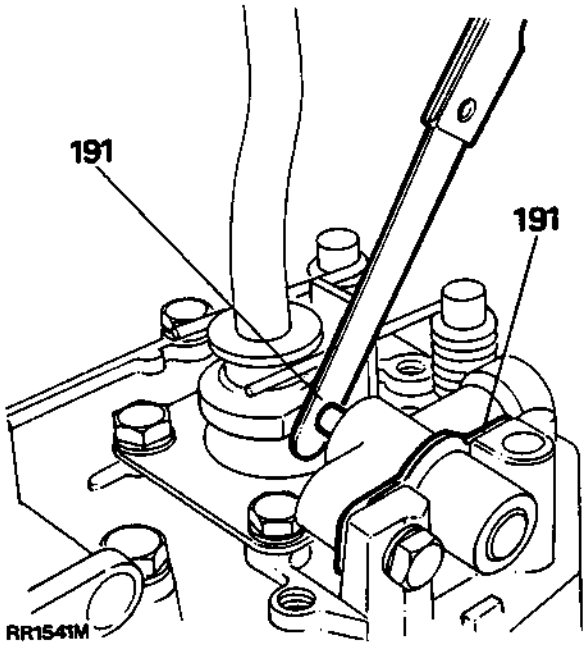
179. Fit a new seal to the bottom of the housing, lips of the seal uppermost.
180. Lightly grease the lower gear lever ball with Shell Alvania R3 and fit the railko bush.
181. Fit the assembly to the housing locating the two pegs on the ball in the recesses of the ball seat.
182. Locate the bias adjustment plate, coat two of the retaining bolts with Hymolar PL32 or Loctite 290 and fit them forward of the gear lever. Do not tighten the bolts at this stage.
183. Inspect the bias springs for condition, renew if necessary. Fit the springs onto the posts, coat the remaining two bolts with Hylomar PG32 or Loctite 290 and fit to the housing to secure the springs in position. Do not tighten the bolts at this stage.
184. Carefully lever the free end of the springs around the rear of the gear lever until they are retained by the stop on the adjustment plate.
185. Fit a NEW gasket to the top of the gearbox.
186. Fit the housing to the gearbox and secure in position with two bolts (diagonally opposite).

Bias adjustment plate setting

187. Select fourth gear and load the gear lever fully to the right hand side of the gearbox.
188. Tighten the four bolts to the specified torque.
189. Select all forward and reverse gears to ensure that gear selection is not inhibited after final tightening of the adjustment plate.

Reverse plunger assembly setting

190. Fit the assembly to the housing and secure in position with the single bolt and washer.
191. Select first gear. Using feeler gauges, check the gap between the reverse plunger nose and the side of the gear lever. The required setting should be 0,6 to 0,85 mm (0.024 to 0.034 in) clearance.
   Adjust the gap by adding or removing the shims behind the plunger assembly.



192. Remove the gear change housing from the gearbox.
193. Fit a new fibre washer to the oil drain plug, fit the plug to the gearbox and tighten to the specified torque.
194. Refill the gearbox with the correct quantity and grade of oil as specified in the 'Recommended Lubricants' section.
195. Refit the gearbox oil level plug, and tighten to the specified torque.
196. Refit the gearbox to the vehicle.
197. Refit the gear change housing to the gearbox after the gearbox has been installed in the vehicle.

LT 230T TRANSFER BOX

The following operations can be carried out with the gearbox in the vehicle. For ease of working, the vehicle should be raised on a ramp or placed over a pit.

RENEW SPEEDOMETER DRIVE PINION

1. Disconnect the battery.
2. Raise the vehicle on a ramp.
3. Remove the speedometer drive clamp and nut and withdraw the cable.
4. Prise out the drive pinion assembly.
5. Push in a new assembly and fit the speedometer cable and secure with the clamp and nut.

RENEW REAR OUTPUT SHAFT OIL SEAL

Special tool:
18G1422

1. Disconnect the battery for safety.
2. Disconnect the rear propshaft from the output flange.
3. Remove the brake drum retaining screws and withdraw the drum.
4. Remove the four back plate bolts that also retain the oil catcher and remove the brake back plate and catcher.

   NOTE: An hexagonal type socket should be used for these bolts.

5. Remove the output shaft nut, steel washer, felt washer and withdraw the flange.
6. Using the slot provided, lever off the dust cover.
7. Prise out the output shaft oil seal(s).
8. Using special tool 18G1422 fit the double-lipped oil seal, open side inwards, with the seal in contact with the bearing circlip, taking care not to touch the seal lips.
9. Fit the dust cover.
10. Lubricate the surface of the flange which runs in the seal and carefully fit the flange.

    NOTE: To renew the flange bolts first remove the circlip before fitting the flange.

11. Secure the flange with the nut and washer and tighten to the specified torque.
12. Fit the oil catcher to the back plate using silicone rubber sealant and secure with the two back plate bolts (with plain washers).
13. Fit the brake drum and retain with the two screws.
14. Reconnect the propeller shaft.

RENEW FRONT OUTPUT SHAFT OIL SEAL

Special tool:
18G1422

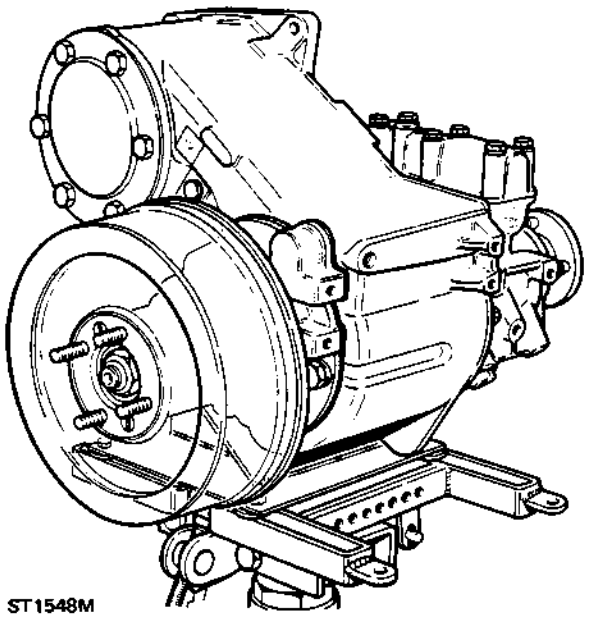
1. Disconnect the front propeller shaft from the flange and move to one side.
2. Remove the output shaft nut, steel washer, felt washer and withdraw the flange.
3. Remove the oil seal shield.
4. Prise out the oil seal(s).
5. Using special oil seal replacer tool 18G1422 fit the double-lipped oil seal, open side inwards, with the seal in contact with the bearing circlip, taking care not to touch the seal lip.
6. Lubricate the running surface of the flange and fit it together with the oil seal shield.
7. Secure the flange with the nut and washer and tighten to the specified torque.
8. Refit the propeller shaft.

REMOVE LT230T TRANSFER GEARBOX

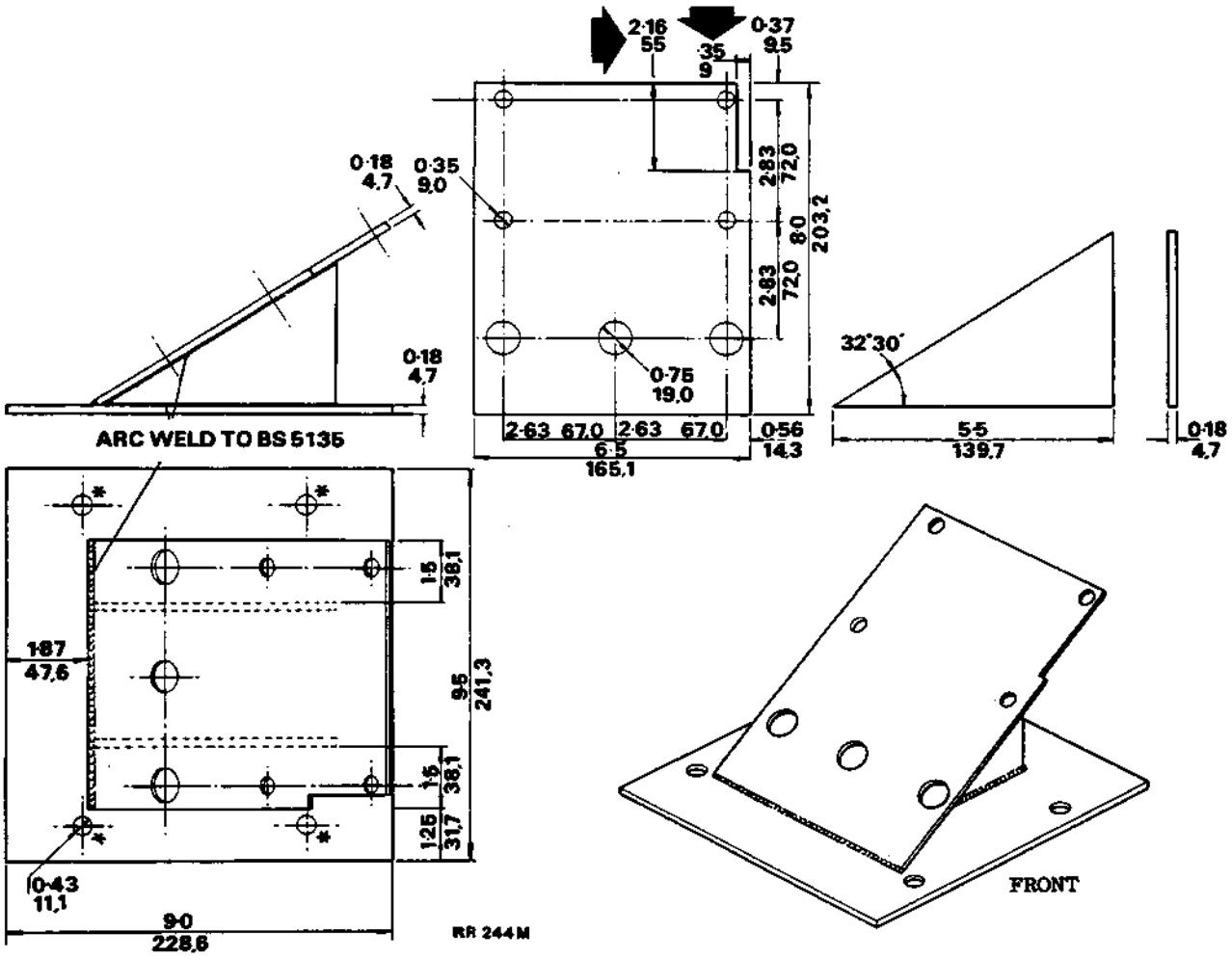
Special tool: 18G 1425—Guide studs (3)
Also, locally manufactured adaptor plate, see below

Adaptor plate for removing transfer gearbox

The transfer gearbox should be removed from underneath the vehicle, using a hydraulic hoist. An adaptor plate for locating the transfer gearbox onto the hoist can be manufactured locally to the drawing below. If a similar adaptor plate was made for the LT230R transfer gearbox, it can be modified to suit both the LT230R and LT230T gearboxes by making the modifications shown by the large arrows.



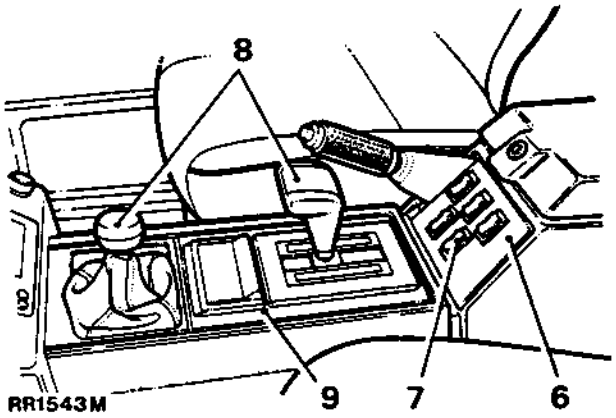
ST1548M



Material: Steel plate BS 1449 Grade 4 or 14.
Holes marked thus * to be drilled to fit hoist being used.

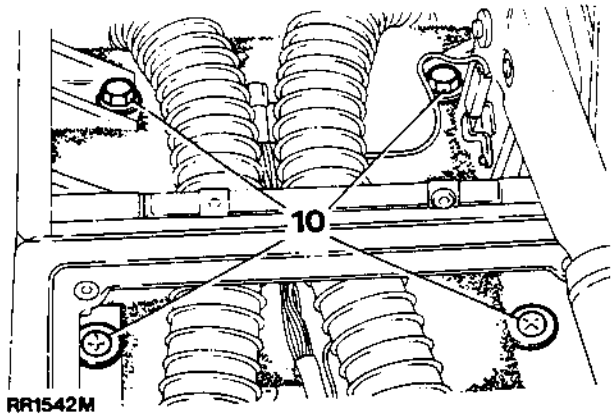
Removing

1. Install the vehicle on a hydraulic ramp.
2. Open the bonnet.
3. Disconnect the battery.
4. **Fuel Injection models** only—release the airflow meter to plenum chamber hose.
   Carburetter models only—Remove the air intake elbows and withdraw the air cleaner from its location.
5. Remove the four screws securing the cubby box liner to the cubby box and lift out the liner.
6. Carefully prise the window lift, switch panel away from the front of the cubby box.
7. Identify each switch connection for reassembly, disconnect the plugs and remove the switch panel.
8. Remove the main and transfer gearbox knobs.
9. Carefully prise the centre panel out of the floor mounted console and remove it from the vehicle.



Automatic version illustrated

10. Release the two bolts and two screws securing the console assembly to the gearbox tunnel.

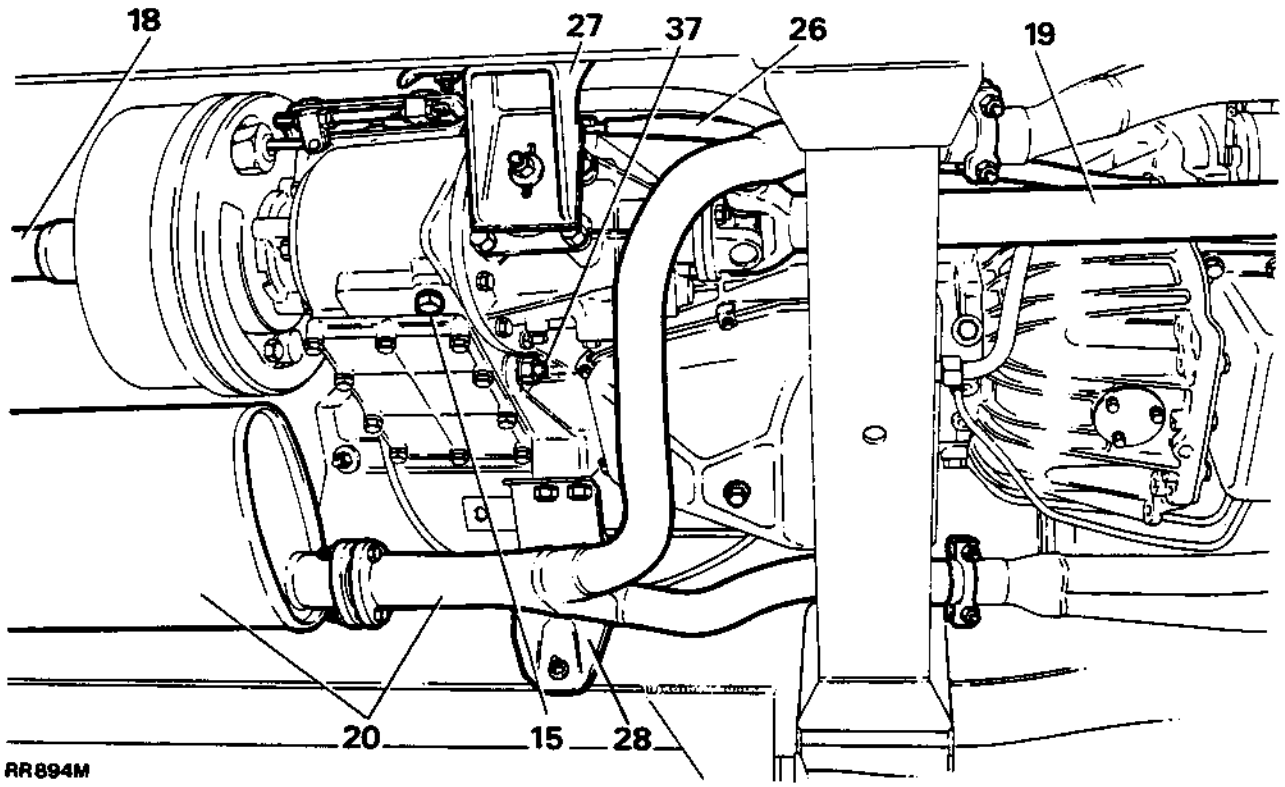


11. Release the handbrake and remove the split pin, clevis pin and washer securing the handbrake cable to the hand brake lever.
12. Carefully manoeuvre the assembly away from the radio housing and remove it from the vehicle.
13. Release the large nut retaining the handbrake outer cable to the top of the gearbox tunnel.
14. Remove the nut and feed the cable through the hole to the underside of the vehicle.

NOTE: The illustration for the following removal instructions is located at top of the following page.

15. Raise the vehicle on the ramp and drain the transfer gearbox.
16. Release the nut and clamp securing the speedometer cable to the rear of the transfer box, withdraw the cable from the speedometer drive pinnion.
17. Release the cable from the clip at the side of the gearbox.
18. Release the four nuts and bolts securing the rear propeller shaft to the rear output flange and tie the shaft to one side.
19. Remove the four nuts and bolts securing the front propeller shaft to the front output flange and tie the shaft to one side.
20. Release the nuts and bolts securing the front down pipe to the front silencer.
21. Release the nut at the rear tailpipe bracket, disconnect the silencer from the down pipe, and tie the rear tail pipe and silencer to one side.
22. Manufacture an adaptor plate in accordance with the drawing, to attach to the gearbox hoist and transfer box to facilitate removal (RR244M).
23. Place four, 30 mm (1.250 in) long spacers between the top of the hoist and the adaptor plate at the securing points and secure the adaptor plate to the hoist.
24. Remove the four central bolts from the transfer box bottom cover, move the hoist into position and secure the adaptor plate to the transfer box.
25. Adjust the hoist to take the weight of the transfer box.
26. Remove the tie bar from the transfer gearbox.
27. Remove the rear left-hand side mounting bracket to chassis nuts and bolts.
28. Remove the right-hand side mounting bracket to chassis nuts and bolts.
29. Remove right-hand side mounting bracket to flexible mounting, rubber retaining nut and place bracket aside.
30. Lower the hoist until the rear brake drum clears the rear passenger footwell.
31. Remove the split pin and washers securing the differential lock lever to the connecting rod, and disconnect the lever from the rod.
32. Disconnect the electrical leads from the differential lock switch.
33. Remove the breather pipe from the top of the transfer gearbox.
34. Select low range transfer box gear position.
35. Release the high/low rod lower lock nut and remove the rod from the yoke.

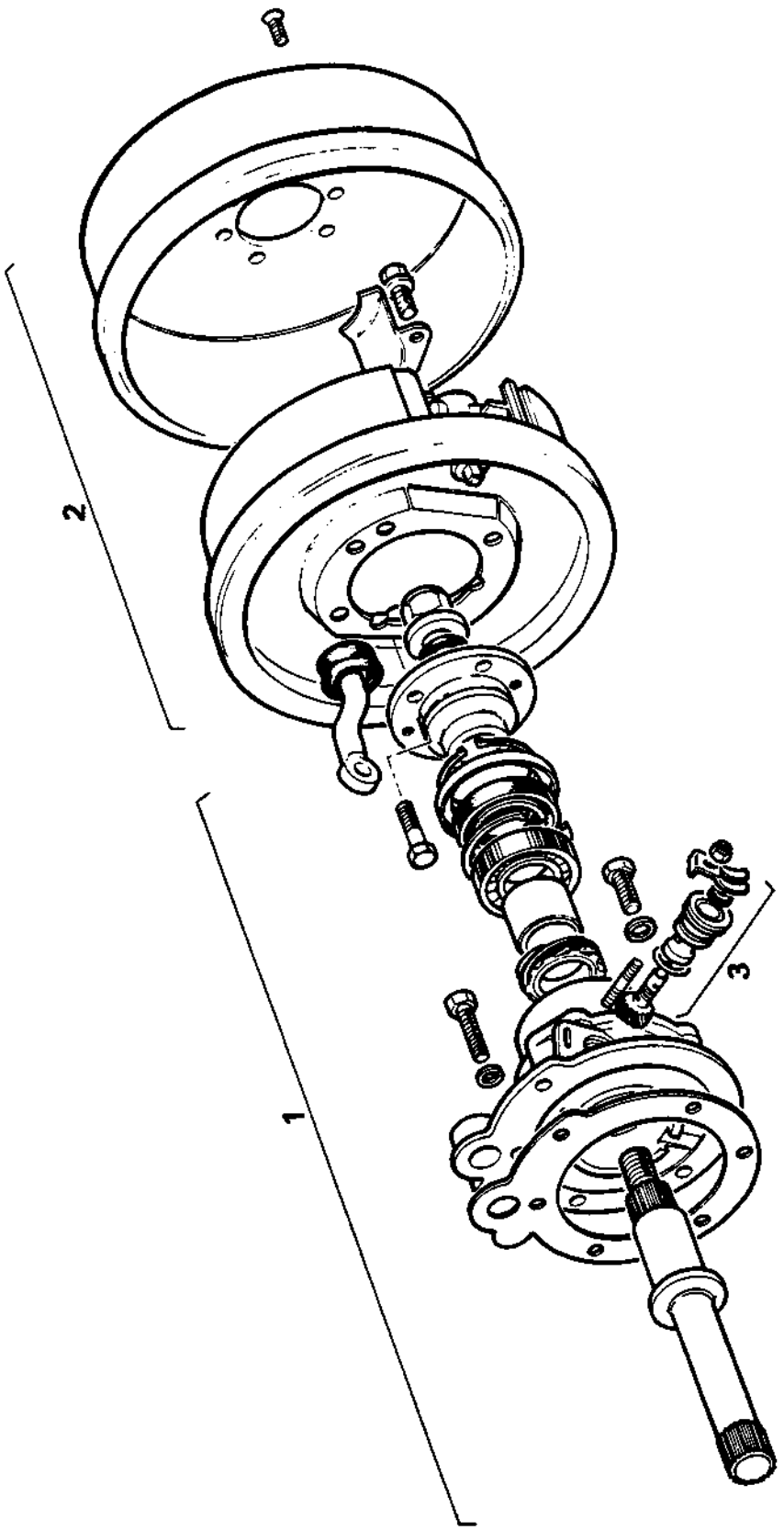
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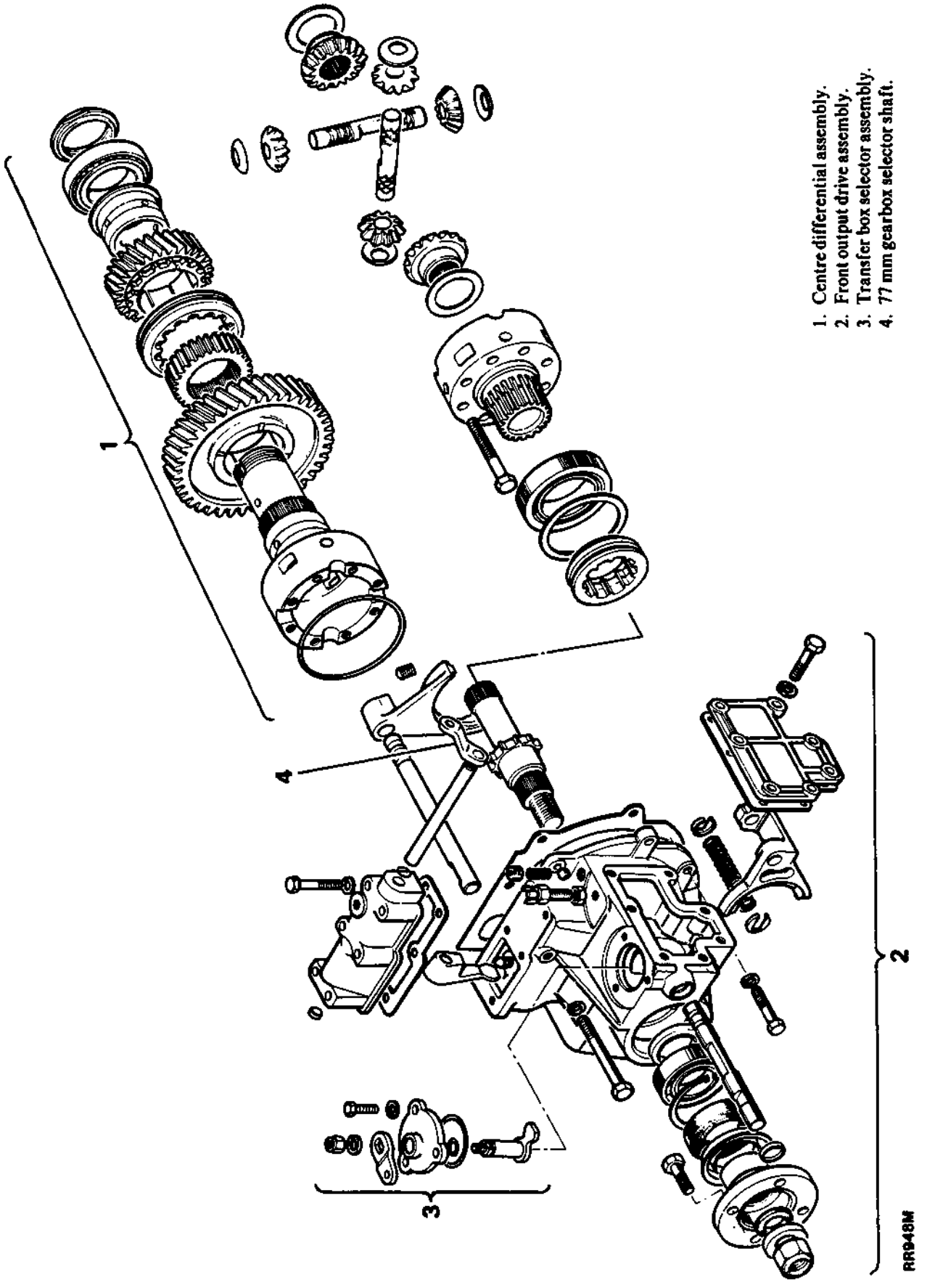
36. Place a suitable wooden block between the main gearbox and chassis cross-member, then lower the hoist until the gearbox contacts the wooden block.
37. Remove the upper and lower bolts securing the transfer box to the main gearbox.
38. Fit three guide studs to the gearbox 18G 1425 and manoeuvre the gearbox rearwards to detach it from the main gearbox.

Refitting

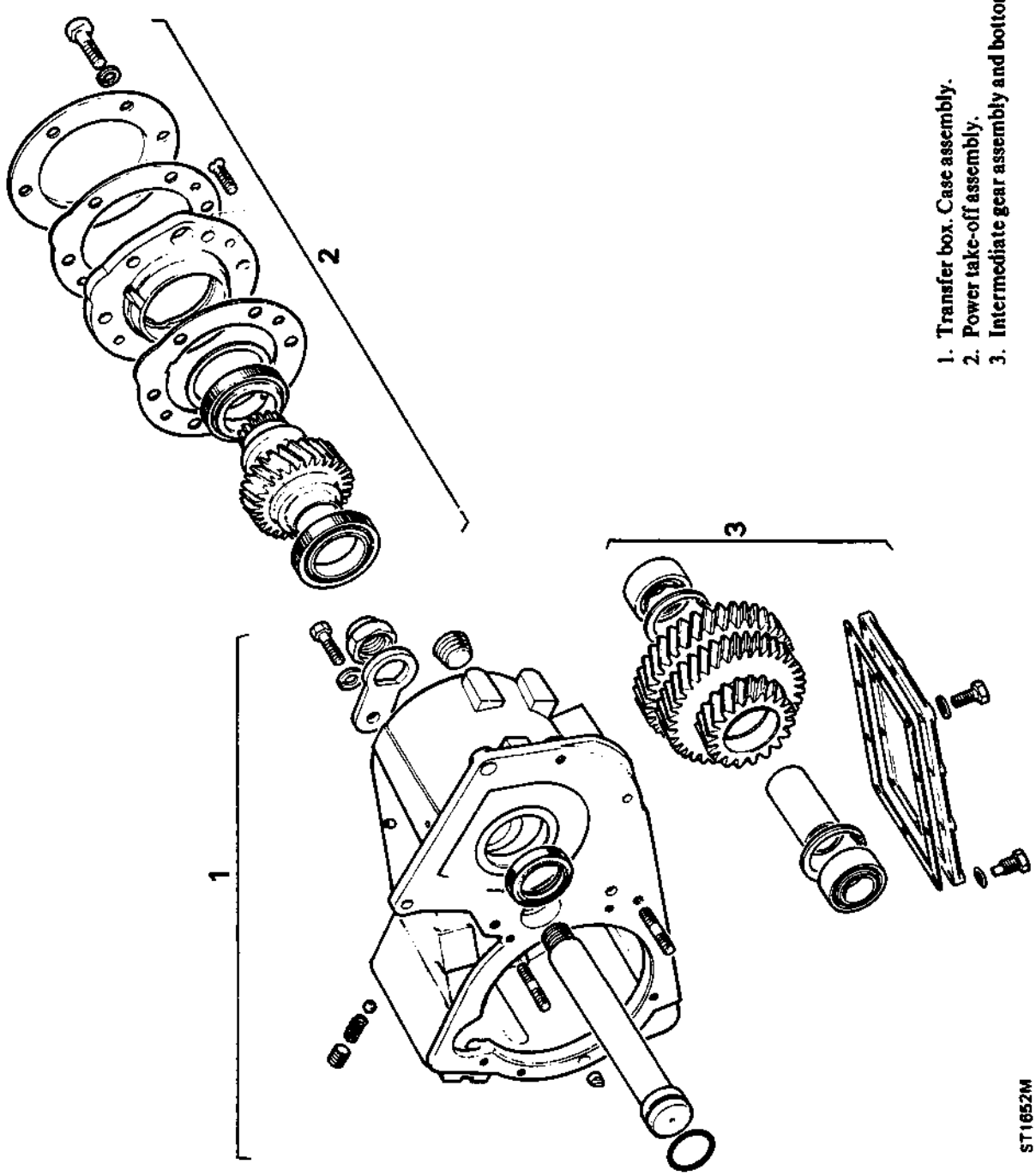
39. Make sure that the joint faces of the transfer box and main gearbox extension case are clean and that the three guide studs, 18G 1425, are fitted to the extension case.
40. Lubricate the oil seal in the joint face of transfer box, secure the transfer box to the adaptor plate on the lifting hoist and raise the hoist until the transfer box can be located over the guide studs.
41. Remove the guide studs and secure the transfer box to the main gearbox extension case. Tighten the nuts and bolts to the correct torque.
42. Complete the refitting procedure by reversing the removal sequence, noting the following important points.
43. After removing the lifting hoist and adaptor plate from the transfer box, clean the threads of the four bolts for the transfer box bottom cover, coat them with Loctite 290, and fit them together with spring washers. Tighten to the correct torque.
44. Refill the transfer box with the correct grade oil to the oil level plug hole.
45. Check, and if necessary top-up the oil level in the main gearbox. Use the correct grade oil.
46. Check the operation of the handbrake and adjust as necessary.



1. Rear output drive assembly.
2. Transmission brake drum assembly.
3. Speedo housing assembly.



1. Centre differential assembly.
2. Front output drive assembly.
3. Transfer box selector assembly.
4. 77 mm gearbox selector shaft.



1. Transfer box. Case assembly.
2. Power take-off assembly.
3. Intermediate gear assembly and bottom cover.

LT230T TRANSFER GEARBOX OVERHAUL

Service Tools:
18G47-7—Input gear cluster bearing cones remover/replacer
18G47BB-1—Adaptor centre differential bearing remover
18G47BB-3—Adaptor centre differential bearing remover button
18G257—Circlip pliers
18G1205—Prop flange wrench
18G1271—Oil seal remover
18G1422—Mainshaft rear oil seal replacer
18G1423—Adaptor/socket centre differential stake nut remover/replacer
18G1424—Centre differential bearing replacer
MS47—Hand press
MS550—Bearing and oil seal replacer handle
LST47-1—Adaptor centre differential bearing remover
LST104—Intermediate gear dummy shaft
LST105—Input gear mandrel
LST550-4—Intermediate gear bearing replacer

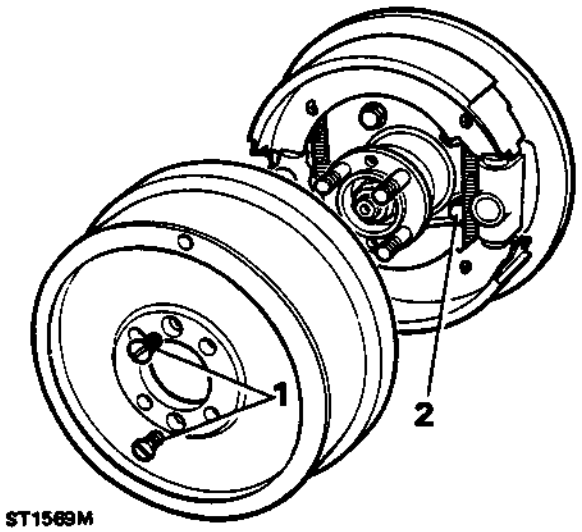
TRANSFER BOX DATA

Front bevel gear end-float	0,025 to 0,075 mm (0.001 to 0.003 in)
Rear bevel gear end-float	0,025 to 0,075 mm (0.001 to 0.003 in)
Rear output housing clearance	1,00 mm (0.039 in)
High range gear end-float	0,05 to 0,15 mm (0.002 to 0.006 in)
Front differential bearing pre-load	1.36 to 4.53 kg (3 to 10 lb)
Input gear bearing pre-load	2.26 to 6.80 kg (5 to 15 lb)
Intermediate shaft bearing pre-load	1.81 to 4.53 kg (4 to 10 lb)

Transmission brake removal

1. Remove two countersunk screws and withdraw brake drum.
2. Remove four bolts securing the brake back-plate; the two bottom fixings retain the oil catcher.

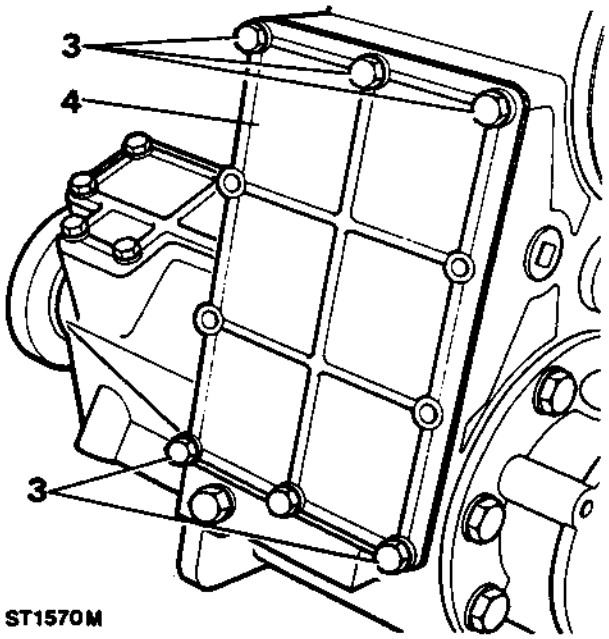
NOTE: An hexagonal type socket should be used for these bolts.



ST1569M

Bottom cover removal

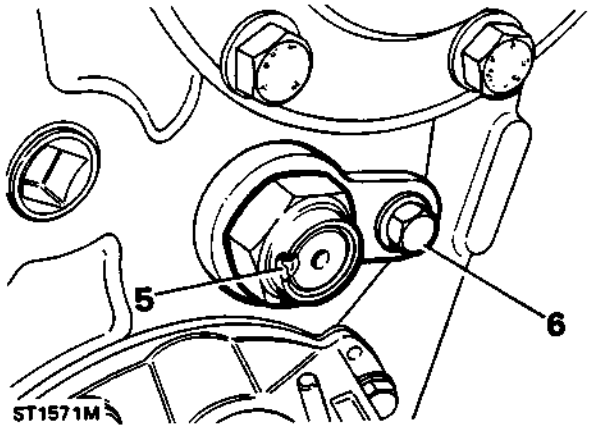
3. Remove the six bolts and washers retaining the bottom cover.
4. Remove the gasket and bottom cover.



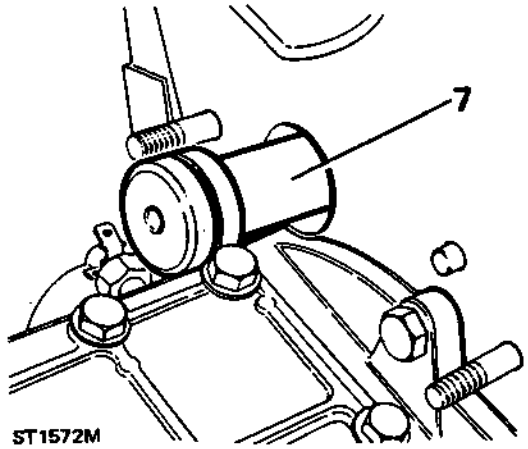
ST1570M

Intermediate shaft and gear cluster removal

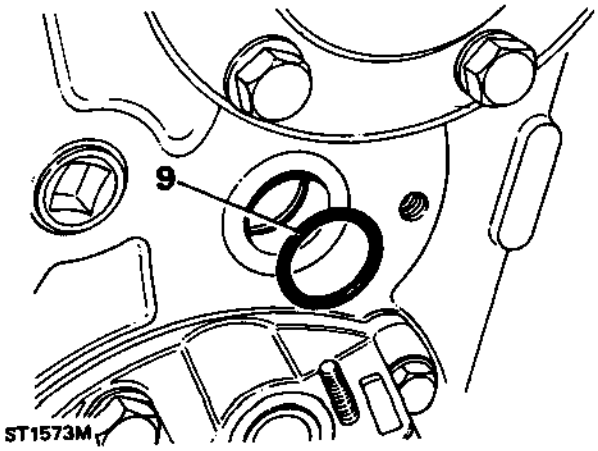
5. Release stake nut from recess in intermediate shaft and remove stake nut and discard.
6. Unscrew the single bolt and remove anti-rotation plate at the rear face of the transfer box.



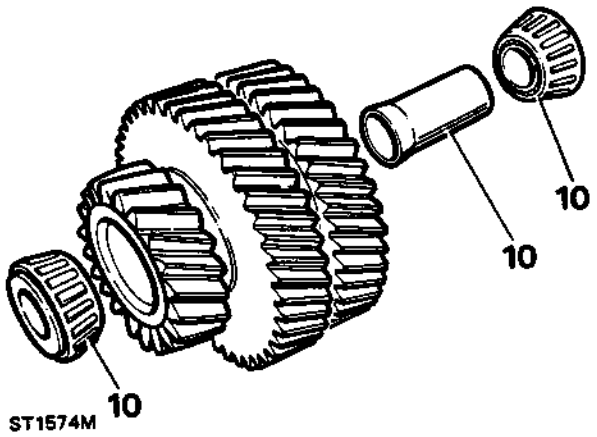
7. Tap the intermediate gear shaft from the transfer box.



8. Lift out the intermediate gear cluster and bearing assembly.
9. Remove the 'O' rings from the intermediate gear shaft and from inside the transfer box.

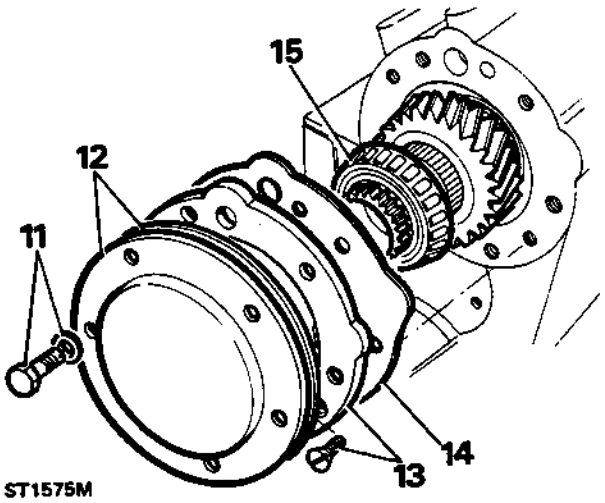


10. Remove taper roller bearings and bearing spacer from the intermediate gear cluster assembly.



Power take-off cover removal

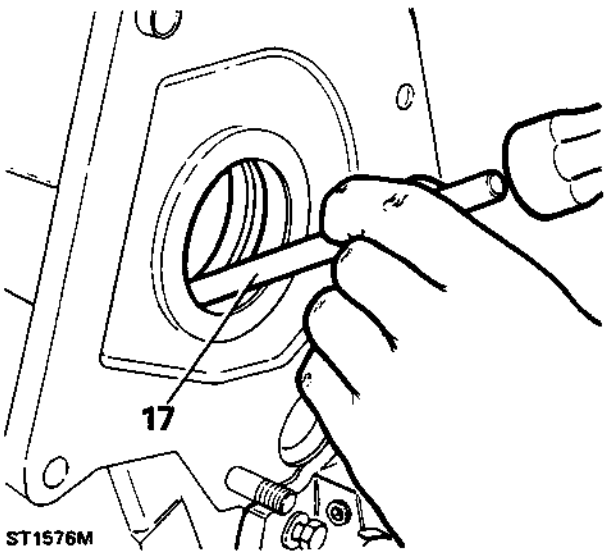
11. Remove six bolts and washers retaining the take-off cover and speedo cable clips.
12. Remove the gasket and cover.



Input gear removal

13. Remove the two countersunk screws and detach the main shaft bearing housing.
14. Remove the gasket.
15. Withdraw the input gear assembly.
16. Prise out and discard the oil seal at the front of the transfer box casing using service tool 18G 1271.
17. Drift out the input gear front bearing track.

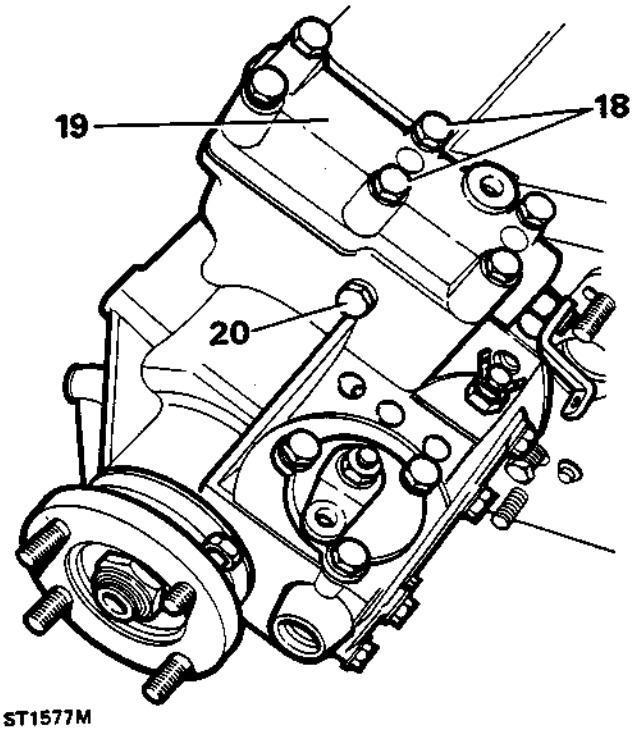
Continued



ST1576M

High/low cross-shaft housing removal

18. Remove the six bolts and washers retaining the cross-shaft housing and earth lead.
19. Remove the gasket and cross-shaft housing.



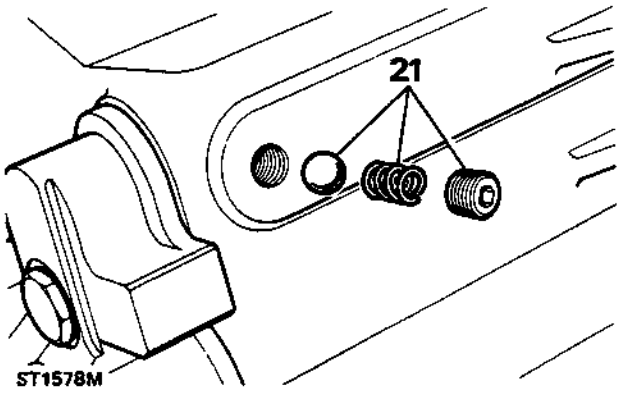
ST1577M

Front output housing removal

20. Remove the eight bolts and washers and detach the output housing from the transfer box casing, taking care not to mislay the dowel.

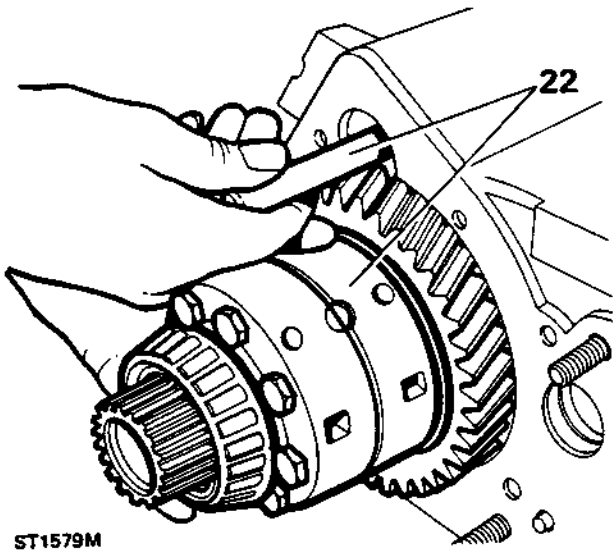
Centre differential removal

21. Remove high/low selector shaft detent plug, spring and retrieve the ball with a suitable magnet.



ST1578M

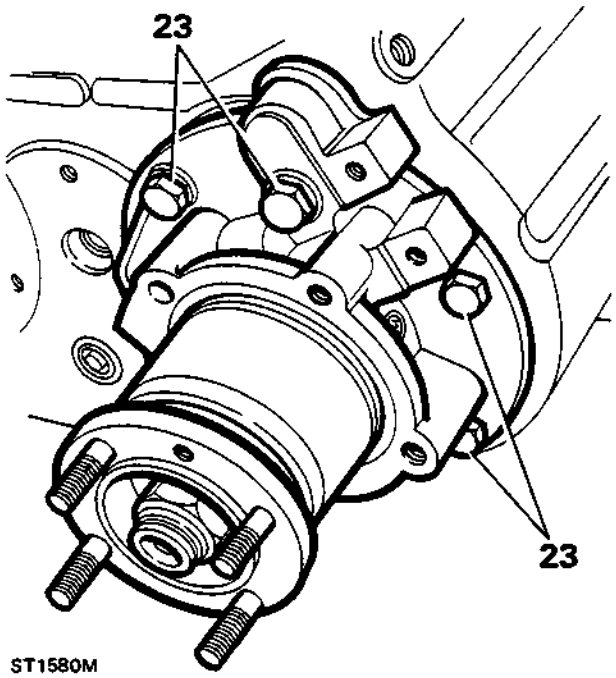
22. Withdraw the centre differential and selector shaft/fork assembly.



ST1579M

Rear output housing removal

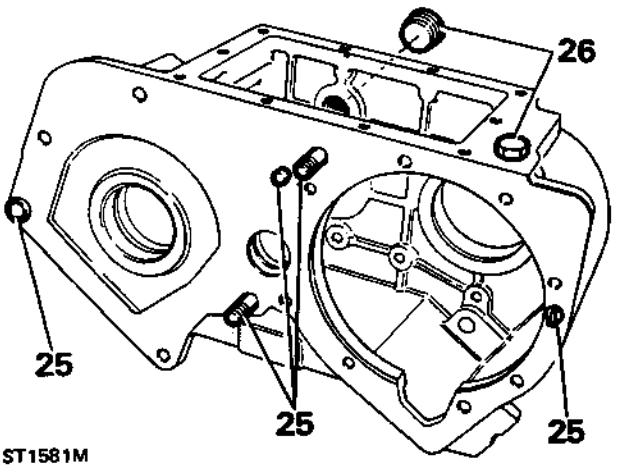
23. Remove six bolts and washers and detach the rear output housing and shaft assembly from the transfer casing.
24. Remove the gasket.



ST1580M

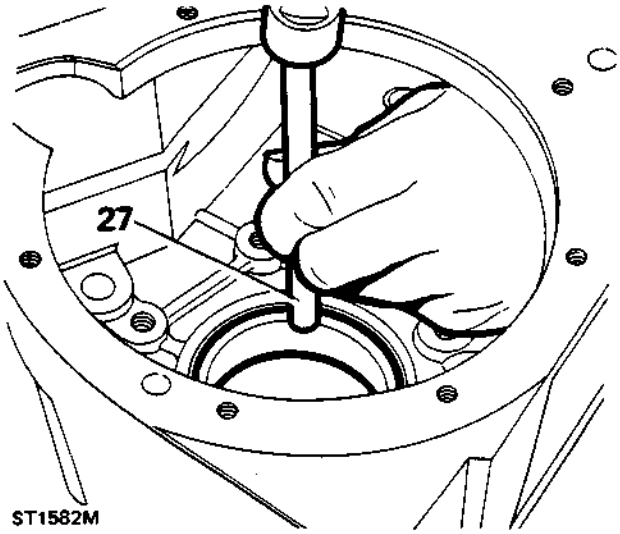
Transfer case overhaul—dismantling

25. Remove the studs and dowels.
26. Remove the magnetic drain plug and filler/level plug.



ST1581M

27. Drift out differential rear bearing track.
28. Clean all areas of the transfer casing ensuring all traces of 'Loctite' are removed from faces and threads.



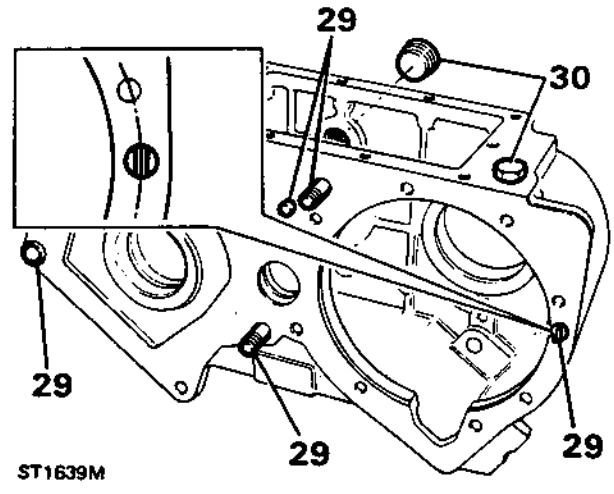
ST1582M

Transfer case overhaul—reassembling

29. Fit studs and dowels to front face of the transfer casing.

NOTE: The position of the radial dowel blade is set in line with the circle which is formed by the front output housing fixing holes.

30. Refit magnetic drain plug with new copper washer and tighten to the specified torque, loosely fit the filler/level plug.



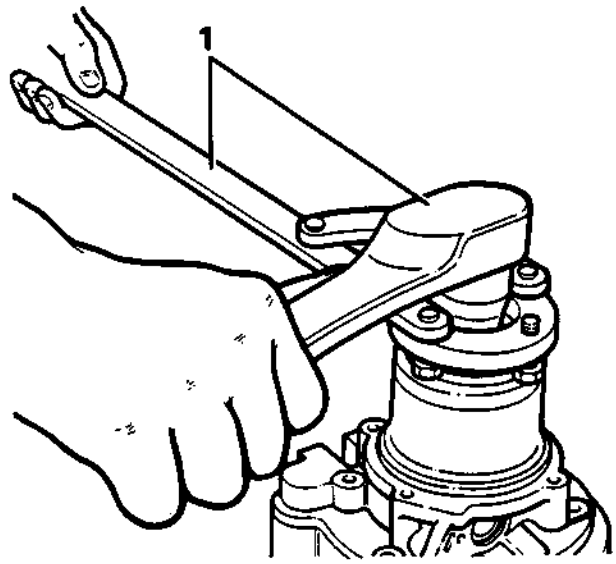
ST1639M

Continued

Rear output housing overhaul—dismantling

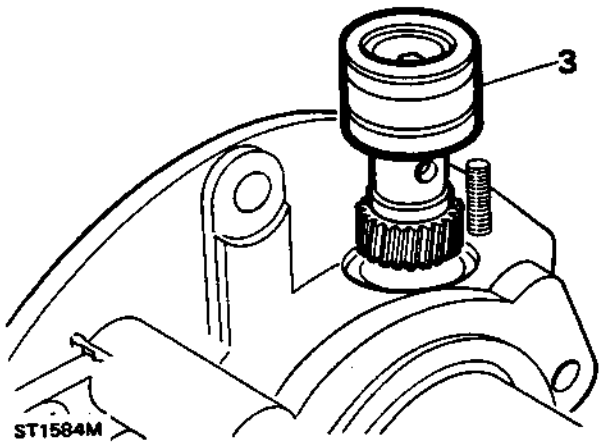
1. Using flange wrench 18G1205 and socket spanner, remove the flange nut, steel and felt washers. Ensure flange bolts are fully engaged in the wrench.
2. Remove output flange with circlips attached. If necessary, use a two-legged puller.

NOTE: The circlip need only be released if the flange bolts are to be renewed.



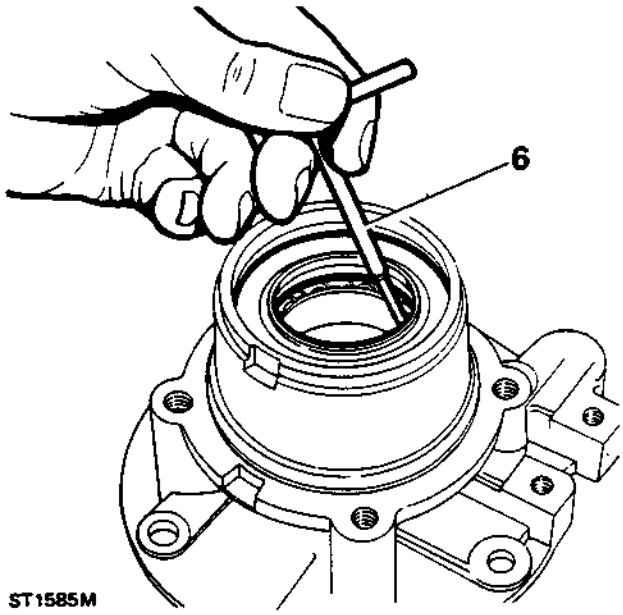
ST1583M

3. Remove speedo-drive housing. This can be prised out with a screwdriver.



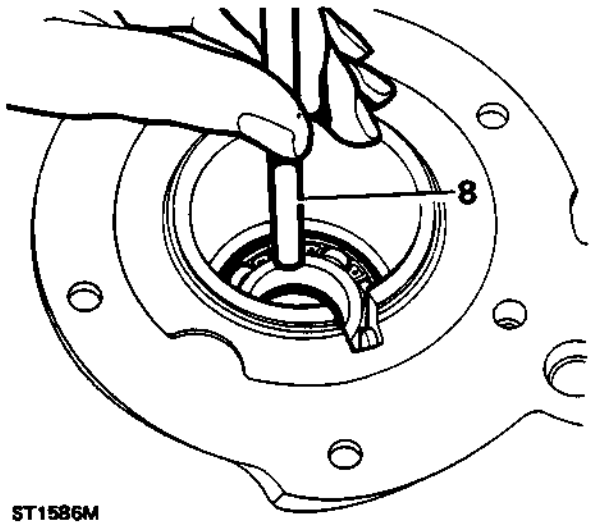
ST1584M

4. Remove housing from the vice and drift out the output shaft, by striking the flange end of the shaft.
5. Carefully prise off the oil catch ring using a screwdriver in the slot provided.
6. Prise out and discard the seal from the output housing using tool 18G 1271.



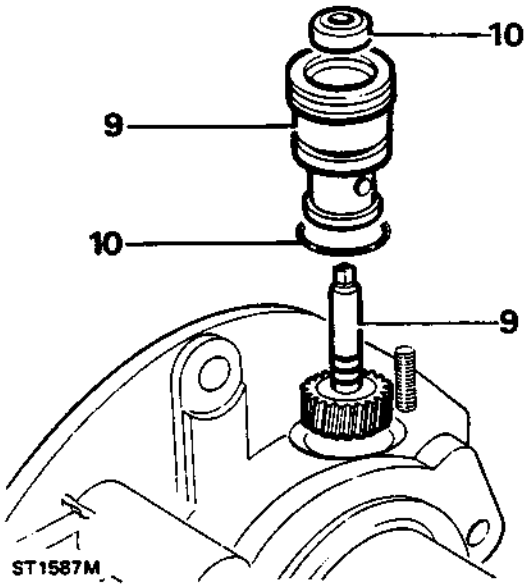
ST1585M

7. Using circlip pliers 18G257, remove the circlip retaining the bearing.
8. Drift out the bearing from the rear of the housing.

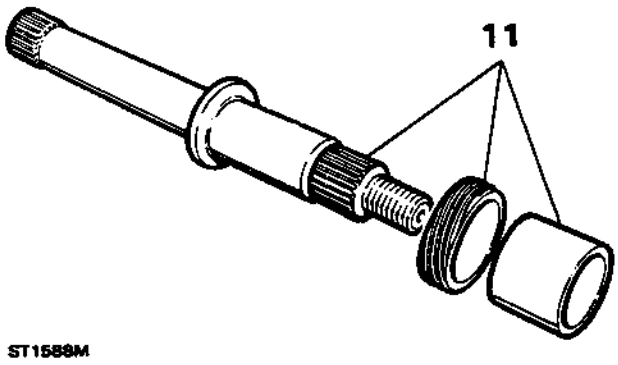


ST1586M

9. Remove speedometer gear (driven) from its housing.
10. Remove the 'O' ring and oil seal and discard.

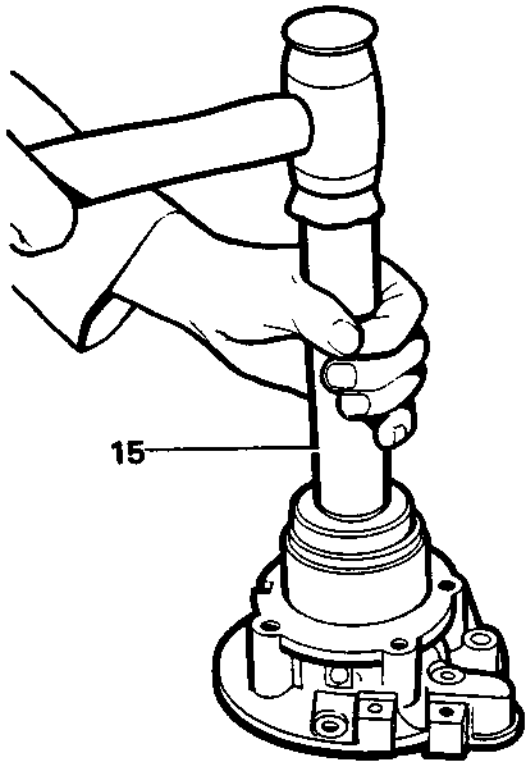


11. Slide off spacer and speedometer drive gear from output shaft.
12. Clean all parts, renew the 'O' ring, oil seals, felt seal and flange nut. Examine all other parts for wear or damage and renew, if necessary.

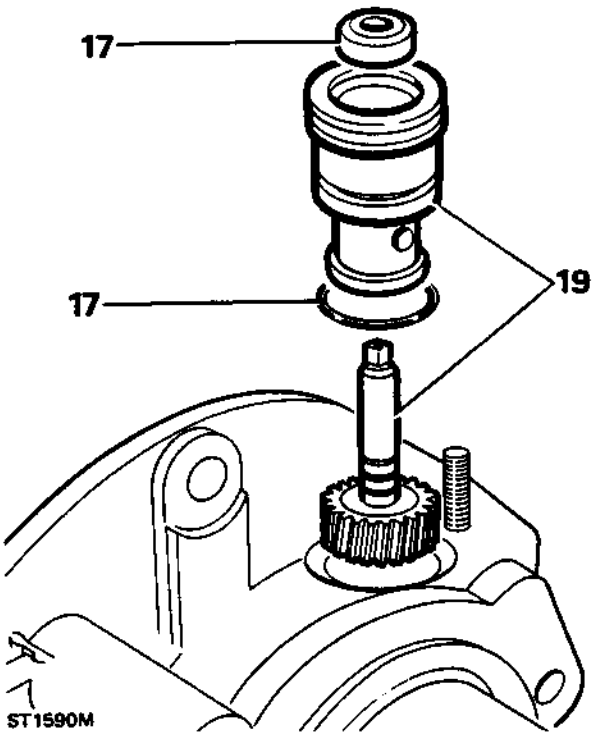


Reassembling

13. Press output bearing into the housing. Do not use excessive force. To facilitate fitting the bearing, heat the output housing case. (This is not to exceed 100°C.)
14. Retain bearing with circlip, using circlip pliers 18G257.
15. Fit new seal (open side inwards) using tool 18G1422. The seal should just make contact with the bearing circlip.
16. Carefully charge the lips of the seal with clean grease and refit oil catch ring on to output housing.

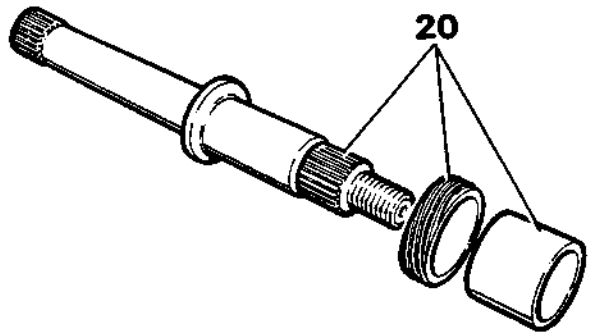


17. Fit the 'O' ring and oil seal (open side inwards) to speedometer housing.
18. Lubricate the 'O' ring and seal with oil.
19. Locate speedometer gear (driven) in housing and press into position.

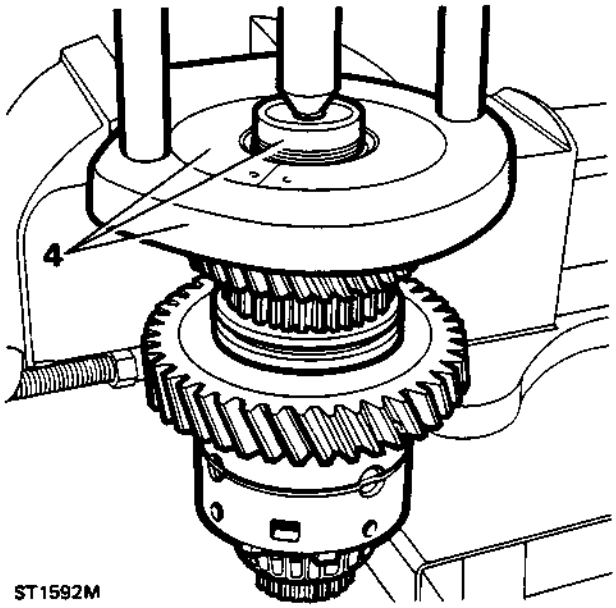


Continued

20. Slide drive gear and spacer on to the output shaft.
21. Locate output shaft into the bearing in the housing and drift into position.
22. Locate speedometer gear (driven) housing assembly into the output housing and press in until flush with the housing face.



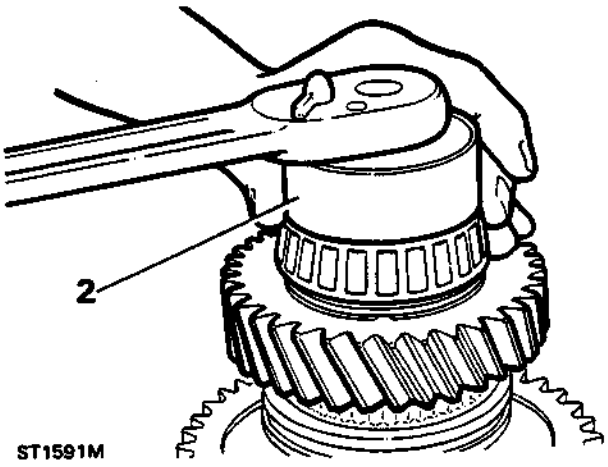
ST1640M



ST1592M

Centre differential unit overhaul—dismantling

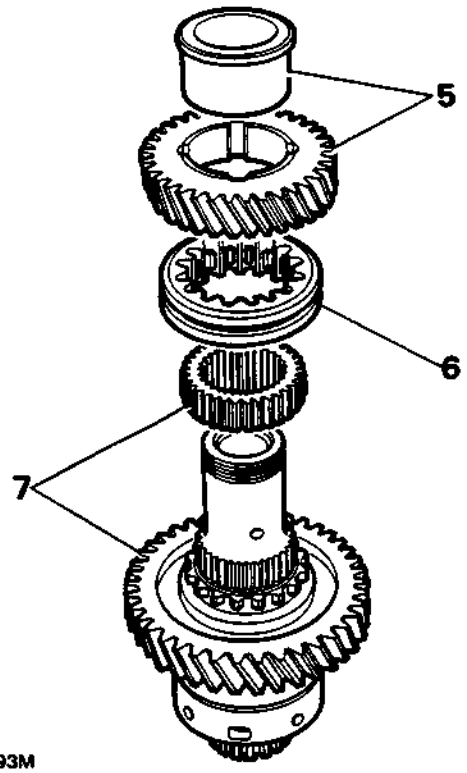
1. Secure centre differential unit to a vice fitted with soft jaws, and release stake nut from recess.
2. Remove stake nut using tool 18G1423 and suitable socket wrench.
3. Remove the differential unit from the vice.



ST1591M

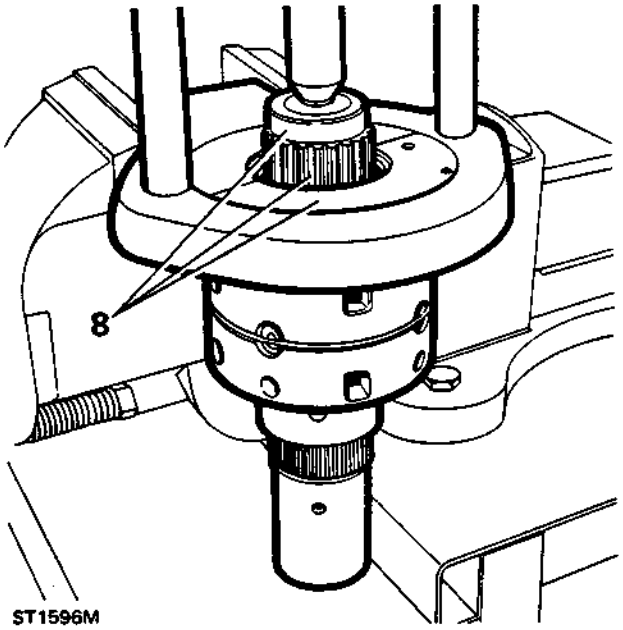
4. Secure hand press MS47 in vice with collars 18G47BB and using button 1847BB/3 remove the rear taper bearing and collars.

5. Remove the high range gear and bush, taking care not to disturb the high/low sleeve.
6. Mark the relationship of the high/low sleeve to the hub and then remove the sleeve.
7. Using a suitable press behind the low range gear carefully remove the high/low hub and low range gear.

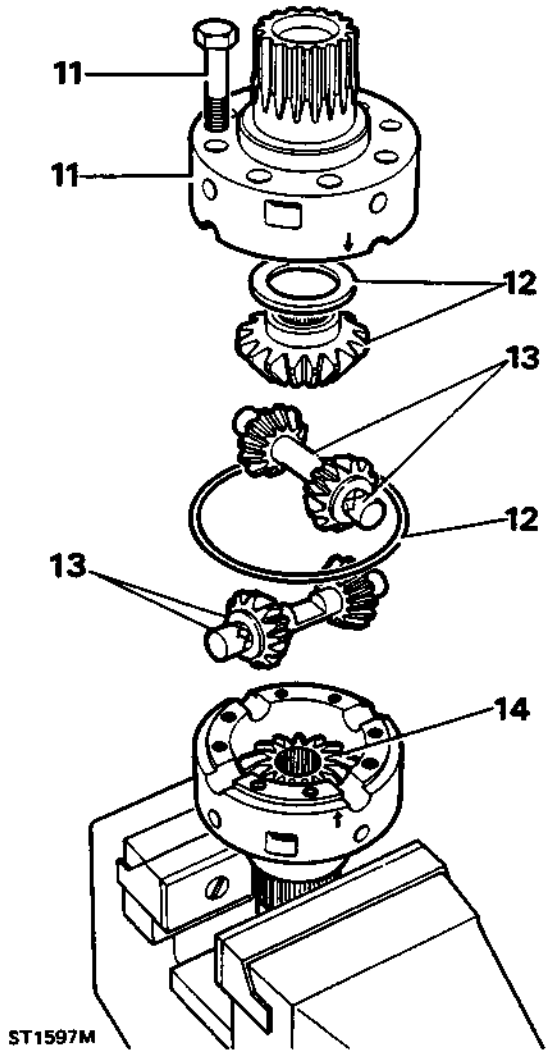


ST1593M

8. Substituting collar LST47-1 remove front taper roller bearing.
9. Remove hand press from the vice.
10. Using soft jaws secure the differential unit in the vice by gripping the hub splines.



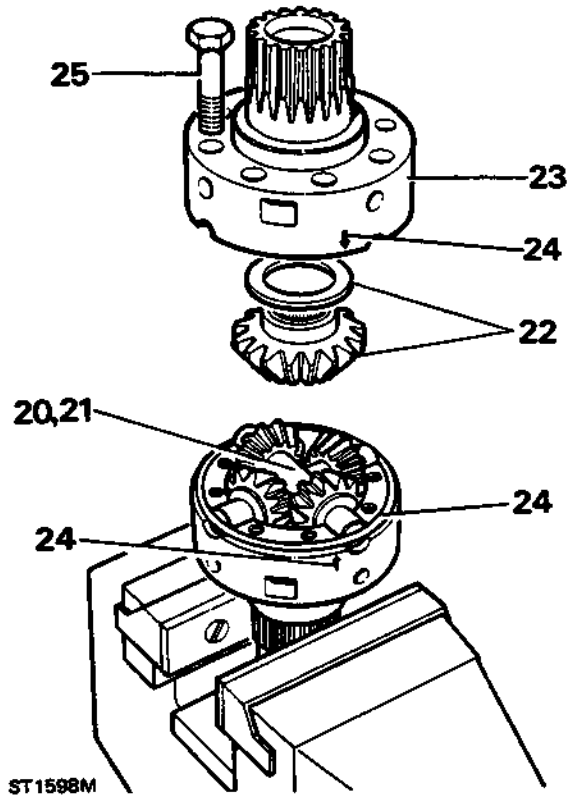
11. Remove the eight retaining bolts and lift off the front part of the differential unit.
12. Release the retaining ring and remove front upper bevel gear and thrust washer.
13. Remove the pinion gears and dished washers along with the cross shafts.
14. Remove the rear lower bevel gear and thrust washer from the rear part of the differential unit.
15. Remove the rear differential unit from the vice and clean all components; examine for wear or damage and renew if necessary.



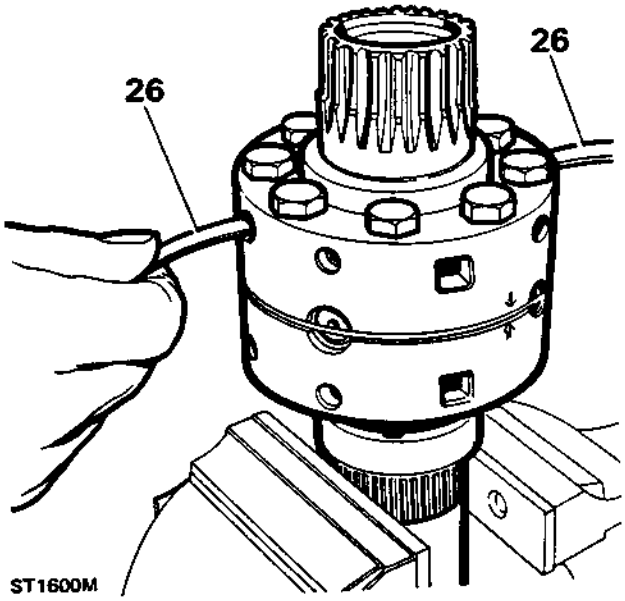
16. Clean all components; examine for wear or damage and renew if necessary.
17. Using soft jaws secure the rear differential unit in the vice by gripping the hub splines.
18. Ensure that all differential components are dry to assist in checking end-float.
19. Using a micrometer, measure one of the bevel gear thrust washers and note the thickness.

Continued

20. Fit the thrust washer and bevel gear to the rear lower differential unit.
21. Assemble both pinion assemblies and dished washers on to their respective shafts and fit to the rear differential unit.
22. Measure the front upper bevel gear thrust washer and note the thickness.
23. Fit the thrust washer and bevel gear to the front unit.
24. Refit the retaining ring and front differential unit, aligning the two engraved arrows marked on both halves of the unit.
25. Fit four bolts equi-spaced and torque to the correct figure.

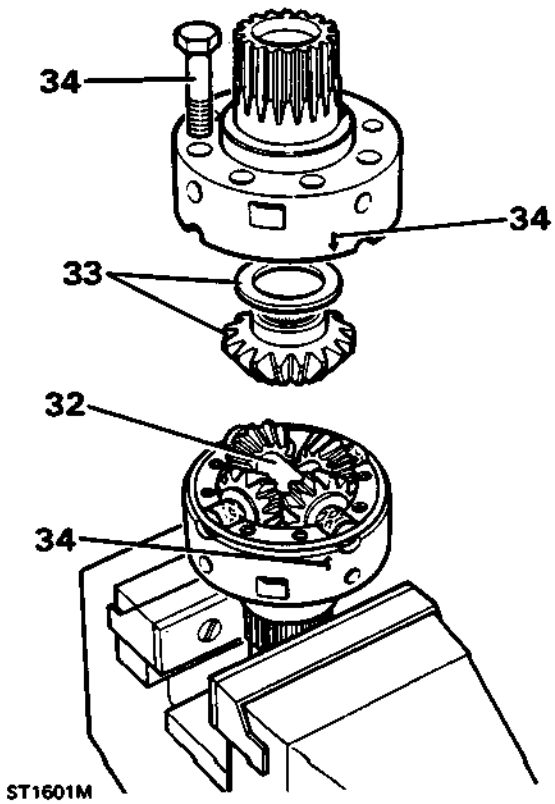


26. Measure the front bevel gear end-float with feeler gauges through the slots provided in the front differential unit. The end-float must be 0,025 to 0,075 mm (0.001 to 0.003 in) maximum. When measuring use two sets of feeler gauges, one on each side of the front differential unit. This will give a true reading of the end-float.
27. Invert the differential unit and repeat operation 26 for the rear bevel gear end-float.
28. Invert the differential unit and secure in vice and remove the four bolts and lift off the front differential unit.
29. Remove the retaining ring, bevel gear and the washer and both pinion assemblies.
30. Select the correct thrust washers required for final assembly.



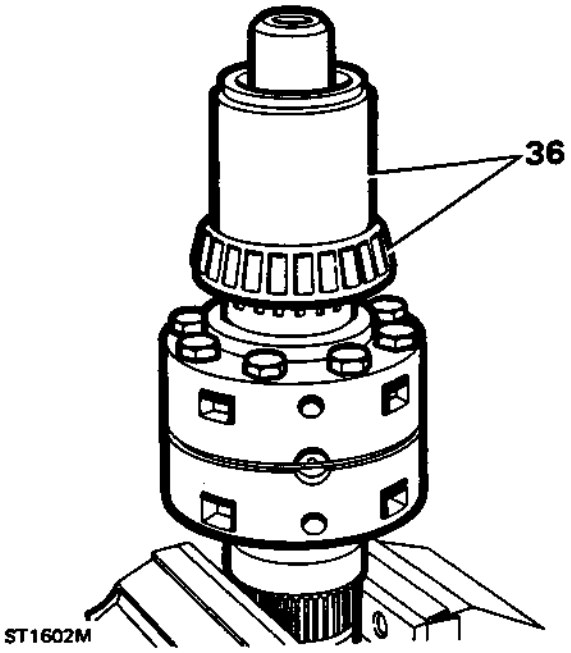
Reassembling

31. Fit the selected thrust washer and bevel gear into the rear lower differential unit.
32. Assemble both pinion assemblies and dished washers on to their respective shafts and fit the rear differential unit. Secure the assemblies with the retaining ring.
33. Lubricate all the components.
34. Fit the selected thrust washer and bevel gear into the front upper differential unit.

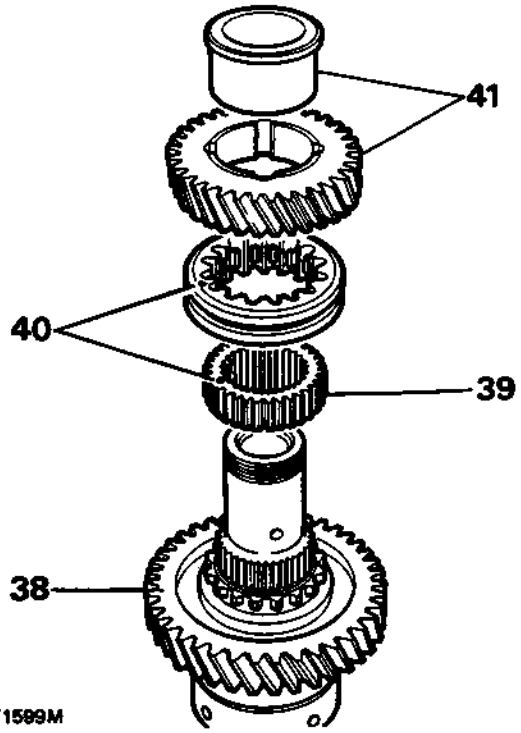


35. Align both units as previously described and secure with the eight bolts to the specified torque.
36. Finally check that the differential gears rotate freely. Locate the front differential bearing onto the front, upper differential shaft and press into position using larger end of tool 18G1424 as shown.
37. Invert the differential unit and secure in the vice.

NOTE: During the following sequences all parts should be lubricated as they are fitted.

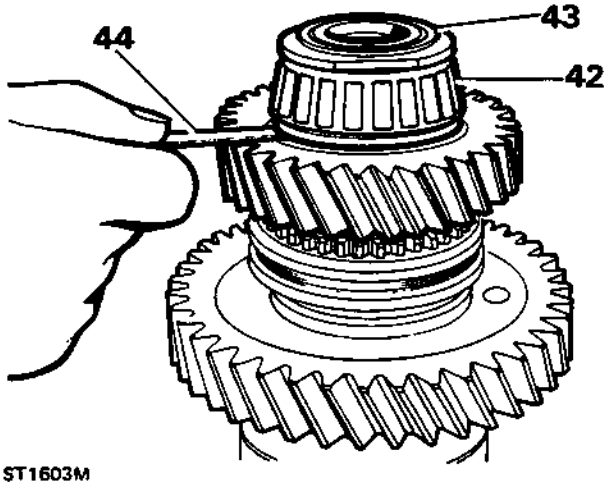


38. Fit the low range gear, with its dog teeth uppermost to the differential assembly.
39. Press the high/low hub on to the differential splines.
40. Slide the high/low selector sleeve on to the high/low hub ensuring that the alignment marks are opposite each other.
41. Fit the bush into the high range gear so that the flange is fitted on the opposite side of the gear to the dog teeth. Slide the bushed gear on to the differential assembly with the dog teeth down.



42. Locate the rear differential bearing on to the hub and press it into position using the smaller end of tool 18G1424.
43. Fit the stake nut and tighten to the specified torque using tool 18G1423.
44. Check the end float of the high and low range gears 0,05 to 0,15 mm (0.002 to 0.005 in).

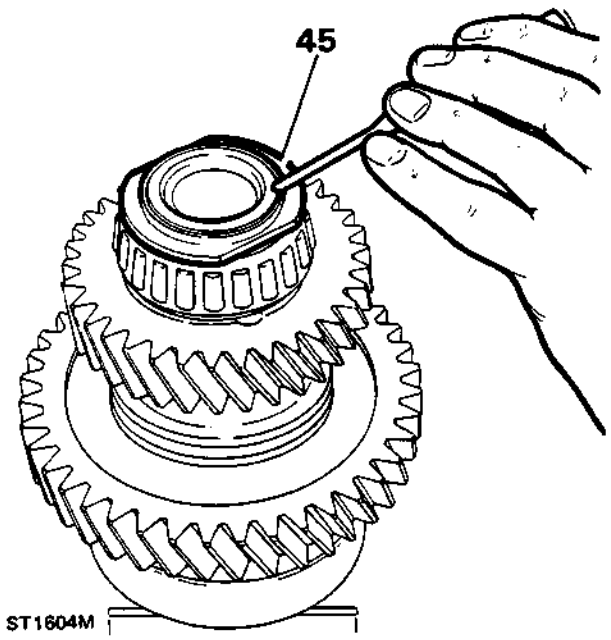
NOTE: If the clearances vary from those specified in the data, the assembly must be rebuilt using the relevant new parts.



Continued

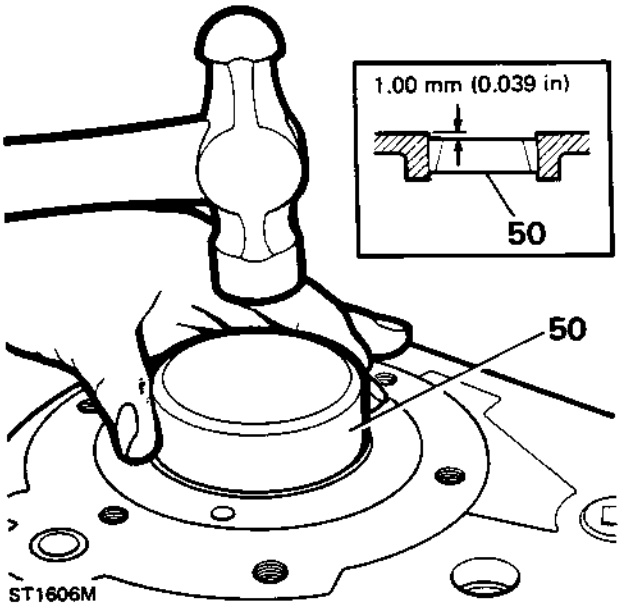
45. Peen the stake nut collar by carefully forming the collar of the nut into the slot as illustrated.

CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut.

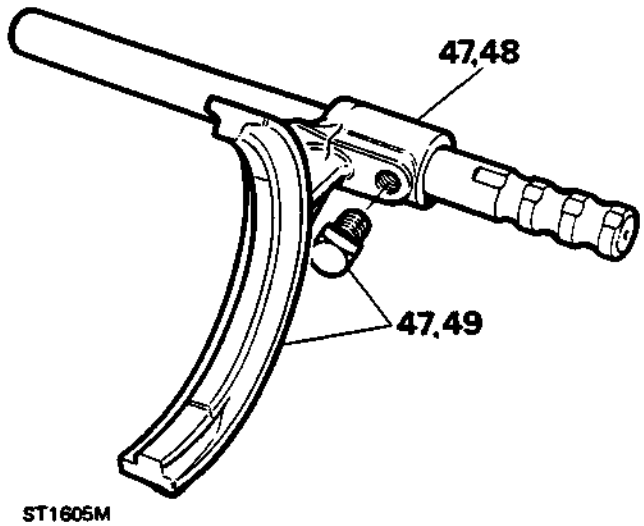


Centre differential rear bearing track

50. Fit the differential rear bearing track 1,00 mm (0.039 in) below the outer face of casing using a suitable tool as shown.

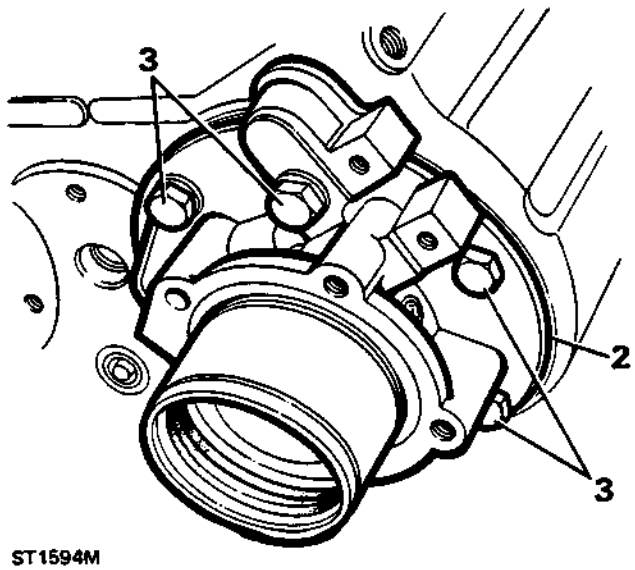


46. Clean and check high/low selector fork assembly for wear and renew if necessary.
47. To renew the selector fork remove the square set screw and slide the fork from the shaft.
48. Fit the new selector fork with its boss towards the three detent grooves. Align the tapped hole in the fork boss with the indent in the shaft nearest to the detent grooves.
49. Apply Loctite 290 to the set screw threads and fit the set screw and tighten to the specified torque.



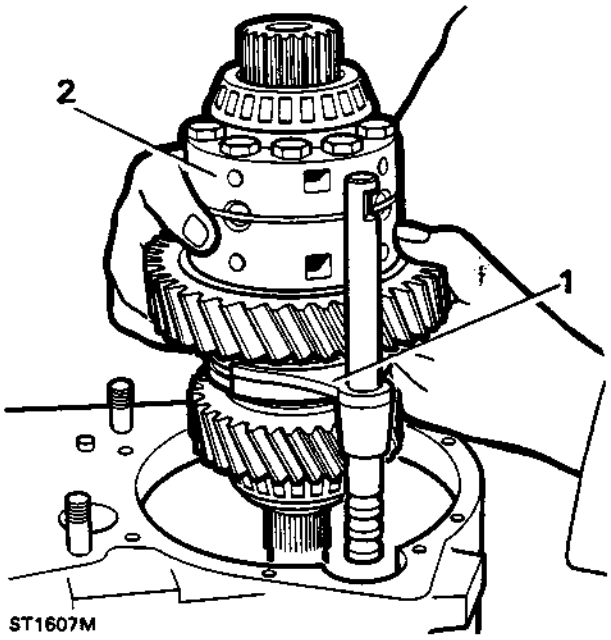
Rear output housing—refit

1. Grease output housing gasket and position on to the rear face of the transfer box casing.
2. Fit output housing and ensure clearance of 100 mm (0.039 in) between housing face and gasket.
3. Fit the six output housing bolts with Loctite 290 on the threads, with washers and tighten evenly to the correct torque, which will pull the rear bearing into position.

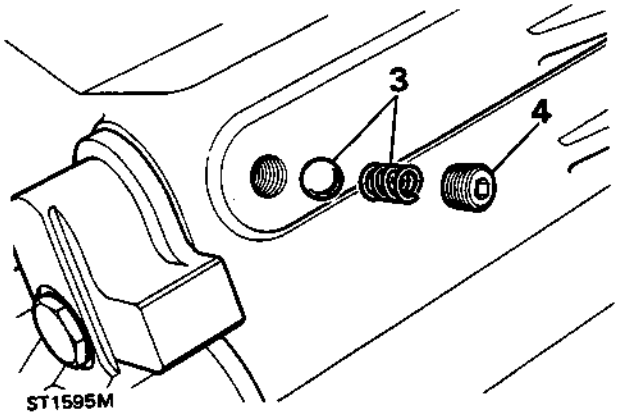


Centre differential unit refit

1. Fit the selector fork/shaft assembly to the high/low selector sleeve on the differential assembly, with detent groove to the rear of the differential assembly.
2. Locate the differential assembly complete with selector fork into the transfer box casing. It may be necessary to rotate the output shaft to ease fitment, and engage selector shaft into its hole.

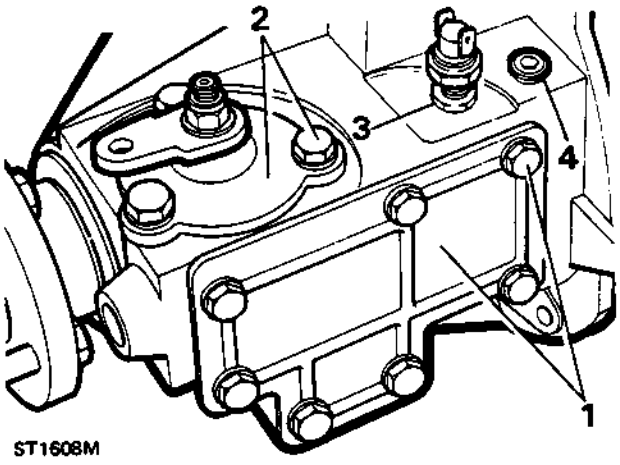


3. Fit selector shaft ball and spring through the side of the transfer box casing.
4. Apply Loctite 290 to detent plug; fit and locate, by screwing gently fully home and then unscrewing two turns.

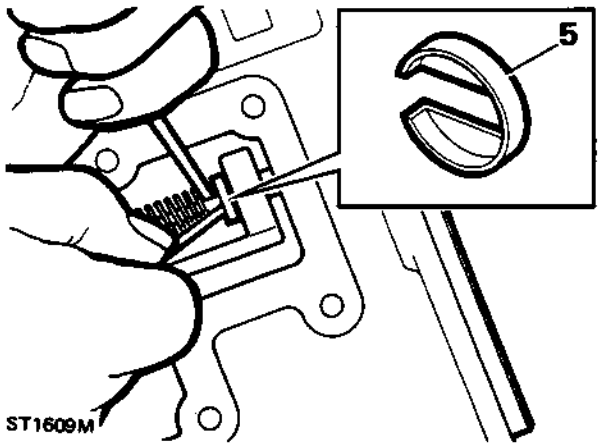


Front output housing overhaul—dismantling

1. Unscrew seven retaining bolts and washers and remove the differential lock selector side cover and gasket.
2. Unscrew three retaining bolts and washers and lift the differential lock finger housing and actuator assembly from the front output housing.
3. Slacken the locknut and unscrew the differential lock warning light switch.
4. Remove selector shaft detent plug, spring and ball using a suitable magnet.

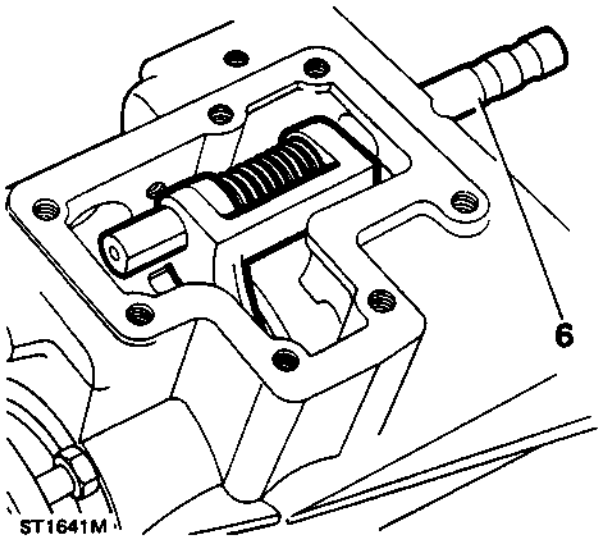


5. Compress the selector fork spring and remove the two spring retaining caps.



Continued

6. Withdraw the selector shaft from the rear of the output housing.
7. Remove the selector fork and spring through the side cover aperture.
8. Remove lock-up sleeve from the rear of the output housing.



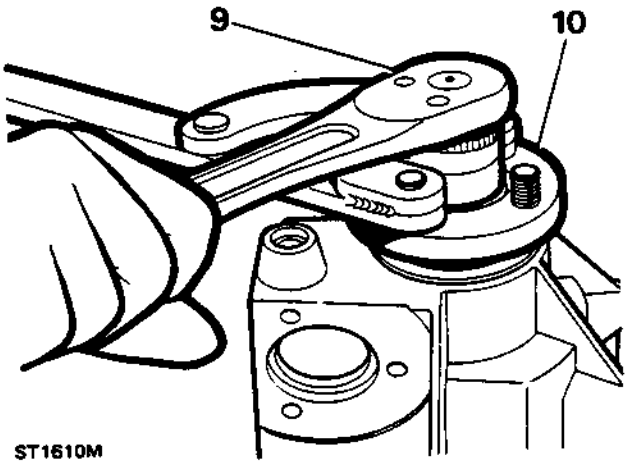
9. Using flange wrench 18G1205 and socket wrench, remove the flange nut, steel and felt washers.

NOTE: Ensure that flange bolts are fully engaged in the wrench.

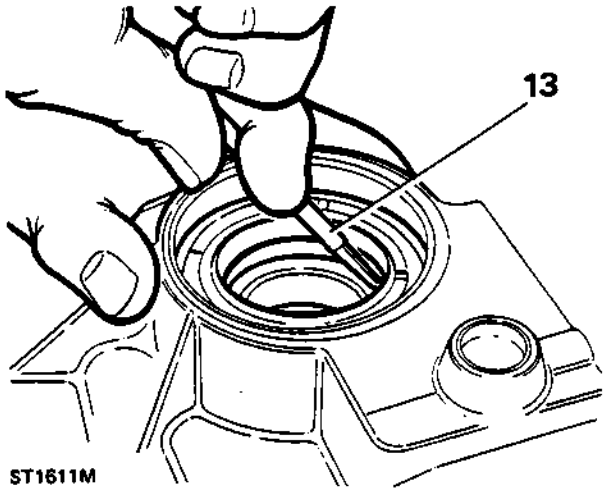
10. Remove the output flange with oil seal shield.

NOTE: These parts need not be separated unless the flange bolts are to be renewed.

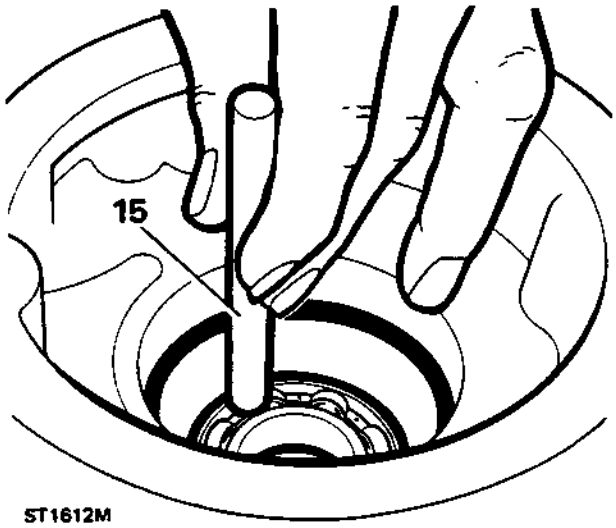
11. Drift output shaft rearwards from housing using a soft headed mallet.
12. Slide off the collar from the output shaft.



13. Prise out and discard oil seal from output housing using service tool 18G1271.
14. Remove circlip with circlip pliers 18G257.

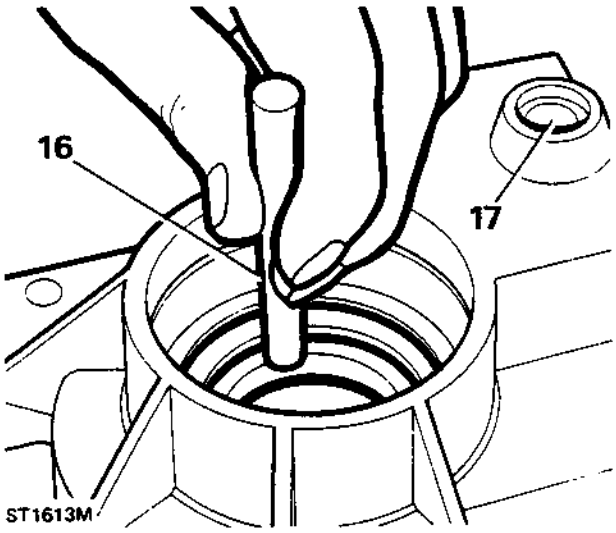


15. Invert housing and drift out bearing from inside the case as shown.



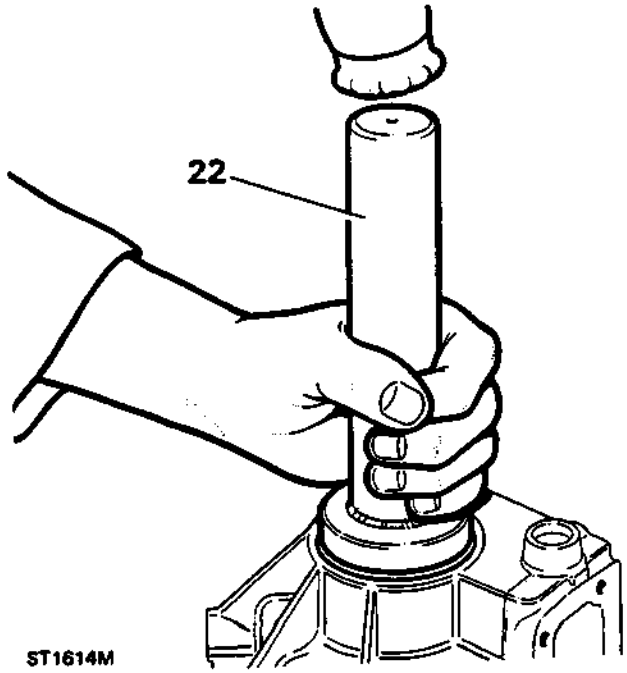
16. Drift out centre differential front taper roller bearing track and shim.
17. Drift out selector shaft cup plug from housing.
18. Clean all components ensuring all traces of 'Loctite' are removed from faces and threads.
19. Examine components for wear or damage and renew if necessary.

NOTE: Renew oil seal and felt seal and flange nut.



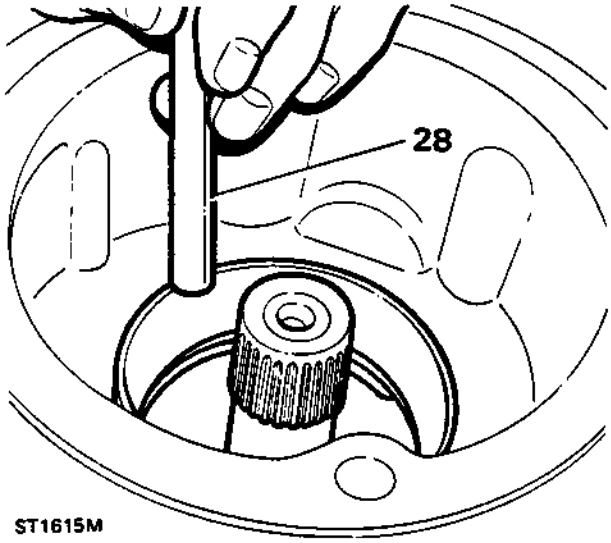
Reassembling

20. Press the bearing into the housing; do not use excessive force. To facilitate fitting the bearing, heat the front output housing. (This is not to exceed 100°C).
21. Using circlip pliers 18G257, fit the bearing retaining clips.
22. Fit a new oil seal (open side inwards) using replacer tool 18G1422, until the seal just makes contact with the circlip.
23. Carefully charge the lips of the seal with clean grease.
24. Slide collar on to the output shaft, with its chamfered edge towards the dog teeth.
25. Fit the output shaft through the bearing and drift home.

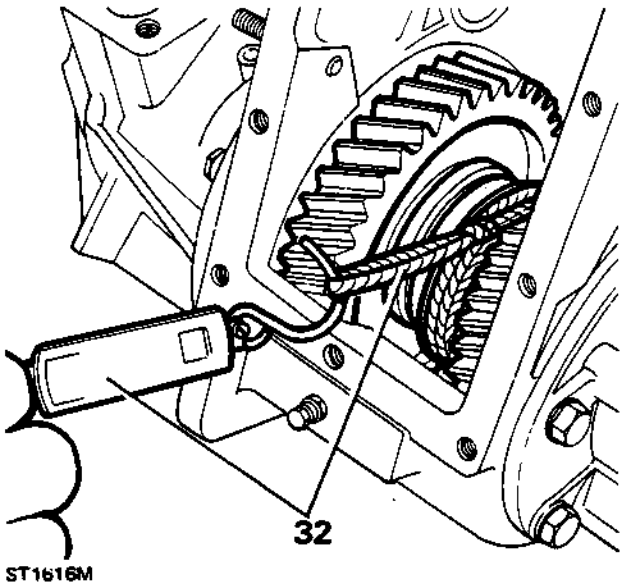


Adjusting front differential bearing pre-load

26. Measure original differential front bearing track shim.
27. Refit original shim into input housing.
28. Drift differential front bearing track into the housing.



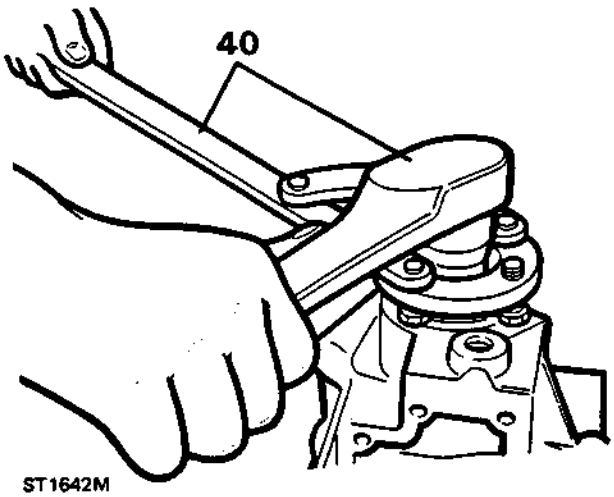
29. Grease and fit new gasket and locate the front output housing on the transfer box casing.
30. Secure housing with the eight retaining bolts and washers, the upper middle bolt being longer than the rest. Do not tighten the bolts at this stage.
31. Engage high or low gear.
32. Check the rolling resistance of the differential using a spring balance and a length of string wound around the exposed splines of the high/low hub.



Continued

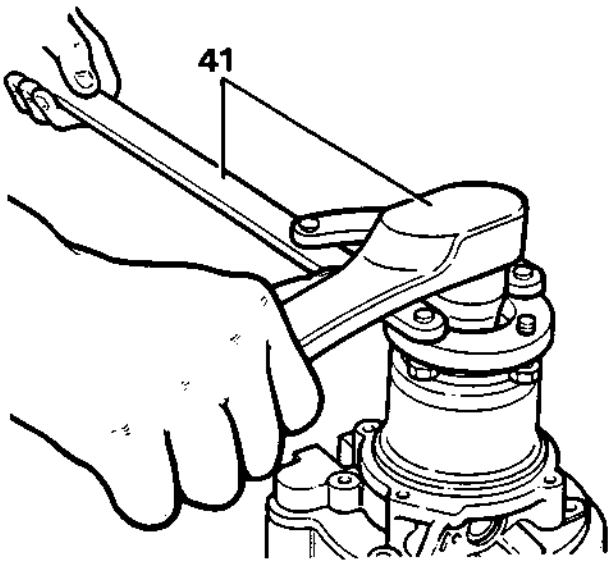
33. With the correct shim fitted the load to turn should be 1,36 kg to 4,53 kg (3 lb to 10lb). This applies to new or used bearings. (New bearings will register at the top end and used bearings will register at the low end.
34. If the reading is in excess of the above measurements, remove the front output housing assembly from the transfer box casing.
35. Using a suitable extractor, withdraw the centre differential bearing track and change the shim for one of a suitable thickness. (A thinner shim will reduce the rolling resistance).
36. Fit the new shim and drift the differential bearing track back into its housing until fully home.
37. Having obtained the load to turn, prop-up the transfer box casing on the bench with the front face uppermost.
38. Apply Loctite 290 to the threads of the housing retaining bolts and fit the eight bolts and washers into the front output housing and secure to transfer box casing.
39. Fit front output flange, felt washers, steel washers and flange nut.
40. Using flange wrench 18G1205 and torque wrench, pull the output shaft up to the correct position. Check that the oil seal shield does not foul the housing.

NOTE: Ensure that the flange bolts are fully engaged in the wrench.



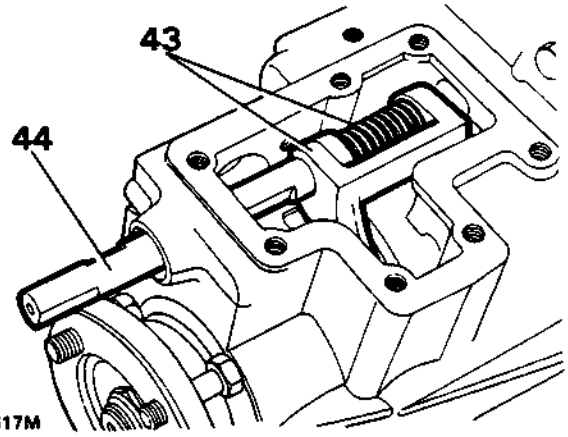
ST1642M

41. Repeat the above operation for the rear output flange.



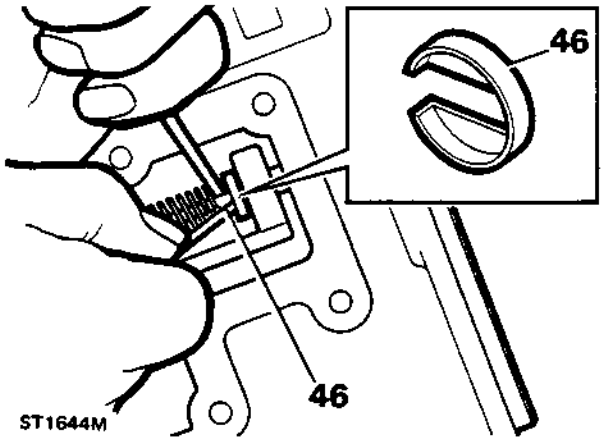
ST1643M

42. Compress the selector shaft spring and fit to the selector fork.
43. Locate selector fork through front output housing side cover aperture, ensuring that the fork engages in the groove of the lock-up sleeve.
44. Fit selector shaft through the aperture in the front of the output housing and pass it through the selector fork lugs and spring into the rear part of the housing.
45. Rotate the selector shaft until the two flats for the spring retaining caps are at right angles to the side cover plate face.

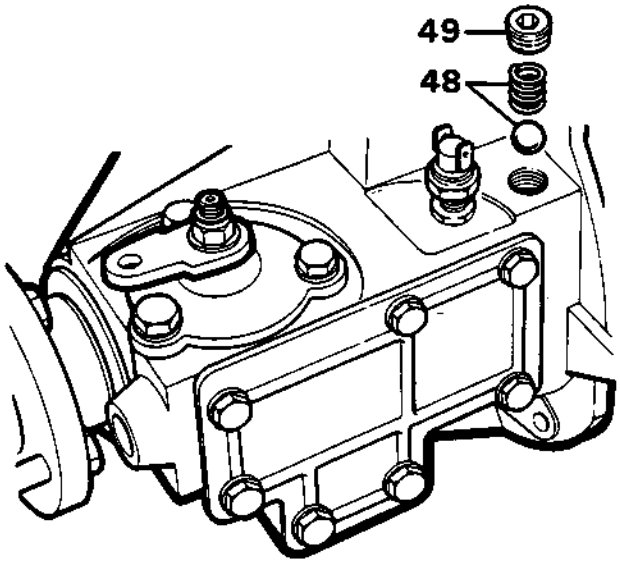


ST1617M

46. Compress the spring between the fork lugs and slide the retaining caps on to the shaft ensuring the spring is captured with the 'cupped' side of the caps.
47. Drift selector shaft seal cup into position.



48. Fit selector shaft detent ball and spring in the tapped hole on top of the output housing.
49. Apply Loctite 290 to detent plug threads. Screw detent plug gently home and then unscrew two turns.

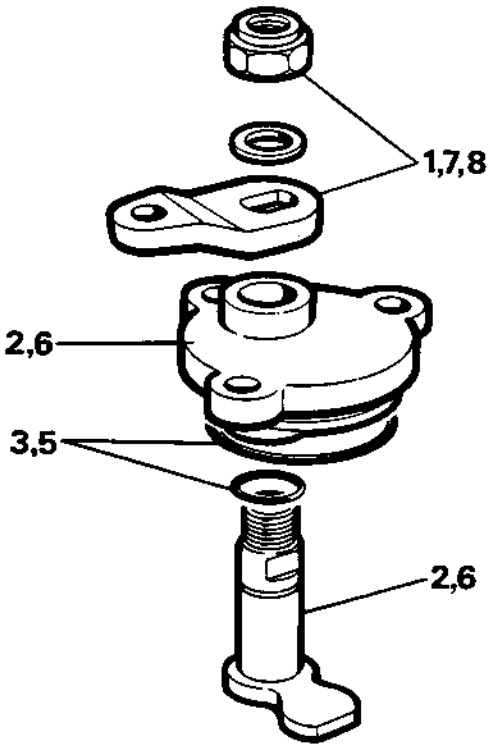


Differential lock finger housing overhaul—dismantling

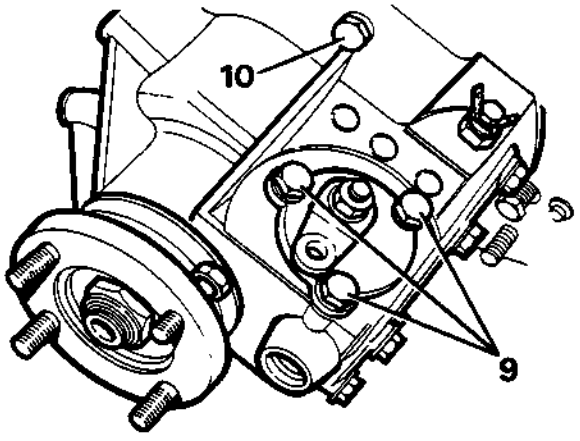
1. Unscrew and discard the 'nyloc' nut and remove the operating lever and washer.
2. Remove the pivot shaft from lock finger housing.
3. Remove the 'O' rings from the pivot shaft and housing and discard.
4. Clean all components; examine for wear or damage and renew if necessary.

Reassembling

5. Fit new 'O' rings on to pivot shaft and lock finger housing and lubricate with oil.
6. Locate the pivot shaft in the housing.
7. Fit the differential lock lever over the pivot shaft so that the lever will face forward to the bend upwards. This lever is then in the correct operating position.
8. Retain the lever with a plain washer and new 'nyloc' nut.



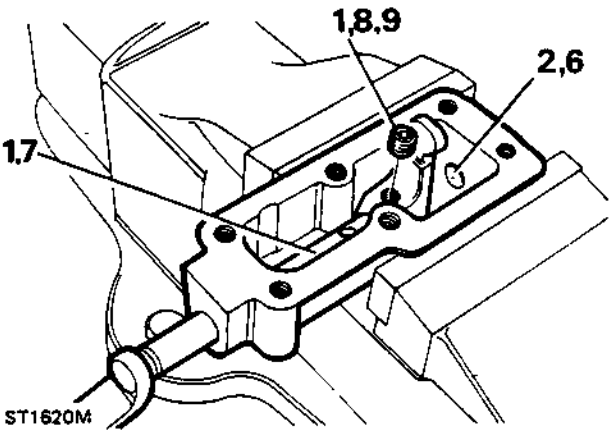
9. Fit the differential lock finger housing into its seating on the front output housing, ensuring that the selector finger is located in the flat of the selector shaft.
10. Apply Loctite 290 to the bolt threads and retain the lock finger housing with the three bolts and washers to the specified torque.



Continued

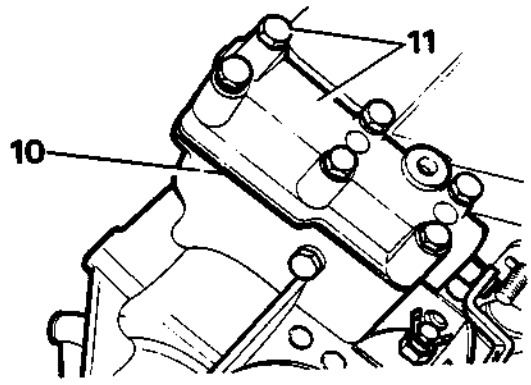
High/low cross-shaft housing overhaul

1. Remove the selector finger grub screw and withdraw the cross-shaft from the cross-shaft housing and remove the selector finger.
2. Remove the 'O' ring from the cross-shaft.
3. Drift out selector housing cup plug if necessary.
4. Clean all the components and check for damage or wear, replace if necessary.
5. Apply sealant to a new cup plug and fit so that the cup is just below the chamfer for the cross-shaft bore.
6. Fit new 'O' ring to cross-shaft.
7. Lubricate the shaft and insert into the cross-shaft housing.
8. Fit selector finger ensuring that it aligns with the recess in the cross-shaft.
9. Apply Loctite 290 to the grub screw and secure the selector finger to the cross-shaft and fully tighten to the specified torque.



ST1620M

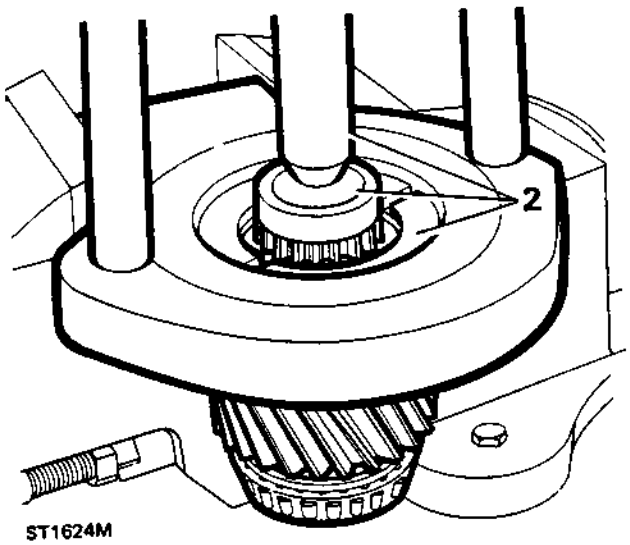
10. Grease and fit the high/low selector housing gasket on the front output housing.
11. Fit high/low cross-shaft housing, ensuring that the selector finger locates in the slot of the selector shaft, and secure with six bolts and washers to the specified torque.



ST1646M

Input gear overhaul—dismantling

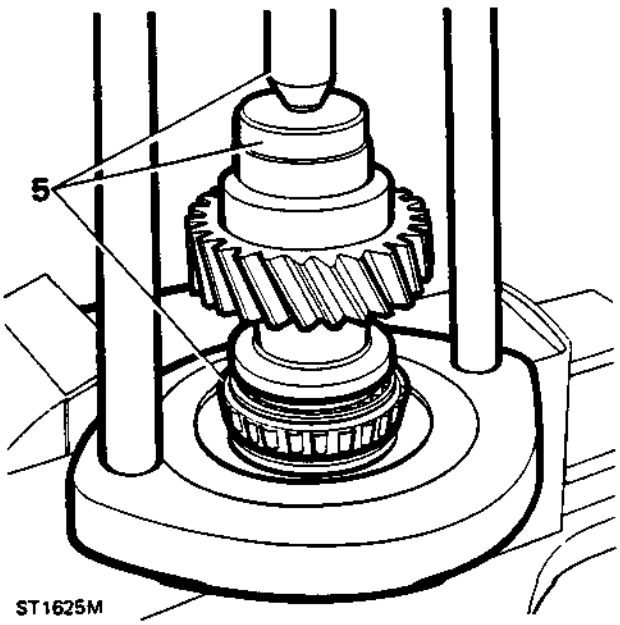
1. Clean the input gear assembly and examine for wear or damage. Remove the bearings only if they are to be renewed.
2. Secure hand press MS47 in the vice and using collars 18G47-7 and button 18G47-BB/3, remove rear taper roller bearing from input gear assembly.
3. Invert input gear assembly in hand press and remove front taper roller bearing.
4. Clean input gear.



ST1624M

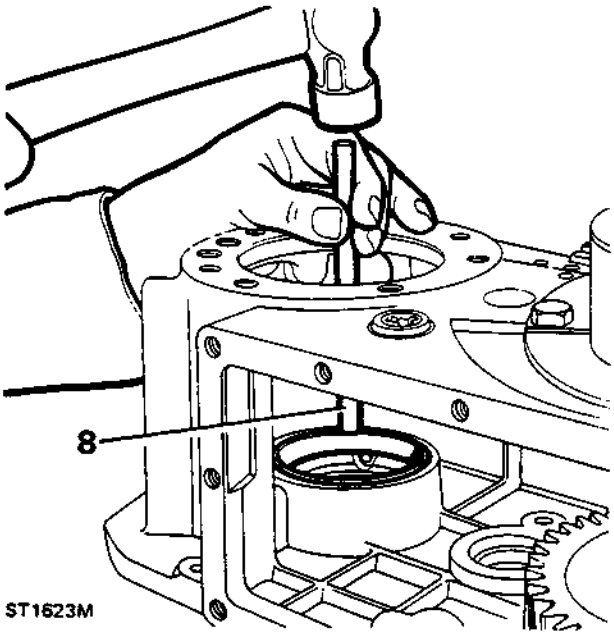
Reassembling

5. Position rear taper roller bearing on input gear and using hand press MS47 and collars 18G47-7 press the bearing fully home.
6. Invert input gear and fit the front taper roller bearing using the press and collars.

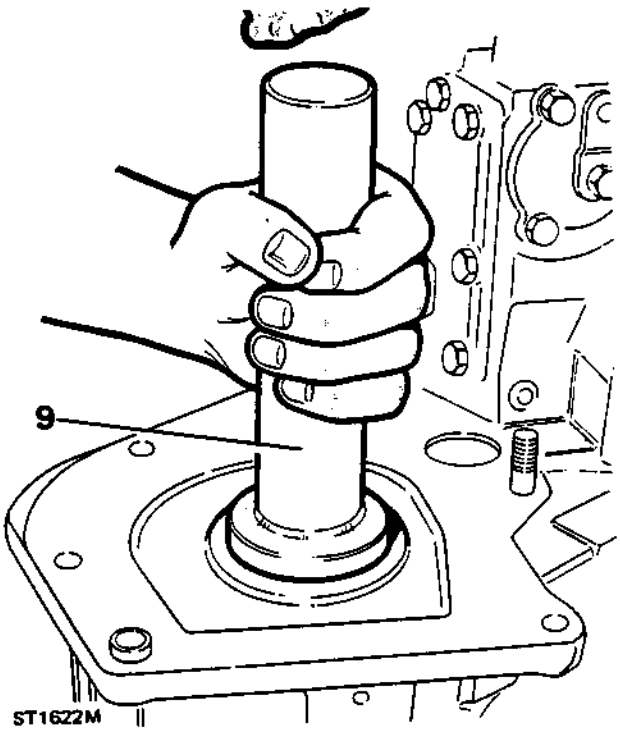


ST1625M

7. Prop up the transfer box casing on the bench with the rear face uppermost.
8. Drift in the front taper bearing track.



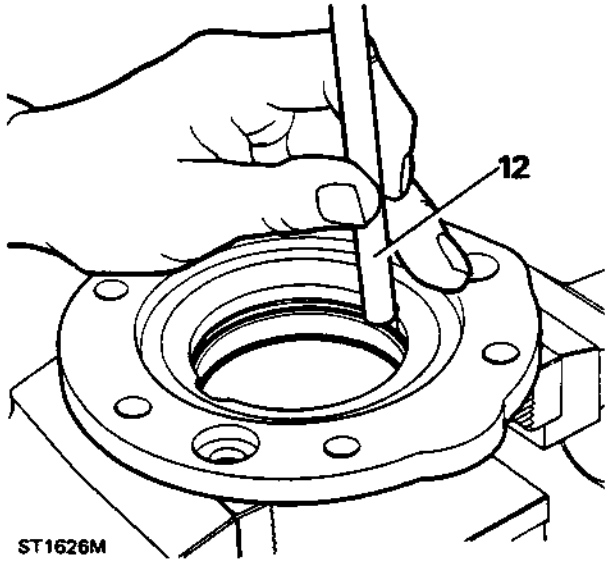
9. Reposition transfer box casing so the front face is uppermost and fit oil seal (open side inwards) using replacer tool 18G1422.



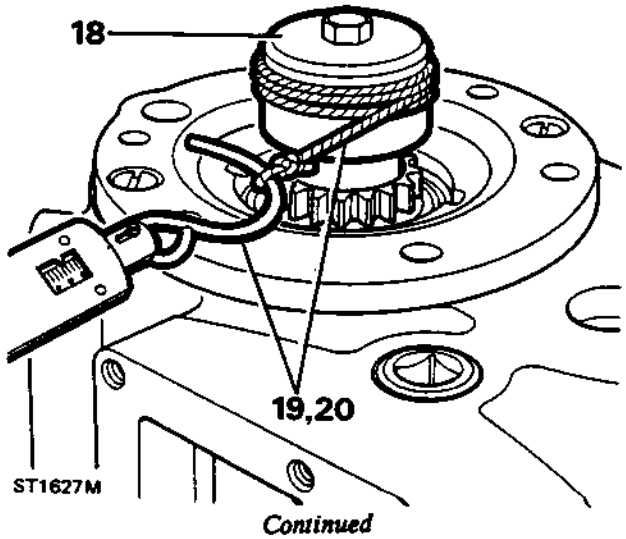
10. Lubricate both bearings with clean oil.
11. Fit the input gear assembly into the transfer box casing with the dog teeth uppermost.

Checking input gear bearing pre-load

12. Secure bearing support plate in the vice. Drift out input gear bearing track, and remove shim.



13. Clean bearing support plate and shim. Measure original shim and note its thickness.
14. Fit the original shim to the support plate.
15. Locate the bearing track in the support plate and press fully home.
16. Apply grease to the gasket and fit on to the transfer box casing.
17. Fit the bearing support plate on to the transfer box casing and secure with the six bolts, but do not tighten.
18. Fit the service tool LST105 to input gear and engage the spline.
19. Tie a length of string to the split pin and fit it to the service tool as shown.
20. Attach a spring balance to the string and carefully tension the spring until a load to turn the input gear is obtained. A pull of 2,26 kg to 6,80 kg (5 lb to 15 lb) is required.
21. If the reading obtained is outside the above limits, the original shim must be changed.

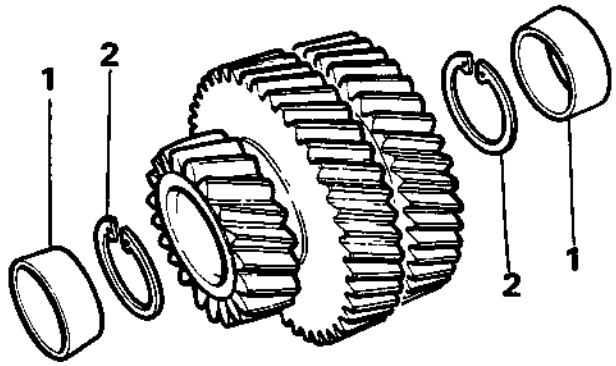


Continued

22. Remove the spring balance, string and service tool.
23. Remove the six bolts and the bearing support plate.
24. Drift out the input gear bearing track from the support plate and discard original shim.
25. Select the correct size shim to obtain a load to turn of 2,26 kg to 6,80 kg (5 lb to 15 lb).
26. Fit shim to support plate, locate bearing track and press home.
27. Fit bearing support plate and secure to transfer box casing with the six bolts (do not tighten).
28. Repeat the rolling resistance check as previously described, and note the value obtained.

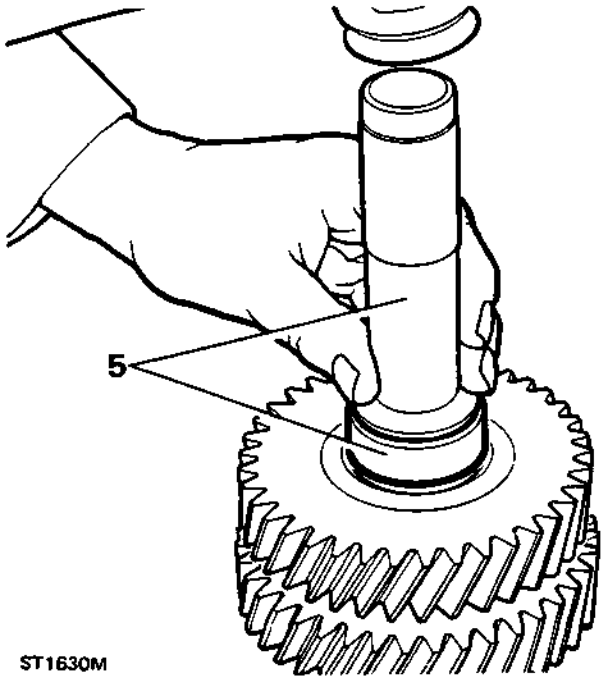
Intermediate gear assembly overhaul

1. Drift out intermediate gear bearing tracks.
2. Remove circlips.



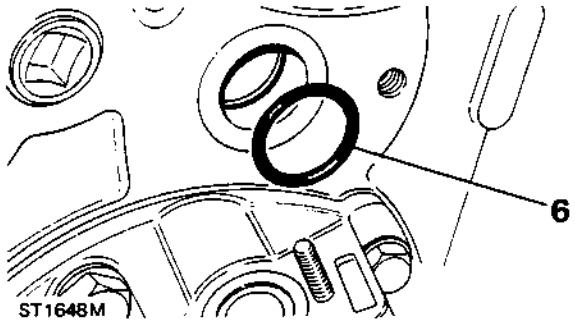
ST1628M

3. Clean all intermediate gear components and lock plate. Check for damage or wear and replace as necessary.
4. Fit new circlips into the intermediate gear cluster.
5. Using tools LST550-4 and MS550 fit bearing tracks into the intermediate gear cluster.



ST1630M

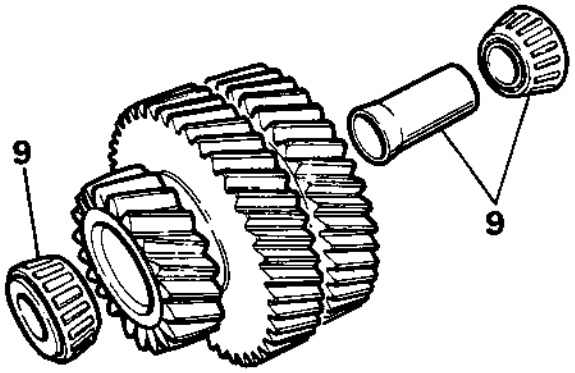
6. Fit the 'O' rings to the intermediate shaft and into the intermediate shaft bore at the front of the transfer box casing.



ST1648M

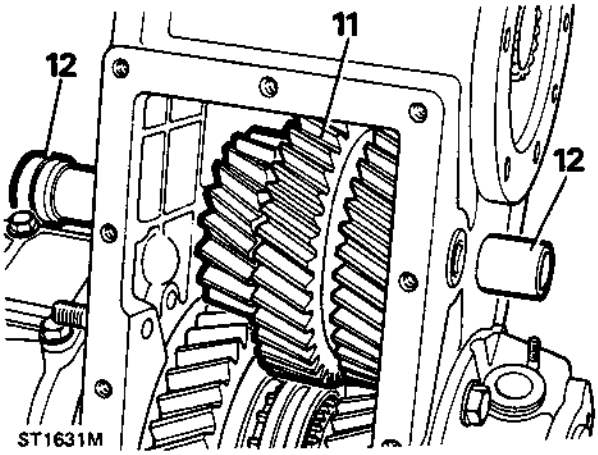
Intermediate gear reassembly

7. Check for damage to the intermediate shaft thread and if necessary clean up with a fine file or stone.
8. Lubricate the taper roller bearings and intermediate gear shaft.
9. Insert new bearing spacer to gear assembly, followed by the taper roller bearings.

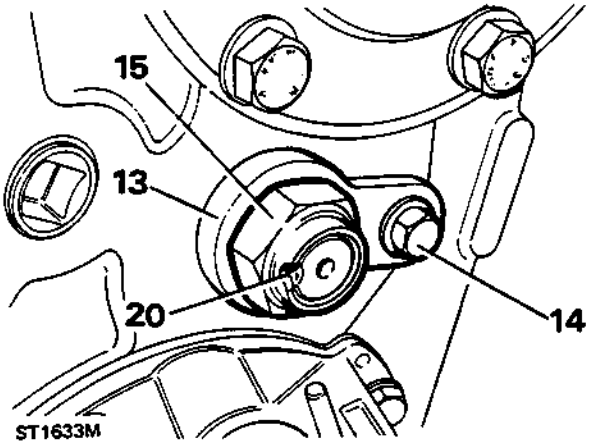


ST1649M

10. Fit dummy shaft LST104 into the intermediate gear cluster.
11. Locate the gear assembly into the transfer box casing from the bottom cover aperture.
12. Insert intermediate shaft from the front of the transfer box casing, pushing the dummy shaft right through as shown and remove. (Making sure that the intermediate gear cluster meshes with the input gear and high range and low range gears.)



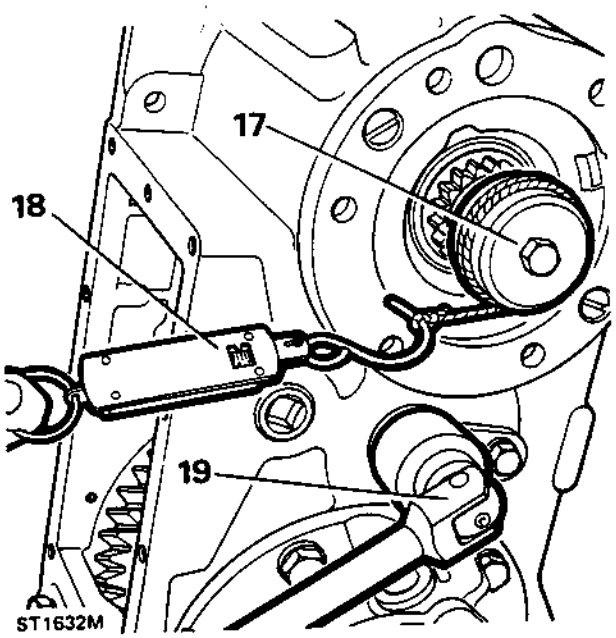
13. Turn the intermediate shaft to allow fitting of retaining plate.
14. Fit retaining plate and secure with retaining bolt and washer.
15. Fit the intermediate gear shaft retaining stake nut.



Adjusting intermediate gear torque-to-turn

16. Select neutral.
17. Fit service tool LST105 to input gear and engage spline.
18. Tie a length of string to a split pin and fit to the service tool as shown. Attach the spring balance to the string.
19. To obtain the correct figures and to collapse the spacer within the intermediate gear cluster, tighten the intermediate shaft nut until the load-to-turn has increased by 3,7 kg (7 lb) ± 1,63 kg (± 3 lb) on that noted when checking input shaft load-to-turn. The torque to tighten the remaining nut will be approximately 203 Nm (150 lb ft).
20. Peel the stake nut by carefully forming the collar of the nut into the intermediate shaft recess, as illustrated.

CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut.



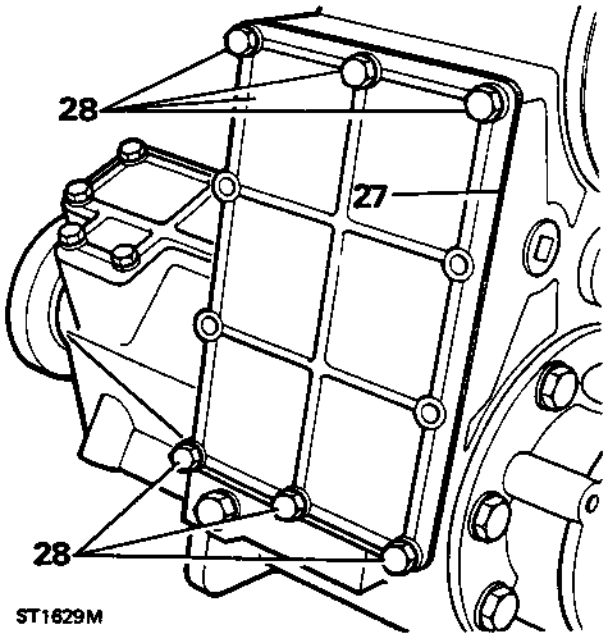
Power take-off cover—reassemble

21. Clean power take-off cover and gasket face.
22. Fit the two countersunk screws and tighten.
23. Remove the six bolts from the bearing support plate.
24. Apply sealant to the cover plate gasket and fit it to the bearing support plate.
25. Apply Loctite 290 to bolt threads and secure the power take-off cover with the six bolts and washers.

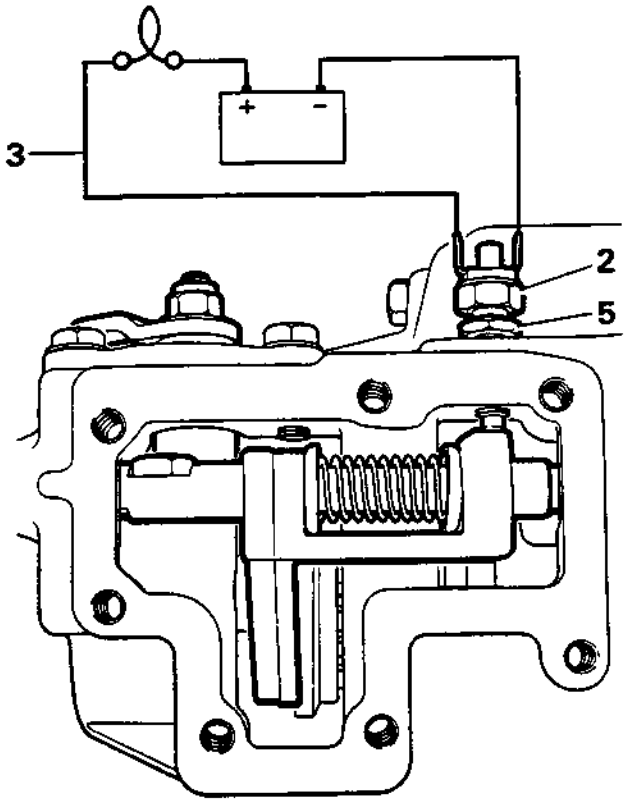
Continued

Bottom cover—reassemble

26. Clean bottom cover and gasket face.
27. Apply sealant to cover gasket and fit to transfer box casing.
28. Apply Loctite 290 to bolt threads and secure the bottom cover with six bolts and washers.



ST1629M



ST1634M

Transmission brake—reassemble

1. Clean brake backplate and oil catcher and apply sealant to the catcher joint face.
2. Locate brake backplate on the rear output housing with the brake operating lever on the right side of the transfer box casing.
3. Secure the backplate (including the oil catcher) with the four special bolts and tighten using a hexagonal socket to the specified torque.
4. Clean and fit brake drum and secure with two countersunk screws.

Differential lock switch adjustment

1. Select differential locked position by moving the lock taper towards the right side of the transfer box casing.
2. Apply sealant to the differential lock warning light switch and fit to the top of the front output housing.
3. Connect a test lamp circuit to the differential lock switch.
4. Screw in the lock switch until the bulb is illuminated.
5. Turn in the switch another half a turn and tighten with the locknut against the housing.

6. Disconnect the battery and move the differential lock lever to the left to disengage differential lock.
7. Clean the front output housing side cover.
8. Grease and fit side cover gasket.
9. Apply Loctite 290 to bolt threads, fit side cover and secure with seven bolts and washers.

FAULT DIAGNOSIS: ZF4HP22 Automatic Gearbox

Before refering to the fault diagnosis chart, ensure that the following static checks are firstly carried out:

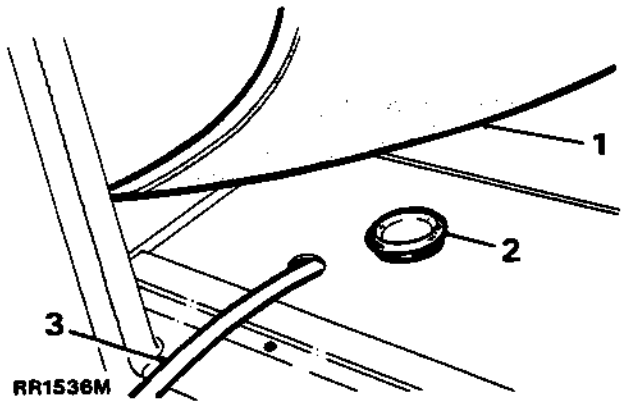
INITIAL STATIC CHECKS

Check start positions	'P' & 'N' only
Reverse lights	'R' only
Gear engagements	N–D, N–3, N–2, N–1, N–R
Full throttle	Engine switched off, check full travel at engine and at pedal
Oil level	'N' selected, engine running at normal running temperature
Pressure test	150 ± 5 lb/in² 2000 rev/min
Idle pressure	100 ± 5 lb/in² (see engine tune data for appropriate idle speeds applicable to model being tested)

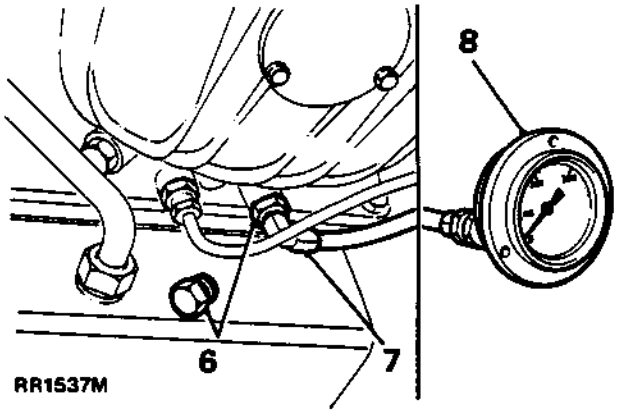
FIT PRESSURE GAUGE

Service tools:
18G502A–0–300 PSI (0–22 kg/cm²) pressure gauge
18G502K—Flexible hose
LST502–1—Hose adaptor

1. Lift the carpet and sound deadening material from the passenger side of the vehicle, to reveal the plastic grommet in the floor well.
2. Prise the grommet from its location.



3. Plug the end of the pressure gauge hose to prevent ingress of dirt. Feed the hose 18G502K through the hole and manoeuvre it between the floor well and top of the chassis, until it is visible from beneath the vehicle.
4. Drive the vehicle onto a suitable hydraulic ramp.
5. From beneath the vehicle, remove the plug from the hose.
6. Remove the plug from the bottom of the gearbox and fit the adaptor LST502–1 and tighten securely.
7. Fit the hose to the adaptor and tighten securely.
8. Fit the gauge 18G502A to the other end of the hose within the vehicle.

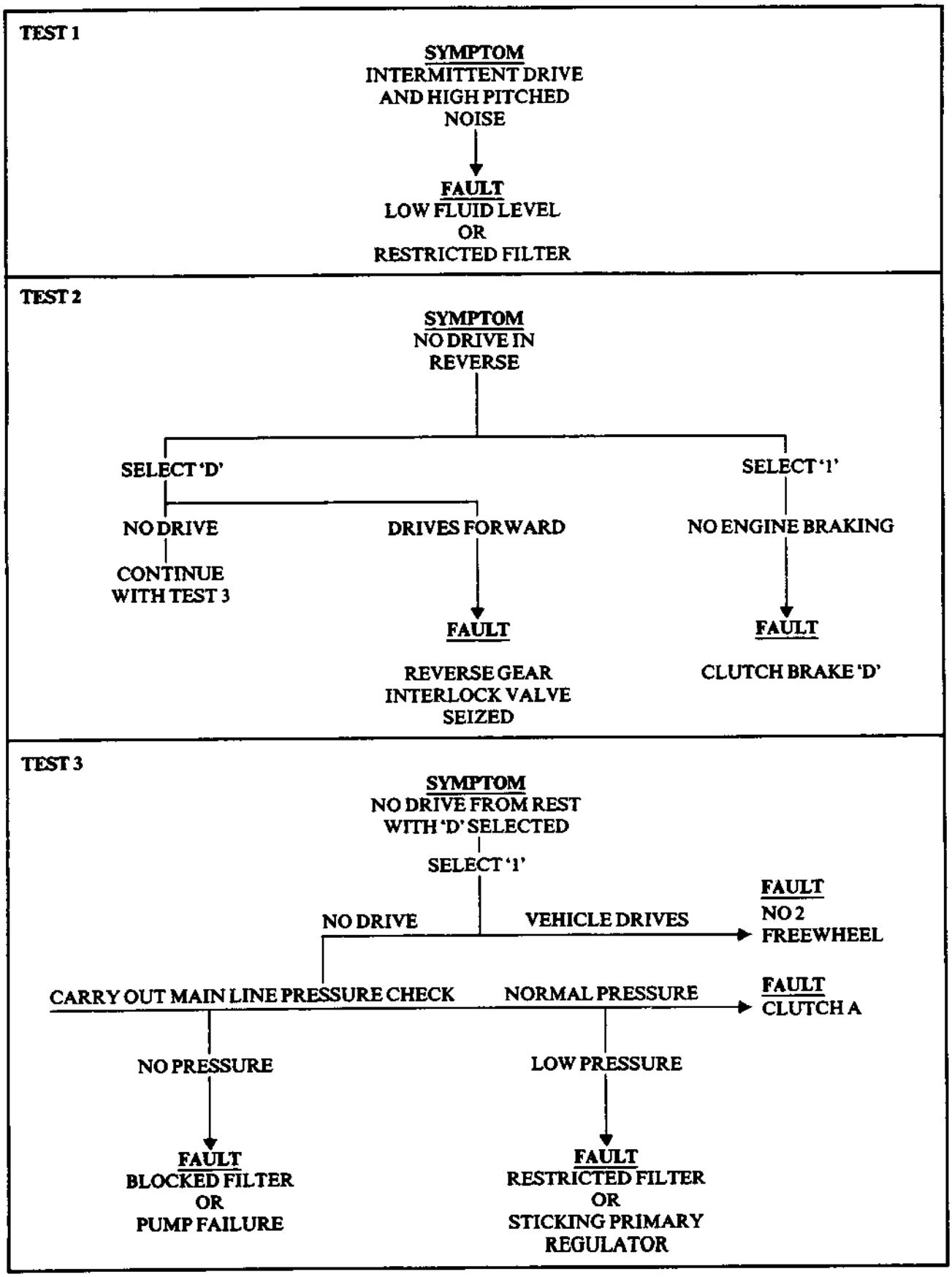


9. Remove the vehicle from the ramp and carry out road test.

Remove the pressure gauge

10. Reverse the instructions 1 to 8.

FAULT DIAGNOSIS—ZF4HP22 AUTOMATIC GEARBOX



TEST 4

SYMPTOM
SLIP IN ALL FORWARD GEARS

CARRY OUT MAIN LINE PRESSURE CHECK

NO PRESSURE	LOW PRESSURE	NORMAL PRESSURE
FAULT	**FAULT**	**FAULT**
BLOCKED FILTER OR PUMP FAILURE	RESTRICTED FILTER STICKING PRIMARY REGULATOR	CLUTCH 'A'

TEST 5

SYMPTOM
HARSH ENGAGEMENT 'N' TO 'D'

CHECK ENGINE IDLE SPEED

CARRY OUT MAIN LINE PRESSURE CHECK

HIGH PRESSURE	NORMAL PRESSURE
FAULT	**FAULT**
PRIMARY REGULATOR SEIZED	CLUTCH 'A' OR DAMPER FOR CLUTCH 'A'

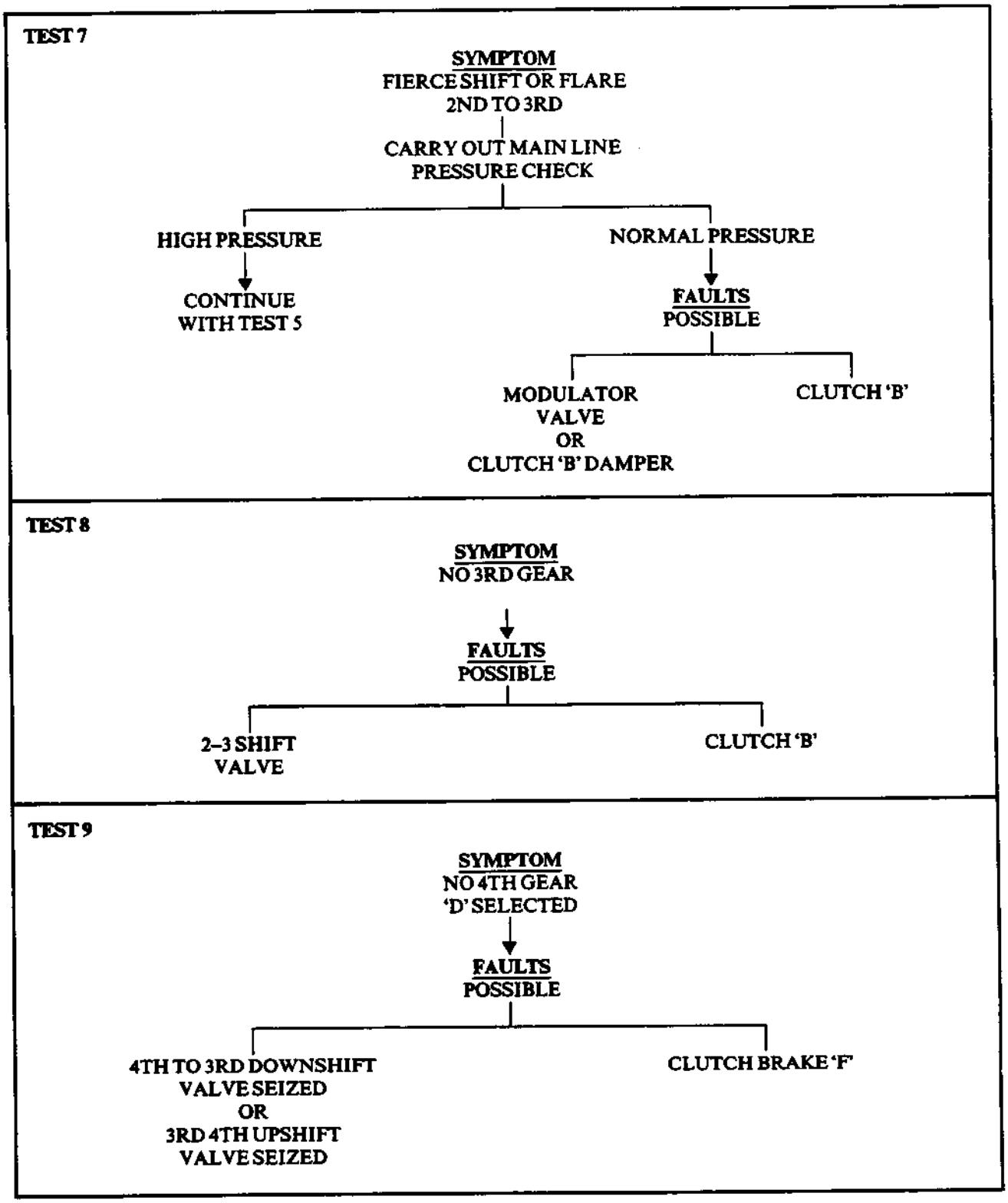
TEST 6

SYMPTOM
FIERCE SHIFT OR FLARE 1ST TO 2ND SHIFT

CARRY OUT MAINLINE PRESSURE CHECK

HIGH PRESSURE	NORMAL PRESSURE		
	FAULTS POSSIBLE		
CONTINUE WITH TEST 5	MODULATOR VALVE OR	DAMPERS FOR CLUTCH BRAKE 'C' AND/OR CLUTCH BRAKE 'C'	CLUTCH BRAKE 'C' AND/OR CLUTCH BRAKE 'C'

Continued


TEST 7
SYMPTOM
FIERCE SHIFT OR FLARE
2ND TO 3RD
CARRY OUT MAIN LINE
PRESSURE CHECK
HIGH PRESSURE
CONTINUE
WITH TEST 5
NORMAL PRESSURE
FAULTS
POSSIBLE
MODULATOR
VALVE
OR
CLUTCH 'B' DAMPER
CLUTCH 'B'
TEST 8
SYMPTOM
NO 3RD GEAR
FAULTS
POSSIBLE
2–3 SHIFT
VALVE
CLUTCH 'B'
TEST 9
SYMPTOM
NO 4TH GEAR
'D' SELECTED
FAULTS
POSSIBLE
4TH TO 3RD DOWNSHIFT
VALVE SEIZED
OR
3RD 4TH UPSHIFT
VALVE SEIZED
CLUTCH BRAKE 'F'

TEST 10

SYMPTOM
NONE OR HARSH ENGAGEMENT OF DIRECT DRIVE CLUTCH

NOTE: THE DIRECT DRIVE CLUTCH WILL ONLY ENGAGE IF 4TH GEAR IS ENGAGED AT 40 TO 44 MPH. DISENGAGEMENT OCCURS AT 39 TO 42 MPH.

CARRY OUT ROAD TEST PRESSURE CHECK WITH GAUGE CONNECTED TO TORQUE CONVERTER

- PRESSURE NORMAL → **FAULT** FAILED DIRECT DRIVE CLUTCH
- PRESSURES CORRECT BUT REMAIN HIGH → **FAULTS POSSIBLE**
  - DIRECT DRIVE CLUTCH AND TORQUE CONVERTER CONTROL VALVE SEIZED
  - HYSTERESIS VALVE SEIZED
  - DIRECT DRIVE CLUTCH CONTROL VALVE SEIZED

TEST 11

SYMPTOM
DIRECT DRIVE CLUTCH SHIFT POINT INCORRECT OR AT LOW SPEED

NOTE: DIRECT DRIVE CLUTCH ENGAGEMENT AT LOW SPEED WILL CAUSE VIBRATION IN THE TORQUE CONVERTER.

CARRY OUT MAIN LINE AND TORQUE CONVERTER PRESSURE CHECK

- PRESSURE NORMAL → **FAULT** GOVERNOR VALVE STICKING
- LOW OR INCORRECT PRESSURE → **FAULTS POSSIBLE**
  - DIRECT DRIVE CLUTCH CONTROL VALVE STICKING
  - HYSTERESIS VALVE STICKING
  - DIRECT DRIVE CLUTCH AND TORQUE CONVERTER CONTROL VALVE STICKING

TEST 12

SYMPTOM
DRIVES IN 'D' 1ST BUT IMMEDIATELY UPSHIFTS TO 3RD

FAULT
2ND TO 3RD SHIFT VALVE SEIZED

Continued

TEST 13

SYMPTOM
WITH 'D' SELECTED
VEHICLE STARTS
IN 2ND

↓

FAULTS
POSSIBLE

- 1ST AND 2ND SHIFT VALVE SEIZED
- GOVERNOR SLEEVE STICKING

TEST 14

SYMPTOM
WITH 'D' SELECTED
VEHICLE STARTS
IN 3RD

↓

FAULTS
POSSIBLE

- GOVERNOR SLEEVE STICKING
- 1ST TO 2ND AND 2ND TO 3RD SHIFT VALVES SEIZED

TEST 15

SYMPTOM
NO KICKDOWN
4TH TO 3RD

↓

FAULT
4TH TO 3RD KICKDOWN
VALVE SEIZED

TEST 16

SYMPTOM
UPSHIFTS/DOWNSHIFTS
AND KICKDOWN SHIFTS
AT INCORRECT ROAD SPEEDS

↓

CHECK THROTTLE KICK DOWN
CABLE ADJUSTMENT

↓

CARRY OUT MAIN LINE
PRESSURE CHECK

- INCORRECT PRESSURE
  - ↓
  - **FAULTS**
  - **POSSIBLE**
    - INCORRECT THROTTLE VALVE ADJUSTMENT
    - PRIMARY REGULATOR STICKING
- NORMAL PRESSURE
  - ↓
  - **FAULT**
  - GOVERNOR VALVE STICKING

TEST 17

SYMPTOM
NO UPSHIFTS AT LIGHT THROTTLE

↓

FAULTS POSSIBLE

- GOVERNOR VALVE STICKING
- SHIFT VALVES STICKING

TEST 18

SYMPTOM
NO ENGINE BRAKING
'3' SELECTED 3RD GEAR

↓

FAULT
CLUTCH 'C'

TEST 19

SYMPTOM
DELAYED OR NO DOWNSHIFT OCCURS WHEN MAKING A MANUAL SELECTION FROM '3' TO '2'

↓

FAULTS POSSIBLE

- GOVERNOR VALVE STICKING
- '2' POSITION INTERLOCK VALVE STICKING
- 2ND AND 3RD UPSHIFT VALVE STICKING

TEST 20

SYMPTOM
AT SPEEDS BELOW 28 MPH WHEN MAKING A MANUAL SELECTION FROM '2' TO '1' 1ST. DOWNSHIFT IS DELAYED OR DOES NOT OCCUR

↓

FAULTS POSSIBLE

- GOVERNOR STICKING
- 1ST TO 2ND SHIFT VALVE STICKING
- '1' POSITION INTERLOCK VALVE STICKING

Continued

TEST 21

SYMPTOM
'1' SELECTED 1ST GEAR
NO ENGINE BRAKING

↓

FAULT
CLUTCH BAND 3

TEST 22

SYMPTOM
'2' SELECTED 2ND GEAR
NO ENGINE BRAKING

↓

FAULT
CLUTCH BAND 1

TEST 23

SYMPTOM
VEHICLE DRIVES
FORWARD IN 'N'

↓

FAULT
CLUTCH 'A' SEIZED

The following repair instructions for the ZF automatic gearbox are divided into three parts. Stage one covers repairs that can be made with the gearbox installed in the vehicle, stage two is with the gearbox removed and stage three a major overhaul procedure.

NOTE: Refer to transfer box section for removal of transfer gearbox.

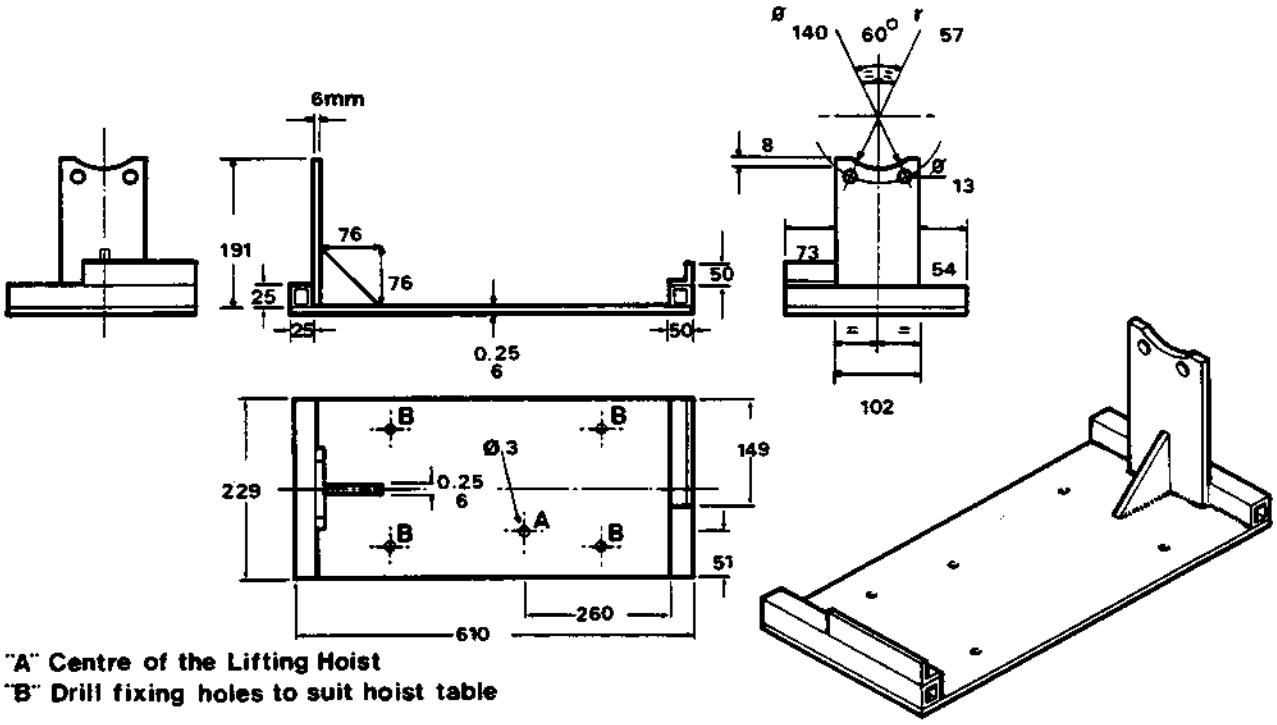
Service Tools

LST 108	**Rear oil seal replacer.**	**TX 30**	**Torx bit.**
LST 109	**Selector linkage setting gauge.**	**18G 1501**	**Torque converter remove/refit handles.**
LST 111	**Oil pump rotation sleeve and end float gauge.**	**LST 115**	**B clutch assembly puller hooks.**
LST 112	**Kickdown cable remover.**	**LST 116**	**B clutch 'O' ring and snap ring replacer.**
LST 113	**Control unit inlet oil seals remover/replacer.**	**LST 117**	**Gear train remover and replacer.**
LST 114	**Selector shaft oil seal replacer.**	**LST 118**	**Transmission holding fixture.**
TX 27	**Torx bit.**	**LST 1016-1**	**Adaptor clutch spring compressor.**

Gearbox Data

Axial end float 0,2 mm to 0,4 mm (0.008 in. to 0.016 in.).
From torque converter boss to torque converter housing face 50 mm (1.96 in.).
Freewheel cage assembly to ring gear; minimum clearance 0,1 mm (0.0039 in.).
Output shaft above cylinder F assembly; dimension 10,00 mm (0.394 in.).
A cylinder protrusion above gearbox front face not more than 8,5 mm (0.33 in.).

In addition to the above service tools, the following items should be manufactured locally to facilitate dismantling and reassembly of the gearbox.

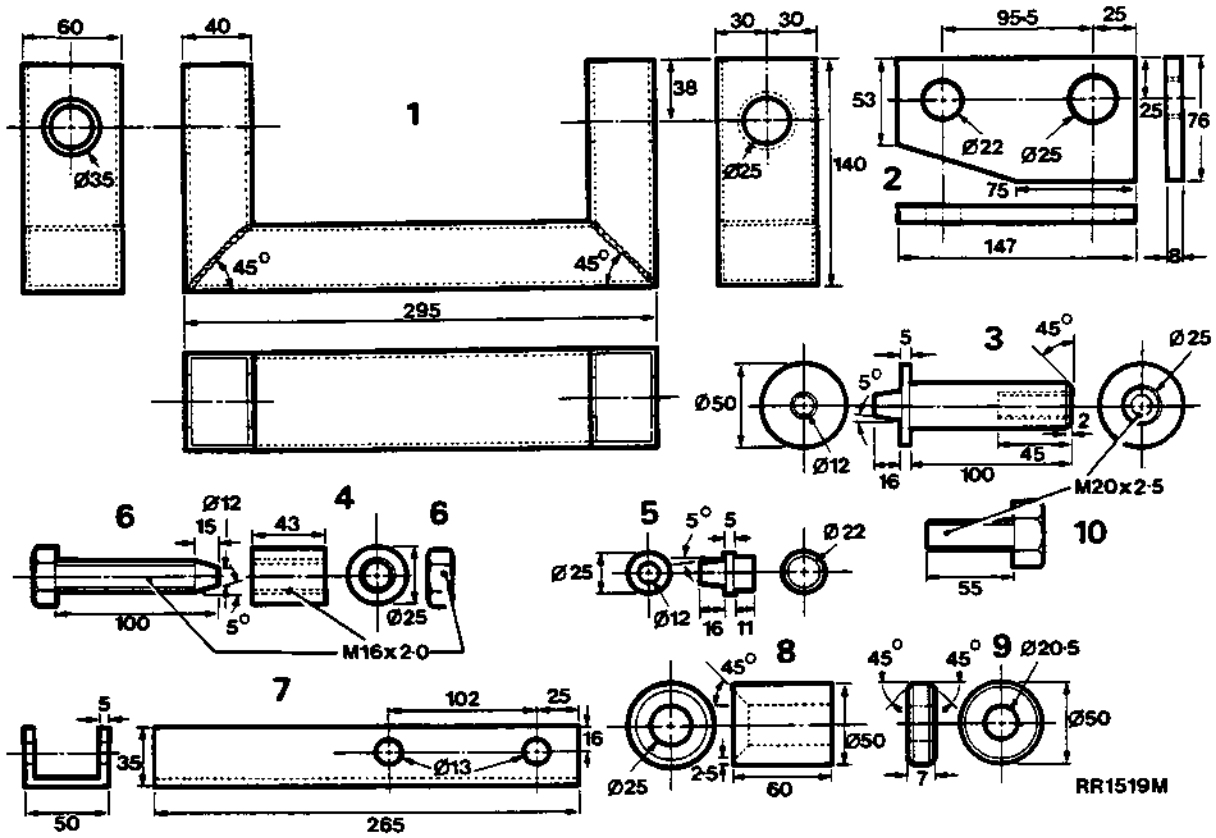


"A" Centre of the Lifting Hoist
"B" Drill fixing holes to suit hoist table

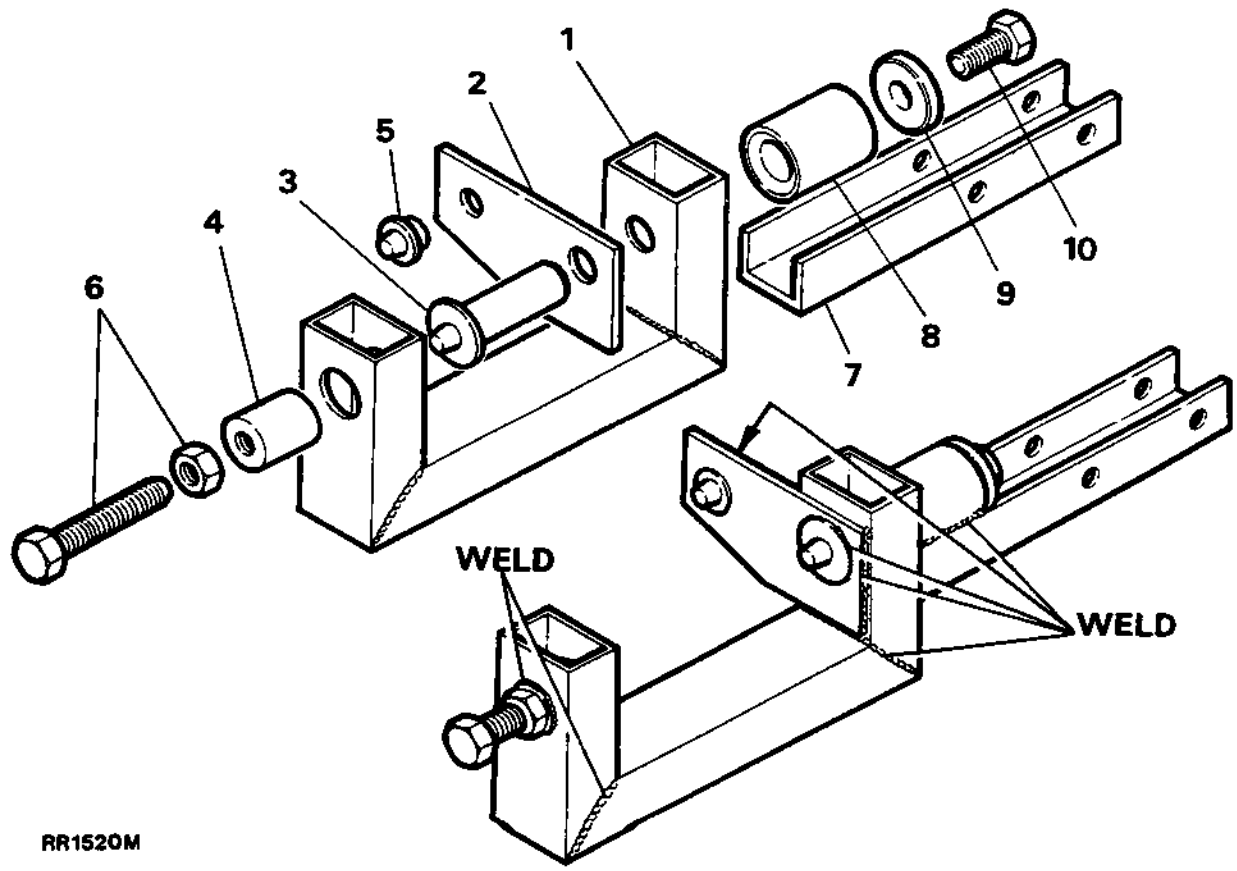
RR739M

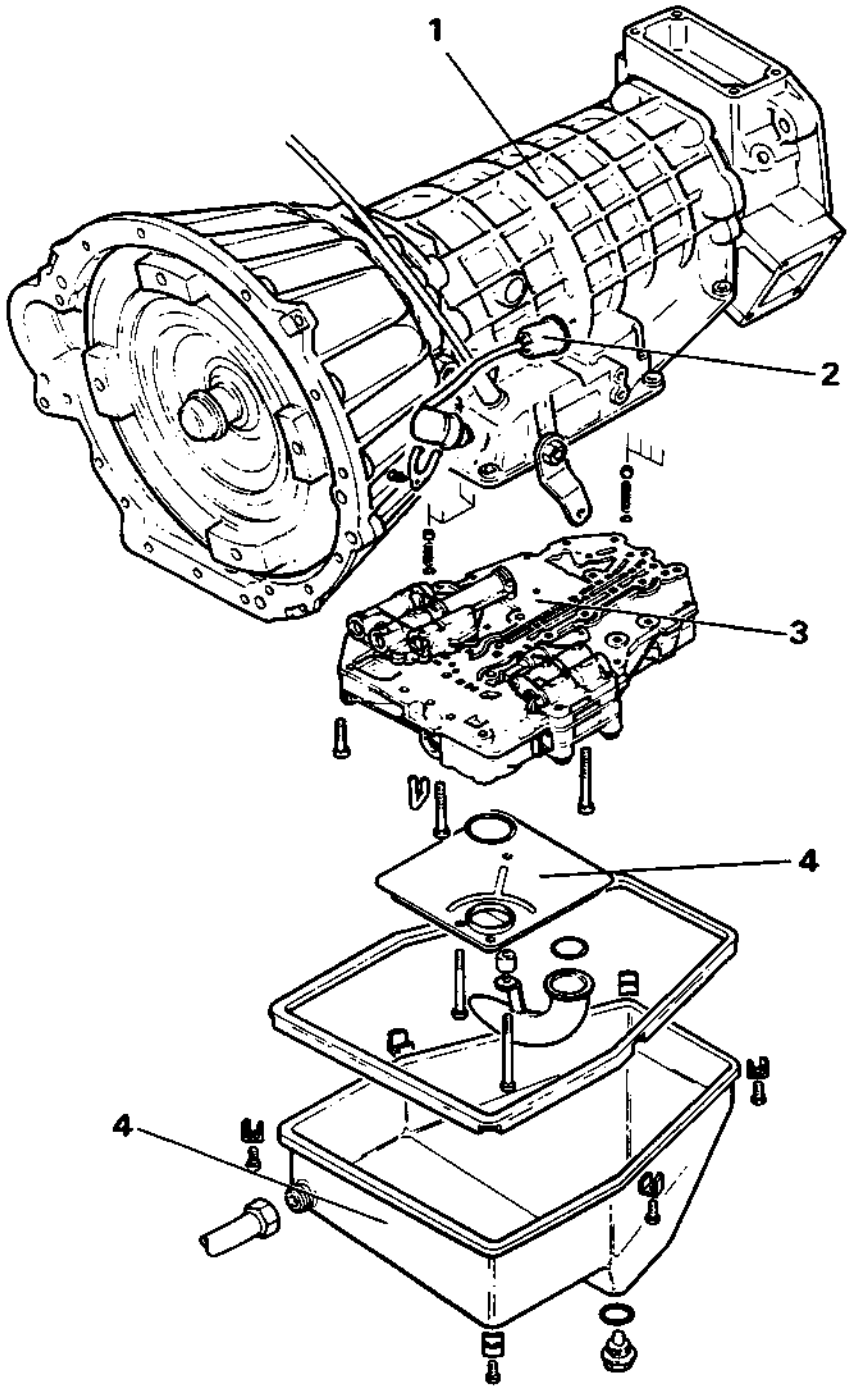
TRANSFER AND AUTOMATIC GEARBOX ADAPTOR PLATE

NOTE: The fixture below can either be manufactured or purchased; fixture number LST 118.



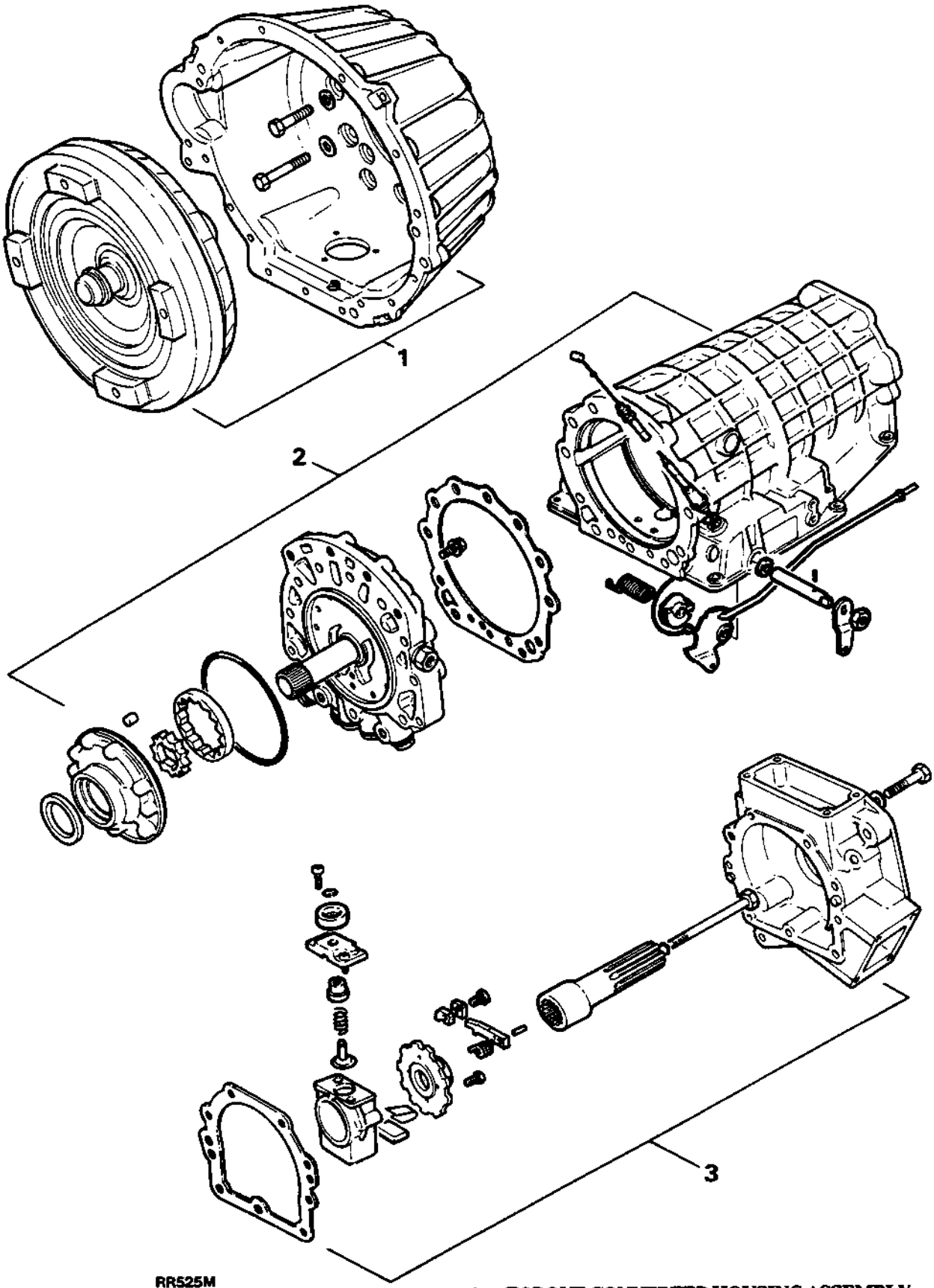
AUTOMATIC GEARBOX HOLDING FIXTURE





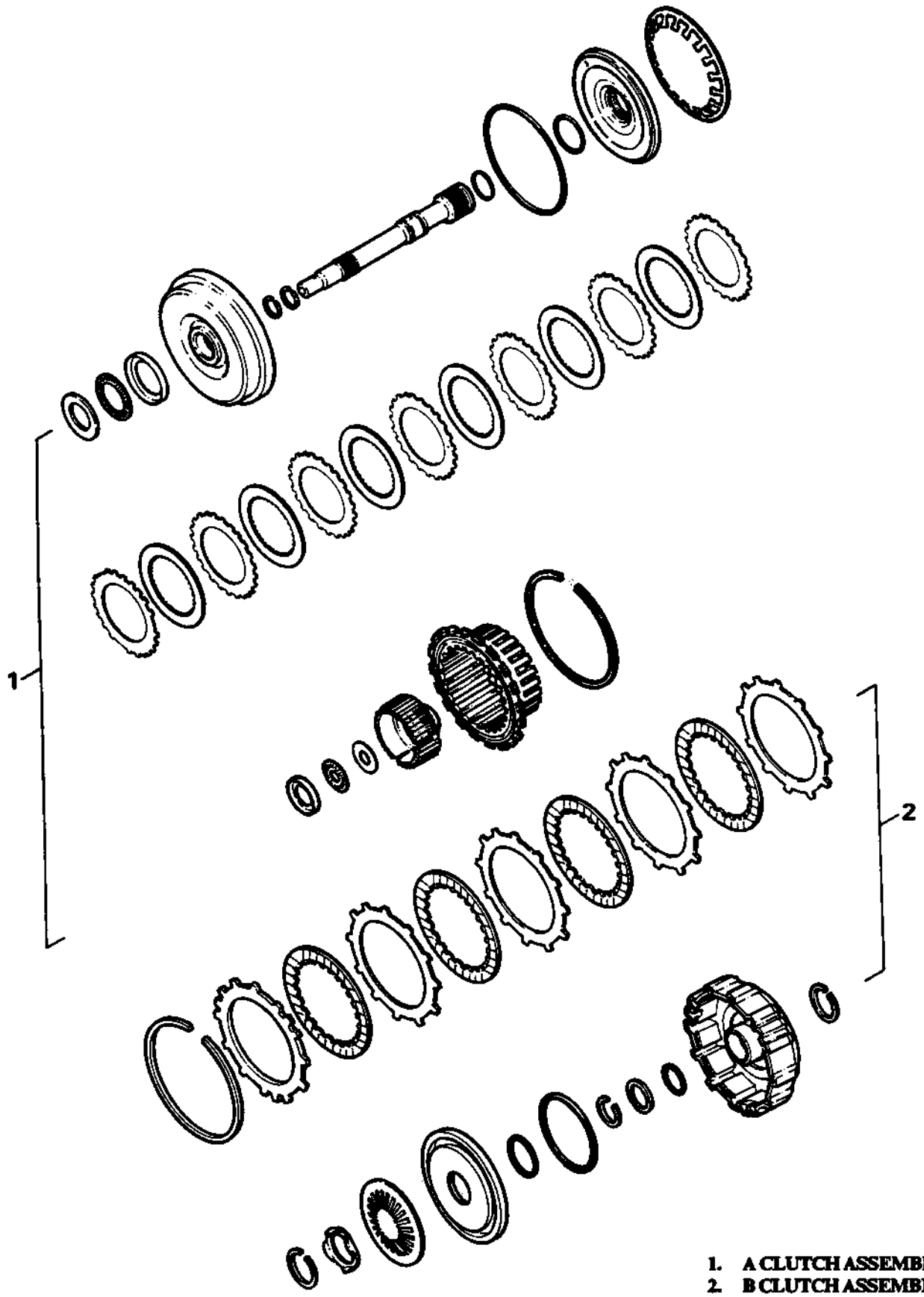
RR524M

1. GEARBOX ASSEMBLY
2. INHIBITOR SWITCH ASSEMBLY
3. CONTROL UNIT ASSEMBLY
4. FILTER AND SUMP ASSEMBLY



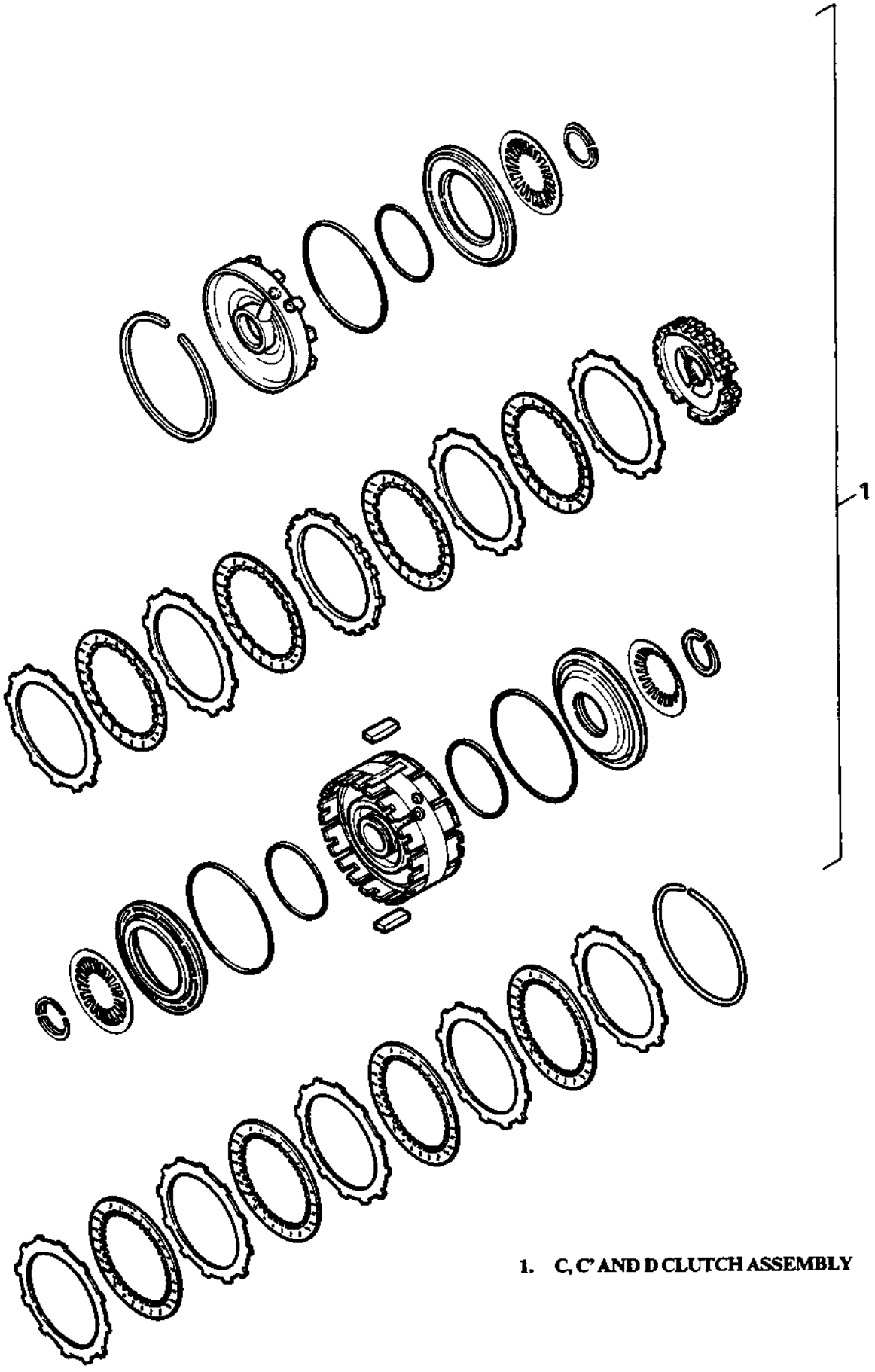
RR525M

1. TORQUE CONVERTER HOUSING ASSEMBLY
2. GEARBOX PUMP AND CASING ASSEMBLY
3. GOVERNOR AND ADAPTOR HOUSING ASSEMBLY



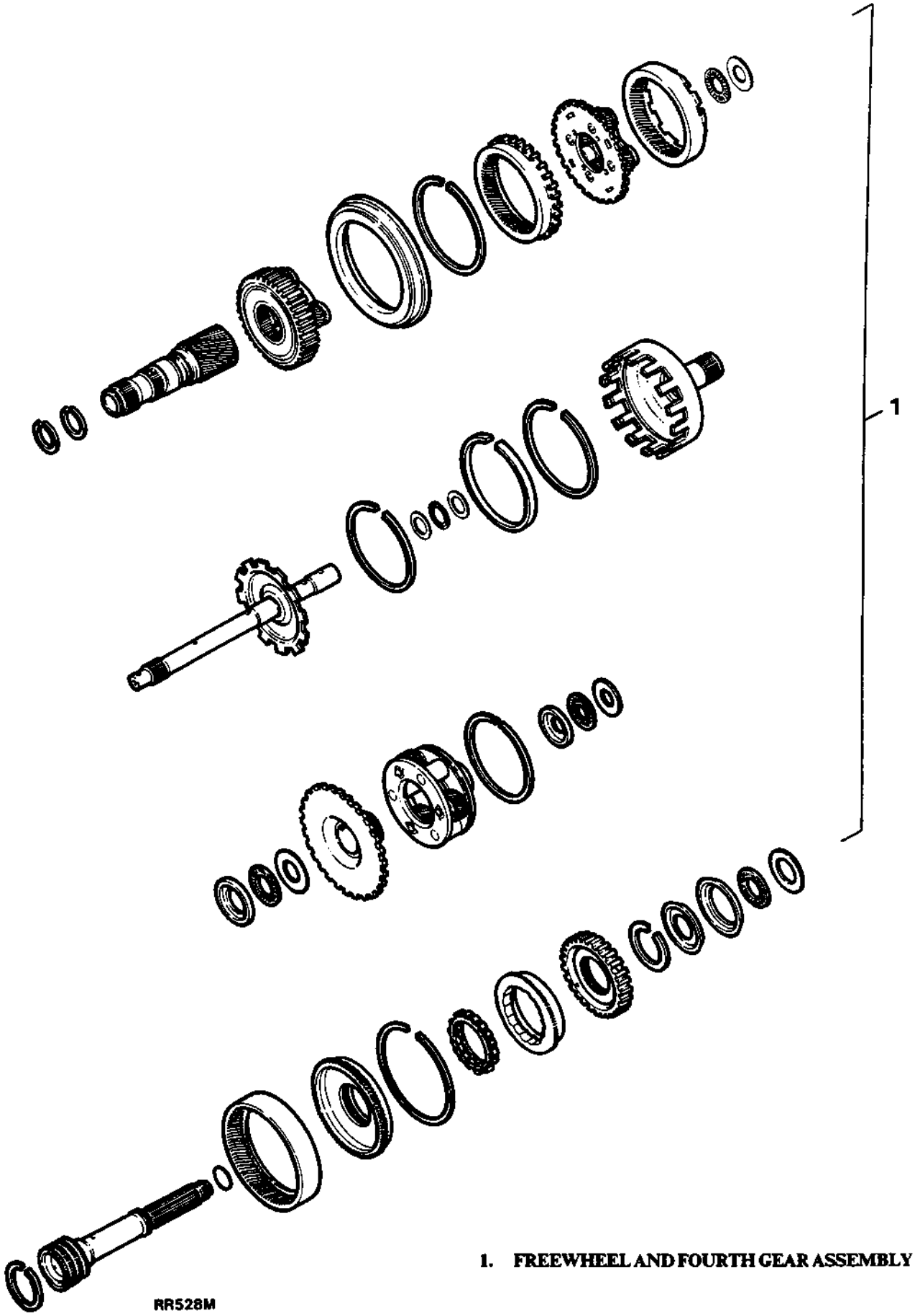
1. A CLUTCH ASSEMBLY
2. B CLUTCH ASSEMBLY

RR526M

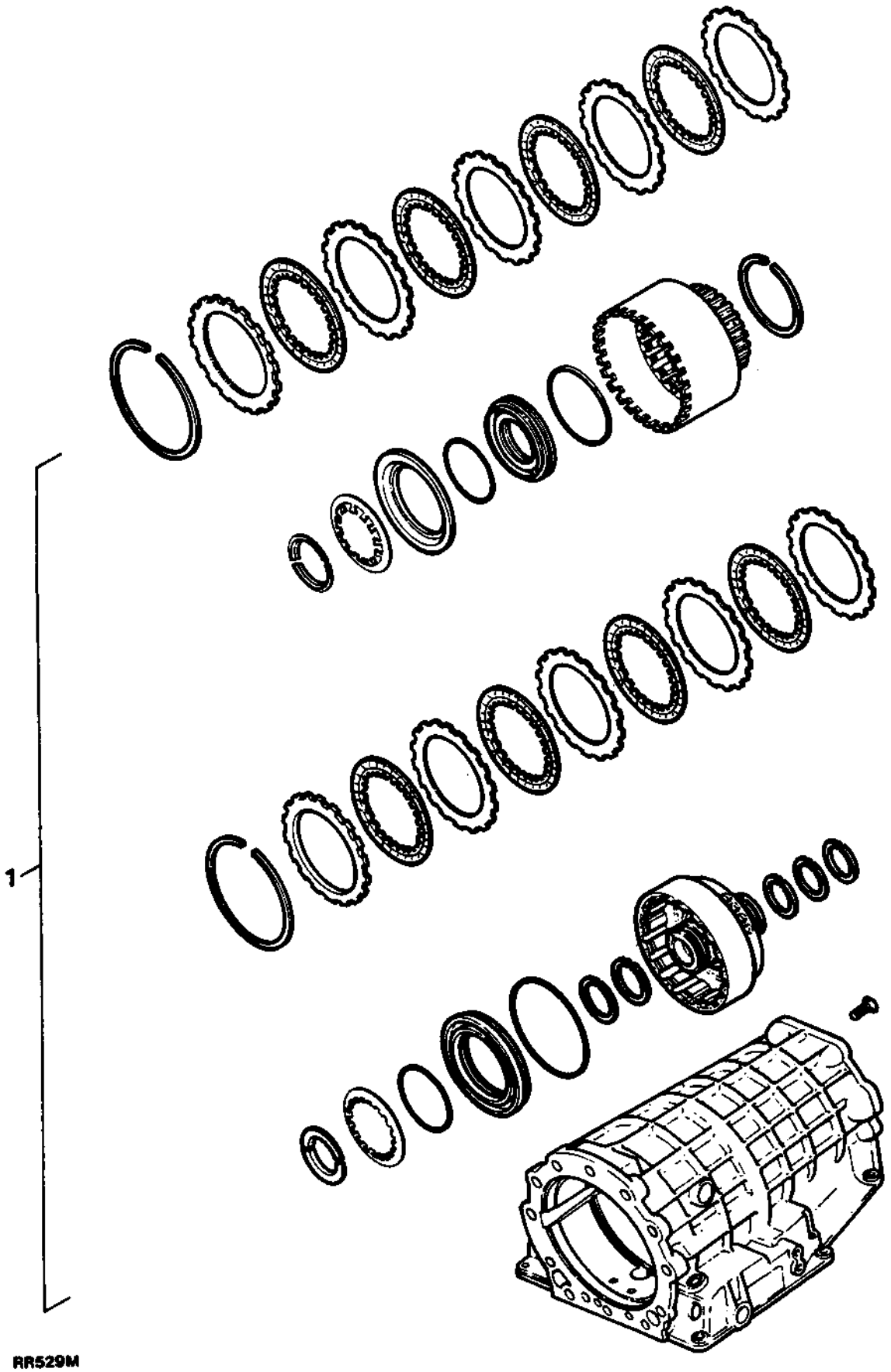


1. C, C' AND D CLUTCH ASSEMBLY

RR527M



1. FREEWHEEL AND FOURTH GEAR ASSEMBLY

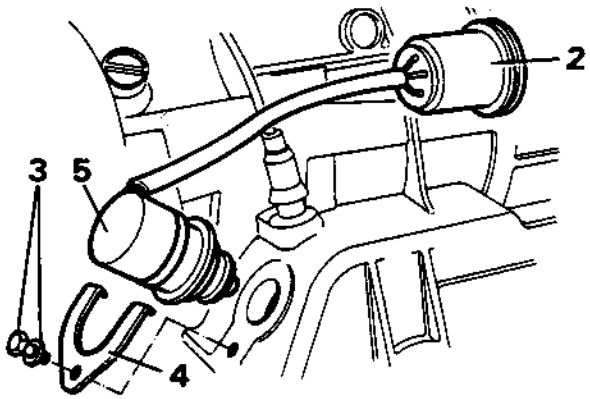


1. E AND F CLUTCH ASSEMBLY

STAGE I

Inhibitor switch leak elimination and replacement

1. Place vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle disconnect the inhibitor lead.
3. Undo and remove the bolt and spring washer.
4. Remove the retaining plate.
5. Using a suitable tool remove the inhibitor switch from the casing.
6. Fit a new inhibitor switch, retaining plate if existing one is damaged, spring washer and bolt.
7. Reconnect the inhibitor leads.

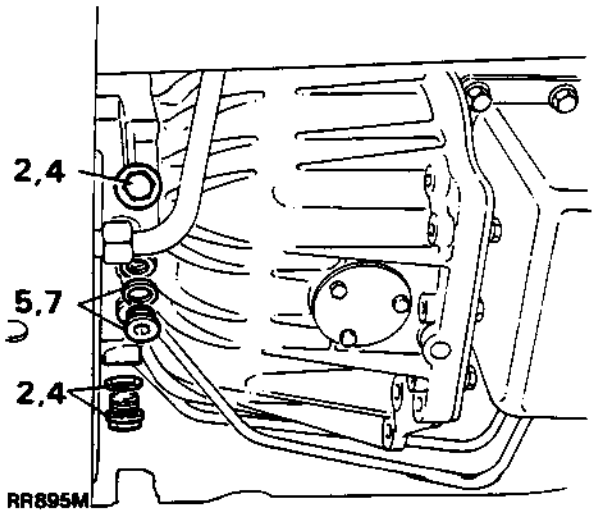


RR579M

Intermediate plate screw plugs leak elimination

NOTE: The following procedure is for all four plugs on the plate. Only one of these plugs may be leaking therefore the procedure will only apply to that particular plug or plugs if more than one are faulty.

1. Place the vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle, using a suitable spanner remove the two hexagon headed plugs situated in the intermediate plate, catching any oil that may leak from the plate.

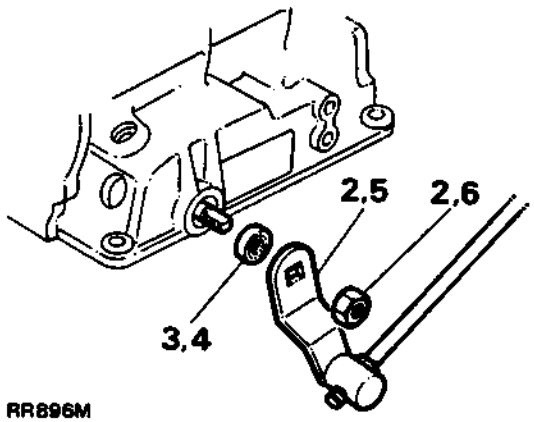


RR895M

3. Remove and discard the sealing rings.
4. Fit new sealing rings and refit the plugs to the specified torque.
5. Using a suitable hexagon shaped tool, remove the two hexagon socket plugs, catching any oil that may leak from the plate.
6. Remove and discard the sealing rings.
7. Fit new sealing rings and refit the plugs to the specified torque.
8. Connect the battery.
9. Top up the gearbox with the correct oil through the filler level tube located within the engine bay. (See Data section.)
10. Ensuring the vehicle is on level ground with the hand-brake applied check oil level while engine is running at idle with neutral selected after selecting each gear.

Selector shaft leak elimination

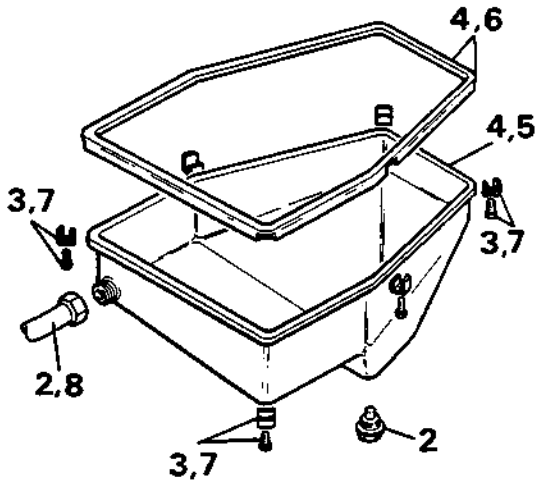
1. Place vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle remove the nut and gear-change lever.
3. Using a suitable tool remove the oil seal.
4. Fit the new oil seal using the selector shaft oil seal replacer LST 114. For ease of fitment use a light grease or vaseline.
5. Refit gear-change lever, ensure that it is located correctly.
6. Fit and tighten nut to the specified torque.



RR896M

Oil pan leak elimination and replacement

1. Place vehicle on a ramp or over a pit open the bonnet and disconnect battery leads.
2. From underneath the vehicle drain the gearbox using a suitable container and remove the oil filler level tube.
3. Remove the six retaining plates and bolts.
4. Remove the oil pan and discard the gasket.
5. Inspect oil pan for wear or damage. Replace if necessary.
6. Fit new gasket onto oil pan.
7. Refit oil pan using the six retaining plates and screws (two straight and four corner plates).

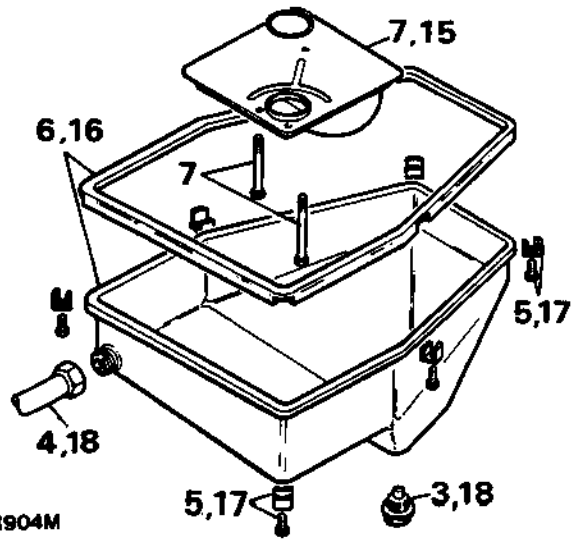


RR903M

8. Reconnect oil filler level tube, oil pan plug with a new seal.
9. Connect the battery leads.
10. Fill the gearbox with the correct oil. (See data section.)
11. Ensuring the vehicle is on level ground with the handbrake applied check oil lever while engine is running at idle with neutral selected after selecting each gear.
    NOTE: If leak persists and old oil pan has been refitted, change the oil pan using the same procedure as above.

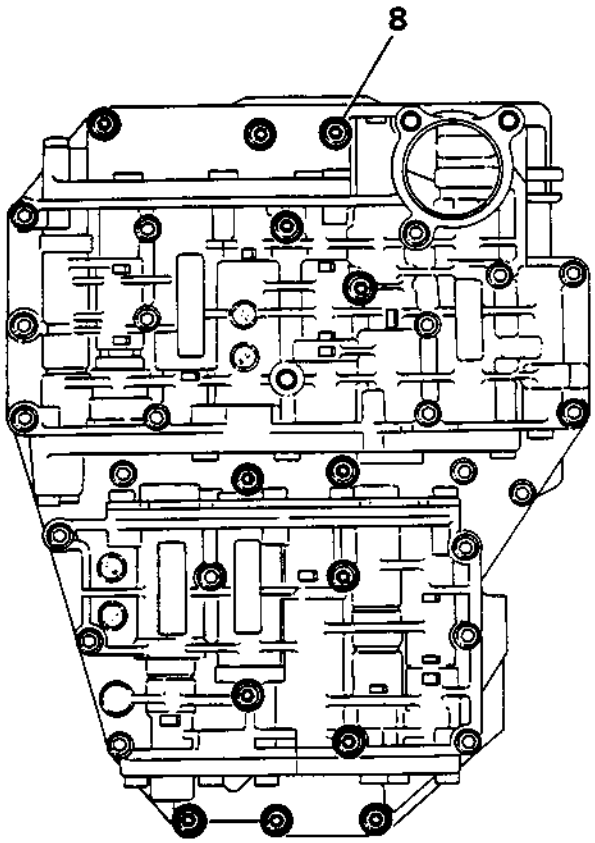
Kickdown cable leak elimination

1. Place the vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. Disconnect the kickdown cable from the rear of the engine.
3. From underneath the vehicle, using a suitable container drain the gearbox and discard the gearbox oil pan seal.
4. Remove the oil filler level tube.
5. Remove the six retaining plates and bolts.
6. Remove the oil pan and discard the gasket.



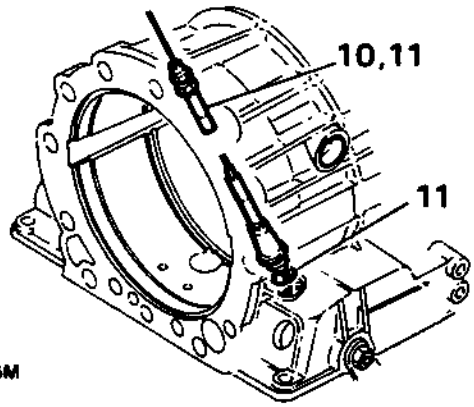
RR904M

7. Remove the oil screen, undoing the three bolts using a TX27 Torx bit.
8. Remove the control unit, undoing the thirteen remaining bolts using a TX27 Torx bit.



RR905M

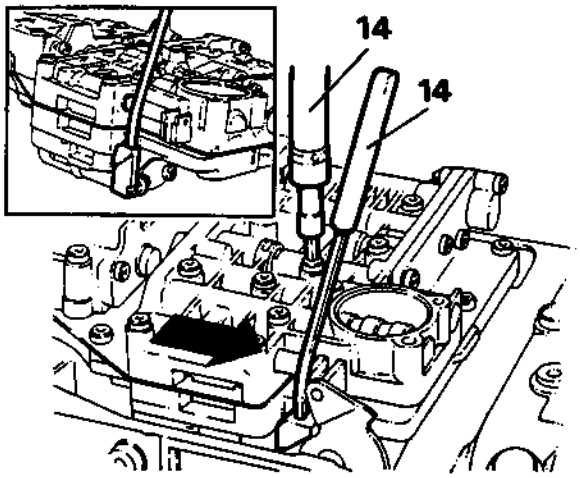
9. Locate the selector cam and remove the nipple holding the kickdown cable from it's seat.
10. Using the kickdown cable remover LST112 remove the cable and it's housing from the casing and discard.
11. Fit new throttle cable with new 'O' ring into the casing.



RR906M

12. Fit the nipple into the cam seat ensuring that the cam has been turned once before fitment. This will spring load the cam.
13. Fit the control unit after cleaning the face with a lint free rag, ensuring the selector shaft locates into the gear shift fork and fit the thirteen bolts loosely by hand.

14. Place the selector linkage setting gauge LST109 in position and gently press the control unit against the tool and tighten all thirteen bolts using TX27 torx bit to the specified torque.

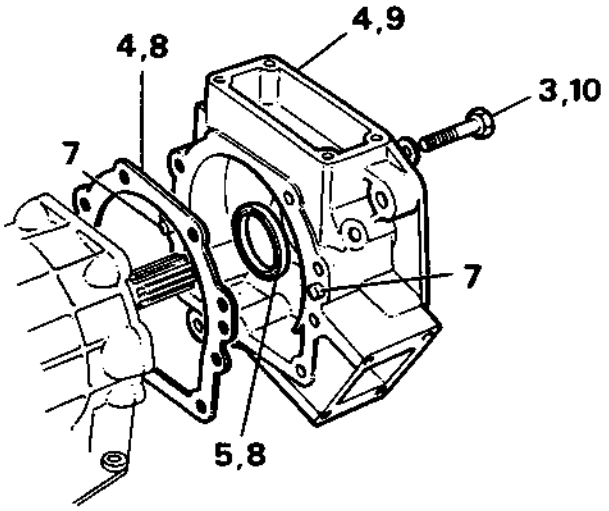


RR907M

15. Remove setting gauge and fit oil screen using TX27 torx bit to the specified torque.
16. Refit oil pan with new gasket.
17. Refit the six retaining plates and screws (two straight and four corner plates).
18. Reconnect oil filler tube and oil pan, plug with a new seal.
19. Connect the battery leads.
20. Fill the gearbox with the correct oil (see 'Data section').
21. Connect the kickdown cable to the rear of the engine.
22. Adjust the outer cable to achieve a crimp gap of 0,25 to 1,25mm (.006 to .031 in).
23. Hold the outer cable while tightening the locknuts. **NOTE: The kickdown cable must be adjusted while the vehicle is running at idle.**
24. Ensuring the vehicle is on level ground with the handbrake applied, check oil level while engine is running at idle with neutral selected, after selecting each gear.

Extension case leak elimination and replacement

1. Remove the transfer box as described in section 37.
2. Using a suitable tool release the four bolts from inside the vehicle holding the transfer gear selector housing and adaptor bracket.
3. From underneath the vehicle using a suitable tool release the nine bolts holding the extension housing.
4. Remove the extension housing and discard the gasket.
5. Place extension housing on the bench and remove the oil seal.
6. Ensure that all the surfaces are clean and the case is free from damage. If damage has been found on the case, replace the case.
7. If the case has to be replaced, fit the two dowels to the case.
8. Fit a new gasket and oil seal using the rear oil seal replacer LST108.

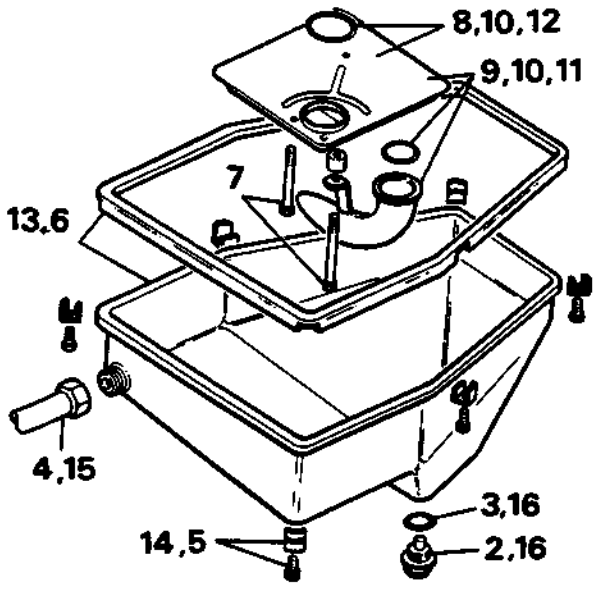


RR908M

9. Fit the extension case onto the gearbox ensuring the oil seal does not get damaged by the extension shaft.
10. Fit and tighten the nine bolts to the specified torque.
11. From inside the vehicle refit the four bolts which hold the transfer gear selector housing and adaptor bracket.
12. Secure the four bolts to the specified torque.
13. Refit the transfer box as described in section 37.

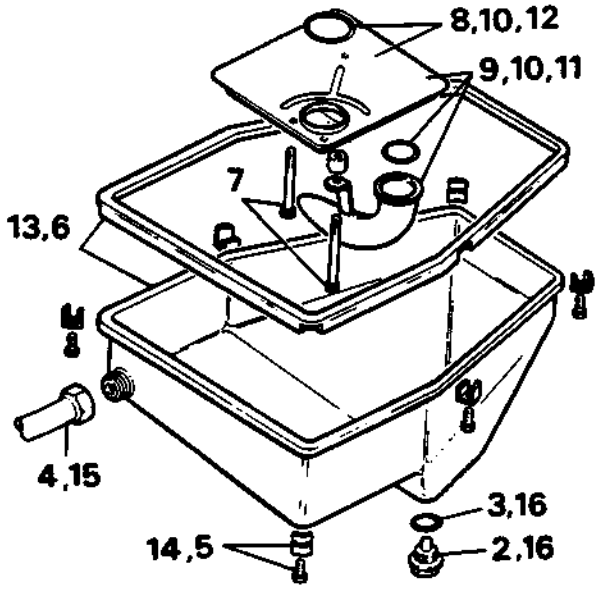
Oil Screen Replacement

1. Place the vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle drain the gearbox using a suitable container.
3. Discard the oil pan plug seal ring.
4. Remove the filler/level tube from the oil pan.
5. Remove the six retaining plates and bolts.
6. Remove the oil pan and discard the gasket.
7. Using TX27 torx bit undo the three screws which hold the oil screen.



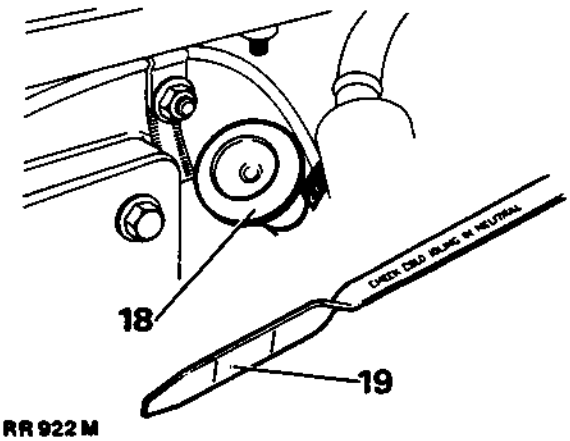
RR691M

8. Remove the oil screen and discard the 'O' rings.
9. Separate the oil screen from the suction tube and discard the 'O' ring and oil screen.



RR691M

10. Fit two new 'O' rings to the oil screen using a light grease for ease of assembly.
11. Fit the suction tube to the oil screen.
12. Fit the oil screen to the control unit and secure with three bolts using TX27 torx bit tighten to the specified torque.
13. Refit the oil pan using a new gasket.
14. Secure using the six retaining plates and bolts (two straight and four corner plates), tighten to the specified torque.

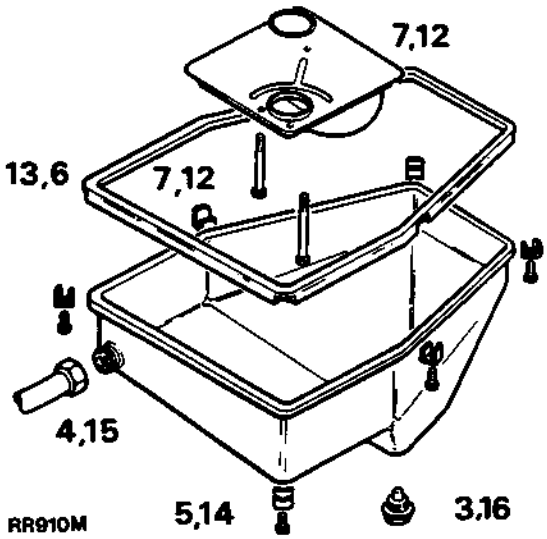


RR 922 M

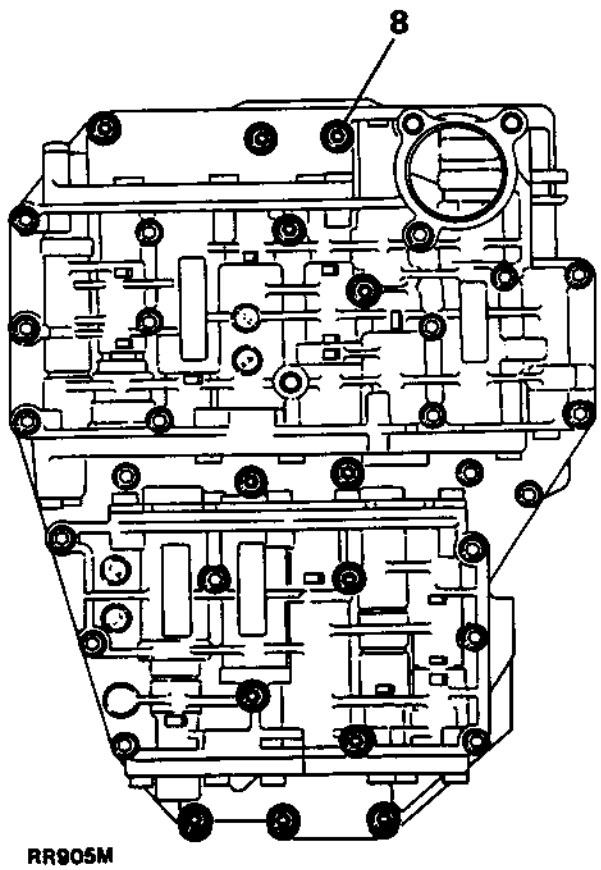
15. Reconnect the oil level/filler tube.
16. Fit oil pan plug using a new seal.
17. Connect the battery leads.
18. Fill the gearbox with the correct oil through the filler/level tube located within the engine bay. (See Data section.)
19. Ensuring the vehicle is on level ground with the hand-brake applied, check oil level while engine is running at idle with neutral selected.

Control Unit Replacement

1. Place the vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle drain the gearbox using a suitable container.
3. Discard the oil pan plug seal ring.
4. Remove the oil filler/level tube from the oil pan.
5. Remove the six retaining plates and bolts.
6. Remove the oil pan and discard the gasket.
7. Using a TX27 torx bit undo the three bolts which hold the oil screen.

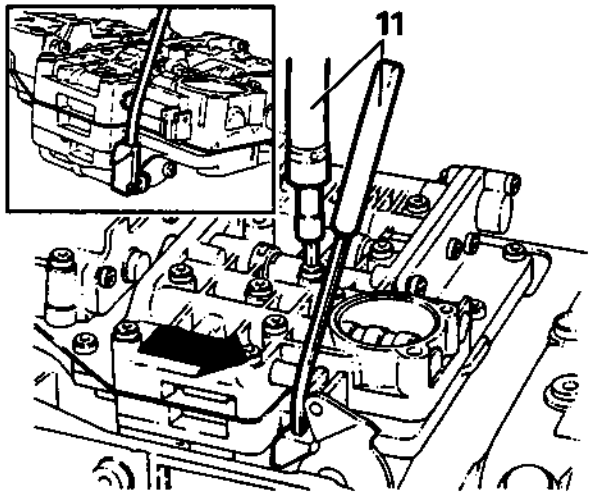


RR910M



RR905M

8. Using a TX27 torx bit undo the remaining thirteen bolts retaining the control unit.
9. Clean the surfaces ensuring no damage has occurred to the mounting face of the case, using a lint-free rag.
10. Fit the new control unit ensuring the selector shaft locates into the gear shift fork and fit the thirteen bolts loosely by hand.
11. Place the selector linkage setting gauge LST 109 in position and gently press the control unit against the tool and tighten all thirteen bolts using TX27 torx bit to the specified torque.

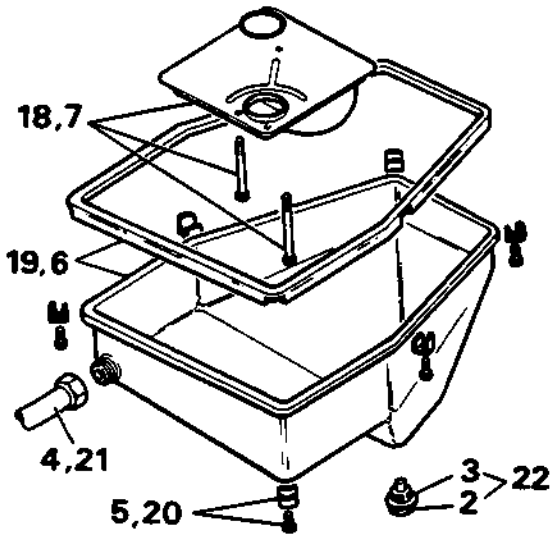


RR585M

12. Remove the setting gauge and fit the oil screen using TX27 torx bit to the specified torque.
13. Refit the oil pan using a new gasket.
14. Secure with the six retaining plates and bolts (two straight and four corner plates), tighten to the specified torque.
15. Reconnect the oil filler/level tube.
16. Fit oil pan plug using a new seal.
17. Connect the battery leads.
18. Fill the gearbox with the correct oil through the filler/level tube located within the engine bay. (See 'Data' section.)
19. Ensuring the vehicle is on level ground with the handbrake applied, check oil level while engine is running at idle with neutral selected, after selecting each gear.

Oil Inlet Sealing Rings Renewal

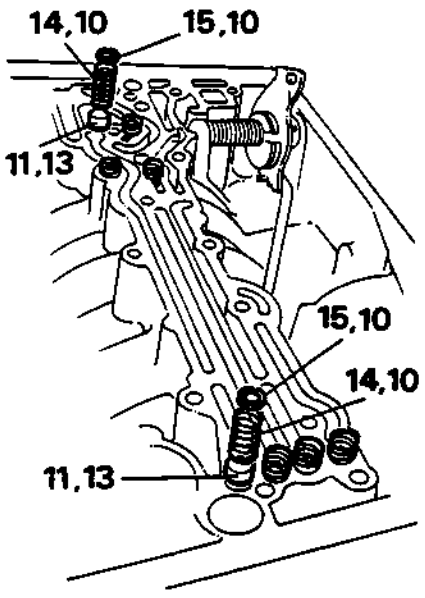
1. Place the vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle drain the gearbox using a suitable container.
3. Discard the oil pan plug seal ring.
4. Remove the oil filler/level tube from the oil pan.
5. Remove the six retaining plates and bolts.
6. Remove the oil pan and discard the gasket.
7. Using a TX27 torx bit undo the three bolts which hold the oil screen.



RR913M

8. Using a TX27 torx bit undo the remaining thirteen bolts retaining the control unit and remove the control unit.
9. Clean the surfaces ensuring no damage has occurred to the mounting face of the case, using a lint-free rag.
10. Using circlip pliers remove the eight circlips and springs from the gearbox.
11. Using control unit inlet oil seals remover/replacer LST 113 remove the eight oil seals.
12. Clean the orifices and check for damage.

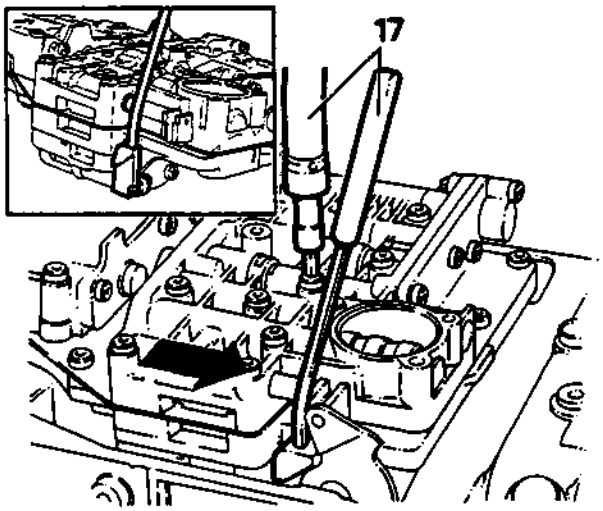
NOTE: If damage has occurred replace the box as described in Stage II.



RR580M

13. Using the control unit inlet oil seal remover/replacer LST 113 fit the new seals ensuring they are seated fully home.

14. Fit the eight compression springs, the four short ones at the front and the four long ones at the rear of the box.
15. Using the circlip pliers fit the eight circlips which retain the compression springs.
16. Fit the control unit ensuring the selector shaft locates into the gear shift fork and fit the thirteen bolts loosely by hand.
17. Place the selector linkage setting gauge LST 109 in position and gently press the control unit against the tool and tighten all thirteen bolts using TX27 torx bit to the specified torque.



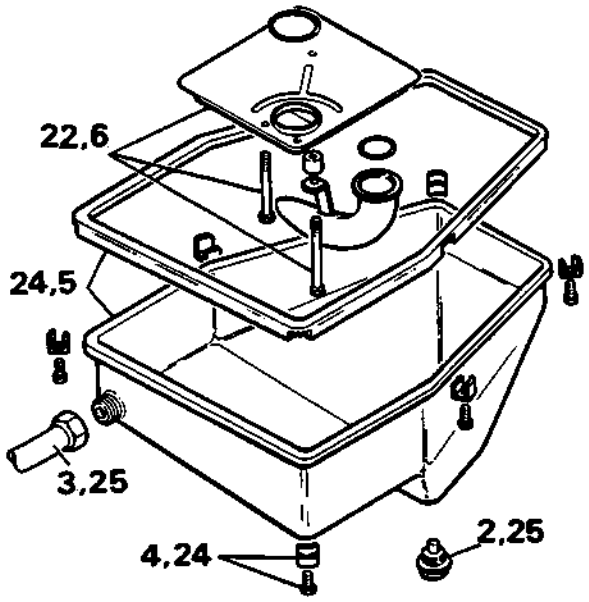
RR909M

18. Remove the setting gauge and fit the oil screen using TX27 torx bit to the specified torque.
19. Refit the oil pan using a new gasket.
20. Secure with the six retaining plates and bolts (two straight and four corner plates), tighten to the specified torque.

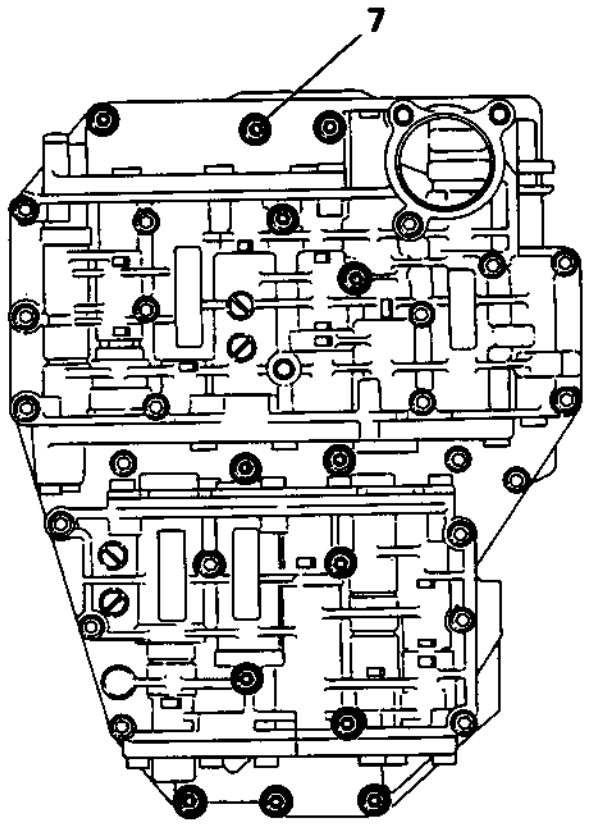
21. Reconnect the oil filler/level tube.
22. Fit oil pan plug using a new seal.
23. Connect the battery leads.
24. Fill the gearbox with the correct oil through the filler/level tube located within the engine bay. (See 'Data' section.)
25. Ensuring the vehicle is on level ground with the hand-brake applied, check oil level while engine is running at idle with neutral selected, after selecting each gear.

Manual Valve Operating Mechanism

1. Place the vehicle on a ramp or over a pit, open the bonnet and disconnect the battery leads.
2. From underneath the vehicle, using a suitable container drain the gearbox and discard the gearbox oil pan seal.
3. Remove the oil filler level tube.
4. Remove the six retaining plates and bolts.
5. Remove the oil pan and discard the gasket.
6. Remove the oil screen, undoing the three bolts using a TX27 torx bit.
7. Remove the control unit, undoing the thirteen remaining bolts using a TX27 torx bit.



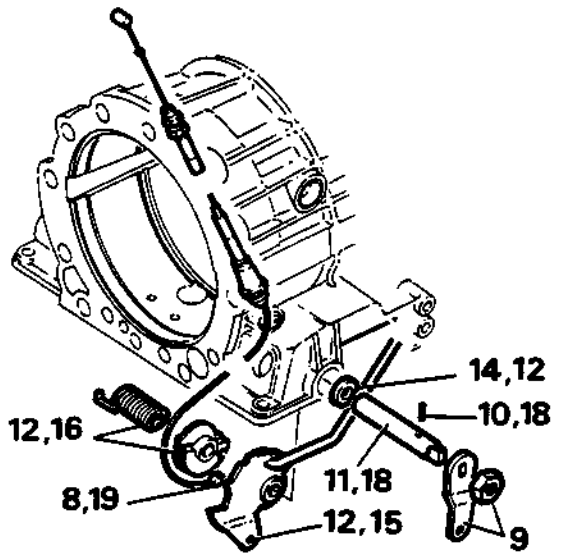
RR582M



RR914M

8. Locate the selector cam and remove the nipple holding the kick-down cable from its seat.
9. Remove the nut and gear change lever.
10. Using a suitable punch drift out the roll pin from the selector shaft and discard it.
11. Using a suitable tool remove the selector shaft from the box, noting the position of the detent plate.

12. Remove the connecting rod complete with detent plate; accelerator cam, spring and using a suitable tool remove the oil seal and discard.
13. Check all parts for wear or damage and replace as necessary.

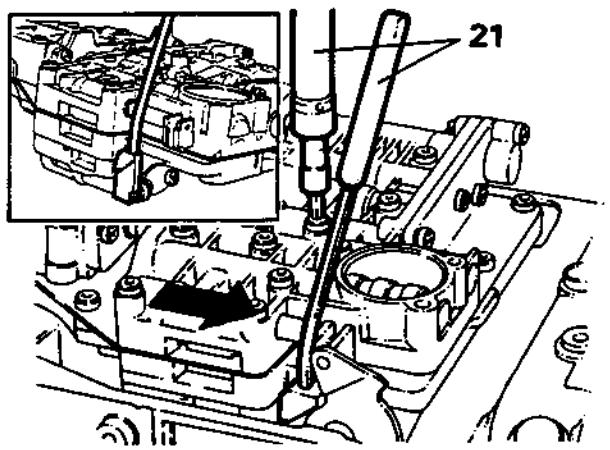


RR581M

14. Using selector shaft oil seal replacer LST114, fit the oil seal. For ease of fitment use a light grease or vaseline.
15. Fit connecting rod to detent plate and locate in the box by pushing the selector shaft through from outside of the casing.

NOTE: The detent plate should go back into the box in the same position as noted earlier.

16. Fit the accelerator cam with the spring.
17. Fit the assembly into the box and secure it by pushing the selector shaft through.
18. Align the hole in the selector shaft with the hole in the detent plate and secure with a new roll pin, using a suitable punch.



RR917M

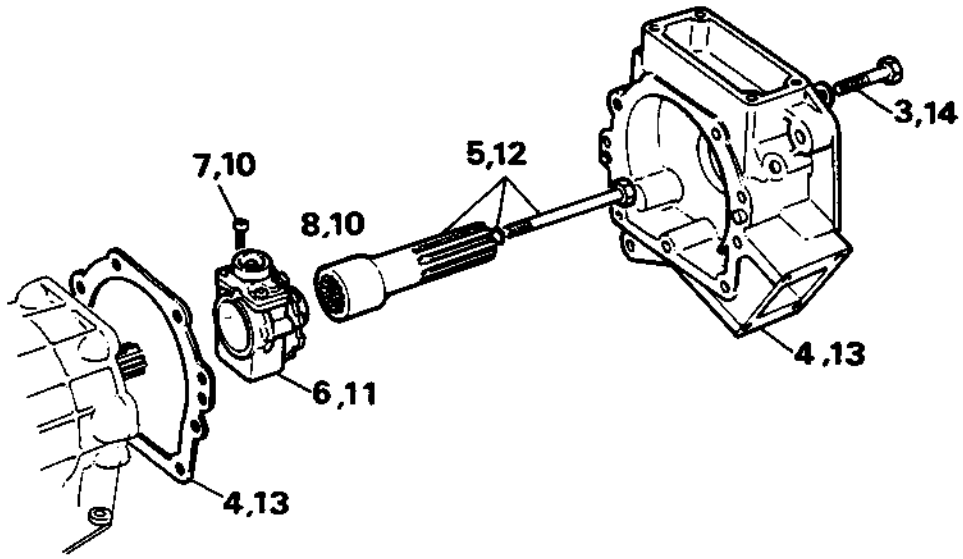
19. Fit kickdown cable nipple into the cam seat ensuring that the cam has been turned once before fitment. This will spring load the cam.
20. Fit the control unit ensuring the selector shaft locates into the gear shift fork and fit the thirteen bolts loosely by hand.
21. Place the selector linkage setting gauge LST109 in position and gently press the control unit against the tool and tighten all thirteen bolts using TX27 torx bit to the specified torque.
22. Remove the setting gauge and fit oil screen using TX27 torx bit to the specified torque.
23. Refit the oil pan with a new gasket.
24. Refit the six retaining plates and screws (two straight and four corner plates).
25. Reconnect the oil filler/level tube, oil pan plug with new seal.
26. Connect the battery leads.
27. Fill the gearbox with the correct oil. (See Data section.)
28. Ensuring the vehicle is on level ground with the handbrake applied, check oil level while engine is running at idle with neutral selected, after selecting each gear.

Governor Housing Renewal

1. Remove the transfer box as described in section 37.
2. Using a suitable tool release the four bolts from inside the vehicle holding the transfer gear selector housing and adaptor bracket.
3. From underneath the vehicle using a suitable tool release the nine bolts holding the extension housing.
4. Remove the extension housing ensuring that the seal is not damaged and discard the gasket.
5. Remove the extension shaft and retaining bolt with 'O' ring.
6. Remove the governor assembly with parking wheel.
7. Remove the two screws holding the governor housing using TX27 torx bit.
8. Remove the governor housing complete and discard.
9. Inspect the governor hub and parking wheel for damage, if satisfactory, clean.
10. Fit new governor housing complete to governor hub and parking wheel using TX27 torx bit to the specified torque.
11. Refit the governor assembly with parking wheel onto the output shaft and push the assembly till fully seated.

    NOTE: To avoid damage to 'O' ring use a light grease or vaseline. Ensure the seal rings are snapped together and are seated correctly.

12. Fit the extension shaft and retaining bolt using a new 'O' ring.
13. Fit new gasket onto rear of gearbox and fit the extension housing, taking care not to damage the seal on assembly.
14. Secure the extension housing using the nine bolts to the specified torque.
15. From inside the vehicle refit the four bolts which retain the transfer gear selector housing and adaptor bracket.
16. Secure the four bolts to the specified torque.
17. Refit the transfer box as described in section 37.



RR586M

Governor Hub Renewal

1. Remove the transfer box as described in section 37.
2. Using a suitable tool release the four bolts from inside the vehicle holding the transfer gear selector housing and adaptor bracket.
3. From underneath the vehicle using a suitable tool release the nine bolts holding the extension housing.
4. Remove the extension housing ensuring that the seal is not damaged and discard the gasket.
5. Remove the extension shaft and retaining bolt with 'O' ring.
6. Remove the governor assembly with parking wheel.
7. Remove the two screws holding the governor housing using TX27 torx bit.
8. Using a TX27 torx bit unscrew the two bolts and remove the parking wheel and discard governor hub.
9. Remove the security clip and counter-weight.
10. Remove the 'O' ring from off the output shaft and discard.
11. Remove the three seal rings from the 'F' clutch housing shaft.
12. Inspect all parts for damage or wear, replace if necessary.

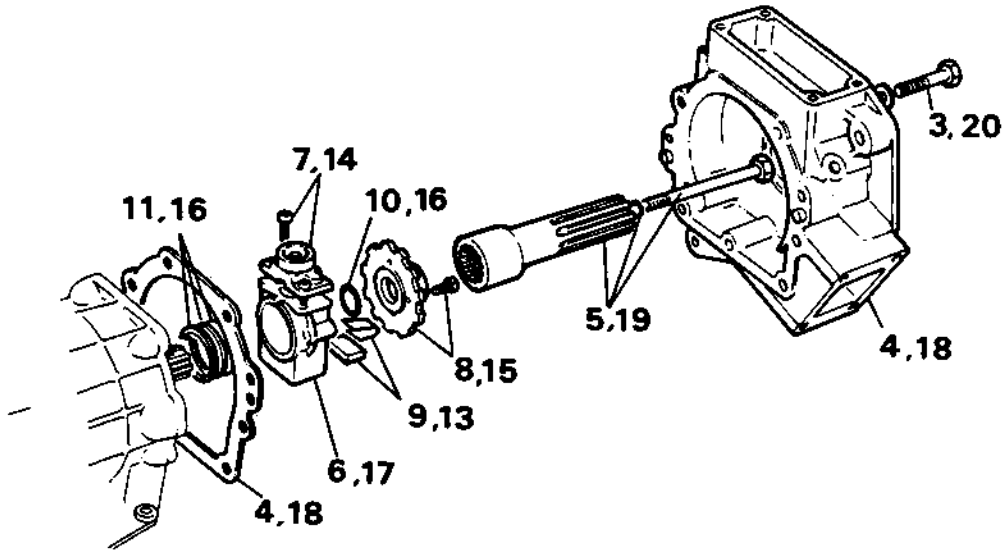
13. Fit the counterweight and security clip into the new governor hub.
14. Secure governor housing onto governor hub using TX27 torx bit to the specified torque.
15. Fit the parking wheel to the governor hub using TX27 torx bit to the specified torque.
16. Fit three new seal rings onto the F clutch housing shaft and fit 'O' ring onto output shaft.

    NOTE: For ease of fitment of the 'O' ring use a light grease or vaseline.

17. Fit governor assembly and parking wheel onto the output shaft and push the assembly till fully seated.

    NOTE: To avoid damage to 'O' ring use a light grease or vaseline. Ensure the seal rings are snapped together and are seated correctly.

18. Fit new gasket onto rear of gearbox and fit the extension housing taking care not to damage the seal or assembly.
19. Fit the extension shaft and retaining bolt using a new 'O' ring.
20. Secure the extension housing using the nine bolts to the specified torque.
21. From inside the vehicle refit the four bolts which retain the transfer gear selector housing and adaptor bracket. Secure the four bolts to the specified torque. Refit the transfer box as described in section 37.



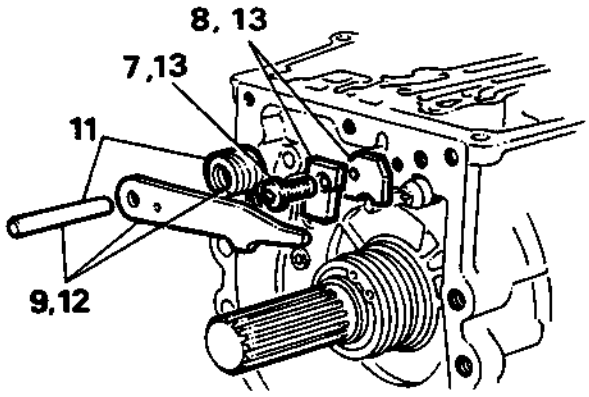
RR919M

Parking Brake Mechanism Renewal

1. Remove the transfer box as described in section 37.
2. Using a suitable tool, release the four bolts from inside the vehicle holding the transfer gear selector housing and adaptor bracket.
3. From underneath the vehicle, using a suitable tool, release the nine bolts holding the extension housing.
4. Remove the extension housing ensuring that the seal is not damaged and discard the gasket.
5. Remove the extension shaft and retaining bolt with 'O' ring.
6. Remove the governor assembly with parking wheel.
7. Remove guide plate bolt, using TX27 torx bit.
8. Remove the plate and guide plate from the gearbox case.
9. Remove the pin, pawl and the spring.

   NOTE: Take care when removing park assembly as spring tension will be reduced.

10. Inspect all parts for wear or damage and replace if necessary.



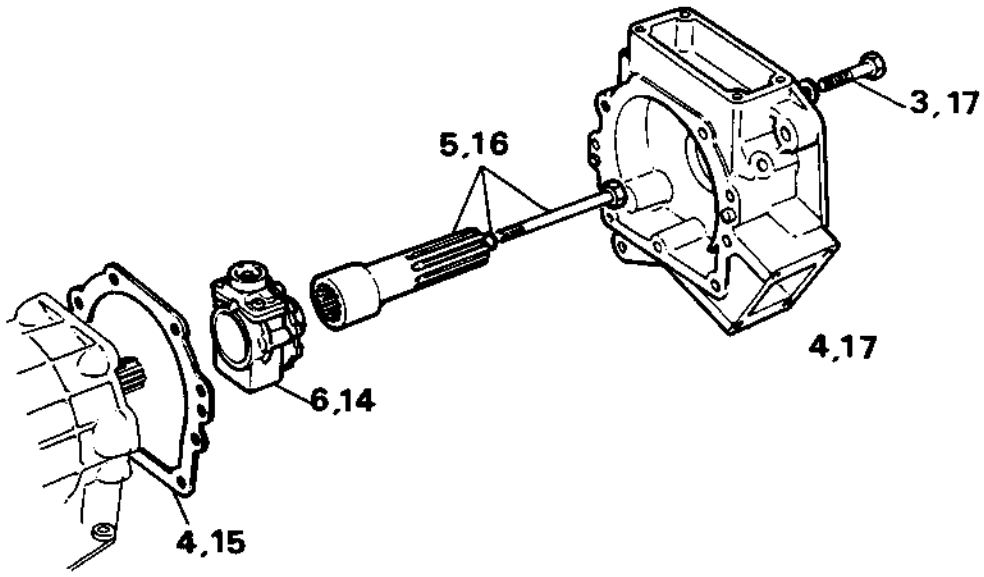
RR584M

11. Fit the pin and the leg spring ensuring that the spring is located correctly.
12. Fit the pawl onto the pin and the spring leg into the hole in the pawl. This creates tension in the spring.
13. Fit the plate and guide plate using TX27 torx bit to the specified torque.

14. Refit the governor assembly with parking wheel onto the output shaft and push the assembly till fully seated.

    NOTE: To avoid damage to 'O' ring use a light grease or vaseline. Ensure the seal rings are snapped together and are seated correctly.

15. Fit new gasket onto rear of gearbox and fit the extension housing, taking care not to damage the seal or assembly.
16. Fit the extension shaft and retaining bolt using a new 'O' ring.
17. Secure the extension housing using the nine bolts to the specified torque.
18. From inside the vehicle refit the four bolts which retain the transfer gear selector housing and adaptor bracket.
19. Secure the four bolts to the specified torque.
20. Refit the transfer box as described in section 37.



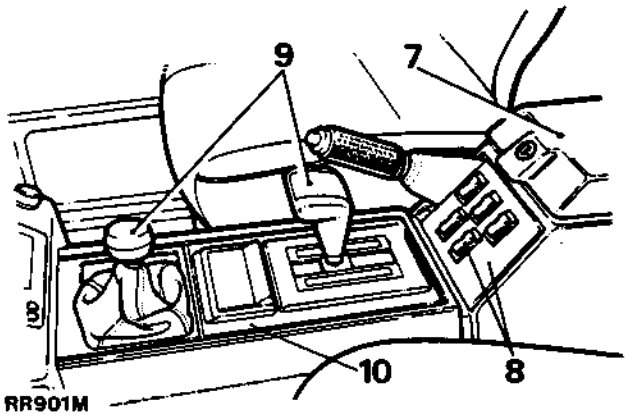
RR920M

STAGE II

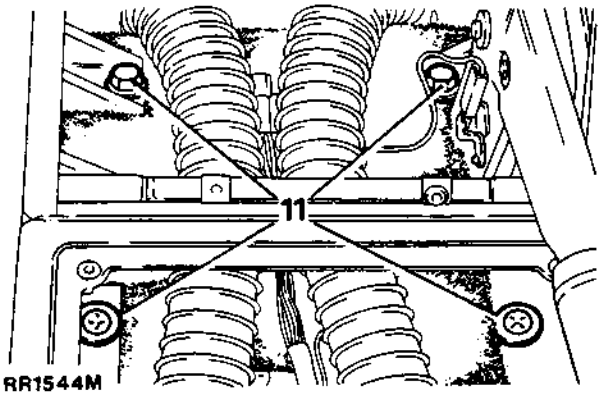
ZF Gearbox—Remove and Refit

Removing

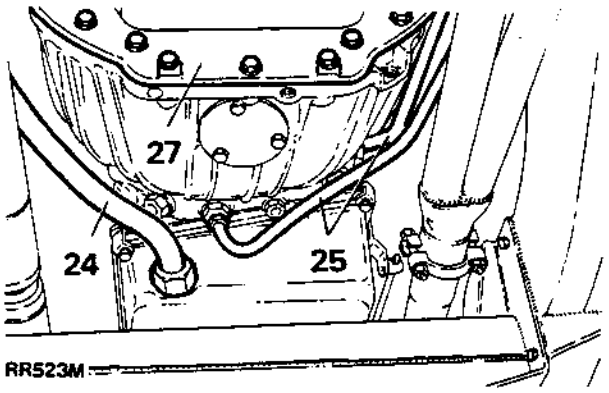
1. Install the vehicle on a hydraulic ramp.
2. Open the bonnet.
3. Disconnect the battery leads.
4. **Fuel Injection models only**—release the airflow meter to plenum chamber hose.
   Carburetter models only—Remove the air intake elbows and withdraw the air cleaner from its location.
5. Disconnect the kickdown cable from throttle linkages.
   Fuel injection models: located on the throttle lever bracketry at the rear of the plenum chamber.
   Carburetter models: located at the rear of the right-hand carburetter. Remove the transmission dipstick.
6. Remove the fan cowl from the radiator.
7. From inside the vehicle remove the four screws securing the cubby box liner to the cubby box and lift out the liner.
8. Carefully prise the window lift, switch panel away from the front of the cubby box. Identify each switch connection for reassembly, disconnect the plugs and remove the switch panel.
9. Remove the main and transfer gearbox knobs.
10. Carefully prise the centre panel out of the floor mounted console and remove it from the vehicle.



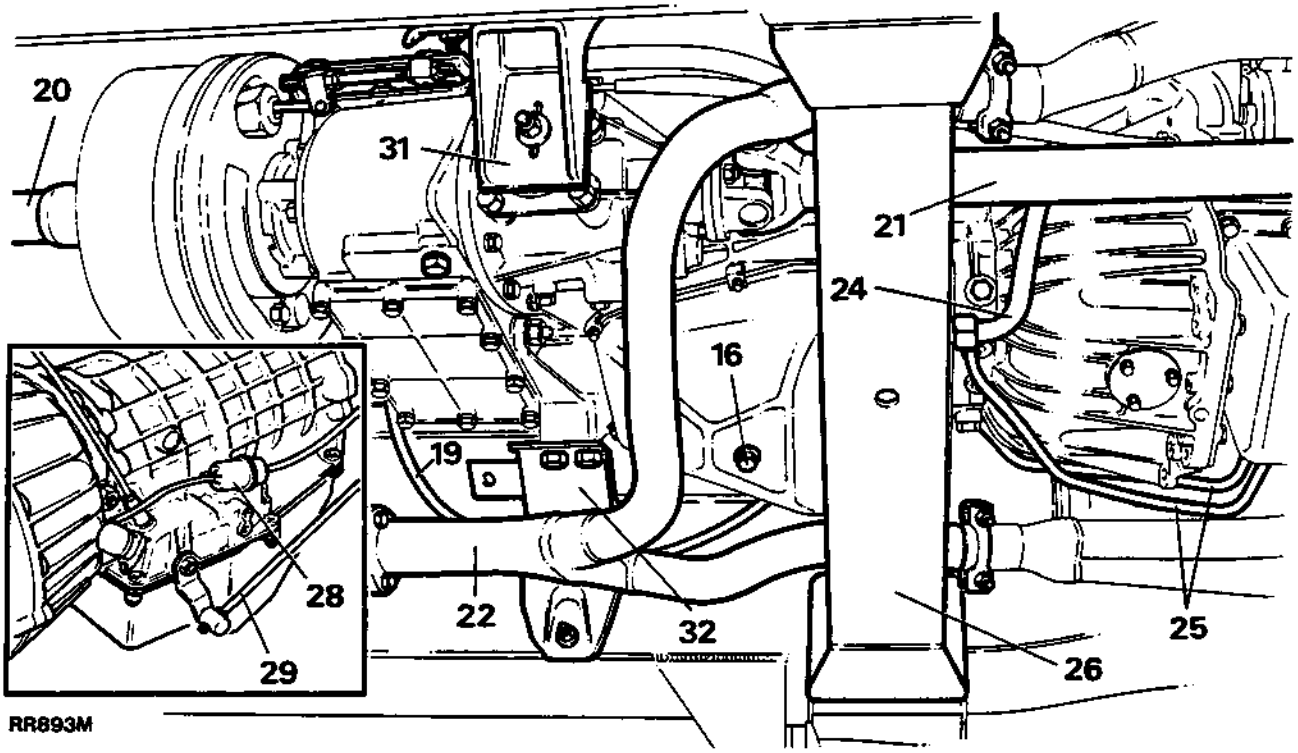
11. Release the two bolts and two screws securing the console assembly to the gearbox tunnel.
12. Release the handbrake and remove the split pin, clevis pin and washer securing the handbrake cable to the handbrake lever.
13. Carefully manoeuvre the console assembly away from the radio housing and remove it from the vehicle.
14. Release the large nut retaining the handbrake outer cable to the top of the gearbox tunnel.
15. Remove the nut and feed the cable through the hole in the tunnel to the underside of the vehicle.
16. Raise the vehicle on the ramp and drain the gearbox.
17. Release the nut and clamp securing the speedometer cable to the rear of the transfer box.
18. Withdraw the cable from the speedometer drive pinnion.



19. Release the cable from the clips at the side of the gearbox.
20. Release the four nuts and bolts securing the rear propeller to the rear output flange and tie the shaft to one side.
21. Remove the four nuts and bolts securing the front propeller shaft to the front output flange and tie the shaft to one side.
22. Release the nuts and bolts securing the front downpipe to the front silencer.
23. Release the nut at the rear tailpipe bracket, disconnect the silencer from the downpipe, and tie the rear tail pipe and silencer to one side.
24. Disconnect the oil filler tube from the front of the gearbox oil pan.
25. Disconnect the two oil cooler pipes from the rear of the gearbox bellhousing.



26. Remove the bolts securing the cross-member in position, using suitable equipment expand the chassis and withdraw the cross-member.
27. Remove the front cover from the bottom of the torque converter housing and from inside the housing remove the converter drive-bolts.
28. Disconnect the inhibitor switch.
29. Disconnect the selector linkage.
30. Manufacture an adaptor plate in accordance with the drawing (RR739M), to attach to the gearbox hoist and transfer box to facilitate removal.
31. Remove the nuts and bolts holding rear left-hand side, mounting bracket to chassis.
32. Remove the nuts and bolts holding right-hand side mounting bracket to chassis.



RR893M

33. Lower the hoist until the rear brake drum clears the rear passenger footwell.
34. Remove the split pin and washers securing the differential lock lever to the connecting rod, and disconnect the lever from the rod.
35. Disconnect the electrical leads from the differential lock switch.
36. Remove the breather pipe from the top of the transfer gearbox.
37. Using a suitable jack support the rear of the engine.
38. Remove the torque converter housing to engine bolts.
39. Carefully withdraw the gearbox and transfer box from the engine taking care not to damage any seats.

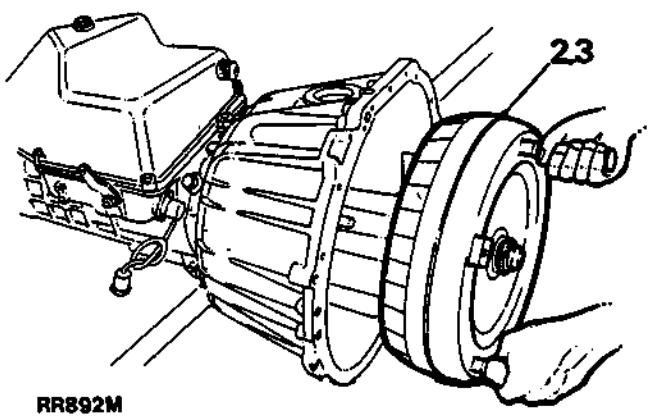
Refitting

40. Reverse the removal instructions.
41. Refill the gearbox with the correct grade and quantity of oil. See data section.
42. Ensuring the vehicle is on level ground with the handbrake applied, check oil level whilst engine is running at idle with neutral selected, after selecting each gear.

There are several places where leaks can occur at the front of the gearbox. The following are remedies for curing any one of these problems.

Eliminating leaks/replacing Torque Converter

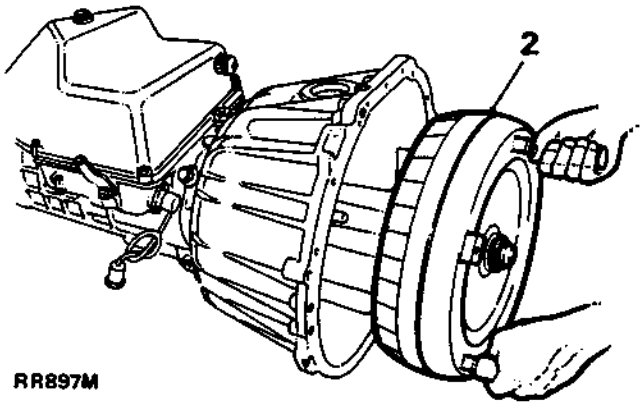
1. Remove the gearbox/transfer box assembly as previously described.
2. Place the gearbox on the bench using the torque converter handles 18G1501, remove the torque converter, taking care not to damage the torque converter/oil pump housing oil seal.
3. Replace with new torque converter using torque converter handles 18G1501, checking that the dimension from the converter fixing bolt boss to the converter housing face is 50 mm (1.96 in). If this dimension is achieved the converter is properly seated in the housing.
4. Refit the gearbox and transfer box assembly as previously described.



RR892M

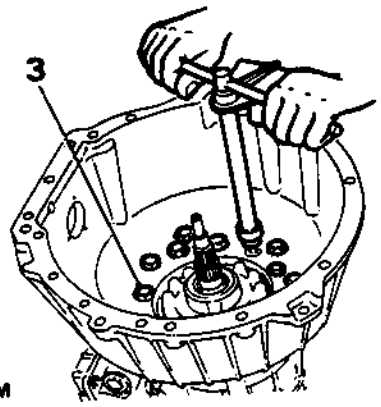
Eliminating Leaks on the Pump Housing

1. Remove the gearbox/transfer box assembly as previously described.
2. Place the gearbox on the bench and remove the torque converter using torque converter handles 18G1501, taking care not to damage the converter/oil pump housing oil seal.

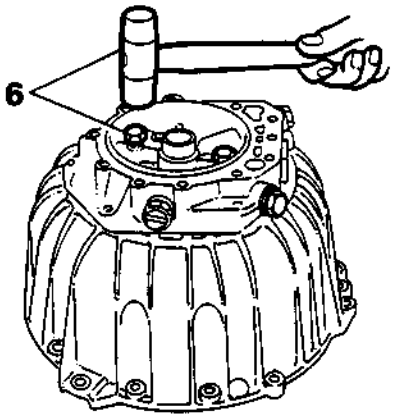


RR897M

3. Remove the twelve hexagonal bolts (inner ring pattern).

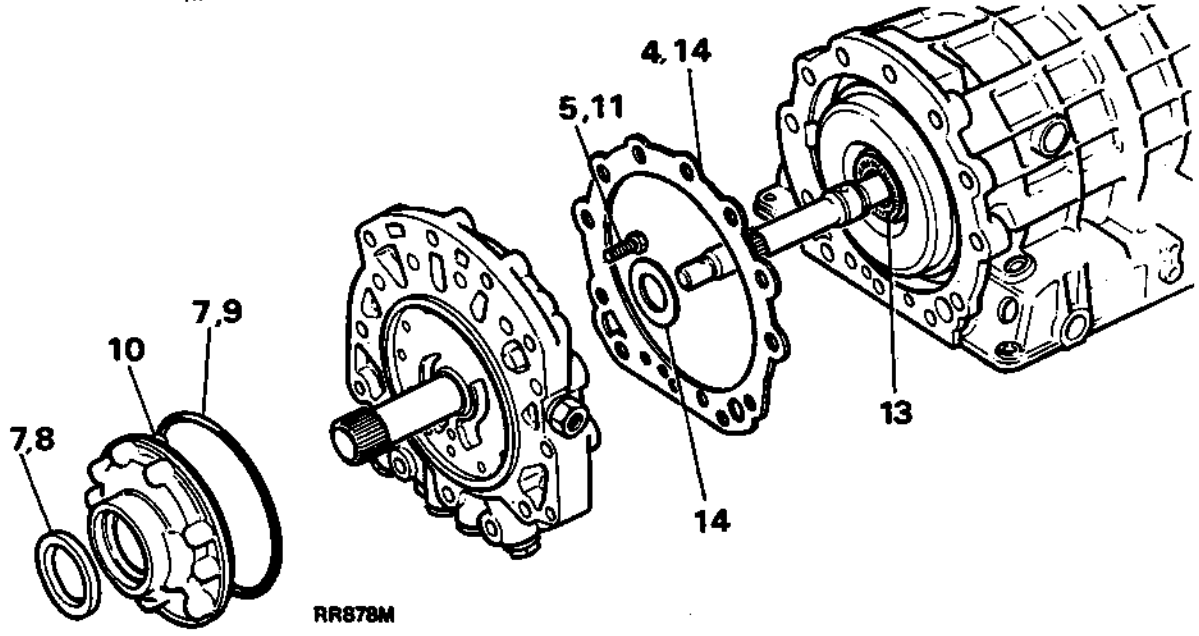


RR577M



RR578M

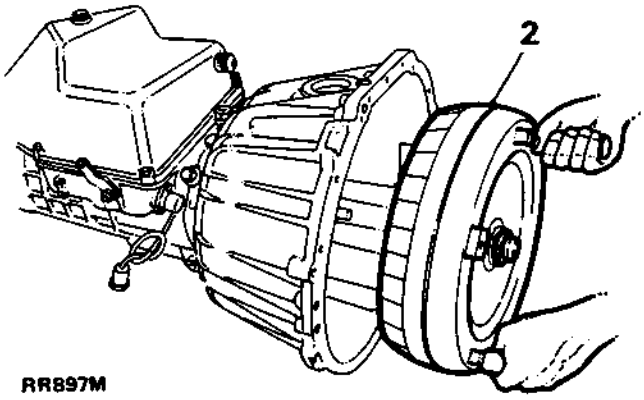
4. Remove bellhousing and pump assembly from gearbox case and discard the gasket.
5. Remove the eight hexagonal bolts on the rear of the pump.
6. Screw in two of the bolts, diagonally opposite each other, tap lightly using a soft headed mallet; this will free the pump assembly from the intermediate plate.
7. Remove the shaft sealing ring and 'O' ring from the pump housing and discard.
8. Using oil seal replacer LST108 fit the shaft seal ring into the pump housing.
9. Fit the 'O' ring onto the circumference of the pump housing.
10. Align the dowel with its hole in the intermediate plate and press the pump housing home.
11. Secure the pump housing to the intermediate plate using the eight hexagonal bolts and tighten to their specified torque.
12. Place the bellhousing and intermediate plate assembly on the bench, front face up. Using the oil pump rotation sleeve LST111, check that the pump gears rotate freely.
13. Before replacing the intermediate plate and bellhousing assembly, check that the thrust washer and axle cage are seated on the A clutch housing.



RR878M

14. Place the gasket and disc washer onto the bellhousing and intermediate plate assembly using a light grease or vaseline.

15. Fit bellhousing and intermediate plate assembly onto gearcase and secure with the twelve hexagonal bolts tightened to the specified torque.
16. Place the end float gauge LST111 onto the pump housing and check that the axial play is between 0,2–0,4 mm. (0.008 in to 0.016 in). If the end float is excessive or tight, replace existing washer, situated at the rear of the intermediate plate, with a suitable washer to give the required end float as stated above.
17. Refit torque converter into housing using torque converter handles 18G1501, checking that the dimension from the converter fixing bolt boss to the converter housing face is 50 mm (1.96 in). If this dimension is achieved the converter is properly seated in the housing.
18. Refit the gearbox/transfer box assembly as previously described.

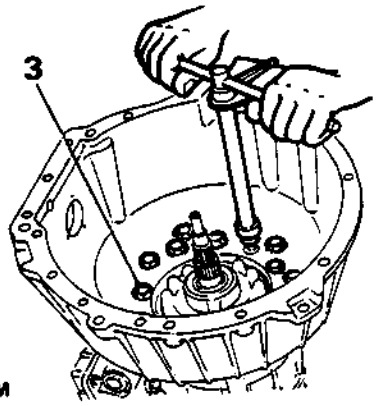


RR897M

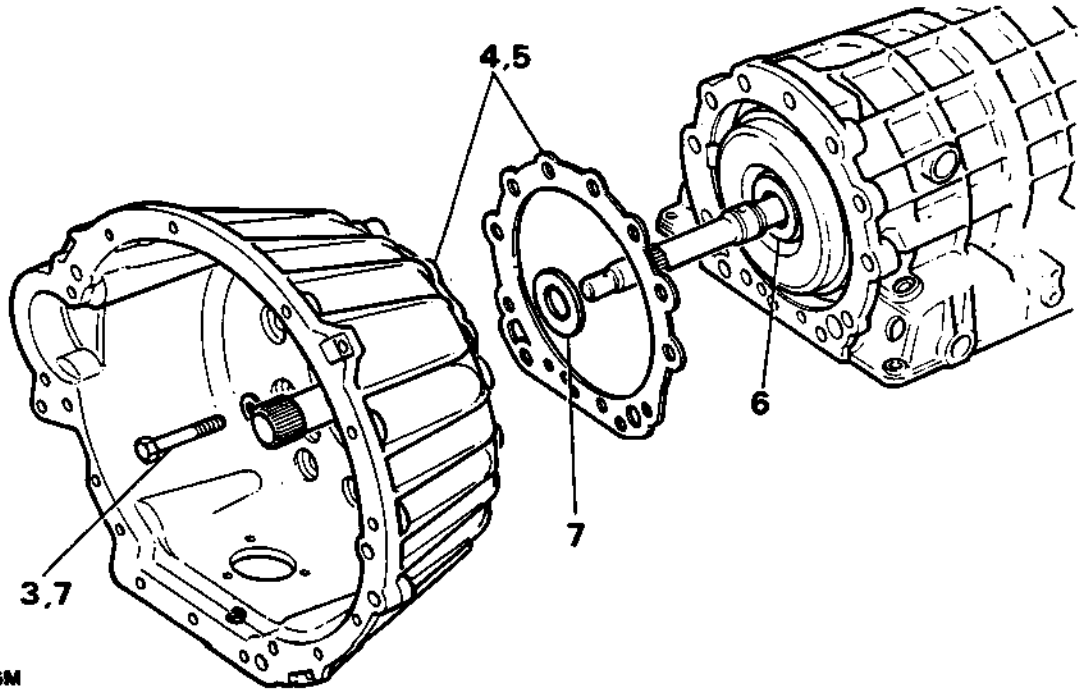
5. Place new gasket onto intermediate plate using a light grease or vaseline.
6. Before replacing the intermediate plate/bellhousing assembly check that the thrust washer and axle cage are seated on the A clutch housing.
7. Fit bellhousing/intermediate plate assembly with disc washer onto gearcase and secure with the twelve hexagonal bolts tightened to the specified torque.

Eliminating leaks between Gearbox Housing and Intermediate Plate

1. Remove the gearbox/transfer box assembly as previously described.
2. Place the gearbox on the bench and remove the torque converter using torque converter handles 18G 1501, taking care not to damage the converter/oil pump housing oil seal.
3. Remove the 12 hexagonal bolts (inner ring pattern).
4. Remove the bellhousing intermediate plate assembly from gearbox case and discard the gasket.



RR577M

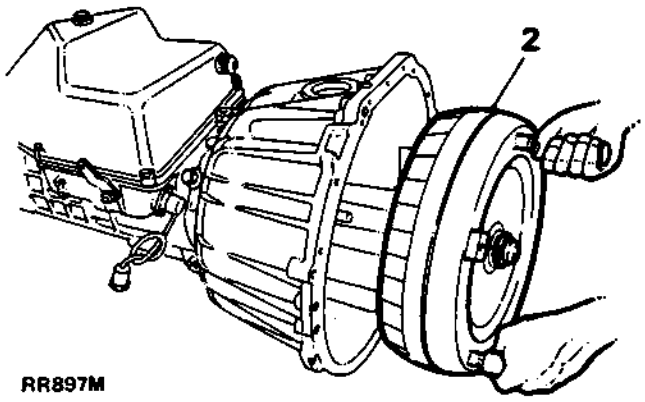


RR576M

8. Place the end-float gauge LST 111 onto the pump housing and check that the axial play is between 0,2–0,4 mm (0.008 in to 0.016 in). If the end-float is excessive or tight, replace existing washer, situated at the rear of the intermediate plate, with a suitable washer to give the required end-float as stated above.
9. Refit torque converter into housing using torque converter handles 18G 1501, checking that the dimension from the converter fixing bolt boss to the converter housing case is 50 mm (1.96 in). If this dimension is achieved the converter is properly seated in the housing.
10. Refit the gearbox/transfer box assembly as previously described.

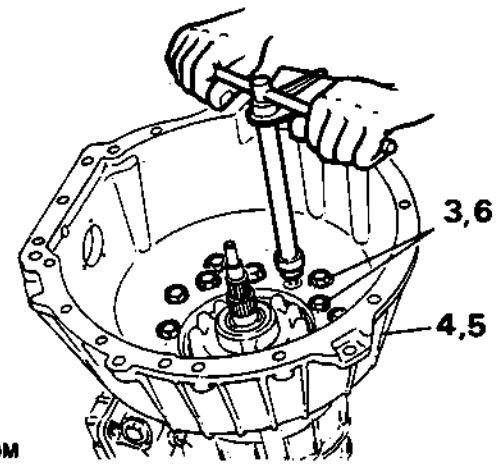
Replacing Bellhousing

1. Remove the gearbox/transfer box assembly as previously described.
2. Place the gearbox on the bench and using the torque converter handles 18G 1501 remove the torque converter, taking care not to damage the converter/oil pump housing oil seal.



RR897M

3. Remove the eighteen hexagonal bolts.
4. Remove bellhousing.
5. Fit new bellhousing.
6. Secure bellhousing with the eighteen hexagonal bolts to the specified torque.

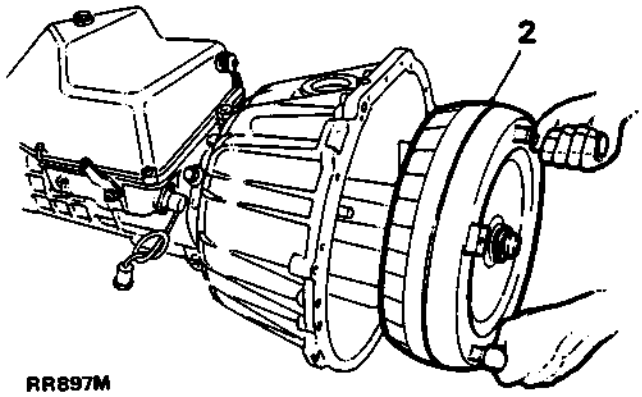


RR899M

7. Refit the torque converter into the housing using torque converter handles 18G 1501, checking that the dimension from the converter fixing bolt boss to the converter housing face is 50 mm (1.96 in). If this dimension is achieved the converter is properly seated in the housing.
8. Refit the gearbox/transfer box assembly as previously described.

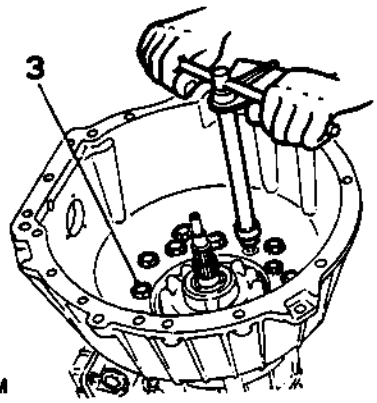
Replacing Pump

1. Remove the gearbox/transfer box assembly as previously described.
2. Place the gearbox on the bench and remove the torque converter using torque converter handles 18G 1501, taking care not to damage the converter/oil pump housing oil seal.



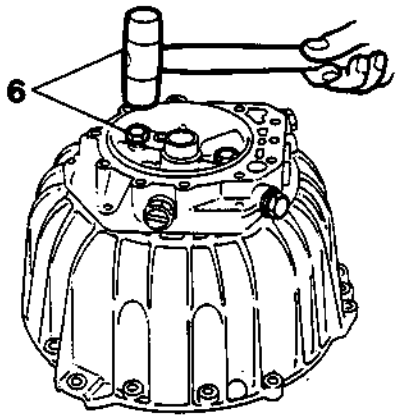
RR897M

3. Remove the twelve hexagonal bolts (inner ring pattern).



RR577M

4. Remove bellhousing and pump assembly from gearbox case and discard the gasket.
5. Remove the eight hexagonal bolts on the rear of the pump.
6. Screw in two of the bolts, diagonally opposite each other, tap lightly using a soft headed mallet; this will free the pump assembly from the intermediate plate.

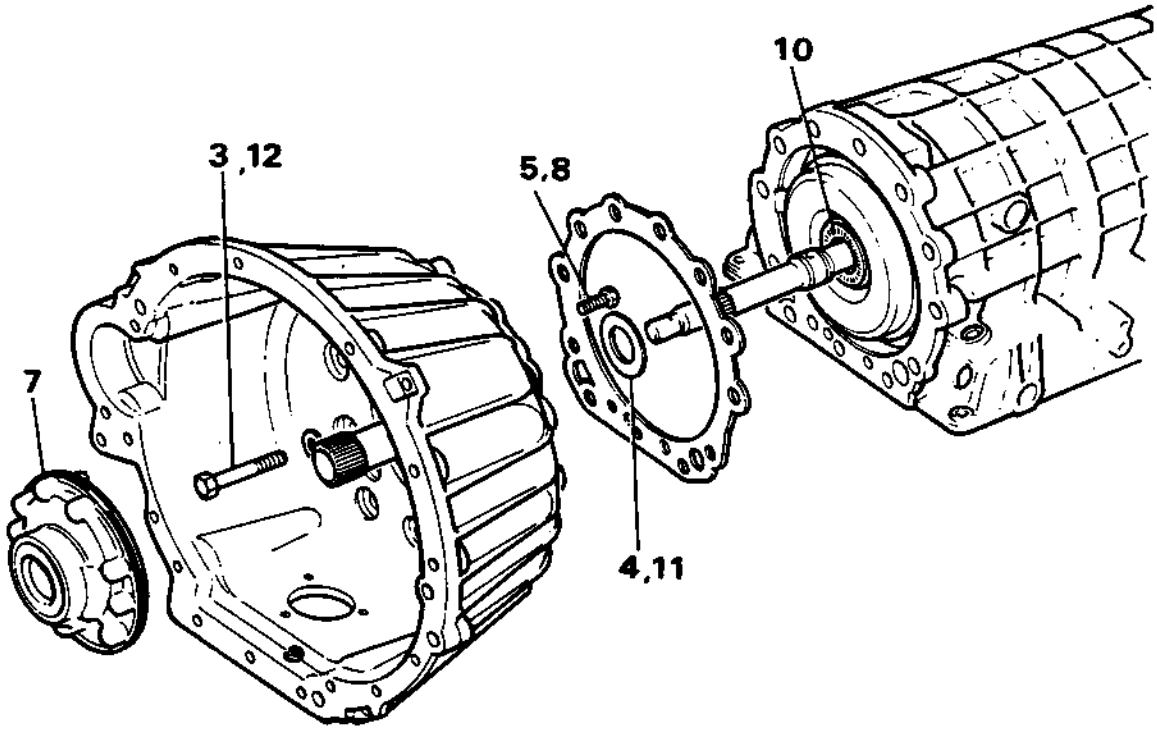


RR578M

7. Fit new pump assembly aligning the dowel with its hole in the intermediate plate and press the pump housing home.
8. Secure the pump housing to the intermediate plate using the eight hexagonal bolts and tighten to their specified torque.
9. Place the bellhousing and intermediate plate assembly on the bench, front face up. Using the oil pump rotation sleeve LST 111, check that the pump gears rotate freely.
10. Before replacing the intermediate plate and bellhousing assembly check that the thrust washer and axle cage are seated on the A clutch housing.
11. Place the gasket and disc washer onto the bellhousing and intermediate plate assembly using a light grease or vaseline.
12. Fit bellhousing and intermediate plate assembly onto gearcase and secure with the twelve hexagonal bolts tightened to the specified torque.
13. Place the end-float gauge LST-111 onto the pump housing and check that the axial play is between 0,2–0,4 mm (0.008 in to 0.016 in). If the end-float is excessive or tight, replace existing washer, situated at the rear of the intermediate plate, with suitable washer to give required end-float as stated above.

NOTE: If damage is apparent to the bolts they should be replaced.

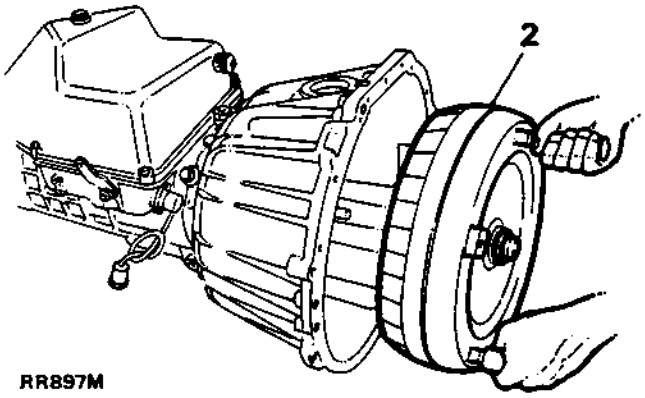
14. Refit the torque converter into the housing using torque converter handles 18G 1501, checking that the dimension from the converter fixing bolt boss to the converter housing face is 50 mm (1.96 in). If this dimension is achieved, the converter is properly seated in the housing.
15. Refit the gearbox/transfer box assembly as previously described.



RR891M

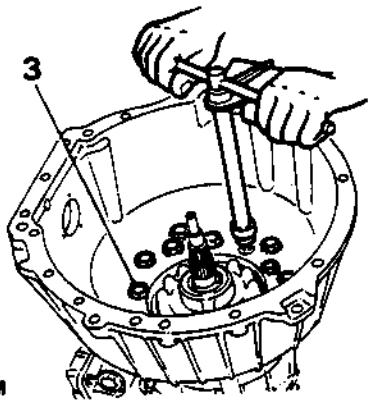
Replacing Intermediate Plate

1. Remove the gearbox/transfer box assembly as previously described.
2. Place the gearbox on the bench, and remove the torque converter using torque converter handles 18G1501, taking care not to damage the torque converter/oil pump housing oil seal.

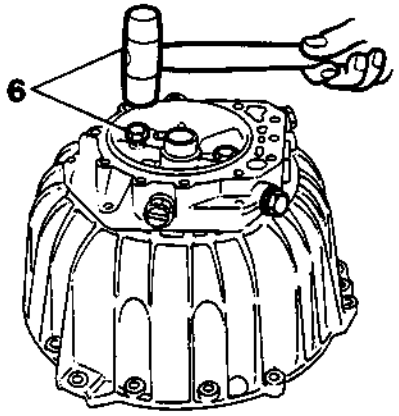


RR897M

3. Remove the twelve hexagonal bolts (inner ring pattern).
4. Remove bellhousing and pump assembly from gearbox case and discard the gasket.
5. Remove the eight hexagonal bolts on the rear of the pump.
6. Screw in two of the bolts, diagonally opposite each other, tap lightly using a soft headed mallet; this will free the pump assembly from the intermediate plate.

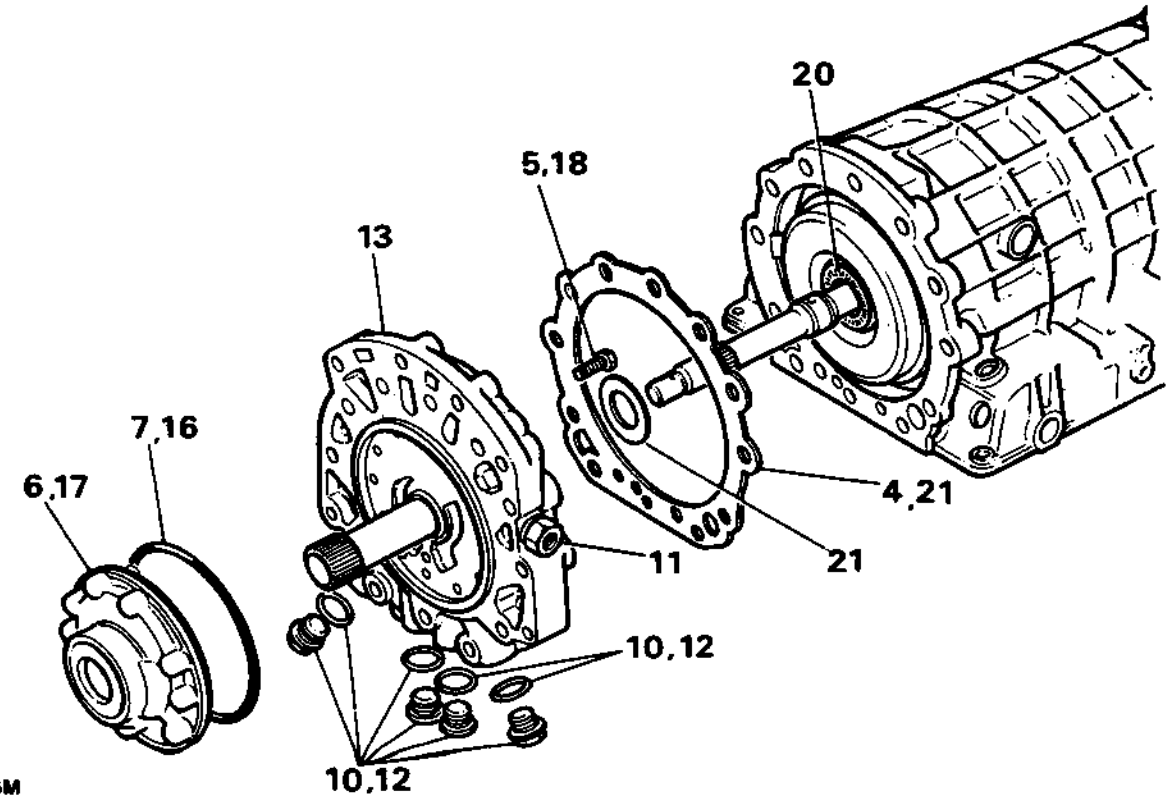


RR577M



RR578M

7. Remove the 'O' ring from the pump housing and discard.
8. Place the bellhousing and intermediate plate assembly on the bench, front side up.



RR876M

9. Remove the six remaining hexagon bolts and remove the bellhousing from the intermediate plate assembly.
10. Remove the four screw plugs and seal rings from the intermediate plate, discard the seal rings.
11. Remove the oil cooler pipe adaptors and fit them into the new intermediate plate.
12. Fit plugs and new seal rings into the new intermediate plate.
13. Fit intermediate plate assembly onto the bellhousing.
14. Secure with six hexagonal bolts (outer ring pattern) and tighten to the specified torque.
15. Place intermediate plate and bellhousing assembly on bench, front face up.
16. Fit the 'O' ring onto the circumference of the pump housing.
17. Align the dowel with its hole in the intermediate plate and press the pump housing home.
18. Secure the pump housing to the intermediate plate using the eight hexagonal bolts and tighten to the specified torque.
19. Place the bellhousing and intermediate plate assembly on the bench, front face up. Using the oil pump rotation sleeve LST111, check that the pump gears rotate freely.
20. Before replacing the intermediate plate and bellhousing assembly check that the thrust washer and axle cage are seated on the A clutch housing.
21. Place the gasket and disc washer onto the bellhousing and intermediate plate assembly using a light grease or vaseline.
22. Fit bellhousing and intermediate plate assembly onto gearcase and secure with the twelve hexagonal bolts tightened to the specified torque.
23. Place the end float gauge LST111 onto the pump housing and check that the axial play is between 0,2–0,4 mm. (0.008–0.016 in.). If end float is excessive or tight, replace existing washer, situated at the rear of the intermediate plate, with suitable washer to give required end float as stated above.
24. Refit the torque converter into the housing using torque converter handles 18G1501, checking that the dimension from the converter fixing bolt boss to the converter housing face is 50 mm (1.96 in.). If this dimension is achieved the converter is properly seated in the housing.
25. Refit the gearbox/transfer box assembly as previously described.

AUTOMATIC GEARBOX—OVERHAUL

Remove Torque Converter

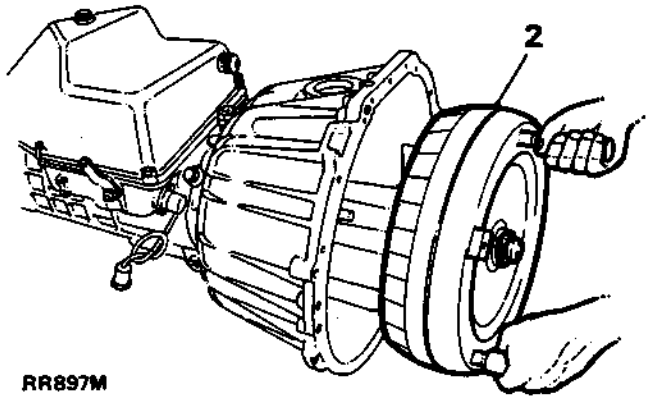
NOTE: Refer to Stage II Section for removal of the gearbox from the vehicle.

1. Place gearbox into transmission holding fixture LST118 and tighten.

   NOTE: Care must be taken not to over-tighten as casing will distort.

2. Using the torque converter handles 18G1501 remove the converter from the bell housing.

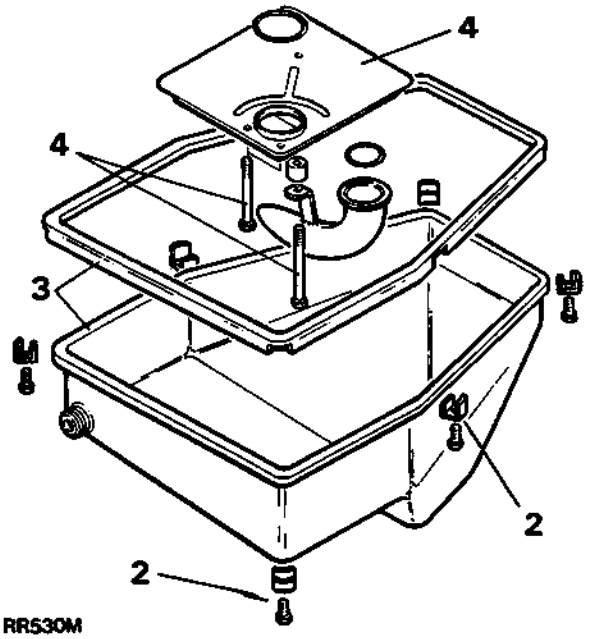
   CAUTION: Ensure no damage occurs to the pump bush and seal ring lip when removing the torque converter. The converter is still full of oil even after the gearbox has been drained, so care should be taken when removing the unit.



RR897M

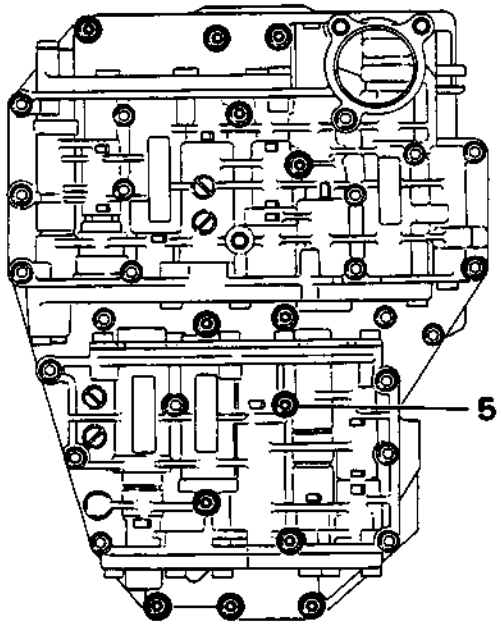
Remove Valve Body

1. Turn the gearbox upside down in the fixture.



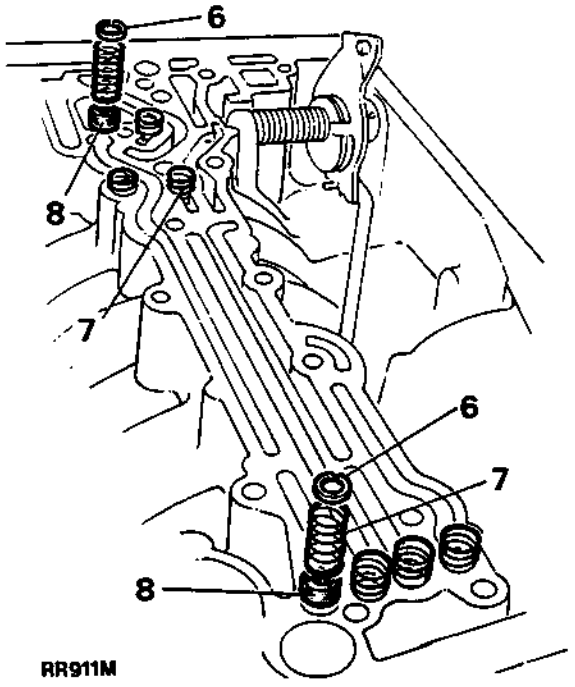
RR530M

2. Remove the six bolts and retaining plates which hold the oil pan.
3. Remove the oil pan and rubber seal and discard seal.
4. Using torx bit TX27, unscrew the three torx headed bolts which hold the oil screen and remove. Separate the oil screen from the suction tube and discard the two 'O' rings and oil screen.
5. Using torx bit TX27, unscrew the thirteen torx headed bolts which retain the valve block to the gearbox.



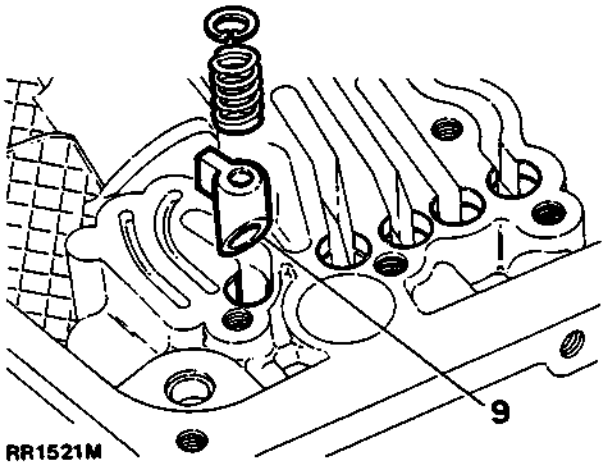
RR531M

6. Using circlip pliers remove the eight circlips.
7. Remove the eight springs (four short springs at the front of the gearbox and four long springs at the rear of the gearbox).



RR911M

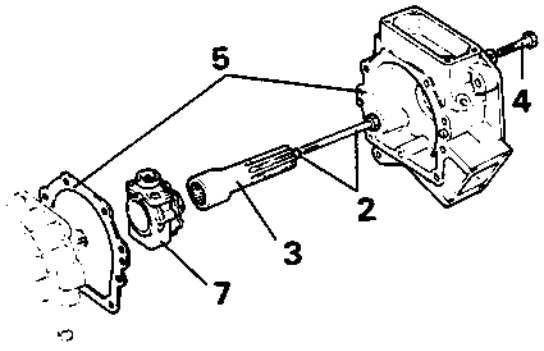
8. Remove the eight sealing rubbers using tool LST113 and discard.
9. Remove the circlip and spring, using tool LST113 remove the restrictor at the rear of the gearbox.



RR1521M

Remove Parking Pawl and Governor

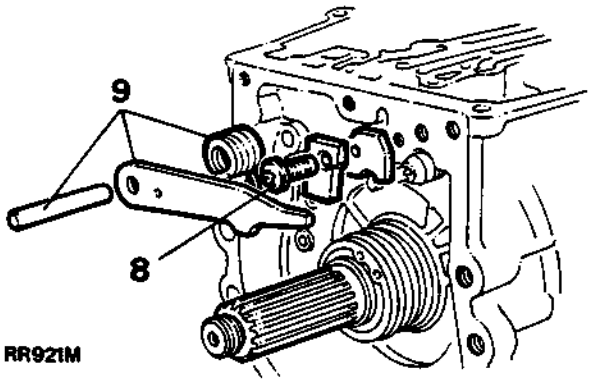
1. Engage 'Park' position.
2. Using a suitable spanner unscrew the coupling shaft bolt and remove the 'O' ring.
3. Remove the coupling shaft.
4. Remove the nine bolts and washers from the extension housing.
5. Remove the extension housing and gasket from the gearbox and discard the gasket.
6. Disengage 'Park' position.
7. Withdraw the parking wheel and governor hub.



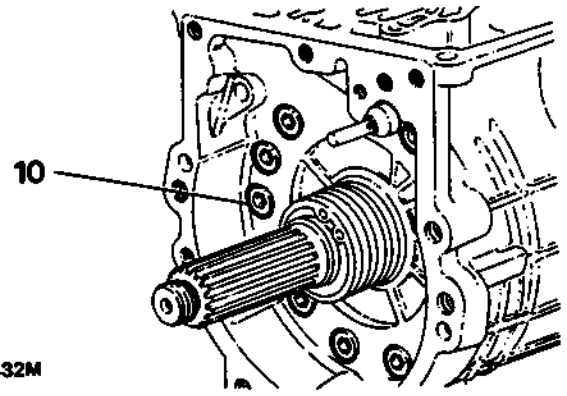
RR918M

8. Unscrew the bolt which retains the guide plate using torx bit TX27.
9. Disengage the spring and remove, also the pin and pawl.

NOTE: When pawl is removed the tension on the spring is reduced.

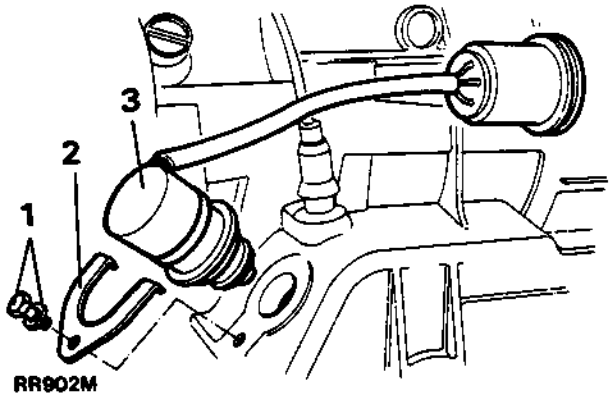


10. Using torx bit TX30 remove the ten torx bolts from rear of casing.



Remove Inhibitor Switch

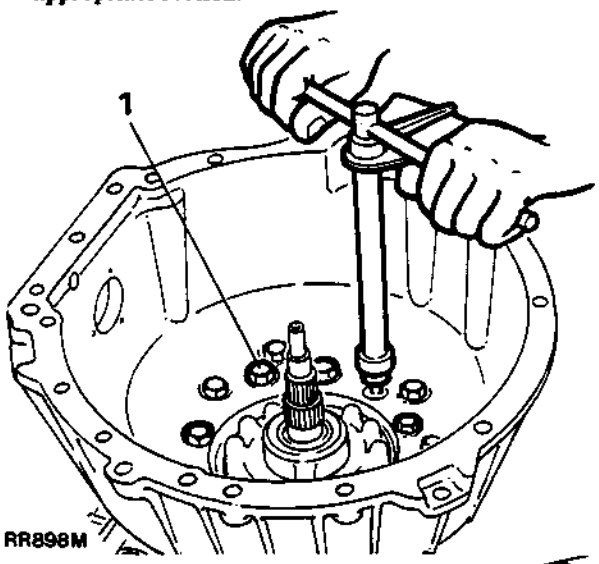
1. Using a suitable spanner remove the bolt and spring washer.
2. Remove the retaining plate.
3. Using a suitable tool remove the inhibitor switch from the casing.
4. Discard switch if damaged.

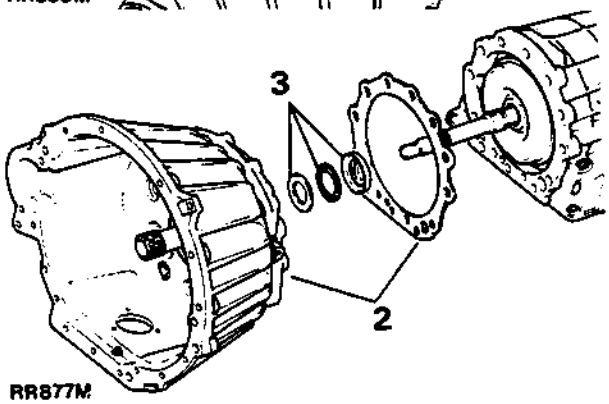


Remove Bell Housing and Intermediate Plate

1. Using a suitable socket spanner remove the twelve bolts (inside diameter bolt pattern) holding the bell housing.
2. Remove the bell housing and intermediate plate assembly complete, and discard the gasket.
3. Remove the thrust washer, axle bearing and disc washer from the input shaft.

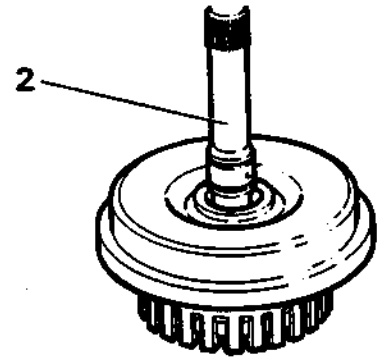
NOTE: Under normal working conditions there is no need to separate the bell housing from the intermediate plate assembly. If damage has occurred to either the bell housing or intermediate plate see appropriate section.

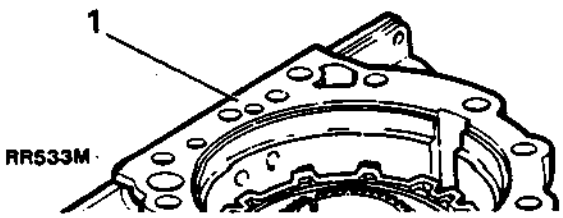




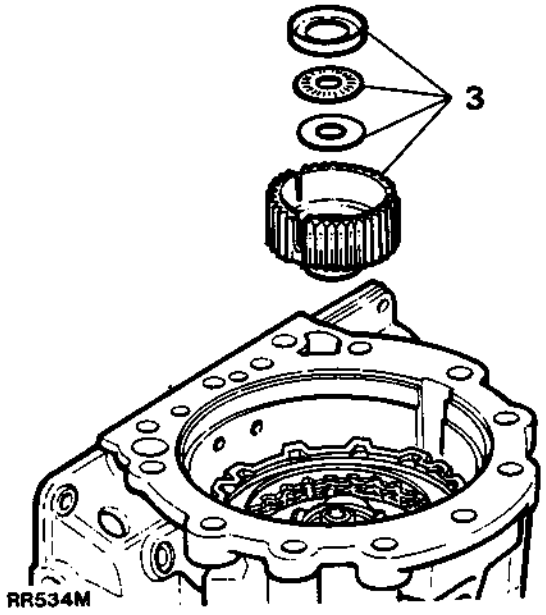
Remove A Clutch Assembly

1. Turn gearbox with front facing upwards.
2. Remove input shaft and A clutch assembly from gearbox.



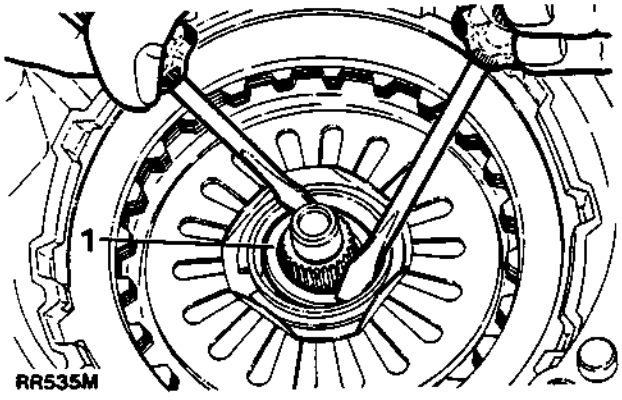


3. Remove inner carrier A, disc, axial bearing and thrust washer.



Remove B Clutch Assembly

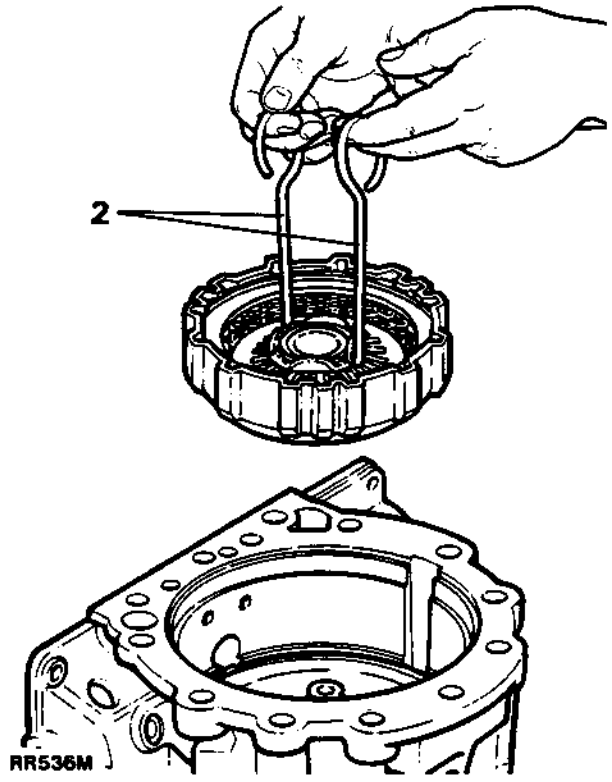
1. Using two suitable screwdrivers remove the small snap ring in cylinder B.



2. Using the B clutch assembly puller hooks LST115 remove the B clutch assembly.

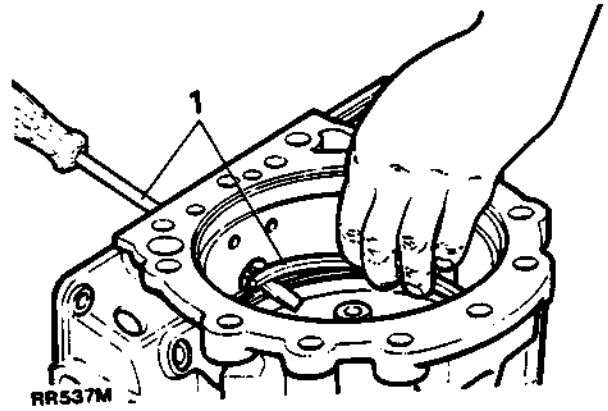
NOTE: To remove assembly, lift up cylinder B until it stops, push assembly back down and lift up again using more weight.

3. Remove support ring and 'O' ring.

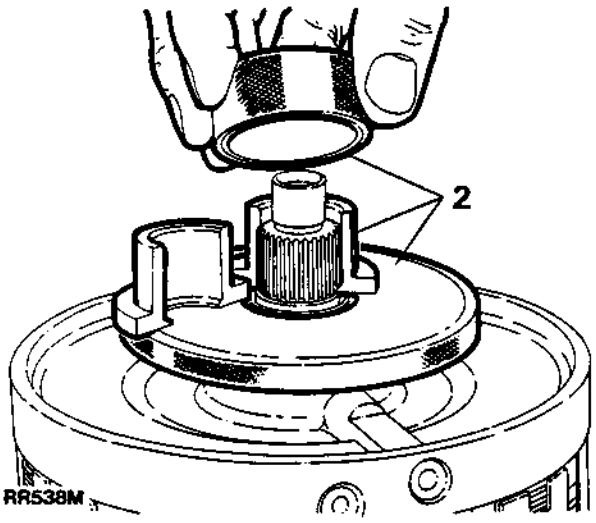


Remove C, C' and D Clutch Assembly

1. Using a suitable screwdriver remove centreplate snap ring via a hole in the casing.



2. Using tool LST117 attached to intermediate shaft remove C, C' and D clutch assembly.
3. Remove disc, axial bearing and thrust washer.



Remove 4th Gear Assembly

1. Turn gearbox to the horizontal position.
2. Push assembly out from the rear, guiding it from the front of the casing.

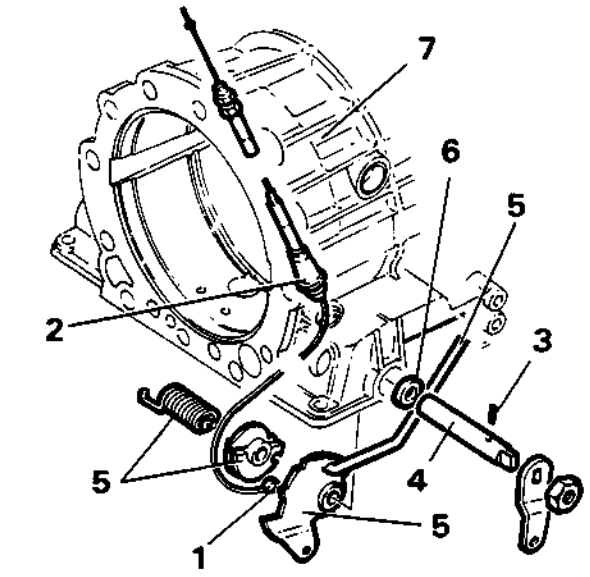
Transmission Gear Selector Assembly

Remove and overhaul

1. Remove the kickdown cable from the cam.
2. Using kickdown cable remover LST112, remove the kickdown cable from the casing.
3. Using a punch remove the roll pin from the selector shaft.
4. Using a pair of pliers or grips pull the selector shaft from the casing.
5. Remove the stop washer, connection rod, cam and leg spring.
6. Using a screwdriver prise out the seal ring located in the gearbox casing and discard.

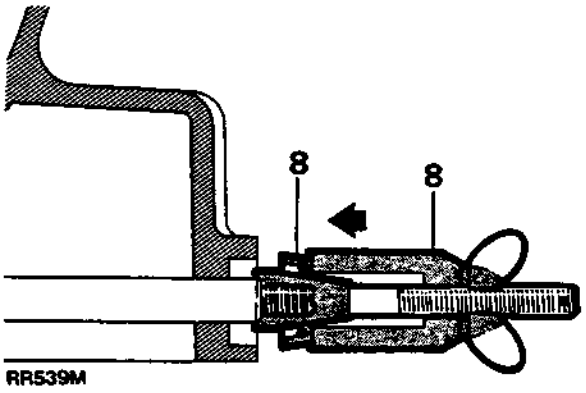
NOTE: At this stage the gearbox is totally stripped.

7. Inspect and clean casing ensuring no damage has occurred.

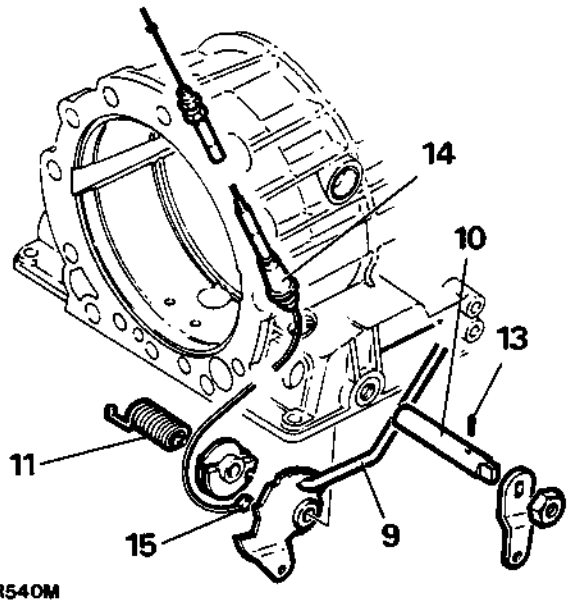


Assemble

8. Fit new seal ring into gearbox casing using selector shaft oil seal replacer LST114.



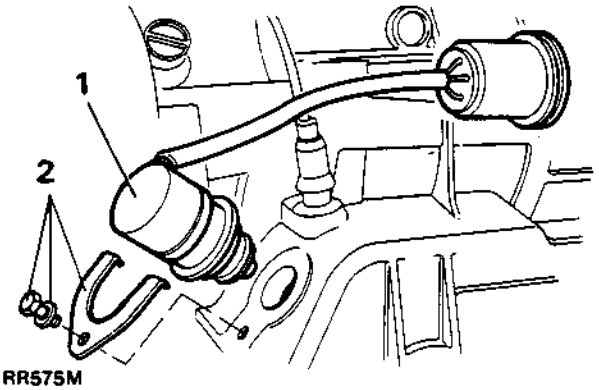
9. Fit connection rod into the stop washer.
10. Place stop washer with connection rod into the gearbox casing and then feed the selector shaft into the casing.
11. Fit the leg spring onto the cam.
12. Place the assembly into the gearbox casing and push the selector shaft through until the hole in the shaft aligns with the hole in the stop washer.
13. Using a suitable punch, fit roll pin with the open side facing the rear of the gearbox casing.
14. Fit new kickdown cable assembly into its seat on the gearbox casing.
15. Fit the nipple of the kickdown cable into the cam seat ensuring the cam has been turned once to load the spring.



RR540M

Fit inhibitor switch

1. Fit new inhibitor switch if existing one was damaged.
2. Replace retaining plate and fix with spring washer and bolt.



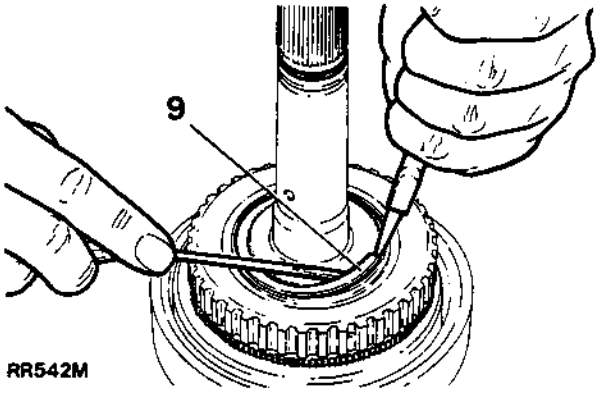
RR575M

4th Gear Assembly Overhaul

1. Using soft-jawed vice secure the 4th gear assembly by gripping the output shaft.
2. Remove the sungear.
3. Remove the planet gear assembly.

NOTE: Removal of snap-ring on assembly is not necessary unless damage has occurred.

4. Remove the disc washer, axial bearing and thrust washer.
5. Remove assembly from the vice and turn upside down onto the bench.
6. Remove cylinder F from cylinder E.
7. Remove cylinder E from the freewheel 3rd.
8. Remove axial disc, cage and two thrust washers.
9. Using pliers and screwdriver remove the snap-ring on carrier E.



RR542M

10. Turn the assembly around and remove the output shaft from ring gear by pushing the gear downwards.

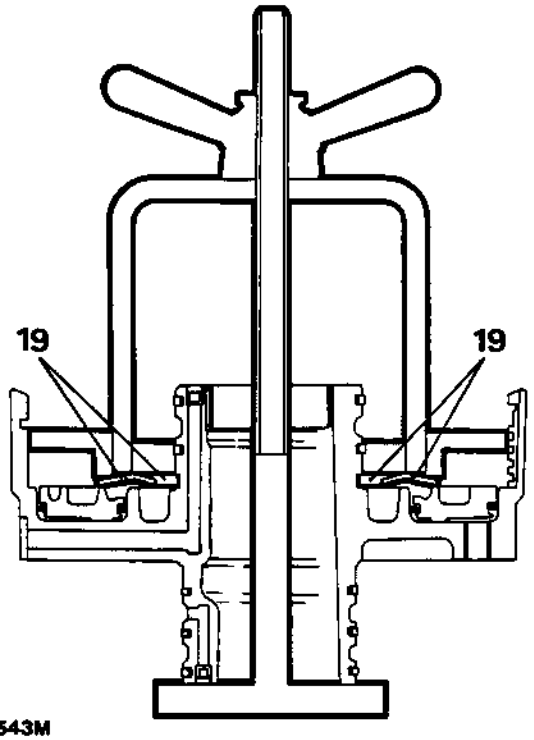
NOTE: Do not remove the snap-ring on output shaft.

11. Place ring gear on bench, teeth side down.
12. Remove carrier E from the ring gear assembly.
13. Remove the freewheel cage assembly from the ring gear by using an upward turning motion.
14. Remove the snap-ring retaining the freewheel ring (inner) to the hollow gear.
15. Remove the freewheel ring (inner) from the hollow gear.
16. Remove freewheel cage from freewheel ring (outer).

NOTE: Care should be taken when removing the freewheel ring, which due to the rollers and springs becoming loose may fall out.

17. Remove the snap-ring retaining the clutch plates and steel plates in cylinder F.
18. Remove four clutch plates and five steel plates from cylinder F.

19. Using clutch spring compressor LST1016-1, press down on the spring plate and remove the split rings.
20. Remove the spring plate.
21. Turn the cylinder upside down, using two small punches placed in the holes (diametrically opposite each other), push down and remove the piston.
22. Remove and discard the two 'O' rings from the piston.



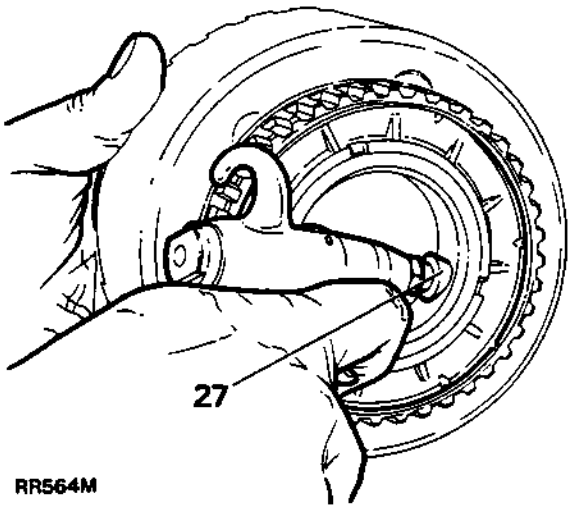
RR543M

NOTE: The five sealing rings do not need to be removed on the cylinder unless any damage has occurred to them.

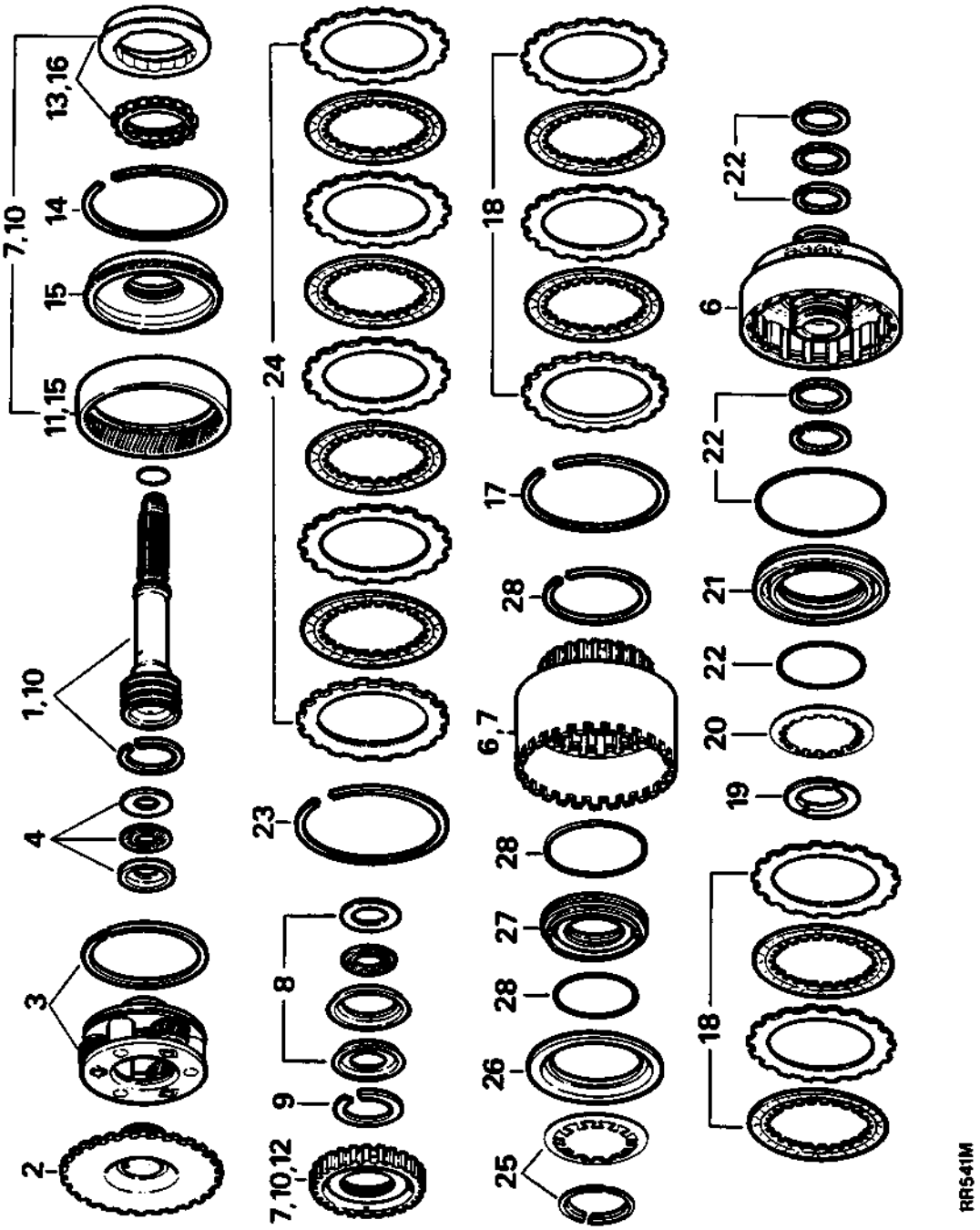
23. Remove the snap ring from cylinder E.
24. Remove the four clutch plates and five steel plates from cylinder E.
25. Using clutch spring compressor LST1016-1, press down on the spring plate and remove the split rings.
26. Remove the pressure plate.
27. Remove piston E by using air pressure directed into the oil feed hole.
28. Remove and discard the two 'O' rings from the piston.

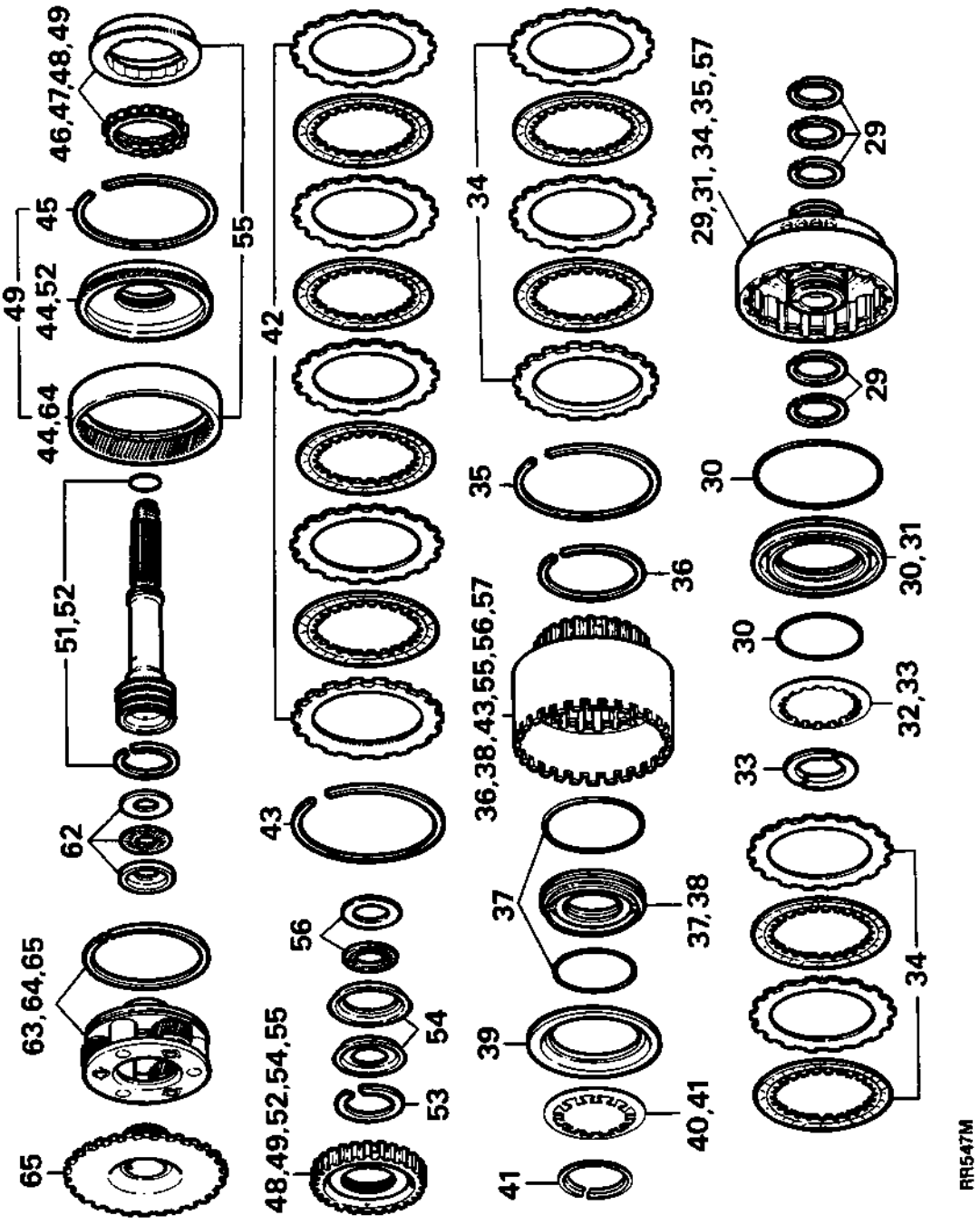
WARNING: Care should be taken using air pressure when removing the piston.

NOTE: Do not remove the snap-ring at the bottom of the E cylinder, unless damaged.



RR564M


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RR541M


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RR547M

Assemble

29. Fit three seal rings on the outside hub and two seal rings on inside hub of cylinder F if they have been removed.

    NOTE: Ensure each seal ring is snapped together.

30. Fit new 'O' rings onto the F piston.

    NOTE: For ease of assembly apply petroleum jelly on 'O' rings and stretch the inner 'O' ring to avoid damage on installation.

31. Fit piston F into cylinder F.
32. Fit spring plate using clutch spring compressor LST1016-1.
33. Fit the two halves of the split ring to secure the spring plate in position, then remove the clutch spring compressor.
34. Install the clutch plates and steel plates into the F cylinder starting with a steel plate then clutch plate finishing up with the end plate which is thicker than the normal steel plates.
35. Fit the snap-ring into cylinder F to retain the clutch plate assembly.

    NOTE: Do not confuse the steel plates of F clutch with that of the E clutch. The differences are thus:
    F clutch—steel plates are thicker and the end plate has no inner teeth.

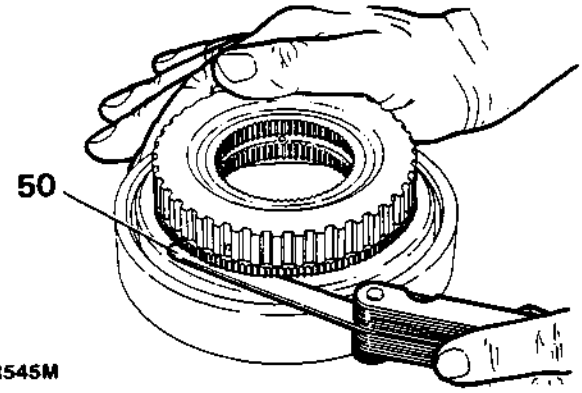
36. Fit new snap-ring at bottom of cylinder E if it has been removed.
37. Fit the two 'O' rings onto the E piston.

    NOTE: For ease of assembly apply petroleum jelly.

38. Fit E piston into cylinder E.
39. Fit the pressure plate with 'depression' facing downwards.
40. Fit spring plate using clutch spring compressor LST1016-1.
41. Fit the two halves of the split ring to secure the spring plate in position then remove the clutch spring compressor.
42. Install the clutch plates and steel plates, starting with a steel plate then clutch plate, finishing up with the end plate which is thicker than the normal steel plates.
43. Fit the snap-ring into cylinder E to retain the clutch plate assembly.

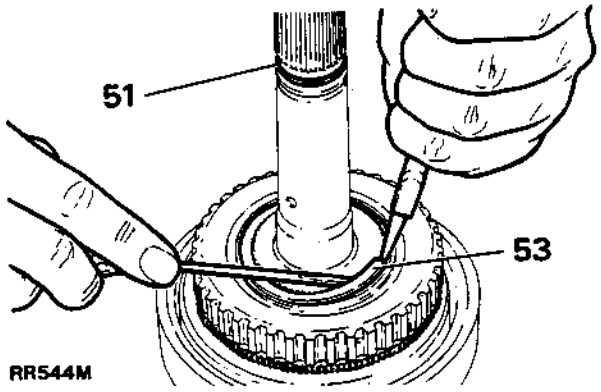
    NOTE: Do not confuse the steel plates of E clutch with that of the F clutch. The differences are thus:
    E clutch—steel plates are thinner and the end plate has inner teeth.

44. Fit the freewheel ring (inner) to the hollow gear.
45. Secure using the snap-ring.
46. Fit freewheel cage into the freewheel ring (outer), and press home.
47. Turn the freewheel cage in the freewheel ring (outer) until rim of the cage has been seated.
48. Fit carrier E to freewheel cage assembly.
49. Fit freewheel cage assembly to ring gear assembly using a clockwise motion.
50. A minimum clearance of 0,1 mm (0.0039 in) should be obtained between the freewheel cage assembly and ring gear.



RR545M

51. Inspect the output shaft for damage to the snap-ring, if any, replace snap-ring; also remove 'O' ring and discard, replace with new 'O' ring.
52. Align inner teeth of carrier E with freewheel ring (inner) teeth and then place freewheel 3rd assembly onto the output shaft.
53. Secure snap-ring into position, retaining the freewheel 3rd.



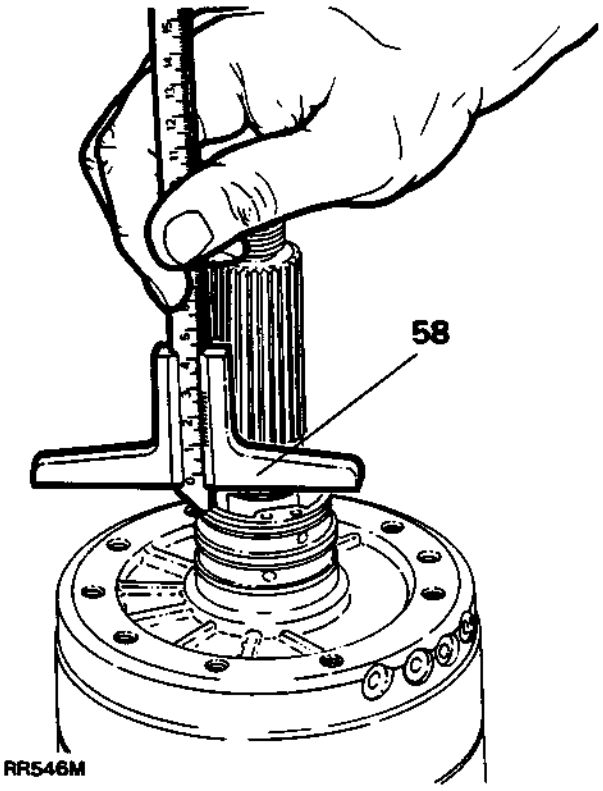
RR544M

54. Fit the steel thrust washer and then the copper thrust washer onto the freewheel 3rd assembly.
55. Fit cylinder E onto freewheel 3rd assembly using a turning motion, ensuring that the teeth of the end plate line up with the freewheel ring (outer).

    NOTE: When correctly assembled, copper thrust washer must be touching cylinder E assembly.
    The cylinder E assembly will turn in a clockwise direction when holding the output shaft. If the cylinder E assembly is turned in a counter clockwise direction the freewheel will lock up.

56. Fit the axial cage and axial disc onto the rear of cylinder E.
57. Using a turning motion, fit cylinder F assembly onto cylinder E assembly.
58. When correctly mounted the raised edge of the output shaft will be 10,00 mm (0.393 in) above the top surface of cylinder F assembly.

NOTE: Disengagement of end plate and freewheel ring (inner) will occur if end play exceeds 3,00 mm (0.118 in).



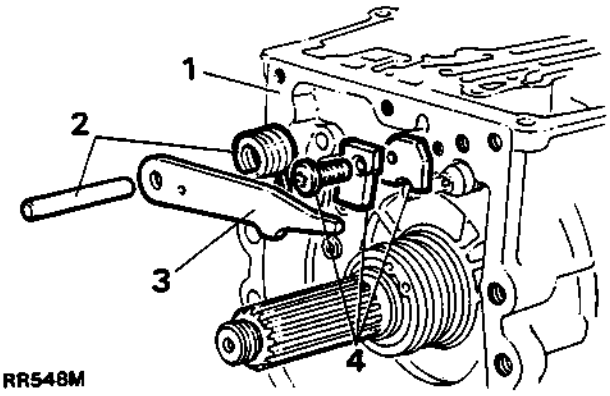
59. Fit the complete 4th gear assembly into the gearbox, ensuring that the oil feed holes in cylinder F line up with the corresponding holes in the gearbox casing.
60. Secure the 4th gear assembly to the gearbox using ten countersunk screws. Tighten screws to the specified torque using torx bit TX30.

NOTE: If screws are not tightened correctly, clutch pressure will be lost in clutch F.

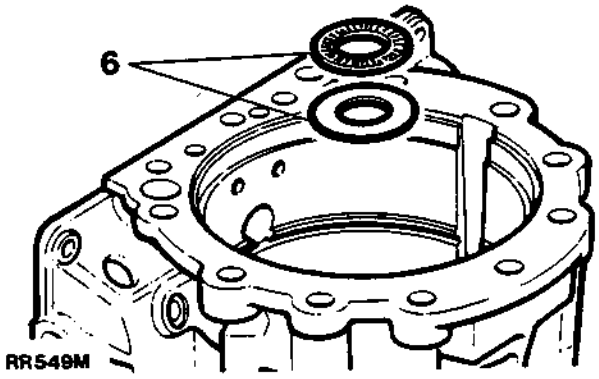
61. Turn the gearbox so that the front of the case is uppermost.
62. Fit the disc washer, axial cage and thrust washer onto the 4th gear assembly.
63. Fit the seal ring onto the planetary case and snap together if ring has been removed.
64. Fit the planetary set into the hollow gear using a turning motion.
65. Fit the sun gear onto the planetary set.

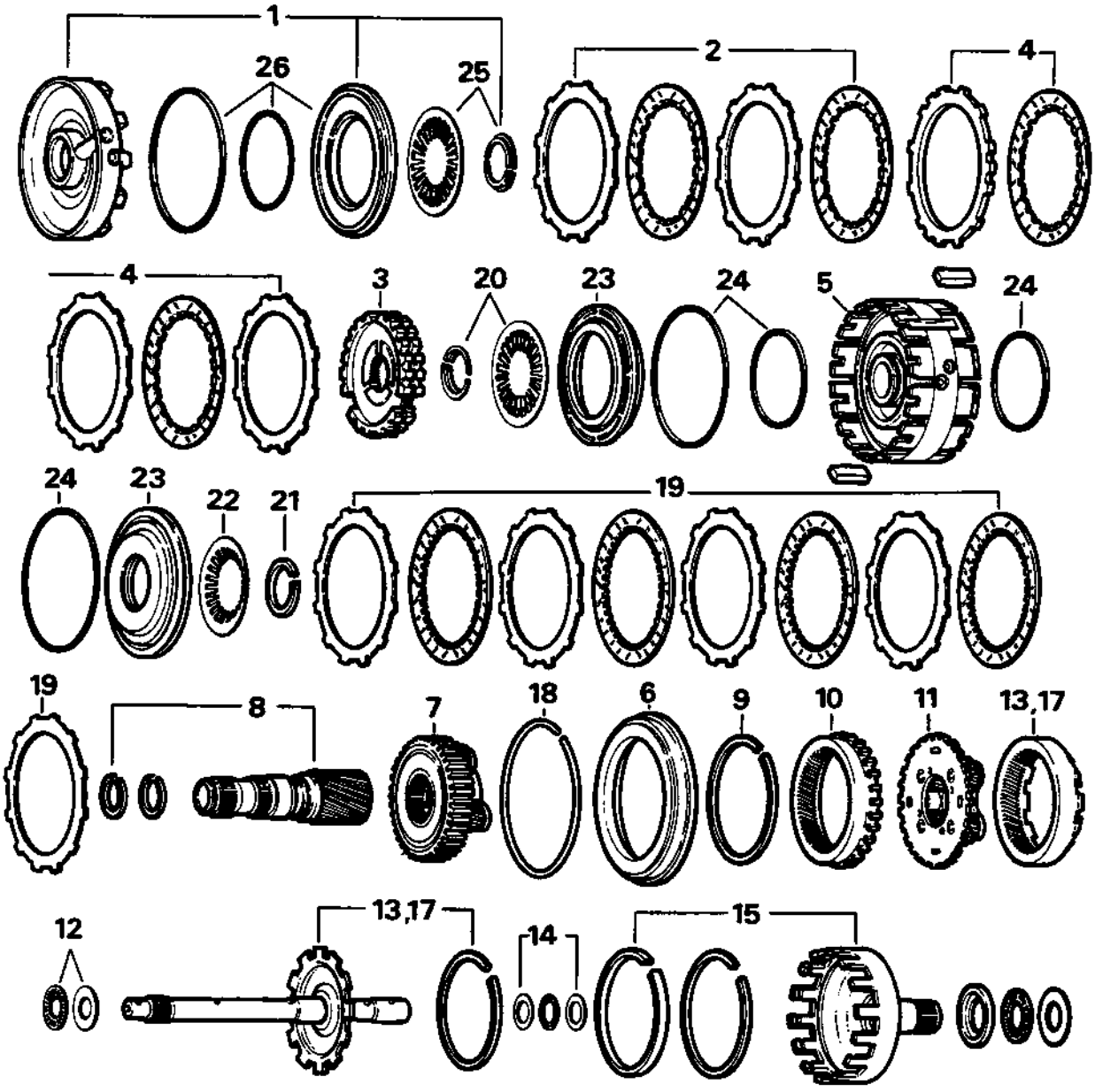
Refit park mechanism

1. Turn gearbox into a horizontal position.
2. Fit leg spring over pin and place into rear of gearbox.
3. Fit pawl onto pin, to tension spring fit leg of spring into hole of pawl.
4. Fit plate and guide plate and tighten to specified torque using torx bit TX27.



5. Turn gearbox so that the front of the case is uppermost.
6. Fit the disc and axial cage.





RR550M

Brakes C, C' and D with planetary sets—overhaul

1. Remove the centre plate assembly.
2. Remove the two brake C' clutches and two steel plates from cylinder C–D.
3. Remove freewheel 2nd complete.
4. Remove the two brake C' clutches and three steel plates from cylinder C–D.
5. Remove the cylinder C–D with brake D assembly.
6. Remove the support ring from the planetary sets assembly.
7. Remove the front planetary set with freewheel assembly.
8. Remove the sunshaft from the assembly.

NOTE: Do not remove the seal ring unless damaged from the sunshaft.

9. Remove the snap-ring from the hollow gear.
10. Remove the hollow gear from the assembly.
11. Remove the rear planetary set.
12. Remove the thrust washer and axial bearing.
13. Remove the intermediate shaft with the hollow gear complete.
14. Remove the axial bearing and two thrust washers, one from each side of the bearing.
15. Remove the distance ring.

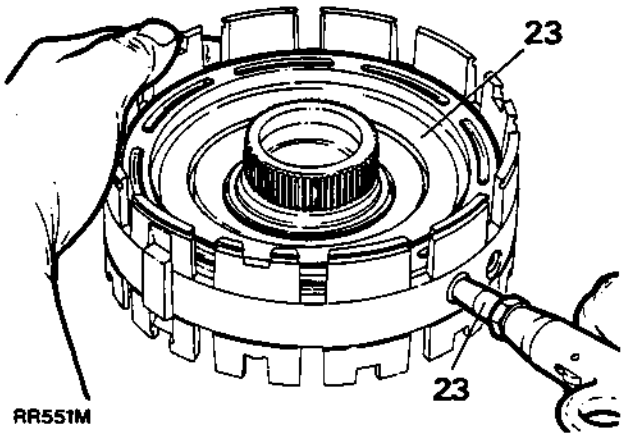
NOTE: The snap-ring in the webshaft need only be removed if damaged.

16. Holding the hollow gear with the rear face uppermost, remove the snap-ring.
17. Disconnect the hollow gear from the intermediate shaft.

18. Remove the external snap-ring from the brake D assembly.
19. Remove the four clutch plates and five steel plates from the assembly.
20. Using clutch spring compressor LST1016-1 press down on the spring plate to remove the split rings.
21. Turn cylinder C–D upside down and using the clutch spring compressor, remove the snap-ring with pliers.
22. Remove the spring plate.
23. For ease of removal of both piston C and piston D, use air pressure fed through the oil feed holes.

WARNING: Care should be taken using air pressure when removing the pistons.

24. Discard 'O' rings from both piston assemblies.
25. Using the clutch spring compressor remove the spring plate, as previously explained, from the centre plate assembly.
26. To remove the piston use air pressure as previously described and discard 'O' rings.



RR551M

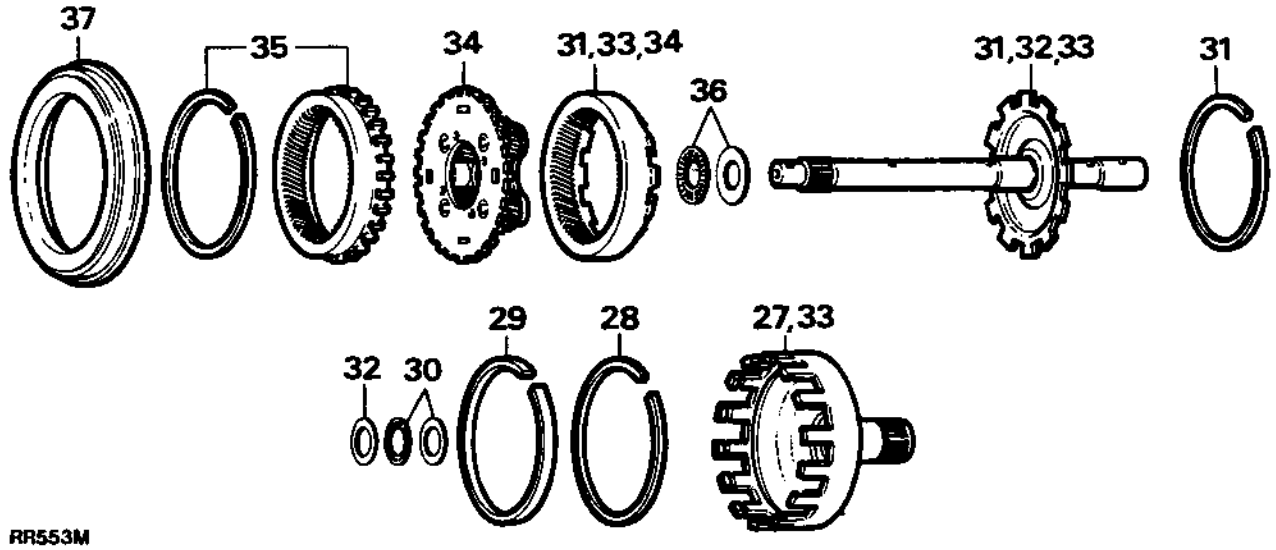
Assemble

27. Secure the webshaft into a soft-jawed vice.
28. Fit the snap-ring if it has been removed into the lower groove.
29. Fit the distance ring into the webshaft.
30. Place a disc washer and axial cage into the assembly.
31. Assemble together the hollow gear with the intermediate shaft and secure with the snap-ring.
32. Place the other disc washer onto the rear of the intermediate shaft using grease.
33. Fit the intermediate shaft assembly into the webshaft ensuring the disc washer mates up to the axial cage.
34. Using a turning motion fit the rear planetary set into the hollow gear.
35. Fit the front hollow gear into the webshaft assembly and secure with a snap-ring.
36. Insert disc washer and axial cage.
37. Place support ring onto the webshaft assembly.
38. Tap the two fitting pegs down into the slots on the side of the cylinder C–D if they have been removed.
39. Place the two 'O' rings onto piston D.

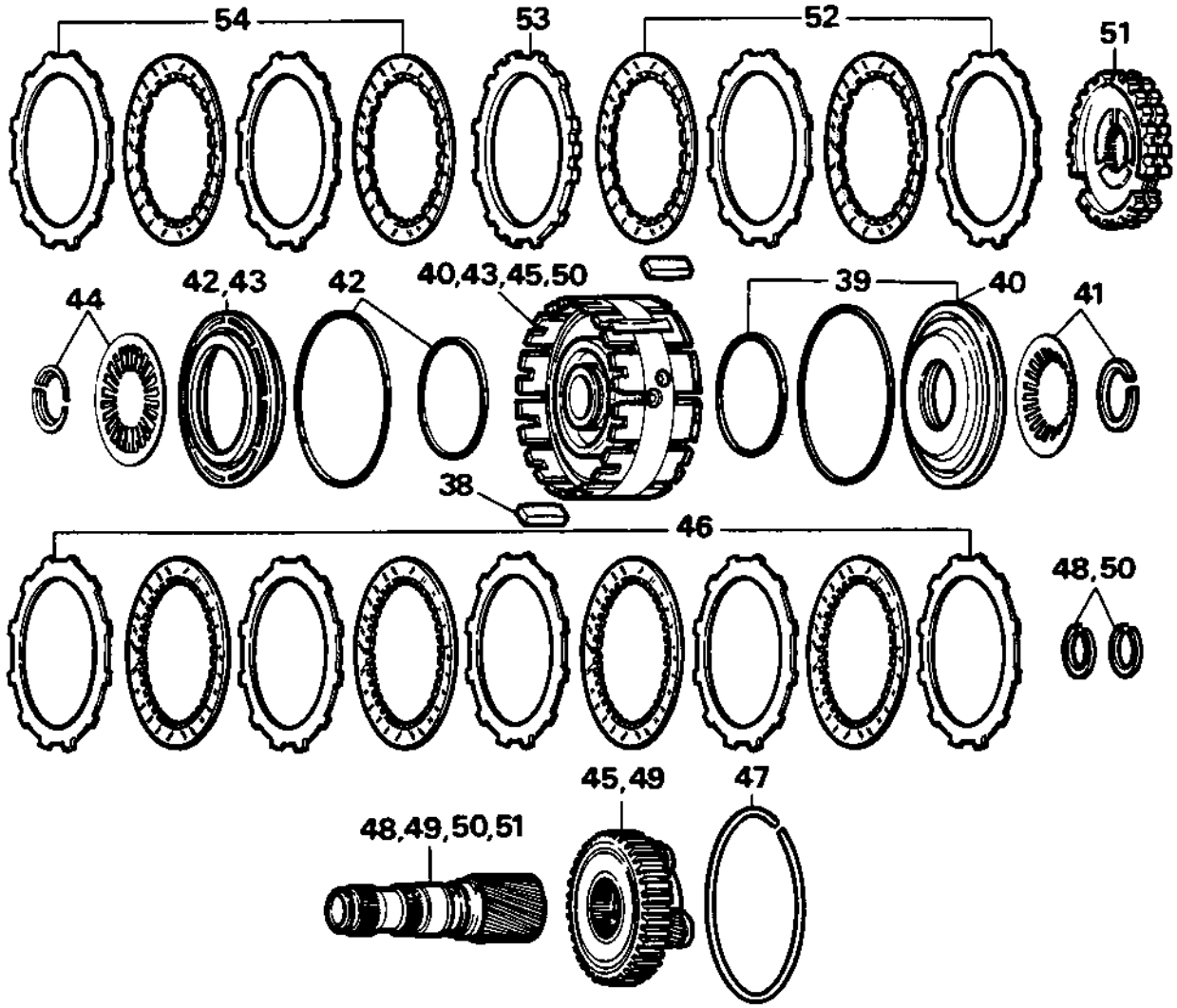
NOTE: For ease of assembly, apply petroleum jelly to the 'O' rings.

40. Fit the D piston into cylinder C–D ensuring that the correct side is selected, that is, the side with the least number of slots in cylinder C–D.
41. Fit the spring plate and using the clutch spring compressor LST1016-1, fit the snap-ring into the groove.
42. Place the two 'O' rings onto piston C.

NOTE: For ease of assembly, apply petroleum jelly to the 'O' rings.



RR553M



RR552M

43. Fit the C piston into cylinder C–D.
44. Using the clutch spring compressor LST1016-1, fit the spring plate and the two halves of the split rings.
45. With the clutch D aperture uppermost, fit the planetary set with freewheel 1st gear onto the hub of cylinder C–D.
46. Fit the clutch plates and steel plates starting with a steel plate then a clutch plate, finishing up with the thin end plate.
47. Fit the snap-ring on the outside of the C–D cylinder which secures the D clutch assembly.
48. Fit two seal rings onto the sunshaft and snap together if they have been removed.
49. Fit the sunshaft into the planetary set, splines first.
50. Turning the whole assembly around so the C clutch side is uppermost, fit the assembly into the webshaft assembly.
51. Fit freewheel second onto the sunshaft, before fitting align the upper and lower halves.

NOTE: To ensure correct fitment of the freewheel second, the top of the assembly is marked with the word 'open'.

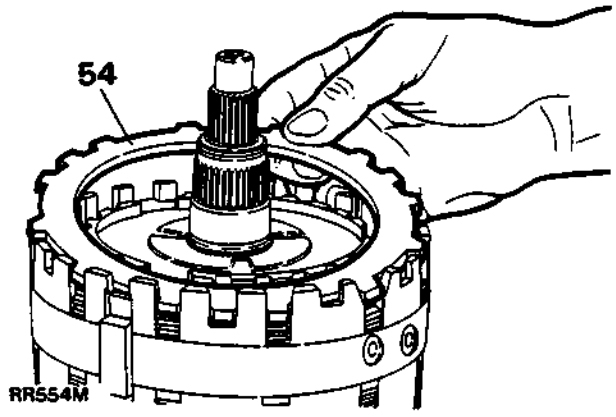
52. Fit the C clutch plates and steel plates starting with a steel plate then a clutch plate into the longer slots of C–D cylinder.
53. Fit end plate which has three groups of three teeth, of which the middle tooth must fit into the short slots in the C–D cylinder.
54. Fit the C' clutch assembly starting with a clutch plate ending with a steel plate.

NOTE: When fitting these plates ensure teeth on the outside do not go into the 'V' shaped area of the C–D cylinder.

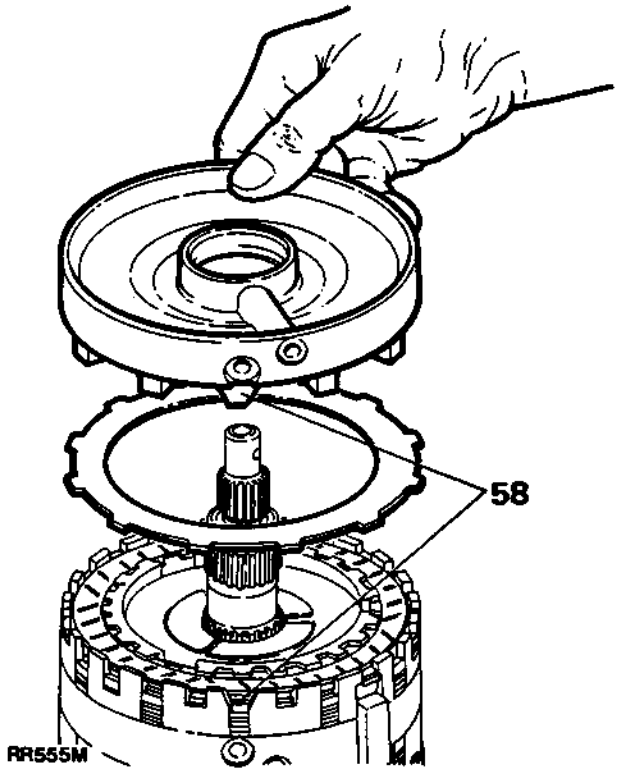
If thin steel plates have to be added into the C or C' clutch assembly ensure that these plates are placed on the side nearer to the respective pistons.

55. Fit the two 'O' rings onto the piston C'.

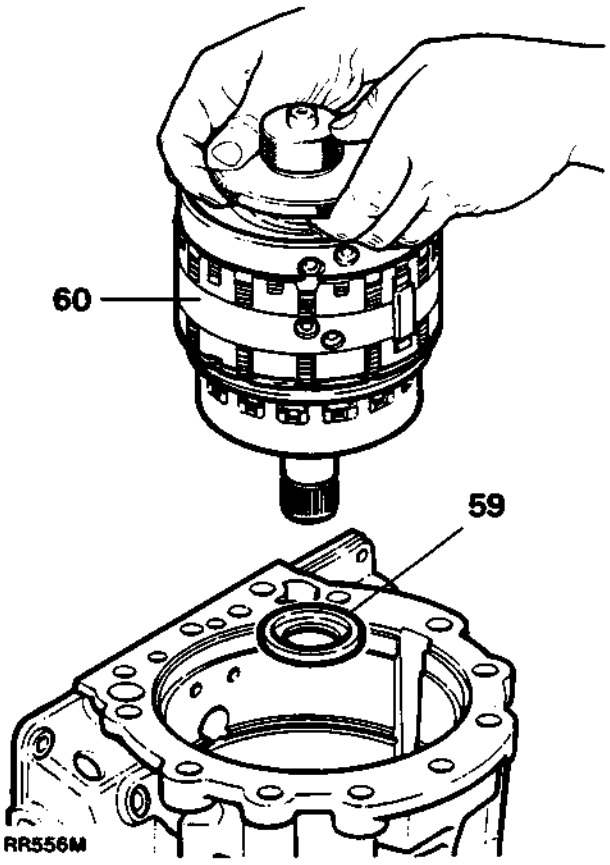
NOTE: For ease of assembly use a petroleum jelly.



56. Fit C' piston assembly into centre plate.
57. Using clutch spring compressor LST1016-1, fit spring plate and the two halves of the split rings.
58. Place the centre plate onto the C–D cylinder making sure that the 'V' shaped tag on the centre plate fits the 'V' shaped hollow in the C–D cylinder.



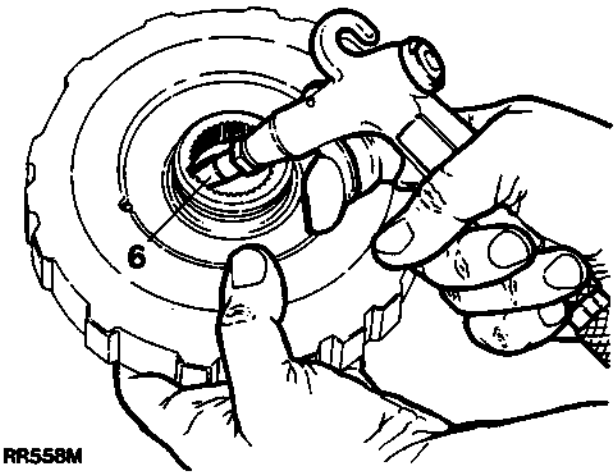
59. Remove the C, C' and D clutch assembly from vice and place a greased thrust washer rear face of the webshaft.
60. Fit the whole assembly into the transmission case using the gear train remover/replacer LST117, ensuring that the oil feed holes are aligned with those in the bottom of the casing.
61. Secure the whole assembly with a snap-ring which fits into the groove inside the casing.

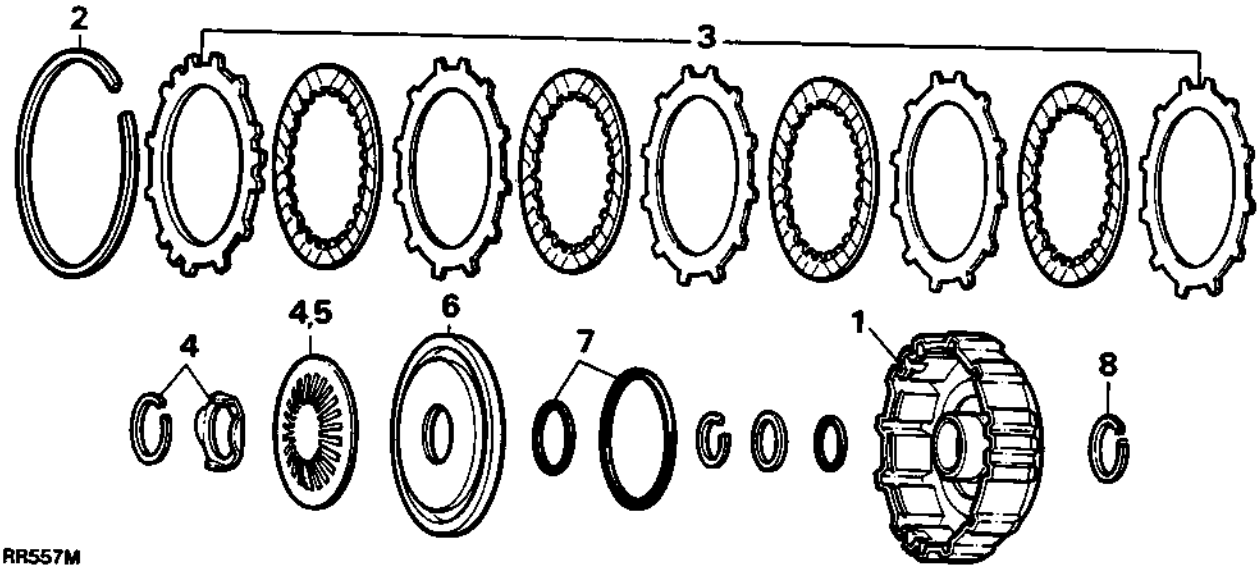


Clutch B overhaul

1. Place B clutch assembly with open face upwards.
2. Remove the snap-ring from inside the assembly.
3. Remove the four clutch plates and five steel plates.
4. Using clutch spring compressor LST1016-1, depress spring plate and remove snap-ring and retaining washer.
5. Remove the spring plate.
6. For ease of removal of the piston B, use air pressure fed through the oil feed hole, then turn assembly upside down and tap lightly on the working surface.

WARNING: Care should be taken using air pressure when removing the piston.





RR557M

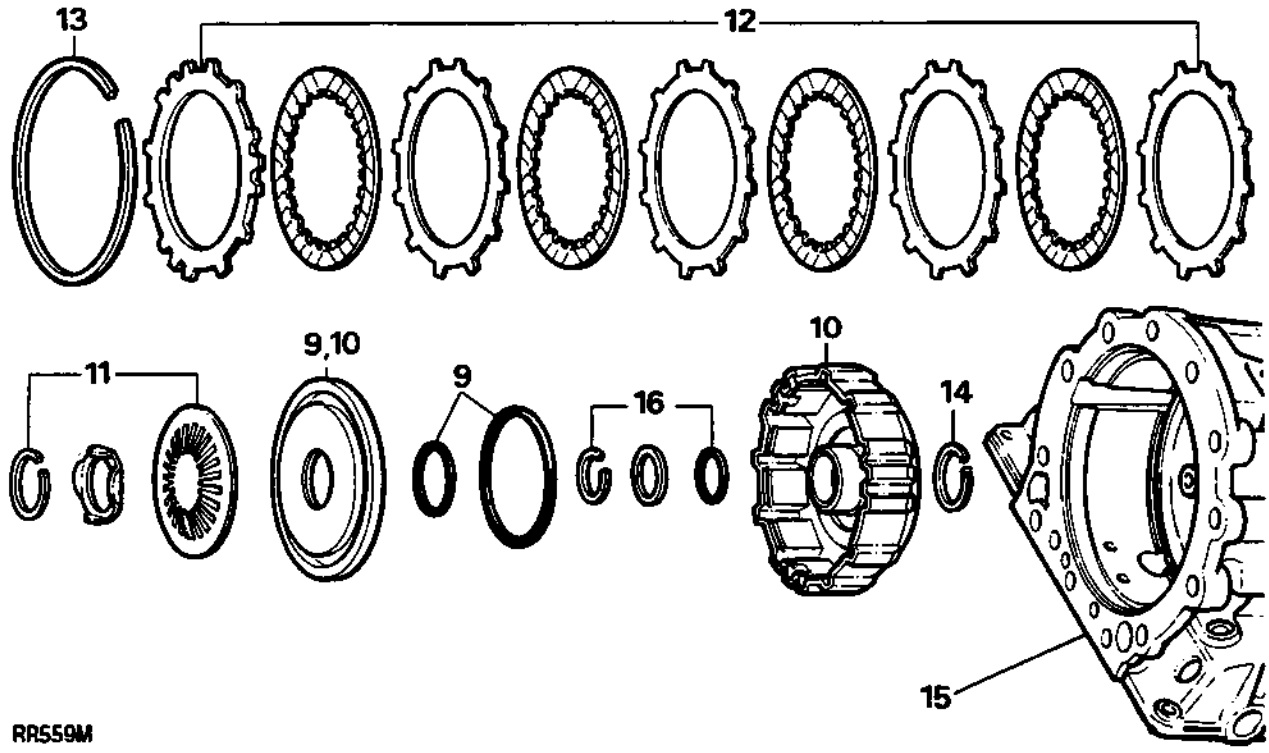
7. Remove and discard the two 'O' rings on piston B.
8. Remove seal ring on bottom of B cylinder if damage has occurred.

Assemble

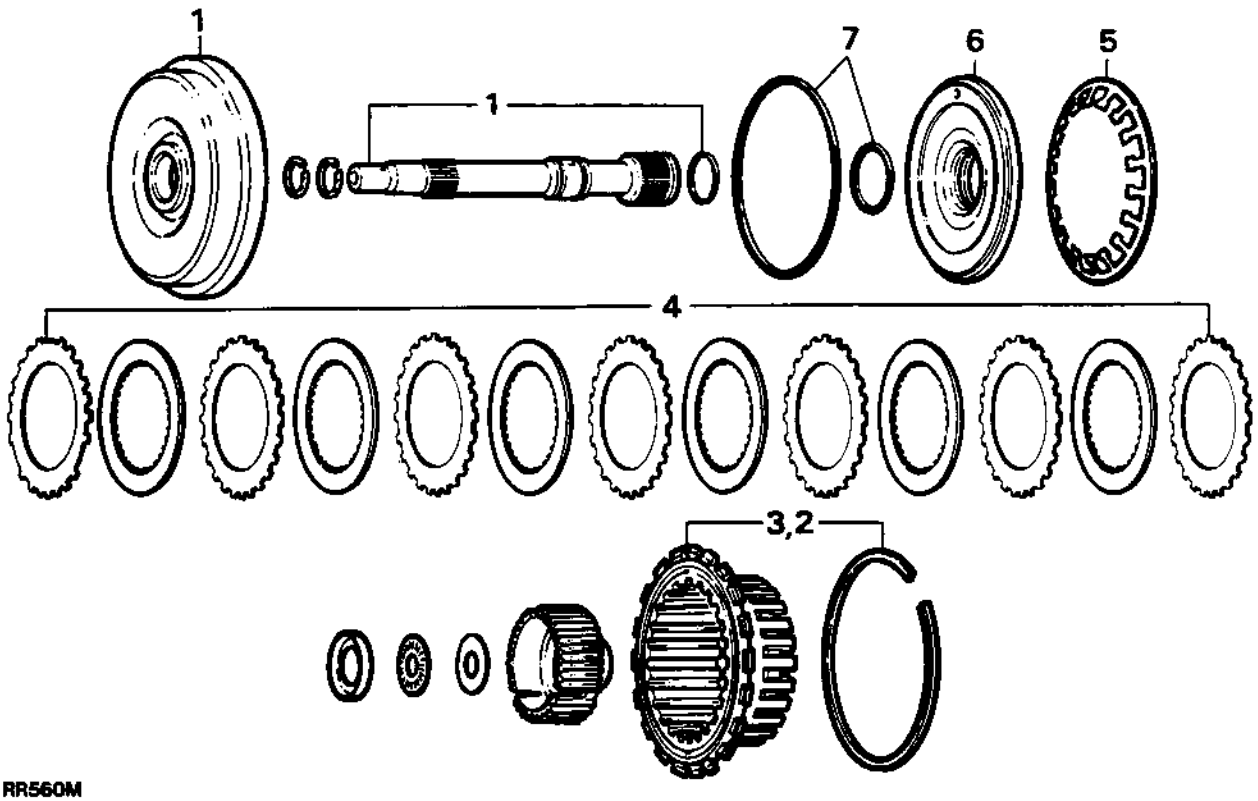
9. Fit the two 'O' rings onto piston B.

   NOTE: For ease of assembly use a petroleum jelly.

10. Install piston B into cylinder B.
11. Place spring plate into cylinder B and using clutch spring compressor LST1016-1, fit retaining washer (lips facing upward) and snap-ring.
12. Fit the clutch and steel plates starting with a steel plate finishing with the steel plate with three sets of three teeth grouped together.
13. Fit snap-ring into the clutch B assembly.
14. Turn upside down and fit seal ring and snap together if removed.
15. Install B clutch assembly into the transmission case, clutch plates facing upwards.
16. Using B clutch 'O' ring and snap-ring replacer LST116, fit 'O' ring, support ring and finally the snap-ring.



RR559M



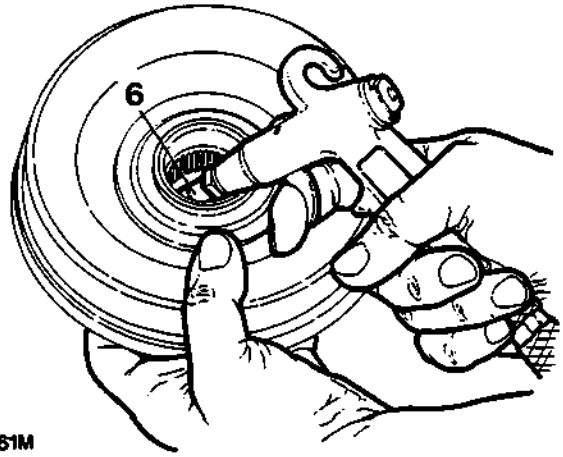
RR560M

A clutch assembly overhaul

1. Remove the input shaft by holding the A clutch assembly firmly and pushing the shaft against the working surface. Remove the 'O' ring and discard.
2. Using a suitable press, depress the A–B carrier and remove the snap-ring.
3. Remove carrier A–B.
4. Remove the six clutch plates and seven steel plates.
5. Remove spring plate.
6. For ease of removal of piston A, use air pressure fed through the oil feed hole.

   WARNING: Care should be taken using air pressure when removing the piston.

7. Remove and discard both 'O' rings on piston A.



RR561M

Assemble

8. Fit the two 'O' rings onto piston A.
9. Place the piston into cylinder A.
10. Fit the spring plate into the cylinder A with the convex side facing the piston.
11. Placing carrier A–B on the bench fit the clutch and steel plates starting with a steel plate and then a clutch plate, finishing with a steel plate.
12. Fit carrier A–B with the clutch assembly onto cylinder A.
13. Using a suitable press, depress the A–B carrier and secure with the snap-ring.
14. Fit the two seal rings, if removed, and an 'O' ring onto the input shaft.
15. Fit the input shaft into the cylinder A assembly and press downwards until shaft meets the stop.
16. Fit the thrust washer onto the input shaft seat.

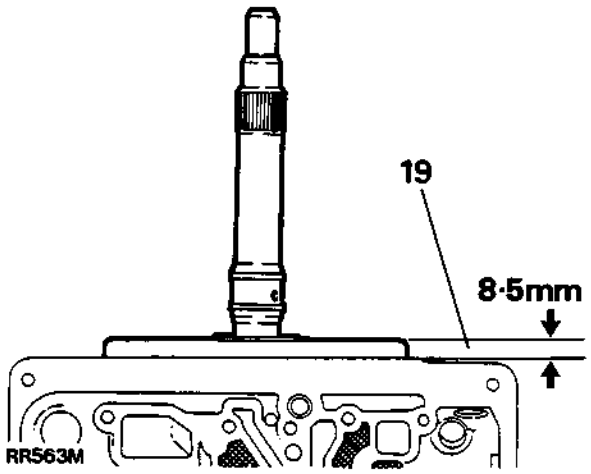
    NOTE: Use petroleum jelly to retain washer in place.

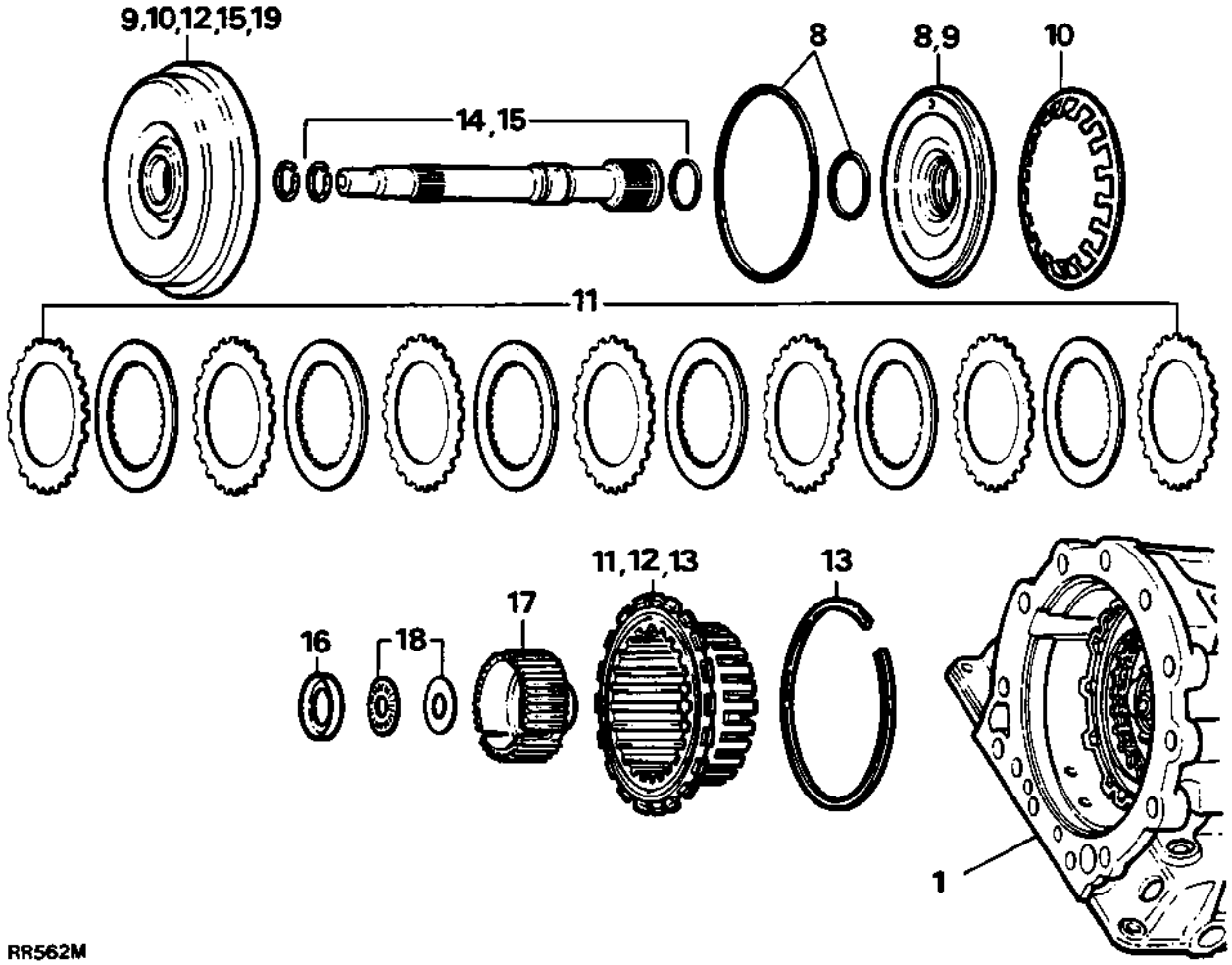
17. Install the inner carrier A onto the intermediate shaft within the gearbox.
18. Place the disc washer and axial cage into the inner carrier A.

19. Fit cylinder A assembly into the gearbox using a right to left twisting motion. This will enable the teeth of the clutch plates to mesh into the A–B carrier and inner carrier.

    NOTE: When properly engaged the top of cylinder A should not protrude more than 8,5 mm (0.33 in) above the gearbox front face.

20. Place the thrust washer and axial cage onto the A cylinder.

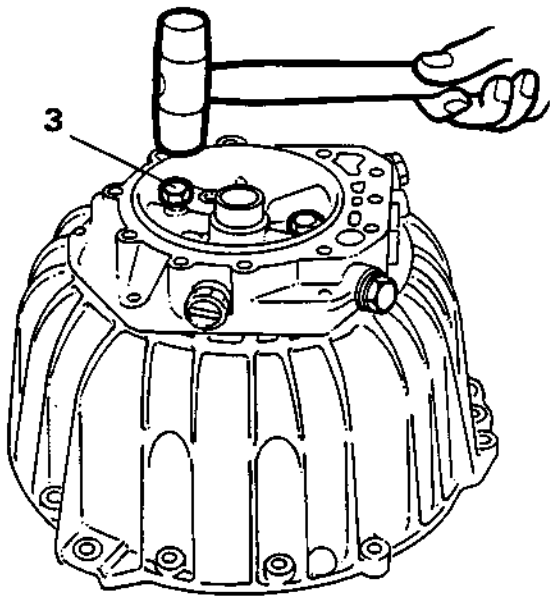




Pump, Intermediate Plate and Bell Housing

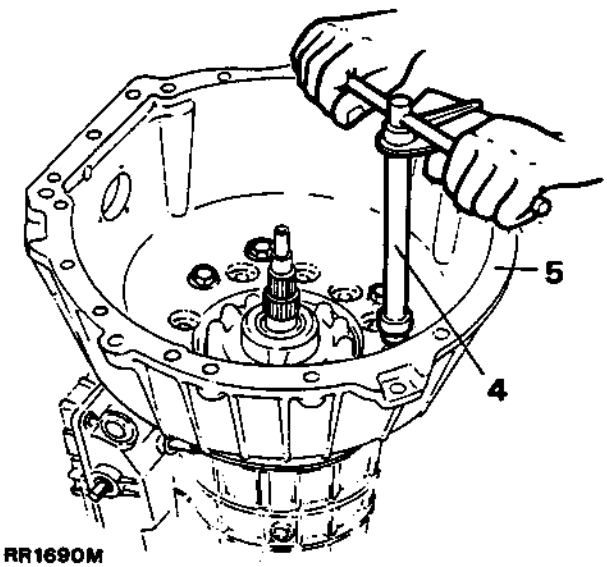
Remove and overhaul

1. Place the bell housing on the bench, open face down.
2. Remove the eight hexagonal bolts on the rear of the pump.
3. Screw in two bolts, diagonally opposite each other, tap lightly using a soft-headed mallet, this will free the pump assembly from the intermediate plate.



RR900M

4. Remove the six remaining bolts situated on the inside of the bell housing.
5. Separate the bell housing from the intermediate plate.



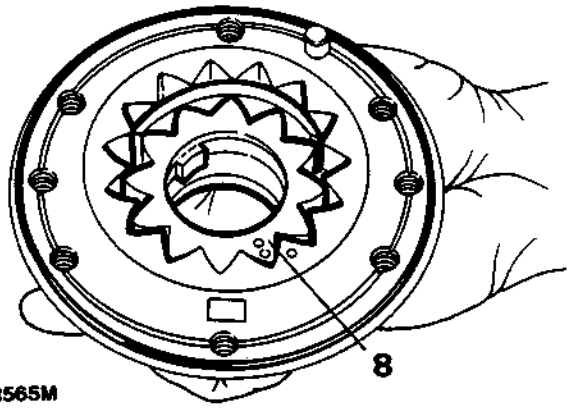
RR1690M

Pump assembly

6. Using a suitable tool remove the shaft sealing ring and 'O' ring from the pump housing and discard.
7. Strip, inspect and clean the pump assembly using a lint-free rag.

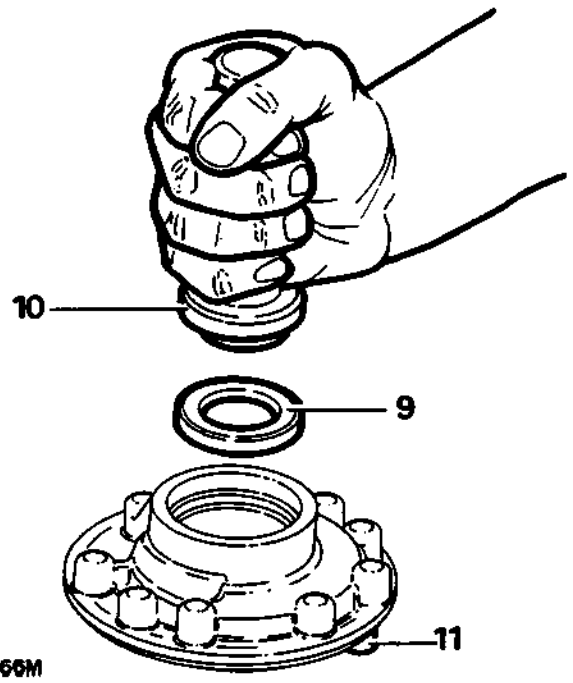
   NOTE: If damage has occurred to the assembly, replace the whole pump.

8. Replace the pump hollow gear and pump gear into pump housing with the marked side of gears facing upwards.



RR565M

9. Fit the 'O' ring onto the circumference of the pump housing.
10. Using oil seal replacer LST108, fit the shaft seal ring into the pump housing.
11. Fit the alignment pin into the pump housing.



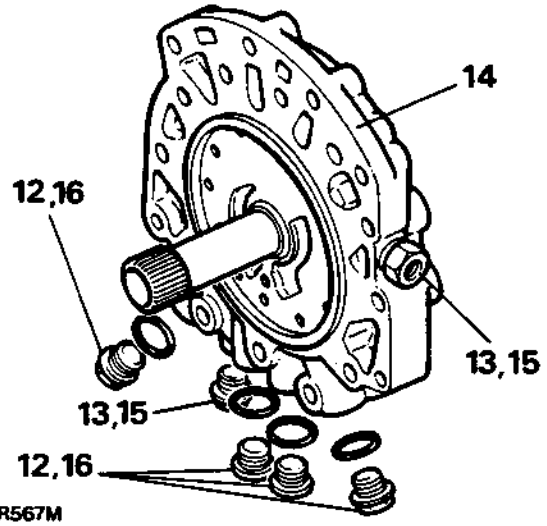
RR566M

Intermediate assembly

12. Remove the four screw plugs and seal rings from the plate and discard the seal ring.
13. Remove the oil cooler pipe adaptors.
14. Inspect and clean the intermediate plate with a lint-free rag.

NOTE: If damage is found replace the intermediate plate.

15. Fit the oil cooler pipe adaptors.
16. Fit the four screw plugs into their correct locations with new seal rings.



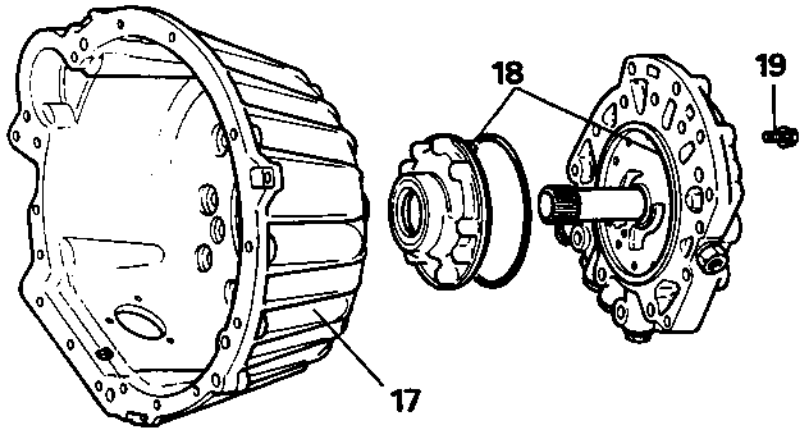
RR567M

Refit bell housing, intermediate plate and pump assembly

17. Inspect and clean the bell housing.

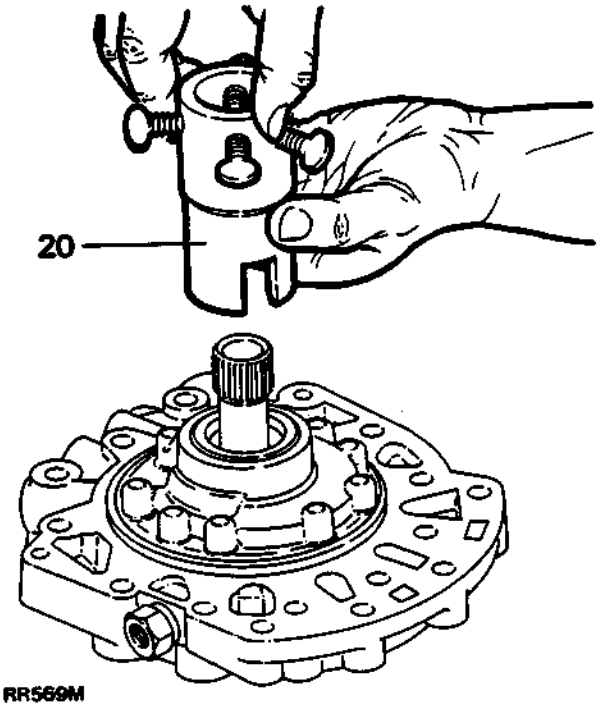
NOTE: If damage is found replace the bell housing.

18. Align the dowel in the pump with its hole in the intermediate plate and press the housing into position.
19. Secure the pump housing to the intermediate plate with the eight hexagonal bolts and tighten to the specified torque.



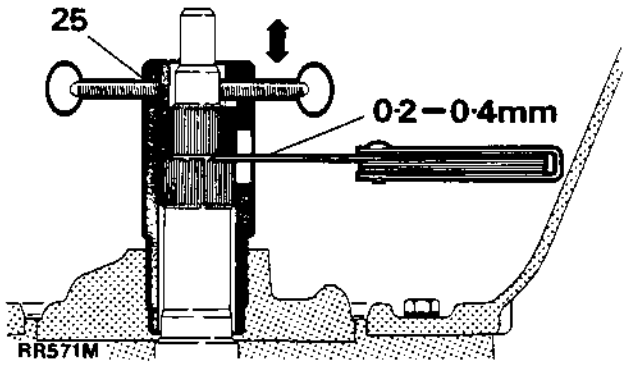
RR568M

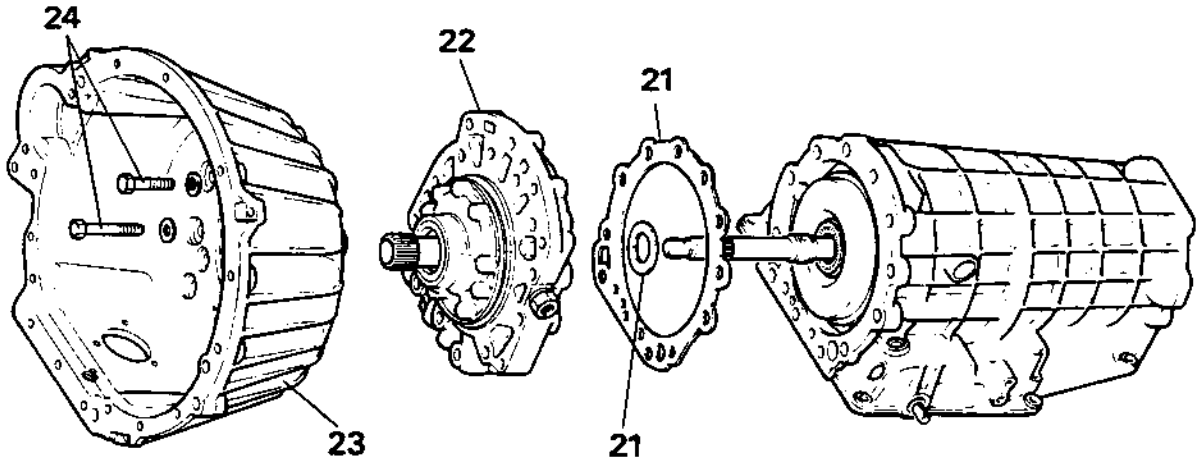
20. Using the oil pump rotation sleeve LST111 check that the pump gears rotate freely.
21. Place the gasket and disc washer onto the intermediate plate assembly using a petroleum jelly or vaseline.
22. Fit the intermediate plate onto the gearbox.
23. Fit the bell housing onto the intermediate plate assembly.



RR569M

24. Secure with the six short bolts which locate on the outside diameter ring pattern within the bell housing and the twelve long bolts which are located in the inner diameter ring pattern. All the bolts to be tightened to the specified torque.
25. Using the end-float gauge LST111 check the axial clearance 0,2 to 0,4 mm (0.008 to 0.016 in). If the axial clearance is not achieved, remove the bell housing/intermediate plate assembly complete and replace existing disc washer using a thicker or thinner one depending on the reading first taken. Reassemble bell housing/intermediate plate and check the axial clearance once again. Repeat this operation until axial clearance has been achieved.





Check axial clearance

1. Fit LST111 end-float gauge onto the output shaft, making sure the outer shaft engages into the pump.
2. Pressing the output shaft towards the rear of the gearbox and tighten the three screws on the gauge.
3. Measure the clearance and note.
4. Now secure the remaining screw which retains the outer shaft to the inner collar.
5. Pull the whole assembly away from the bell housing, measure the clearance and note.
6. Subtract the first measurement from the second to obtain the axial clearance.

Extension housing and governor—overhaul

1. Remove the two bolts using torx bit TX27 retaining the parking wheel.
2. Remove the clip and counterweight from inside the governor hub.
3. Remove the two bolts from the top of the governor hub which releases the housing and discard.
4. Release the retaining clip and discard.
5. Remove the pin, spring, piston and weight from the governor housing.
6. Clean and inspect all parts for damage.

NOTE: Replace any part which may be damaged.

7. Remove the seal ring from the extension housing.
8. Clean and inspect the extension housing for damage.

NOTE: If the dowels are damaged replace the dowels only. If extension casing is damaged replace the case and dowels.

9. Inspect and clean extension shaft and bolt for damage, replace if necessary.

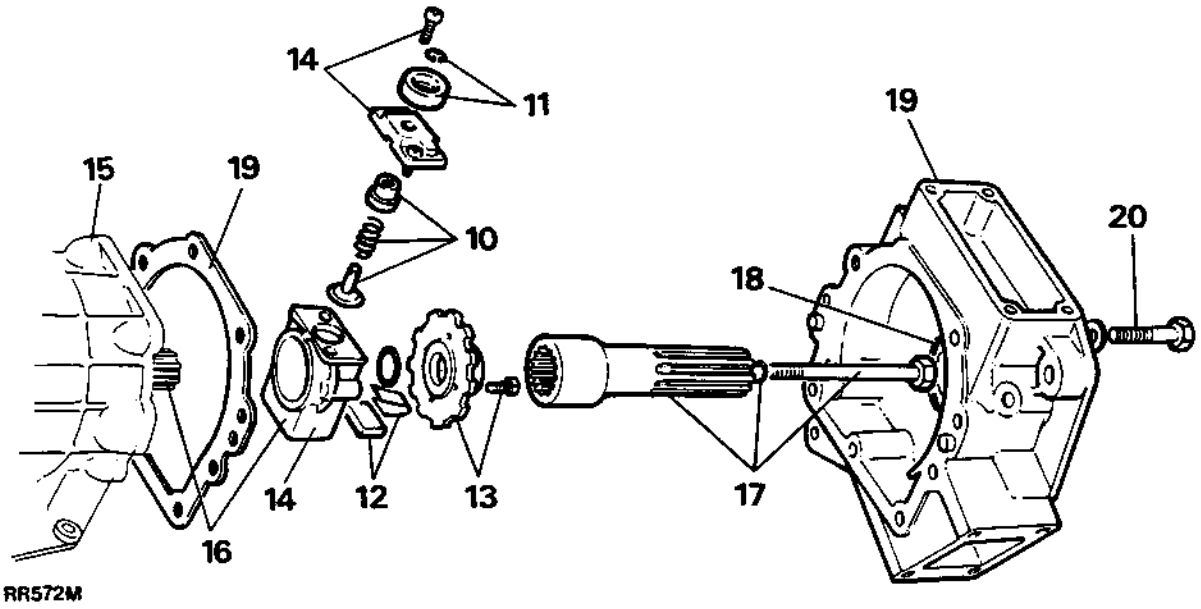
Assemble

10. Fit the pin, spring and piston to the governor housing.
11. Fit the weight on the top of the governor housing and secure with a new retaining clip.
12. Fit the counterweight into the governor hub and secure with the clip.
13. Fit the parking wheel and secure with two bolts using torx bit TX27 to the specified torque.
14. Fit the governor housing assembly to the hub and secure with two bolts using torx bit TX27 to the specified torque.
15. Turn gearbox over in holding fixture so that the rear of the box is uppermost.

16. Fit the governor/parking wheel assembly onto the output shaft and press the assembly until fully seated.

    NOTE: To avoid damage to the 'O' ring use a petroleum jelly. Ensure the seal rings are snapped together and are seated correctly.

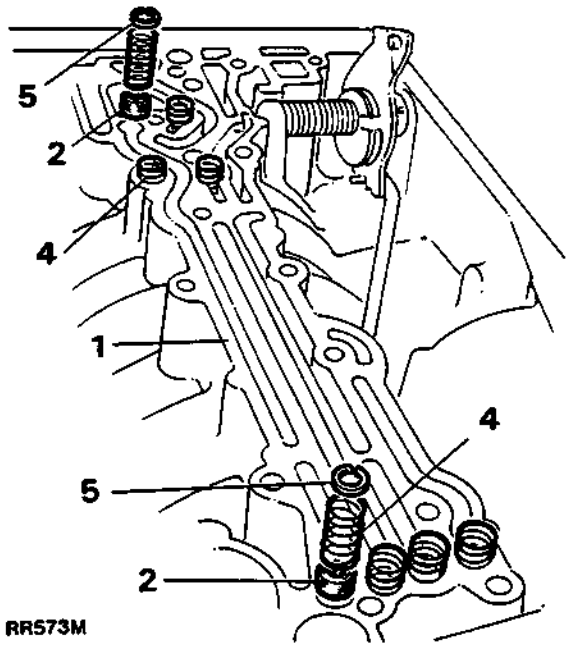
17. Fit the extension shaft and retaining bolt using a new 'O' ring.
18. Fit a new seal to the extension housing using the rear oil seal replacer LST108.
19. Fit a new gasket onto the rear of the gearbox and fit the extension housing taking care not to damage the seal on assembly.
20. Secure the extension housing using the nine bolts to the specified torque.



RR572M

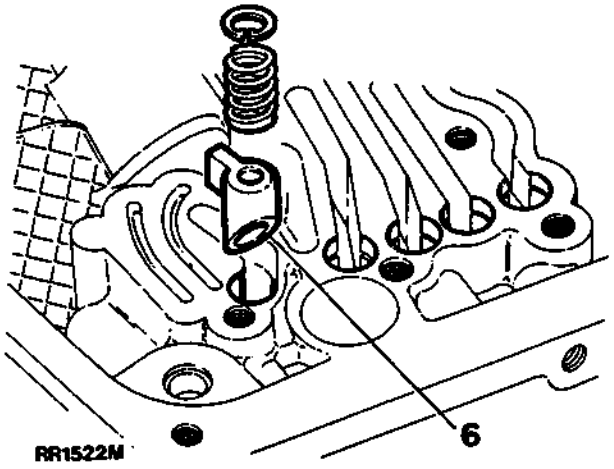
Refit valve body, oil pan and torque converter

1. Position the gearbox so that the bottom is uppermost.
2. Insert the eight sealing bushes into the oil feed holes using the control unit inlet oil seal remover/replacer LST113.
3. As a test to check the function of the clutch and brake assemblies, insert an air gun into the oil feed holes and exert a pressure of 5 to 6 bar (72.5 to 87 lb/in²).
4. Fit the four short springs into the oil feed holes at the front of the gearbox and four long springs into the oil feed holes at the rear of the gearbox.
5. Fit the eight circlips to retain the springs and sealing bushes.

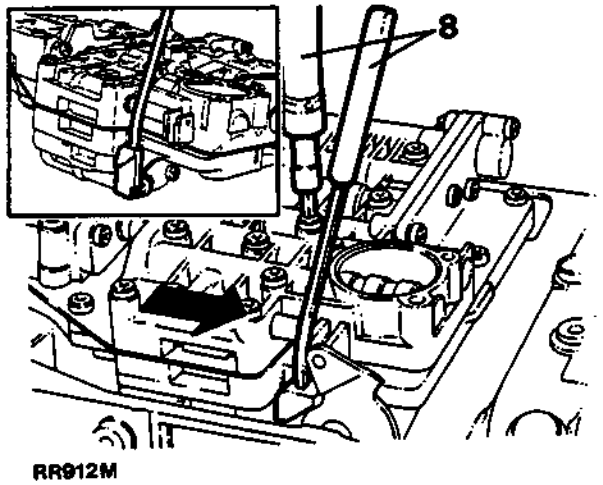


RR573M

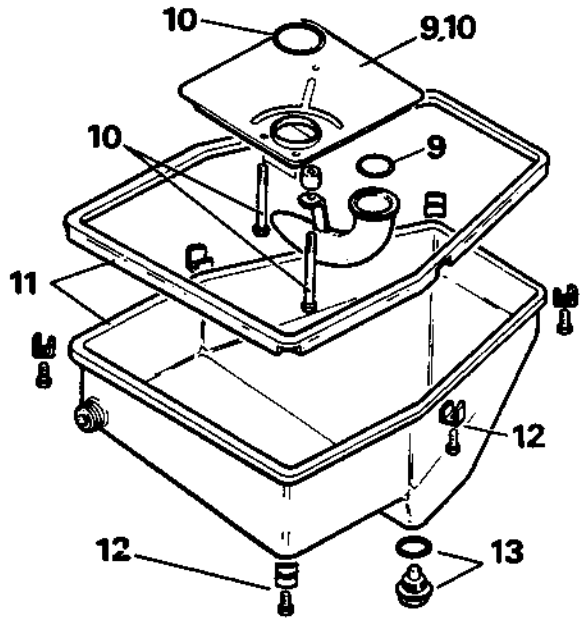
6. Fit the restrictor, spring and circlip using LST 113 into the hole adjacent to the four rear oil feed holes.



7. Place the control unit ensuring the selector shaft locates into the gear shift fork and fit the thirteen bolts loosely by hand.
8. Place the selector linkage setting gauge LST109 in position and gently press the control unit against the tool and tighten all thirteen bolts using torx bit TX27 to the specified torque.

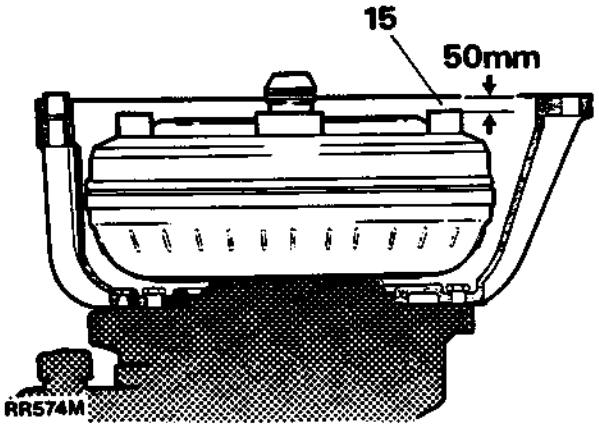


9. Remove the setting gauge and fit the suction and 'O' ring to new oil screen.
10. Fit the new oil screen with new 'O' ring and secure with the three bolts using torx bit TX27 to the specified torque.
11. Fit the oil pan using a new gasket.
12. Secure the oil pan with the six retaining plates (two straight and four corner plates), tighten to the specified torque.
13. Fit oil pan plug with a new seal.



14. Turn the gearbox around until the gearbox is horizontal.
15. Using the torque converter remove/refit handles 18G1501, install the torque converter into the gearbox.

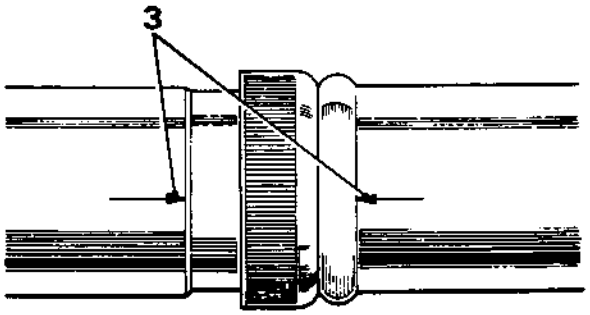
NOTE: Check that the dimension from the converter fixing bolt boss to the converter housing face is 50 mm (1.96 in). If this dimension is achieved the converter is properly seated in the housing.



OVERHAUL PROPELLER SHAFTS

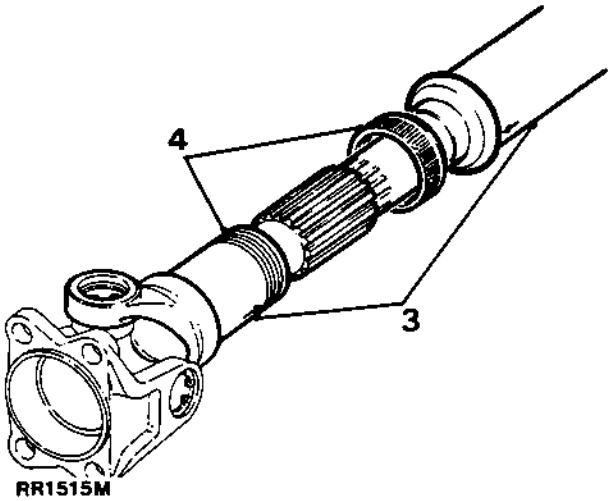
Dismantle

1. Place the vehicle on a suitable ramp.
2. Remove the propeller shaft from the vehicle.
3. Note the alignment markings on the sliding member and the propeller shaft.



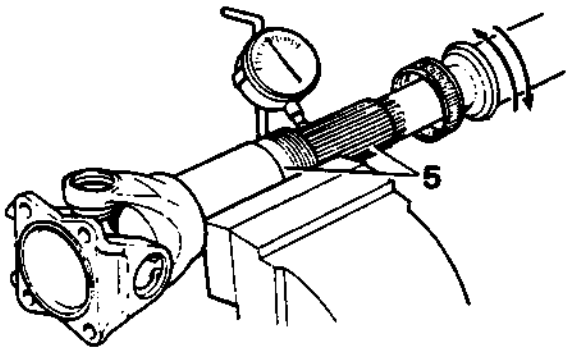
ST1000M

4. Unscrew the dust cap and withdraw the sliding member.



RR1515M

5. Clean and examine the splines for wear. Worn splines or excessive back-lash will necessitate propeller shaft renewal.

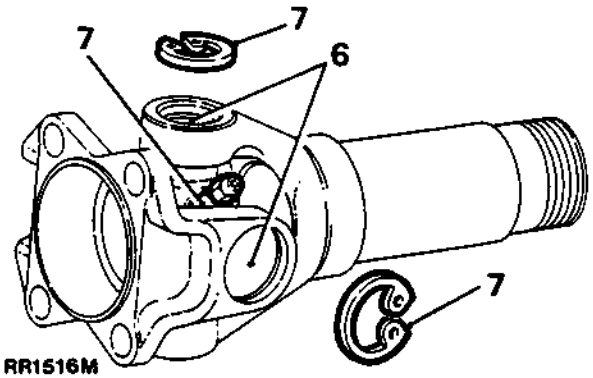


ST1002M

6. Remove paint, rust, etc. from the vicinity of the universal joint bearing cups and circlips.

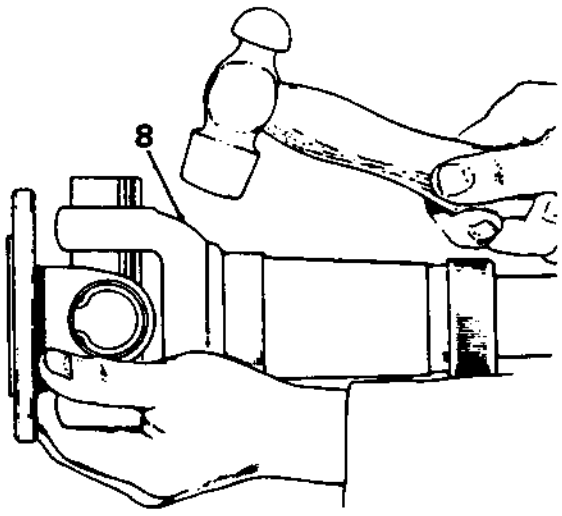
NOTE: Before dismantling the propeller shaft joint, mark the position of the spider pin lubricator relative to the journal yoke ears to ensure that the grease nipple boss is re-assembled in the correct running position to reduce the possibility of imbalance.

7. Remove the circlips, and grease nipple.



RR1516M

8. Tap the yokes to eject the bearing cups.
9. Withdraw the bearing cups and spider and discard.
10. Repeat instructions 5 to 8 at opposite end of propeller shaft.
11. Thoroughly clean the yokes and bearing cup locations.



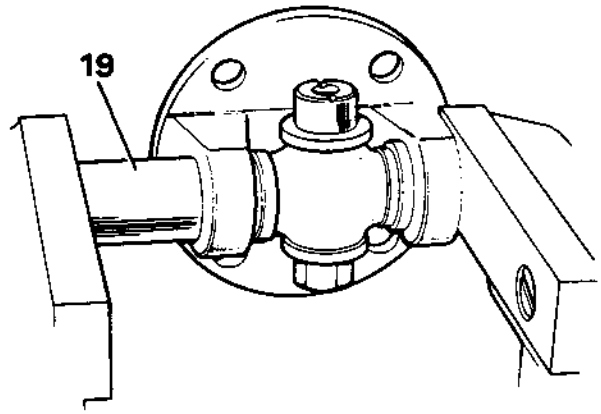
ST1004M

Assemble

12. Remove the bearing cups from the new spider.
13. Check that all needle rollers are present and are properly positioned in the bearing cups.
14. Ensure bearing cups are one-third full of fresh lubricant. See Lubrication chart.
15. Enter the new spider complete with seals into the yokes of the sliding member flange.

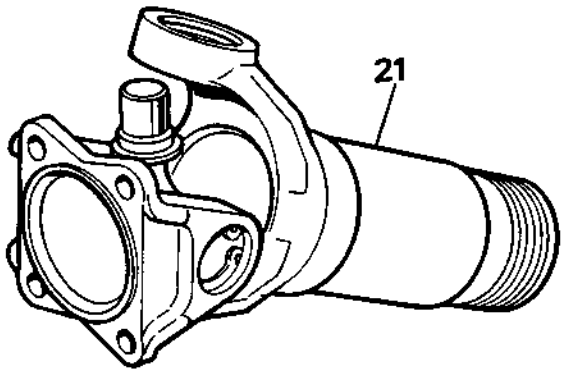
Continued

16. 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.
17. Insert the opposite bearing cup into the flange yoke. Using a vice, carefully press both cups into place taking care to engage the spider trunnion without dislodging the needle rollers.
18. Remove the flange and spider from the vice.
19. Using a flat faced adaptor of slightly smaller diameter than the bearing cups press each cup into its respective yoke until they reach the lower land of the circlip grooves. Do not press the bearing cups below this point or damage may be caused to the cups and seals.



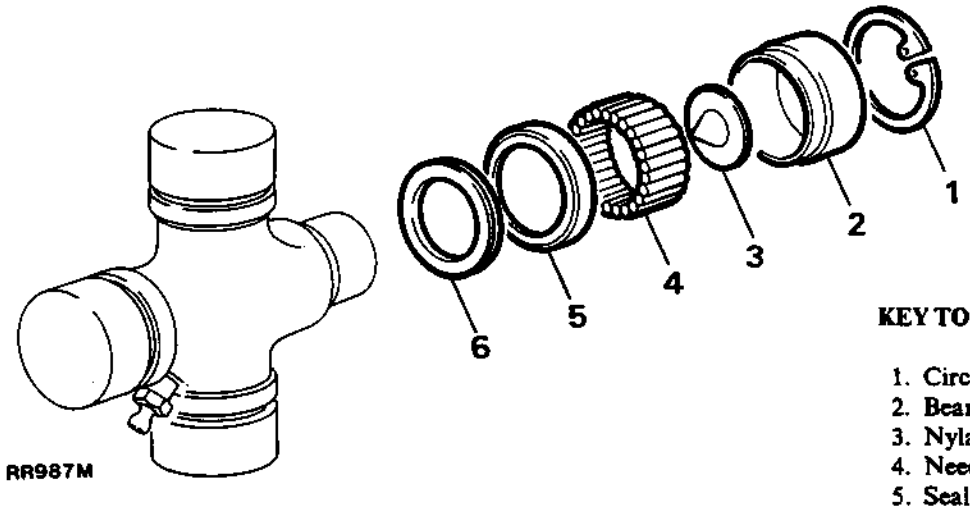
ST1005M

20. Fit the circlips.
21. Engage the spider in the yokes of the sliding member. Fit the bearing cups and circlips as described in instructions 15 to 20.



ST1006M

22. Lubricate the sliding member spines and fit the sliding member to the propeller shaft ensuring that the markings on both the sliding member and propeller shaft align.
23. Fit the tighten the dust cap.
24. Fit the grease nipples to the spider and the sliding member and lubricate.
25. Apply instructions 15 to 20 to the opposite end of the propeller shaft.
26. Fit the grease nipple and lubricate.
27. Fit the propeller shaft to the vehicle.



RR987M

KEY TO SPIDER ASSEMBLY

1. Circlip
2. Bearing cup
3. Nylatron washer
4. Needle rollers (27 per cup)
5. Seal retainer
6. Seal

NOTE: When renewing joints use only 03EHD series replacement spider packs.

REAR AXLE

Remove and refit

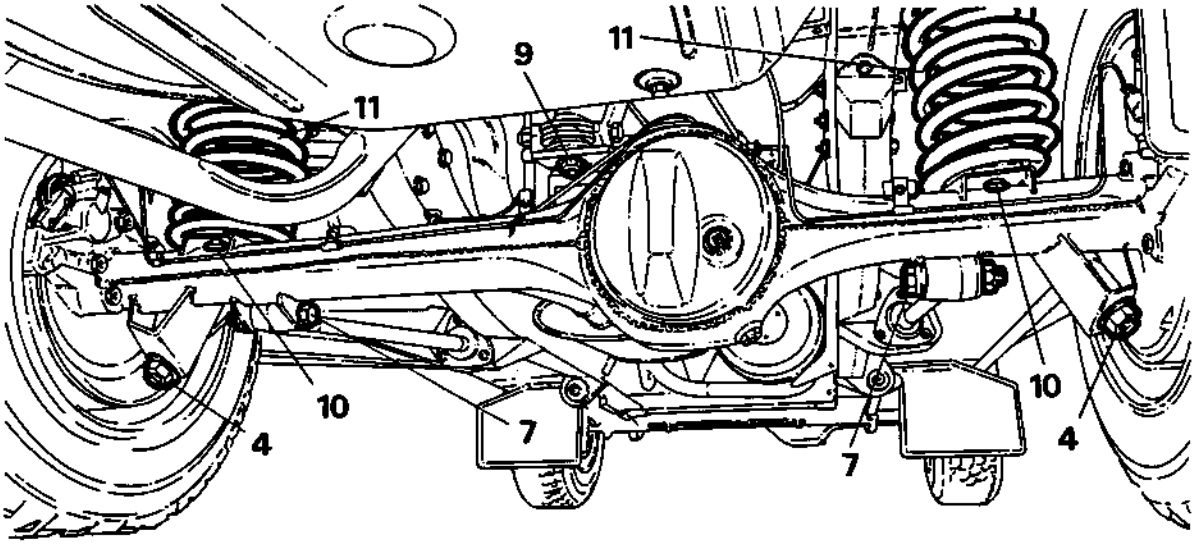
Removing

NOTE: The removal and refitting of the axle from the vehicle requires the assistance of two further personnel to steady the axle, when lowering or repositioning the axle.

1. Jack-up the rear of the vehicle and support the chassis.
2. Remove the road wheels.
3. Support the axle weight with a suitable hydraulic jack.
4. Disconnect the shock absorbers.
5. Disconnect the flexible brake hose at the connection under the floor.
6. Disconnect the pad wear multi-plug at the bracket mounted on the underside of the floor. Prise the rubber grommet out of the bracket and feed the plug through the hole.
7. Disconnect the lower links at the axle.
8. Mark the differential and propeller shaft drive flanges with identification marks to aid reassembly. Remove the four nuts and bolts, lower the propeller shaft and tie it to one side.
9. Disconnect the pivot bracket ball joint at the axle bracket.
10. Release the bolts and remove the coil spring retaining plates.
11. Lower the axle and remove the road springs.
12. Withdraw the axle assembly.

Refitting

13. Position the axle and fit the lower links, and tighten the bolts to the specified torque.
14. Reverse the removal instructions.
15. Tighten the pivot bracket ball joint to axle, to the specified torque.
16. Tighten the propeller shaft to differential drive flange, to the specified torque.
17. Bleed the braking system.



RR1514M

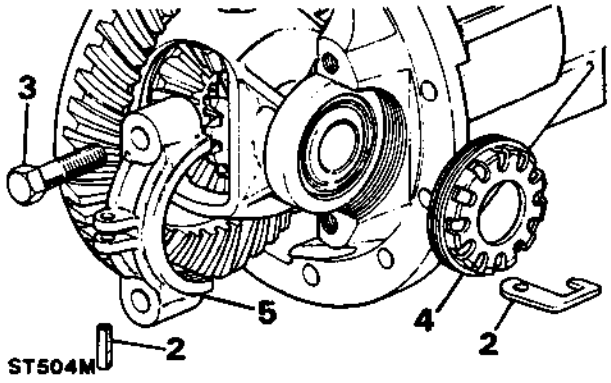
OVERHAUL AXLE DIFFERENTIAL ASSEMBLY

Service tools:
18G 1205 flange holder tool;
18G 191 pinion height setting gauge;
18G 191-4 universal setting block;
18G 47-6 pinion head bearing remover/replacer;
LST 106 oil seal replacer;
RO 262757A extractor for pinion bearing caps;
RO 262757-1 replacer—use with RO 262757A;
RO 262757-2 adaptor tail bearing cap replacer;
RO 530105 spanner—differential flange and carrier bearing nuts;
RO 530106 bracket for dial gauge and indicator;
MS 47 press

DISMANTLE

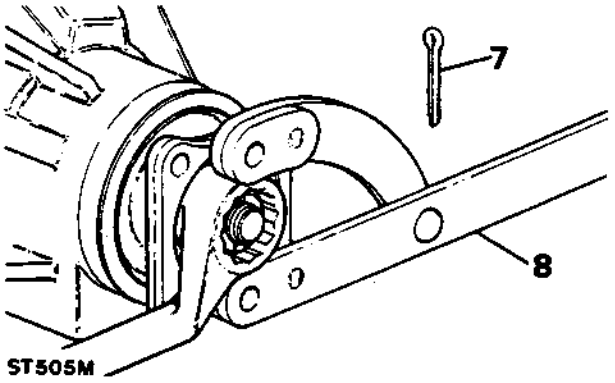
It is essential that differential components are marked in their original positions and relative to other components so that, if refitted, their initial setting is maintained. Note that the bearing caps must not be interchanged.

1. Remove the differential assembly from the axle.
2. Drift out the roll pin securing the bearing nut locking fingers to the bearing caps. Remove the locking fingers.
3. Slacken the bearing cap bolts and mark the caps for reassembly.
4. Using service tool RO 530105, remove the bearing adjusting nuts.
5. Remove the bearing cap bolts and bearing caps.
6. Lift out of the crown wheel, differential unit and bearings.



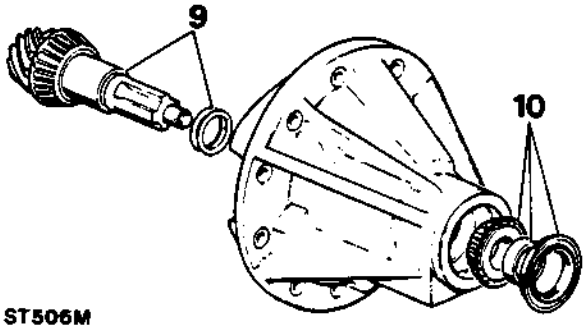
ST504M

7. Remove the split pin securing the pinion flange nut.
8. Remove the pinion flange nut using service tool 18G 1205 to restrain the flange.



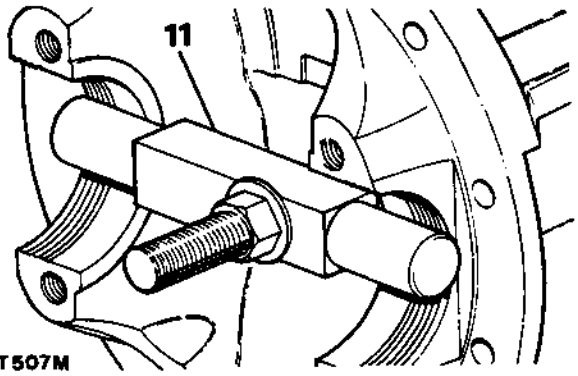
ST505M

9. Withdraw the pinion complete with pinion head bearing and outer bearing shims. Withdraw the shims.
10. Remove the pinion flange oil seal, spacer and bearing. Discard the oil seal.



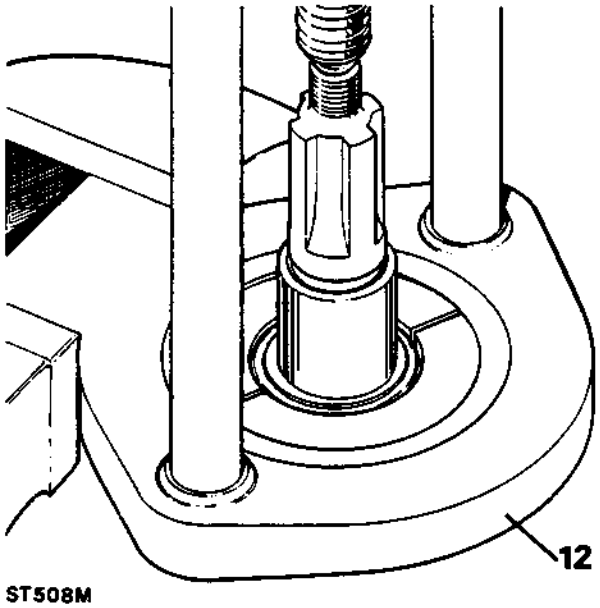
ST506M

11. Using service tool RO 262757A, remove the pinion head bearing track and shim and drift out the outer bearing track from the differential housing.



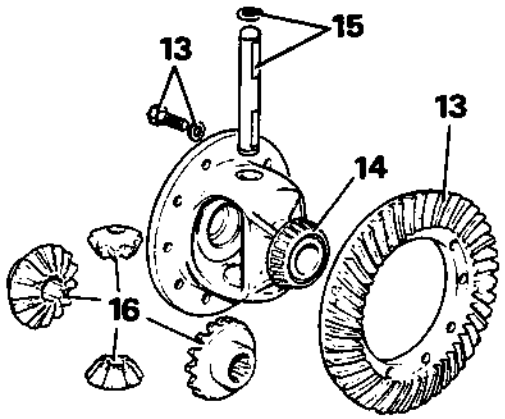
ST507M

12. Remove the pinion head bearing with service tool MS 47 and adaptor 18G 47-6.



ST508M

13. Remove the bolts and washers securing the crown wheel to the differential flange. Withdraw the crown wheel.
14. Remove the differential carrier bearings.
15. Remove the circlips securing the differential cross shaft. Extract the cross shaft.
16. Withdraw the differential gears and pinions.
17. Thoroughly clean all components.



ST509M

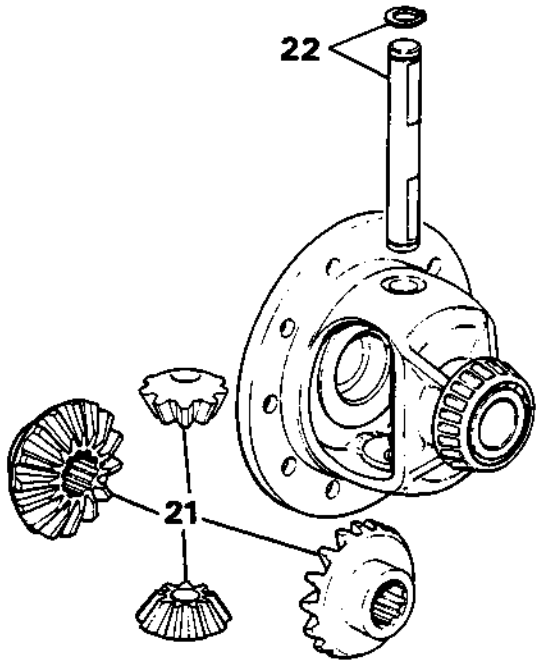
INSPECTION

18. Check all bearings for wear and/or pitting.
19. Check all gears for wear, scuffing, pitting and damaged teeth.
20. **NOTE. The crown wheel and pinion are supplied as a matched set, also the pinion housing and bearing caps.**

ASSEMBLE

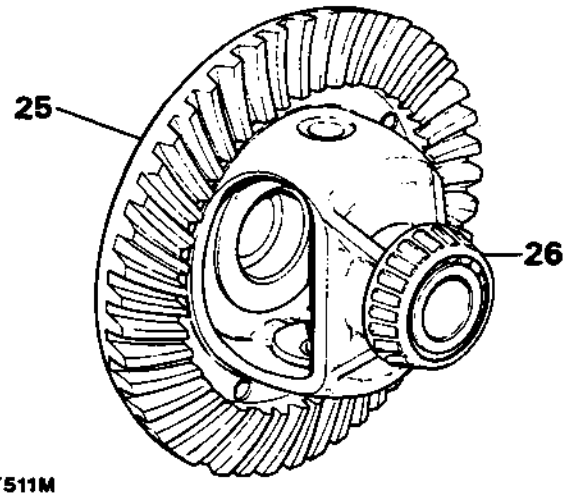
Differential gears

21. Fit the differential gears to the differential housing.
22. Fit the differential cross shaft and retaining circlips.



ST510M

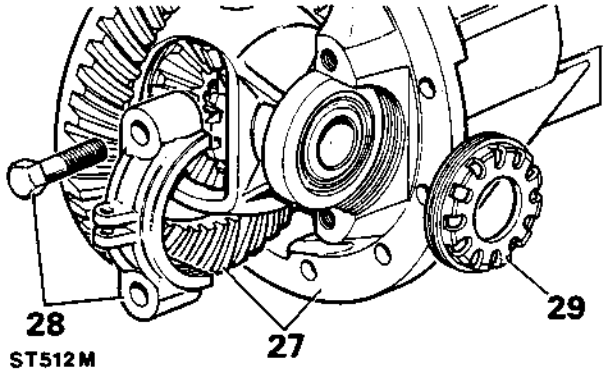
23. Check the gear for freedom of rotation and backlash. Nominal backlash should be present. Excessive backlash will necessitate renewal of the gears and/or the differential housing. No provision is made for backlash adjustment.
24. Check that the serial number marked on the pinion end face matches that marked on the crown wheel.
25. Ensuring that the differential housing flange and crown wheel are thoroughly clean fit the crown wheel. Fit the crown wheel bolts and washers and evenly tighten.
26. Fit the carrier bearings using a suitable press or drift and assemble the tracks to the bearings.



ST511M

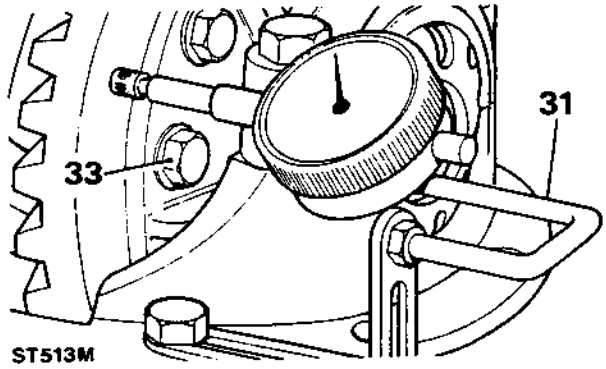
Continued

27. Place the differential housing complete with crown wheel and bearings in the pinion housing.
28. Fit the bearing caps and bolts. Do not fully tighten the bolts.
29. Fit the bearing adjusting nuts and adjust to obtain zero end-float.
30. Tighten the bearing cap bolts.



ST512M

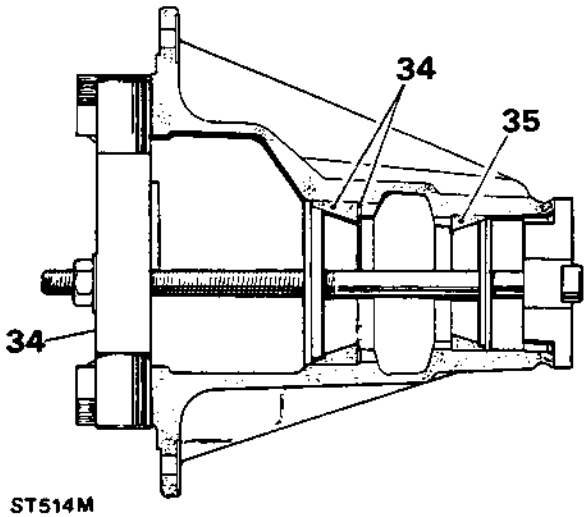
31. Using a dial gauge check the crown wheel for run-out. This should not exceed 0,10 mm (0.004 in). If excessive run-out is recorded remove the crown wheel and examine crown wheel and mounting flange for burrs, grit, etc. Refit the crown wheel and recheck. Run-out, attributable to a buckled or damaged differential housing flange can be corrected only by renewing the differential gear housing.
32. When satisifed that run-out is within the specified limits remove the differential housing from the pinion housing.
33. Remove the crown wheel bolts and refit them using Loctite 'Studlock'. Evenly tighten the bolts to the correct torque.



ST513M

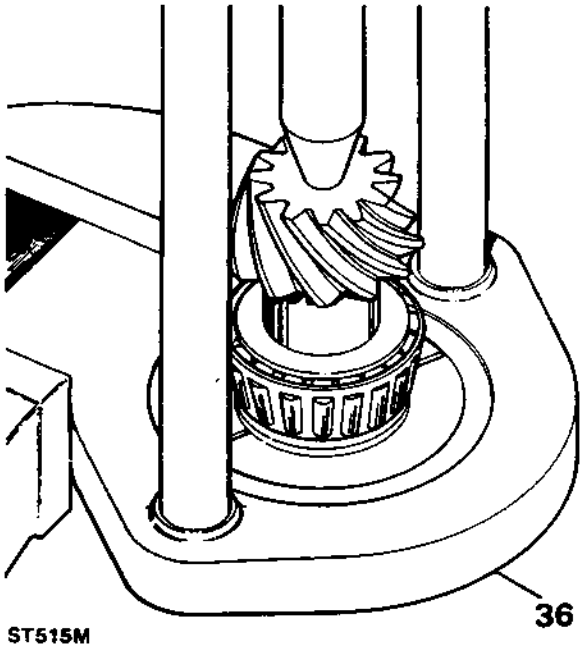
34. Fit the pinion head bearing track and the original shim to the pinion housing using service tools RO 262757A and RO 262757-1. If the original shim was damaged or mislaid use a new shim of at least 1,27 mm (0.050 in) thickness.
35. Fit the pinion outer bearing track to the pinion housing with service tool RO 262757A and RO 262757-2.

NOTE: Instructions 34 and 35 are carried out in one operation as illustrated.



ST514M

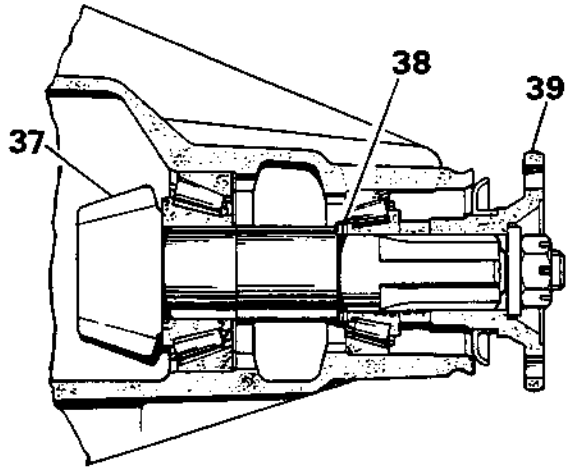
36. Fit the pinion head bearing to the pinion using service tool 18G 47-6.



ST515M

37. Enter the pinion into its location in the pinion housing. Do not fit the shims for bearing pre-load at this stage.
38. Fit the outer bearing and spacer.
39. Fit the driving flange, washer and nut.

Continued

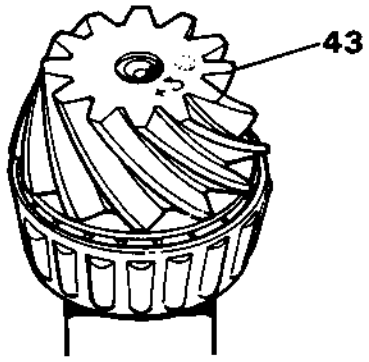


ST516M

40. Do not fit the oil seal at this stage.
41. Tighten the pinion flange nut slowly until the force required to rotate the pinion is 7,6 to 13 kgf cm (7 to 12 lbf in). This will pre-load the bearings in order to check the pinion height dimension.

Drive pinion markings

42. The markings on the end face adjacent to the serial number are of no significance during servicing.
43. The figure marked on the end face opposite to the serial number indicates, in thousandths of an inch, the deviation from nominal required to correctly set the pinion. A pinion marked plus (+) must be set below nominal, a minus (−) pinion must be set above nominal. An unmarked pinion must be set at nominal.
44. The nominal setting dimension is represented by the setting gauge block 18G 191-4 which is referenced from the pinion end face to the bottom radius of the differential bearing bore.



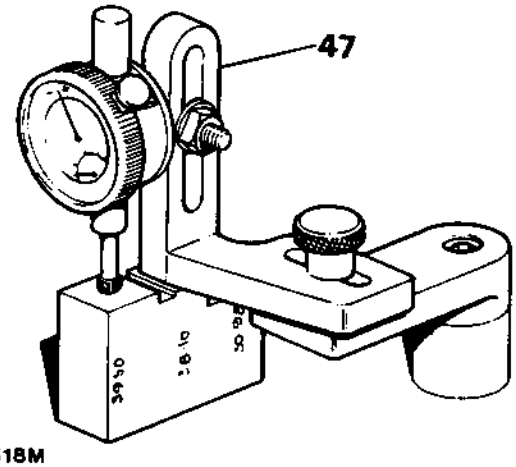
ST517

Drive pinion adjustment

45. Ensure that the pinion end face is free of raised burrs around the etched markings.
46. Remove the keep disc from the magnetised base of dial gauge tool 18G 191.
47. Place the dial gauge and setting block on a flat surface and zero the dial gauge stylus on the setting block.

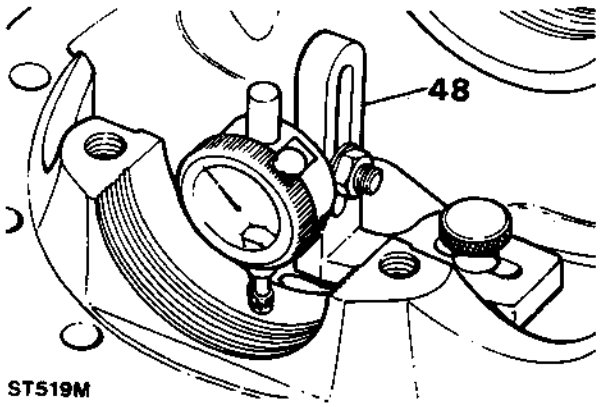
    NOTE: The setting block has three setting heights as follows:
    39,50 mm Rationalised axle
    38,10 mm Pre-Rationalised axle
    30,93 mm Salisbury axle

    Ensure that the height marked 39,50 mm is used for this differential.



ST518M

48. Position the dial gauge centrally on the pinion end face with the stylus registering on the lowest point on one differential bearing bore. Note the dial gauge deviation from the zeroed setting.



ST519M

Continued

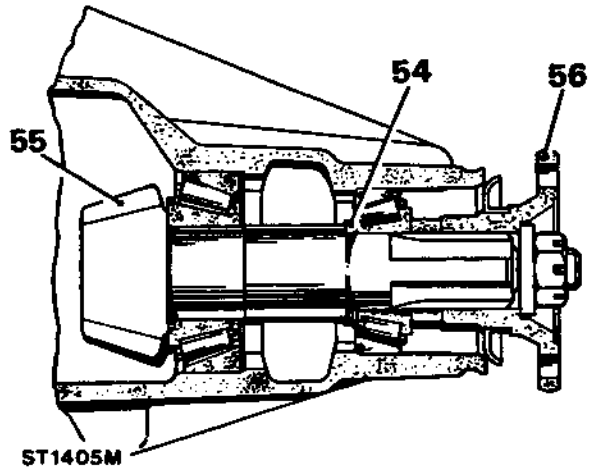
49. Repeat on the other bearing bore. Add together the readings than halve the sum to obtain the mean reading. Note whether the stylus has moved up or down from the zeroed setting.

    a. Where the stylus has moved down, the amount is equivalent to the thickness of shims that must be removed from under the pinion inner track to bring the pinion down to the nominal position.
    b. Where the stylus has moved up, the amount is equivalent to the addition thickness of shims required to bring the pinion up to the nominal position.

50. Before adjusting the shim thickness, check the pinion face marking and if it has a plus (+) figure, subtract that amount in thousandths of an inch from the shim thickness figure obtained in the previous item.
51. Alternatively, if the pinion has a minus (−) figure, add the amount to the shim thickness figure.
    Adjust the shim thickness under the pinion head bearing track as necessary.
52. Recheck the pinion height setting. If the setting is correct, the mean reading on the dial gauge will agree with the figure marked on the pinion end face. For example, with an end face marking of +3, the dial gauge reading should indicate that the pinion is +0.003 in.

Bearing pre-load adjustment

53. Remove the pinion flange, pinion, outer bearing and spacer.
54. Slide new shims, of the same thickness as the originals (bearing pre-load) into position on the pinion shaft. If the original shim was damaged or mislaid use a new shim of at least 4,06 mm (0.160 in) thickness.
55. Enter the pinion in its location in the pinion housing and fit the outer bearing and spacer.
56. Fit the driving flange, washer and nut.
57. Do not fit the oil seal at this stage.

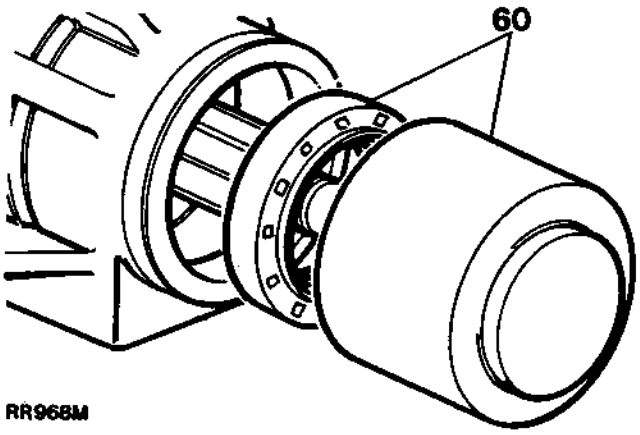


58. Tighten the pinion flange nut to the specified torque. The force required to rotate the pinion shaft should be within 7,6 to 13 kgf cm (7 to 12 lbf in) when initial inertia has been overcome. Change the bearing pre-load shim as necessary to obtain this requirement. A thicker shim will reduce pre-load; a thinner shim will increase pre-load.
59. Remove the pinion flange.

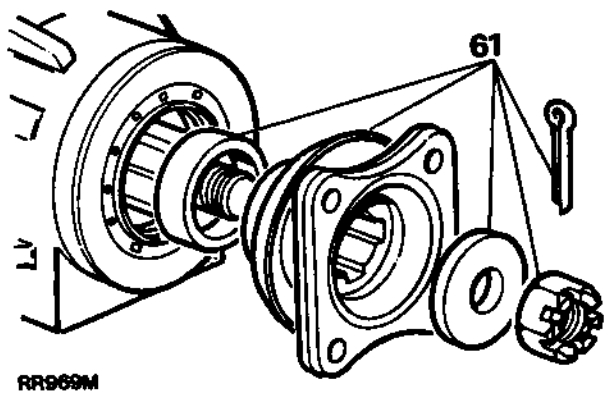
Fitting Pinion Oil Seal

CAUTION—Before fitting the new seal to the differential, examine the seal to ensure that it is clean, undamaged and that the garter spring is properly located. A small scratch on the seal lips could impair its efficiency.

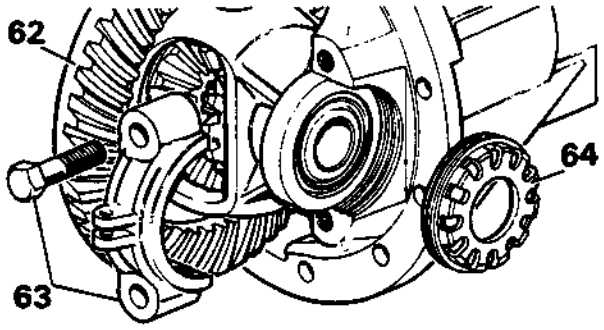
60. Coat the outer diameter of the new seal width an all-purpose grease and fit the seal, lip side leading squarely on the pinion nose housing and drive the seal into position flush with the end face of the housing using seal replacing tool LST106.



61. Lightly lubricate the seal lips with EP90 oil. Fit the distance piece and flange and secure with washer and nut. Tighten the nut to the specified torque and fit a new split pin.

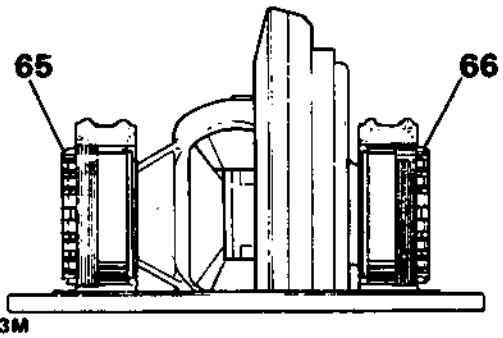


62. Place the differential housing in the pinion housing.
63. Fit the bearing caps and bolts. Do not fully tighten the bolts.
64. Fit the bearing adjusting nuts.



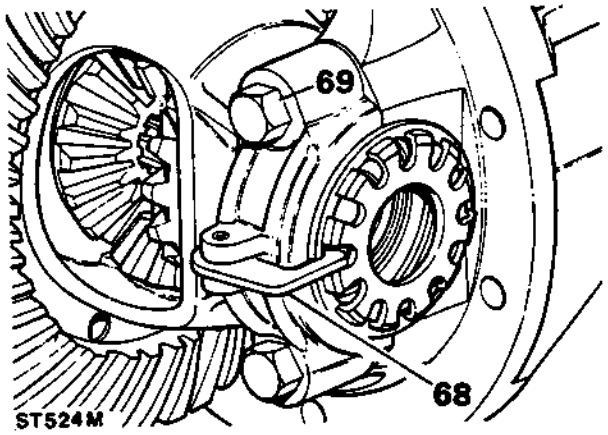
ST522M

65. Using service tool 530105, slacken the left hand bearing adjustment nut (as illustrated) to produce end float.
66. Tighten the right hand nut until crown wheel/pinion backlash is just removed.



ST523M

67. Tighten the left hand nut slowly until the crown wheel/pinion backlash is 0,10 to 0,17 mm (0.004 to 0.007 in).
68. Fit the locking fingers and roll pins. If necessary, tighten the adjustment nuts slightly to align the locking finger with a slot.



ST524M

69. Evenly tighten the bearing cap bolts to the specified torque.
70. Recheck crown wheel/pinion backlash.
71. Lubricate the bearings and gears.

DATA

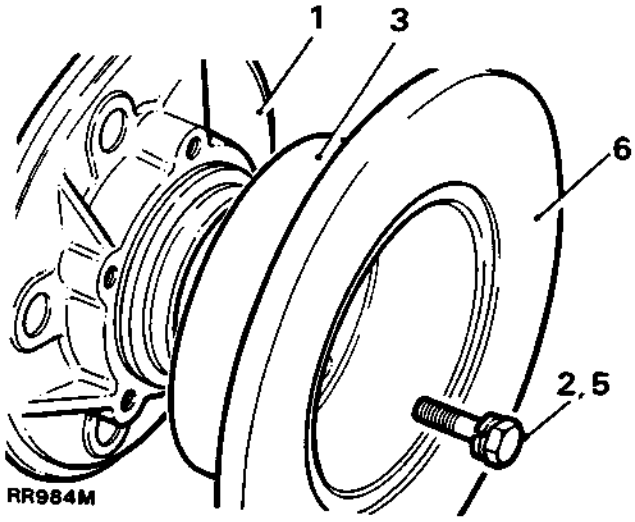
Pinion bearing pre-load	7,6 to 13 kgf cm (7 to 12 lbf in)
Crown wheel run-out	0,10 mm (0.004 in)
Crown wheel/pinion backlash	0,10 to 0,17 mm (0.004 to 0.007 in)

REAR DISCS

Remove and refit

Removing

1. Remove the rear hub assembly.
2. Remove the rear disc fixing bolts.
3. Tap off the disc from the rear hub.



Refitting

4. Locate the disc onto the rear hub.
5. Fit the disc fixing bolts. See 'Data Section' for tightening torques.
6. Using a dial test indicator, check the total disc run out, this must not exceed 0,15 mm (0.006 in). If necessary reposition the disc.
7. Fit the rear hub assembly.

Disc reclamation

Check the disc thickness marked on the disc boss—this dimension may be reduced to a minimum thickness of 13 mm (0.510 in) front and 12 mm (0.460 in) rear, by machining an equal amount off both sides.

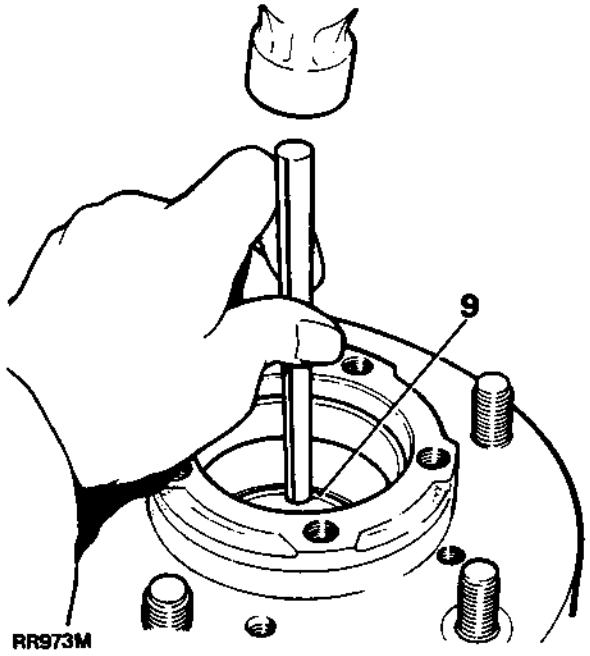
REMOVE AND OVERHAUL REAR HUBS

Special tools:

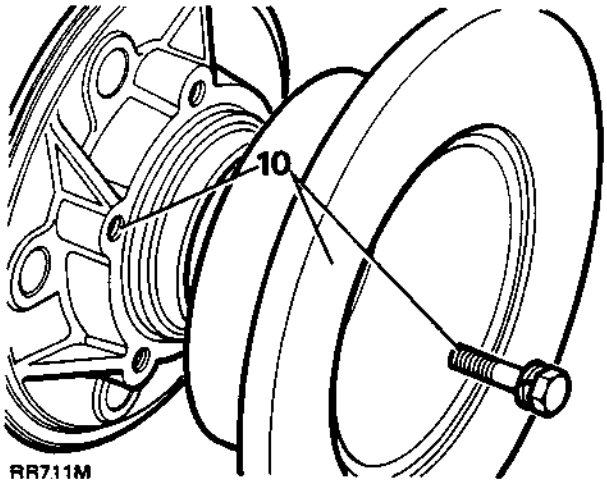
Oil Seal replacer	LST550–5
Drift for above tool	MS550 or 18G134
Hub nut spanner	606435

Remove

1. Jack-up the vehicle, lower on to axle stands and remove the road wheels.
2. Release the brake pipe from the axle, casing clips and remove the brake caliper retaining bolts and secure the assembly to one side. Take care not to kink the brake pipe.
3. Remove the five bolts securing the axle shaft to the hub and withdraw the shaft.
4. Bend back the lock tab and remove the outer nut using box spanner 606435 and remove the lock washer. Likewise remove the inner nut.
5. Remove the seal track spacer.
6. Withdraw the hub complete with bearing oil seals and brake disc.
7. Remove the inner and outer oil seals.
8. Remove the inner and outer bearing cones.
9. Drift-out the inner and outer bearing cups.



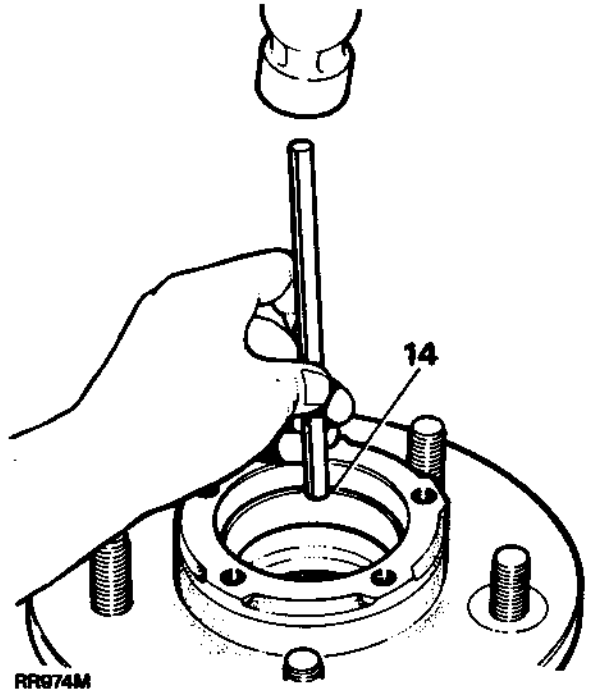
10. Degrease and examine the hub and brake disc and if necessary renew both or whichever part is unserviceable. The disc is attached to the hub with five bolts. Mark the relationship of the hub to the disc if the original parts are to be reassembled.



11. Examine the stub axle and in particular check that the inner seal track is smooth and free from blemishes.
12. If necessary remove the six retaining bolts and remove the stub axle complete with the mudshield and joint washer.

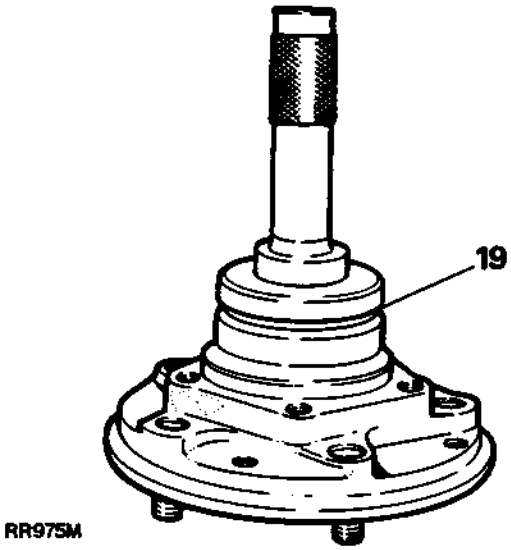
Assemble

13. Using a new joint washer fit the stub axle and mud shield. Coat the threads of the retaining bolts with Loctite 270 and tighten evenly to the correct torque.
14. Fit the new inner and outer bearing cups to the hub.
15. Fit the new inner bearing cone and pack with one of the recommended hub greases.



Fitting new oil seal—inner

16. Clean the hub oil seal housing and ensure that the seal locating surface is smooth and the chamfer on the leading edge is also smooth and free from burrs.
17. Examine the new seal and ensure that it is clean and undamaged and that the garter spring is properly located. Even a small scratch on the seal lip could impair its efficiency.
18. Although the new seal is already pre-greased by the manufacturer, apply one of the recommended hub bearing greases to the outside diameter of the seal before fitting, taking care not to damage the lip.
19. Place the seal, lip side leading, squarely on the hub and using the 76 mm end of seal replacer tool LST 550-5 and drift 550 or 18G 134, drive the seal into position, flush with the end face of the hub.



Fitting outer oil seal

20. Fit the new outer bearing cone and pack with one of the recommended hub greases.

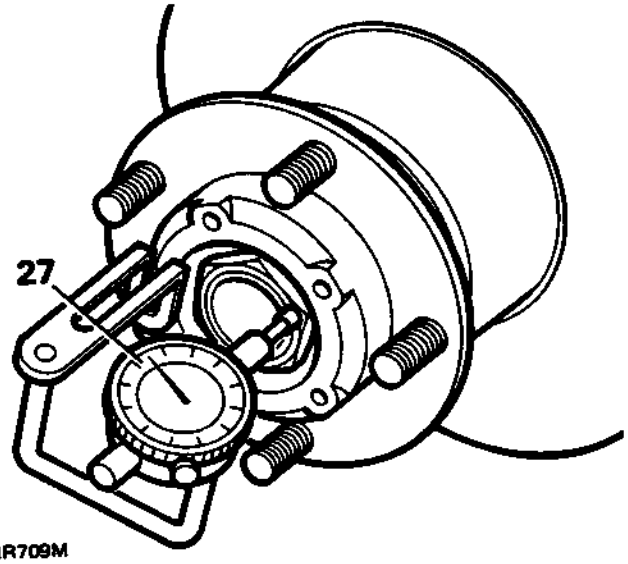
    Carry out instructions 16 to 18.

21. Place the seal, lip side leading, squarely on the hub and using the 72 mm end of seal replacer tool LST 550-5 and drift 550 or 18G 134, drive the seal into position to the depth determined by the tool.
22. Smear the lips of both seals with one of the recommended greases. This is important since a dry seal can be destroyed during the first few revolutions of the hub.

Continued

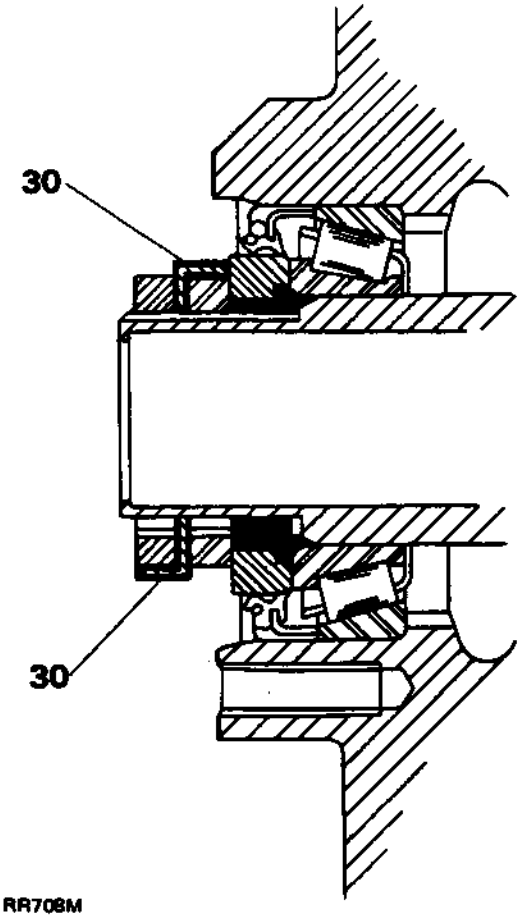
Fitting hub to stub axle

23. Select a new seal track spacer and check that the outer diameter is smooth and free from blemishes and that there are no burrs on the chamfered leading edge.
24. Taking care not to damage the seal lips fit the hub assembly to the stub axle. Do not allow the weight of the hub to rest even temporarily on the outer seal otherwise damage and distortion could occur. Therefore hold the hub clear of the stub axle until the seal track spacer is fitted.
25. Carefully fit the seal track spacer, seal lip leading.
26. Fit the hub inner nut and using spanner 606435 tighten the adjusting nut whilst slowly revolving the hub until all end-float is removed, then back-off the nut approximately half a turn.
27. Mount a dial test indicator and bracket on the hub so that the stylus rests in a loaded condition on the nut. Check the end-float which must be 0,013 to 010 mm (0.0005 to 0.004 in). Adjust the nut as necessary to achieve this.



RR709M

28. Fit the lock washer and locknut and tighten against the adjusting nut.
29. Rotate the hub several times to settle the bearings then re-check the end-float.
30. Bend one segment of the lock washer over the adjusting nut and another, diametrically opposite, over the locknut taking care not to damage the outer seal.

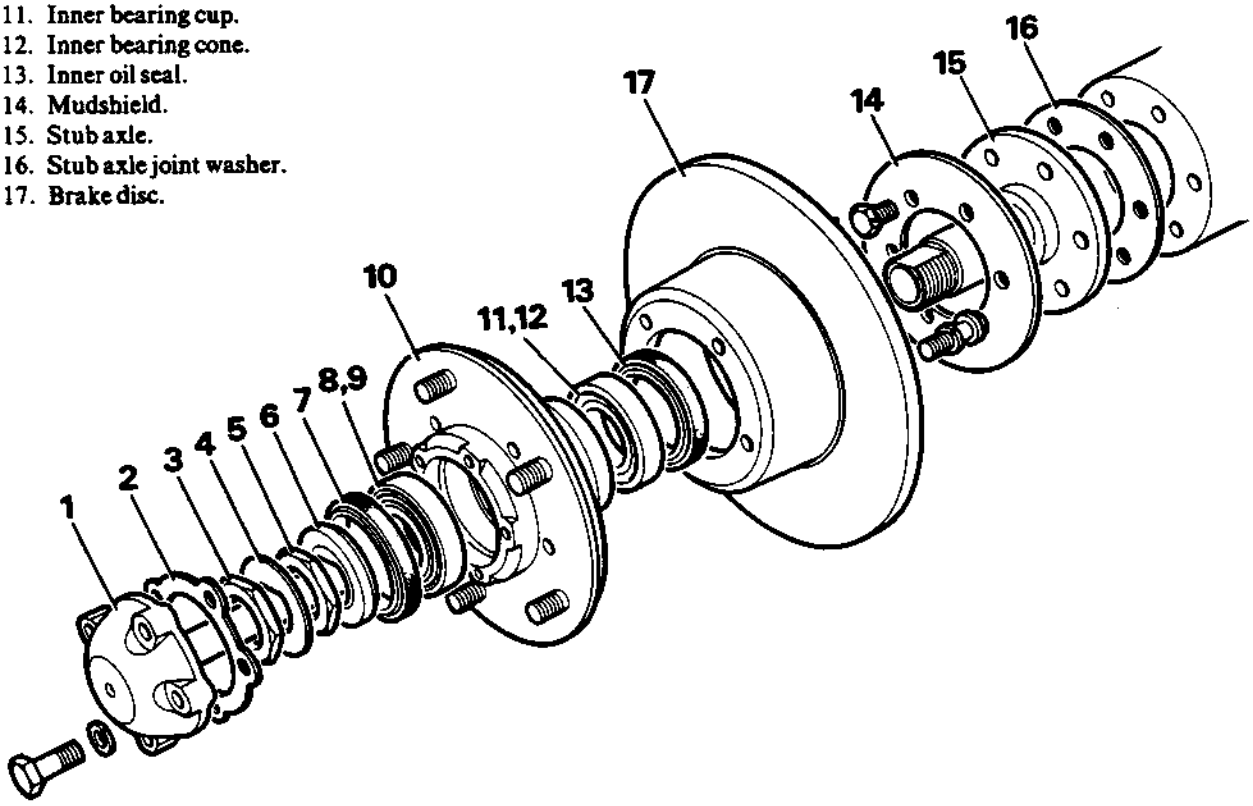


RR708M

31. Using a new joint washer, fit the hub driving shaft and evenly tighten the retaining bolts to the correct torque.
32. Fit the brake caliper and secure with the retaining bolts and tighten to the correct torque. Secure the brake pipes to the axle casing.
33. Fit the road wheels, jack-up the vehicle, remove the axle stands, lower the vehicle to the ground and tighten the road wheel nuts evenly to the correct torque.

KEY TO REAR HUB COMPONENTS

1. Rear axle shaft.
2. Joint washer.
3. Locknut.
4. Lock washer.
5. Adjusting nut.
6. Seal track spacer.
7. Outer oil seal.
8. Outer bearing cone.
9. Outer bearing cup.
10. Hub.
11. Inner bearing cup.
12. Inner bearing cone.
13. Inner oil seal.
14. Mudshield.
15. Stub axle.
16. Stub axle joint washer.
17. Brake disc.



RR706M

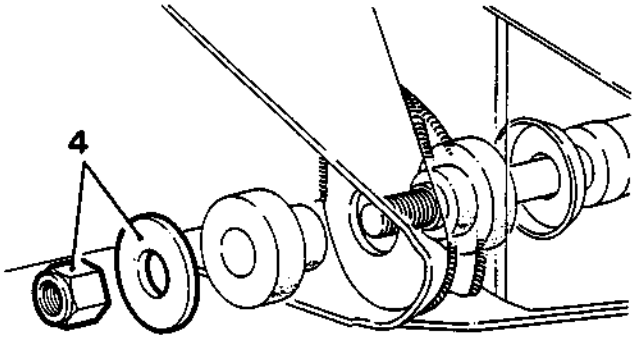
FRONT AXLE ASSEMBLY

Remove and refit

Removing

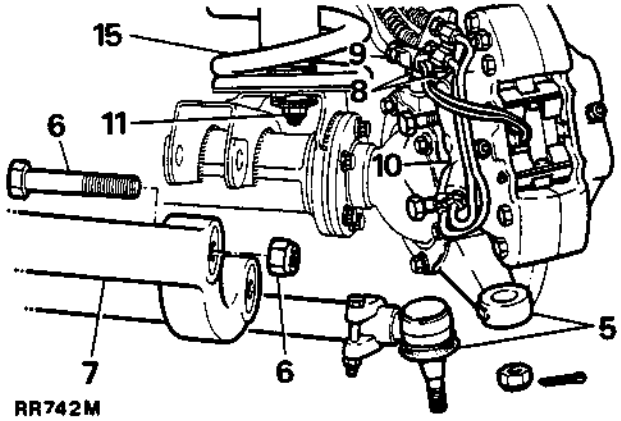
Note: The removal of the axle from the vehicle will require the assistance of two further personnel to steady the axle when lowering from the vehicle.

1. Jack up the front of the vehicle and support the chassis.
2. Remove the front road wheels.
3. Support the axle weight with a suitable hydraulic jack.
4. Remove the nuts securing the radius arms to the chassis side members.



RR983M

5. Disconnect the steering damper at the track rod and using a suitable extractor remove the track rod complete from the hub arms.
6. Remove the four nuts and bolts securing the radius arms to the axle brackets.
7. Lower the radius arms and withdraw them from the chassis side members.
8. Remove the two bolts from the top of the swivel pin housings securing the brake pipe brackets. Remove the brackets and refit the bolts to prevent oil leakage.
9. Disconnect the brake pad wear electrical multi-plug at the rear of the caliper (where applicable).
10. Remove the bolts securing the brake calipers and tie the calipers to one side.
11. Remove the nuts and washers securing the shock absorbers to the axle.
12. Using a suitable extractor disconnect the drag link from the hub arm.
13. Remove the two nuts and bolts securing the panhard rod to the axle bracket and lift the rod clear of the axle.
14. Mark the differential and propeller shaft drive flanges with identification marks to aid re-assembly. Remove the four nuts and bolts, tie the propeller shaft to one side.
15. Carefully lower the axle assembly and remove the road springs.
16. Withdraw the axle assembly.



RR742M

Refitting

17. Position the axle under the vehicle, supporting the left hand side of the axle.
18. Reverse the removal instructions.
19. Tighten the propeller shaft to differential bolts to the specified torque.
20. Tighten the panhard rod to axle bracket to the specified torque.
21. Tighten the drag link to hub arm to the specified torque.
22. Tighten the upper swivel pin retaining bolts to the specified torque.
23. Tighten the radius arms to axle bolts to the specified torque.
24. Tighten the radius arms to chassis side member nuts to the correct torque.
25. Tighten the track rod end to the specified torque and fit a **NEW** split pin.

FRONT DIFFERENTIAL—OVERHAUL

The front and rear differentials fitted to Range Rover are the same type. When overhauling the front differential refer to the rear differential overhaul procedure in section 51 of this manual.

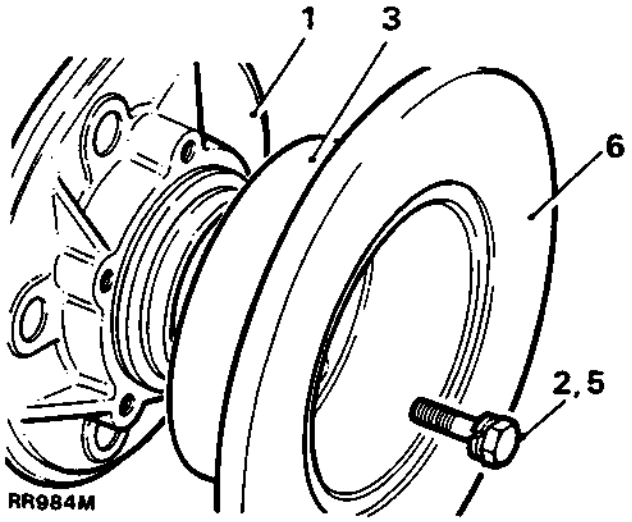
FRONT DISCS

Remove and refit

Removing

1. Remove the front hub assembly.
2. Remove the front disc fixing bolts.
3. Tap the disc off the front hub.

Continued



RR984M

Refitting

4. Locate the disc onto the front hub.
5. Fit the disc fixing bolts. See 'Data section' for tightening torques.
6. Using a dial test indicator, check the total disc run-out, this must not exceed 0,15 mm (0.006 in.). If necessary, reposition the disc.
7. Fit the front hub assembly.

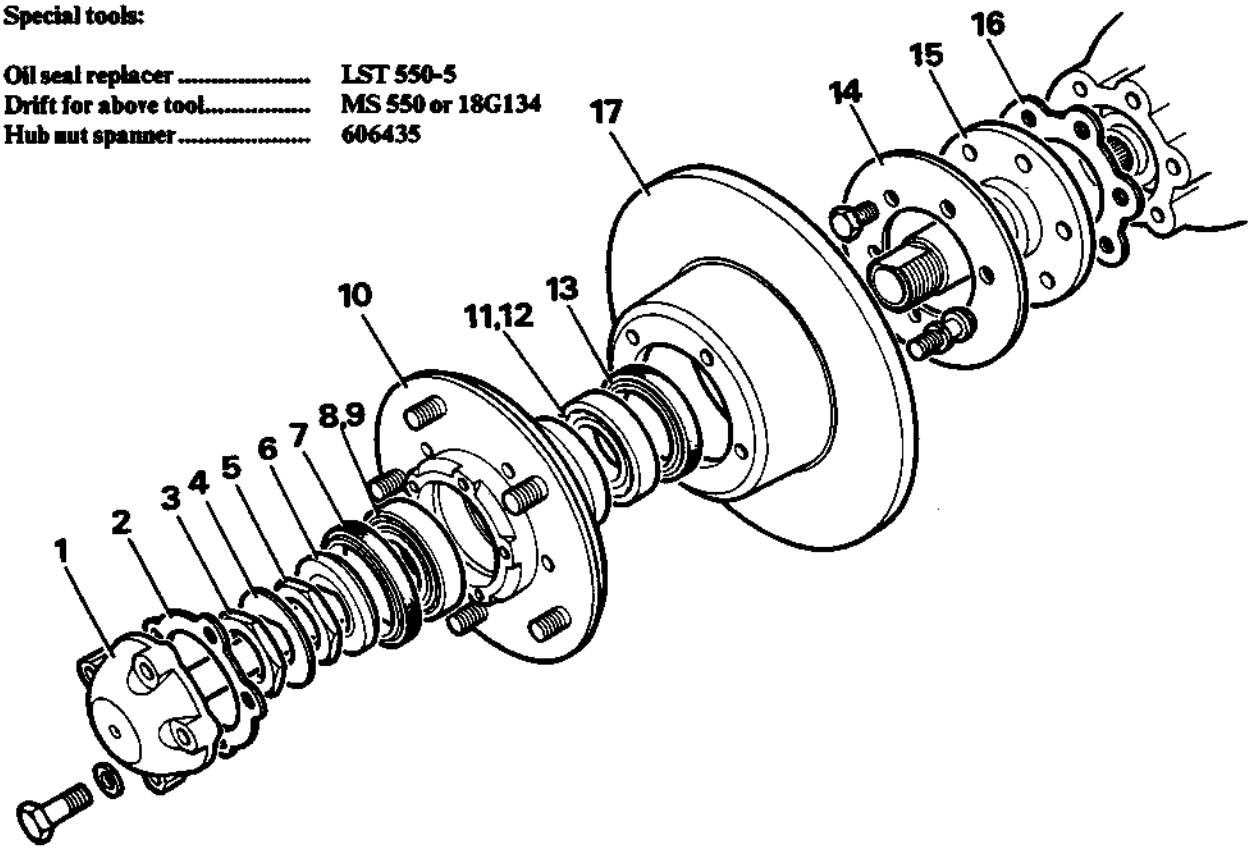
REMOVE AND OVERHAUL FRONT HUB

Special tools:

Oil seal replacer	**LST 550-5**
Drift for above tool	**MS 550 or 18G134**
Hub nut spanner	**606435**

KEY TO FRONT HUB COMPONENTS

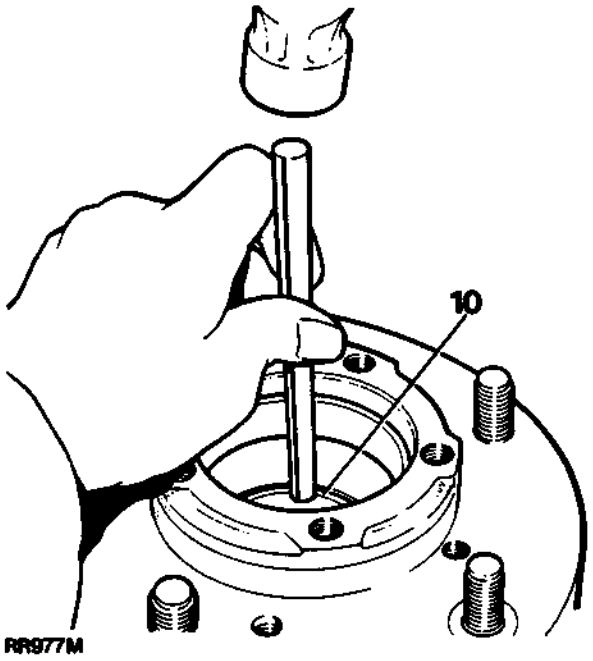
1. Hub driving shaft.
2. Joint washer.
3. Locknut.
4. Lock washer.
5. Adjusting nut.
6. Seal track spacer.
7. Outer oil seal.
8. Outer bearing cone.
9. Outer bearing cup.
10. Hub.
11. Inner bearing cup.
12. Inner bearing cone.
13. Inner oil seal.
14. Mudshield.
15. Stub axle.
16. Stub axle joint washer.
17. Brake disc.



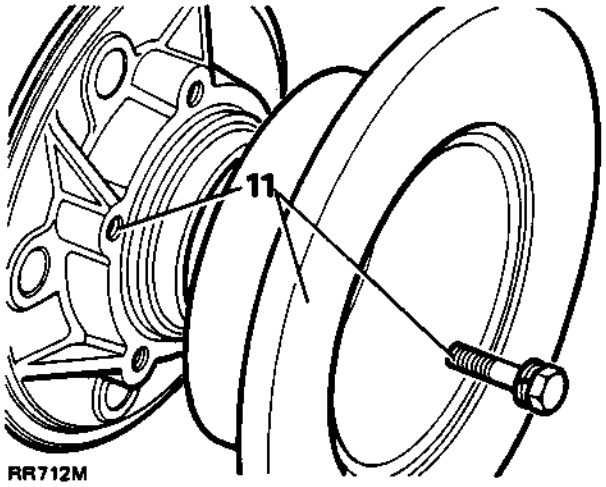
RR707M

Remove

1. Jack-up the vehicle, lower on to axle stands and remove the road wheels.
2. Remove the swivel housing top bolt to release the brake hose bracket.
3. Remove the brake caliper retaining bolts and release the assembly from the brake disc and secure to one side.
4. Remove the five bolts retaining the hub driving shaft and withdraw the shaft from the hub.
5. Bend back the lock-tab and remove the outer nut using spanner 606435 and remove the locker. Similarly, remove the inner nut.
6. Remove the seal track spacer.
7. Withdraw the hub complete with bearings, oil seals and brake disc.
8. Remove the inner and outer oil seals.
9. Remove the inner and outer bearing cones.
10. Drift-out the inner and outer bearing cups.

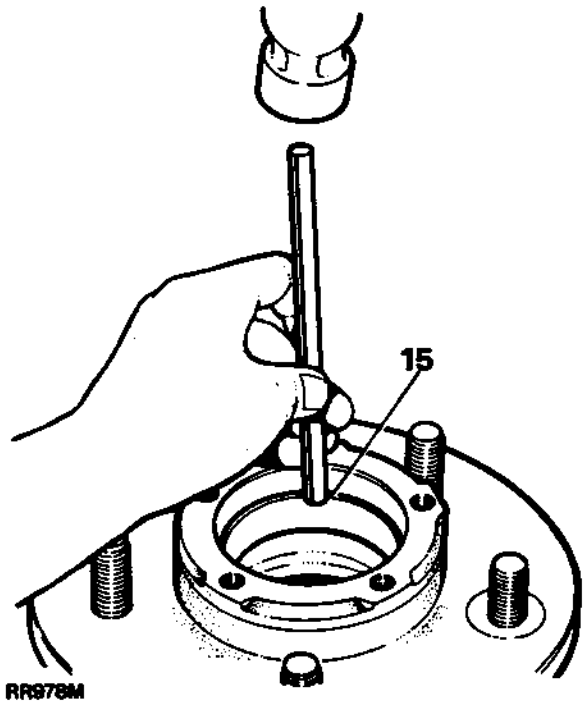


11. Degrease and examine the hub and brake disc and renew both or whichever part is unserviceable. The brake disc is attached to the hub by five bolts. Mark relation of hub to disc before separating.
12. Clean and examine the stub axle and in particular check that the inner seal track diameter is smooth and free from blemishes.
13. If necessary remove the retaining bolts and withdraw the stub axle. Complete with the mudshield and joint washer.



Assemble

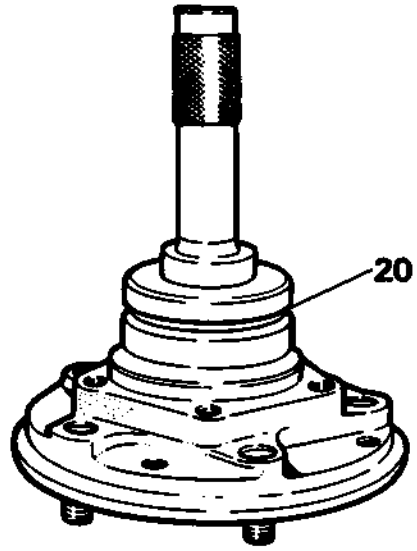
14. Using a new joint washer fit the stub axle and mudshield. Coat the threads of the retaining bolts with Loctite 270 and tighten evenly to the correct torque.
15. Fit the new inner and outer bearing cups to the hub.
16. Fit the new inner bearing cone and pack with one of the recommended hub greases.



Continued

Fitting new oil seal—inner

17. Clean the hub oil seal housing and ensure that the seal locating surface is smooth and the chamfer on the leading edge is also smooth and free from burrs.
18. Examine the new seal and ensure that it is clean and undamaged and that the garter spring is properly located. Even a small scratch on the seal lip could impair its efficiency.
19. Although the new seal is already pre-greased by the manufacturer, apply one of the recommended hub bearing greases to the outside diameter of the seal before fitting.
20. Place the seal, lip side leading, squarely on the hub and using the 76 mm end of seal replacer tool LST 550-5 and drift 550 or 18G 134, drive the seal into position flush with the end face of the hub.



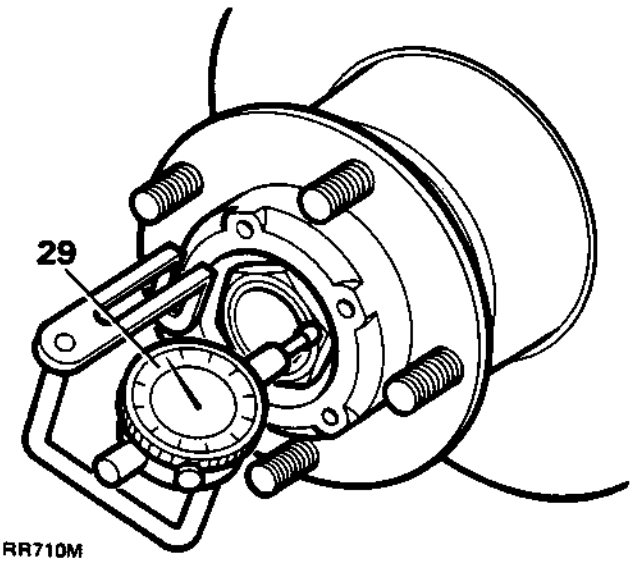
RR979M

Fitting outer oil seal

21. Fit the new outer bearing cone and pack with one of the recommended hub greases.
22. Carry out instructions 17 to 19.
23. Place the seal, lip side leading, squarely on the hub and using the 72 mm end of seal replacer tool LST 550-5 and drift 550 or 18G 134, drive the seal into position to the depth determined by the tool.
24. Smear the lips of both seals with one of the recommended greases. This is important since a dry seal can be destroyed during the first few revolutions of the hub.

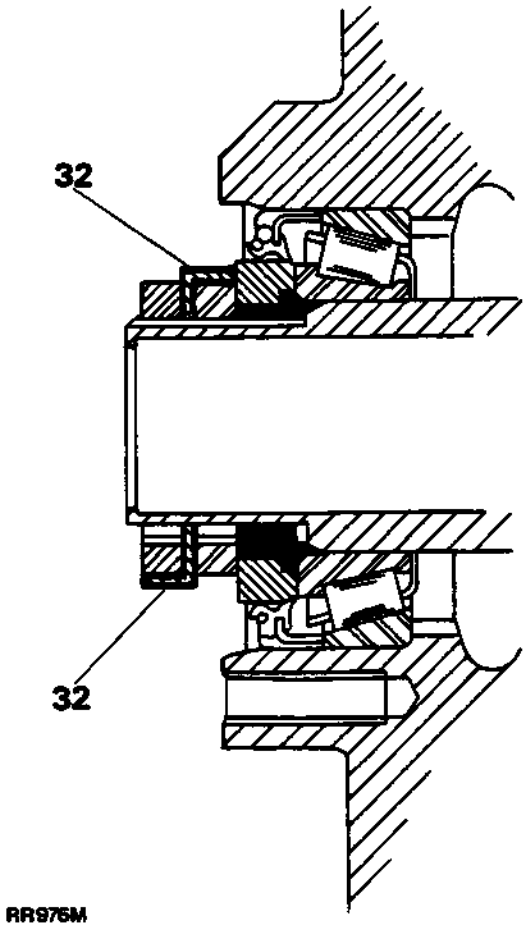
Fitting hub to stub axle

25. Select a new seal track spacer and check that the outer diameter is smooth and free from blemishes and that there are no burrs on the chamfered leading edge.
26. Taking care not to damage the seal lips fit the hub assembly to the stub axle. Do not allow the weight of the hub to rest even temporarily on the outer seal otherwise damage and distortion could occur. Therefore hold the hub clear of the stub axle until the seal track spacer is fitted.
27. Carefully fit the seal track spacer, seal lip leading.
28. Fit the hub inner nut and using spanner 606435 tighten the adjusting nut whilst slowly revolving the hub until all end-float is removed then back-off the nut approximately half a turn.
29. Mount a dial test indicator and bracket on the hub so that the stylus rests in a loaded condition on the nut. Check the end-float which must be 0,013 to 010 mm (0.0005 to 0.004 in). Adjust the nut as necessary to achieve this.



RR710M

30. Fit the locker tab and locknut and tighten against the adjusting nut.
31. Rotate the hub several times to settle the bearings then re-check the end-float.
32. Bend one segment of the locker over the adjusting nut and another, diametrically opposite, over the locknut.
33. Using a new joint washer, fit the hub driving shaft and evenly tighten the retaining bolts to the correct torque.
34. Fit the brake caliper and secure with the retaining bolts and tighten to the correct torque.
35. Fit the swivel housing top bolt and brake hose bracket and tighten to the correct torque.
36. Fit the road wheels, jack-up the vehicle, remove the axle stands, lower the vehicle to the ground and tighten the road wheel nuts evenly to the correct torque.



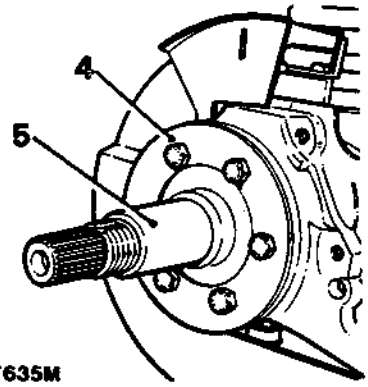
RR976M

OVERHAUL STUB AXLE, AXLE SHAFT, CONSTANT VELOCITY JOINT AND SWIVEL ASSEMBLY

Special tool: 18G 284AAH bush extractor

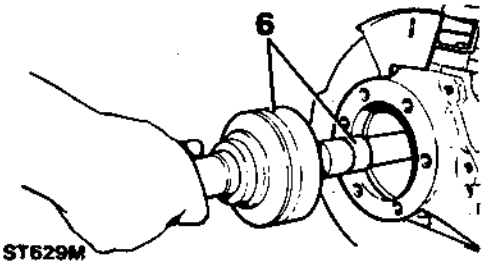
Remove stub axle, axle shaft and constant velocity joint

1. Remove the hub complete as described in the operation to overhaul the hub assembly instructions 1 to 14.
2. Drain the swivel pin housing and refit plug.
3. Remove the six bolts retaining the stub axle to the swivel housing.
4. Remove the mud shield.
5. Remove the stub axle and joint washer.



ST635M

6. Pull-out the axle shaft and constant velocity joint from the axle casing.

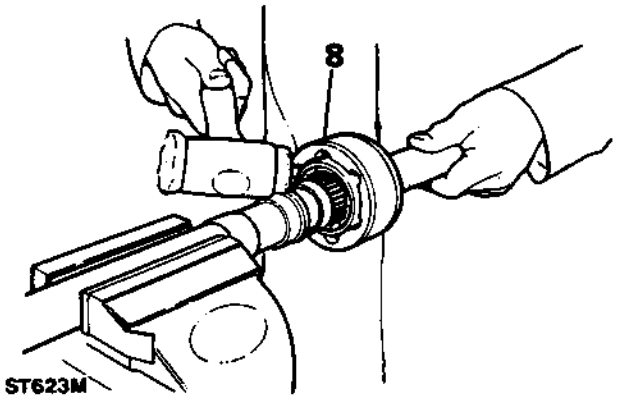


ST629M

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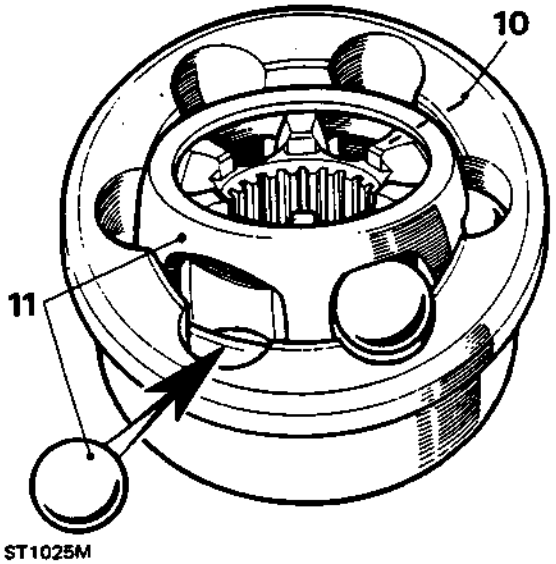
Remove constant velocity joint from axle shaft

7. Hold the axle shaft firmly in a soft jawed vice.
8. Using a soft mallet drive the constant velocity joint from the shaft.
9. Remove the circlip and collar from the axle shaft.

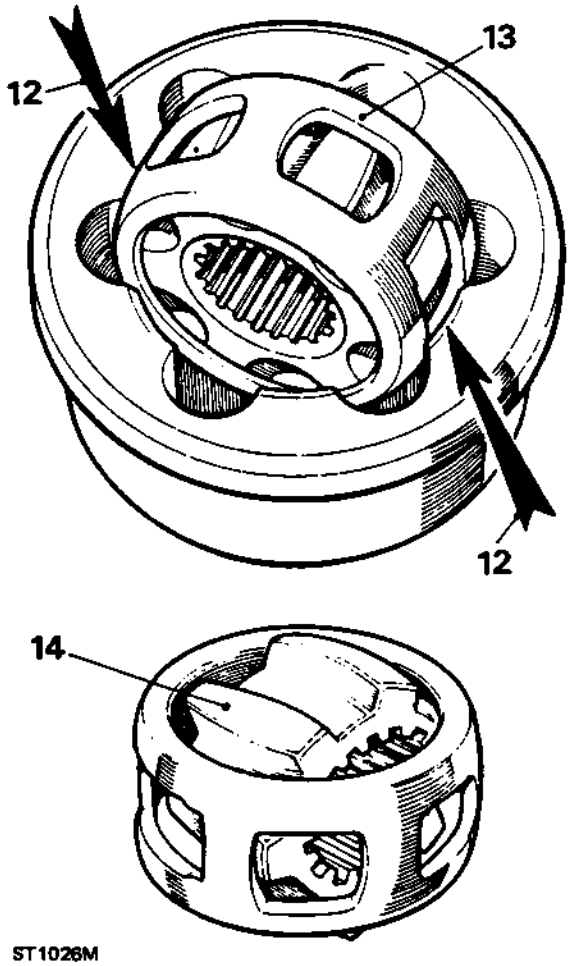


Dismantle the constant velocity joint

10. Mark the relative positions of the constant velocity joint inner and outer race and the cage for correct reassembly.
11. Tilt and swivel the cage and inner race to remove the balls.

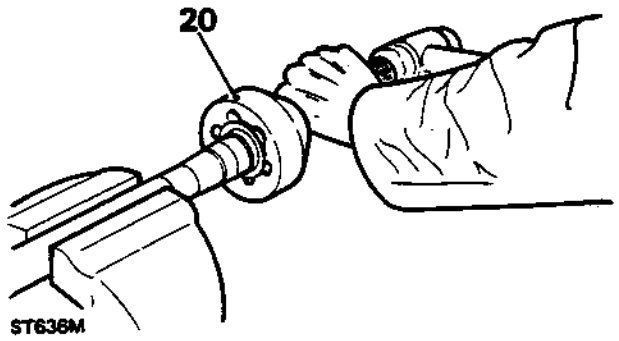


12. Swivel the cage into line with the axis of the joint and turn it until two opposite windows coincide with two lands of the joint housing.
13. Withdraw the cage.
14. Turn the inner track at right angles to the cage with two of the lands opposite the cage openings and withdraw the inner race.
15. The roller bearings must be a light push fit onto the swivel pins. If necessary, drive out the bearing outer tracks and press in replacements.
16. The surface of the bearing housing must be free of corrosion and damage.
17. Examine all components for general condition and examine the inner and outer track, cage balls and bearing surfaces of the constant velocity joint for damage and excessive wear. Maximum acceptable end-float on the assembled joint 0,64 mm (0.025 in).
18. To assemble the constant velocity joint reverse the dismantling instructions and lubricate with a recommended EP oil.



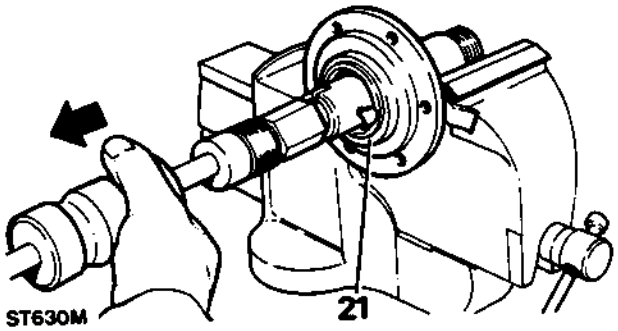
Fit constant velocity joint to axle

19. Fit the collar and new circlip.
20. Engage the constant velocity joint on the axle shaft splines and using a soft mallet, drive the joint home.



Renew stub axle intermediate oil seal and bush

21. To remove the bronze bush and oil seal use special tool 18G 284AAH and a slide hammer. Ensure that the fingers of the tool locate behind the oil seal so that the seal and bush are driven-out together.



22. With the cavity side leading and using a suitable tube, press-in a new intermediate oil seal and apply grease to the lip.
23. Using a suitable block, press or drive-in the bush up to the shoulder.

Remove swivel pin housing

24. Remove the brake disc shield secured by one nut and bolt at the bottom front, and one single bolt, behind the shield, in the swivel housing.
25. Disconnect the track-rod end ball joint from the housing.
26. Disconnect the drag-link ball joint.
27. Remove the seven bolts securing the swivel pin housing oil seal and retaining plate and joint washer and release the assembly from the swivel pin housing. Note that whilst the joint washer can be removed at this stage, the oil seal and retaining plate must remain until the swivel pin bearing housing is removed.
28. Remove the two bolts, complete with the brake disc shield bracket, securing the lower swivel pin to the housing.
29. Withdraw the lower swivel pin and joint washer by tapping the small protruding lug.
30. Remove the top swivel pin retaining bolts complete with the brake jump hose bracket.
31. Withdraw the top swivel pin and shims.
32. Remove the swivel pin housing whilst retrieving the lower taper bearing.
33. If the swivel pin housing is to be renewed, remove the drain and level plugs and lock-stop bolt and nut.

Remove swivel pin bearing housing

34. Remove the seven bolts securing the swivel pin bearing housing to the axle case and remove the housing and joint washer.
35. Remove and discard the swivel pin oil seal and joint washer.

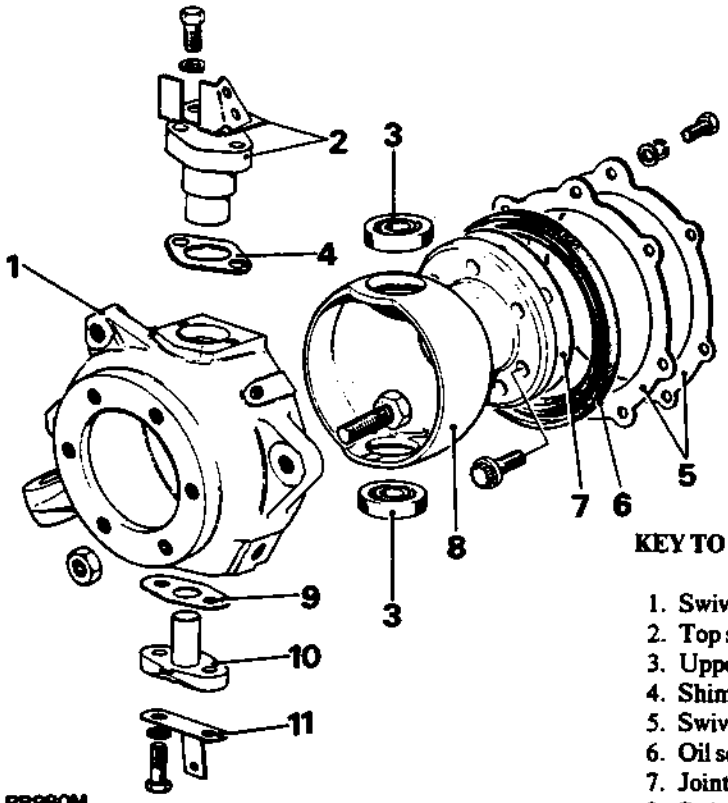
Overhaul swivel pin bearing housing

36. Prise-out the oil seal from the back of the housing.
37. Drift-out the lower swivel pin bearing track.
38. Drift-out the upper swivel pin bearing track.
39. If worn, pitted or damaged, renew the housing.
40. Press-in the lower swivel pin bearing track.
41. Press-in the upper swivel pin bearing track.
42. With the cavity side trailing press the axle shaft oil seal into the housing and grease.

Fit swivel pin bearing housing to axle

43. Coat the swivel pin bearing housing to axle casing bolts with Loctite 270.
44. Coat both sides of a joint washer and place in position on the swivel pin bearing housing to axle mating face.
45. Hang the swivel pin bearing housing oil seal, retainer and joint washer over the back of the housing.
46. Fit and secure the swivel pin bearing housing to the axle with the seven bolts tightening evenly to the specified torque.

Continued



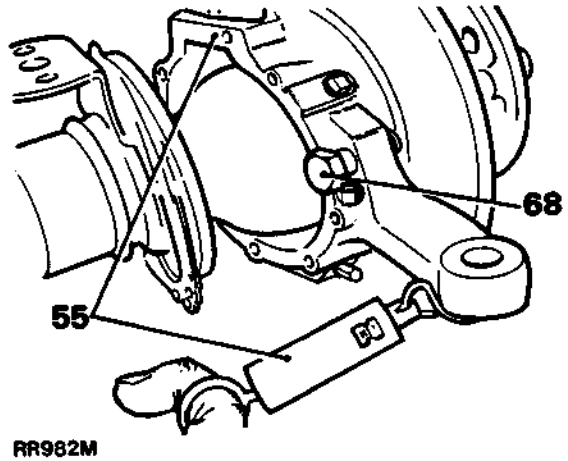
RR980M

KEY TO SWIVEL ASSEMBLY

1. Swivel pin housing.
2. Top swivel pin and jump hose bracket.
3. Upper and lower swivel pin bearings.
4. Shim.
5. Swivel pin bearing housing—oil seal plate and washer.
6. Oil seal.
7. Joint washer.
8. Swivel pin bearing housing.
9. Joint washer.
10. Lower swivel pin.
11. Brake disc mudshield bracket.

Fit swivel pin housing

47. Grease and fit the upper swivel pin bearing to the bearing housing.
48. Grease and place the lower swivel pin bearing onto the swivel pin housing.
49. Place the swivel pin housing in position over the swivel in bearing housing.
50. Coat a joint washer both sides with sealing compound and place in position on the lower swivel pin.
51. Fit the lower pin with lip outboard. Do not secure with bolts at this stage.
52. Fit the top swivel pin with existing shims and fit the securing bolts, jump hose bracket and locking washer (do not tighten the bolts at this stage).
53. Coat the threads of the lower swivel pin bolts with Loctite 270 and fit, together with the brake disc shield bracket, tighten the bolts to the specified torque and bend over the lock tabs of the mudshield bracket.
54. Tighten the top swivel pin securing bolts to the specified torque.
55. To check the top swivel pin pre-load attach a spring balance to the track-rod ball joint bore and pull the balance to determine the effort required to turn the swivel. The resistance, once the initial inertia has been overcome, should be 1,16 to 1,46 kg (2.6 to .2 lb). If necessary, adjust by removing or adding shims to the top swivel pin as required. When the setting has been achieved coat the bolts with Loctite 270 and re-tighten the bolts to the specified torque and bend over the lock tabs of the locking washer.



RR982M

56. Liberally apply—but do not pack—a recommended grease between the lips of the swivel oil seal (2,5 to 4,0 grams).
57. Secure the oil seal and joint washer with the retaining plate and securing bolts tightening evenly to the correct torque.
58. Fit the track-rod and drag link and secure with new split pins.
59. Fit the brake disc shield.
60. Loosely fit the lock stop bolt and nut for later adjustment.

Fit drive shaft and stub axle

61. Place a new joint washer in position on the swivel pin housing to stub axle mating face.
62. Taking care not to damage the axle shaft oil seals, insert the axle shaft, and when the differential splines are engaged, push the assembly home.
63. Fit the stub axle with the keyway uppermost at 12 o'clock. At this stage it is most important to ensure that the constant velocity joint bearing journal engages fully into the bronze bush in the rear of the stub axle before the stub axle is secured with bolts. Damage to the bush can occur if this precaution is not observed. To ensure proper engagement, grasp the stub axle with one hand and with the other pull the axle shaft into the bush. The shaft and bush are correctly engaged when the end of the axle shaft splines are flush with the end of the stub axle. This condition must be maintained during all ensuing assembly operations.
64. Place the mudshield in position and secure the stub axle to the swivel pin housing with the six bolts using Loctite 270 and evenly tighten to the specified torque.
65. To complete the reassembly, follow instructions 25 to 41 covering front hub overhaul.
66. Check that the swivel pin housing drain plug is tightly fitted and remove the filler and level plug.
67. Inject approximately 0.35 litre (0.6 pint) of recommended EP oil until the oil begins to run out of the level hole. Fit and tighten the plug and wipe away any surplus oil.
68. Set the steering lock-stop bolts to provide a minimum clearance of 40,5 mm (1.59 in) between the tyre wall and radius arm. Tighten the locknut.

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—Brakes 2

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STEERING DATA

STEERING

Power steering

Make/type ..... Adwest Varamatic/linkage
Ratio ..... Variable: straight ahead 17.5:1
Steering wheel turns, lock-to-lock 3.375
Steering wheel diameter ..... 431,8 mm (17 in)
Front wheel alignment ..... 1,2 to 2,44 mm (0.046 to 0.093 in) toe out
Camber angle ..... 0°
Castor angle ..... 3°
Swivel pin inclination ..... 7°

Check with vehicle in static unladen condition, that is, vehicle with water, oil and five gallons of fuel. Rock the vehicle up and down at the front to allow it to take up a static position.

ROAD SPRING DATA

† Specification	*Part Number*	*Colour Code*	*Rating*	*Free Length*	*No. of Coils*
A	572315	Blue Stripe	2375.1 kg/m (133 lb/in)	391.16 mm (15.4 in)	7.18
B	NRC4306	Blue & White Stripe	2375.1 kg/m (133 lb/in)	417.57 mm (16.44 in)	7.55
C	NRC8113	Pink & Purple Stripe	3182.1 kg/m (178.2 lb/in)	418.36 mm (16.47 in)	8.75
D	NRC8477	Green & Pink Stripe	3182.1 kg/m (178.2 lb/in)	461.67 mm (18.176 in)	8.75
E	NRC2119	Green Stripe	2678.7 kg/m (150 lb/in)	409.70 mm (16.13 in)	7.63
F	NRC4305	Red & Yellow Stripe	2678.7 kg/m (150 lb/in)	436.4 mm (17.18 in)	7.65

Standard Suspension	*† Specification*		*Heavy Duty Suspension*	*† Specification*	
	Right Side	*Left Side*		*Right Side*	*Left Side*
RHD Front	A	A	RHD Front	E	E
LHD Front	A	B	LHD Front	E	F
RHD Rear	C	C			
LHD Rear	C	*D			

* Specification 'C' spring fitted to early production vehicles.

SHOCK ABSORBERS (DAMPERS)

Type	Telescopic, double-acting non-adjustable
Bore diameter	35.47 mm (1.375 in)

SUSPENSION—All Models

Type	Coil springs controlled by telescopic dampers front and rear
Front	Transverse location of axle by Panhard rod, and fore and aft location by two radius arms
Rear	Fore and aft movement inhibited by two tubular trailing links. Lateral location of axle by a centrally positioned 'A' bracket bolted at the apex to a ball joint mounting. A levelling unit is positioned between the ball joint and upper cross member

BRAKES

Foot brake

Type	Disc
Operation	Hydraulic, servo assisted, self-adjusting

Front brake

Type	Outboard discs with four pistons
Disc diameter	298.17 mm (11.75 in)
Total pad area	381 cm^2 (15 in^2)
Total swept area	4193.5 cm^2 (650.7 in^2)
Pad material	DON 230
Pad wear indicator	Inboard pad right-hand caliper

Rear brake

Type	Outboard discs with two pistons
Disc diameter	290.0 mm (11.42 in)
Total pad area	317.34 cm^2 (49.2 in^2)
Total swept area	3199.2 cm^2 (496 in^2)
Pad material	DON 230
Pad wear indicator	Inboard pad left-hand caliper

Handbrake

Type	Transmission drum brake—cable operated
Drum diameter	254 mm (10 in)
Width	70 mm (2.75 in)
Lining material	DON 269

STEERING

	Nm	lbf ft
Clamp bolt nuts	14	10
Ball joint nuts	40	30
Universal joint pinch bolt	35	26
Drop arm nut	176	130
Steering wheel nut	38	28
Sector shaft cover to steering box	22 to 27	16 to 20
Tie bar to steering box	81	60
Steering box to chassis	81	60
Power steering pump mounting	35	26
Flow control valve cap, power steering pump	40 to 47	30 to 35
Power steering pump cover to body screws	20 to 23	15 to 17
Pulley bolt, power steering pump	14 to 16	10 to 12
Union bolt, inlet adaptor, power steering pump	38 to 41	28 to 30
Steering column bracket nuts	27	20

FRONT SUSPENSION

Drag link to axle	40	30
Securing ring for mounting turret	13.5	10
Radius arm to axle/chassis	176	130
Mounting arm to chassis	89	65
Panhard rod to axle	89	65
Panhard rod to mounting bracket	89	65
Tie bar to Panhard rod	81	60

REAR SUSPENSION

Levelling unit to rear axle	176	130
Top link to levelling unit	115	85
Top link to mounting bracket	176	130
Upper joint to levelling unit	34	25
Lower joint to levelling unit	34	25
Bottom link to axle	176	130
Bottom link to chassis	127	90
Top link bracket to rear cross member	47	35
Levelling unit to cross member	47	35
Shock absorber to axle	52	40

BRAKES

Brake pipe connections to:		
—Brake calipers	12	9
—Jump hoses to brackets	11–13.5	8–10
—Jump hose to three-way connection	12	9
—Front caliper jump hoses	11–13.5	8–10
—Rear caliper jump hoses	11–13.5	8–10
—Jump hoses to calipers (all)	12	9
PDWA switch	1.4–1.7	1–1.3
Master cylinder to servo	13.6–17	10–12.5
Brake caliper to swivel pin housing	75–88	55–65
Handbrake linkage to transfer box	26–32	19–24
Brake disc to hubs	65–80	48–59

	Nm	lbf in
Bleed screws	9–11	80–100
Support plate and tube to valve body (servo)	2–3	16–20
Separator shell to valve body (servo)	13.5–17	120–150
Clamp ring to servo	1–1.6	10–15

ROAD WHEELS

Wheel nuts	Nm	lbf ft
Alloy wheels	122–129	90–95
Steel wheels	102–115	75–85

BODY

Rear seat belt inertia reel to body	68–81	50–60
Rear seat belt guide bracket to body	20–27	15–20

POWER STEERING BOX

Remove and refit

Service tools:
Ball joint extractor—18G1063
Drop arm extractor—MS252A

NOTE: It is important that whenever any part of the system, including the flexible piping, is removed or disconnected, that the utmost cleanliness is observed.

All ports and hose connections should be suitably sealed off to prevent ingress of dirt, etc. If metallic sediment is found in any part of the system, the complete system should be checked, the cause rectified and the system thoroughly cleaned.

Under no circumstances must the engine be started until the reservoir has been filled. Failure to observe this rule will result in damage to the pump.

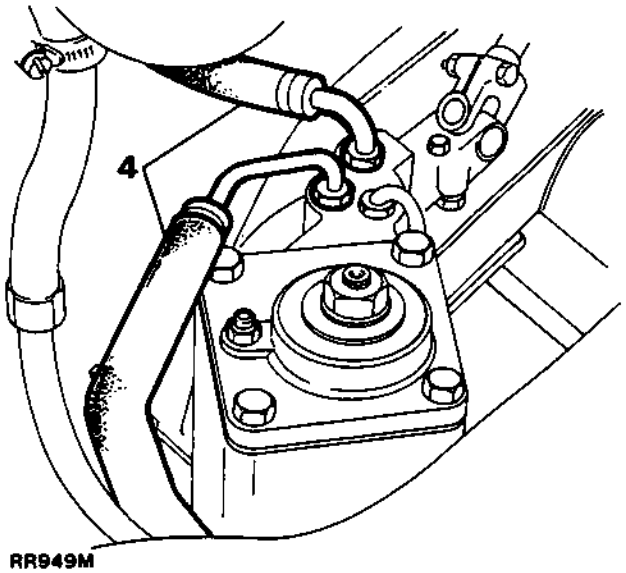
Metric pipe fittings are now used with 'O' ring pipe ends on the fittings to the steering box.

Follow normal 'O' ring replacement procedure whenever pipes are disconnected.

Ensure that compatible metric components are used when fitting replacement pipes.

Removing

1. Park the vehicle on level ground.
2. Prop open the bonnet.
3. Remove the filler cap from the power steering fluid reservoir. Disconnect the pipes from the pump. Drain and discard the fluid. Replace the filler cap.
4. Disconnect the flexible hoses from the steering box.

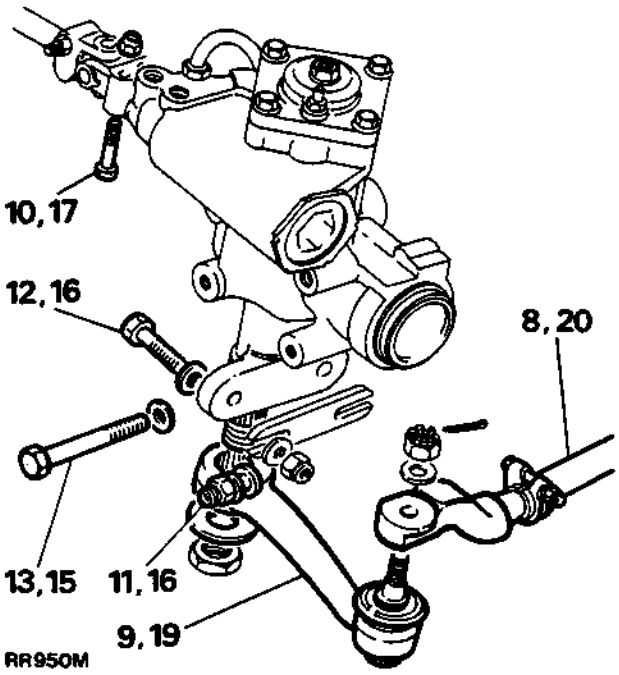


RR949M

5. Blank off all disconnected hose connections to prevent ingress of foreign matter.
6. Jack up and support the chassis front end. Alternatively, raise the vehicle on a ramp.

   WARNING: Whichever method is adopted, it is essential that the wheels are chocked and the handbrake applied.

7. Right-hand drive vehicles only—disconnect the lead from the oil pressure switch.
8. Uncouple the drag link and remove, using ball joint extractor 18G1063.
9. Remove the drop arm, using drop arm extractor MS252A.



RR950M

10. Remove the pinch bolt attaching the universal joint to the power steering box.
11. Slacken the nut securing the tie bar to the chassis.
12. Remove the bolts securing the tie bar to the steering box and move the tie bar aside.
13. Remove the fixings attaching the power steering box to the chassis side member.
14. Withdraw the power steering box.

continued

Refitting

15. Refit the steering box to the chassis side member and tighten the four Nyloc nuts to the correct torque.
16. Refit the tie bar to the steering box, and tighten the tie bar securing nut to the correct torque.
17. Reconnect the pinch bolt, attaching the universal joint to the power steering box, and tighten to the correct torque.
18. Reconnect the lead to the oil pressure switch.
19. Refit the drop arm.
20. Refit the drag link and secure.
21. Lower the vehicle to ground level.
22. Remove the blanking plugs and reconnect the flexible hoses to the steering box.
23. Remove the blanking plug and refit the flexible hose to the power steering pump.
24. Ensure that the steering wheel is correctly aligned when the wheels are in the straight-ahead position.

    NOTE: It may be necessary to remove the steering wheel and reposition on the splines to obtain this condition. See steering wheel—remove and refit.

25. Remove the filler cap from the power steering fluid reservoir. Fill the reservoir to the oil level mark with the recommended fluid (see Section 09) and bleed the power steering system. See power steering system—bleed.
26. Check the fluid level and replace the filler cap.
27. Check, and if necessary, adjust the steering box.
28. Test the steering system for leaks, with the engine running, by holding the steering hard on full lock in both directions.

    CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals.

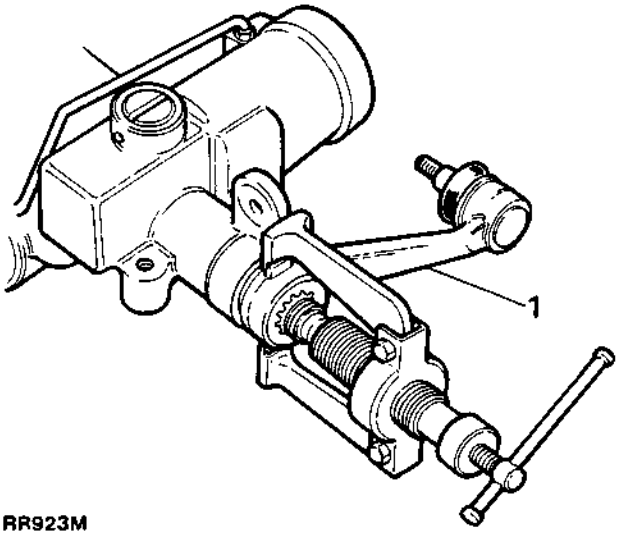
29. Close the bonnet.
30. Road test the vehicle.

POWER STEERING BOX OVERHAUL

Service tools:
'C' Spanner—LST120
Worm adjusting socket—LST119
Drop arm extractor—MS252A
Ring expander—606602
Ring compressor—606603
Seal saver, sector shaft—606604
Seal saver, valve and worm—R01015
Torque setting tool—R01016

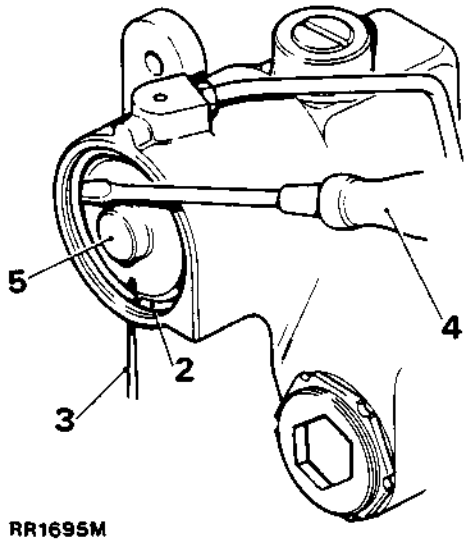
Dismantle

1. Remove the steering box from the vehicle, and withdraw the drop arm.



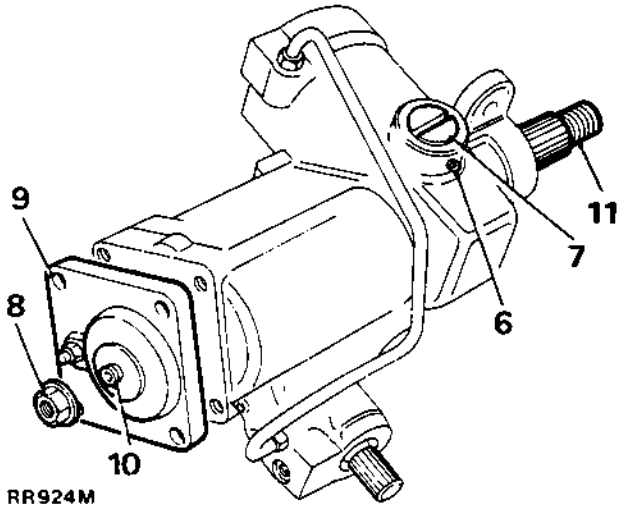
RR923M

2. Rotate the retainer ring, as necessary, until one end is approximately 12 mm (0.500 in) from the extractor hole.
3. Lift the cover retaining ring from the groove in the cylinder bore, using a suitable pointed drift applied through the hole provided in the cylinder wall.
4. Complete the removal of the retainer ring, using a screwdriver.
5. Turn on left lock (LH steering) until the piston pushes out the end cover (for RH steering models, turn on right lock).



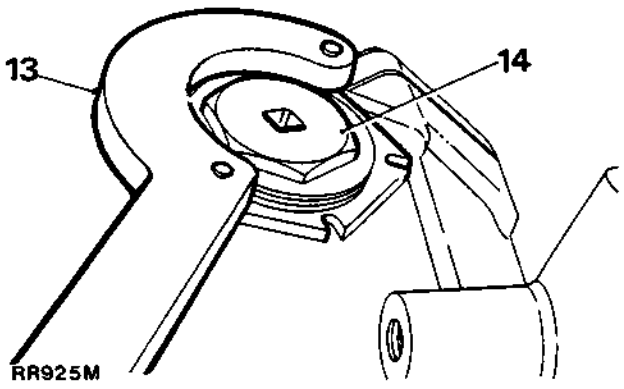
RR1695M

6. Slacken the grub screw retaining the rack pad adjuster.
7. Remove the rack pad adjuster.
8. Remove the sector shaft adjuster locknut.
9. Remove the sector shaft cover fixings.
10. Screw in the sector shaft adjuster until the cover is removed.
11. Slide out the sector shaft.



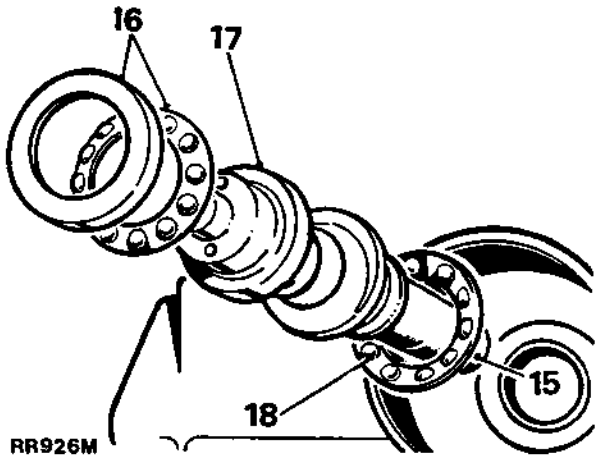
RR924M

12. Withdraw the piston, using a suitable bolt screwed into the tapped hole in the piston.
13. Remove the worm adjuster locknut using 'C' spanner, LST120.
14. Remove the worm adjuster using socket LST119.



RR925M

15. Tap the splined end of the spindle shaft to free the bearing.
16. Withdraw the bearing cup and caged ball bearing assembly.



RR926M

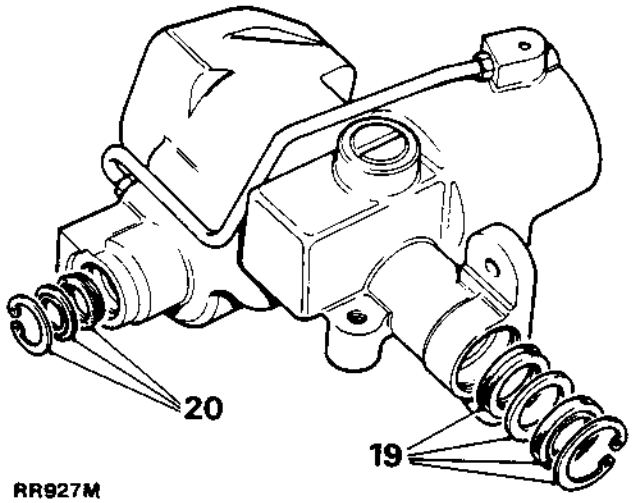
17. Withdraw the valve and worm assembly.
18. Withdraw the inner bearing ball race and shims. Retain the shims.

Continued

Steering box seals

19. Remove the circlip and seals from the sector shaft housing bore.

NOTE: Do not remove the sector bush unless replacement is required. Refer to instruction 22.



RR927M

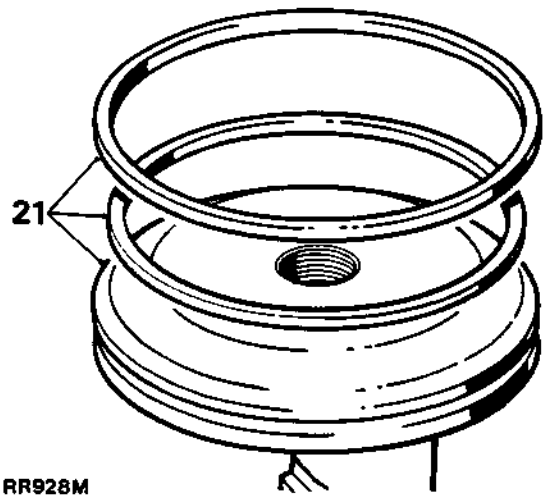
20. Remove the circlip and seals from the input shaft housing bore.

NOTE: Do not remove the input shaft needle bearing unless replacement is required.

Inspecting

21. Discard all rubber seals and provide replacements.

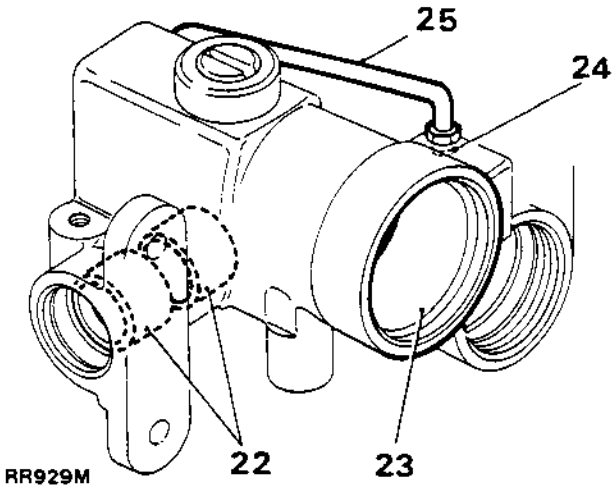
NOTE: A rubber seal is fitted behind the plastic ring on the rack piston. Discard the seal also the plastic ring and provide replacements.



RR928M

Steering box casing

22. If necessary, replace the sector shaft bush, using suitable tubing as a drift.
23. Examine the piston bore for traces of scoring and wear.

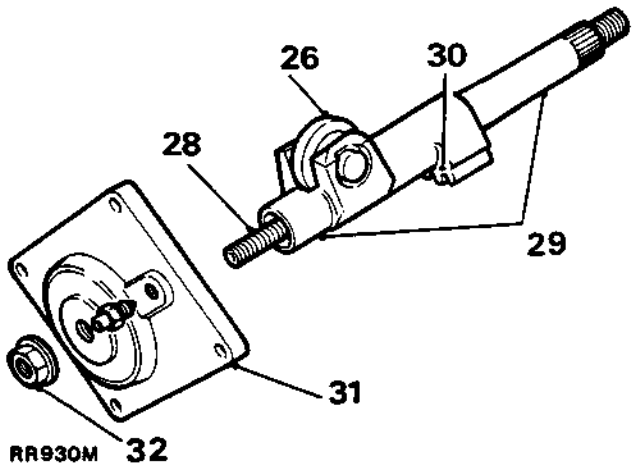


RR929M

24. Examine the inlet tube seat for damage. If replacement is necessary this can be undertaken by using a suitable tap.
25. Examine the feed tube for signs of cracking.

Sector shaft assembly

26. Check that there is no side play on the rollers.
27. If excessive side play on the roller does exist renew the sector shaft.
28. Check the condition of the adjuster screw threads.
29. Examine the bearing areas on the shaft for excessive wear.
30. Examine the gear teeth for uneven or excessive wear.



RR930M

Sector shaft cover assembly

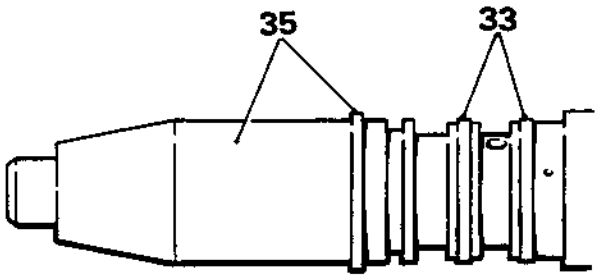
31. The cover, bush and seat are supplied as a complete assembly for replacement purposes.

Sector shaft adjuster locknut

32. The locknut functions also as a fluid seal and must be replaced at overhaul.

Valve and worm assembly

33. Examine the valve rings which must be free from cuts, scratches and grooves. The valve rings should be a loose fit in the valve grooves.

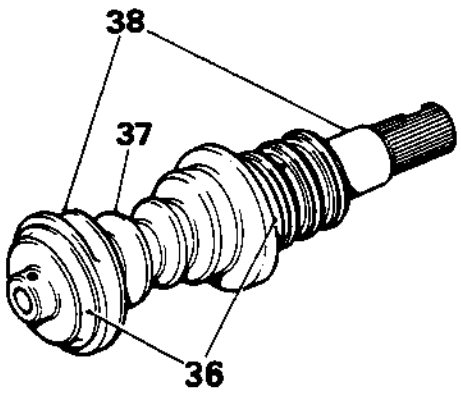


RR931M

34. Remove the damaged rings ensuring that no damage is done to the seal grooves.
35. If required, fit replacement rings, using the ring expander 606602. Both rings and tool may be warmed if found necessary. Use hot water for this purpose. Then insert into the ring compressor 606603 to cool.

    NOTE: The expander will not pass over rings already fitted. These rings must be discarded to allow access then renewed.

36. Examine the bearing areas for wear. The areas must be smooth and not indented.



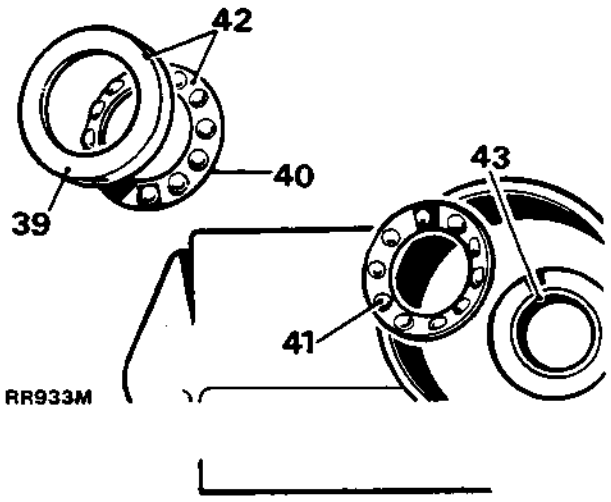
RR932M

37. Examine the worm track which must be smooth and not indented.
38. Check for wear on the torsion bar assembly pins; no free movement should exist between the input shaft and the worm.

    NOTE: Any sign of wear makes it essential that the complete valve and worm assembly is renewed.

Ball bearing and cage assemblies

39. Examine the ball races and cups for wear and general condition.
40. If the ball cage has worn against the bearing cup, fit replacements.



RR933M

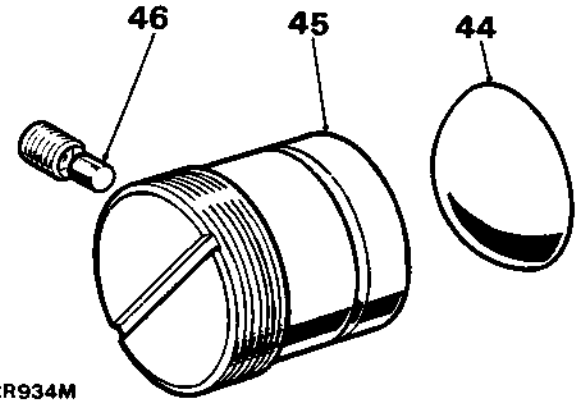
41. Bearing balls must be retained by the cage.
42. Bearings and cage repair are carried out by the complete replacement of the bearings and cage assembly.
43. To remove the inner bearing cup and shim washers, jar the steering box on the work bench, or use a suitable extractor.

    NOTE: Should difficulty be experienced at this stage, warm the casing and the bearing assembly. Cool the bearing cup using a suitable mandrel and jar the steering box on the bench.

Continued

Rack thrust pad and adjuster

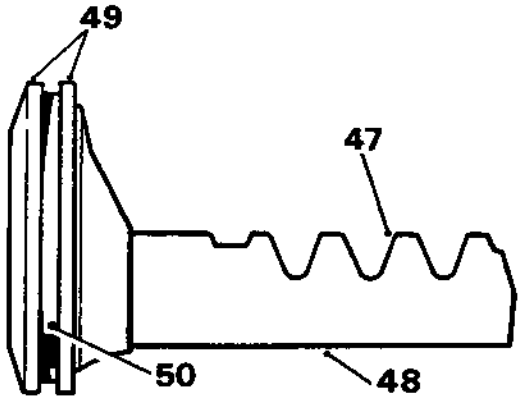
44. Examine the thrust pad for scores.
45. Examine the adjuster for wear in the pad seat.
46. Examine the nylon pad for distortion and adjuster grub screw assembly for wear.



RR934M

Rack and piston

47. Examine for excessive wear on the rack teeth.
48. Ensure the thrust pad bearing surface is free of scores and wear.

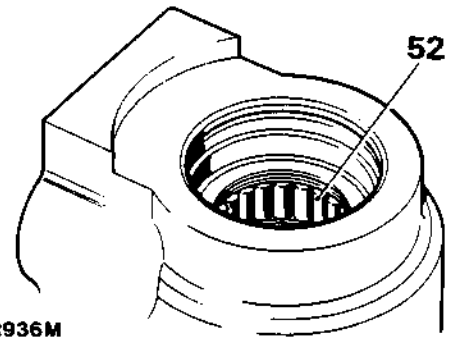


RR935M

49. Ensure that the piston outer diameters are free from burrs and damage.
50. Examine the seal and ring groove for scores and damage.
51. Fit a new rubber ring to the piston. Warm the white nylon seal and fit this to the piston. Slide the piston assembly into the cylinder with the rack tube outwards. Allow to cool.

Input shaft needle bearing

52. If necessary, replace the bearing. The replacement must be fitted squarely in the bore (numbered face of the bearing uppermost). Then, carefully push the bearing in until it is flush with the top of the housing bore. Ideally, the bearing will be just clear of the bottom of the housing bore.



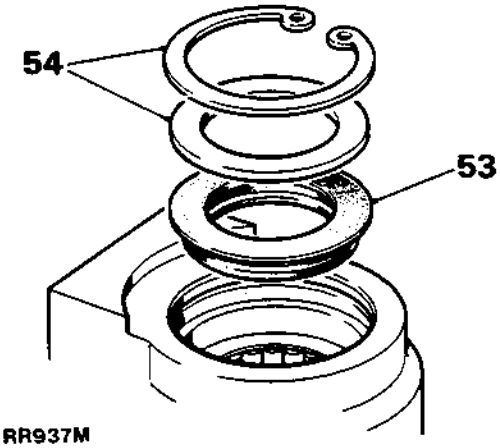
RR936M

Reassemble

NOTE: When fitting replacement oil seals, these must be lubricated with recommended fluid. Also ensure that absolute cleanliness is observed during assembly.

Input shaft oil seal

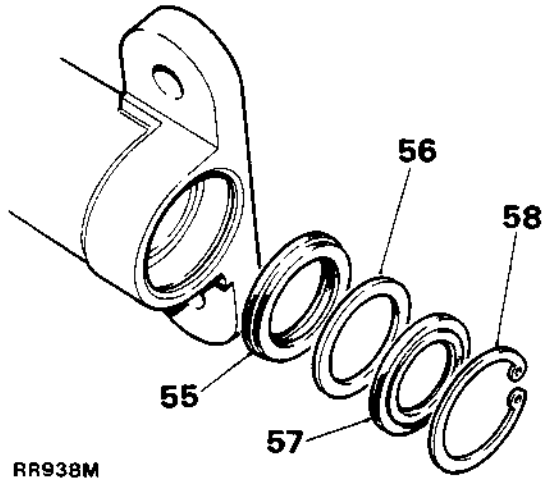
53. Fit the seal, lipped side first, into the housing. When correctly seated, the seal backing will lie flat on the bore shoulder.
54. Fit the extrusion washer and secure with the circlip.



RR937M

Sector shaft seal

55. Fit the oil seal, lipped side first.
56. Fit the extrusion washer.
57. Fit the dirt seal, lipped side last.
58. Fit the circlip.



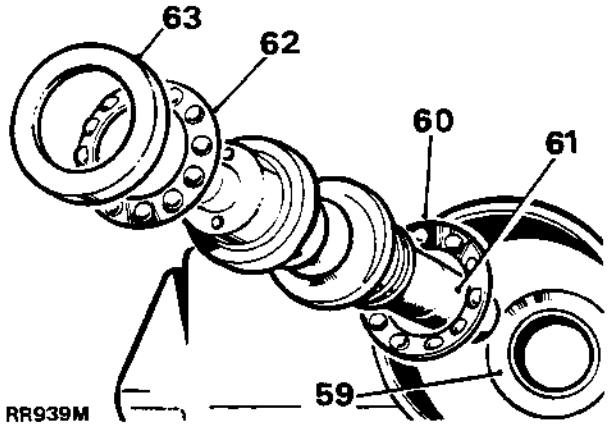
RR938M

Fitting the valve and worm assembly

59. If removed, refit the original shim washer(s) and the inner bearing cap. Only vaseline must be used as an aid to assembling the bearings.

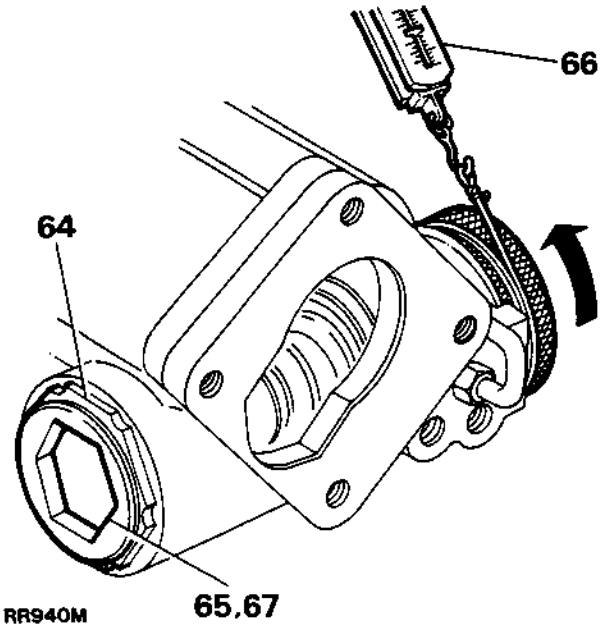
    NOTE: **If the original shims are not available, fit shim(s) of 0.76 mm (0.030 in) nominal thickness.**

60. Fit the inner cage and bearings assembly.
61. Fit the valve and worm assembly, using seal saver R01015 to protect the input shaft seal.
62. Fit the outer cage and bearings assembly.
63. Fit the outer bearing cup.



RR939M

64. Renew the worm adjuster sealing ring and loosely screw the adjuster into the casing. Fit the locknut, but do not tighten.
65. Turn in the worm adjuster until the end-float at the input is almost eliminated.
66. Measure and record the maximum rolling distance of the valve and worm assembly, using a spring balance and cord coiled around the torque setting tool RO1016.
67. Turn in the worm adjuster to increase the figure recorded in instruction 66 by 1.8 to 2.2 kg (4 to 5 lb) at 1.250 in (31.7 mm) radius to settle the bearings, then back off the worm adjuster until the figure recorded in instruction 66 is increased by 0.9 to 1.3 kg (2 to 3 lb) only, with locknut tight. Use worm adjusting socket LST119 and 'C' spanner LST120.

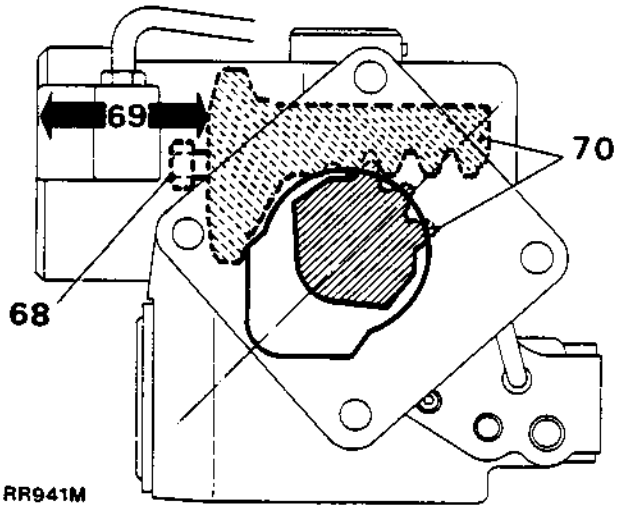


RR940M

Continued

Fitting the rack and piston

68. Screw a suitable bolt into the piston head for use as an assembly tool.

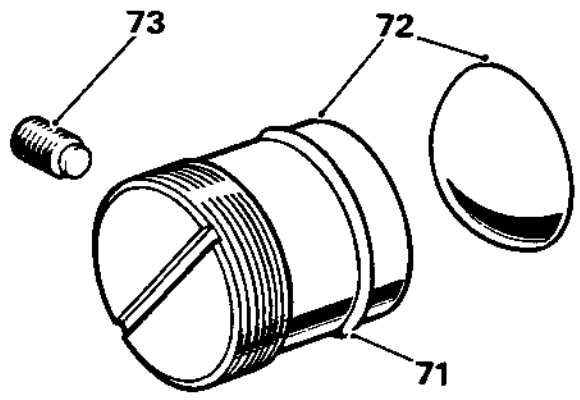


RR941M

69. Fit the piston and rack assembly so that the piston is 63.5 mm (2.5 in) approximately from the outer end of the bore.
70. Feed in the sector shaft using seal saver 606604 aligning the centre gear pitch on the rack with the centre gear tooth on the sector shaft. Push in the sector shaft, and, at the same time rotate the input shaft about a small arc to allow the sector roller to engage the worm.

Fitting the rack adjuster

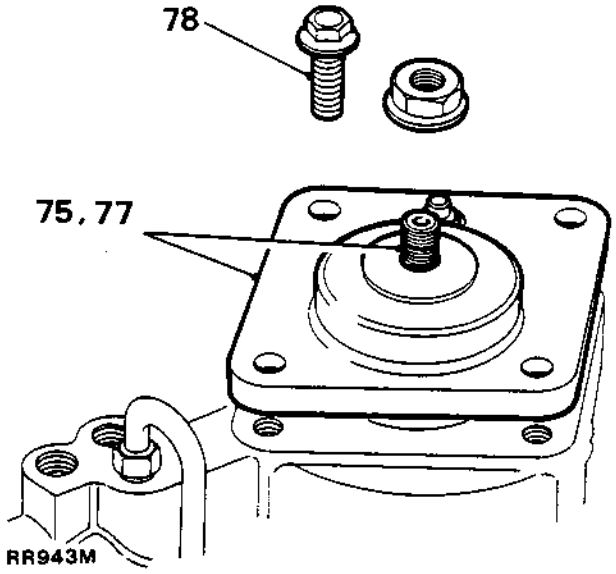
71. Fit the sealing ring to the rack adjuster.
72. Fit the rack adjuster and thrust pad to engage the rack. Back off a half turn on the adjuster.
73. Loosely fit the nylon pad and adjuster grub screw assembly to engage the rack adjuster.
73. Loosely fit the nylon pad and adjuster grub screw assembly to engage the rack adjuster.



RR942M

Fitting the sector shaft cover

74. Fit the sealing ring to the cover.
75. Screw the cover assembly fully on to the sector shaft adjuster screw.



RR943M

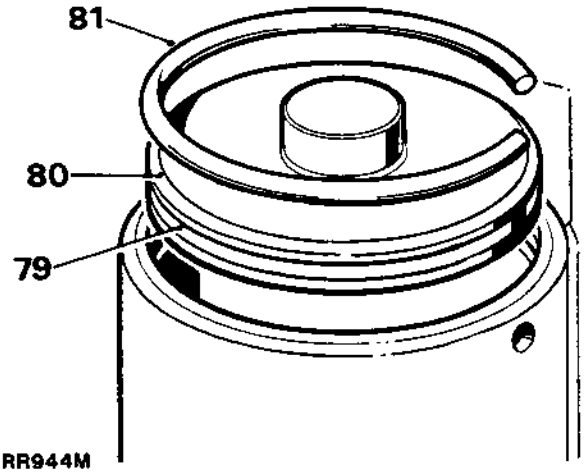
76. Position the cover on to the casing.
77. Tap home the cover. If necessary back off on the sector shaft adjuster screw to allow the cover to joint fully with the casing.

NOTE: Before tightening the fixings, rotate the input shaft about a small arc to ensure that the sector roller is free to move in the valve worm.

78. Fit the cover fixings and tighten to the correct torque.

Fitting the cylinder cover

79. Fit the square section seal to the cover.
80. Remove the slave bolt and press the cover into the cylinder just sufficient to clear the retainer ring groove.

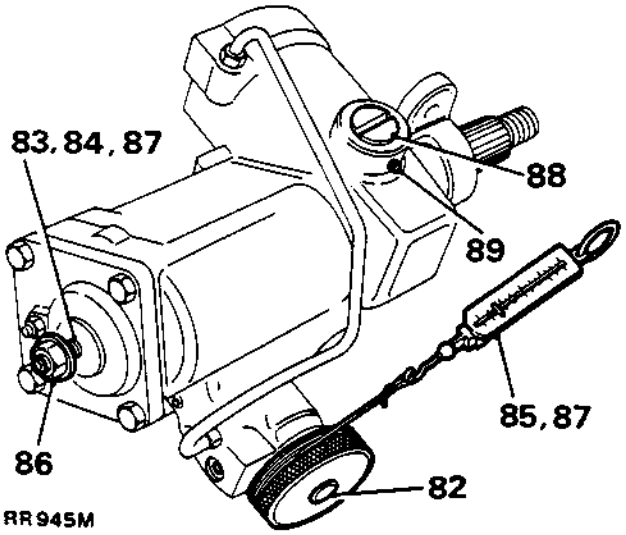


RR944M

81. Fit the retainer ring to the groove with one end of the ring positioned 12 mm (0.5 in) approximately from the extractor hole.

Adjusting the sector shaft

82. Set the worm on centre by rotating the input shaft half the total number of turns from either lock.



RR945M

83. Rotate the sector shaft adjusting screw anti-clockwise to obtain backlash between the input shaft and the sector shaft.
84. Rotate the sector shaft adjusting screw clockwise until the backlash is just eliminated.
85. Measure and record the maximum rolling resistance at the input shaft, using a spring balance, cord and torque tool R01016.
86. Hold still the sector shaft adjuster screw and loosely fit a new locknut.
87. Turn in the sector shaft adjuster screw until the figure recorded in instruction 88 is increased by 0.9 to 1.3 kg (2 to 3 lb) with the locknut tightened.

Adjusting the rack adjuster

88. Turn in the rack adjuster to increase the figure recorded in 90 by 0.9 to 1.3 kg (2 to 3 lb). **The final figure may be less than but must not exceed 7.25 kg (16 lb).**
89. Lock the rack adjuster in position with the grub screw.

Torque peak check

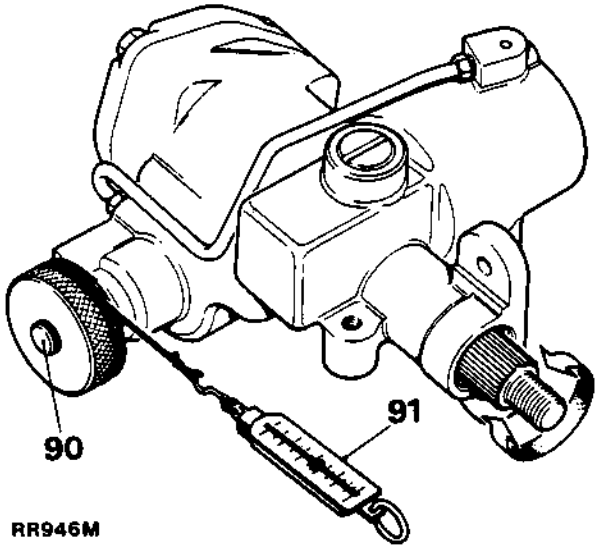
With the input shaft rotated from lock-to-lock, the rolling resistance torque figures should be greatest across the centre position (1½ turns approximately from full lock) and equally disposed about the centre position.

The condition depends on the value of shimming fitted between the valve and worm assembly inner bearing cup and the casing. The original shim washer value will give the correct torque peak position unless major components have been replaced.

NOTE: During the following 'Procedure', the stated positioning and direction of the input shaft applies for both LH and RH boxes. However, the procedure for shim adjustment where necessary, differs between LH and RH steering boxes and is described under the applicable LH stg. and RH stg. headings.

Procedure

90. With the input coupling shaft toward the operator, turn the shaft fully anti-clockwise.
91. Check the torque figures obtained from lock-to-lock using a spring balance cord and torque tool R01016.



RR946M

Adjustments

92. Note where the greatest figures are recorded relative to the steering position. If the greatest figures are not recorded across the centre of travel (i.e. steering straight-ahead position), adjust as follows:
    LH steering models. If the torque peak occurs **before** the centre position, add to the shim washer value; if the torque peak occurs **after** the centre position, **subtract** from the shim washer value.
    RH steering models. If the torque peak occurs **before** the centre position, subtract from the shim washer value; if the torque occurs **after** the centre position, **add** to the shim washer value.

Shim washers are available as follows:
0.03 mm, 0.07 mm, 0.12 mm and 0.24 mm (0.0015 in, 0.003 in, 0.005 in and 0.010 in).

NOTE: Adjustment of 0.07 mm (0.003 in) to the shim value will move the torque peak area by ¼ turn approximately on the shaft.

93. Fit the drop arm to the steering box using a new tab washer. Tighten the nut to the correct torque and bend over tab.
94. Refit the steering box to the vehicle.
95. Replenish the system with the correct grade of fluid. Refer to Recommended Lubricants and Power Steering System—bleed.
96. Test the system for leaks, with the engine running, by holding the steering hard on full lock in both directions.

    NOTE: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating the fluid and possibly damaging the seals.

97. Road test the vehicle.

5. Ensure that the fluid level is in alignment with the mark on the reservoir.
6. Wipe off all fluid released during bleeding.
7. Check all hose joints, pump and steering box for fluid leaks under pressure by holding the steering hard on full lock in both directions.

   CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals. The steering should be smooth lock-to-lock in both directions, that is, no heavy or light spots when changing direction when the vehicle is stationary.

8. Carry out a short road test. If necessary, repeat the complete foregoing procedure.

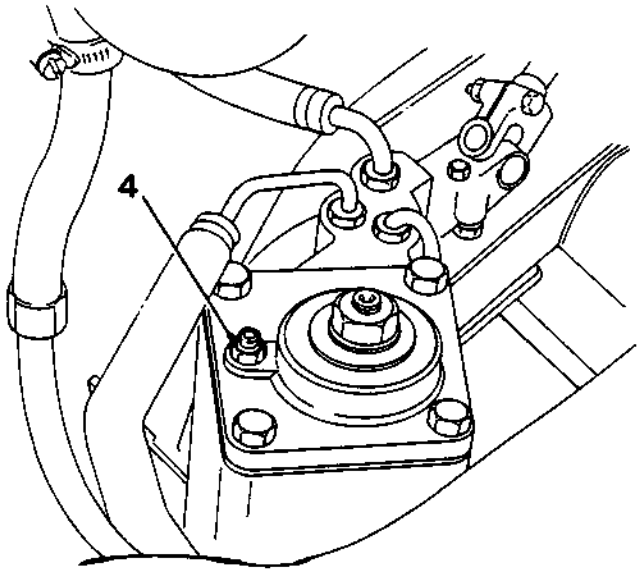
POWER STEERING SYSTEM

Bleed

1. Fill the steering fluid reservoir to the mark on the side of the reservoir with one of the recommended fluids.
2. Start and run the engine until it attains normal operating temperature.
3. Check and correct the reservoir fluid level.

   NOTE: During the carrying out of items 4, 5 and 6, ensure that the steering reservoir is kept full. Do not increase the engine speed or move the steering wheel.

4. Run the engine at idle speed, slacken the bleed screw. When fluid seepage past the bleed screw is observed, retighten the screw.



RR947M

POWER STEERING SYSTEM

Test

If there is a lack of power assistance for the steering the pressure of the hydraulic pump should be checked first before renewing any components of the system. The fault diagnosis chart should also be used to assist in tracing faults in the power steering system.

Procedure

1. The hydraulic pressure test gauge is used for testing the power steering system. This gauge is calibrated to read up to 140 kgf/cm² (2000 lbf/in²) and the normal pressure which may be expected in the power steering system is 77 kgf/cm² (1100 lbf/in²).
2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm² (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.
3. Check, and if necessary replenish, the fluid reservoir.
4. Examine the power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.
5. Check the steering pump drive belt for condition and tension, rectify as necessary.
6. Assemble the test equipment and fit to the vehicle.
7. Open the tap in the adaptor.
8. Bleed the system but exercise extreme care when carrying out this operation so as not to overload the pressure gauge.

9. With the system in good condition, the pressures should be as follows:
   (a) Steering wheel held hard on full lock and engine running at 1,000 rev/min, the pressure should be 70 to 77 kgf/cm² (1000 to 1100 lbf/in²).
   (b) With the engine idling and the steering wheel held hard on full lock, the pressure should be 28 kgf/cm² (400 lbf/in²) minimum.

These checks should be carried out first on one lock, then on the other.

CAUTION: Under no circumstances must the steering wheel be held on full lock for more than 30 seconds in any one minute, otherwise there will be a tendency for the oil to overheat and possible damage to the seals may result.

10. Release the steering wheel and allow the engine to idle. The pressure should be 7 kgf/cm² (100 lbf/in²).
11. If the pressures recorded during the foregoing test 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, close the adaptor tap for a period not exceeding five seconds.
12. If the gauge fails to register the specified pressure, the pump is inefficient and the pump relief valve should be examined and renewed as necessary.
13. Repeat the foregoing test after renewing the relief valve and bleeding the system. If the pump still fails to achieve the specified pressures, the pump should be overhauled or a new unit fitted.
14. If pump delivery is satisfactory and low pressure or marked imbalance exists, the fault must be in the steering box valve and worm assembly.

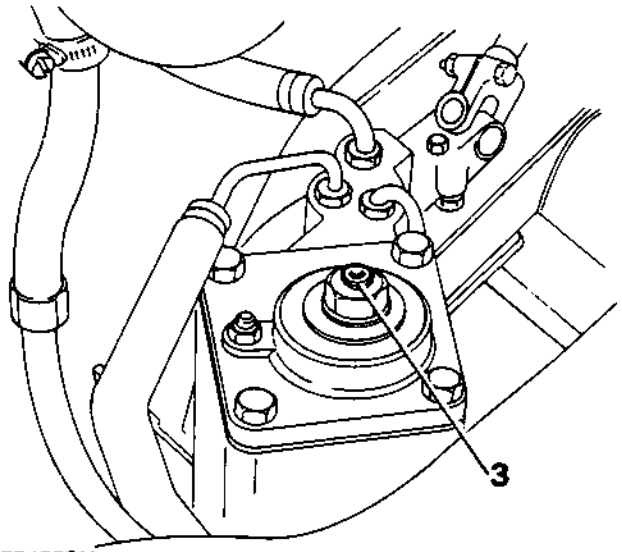
ADJUST POWER STEERING BOX

NOTE: The condition of adjustment which must be checked is one of minimum backlash without overtightness when the wheels are in the straight-ahead position.

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

   WARNING: Wheels must be chocked in all circumstances.

2. Gently rock the steering wheel about the straight-ahead position to obtain the 'feel' of the backlash present. This backlash must not be more than 9.5 mm (0.375 in).
3. Continue the rocking action whilst an assistant slowly tightens the steering box adjuster screw after slackening the locknut until the rim movement is reduced to 9.5 mm (0.375 in) maximum.



RR1563M

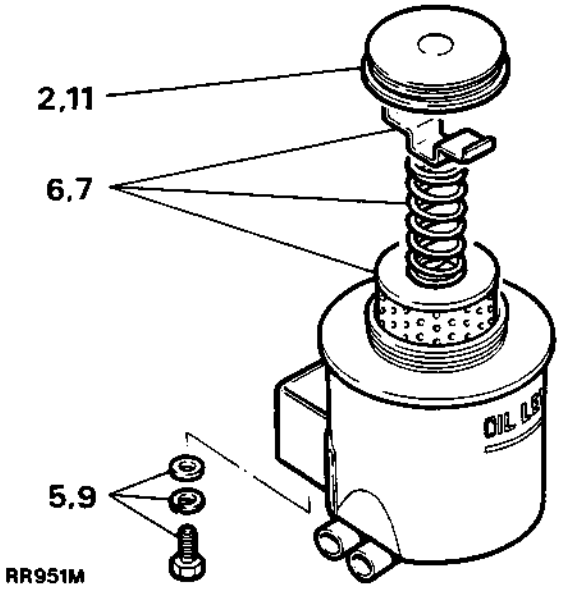
4. Tighten the locknut, then turn the steering wheel from lock to lock and check that no excessive tightness exists at any point.
5. Lower the vehicle to ground level and remove the wheel chocks.
6. Road test the vehicle.

POWER STEERING FLUID RESERVOIR

Remove and refit

Removing

1. Prop open the bonnet.
2. Remove the reservoir filler cap.



3. Disconnect the return hose from the steering box. Drain the fluid completely from the reservoir.

   CAUTION: It is most important that this fluid is not re-used.

4. Refit the return hose to the steering box.
5. Remove the fixings attaching the reservoir to the wing valance. Disconnect the flexible hoses and withdraw the reservoir.

   NOTE: If the reservoir is not to be refitted immediately, the hoses must be sealed to prevent the ingress of foreign matter.

6. Depress the spring retainer and withdraw the filter element.

Refitting

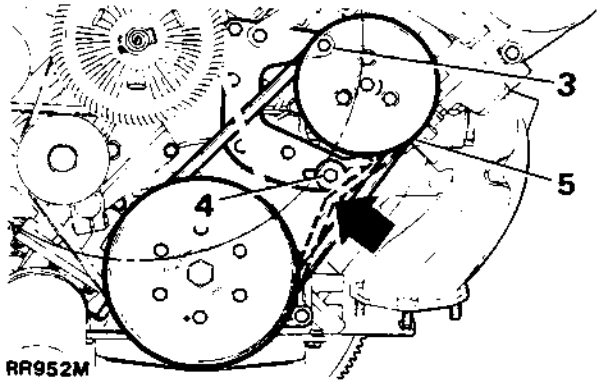
7. Fit a new filter element.
8. Refit and tighten the fixings attaching the reservoir to the wing valance.
9. Reconnect the flexible hoses to the reservoir. Tighten the clips.
10. Fill the reservoir to the prescribed level with one of the recommended fluids (Section 09) and bleed the power steering system. See power steering system—bleed.
11. Fit the reservoir filler cap.
12. Close the bonnet.

POWER STEERING PUMP DRIVE BELT

Adjust

Procedure

1. Prop open the bonnet.
2. Check, by thumb pressure, the belt tension between the crankshaft and the pump pulley.
   There should be a free movement of between 11 to 14 mm (0.437 to 0.562 in).
   If adjustment is necessary, proceed as follows:
3. Slacken the nut securing the pump mounting bracket to the cylinder head.



4. Slacken the bolt securing the pump lower bracket to the slotted adjustment link.
5. Pivot the pump as necessary and adjust until the correct belt tension is obtained.
6. Maintaining the tension, tighten the pump adjusting bolt and the top pivot nut.

   NOTE: Check the alternator drive belt tension after adjusting the power steering pump belt.

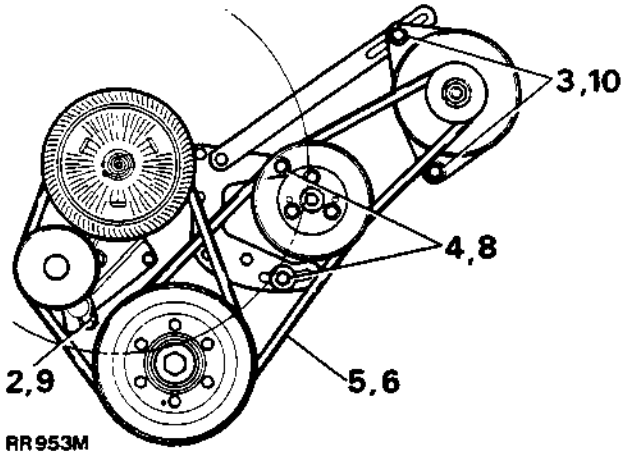
7. Close the bonnet.

POWER STEERING PUMP DRIVE BELT

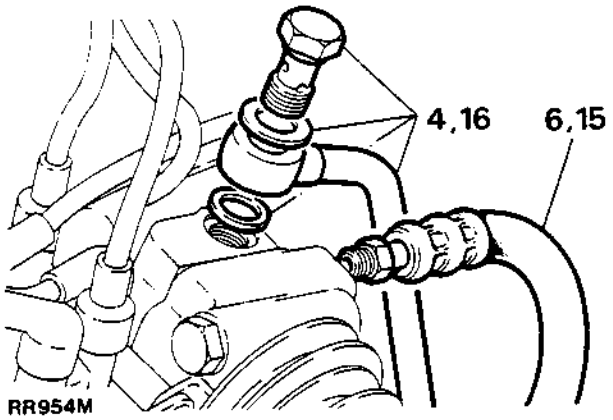
Remove and refit

Removing or preparing for the fitting of a new belt

1. Prop open the bonnet.
2. Slacken the jockey pulley bolt and remove the fan belt.
3. Slacken the alternator mountings and remove the drive belt.
4. Slacken the power steering pump mountings.
5. Pivot the pump and remove the drive belt.



RR953M



RR954M

Refitting

6. Locate the driving belt over the crankshaft and pump pulleys.
7. Adjust the position of the pump to give a driving belt tension of 11 to 14 mm (0.437 to 0.562 in) movement when checked by thumb pressure midway between the crankshaft and pump pulleys.
8. Maintaining the tension, tighten the pump adjusting bolt and the top pivot nut.
9. Refit the fan belt and adjust the tension to give 11 to 14 mm (0.437 to 0.562 in) movement when checked by thumb pressure midway between the crankshaft and water pump pulleys.
10. Refit the alternator drive belt and adjust to give 11 to 14 mm (0.437 to 0.562 in) movement when checked midway between the power steering pump and alternator pulleys.

    NOTE: Whenever a new belt is fitted, it is most important that its adjustment is rechecked after approximately 1,500 km (1,000 miles) running.

11. Close the bonnet.

POWER STEERING PUMP

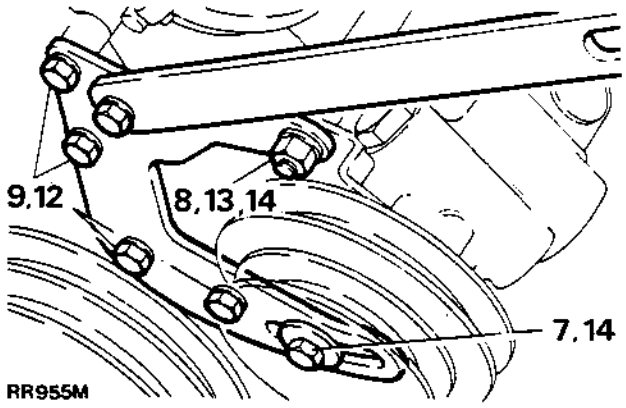
Remove and refit

Removing

1. Prop open the bonnet.
2. Remove the alternator.
3. Remove the filler cap from the power steering fluid reservoir.
4. Disconnect the inlet hose from the pump, retaining the copper crimp washer and rubber gasket. Drain the fluid into a suitable container and blank off the orifices against the ingress of dirt.

   CAUTION: Under no circumstances must the fluid be re-used.

5. Replace the reservoir filler cap.
6. Disconnect the outlet hose from the pump. Blank off the orifices to prevent ingress of foreign matter.
7. Slacken and remove the adjuster bolt below the pulley.
8. Slacken and remove the nut on the front mounting bracket.
9. Remove four bolts and withdraw the front mounting bracket complete with the alternator adjusting link.
10. Slide off the power steering pump.



RR955M

Refitting

11. Offer up the power steering pump, locating the driving belt over the pulley.
12. Refit the pump mounting bracket and tighten the four bolts.
13. Refit the nut to the front mounting bracket.
14. Adjust the position of the pump to give a driving belt tension of 11 to 14 mm (0.437 to 0.562 in) movement when checked by thumb pressure midway between the crankshaft and pump pulleys. Fit and tighten the pump adjuster bolt below the pulley, also tighten the nut at the front mounting bracket.
15. Remove the blank and reconnect the outlet hose to the pump.

Continued

16. Replace the square sectioned rubber gasket to the groove around the inlet port and replace the inlet hose to the pump. Tighten the union bolt to the correct torque.
17. Fit the alternator, fit and adjust the drive belt to the correct tension.
18. Remove the filler cap from the steering fluid reservoir.
19. Fill the steering fluid reservoir to the level mark with one of the recommended fluids (Section 09).
20. Replace the filler cap.
21. Bleed the power steering system.
22. Test the steering system for leaks with the engine running, by holding the steering hard on full lock in both directions.

    CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals.

23. Close the bonnet.
24. Road test the vehicle.

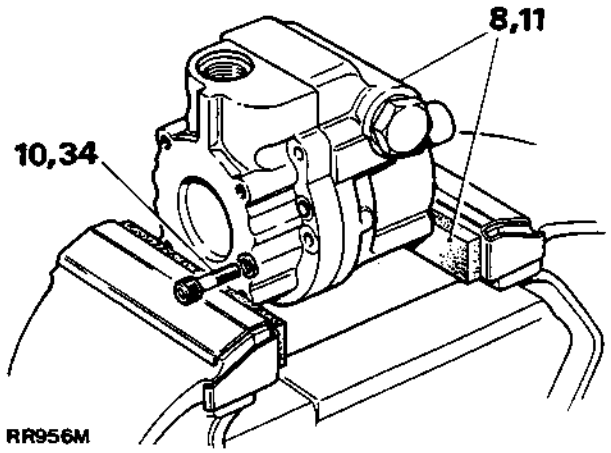
POWER STEERING PUMP OVERHAUL—Series 30

Dismantle

1. Remove the steering pump from the vehicle.
2. Clean the exterior of the pump and drain off any oil.
3. Remove the bolt, spring washer and large plain washer securing the pulley to the pump shaft.
4. Using a suitable puller, withdraw the pulley. Do not attempt to hammer the shaft from the pulley, or lever the pulley from the shaft, as this may cause internal damage.
5. Withdraw the square key from the shaft.
6. Remove the four bolts and spring washers securing the bearing retainer plate and front mounting plate to the pump body. Remove the plates.
7. Remove the three bolts and spring washers securing the rear mounting plate to the pump body and remove the plate.
8. Clamp the pump body in a vice, ensuring that the jaws are protected.
9. Remove the blank from the inlet port.

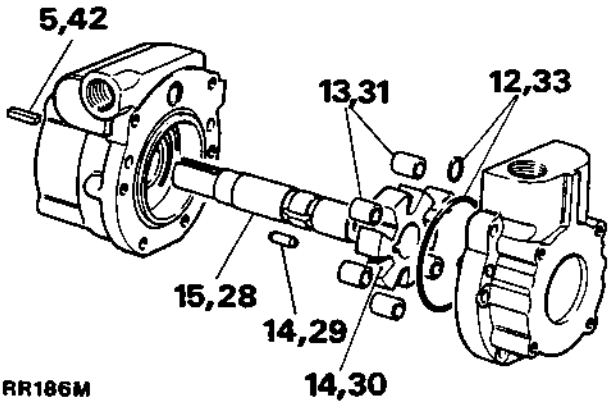
   NOTE: The tubular steel venturi flow director under the inlet adaptor is pressed into the cover and should not be removed.

10. Remove the six Allen screws securing the cover to the pump body. Separate the cover from the body vertically to prevent the parts falling out.
11. Remove the pump from the vice.
12. Remove the 'O' ring seals from the grooves in the pump body.
13. Carefully tilt the pump body, and remove the six rollers.



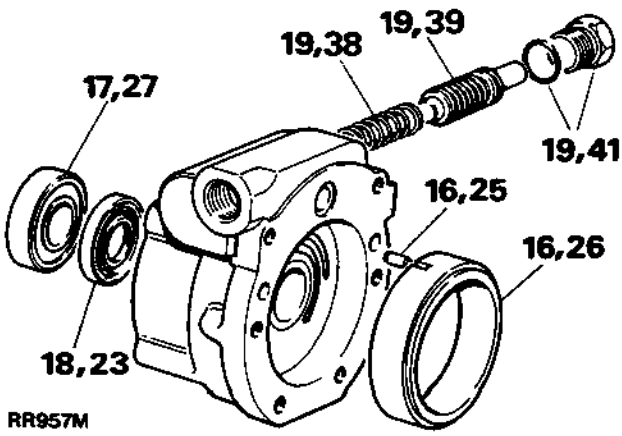
RR956M

14. Draw the carrier off the shaft, and remove the drive pin.
15. Remove the shaft from the body.
16. Remove the cam and the cam lock peg from the pump body.



RR186M

17. If necessary withdraw the sealed bearing from the shaft.
18. Remove the shaft seal from the body, ensuring that no damage is caused to the shaft bushing.
19. Remove the valve cap, 'O' ring, valve and valve spring from the body. Place all parts where they will not be damaged, or subject to contamination.



RR957M

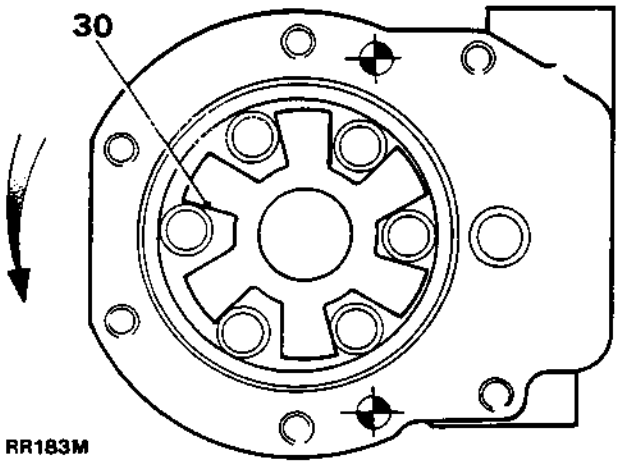
Inspection

20. Wash all parts in a suitable solvent, air dry, or wipe clean with a lint-free cloth if air is not available.
21. Check the pump body and cover for wear. Renew either part, if faces or bushes are worn.
22. Check the pump shaft around the drive pin slot. Remove any burrs.

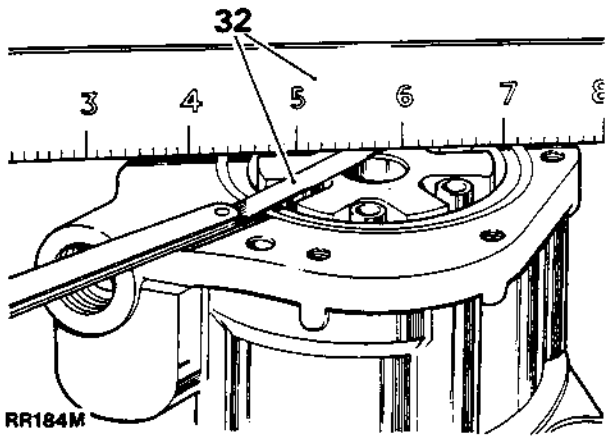
NOTE: Ensure that the aluminium restrictor in the output port is thoroughly cleaned but not dislodged.

Reassemble

23. Carefully examine a new shaft seal to ensure that it is clean and undamaged. Smear the sealing lips with grease and apply a fine smear of 'Wellseal' to the pump body where the outside diameter of the oil seal locates (applies to metal cased seals). Place the seal square to the housing recess with the lip towards the inside of the housing.
24. Press the seal into position approximately 0.80 mm ($\frac{1}{32}$ in) below the seal housing face, ensuring that it does not tilt.
25. Replace the cam lock peg into the location in the body.
26. Renew the cam if worn or damaged. Refit the cam, ensuring that it seats correctly in the body and that the slot locates over the locking peg.
27. Fit a new sealed bearing onto the pump shaft.
28. Insert the shaft and bearing assembly into the seal side of the body.
29. Refit the carrier drive pin in the shaft.
30. Inspect the carrier and replace in position, ensuring that the greater angle on the carrier teeth is in the leading position as illustrated.



31. Inspect the rollers, paying particular attention to the finish on the end. Renew the rollers if scored, damaged or oval. Refit the rollers to the carrier.
32. Using a straight edge across the cam surface, and a feeler gauge, check the end clearance of the carrier and rollers in the pump body. If the end clearance is more than 0.05 mm (0.002 in) renew the carrier and rollers.



33. Smear a fine trace of Loctite 275 to the pump body in a 'figure of 8' outside the 'O' rings and inside the bolt holes. Install new 'O' rings to the body of the pump.
34. Refit the cover on the pump body and secure with six Allen screws and spring washers.
35. Tighten the Allen screws, in diagonal sequence, checking that the shaft rotates freely and does not bind. Finally, tighten to the correct torque.
36. Refit the rear mounting plate to the pump body and secure with three bolts and spring washers.
37. Refit the front mounting plate and the bearing retainer plate to the pump body and secure with four bolts and spring washers.
38. Refit the flow control valve spring in the bore. The spring tension should be 8 to 9 lbf (11 to 12 Nm) at 21 mm (0.820 in). If not, renew the spring.
39. Replace the valve in the bore, inserting the valve so that the exposed ball end enters last. Ensure that the valve is not sticking.
40. Renew the 'O' ring on the valve cap and assemble in the pump. Tighten the cap to the correct torque.
41. Refit the pulley key.
42. Refit the pulley to the shaft and secure with the special washer, spring and washer and bolt. Tighten the bolt to the correct torque.
43. Refit the steering pump to the vehicle.

POWER STEERING

FAULT DIAGNOSIS

SYMPTOM	CAUSE	TEST ACTION	CURE
INSUFFICIENT POWER ASSISTANCE WHEN PARKING	(1) Lack of fluid	Check hydraulic fluid tank level	If low, fill and bleed the system
	(2) Engine idling speed too low	Try assistance at fast idle	If necessary, reset idle speed
	(3) Driving belt slipping	Check belt tension	Adjust the driving belt
	(4) Defective hydraulic pump and/ or pressure relief valve	(a) Fit pressure gauge between high pressure hose and steering pump, with steering held hard on full lock, see Note 1 below, and 'Power steering system test'	If pressure is outside limits (high or low) after checking items 1 and 3, see Note 2 below
		(b) Release steering wheel and allow engine to idle. See 'Power steering system test'	If pressure is greater, check steering box for freedom and self-centring action
POOR HANDLING WHEN VEHICLE IS IN MOTION	Lack of castor action	This is caused by over-tightening the rocker shaft backlash adjusting screw on top of steering box	It is most important that this screw is correctly adjusted. See instructions governing adjustment
	Steering too light and/or over-sensitive	Check for loose torsion bar fixings on steering box valve and worm assembly	Fit new valve and worm assembly
HYDRAULIC FLUID LEAKS	Damaged pipework, loose connecting unions, etc.	Check by visual inspection; leaks from the high pressure pipe lines are best found while holding the steering on full lock with engine running at fast idle speed (see Note 1 below)	Tighten or renew as necessary
		Check 'O' rings on pipework	Renew as necessary
		(Leaks from the steering box tend to show up under low pressure conditions, that is, engine idling and no pressure on steering wheel)	
EXCESSIVE NOISE	(1) If the high pressure hose is allowed to come into contact with the body shell, or any component not insulated by the body mounting, noise will be transmitted to the car interior	Check the loose runs of the hoses	Alter hose route or insulate as necessary
	(2) Noise from hydraulic pump	Check oil level and bleed system	If no cure, change hydraulic pump

Note 1. Never hold the steering wheel on full lock for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals.

Note 2. High pressure — In general it may be assumed that excessive pressure is due to a faulty relief valve in the hydraulic pump.
Low pressure — Insufficient pressure may be caused by one of the following:

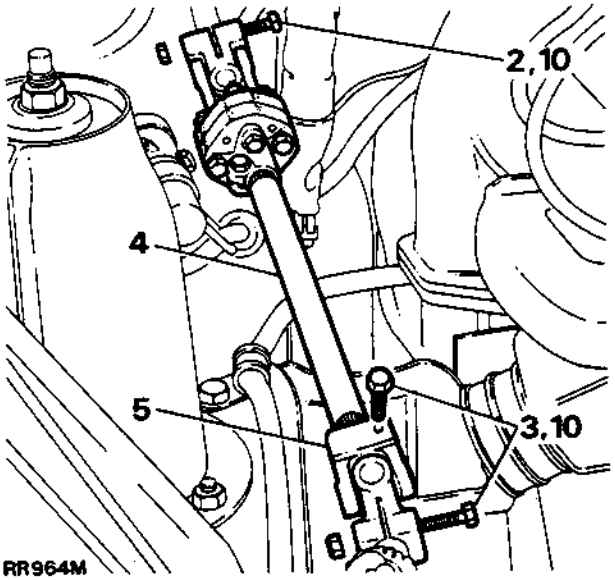
1. Low fluid level in reservoir } Most usual cause of
2. Pump belt slip } insufficient pressure
3. Leaks in the power steering system
4. Faulty relief valve in the hydraulic pump
5. Fault in steering box valve and worm assembly
6. Leak at piston sealing in steering box
7. Worn components in either steering box or hydraulic pump

COUPLING SHAFT AND UNIVERSAL JOINTS

Remove and refit

Removing

1. Note the position of the steering wheel spokes.
2. Remove one pinch bolt from the top universal joint to the steering column.



3. Remove two pinch bolts from the lower universal joint.
4. Withdraw the shaft and universal joints.
5. Withdraw the lower universal joint from the shaft.

NOTE: Do not dismantle the upper coupling joint. The steering shaft, rubber coupling and top universal joint is only available as an assembly.

Refitting

6. Position the lower universal joint on the shaft.
7. Offer the shaft assembly to the steering column, aligning the pinch bolt hole with the flat on the column.
8. Position the steering wheel as noted in 1.
9. Fit the lower universal joint to the steering box shaft.
10. Fit the pinch bolts, and tighten to the correct torque.

STEERING COLUMN

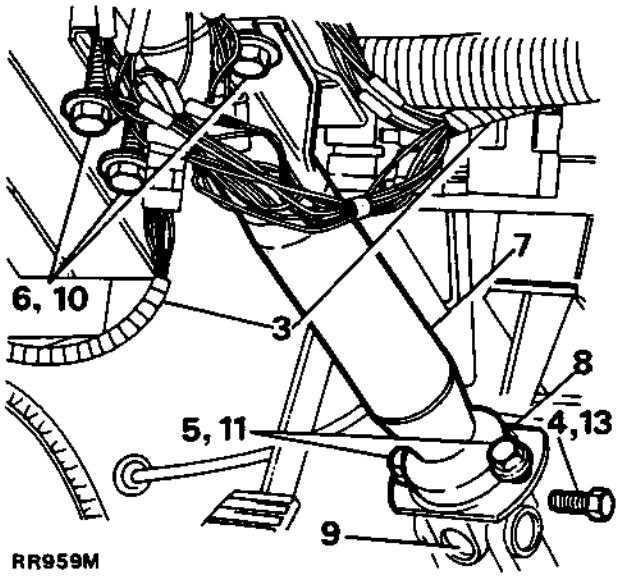
Remove and refit

Service tool: 18G1014 Extractor for steering wheel

IMPORTANT: The steering column is of a 'safety' type and incorporates shear pins. Therefore do not impart shock loads to the steering column at any time.

Removing

1. Remove the steering wheel using extractor 18G1014.
2. Remove the lower fascia panel, driver's side.
3. Disconnect the electrical leads from the steering column switches.



4. Remove the top pinch bolt, universal joint to steering column.
5. Remove the fixings, steering column to toe board.
6. Remove the fixings, steering column to dash bracket.
7. Withdraw the steering column assembly.

Refitting

8. Position the sealing gasket on the end of the column assembly.
9. Feed the steering shaft through the tow board and engage the drive splines at the coupling shaft.
10. Loosely fit the column upper fixings.
11. Loosely fit the column lower fixings.
12. Tighten upper and lower fixings.
13. Fit universal joint pinch bolt, and tighten to the correct torque.
14. Reverse 1 to 3.

STEERING COLUMN ASSEMBLY

Overhaul

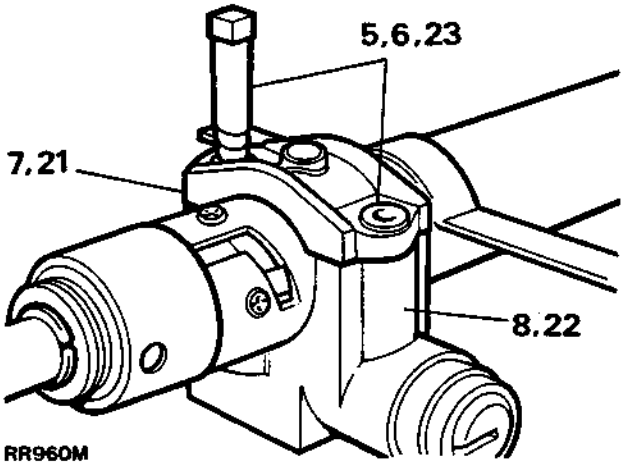
1. Remove the steering column assembly.

Dismantling

2. Remove the lighting switch from the lower shroud.
3. Remove the direction indicator switch from the column assembly.
4. Remove the wiper/washer switch from the column assembly.

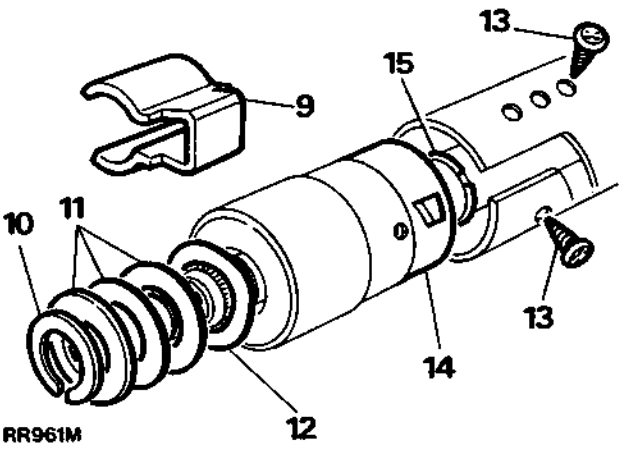
Removing the steering column lock assembly, 5 to 8

5. Drill a hole in each sheared bolt to accept an 'easy-out' extractor.



RR960M

6. Remove the sheared bolts.
7. Detach the end cap.
8. Withdraw the column lock assembly.
9. Lift off the cam for the self-cancelling switch from the column.



RR961M

Removing the top bearing assembly, 10 to 15

10. Remove the circlip.
11. Withdraw the thrust washer and shim washer(s).
12. Withdraw the wave washer.
13. Remove the fixings, top bearing assembly to steering column.
14. Withdraw the top bearing assembly.
15. Remove the retaining ring from groove in the steering column.
16. If required, renew the mesh cover, using heat fusing to join together the replacement cover edges.

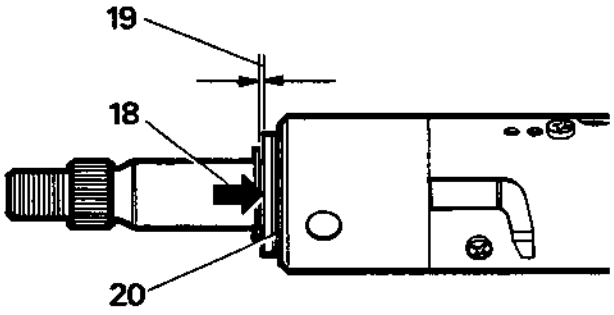
IMPORTANT: The steering column is now dismantled as far as is permitted. A replacement steering column comprises outer column, inner column and lower bearing assembly.

Assembling

17. Reverse 10 to 15.

Checking the top bearing end load, items 18 to 20

18. Hold down the thrust washer and shims fully against the wave washer spring load.



RR962M

19. Measure the clearance between the thrust washer and the circlip. The clearance must be 0.12 mm (.005 in).
20. Adjust the clearance as necessary by fitting replacement shim washer(s) which are available in the range 0.127 to 0.762 mm (.005 to .030 in) in 0.127 (.005) stages.

Fitting the steering column lock

21. Position the steering lock cap on the outer column, locating the spigot in the hole provided.
22. Offer the lock assembly to the column.
23. Fit the shear bolts to retain the cap and lock assembly.
24. Tighten the bolts sufficient to shear the heads.
25. Reverse 1 to 4.

STEERING COLUMN LOCK AND IGNITION/STARTER SWITCH

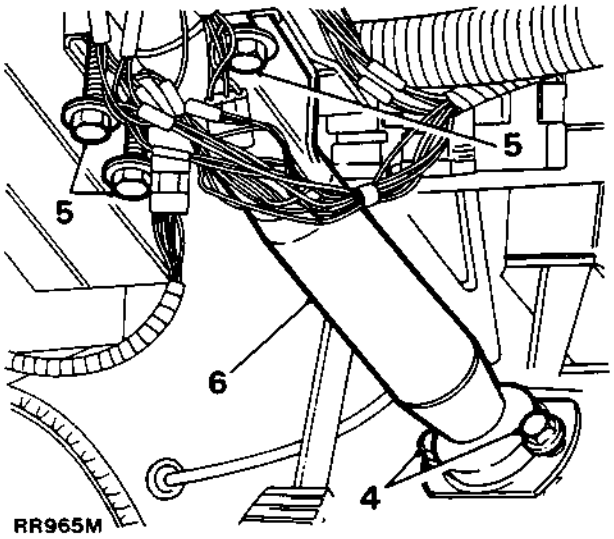
Remove and refit

IMPORTANT: The steering column is of a 'safety' type and incorporates shear pins. Therefore do not impart shock loads to the steering column at any time.

Ignition/starter switch only remove and refit is described in Electrical Section 86.

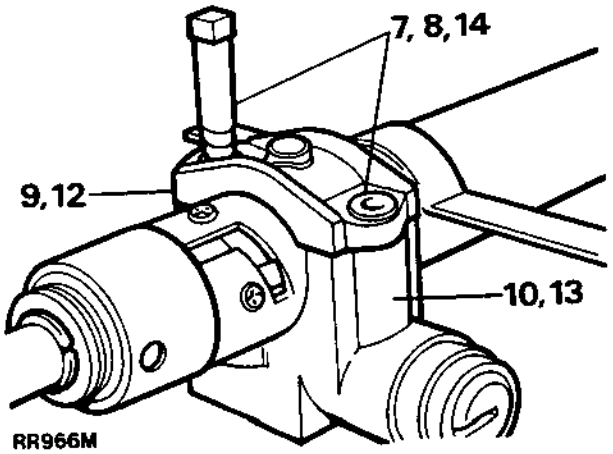
Removing

1. Remove the lower fascia panel, driver's side.
2. Remove the top shroud.
3. Remove the lighting switch from the lower shroud.
4. Remove the steering column fixings at the toe board.



RR965M

5. Remove the fixings, steering column to dash bracket.
6. Lower the steering column to gain access to the column lock fixings and remove the insulating cover.
7. Drill a hole in each sheared bolt to accept an 'Easiout' extractor.



RR966M

8. Remove the sheared bolts.
9. Detach the end cap.
10. Withdraw the column lock assembly.
11. Remove the ignition/starter switch.

Refitting

12. Position the steering lock cap on the outer column, locating the spigot in the hole provided.
13. Offer the lock to the column.
14. Fit the shear bolts to retain the cap and lock.
15. Tighten the bolts sufficient to shear off the heads.
16. Fit the ignition/starter switch.
17. Reverse 1 to 6.

STEERING WHEEL

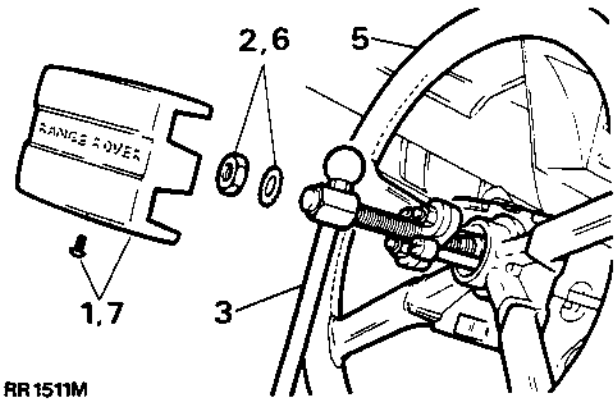
Remove and refit

Service tools: 18G 1014—Steering wheel remover
18G 1014-2—Adaptor pins

IMPORTANT: The steering column is of a 'safety' type and incorporates shear pins. Therefore do not impart shock loads to the steering column during removing and refitting the steering wheel or at any time.

Removing

1. Remove the securing screw and withdraw the trim pad.
2. Remove the steering wheel nut and washer.



RR1511M

3. Extract the steering wheel using service tool 18G 1014. Ensure the adaptor pins are inserted to their full length and tighten the cap screws.

Refitting

4. Position the road wheels 'straight ahead'.
5. Position the steering wheel on the column splines, in the straight ahead position.
6. Fit the nut and washer, tighten to the correct torque.
7. Fit the trim pad and tighten the securing screw.

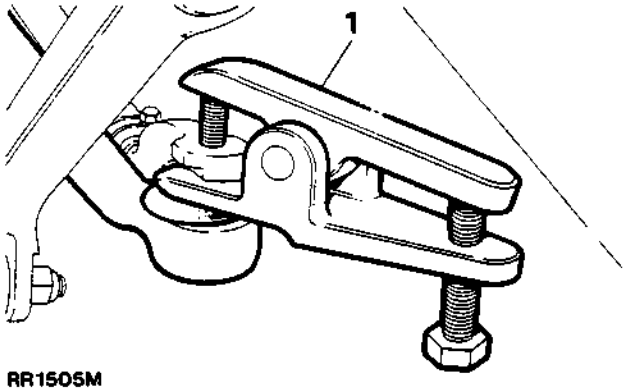
DROP ARM

Remove and refit

Service tools: **18G1063 Ball joint extractor**
MS252A Drop arm extractor

Removing

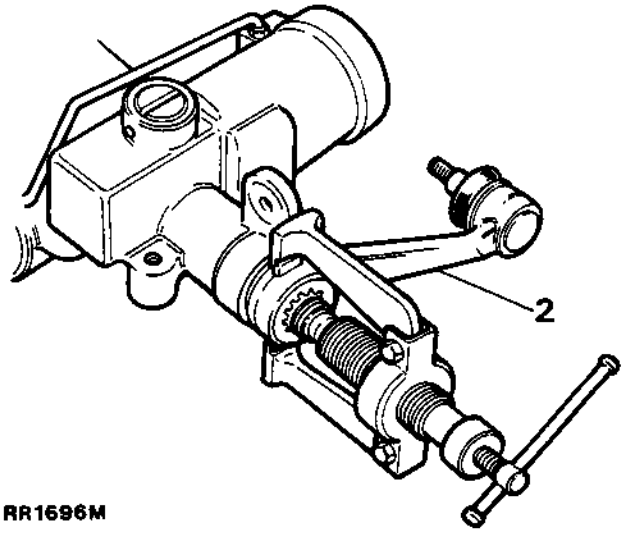
1. Disconnect the drag link from the drop arm ball joint, using extractor 18G1063.



RR1505M

2. Remove the drop arm from the steering box rocker shaft, using extractor MS252A.

NOTE: The drop arm ball joint is integral with the drop arm.



RR1696M

Refitting

3. Set the steering box in the midway lock-to-lock position.
4. Fit the drop arm in position, aligning the dead splines.
5. Fit the drop arm fixings and tighten to the correct torque.
6. Fit the drag link and tighten to the correct torque.

DROP ARM BALL JOINT

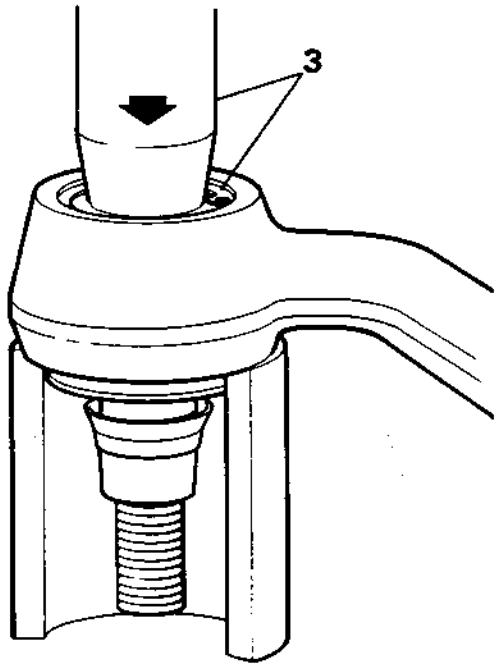
Overhaul

The drop arm ball joint can be overhauled and there is a repair kit available which consists of the following items.

Ball pin	**Ball lower socket**
Retainer	**Spring**
Spring rings	**'O' ring**
Dust cover	**Cover-plate**
Ball top socket	**Circlip**

Dismantle

1. Remove the drop arm from the vehicle and clean the exterior.
2. Remove the spring rings and prise off the dust cover.
3. In the interests of safety, position the ball joint under a press to relieve the spring tension and support the housing both sides of the ball pin, as illustrated. Apply pressure to the cover plate and remove the circlip and slowly release the pressure.

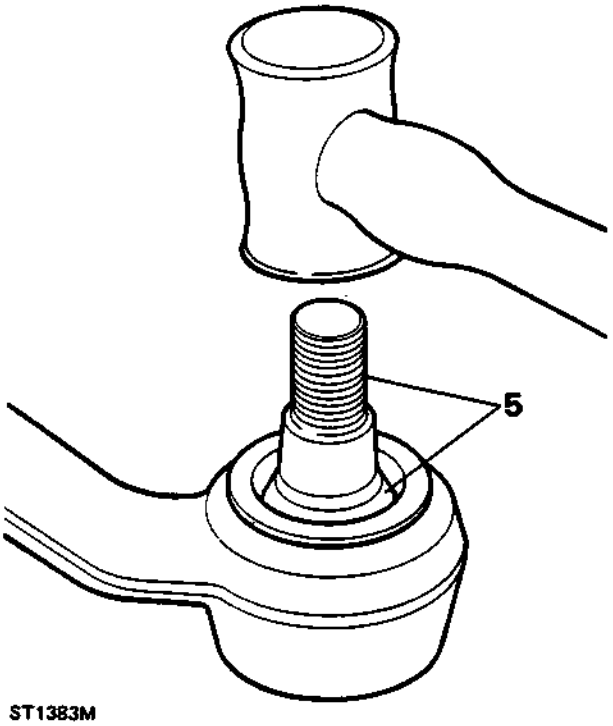


ST1382M

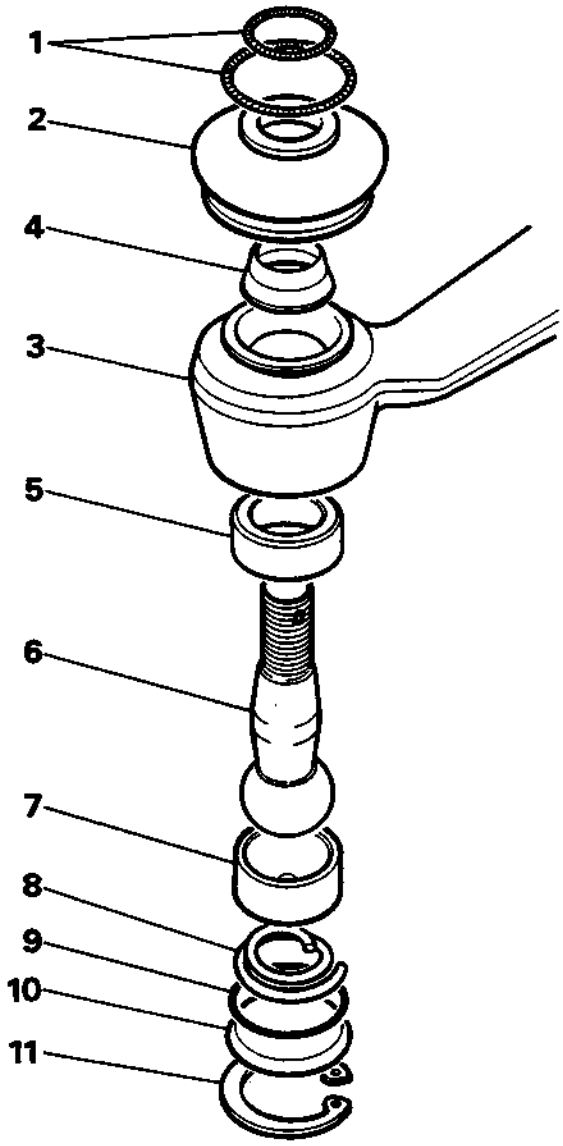
WARNING: Personal injury could result if the circlip is removed without pressure being applied and maintained to the cover plate.

4. Remove the spring, top socket and 'O' ring.

5. Since the ball pin cannot be removed with the retainer in position, tap the threaded end of the ball pin to release the retainer and to remove the pin from the housing.



ST1383M



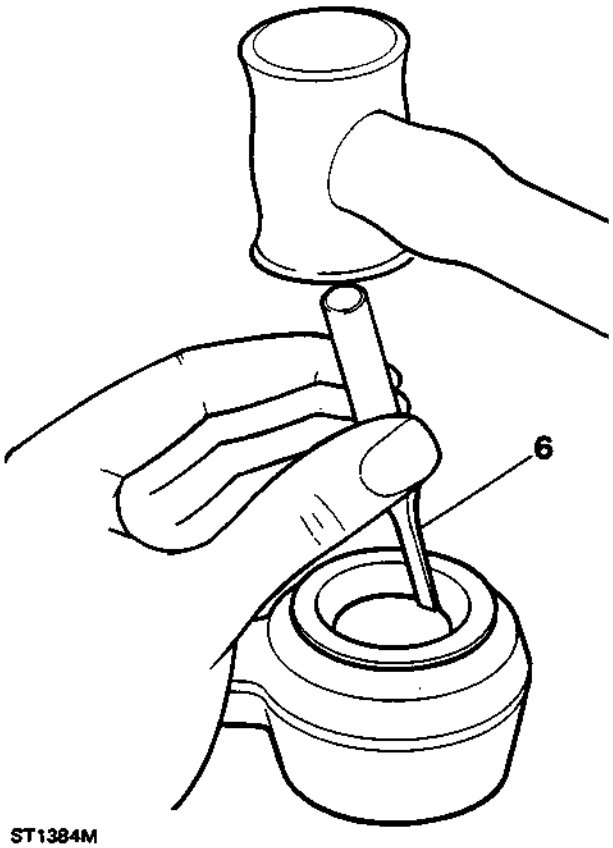
ST1381M

KEY TO BALL JOINT

1. Spring rings
2. Dust cover
3. Ball housing
4. Retainer
5. Bottom socket
6. Ball pin
7. Top socket
8. Spring
9. 'O' ring
10. Cover-plate
11. Circlip

Continued

6. Using a sharp-edged punch or chisel, drive the ball lower socket from the housing. Should difficulty be experienced, apply gentle heat to the housing and then continue to drive the socket from the housing.

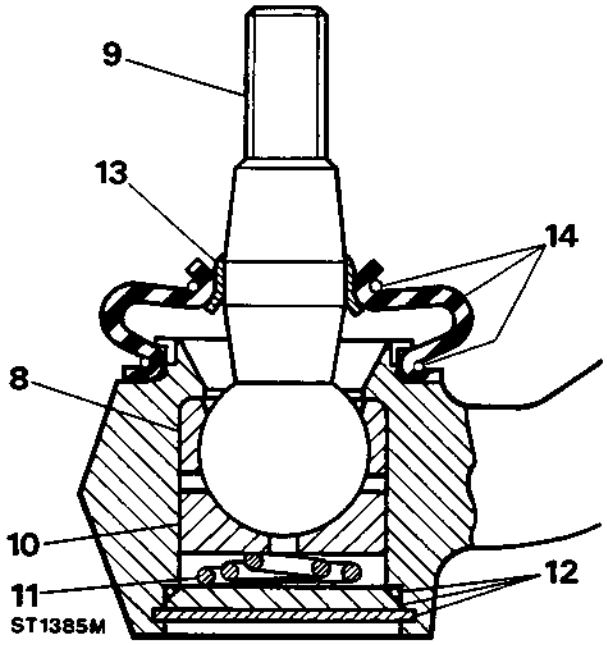


ST1384M

7. Clean the housing and remove any burrs.

Assemble

8. Press in the lower socket squarely up to the shoulder.
9. Dip the ball in Duckhams LB10 grease, or equivalent and fit to the housing and pack with grease.
10. Fit the top socket.
11. Fit the spring, small diameter towards the ball.
12. Fit the 'O' ring and using the same method as for removing the circlip, compress the cover plate and secure with the circlip. Ensure that the circlip is fully seated in the machined groove.
13. Press the retainer onto the ball pin so that the top edge is level with the edge of the taper.



ST1385M

14. Fit the dust cover and retain with the two spring rings.
15. Fit the drop arm to the steering box using a new lock washer. Tighten the retaining nut to the correct torque and bend over the lock washer.
16. Assemble the ball pin to the drag link, see instructions for fitting drag link and track rod, and tighten the castle nut to the correct torque and secure with a new split pin.

TRACK ROD AND LINKAGE

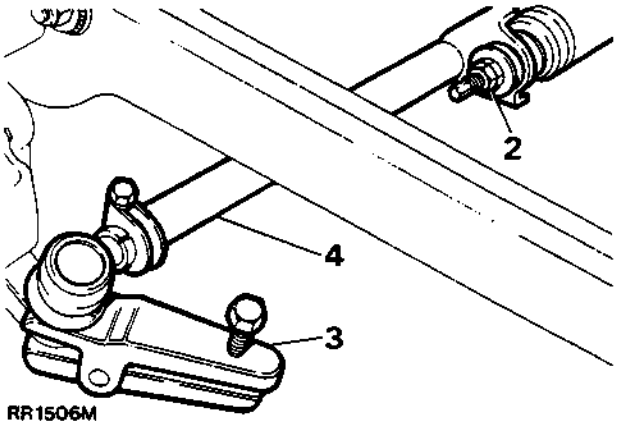
Remove and refit

Service tool: 18G 1063—Ball joint extractor

TRACK ROD

Removing

1. Jack-up and support chassis.
2. Disconnect the steering damper at the track rod.
3. Disconnect the track rod at the ball joints, using extractor 18G 1063.
4. Withdraw the track rod complete.

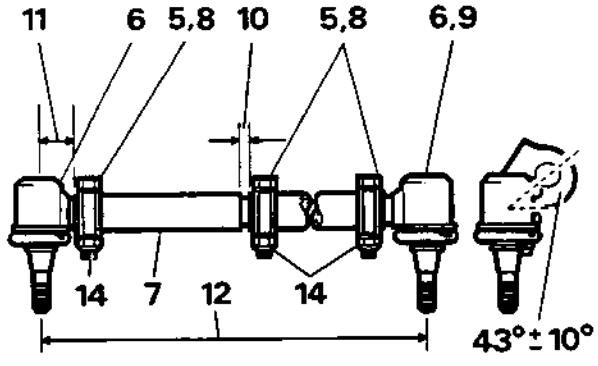


RR1506M

LINKAGE

Removing

5. Slacken the clamp bolts.
6. Unscrew the ball joints.
7. Unscrew the track rod adjuster, left-hand thread.



RR1507M

Refitting

8. Fit the replacement parts. Do not tighten the clamp pinch bolts at this stage.
9. Screw in a ball joint to the full extent of the threads.
10. Set the adjuster dimensionally to the track rod as illustrated, to 8.9 mm (.350 in).
11. Set the adjuster end ball joint dimensionally, as illustrated to 28.57 mm (1.125 in).
12. The track rod effective length of 1230.0 mm (48.4 in) is subject to adjustment during the subsequent wheel alignment check.

TRACK ROD

Refitting

13. Fit the track rod and tighten the ball joint nuts to the correct torque.
14. Check the front wheel alignment.
15. Reverse 1 and 2.

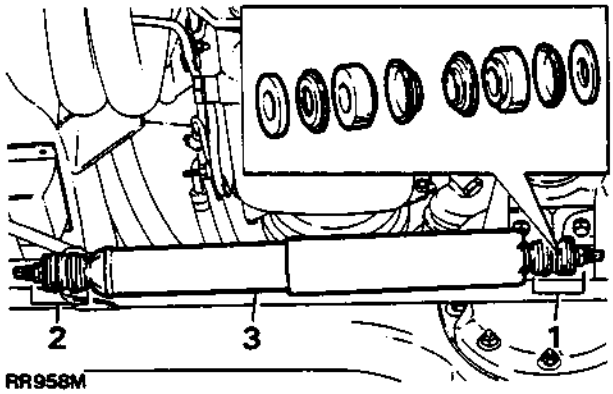
CAUTION: A track rod that is damaged or bent must be renewed. No attempt should be made to repair or straighten it.

STEERING DAMPER

Remove and refit

Removing

1. Remove the fixings at the differential case bracket.



RR958M

2. Remove the fixings at the track rod bracket.
3. Withdraw the steering damper.

Refitting

4. Reverse 1 to 3.

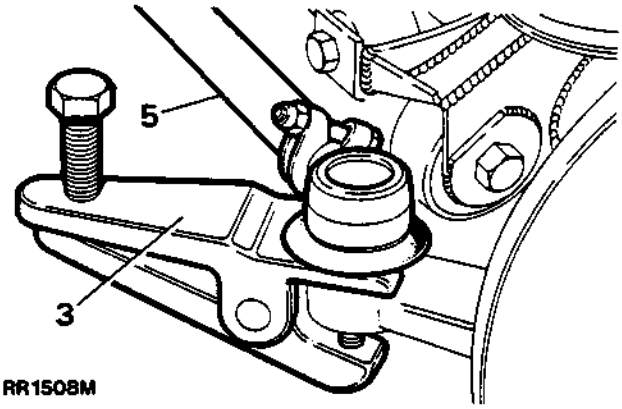
DRAG LINK AND DRAG LINK ENDS

Remove and refit

Service tool 18G 1063—Extractor for ball joint

Removing

1. Jack-up and support chassis.
2. Remove the passenger's side road wheel.
3. Disconnect the drag link ball joint at the swivel housing arm, using extractor 18G 1063.



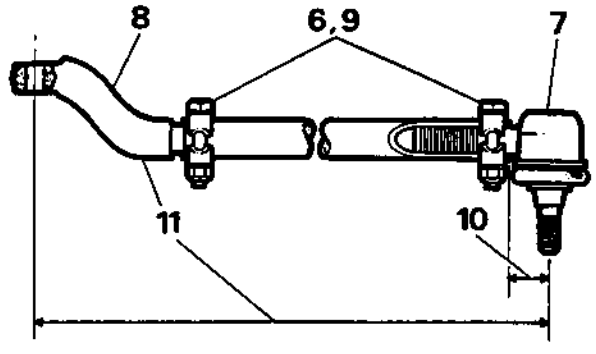
RR1508M

4. Disconnect the drag link end at the drop arm ball joint, using extractor 18G 1063.
5. Withdraw the drag link.

DRAG LINK ENDS

Removing

6. Slacken the clamp bolts.
7. Unscrew the ball joint.
8. Unscrew the cranked end.



RR1509M

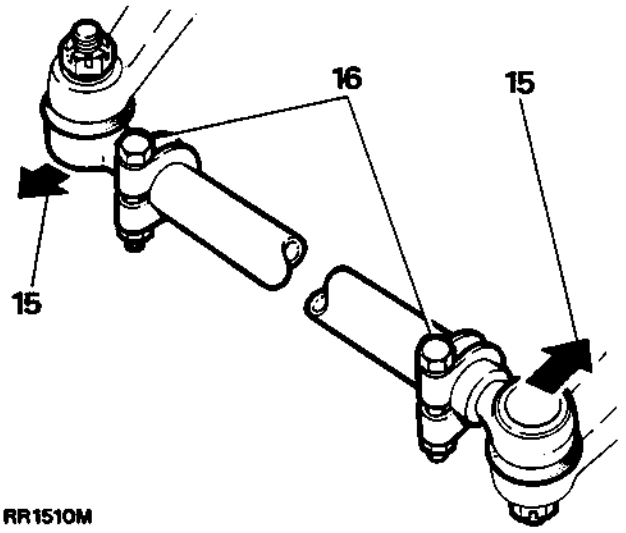
Refitting

9. Fit the replacement ends. Do not tighten the clamp bolts at this stage.
10. Set the ball joint dimensionally to the drag link, as illustrated, to 28.57 mm (1.125 in).
11. Adjust the cranked end to obtain the nominal overall length of 919.0 mm (36.2 in). The length is finally adjusted during refitting.

DRAG LINK

Refitting

12. Fit the drag link. Tighten the ball-joint nuts to the correct torque.
13. Check, and if necessary, set the steering lock stops.
14. Turn the steering and ensure that full travel is obtained between the lock stops. Adjust the drag link length to suit.
15. Using a mallet, tap the ball joints in the direction indicated so that both ball pins are in the same angular plane.



RR1510M

16. Tighten the clamp bolts to the correct torque.
17. Reverse 1 and 2.

CAUTION: A drag link that is damaged or bent must be renewed. No attempt should be made to repair or straighten it.

FRONT WHEEL ALIGNMENT

Check and adjust

Checking

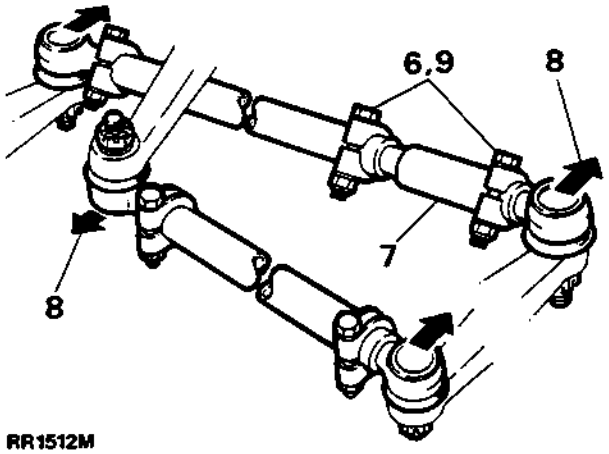
Toe-out dimensions

NOTE: No adjustment is provided for castor, camber or swivel pin inclination.

1. Set the vehicle on level ground with the road wheels in the straight-ahead position.
2. Push the vehicle back then forwards for a short distance to settle the linkage.
3. Measure the toe-out at the horizontal centre-line of the wheels.
4. Toe-out must be 1.2 to 2.4 mm (.04 to .09 in).
5. Check-tighten the clamp bolts fixings to the correct torque.

Adjusting

6. Slacken the adjuster sleeve clamp bolts.
7. Rotate the adjuster to lengthen or shorten the track rod.



RR1512M

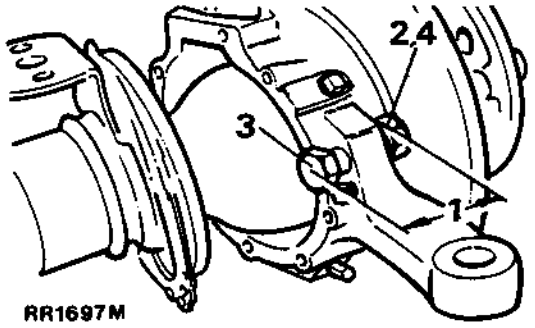
8. Check the toe-out setting as in instructions 1 to 4. When the toe-out is correct, lightly tap the steering linkage ball joints, in the directions illustrated, to the maximum of their travel to ensure full unrestricted working travel.
9. Finally, tighten the clamp bolts to the correct torque.

STEERING LOCK STOPS

Check and adjust

Checking

1. Measure the stop bolt protrusion as illustrated. This must be 40.5 mm (1.59 in).



RR1697M

Adjusting

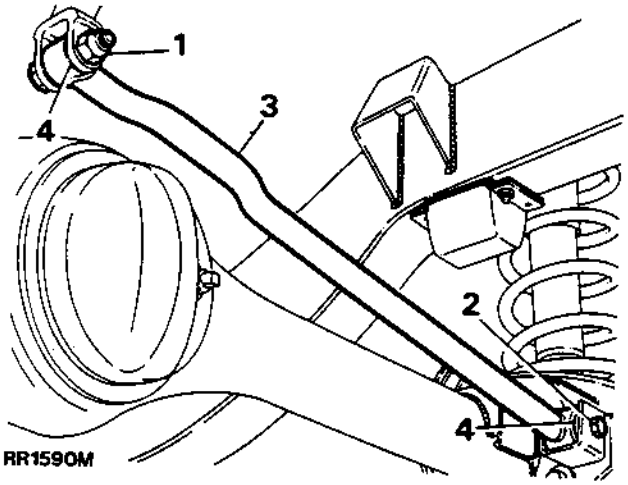
2. Slacken the stop bolt locknut.
3. Turn the stop bolt in or out as required.
4. Tighten the locknuts.
5. Check the wheels position at full lock.

PANHARD ROD

Remove and refit

Removing

1. Remove the fixings at the mounting arm.
2. Remove the fixings at the axle bracket.
3. Withdraw the Panhard rod.
4. If required press out the bushes.
5. Fit replacement bushes central in the rod.



RR1590M

Refitting

6. Reverse 1 to 4. Tighten the fixings to the correct torque.

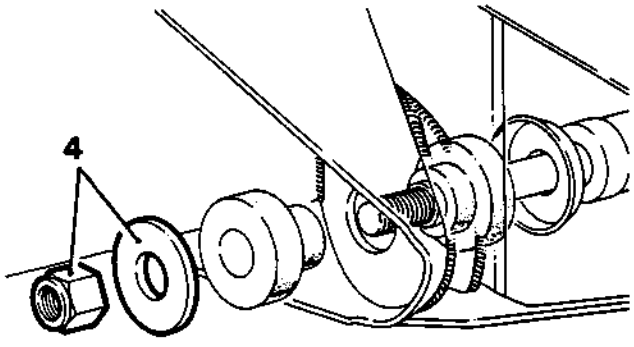
RADIUS ARM

Remove and refit

Service tool:
18G 1063 Extractor for ball joint

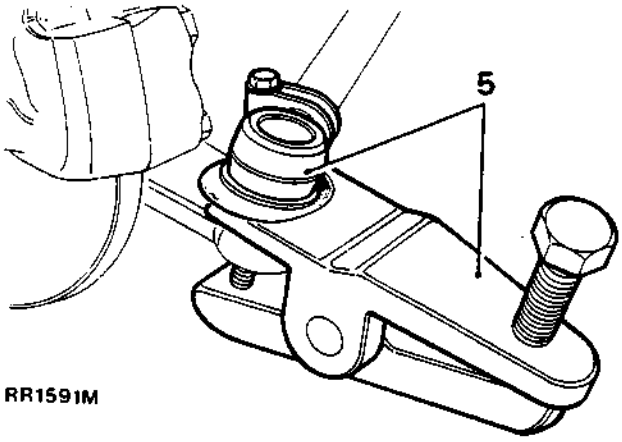
Removing

1. Remove the road wheel.
2. Support the chassis.
3. Support the axle weight.
4. Remove the fixings, radius arm to chassis side member.



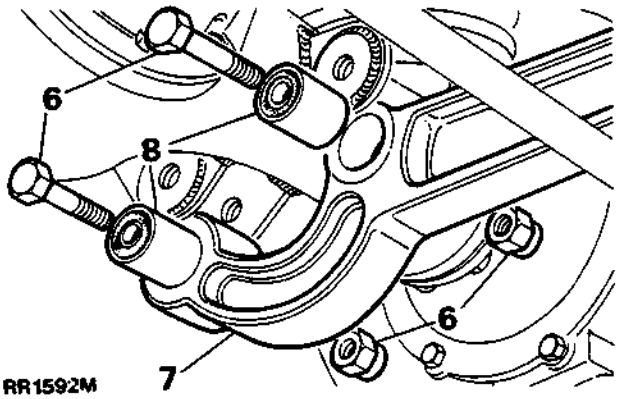
RR983M

5. Disconnect the track rod at the ball joint. Extractor 18G 1063.



RR1591M

6. Remove the fixings, radius arm to axle.
7. Lower the radius arm front end to clear the axle and withdraw.
8. If required, press out the bush assemblies.



RR1592M

9. Fit the replacement bushes centrally in the arm.

Refitting

10. Reverse 1 to 7. Tighten the fixings to the correct torque.

FRONT ROAD SPRING

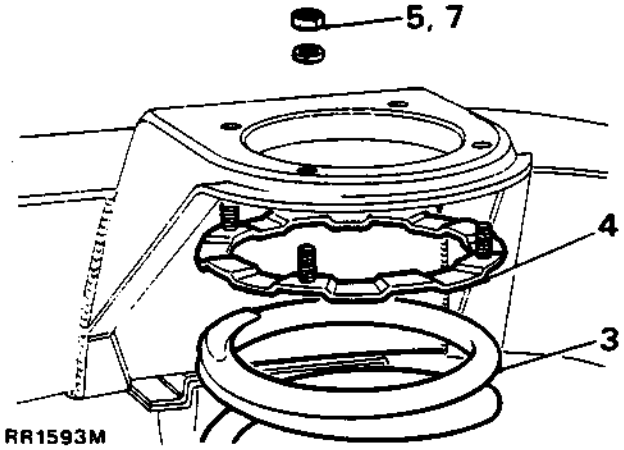
Remove and refit

Removing

1. Remove the front shock absorber.

   WARNING: During the following procedure avoid over stretching the brake hoses. If necessary, turn back the hose connector locknuts to allow the hoses to follow the axle.

2. Lower the axle sufficient to free the road spring.
3. Withdraw the road spring.



4. Withdraw the shock absorber bracket securing ring.

Refitting

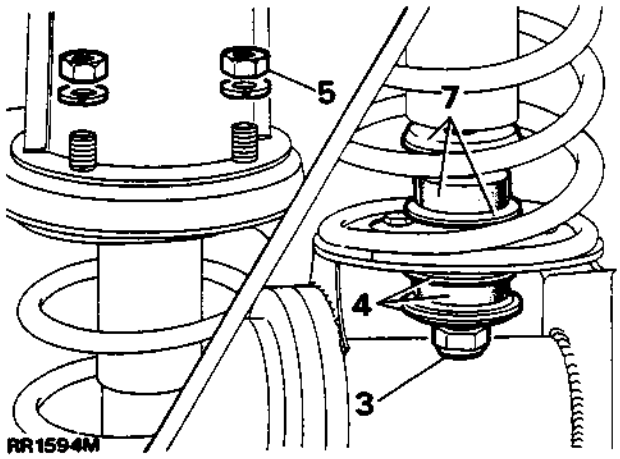
5. Reverse 4. Retain in position with a slave nut.
6. Reverse 2 and 3.
7. Remove the nut retaining the securing ring.
8. Fit the front shock absorber.

FRONT SHOCK ABSORBER

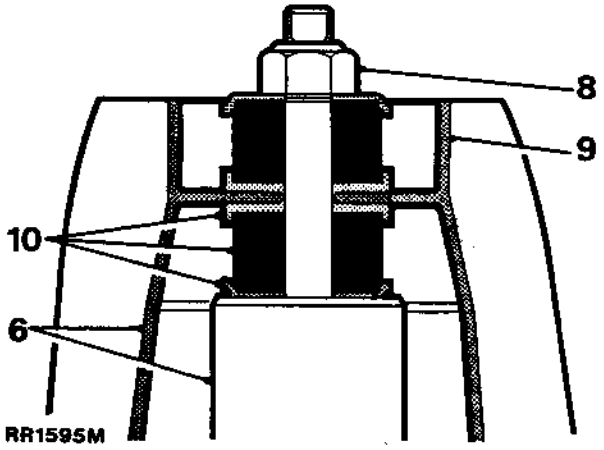
Remove and refit

Removing

1. Remove the road wheel.
2. Support the axle weight.
3. Remove the shock absorber lower fixing.



4. Withdraw the cupwasher, rubber bush and seating washer.
5. Remove the shock absorber bracket fixings.
6. Withdraw the shock absorber and bracket complete.



7. Withdraw the seating washer, rubber bush and cupwasher.
8. Remove the fixings, shock absorber to mounting bracket.
9. Withdraw the mounting bracket.
10. Lift off the top seating washer, rubber bush and cupwasher.

Refitting

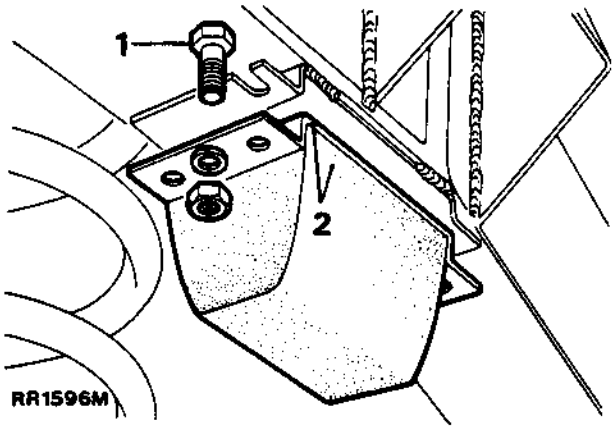
11. Reverse 1 to 10.

BUMP STOP

Remove and refit

Removing

1. Remove the fixings.
2. Withdraw the bump stop assembly.



Refitting

3. Position the fixing bolts in the slots in the chassis brackets.
4. Fit the bump stop assembly.

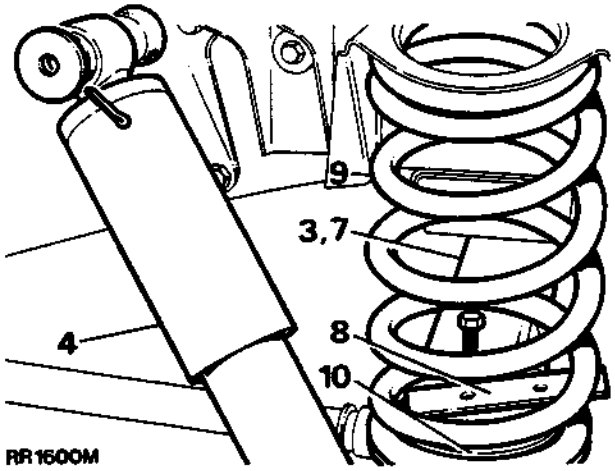
REAR ROAD SPRING

Remove and refit

Service tool:
RO1006 Extractor for ball joint.

Removing

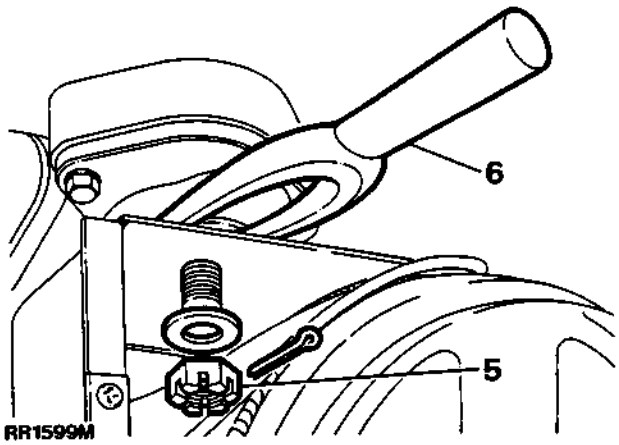
1. Raise rear of vehicle and support chassis.
2. Remove road wheels.
3. Support the axle weight.
4. Disconnect the shock absorbers at one end.



RR1600M

5. Remove fixings, pivot bracket ball joint to axle.
6. Extract the ball joint pin from the tapered housing. Extractor RO1006.
7. Lower the axle further, sufficient to free the road spring from the upper seat.

WARNING: Avoid lowering the axle further than necessary otherwise the rear brake flexible hose will become stretched.



RR1599M

8. Remove the spring retainer plate.
9. Withdraw the road spring.
10. Lift off the spring seat.

Refitting

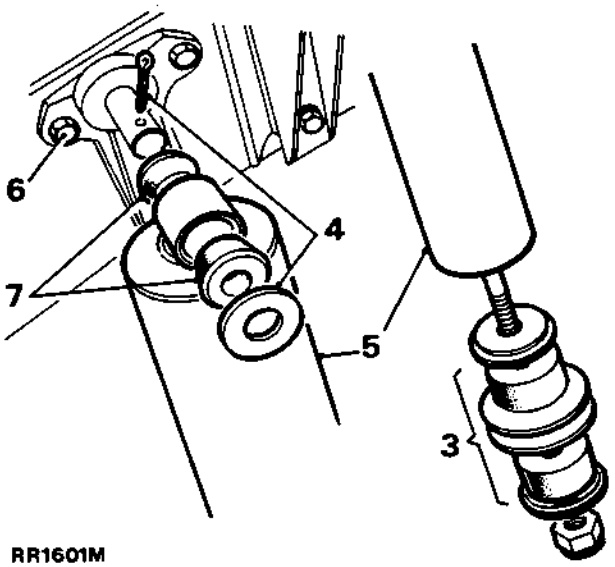
11. Reverse 1 to 10. Tighten the pivot bracket ball joint nut to the correct torque.

REAR SHOCK ABSORBER

Remove and refit

Removing

1. Remove road wheel.
2. Support the rear axle.
3. Remove the fixings and withdraw the shock absorber from the axle bracket.



RR1601M

4. Remove upper fixings.
5. Withdraw the shock absorber.
6. If required, remove the mounting bracket at the chassis side member.
7. If required, lift out the mounting rubbers at the upper end.

Refitting

8. Reverse items 7 and 8 as applicable.
9. Reverse items 1 to 6.

LEVELLING UNIT

Functional check

A Boge Hydromat levelling unit is located in the centre of the rear axle.

When the vehicle is unladen the levelling unit has little effect. The unit is self-energising and hence the vehicle has to be driven before the unit becomes effective, the time taken for this to happen being dependent upon the vehicle load, the speed at which it is driven and the roughness of the terrain being crossed.

If the vehicle is overloaded the unit will fail to level fully and more frequent bump stop contact will be noticed.

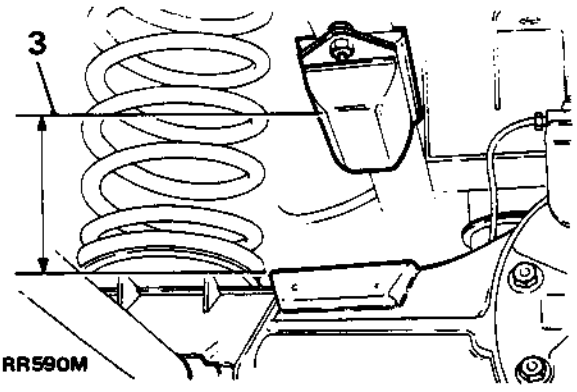
Should the vehicle be left for a lengthy period, e.g. overnight, in a laden condition, it may settle. This is due to normal internal fluid movement in the unit and is not detrimental to the unit performance.

Before carrying out the checks below, verify that the vehicle is being operated within the specified maximum loading capabilities. If the levelling unit is then believed to be at fault, the procedure below should be followed.

1. Check the levelling unit for excessive oil leakage and if present the unit must be changed. Slight oil seepage is permissible.

2. Remove excessive mud deposits from underneath the vehicle and any heavy items from inside the vehicle that are not part of the original equipment.

3. Measure the clearance between the rear axle bump pad and the bump stop rubber at the front outer corner on both sides of the vehicle. The average clearance should be in excess of 67 mm (2.8 in). If it is less than this figure remove the rear springs and check their free length against the 'Road Spring Data'. Replace any spring whose free length is more than 20 mm (0.787 in) shorter than the figure given. If after replacing a spring the average bump clearance is still less than 67 mm (2.8 in), replace the levelling unit.



4. With the rear seat upright, load 450 kg (992 lb) into the rear of the vehicle, distributing the load evenly over the floor area. Check the bump stop clearance, with the driving seat occupied.

5. Drive the vehicle for approximately 5 km (3 miles) over undulating roads or graded tracks. Bring the vehicle to rest by light brake application so as not to disturb the vehicle loading. With the driving seat occupied, check the bump stop clearance again.

6. If the change in clearance is less than 20 mm (0.787 in) the levelling unit must be replaced.

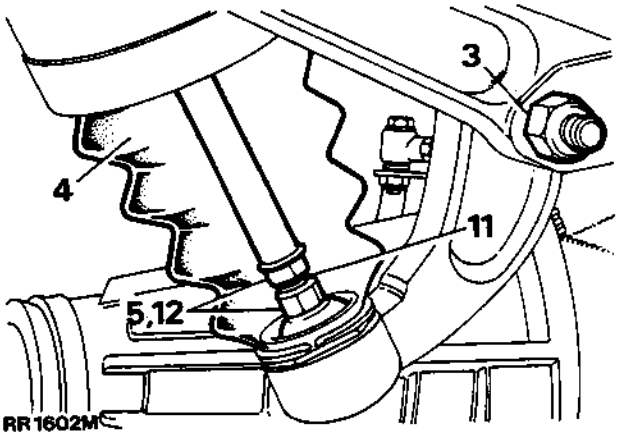
LEVELLING UNIT

Remove and refit

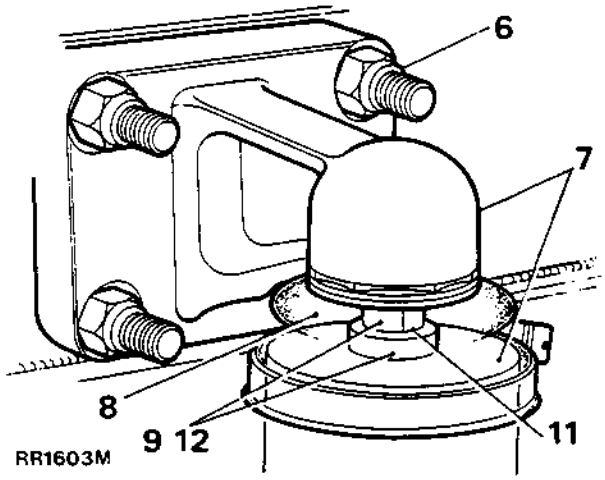
Removing

WARNING: The levelling unit contains pressurised gas and must not be dismantled nor the casing screws removed. Repair is by replacement of complete unit only.

1. Raise and support the chassis rear end.
2. Support the axle weight.
3. Disconnect the suspension upper links at the pivot bracket.



4. Ease up the lower gaiter.
5. Unscrew the lower ball joint at the levelling unit push rod, using thin jawed spanners.
6. Remove the top bracket fixings at the cross member.
7. Withdraw the levelling unit and top bracket complete.
8. Ease back the upper gaiter.
9. Unscrew the upper ball joint at the levelling unit, using thin jawed spanners.
10. Withdraw the upper and lower gaiters and their retaining spring rings.



Refitting

11. Smear 'Loctite' grade CVX or suitable equivalent sealant on to ball pin threads.
12. Reverse items 1 to 10. Do not fully tighten the fixings until all items are in their fitted position. Finally tighten to the correct torque.

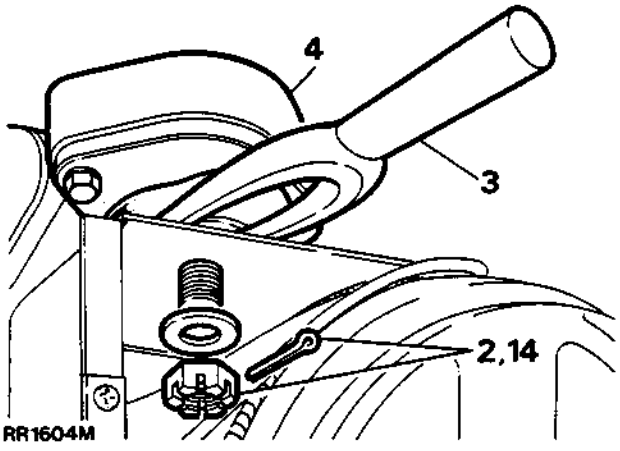
LEVELLING UNIT BALL JOINTS

Remove and refit

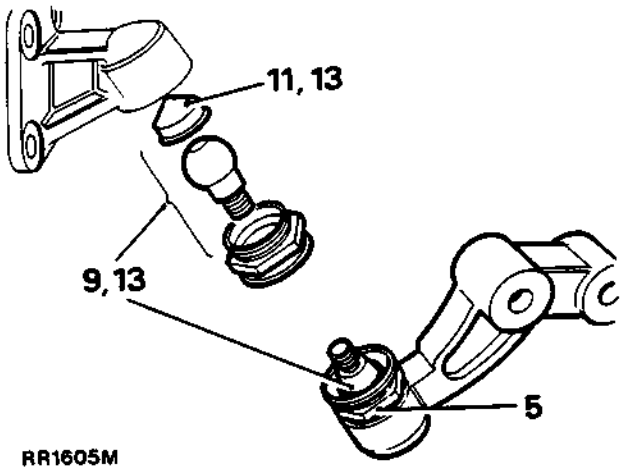
Service tools: RO 1006 Extractor for axle bracket ball joint

Removing

1. Remove the levelling unit.
2. Remove the split pin and nut at the rear axle bracket.
3. Extract the ball pin from the axle bracket. Extractor RO 1006.



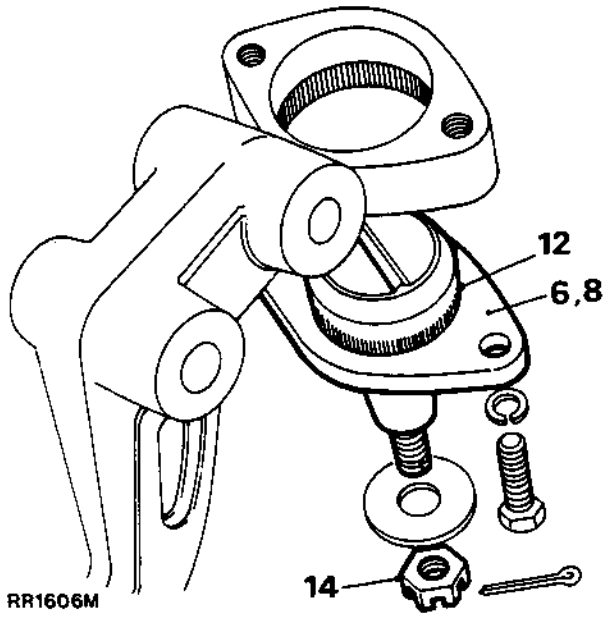
4. Withdraw the pivot bracket complete with ball joints.
5. Unscrew the ball joint assembly for the levelling unit.
6. Remove the ball joint assembly for the axle bracket.



7. Replacement ball joints are supplied as complete assemblies, less fixings, and are pre-packed with grease.
8. The ball joint for the axle bracket must not be dismantled.
9. The ball joints for the levelling unit may be dismantled and cleaned if required.
10. Pack the ball joint with Dextagrease GP or an equivalent grease when assembling.
11. Ensure that the ball seating is square in its housing before refitting.

Refitting

12. Press the knurled ball joint into the pivot bracket.



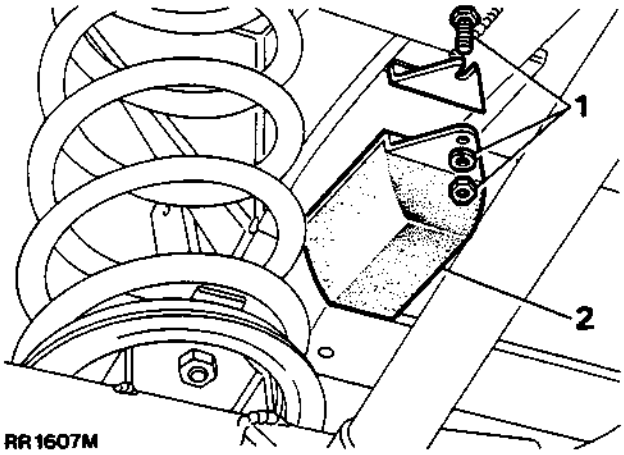
13. Screw the ball joints for the levelling unit into the mounting brackets. If the ball joints do not screw in easily and fully, remove and refit the assemblies ensuring that the plastic seats do not foul in the housings. Tighten to the correct torque.
14. Fit the pivot bracket complete with ball joints to the rear axle. Tighten to the correct torque.
15. Fit the levelling unit.

BUMP STOP

Remove and refit

Removing

1. Remove the fixings.
2. Withdraw the bump stop assembly.



RR1607M

Refitting

3. Position the fixing bolts in the slots in the chassis brackets.
4. Fit the bump stop assembly, position the shoulder on the carrier to suit the chassis configuration.

UPPER SUSPENSION LINK

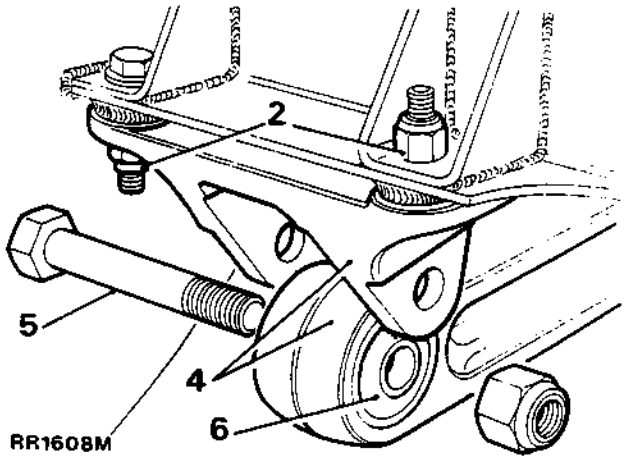
Remove and refit 1 to 6 and 9

BUSH

Remove and refit 7 and 8

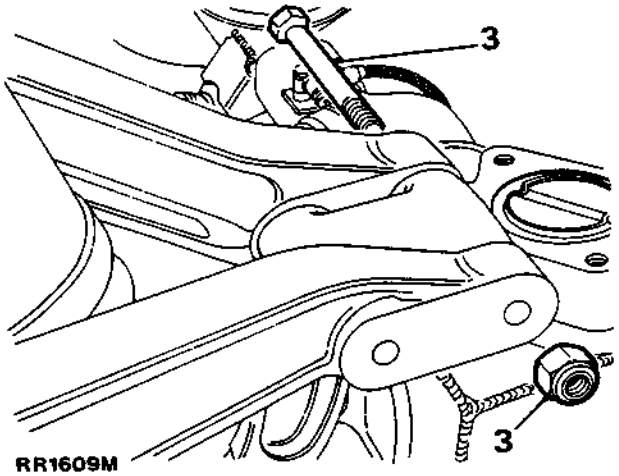
Removing

1. Jack up under the chassis until the rear axle is freely suspended.
2. Remove the fixings, upper link bracket to frame.



RR1608M

3. Remove the fixings, upper links to pivot bracket.
4. Withdraw the upper link complete with frame bracket.
5. Remove the fixing bolt.
6. Separate link and bush assembly from bracket.



RR1609M

Replacing the bush

7. Press out the bush assembly.
8. Fit the replacement bush assembly central in the housing.

Refitting

9. Reverse 1 to 6. Do not fully tighten the fixings until all components are in position.

LOWER SUSPENSION LINK

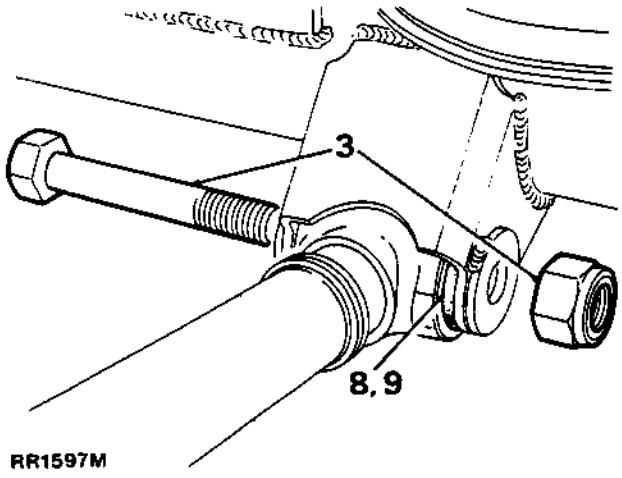
Remove and refit 1 to 7, 10 to 12

BUSH

Remove and refit 8 and 9

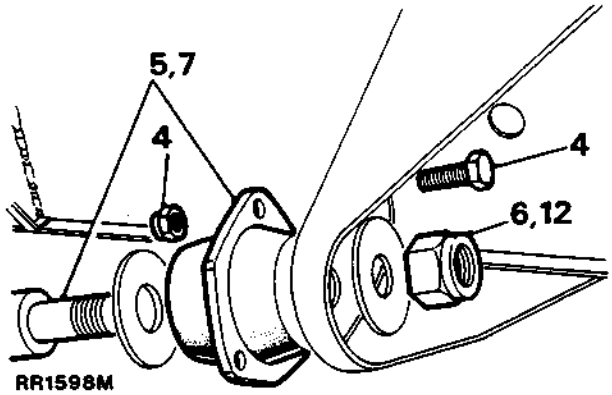
Removing

1. Jack up the rear end or use a ramp for accessibility.
2. LH side only. Remove the shock absorber lower fixings and withdraw the shock absorber from the axle bracket.
3. Remove the link rear fixings.



RR1597M

4. Remove the mounting bracket fixings at the side member bracket.
5. Withdraw lower link complete with mounting bracket.
6. Remove the locknut.
7. Withdraw the mounting bracket from the lower link.



RR1598M

Replacing the bush

8. Press out the bush assembly from the rear end.
9. Fit the replacement bush assembly central in the housing.

Refitting

10. Reverse items 6 and 7. Do not tighten the locknut at this stage.
11. Reverse items 3 to 5.
12. Lower the vehicle, remove the jack and allow the axle to take up its static laden position.
13. Tighten the locknut to the correct torque.

BRAKE SYSTEM

Description

The hydraulic braking system fitted to the Range Rover is of the dual line type, incorporating primary and secondary hydraulic circuits.

NOTE: References made to primary and secondary do not imply main service brakes or emergency brakes but denote hydraulic line identification.

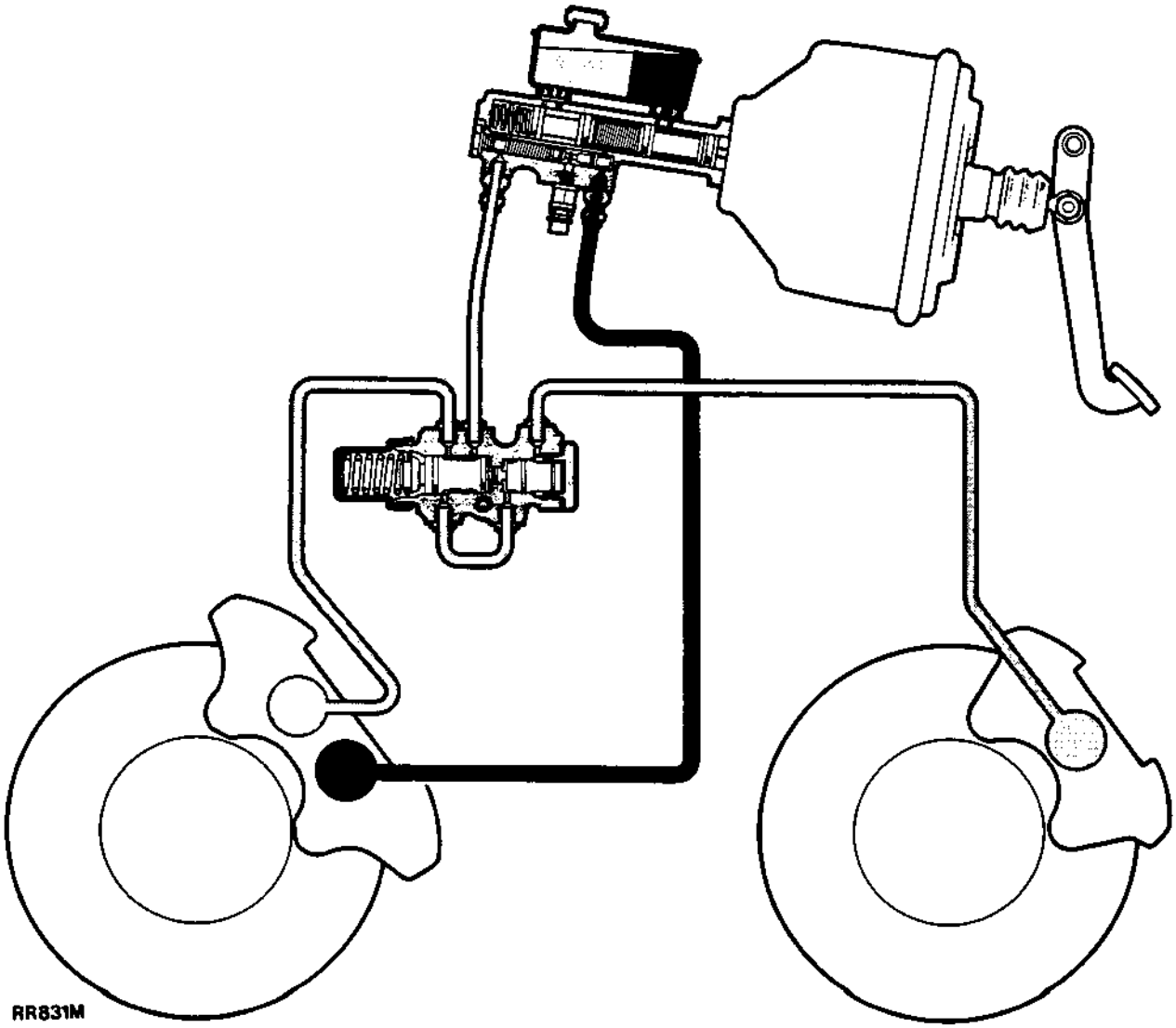
The brake pedal is connected to a vacuum-assisted mechanical servo which in turn operates a tandem master cylinder. The front disc brake calipers each house four pistons, the lower pistons are fed by the primary hydraulic circuit, the upper pistons by the secondary hydraulic circuit. The rear disc brake calipers each house two pistons and these are fed by the secondary hydraulic circuit via a pressure reducing valve.

A brake failure switch incorporated in the master cylinder will illuminate a panel warning light if a failure occurs in either the primary or secondary hydraulic circuits.

Continued

PRIMARY HYDRAULIC CIRCUIT - EMERGENCY BRAKE

SECONDARY HYDRAULIC CIRCUIT - SERVICE BRAKE



RR831M

The brake fluid reservoir is divided, the front section (section closest to the servo) feeds the primary circuit and the rear section feeds the secondary circuit. Under normal operating conditions both the primary and secondary hydraulic circuits operate simultaneously on brake pedal application. In the event of a failure in the primary circuit the secondary circuit will still function and operate front and rear calipers. Alternatively, if the secondary circuit fails, the primary circuit will still function and operate the lower pistons in the front calipers.

If the servo should fail, both hydraulic circuits will still function but would require greater pedal pressure.

The hand-operated transmission brake is completely independent of the hydraulic circuits.

Brake pad wear sensors are incorporated into the front right-hand side, inboard brake pad and rear left-hand side, inboard pad. The sensors will illuminate a brake pad wear warning light in the instrument binnacle, when pad thickness has been reduced to approximately 3 mm (0.118 in).

HOSES

1 **Front left-hand flexible hoses**

2 **Front right-hand flexible hoses**

3 **Intermediate flexible hose**

PIPES

4 **Feed to front left-hand hose connector**

5 **Feed to front right-hand hose connector**

6 **Feed to front left-hand caliper**

7 **Feed to front right-hand caliper**

8 **Feed to rear left-hand caliper**

9 **Feed to rear right-hand caliper**

10 **Feed to two-way connector**

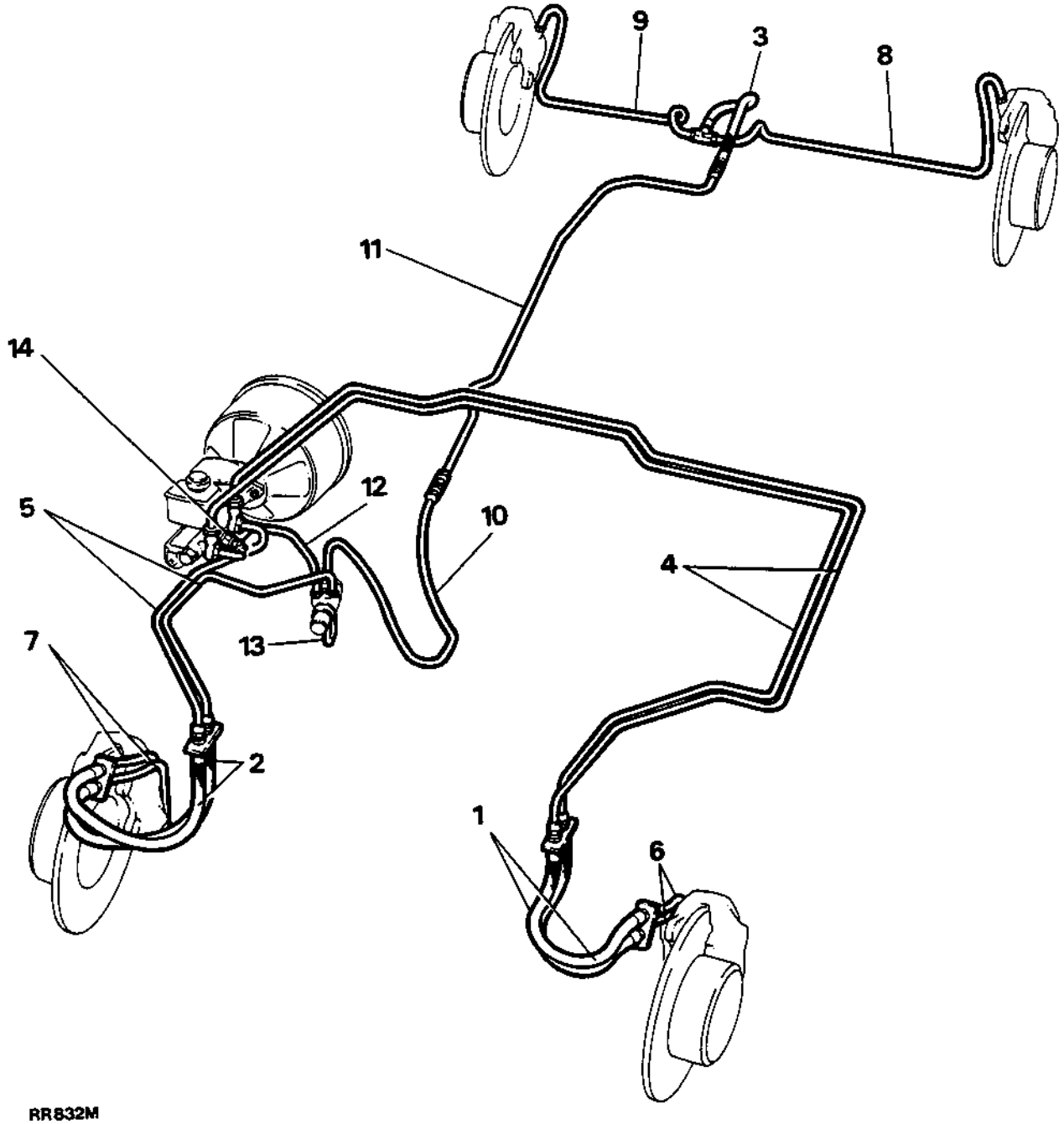
11 **Feed to intermediate hose**

12 **Feed to pressure reducing valve**

13 **Transfer pipe—pressure reducing valve**

14 **Brake failure warning switch**

BRAKE SYSTEM LAYOUT—RIGHT-HAND STEERING



BRAKES

Bleed

The hydraulic system comprises two completely independent sections. The rear calipers and the upper pistons in the front calipers form the secondary section, while the lower pistons in the front calipers form the primary section. The following procedure covers bleeding the complete system, but it is permissible to bleed one section only if disconnections are limited to that section.

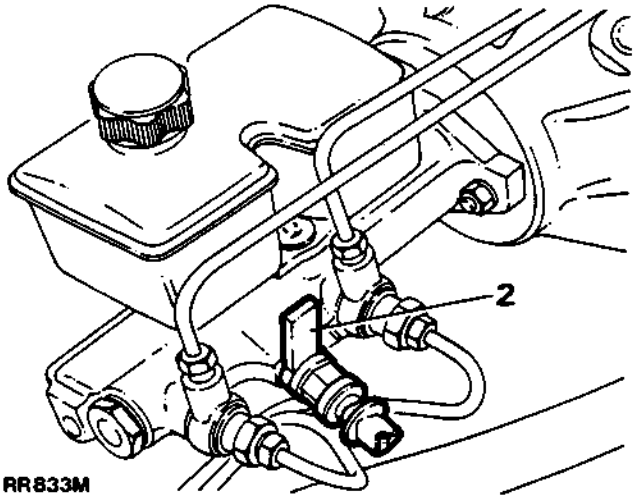
Bleeding will be assisted if the engine is run or a vacuum supply is connected to the servo.

WARNING: IF THE ENGINE IS RUNNING DURING THE BRAKE BLEEDING PROCESS ENSURE THAT NEUTRAL GEAR IS SELECTED AND THAT THE HANDBRAKE IS APPLIED.

When bleeding any part of the secondary section, almost full brake pedal travel is available. When bleeding the primary section only, brake pedal travel will be restricted to approximately half.

Before commencing to bleed the system it is necessary to slacken off the brake failure warning switch to prevent the shuttle value restricting the hydraulic fluid flow.

1. Disconnect the leads from the switch.
2. Unscrew the switch and insert the 'C' washer between the switch and master cylinder before depressing the brake pedal.
3. After completion of bleeding, screw in the switch and tighten to the correct torque. See 'Data section'.



RR833M

NOTE: When bleeding the system commence with the caliper furthest from the master cylinder and bleed from the screw on the same side as the fluid inlet pipes, then close the screw and bleed from the screw on the opposite side of the same caliper. Tighten the bleed screws to the correct torque. See 'Data section'.

Bleeding

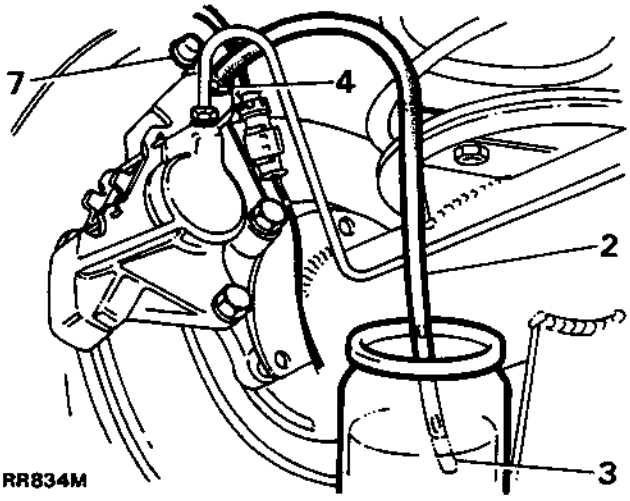
1. Fill the fluid reservoir with the correct fluid, see 'Data section'.

   NOTE: The correct fluid level must be maintained throughout the procedure of bleeding.

2. Connect a bleed tube to the bleed screw on the rear caliper furthest from the master cylinder.
3. Submerge the free end of the bleed tube in a container of clean brake fluid.
4. Slacken the bleed screw.
5. Operate the brake pedal fully and allow to return.

   NOTE: Allow at least five seconds to elapse with the foot right off the pedal to ensure that the pistons fully return before operating the pedal again.

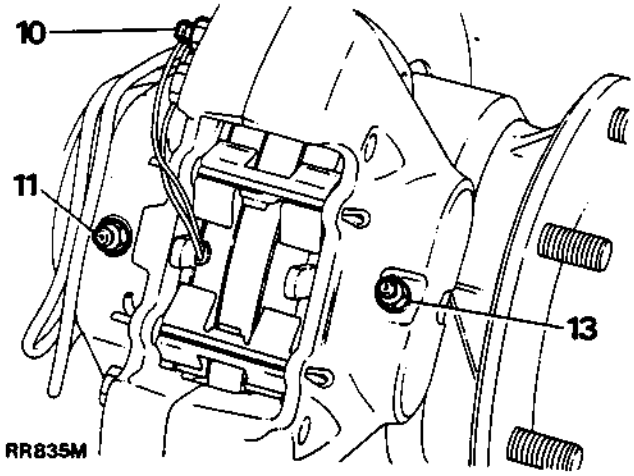
6. Repeat 5 until fluid clear of air bubbles appears in the container, then keeping the pedal fully depressed, tighten the bleed screw.
7. Remove the bleed tube and replace the dust cap on the bleed screw.



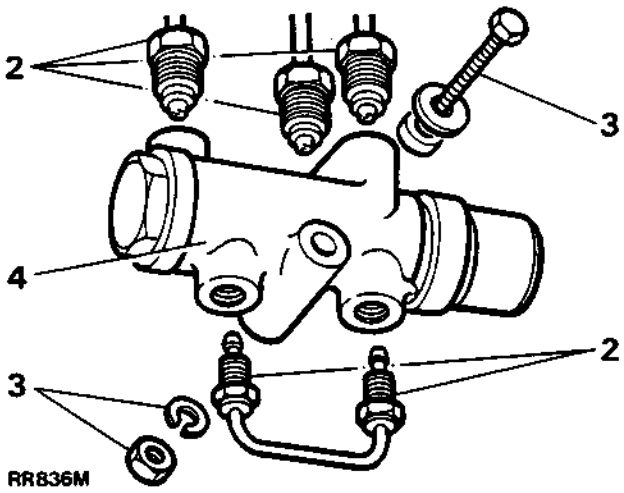
RR834M

8. Repeat 1 to 7 for the other rear caliper.
9. Remove the front wheel on the side furthest from the master cylinder.

10. Connect a bleed tube to the primary bleed screw on the front caliper furthest from the master cylinder.
11. Connect a bleed tube to the secondary bleed screw on the same side of the caliper as the primary screw.
12. Repeat 3 to 7 for the front caliper, bleeding from the two screws simultaneously.
13. Connect a bleed tube to the other screw on the front caliper furthest from the master cylinder.



14. Repeat 3 to 7 for the second secondary screw on the front caliper.
15. Refit the front wheel.
16. Repeat 9 to 15 for the front caliper nearest the master cylinder.
17. Remove the 'C' washer and tighten the PDWA switch to the correct torque. See 'Data section'.



Refitting

5. Reverse the removal instructions.
6. Bleed the brake systems.

NOTE: The pressure reducing valve is not a serviceable item, in the event of a failure or damage, a new unit must be fitted.

BRAKE PRESSURE REDUCING VALVE

Remove and refit

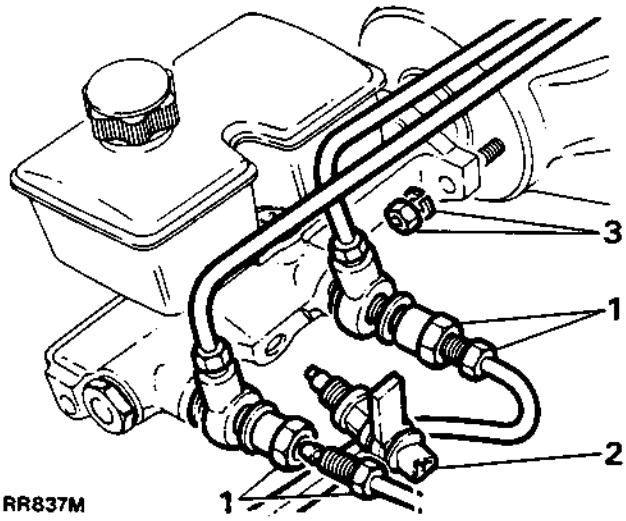
Removing

1. Remove all dust, grime, etc. from the vicinity of the pressure reducing valve fluid pipe unions.
2. Disconnect the inlet and outlet fluid pipes from the pressure reducing valve. Plug the pipes and reducing valve ports to prevent the ingress of foreign matter.
3. Remove the nut, spring washer, bolt, plain washer and distance piece securing the reducing valve to the vehicle.
4. Withdraw the pressure reducing valve from the engine compartment.

MASTER CYLINDER—OVERHAUL

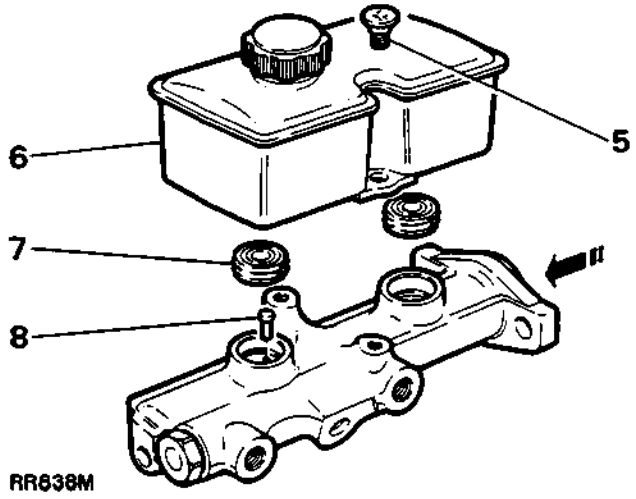
CAUTION: Brake fluid is corrosive, if any fluid comes into contact with body paintwork, immediately wipe clean with a soft cloth.

1. Disconnect the brake pipes from the side of the master cylinder and plug the outlet ports.
2. Disconnect the electrical plug from the PDWA switch.
3. Remove the two nuts and spring washers securing the cylinder to the servo unit.



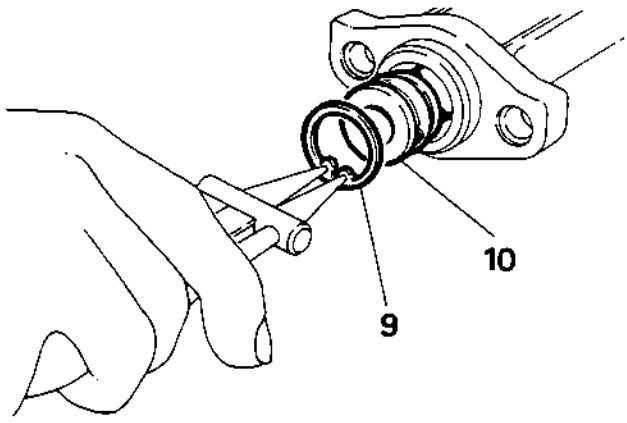
RR837M

4. Remove the reservoir filler cap and drain off the surplus fluid.
5. Remove the two screws securing the reservoir to the master cylinder.
6. Lift the reservoir off the master cylinder.
7. Prise the two reservoir sealing rubbers from the master cylinder.
8. Secure the master cylinder in a vice and push the primary piston down the bore and withdraw the secondary piston stop pin.



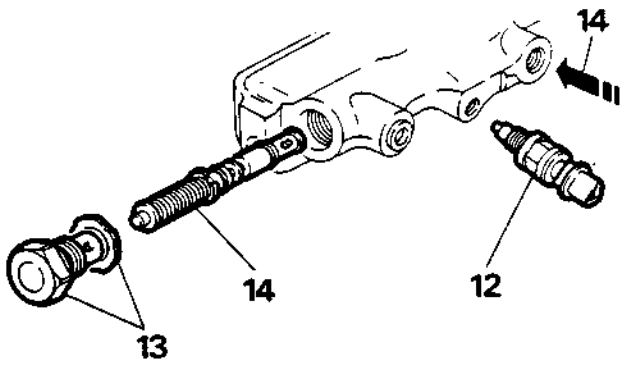
RR838M

9. Press down the primary piston and remove the circlip.
10. Withdraw the primary piston assembly.



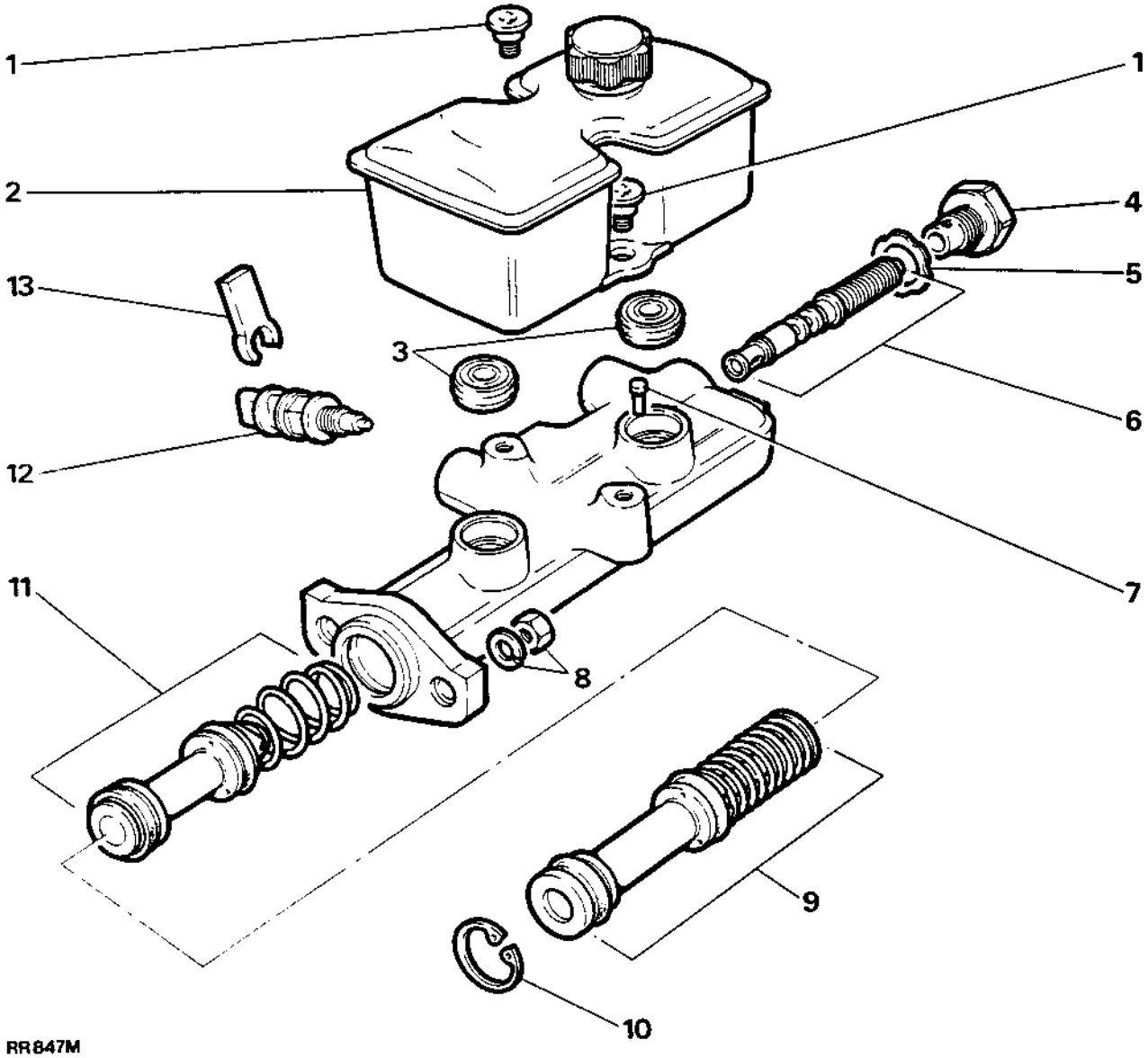
RR839M

11. Apply a high pressure air line to the secondary outlet port to expel the secondary piston assembly.
12. Remove the PDWA switch from the side of the master cylinder.
13. Remove the large end plug and copper washer retaining the shuttle valve in the master cylinder.
14. Apply a high pressure air line to the primary outlet port to expel the shuttle valve from its bore.



RR840M

Continued

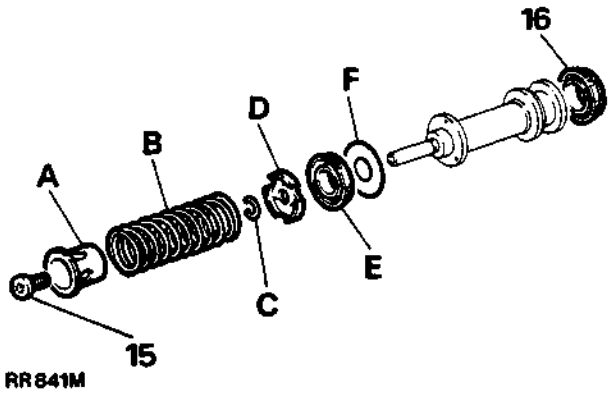


KEY TO MASTER CYLINDER

1. Securing screws
2. Reservoir
3. Reservoir seals
4. End plug
5. Copper washer
6. Shuttle valve
7. Secondary piston stop pin
8. Nuts and washers securing cylinder to servo
9. Primary piston
10. Circlip
11. Secondary piston
12. PDWA switch
13. 'C' washer

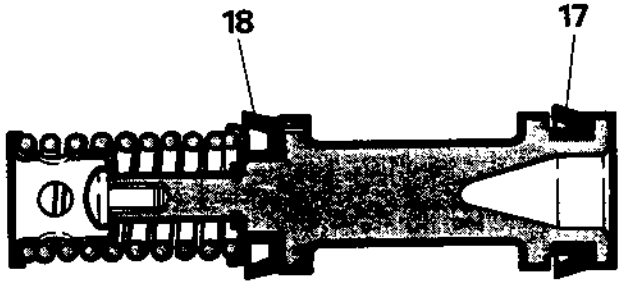
RENEWING PRIMARY PISTON SEALS

15. Remove the retaining screw from the primary piston and remove the following items:
    (A) Spring retainer.
    (B) Piston spring.
    (C) Circlip.
    (D) Seal retainer.
    (E) Recuperating seal.
    (F) Washer.
16. Taking care not to damage the piston, prise off the outer seal.



RR841M

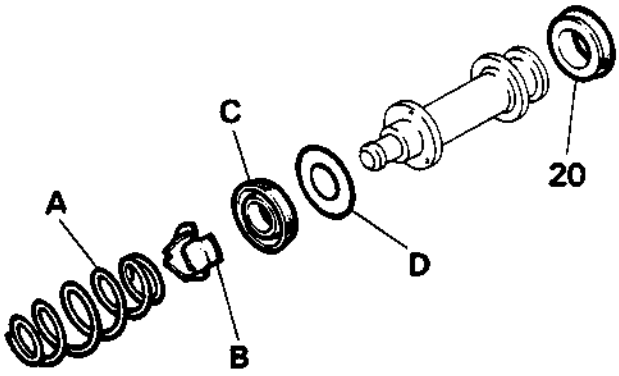
17. Fit a new outer seal into its groove by squeezing the seal between the finger and thumb into an ellipse and press the raised part of the seal over the flange using the fingers of the other hand.
18. Fit a new recuperating seal and assemble the parts in the reverse order of removal. Compress the spring and secure the assembly with the retaining screw. Tighten the screw securely.



RR842M

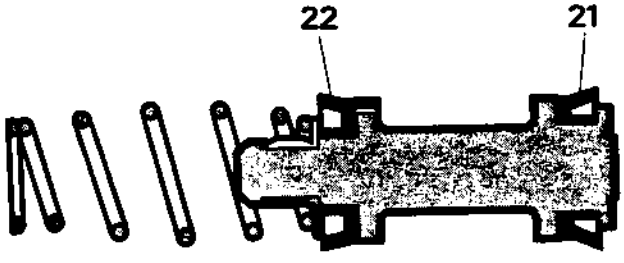
RENEWING SECONDARY PISTON SEALS

19. Remove the following items from the secondary piston:
    (A) Spring.
    (B) Seal retainer.
    (C) Recuperating seal.
    (D) Washer.
20. Taking care not to damage the piston prise off the outer seal.



RR843M

21. Fit a new outer seal using the same procedure as for the primary piston outer seal by squeezing the seal between the finger and thumb into an ellipse and press the raised part of the seal over the flange using the fingers of the other hand,
22. Fit the recuperating seal assembly parts in the reverse order of removal.

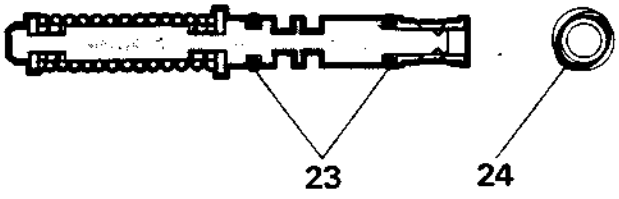


RR844M

RENEW SHUTTLE VALVE 'O' RINGS

23. Carefully remove the two 'O' rings from the valve taking care not to damage the piston.
24. Fit new 'O' rings.

NOTE: The 'O' rings should not be rolled along the piston, but should be stretched slightly and eased down the piston and into the grooves.



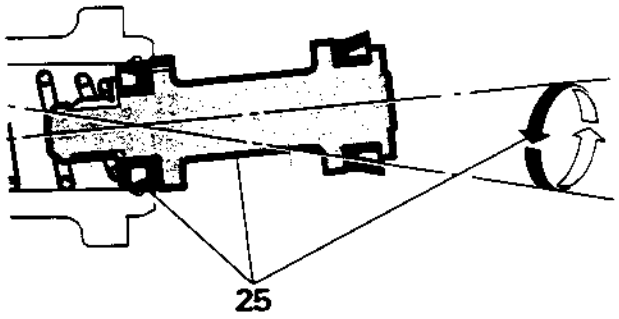
RR845M

26. Slowly press the piston down the bore and fit the secondary piston stop-pin.
27. Fit the primary plunger assembly using the same method as for the secondary plunger. Press the plunger down and secure the assembly with the circlip.
28. Lubricate the 'O' rings and fit the shuttle valve. Fit the end plug using a new copper sealing washer and tighten the plug securely.
29. Fit the plastic 'C' washer to the end of the PDWA switch and screw the switch into the master cylinder.
30. Fit new seals to the bottom of the reservoir.
31. Press the reservoir into the top of the master cylinder and secure in position with the two retaining screws.
32. Fit the master cylinder to the servo and secure with the two nuts and spring washers and tighten to the correct torque. See 'Data section'.
33. Bleed the brakes. After final bleed remove the 'C' washer from the PDWA switch and tighten the switch to the correct torque. See 'Data section'.

ASSEMBLING MASTER CYLINDER

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. Never use old fluid or any other form of cleaning and lubricating material. Cleanliness throughout is essential.

25. Clamp the cylinder in a vice and lubricate the secondary piston seals and cylinder bore. Offer the piston assembly to the cylinder until the recuperation seal is resting centrally in the mouth of the bore. Gently introduce the piston with a circular rocking motion, as illustrated. Whilst ensuring that the seal does not become trapped, ease the seal into the bore and slowly push the piston down in one continuous movement.

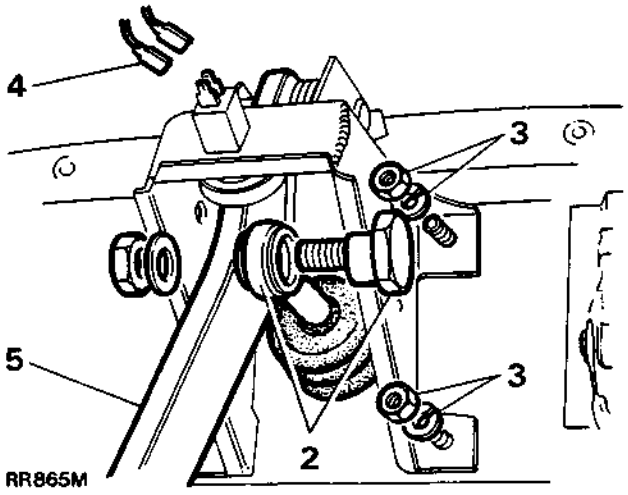


RR846M

PEDAL ASSEMBLY—OVERHAUL

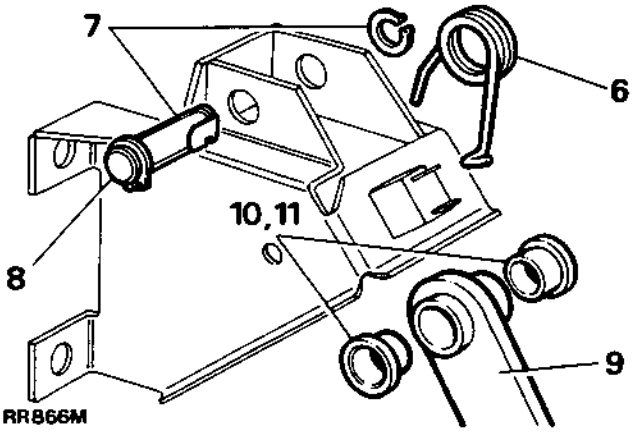
Remove the pedal assembly

1. Remove the lower fascia panel.
2. Disconnect the servo operating rod from the brake pedal.
3. Remove the four nuts and spring washers securing the brake pedal and servo assemblies to the engine compartment closure panel.
4. Withdraw the brake pedal assembly sufficient to disconnect the electrical leads from the stop light switch.
5. Lift the pedal assembly clear.



DISMANTLING

6. Disconnect the pedal return spring.
7. Remove the circlip from the 'D' shaped end of the pedal shaft.
8. Withdraw the pedal shaft.
9. Withdraw the pedal from the box.
10. Remove the bushes from the pedal pivot tube.

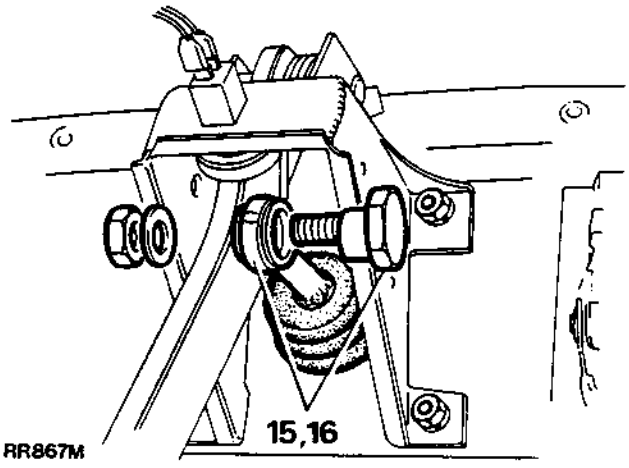


Assembling

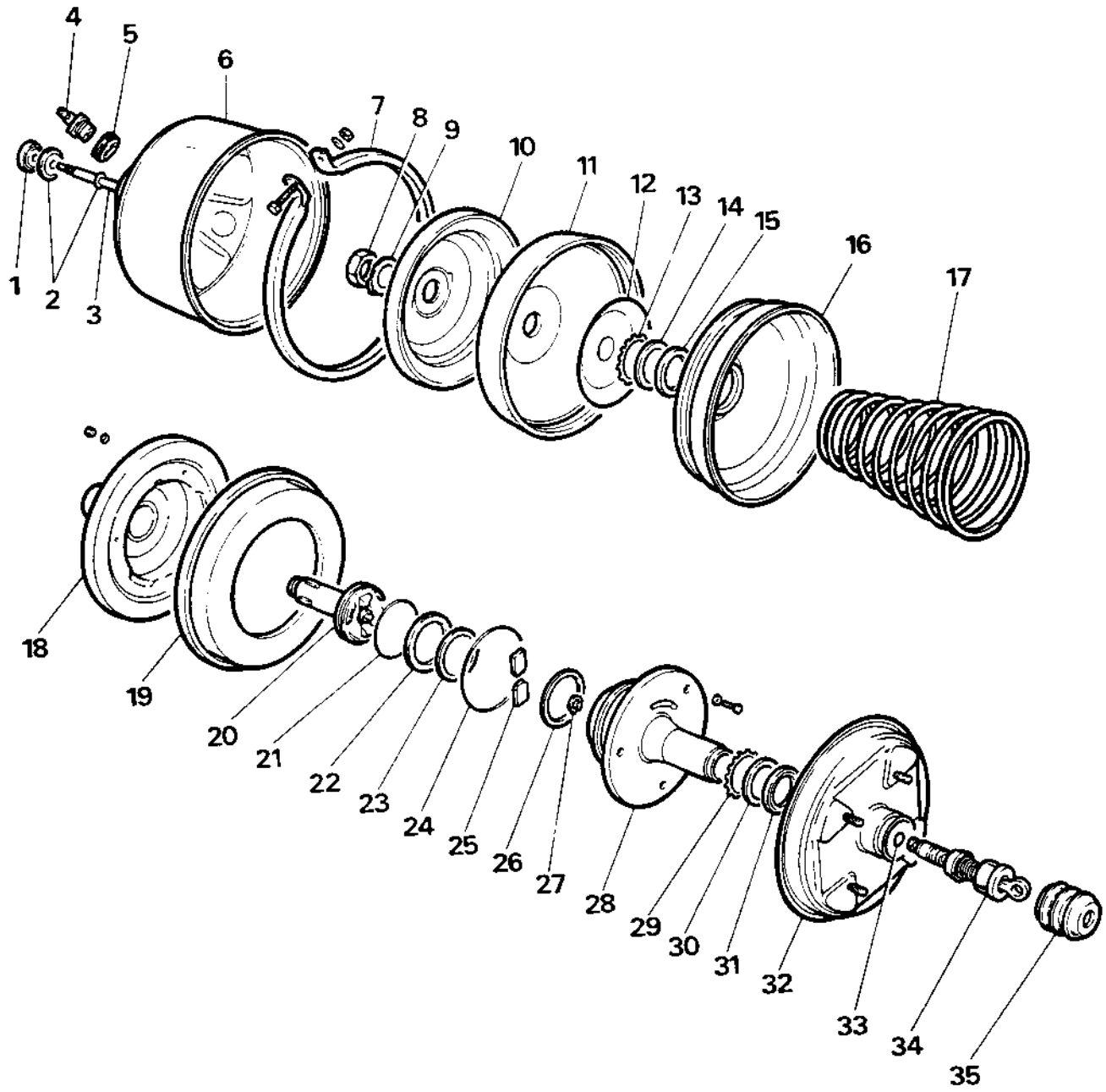
11. Press the new bushes into the pedal pivot tube. If necessary, reamer the bushes to 15.87 mm plus 0.05 mm (.625 in plus .002 in).
12. Lightly oil the bushes and pedal shaft.

Refit the pedal assembly

13. Refit the assembly to the engine compartment closure panel, tighten the four nuts securely.
14. Connect the electrical leads to the stop light switch.
15. Connect the servo operating rod to the brake pedal with the pivot bolt eccentric, in the forward position. Do not fully tighten the pivot bolt nut.
16. Turn the pivot bolt to bring the brake pedal back until it just contacts the rubber buffer, then secure the pivot bolt nut.



17. Refit the lower fascia.



RR848M

KEY TO BRAKE SERVO

1. Push rod seal
2. Retainer
3. Push rod
4. Non-return valve
5. Seal
6. Servo shell
7. Clamp ring
8. Locknut
9. Lock washer
10. Support plate
11. Diaphragm
12. Backing washer
13. Bearing retainer
14. Nylon bearing
15. Seal
16. Separator shell
17. Spring
18. Diaphragm support and tube
19. Diaphragm
20. Reaction piston
21. Rubber 'O' ring
22. Sponge seal
23. Backing ring
24. Rubber 'O' ring
25. Levers
26. Bearing ring
27. Circlip
28. Valve body
29. Bearing retainer
30. Nylon bearing
31. Seal
32. Servo cover
33. Rubber 'O' ring
34. Valve/push rod assembly
35. Rubber boot

BRAKE SERVO—Overhaul

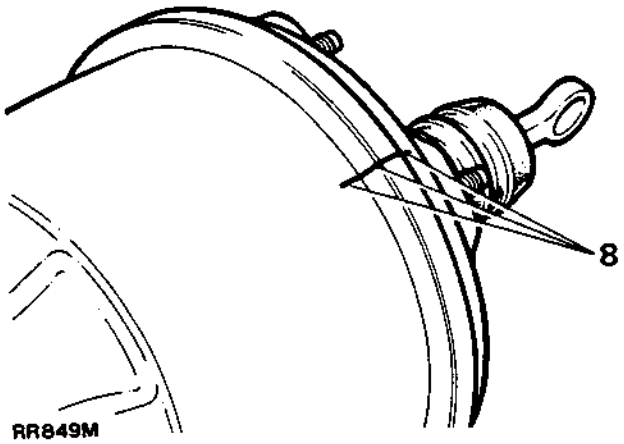
REMOVING THE SERVO

1. Remove the master cylinder from the servo.
2. Disconnect the servo vacuum hose from the non-return valve.
3. Remove the lower fascia within the vehicle to gain access to the brake pedal linkage and servo retaining nuts located on the rear of the engine compartment closure panel.
4. Disconnect the brake pedal linkage.
5. Remove the four nuts with spring washers securing the servo to the closure panel.
6. Remove the servo from the engine compartment and place on a suitable clean bench.
7. Thoroughly clean the exterior of the servo.

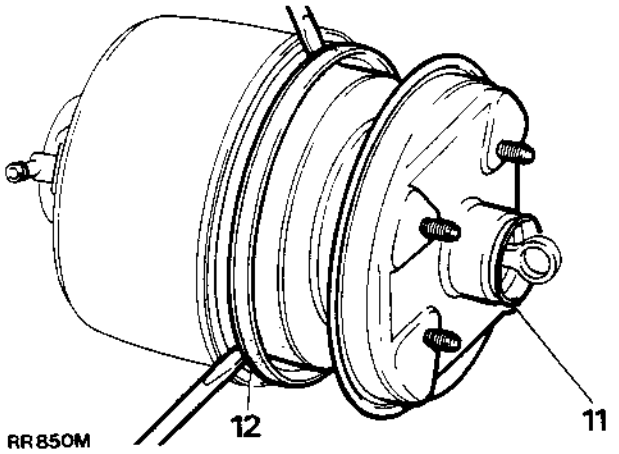
CAUTION: CARE MUST BE TAKEN TO ENSURE THAT ALL COMPONENTS ARE SCRUPULOUSLY CLEAN BEFORE UNDERTAKING THE OVERHAUL PROCEDURE. ANY DIRT OR GRIT WITHIN THE SERVO COULD RESULT IN DAMAGE TO THE DIAPHRAGMS.

DISMANTLING THE SERVO

8. Before dismantling the servo lightly stamp identification marks on the servo shell, clamp ring and cover plate to aid the assembly procedure.



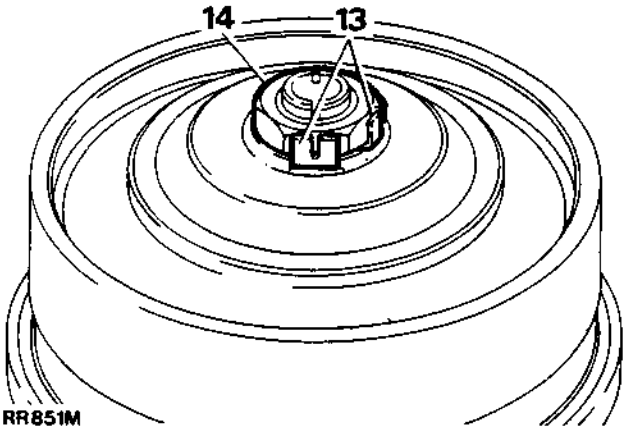
9. Remove the nut, bolt and plain washer securing the clamping to the servo.
10. Remove the rubber boot from the valve/push rod assembly.
11. Slide the servo cover off the valve body.
12. Using two screwdrivers inserted between the separator shell outer lip and servo shell, carefully lever the diaphragm assembly out of the shell.



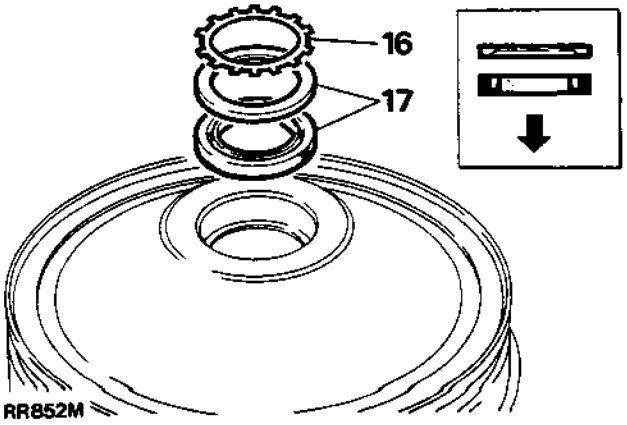
13. Bend back the tabs of the locking washer.

WARNING: Assistance may be required, to hold the diaphragm assembly together whilst the locknut is released, to prevent the unit separating due to internal spring pressure.

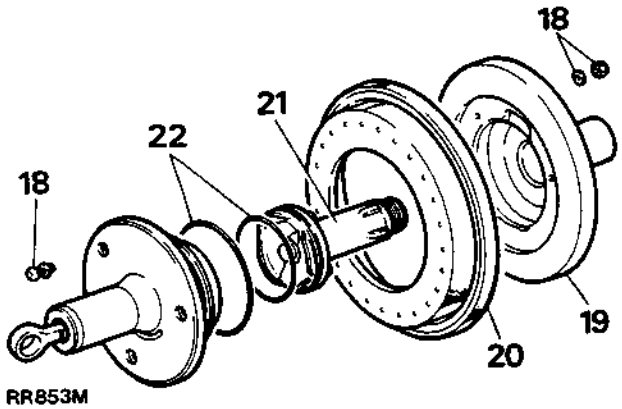
14. Remove the locknut and separate the assembly.



15. Remove the support plate, diaphragm and backing washer from the separator shell.
16. Prise the serrated bearing retainer out of the separator shell.
17. Remove the nylon bearing and rubber seal from the separator shell. Note their position for reassembly.

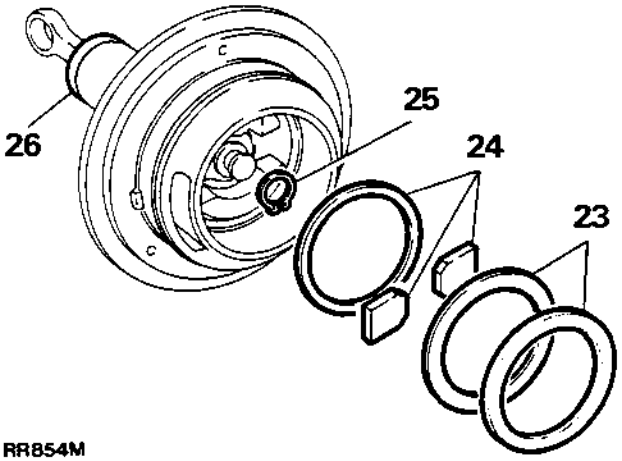


18. Remove the three screws, locknuts plain and fibre washers securing the diaphragm to the valve body.
19. Remove the diaphragm support and tube from the front of the diaphragm.
20. Remove the diaphragm from the valve body.
21. Pull the piston out of the valve body.
22. Remove the 'O' rings from the valve body and piston.



RR853M

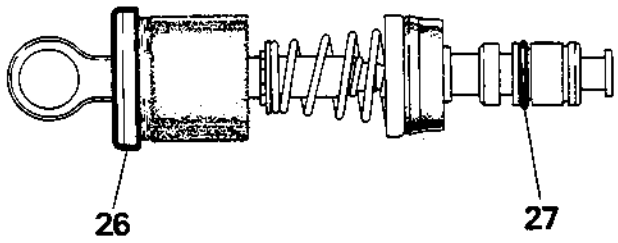
23. Remove the sponge seal and backing ring from the valve body.
24. Lift out the two levers and remove the bearing ring.
25. Release the circlip securing the valve/push rod assembly in the valve body.



RR854M

26. Prise the end cap from the opposite end of the valve body and withdraw the valve/push rod assembly complete.
27. Remove the small 'O' ring from the assembly.

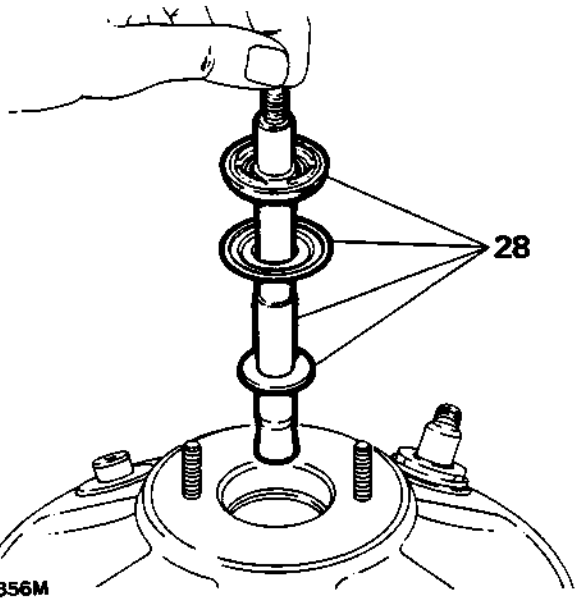
NOTE: The valve/push rod assembly cannot be further dismantled, if the seals and assembly are in a poor condition, renew the complete assembly.



RR855M

28. Remove the push rod, seal, retainer and washer from the servo shell.

NOTE: If the push rod is to be renewed the operating length must be set after the servo has been assembled, see assembling procedure instruction number 61.



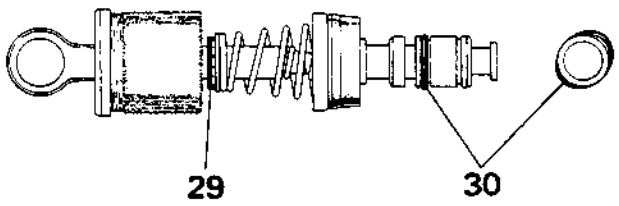
RR856M

Continued

ASSEMBLE THE SERVO

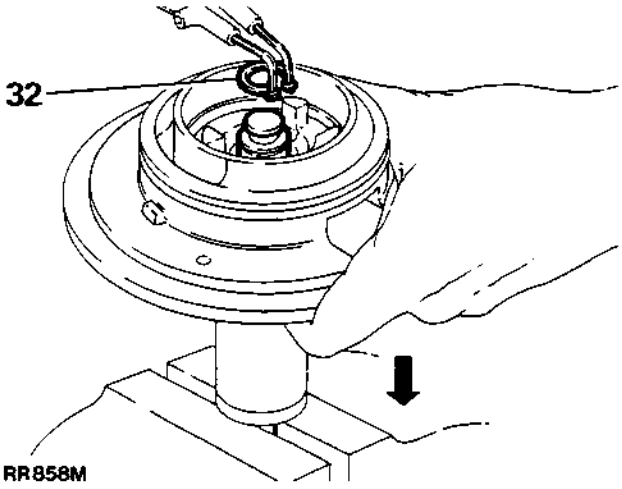
Carefully inspect all parts for wear and damage. Scrupulous cleanliness of all parts of the servo is essential.

29. If a new valve/push rod assembly is being fitted it will be necessary to compress the spring located in the centre of the valve, to enable the circlip to be inserted into the groove, thus tensioning the seal.



RR857M

30. Fit a new 'O' ring to the end of the valve. DO NOT ROLL THE 'O' RING INTO THE GROOVE. Carefully stretch the seal and ease it down the valve and into the groove.
31. Lubricate the seals with Lockheed disc brake lubricant and push the assembly fully into the bore of the valve body.
32. Clamp the eye of the assembly in a bench vice. Press the valve body down to expose the circlip groove at the end of the valve/push rod assembly and fit the circlip.

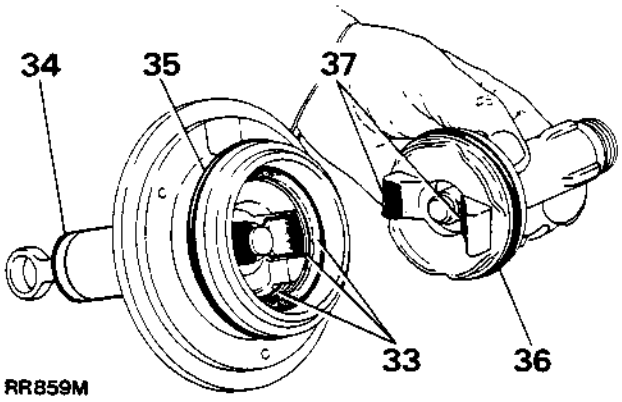


RR858M

33. Fit the bearing ring (thicker of the two rings), levers, backing ring and sponge seal to the valve body,

NOTE: Ensure that the chamfered edges of the levers are fitted firmly into the groove at the end of the push rod assembly.

34. Feed the sponge filter and felt pad into the opposite end of the valve body and press the end cap into position.
35. Lightly coat the new valve body 'O' ring with disc brake lubricant and ease the seal into the groove.
36. Lightly coat the new reaction piston 'O' ring with disc brake lubricant and ease the seal into the groove.
37. Push the piston into the valve body ensuring that the two projections on the piston are located over the levers in the valve body, push the piston firmly into position.

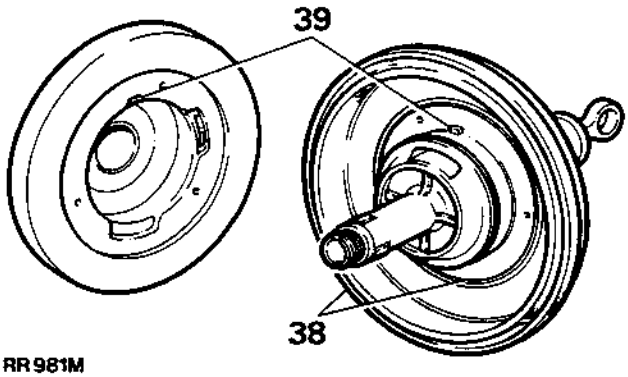


RR859M

38. Place the new diaphragm onto the valve body, locating the inner diaphragm bore onto the shoulder just outside the three bolt holes.

NOTE: DO NOT LUBRICATE THE DIAPHRAGM.

39. Fit the diaphragm support plate and tube to the valve body ensuring that the indent in the support plate lines up with the corresponding projection on the valve body.

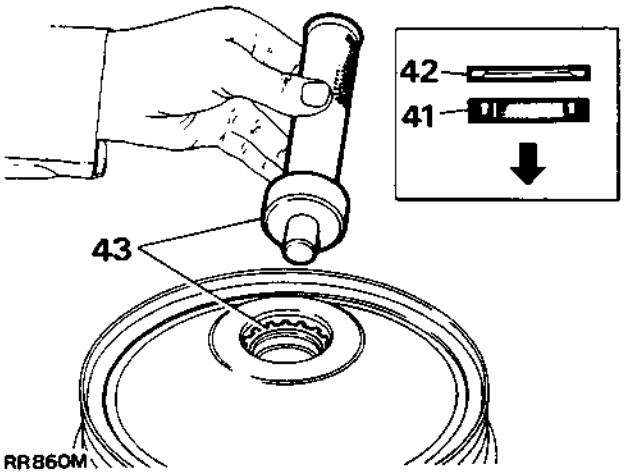


RR981M

40. Fit the three securing screws washers and nuts, entering the bolts from the valve body side.
NOTE: The fibre washer is inserted behind the screw head.

Tighten to the correct torque see 'Data Section'.

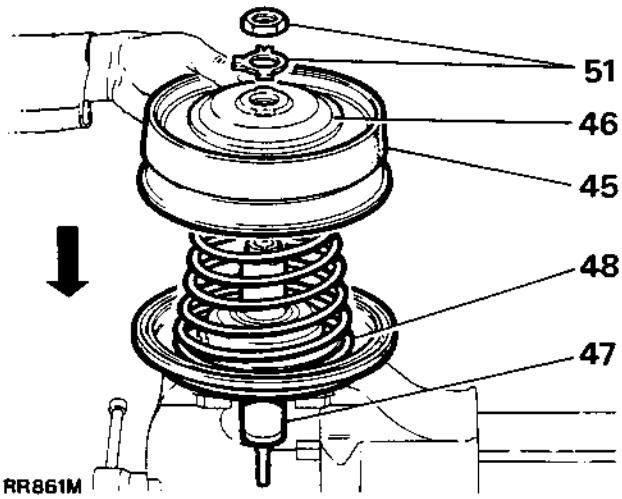
41. Coat the new nylon bearing and seal with Lockheed disc brake lubricant and insert the seal into the separator shell, with the open edge of the seal facing upwards.
42. Fit the nylon bearing washer with the chamfered inner edge downwards.
43. Using a suitable service tool, example MS 550 press in the new retaining ring, convex side first, until the retainer sits firmly on the nylon bearing.



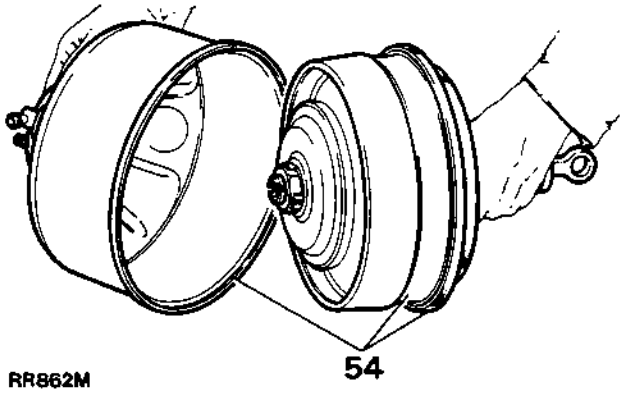
44. Fit the backing washer to the concave side of the separator shell diaphragm.
45. Fit the diaphragm to the separator shell, concave side first, locate the sealing lip over the edge of the separator.
46. Place the support plate onto the face of the diaphragm.
47. Mount the valve body into a bench vice.

CAUTION: DO NOT OVERTIGHTEN THE VICE
Coat the support plate tube with disc brake lubricant.

48. Place the spring onto the valve body, largest diameter to sit on support plate and tube.
49. Holding the separator shell assembly together place it on to the top of the spring.
50. Compress the complete assembly until the thread on the end of the reaction piston protrudes beyond the separator shell assembly.
51. Fit a new tab washer and screw on the large nut.



52. Remove the complete assembly from the vice. Tighten the locknut to the correct torque. See 'Data Section'.
53. Bend up the tabs on the lock washer.
54. Locate the outer edge of the valve body diaphragm into the indent around the separator shell and push the assembly into the servo vacuum shell, ensure that the diaphragm remains in position.



55. Coat the new nylon bearing and seal for the servo end cover with disc brake lubricant and press the seal into the cover.

NOTE: THE OPEN FACE OF THE SEAL DOWNWARDS.

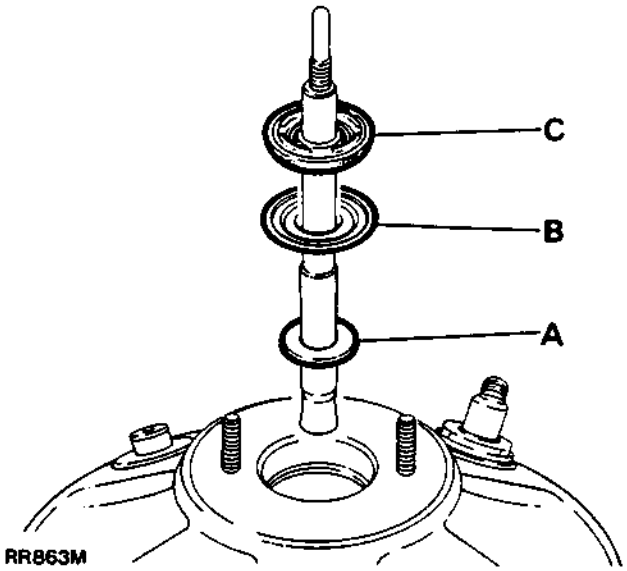
56. Fit the new bearing retainer using a suitable service tool example: MS 550. Ensure the retainer sits firmly on top of the nylon bearing.
57. Lightly coat the valve body with disc brake lubricant ease the end cover onto the assembly and align the identification marks. Locate the beaded edge of the diaphragm between the end cover and servo shell.
58. Fit the clamp ring, bolt and nut, rotate the ring until the identification mark lines up with those on the servo unit. Tighten the clamp ring to the correct torque. See 'Data section'.
59. Fit a new rubber boot over the valve/push rod assembly.

Continued

60. Fit a new nylon washer, retainer and seal to the push rod, fit the push rod to the servo.

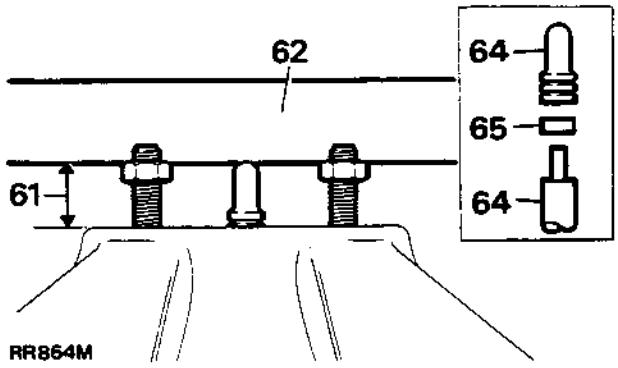
NOTE: Flat face of the seal to the bottom of the seal recess in the servo shell.

(a). Nylon washer.
(b). Retainer.
(c). Seal.



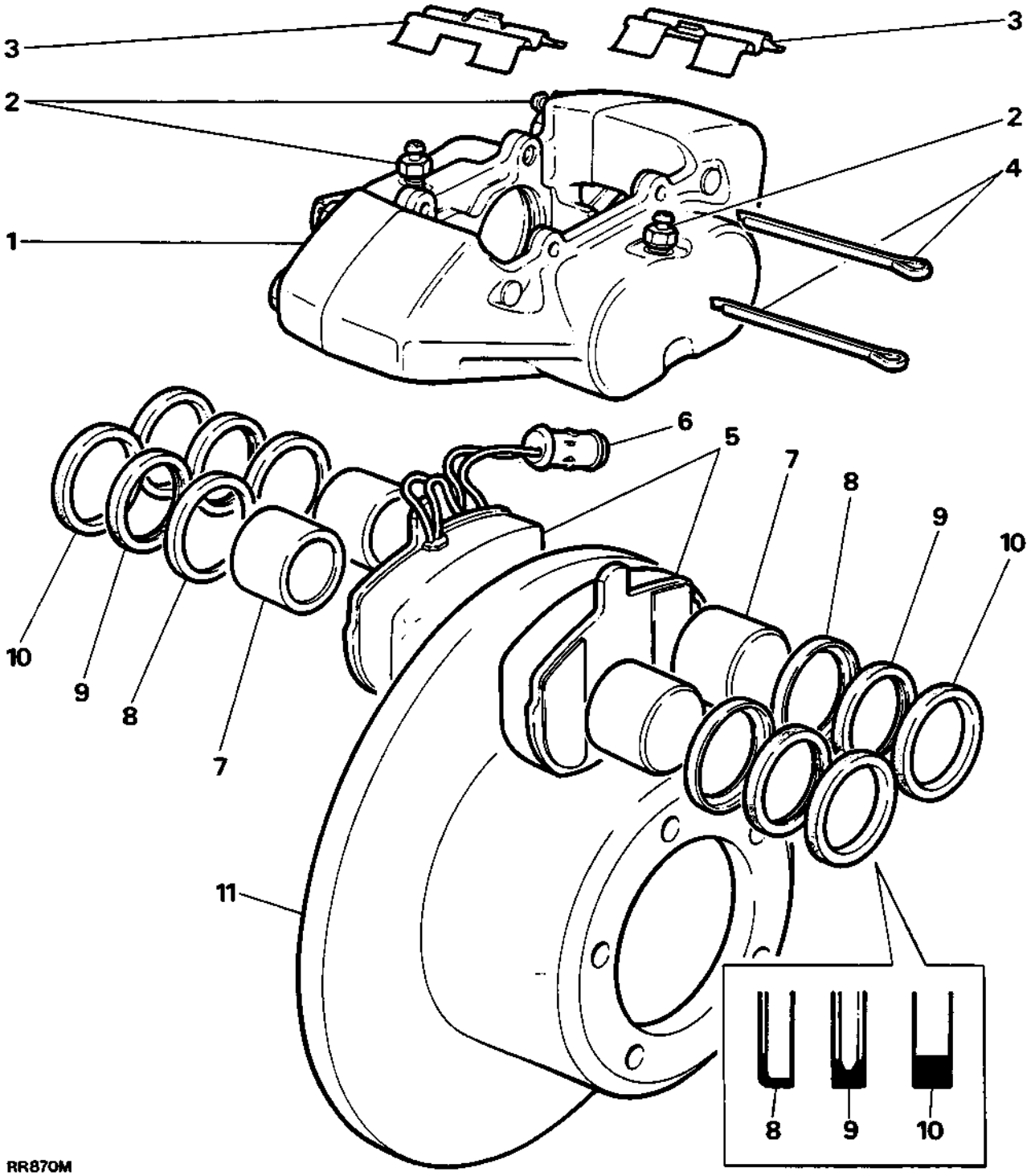
NOTE: If a new push rod is fitted, the operating length must be checked, if adjustment to the rod is required, adjust as follows.

61. Run two nuts down the studs at the master cylinder joint face of the servo. Set the top of the nuts to a dimension of 22.1–21.9 mm (0.871–0.861 inch).
62. Lay a straight edge across the top of the two nuts. Check the height of the push rod to the bottom of the straight edge.
63. If the push rod is out of the limits specified adjust as follows.
64. Remove the push rod from the servo, clamp the small domed end of the rod in a bench vice and detach the main stem.
65. Remove the small spacer. Increase or decrease the size of the spacer accordingly until the correct dimension is attained.



66. Coat the push rod seal with Lockheed disc brake lubricant and fit to the servo.
67. Carefully prise the non-return valve and seal out of the servo shell.
68. Fit new seal.
69. Inspect the non-return valve for condition, renew if necessary.
70. Fit non-return valve.
71. Install the servo into the vehicle and tighten all bolts to the correct torque see 'Data section'.
72 Reconnect the servo operating rod to the brake pedal with the pivot bolt eccentric in the forward position, do not fully tighten the pivot bolt nut.
73. Turn the pivot bolt to bring the brake pedal back until it just contacts the rubber then secure the pivot bolt nut.

FRONT BRAKE CALIPER ASSEMBLY



KEY TO CALIPER

1. Caliper
2. Bleedscrews
3. Pad retaining springs
4. Retaining pins
5. Friction pads
6. Pad wear indicator plug
7. Piston
8. Wiper seal retainer
9. Wiper seal
10. Fluid seal
11. Brake disc

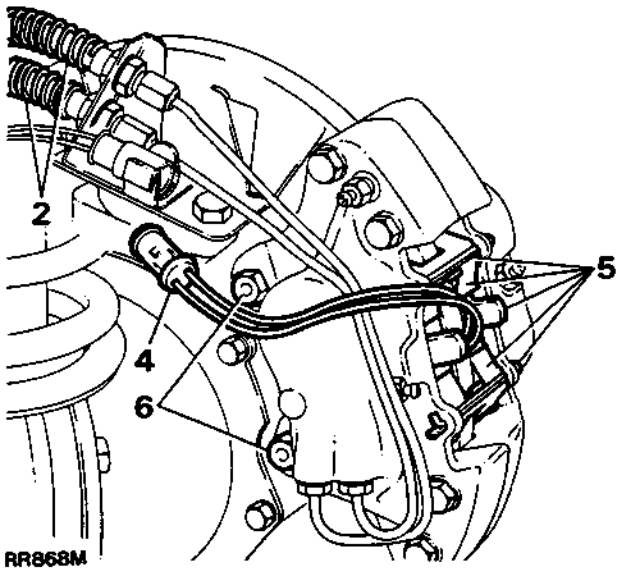
REMOVE AND OVERHAUL FRONT BRAKE CALIPERS

Service tool:
18G 672—Piston clamp

NOTE: Pad wear warning indicators are incorporated into the front right-hand inboard pad and the rear left hand inboard pad.

Remove caliper

1. Slacken the front wheel retaining nuts, jack up the front of the vehicle and lower onto code stands and remove the wheels.
2. Expose the two flexible brake hoses by moving the coiled protective covering.
3. Clamp both hoses to prevent loss of brake fluid, and disconnect the hoses from the caliper.
4. Disconnect the pad wear warning indicator (front right-hand side only).
5. Remove the retaining pins and springs, withdraw the pads. If the same pads are to be refitted, identify them for assembly to their original locations.
6. Remove the two bolts and withdraw the caliper from the disc.

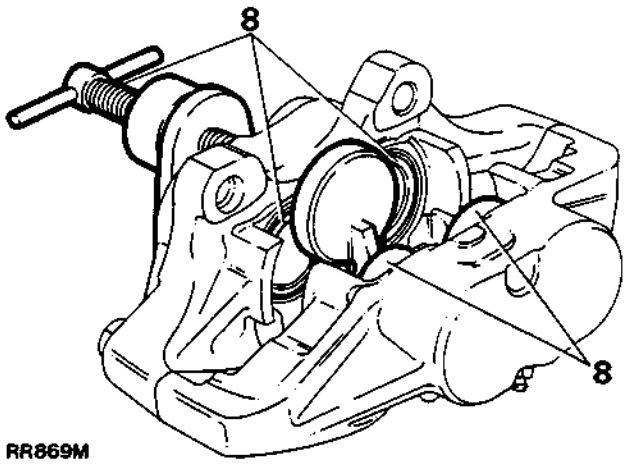


RR868M

DISMANTLE AND OVERHAUL

Do not separate the caliper halves

7. Clean the outer surfaces of the caliper with methylated spirit.
8. Using special tool 18G 672, clamp the pistons in the mounting half of the caliper and gently, keeping fingers clear, and with CAUTION, apply air pressure to the fluid inlet port to expel the rim half 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 caliper.



RR869M

9. Finally, remove the pistons keeping them identified with their respective bores.
10. Remove the wiper seal retainer by inserting a blunt screwdriver between the retainer and the seal and prise the retainer carefully from the mouth of the bore.
11. Taking care not to damage the seal grooves, extract the wiper seal and fluid seal.
12. Clean the bores, pistons and particularly the seal grooves with clean brake fluid or methylated spirit only. If the caliper or pistons are corroded or if their condition is not perfect the parts must be renewed.

Assemble rim-half pistons

13. Coat a new fluid seal with Lockheed disc brake lubricant. 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 so that when the seal is seated it feels proud to the touch at the edge furthest away from the mouth of the bore.
14. Smear the appropriate piston with disc brake lubricant and insert it squarely into the bore by hand only. Do not tilt the piston during insertion and leave approximately 8 mm projecting from the bore.
15. Coat a new wiper seal with disc brake lubricant and fit it to a new seal retainer. Slide the assembly, seal first, over the protruding piston and into the bore recess. Remove the piston clamp from the mounting half and use the clamp to press home the seal retainer and piston.

Mounting rim-half pistons

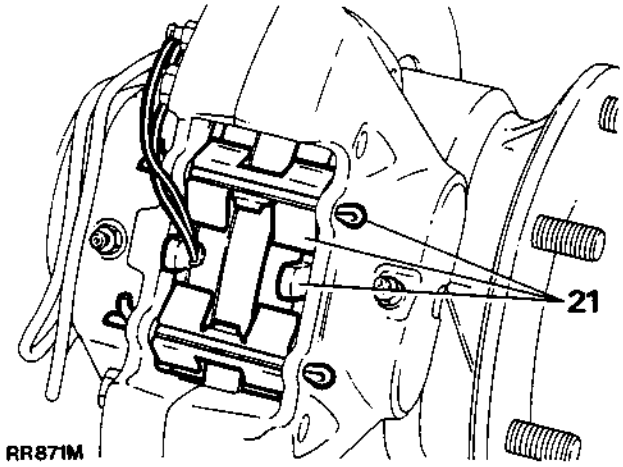
16. Clamp the rim-half pistons and carry out the same procedure as for removing and fitting the rim-half pistons and seals, instructions 8 to 15.

Fit calipers and pads to vehicle

17. Fit the caliper to the axle and secure with the two bolts tightening evenly to the correct torque, see data section.

18. Connect the brake flexible hose to the caliper and tighten to the correct torque, see data section.
19. Remove the clamps from the hoses.
20. Lightly smear the back and edges of the pads with disc brake lubricant carefully avoiding the friction material.
21. Insert the pads and retaining springs and secure with new pins and splay the ends. Note the correct position of the retaining springs.

NOTE: Ensure that the friction pad with the wear indicator is fitted to the inboard side of the front right-hand caliper.



RR871M

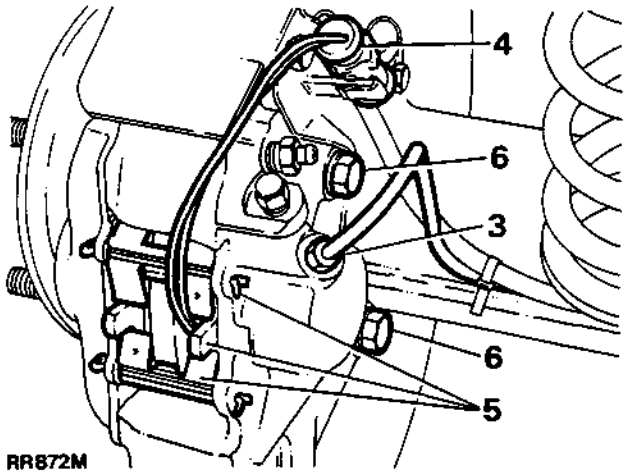
22. Reconnect the pad wear indicator electrical plug.
23. Bleed both the primary and secondary brake systems at the front calipers.
24. When the foregoing instructions have been completed on both calipers, depress the brake pedal firmly several times to locate the friction pads.
25. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts.
26. Road test the vehicle, remembering that if new friction pads have been fitted they are not 'bedded-in' and may take several hundred miles before the brakes are at maximum efficiency.

REMOVE AND OVERHAUL REAR BRAKE CALIPERS

Service tool:
18G 672—Piston clamp

Remove caliper

1. Slacken the rear road wheel nuts and jack up the rear of the vehicle, and lower onto axle stands and remove the wheels.
2. Clamp the flexible brake hose above the rear axle, to prevent loss of fluid.
3. Remove the brake pipe from the rear brake caliper.
4. Disconnect the pad wear indicator (rear left-hand side only.).
5. Remove the retaining pins and springs and withdraw the pads. If the same pads are to be refitted, identify them for assembly to their original locations.
6. Remove the two bolts and withdraw the caliper from the axle.

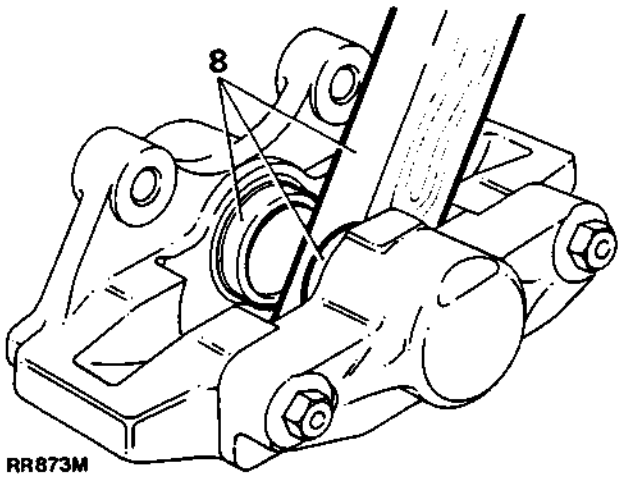


RR872M

Dismantle and overhaul

Do not separate the caliper halves

7. Clean the outer surfaces of the caliper with methylated spirit.
8. Expel the pistons from their bores by applying air pressure to the fluid inlet port. Since it is unlikely that both pistons will expel at the same time, regulate the rate with a suitable piece of timber inserted between the two pistons.



RR873M

Continued

9. Finally, remove the pistons keeping them identified with their respective bores.
10. Remove the wiper seal retainer by inserting a blunt screwdriver between the retainer and the seal and prise the retainer carefully from the mouth of the bore.
11. Taking care not to damage the seal grooves, extract the wiper seal and fluid seal.
12. Clean the bores, pistons and particularly the seal grooves with clean brake fluid or methylated spirit only. If the caliper or pistons are corroded or if their condition is not perfect the parts must be renewed.

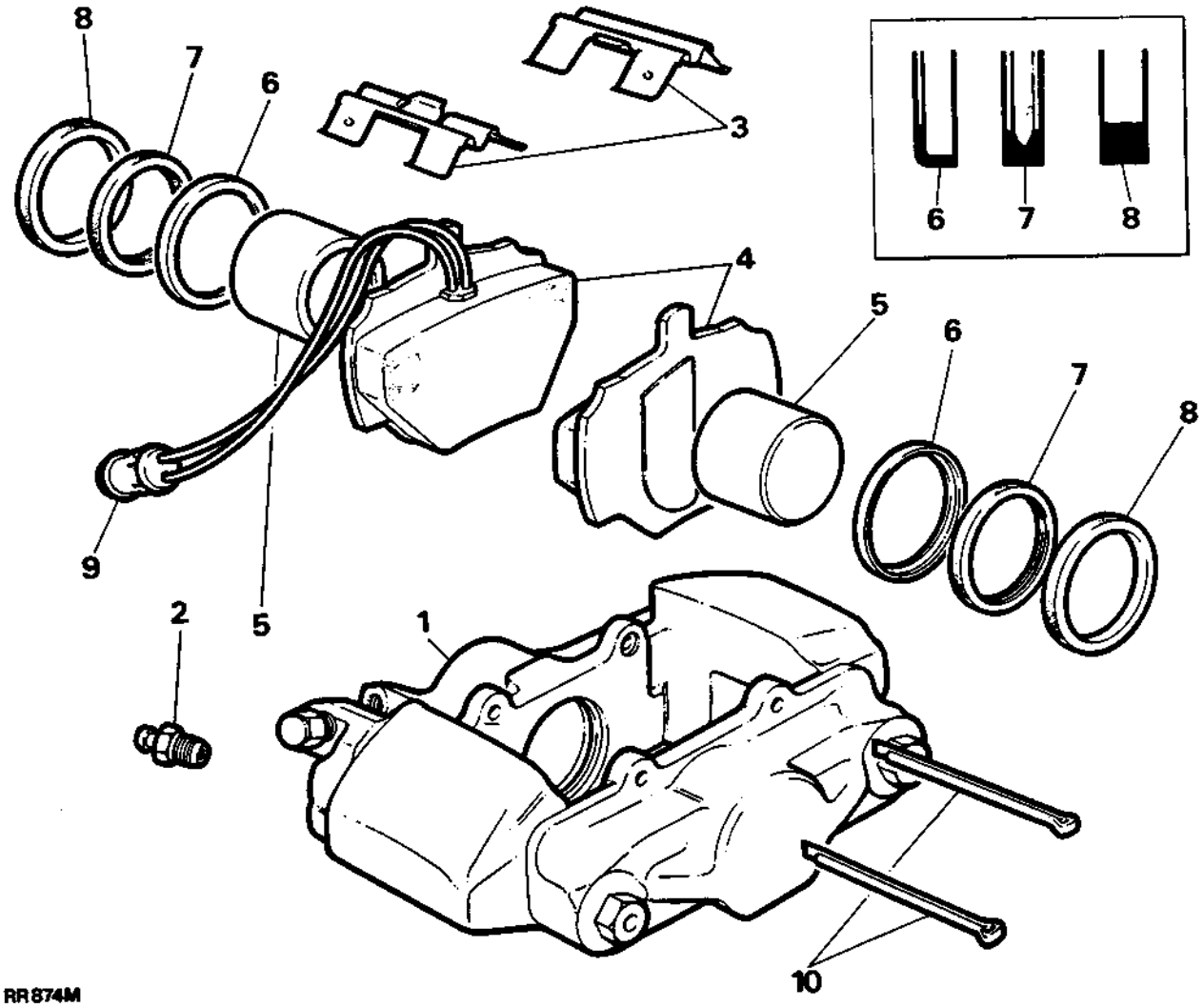
Assemble rim-half piston

13. Coat a new fluid seal with Lockheed disc brake lubricant. 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 so that when the seal is seated it feels proud to the touch at the edge furthest away from the mouth of the bore.

Continued

REAR BRAKE CALIPER ASSEMBLY

LH Rear Caliper illustrated



RR 874M

KEY TO CALIPER

1. Caliper.
2. Bleed screw.
3. Pad retaining springs.
4. Friction pads.
5. Piston.
6. Wiper seal retainer.
7. Wiper seal.
8. Fluid seal.
9. Pad wear indicator plug.
10. Retaining pins.

14. Smear the appropriate piston with disc brake lubricant and insert it squarely into the bore by hand only. Do not tilt the piston during insertion and leave approximately 8 mm projecting from the bore.
15. Coat a new wiper seal with disc brake lubricant and fit it to a new seal retainer. Slide the assembly, seal first, over the protruding piston and into the bore recess.
16. Using special tool 18G 672—piston clamp, press home the seal retainer and piston.

Mounting rim-half piston

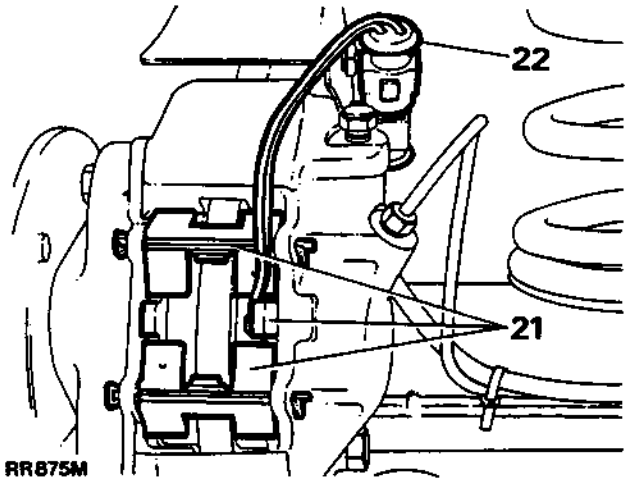
17. Carry out the same procedure as for removing and fitting the rim-half piston and seals, instructions 8 to 16.

Fit calipers and pads to vehicle

18. Fit the caliper to the axle and secure with the two bolts tightening evenly to the correct torque, see 'Data section'.
19. Connect the brake pipes to the calipers and remove the clamp from the flexible brake hose above the rear axles, see 'Data section' for brake pipe to caliper tightening torque.
20. Lightly smear the back and edges of the pads with disc brake lubricant carefully avoiding the friction material.
21. Insert the pads and retaining springs and secure with new pins and splay the ends. Note the correct position of the retaining springs.

    NOTE: Ensure that the friction pad with the wear indicator is fitted to the inboard side of the rear left-hand brake caliper.

22. Reconnect the pad wear indicator electrical multi-plug.



23. Bleed the secondary brake system at the rear calipers, starting at the caliper furthest away from the master cylinder.
24. When the foregoing instructions have been completed on both calipers, depress the brake pedal firmly several times to locate the friction pads.
25. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts, see data.
26. Road test the vehicle, remembering that if new friction pads have been fitted they are not 'bedded-in' and may take several hundred miles before the brakes are at maximum efficiency.

TRANSMISSION BRAKE LEVER (HANDBRAKE)

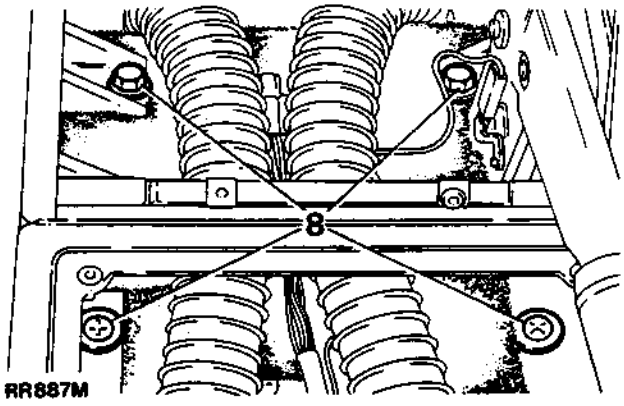
Remove and refit

Removing

1. Disconnect the battery.
2. Chock the road wheels and release the handbrake.
3. Open the cubby box lid and remove the four screws securing the cubby box liner to the outer surround and lift out the liner.
4. Remove the two electrical leads at the rear of the cubby box cigar lighter and release the two heater hoses from their retaining clips.
5. Remove the five electrical multi-plugs from the rear of the window lift switch panel, noting their position for re-assembly.
6. Remove the main gear selector knob and transfer gearbox knob.
7. Carefully prise the centre panel out of the gearbox tunnel mounted console.

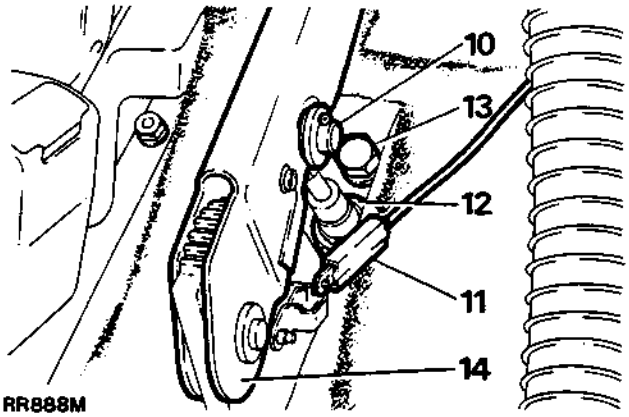
   NOTE: On Automatic gearbox models it is necessary to remove the two selector panel illumination bulbs from the graphics panel.

8. Remove the four bolts and plain washers, two are located immediately behind the handbrake lever accessible from inside the cubby box. The remaining two bolts are located forward of the handbrake lever accessible from the floor mounted console aperture.



Continued

9. Ease the cubby box and console assembly rearwards to release the location tab from the radio housing and lift the assembly off the gearbox tunnel.
10. Release the split pin and remove the clevis pin, plain and thackeray washer securing the handbrake cable to the lever.
11. Disconnect the electrical lead from the hand brake warning switch.
12. Release the handbrake cable outer retaining nut.
13. Remove the remaining single bolt with plain washer securing the front of the handbrake mounting bracket.
14. Withdraw the handbrake assembly and remove the cable outer.



RR888M

Refitting

15. Attach the cable outer to the handbrake mounting bracket and tighten the retaining nut securely.
16. Fit the assembly to the gearbox tunnel, lightly secure in position with the front retaining bolt.
17. Fit the inner cable to the handbrake assembly, secure in position with a **new** split pin.
18. Fit the cubby box console assembly, securing in position with the two screws, two bolts with plain washers.
19. Tighten the two handbrake securing bolts.
20. Reverse the remaining removal instructions, ensuring that the electrical wiring in the cubby box assembly is arranged to prevent it becoming trapped between any mating faces.

OVERHAUL TRANSMISSION BRAKE

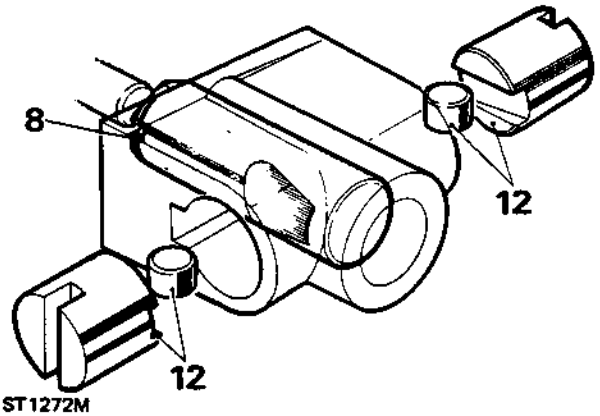
WARNING: Do not use an air line to remove dust from the brake assembly. Asbestos dust from the brake linings can be a serious health risk, if inhaled.

DISMANTLING

1. Disconnect the battery and chock the road wheels for safety.
2. Disconnect the propeller shaft from the output flange.
3. Remove the two screws and withdraw the brake drum. Skim if excessively scored or oval.
4. Remove the split pin and clevis pin connecting the drawlink to the actuating lever.
5. Remove the brake shoes complete with pull-off springs. Note position of springs in relation to the shoes.
6. Remove the four bolts securing back plate to transfer box and withdraw the back plate complete with oil catcher.

Remove and overhaul expander assembly

7. Remove the rubber dust cover.
8. Remove the expander and draw link.
9. Remove the retainer spring plate.
10. Remove the locking plate.
11. Remove the packing plate and withdraw the expander assembly from the back plate.
12. Remove the two plungers and rollers.

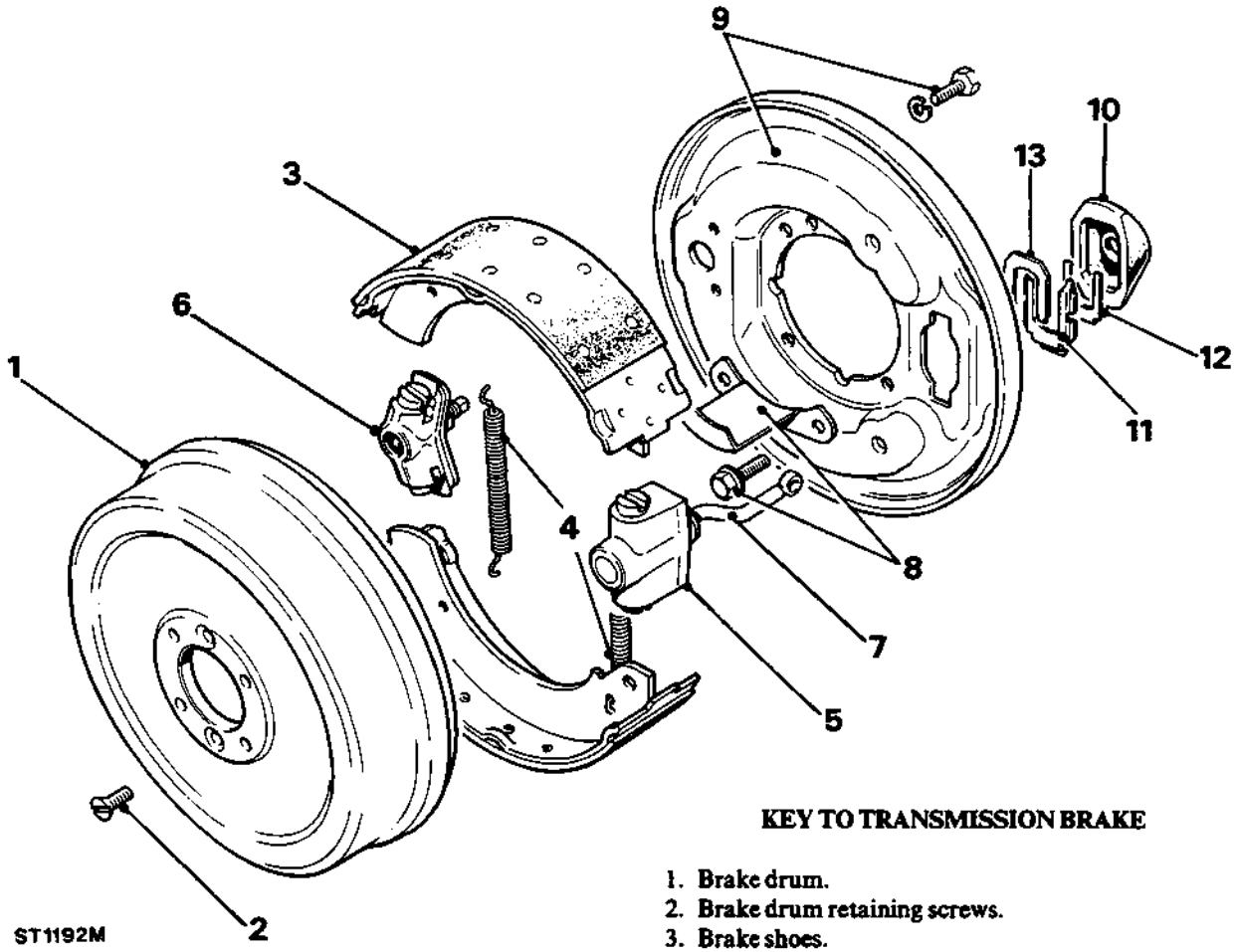


ST1272M

13. Clean all parts in Girling cleaning fluid and allow to dry. Examine the components for wear and discard if unsatisfactory.

Assemble expander assembly

14. Grease and fit the expander and drawlink.
15. Grease and fit the plungers and rollers noting that the highest end of the ramp on the plungers is fitted towards the back plate. Secure the assembly with a rubber band to prevent the plungers falling out and place to one side for assembly to back plate.



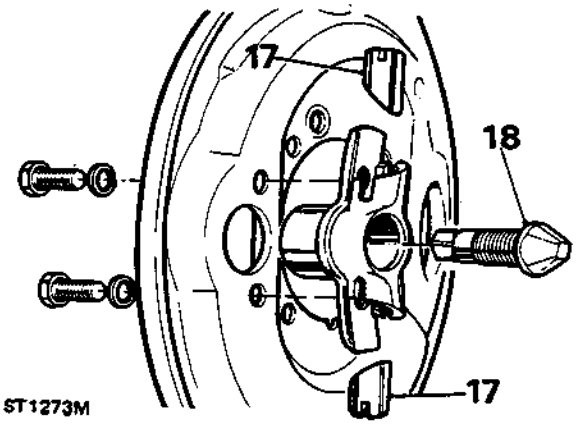
ST1192M

KEY TO TRANSMISSION BRAKE

1. Brake drum.
2. Brake drum retaining screws.
3. Brake shoes.
4. Brake shoes pull-off springs.
5. Expander assembly.
6. Adjuster assembly.
7. Draw link.
8. Oil catcher.
9. Back plate and retaining bolts.
10. Dust cover.
11. Locking plate.
12. Packing plate.
13. Spring plate.

Remove and overhaul adjuster assembly

16. Remove the two bolts and withdraw the adjuster assembly from the back plate.
17. Remove the plungers.
18. Screw the adjuster cone inwards to remove from the housing.
19. Clean the parts in Girling cleaning fluid and discard any unsatisfactory components.



ST1273M

Assemble adjuster assembly

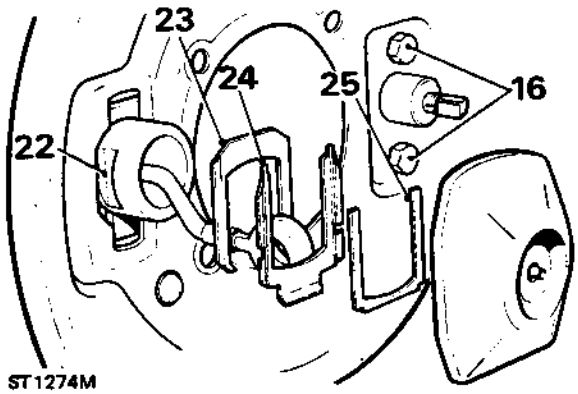
20. Grease and screw in the adjuster cone.
21. Grease and fit the adjuster plungers and align the chamfered ends with the adjuster cone. Note that the two plungers are identical and can be fitted to either bore. Secure the assembly with a rubber band to prevent the plungers falling out.

Continued

ASSEMBLE

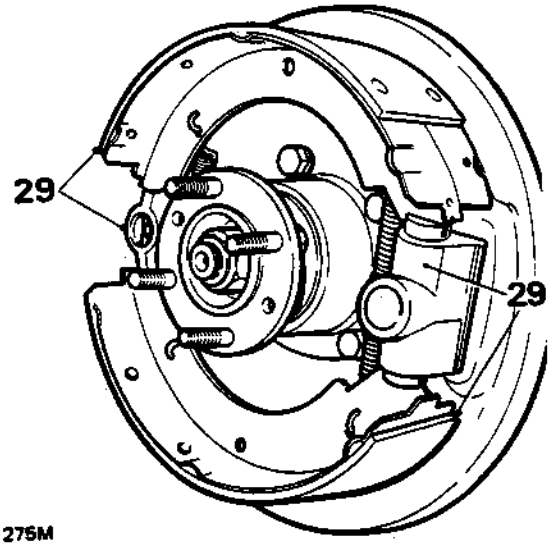
NOTE: If the brake linings are oil-soaked check and if necessary renew the output shaft oil seal.

22. Position the expander assembly on the inside of the back plate and secure with the following plates at the rear of the back plate.
23. Packing piece.
24. Locking plate.
25. Retainer spring.
26. Fit the rubber dust cover.



ST1274M

27. Fit the adjuster assembly to the back plate with the two bolts but do not fully tighten at this stage.
28. Fit the back plate assembly and mud shield to the transfer box with the four bolts and tighten to the correct torque.
29. Fit new pull-off springs to relined brake shoes and fit to the back plate. Note that the fully lined end of the lower shoe must be toward the expander assembly and the fully lined end of the upper shoe towards the adjuster assembly.



ST1275M

30. Fit the brake drum and secure with the two screws.
31. Connect the expander drawlink to the actuating lever with a new clevis pin, washer and split pin.
32. Turn the adjuster cone fully in and tighten the two retaining bolts left slack in instruction 27.
33. Slacken off the adjuster two 'clicks' and firmly apply the hand lever to centralise the shoes. The drum should then rotate freely.
34. Adjust the handbrake cable to give the pawl two 'clicks' free movement on the ratchet before the third 'click' fully expands the shoes against the drum.
35. Connect the propeller shaft and evenly tighten the retaining nuts to the correct torque.
36. Remove chocks from wheels and connect the battery.

TRANSMISSION BRAKE CABLE (HANDBRAKE)

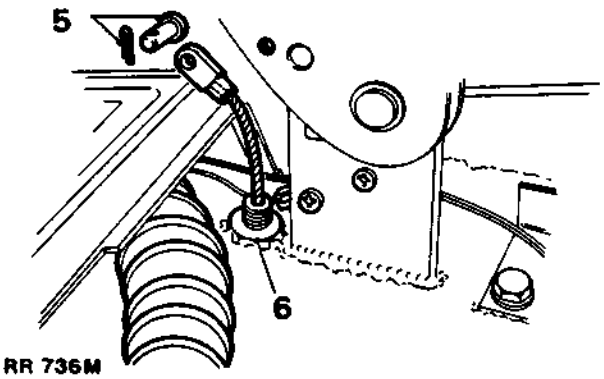
Remove and refit

Removing

1. Set the vehicle on level ground and chock the wheels.
2. Release the handbrake.

From inside the vehicle

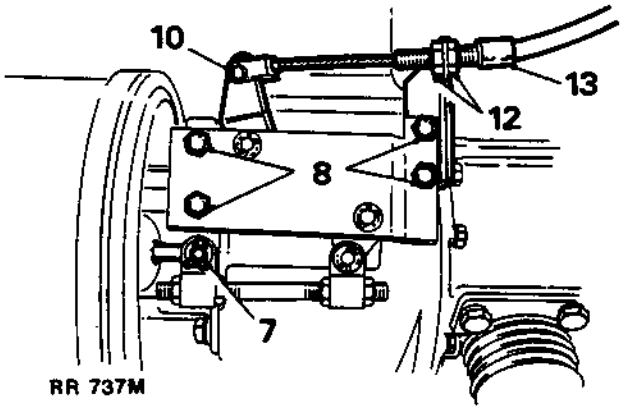
3. Remove the two screws securing the liner in the cubby box.
4. Lift out the liner to gain access to the bottom of the handbrake pivot bracket.
5. Remove the split pin and clevis pin from the handbrake lever.
6. Release the nut securing the handbrake outer cable to the top of the tunnel. Slide the nut up the cable and push the inner and outer cable through the floor panel to the underside of the vehicle.



RR 736M

From underneath the vehicle

7. Remove the split pin, plain and thackery washer and clevis pin securing the adjustment link to the brake drum actuating lever.
8. Remove the four bolts with spring washers securing the handbrake linkage assembly to the side of the transfer gearbox.
9. Withdraw the linkage from beneath the vehicle complete, with handbrake cable attached.
10. Remove the split pin, plain and thackery washer securing the cable to the handbrake linkage.
11. Withdraw the clevis pin.
12. Release the locknuts securing the handbrake outer cable to the retaining bracket.
13. Remove the cable from the bracket.



Fit new cable

14. Feed the handbrake cable through the floor aperture and secure the outer cable in position with the retaining nut.
15. Secure the cable to the handbrake lever, using a **new** split pin.
16. Fit the other end of the cable to the handbrake linkage using a **new** split pin.
17. Secure the outer cable to the retaining bracket and lightly tighten the two locknuts.

NOTE: To ensure that adjustment is not exhausted on the adjustment link, initial handbrake setting should be taken up at the outer cable locknuts.

18. Apply the handbrake, the brake shoes should make contact with the drum on the first notch of the handbrake quadrant. Adjust the locknuts on the outer cable as necessary. Release the handbrake.
19. Refit the handbrake linkage assembly to the side of the transfer box, tighten the bolts to the specified torque, see 'data' section.
20. Rotate the brake drum adjuster clockwise until the shoes are fully expanded against the drum.
21. Release the four locknuts at the adjustment link, rotate the link until the clevis pin holes in the adjustment link and brake drum actuating lever line up.
22. Refit the clevis pin, washers and split pin.
23. Apply the handbrake, and slacken the brake drum adjuster until the handbrake lever fully operates the brake shoes on the third or fourth handbrake quadrant notch.

Body repairs, general information

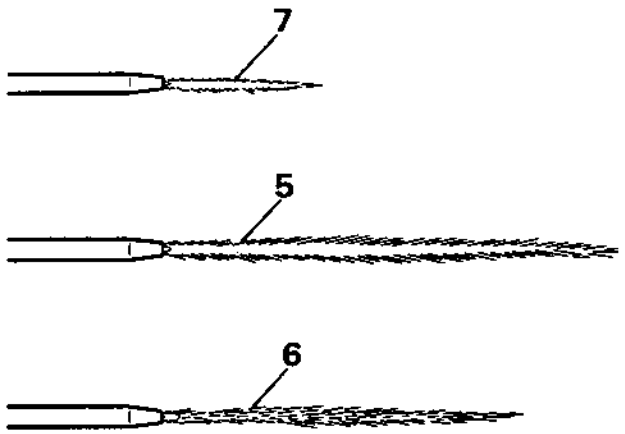
1. The Range Rover body consists of a steel frame to which alloy outer panels are attached. The radiator grille, front deck panel, front wings, side door outer panels, body side outer panels, roof, rear floor and upper rear quarter panels are made from a special light magnesium-aluminium alloy known as 'Birmabright'.
2. 'Birmabright' was developed for aircraft use, and it is much stronger and tougher than pure aluminium. It melts at a slightly lower temperature than pure aluminium and will not rust nor corrode under any normal circumstances. It is work-hardening, and so becomes hard and brittle when hammered, but it is easily annealed. Exposed to the atmosphere, a hard oxide skin forms on the surface of it.

Panel beating 'Birmabright'

3. 'Birmabright' panels and wings can be beaten out after accidental damage in the same way as sheet steel. However, under protracted hammering the material will harden, and then it must be annealed to prevent the possibility of cracking. This is quite easily done by the application of heat, followed by slow air-cooling, but as the melting point is low, heat must be applied slowly and carefully. A rough but very useful 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, which it will do quite quickly, 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. Another 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 stain to clear. Then allow to cool, as for the oil method. When applying the heat for annealing, always hold the torch some little distance from the metal, and move it about, so as to avoid any risk of melting it locally.

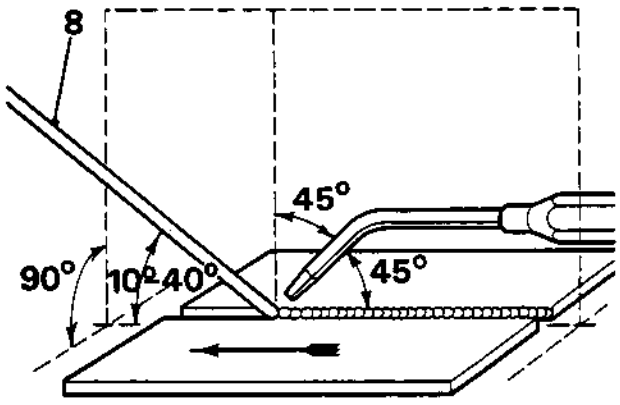
Gas welding 'Birmabright'

4. A small jet must be used, one or two sizes smaller than would be used for welding sheet steel of comparable thickness. For instance, use a No. 2 nozzle for welding 18 swg (0.048 in.) sheet, and a No. 3 for 16 swg (0.064 in.) sheet.
5. The flame should be smooth, quiet and neutral, 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.
6. 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.



RR1546M

7. Do not use an oxydising flame, which has a short pointed inner core bluish white with a bluish envelope.
8. Use only 5 per cent magnesium/aluminium welding rod (5 Mg/A). Sifalumin No. 27 (MG.5 Alloy) (Use Sifbronze Special flux with this rod) or a thin strip cut of parent metal—that is to say, a strip cut from an old and otherwise useless 'Birmabright' panel or sheet. Do not use too wide or thick a strip, or trouble may be experienced in making it melt before the material which is being welded.



RR1547M

9. Clean off all grease and paint, dry thoroughly and 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. Cleanliness is essential. Also clean the welding rod or strip with wire wool.
10. A special acid flux must be used, and we recommend 'Hari-Kari' which is obtainable from:
The Midland Welding Supply Co. Ltd.,
105 Lakey Lane,
Birmingham 28, England.
or
Sifbronze Special Flux, which is obtainable from:
Suffolk Iron Foundry (1920) Ltd.,
Sifbronze Works.
Stowmarket, England.

11. A small quantity of 'Hari-Kari' may be made into a paste with water, following the directions on the tin, and the paste must be applied to both surfaces to be welded, and also to the rod. In the case of Sifbronze Special Flux use in powder form as directed. Remember that aluminium and its alloys do not show 'red-hot' before melting, and so there is nothing 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, but a useful guide is to sprinkle a little sawdust over the work; this will sparkle and char when the right temperature is approached; a piece of dry wood rubbed over the hot metal will sparkle at the point of contact.
12. As the flux used is highly acid, it is essential to wash it off thoroughly immediately after a weld is completed. The hottest possible water should be used, with wire wool or a scratch-brush. Very hot soapy water is good, because of the alkaline nature of the soap, which will tend to 'kill' the acid.

13. It is strongly recommended that a few welds are made on scrap metal before the actual repair is undertaken if the operator is not already experienced in welding aluminium and its alloys.
14. The heat of welding will have softened the metal in the area of the repair, and it may be hardened again by peening with a light hammer. Many light blows are preferable to fewer heavy ones. Use a 'dolly' or anvil behind the work to avoid denting and deformation, and to make the hammering more effective. Filing of surplus metal from the weld will also help to harden the work again.

Welding tears and patching

15. If a tear extends to the edge of a panel, start the weld from the end away from the edge and also at this point drill a small hole to prevent the crack spreading, then work towards the edge.
16. When welding a long tear, or making a long welded joint, tack the edges to be welded at intervals of from 2 in to 4 in (50 to 100 mm) with spots. This is done by melting the metal at the starting end and fusing into it a small amount of the filler rod, repeating the process at the suggested intervals. After this, weld continuously along the joint from right to left, increasing the speed of the weld as the material heats up.
17. After the work has cooled, wash off all traces of flux as described above, and file off any excess of build-up metal.
18. When patching, cut the patch to the correct shape for the hole to be filled, but of such sizes as to leave a gap of $\frac{1}{32}$ in (0.80 mm) between it and the panel, and then weld as described above. Never apply an 'overlay' patch.

Electric welding

19. CAUTION. **The battery earth lead must be disconnected before commencing electric welding, otherwise the alternator will be damaged.**

20. At the Rover factory the 'Argon-Arc' process is used, and this is very satisfactory, since all atmospheric oxygen is excluded from the weld by the Argon gas shield. For all body repair work normally undertaken by a Distributor's or Dealer's service department, the gas welding method is sufficient and quite satisfactory.

Spot welding

21. Spot welding is largely used in the manufacture of Range-Rover bodies, but this is a process which can only be carried out satisfactorily by the use of the proper apparatus. Aluminium and its alloys are very good conductors of heat and electricity, and thus it is most important to maintain the right conditions for successful spot welding. The correct current density must be maintained, and so must the 'dwell' of the electrodes. Special spot welding machines have been developed, but they are expensive, and though the actual work can be carried out by comparitively unskilled labour, supervision and machine maintenance must be in the hands of properly qualified persons.

Riveting

22. Where both sides of the metal 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 head on the work. For riveting blind holes, 'pop-rivets' must be used. These are inserted and closed by special 'Lazy-Tong' 'pop-rivet' pliers.

Painting 'Birmabright'

23. Refer to the procedure detailed in Paintwork.

PAINTWORK

General information

Body panels

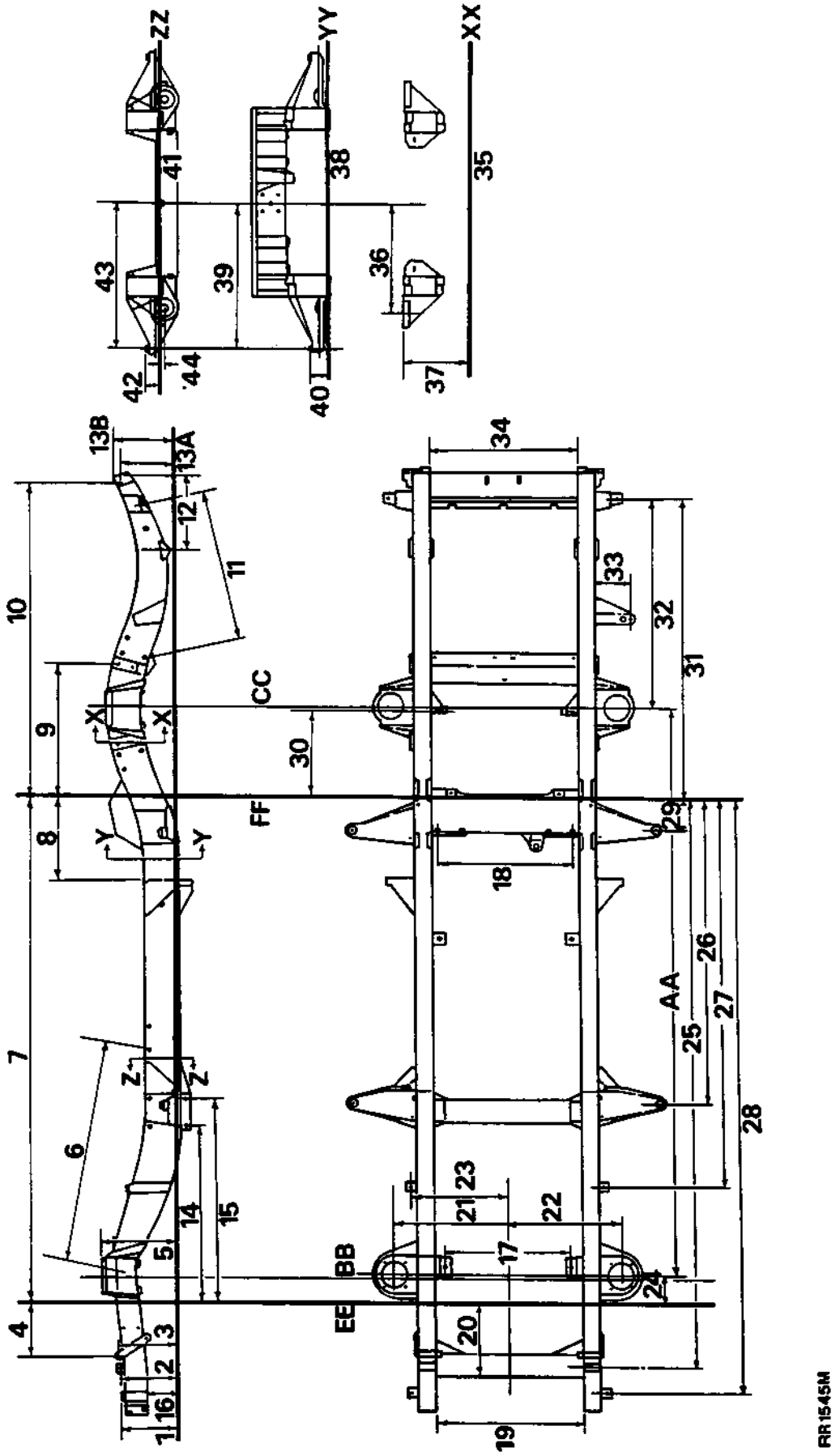
1. Range Rover body panels are manufactured from a special aluminium-alloy known as 'Birmabright' and the following paintwork procedure should be followed on these panels.

Painting 'Birmabright'

2. 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 and the use of ICI Etching Primer P565-5002 is recommended. It is quick and easy to apply, and it prolongs the life of the paint film by ensuring excellent adhesion.

Application

3. The activated Etching Primer has a limited pot-life of about eight hours at normal temperatures and should not be used after this time, as it may have inferior adhesion and corrosion resistance. Any Etching Primer which has been mixed for more than eight hours must be thrown away, and not returned to the can.
4. Apply Etching Primer as soon as possible after cleaning, and paint as soon as the pre-treatment is completed. Undue delay may cause the surface to be contaminated again and thus nullify the treatment. Do not leave pre-treated work overnight before it is painted.
5. Etching Primer, when followed by a suitable paint system, gives a film which is very resistant to moisture, but the Etching Primer itself is water sensitive. It should therefore be coated with paint as soon as possible when it is dry.
6. Activate the Etching Primer by mixing it with an equal volume of Activator P273-5021 and allow to stand for 10 minutes.
7. Adjust the spraying viscosity of the mixture if necessary to 22-25 sec. BSB4 Cup by adding small quantities of Thinner 851-565; never add more Activator.
8. Apply by spray to a clean, dry surface in a thin uniform coat, rather than a thick heavy one which may impair adhesion.
9. Air dry for at least 15 minutes before applying undercoat by spray or for two hours before brush application. If required, these times can be shortened by force drying, this also gives increased hardness to the film.
10. Subsequent painting follows normal paintshop practice.
11. When wet flatting the subsequent paint layers take care not to rub through to the Etching Primer. If this does occur allow to dry out thoroughly, dry flat the area and spot in with Etching Primer.


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RR1545M

CHASSIS FRAME

Alignment check

Diagram reference		millimetres	inches
AA	Wheelbase—Reference dimension	2540.00	100.000
BB	Centre line of front axle		
CC	Centre line of rear axle		
DD	Frame datum line		
EE	Side member datum line		
FF	Datum line		
1	(with mounting washers)	254.00 ± 0.63	$10.000 \pm .025$
	(without washers)	$263.525^{+1.91}_{-0.63}$	$10.375^{+.075}_{-.025}$
2		261.11 ± 2.54	$10.280 \pm .100$
3		266.70 ± 2.54	$10.500 \pm .100$
4		237.74 ± 1.27	$9.360 \pm .050$
5		327.81 ± 2.54	$12.906 \pm .100$
6		979.93 ± 1.27	$38.580 \pm .050$
7		2244.72 ± 2.54	$88.375 \pm .100$
8		356.74 ± 2.54	$14.045 \pm .100$
9		605.15 ± 2.54	$23.825 \pm .100$
10		1405.38 ± 2.54	$55.330 \pm .100$
11		694.44 ± 2.54	$27.340 \pm .100$
12		338.83 ± 2.54	$13.340 \pm .100$
13A		222.25 ± 5.08	$8.750 \pm .200$
13B		240.54 ± 2.54	$9.470 \pm .100$
14	Reference dimension	794.91	31.296
15	To face of boss	935.43 ± 2.54	$36.828 \pm .100$
16	Frame datum to underside of crossmember	150.79	5.937
17		535.94 ± 2.54	$21.100 \pm .100$
18		590.55 ± 0.64	$23.250 \pm .025$
19	Check Figure	630.93 ± 1.27	$24.840 \pm .050$
20		344.17 ± 1.27	$13.550 \pm .050$
21		485.77 ± 2.54	$19.125 \pm .100$
22		485.77 ± 2.54	$19.125 \pm .100$
23		414.32 ± 2.54	$16.312 \pm .100$
24		129.03 ± 2.54	$5.080 \pm .100$
25		2544.44 ± 0.25	$100.175 \pm .010$
26		1355.34 ± 0.38	$53.360 \pm .015$
27		1722.04 ± 0.38	$67.797 \pm .015$
28		2663.44 ± 0.38	$104.860 \pm .015$
29		144.09 ± 0.38	$5.673 \pm .015$
30		400.48 ± 2.54	$15.767 \pm .100$
31		1333.88 ± 0.38	$52.515 \pm .015$
32	Reference dimension	925.49	36.437
33	Reference dimension	147.62	5.812
34	Reference dimension	635.00	25.000
SECTION XX			
35	Frame datum line DD		
36		488.95 ± 2.54	$19.250 \pm .100$
37		295.27 ± 2.54	$11.625 \pm .100$
SECTION YY			
38	Frame datum line DD		
39		660.40 ± 0.17	$26.000 \pm .007$
40		$80.95^{+1.91}_{-0.63}$	$3.187^{+.075}_{-.025}$
SECTION ZZ			
41	Frame datum line DD		
42		$80.95^{+1.91}_{-0.63}$	$3.187^{+.075}_{-.025}$
43		660.4 ± 0.17	$26.000 \pm .007$
44		9.525 ± 2.54	$0.375 \pm .100$

BODY

Introduction:

The information which follows is concerned solely with the 'Monocoque' assembly of the inner body shell on Range Rover models.

Body repairs often require the removal of mechanical and electrical units and associated wiring. Where necessary, reference should be made to the relevant section of the Repair Manual for removal and refitting instructions.

The inner body shell is of 'Monocoque' construction and to gain access to the repair area, it may be necessary to remove exterior body panels, all exterior body panels are bolted to the inner body shell to facilitate easier panel removal and renewal or repair.

It is expected that a repairer will select the best and most economic repair method possible, making use of the facilities available. The instructions given are intended to assist a skilled body repairer by expanding approved procedures for panel replacement with the objective of restoring the car to a safe running condition and effecting a repair which is visually acceptable.

WELDING

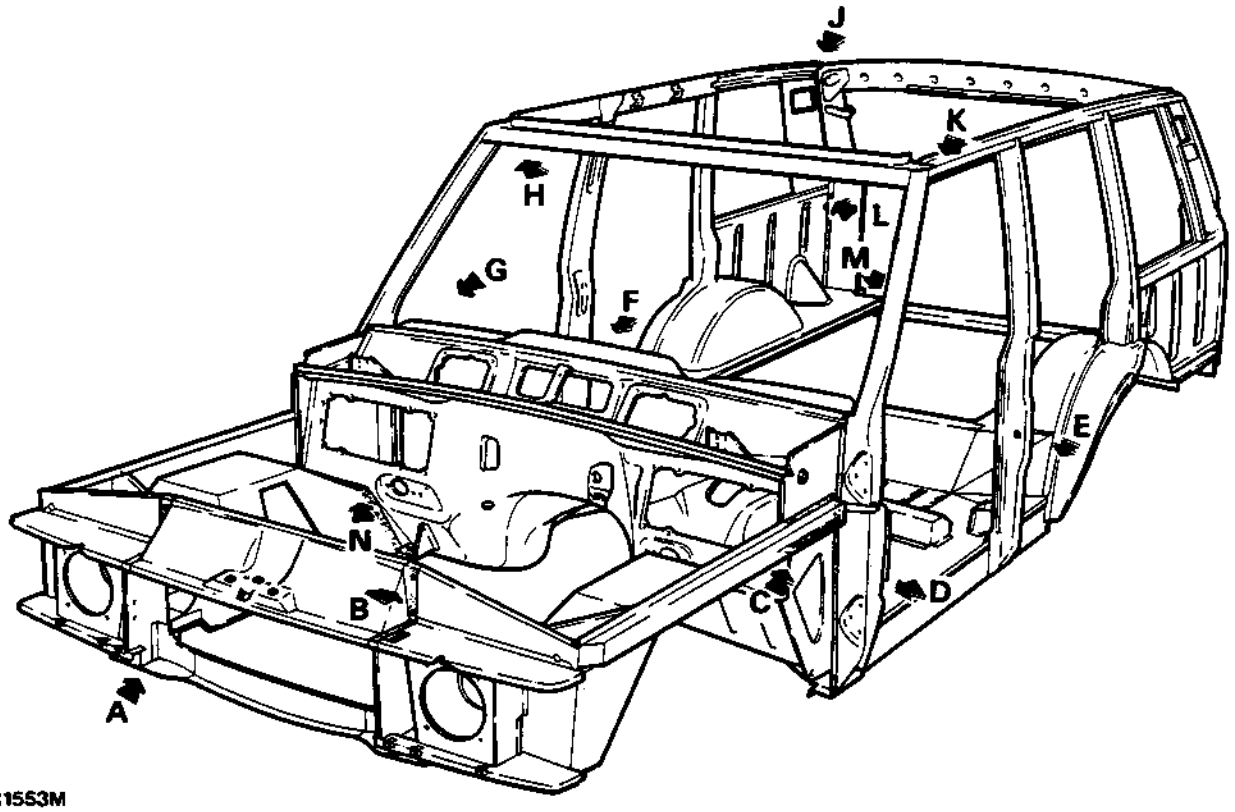
The following charts and illustrations show the locations and types of weld for securing the body side assembly, tailgate frame assembly and the front valance and wheel arch assembly. Before undertaking any spot weld joints to the inner body, it is advisable to make a test joint using offcuts of the damaged components, and to use this test piece to perform a weld integrity test.

Spot welding is satisfactory if the joints do not pull apart. If the weld pulls a hole or tears the metal the weld is satisfactory. It is defective if the weld joint pulls apart or if there are signs of burning, porosity or cracking evident.

PREPARATION

Thoroughly clean all areas to be welded, remove any sealants and corrosion protectives from around original panels. Align and clamp all new panels in position and check relationship to one another.

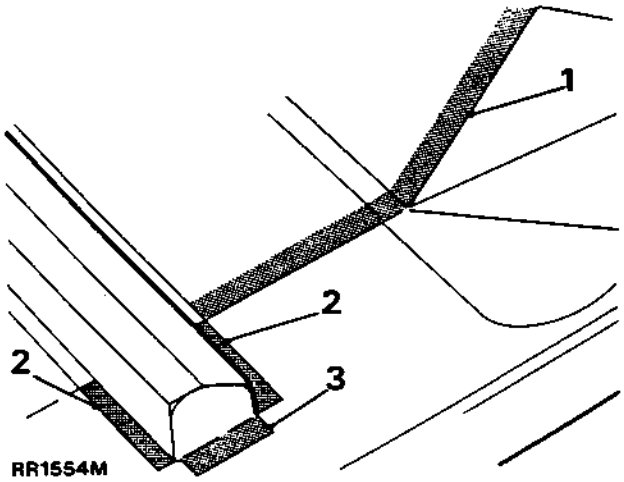
INNER BODY SHELL ASSEMBLY



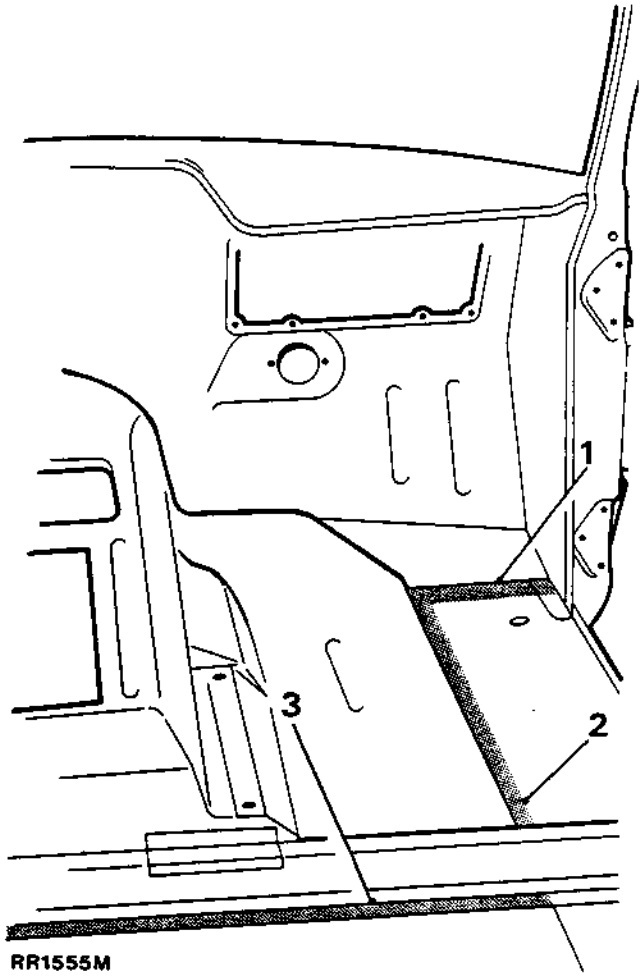
RR1553M

LOCATION	FACTORY JOINT (minimum number of spot welds quoted)
A. Front cross member to valance and wheel arch assembly	6 spot welds, 20 mm pitch
B. Bonnet locking platform to valance and wheel arch assembly	10 spot welds, 25 mm pitch
C. Valance and wheel arch assembly to dash and tunnel assembly	16 spot welds, 25 mm pitch
D. Body side complete to dash and tunnel assembly	10 spot welds, 65 mm pitch

Continued

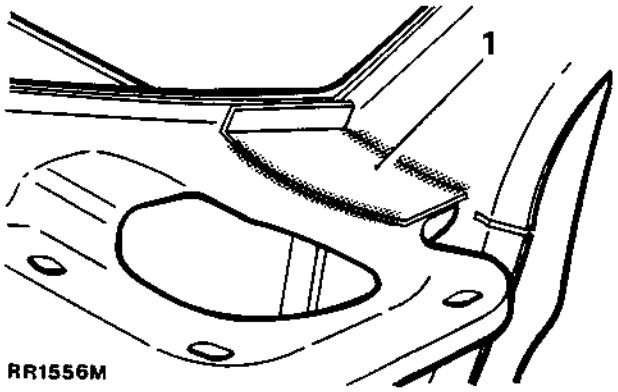


LOCATION E

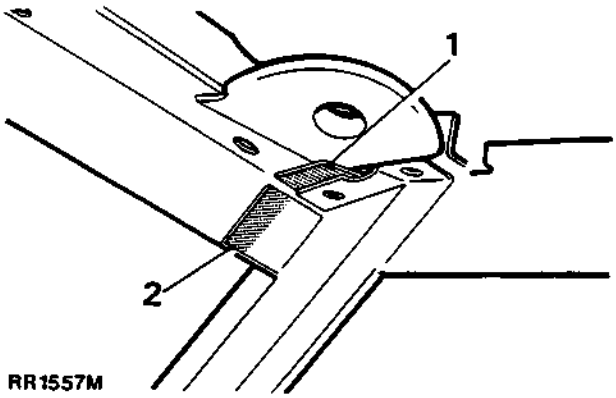


LOCATION F

LOCATION	FACTORY JOINT (minimum number of spot welds quoted)
E. 1. Body side complete to heelboard panel assembly	14 spot welds, 35 mm pitch
2. Body side complete to dash and tunnel assembly complete	10 spot welds, 25 mm pitch
3. Body side complete to dash and tunnel assembly	3 spot welds, 30 mm pitch
F. 1. Body side complete to dash and tunnel assembly complete	7 spot welds, 30 mm pitch
2. Body side complete to dash and tunnel assembly complete	18 spot welds, 40 mm pitch
3. Body side complete to dash and tunnel assembly complete	30 spot welds, 34 mm pitch

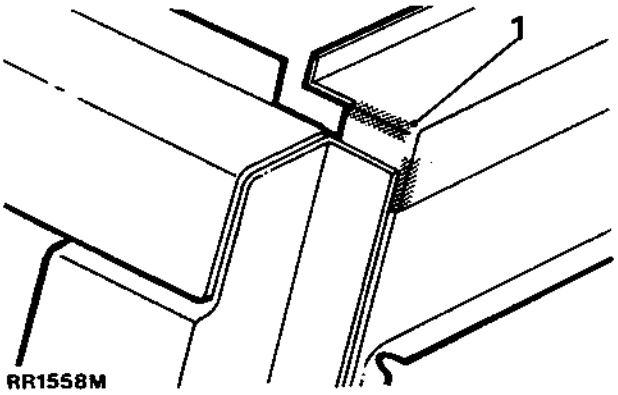


LOCATION G

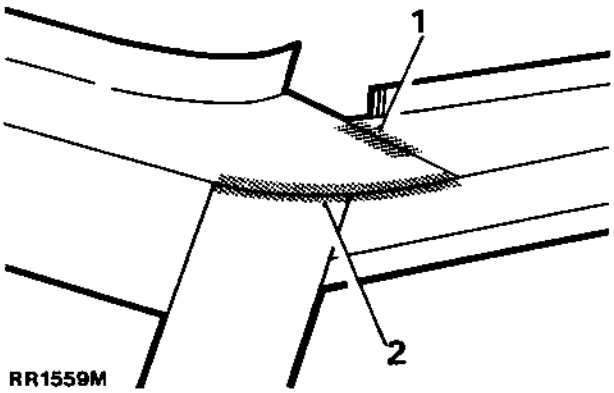


LOCATION H

LOCATION	FACTORY JOINT (minimum weld requirement quoted)
G. 1. Reinforcement plate to dash and tunnel assembly and body side assembly complete	CO_2 weld, 2 places 75 mm long each weld
H. 1. Body side complete to roof header panel assembly (internal joint)	3 spot welds, 15 mm pitch
2. Body side complete to roof header panel assembly (internal joint)	3 spot welds, 15 mm pitch

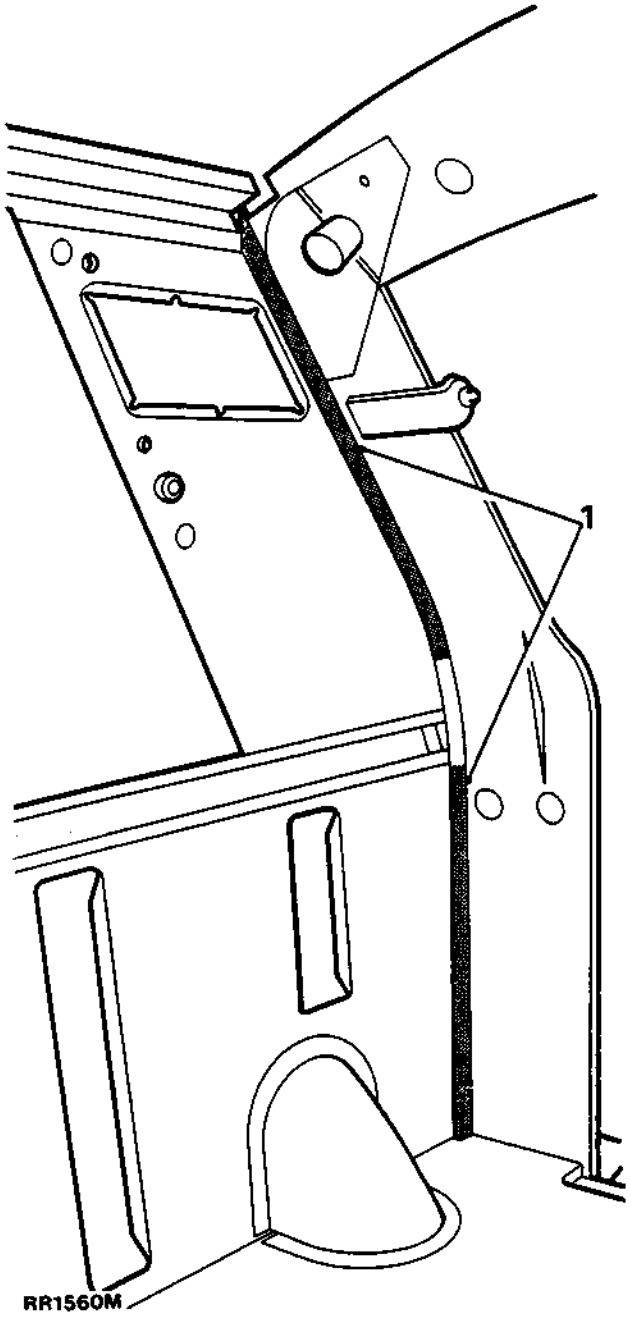


LOCATION J

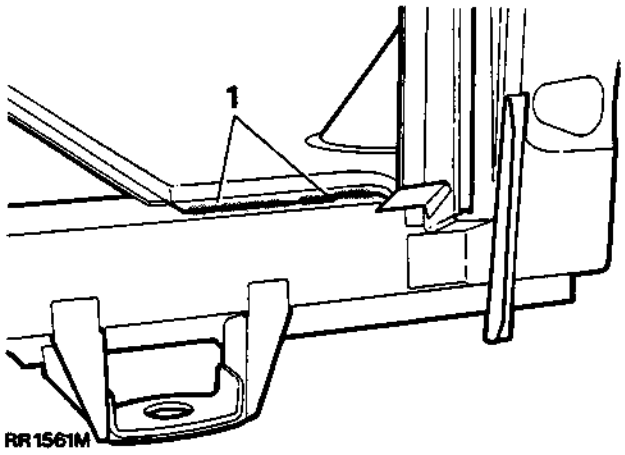


LOCATION K

LOCATION	FACTORY JOINT (minimum weld requirement quoted)
J. 1. Body side complete to rear tailgate frame assembly	CO_2 weld, one run 40 mm long
K. 1. Body side complete to roof header panel assembly (External joint)	CO_2 weld, one run 20 mm long
2. Body side complete to roof header panel assembly (External joint)	CO_2 weld, one run 100 mm long

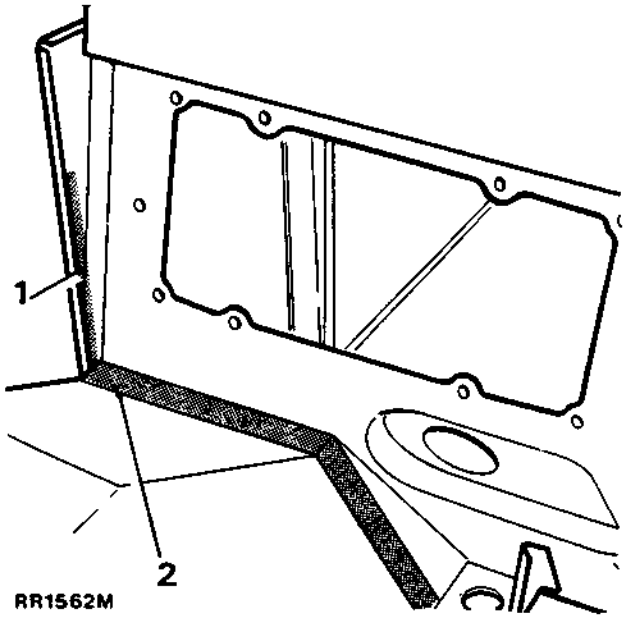


LOCATION L



LOCATION M

LOCATION	FACTORY JOINT (minimum weld requirement quoted)
L. 1. Body side complete to rear tailgate side member	32 spot welds, 30 mm pitch
M. 1. Body side complete to rear tailgate bottom cross member	CO_2 weld, 2 runs 40 mm long



LOCATION N

LOCATION	FACTORY JOINT (minimum number of spot welds quoted)
N. 1. Valance and wheel arch assembly to dash and tunnel assembly	4 spot welds, 45 mm pitch
2. Valance and wheel arch assembly to dash and tunnel assembly	15 spot welds, 25 mm pitch

FRONT AND REAR HEADLINING AND ROOF PANEL

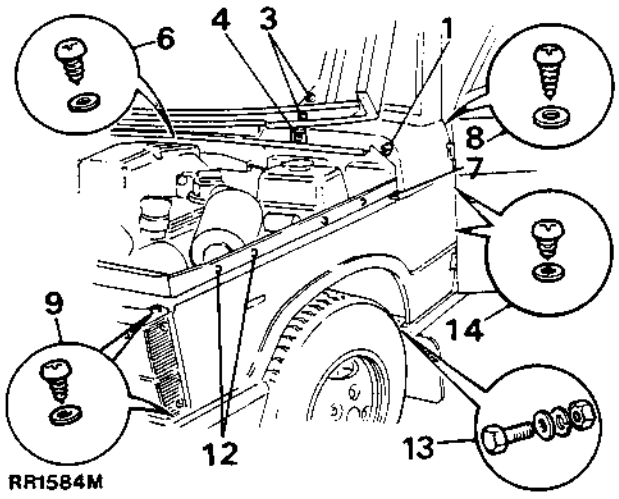
Remove and refit

Removing

1. Remove the two roof lamp assemblies.
2. Remove the rear view mirror and mounting bracket.
3. Remove the two sun visors and centre retaining bracket.
4. Remove the rear passenger grab rails.
5. Prise out the four plastic retaining clips securing the front and rear sections of the headlining to the roof panel.
6. Lower the front headlining and remove it from the vehicle.
7. Remove the two plastic retaining clips securing the end of the rear headlining, located adjacent to the upper tailgate hinges.
8. Lower the headlining and disconnect the electrical leads from the rear radio speakers, and remove the lining from the vehicle.
9. Remove the screws (with washers) from around the inner edge of the roof panel.
10. Lift the roof panel from the body and remove any previous sealing compounds from around the edge of the roof panel and body.

Refitting

11. Reverse the removal instructions 1 to 9.
12. Apply a suitable waterproof sealant to roof and body mating faces.



RR1584M

BONNET—DECKER PANEL—FRONT WING

Remove and refit

Removing

1. Open the bonnet and disconnect the under-bonnet lamp electrical leads.
2. Disconnect the windscreen washer tube at the 'T' joint.
3. Release the four bolts securing the bonnet to the hinges, and lift the bonnet clear of the vehicle.
4. Remove the four cross-head screws securing the hinges to the bulkhead mounting brackets.
5. Remove the wiper arms and two nuts securing the wheel boxes to the decker panel and remove the two exterior sealing rubbers.
6. Remove the nine cross-head screws securing the front of the decker panel.
7. Remove the four bolts (with spring and plain washers) retaining the decker panel to the top of the wing, retrieve the nylon spacing washers from between decker panel and wing.
8. Remove the four cross-head screws retaining the panel to the 'A' post mounting brackets located above the front door hinges.

NOTE: If a radio aerial is fitted, remove it from the panel to enable the panel to be lifted clear of the body.

9. Remove the two cross-head screws from the top of the front side light assembly, manoeuvre the assembly out of the two bottom location holes and disconnect the electrical plug at the rear of the lamp. Remove the two screws (with plain washers) from the bottom of the side light aperture.
10. Disconnect the side flasher lamp electrical plug, located inside the engine compartment and feed the plug and grommet through the hole in the inner wing to the underside of the exterior wing.
11. Remove the three fixings securing the bumper wrap around end cap and remove the moulding from the bumper.

NOTE: If a front spoiler is fitted, remove the single bolt which secures the end of the spoiler to the front of the wheel arch, located forward of the road wheel at the bottom of the wing.

12. Remove the five nuts and bolts (with plain and spring washers) securing the top edge of the wing to the wheel arch and valance assembly.
13. Remove the two bolts (with plain washers) securing the sill finishing strip to the bottom of the wing.
14. Remove the two cross-head screws securing the wing to the mounting bracket attached to the 'A' post located in between the front door hinges.

Refitting

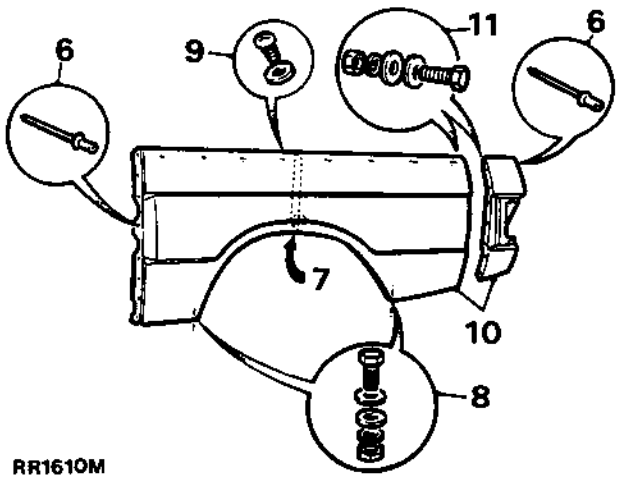
15. Apply a suitable underseal to the inner face of the wing.
16. Ensure that before final tightening of the wing securing bolts the wing aligns with the edge of the front door.
17. Locate the decker panel under the lip of the windscreen sealing rubber.
18. Fit the bonnet ensuring that before final tightening of the securing bolts, the bonnet aligns with the decker panel, wing and front grille.
19. Reverse the remaining removal instructions.

BODY REAR CORNER PANEL AND WING—TWO AND FOUR DOOR MODELS

Remove and refit

Removing

1. Remove the fuel tank filler cap (right hand rear wing only).
2. Remove the fuel tank filler neck (right hand rear wing only).
3. Remove the rear stowage area parcel shelf, shelf side panels and spare wheel.
4. Remove the two nuts (with washers) securing the bumper wrap around end cap and slide the cap off the bumper.
5. Release the rear tail light cluster from the rear corner panel and disconnect the electrical plug.
6. Drill out all the pop-rivets securing the front of the wing **(two door model only)** and the corner panel **(two and four door)**.
7. Remove the two nuts and bolts securing the front of the wing to the 'D' post located beneath the wheel arch **(four door only)**.
8. Release the single nut and bolt retaining the mud-flap to the bottom of the wing.
   Two door models only: Remove the single bolt from the bottom of the wing forward of the road wheel.



RR1610M

9. From inside the tailgate area remove all the cross-head screws retaining the top of the wing.
10. Remove the rear wing and cover panel complete.
11. Remove the seven bolts (with plain and spring washers) securing the wing to the corner panel and separate the two panels.

Refitting

12. Apply a suitable waterproof sealant to the wing and cover panel mating faces, fit the bolts and ensure both panels align before final tightening.
13. Fit the assembly to the vehicle ensuring the door shut face to wing and corner panel to lower tailgate are in alignment before the final tightening of screws and fitting of pop-rivets.
14. Coat the underside of panels with a suitable underseal.
15. Reverse the remaining removal instructions.

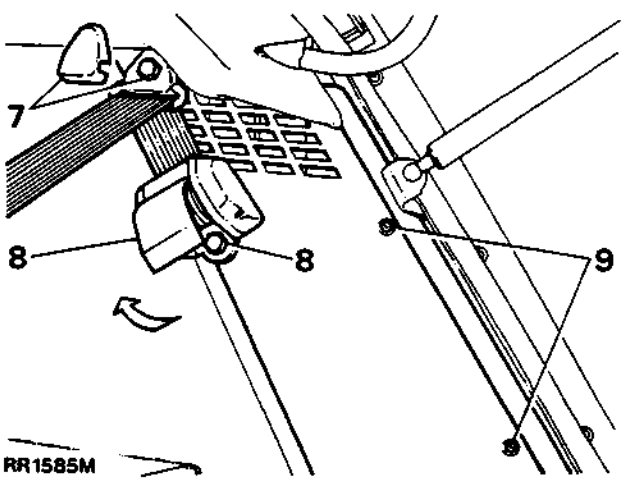
BODY REAR QUARTER PANEL — INTERIOR

Remove and refit

Removing

1. Remove the rear passenger grab rails.
2. Remove the rear interior light assembly.
3. Remove the four plastic retaining clips securing the front and rear headlining sections to the centre of the roof panel.
4. Remove the two rear plastic retaining clips located adjacent to the upper tailgate fixings from the rear headlining section.
5. Lower the headlining and disconnect the electrical leads from the two radio speakers.
6. Remove the rear headlining section from the vehicle.

NOTE: If rear seat belts are fitted it will be necessary to remove them to enable the interior panel to be detached, these are removed as follows.



RR1585M

Continued

7. Detach the plastic cover from the upper seat belt guide bracket and remove the single bolt.
8. Remove the clip-on black plastic cover from the seat belt inertia reel. Remove the two retaining bolts and place the reel to one side.
9. Release the two small cross-head screws and remove the panel from the vehicle.

Refitting

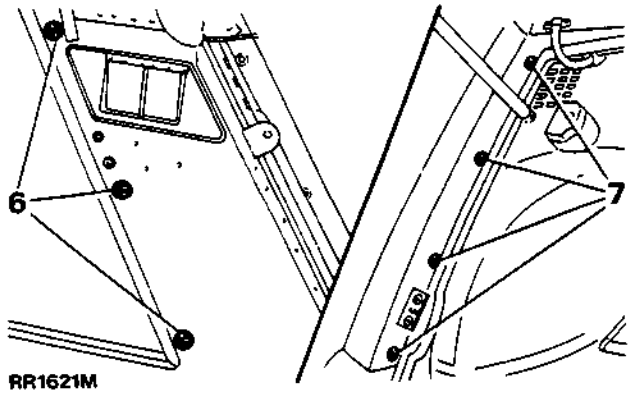
10. When refitting the seat belt assembly ensure the belts are not twisted and that the securing bolts are tightened to the correct torque.
11. Reverse the removal procedure.

BODY REAR QUARTER PANEL — EXTERIOR

Remove and refit

Removing

1. Remove the rear passenger grab rails.
2. Remove the rear interior light assembly.
3. Remove the rear headlining section.
4. Remove the rear seat belts (if fitted).
5. Remove the two securing screws and detach the interior quarter panel.
6. Remove the three nuts (with plain washers) securing the outer quarter panel to the body side. The nuts are accessible through the large holes located adjacent to the rear window.
7. Remove the four screws securing the quarter panel to the inside edge of the tailgate aperture.
8. Withdraw the panel.



RR1621M

Refitting

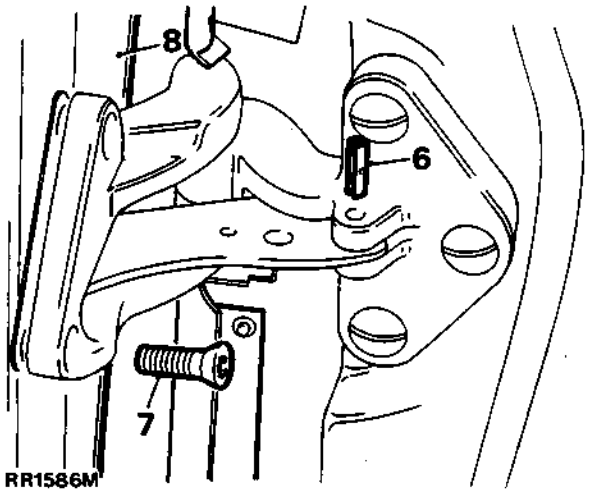
9. Reverse the removal instructions.
10. Using a suitable tool carefully ease the rear side window sealing rubber over the front edge of the exterior quarter panel.

FRONT DOOR

Remove and refit

Removing

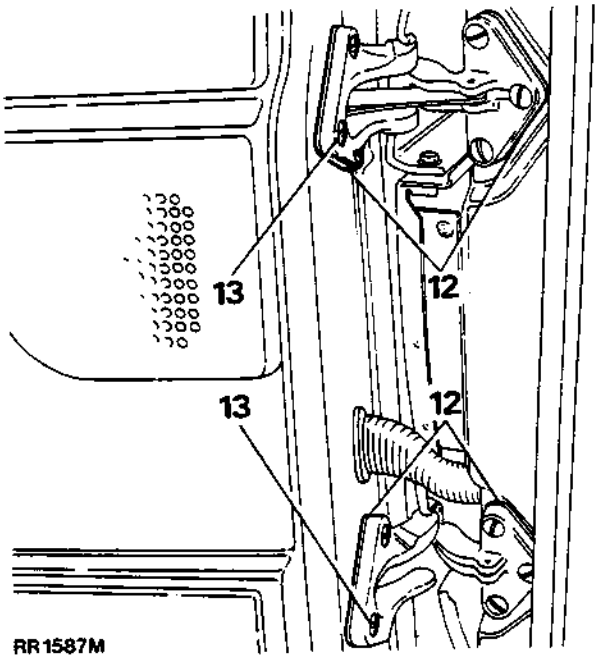
1. Disconnect the battery negative lead.
2. Open the appropriate door to be removed.
3. Remove the two screws and detach the side trim panel from the front footwell.
4. Carefully pull the door wiring harness from above the fascia until the electrical plugs are exposed.
5. Disconnect the electrical plugs and feed them through the aperture in the 'A' post.
6. Drive out the roll pin from the door check strap.
7. With assistance support the door and remove the screws, securing door to hinges.
8. Lift the door clear.



RR1586M

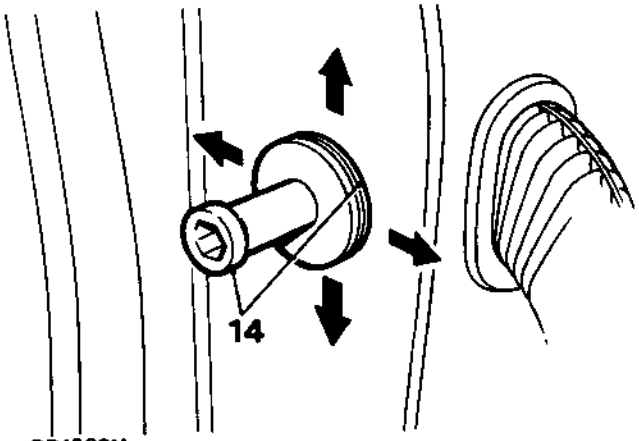
Refitting

9. Refit the door and feed the electrical cables through the 'A' post.
10. Fully open the door and reconnect the electrical leads, take up the slack in the leads and clip them securely to the footwell side panel, refit the convolute grommet to the 'A' post aperture.
11. Check the location of the door and the operation of the door lock. If necessary, adjust the door and striker plate.
12. By the addition of shims between the hinge and door or hinge and 'A' post to take the door forward or rearward in the aperture.
13. By slackening the six screws securing the hinges to the door, the door can be adjusted up and down or in and out of the aperture.



RR1587M

14. The door lock striker can be adjusted by slackening the striker and moving it in the appropriate direction or adding and subtracting spacing washers between the striker and 'B' post.



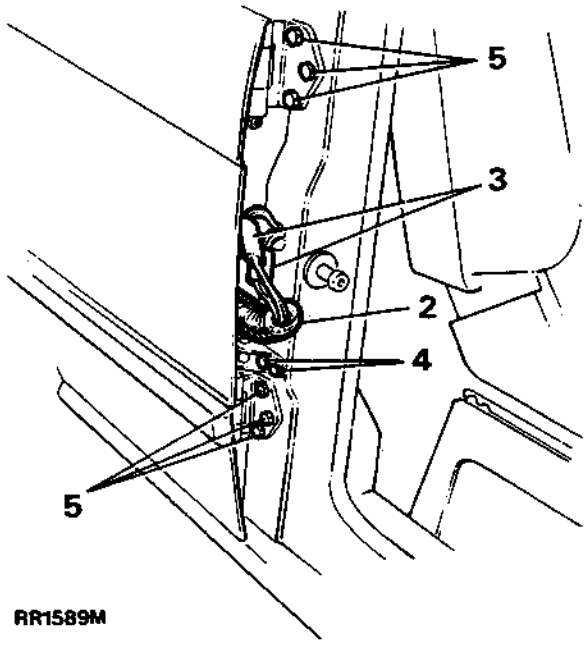
RR1588M

REAR PASSENGER DOOR

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Pull the convolute grommet out of the face of the 'B' post.
3. Withdraw the electrical leads from the 'B' post until the electrical plugs are exposed and disconnect the plugs.
4. Remove the two bolts (with spring and plain washers) securing the door check strap.
5. Open the door slightly, support the door and remove the six bolts (with spring washers) securing the hinges to the 'B' post.
6. Lift the door clear.



RR1589M

Refitting

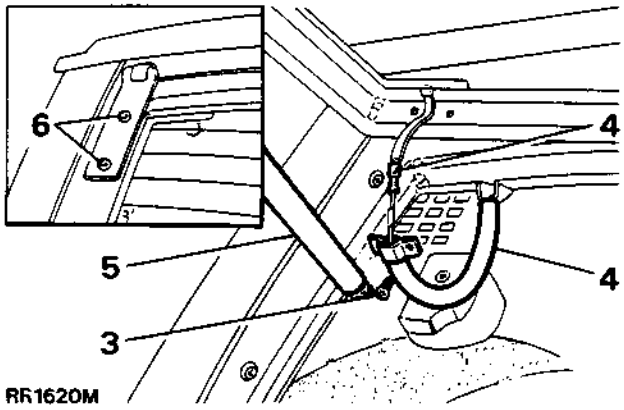
7. Reverse the removal procedure.
8. Adjustment to the rear doors is made by releasing the six hinge securing bolts (hinge to 'B' post) and moving the door either rearwards, forward, up or down in the door aperture.
9. Adjustment to the door striker is identical to front door adjustment.

UPPER TAILGATE

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the tailgate wiper arm
3. Open the tailgate and remove the four screws securing the two rear screen electrical lead shrouds located at either end of the tailgate.
4. Manoeuvre the shroud away from the screen and out of the headlining to reveal the electrical connections, disconnect the leads.
5. Prise the two stays off the tailgate.



RR1620M

6. Remove the four hinge to tailgate screws.
7. Lift the upper tailgate clear.

Refitting

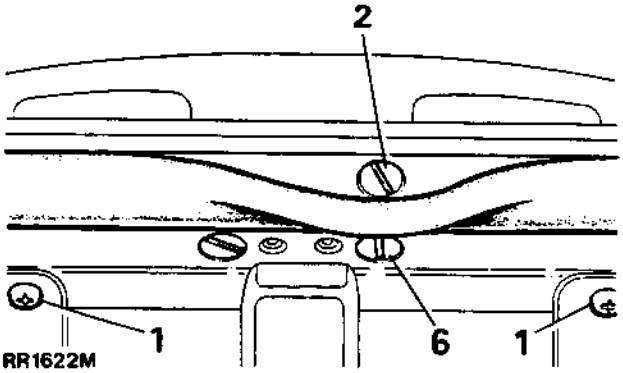
8. Reverse the removal instructions.

UPPER TAILGATE — LOCK

Remove and refit

Removing

1. Remove the two cross-head screws securing the upper tailgate release handle.

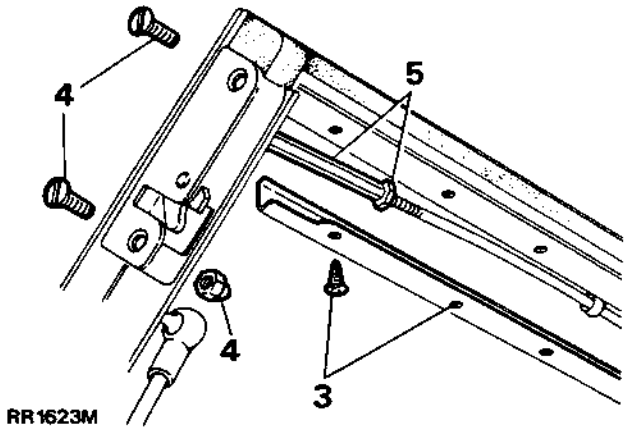


RR1622M

2. Ease the sealing rubber away to reveal the single screw securing the centre of the release handle, remove the screw and detach the handle from the lock mechanism complete with key barrel.

   NOTE: At this stage the barrel can be removed from the handle by releasing the two small cross-head screws at the joint-face. Remove the retaining plate and release the spring and key barrel from its bore.

3. Release the eight screws and remove the operating rod covers located either side of the centre lock mechanism.
4. Remove the four screws and two nuts securing the lock catches to the sides of the tailgate.
5. Release the two small locknuts on the operating rods and rotate the hexagonal connecting rod until the side catches can be removed.
6. Release the two screws securing the centre lock mechanism and remove the unit complete with operating rods.



RR1623M

Refitting

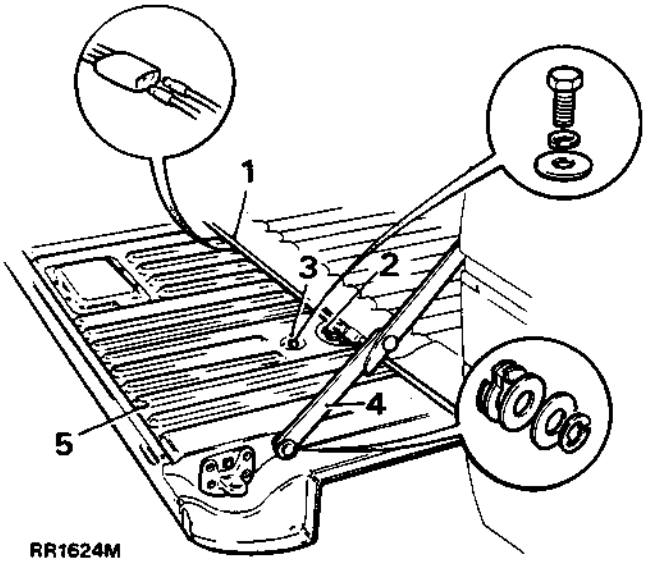
7. Reverse the removal procedure.
8. Adjustment of the side catches may be required after assembly, this is achieved by releasing the locknuts on the operating rods, and rotating the hexagonal link clockwise or anti-clockwise to shorten or extend the length of the operating rods.

LOWER TAILGATE

Remove and refit

Removing

1. Disconnect the electrical leads from the rear number plate lamp.
2. Remove the four cross-head screws securing the sealing rubber around the tailgate hinge bolts.
3. Remove the fixings, tailgate to hinges.
4. Disconnect the check straps.

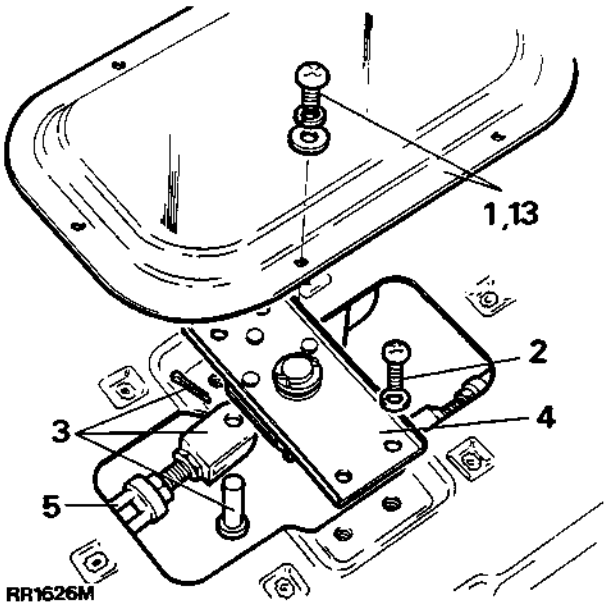


RR1624M

5. Withdraw the tailgate.

Refitting

6. Reverse 1 to 4.



RR1626M

Refitting

6. Reverse 2 to 5.
7. Close the lower tailgate and check the operation of the lock, the bolts should engage automatically and release when the handle is moved fully right against spring pressure.

Adjusting the lock 8 to 12

8. Slacken the locknuts at the lock end of the adjuster.
9. Slacken the locknuts at the bolt end of the adjuster, noting that they have a LEFT HAND thread.
10. Turn the adjuster as required to move the bolt in or out.
11. Secure the adjuster locknuts.
12. The eye brackets at each side of the tailgate can also be adjusted to align with their locating dowels, by slackening the fixings, slightly repositioning the brackets and retightening the fixings.

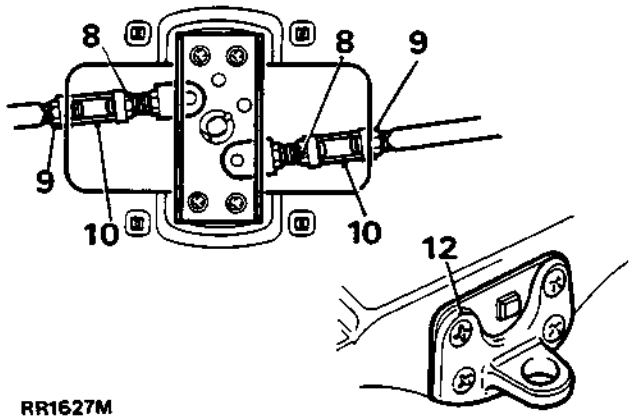
LOWER TAILGATE LOCK

Adjust 1 and 8 to 13

Remove and refit 1 to 7 and 13

Removing

1. Remove the lock cover plate.
2. Remove the fixings from the lock mounting plate.
3. Disconnect either one of the bolt arms from the door lock.
4. Withdraw the lock complete with the fixed bolt arm.
5. Withdraw the loose bolt arm.



RR1627M

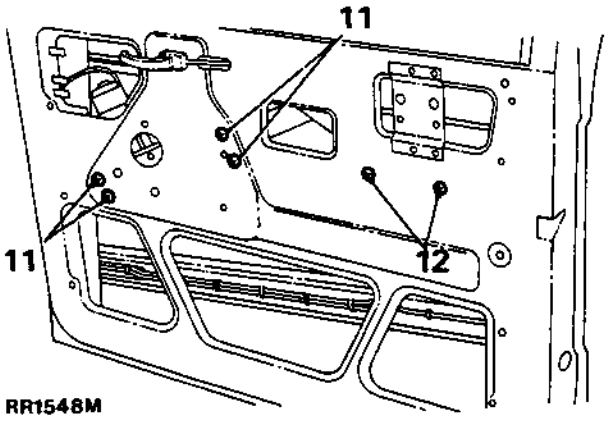
13. Fit the lock cover plate.

FRONT DOOR GLASS AND REGULATOR—Four door models

Remove and refit

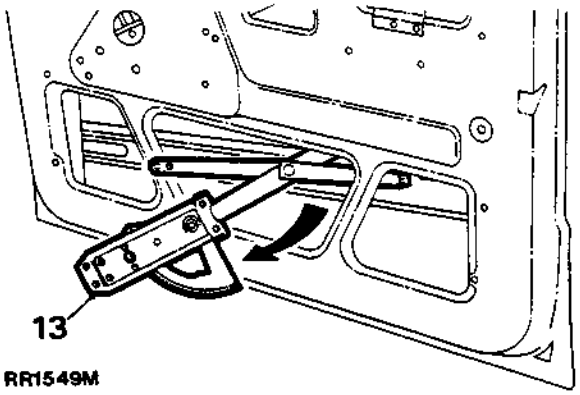
Removing

1. Ensure the window is in its fully closed position and secure it with adhesive tape to prevent the window dropping down.
2. Disconnect the battery.
3. Detach the armrest/door-pull finisher to reveal the two securing screws.
4. Remove the two securing screws (with plain washers) to enable the armrest/door-pull to be detached from the inner door panel.
5. Remove the interior door handle finisher button to reveal the screw retaining the handle surround.
6. Remove the screw and detach the handle surround from the inner door panel.
7. Detach the inner door trim pad by inserting a screwdriver between the trim pad and inner door panel, gently prising out the nine plastic securing clips from their respective holes in the inner door panel.
8. Disconnect the two speaker connections inside the door and remove the door trim pad complete with speaker.
9. Remove the plastic weather sheet.
10. Remove the window lift motor (refer to electrical section).
11. Remove the four window regulator retaining bolts with shakeproof washers from the inner door panel.



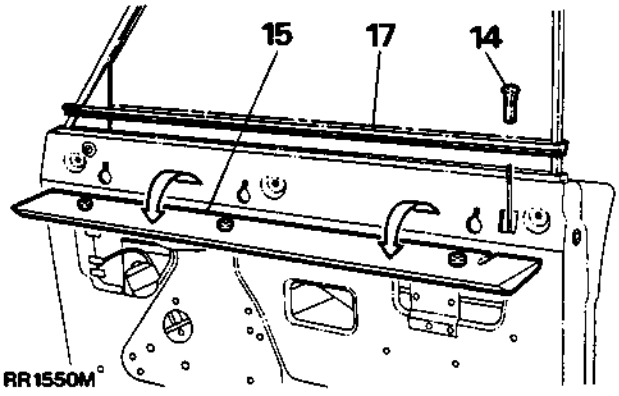
RR1548M

12. Remove the two screws with shakeproof washers retaining the lower window lift channel and slide the channel off the stud.
13. Disengage the lifting arm stud from the upper lifting channel, manoeuvre the window regulator and remove it from the lower centre aperture in the inner door panel.



RR1549M

14. Remove the sill locking knob.
15. Remove the inner door capping off its keyhole location.
16. Remove the exterior driving mirror (refer to exterior driving mirrors removal and refit in electrical section).
17. Remove the waist rail seal from the top of the door panel.



RR1550M

18. Remove the two bolts (shakeproof and plain washers) from the hinge face of the door which secure the front door frame.
19. Remove the single bolt (spring and plain washer) from the shut face of the door which secures the door rear frame.
20. Remove the bolt (spring and plain washer) from the recessed hole in the front of the inner door panel under the exterior driving mirror mounting plate.
21. Remove the single screw (spring and plain washer) from inside the door securing the bottom front glass channel.
22. Remove the single screw (spring and plain washer) from inside the door securing the bottom rear glass channel.
23. Lift the door glass frame complete with glass out of the door panel and remove to a suitable bench.
24. Remove the adhesive tape securing the glass to the frame.
25. Slide the glass out of the door frame channel.

Refitting

26. Reverse the removal instructions, items 1 to 25.

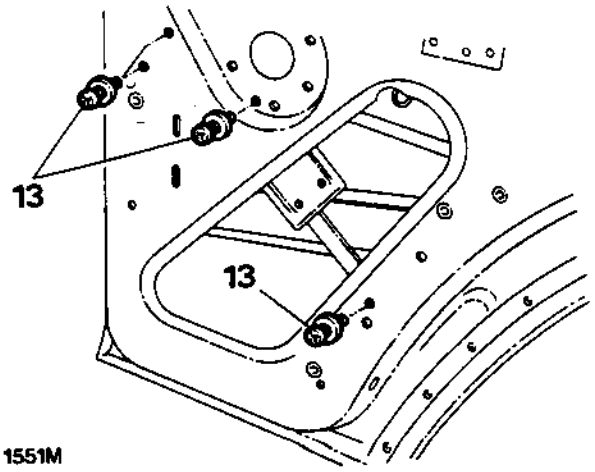
NOTE: When refitting the door glass frame, ensure it is repositioned to suit the door aperture before fully tightening the door frame securing bolts.

REAR DOOR GLASS AND REGULATOR

Remove and refit

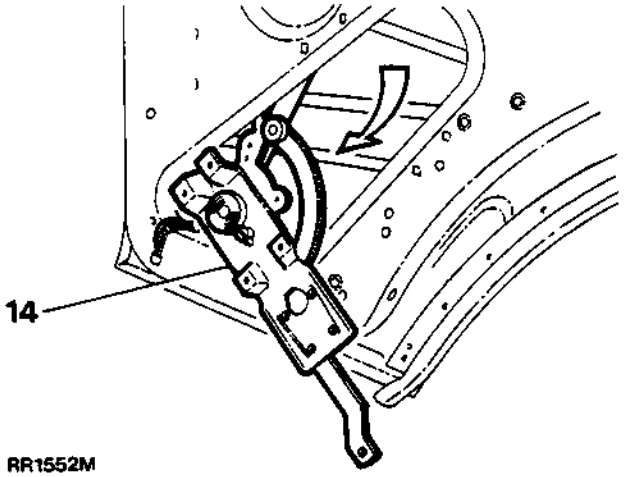
Removing

1. Ensure the window is in its fully closed position and secure it with adhesive tape over the top of the door to prevent the window dropping down.
2. Disconnect the battery.
3. Remove the armrest/door-pull finisher to reveal the two securing screws.
4. Remove the two securing screws (with plain washers) and detach the armrest/door-pull from the inner door panel.
5. Disconnect the window lift switch multi-plug at the rear of the armrest/door-pull.
6. Remove the interior handle finisher button to reveal the screw retaining the handle surround.
7. Remove the screw and detach the handle surround from the door trim pad.
8. Remove the door trim pad by inserting a screwdriver between the trim pad and the inner door panel, gently prising out the six plastic clips from their respective holes around the edges of the trim.
9. Remove the sill locking button.
10. Remove the inner door capping from its keyhole location.
11. Remove the plastic weather sheet.
12. Remove the window lift motor (refer to electrical section).
13. Remove the four window regulator securing screws (with shakeproof washer).



RR1551M

14. Carefully disengage the lifting arm stud from the glass lifting channel and remove the window regulator from the lower aperture in the inner door panel.



RR1552M

15. Remove the waist rail seal from the top of the door panel.
16. Remove the single bolt (spring and plain washers) from inside the door which secures the bottom of the short rear glass run channel.
17. Remove the two bolts (spring and plain washers) from the hinge face of the door which secure the front door frame.
18. Remove the two bolts (spring and plain washers) from the shut face of the door which secure the rear door frame.
19. Lift out the door frame with the glass in position and remove to a suitable workbench.
20. Remove the tape and slide the glass out of the door frame channel.

Refitting

21. Reverse the removal procedure items 1 to 20.

NOTE: When refitting the door glass frame securing bolts, ensure that the door frame is adjusted to suit the door aperture before fully securing the frame to the door.

FRONT DOOR LOCK, OUTSIDE AND INSIDE DOOR RELEASE HANDLES — FOUR DOOR MODELS

Remove and refit

Removing

1. Remove the window lift motor (refer to electrical section).
2. Remove door glass and regulator (refer to door glass and regulator remove and refit).
3. Remove door actuator units (refer to electrical section).
4. Disconnect the control rod from the private key operated lock by releasing the metal clip at the bottom of the rod.
5. Disconnect the control rod from the outside door release handle by pulling it out of the plastic ferrule.
6. Disconnect the control rod connector between the inside door release handle and the door lock by releasing the metal clip and pulling one of the control rods out of the plastic connecting block. This is accessible through the small centre cut-out in the door panel. (The control rod also passes through a guide bracket on the inside of the inner door panel).
7. Release the door lock by removing the two counter-sunk screws from the door shut face and the single screw (with shakeproof washer) on the inner door panel.
8. Withdraw the lock through the lower rear cut-out on the inner door panel.

NOTE: If necessary the following items can also be removed.

9. Remove the two nuts (with shakeproof washers) and retaining bracket securing the **outside door release handle** to the outer door panel, accessible through the upper rear cut-out on the inner door panel.
10. Carefully detach the door release handle from the outer door panel.
11. Remove the two screws securing the **inside door release handle** to the inner door panel.
12. Withdraw the handle from its location with half the connecting rod still attached.
13. Unclip the spring tensioned end of the connecting rod from the door release handle.

Refitting

14. Reverse the removal procedure items 1 to 13.

NOTE: When refitting the door glass frame, ensure that it is positioned to suit the door aperture before fully tightening the door frame securing bolts.

ADJUSTMENT — FRONT DOOR LOCK AND HANDLE ASSEMBLY

Inside door release handle to lock

Refit the inside door release handle surround before any adjustment is made, allowing the handle to be set from the correct operating position. Rotate the spring tensioned nyloc nut at the opposite end of the interior handle connecting rod, clockwise or anti-clockwise to shorten or extend the operating length.

Outside door release handle to lock

Disconnect the small connecting rod at the rear of the outer door release handle by releasing the small metal clip, rotate the rod clockwise or anti-clockwise to shorten or extend the operating length.

NOTE: Door release should be effective before the total handle movement is exhausted to provide a small over-throw movement.

REAR DOOR LOCK, OUTSIDE AND INSIDE DOOR RELEASE HANDLES

Remove and refit

Removing

1. Ensure the window is in its fully closed position.
2. Remove all the interior door trim (refer to door glass and regulator remove and refit, items 2 to 11).
3. Disconnect the control rod from the inside door release handle by pulling the rod out of its location at the door lock.
4. Disconnect the sill locking control rod from the door lock by releasing the metal clip.
5. Disconnect the control rod from the outside door release handle by pulling it out of the plastic ferrule.
6. Release the door lock by removing the two counter-sunk screws from the door shut face and the single screw (with shakeproof washer) on the inside of the door. Retrieve any spacing washers which may be fitted between the inner door panel and the lock.
7. Withdraw the lock through the upper rear aperture in the inner door panel.

NOTE: If necessary the following items can also be removed.

8. Remove the two nuts (with shakeproof washers) and retaining bracket securing the **outside door release handle** to the outer door panel, accessible through the upper rear cut-out on the inner door panel.
9. Carefully detach the outside door release handle from the outer door panel.
10. Remove the two screws (with plain washers) securing the **inside door release handle** to the inner door panel.

11. Withdraw the handle from its location with the connecting rod still attached.
12. Unclip the spring tensioned end of the connecting rod from the door release handle.

Sill locking quadrants

13. Use a small screwdriver, or 3.175 mm diameter (⅛ in) rod, to press the plastic locking pins through the respective square inserts in the inner door panel, until they can be retrieved from inside the door.
14. Release the quadrants from the inner door panel and unhook the respective connecting rods.
15. Withdraw the quadrant from inside the door.

NOTE: When refitting the quadrants the plastic locking pins are entered into the square insert from outside and pressed in flush.

Refitting

16. Reverse the removal procedure 1 to 15.

ADJUSTMENT — REAR DOOR LOCK AND HANDLE ASSEMBLY

Outside door release handle to lock

Disconnect the short cranked connecting rod at the rear of the outer door release handle, rotate the rod clockwise or anti-clockwise to shorten or extend the operating length.

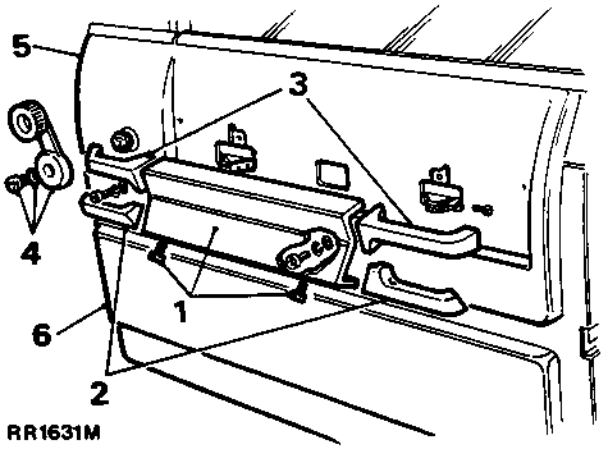
NOTE: Door release should be effective before the total handle movement is exhausted to provide a small over-throw movement.

FRONT DOOR GLASS AND REGULATOR—TWO DOOR MODEL

Remove and refit

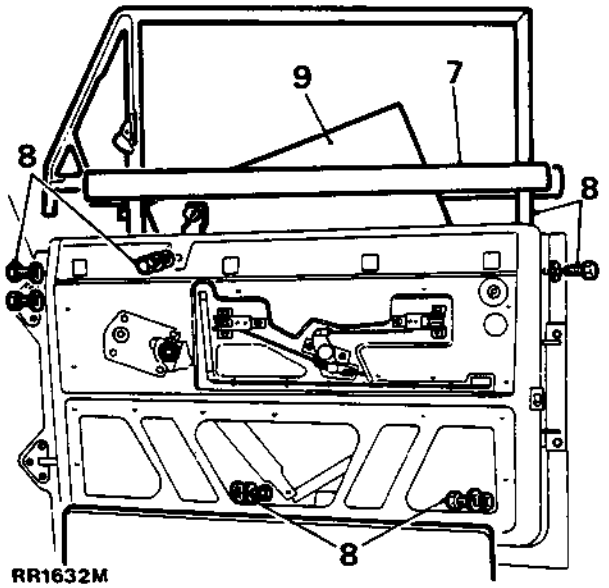
Removing

1. Remove the armrest.
2. Remove both interior door handles.
3. Remove both door-pull handles.
4. Remove the window regulator handle.
5. Prise the upper trim panel from the door.
6. Prise the lower trim panel from the door.



RR1631M

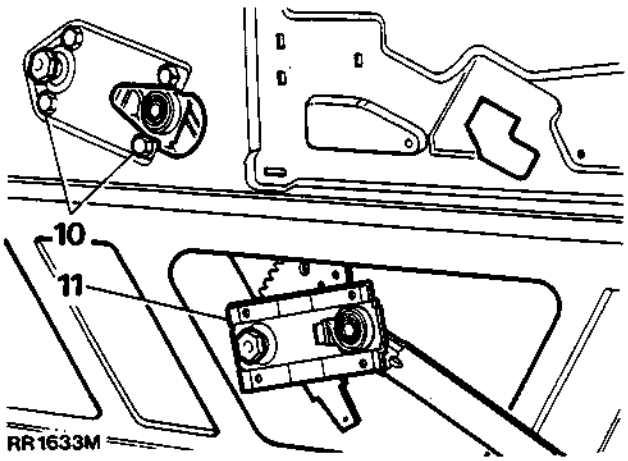
7. Withdraw the seals from the top edge of the door.
8. Remove the door glass frame.
9. Withdraw the glass.



RR1632M

Continued

10. Remove the four bolts securing the window regulator.
11. Withdraw the regulator out of the centre lower aperture.



Refitting

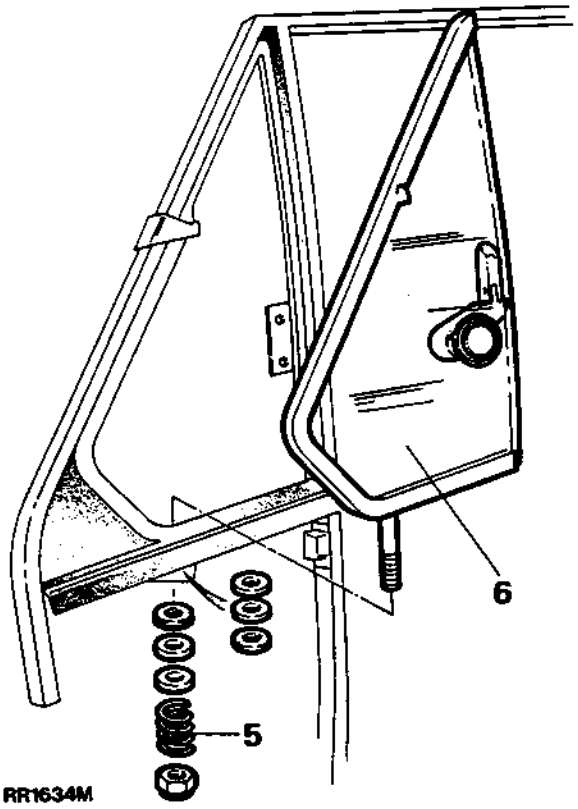
12. Fit the door frame and glass, do not fit the securing bolts at this stage.
13. Push the glass down the frame until the regulator runner is located in the glass channel.
14. Position the regulator and frame in the door panel and fit all retaining bolts.
15. Reverse the remaining removal instructions.

FRONT QUARTER VENT—TWO DOOR MODELS

Remove and refit

Removing

1. Remove the interior door handles.
2. Detach the upper and lower trim panels.
3. Remove all the door glass frame securing bolts (see Door glass and regulator removal instructions).
4. Remove the seals from the top edge of the door.
5. Pull the frame out of the door until access is gained to the nut, spring and washers at the bottom of the vent.
6. Remove the fixings and withdraw the quarter vent.



Refitting

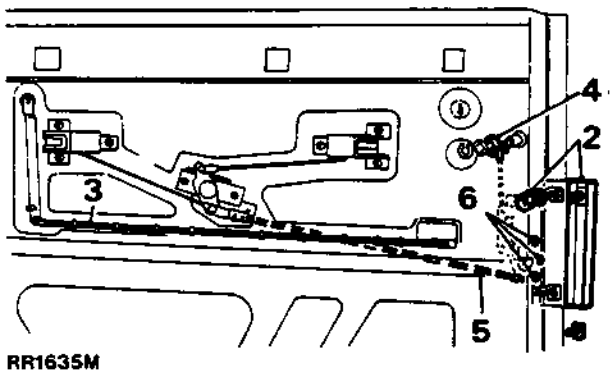
7. Reverse the removal instructions.

FRONT DOOR LOCK—TWO DOOR MODEL

Remove and refit

Removing

1. Remove the front door glass and frame (see door glass and regulator removal instructions).
2. Release the two nuts securing the exterior door handle, remove the handle from the door.
3. Disconnect the operating rod from between the interior locking lever and the lock.
4. Disconnect the operating rod at the private key lock.
5. Disconnect the operating rod from the interior door handle relay, at the lock end.
6. Remove the three screws securing the lock to the door panel, and withdraw the lock.



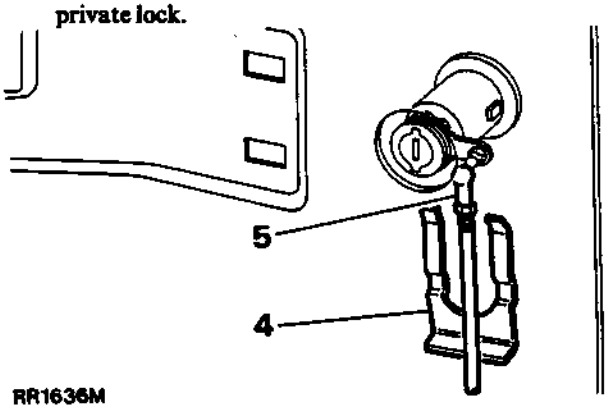
RR1635M

Refitting

7. Reverse the removal instructions.

PRIVATE LOCK, FRONT DOOR—TWO DOOR MODEL

1. Fully close the side door window.
2. Remove the interior door handles.
3. Carefully prise the upper and lower trim panels away from the door.
4. Disconnect the operating rod from the lever.
5. Using a bent piece of metal pull the spring clip off the private lock.



RR1636M

6. Manoeuvre the lock and remove it from the door.

Refitting

7. Reverse the removal instructions.

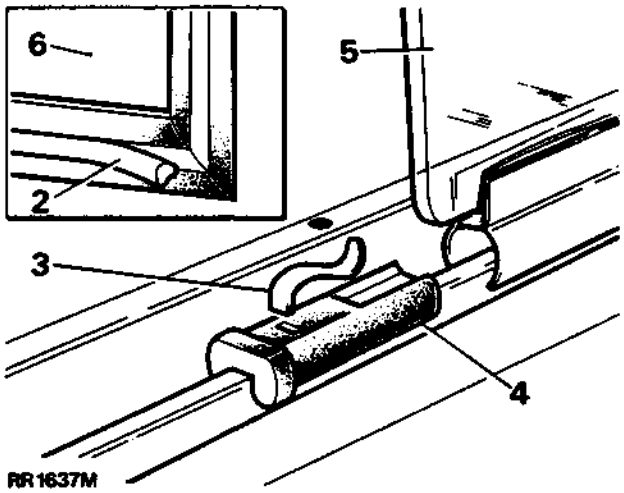
BODY SIDE GLASS—TWO DOOR MODEL

Front—remove and refit 3 to 7

Rear—remove and refit 1, 2 and 6

Removing

1. Remove the headlining rear section.
2. Remove the expander strip from the channel in the rubber moulding around the glass.
3. Lift the tongue of the spring clips from each of the front glass runners.
4. Slide both runners clear of the glass.
5. Lift out the front glass.
6. Lift out the rear glass.



RR1637M

Refitting

7. Reverse 1 to 6.

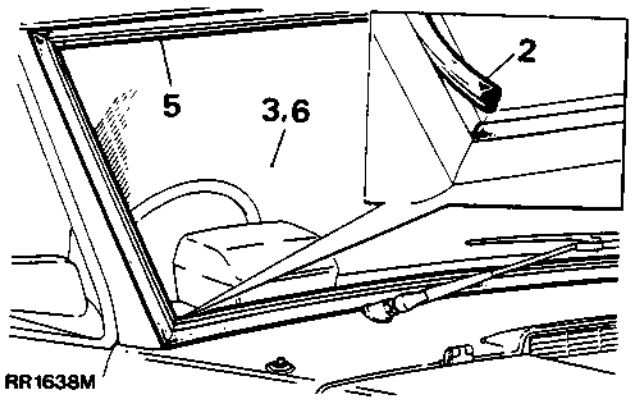
WINDSCREEN GLASS

Remove and refit

Removing

1. Remove the windscreen wiper arms.
2. Remove the expander strip from the channel in the rubber moulding around the glass.
3. Ease the bottom edge of the windscreen glass from the rubber moulding.
4. Lift the windscreen glass clear.

Continued



RR1638M

Refitting

5. Smear soft soap around the windscreen glass location channel in the rubber moulding.
6. Locate the bottom edge of the windscreen glass into the rubber moulding.
7. Use a suitable tool tapered to a thin end, to prise the rubber moulding over the windscreen glass all the way round.
8. Using a suitable tool insert the expander rubber into the channel around the windscreen moulding.

TAILGATE GLASS

Remove and refit

Removing

1. Remove the upper tailgate.
2. Remove the lock.
3. Remove the lift handle and trim.
4. The upper tailgate glass and frame are serviced as one unit.

Refitting

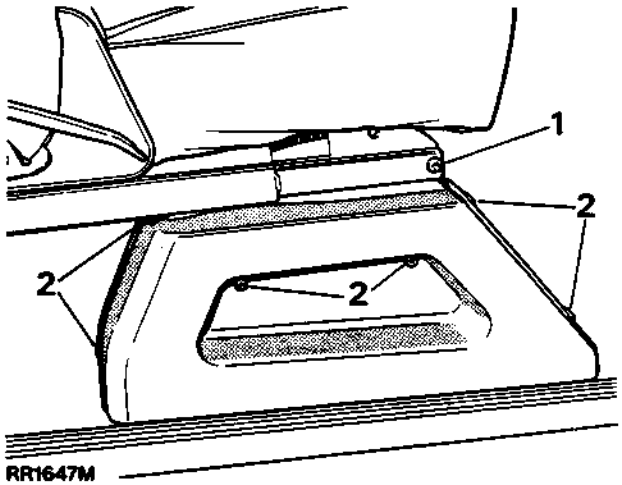
5. Reverse instructions 1 to 3.

FRONT SEAT—TWO DOOR MODEL

Remove and refit

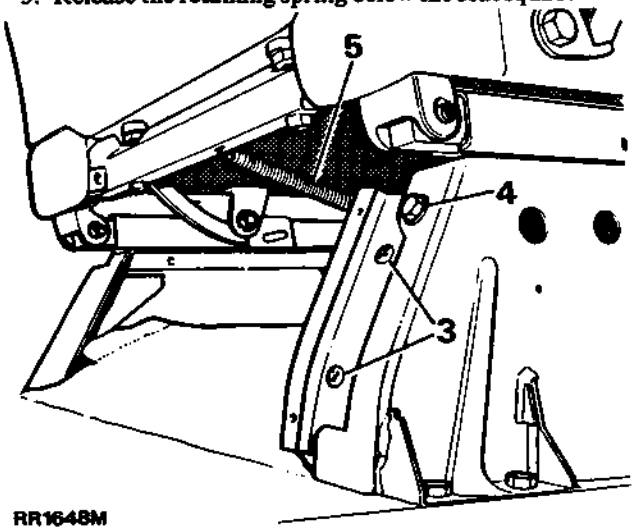
Removing

1. Remove the nut and bolt from the front of each seat slide.
2. Remove the six screws and the outside seat base cowling.



RR1647M

3. Remove the two screws and the plate from the outside rear of the seat base.
4. Remove the upper bolt from the rear retention bar and push the bar downward.
5. Release the retaining spring below the seat squab.



RR1648M

6. Working from the rear seat slide the front seat rearward and manoeuvre over the rear kick plate.
7. Withdraw the front seat.

NOTE: It may be found necessary to remove the 'B' post trim if fouling is experienced.

Refitting

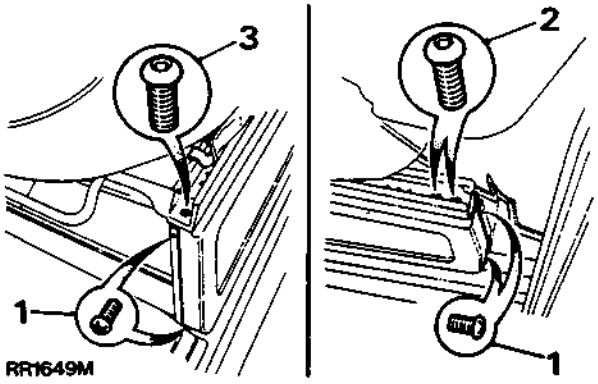
8. Reverse instructions 1 to 7.
9. Refit the 'B' post trim, if removed.

FRONT SEAT—FOUR DOOR MODEL

Remove and refit

Removing

1. Remove the four cross-head screws securing the outside seat base cowling.
2. Slide the seat forward and remove the four Allen type screws located inside the seat slide channel at the rear of the seat.
3. Move the seat rearwards and remove the two Allen type screws with nuts located inside the runner channel at the front of the seat.



4. Remove the seat from the vehicle.

Refitting

5. Reverse the removal procedure.

FRONT SEAT BASE—TWO AND FOUR DOOR MODELS

Remove and refit

Removing

1. Remove the seat.
2. Release the front and rear footwell carpets to give access to the seat belt bolts.
3. Remove the twelve bolts (with washers) securing the seat base to the floor.
4. Disengage the eyebolts, seat base to chassis.

NOTE: Four door Fuel Injection models only. Disconnect the multi-plug from the electronic control unit located under the right-hand front seat.

5. Withdraw the seat base.

Refitting

6. Reverse the removal procedure.

CUBBY BOX AND FLOOR MOUNTED CONSOLE ASSEMBLY

Remove and refit

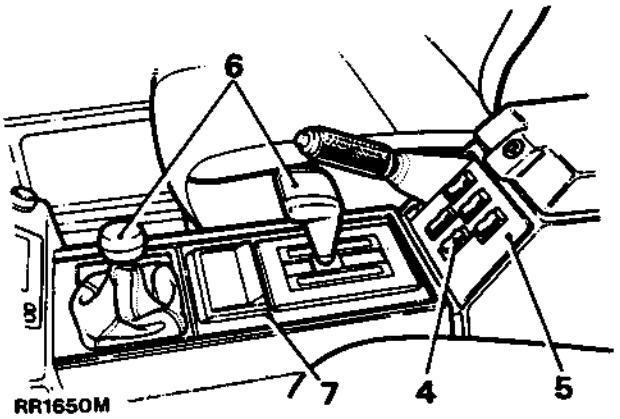
Removing

1. Disconnect the battery negative lead.
2. Remove the four cross-head screws securing the cubby box liner to the cubby box and withdraw the liner.
3. Disconnect the electrical leads to the rear passenger cigar lighter.
4. Disconnect the electrical multi-plugs from the rear of the window lift switches, labelling each plug for identification on re-assembly.
5. Prise out the window lift panel complete with switches.

NOTE: To enable the cubby box/console assembly to be removed, disconnect the handbrake cable from the handbrake lever, to allow the lever to be raised to its uppermost position.

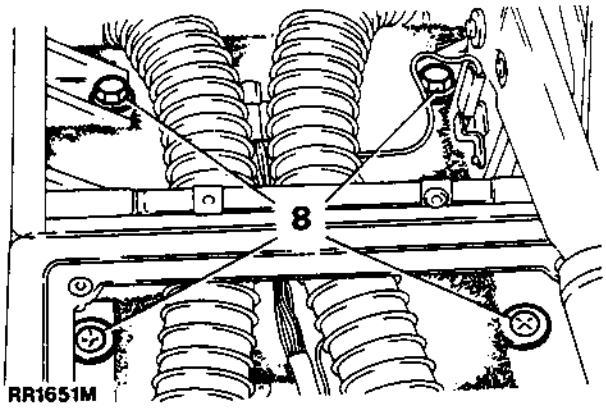
6. Remove the main and transfer gear selector knobs.
7. Carefully prise the inset panel around the main gear selector away from the outer surround.

NOTE: Automatic transmission models—Disconnect the graphics illumination bulbs from the selector panel.



8. Remove the two bolts (with washers) and two screws (with washers) securing floor-mounted console to the gearbox tunnel.
9. Ease the assembly rearwards to detach the small location tab at the front of the console from the bottom of the radio housing.
10. Manoeuvre the assembly from the handbrake and gear levers and remove it from the vehicle.

Continued



RR1651M

Refitting

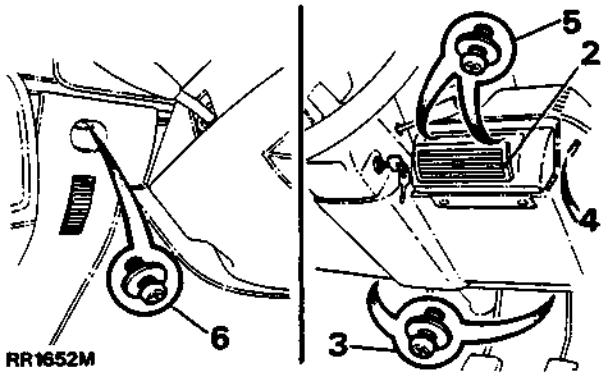
11. Reverse the removal procedure ensuring that all electrical plugs are fitted securely and correctly. Arrange the electrical wiring beneath the console to ensure it does not become trapped between any joint faces.

LOWER FASCIA PANEL

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Prise the louvre from the fascia (Air conditioning models only).
3. Remove the two cross-head screws from the bottom of the panel located above the pedals.
4. Remove the single cross-head screw from the side of the panel adjacent to the front door courtesy light switch.
5. Remove the two cross-head screws from the top of the louvre aperture.
6. Remove the single cross-head screw above the rheostat switch.



RR1652M

7. Lower the fascia and disconnect the electrical plug at the rear of the rheostat switch.
8. Remove the panel from the vehicle.

Refitting

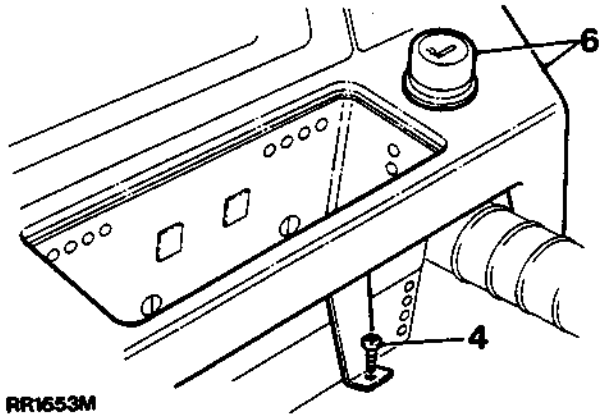
9. Reverse the removal procedure.

RADIO HOUSING

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the cubby box and floor-mounted console assembly.
3. Remove the radio from the housing (see Radio—remove and refit in electrical section).
4. Remove the single screw securing the housing to the gearbox tunnel.
5. Tilt the front of the housing upwards and manoeuvre it away from the centre fascia unit as far as the cigar lighter electrical leads will permit.
6. Disconnect the leads from the rear of the cigar lighter and remove radio housing complete with lighter unit.



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Refitting

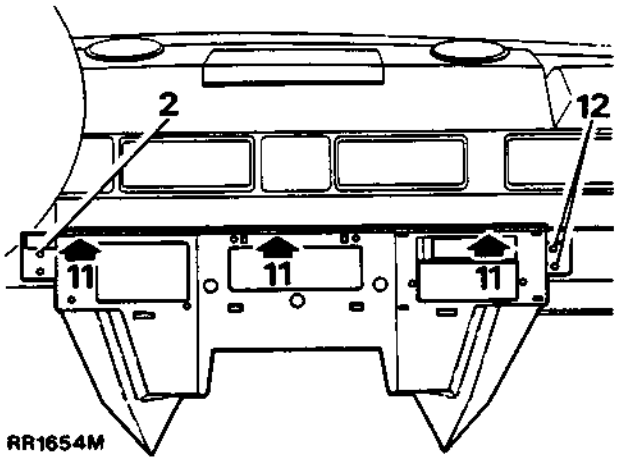
7. Reverse the removal procedure ensuring the radio electrical leads do not become trapped when refitting the radio to the housing.

CENTRE FASCIA PANEL

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the lower fascia panel to give access to the single screw securing the side of the centre fascia and release the screw (driver's side).
3. Remove the cubby box and floor-mounted console assembly.
4. Remove the radio and radio housing.
5. Detach the fuse box cover and remove the three screws securing the main and auxiliary fuse box body to the fascia.
6. Pull the four heater control knobs off their levers.
7. Remove the two screws at the top of the heater graphics panel. Pull the panel away from the fascia and remove the illumination bulbs from their locations.
8. Withdraw the graphics panel.
9. Prise the auxiliary switch panel away from the fascia.
10. Identify each switch multi-plug to aid re-assembly, and disconnect them from the switches.
11. Release the three screws securing the top of the centre fascia to the louvre fascia panel.
12. Remove the two screws securing the side of the centre fascia unit (front passenger side).
13. Manoeuvre the centre fascia away from the louvre fascia and remove it from the vehicle.



RR1654M

Refitting

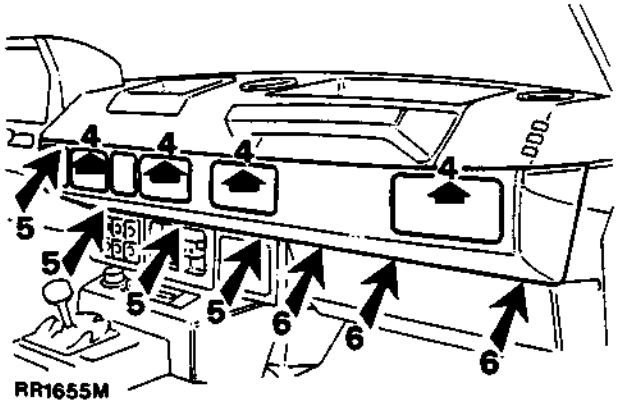
14. Reverse the removal procedure ensuring that all electrical multi-plugs are fitted correctly and secure in their respective switches.
15. Arrange all electrical wiring and harnesses so that they do not become trapped between any mating faces.

LOUVRE FASCIA PANEL

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Carefully prise the clock out of the fascia, disconnect the electrical leads and remove the bulb and holder from its holder.
3. Remove the single screw securing the end of the fascia panel located adjacent to the passenger courtesy light switch.
4. **AIR CONDITIONED MODELS**—Remove the four louvres to give access to the eight securing screws located at the top of the louvre apertures.
   NON-AIR CONDITIONED MODELS—Remove the five screws securing the parcel shelf, withdraw the shelf to give access to the four nuts and bolts (with plain washers) located behind the louvre fascia panel retaining the panel to the top rail. Prise out the two centre louvres and release the four screws located within the louvre apertures.
5. **AIR CONDITIONED MODELS**—Remove the remaining screw above the air-conditioning control panel.
6. Remove the three screws securing the bottom of the panel to the centre fascia panel (**both models**). Remove the remaining three screws above the blower motor trim panel (air-conditioned models only).



RR1655M

7. Ease the fascia panel forward and disconnect the electrical leads from the rear of the air conditioning switch (air conditioned models only).
8. Withdraw the panel from the vehicle.

Refitting

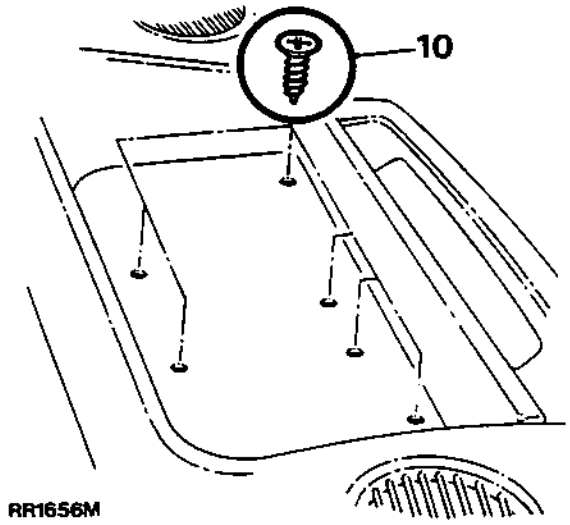
9. Reverse the removal procedure.

FASCIA TOP RAIL

Remove and refit

Removing

1. Disconnect the battery negative lead and remove the steering wheel.
2. Remove the lower fascia panel.
3. Remove the cubby box and floor mounted console assembly.
4. Remove the radio and radio housing.
5. Detach the heater control graphics panel, auxiliary switch panel and fuse box from the centre fascia panel.
6. Remove the centre fascia panel.
7. Remove the louvre fascia panel.
8. Remove the instrument binnacle (see instrument binnacle Remove and refit in Electrical section).
9. Remove the rubber mat from the passenger map tray.
10. Remove the five screws, nuts and washers securing the grab rail and fascia top rail to the inner bulkhead.



RR1656M

11. Disconnect side and centre air vent hoses from the heater unit.
12. Withdraw the fascia top rail.

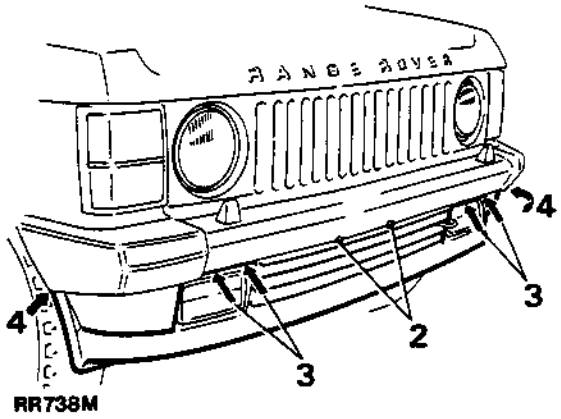
Refitting

13. Reverse the removal procedure ensuring that the fascia top rail locates on three brackets below the windscreen inner sealing rubber.
14. Ease the sealing rubber over the top of the fascia top rail.

FRONT SPOILER—option

A front spoiler is fitted as a standard item on Range Rover Vogue and as an option on all other Range Rover models. The spoiler, if fitted, will reduce the vehicle approach angle by approximately 10°. Where the vehicle is expected to perform on rough or hilly terrain, it is advisable to remove the spoiler to prevent any damage which may occur due to ground contact.
The spoiler may be removed as follows.

1. Disconnect the electrical connections at the rear of both auxiliary driving lamps, accessible through the front wheel arches.
2. Remove the two screws (with spring washers) securing the centre of the spoiler.
3. Remove the four nuts (with spring washers) located behind the front bumper above the driving lamp pockets, accessible from beneath the vehicle.
4. Remove the two bolts, nuts and washers securing the outer edges of the spoiler to the corners of the front wings, located forward of the front road wheels.



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5. Remove the spoiler complete with driving lamps.

Refitting

6. Reverse the removal instructions.

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AIR CONDITIONING

System	A.R.A.
Compressor	Sanden SD510

ELECTRICAL

System	12 volt, negative earth
Battery	
Make/type	Chloride maintenance free 9-plate—210/85/90 Chloride maintenance free 14-plate—380/120/90

ALTERNATOR

Manufacturer	Lucas
Type	133/65
Polarity	Negative earth
Brush length	
New	20 mm (0.78 in)
Worn, minimum free protrusion from brush box	10 mm (0.39 in)
Brush spring pressure flush with brush box face	136 to 279 g (5 to 10 oz)
Rectifier pack output rectification	6 diodes (3 live side and 3 earth side)
Field winding supply rectification	3 diodes
Stator windings	3 phase—delta connected
Field winding rotor poles	12
Maximum speed	15,000 rev/min
Shaft thread	M15—1.5—6 g
Winding resistance at 20°C	3.2 ohms
Control	Dual—battery sensed with machine sensed safety control
Regulator—type	15 TR
voltage	13.6 to 14.4 volts
Nominal output	
Condition	Hot
Alternator speed	6000 rev/min
Control voltage	14 volt
Amp	65 amp

REPLACEMENT BULBS		TYPE		
Headlamps	Exterior lights	12V	60/55W	(Halogen)
Headlamps—France (amber)		12V	60/55W	(Halogen)
Auxiliary driving lamps		12V	55W H3	(Halogen)
Sidelamps		12V	4W	bayonet fitting
Stop/tail lamps		12V	5/21W	bayonet fitting
Reverse lamps		12V	21W	bayonet fitting
Rear fog guard lamps		12V	21W	bayonet fitting
Direction indicator lamps		12V	21W	bayonet fitting
Side repeater lamps		12V	4W	bayonet fitting
Number plate lamps		12V	4W	bayonet fitting
Instrument panel lamps and warning lamps		12V	1.2W	bulb/holder unit
Ignition warning lamp (Instrument panel)		12V	2W	capless
Interior roof lamps		12V	10W	'Festoon'
Clock illumination		12V	2W	bayonet fitting
Cigar lighter illumination	Interior lights	12V	1.2W	capless
Door edge/puddle lamps		12V	10/5W	capless
Auxiliary switch panel illumination (green)		12V	1.2W	capless
Heated rear screen warning lamp (amber)		12V	1.2W	capless
Hazard warning lamp (red)		12V	1.2W	capless
Automatic graphics illumination		24V	5W	capless
Air conditioning graphics illumination		12V	1.2W	capless

DISTRIBUTOR

Make/type	Lucas 35DM8
Firing angles	0°—45°—90° etc. ± 1°
Application	12V Negative earth
Pick-up air gap adjustment (Pick-up limb/reluctor tooth)	0.20 mm–0.35 mm (0.008 in–0.014 in)
Pick-up winding resistance	2k–5k ohms

FUSES

Type	Autofuse (Blade type) Blow ratings to suit individual circuits

HORNS

Make/type	Klamix (Mixo) TR99

IGNITION MODULE

Make/type	Lucas 2CE 12-volt electronic

SPARK PLUGS

Make/type	Champion N9YC
Gap	0.70 to 0.80 mm (0.030 to 0.032 in)

STARTER MOTOR

Make/type	Lucas 3M100 pre-engaged
British spring tension	1020 gms (36 ozs)
Minimum brush length	9.5 mm (.375 in)

TAILGATE WIPER MOTOR

Make/type	Lucas 14W PM
Armature end float	0.05–0.25 mm (0.002 in–0.010 in)
Minimum brush length	4.8 mm (0.187 in)
Running current (rack disconnected)	1.5 amps
Wiper speed after 60 seconds	46–52 rev/min

WINDSCREEN WIPER MOTOR

Make/type	Lucas 28W 2-speed
Running current (rack disconnected)	1.5 amps at 39–45 rev/min (normal speed)
Rotary link speed	60–73 rev/min (high speed)

TORQUE WRENCH SETTINGS

	Nm	lbf ft
AIR CONDITIONING		
Compressor hose	34–40	24–29
Receiver drier hose	14–21	10–15
Receiver drier switch	21–25	15–19
Compressor oil filler plug	8–12	6–9
ELECTRICAL		
Alternator mounting bracket to cylinder head	34	25
Alternator to mounting bracket	24	17
Alternator to adjusting link	24	17
Alternator shaft nut	27.2 to 47.5	20 to 35
Alternator through bolts	4.5 to 6.2	3.3 to 4.6
Alternator rectifier bolts	3.4 to 3.96	2.5 to 2.9
Distributor clampbolt	19 to 22	14 to 16
Distributor pick-up bearing plate support pillars	1.0 to 1.2	9 to 11 lbf in
Distributor pick-up barrel nuts	1.1 to 1.5	10 to 12 lbf in
Spark plug	13.8 to 16.2	10 to 12
Starter motor to engine bolts	40.6 to 47.4	30 to 35
Starter motor through bolts	10.8	8
Solenoid fixing stud nut	6	4.5
Solenoid upper terminal nut	4	3
Reverse light switch	20 to 27	15 to 20
Wiper motor yoke retaining bolts	1.35–1.8	12–16

Charts below give torque settings for all screws and bolts used—except for those that are specified.

SIZE	NM	LB/FT
M5	5–7	3.7–5.2
M6	7–10	5.2–7.4
M8	22–28	16.2–20.7
M10	40–50	29.5–36.9
M12	80–100	59.0–73.8
M14	90–120	66.4–88.5
M16	160–200	118.0–147.5

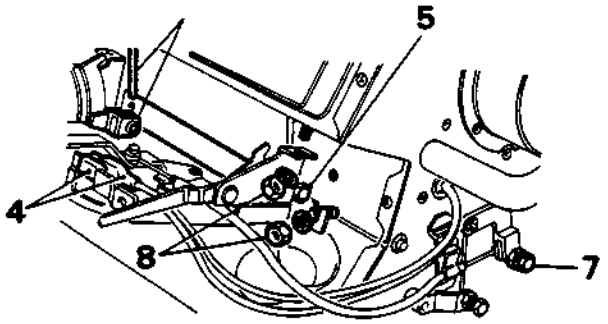
SIZE	UNC		UNF	
	LB/FT	NM	LB/FT	NM
¼	5–7	6.8–9.5	6–9	8.1–12.2
5/16	15–20	20.3–27.1	15–20	20.3–27.1
⅜	26–32	35.2–43.4	26–32	35.2–43.4
7/16	50–65	67.8–88.1	50–65	67.8–88.1
½	60–75	81.3–101.7	60–75	81.3–101.7
⅝	90–110	122.0–149.1	90–110	122.0–149.1

HEATER CONTROLS

Remove and refit

Removing

1. Remove the transmission lever surround.
2. Remove the radio mounting console.
3. Remove the centre console unit.
4. Disconnect the electrical leads from the control switch.



RR791M

5. Disconnect the relay rod from the 'SCREEN-CAR' lever.
6. Disconnect the relay rod from the 'VENT' lever.
7. Disconnect the control cables from each side of the heater unit.
8. Remove the four securing nuts and washers and withdraw the heater controls assembly.

Refitting

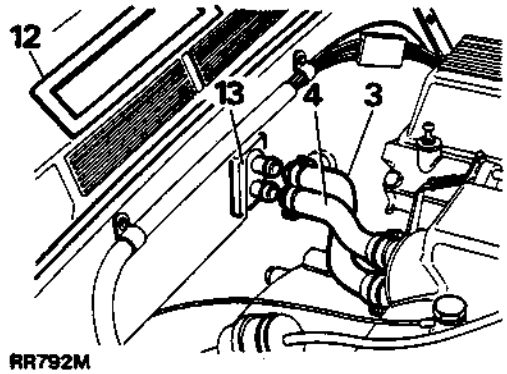
9. Reverse 5 to 8.
10. Check that the control levers give full movement of the flaps. If necessary, adjust at the relay rod or cable end fixings.
11. Connect the electrical leads to the control switch, the Black/White lead connects to the front terminal.
12. Reverse 1 to 3.

HEATER UNIT

Remove and refit

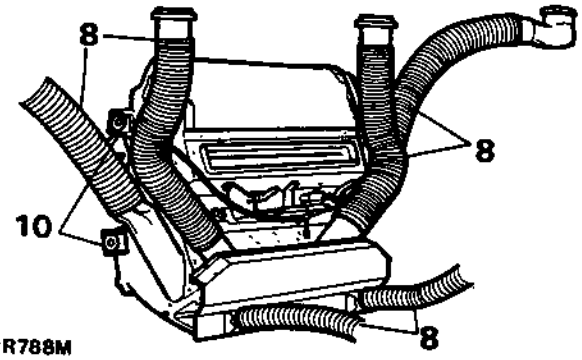
Removing

1. Drain the cooling system.
2. Remove the air cleaner (carburetter vehicles).
3. Disconnect the water inlet hose from the heater.
4. Disconnect the water outlet hose from the heater.



RR792M

5. Remove the lower fascia panel.
6. Remove the transmission lever surround.
7. Remove the centre console unit.
8. Disconnect the six hoses from the heater unit.



RR788M

9. Disconnect the electrical leads from the heater unit.
10. Remove the four heater mounting bolts.
11. Remove the heater unit.

Refitting

12. Check that the seal for the fresh air intake is in place on the back of the heater unit.
13. Check that the seal for the heater radiator is in place on the radiator pipes.
14. Reverse 1 to 11.

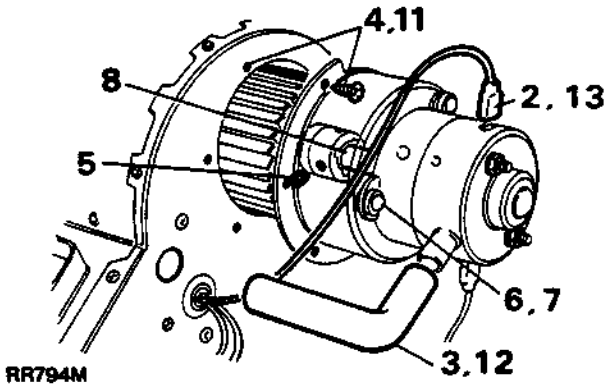
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HEATER FAN MOTOR

Remove and refit

Removing

1. Remove the heater unit.
2. Disconnect the electrical leads.
3. Disconnect the air cooling hose.
4. Remove five screws and withdraw the fan and motor assembly.
5. Slacken two grub screws securing the fan to the motor spindle and remove the fan.
6. Drill out three pop-rivets and remove the fan motor.



RR794M

Refitting

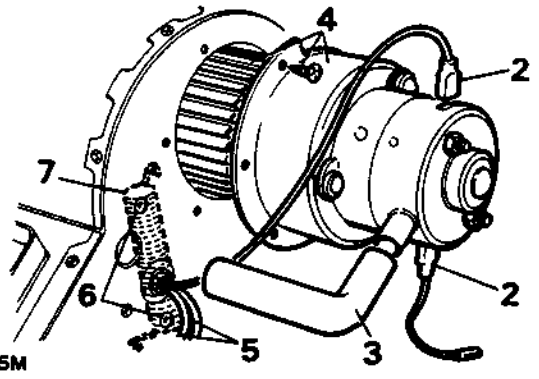
7. Locate the fan motor and secure using suitable pop rivets.
8. Engage the fan motor spindle into the boss on the fan and secure the grub screws.
9. Locate the fan motor in position, engaging the fan spindle into the bearing.
10. Hold the fan motor firmly in position and check that the fan rotates freely. If necessary, adjust the position of the fan on the motor spindle.
11. Align the air cooling hose connection and refit the five screws securing the fan motor assembly.
12. Connect the air cooling hose.
13. Connect the electrical leads.
14. Refit the heater unit.

FAN MOTOR RESISTANCE UNIT

Remove and refit

Removing

1. Remove the heater unit.
2. Disconnect the electrical leads from the fan motor.
3. Disconnect the air cooling hose.
4. Remove the fan motor and fan assembly.
5. Disconnect the electrical leads from the control switch.
6. Drill out the two pop-rivets securing the resistance unit.
7. Withdraw the resistance unit complete with leads.



RR795M

Refitting

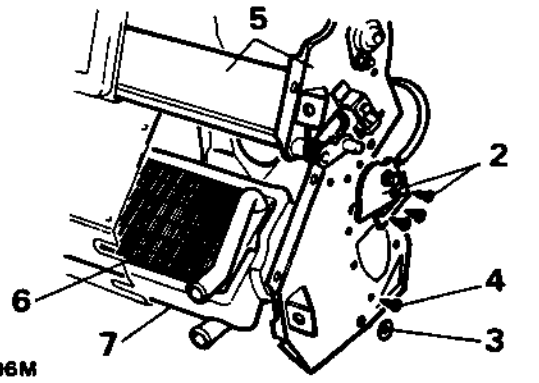
8. Reverse 1 to 7. When connecting the electrical leads, connect the Black/White resistance unit lead to the front terminal on the control switch.

HEATER RADIATOR

Remove and refit

Removing

1. Remove the heater unit.
2. Remove the fixings from the cam bracket for the fresh air flap, and move the cam and bracket assembly aside.
3. Remove the lock-washers from the four flap spindles.
4. Remove all the drive screws from the left hand side cover.
5. Withdraw the left hand side cover complete with the fresh air flap.
6. Withdraw the heater radiator complete with seals.
7. Withdraw the seals from the heater radiator.



RR796M

Refitting

8. Apply Bostik sealing compound around the flange of the left hand side cover.
9. Reverse 1 to 7.

AIR CONDITIONING — A.R.A. SYSTEM

Description

The A.R.A. air conditioning system comprises four units:

1. An engine-mounted compressor.
2. A condenser mounted in front of the radiator.
3. A receiver/drier unit located in the engine compartment.
4. An evaporator unit mounted behind the fascia.

The four units are interconnected by hoses carrying refrigerant, and the evaporator is linked into the vehicle ventilation system.

WARNING: Under no circumstances should refrigerant pipes be disconnected without first depressurising the system.

Cold refrigerant circuit

The function of the refrigeration circuit is to cool the evaporator.

1 *Compressor*

The compressor draws vaporized refrigerant from the evaporator. It is compressed, and thus heated, and passed on to the condenser as a hot, high pressure vapour.

2 *Condenser*

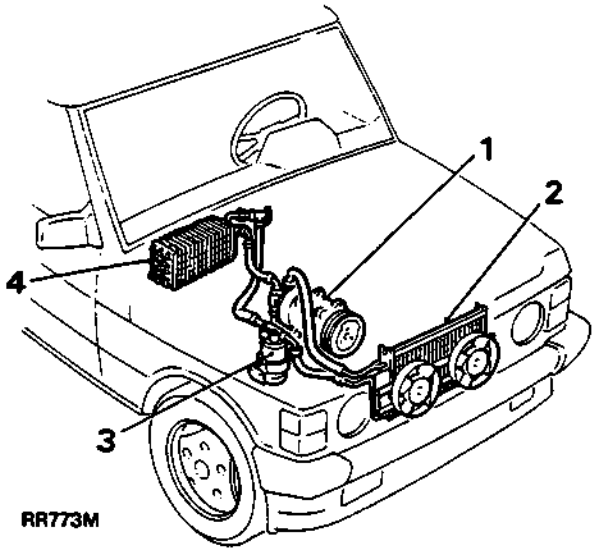
The condenser is mounted directly in front of the vehicle radiator. It consists of a refrigerant coil mounted in a series of thin cooling fins to provide the maximum heat transfer in a minimum amount of space. Airflow across the condenser is induced by vehicle movement and is assisted by two electric condenser fans.

The refrigerant enters the inlet at the top of the condenser as a heat laden high pressure vapour. As this vapour passes down through the condenser coils, heat will follow its natural tendency and flow from the hot refrigerant vapour into the cooler air flowing across the condenser coils and fins.

When the refrigerant vapour reaches the temperature and pressure that will induce a change of state a large quantity of latent heat will be transferred to the outside air. The refrigerant will change from a high pressure HOT VAPOUR to a high pressure WARM LIQUID.

3 *Receiver drier*

This unit filters, removes moisture, and acts as a reservoir for the liquid. To prevent icing inside the system, extreme precautions are taken during servicing to exclude moisture. The receiver drier should be considered as a second stage insurance to prevent the serious consequences of ice obstructing the flow. A sight glass provided in the unit top enables a visual check to be made of the high pressure liquid flow.



4 *Expansion valve and evaporator*

High pressure liquid refrigerant is delivered to the expansion valve. A severe pressure drop occurs across the valve and as the refrigerant enters the evaporator space at a temperature of approximately −6°C it boils and vaporizes. As this change of state occurs, a large amount of latent heat is absorbed. The evaporator is therefore cooled and as a result heat is extracted from the air flowing across the evaporator. The air flow is controlled by two evaporator fans regulated by the air conditioner fan control.

Second cycle

Vaporized refrigerant is then drawn from the evaporator by the compressor and a second cycle commences.

GENERAL SERVICE INFORMATION

Introduction

Before any component of the air conditioning system is removed, the system must be depressurised. When the component is replaced, the system must be evacuated to remove all traces of old refrigerant and moisture. Then the system must be recharged with new refrigerant.

Any service operation that requires the loosening of a refrigerant line connection should be performed only by qualified service personnel. Refrigerant and/or oil will escape whenever a hose or pipe is disconnected.

All work involving the handling of refrigerant requires special equipment, a knowledge of its proper use and attention to safety measures.

Continued

Servicing equipment

The following equipment is required for full servicing of the air conditioning system.
Charging trolley
Leak detector
Tachometer
Safety goggles
Refrigerant charging line gaskets
Thermometer: 20°C to −60°C (68°F to −76°F)
Valve core removers
Compressor dipstick

SERVICING MATERIALS

Refrigerant: Refrigerant 12, which includes Freon 12 or Arcton 12.

CAUTION: Methychloride refrigerants must not be used.

Nominal charge weight:
RHD vehicles: 1.25 kg (44 oz)
LHD vehicles: 1.08 kg (38 oz)
Compressor oil: See Recommended Lubricants.

PRECAUTIONS IN HANDLING REFRIGERANT

Refrigerant 12 is transparent and colourless in both the gaseous and liquid state. It has a boiling point of −29.8°C (−21.7°F) at atmospheric pressure and at all normal pressures and temperatures it becomes a vapour. The vapour is heavier than air, non-flammable, and non-explosive. It is non-poisonous except when in contact with an open flame, and non-corrosive until it comes in contact with water.

The following precautions in handling Refrigerant 12 should be observed at all times.

DO NOT
- leave refrigerant drum without its heavy cap fitted.
- carry refrigerant drum inside a vehicle.
- subject refrigerant drums to high temperature.
- weld or steam clean near an air conditioning system.
- expose eyes to liquid refrigerant, ALWAYS wear goggles.
- discharge refrigerant vapour into an area with an exposed flame or into an engine intake. Heavy concentrations of refrigerant in contact with naked flame produces a toxic gas.
- allow liquid refrigerant to contact bright metal, it will tarnish metal and chrome surfaces, and combined with moisture can seriously corrode all metal surfaces.

PRECAUTIONS IN HANDLING REFRIGERANT LINES

WARNING: Always wear safety goggles when opening refrigerant connections.

(a) When disconnecting any pipe or flexible 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.
(b) Lines, flexible end connections and components must be capped immediately they are opened to prevent the entrance of moisture and dirt.
(c) 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 pipes, they must be replaced with new pipes.
(d) All replacement components and flexible end connections are sealed, and should only be opened immediately prior to making the connection.
(e) Ensure the components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters.
(f) Components must not remain uncapped for longer than fifteen minutes. In the event of delay, the caps must be replaced.
(g) Receiver/driers must never be left uncapped as they contain Silica Gel crystals which will absorb moisture from the atmosphere. A receiver/drier left uncapped must be replaced, and not used.
(h) The compressor shaft must not be rotated until the system is entirely assembled and contains a charge of refrigerant.
(j) A new compressor contains an initial charge of 135 ml (4.6 UK fluid oz) of oil when received, part of which is distributed throughout the system when it has been run. The compressor contains a holding charge of gas when received which should be retained until the hoses are connected.
(k) The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
(l) 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.
(m) Always use two spanners of the correct size, one on each hexagon, when releasing and tightening refrigeration unions.
(n) 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.
(o) All lines must be free of kinks. The efficiency of the system is reduced by a single kink or restriction.
(p) Flexible hoses should not be bent to a radius less than ten times the diameter of the hoses.

Continued

(q) Flexible connections should not be within 50 mm (2 in) of the exhaust manifold.
(r) 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

Routine servicing, apart from visual checks, is not necessary. The visual inspections are as follows:

Condenser

With a hose pipe or air line, clean the face of the condenser to remove flies, leaves, etc. Check the pipe connections for signs of oil leakage.

Compressor

Check hose connections for signs of oil leakage. Check flexible hoses for swelling. Examine the compressor belt for tightness and condition. Checking the compressor oil level and topping-up is only necessary after charging the system or in the event of a malfunction of the system.

Receiver/Drier

Examine the sight glass for bubbles with the system operating. Check connections for leakage.

Evaporator

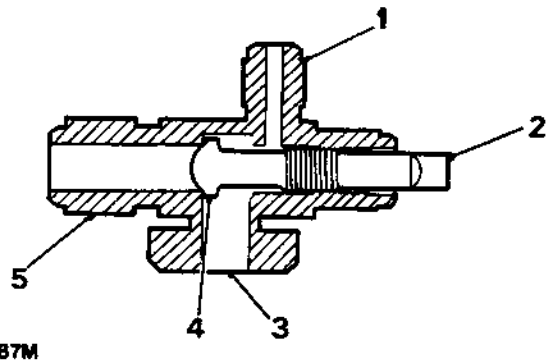
Examine the refrigeration connections at the unit. If the system should develop a fault, or if erratic operation is noticed, refer to the fault diagnosis chart.

SERVICE VALVES

There are two types of service valves in operation: 'Stem' and 'Schrader'.

Stem type

Stem type service valves allow for the isolation of the compressor from other parts of the system. When these valves are used in conjunction with the liquid line quick-disconnect fittings, the three major assemblies of the system can be removed from the vehicle with a minimal loss of refrigerant. In addition, it is possible to remove major assemblies for repair of components which are not part of the refrigeration system, or provide access to parts of the vehicle which are obstructed by the air conditioning system, without fully discharging the system. A thorough understanding of the stem type service valve is necessary before undertaking servicing or repair involving the air conditioning system.

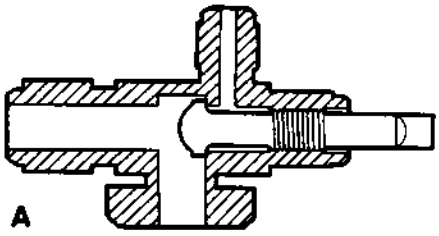


ST1387M

Stem type service valve
1. Service port.
2. Valve stem.
3. Compressor port.
4. Valve seat.
5. Hose connector.

NOTE: A special wrench should be used to adjust the valve to prevent damage to the stem.

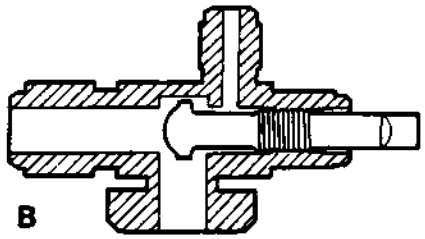
The stem type service valve has three positions, the operation of which is explained as follows.



RR1734M

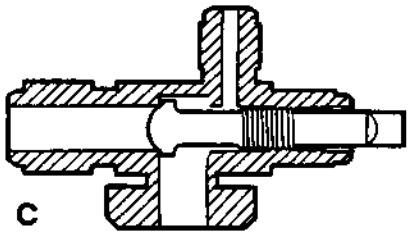
A. ON: FULLY ANTICLOCKWISE — Normal operating position, and the position which is used for connecting and disconnecting the manifold gauge set, is the 'on' position. The stem is turned fully anticlockwise. This seals the service gauge port from receiving any refrigerant flow.

Continued



RR1735M

B. MID (Test) POSITION — After the service gauge manifold has been installed (the valve stem is in the on position), turn the valve stem the required number of turns clockwise. This will put the valve stem seat midway in the service valve and allow full system operation while permitting refrigerant pressure to reach the gauges.



RR1736M

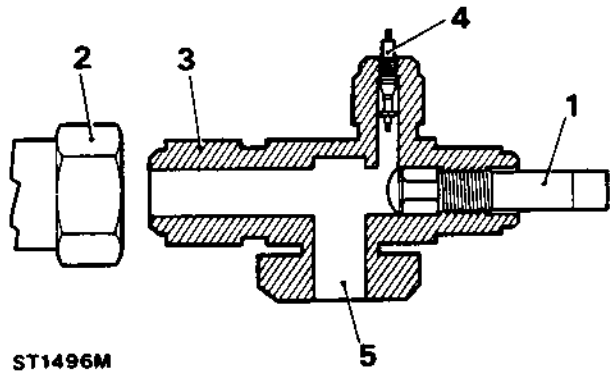
C. OFF: FULLY CLOCKWISE — With the service valve stem turned fully clockwise, the valve will block passage of refrigerant flow through the system. As illustrated, the refrigerant flow to or from the compressor (depending on whether it is high side or low side) is blocked.

WARNING: NEVER operate the air conditioning system with the service valves in the OFF POSITION, it will cause severe damage to the compressor.

Schrader type

These are secured to the head of the compressor, and the suction and discharge flexible end connections are secured to them by unions.
The service valves are identified as suction or low pressure, and discharge or high pressure. Whilst they are identical in operation they are not interchangeable, as the connections are of different sizes.
The valve with the larger connections fits the suction side.
As the name suggests, these valves are for service purposes, providing connections to external pressure/vacuum gauges for test purposes. In combination with charging and testing equipment they are used to charge the system with refrigerant.

Schrader service valve



ST1496M

1. Valve stem.
2. Hose connection.
3. Service valve.
4. Schrader valve core.
5. Compressor port.

NOTE: A special wrench should be used to adjust the valve to prevent damage to the stem.

The Schrader type service valve has two positions, the operation of which is explained as follows.

A. ON: FULLY ANTICLOCKWISE — Normal operating position, and the position which is used for connecting and disconnecting the manifold gauge set, is the 'on' position. The stem is turned fully anticlockwise. This seals the service gauge port from receiving any refrigerant flow.

B. OFF: FULLY CLOCKWISE — With the service valve stem turned fully clockwise, the valve will block passage of refrigerant flow through the system. As illustrated, the refrigerant flow to or from the compressor (depending on whether it is high side or low side) is blocked.

WARNING: NEVER operate the air conditioning system with the service valves in the OFF POSITION, it will cause severe damage to the compressor.

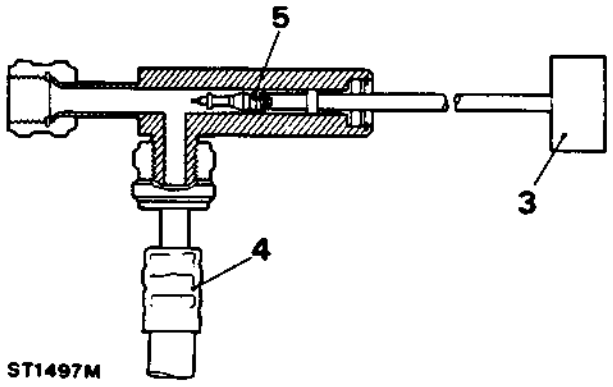
Valve core remover

Where Schrader valve depressors are not fitted to the testing equipment lines, valve core removers can be used.

Valve core removal

The use of valve core removers will facilitate servicing operations and should be used as follows:

1. Close all valves on the charging trolley.
2. Remove the service valve cap and seals from the valve core remover.



3. Withdraw the plunger as far as possible and connect the core remover to the service valve.
4. Connect the hose to the core remover.
5. Depress the plunger until it contacts the valve core. Unscrew the valve until it is free. Withdraw the plunger to its full extent.

Service valve caps must be replaced when service operations are completed. Failure to replace caps could result in refrigerant loss and system failure.

Electrical supply switches and fuses

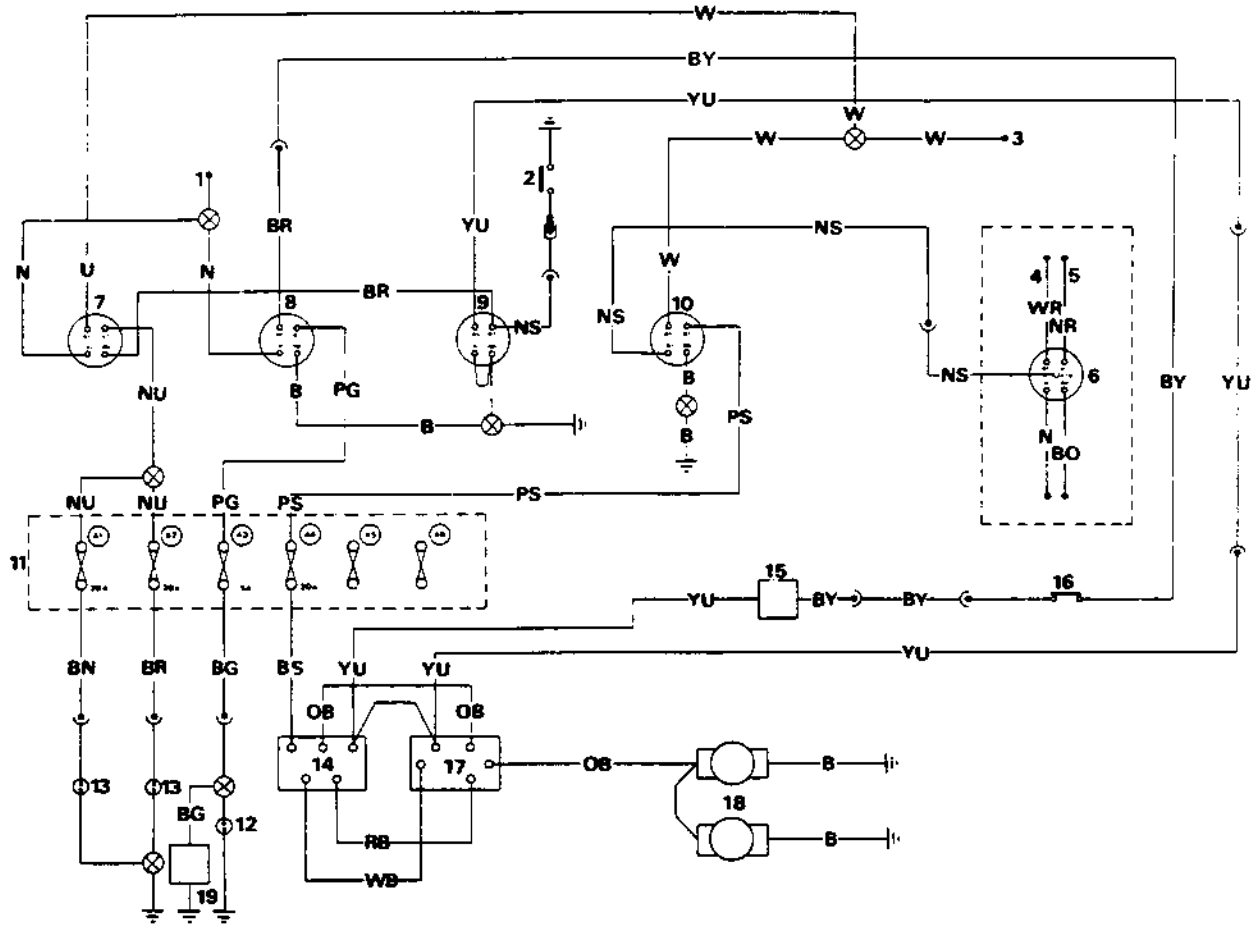
The four main components of the air conditioning system draw current from their own separate relays. The air conditioning system is mastered from the starter relay and is switched 'off' during engine cranking. Each component in turn is energised and controlled by a series of relays and switches of various types as indicated by the circuit diagram.

The relays are mounted on the engine compartment closure panel. Both condenser fans operate together when the air conditioning circuit is switched 'on' or when the ignition is switched 'on' and the coolant temperature is high, on automatic vehicles only.

Electronic Fuel Injection vehicles have a solenoid operated air valve, which is activated when the compressor clutch is energized. This increases engine rev/min when the air conditioning system is operative at idle speed.

The four Autofuse type fuses are located in the fuse box mounted on the lower fascia panel. They are numbered A1 to A4. It is essential that a fuse of the same value is used when fitting a replacement.

Continued

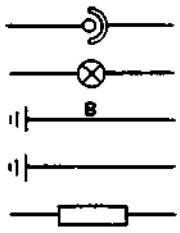


RR613M

KEY TO CIRCUIT DIAGRAM

1. Terminal post.
2. Engine water temperature switch (Automatic only).
3. Ignition feed.
4. Crank feed.
5. Starter solenoid.
6. Starter relay.
7. Fan relay.
8. Compressor clutch relay.
9. Air conditioning controlled fan relay.
10. Air conditioning relay (Ignition controlled).
11. Auxiliary fuse box.
12. Compressor clutch.
13. Fans.
14. Control switch.
15. Thermostat.
16. High pressure switch.
17. Resistor.
18. Blower motors.
19. Solenoid operated air valve.

Circuit symbols



Plug and socket

Clinch connector

Earth connection via cables

Earth connection via bolts

Snap connectors

Cable colour code

B	Black	G	Green	R	Red
U	Blue	O	Orange	W	White
N	Brown	P	Purple	Y	Yellow

The last letter of a colour code denotes the tracer.

Electrical System Fault Diagnosis

FAULT	CAUSE	REMEDY
A. MOTOR INOPERATIVE OR SLOW RUNNING	1 Incorrect voltage. 2 Open or defective fuse or relay. 3 Loose wire connection, including ground. 4 Switch open or defective. 5 Tight, worn, or burnt motor bearings. 6 Open rotor windings. 7 Worn motor brushes. 8 Shaft binding—blade misaligned. 9 Defective resistor board.	1 Check voltage. 2 Check and replace as necessary. 3 Check system wires; tighten all connections. 4 Replace switch. 5 Replace motor. 6 Replace motor. 7 Replace motor. 8 Check alignment. Repair or replace as necessary. 9 Rectify or replace.
B. CLUTCH INOPERATIVE	1 Incorrect voltage. 2 Open or defective fuse or relay. 3 Defective thermostat control or pressure switch. 4 Shorted or open field coil. 5 Bearing seized (clutch will not disengage). 6 Refrigeration circuit problem causing heavy load and excessive drive torque.	1 Check voltage. 2 Check and replace as necessary. 3 Replace thermostat or pressure switch. 4 Replace coil. 5 Replace bearing. 6 Check and rectify.
C. CLUTCH NOISY	1 Incorrect alignment. 2 Loose belt. 3 Compressor not mounted securely. 4 Bearing in clutch-pulley assembly not pressed in properly. 5 Low voltage to clutch. 6 Clutch will not spin freely. 7 Oil on clutch face. 8 Slipping clutch. 9 Overloaded or locked compressor. 10 Icing.	1 Check alignment; repair as necessary. 2 Adjust to proper tension. 3 Repair as necessary. 4 Remove clutch and replace bearing. 5 Check connections and voltage. 6 Refer to B5 above. 7 Check compressor seals for leaks. 8 Refer to C5 above. 9 Repair or replace compressor. 10 Check for suction line frosting. Replace expansion valve if necessary. Replace receiver/drier if necessary.
D. CONDENSER AND/OR EVAPORATOR VIBRATION	1 Motor and/or blades improperly mounted. 2 Blade corrosion or foreign matter build-up. 3 Excessive wear of motor bearings.	1 Check mountings, adjust as necessary. 2 Clean blades with solvent or other non-inflammable cleaner. 3 Replace motor.

Refrigeration System Fault Diagnosis

For any refrigeration system to function properly all components must be in good working order. The unit cooling cycle and the relationship between air discharge temperature and ambient temperature and the pressures at the compressor can help to determine proper operation of the system.
The length of any cooling cycle is determined by such factors as ambient temperature and humidity, thermostat setting, compressor speed and air leakage into the cooled area, etc. With these factors constant, any sudden increase in the length of the cooling cycle would be indicative of abnormal operation of the air conditioner.
The low and high side pressures at the compressor will vary with changing ambient temperature, humidity, cab temperature and altitude.

The following conditions should be checked after operating the system for several minutes:

1. All high side lines and components should be warm to the touch.
2. All low side lines should be cool to the touch.
3. Inlet and outlet temperatures at the receiver/drier should be at the same temperature (warm). Any very noticeable temperature difference indicates a blocked receiver/drier.
4. Heavy frost on the inlet to the expansion valve may indicate a defective valve or moisture in the system.
5. With ambient humidity between 30% and 60%, compressor pressures and evaporator air discharge temperature should fall within the general limits given in the table below.

Type of Weather	Evaporator Air Temp °F (°C)	Low Side Pressure lb/in² (kg/cm²)	High Side Pressure lb/in² (kg/cm²)
Cool Day 70–80°F (21–27°C)	35–45°F (1.7–7.2°C)	15–20 (1.1–1.4)	160–200 (11.2–14)
Warm Day 80–90°F (27–32°C)	40–50°F (4.4–10°C)	20–25 (1.4–1.8)	190–240 (13.4–16.9)
Hot Day Over 90°F (Over 32°C)	45–60°F (7.2–15.6°C)	25–30 (1.8–2.1)	220–270 (15.5–19)

NOTE:
1. Low and high side pressures are guides not specific limits.
2. Evap. air temperatures will be lower on dry days, higher on humid days.

FAULT	CAUSE	REMEDY
A. HIGH HEAD PRESSURE	1 Overcharge of refrigerant.	1 Purge with bleed hose until bubbles start to appear in sight glass; then, add sufficient refrigerant gas to clear sight glass.
	2 Air in system.	2 Slowly blow charge to atmosphere. Install new drier; evacuate and charge system.
	3 Condenser air passage clogged with dirt or other foreign matter.	3 Clean condenser of debris.
	4 Condenser fan motor defective.	4 Replace motor.
B. LOW HEAD PRESSURE	1 Undercharge of refrigerant; evident by bubbles in sight glass while system is operating.	1 Evacuate and recharge the system. Check for leakage.
	2 Split compressor gasket or leaking valves.	2 Replace gasket and/or reed valve; Install new drier, evacuate and charge the system.
	3 Defective compressor.	3 Repair or replace compressor.
C. HIGH SUCTION PRESSURE	1 Slack compressor belt.	1 Adjust belt tension.
	2 Refrigerant flooding through evaporator into suction line; evident by ice on suction line and suction service valve.	2 Check thermobulb. Bulb should be securely clamped to clean horizontal section of copper suction pipe.
	3 Expansion valve stuck open.	3 Replace expansion valve.
	4 Compressor suction valve strainer restricted.	4 Remove and clean or replace strainer.
	5 Leaking compressor valves, valve gaskets and/or service valves.	5 Replace valves and/or gaskets. Install new drier, evacuate and charge the system.
	6 Receiver/drier stopped; evident by temperature difference between input and output lines.	6 Install new drier, evacuate and charge the system.
D. LOW SUCTION	1 Expansion valve thermobulb not operating.	1 Warm thermobulb with hand. Suction should rise rapidly to 20 lb. or more. If not, replace expansion valve.
	2 Expansion valve sticking closed.	2 Check inlet side screen. Clean if clogged. Refer to C-2 and C-3.
	3 Moisture freezing in expansion valve orifice. Valve outlet tube will frost while inlet hose tube will have little or no frost. System operates periodically.	3 Install new drier, evacuate and charge the system.
	4 Dust, paper scraps, or other debris restricting evaporator blower grille.	4 Clean grilles as required.
	5 Defective evaporator blower motor, wiring, or blower switch.	5 Refer to Fault Diagnosis Chart for Electrical System.
E. NOISY EXPANSION VALVE (steady hissing)	1 Low refrigerant charge; evident by bubbles in sight glass.	1 Leak test. Repair or replace components as required.
F. INSUFFICIENT COOLING	1 Expansion valve not operating properly.	1 Refer to C-2, C-3, D-1 and E.
	2 Low refrigerant charge—evident by bubbles in sight glass.	2 Refer to B-1 and E.
	3 Compressor not pumping.	3 Refer to B-2 and B-3.
G. COMPRESSOR BELT SLIPPING	1 Belt tension.	1 Adjust belt tension.
	2 Excessive head pressure.	2 Refer to A-1 through A-4 and C-6.
	3 Incorrect alignment of pulleys or worn belt not riding properly.	3 Repair as needed.
	4 Nicked or broken pulley.	4 Replace as needed.
	5 Seized compressor.	5 Replace compressor.
H. ENGINE NOISE AND/OR VIBRATION	1 Loose or missing mounting bolts.	1 Repair as necessary.
	2 Broken mounting bracket.	2 Replace bracket.
	3 Loose flywheel or clutch retaining bolt.	3 Repair as necessary.
	4 Rough idler pulley bearing.	4 Replace bearing.
	5 Bent, loose, or improperly mounted engine drive pulley.	5 Repair as necessary.
	6 Defective compressor bearing.	6 Replace bearing.
	7 Insecure mountings of accessories: generator, power steering, air filter, etc.	7 Repair as necessary.
	8 Excessive head pressure.	8 Refer to A-1, A-2, A-3, A-4 and C-6.
	9 Incorrect compressor oil level.	9 Refer to compressor Oil Level Check.

CHARGING AND TESTING EQUIPMENT

This is standard equipment for the servicing of automotive air conditioning systems, and is used for all testing, trouble shooting, evacuating and charging operations.
Various designs of charging and testing equipment are available depending upon the manufacturer chosen by the user. As slight variations do occur it is recommended that the operator adheres to the appropriate manufacturers' instructions for the equipment in use.

WARNING: The air conditioning system is charged with a high pressure, potentially toxic refrigerant. Repairs or servicing MUST only be carried out by an operator familiar with both the vehicle system and the charging and testing equipment.
All operations must be carried out in a well-ventilated area away from open flame and heat sources.
Always wear safety goggles when opening refrigerant connections.

Connecting

1. Check that both service valves are fully open (turned anti-clockwise).
2. Wearing safety goggles remove the caps from the gauge connections on the service ports.
3. Coat the threads and flares with compressor oil.
4. Connect the charging and testing equipment referring to the equipment manufacturer's instructions.

Removing

5. If the engine has been operated it must be stopped prior to disconnecting the equipment.
6. Close both the service ports by turning fully anti-clockwise.
7. Disconnect the charging lines from the service ports.
8. Refit the blanking caps to the compressor valve stems and service ports, and to the charging lines.

AIR CONDITIONING SYSTEM

Depressurise

NOTE: The air conditioning refrigeration system contains 'Refrigerant 12' under pressure, and before any component is disconnected or removed, the system must be discharged of all pressure.
Refrigerant 12 evaporates so rapidly at normal atmospheric pressures and temperatures that it tends to freeze anything it contacts. Extreme care must be taken to prevent any liquid refrigerant from contacting the skin and especially the eyes. Should any liquid refrigerant get into the eyes, use a few drops of sterile mineral oil to wash them out and then wash the eyes with a weak solution of boric acid. Seek medical attention immediately even though the initial irritation has ceased after first-aid treatment. Always wear safety goggles when opening refrigerant connections.

WARNING: Open connections slowly, keeping the hands and face well clear, so that no injury occurs if there is liquid in the line. If presssure is noticed allow it to bleed off slowly.

Depressurising

1. Connect the equipment according to the manufacturer's instructions.
2. Run the blue, low pressure hose to an open-topped container of approximately one litre capacity. Attach the hose to the container so that it will not blow out of the container. The purpose of the container is to collect any oil carried by the refrigerant.
3. When depressurising adjust the refrigerant flow to ensure that oil is not blown out of the container.
4. Measure the amount of oil discharged from the system. Add an equal amount of new oil to the system during the charging operation. Discard the old oil.

NOTE: If it is necessary to disconnect the compressor hoses, the compressor should be sealed by fully closing the relevant service valve (turn fully clockwise). It is essential to ensure that both service valves are open before operating the compressor. Similarly any other component of the refrigeration system should be capped immediately when disconnected.

Evacuate

Whenever the system has been opened to the atmosphere it is necessary that the system be evacuated to remove all air and moisture. It is also an essential preliminary operation to charging the system with Refrigerant 12. The evacuate operation also provides a check for leaks due to faulty connections.

Evacuating

1. Depressurise the system as previously described, and connect the charging and testing equipment referring to the manufacturer's instructions.
2. Slowly open the vacuum control valve. If the vacuum is applied to the system too quickly, the residual oil may be drawn out.
3. In evacuating the system it is necessary to lower the pressure so that the boiling point of water in the system is lower than the surrounding air temperature. At an ambient temperature of 23.8°C (75°F), it is necessary to lower the system pressure to 29.5 in Hg vacuum to bring the boiling point of water to 22°C (72°F). Atmospheric pressure (and vacuum gauge readings) decrease as altitude increases by approximately 25 mm (1 in) Hg per 300 m (100 ft). The following chart provides a guide to the various gauge readings at differing altitudes, for the same 10 mm (0.4 in) Hg absolute pressure.

Altitude, ft	Vacuum Reading in Hg
0	29.5
1,000	28.5
2,000	27.4
3,000	26.4
4,000	25.4
5,000	24.5
6,000	23.5
7,000	22.6
8,000	21.8
9,000	20.9
10,000	20.1

4. The low side gauge should indicate a vacuum of 660 mm (26 in) Hg within five minutes.
5. If 660 mm (26 in) Hg of vacuum is not achieved within five minutes, it signifies either the system has a leak or the vacuum pump is defective. Initially check the vacuum pump, if the pump proves to be functioning properly then investigate for a leak in the air conditioning system.
6. Stop the vacuum pump and allow the vacuum to hold for fifteen minutes, then check that there is no pressure rise (a loss of vacuum) evident on the compound gauge. Any pressure rise denotes a leak which must be rectified before proceeding further. Refer to the heading titled 'Leak Detection' later in this section.
   With the system satisfactorily evacuated, the system is ready for charging with refrigerant.

Sweep

NOTE: This operation is in addition to evacuating, and is to remove moisture from systems that have been open to atmosphere for a long period, or that are known to contain excessive moisture.

Sweeping

1. Fit a new liquid receiver drier, as detailed under the heading 'Receiver Drier'.
2. Connect the charging and testing equipment and follow the equipment manufacturer's instructions for sweeping.
3. Maintain the vacuum for twenty minutes. The air conditioning system is now ready for charging with refrigerant.

Charge

CAUTION: Do not charge liquid refrigerant into the compressor. Liquid cannot be compressed; and if liquid refrigerant enters the compressor inlet valve, severe damage is possible; in addition, the oil charge may be absorbed into the refrigerant, causing damage when the compressor is operated.

Charging

1. Ensure that the air conditioning system is evacuated as previously described.
2. Follow the equipment manufacturer's instructions for charging the system with refrigerant.
3. Ensure that the full charge of refrigerant (RHD 1.25 kg (44 oz), LHD 1.08 kg (38 oz) is drawn into the system.
4. After completing the procedure check the air conditioning system is operating satisfactorily by carrying out a pressure test, as described later in the Section.

CAUTION: Do not overcharge the air conditioning system as this will cause excessive head pressure.

Leak test

The following instructions refer to an electronic type refrigerant leak detector which is the safest, most sensitive and widely used.

1. Place the vehicle in a well ventilated area but free from draughts, as leakage from the system could be dissipated without detection.
2. Follow the instructions issued by the manufacturer of the particular leak detector being used. Certain detectors have visual and audible indicators.
3. Commence searching for leaks by passing the detector probe around all joints and components, particularly on the underside, as the refrigerant gas is heavier than air.
4. Insert the probe into an air outlet of the evaporator. 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.
5. Insert the probe between the magnetic clutch and compressor to check the shaft seal for leaks.
6. Check all service valve connections, valve plate, head and base plate joints and back seal plate.
7. Check the condenser for leaks at the pipe connections.
8. If any leaks are found, the system must be depressurised before attempting rectification. If repairs by brazing are necessary, the component must be removed from the vehicle and all traces of refrigerant expelled before heat is applied.
9. After repairs check the system for leaks and evacuate prior to charging.

Continued

Pressure test

1. Fit the charging and test equipment as previously described.
2. Start the engine.
3. Run the engine at 1,000 to 1,200 rev/min with the heat control set to cold (blue) zone, air distribution to the central position, recirculation control to recirculation and the air conditioning control 'ON' with fan speed to maximum.
4. Note the ambient air temperature control in the immediate test area in front of the vehicle, and check the high pressure gauge readings—discharge side —against table 1.

Table 1

Ambient Temperature		Compound Gauge Readings		High Pressure Gauge Readings	
°C	°F	kgf/cm²	lbf/in²	kgf/cm²	lbf/in²
16	60	1.05-1.4	15-20	7.0-10.2	100-150
26.7	80	1.4-1.75	20-25	9.8-13.3	140-190
38	100	1.75-2.1	25-30	11.6-15.8	180-225
43.5	110	2.1-2.45	30-35	15.1-17.5	215-250

The pressure gauge readings will vary within the range quoted with the rate of flow of air over the condenser, the higher readings resulting from a low air flow. It is recommended that a fan is used for additional air flow over the condenser if the system is to be operated for a long time. Always use a fan if temperatures are over 26.7°C (80°F) so that a consistent analysis can be made of readings.

5. If the pressure readings are outside the limits quoted, refer to the fault diagnosis chart at the beginning of this section.
6. Stop the engine.
7. Close both service ports (turn fully anti-clockwise) and close all valves on the charging and test equipment. Disconnect the charging lines from the compressor. Refit the blanking caps to the compressor valve stems, port connections and charging lines.
8. Close the bonnet.

System test

1. Place the vehicle in a ventilated, shaded area free from excessive draught, with the doors and windows open.
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.
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.
4. Check that the evaporator condensate drains are open and clear.
5. Check the tension of the compressor driving belt, and adjust if necessary.
6. Inspect all connections for the presence of refrigerant oil. If oil is evident, check for leaks, and rectify as necessary.

NOTE: The compressor oil is soluble in Refrigerant 12 and is deposited when the refrigerant evaporates from a leak.

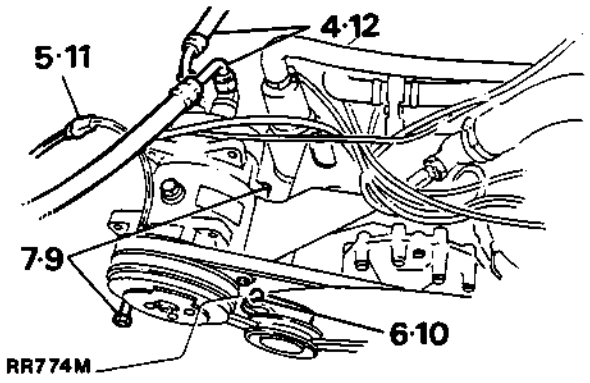
7. Start the engine.
8. Set the temperature control switch to maximum cooling and switch the air conditioner blower control on and off several times, checking that the magnetic clutch on the compressor engages and releases each time.
9. With the temperature control at maximum cooling and the blower control at high speed, warm up the engine and fast idle at 1,000 rev/min. Check the sight glass for bubbles or foam. The sight glass should be generally clear after five minutes running, occasional bubbles being acceptable. Continuous bubbles may appear in a serviceable system on a cool day, or if there is insufficient air flow over the condenser at a high ambient temperature.
10. Repeat at 1,800 rev/min.
11. Gradually increase the engine speed to the high range, and check the sight glass at intervals.
12. Check for frosting on the service valves and evaporator fins.
13. Check the high pressure pipes and connections by hand for varying temperature. Low temperature indicates a restriction or blockage at that point.
14. Switch off the air conditioning blower and stop the engine.
15. If the air conditioning equipment is still not satisfactory, proceed with the pressure test as previously described in this section.

COMPRESSOR

Remove and refit

Removing

1. Place the vehicle in a ventilated area away from open flames and heat sources.
2. Stop the engine and secure the bonnet in an open position.
3. Depressurise the air conditioning system.
4. Using goggles to protect the eyes, and wearing gloves, disconnect the suction and discharge unions from the back of the compressor. Cap the flexible end connections and service valves immediately.
5. Disconnect the lead to the compressor magnetic clutch at the connector.
6. Slacken the jockey pulley securing bolt and release the driving belt.
7. Remove the two compressor mounting bolts and lift compressor clear.



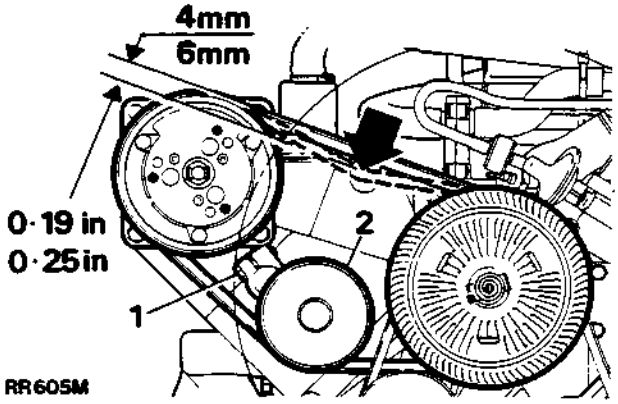
Refitting

8. If a new compressor is being fitted, drain the oil from the new compressor. Drain and measure the oil from the old compressor. Measure new oil equal to the amount drained from the old compressor. Add 30 ml (1 UK fluid oz) of new oil to this amount and refill the new compressor.
9. Locate the compressor in position, fit and tighten the mounting bolts.
10. Fit the compressor driving belt and adjust as described under 'Compressor drive belt—adjust'.
11. Connect the lead to the compressor magnetic clutch at the connector.
12. Refit the suction and discharge flexible end connectors to the service valves, lubricating the flares and threads of the unions with compressor oil.
13. Evacuate the air conditioning system, maintaining the vacuum for ten minutes.
14. Charge the air conditioning system.

COMPRESSOR DRIVE BELT

Adjust

1. Slacken the jockey wheel securing bolt.
2. Adjust the position of the jockey wheel until the



correct tension is obtained. The belt must be tight with 4 to 6 mm (0.19 to 0.25 in) total deflection when checked by hand midway between the pulleys on the longest run.

3. Tighten the securing bolt and recheck the tension.

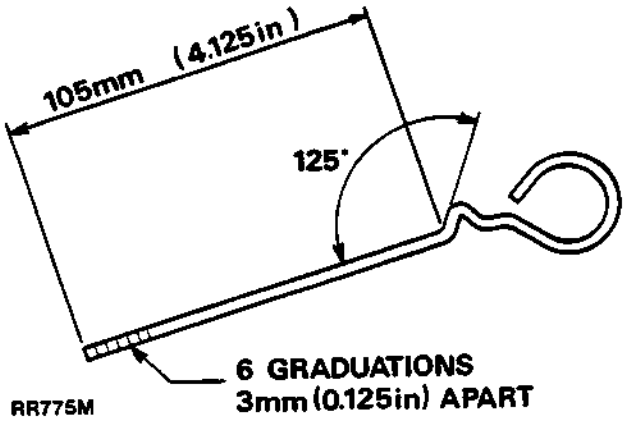
COMPRESSOR OIL LEVEL

Check

NOTE: The compressor oil level should be checked whenever any components, including the compressor are removed and refitted, or when a pipe or hose has been removed and reconnected or, if a refrigerant leak is suspected. All compressors are factory charged with 135 ± 15 ml (4.6 ± 0.5 UK fl oz) of oil. When the air conditioning equipment is operated some of the oil circulates throughout the system with the refrigerant, the amount varying with engine speed. When the system is switched off the oil remains in the pipe lines and components, so the level of oil in the compressor is reduced, by approximately 30 ml (1 UK fl oz). The compressor oil level must finally be checked after the system has been fully charged with refrigerant and operated to obtain a refrigerated temperature of the car interior. This ensures the correct oil balance throughout the system.

Continued

The compressor is not fitted with an oil level dipstick, and a suitable dipstick must be made locally from 3 mm (0.125 in) diameter soft wire in accordance with the accompanying illustration. After shaping, mark the end of the dipstick with six graduations 3 mm (0.125 in) apart.

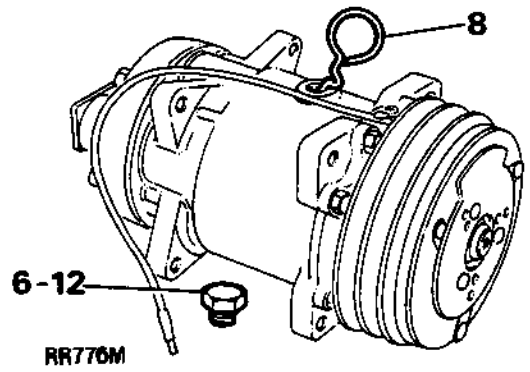


Procedure

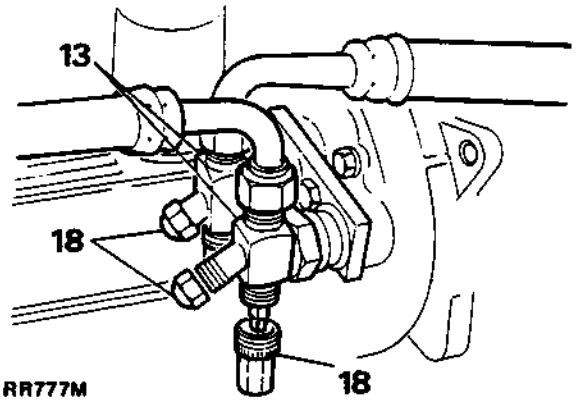
1. Open the bonnet.
2. Fit the charging and testing equipment.
3. Start the engine and turn the temperature control to maximum cooling position, and the air flow control to HIGH speed. Operate the system for five minutes at 1,200–1,500 rev/min.

NOTE: It is important to open the valve slowly during the following item to avoid a sudden pressure reduction in the compressor crankcase that could cause a large amount of oil to leave the compressor.

4. Reduce the engine speed to idling, and SLOWLY open the suction side valve on the test equipment until the compound gauge reads 0 or a little below.
5. Stop the engine at this point and quickly open the suction valve and discharge valve.
6. Loosen the oil filler plug and unscrew it slowly by five turns to bleed off crankcase pressure.



7. Remove the oil filler plug. Looking through the oil filler orifice, centralise the internal components by slowly turning the compressor clutch plate. This will enable the dipstick to be inserted to its full depth.
8. Wipe the dipstick and insert to its stop position, ensuring the angle of the dipstick is flush with the surface of the filler orifice.
9. Withdraw the dipstick and count the number of graduations to determine the depth of oil.
10. The acceptable level is two to four graduations, if required add or remove oil until the mid-range figure is obtained. Use only the correct compression oil. See Recommended Lubricants, Section O9.
11. Lubricate a new 'O' ring with compressor oil, fit it over the threads of the level plug without twisting, and install the level plug loosely.
12. Evacuate the air from the compressor using the vacuum pump on the charging and testing equipment, following the equipment manufacturer's instructions. Tighten the filler plug to the correct torque, see Section 06.
13. Close fully the suction and discharge valves.



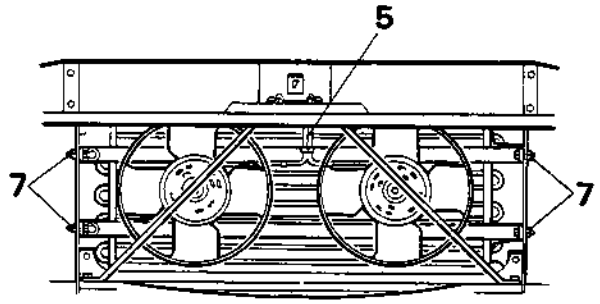
14. Start and run the engine at 1,200 rev/min and check for leak at the compressor level plug. Do not overtighten to correct a leak. In the event of a leak isolate the compressor as previously described in items 4 to 6, and check the 'O' ring seats for dirt, etc.
15. Stop the engine.
16. Close all valves on the charging and testing equipment.
17. Disconnect the charging lines from the compressor.
18. Refit the blanking caps to the compressor valve stems and gauge connections, and to the charging lines.
19. Close the bonnet.

CONDENSER

Remove and refit

Removing

1. Open the bonnet and disconnect the battery.
2. Depressurise the air conditioning system.
3. Remove six screws and withdraw the front grille panel.
4. Remove the radiator.
5. Disconnect the two fan motor wiring connections.



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CAUTION: Before carrying out instruction 6 protect the eyes with safety goggles and wear protective gloves.

6. Using two spanners on each union, carefully disconnect the pipes at the condenser end. Fit blanks to the exposed ends of the pipes.
7. Remove four bolts securing the condenser and remove condenser complete with fan motor assemblies.

Refitting

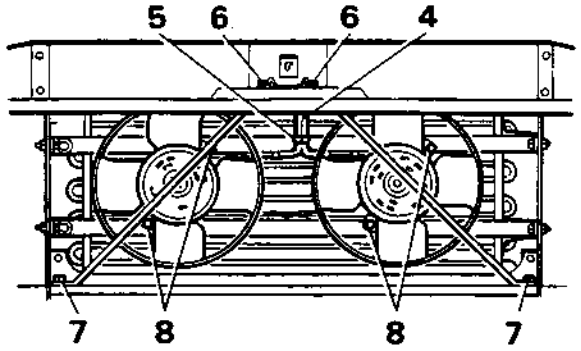
8. Reverse instructions 3 to 7 above.
9. Add 30 ml (1 UK fl oz) of the correct oil to the compressor to compensate for oil loss if a new condenser is to be fitted.
10. Evacuate the air conditioning system.
11. Charge the system.
12. Carry out a leak test on the disturbed joints.
13. Check the air conditioning operation by carrying out a System Test.

CONDENSER FANS AND MOTORS

Remove and refit

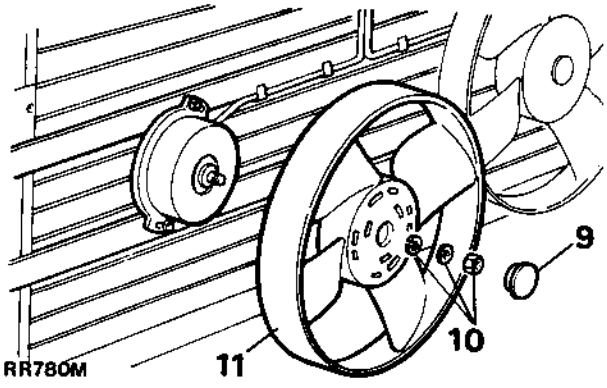
Removing

1. Open the bonnet and disconnect the battery.
2. Remove the six screws and withdraw the grille panel.
3. **(Automatic vehicles only)** remove the transmission oil cooler by disconnecting the wiring, detaching the two oil pipes and two mounting bolts each side.
4. Disconnect the two fan motor wiring connectors.
5. Release the wiring securing clips.



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6. Slacken the two upper bolts securing the left- and right-hand bonnet striker support stays.
7. Remove the lower bolts securing the lower ends of the stays and pivot both stays forward.
8. Remove the two nuts and washers securing each motor and withdraw the fan motor assemblies from the vehicle.
9. Remove the blanking caps from the fan centres.



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10. Remove the securing nut and washers.
11. Withdraw the fan blades from the motor spindle.

Refitting

12. Reverse 1–11 above, ensuring that the wire is correctly clipped and no fouling of the fan blades occurs.
13. Automatic only: check transmission fluid level.

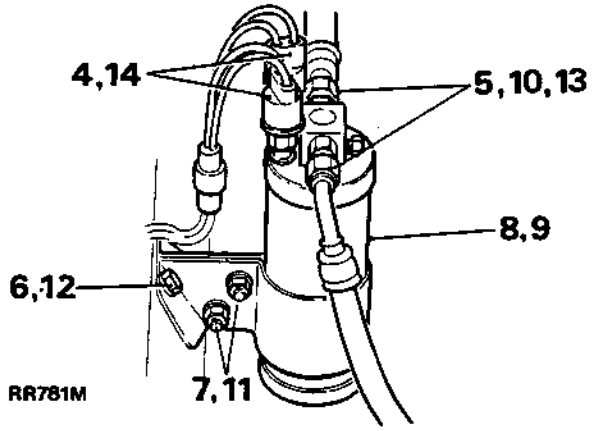
RECEIVER DRIER

Remove and refit

CAUTION: Immediate blanking of the receiver drier is important. Exposed life of the unit is only 15 minutes.

Removing

1. Connect the gauge set.
2. Discharge the complete system.
3. Protect the eyes with safety goggles and wear gloves during operations 4 and 5.
4. Disconnect the electrical leads at the snap connectors and carefully unscrew the pressure switches from the receiver drier. Blank the exposed connections immediately.



5. Carefully disconnect the two hose connections. Use a second spanner to support the hose adaptor. Blank the exposed connections immediately.
6. Remove one bolt, nut and washers securing the mounting bracket to the wing valance.
7. Remove the clamp bolts, washers and nuts.
8. Withdraw the receiver drier from the mounting bracket.

Refitting

9. Insert the receiver drier into the mounting bracket with the inlet and outlet connections correct to the refrigerant circuit as shown.
10. Connect the two hose connections finger tight. Use refrigerant compressor oil on all mating surfaces to assist leakage prevention.
11. Fit the clamp bolts, washers and nuts.
12. Secure the mounting bracket to the wing valance.
13. Tighten the two hose connections to the correct torque. Use a second spanner to support the hose adaptor.
14. Carefully refit the pressure switches to the receiver drier. Use refrigerant compressor oil on all mating surfaces to assist leakage prevention and tighten the switches to the correct torque. Reconnect the electrical leads.
15. To compensate for oil loss, add 15 ml (½ UK fl oz) of the correct oil to the compressor.
16. Evacuate the complete system.
17. Charge the complete system.
18. Perform a leak test on any disturbed joints.
19. Carry out a functional check.
20. Disconnect the gauge set.

DASHBOARD UNIT—ARA

EVAPORATOR

Remove and refit

Expansion valve
Remove and refit 1 to 22 and 34 to 56

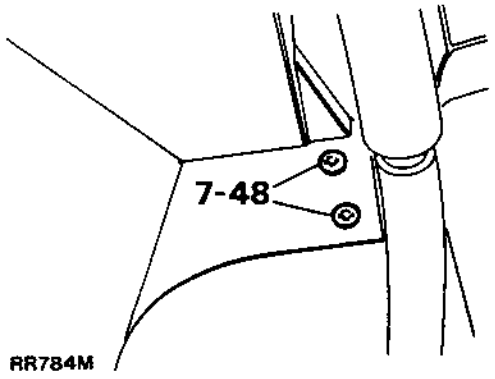
Hose—compressor to evaporator
Remove and refit 1 to 5 and 50 to 56

Hose—receiver drier to evaporator
Remove and refit 1 to 5 and 50 to 56

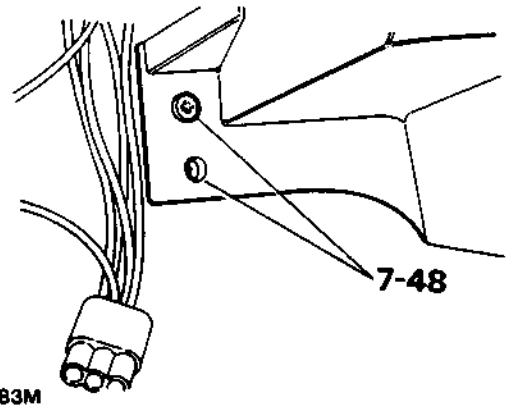
Blower assembly
Remove and refit 1 to 24 and 32 to 56

Removing

1. Open the bonnet and connect the gauge set.
2. Depressurise the system.
3. Isolate the battery.
4. Protect the eyes with safety goggles and wear gloves during instruction 5.
5. Disconnect the evaporator hoses from the compressor and the receiver drier. Use a second spanner to support the hose adaptors and blank all the exposed connections immediately.
6. Disconnect the dash unit electrical harness at the underbonnet relays and release the cable from the clips.
7. Working inside the vehicle, withdraw the lower fascia panel and remove the screws securing the lower edge of the centre console.

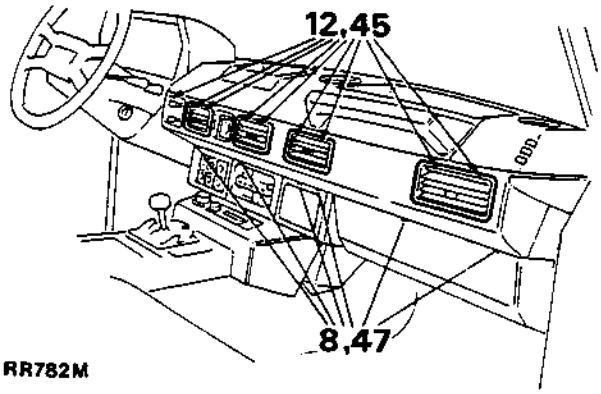


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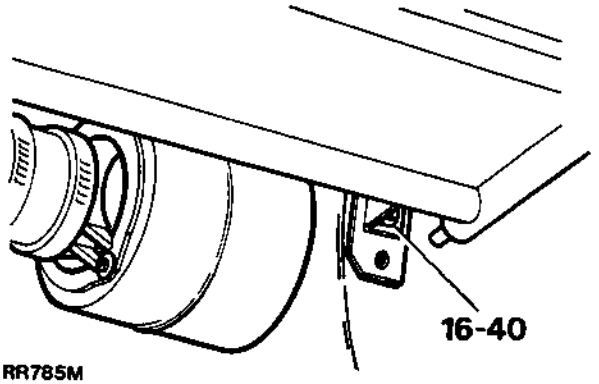
RR783M

8. Remove the six screws securing the lower edge of the louvre panel to the console and evaporator case.



RR782M

9. Remove the heater control panel and knobs from the centre console.
10. Remove the centre console.
11. Carefully prise out the four air vents.
12. Remove the screws securing the evaporator plenum and louvre panel to the dash top panel.
13. Withdraw the thermostat sensor from the evaporator.
14. Withdraw the louvre panel clear of the dash.
15. Depress the left end of the plenum and remove the air hoses from the upper panel.



RR785M

Continued

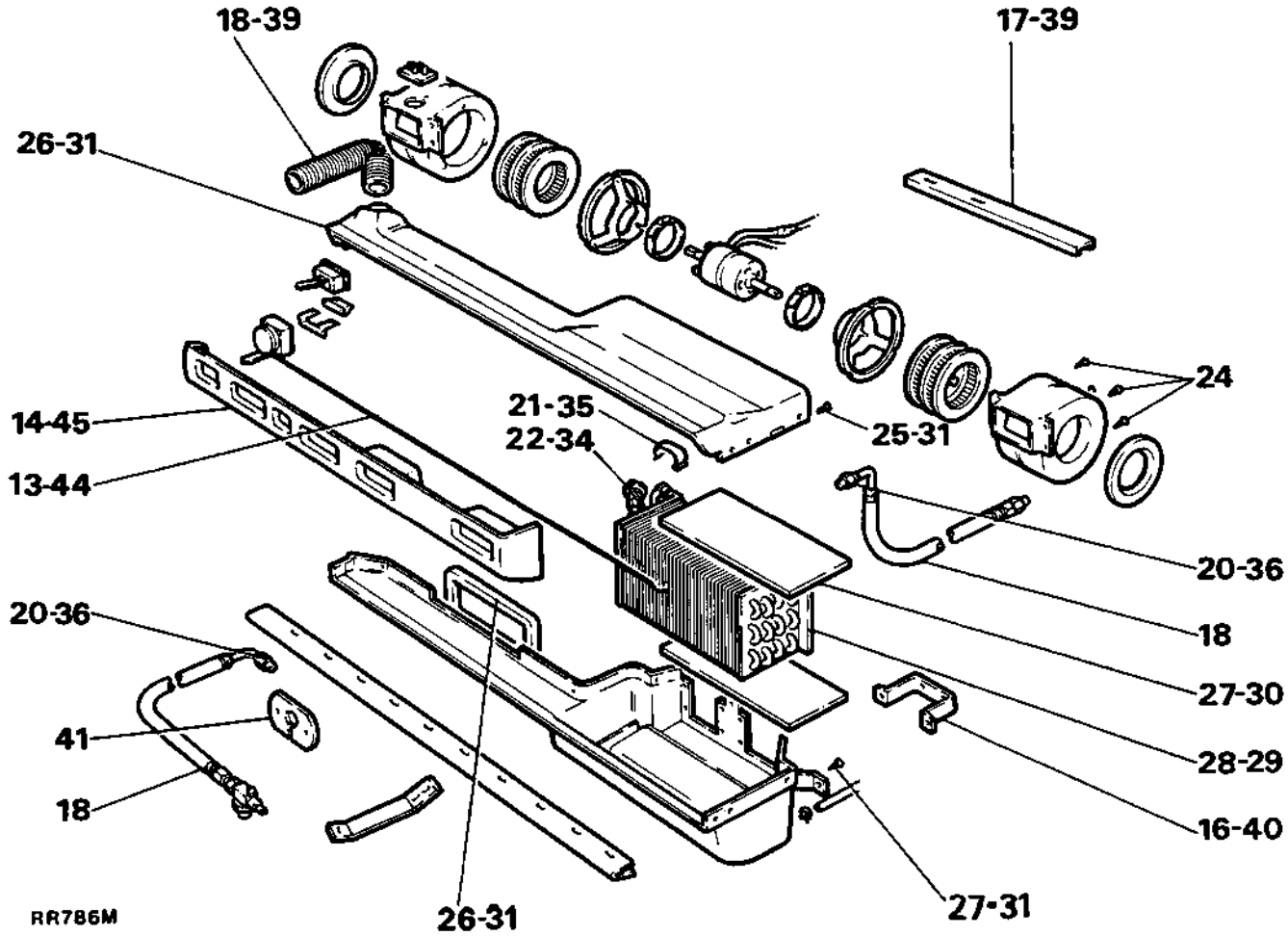
16 Remove the screws securing the lower right evaporator bracket.
17 Support the evaporator case and remove the two nuts securing the case and reinforcing strip to the upper mounting bracket.
18. Carefully withdraw the refrigerant hoses, electrical harness and evaporator condensate tubes through the bulkhead and remove the rear left-hand air hose from the plenum. Remove the evaporator and plenum assembly from the vehicle.

Dismantling

19. Remove the insulation from the evaporator and expansion valve hose connections.
20. Disconnect the hoses from the expansion valve and evaporator. Use a second spanner to support the hose adaptors and blank all the exposed connections immediately.
21. Unclip the sensor coil from the evaporator outlet pipe.
22. Carefully unscrew the expansion valve from the evaporator. Blank the exposed connections immediately.
23. Unplug the electrical harness at the connector on the left-hand blower casing.
24. Remove the eight securing screws and detach the blower units from the evaporator case.
25. Remove the screws securing the upper evaporator/plenum casing to the evaporator and lower casing.
26. Remove the heater seal and lift off the upper casing.
27. Remove the insulation pad and the two screws securing the evaporator to the lower casing.
28. Withdraw the evaporator from the casing.

Assembling

29. Secure the evaporator to the lower casing.
30. Fit the insulation pad and run the electrical leads under the evaporator outlet pipe.
31. Secure the casings together with the screws and refit the heater seal.
32. Refit and secure the blower units to the evaporator casing.
33. Connect the electrical lead to the connector on the left-hand blower casing.
34. Assemble the expansion valve to the evaporator with the inlet facing downwards. Use refrigerant compressor oil on all mating surfaces to assist leakage prevention. Tighten the connection to the correct torque.



35. Clip the sensor coil to the evaporator outlet pipe.
36. Connect the hoses to the evaporator and expansion valve. Use new 'O' rings and refrigerant compressor oil on all mating surfaces to assist leakage prevention. Tighten the connections to the correct torque.
37. Wrap all exposed metal at the hose connections with 'prestite' tape.

Refitting

38. Place the evaporator assembly on the floor of the vehicle and route the electrical harness and the refrigerant hoses through the bulkhead.
39. Lift the unit into the mounting position and connect the rear left-hand air hose. Fit the reinforcement strip and secure the casing to the upper bracket with two nuts.
40. Secure the lower right mounting bracket to the vehicle.
41. Feed the hoses, electrical harness and evaporator condensate tubes through the bulkhead. Ensure that the apertures and grommets are adequately sealed against ingress of dust and moisture.
42. Depress the left end of the plenum and connect the two upper air hoses.
43. Position the left-hand of the plenum so that the opening is centered over the fresh air outlet of the heater.
44. Carefully push the thermostat pipe into the evaporator fins.
45. Refit the louvre panel and secure the plenum casing and grille panel to the dash top panel with screws.
46. Refit the centre console.
47. Refit the six screws securing the louvre panel to the centre console and evaporator case.
48. Secure the lower edge of the console and refit the lower fascia panel.
49. Working under the bonnet, connect the dash harness to the two relays.
50. Connect the two refrigerant hoses to the compressor and receiver drier. Use refrigerant compressor oil on all mating surfaces to assist leakage prevention. Tighten the connections to the correct torque.
51. To compensate for oil loss, add 45 ml (1.5 UK fl oz) of the correct oil to the compressor.
52. Evacuate the system.
53. Charge the complete system.
54. Perform a leak test on any accessible disturbed joints.
55. Perform a functional check.
56. Disconnect the gauge set.

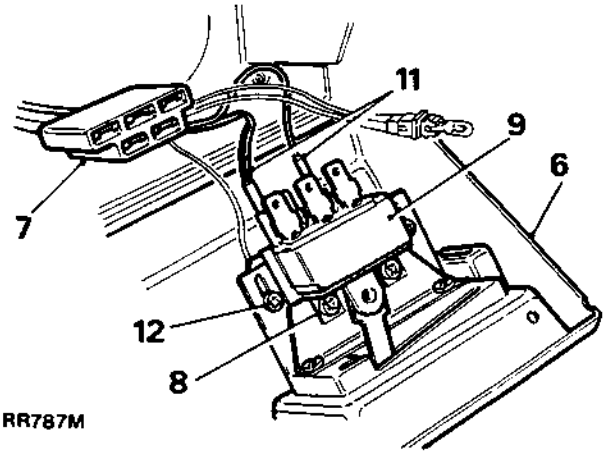
CONTROL PANEL

Thermostat
Remove and refit—1 to 6 and 10 to 14

Fan control switch
Remove and refit—1 to 9 and 14

Removing

1. Disconnect the battery.
2. Pull the finger tip control knobs off the control levers.
3. Carefully prise the four air vents out of the louvre panel.
4. Remove the nine screws securing the louvre panel to the upper panel.
5. Remove the six screws securing the louvre panel to the lower panel.
6. Withdraw the panel only as far as the electrical leads will permit.



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7. Disconnect the multi-plug from the rear of the fan control switch.
8. Remove the two securing screws.
9. Withdraw the fan control switch.
10. Withdraw the thermostat sensor from the fins of the evaporator.
11. Disconnect the electrical leads from the rear of the thermostat.
12. Remove the two securing screws.
13. Withdraw the thermostat.

Refitting

14. Reverse the removal procedure.

WIPERS AND WASHERS

Description

Headlamp power wash
A headlamp power wash is fitted as standard equipment on Vogue models and as an optional extra on other models. The power wash is actuated when the windscreen washer control is used with the headlamps illuminated.

Washer reservoir
A combined underbonnet washer reservoir supplies the windscreen, tailgate glass and headlamp power wash. Three separate supply pipes are used with an electric pump for each facility.

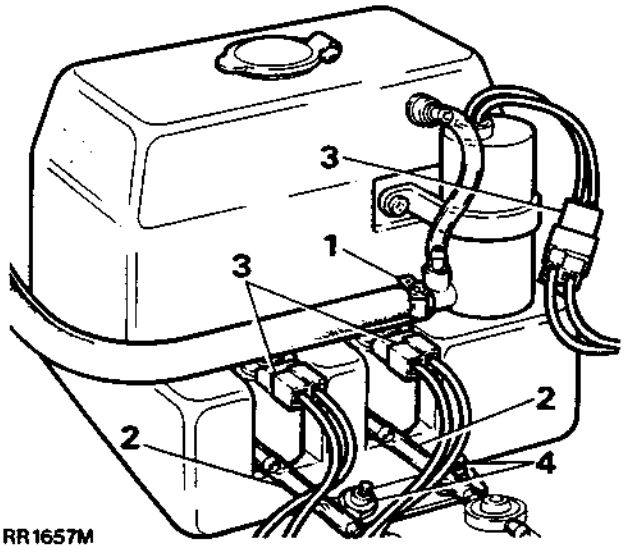
NOTE: See Electrical Section for wiring diagram.

WASHER RESERVOIR

Remove and refit

Removing

1. Slacken the hose-clip and remove the power wash hose.
2. Disconnect the tubing from the washer pumps.



RR1657M

3. Disconnect the electrical leads from the pumps.
4. Remove the three securing bolts from below and withdraw the reservoir.

Refitting

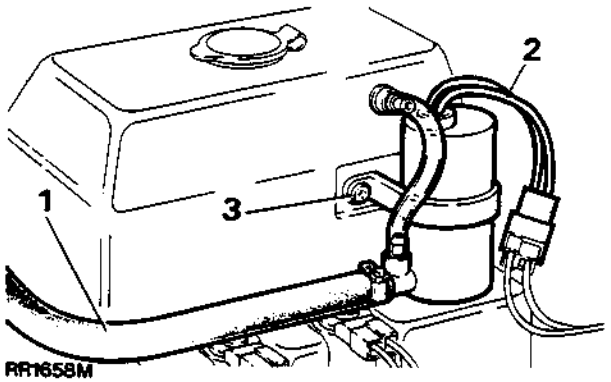
5. Reverse instructions 1 to 4.

POWER WASH PUMP

Remove and refit

Removing

1. Disconnect the hose from the power wash pump.
2. Disconnect the electrical leads from the pump.



RR1658M

3. Remove two screws and withdraw the power wash pump.

Refitting

4. Reverse instructions 1 to 3.

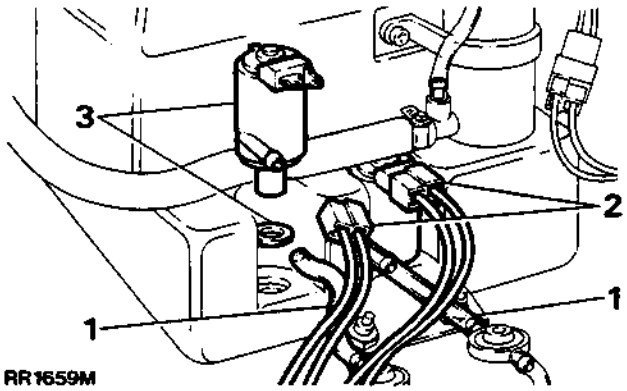
WINDSCREEN WASHER PUMP

TAILGATE GLASS WASHER PUMP

Remove and refit

Removing

1. Disconnect the washer tubing from the pump.
2. Disconnect the electrical leads from the pump.



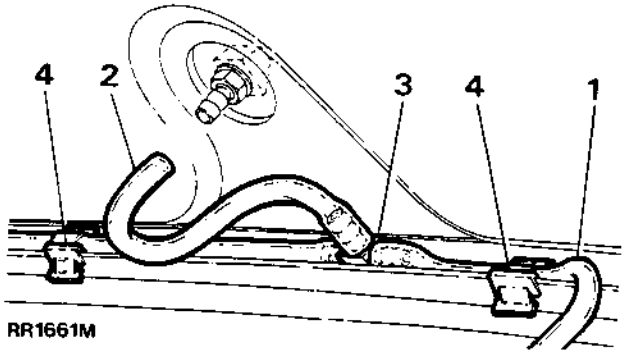
RR1659M

Continued

3. Pull the top of the pump away from its location in the reservoir and remove the pump. Note the position of the sealing gasket in the reservoir.

Refitting

4. Reverse instructions 1 to 3.



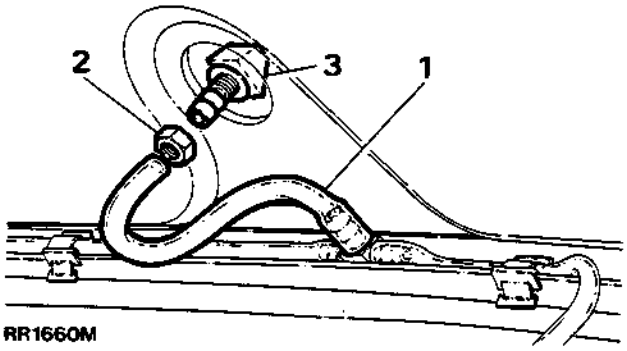
RR1661M

WINDSCREEN WASHER JETS

Remove and refit

Removing

1. Disconnect tubes from the jets.
2. Remove the locknut and washer securing jet to bonnet.



RR1660M

3. Remove jet.

Refitting

4. Reverse instructions 1 to 3.

WINDSCREEN WASHER TUBES

Remove and refit

Removing

1. Disconnect tubing from reservoir pump.
2. Disconnect tubing from washer jets.
3. Disconnect tubing from three-way tee piece.
4. Release tubing from edge clips.

Refitting

5. Reverse the removal procedure.

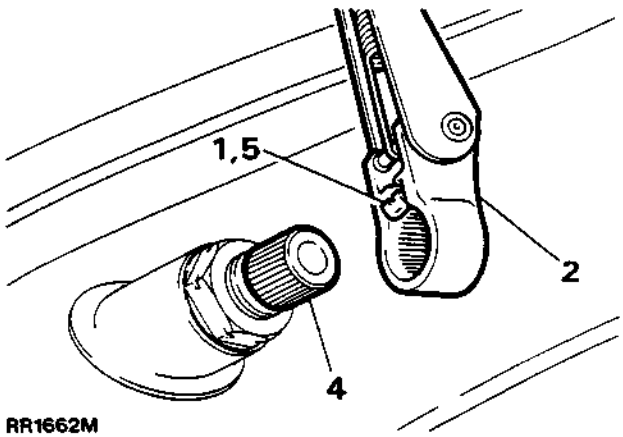
NOTE: A non-return valve is fitted between the washer motors and jets. Ensure that this valve is correctly fitted when replacing the washer tubes.

WIPER ARMS

Remove and refit

Removing

1. Hold back the small spring clip which retains the wiper arm on the spindle boss, by means of a suitable tool.
2. Gently prise off the wiper arm from the spindle boss.



RR1662M

Refitting

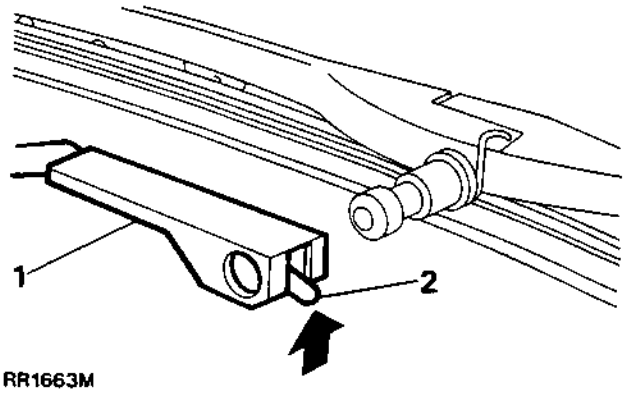
3. Allow the motor to move to the 'park' position.
4. Push the arm on to the boss, locating it on the splines so that the wiper blades are just clear of the screen rail.
5. Ensure that the spring retaining clip is located in the retaining groove on the spindle boss.

WIPER BLADES

Remove and refit

Removing

1. Pull the wiper arm away from the glass.
2. Lift the spring clip and withdraw the blade from the arm.



RR1663M

Refitting

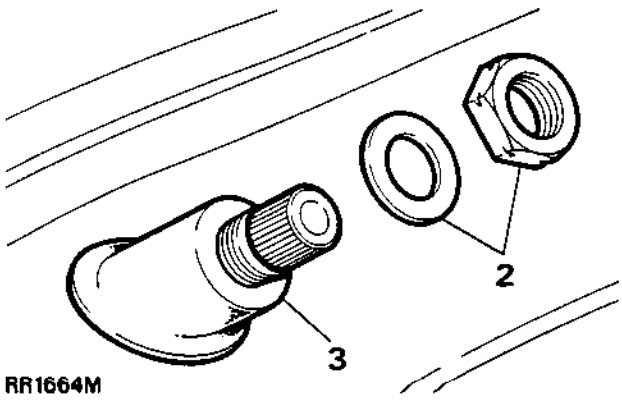
3. Reverse instructions 1 and 2.

WINDSCREEN WIPER MOTOR, LINKAGE AND WHEEL BOXES

Remove and refit

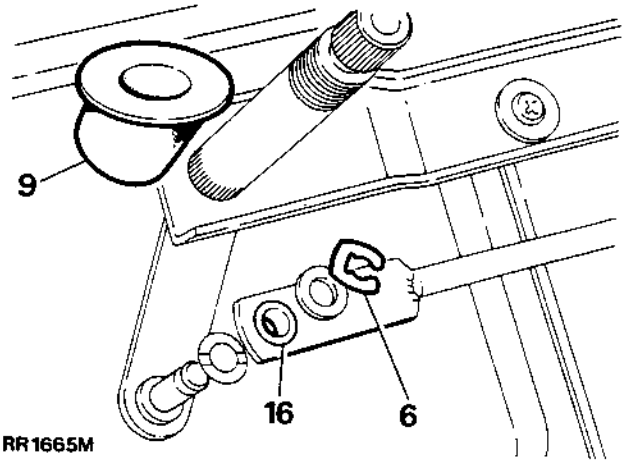
Removing

1. Remove wiper arms.
2. Remove locknuts from wheel boxes.
3. Remove grommet from wheel boxes.



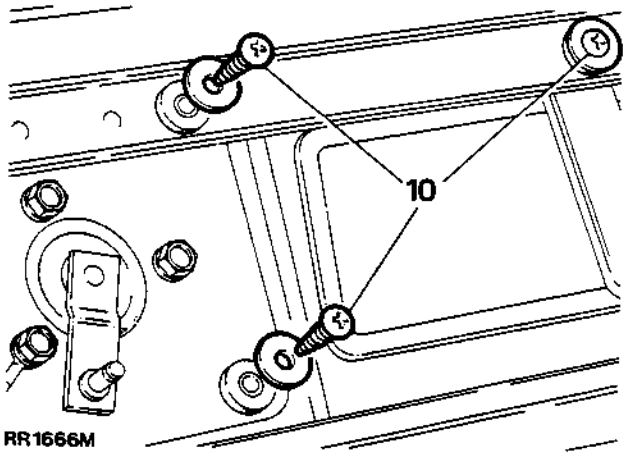
RR1664M

4. Remove bonnet.
5. Remove front decker panel.
6. Remove the spring clips securing the primary links to the wheelbox spindle links.
7. Remove the spring clips securing the primary links to the motor crank.
8. Remove the primary links.
9. Remove the lower grommet from the wheelboxes.



RR1665M

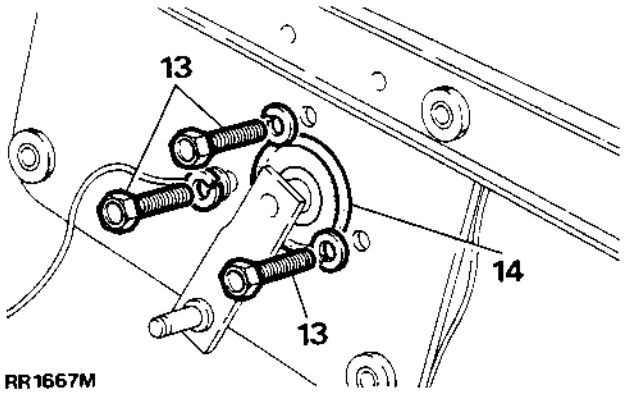
10. Remove the screws securing the motor and linkage assembly to the bulkhead.
11. Gently ease the unit out of its mounting aperture and disconnect the electrical leads at the plug and socket.
12. Withdraw the unit.



RR1666M

Continued

13. Remove the three bolts securing the motor to the mounting plate.
14. Separate the motor from the mounting plate by pulling the motor crank through the grommet.



RR1667M

Refitting

15. Reverse the removal procedure.
16. When replacing the primary links ensure that they are mounted with the bushes on the inside, that is, towards the wiper motor. The shorter primary link is mounted on the drivers' side.
17. Replace the front decker panel.
18. Replace the bonnet.
19. Replace the wiper arms.

WIPER MOTOR CHECKING

NOTE: These instructions apply to both Windscreen and Tailgate glass wiper motors.

If unsatisfactory operation of the wiping equipment is experienced, a systematic check to determine the origin of the fault should be carried out as follows:

1. Check the blades for signs of excessive friction. Frictional blades will greatly reduce the wiping speed of the motor and cause increased current draw which may damage the armature. Check by substitution.

2. Check the motor light running current and speed with the motor coupling link disconnected from the wiper spindle transmission linkage. Connect a first grade moving coil ammeter in series with the motor supply and measure the current consumption when the motor is switched on. Check the operating speed by timing the speed of rotation of the motor coupling link. The results should compare with the figures given in the technical data.

NOTE: If the vehicle wiring connections are disconnected and an alternative supply source is applied it is essential that the correct polarity is observed.
Failure to observe this will cause the motor to rotate in the reverse direction, which may result in the limit switch contacts being damaged.

3. If the motor does not run satisfactorily or takes higher than normal current, then a fault is apparent and should be investigated.
4. If the current consumption and speed of the motor are satisfactory, then a check should be carried out for proper functioning of the transmission linkage and wiper arm spindles.

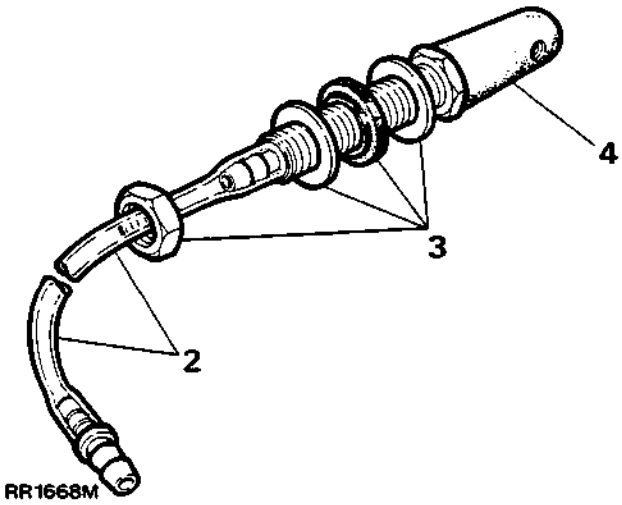
NOTE: Service parts are not available for the windscreen wiper motor with the exception of the rotary connecting link.
The complete unit must be renewed in the event of a failure.

TAILGATE GLASS WASHER JET

Remove and refit

Removing

1. Lower or remove the headlining rear section to gain access to the jet securing nut and washer tube connection.
2. Disconnect the washer tube, and remove the grommet. Drain away any water in the tube to avoid damaging the trim.



RR1668M

3. Hold the base of the jet and remove the nut and washer.
4. Withdraw the washer jet from outside the vehicle.

Refitting

5. Reverse instructions 1 to 4 as appropriate.

TAILGATE GLASS WASHER TUBE

Remove and refit

Removing

1. Remove the rear headlining.
2. Disconnect the washer tube from the pump and washer jet.
3. Secure a length of strong cord to the rear end of the tube. On withdrawing the tube, the cord will follow the route of the tube through the body trim.
4. Remove the tube by feeding it in stages towards the engine compartment.

Refitting

5. Reverse instructions 1 to 4 securing the cord to the tube and using it to draw the tube through the body trim.

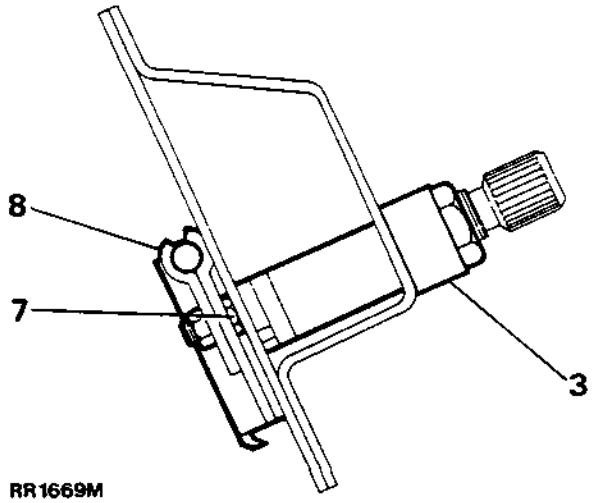
TAILGATE GLASS WIPER MOTOR

Remove and refit

Wiper wheelbox remove and refit instructions 1 to 8 and 11.
Wiper rack remove and refit instructions 1 to 10 and 11.

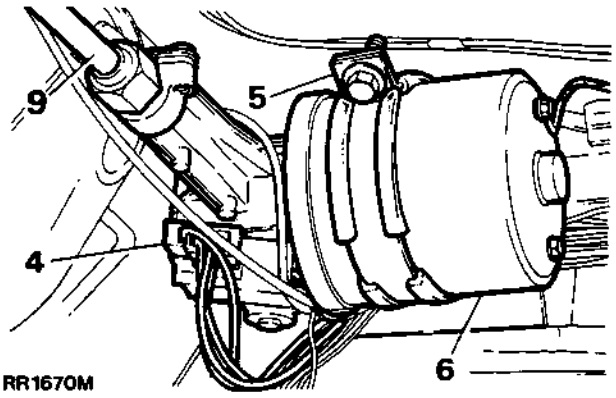
Removing

1. Lower or remove the headlining rear section to gain access to the wiper motor assembly.
2. Remove the wiper arm and blade.
3. Remove one nut and spacer to release the wiper wheelbox from the body.



RR1669M

4. Disconnect the electrical leads from the wiper motor, including the earth lead.
5. Support the wiper motor and remove the bolt and bracket.
6. Withdraw the wiper motor from the body, complete with rack tube and wheelbox.



RR1670M

7. Slacken two bolts and nuts on the wheelbox to release it from the rack.
8. Slide the wheelbox and end rack tube off the rack.
9. Unscrew the rack tube nut and slide the tube off the rack.
10. Remove the wiper motor gearbox cover and withdraw the rack.

Refitting

11. Reverse instructions 1 to 10, ensuring that the wheelbox is correctly located on the rack before tightening the two wheelbox bolts and nuts.

Continued

TAILGATE GLASS WIPER MOTOR

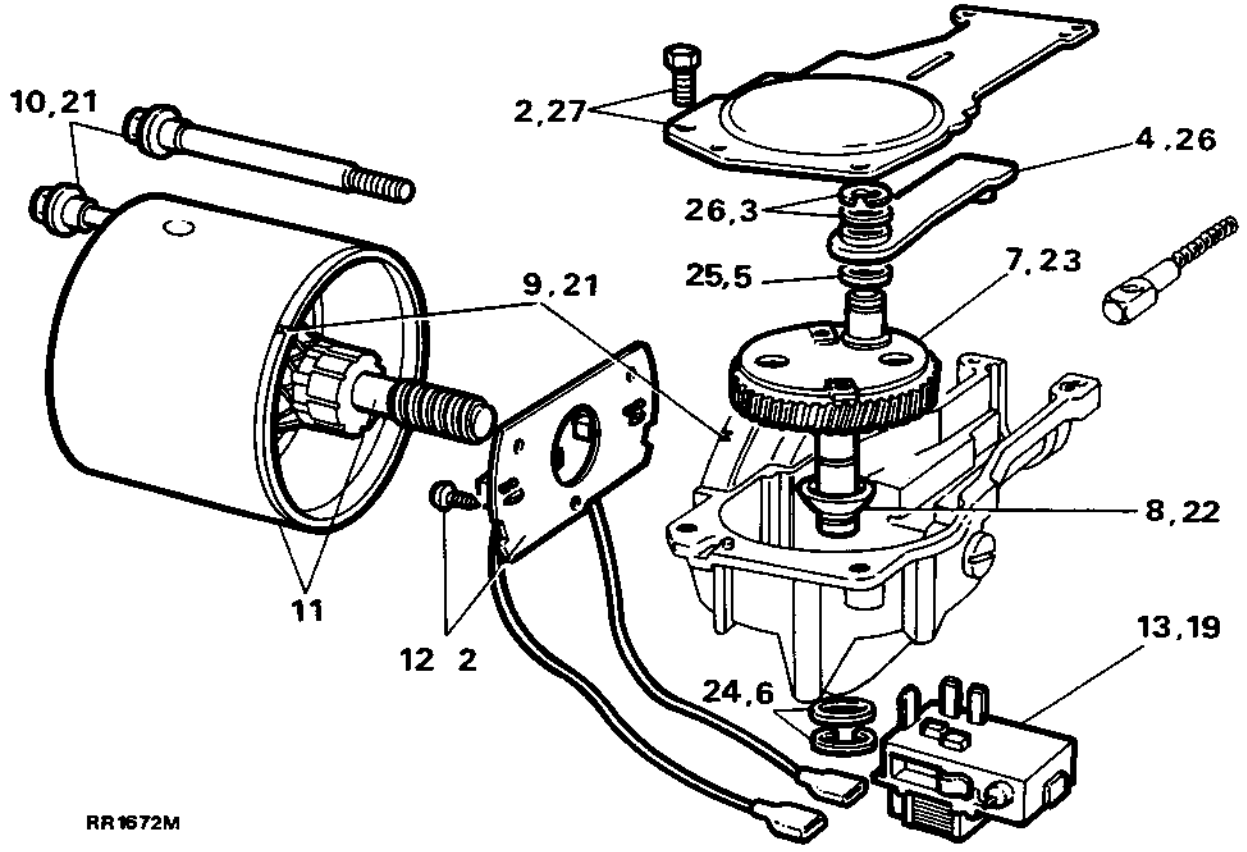
Overhaul

Dismantle

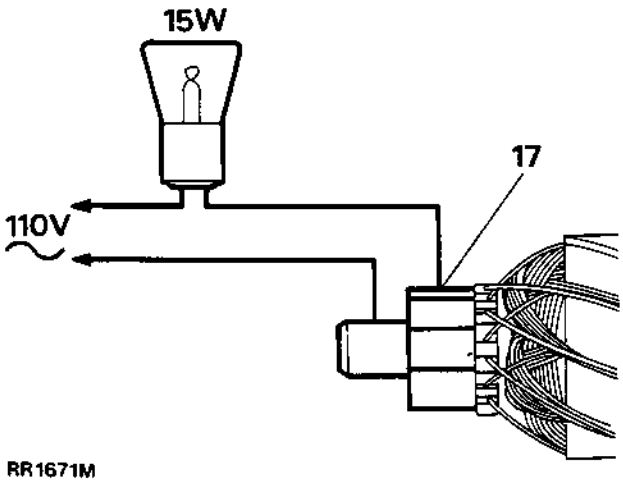
1. Remove the wiper motor and drive from the vehicle.
2. Remove the wiper motor gearbox cover.
3. Remove the circlip and plain washer securing the connecting rod.
4. Withdraw the connecting rod.
5. Withdraw the flat washer.
6. Remove the circlip and washer securing the shaft and gear.
7. Clean any burrs from the gear shaft and withdraw the gear. Do not detach the crankpin mounting plate.
8. Withdraw the dished washer.
9. Note the alignment marks on the yoke and gearbox. To ensure correct rotation of the motor, the mark on the yoke must be adjacent to the arrow-head marked on the gearbox case.
10. Remove the yoke securing bolts.
11. Withdraw the yoke and armature.
12. Remove the brush gear assembly.
13. Remove the limit switch.

INSPECTION AND TEST

14. Check the brushes for excessive wear, if they are worn to 4,8mm (0.190 in) in length, fit a new brush gear assembly.
15. Using a push type gauge, check that the brush spring pressure is 170gf (6ozf) when the bottom of the brush is level with the bottom of the slot in the brush box. Fit a new brush gear assembly if the springs are not satisfactory.
16. Check the armature windings for open or short circuit using armature testing equipment.



17. Test the armature insulation using a 110V, 15W test lamp. Lighting of the lamp indicates faulty insulation. Renew the armature if faulty.



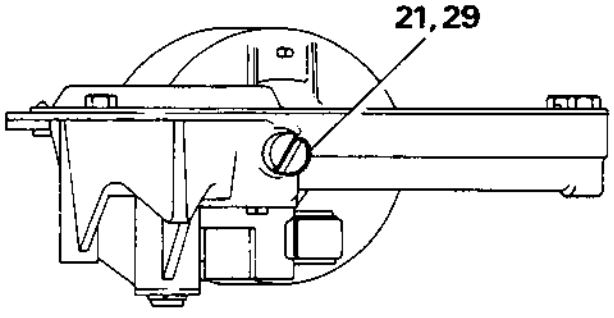
RR1671M

18. Examine the gear wheel for damage or excessive wear.

ASSEMBLE

Use Ragosine Listate Grease to lubricate the gear wheel teeth, armature shaft worm gear, connecting rod and pin, cable rack and wheelbox gear wheels.
Use Shell Turbo 41 oil sparingly to lubricate the bearing bushes, armature shaft bearing journals, gear wheel shaft and wheelbox spindles. Thoroughly soak the felt washer in the yoke bearing with oil.

19. Fit the limit switch.
20. Fit the brush gear assembly.
21. Fit the armature and yoke to gearbox using alignment marks, secure with the yoke retaining bolts tightening to the correct torque. If a replacement armature is being fitted slacken the thrust screw to provide end-float for fitting the yoke.



RR1673M

22. Fit the dished washer beneath the gear wheel with the concave side towards the gear wheel.
23. Fit the gear wheel to the gearbox.
24. Secure the gear wheel shaft with the plain washer and circlip.
25. Fit the larger flat washer over the crankpin.
26. Fit the connecting rod and secure with the smaller plain washer and circlip.
27. Fit the gearbox cover and secure with the retaining screws.
28. Connect the electrical leads between the wiper motor and limit switch.
29. To adjust the 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.

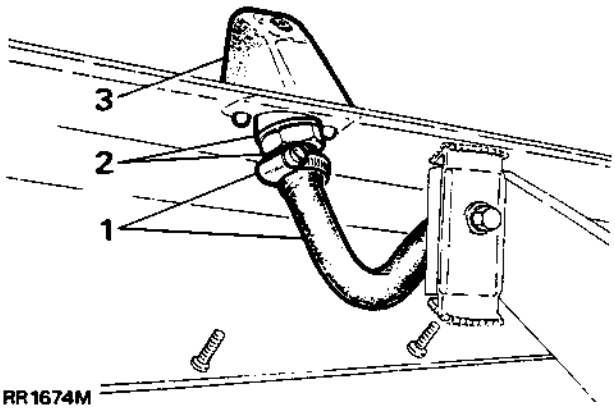
Continued

HEADLAMP POWER WASH JET

Remove and refit

Removing

1. Disconnect the hose from the power wash jet.
2. Remove the nut securing the jet to the bumper.
3. Remove the power wash jet.



Refitting

4. Reverse instructions 1 to 3.

POWER WASH HOSE

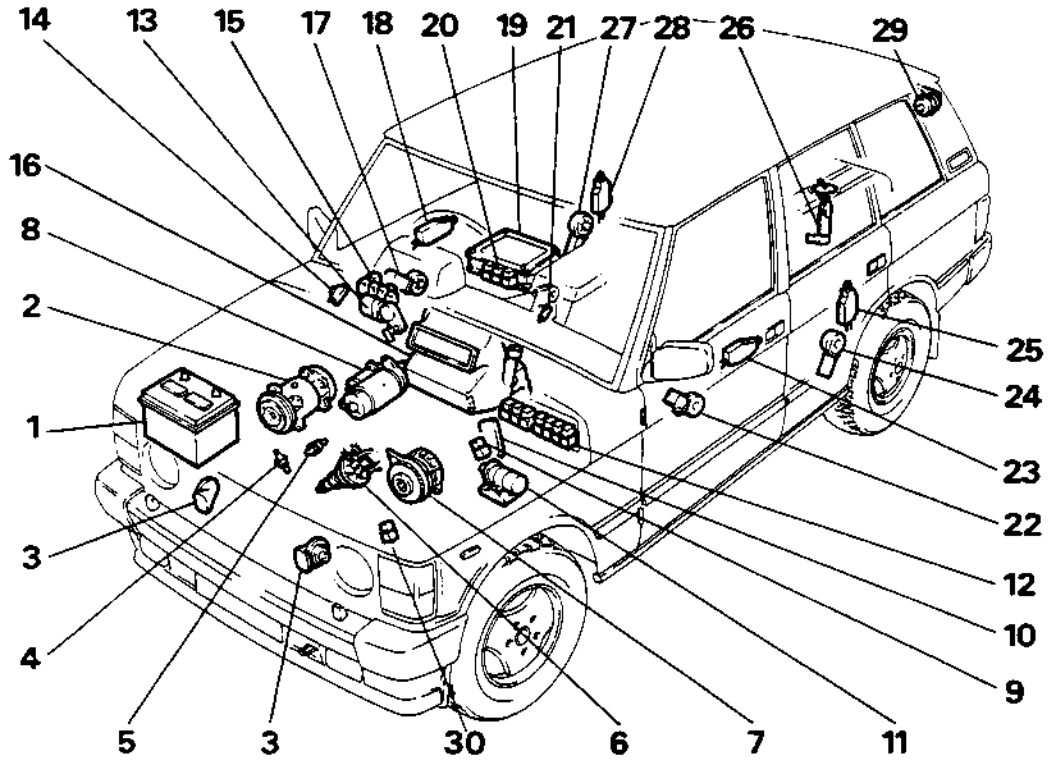
Remove and refit

Removing

1. Disconnect the hoses from the jets and the washer pump.
2. Release the clips locating the hose.
3. Remove the power wash hose.

Refitting

4. Reverse instructions 1 to 3 ensuring the pipe run is correct.



LOCATION OF ELECTRICAL EQUIPMENT

1. Battery
2. Air conditioning compressor (if fitted)
3. Horns
4. Oil pressure switch
5. Water temperature switch
6. Electronic distributor
7. Alternator
8. Starter motor
9. Fuel shut-off relay (fuel injection models only)
10. Power resistor (fuel injection models only)
11. Coil and amplifier assembly
12. Relays
13. Wiper motor—front screen
14. Choke warning light switch (carburetter models only)
15. Relays
16. Heater
17. Window lift motor (front right-hand door)
18. Door lock actuator (front right-hand door)
19. Electronic control unit (fuel injection models only)
20. Relays (fuel injection models only)
21. Handbrake warning light switch
22. Window lift motor (front left-hand door)
23. Door lock actuator (front left-hand door)
24. Window lift motor (rear left-hand door)
25. Door lock actuator (rear left-hand door)
26. Electrical in-tank fuel pump
27. Window lift motor (rear right-hand door)
28. Door lock actuator (rear right-hand door)
29. Wiper motor—rear screen
30. Fuel cut-off relay (carburetter models only)

NOTE: Right-hand drive vehicle illustrated: Certain electrical components may change position on left-hand drive vehicles, but can be found in a similar location on the opposite side of the vehicle.

For full information on fuel injection related items—see fuel injection section of manual.

To identify individual relays (items 12 and 15) see relays in electrical section of manual.

FAULT DIAGNOSIS

SYMPTOM	*POSSIBLE CAUSE*	*CURE*
A— Battery in low state of charge	1. Broken or loose connection in alternator circuit	1. Examine the charging and field circuit wiring. Tighten any loose connections and renew any broken leads. Examine the battery connection
	2. Current voltage regulator not functioning correctly	2. Adjust or renew
	3. Slip rings greasy or dirty	3. Clean
	4. Brushes worn, not fitted correctly or wrong type	4. Renew
B— Battery overcharging, leading to burnt-out bulbs and frequent need for topping-up	1. Current voltage regulator not functioning correctly	1. Renew
C— Lamps giving insufficient illumination	1. Battery discharged	1. Charge the battery from an independent supply or by a long period of daylight running
	2. Bulbs discoloured through prolonged use	2. Renew
D— Lamps light when switched on but gradually fade out	1. Battery discharged	1. Charge the battery from an independent supply or by a long period of daylight running
E— Lights flicker	1. Loose connection	1. Tighten
F— Failure of lights	1. Battery discharged	1. Charge the battery from an independent supply or by a long period of daylight running
	2. Loose or broken connection	2. Locate and rectify
G— Starter motor lacks power or fails to turn engine	1. Stiff engine	1. Locate cause and remedy
	2. Battery discharged	2. Charge the battery either by a long period of daytime running or from independent electrical supply
	3. Broken or loose connection in starter circuit	3. Check and tighten all battery, starter and starter switch connections and check the cables connecting these units for damage
	4. Greasy or dirty slip rings	4. Clean
	5. Brushes worn, not fitted correctly or wrong type	5. Renew
	6. Brushes sticking in holders or incorrectly tensioned	6. Rectify
	7. Starter pinion jammed in mesh with flywheel	7. Remove starter motor and investigate
H— Starter noisy	1. Starter pinion or flywheel teeth chipped or damaged	1. Renew
	2. Starter motor loose on engine	2. Rectify, checking pinion and the flywheel for damage
	3. Armature shaft bearing	3. Renew
J— Starter operates but does not crank the engine	1. Pinion of starter does not engage with the flywheel	1. Check operation of starter solenoid. If correct, remove starter motor and investigate
K— Starter pinion will not disengage from the flywheel when the engine is running	1. Starter pinion jammed in mesh with the flywheel	1. Remove starter motor and investigate
L— Engine will not start	1. The starter will not turn the engine due to a discharged battery	1. The battery should be recharged by running the car for a long period during daylight or from an independent electrical supply
	2. Sparking plugs faulty, dirty or incorrect plug gaps	2. Rectify or renew
	3. Defective coil or distributor	3. Remove the lead from the centre distributor terminal and hold it approximately 6 mm (¼ in) from some metal part of the engine while the engine is being turned over. If the sparks jump the gap regularly, the coil and distributor are functioning correctly. Renew a defective coil or distributor
	4. A fault in the low tension wiring circuit	4. Examine all the ignition cables and check that the bottom terminals are secure and not
	5. Faulty amplifier	5. corroded
	6. Air gap out of adjustment	6. Check or renew
	7. Controls not set correctly or trouble other than ignition	7. Adjust See Starting Procedure in the Owner's Instruction Manual
M— Engine misfires	1. Distributor incorrectly set	1. Adjust
	2. Faulty coil or reluctor	2. Renew
	3. Faulty sparking plugs	3. Rectify
	4. Faulty carburetter	4. Check and rectify

Continued

	SYMPTOM	POSSIBLE CAUSE	CURE
N—	Frequent recharging of the battery necessary	1. Alternator inoperative	1. Check the brushes, cables and connections or renew the alternator
		2. Loose or corroded connections	2. Examine all connections, especially the battery terminals and earthing straps
		3. Slipping fan belt	3. Adjust
		4. Voltage control out of adjustment	4. Renew
		5. Excessive use of the starter motor	5. In the hands of the operator
		6. Vehicle operation confined largely to night driving	6. In the hands of the operator
		7. Abnormal accessory load	7. Superfluous electrical fittings such as extra lamps, etc.
		8. Internal discharge of the battery	8. Renew
P—	Alternator not charging correctly	1. Slipping fan belt	1. Adjust
		2. Voltage control not operating correctly	2. Rectify or renew
		3. Greasy, charred or glazed slip rings	3. Clean
		4. Brushes worn, sticking or oily	4. Rectify or renew
		5. Shorted, open or burn-out field coils	5. Renew
Q—	Alternator noisy	1. Worn, damaged or defective bearings	1. Renew
		2. Cracked or damaged pulley	2. Renew
		3. Alternator out of alignment	3. Rectify
		4. Alternator loose in mounting	4. Rectify
		5. Excessive brush noise	5. Check for rough or dirty slip rings, badly seating brushes, incorrect brush tension, loose brushes and loose field magnets. Rectify or renew
R—	Defective distributor (refer to distributor overhaul and test procedure)	1. Air gap incorrectly set	1. Adjust
		2. Distributor cap cracked	2. Renew
		3. Faulty pick-up or reluctor	3. Renew
		4. Excessive wear in distributor shaft bushes, etc.	4. Renew
		5. Rotor arm and flash shield cracked or showing signs of tracking	5. Renew
S—	Mixture control warning light fails to appear when engine reaches running temperature	1. Mixture control already pushed in	1. In the hands of the operator
		2. Broken connection in warning light circuit	2. Rectify
		3. Blown bulb	3. Renew
		4. Faulty thermostat switch (at cylinder head)	4. Renew
		5. Faulty manual switch (at mixture control)	5. Renew
		6. Broken operating mechanism at manual switch	6. Rectify
T—	Mixture control warning light remains on with engine at running temperature	1. Mixture control out	1. Push control right in
		2. Faulty manual switch	2. Renew
		3. Broken operating mechanism at manual switch	3. Rectify
U—	Poor performance of horns	1. Low voltage due to discharged battery	1. Recharge
		2. Bad connections in wiring	2. Carefully inspect all connections and horn push
		3. Loose fixing bolt	3. Rectify
		4. A faulty horn	4. Renew
V—	Central door locking does not operate (on all four doors)	1. Battery discharged	1. Recharge
		2. Control unit in driver's door lock actuator faulty	2. Renew
		3. Loose or broken connection in driver's door	3. Locate and rectify
		4. Blown fuse	4. Rectify
W—	Central door locking does not operate (on one door only)	1. Loose or broken connection	1. Locate and rectify
		2. Lock actuator failure	2. Renew
		3. Faulty lock	3. Rectify
		4. Mechanical linkages disconnected	4. Locate and rectify
X—	Window lift will not operate	1. Motor failure	1. Renew
		2. Loose or broken connection	2. Locate and rectify
		3. Faulty switch	3. Renew
		4. Mechanical linkage faulty	4. Rectify
Y—	Exterior mirrors fail to operate	1. Loose or broken connection	1. Locate and rectify
		2. Faulty switch	2. Renew
		3. Mirror motor failure	3. Renew

ELECTRICAL EQUIPMENT

DESCRIPTION

The electrical system is Negative earth, and it is most important to ensure correct polarity of the electrical connections at all times. Any incorrect connections made when reconnecting cables may cause irreparable damage to the semiconductor devices used in the alternator and regulator. Incorrect polarity would also seriously damage any transistorised equipment such as radio and tachometer etc.

Before carrying out any repairs or maintenance to an electrical component, always disconnect the battery.

ALTERNATOR

The V-drive fan belt used with alternators is not the same as that used with d.c. machines. Only use the correct Rover replacement fan belt. Occasionally check that the engine and alternator pulleys are accurately aligned.

It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.

Do not disconnect battery cables while the engine is running or damage to the semi-conductor devices may occur. It is also inadvisable to break or make any connections in the alternator charging and control circuits while the engine is running.

The Model 15TR electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse effects of temperature, dust, and moisture etc.

The regulating voltage is set during manufacture to give the required regulating voltage range of 14.2 ± 0.2 volts, and no adjustment is necessary. The only maintenance needed is the occasional check on terminal connections and wiping with a clean dry cloth.

The alternator system provides for direct connection of a charge (ignition) indicator warning light, and eliminates the need for a field switching relay or warning light control unit. As the warning lamp is connected in the charging circuit, lamp failure will cause loss of charge. Lamp should be checked regularly and a spare carried.

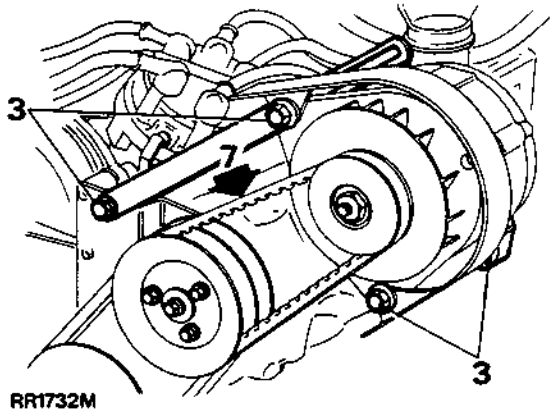
When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.

ALTERNATOR

Remove and refit

Removing

1. Disconnect battery earth lead.
2. Disconnect leads from alternator.
3. Slacken alternator fixings, pivot alternator inwards and remove fan belt.
4. Remove alternator.

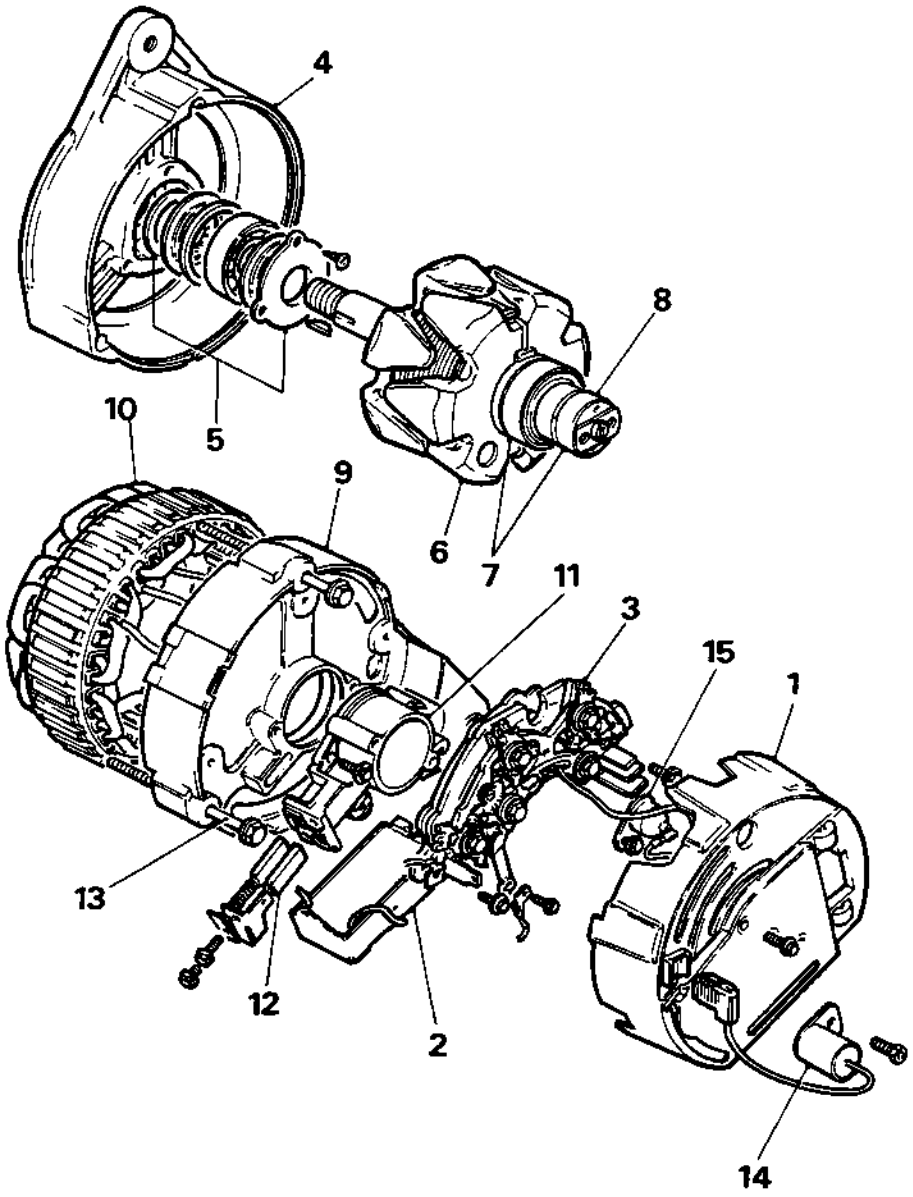


Refitting

5. Attach the alternator lower fixing bolts and nuts.

NOTE: The fan guard is attached to the front fixing and the adjustment bracket bolt.

6. Slacken the alternator adjustment bracket and attach the alternator to the bracket.
7. Fit the fan belt and adjust the belt tension.
8. Connect the wiring plug to the alternator.
9. Connect the battery.



RR171M

Alternator type 133/65

1. Cover
2. Regulator
3. Rectifier
4. Drive end bracket
5. Bearing assembly
6. Rotor
7. Slip ring end bearing
8. Slip rings
9. Slip ring end bracket
10. Stator
11. Brush box
12. Brushes
13. Through bolt
14. Suppressor
15. Surge protection diode

ALTERNATOR — Lucas — 133/65

Overhaul

Including Test (Bench)

NOTE: Alternator charging circuit — The ignition warning light is connected in series with the alternator field circuit. Bulb failure would prevent the alternator charging, except at very high engine speeds, therefore, the bulb should be checked before suspecting an alternator failure.

Precautions

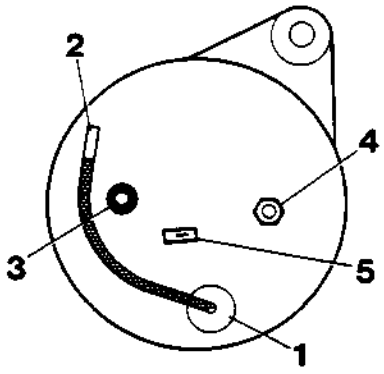
Battery polarity is NEGATIVE EARTH, which must be maintained at all times.

No separate control unit is fitted; instead a voltage regulator of micro-circuit construction is incorporated on the slip ring end bracket, inside the alternator cover.

Battery voltage is applied to the alternator output cable even when the ignition is switched off, the battery must be disconnected before commencing any work on the alternator. The battery must also be disconnected when repairs to the body structure are being done by arc welding.

Surge protection device

Some protection of the alternator is provided by a surge protection device, to absorb high transient voltages.



RR 172M

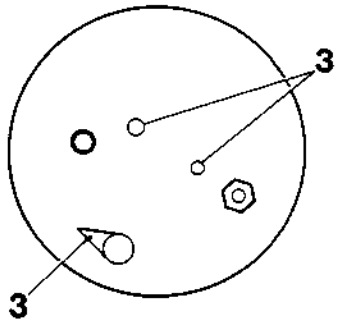
1. Suppression capacitor
2. Positive suppression terminal
3. IND terminal
4. + output terminal
5. Sensing terminal

Testing in position

Surge protection device

If the alternator output falls to zero, the fault may be caused by the surge protection device failing safe, short-circuit, or a fault in the alternator circuit. Check the surge protection device as follows:

1. Check that the fan belt is correctly tensioned.
2. Withdraw the connectors from the alternator.
3. Disconnect the suppressor and remove the alternator cover.



RR 173M

4. Remove the surge protection device.
5. Refit the alternator cover, and connectors. Ensure that all circuit connections are clean and tight.
6. Start and run the engine. If the alternator output is now normal, fit a new surge protection device.

Output test

7. Check that the fan belt is correctly tensioned and that all charging circuit connections are secure.
8. Run the engine at fast idle until normal operating temperature is attained.
9. Stop the engine.
10. Withdraw the connectors from the alternator.
11. Disconnect the suppressor and remove the alternator cover.
12. Connect the regulator case to the alternator frame.
13. Connect a 0–60 ammeter between the alternator and the battery.
14. Connect a 0–20 voltmeter across the battery terminals.
15. Connect a 15 ohm 35 amp variable resistor across the battery terminals.

CAUTION: Do not leave the variable resistor connected across the battery terminals for longer than is necessary to carry out the following test, items 16 and 17.

16. Start the engine and run at 750 rev/min. The warning light bulb should be extinguished.

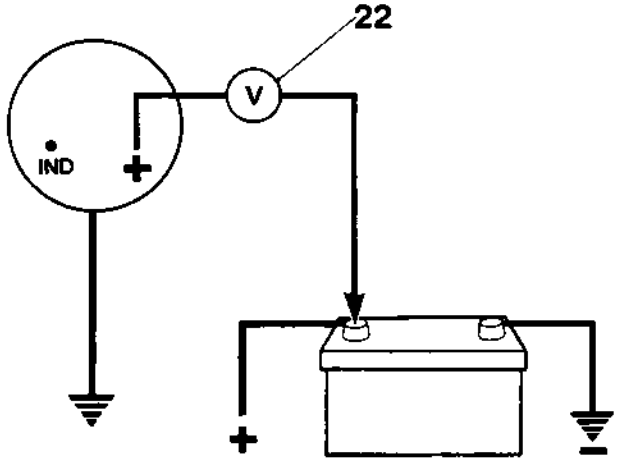
17. Increase the engine speed to 3000 rev/min, and adjust the variable resistance until the voltmeter reads 13.6 volts. The ammeter reading should then be approximately 60 amps. Any appreciable deviation from this figure will necessitate removing and dismantling the alternator. If the output test is satisfactory, proceed with the regulator test.

Regulator test

18. Disconnect the variable resistor and remove the connection between the regulator and the alternator frame.
19. With the remainder of the circuit connected as for the alternator output test, start the engine and run at 3000 rev/min, until the ammeter shows an output current of less than 10 amperes.
20. The voltmeter should now give a reading of 13.6 to 14.4 volts. Any appreciable deviation from this (regulating) voltage indicates a faulty regulator which must be replaced.
21. If the foregoing output and regulator tests show the alternator and regulator to be performing satisfactorily, disconnect the test circuit, reconnect the alternator terminal connector and proceed with the charging circuit resistance test.

Charging circuit resistance test

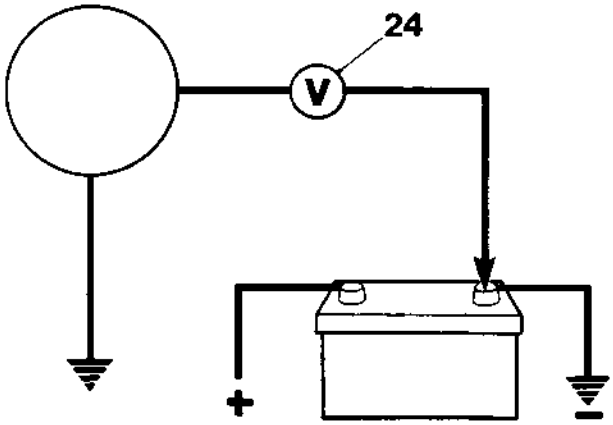
22. Connect a low range voltmeter between either of the alternator terminals marked + and the positive terminal of the battery.



RR 175M

23. Switch on the headlamps and start the engine. Set the throttle to run at approximately 3000 rev/min. Note the voltmeter reading.

24. Transfer the voltmeter connections to the frame of the alternator and the negative terminal of the battery, and again note the voltmeter reading.



RR174M

25. If the reading exceeds 0.5 volt on the positive side or 0.25 volt on the negative side, there is a high resistance in the charging circuit which must be traced and remedied.

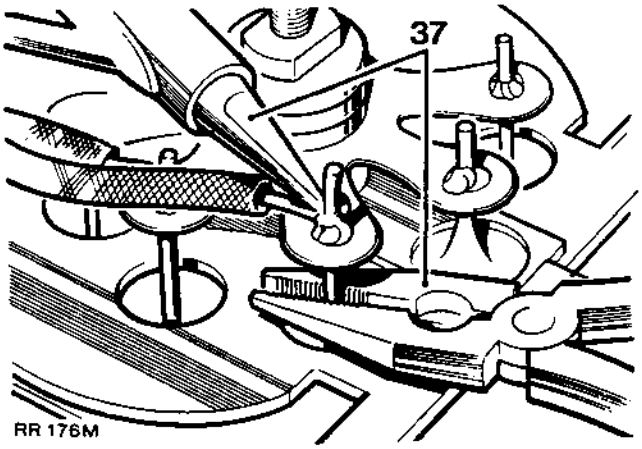
Testing — alternator removed

26. Withdraw the connectors from the alternator.
27. Remove the alternator.
28. Disconnect the suppressor and remove the alternator cover.
29. Detach the surge protection device.
30. Disconnect the lead and remove the rectifier assembly.
31. Note the arrangement of the brush box connections and remove the screws securing the regulator to the brush box and withdraw. This screw also retains the inner brush mounting plate in position.
32. Remove the screw retaining the outer brush box in position and withdraw both brushes.
33. Check brushes for wear by measuring length of brush protruding beyond brush box moulding. If length is 10 mm (0.4 in) or less, brush must be renewed.
34. Check that brushes move freely in holders. If brush is sticking, clean with petrol moistened cloth or polish sides of brush with fine file.
35. Check brush spring pressure using push-type spring gauge. Gauge should register 136 to 279 g (5 to 10 oz) when brush is pulled back until face is flush with housing. If reading is outside these limits, renew brush assembly.
36. Remove the two screws securing the brush box to the slip ring end bracket and lift off the brush box assembly.

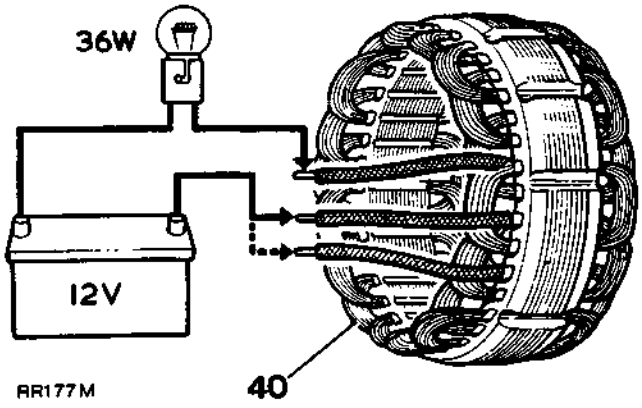
continued

37. Securely clamp alternator in a vice and release the stator winding cable ends from the rectifier by applying a hot soldering iron to the terminal tags of the rectifier. Prise out the cable ends when the solder melts.

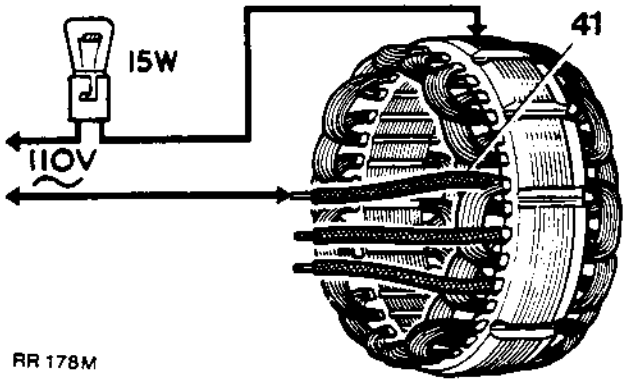
CAUTION: When soldering or unsoldering connections to diodes take care not to overheat the diodes or bend the pins. During soldering operations, diode pins should be gripped lightly with a pair of long nosed pliers which will act as a thermal shunt.



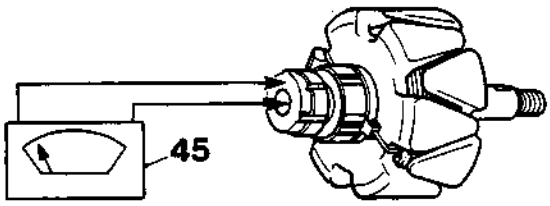
38. Remove the two remaining screws securing the rectifier assembly to the slip ring end bracket and lift off the rectifier assembly. Further dismantling of the rectifier is not required.
39. Remove the slip ring end bracket bolts and lift off the bracket.
40. Connect a 12 volt battery and a 36 watt test lamp to two of the stator connections. Repeat the test replacing one of the two stator connections with the third. If test lamp fails to light in either test, stator must be renewed.



41. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between any one of the three stator connections and stator laminations. If test lamp lights, stator must be renewed.



42. Clean surfaces of slip rings using petrol moistened cloth.
43. Inspect slip ring surfaces for signs of burning; remove burn marks using very fine sandpaper. On no account should emery cloth or similar abrasives be used, or any attempt made to machine the slip rings.
44. Note the position of the stator output leads in relation to the alternator fixing lugs, and lift the stator from the drive end bracket.
45. Connect an ohmmeter or a 12 volt battery and an ammeter to the slip rings. An ohmmeter reading of 3.2 ohms or an ammeter reading of 4 amps should be recorded.



46. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between one of the slip rings and one of the rotor poles. If the test lamp lights, the rotor must be renewed.
47. To separate the drive end bracket and rotor, remove the shaft nut, washers, woodruff key and spacers from the shaft.
48. Remove bearing retaining plate by removing the three screws. Using a press, drive the rotor shaft from the drive end bearing.
49. If necessary, to remove the slip rings or the slip ring end bearing on the rotor shaft, unsolder the outer slip ring connection and gently prise the slip ring off the shaft, repeat the procedure for the inner slip ring connection. Using a suitable extraction tool, withdraw the slip ring bearing from the shaft.

Continued

Reassembling

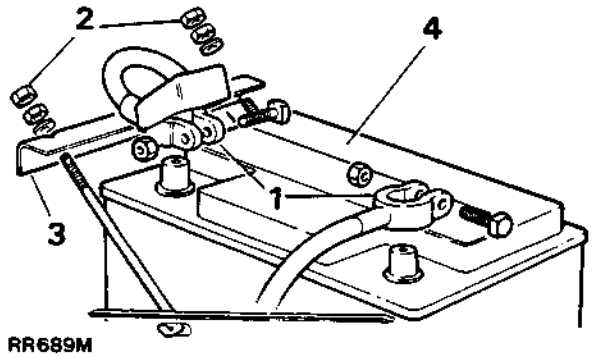
50. Reverse the dismantling procedure, noting the following points.
    (a) Use Shell Alvania 'RA' to lubricate bearings.
    (b) When refitting slip ring end bearing, ensure it is fitted with open side facing rotor.
    (c) Use Fry's H.T.3 solder on slip ring field connections.
    (d) When refitting rotor to drive end bracket, support inner track of bearing. Do not use drive end bracket to support bearing when fitting rotor.
    (e) Tighten through-bolts evenly.
    (f) Fit brushes into housings before fitting brush moulding.
    (g) Tighten shaft nut to the correct torque, see Torque Wrench Settings.
    (h) Refit regulator pack to brush moulding.
51. Reconnect the leads between the regulator; brush box and rectifier, as illustrated.
52. Refit the alternator.

BATTERY

Remove and refit

Removing

1. Disconnect the battery.
2. Release the four nuts securing the battery bracket in position.
3. Remove the bracket from the studs.
4. Remove the battery.



RR689M

Refitting

5. Reverse the removal procedure.

NOTE: Smear the battery clamps and terminals with petroleum jelly before refitting.

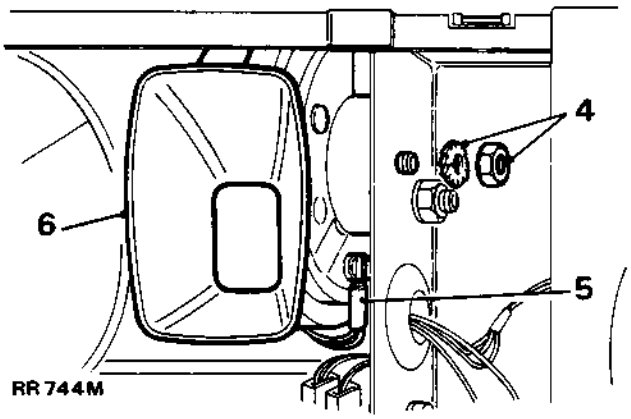
HORNS

Remove and refit

Removing

1. Disconnect the battery.
2. Remove radiator grille.
3. Remove the headlamp surround.
4. Remove the nut and serrated washer securing the horn in position.
5. Disconnect the electrical leads.
6. Withdraw the horns.

NOTE: Twin horns are fitted. An identification letter is stamped on the front outer rim of the horn; 'H'—high note, 'L'—low note.



RR744M

Refitting

7. Reverse removal procedure.

SPARK PLUGS

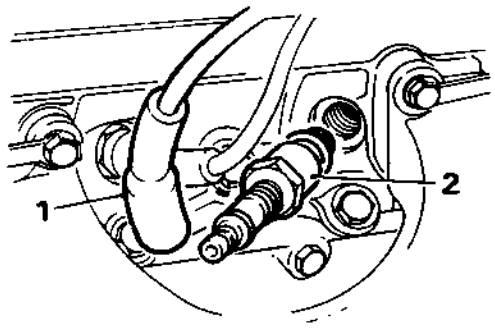
Remove, clean, adjust and refit

Removing

1. Withdraw leads by gripping end shrouds. DO NOT pull leads alone.

   NOTE: Remove the hot air pipe for access to the RH plugs as necessary.

2. Remove sparking plugs and washers.



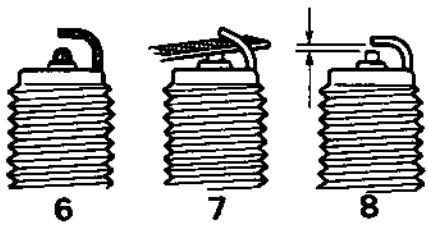
RR 615 M

Cleaning

3. Fit plug in plug cleaning machine.
4. Wobble plug with circular motion while operating abrasive blast for a maximum of four seconds.

   CAUTION: Excessive abrasive blasting will erode insulator nose.

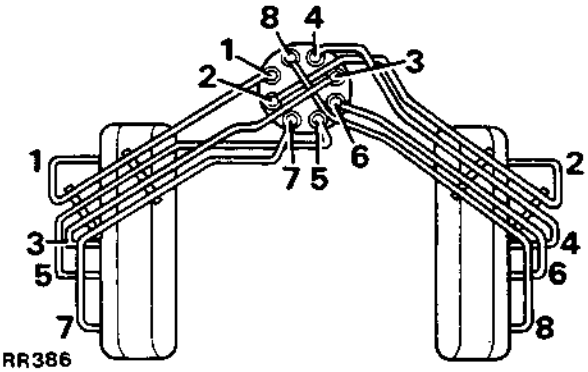
5. Change to air blast only and continue to wobble plug for a minimum of thirty seconds to remove abrasive grit from plug cavity.
6. Wire brush plug threads, open gap slightly.
7. Using point file, square off electrode surfaces.
8. Set electrode gap: 0,80 mm (0.030 in).



RR475M

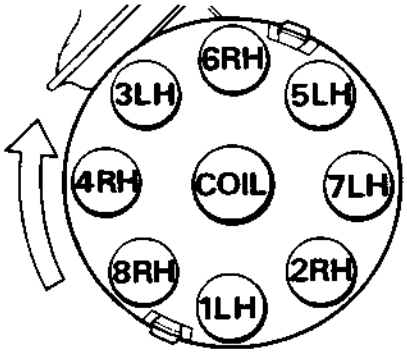
9. Test plugs in accordance with cleaning machine manufacturers instructions. If satisfactory, refit plugs in engine.

10. Examine high tension leads, including coil to distributor lead, for insulation cracking or corrosion at end contacts. Fit new leads as necessary.
11. In addition to correct firing order, high tension leads must also be fitted in correct relation to each other to avoid cross firing.



RR386

12. Leads at distributor cap must be connected as illustrated—Figures 1 to 8 inclusive—indicate plug lead numbers. RH—Right-hand side of engine when viewed from rear. LH—Left-hand side of engine when viewed from rear.



RR616M

13. When pushing leads on plugs ensure ferrules within shrouds are firmly seated on plugs. A guide is that shroud ends are within 6 mm (0.250 in) of metal body of plugs.

    NOTE: If new plugs are necessary refer to technical data section.

ELECTRONIC IGNITION

A Lucas model 35DM8 distributor is employed. This has a conventional advance/retard vacuum unit and centrifugal automatic advance mechanism.

A pick-up module, in conjunction with a rotating timing reluctor inside the distributor body, generates timing signals. These are applied to an electronic ignition amplifier unit fitted under the ignition coil mounted on top of the left front wing valance.

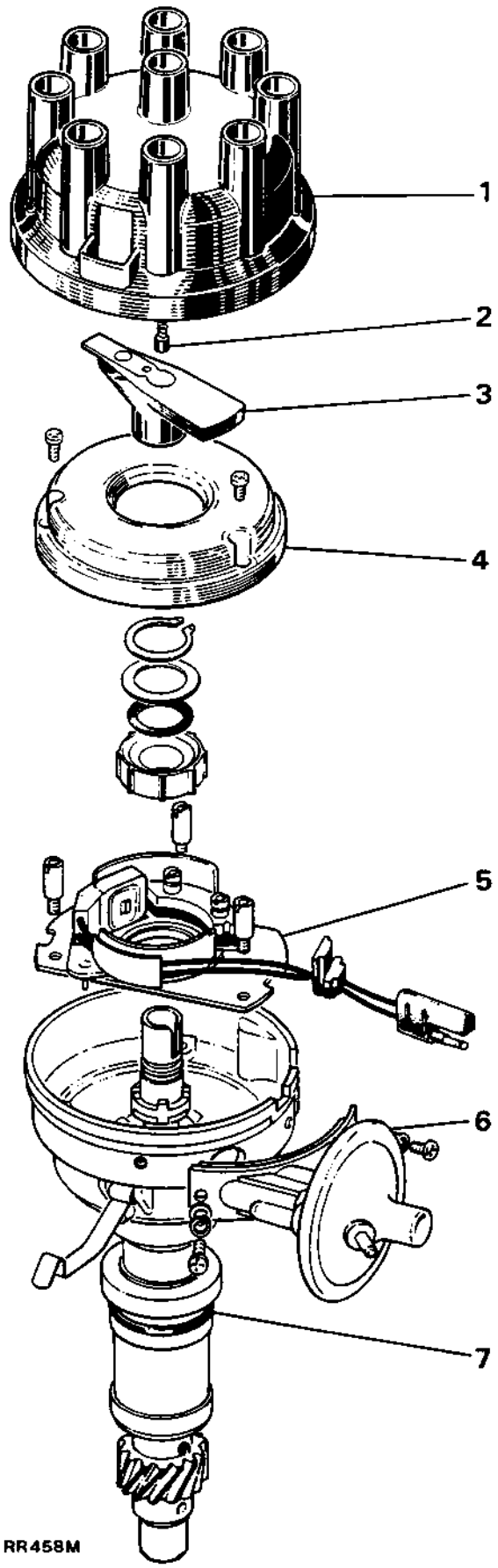
MAINTENANCE

80,000 km (48,000 miles).
Remove the distributor cap and rotor arm and wipe inside with a nap-free cloth.

DO NOT DISTURB the clear plastic insulating cover which protects the magnetic pick-up module.

Service Parts

1. Cap
2. H.T. brush and spring
3. Rotor arm
4. Insulation cover (Flash shield)
5. Pick-up and base plate assembly
6. Vacuum unit
7. 'O' ring oil seal

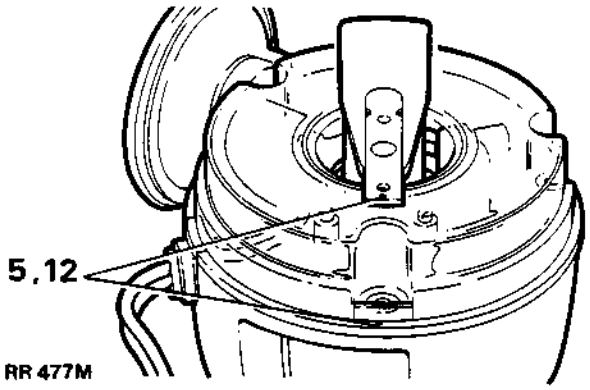


DISTRIBUTOR

Remove and refit

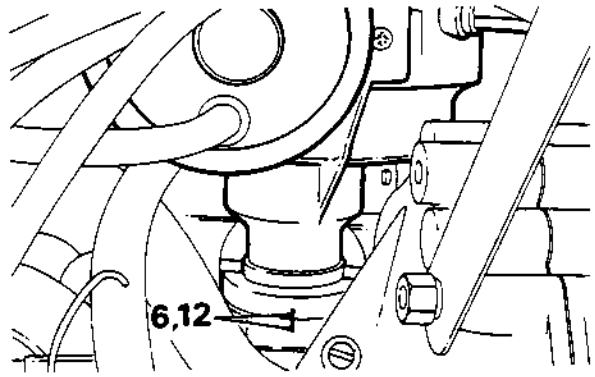
Removing

1. Disconnect battery.
2. Disconnect vacuum pipe(s).
3. Remove distributor cap.
4. Disconnect low tension lead from coil.
5. Mark distributor body in relation to centre line of rotor arm.



RR 477M

6. Add alignment marks to distributor and front cover.



RR476M

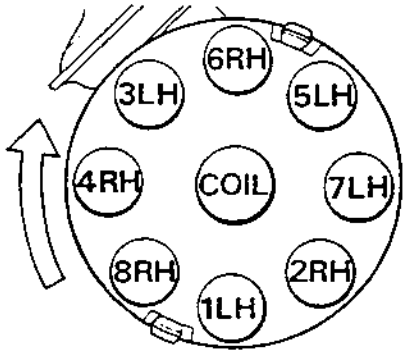
NOTE: Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

7. Release the distributor clamp and remove the distributor.

Refitting

NOTE: If a new distributor is being fitted, mark body in same relative position as distributor removed.

8. Leads for distributor cap should be connected as illustrated.
   Figures 1 to 8 inclusive indicate plug lead numbers.
   RH—Right-hand side of engine, when viewed from the rear.
   LH—Left-hand side of engine, when viewed from the rear.



RR616M

9. If engine has not been turned whilst distributor has been removed, proceed as follows (items 10 to 17).
10. Fit new 'O' ring seal to distributor housing.
11. Turn distributor drive until centre line of rotor arm is 30° anti-clockwise from mark made on top edge of distributor body.
12. Fit distributor in accordance with alignment markings.

    NOTE: It may be necessary to align oil pump drive shaft to enable distributor drive shaft to engage in slot.

13. Fit clamp and bolt. Secure distributor in exact original position.
14. Connect vacuum pipe to distributor and low tension lead to coil.
15. Fit distributor cap.
16. Reconnect battery.
17. Using suitable electronic equipment, set the ignition timing as follows.
18. If, with distributor removed, engine has been turned it will be necessary to carry out the following procedure.
19. Set engine—No. 1 piston to static ignition timing figure (see data section) on compression stroke.
20. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
21. Fit distributor to engine.
22. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
23. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.

24. Fit clamp and bolt leaving both loose at this stage.
25. Set the ignition timing statically to within 2°–3° of T.D.C.
26. Connect the vacuum pipe to the distributor.
27. Fit low tension lead to coil.
28. Fit distributor cap.
29. Reconnect the battery.
30. Using suitable electronic equipment set the ignition timing.

DISTRIBUTOR—LUCAS 35DM8

Overhaul

DISTRIBUTOR CAP

1. Unclip and remove cap.
2. Renew cap if known to be faulty.
3. Clean cap with a nap-free cloth.

ROTOR ARM

4. Pull rotor arm from keyed shaft.
5. Renew rotor arm if known to be faulty.

INSULATION COVER (Flash shield)

6. Remove cover, secured by three screws.
7. Renew cover if known to be faulty.

VACUUM UNIT

8. Remove two screws from vacuum unit securing bracket, disengage vacuum unit connecting rod from pick-up base plate connecting peg, and withdraw vacuum unit from distributor body.

PICK-UP AND BASE PLATE ASSEMBLY

9. Use circlip pliers to remove the circlip retaining the reluctor on rotor shaft.
10. Remove the flat washer and then the 'O' ring recessed in the top of the reluctor.
11. Insert the blade of a small screwdriver beneath the reluctor and prise it partially along the shaft, sufficient to enable it to be gripped between the fingers and withdrawn from the shaft.

    NOTE: Coupling ring fitted beneath reluctor.

12. Remove pick-up and base plate assembly, secured by three support pillars.

    NOTE: Do not disturb the two barrel nuts securing the pick-up module, otherwise the air gap will need re-adjustment.

13. Renew pick-up and base plate assembly if module is known to be faulty, otherwise check pick-up winding resistance (2k–5k ohm).

RE-ASSEMBLY

14. This is mainly a reversal of the dismantling procedure, noting the following points:

LUBRICATION

Apply clean engine oil:

a. Three drops to felt pad reservoir in rotor shaft.

Apply Chevron SR1 (or equivalent) grease.

b. Auto advance mechanism.
c. Pick-up plate centre bearing.
d. Pre tilt spring and its rubbing area (pick-up and base plate assy).
e. Vacuum unit connecting peg (pick-up and base plate assy).
f. The connecting peg hole in vacuum unit connecting rod.

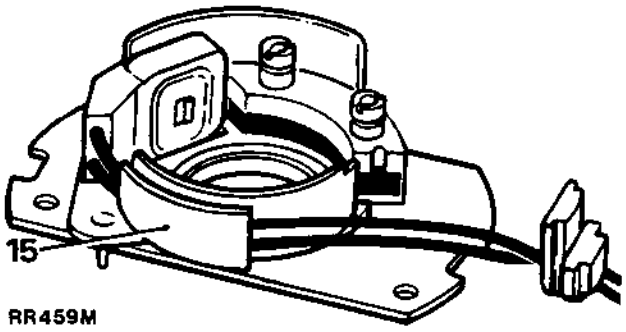
Apply Rocal MHT (or equivalent) grease:

g. Vacuum unit connecting rod seal (located in vacuum unit where connecting rod protrudes).

NOTE: Applicable only to double acting vacuum units.

FITTING PICK-UP AND BASE PLATE ASSEMBLY

15. Pick-up leads must be prevented from fouling the rotating reluctor. Both leads should be located in plastic carrier as illustrated. Check during re-assembly.



RR459M

REFITTING RELUCTOR

16. Slide reluctor as far as it will go on rotor shaft, then rotate reluctor until it engages with the coupling ring beneath the pick-up base plate. The distributor shaft, coupling ring and reluctor are 'keyed' and rotate together.

Continued

PICK-UP AIR GAP ADJUSTMENT

17. The air gap between the pick-up limb and reluctor teeth must be set within the specified limits, using a non-ferrous feeler gauge.

NOTE: When the original pick-up and base plate assembly has been refitted the air gap should not normally require resetting as it is pre-set at the factory. When renewing the assembly the air gap will require adjusting to within the specified limits. Refer to 'Engine Tuning Data' for ignition timing data.

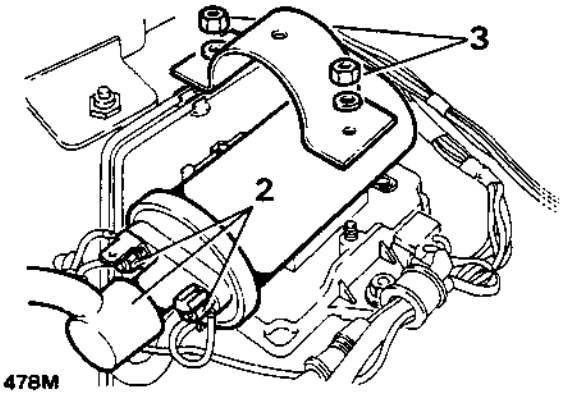
IGNITION COIL

Remove and refit

Removing

1. Disconnect the battery.
2. Disconnect the electrical leads from the coil.
3. Remove the two retaining nuts and washers securing the coil to the amplifier.

4. Lift the coil off the amplifier.



RR 478M

Refitting

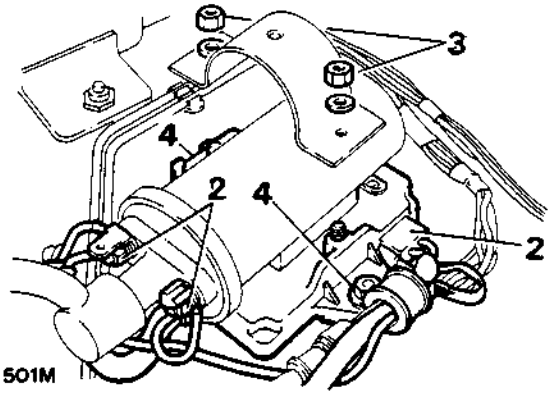
5. Reverse the removal procedure.

AMPLIFIER

Remove and Refit

Removing

1. Disconnect the battery.
2. Disconnect the electrical leads from the amplifier and coil.
3. Remove the two retaining nuts with washers securing the coil to the amplifier.
4. Remove the two bolts, nuts, spring washers and plain washers securing the amplifier to the valance.
5. Remove the amplifier from the valance.



RR 501M

Refitting

6. Reverse the removal procedure, ensuring that all electrical leads are correctly reconnected.

NOTE: The amplifier is not serviceable, in the event of a fault a new amplifier must be fitted.

IGNITION TIMING

1. It is essential that the following procedures are adhered to. Inaccurate timing can lead to serious engine damage and additionally create failure to comply with the emission regulations applying to the country of destination. If the engine is being checked in the vehicle and is fitted with an air conditioning unit the compressor must be isolated.

2. On initial engine build, or if the distributor has been disturbed for any reason, the ignition timing must be set statically to within 2°–3° of T.D.C.
(This sequence is to give only an approximation in order that the engine may be started) **ON NO ACCOUNT MUST THE ENGINE BE STARTED BEFORE THIS OPERATION IS CARRIED OUT.**

Equipment required

Calibrated Tachometer
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following the manufacturers instructions.

4. Disconnect the vacuum pipes from the distributor.

5. Start engine, with no load and not exceeding 3,000 rpm, run engine until normal operating temperature is reached. (Thermostat open). Check that the normal idling speed falls within the tolerance specified in the data section.

6. Idle speed for timing purposes must not exceed 750 rpm, and this speed should be achieved by removing a breather hose **NOT BY ADJUSTING IDLE SETTING SCREWS.**

7. With the distributor clamping bolt slackened turn distributor until the timing flash coincides with the timing pointer and the correct timing mark on the rim of the torsional vibration damper as shown in the engine tuning section.

8. Retighten the distributor clamping bolt securely. Recheck timing in the event that retightening has disturbed the distributor position.

9. Refit vacuum pipes.

10. Disconnect stroboscopic timing lamp and tachometer from engine.

LUCAS CONSTANT ENERGY IGNITION SYSTEM 35DM8 PRELIMINARY CHECKS

Inspect battery cables and connections to ensure they are clean and tight. Check battery state of charge if in doubt as to its condition.

Inspect all LT connections to ensure that they are clean and tight. Check the HT leads are correctly positioned and not shorting to earth against any engine components. The wiring harness and individual cables should be firmly fastened to prevent chafing.

PICK-UP MODULE AIR GAP SETTINGS

Air gap settings vary according to vehicle application.

NOTE: The gap is set initially at the factory and will only require adjusting if tampered with or when the pick-up module is replaced.

Test Notes

(i) The ignition must be switched on for all checks.
(ii) Key to symbols used in the charts for Tests 2.

✓	Correct Reading	H	High Reading	L	Low Reading

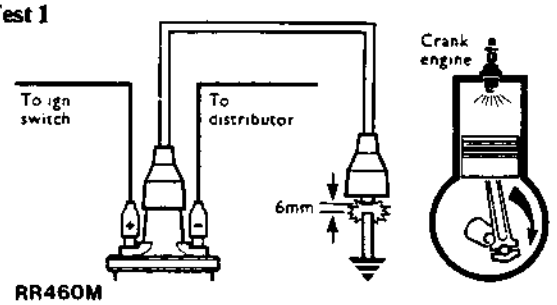
(iii) Use feeler gauges manufactured from a non-magnetic material when setting air gaps.

TEST 1:

Check HT Sparking

Remove coil/distributor HT lead from distributor cover and hold approximately 6 mm (0.25 in) from the engine block. Switch the ignition 'on' and operate the starter.
If regular sparking occurs, proceed to Test 6. If no sparking proceed to Test 2.

Test 1



TEST 2:

Amplifier Static Checks

Switch the ignition 'on'
(a) Connect voltmeter to points in the circuit indicated by the arrow heads and make a note of the voltage readings.

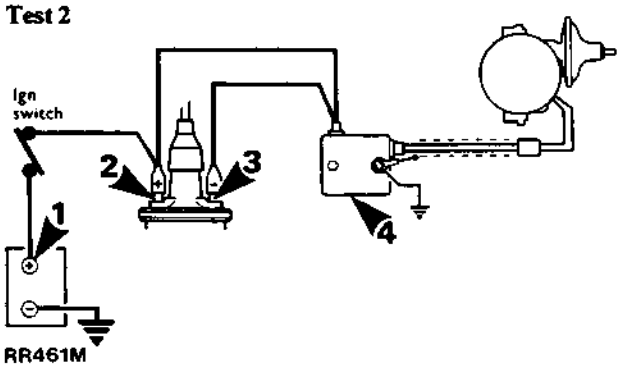
NOTE: Only move the voltmeter POSITIVE lead during tests 2, 3 and 4.

(b) Compare voltages obtained with the specified values listed below:

EXPECTED READINGS

1. More than 11.5 volts
2. 1 volt max below volts at point 1 in test circuit
3. 1 volt max below volts at point 1 in test circuit
4. 0 volt—0.1 volt

Test 2



Continued

(c) If all readings are correct proceed to Test 3.
(d) Check incorrect reading(s) with chart to identify area of possible faults, i.e. faults listed under heading 'Suspect'.

1	2	3	4	SUSPECT
L	✓	✓	✓	DISCHARGED BATTERY
✓	L	L	✓	IGN. SWITCH AND/OR WIRING
✓	✓	L	✓	COIL OR AMPLIFIER
✓	✓	✓	H	AMPLIFIER EARTH

TEST 3:

Check Amplifier Switching

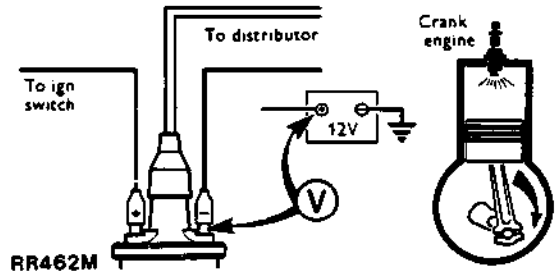
Disconnect the high tension lead between the coil and distributor.

Connect the voltmeter between battery positive (+ ve) terminal and H.T. coil negative (− ve) terminal, the voltmeter should register zero volts.

Switch the ignition 'on' then crank the engine. The voltmeter reading should increase just above zero, in which case proceed with Test 5.

If there is no increase in voltage during cranking proceed to Test 4.

Test 3



TEST 4:

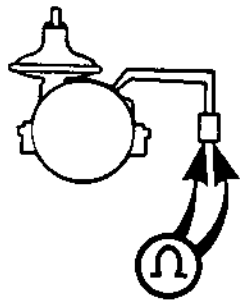
Pick-Up Coil Resistance
Applications with Separate Amplifier

Disconnect the pick-up leads at the harness connector. Connect the ohmmeter leads to the two pick-up leads in the plug.

The ohmmeter should register between 2k and 5k ohm if pick-up is satisfactory. Change the amplifier if ohmmeter reading is correct. If the engine still does not start carry out Test 5.

Change the pick-up if ohmmeter reading is incorrect. If the engine still does not start proceed to Test 5.

Test 4



TEST 5:

Check H.T. Sparking

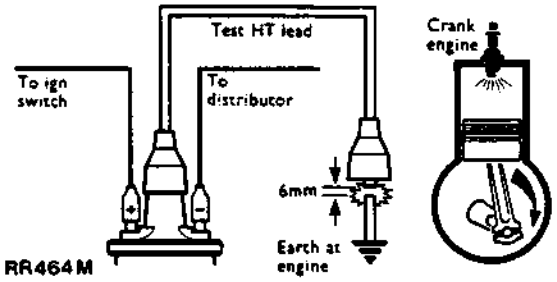
Remove existing coil/distributor H.T. lead and fit test H.T. lead to coil chimney. Hold free end about 6 mm (0.25 in) from the engine block and crank the engine.

H.T. sparking good, repeat test with original H.T. lead, if then no sparking, change H.T. lead. If sparking is good but engine will not start, proceed to Test 6.

If no sparking, replace coil.

If engine will not start carry out Test 6.

Test 5



Continued

TEST 6:

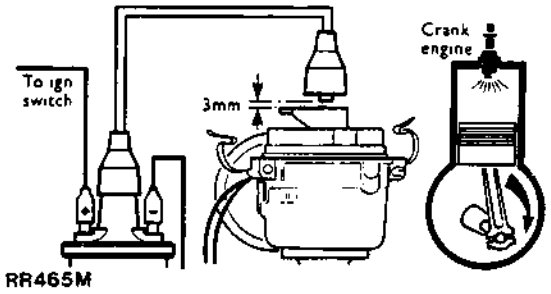
Check Rotor Arm

Remove distributor cover. Disconnect coil H.T. lead from cover and hold about 3 mm (0.13 in) above rotor arm electrode and crank the engine. There should be no H.T. sparking between rotor and H.T. lead. If satisfactory carry out Test 7.

H.T. sparking, replace rotor arm.

If engine will not start carry out Test 7.

Test 6



TEST 7:

Visual and H.T. Cable Checks

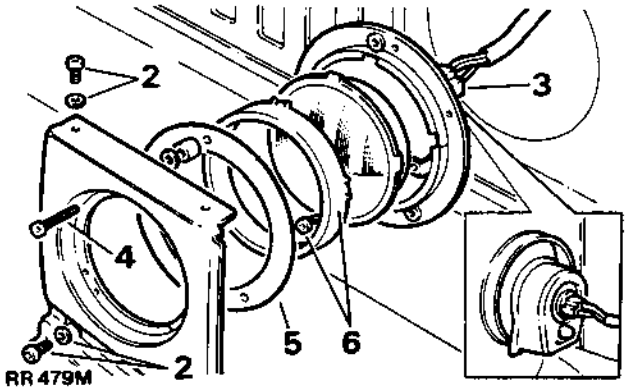
Examine:	Should be:
1. Distributor Cover.	Clean, dry, no tracking marks.
2. Coil Top.	Clean, dry, no tracking marks.
3. H.T. Cable Insulation.	Must not be cracked, chafed or perished.
4. H.T. Cable Continuity.	Must not be open circuit.
5. Sparking Plugs.	Clean, dry, and set to correct gap.
NOTE:	
1. Reluctor.	Must not foul pick-up or leads.
2. Rotor and Flash Shield.	Must not be cracked or show signs of tracking marks.

HEADLAMP ASSEMBLY

Remove and refit

Removing

1. Disconnect the battery.
2. Remove screws and washers securing the headlamp frame to the body.
3. Ease the headlamp assembly forward and disconnect.
4. Remove the two adjusting screws and one clamp to separate lamp unit from the frame.
5. Remove the rubber seal.
6. Separate the lamp unit from rim by loosening the three retaining screws.



RR 479M

Refitting

7. Reverse removal procedure.

HEADLAMP BULB

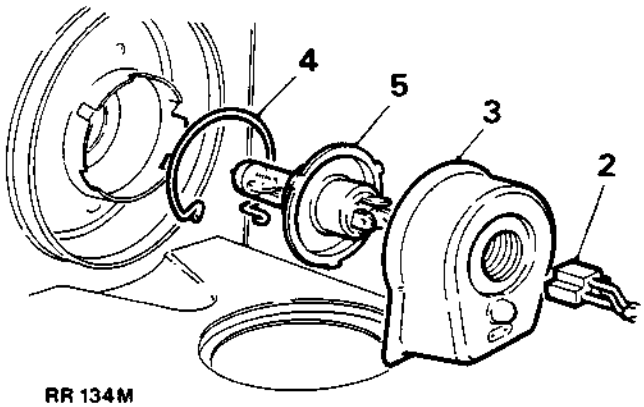
Remove and refit (Halogen)

Removing

1. Prop open the bonnet. Two large clearance holes are provided, one on each side of the front valance, to give access to the respective bulb holders in the headlamp reflectors.

   NOTE: To obtain access to the right-hand clearance hole it will be necessary to remove the battery from the vehicle.

2. Disconnect the multi-plug lead.
3. Remove the rubber dust cover.
4. Release the bulb retaining spring clip.
5. Remove the faulty bulb.



RR 134M

Refitting

6. Fit the correct 'Halogen' type. The bulb holder is keyed to facilitate fitting.

   IMPORTANT: Do not touch the quartz envelope of the bulb with the fingers. If contact is accidentally made wipe gently with methylated spirits.

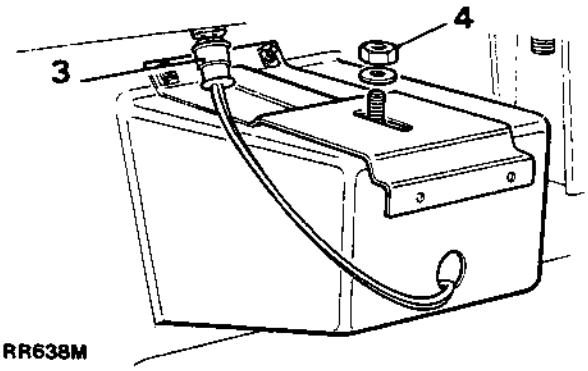
7. Reverse remaining removal procedure.

AUXILIARY DRIVING LAMP—RH AND LH

Remove and refit

Bulb replacement

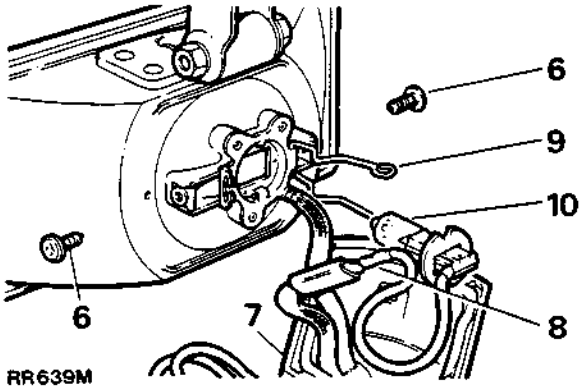
1. Disconnect the battery.
2. The auxiliary driving lamp securing nut is located beneath the front wing adjacent to the front body fixing. Access to the lamp is gained through the front wheel arch.
3. Disconnect the electrical plug.
4. Remove the single nut and washer.



RR638M

5. From the front of the vehicle, manoeuvre the lamp and remove it from the spoiler aperture.

6. Remove the two screws securing the cover to the rear of the lamp.
7. Withdraw the cover.
8. Disconnect the lucar connector.
9. Release the spring clip securing the bulb to the lamp unit.
10. Remove the bulb.



Refitting

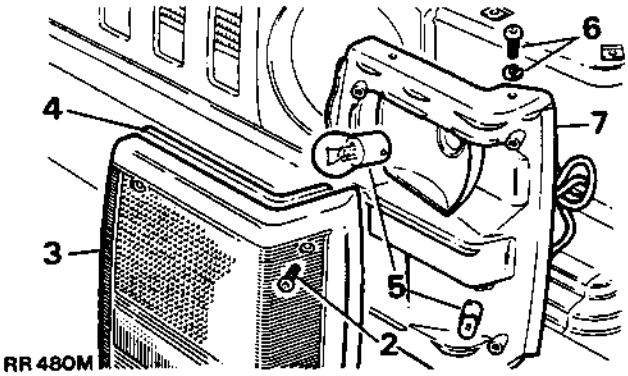
11. Reverse the removal procedure.
12. Fit a new bulb ensuring that the two notches on the bulb body locate with the registers on the lamp unit.

SIDE LIGHT AND FLASHER LAMP ASSEMBLY—RH AND LH AND BULB

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the four screws securing the lamp lens.
3. Release the lamp lens from the lamp body.
4. Remove the foam rubber seal.
5. Remove the two bayonet fitting bulbs.
6. Remove the two screws securing the lamp body.
7. Ease the lamp body forward to reveal the electrical connection.



8. Disconnect the electrical plug at the rear of the lamp body.
9. Remove the lamp body.

Refitting

10. Reverse the removal procedure.

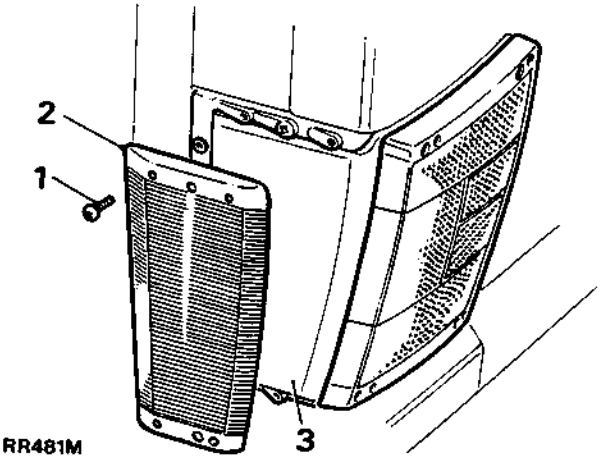
REFLECTORS

Remove and refit

Removing

1. Remove the four screws securing reflector.
2. Remove reflector.
3. Remove rubber seal.

NOTE: To remove the rubber seal completely it is necessary to remove the tail light lens.



Refitting

4. Reverse the removal procedure.

TAIL, STOP, REVERSE, FOG GUARD AND FLASHER LAMP ASSEMBLY—RH AND LH

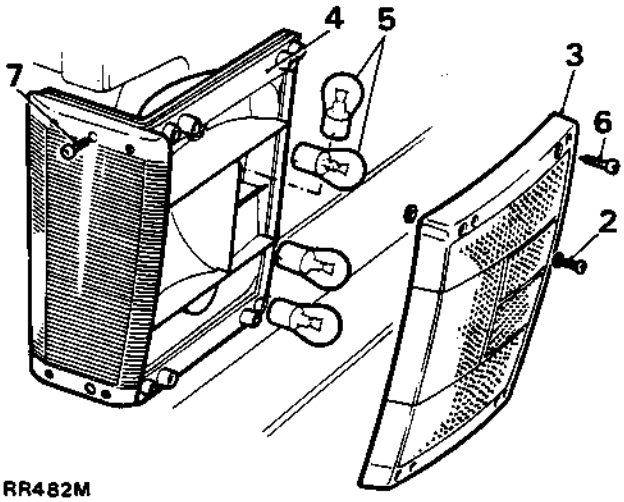
Remove and refit

Removing

1. Disconnect the battery.
2. Remove the four lens retaining screws.
3. Remove lens.
4. Remove sealing rubber.

NOTE: To remove the sealing rubber complete it is necessary to remove the side reflector lens.

5. Remove the bulbs.
6. Remove the four screws securing the lamp unit to the body.
7. Remove the two through-screws from the reflector side, which also secure the lamp unit to the body.
8. Ease the lamp unit forward and disconnect leads at moulded connectors.



RR482M

Refitting

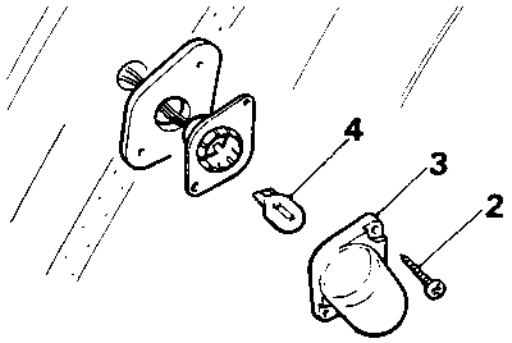
9. Reverse the removal procedure.

UNDER BONNET LAMP ASSEMBLY

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the two securing screws.
3. Remove the lamp glass.
4. Pull the five-watt 'wedge' type bulb from the bulb holder.



RR483M

5. Disconnect the electrical leads located below the bonnet lamp switch attached to the inner wing.
6. Pull the rubber grommet off the leads and pull the lamp and leads up through the bonnet stiffener channel.

Refitting

7. Reverse operations 1 to 6.

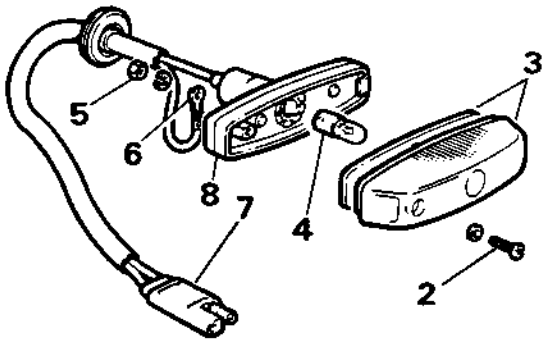
NOTE: A piece of bent wire will be needed to pull the electrical leads out of the channel exit hole when fitting a new lamp assembly.

SIDE REPEATER LAMPS

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the single screw retaining the lamp lens.
3. Remove the lamp lens and rubber seal.
4. Remove the four-watt bayonet fitting bulb.
5. Remove the two nuts and spring washers from the rear of the lamp body accessible from behind the front wing.
6. Remove the earth wire from the rear of the lamp.
7. Disconnect the twin snap connector from within the engine compartment located directly behind the lamp.
8. Remove the lamp body from the outer wing.



RR457M

Refitting

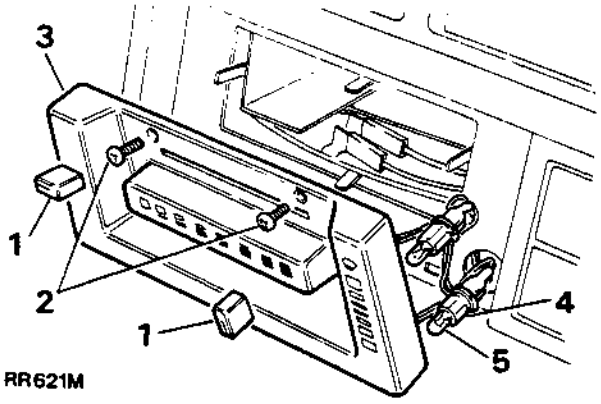
9. Reverse the removal procedure.

HEATER/VENTILATION CONTROL PANEL

Bulb replacement

The heater/ventilation control panel is illuminated by four 12-volt 1.2-watt 'wedge' type (capless) bulbs. In the event of a bulb failure a replacement bulb can be fitted as follows:

1. Pull the four finger tip knobs off the control levers.
2. Remove the two screws at the top of the panel.
3. Carefully ease the panel away from the centre console only as far as the electrical leads will permit.
4. Pull the appropriate bulb holder out of the rear of the panel.
5. Pull the bulb from the holder.
6. Renew the bulb and push the bulb holder firmly back into its location at the rear of the panel.



RR621M

Refitting

7. Ensuring that the electrical leads do not become trapped between the panel console and operating levers, refit the panel.

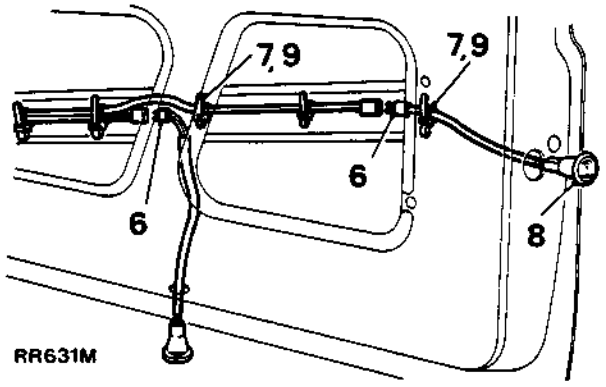
DOOR EDGE LAMPS/PUDDLE LAMPS

Incorporated into the front door assemblies are door edge lamps and puddle lamps, these are located on the shut face and bottom of the door. The lamps are activated by the courtesy light switches when either front door is opened and will immediately switch off when both doors are closed.

Remove and Refit

Removing

1. Ensure the side door glass is fully closed.
2. Disconnect the battery.
3. Remove the interior door handle and arm rest/door pull from the door.
4. Carefully release the interior door trim pad from the inner door panel.
5. Peel back the lower half of the plastic weather sheet.
6. Disconnect the door edge lamp and puddle lamp two pin electrical plugs within the door, accessible through the lower centre and outer apertures of the inner door panel.
7. Release the door edge lamp electrical leads from the retaining clips.
8. Prise the lamps out of the door and withdraw the electrical leads.



RR631M

Refitting

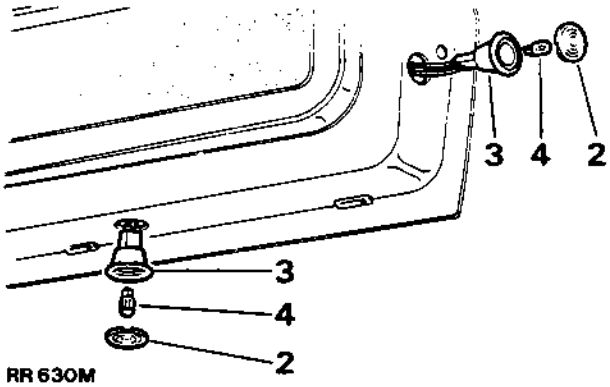
9. Reverse the removal procedure.

NOTE: Ensure the door lamp wiring harness is securely clipped to the lower stiffener plate within the door to prevent damage occurring to the electrical leads when the door glass is in its lowest position.

DOOR EDGE LAMPS/PUDDLE LAMPS

Bulb replacement

1. Disconnect battery.
2. Carefully prise out the lamp lens.
3. Withdraw the lamp body from the door **ONLY** as far as the electrical leads will permit.
4. Pull the bulb from the holder.



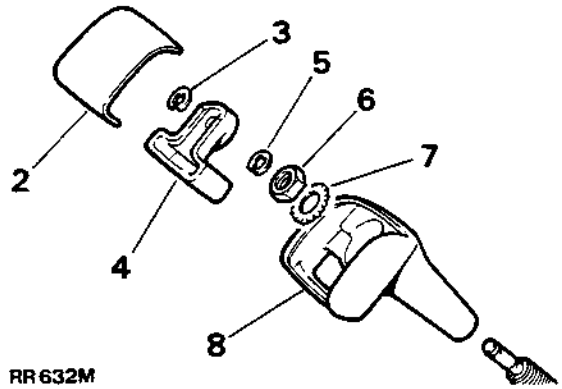
RR630M

5. Renew the bulb and refit the lamp lens.
6. Push the lamp into the door.
   The correct bulb type is a 12-volt 10/5-watt capless.

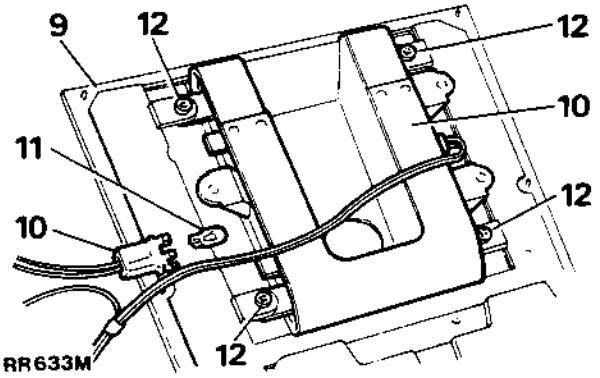
AUTOMATIC GEAR SELECTOR—PANEL ILLUMINATION

Bulb replacement

1. Disconnect the battery.
2. Unclip the cover from the top of the gear selector knob.
3. Remove the circlip retaining the detent button.
4. Withdraw the detent button.
5. Remove the lower circlip above the gear selector knob securing nut.
6. Remove the securing nut.
7. Withdraw the serrated washer.
8. Slide the selector knob off the shaft.



9. Carefully prise the inset panel out of the floor mounted console, complete with selector illumination panel and ash tray.
10. The two illumination bulbs are located on the reverse side of the illumination panel.
11. Pull the appropriate bulb holder from its location.
12. If necessary, to facilitate easier removal of the bulb holders, remove the four screws securing the illumination panel to the outer surround panel.



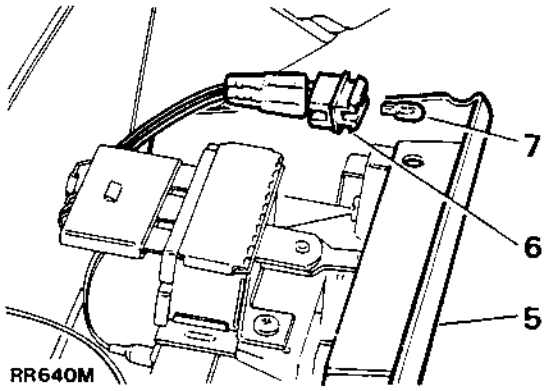
13. Pull the bulb from the holder.
    The correct bulb type is a 24-volt 5-watt 'wedge' base (capless).

Refitting

14. Reverse the removal procedure ensuring that the electrical leads beneath the floor mounted console do **NOT** become trapped between mating surfaces.
15. To prevent damage to the gear selector knob (Automatic only) on reassembly do **NOT** overtighten the retaining nut, see data section for correct torque.

AIR CONDITIONING CONTROL PANEL ILLUMINATION—Bulb replacement

1. Disconnect the battery.
2. Pull the finger tip control knobs off the control levers.
3. Carefully prise the four air vents out of the fascia panel.
4. Remove the fifteen screws securing the panel to the upper and lower panels.
5. Withdraw the panel only as far as the electrical leads will permit.
6. Pull the bulb holder from the rear right-hand side of the control panel.
7. Pull the bulb from the holder.



Refitting

8. Reverse the removal procedure.
   The correct bulb type is a 12-volt 1.2-watt 'wedge' base (capless).

NUMBER PLATE LAMP ASSEMBLY AND BULB REPLACEMENT

Remove and refit

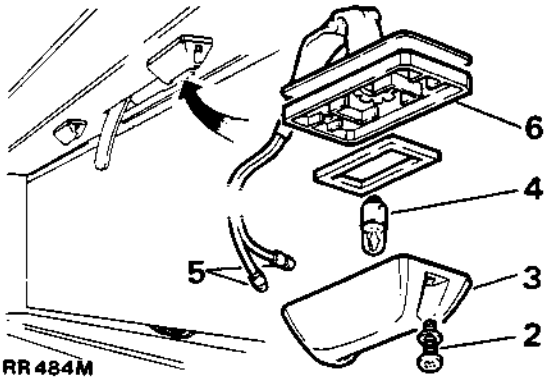
Removing

1. Disconnect the battery.
2. Remove the two self-tapping screws and fibre washers.
3. Detach the lens surround and lamp lens.
4. Remove the bulb.

Continued

NOTE: Carefully pull the electrical leads out of the bottom of the lower tailgate panel to reveal the snap connectors.

5. Disconnect the electrical connections located at the bottom of the lower tailgate.
6. Remove the bulb holder surround.
7. Carefully pull the electrical leads up through the inside of the lower tailgate panels.



RR484M

Refitting

8. Reverse the removal procedure.

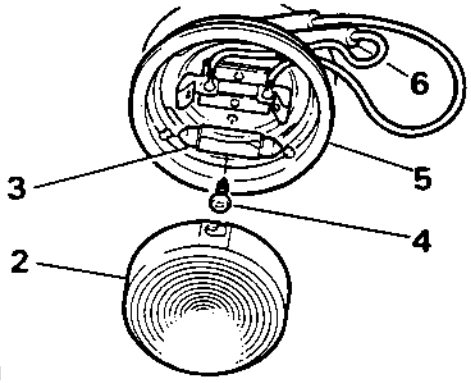
INTERIOR ROOF LAMPS

Remove and refit

The interior roof lamps are operated automatically via the side door and tailgate courtesy switches or by an independent switch located on the auxiliary switch panel.

Removing

1. Disconnect the battery.
2. Remove the lens from the courtesy lamp by pressing upward and turning it anti-clockwise.
3. Withdraw bulb from spring clip holder.
4. Remove screws securing lamp base to roof panel.
5. Lower the lamp to reveal the cable snap connections.
6. Disconnect the electrical connections.



RR485M

Refitting

7. Reverse the removal procedure.

INTERIOR ROOF LAMPS CIRCUIT DELAY

Remove and refit

The roof lamp circuit incorporates a delay function which is designed to allow the lamps to remain on for 12 to 18 seconds after either of the front doors are closed.

NOTE: Switching on the ignition (with both doors closed) will immediately over-ride this feature, switching the interior lamps off.

Removing

1. Disconnect the battery.
2. Remove the six screws securing the lower fascia panel.
3. Lower the fascia panel to gain access to the red delay unit attached to the steering column support bracket.
4. Remove the delay unit by pushing the unit up off its retaining bracket, to clear the steering column support bracket.
5. Pull the red multi-plug off the delay unit.

Refitting

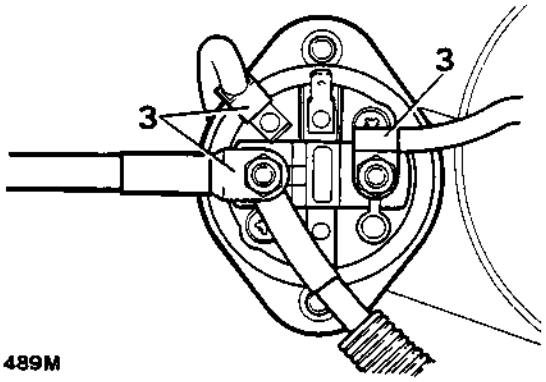
6. Reverse the removal operations.

STARTER MOTOR

Remove and refit

Removing

1. Place car on a suitable ramp.
2. Disconnect the battery.
3. Disconnect the leads from the solenoid and starter motor and remove the exhaust heat shield.
4. Remove the two bolts securing the starter motor to the flywheel housing.
5. Remove starter motor from underneath the vehicle.



RR 489M

Refitting

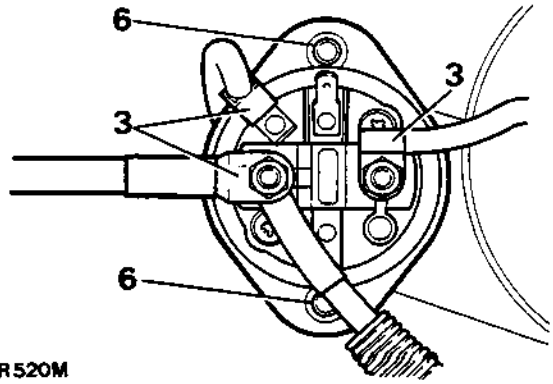
6. Reverse the removal procedure.

STARTER SOLENOID

Remove and refit

Removing

1. Place car on a suitable ramp.
2. Disconnect the battery.
3. Disconnect the leads from the solenoid and starter motor and remove the exhaust heat shield.
4. Remove the two bolts securing the starter motor to the flywheel housing.
5. Remove the starter motor from underneath the vehicle.



RR 520M

6. Remove the two bolts securing the solenoid to the starter motor.
7. Withdraw the solenoid from the solenoid housing.

Refitting

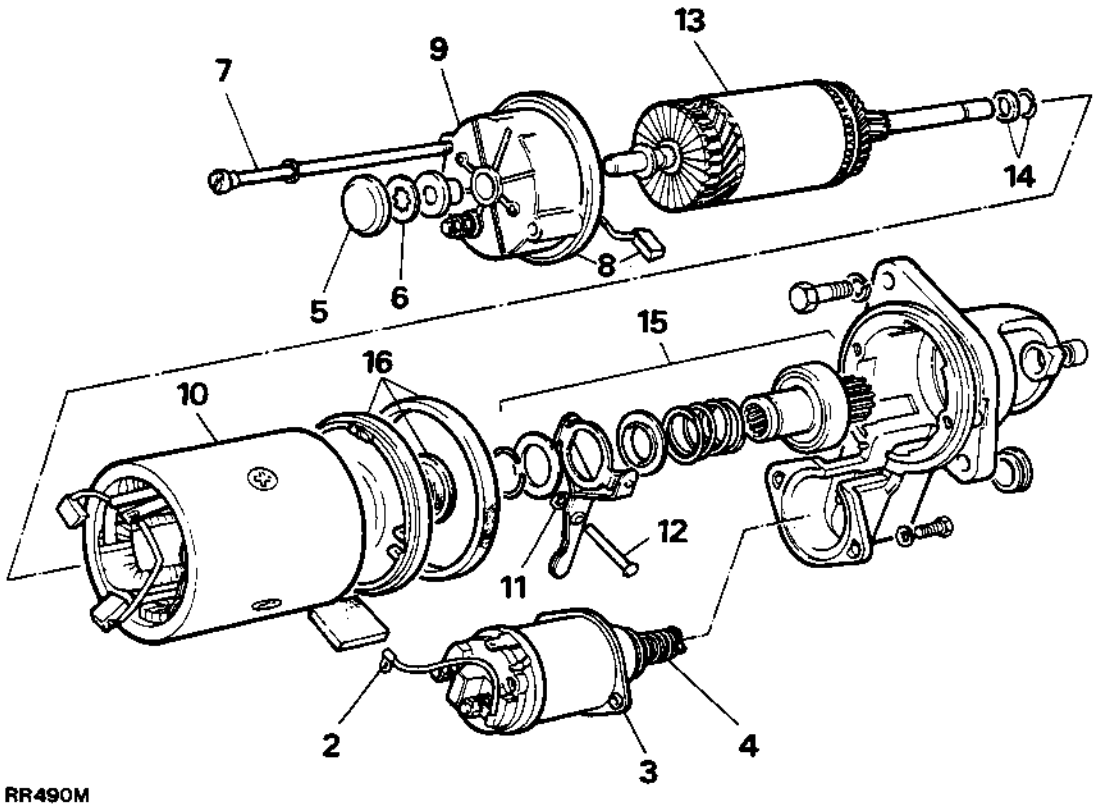
8. Reverse the removal procedure.

STARTER MOTOR—Lucas 3M100PE

Overhaul

Dismantling

1. Remove the starter motor.
2. Remove the connecting link between the starter and the solenoid terminal 'STA'.
3. Remove the solenoid from the drive end bracket.
4. Grasp the solenoid plunger and lift the front end to release it from the top of the drive engagement lever.
5. Remove the end cap seal.
6. Using an engineer's chisel, cut through a number of the retaining ring claws until the grip on the armature shaft is sufficiently relieved to allow the retaining ring to be removed.
7. Remove the two through bolts.
8. Partially withdraw the commutator end cover and disengage the two field coil brushes from the brush box.
9. Remove the commutator end cover.
10. Withdraw the yoke and field coil assembly.
11. Remove the retaining ring from the drive engagement lever pivot-pin, using the method previously described.
12. Withdraw the pivot pin.
13. Withdraw the armature.
14. Using a suitable tube, remove the collar and jump ring from the armature shaft.
15. Slide the thrust collar and the roller clutch drive and lever assembly off the shaft.
16. Remove the intermediate bracket and seals.



RR490M

Continued

Inspecting

Clutch

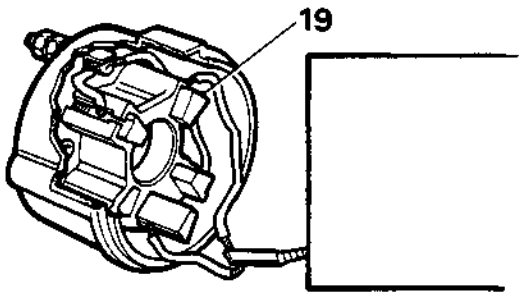
17. Check that the clutch gives instantaneous take-up of the drive in one direction and rotates easily and smoothly in the other direction.
    Ensure that the clutch is free to move round and along the shaft splines without any tendency to bind.

NOTE: The roller clutch drive is sealed in a rolled steel cover and cannot be dismantled.

18. Lubricate all clutch moving parts with Shell SB 2628 grease for cold and temperate climates or Shell Retinax 'A' for hot climates.

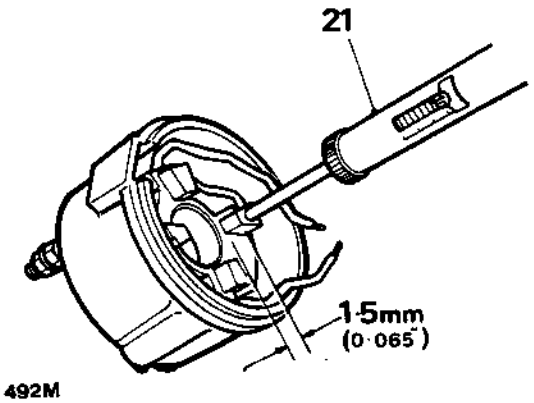
Brushes

19. Check that the brushes move freely in the brush box moulding. Rectify sticking brushes by wiping with a petrol moistened cloth.



RR491M

20. Fit new brushes if they are damaged or worn to approximately 9.5 mm (0.375 in).
21. Using a push-type spring gauge, check the brush spring pressure. With new brushes pushed in until the top of the brush protrudes about 1.5 mm (0.065 in) from the brush box moulding, the spring pressure reading should be 1.0 kgf (36 ozf).

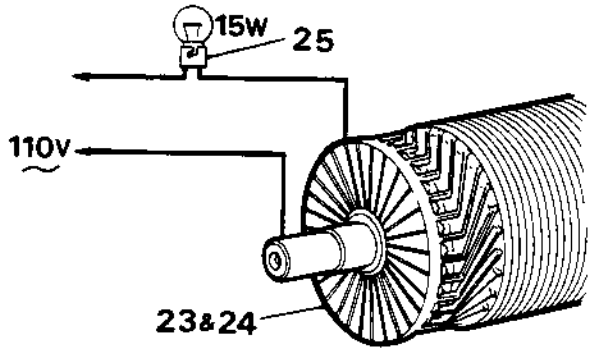


RR492M

22. Check the insulation of the brush springs by connecting a 110-volt a.c. 15-watt test lamp between a clean part of the commutator end cover and each of the springs in turn. The lamp should not light.

Armature

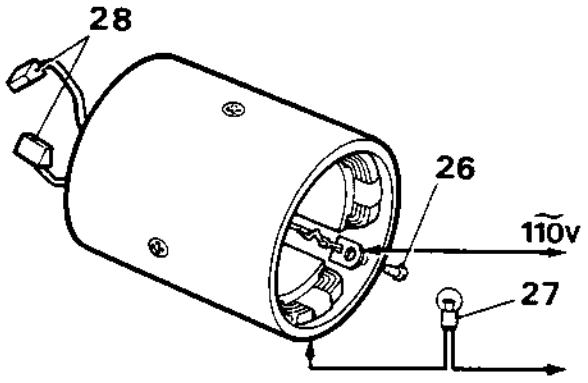
23. Check the commutator. If cleaning only is necessary, use a flat surface of very fine glass paper, and then wipe the commutator surface with a petrol moistened cloth.
24. If necessary, the commutator may be machined providing a finished surface can be obtained without reducing the thickness of the commutator copper below 3.5 mm (0.140 in), otherwise a new armature must be fitted. Do not undercut the insulation slots.
25. Check the armature insulation by connecting 110-volt a.c. 15-watt test lamp between any one of the commutator segments and the shaft. The lamp should not light, if it does light fit a new armature.



RR493M

Field coil insulation

26. Disconnect the end of the field winding where it is riveted to the yoke, by filing away the riveted over end of the connecting-eyelet securing rivet, sufficient to enable the rivet to be tapped out of the yoke.

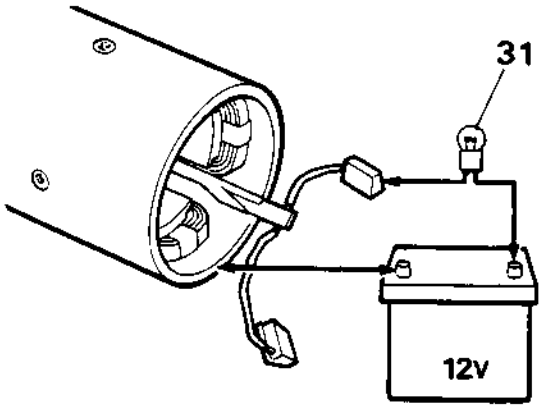


RR494M

27. Connect a 110-volt a.c. 15-watt test lamp between the disconnected end of the winding and a clean part of the yoke.
28. Ensure that the brushes or bare parts of their flexibles are not touching the yoke during the test.
29. The lamp should not light, if it does light, fit a new field coil assembly.
30. Resecure the end of the field winding to the yoke.

Field coil continuity

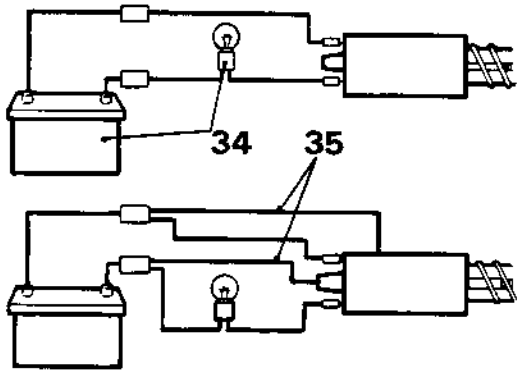
31. Connect a 12-volt battery operated test lamp between each of the brushes in turn and a clean part of the yoke.
32. The lamp should light, if it does not light, fit a new field coil assembly.



RR495M

Solenoid

33. Disconnect all cables from the solenoid terminals and connectors.
34. Connect a 12-volt battery and a 12-volt 60-watt test lamp between the solenoid main terminals. The lamp should not light, if it does light, fit new solenoid contacts or a new solenoid complete.
35. Leave the test lamp connected and, using the same 12-volt battery supply, energise the solenoid by connecting 12-volt between the small solenoid operating 'Lucar' terminal blade and a good earth point on the solenoid body.



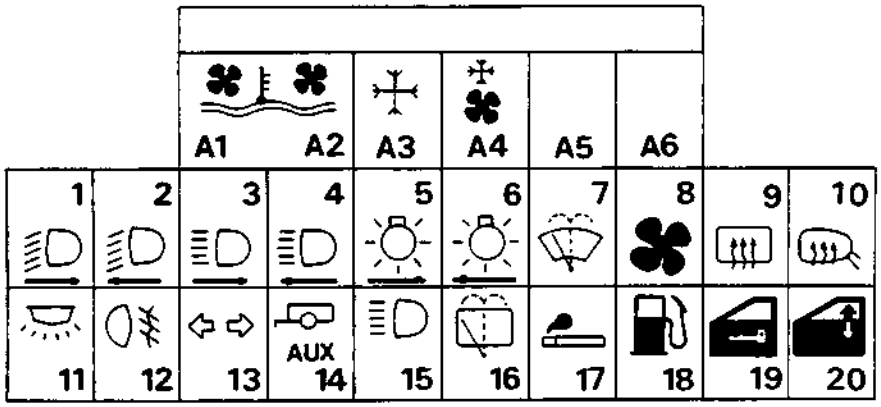
RR496M

36. The solenoid should be heard to operate and the test lamp should light with full brilliance, otherwise fit new solenoid contacts or a new solenoid complete.

Reassembling

37. Reverse 1 to 15, including the following:
38. Fit the commutator end cover before refitting the solenoid to facilitate assembly of the block shaped grommet which, when assembled, is compressed between the yoke, solenoid and fixing bracket.
39. Ensure that the internal thrust washer is fitted to the commutator end of the armature shaft.
40. Tighten the through bolts, solenoid fixing and upper terminal nuts to the correct torque—see Torque Wrench Settings.
41. Set the armature end float by driving the retaining ring on the armature shaft into a position that provides a maximum of 0.25 mm (0.010 in) clearance between the retaining ring and the bearing bush shoulder.

FUSE BOX



RR622M

AUXILIARY FUSE PANEL—(applicable to Air conditioning only)

Fuse No.	Colour Code	Fuse Value	Circuit Served	Ignition Key Controlled
A1	Yellow	20 amp	Air Conditioning fan—option	IGN
A2	Yellow	20 amp	Air Conditioning fan—option	IGN
A3	Tan	5 amp	Air Conditioning Compressor clutch—option	IGN
A4	Yellow	20 amp	Air Conditioning Blower Motor—option	IGN
A5	—	—	Spare	—
A6	—	—	Spare	—

MAIN FUSE PANEL

Fuse No.	Colour Code	Fuse Value	Circuit Served	Ignition Key Controlled
1	Brown	7.5 amp	RH headlamp dipped beam	—
2	Brown	7.5 amp	LH headlamp dipped beam	—
3	Brown	7.5 amp	RH headlamp main beam	—
4	Brown	7.5 amp	LH headlamp main beam	—
5	Tan	5 amp	RH side and panel lamps	—
6	Tan	5 amp	LH side lamps	—
7	Blue	15 amp	Front wash/wipe motor	Aux
8	Yellow	20 amp	Heater motor	Aux
9	Blue	15 amp	Heated rear screen	Ign
10	Violet	3 amp	Electric mirror heating element—option	Ign
11	Blue	15 amp	Interior lights, under bonnet illumination, clock, headlamp flash, horns	Ign
12	Red	10 amp	Rear fog guard (from dipped headlamps)	—
13	Blue	15 amp	Directional indicators, stop lights, reverse lights, electric mirror motors	Ign
14	Blue	15 amp	Auxiliary circuit to trailer	—
15	Blue	15 amp	Auxiliary driving lamps	—
16	Red	10 amp	Rear wash/wipe motor	Aux
17	Yellow	20 amp	Cigar lighters (front and rear)	Ign
18	Red	10 amp	Fuel pump	Ign
19	Red	10 amp	Central door locking—option	—
20	White	25 amp	Electric window lifts—option	Aux

NOTE: Radio/Cassette combination—option. An in-line type 7 amp fuse is incorporated into the power input lead of the unit.

FUSE BOX—Main and Auxiliary

Remove and refit

Remaining

1. Disconnect the battery.
2. Remove the clip-on fuse box cover
3. Remove the fuses from the main and auxiliary fuse boxes.

NOTE: The fuses in the six-way auxiliary fuse box will only be present when air-conditioning is fitted to the vehicle.

4. Remove the single screw securing the top auxiliary fuse box to the fuse box surround.
5. Unclip the opposite end of the fuse box.
6. Remove the two screws securing the main fuse box to the lower centre fascia panel.
7. Withdraw the auxiliary fuse box surround.
8. Manoeuvre the main and auxiliary fuse box to enable them to be withdrawn through the fuse box aperture.
9. Remove the leads from the fuse boxes, by inserting a small screwdriver into each fuse socket to depress the small retaining tab on the back of the lucar connections, withdraw the leads from the rear of the fuse box.

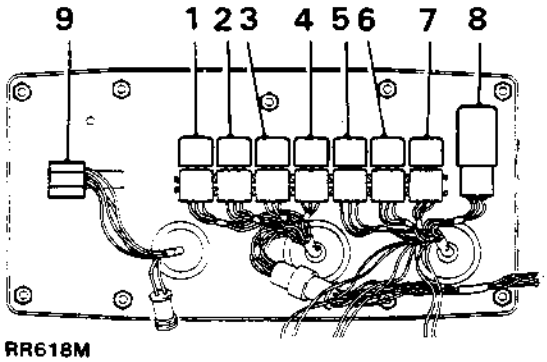
Refitting

10. Reverse the removal instructions ensuring that all leads are refitted to the correct fuse socket (refer to main circuit diagram).

NOTE: When refitting the leads to the fuse box, the retaining tabs on the back of the lucar connectors must be in their raised position to prevent the leads being pushed out of the rear of the fuse box when the fuse is refitted.

RELAYS—Identification

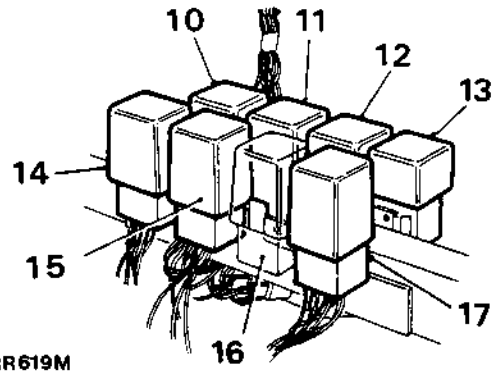
Incorporated in the vehicle electrical circuits are several relays, some of which are located behind the lower fascia panel attached to the steering column support bracket. The remaining relays are located in the engine compartment attached to the closure panel, these relays are accessible having removed the black protective cover.



RR618M

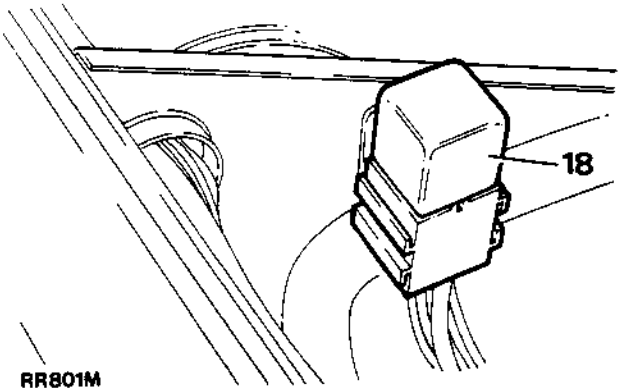
Closure panel viewed from the engine compartment. (RH drive vehicle illustrated—LH drive is a mirror image of RH drive).

NOTE: Refer to fuel injection section of manual (Book 2) for full information E.F.I. related to relays.



RR619M

Viewed from inside the vehicle with the lower fascia removed.



RR801M

Fuel cut-off relay (carburetter models only) located in the engine compartment attached to the left hand valance stiffener bracket.

RELAY	CIRCUIT DIAGRAM ITEM NUMBER	COLOUR
1. Air conditioning controlled fan relay	9. On air conditioning circuit diagram	Natural
2. Air conditioning relay (ignition controlled)	10. Air conditioning circuit diagram	Natural
3. Compressor clutch relay	8. On air conditioning circuit diagram	Natural
4. Fan relay	7. On air conditioning diagram	Natural
5. Starter solenoid relay	122. On main circuit diagram	Natural
6. Heated rear window relay	126. On main circuit diagram	Natural
7. Brake failure warning check relay	103. On main circuit diagram	Natural
8. Headlamp wash timer unit	73. On main circuit diagram	Natural
9. Ignition pick-up point	—	—
10. Hazard and flasher relay	96. On main circuit diagram	Blue
11. Voltage sensitive switch	— (only fitted to vehicles with air conditioning or split charge facility)	Yellow
	5. On split charge circuit diagram	
	129. On main circuit diagram	
12. Interior lamp delay	38. On main circuit diagram	Red
13. Auxiliary driving lamps relay	43. On main circuit diagram	Natural
14. Rear wiper delay	136. On main circuit diagram	Black
15. Rear wiper relay	138. On main circuit diagram	Black
16. Speed warning unit (Saudi only)		Green
17. Front wiper delay	78. On main circuit diagram	Black
18. Fuel cut off relay (carburetter models)	121. On main circuit diagram	Natural

RELAYS—(Mounted on the engine compartment closure panel).

Remove and refit

Removing

1. Lift the bonnet.
2. Disconnect the battery.
3. Remove the bolt securing the relay protective cover, located on the front of the engine compartment closure panel.
4. Remove the cover.
5. Pull the appropriate relay off its multi-plug.

Refitting

6. Reverse the removal procedure.

RELAYS—(Mounted on the steering column support bracket).

Remove and Refit

Removing

1. Disconnect the battery.
2. Remove the six screws securing the lower fascia panel.
3. Lower the fascia panel, disconnect the electric leads from the dimming control switch and remove the fascia panel.
4. Locate the appropriate relay on the relay mounting bracket, carefully pull the relay off the multi-plug.

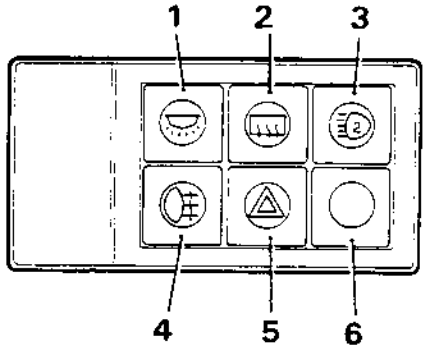
Refitting

5. Reverse the removal procedure.

AUXILIARY SWITCH PANEL

The auxiliary switch panel contains four 'push-push' type switches (five when auxiliary driving lamps are fitted) which incorporate integral symbols for identification.
(The sixth switch aperture is fitted with a blank cover, which is removable, to facilitate the fitting of an extra switch if required).
The symbols are illuminated by two bulbs which become operational when the vehicle lights are on.

The heated rear screen and hazard warning switches (2 and 5) are also provided with individual warning lights, illuminated when the switches are operated.



RR627M

1. Interior roof and tailgate lights.
2. Heated rear screen.
3. Auxiliary driving lamps—option.
4. Rear fog guard lamps.
5. Hazard warning.
6. Blank.

AUXILIARY SWITCH PANEL

Remove and Refit

Removing

1. Disconnect the battery.
2. Carefully prise the auxiliary switch panel surround away from the centre console.
3. Withdraw the switch panel as far as the electrical leads will permit.
4. Unclip the multi-plugs at the rear of the switches by depressing the retaining lugs.
5. Pull the plugs from the switches.
6. Remove the switch assembly complete.

NOTE: If necessary each individual switch can now be removed as follows.

7. Depress the small retaining lugs on the top and bottom of the switch and push the switch(es) through the front of the switch surround.

Refitting

8. Reverse the removal procedure.

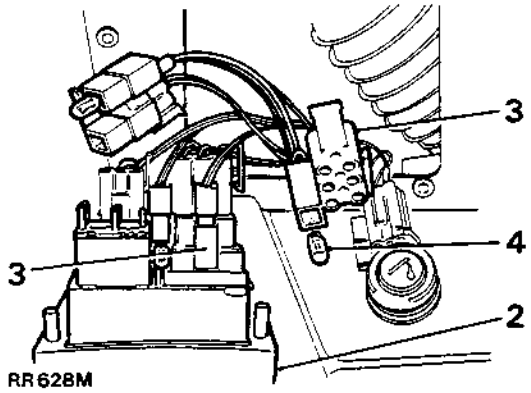
NOTE: To aid identification and location of mutli-plug to switch a coloured plastic tab is attached to each switch body which corresponds with an appropriate coloured multi-plug.
The switches if removed, should always be refitted in their original position.

Continued

Auxiliary switch panel warning lights—bulb replacement (switches 2 and 5).

To replace either bulb

1. Disconnect the battery.
2. Carefully prise the switch panel surround away from the centre console.
3. Unclip the multi-plug from the rear of the appropriate switch and disconnect the plug.
4. The warning light bulb is located in the multi-plug and is removed by pulling the bulb from its location.
5. Renew the bulb and refit the multi-plug.



RR628M

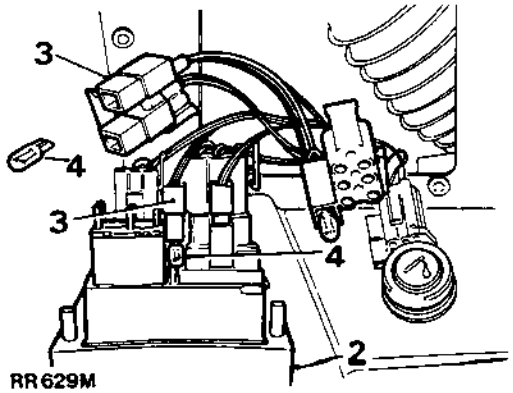
6. Press the auxiliary switch panel back into the centre console.
   Red bulb—Hazard warning/Amber bulb—Heated rear screen. The correct bulb type is a 12-volt 1.2-watt 'wedge' base (capless).

Auxiliary switch panel illumination

To replace either bulb

The auxiliary panel green illumination bulbs are located in the rear fog and hazard warning multi-plugs, each bulb is positioned in the centre of a group of four switches.

1. Disconnect the battery.
2. Carefully prise the switch panel surround away from the centre console to give access to the multi-plugs at the rear of the switches.
3. Unclip and pull the multi-plug from the rear of the appropriate switch.
4. Pull the green illumination bulb from its location.



RR629M

5. Renew the bulb and refit the multi-plug.
6. Press the auxiliary panel surround back into the centre console.

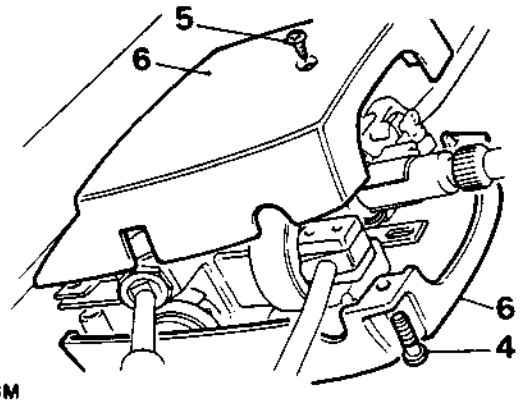
The correct bulb type is a 12-volt 1.2-watt 'wedge' base (capless).

IGNITION STARTER SWITCH

Remove and refit

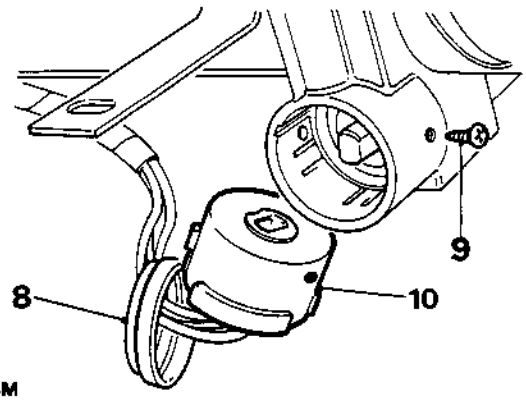
Removing

1. Disconnect the battery.
2. Remove the steering wheel centre cover.
3. Remove the lower fascia panel.
4. Remove the four screws securing bottom shroud to top shroud.
5. Remove the single screw securing top shroud to switch housing bracket.
6. Remove top shroud and lower the bottom shroud.



RR503M

7. Disconnect the ignition switch cable at the multi-plug.
8. Remove the rubber cover protecting the switch.
9. Remove the single screw securing the ignition/starter switch to the housing.
10. Withdraw the switch.



RR504M

Refitting

11. Reverse the removal procedure.

STEERING COLUMN CONTROLS

The steering column switch layout has been standardised for left- and right-hand drive vehicles and is as follows:—

LEFT-HAND CONTROLS

Lower switch—Main lighting switch.
Upper switch—Main and dipped beam, direction indicators and horn.

RIGHT-HAND CONTROLS

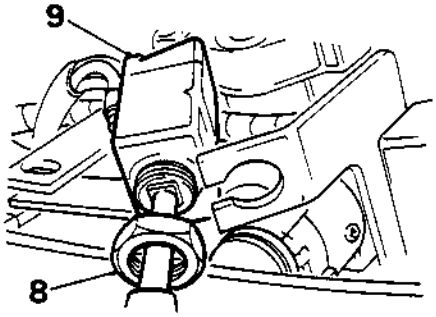
Lower switch—Rear screen programmed/wash/wipe.
Upper switch—Windscreen programmed wash/wipe.

MAIN LIGHTING SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the steering wheel centre cover.
3. Remove the lower fascia panel.
4. Remove the four screws securing bottom shroud to top shroud.
5. Remove the single screw securing top shroud to switch housing bracket.
6. Remove top shroud, and lower the bottom shroud.
7. Disconnect cables at snap connectors.
8. Loosen the switch retaining lock-nut.
9. Slide switch unit away from its bracket.



RR505M

Refitting

10. Reverse the removal procedure.

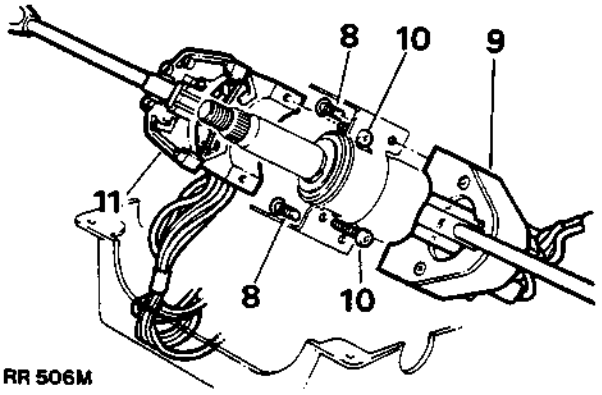
WINDSCREEN PROGRAMMED WASH WIPE SWITCH

MAIN AND DIPPED BEAM, DIRECTION INDICATORS AND HORN SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the steering wheel centre cover.
3. Remove the lower fascia panel.
4. Remove the four screws securing the bottom shroud to the top shroud.
5. Remove the single screw securing the top shroud to the switch housing bracket.
6. Remove the top shroud and lower the bottom shroud.
7. Disconnect the electrical leads at the multi-plugs.
8. Remove the two screws securing the windscreen wash/wipe switch to the column switch bracket.
9. Remove the switch to give access to the screws securing the main and dipped beam switch.
10. Release the two screws securing the upper switch to the switch bracket.
11. Slide the switch and bracket off the steering column.



RR 506M

Refitting

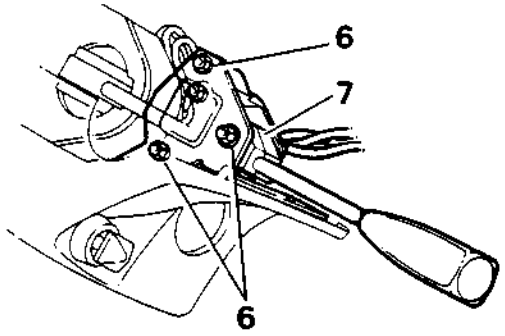
12. Reverse the removal procedure.

REAR SCREEN PROGRAMMED WASH WIPE SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the steering wheel centre cover.
3. Remove the lower fascia panel.
4. Remove the top and bottom shroud (refer to main and dipped beam switch removal and refit-items 4 to 7).
5. Disconnect the electrical leads at the multi-plug.
6. Remove the four small bolts securing the switch to the switch mounting bracket.
7. Remove the switch from the bracket.



RR 507M

Refitting

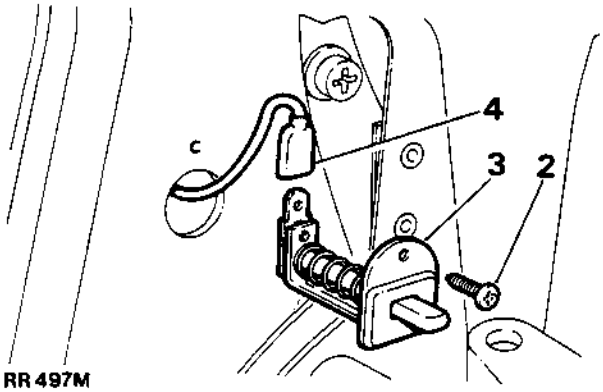
8. Reverse the removal procedure.

DOOR PILLAR SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Remove screw securing switch to door pillar.
3. Withdraw switch.
4. Disconnect electrical lead from connector blade.



RR 497M

Refitting

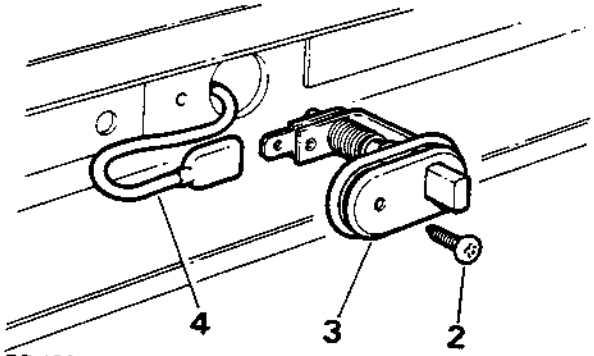
5. Reverse removal procedure.

REAR TAILGATE SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the single screw securing the switch to the tailgate aperture.
3. Withdraw the switch.
4. Disconnect the electrical lead.



RR 498M

Refitting

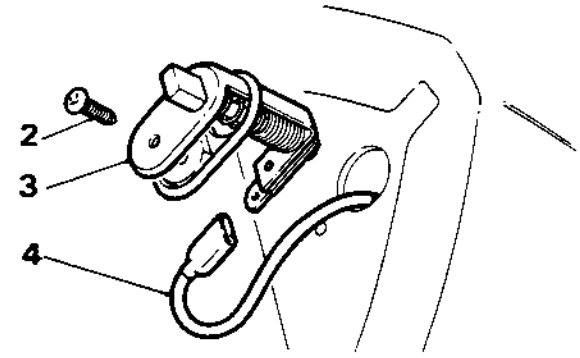
5. Reverse the removal procedure.

UNDER BONNET ILLUMINATION SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the single screw securing the switch to the decker panel.
3. Withdraw the switch.
4. Disconnect the electrical lead.



RR499M

Refitting

5. Reverse the removal procedure.

CIGAR LIGHTER—radio housing

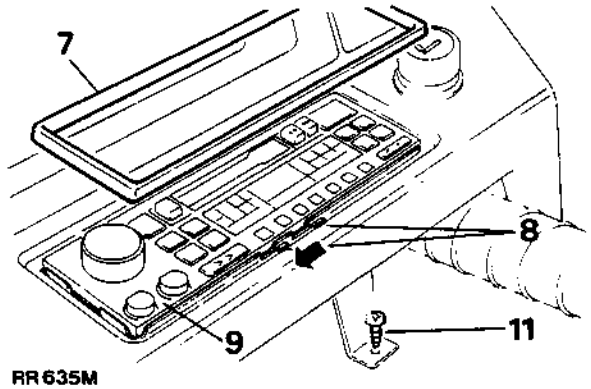
Remove and refit

Removing

1. Disconnect the battery.
2. Remove the High/Low range gear knob.
3. Remove the main gearbox knob.
   Manual gearbox versions—unscrew the knob.
   Automatic gearbox versions—See Automatic gear selector panel illumination.
4. Remove the cubby box liner and release the handbrake cable from the handbrake lever, prise the inset panel out of the floor mounted console.
   Automatic gearbox versions—Pull the two illumination bulbs from the selector panel.
5. Release the cubby box from its four floor mounted fixings.
6. Raise the front of the cubby box and console assembly and ease the unit away from the radio housing.

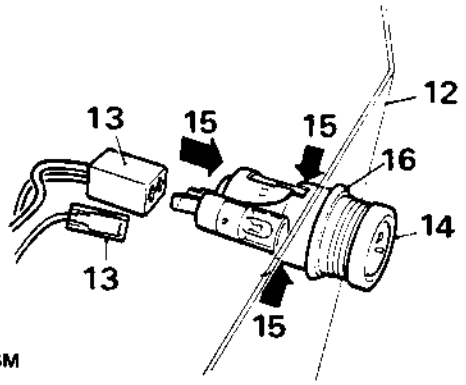
   NOTE: It is necessary to remove the radio from its housing to facilitate easy removal of the radio console. The radio is removed as follows.

7. Carefully prise the outer surround away from the radio.
8. Slide the retaining clip to the left.
9. Lift the radio out of the housing.
10. Disconnect the electrical connections and aerial plug from the rear of the radio.
11. Remove the single screw securing the housing to the top of the gearbox tunnel.



RR635M

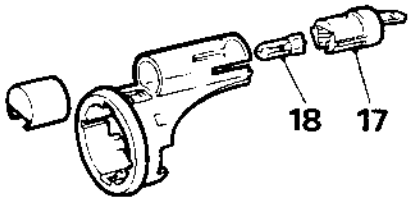
12. Pull the housing away from the lower fascia.
13. Disconnect the electrical leads at the rear of the cigar lighter.
14. Remove the push in switch from the lighter outer body.
15. Depress the outer plastic surround where denoted by the arrows and push the outer body through the surround.
16. Manoeuvre the plastic surround and remove it from the radio housing.



RR636M

CIGAR LIGHTER ILLUMINATION—Bulb replacement

17. Remove the bulb holder from the plastic surround.
18. Pull the bulb from the holder. The correct bulb type is a 12v 1.2 watt wedge base (capless).



RR637M

Refitting

19. Reverse the removal procedure.

CIGAR LIGHTER—Cubby Box

The rear cigar lighter is located in the bottom of the cubby box, access to the rear of the lighter is gained through heater/air vent duct below the rear ashtray.
Follow instructions 13 to 16 of CIGAR LIGHTER —radio housing to remove the lighter from the cubby box.

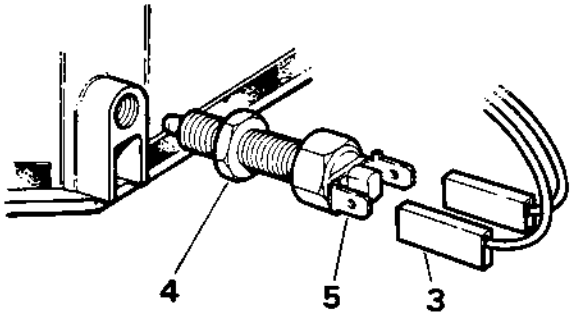
REVERSE LIGHT SWITCH—MANUAL GEARBOX (5 SPEED)

Remove and refit

Removing

The reverse light switch is located at the rear of the gear selector housing and is accessible from underneath the vehicle.

1. Drive vehicle onto a ramp.
2. Disconnect the battery.
3. From underneath the vehicle, disconnect the electrical leads.
4. Release the locknut securing the switch in position.
5. Unscrew the reverse light switch from the gear selector housing.



RR1723M

Refitting

NOTE: The reverse light switch will require re-setting on reassembly.

6. Select reverse gear.
7. Connect a 12-volt supply to either of the switch terminals.
8. Connect a test lamp to the remaining terminal.
9. Screw the switch into the housing until the test lamp is illuminated. Rotate the switch a further half-turn.
10. Tighten the locknut to secure the switch in position.
11. Re-connect the switch electrical leads.
12. Re-connect the battery.
13. Drive the vehicle off the ramp.

REVERSE LIGHT SWITCH—START INHIBITOR SWITCH

Automatic gearbox

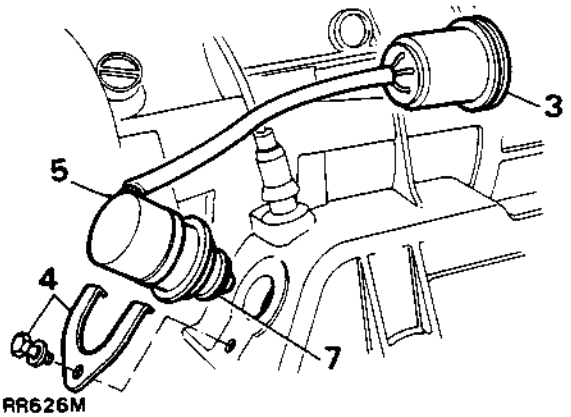
Remove and refit

The reverse light switch is an integral part of the start inhibitor switch and is located on the left-hand side of the gearbox above the front of the gearbox sump and is accessible from beneath the vehicle.

Continued

Removing

1. Drive the vehicle onto a suitable ramp.
2. Disconnect the battery.
3. Disconnect the multi-plug.
4. Release the clamp bolt and remove the clamp.
5. Withdraw the switch from its location.



RR626M

Refitting

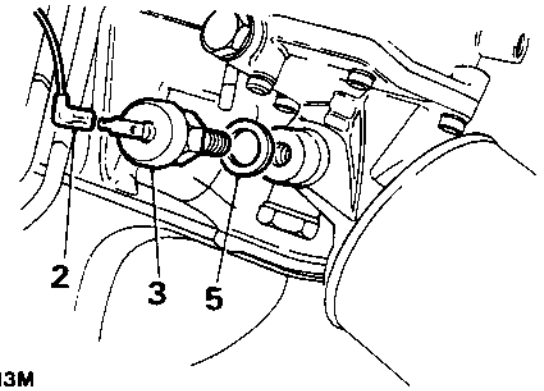
6. Reverse the removal instructions.
7. Fit a NEW 'O' ring to the switch.

OIL PRESSURE WARNING SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Disconnect the electrical lead from the switch.
3. Unscrew the switch unit.
4. Remove switch and sealing washer.



RR513M

Refitting

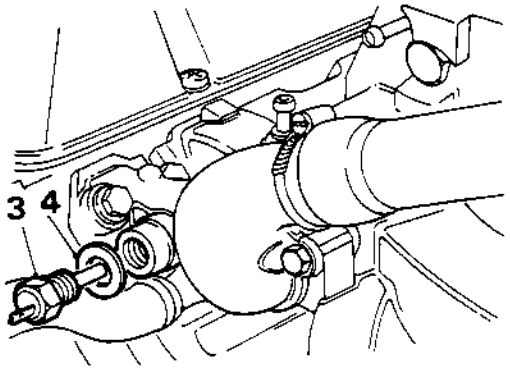
5. Reverse the removal procedure, using a NEW sealing washer.

COOLANT TEMPERATURE TRANSMITTER —Carburetter Models only

Remove and refit

Removing

1. Disconnect the battery.
2. Disconnect the electrical lead from the transmitter and the air cleaner hose.
3. Remove the transmitter from the inlet manifold.



RR514M

Refitting

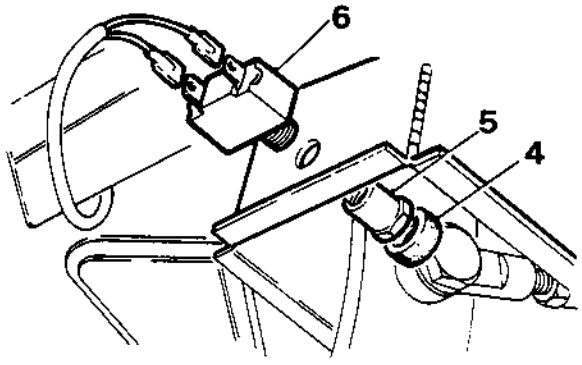
4. Reverse the removal procedure, using a NEW joint washer.

STOP LIGHT SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the lower fascia panel.
3. Depress the foot brake.
4. Remove the rubber protector from switch (where fitted).
5. Remove the hexagon nut.
6. Withdraw the switch.
7. Disconnect the electrical leads.



RR509M

Refitting

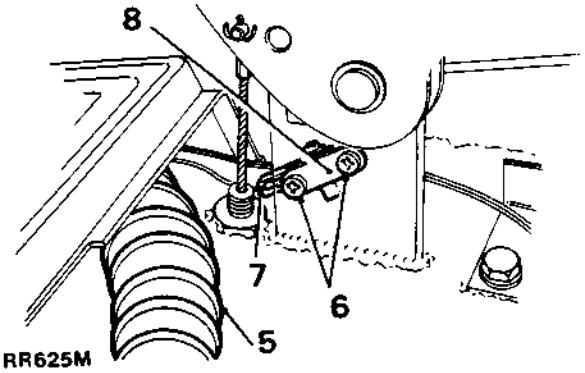
8. Reverse the removal procedure.

HANDBRAKE WARNING SWITCH

Remove and refit

Removing

1. Disconnect the battery.
2. Apply the handbrake.
3. To gain access to the warning switch located on the side of the handbrake mounting bracket, it is necessary to remove the cubby box liner.
4. Remove the four screws securing the cubby box liner and lift out the liner.
5. Carefully pull the rear warm air flow hose away from the side of the handbrake mounting bracket to give access to the two screws securing the switch in position.
6. Remove the two screws.
7. Manoeuvre the switch around the front of the handbrake mounting bracket and disconnect the electrical lead.
8. Withdraw the switch.



RR625M

Refitting

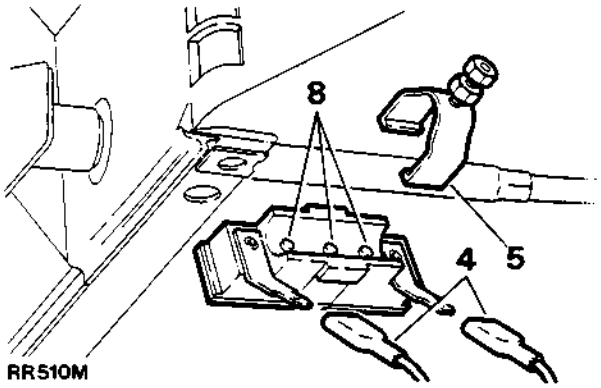
9. Reverse the removal procedure.

CHOKE WARNING LIGHT SWITCH—Carburetter Versions only

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the six screws securing the lower fascia panel.
3. Remove the lower fascia panel to give access to the rear of the upper fascia.
4. Remove the two electrical leads from the switch.
5. Remove the screw and clip securing the switch to the choke cable and slide the clip off the switch.
6. Remove the switch.



RR510M

Refitting

7. Reverse the removal procedure.
8. Ensure that the three pegs on the switch locate in the corresponding holes on the choke outer cable.

EXTERIOR DRIVING MIRRORS—4 DOOR ONLY

1. The mirror housing is hinged vertically and should be set in one of the two fixed angle positions provided to suit the respective left or right side mirror location.
2. Additionally, for safety and convenience, the mirror housing is designed to fold completely forwards or rearwards against the vehicle body.

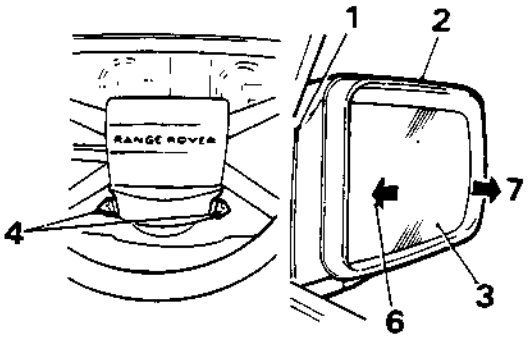
NOTE: Flat mirrors are fitted to Australian vehicles.

Setting the mirror—manual version

3. The glass angle is finely adjusted by moving it vertically or horizontally as required.

Setting the mirror—electrically operated

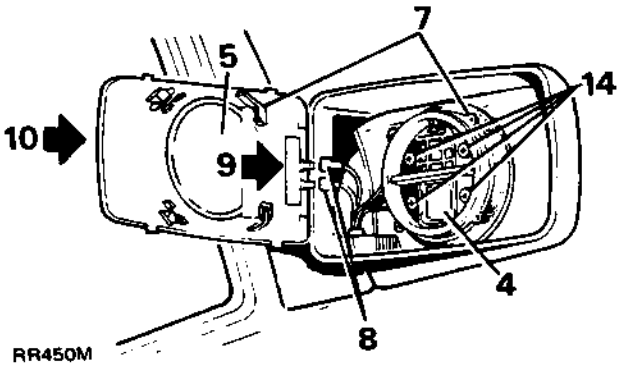
4. Fine adjustment is controlled by an electric motor inside the mirror housing. This is operated by individual finger-tip operated controls fitted on either side of the steering column lower cover. To adjust, move the head of the appropriate control to the left, right, up or down as required. The mirror selected will respond accordingly.
5. The mirror also incorporates a demist facility, activated by operation of the rear window demist switch.



RR521M

Renewing the mirror glass—manual and electric versions

6. Press the inner (wider) end of the glass inwards to its full extent.
7. Insert the fingers under the outer (narrower) end of the glass, and pull outwards until the glass is released from its four retaining clips.
8. On electrical versions disconnect the two demister leads attached to back of the glass unit.



RR450M

9. To replace the glass, locate the inner (wider) end of the glass in the mirror housing first.
10. Carefully press the outer (narrower) end of the glass inwards until it is safely held by its four retaining clips.
11. Reset the fine adjustment as required.

EXTERIOR DRIVING MIRRORS

ELECTRIC MOTORS

Remove and Refit

Removing

12. Disconnect the battery.
13. Remove the mirror glass, as described in items 6 to 8.
14. Remove the four self-tapping screws securing the motor assembly to the mirror body.

Continued

15. Manoeuvre the motor assembly to reveal the electrical connections on the rear of the motor.
16. Pull the leads from the rear of the motor assembly.

Refitting

17. Reverse operations 12 to 16, ensuring that the electrical leads are correctly refitted (see electric mirror, circuit diagram).

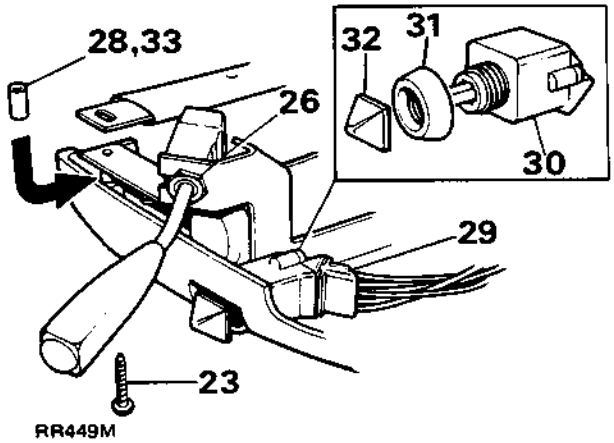
EXTERIOR DRIVING MIRRORS– FINGERTIP CONTROLLED SWITCHES

Remove and Refit

Service tool: 18G 1014 Extractor for steering wheel.
18G 1014-2 Adaptor pins.

Removing

18. Disconnect the battery.
19. Release the screw retaining the centre cover to the steering wheel and remove the cover.
20. Remove the retaining nut and washer securing the steering wheel.
21. Remove the steering wheel using the correct service tool.
22. Remove the lower fascia panel by releasing the six securing screws.
23. Remove the four screws securing the bottom shroud to the top shroud.
24. Remove the single screw securing the top shroud to the switch housing bracket.
25. Remove the top shroud.
26. Release the light switch locknut and remove the switch from the mounting bracket.
27. Manoeuvre the bottom shroud to clear the ignition switch/steering lock assembly.



28. Retrieve the small spacing collar located on the forward left hand side of the bottom shroud.
Note: It is important that the spacing collar is refitted on assembly.
29. Pull the multi-plug from the rear of the fingertip controlled mirror switch.
30. Carefully prise off the fingertip button at the operating end of the switch.
31. Unscrew the black plastic retaining collar securing the switch to the bottom shroud.
32. Remove the switch from the shroud.

Refitting

33. Reverse operations 18 to 32, ensuring that the black spacing collar is refitted.

NOTE: To prevent damage to the electrical wiring within the top and bottom shroud, the leads should be arranged carefully to avoid contact with mating faces on re-assembly.

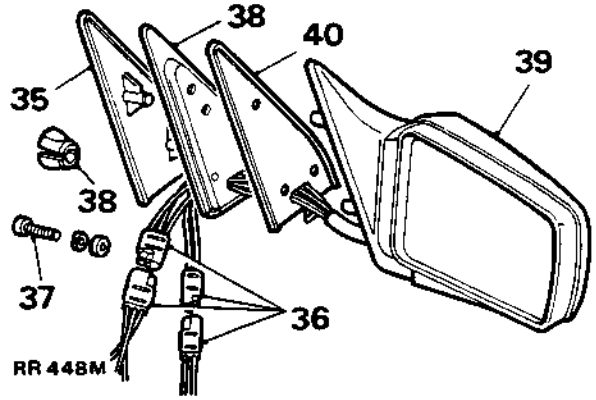
EXTERIOR DRIVING MIRRORS

COMPLETE ASSEMBLY

Remove and Refit

Removing

34. Disconnect the battery.
35. Carefully prise off the interior finisher plate to reveal the three securing screws and electric wiring.
36. Disconnect the two electrical plugs (one two pin, one three pin).
37. Supporting the exterior mirror assembly remove the three securing screws (with plain and spring washer).
38. Pull the inner mounting plate away from the inner door frame complete with the two retaining clips.
39. Detach the mirror assembly from the outer door frame.
40. Remove the sealing rubber.



Refitting

41. Reverse the operations 34 to 40.

NOTE: To prevent damage to the electrical wiring do not push the leads down inside the door casing.

INSTRUMENT ILLUMINATION
ELECTRONIC DIMMING CONTROL

The electronic dimming control switch is located on the lower fascia panel adjacent to the steering column. Rotate the control upwards to fully illuminate the instruments and downwards to reduce intensity.
The dimming control unit also controls the clock, heater and cigar lighter illumination.

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the lower fascia panel by releasing the six securing screws.
3. Disconnect the dimming control multi-plug.
4. Remove the two screws securing the dimmer control switch to the under-side of the lower fascia panel.

Refitting

Reverse operations 1 to 4.

INSTRUMENT BINNACLE
WARNING LIGHT SYMBOLS


Direction indicator — left turn (green)


Direction indicator — right turn (green)



Park brake on — Australia only (red)


Headlamp main beam on (blue)


Trailer connected — flashes with direction indicators (green)


Rear fog guard lamps on (amber)


Ignition on (red)


Automatic gearbox oil temperature high (red)


Engine oil pressure, low (red)


Cold start, engaged (amber)


Fuel indicator, low (amber)


Differential lock engaged (amber)



Transmission handbrake on — except Australia (red)


Brake padwear (amber)



Brake fluid pressure, failure (red)

NOTE: The ignition and engine oil pressure symbols will be automatically illuminated when the ignition is switched on and extinguished when the engine is running. The brake fluid pressure symbol will also be illuminated while the ignition key is being held over to actuate the starter, confirming that the warning circuit is functioning correctly.

Continued

RENEWAL OF PANEL AND WARNING LIGHT BULBS

1. Disconnect the battery.
2. Unclip the back of the cowl from the instrument binnacle to give access to the panel and warning light bulbs in the back of the instrument case.
3. Remove the appropriate bulb holder unit by rotating it anti-clockwise and withdrawing it.

NOTE: The No charge ignition warning light, identified by its red coloured bulb holder, is of a higher wattage and is the only bulb which can be pulled from its holder and replaced independently.

4. Fit a new bulb holder unit and rotate clockwise to lock in position. The correct bulb type is a 1.2 watt bulb/holder unit, except the ignition bulb which is 2 watt wedge base type.
5. Refit the cowl and reconnect the battery.

NOTE: If difficulty is experienced in changing bulbs, due to the limited space available the instrument binnacle fixings should be removed to enable the binnacle to be raised above the fascia as far as other connections permit. See 'Instrument Binnacle removal' below for details of binnacle mounting bracket fixing.

INSTRUMENT BINNACLE

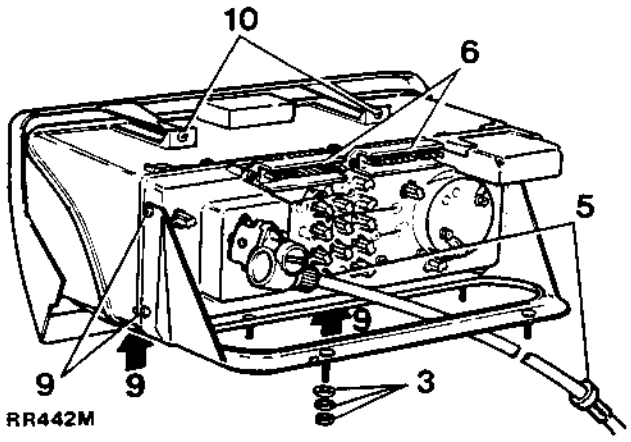
Remove and refit

Remove

1. Disconnect the battery.
2. Remove the lower fascia by releasing the six retaining screws.
3. Remove the four nuts (with spring and plain washers) from under the top fascia rail which secure the instrument binnacle to the vehicle.
4. Unclip the binnacle cowl, from the rear, to provide access to the two-part speedometer cable.
5. Disconnect the two-part speedometer cable from the speedometer drive on the back of the instrument case. Alternatively, from under the top fascia rail, release the cable connector ring at the intermediate clamped connection. This is located some 470 mm. (18.5 in.) from the speedometer drive. This connection is provided to facilitate separate renewal of either the upper or lower part of the cable in service.
6. Disconnect the two multi-plugs from the printed circuit connectors.
7. Lift the instrument binnacle from the top fascia rail and transfer it to the workbench.

Refitting

8. Reverse the removal instructions 1 to 7.



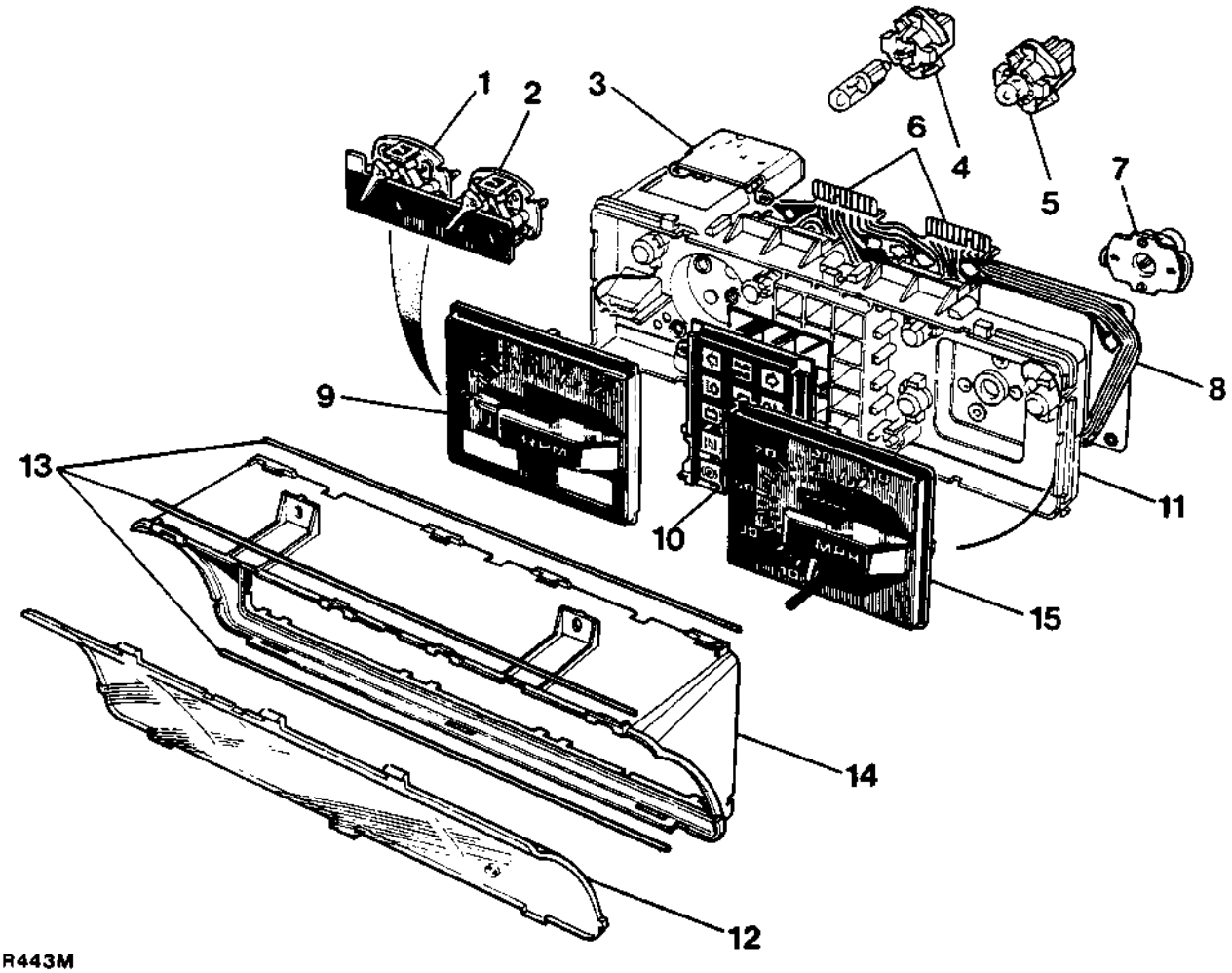
NOTE: On LHD vehicles, where an over-speed buzzer is fitted, the intermediate speedometer cable connections are threaded and retain a sensor unit between the two parts of the cable.
A lead from the sensor unit is connected to a black two-pin socket (black and white leads) below the binnacle, above the steering column area. The adjacent buzzer will be audible at approximately 120 kph. (75 mph.).

Removing Instrument Pack

9. Having removed the instrument binnacle from the vehicle, detach the binnacle mounting bracket. This is secured to the instrument case by two screws and to the bottom of the binnacle bezel by two smaller screws.
10. Remove the two screws retaining the top of the bezel to the front housing and detach the bezel.
11. Separate the instrument case from the binnacle housing by releasing the two wire clips.
12. Detach the curved lens from the binnacle housing by releasing the wire clip at the top.

Refitting Instrument Pack to Binnacle

13. Reverse removal instructions 9 to 12.



RR443M

Instrument Pack

1. Fuel gauge
2. Temperature gauge
3. Voltage stabiliser
4. Ignition warning bulb (with separate red holder unit)
5. Panel/warning lights bulb/holder
6. Printed circuit input tags (for harness connection)
7. Speedometer drive unit
8. Printed circuit
9. Tachometer
10. Warning lights panel
11. Instrument case (front)
12. Curved lens
13. Wire connecting clips
14. Binnacle housing
15. Speedometer

Continued

Renewing panel and warning lamp bulbs

14. Remove the appropriate bulb holder unit from the back of the instrument case by rotating the bulb holder anti-clockwise and withdrawing it.

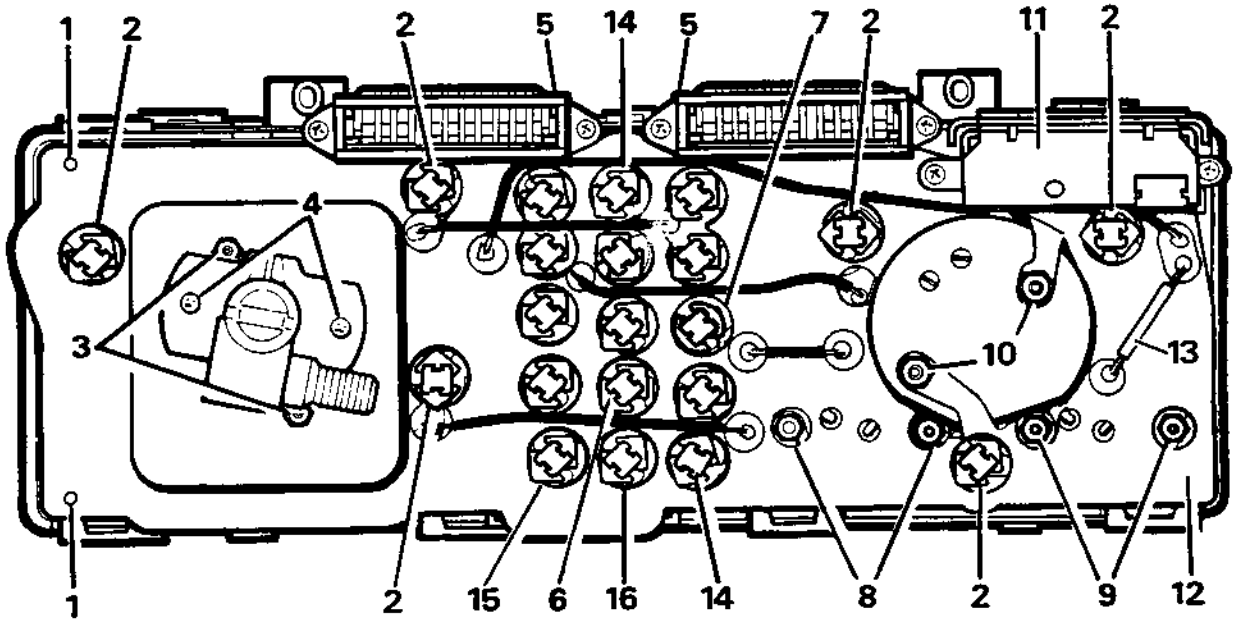
    NOTE: The No charge ignition warning light, identified by its red coloured bulb holder is of a higher wattage and is the only bulb which can be separated from its holder and replaced independently.

15. Fit a new bulb holder unit to the printed circuit and rotate clockwise to lock in position.
    The correct bulb type is a 1.2 watt bulb/holder, except the ignition bulb which is 2 watt wedge base type.

Removing printed circuit

16. Remove the two tachometer nuts (with washers) to release the printed circuit connecting tags.
17. Remove the four nuts (with washers) securing the fuel and temperature gauges to release the printed circuit from the fixing studs.
18. Release the two screws retaining the multi-function unit and lift off to release the printed circuit connecting tag.
19. Remove the two harness connectors, retained by four screws, to release the printed circuit tags.
20. Carefully ease the printed circuit from its four locating pegs.

Continued

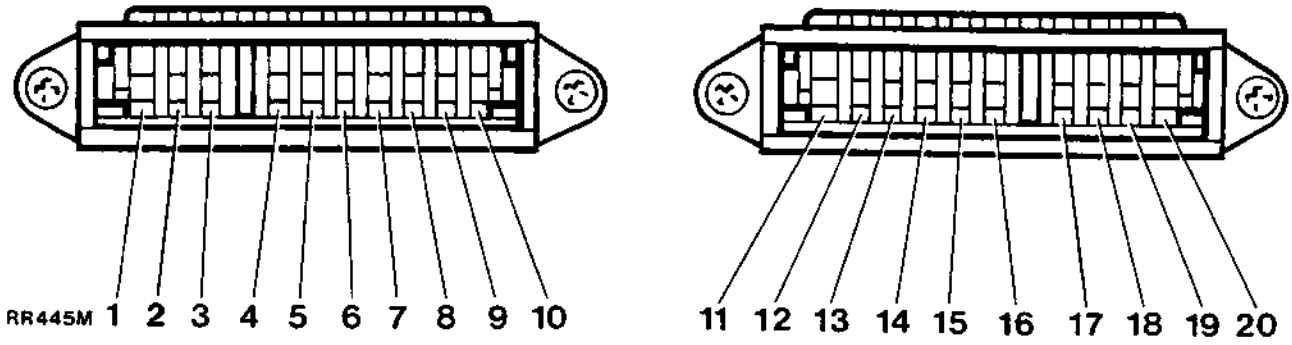


RR617M

Instrument case (back)

1. Locating pegs
2. Panel light bulbs
3. Speedometer securing screws
4. Speedometer drive securing screws
5. Harness connectors
6. Warning light bulbs
7. No charge warning light bulb (red holder)
8. Temperature gauge securing nuts
9. Fuel gauge securing nuts
10. Tachometer securing nuts
11. Multi-function unit
12. Printed circuit
13. Pull-up resistor—high temperature gearbox oil
14. Park/hand brake
15. Brake failure
16. Brake pad wear

PRINTED CIRCUIT HARNESS CONNECTIONS

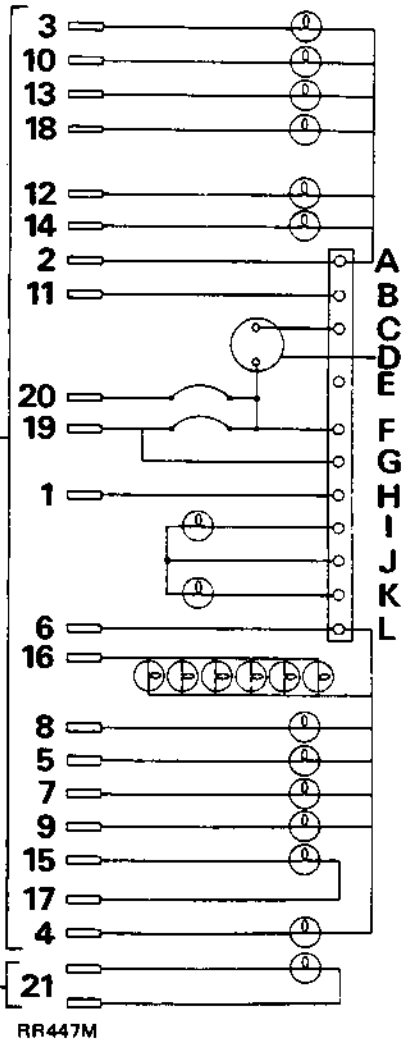


(Sequence of connections viewed from back of instrument case.)

CIRCUIT SERVED

Tacho signal 1
Ignition switch 12v+ 2
Ignition warning light 3
Trailer warning light 4
Main beam warning light 5
Earth 6
Direction indicators left hand 7
Rear fog warning light 8
Direction indicators right hand 9
Oil pressure warning light 10
High oil temperature warning light (Auto gearbox) 11
Cold start warning light 12
Differential lock warning light 13
Brake failure warning light 14
Brake pad wear warning light 15
Panel illumination warning light 16
Brake pad wear warning light 17
Park brake warning light 18
Fuel tank gauge 19
Coolant temperature gauge 20

Additional wired circuit on RHD vehicles for alternative Australian park brake warning light symbol. Connected to a black two-pin socket (white & black/pink leads) located under the binnacle, above the steering column area. 21



RR447M

MULTI-FUNCTION UNIT CONNECTIONS

A — 12v+ supply
B — Input to high oil temp warning light circuit
C — Tacho drive
D — Tachometer
E — Spare
F — 10v+ stabilised
G — Input to low fuel warning light circuit
H — Tacho signal
I — Low fuel warning light
J — 12v+ protected
K — High oil temperature warning light
L — Earth

Continued

Refitting the Printed Circuit

21. Reverse the removal procedure, items 16 to 20.
22. Ensure that the fuel and temperature gauge mounting studs are correctly located before pressing the printed circuit on to its four locating pegs.

Removing Tachometer

23. Carefully prise the needle shroud from the tachometer and disconnect the fibre optic element underneath the shroud.
24. Remove the two nuts (with washers) at the back of the instrument case which retains the tachometer and release the printed circuit tags.
25. Slacken the four nuts retaining the fuel and temperature gauges and carefully manoeuvre the tachometer from the front of the instrument case.

Refitting the Tachometer

26. Reverse the removal procedure, items 23 to 25.

Removing Fuel and Temperature Gauge Unit

27. Carefully prise the needle shroud from the tachometer and disconnect the fibre optic element underneath the shroud.
28. Remove the two nuts (with washers) retaining the tachometer and release the printed circuit tags.
29. Remove the four nuts (with washers) retaining the fuel and temperature gauges and carefully manoeuvre the tachometer, fuel and temperature gauge unit from the front of the instrument case.

Refitting the Fuel and Temperature Gauges

30. Locate the fuel and temperature gauge unit in the instrument panel but **do** not fit the washers and nuts at this stage.
31. Feed the fibre optic element through the aperture in the tachometer then locate the tachometer in the instrument panel.
32. Position the printed circuit tags over the two tachometer studs, fit the washers and fit and tighten the retaining nuts.
33. Fit the washers to the four fuel and temperature gauge studs and fit and tighten the retaining nuts.

Removing the Speedometer and Speedometer Drive Unit

34. Carefully prise the needle shroud from the speedometer and disconnect the fibre optic element underneath the shroud.
35. Remove the two hexagonal headed screws (with washers) at the back of the instrument case which retain the speedometer.
36. Carefully remove the speedometer from the front of the instrument case.
37. To release the speedometer drive unit, remove the two self-tapping screws securing it to the back of the instrument case.

Refitting the Speedometer and Speedometer Drive Unit

38. Reverse the removal procedure items 34 to 37 ensuring that the rubber gasket is fitted behind the speedometer drive unit.

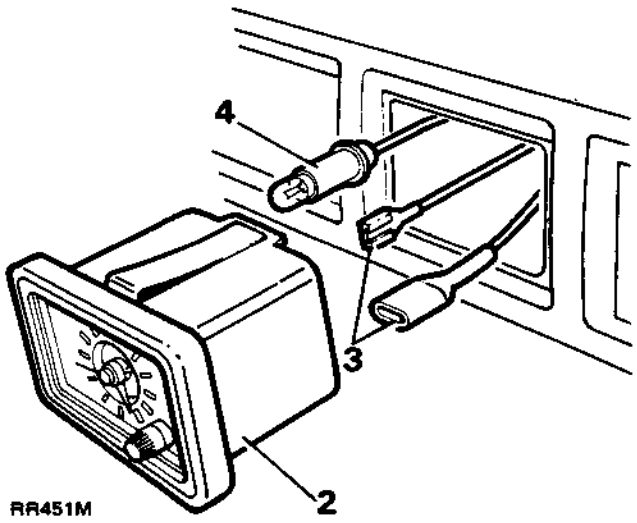
CLOCK

Remove and refit

Removing

1. Disconnect the battery.
2. Carefully prise the clock out of the fascia panel to reveal the electrical connections.
3. Disconnect the two electrical leads.
4. Remove the illumination lead complete with holder and bulb.

NOTE: The clock is illuminated by a 2-watt bayonet type bulb.



Refitting

5. Reverse the removal procedure.

SPEEDOMETER CABLE ASSEMBLY

The speedometer cable is a two part assembly, consisting of an upper cable, connected to the rear of the binnacle and a lower cable connected to the speedometer drive housing at the rear of the transfer gearbox. The two cables are joined by a connector ring behind the lower fascia, this connection is provided to facilitate separate renewal of either the upper or lower part of the cable in service.

To remove the upper cable refer to instrument binnacle removal.

Lower Speedometer cable

Remove and refit

Removing

1. Disconnect the battery.
2. Remove the lower fascia panel by releasing the six retaining screws.
3. Release the cable connector ring between the upper and lower cables and withdraw the cable and grommet from the bulkhead.
4. Remove the single nyloc nut and clamp securing the cable to the speedometer drive housing at the rear of the transfer gearbox.
5. Release the cable from the two retaining clips.

   NOTE: On left-hand-drive vehicles with automatic gearbox the speedometer cable is secured by a further two clips located above the cross-member attached to the chassis side-member.

6. Withdraw the cable from the speedometer drive housing.

Refitting

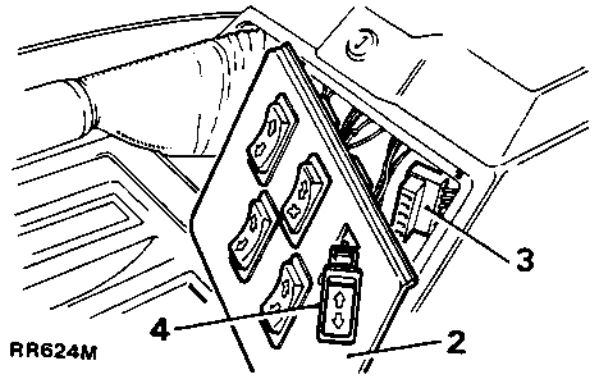
7. Reverse the removal procedure.

WINDOW LIFT SWITCHES

Remove and refit

Removing

1. Disconnect the battery.
2. Carefully prise the window lift switch surround away from the front of the cubby box.
3. Disconnect the multi-plug at the rear of the switch(es).
4. Apply pressure to the rear of the switch to push it through the surround.



Refitting

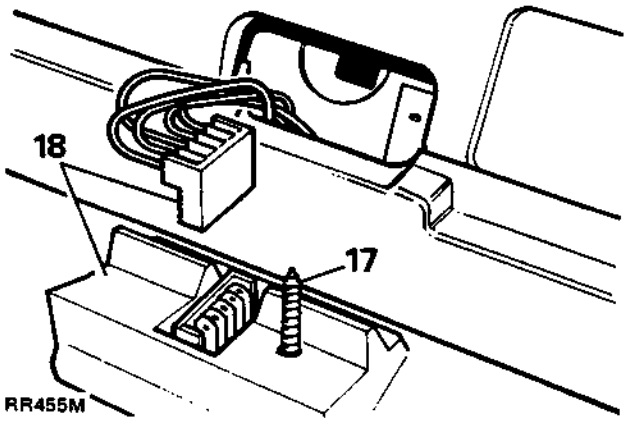
5. Reverse the removal procedure.

WINDOW LIFT MOTOR—Rear doors

Remove and refit

Removing

15. Ensure the side door glass is in its fully closed position and secure it with adhesive tape.
16. Disconnect the battery.
17. Remove the arm-rest/door-pull finisher to reveal the two securing screws.
18. Remove the two screws (with plain washers) and detach the arm-rest/door-pull from the inner door panel. To enable the arm-rest/door-pull to be removed from the door, the window operating switch multi-plug must be disconnected from the rear of the switch.

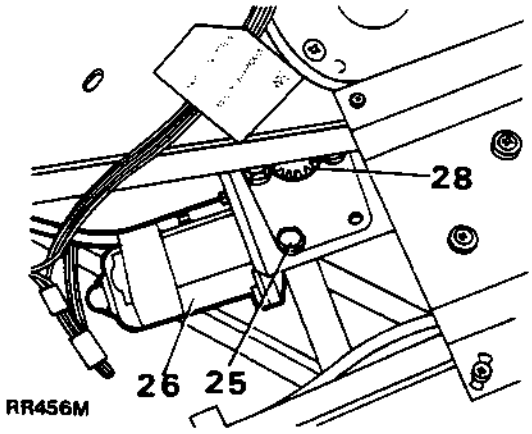


NOTE: At this stage the window operating switch can be removed by applying a little pressure to the rear of the switch to push it through the door-pull handle.

19. Remove the interior handle finisher button to reveal the screws retaining the handle surround.

Continued

20. Remove the screw and detach the handle surround from the door trim pad.
21. Remove the door trim pad by inserting a screwdriver between the trim pad and inner door panel, gently prising out the six plastic securing clips from their respective holes in the inner door panel.
22. Displace the bottom half of the plastic weather sheet to reveal the window lift motor.
23. Release the lift motor wiring harness from the retaining clips.
24. Disconnect the lift motor harness snap connections from the main door harness.
25. Supporting the lift motor release the three bolts securing the motor to the inner door panel.
26. Withdraw the lift motor from the lower aperture in the inner door panel.



Refitting

27. Reverse operations 15 to 26.
28. Ensure the lift motor drive gear is engaged and correctly aligned with the window lift linkage before fitting the securing bolts.

WINDOW LIFT MOTOR—Front doors

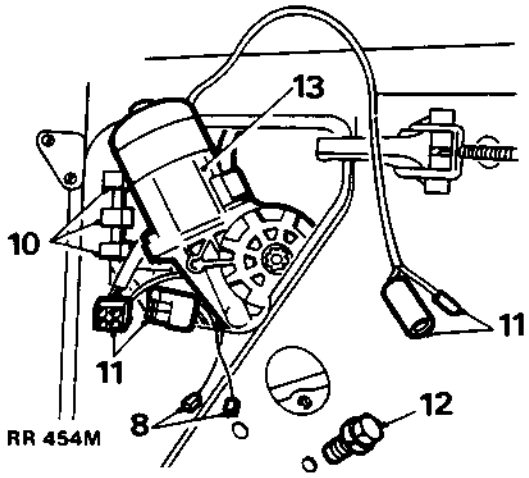
Remove and refit

Removing

1. Ensure that the side door glass is in its fully closed position and secure it with adhesive tape.
2. Disconnect the battery.
3. Detach the arm-rest/door-pull finisher to reveal the two securing screws.
4. Remove the two screws (with plain washers) to enable the arm-rest/door-pull to be detached from the inner door panel.
5. Remove the interior door handle finisher button to reveal the screw retaining the handle surround.
6. Remove the screw and detach the handle surround from the inner door panel.
7. Detach the inner door trim pad by inserting a screwdriver between the trim pad and inner door panel gently prising out the nine plastic securing clips from their respective holes in the inner door panel.
8. Disconnect the two radio speaker connections behind the trim pad, remove the trim pad complete with speaker.

NOTE: At this stage the speaker can be removed by releasing the four nuts (with plain washers) located on the back of the trim pad.

9. Peel back the front top corner of the plastic weather sheet to reveal the window lift motor.
10. Release the window lift motor wiring harness from the three retaining clips to allow the harness to be pulled out of the aperture at the front of the inner door panel.
11. Disconnect the window lift motor multi-plug from the main door harness.
12. Supporting the motor, remove the three securing bolts.
13. Withdraw the motor through the top front aperture of the door.



Refitting

14. Reverse operations 1 to 13.

NOTE: Ensure that the drive gear is engaged and correctly aligned with the window lift linkage before fitting the securing bolts.

ELECTRICALLY OPERATED CENTRAL DOOR LOCKING SYSTEM

An electrically operated central door locking system is fitted as an option on four door models.

Locking or unlocking the drivers door from outside by key operation, or from inside by sill knob automatically locks or unlocks all four doors.

Front and rear passenger doors can be independently locked or unlocked from inside the vehicle by sill knob operation but can be overidden by further operation of the drivers door locking control.

On rear doors only a child safety lock is provided which can be mechanically pre-set to render the interior door handles inoperative.

Failure of an actuator will not affect the locking of the remaining three doors. The door with the inoperative actuator can still be locked or unlocked manually.

NOTE: The door lock actuator units contain non-serviceable parts. If a fault should occur replace the unit concerned with a new one.

Before carrying out any maintenance work disconnect the battery.

FRONT DOOR ACTUATOR UNITS

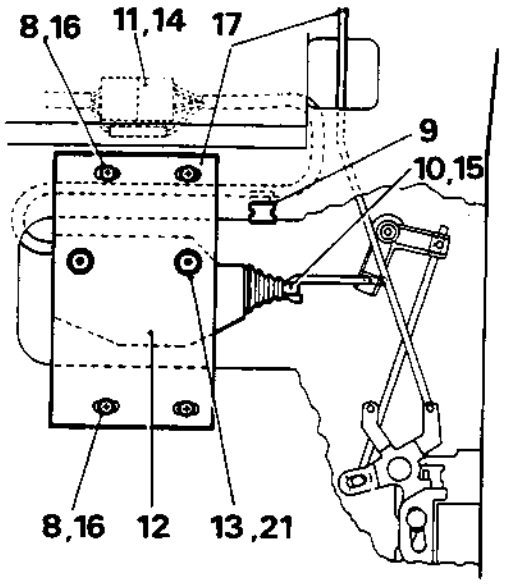
Remove and refit

Removing

1. Ensure the window is in its fully closed position.
2. Remove the arm-rest/door-pull finisher to reveal the two retaining screws.
3. Remove the interior door handle finisher button to reveal the screw retaining the handle surround.
4. Release the screw and remove the handle surround from the interior door trim pad.

   NOTE: On models fitted with manually operated side door windows it is necessary to remove the window regulator handle to enable the trim pad to be removed.

5. Release the door trim pad by inserting a screwdriver between the trim pad and the inner door panel, gently prising out the nine plastic clips from their respective holes around the edges of the trim pad.
6. Disconnect the two speaker connections inside the door and remove the door trim pad complete with speaker.
7. Peel back the top of the plastic weather sheet at the rear of the inner door panel to expose the lock actuator unit.
8. Remove the four screws (with plain washers) securing the lock actuator mounting plate to the inner door panel.
9. Release the clip retaining the electrical cable.
10. Manoeuvre the actuator assembly to detach the operating rod 'eye' from the hooked end of the actuator link on the door lock.
11. Withdraw the actuator assembly from the door until the electrical cable is pulled out of its channel sufficiently to expose the connectors which can then be detached.
12. Remove the actuator assembly from the door.
13. The actuator unit may be changed if necessary by removing the two rubber mounted screws which secure it to the mounting plate.



RR369M

Refitting

14. Locate the actuator assembly in the inner door panel and fit the electrical cable connectors. The cable, and connectors, are pulled back into the channel from the font end and the cable clip refitted.
15. Manoeuvre the actuator assembly to engage the operating rod 'eye' on the hooked actuator link.
16. Loosely fit the actuator mounting plate to the inner door panel with the four screws, setting the mounting plate in the centre of the slotted holes.
17. Ensure that manual operation of the sill locking control is not restricted by the operation of the actuator operating rod and vice versa, resetting the mounting plate as necessary.
18. Reconnect the vehicle battery.
19. Check that electrical operation of the door lock occurs when the sill locking control is moved through half of its total movement. Reset the mounting plate if necessary and tighten the four screws.

    NOTE: The above adjustment ensures that the full tolerance on the switching operation is utilised.

REAR DOOR ACTUATOR UNITS

Remove and refit

Instructions as for front doors with the following exceptions:

20. No radio speaker is involved.
21. The electrical cable and plug is retained to the inner door panel by two spring clips and is immediately accessible through the large aperture in the door.
22. Instruction 19 does not apply to rear actuator units which are not fitted with switches.

NOTE: If necessary the lock actuator may be detached from its mounting plate to facilitate the removal of the lock actuator from the connector rod inside the door panel.

FUEL TANK GAUGE UNIT

Remove and refit

Service tool–18G 1001 Locking spanner

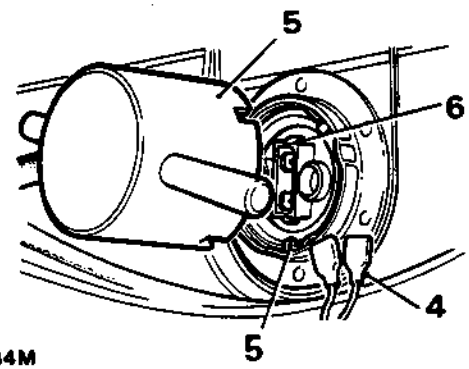
Removing

1. Disconnect the battery.

   NOTE: Ensure the fuel level is below the level of the gauge unit.

2. Chock the front wheels, raise the rear wheels clear of the ground and support the vehicle on stands.

3. Remove the left side rear wheel to provide easy access to the gauge unit which is fitted in the side of the fuel tank.
4. Disconnect the electrical leads from the gauge unit.
5. Using tool 18G 1001 release the tank unit locking ring.
6. Remove the gauge unit and sealing washer.



RR634M

Refitting

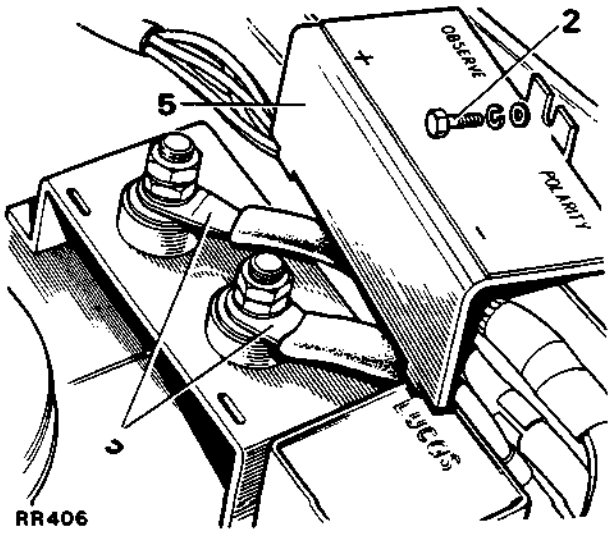
7. Fit a NEW sealing washer and locate the gauge unit in the tank ensuring that the notch in the periphery of the gauge unit locates with the register in the gauge aperture of the tank.

8. Refit the electrical leads.
   Green/Black lead to top terminal.
   Black lead to lower terminal.
9. Reverse the removal procedure.

SPLIT CHARGING FACILITY—OPTION

The circuit provides an additional source of electrical supply allowing separate charging and discharging of an additional battery for auxiliary equipment without affecting the charge state of the vehicle's main battery.
A terminal bracket, heavy duty relay and cables are fitted on the left hand front wing valance adjacent to the power steering reservoir.
The additional battery, leads and fixing clamps are **not** included in the option.
The split charging system is controlled by a voltage sensitive switch which energises the relay when the ignition voltage exceeds a pre-set level, thus supplying current to the positive terminal on the terminal bracket. Conversely, if the ignition voltage falls below the pre-set level the split charging circuit will cut out.

NOTE: The split charge facility is not available on fuel injection models.



RR406

To operate split charging system

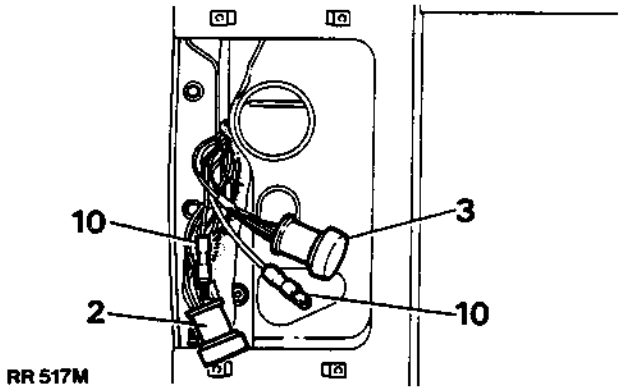
1. Install the additional battery.
2. Remove the fixing bolt securing the terminal bracket cover.
3. Ensure that the positive and negative leads are correctly connected to the terminals and the battery in accordance with the markings on the terminal bracket cover.
4. Start the engine. As soon as the alternator is charging the vehicle battery and the voltage exceeds the pre-set level the split charge function will operate.
5. After charging replace terminal bracket cover.

TRAILER SOCKET—OPTION

Incorporated in the vehicle electrical circuit is a facility for fitting a seven pin trailer lighting socket.
The pick-up point is located behind the left-hand rear tail light cluster and is accessible by removing the tail light assembly.
The pick-up point consists of a seven pin pre-wired plug, a separate auxiliary fused line feed and reverse light lead.

1. Disconnect the battery.
2. Remove the rear tail light assembly and disconnect the electrical plug.
3. Remove the protective cap from the trailer pick-up point plug.
4. Feed a seven core cable (fitted with a pre-wired plug to one end—suitable for connection to pick-up point) down between the inner and outer body panels through the rear light aperture.
5. Feed the cable alongside the existing rear lighting harness.
6. Pull the cable through the aperture between the chassis side member and fuel tank.
7. Fit two retaining clips to the cable and secure it to the rear end cross member.
8. Connect the electrical leads to the vehicle trailer socket. (Refer to current trailer wiring regulations).
9. Secure trailer socket to the tow bar.
10. If it is necessary to provide a line feed and reverse light feed, provision is made for this by the presence of two extra leads in the rear light aperture. Means of identification are as follows:

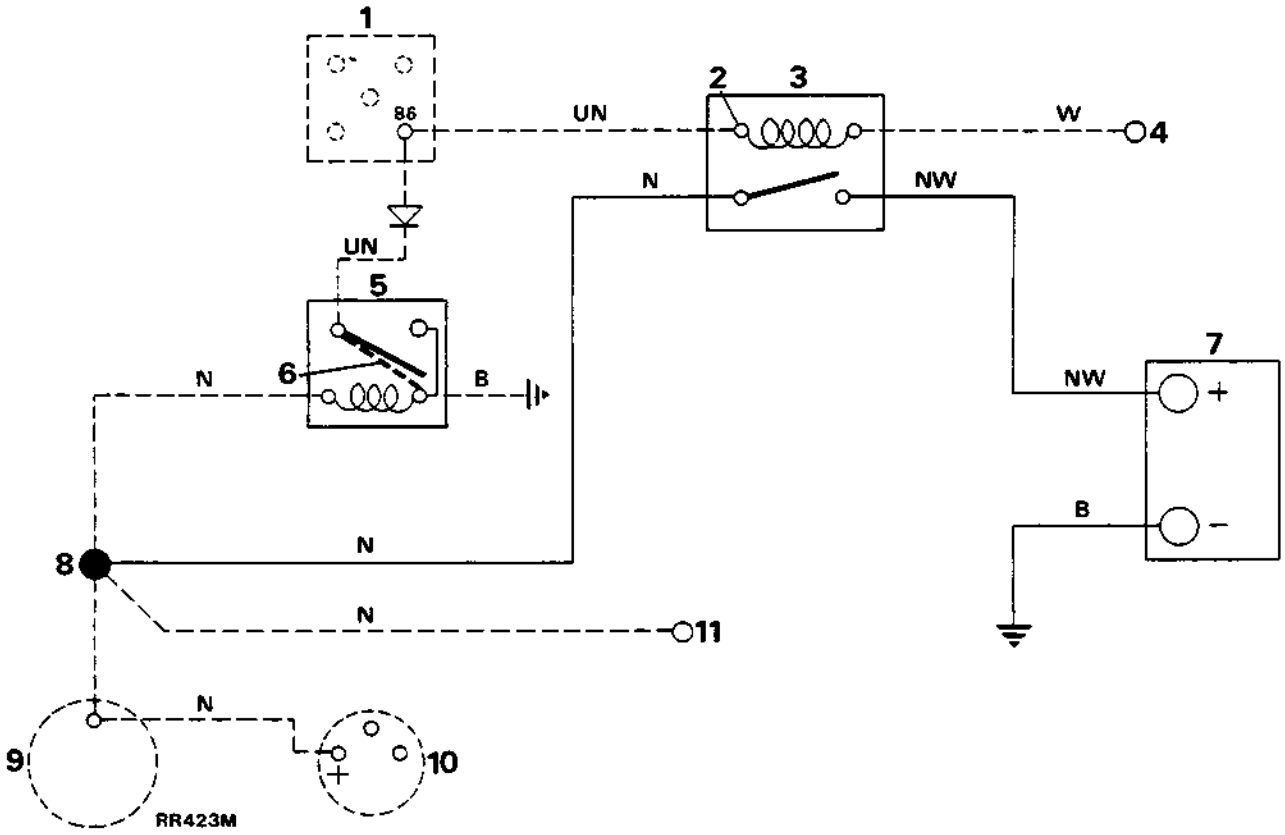
    Fused auxiliary line feed—**Pink lead**
    Reverse light feed—**Green/Brown lead**



RR 517M

11. Refit rear tail light.
12. Reconnect the battery.

ELECTRICAL EQUIPMENT—CIRCUIT DIAGRAMS

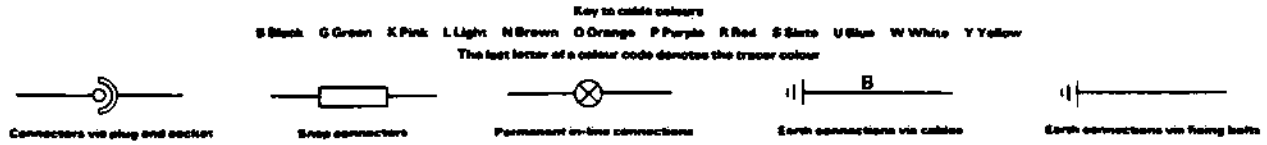


OPTIONAL ELECTRICAL EQUIPMENT—RANGE ROVER 2- AND 4-DOOR MODELS

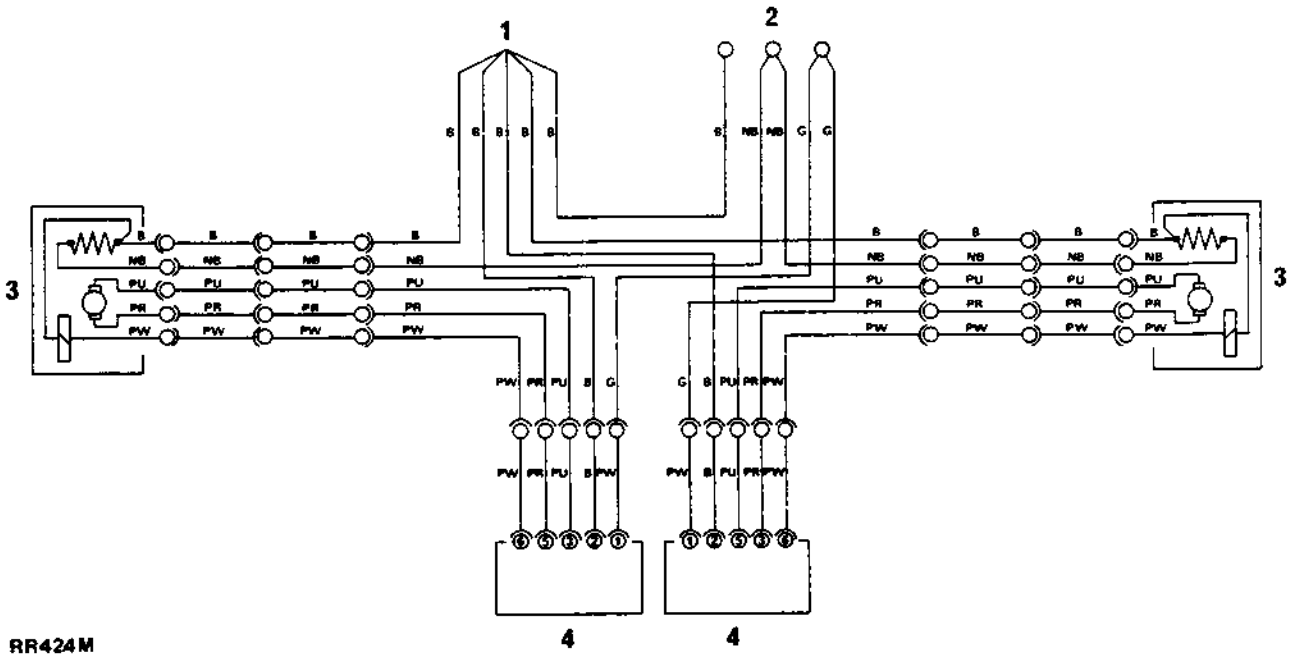
Split Charge Circuit Diagram

1. Heated rear window relay
2. Pick-up point for split charge relay (items 106 and 125 on main circuit diagram)
3. Split charge relay
4. Fuse box
5. Voltage sensitive switch
6. Link wire (removed from plug when voltage sensitive switch is fitted)
7. Terminal box auxiliary battery
8. Terminal post
9. Starter motor
10. Alternator
11. Vehicle battery

NOTE: Chain dotted lines indicate existing parts.



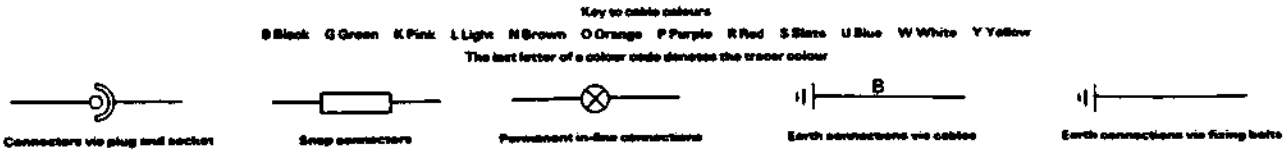
OPTIONAL ELECTRICAL EQUIPMENT—RANGE ROVER 4-DOOR MODELS



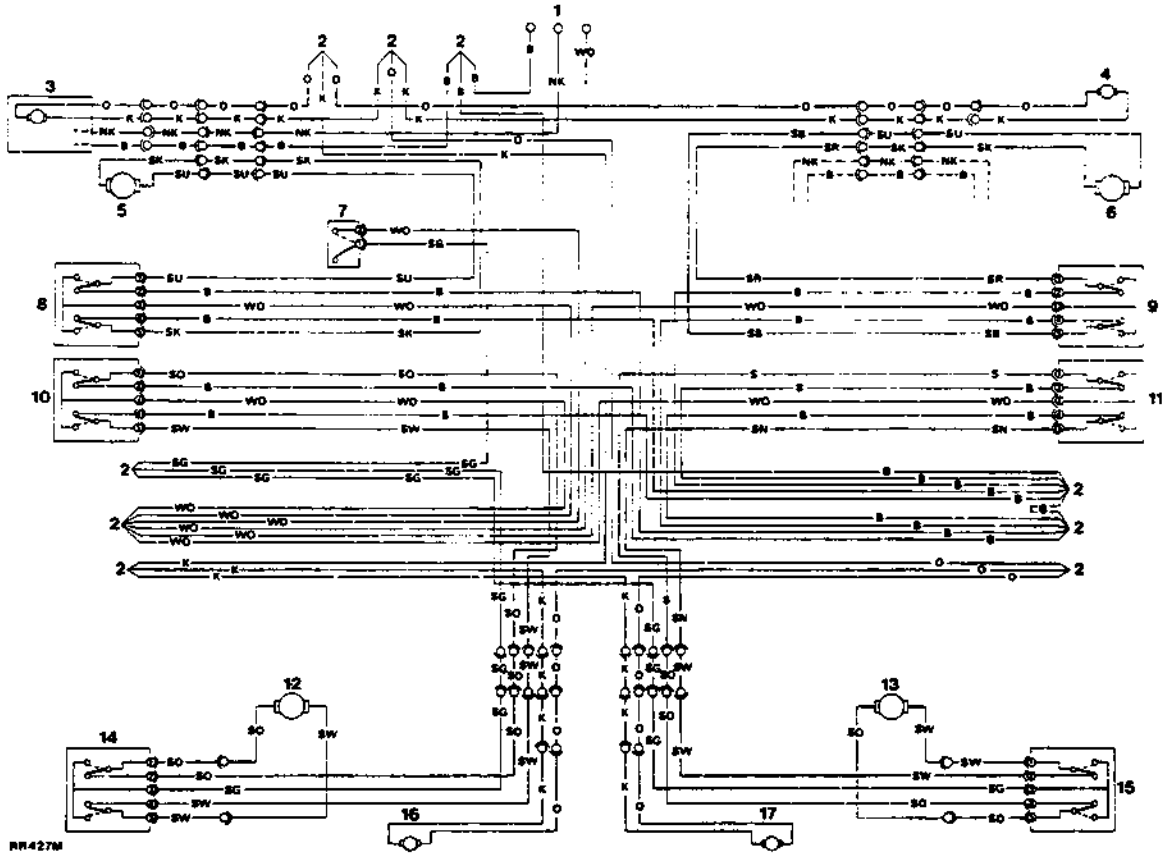
RR424M

Electric Mirrors Circuit Diagram

1. Clinch
2. Main cable connections (item 75 on main circuit diagram)
3. Mirrors
4. Mirror switches

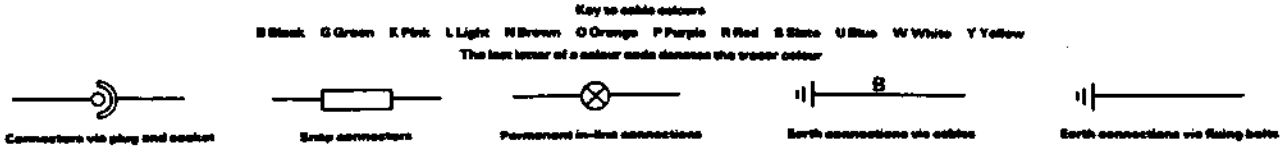


OPTIONAL ELECTRICAL EQUIPMENT—RANGE ROVER 4-DOOR MODELS



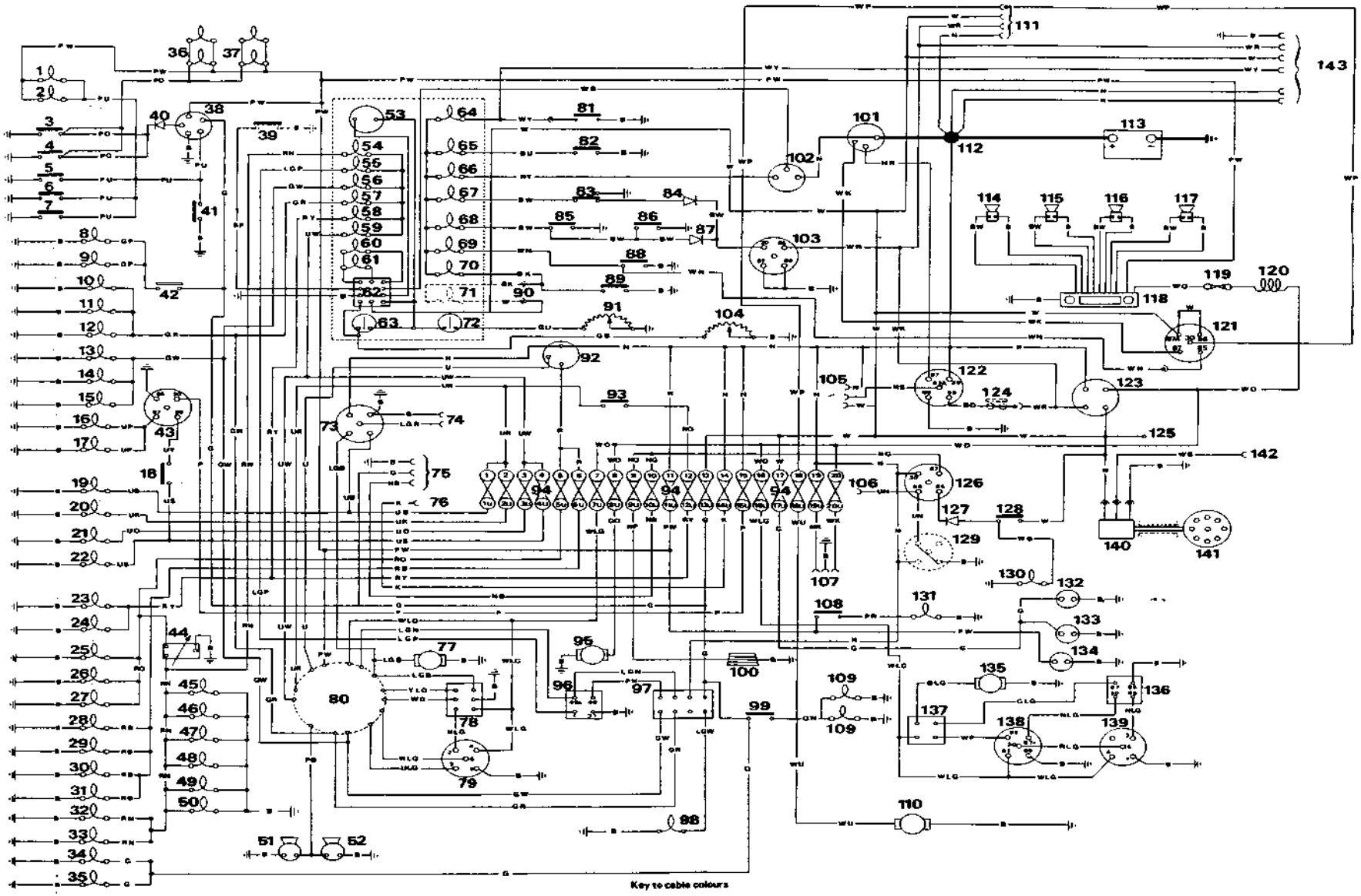
Window Lifts and Door Locks Circuit Diagram

1. Main cable connections (item 107 on main circuit diagram)
2. Clinches
3. Switch unit central door locking (drivers door)
4. Lock unit central door locking (front passenger door)
5. Window lift motor left-hand front
6. Window lift motor right-hand front
7. Isolator switch
8. Window lift switch left-hand front
9. Window lift switch right-hand front
10. Window lift switch left-hand rear
11. Window lift switch right-hand rear
12. Window life motor left-hand rear
13. Window lift motor right-hand rear
14. Window lift switch left-hand rear door
15. Window lift switch right-hand rear door
16. Lock unit central door locking left-hand rear
17. Lock unit central door locking right-hand rear



CIRCUIT DIAGRAM LEGEND—1986 onwards

1. Front interior lamp
2. Rear interior lamp
3. LH front door switch
4. RH front door switch
5. Tailgate switch
6. LH rear door switch
7. RH rear door switch
8. RH stop lamp
9. LH stop lamp
10. LH front indicator lamp
11. LH rear indicator lamp
12. LH side repeater lamp
13. RH front indicator lamp
14. RH rear indicator lamp
15. RH side repeater lamp
16. RH auxiliary driving lamp
17. LH auxiliary driving lamp
18. Auxiliary driving lamp switch
19. RH headlamp dip
20. LH headlamp dip
21. RH headlamp main
22. LH headlamp main
23. RH rear fog lamp
24. LH fog lamp
25. RH number plate lamp
26. RH side lamp
27. RH tail lamp
28. LH number plate lamp
29. LH side lamp
30. LH tail lamp
31. Radio illumination
32. Switch illumination
33. Switch illumination
34. Automatic selector illumination
35. Automatic selector illumination
36. LH door lamps
37. RH door lamps
38. Interior lamp delay
39. Automatic transfer oil temperature switch
40. Diode
41. Interior lamp switch
42. Stop lamp switch
43. Auxiliary lamps delay
44. Rheostat
45. Front cigar lighter illumination
46. Clock illumination
47. Heater illumination
48. Heater illumination
49. Heater illumination
50. Heater illumination
51. LH horn
52. RH horn
53. Tachometer
54. Instrument illumination (6 bulbs)
55. Trailer warning
56. RH indicator warning light
57. LH indicator warning light
58. Rear fog warning light
59. Head lamp warning light
60. High transfer oil temperature warning light
61. Low fuel warning light
62. Multi-function unit in binnacle
63. Fuel indicator gauge
64. Cold start warning light—(carburetter versions only)
65. Differential lock warning light
66. Ignition warning light
67. Brake failure warning light
68. Brake pad wear warning light
69. Oil pressure warning light
70. Park brake warning light
71. Park brake warning light (Australia)
72. Water temperature gauge
73. Headlamp wash timer (option)
74. Headlamp wash pump (option)
75. Head electric mirrors (option)
76. Trailer socket (option)
77. Front screen wash
78. Front wiper delay
79. Wiper motor
80. Steering column switches
81. Cold start warning lamp switch (carburetter only)
82. Differential lock switch
83. Brake failure switch
84. Diode
85. Front brake pad wear
86. Rear brake pad wear
87. Diode
88. Oil pressure switch
89. Park brake switch
90. Pick-up point-park brake warning light (Australia)
91. Water temperature transducer
92. Light switch
93. Rear fog lamp switch
94. Main fuse box
95. Heater motor and switch unit
96. Flasher unit
97. Hazard switch
98. Hazard warning lamp
99. Reverse lamp switch
100. Heated rear screen
101. Starter solenoid
102. Alternator
103. Brake failure warning lamp check relay
104. Fuel tank unit
105. Air conditioning (option)
106. Split charge relay (option)
107. Electric windows and central door locking (option)
108. Under bonnet illumination switch
109. Reverse lamps
110. Fuel pump
111. Pick-up point for petrol ignition wiring
112. Terminal post
113. Battery
114. LH rear speaker (option)
115. RH rear speaker (option)
116. LH front speaker
117. RH front speaker
118. Radio (option)
119. Radio fuse
120. Radio choke
121. Fuel shut-off relay (carburetter models only)
122. Starter solenoid relay
123. Ignition start switch
124. Start inhibitor switch (Automatic)
125. Split charge relay (option)
126. Heated rear window relay
127. Diode
128. Heated rear window switch
129. Voltage switch (option)
130. Heated rear window warning lamp
131. Bonnet lamp
132. Cigar lighter (dash)
133. Cigar lighter (cubby box)
134. Clock
135. Rear screen wash motor
136. Rear wiper delay
137. Rear wash wipe switch
138. Rear wiper relay
139. Rear wiper motor
140. Constant energy unit
141. Distributor
142. Ignition pick-up point (petrol injection only)
143. Not used



Key to cable colours

B Black G Green K Pink L Light N Brown O Orange P Purple R Red S Slate U Blue W White Y Yellow

The last letter of a colour code denotes the tracer colour

RR611M

Connectors via plug and socket

Snap connectors

Permanent in-line connections

Earth connections via cables

Earth connections via fixing bolts

1987 Model Year Supplement

RANGE ROVER
1987

WORKSHOP MANUAL SUPPLEMENT

Publication Number LSM180WS1 (Edition 2)

Published by the
Technical Publications Department of

A Managing Agent for Land Rover
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INTRODUCTION

A number of major and minor detail changes are introduced on Range Rover Petrol and Diesel models for the 1987 model year.

Specification for individual vehicles may vary, but all models will include some of the new features and options summarised below.

- General Specification Data (petrol models only).
- Engine Tuning Data (petrol models only).
- Revised drive belt arrangement (petrol models only).
- SU carburetters and linkage
- Steering wheel.
- Power steering pump and fluid reservoir.
- Revised handbrake linkage.
- Front door stowage bins.
- Lower tailgate release mechanism.
- Assisted bonnet lift.
- Radiator grille.
- Fuel filler flap
- Asymmetric split rear seats
- Revised front lamps.
- Revised fuse box.
- Distributor (petrol models only).
- Starter motor.
- Rear wiper motor.
- Rear upper tailgate screen incorporating radio antenna.
- Column control switches.
- Revised instrument binnacle to include new warning symbols for low level coolant and screen wash fluid.
- Exterior driving mirror controls.
- Central locking on fuel filler flap.
- Revised heater and controls.

Service and repair information for the new equipment is included in this supplement, which should be used in conjunction with the existing Workshop Manual LSM 180WM and Diesel Model Supplement LSM 227WS.

GENERAL SPECIFICATION DATA

STEERING PUMP

Make/type	Hobourn-Eaton series 200
Operating pressure - straight ahead position - at idle	7 kgf/cm² (100 lbf/in²) maximum
Full lock (left or right) at idle	28 kgf/cm² (400 lbf/in²) minimum
Full lock (left or right) 1000 rev/min	70-77 kgf/cm² (1000-1110 lbf/in²)

COIL

Make/type	Lucas 32C5

DISTRIBUTOR

Make/type	Lucas 35 DLM8
Rotation	Clockwise
Air gap	0.20 - 0.35mm (0.008 - 0.014)

IGNITION MODULE

Make/type	Lucas 9EM amplifier module, distributor mounted

STARTER MOTOR (Petrol models)

Make/type	Lucas M78R pre-engaged
Minimum brush length	3.5mm (0.138 in)
Minimum commutator diameter	28.8mm (1.13 in)

STARTER MOTOR (Diesel models)

Make/type	Bosch 544 pre-engaged
Minimum brush length	15.5mm (0.610 in)
Minimum commutator diameter	39.5mm (1.55 in)

TAILGATE WIPER MOTOR

Make/type	IMOS (non-serviceable)
Running current, wet screen at 20°C ambient	1.0 to 2.8 amps
Wiper speed, wet screen at 20°C ambient	37 to 43 cycles per minute

REPLACEMENT BULBS		TYPE		
Headlamps	Exterior lights	12V	60/55W	(Halogen) sealed beam
Headlamps - France amber	Exterior lights	12V	60/55W	(Halogen)
Auxiliary driving lamps	Exterior lights	12V	55W H3	(Halogen)
Sidelamps	Exterior lights	12V	5W	bayonet fitting
Stop/tail lamps	Exterior lights	12V	5/21W	bayonet fitting
Reverse lamps	Exterior lights	12V	21W	bayonet fitting
Rear fog guard lamps	Exterior lights	12V	21W	bayonet fitting
Direction indicator lamps	Exterior lights	12V	21W	bayonet fitting
Number plate lamps	Exterior lights	12V	5W	capless
Instrument panel lamps and warning lamps	Interior lights	12V	1.2W	bulb/holder unit
Ignition warning lamp (Instrument panel)	Interior lights	12V	2W	capless
Interior roof lamps	Interior lights	12V	10W	'Festoon'
Clock illumination	Interior lights	12V	2W	bayonet fitting
Cigar lighter illumination	Interior lights	12V	1.2W	capless
Door edge/puddle lamps	Interior lights	12V	5W	capless
Auxiliary switch panel illumination (green)	Interior lights	12V	1.2W	capless
Heated rear screen warning lamp (amber)	Interior lights	12V	1.2W	capless
Hazard warning lamp	Interior lights	12V	1.2W	capless
Automatic graphics illumination	Interior lights	24V	5W	capless
Heater/air conditioning graphics illumination	Interior lights	12V	1.2W	capless
Differential lock warning lamp	Interior lights	12V	2W	bayonet fitting
Column switch illumination	Interior lights	12V	1.2W	capless
Rear fog warning lamp (amber)	Interior lights	12V	1.2W	capless

ENGINE TUNING DATA

Type	V8 Cylinder
Firing order	1.8.4.3.6.5.7.2
Cylinder Numbers - Left bank	1.3.5.7.
Right bank	2.4.6.8.
No. 1 Cylinder location	Pulley end of left bank
Timing marks	On crankshaft vibration damper
Spark plugs	
Make/type	Champion N9YC
Gap	0.85 - 0.95mm (0.033 - 0.038 in)
Distributor	
Make/type	Lucas 35DLM8 Electronic
Air gap	0.20 - 0.35mm (0.008 - 0.014 in)

FUEL INJECTION MODELS

Compression ratio ..... 9.35:1 and 8.13:1

Fuel injection system ..... Lucas 'L' system

Valve timing	**Inlet**	**Exhaust**
Opens	24° BTDC	62° BBDC
Closes	52° ABDC	14° ATDC
Duration	256°	256°
Valve peak	104° ATDC	114° BTDC

Idle speed ..... 700 - 800 rev/min

Ignition timing at ..... 600 rev/min *

Ignition timing

Dynamic or static ..... TDC ± 1°
Exhaust gas CO content at idle ..... 0.5 - 1.0% max

Distributor

Make/type ..... Lucas 35 DLM8 electronic
Rotation ..... Clockwise
Air gap ..... 0.20mm - 0.35mm (0.008 - 0.014 in)
Serial number 42649

Centrifugal advance

Distributor decelerating speeds *	-1600 distributor advance	11° to 14°
	-1100	9° to 11°
	- 600	1° 30' to 4°

No centrifugal advance below ..... 100 rev/min

Fuel ..... 94 min octane - 9.35:1
90 min octane - 8.13:1

*Vacuum pipe disconnected

UK AND EUROPE

CARBURETTER MODELS

Compression ratio	9.35:1

Valve timing	**Inlet**	**Exhaust**
Opens	36° BTDC	74° BBDC
Closes	64° ABDC	26° ATDC
Duration	280°	280°
Valve peak	99° ATDC	119° BTDC

Carburetters

Type	2 x SU HIF44
Specification number	FZX 2006
Needle	BCD
Idle speed (engine hot)	700 - 800 rev/min
Fast idle speed (engine hot)	1050 - 1150 rev/min
Mixture setting -CO at idle	0.5% - 2.5% pulsair connected

Ignition

Distributor make/type	Lucas 35 DLM8 electronic
Direction of rotation	Clockwise
Air gap	0.20mm - 0.33mm (0.008 - 0.014 in)
Distributor serial number	42650

Centrifugal advance

Decelerating check with vacuum pipe disconnected

Distributor decelerating speeds	-2800 Distributor advance	5° 30' to 9°
	-1450	6° to 8°
	-1000	2° 30' to 4° 30'

No advance below ..... 250 rev/min

Ignition timing

Dynamic or static	6° ± 1° BTDC at 750 rev/min max (vacuum pipe disconnected)
Fuel	94 min Octane
Delay valve	Orange (manual) Blue (automatic)

R.O.W./GULF STATES

CARBURETTER MODELS

Compression ratio	8.13:1	
Valve timing	**Inlet**	**Exhaust**
Opens	30° BTDC	68° BBDC
Closes	75° ABDC	37° ATDC
Duration	285°	285°
Valve peak	106° ATDC	112° BTDC

Carburetters

Type	2 x HIF44
Specification number	FZX 2005
Needle	BGC
Idle speed (engine hot)	700 - 800 rev/min
Fast idle speed (engine hot)	1050 - 1150 rev/min
Mixture setting - CO at idle	0.5% to 2.5%

Ignition

Distributor make/type	Lucas 35DLM8 electronic
Direction of rotation	Clockwise
Air gap	0.20mm - 0.35mm (0.008 - 0.014 in)
Distributor serial number	42652

Centrifugal advance

Decelerating check with vacuum pipe disconnected

Distributor decelerating speeds	-2300 Distributor advance	10° 30' to 12° 30'
	-1800	8° to 10°
	-1200	3° 30' to 5° 30'
No advance below	450 rev/min	

Ignition timing

Dynamic or stati	6° ± 1° BTDC at 750 rev/min max (vacuum pipe disconnected)
Fuel	90 min octane

Recommended Lubricants and fluids

Use only the recommended grades of oil set out below.

These recommendations apply to temperate climates where operational temperatures may vary between -10°C (14°F) and 35°C (95°F)

COMPONENTS	BP	CASTROL	DUCKHAM	ESSO	MOBIL	PETROFINA	SHELL	TEXACO
Petrol engine sump Dash pots (Carburetter models only) Oil can	BP Visco 2000 (15W/40) or BP Visco Nova (10W/30)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube (15W/40)	Mobil Super 10W/40 or Mobil 1 Rally Formula	Fina Supergrade Motor Oil 15W/40 or 10W/40	Shell Super Motor Oil 15W/40 or 10W/40	Havoline Motor Oil 15W/40 or Eurotex HD (10W/30)
Diesel engine sump	BP Vanellus C3 Extra (15W/40)	Castrol Turbomax (15W/40)			Mobil Delvac 1400 Super (15W/40)		Shell Myrina (15W/40)	
	The following list of oils are for emergency use only if the above oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes Use only oils to MIL-L-2104D or CCMC D2 or API Service levels CD or SE/CD - 15W/40							
	BP Vanellus C3 Multigrade 15W/40)	Castrol Deusol RX Super (15W/40)	Duckhams Hypergrade (15W/50)	Esso Essolube XD - 3(15W/40)	Mobil Delvac Super (15W/40)	Fina Dilano HPD (15W/40)	Shell Rimula X (15W/40)	Texaco URSA Super Plus (15W/40)
Automatic gearbox	BP Autran DX2D	Castrol TQ Dexron IID	Duckhams Fleetmatic CD or Duckhams D-Matic	Esso ATF Dexron IID	Mobil ATF 220D	Fina Dexron IID	Shell ATF Dexron IID	Texamatic Fluid 9226
Manual gearbox	BP Autran G	Castrol TQF	Duckhams Q-Matic	Esso ATF Type G	Mobil ATF 210	Fina Purfimatic 33G	Shell Donax TF	Texamatic Type G
Front and Rear differential Swivel pin housings and LT230T Transfer gearbox	BP Gear Oil SAE 90EP	Castrol Hypoy SAE 90EP	Duckhams Hypoid 90	Esso Gear Oil GX 85W/90	Mobil Mobilube HD90	Fina Pontonic MP SAE 80W/90	Shell Spirax 90EP	Texaco Multigear Lubricant EP 85W/90
Propeller shaft Front and Rear	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All Purpose Grease
Power steering box and fluid Reservoir	BP Autran DX2D *	Castrol TQ Dexron IID *	Duckhams Fleetmatic CD or Duckhams D-Matic *	Esso ATF Dexron IID *	Mobil ATF 220D *	Fina Dexron II *	Shell ATF Dexron IID *	Texamatic Fluid 9226 *
Brake and clutch reservoirs	Brake fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT3 or DOT4							
Lubrication nipples (hubs, ball joints etc.)	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All Purpose Grease
Ball joint assembly Top Link	Dextragrease Super GP							
Seat slides Door lock striker	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All purpose grease
	NLGI-2 Multi-purpose Lithium-based Grease							

* Or fluids listed for manual gearbox

Bonnet plinth	Graphite Lock Grease Type 'R'
Door locks (anti-burst) Inertia reels	**DO NOT LUBRICATE.**These components are 'life' lubricated at the manufacturing stage.
Battery lugs Earthing surfaces Where paint has been removed	Petroleum jelly **NOTE:** Do not use silicon grease
Fuel	**Petrol engines** - 9.35:1 97 octane (4 star rating in UK) - 8.13:1 90 octane (2 star rating in UK) with standard ignition timing **Diesel engines** - 22:1 Diesel fuel oil, distillate, diesel fuel, automotive gas oil or Derv fuel to British Standard 2869, 1967 Class A1
Windscreen washers	Universal screen washer fluid
Engine cooling	For all Petrol and Diesel Models use an ethylene glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors suitable for use in aluminium engines to ensure the protection of the cooling system against frost and corrosion in all seasons. Use one part anti-freeze to one part water for protection down to -36°C (-33°F) **IMPORTANT:**Coolant solution must not fall below proportions one part anti-freeze to three parts water, i.e. minimum 25% anti-freeze in coolant otherwise damage to engine is liable to occur. When anti-freeze is not required, the cooling system must be flushed out with clean water and refilled with a solution of one part Marstons SQ36 inhibitor to nine parts water i.e. minimum 10% inhibitor in coolant.
Air conditioning system Refrigerant	**METHYLCHLORIDE REFRIGERANTS MUST NOT BE USED** Use only with refrigerant 12. This includes 'Freon 12' and 'Arcton 12'
Compressor oil	Shell Clavus 68, BP Energol LPT68, Sunisco 4GS Texaco Capella E Wax Free 68

RECOMMENDED LUBRICANTS AND FLUIDS - ALL CLIMATES AND CONDITIONS

COMPONENTS	SERVICE CLASSIFICATION		AMBIENT TEMPERATURE °C
	Specification	SAE Classification	-30 -20 -10 0 10 20 30 40 50
Petrol models Engine sump Dash pots (carburetter models only) Oil can	Oils must meet BLS.22.OL.07 or	5W/30 5W/40) 5W/50)	
	CCMC3 or API service levels SF	10W/30 10W/40) 10W/50)	
	Oils must meet BLS.22.OL.02	15W/40) 15W/50)	
	or CCMC G1 or G2	20W/40) 20W/50)	
	or API service levels SE or SF	25W/40) 25W/50)	
Diesel models engine sump	SHPD oils meeting CCMC D3	10W/30 15W/40	
	* **Emergency only:** Oils meeting MIL-L-2104D or CCMCD2 or API CD		
Main Gearbox Automatic	ATF Dexron IID		
Main Gearbox manual	ATF M2C33 (F or G)		
Transfer gearbox Final drive units Swivel pin housings	API GL4 or GL5 MIL-L-2105 or MIL-L-2105B	90 EP 80W EP	
Power steering	ATF M2C 33 (F or G) or ATF Dexron IID		

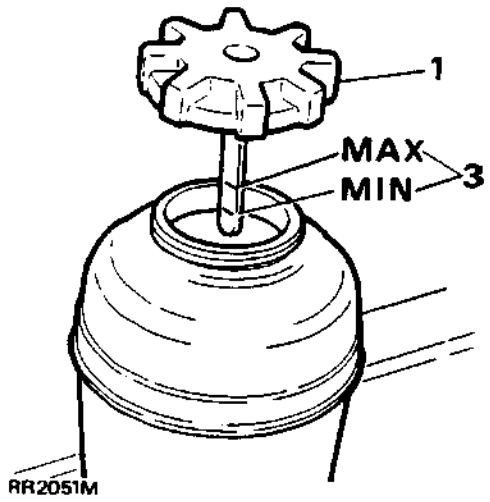
* Oils for emergency use only if the above oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes.

Lubrication nipples (hubs, ball joints propeller shafts,etc)	NLGI-2 Multi-purpose lithium based grease
Brake and clutch	Universal Brake Fluids or other Brake Fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT3 or DOT4
Windscreen	Universal screen washer fluid
Engine cooling system	For all Petrol and Diesel models use an ethylene glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors suitable for use in aluminium engines to ensure the protection of the cooling system against frost and corrosion in all seasons. Use one part anti-freeze to one part water for protection down to -36°C (-33°F) **IMPORTANT:**Coolant solution must not fall below proportions of one part anti-freeze to three parts water i.e. minimum 25% anti-freeze in coolant otherwise damage to engine is liable to occur. When anti-freeze is not required, the cooling system must be flushed out with clean water and refilled with a solution of one part Marstons SQ36 inhibitor to nine parts water, i.e. minimum 10% inhibitor in coolant.
Air conditioning Refrigerant	**METHYCHLORIDE REFRIGERANTS MUST NOT BE USED** Use only with refrigerant 12. This includes 'Freon 12' and 'Arcton 12'
Compressor oil	Shell Clavus 68, BP Energol LPT 68, Sunisco 4GS, Texaco Capella E Wax Free 68.

MAINTENANCE

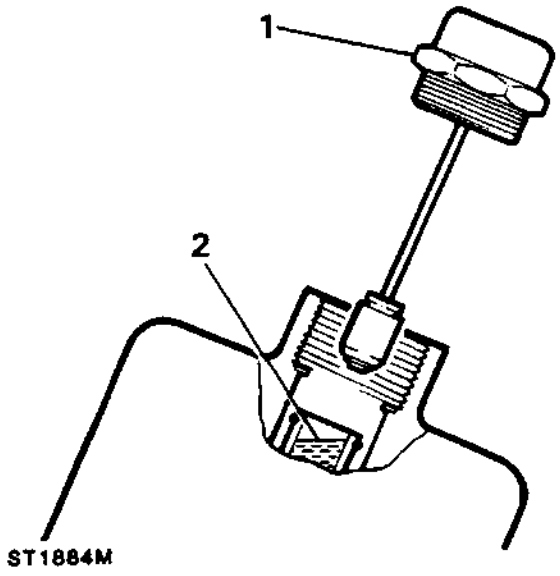
TOP UP STEERING BOX FLUID

1. Clean and remove the reservoir cap.
2. Wipe the reservoir dipstick clean and refit the cap.
3. Remove the cap again and check that the fluid level registers between the **MAX** and **MIN** level markings on the dipstick.
4. Top up as necessary and refit the cap.



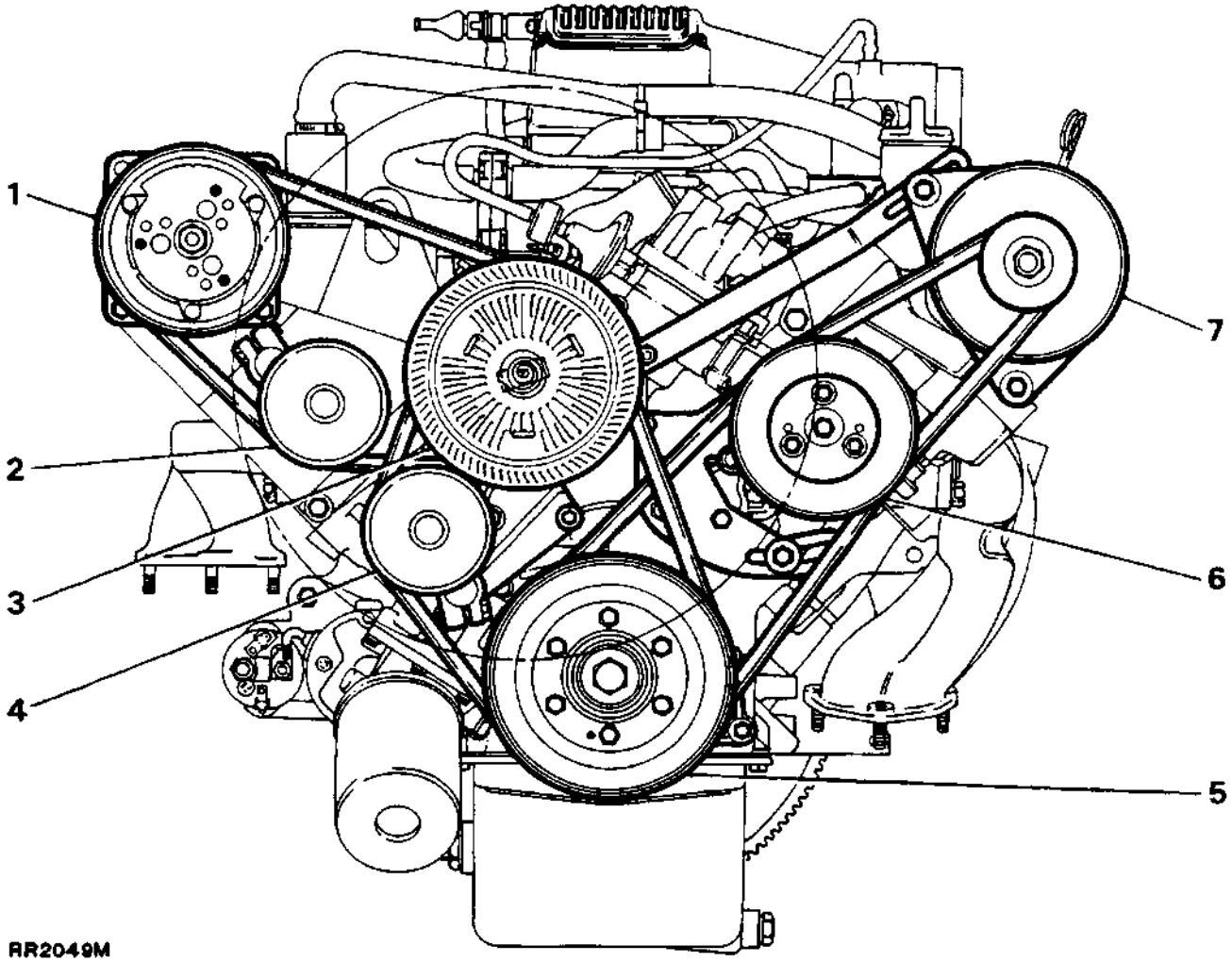
CARBURETTER DAMPER- Topping up

1. Unscrew the cap from the top of the carburetter suction chamber and withdraw the cap and plunger.
2. Top-up with clean engine oil to bring the level to the top of the hollow piston rod.
3. Screw the cap firmly into the carburetter.



MAINTENANCE SCHEDULES

All Range Rovers fitted with a manual gearbox must have the main and transfer gearbox oils changed at 20,000 km (12,000 mile) service intervals.



1. Air conditioning compressor.
2. Jockey wheel.
3. Viscous fan-water pump unit.
4. Jockey wheel.
5. Crankshaft.
6. Power steering pump.
7. Alternator.

WARNING: DISCONNECT THE BATTERY NEGATIVE TERMINAL BEFORE ADJUSTING DRIVE BELTS TO AVOID THE POSSIBILITY OF THE VEHICLE BEING STARTED.

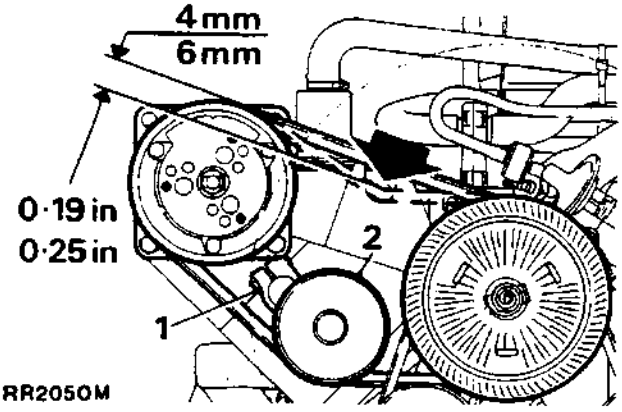
DRIVE BELTS-adjust or renew (Petrol models only)

COMPRESSOR DRIVE BELT

The belt must be tight with not more than 4 to 6mm (0.19 to 0.25 in) total deflection when checked by hand midway between the pulleys on the longest run.

Where a belt has stretched beyond the limits, a noisy whine or knock will often be evident during operating, if necessary adjust as follows:

1. Slacken the jockey wheel securing bolt.
2. Adjust the position of the jockey wheel until the correct tension is obtained.
3. Tighten the securing bolt and re-check the belt tension.



Check driving belts, adjust or renew as necessary

1. Examine the following belts for wear and condition and renew if necessary.

   (A) Crankshaft-Jockey Pulley-Water pump
   (B) Crankshaft-Steering Pump
   (C) Steering Pump-Alternator

ILLUSTRATION A

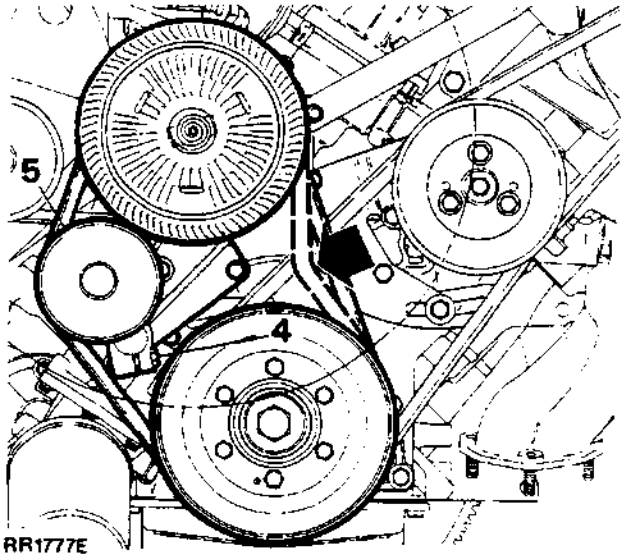


ILLUSTRATION B

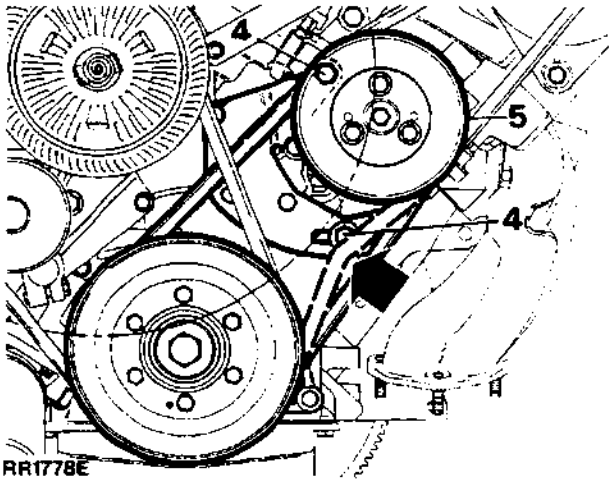
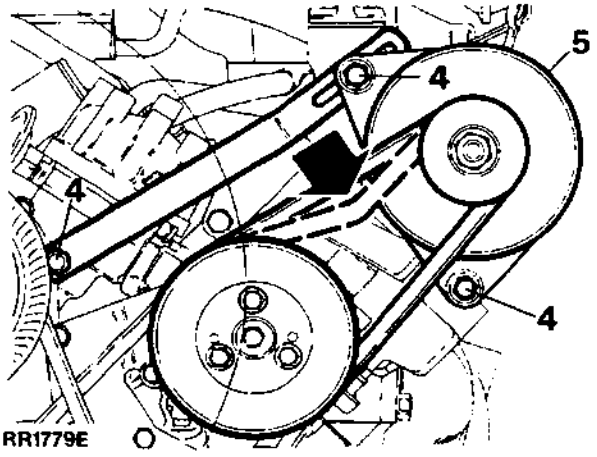
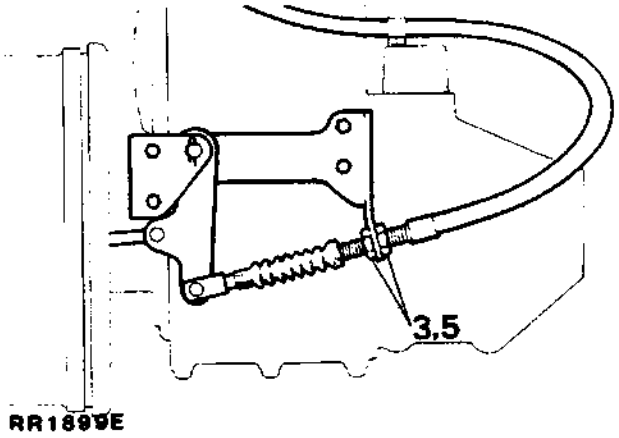


ILLUSTRATION C



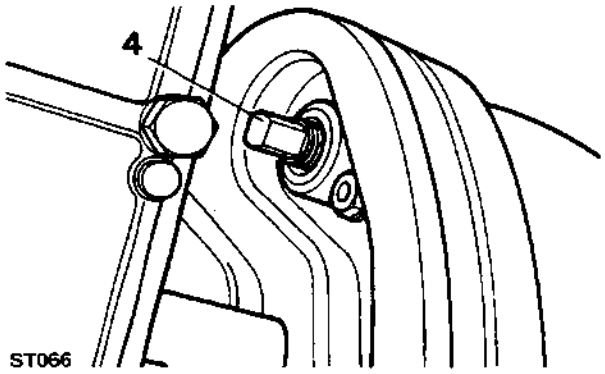
2. Each belt should be sufficiently tight to drive the appropriate auxiliary unit without undue load on the bearings.
3. Slacken the bolts securing the unit to its mounting bracket.
4. Slacken the appropriate pivot bolt or jockey wheel and the fixing at the adjustment link where applicable.
5. Pivot the unit inwards or outwards as necessary and adjust until the correct belt tension is obtained.
6. Belt tension should be approximately 11 to 14mm (0.437 to 0.562 in) at the points denoted by the bold arrows.
7. Tighten all unit adjusting bolts. Check adjustment again, when a new belt is fitted, after approximately 1,500 km (1,000 miles) running.



ADJUST HANDBRAKE CABLE

The handbrake lever acts on a transmission brake drum at the rear of the transfer box.

1. Set the vehicle on level ground and select 'P' in main gearbox. Disconnect the battery negative lead.
2. Fully release the handbrake.
3. From underneath the vehicle slacken the two locknuts securing the handbrake outer cable to the mounting bracket, to enable the brake drum to be adjusted without putting any tension on the handbrake outer cable.
4. Rotate the adjuster on the brake drum back plate clockwise, until the brake shoes are fully expanded against the drum.



5. Rotate the two outer cable locknuts until contact is made with the mounting bracket, tighten the two nuts consecutively to prevent any movement occurring on the outer cable.
6. Slacken the adjuster on the back of the brake drum until the handbrake lever becomes fully operational on the second or third notch of the handbrake ratchet.
7. Lightly grease the handbrake linkage with a general purpose grease.

CAUTION: DO NOT over-adjust the handbrake, the drum must be free to rotate when the handbrake is released, otherwise serious damage will result.

CARBURETTER OVERHAUL-S.U. HIF 44

Right hand
(Horizontal integral float chamber)

DISMANTLE

1. Remove the carburetters from the engine and clean the exteriors with a suitable solvent.
2. Remove the two nuts and spring washers and withdraw the air intake adaptor and joint washer.
3. Unscrew and remove the piston damper assembly and drain the oil.
4. Remove the three screws and lift-off the suction chamber complete with piston and spring.
5. Remove the spring clip from the top of the piston rod and withdraw the piston and spring.
6. Unscrew the metering needle guide locking screw. Attempt to remove assy with fingers. If difficulty is experienced then holding the needle as close to the piston as possible in a soft jawed vice with a sharp pull, withdraw the needle, guide and spring assembly.
7. Remove the four screws and withdraw the float chamber cover plate and sealing ring.
8. Remove jet adjusting lever retaining screw and spring.
9. Withdraw the jet complete with the bi-metal lever and separate the lever from the jet.
10. Unscrew and remove the float pivot spindle and plain washer, and remove the float.
11. Lift-out the needle valve.
12. Unscrew and remove the needle valve and filter.
13. Unscrew and remove the jet bearing nut.
14. Invert the carburetter body to allow the jet bearing to fall out. If the bearing sticks, carefully tap it out from the bridge side.
15. Remove the piston guide peg.
16. Remove the suction chamber-to-body sealing ring.
17. Unscrew and remove the mixture adjusting screw and seal. Use thin nosed pliers to finally withdraw the screw.
18. Bend-back the cam lever nut lock tabs and remove the nut and lock washer.
19. Remove the cam lever and spring.
20. Remove the end seal cover and seal.
21. Remove the two screws and withdraw the cold start valve body and seal together with the valve spindle. Also collect the paper joint washer.
22. Note the position of the throttle levers and return spring.
23. Bend-back the lock washer tabs and remove the throttle lever nut.
24. Remove the lock washer, bush washer and throttle actuating lever.
25. Release the throttle return spring and remove the throttle adjusting lever from the throttle butterfly spindle and remove the return spring.
26. Hold the butterfly closed and mark the relationship of the butterfly to the carburetter flange.
27. Remove the butterfly two retaining screws and withdraw the butterfly from the spindle.
28. Withdraw the throttle butterfly spindle from the carburetter body together with the two seals.
29. Clean all components with petrol or de-natured alcohol ready for inspection. Do not use abrasives for the removal of stains or deposits.

INSPECTION

30. Examine the throttle spindle and bearings for excessive axial clearance.
31. Check the float needle and seating for wear and the float for punctures and renew if necessary.
32. Check the condition of all rubber seals, 'O' rings and joint washers and renew if necessary. The float cover plate seal must be renewed.
33. Examine the carburetter body for cracks and damage.
34. Ensure that the inside of the suction chamber is clean and fit the piston into the chamber without the spring. Hold the assembly horizontally and spin the piston. The piston should spin freely in the suction chamber without any tendency to stick.
35. Inspect the metering needle for wear, scores and distortion. Check also that it has the correct designation number - see Engine Tuning Data, Section 05.

36. Examine the bi-metal jet lever for cracks.
37. Check all springs for cracks and distortion.

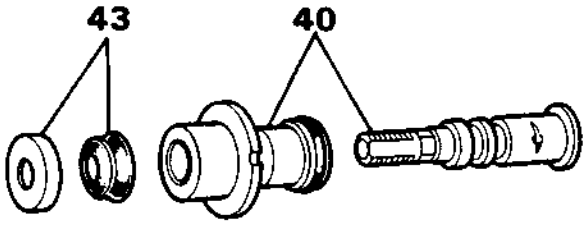
ASSEMBLE

Fit throttle butterfly

38. Fit the throttle spindle to the carburetter body and insert the throttle disc into the spindle in its original position. Secure the disc with new screws and ensure that before tightening the throttle disc is correctly positioned and closes properly. Splay the split ends of the screws to prevent turning.
39. Fit new seals to both ends of the throttle spindle ensuring that they are fitted the correct way round.

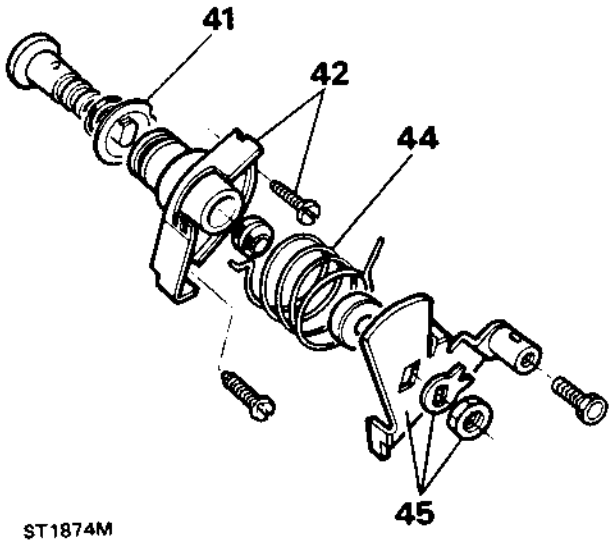
Fit cold start assembly

40. Fit a new 'O' ring to the valve body and assemble the valve spindle to the valve body.
41. Fit a new paper joint washer to the valve noting that the half-moon cut-out in the washer is clearance for the top retaining screw.
42. Fit the starter assembly to the carburetter body and secure with the two screws.
43. Fit the end seal and cover.



ST1873M

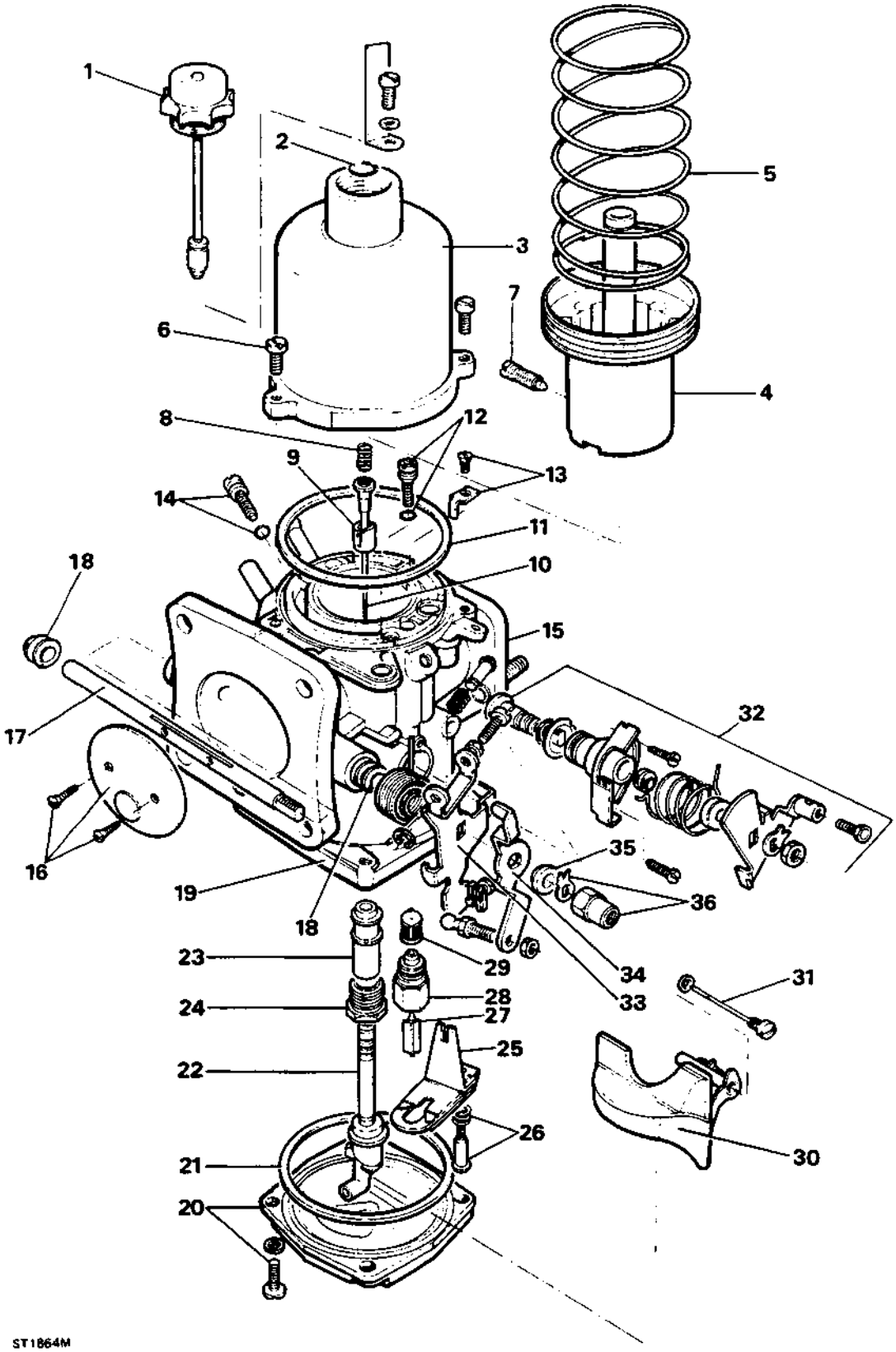
44. Fit the return spring.
45. Fit the cam lever and tension the spring. Fit a new lock washer and secure with the nut and bend the tabs over a convenient flat.
46. Adjust the coils of the spring, if necessary, to prevent coil binding.



ST1874M

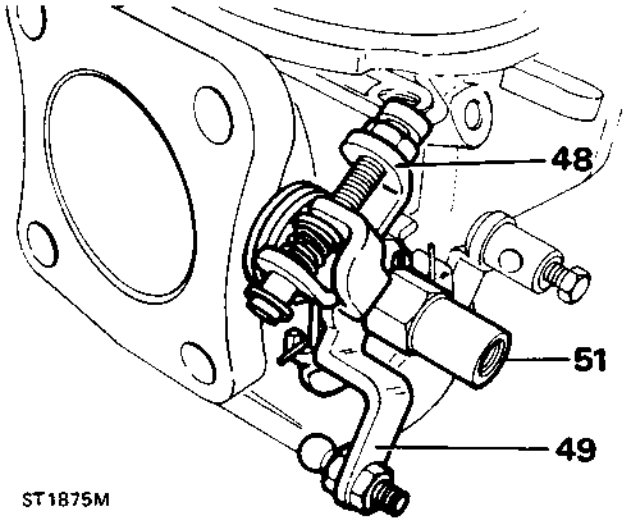
KEY TO S.U. CARBURETTER COMPONENTS

1. Piston damper.
2. Spring clip.
3. Suction chamber.
4. Piston.
5. Piston spring.
6. Suction chamber retaining screws -3 off.
7. Needle retaining screw.
8. Needle bias spring.
9. Needle guide.
10. Needle.
11. Suction chamber sealing ring.
12. Throttle adjusting screw and seal.
13. Piston key and retaining screw.
14. Mixture adjusting screw and seal.
15. Carburetter body.
16. Throttle butterfly and retaining screws.
17. Throttle spindle.
18. Throttle spindle seals - 2 off.
19. Float chamber.
20. Float chamber cover and retaining screws.
21. Float chamber cover seal.
22. Jet assembly.
23. Jet bearing.
24. Jet bearing nut.
25. Bi-metal jet lever.
26. Jet retaining screw and spring.
27. Float needle.
28. Float needle seat.
29. Float needle seat filter.
30. Float.
31. Float pivot spindle.
32. Cold start and cam lever assembly.
33. Throttle adjusting lever and lost motion assembly.
34. Throttle actuating lever.
35. Bush washer.
36. Throttle lever assembly retaining nut and lock washer.


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ST1864M

Fit throttle lever assembly

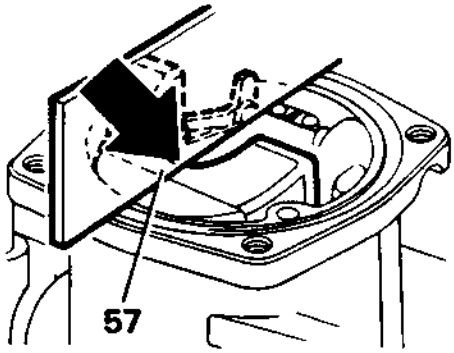
47. Fit the return spring so that the longest leg rests against the throttle adjusting screw housing.
48. Fit the throttle adjusting lever and lost motion assembly and tension the return spring.
49. Fit the throttle actuating lever.
50. Fit the bush washer and lock washer.
51. Fit and tighten the special nut and bend the lock tabs over a convenient flat.

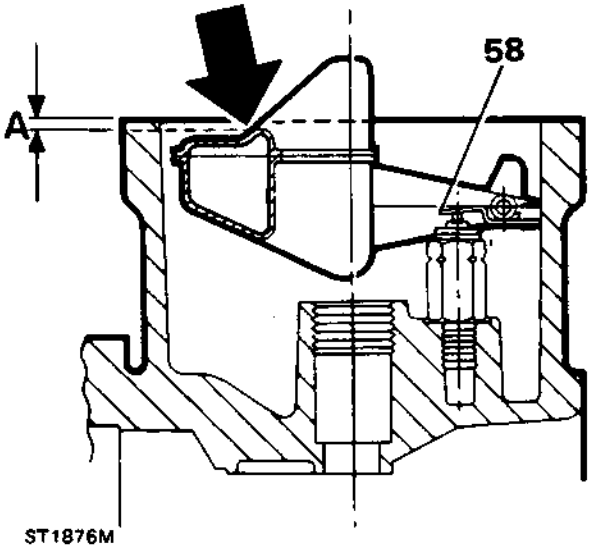


ST1875M

Fit jet and float assembly

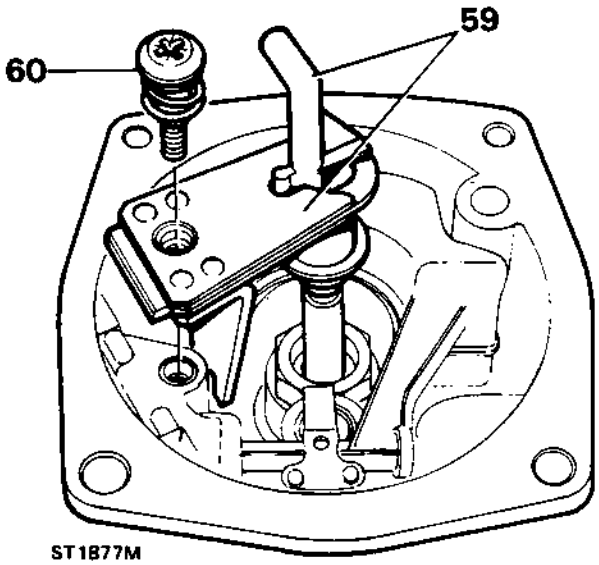
52. Fit the jet bearing, long end towards the float.
53. Fit the jet bearing nut.
54. Clean or renew the filter and fit the float needle seat.
55. Fit the needle valve, spring loaded pin uppermost.
56. Fit the float and secure with the pivot pin.
57. Hold the carburetter in the inverted position so that the needle valve is closed by the weight of the float only. Check using a straight edge that the point on the float, arrowed on the illustration, is 0.5 to 1.5mm (0.020 to 0.059 in) below the level of the float chamber face, dimension 'A'.
58. Adjust the float position by carefully bending the brass pad until the correct dimension is achieved. After adjustment, check that the float pivots freely about the spindle.





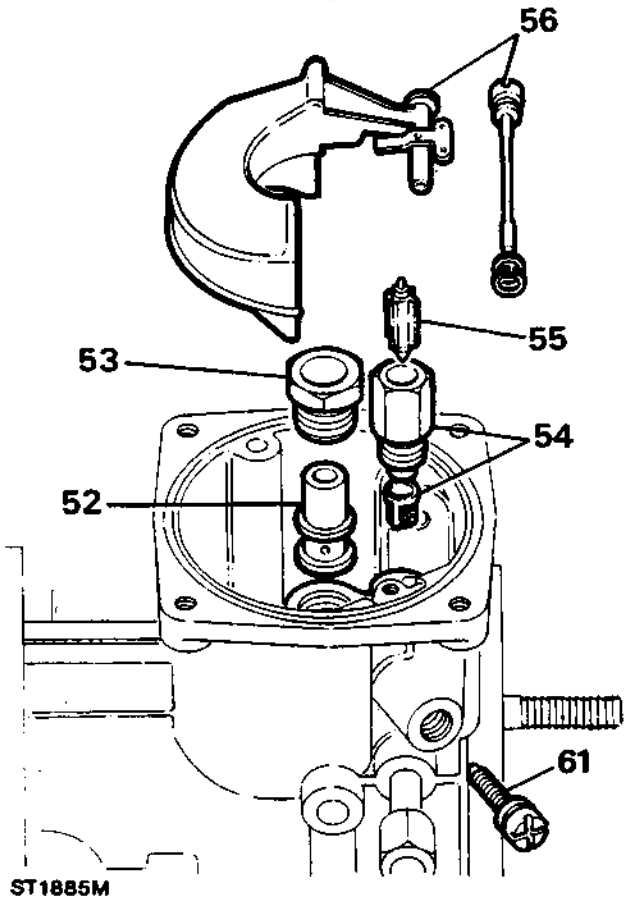
ST1876M

59. Assemble the jet to the bi-metal jet lever and ensure that the jet head moves freely in the cut-out.
60. Fit the jet and bi-metal jet lever to the carburetter and secure with the spring loaded jet retaining screw.



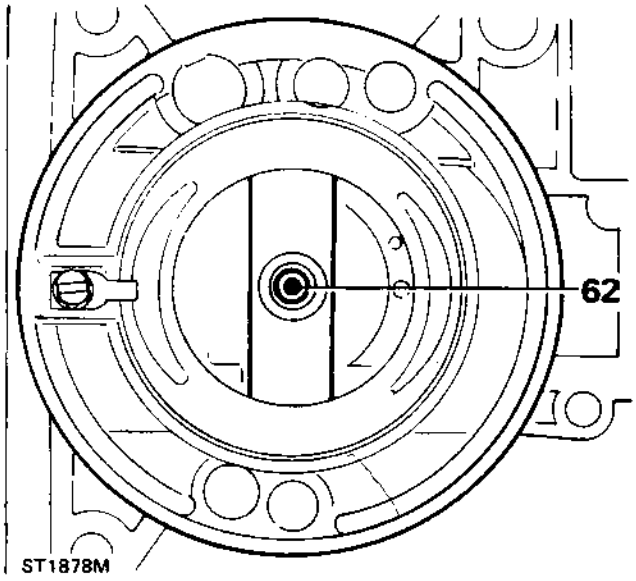
ST1877M

61. Fit the mixture adjusting screw.



ST1885M

62. Adjust until the jet is flush with the carburetter bridge, then re-adjust jet three and one-half turns clockwise.

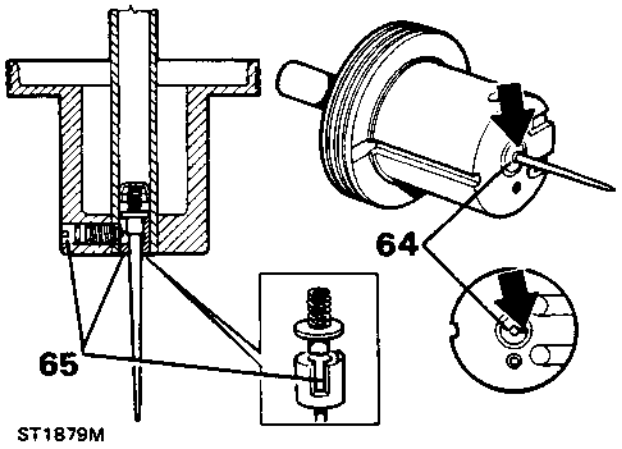


ST1878M

63. Using a new sealing ring, fit the float chamber cover, noting that it can only be fitted one way. Secure with the four screws and spring washers and evenly tighten.

Fit piston and suction chamber

64. Fit the needle, spring and guide assembly to the piston ensuring that the etched arrow head on the needle locating guide is aligned between the piston transfer holes, as illustrated.
65. Secure and ensure that when the screw is tightened the guide is flush with the piston and that the screw locates in the guide slot.



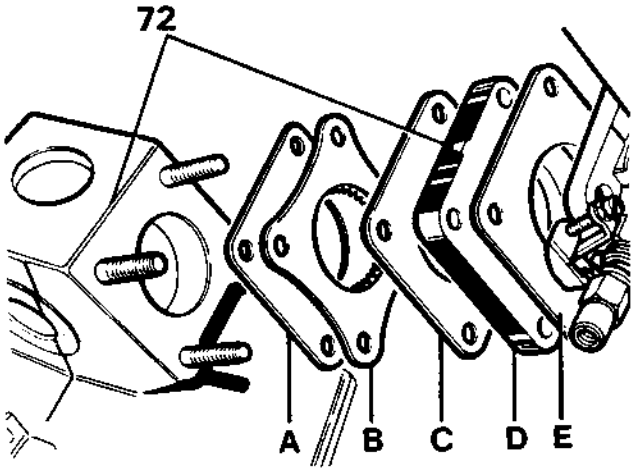
ST1879M

66. Fit the piston key to the carburetter body using a new screw. Tighten the screw and splay the end.
67. Fit a new suction chamber sealing ring to the groove in the carburetter body.
68. To prevent the piston spring being 'wound-up' during assembly, temporarily fit the piston and suction chamber less the spring to the body, and pencil mark the relationship of the chamber to the body. Remove the suction chamber and fit the spring to the piston. Hold the suction chamber above the spring and piston, align the pencil marks and lower the chamber over the spring and piston, taking care not to rotate the suction chamber. Secure the chamber to the body with the three screws, tightening evenly and check that the piston moves freely.
69. Hold the piston at the top of its stroke and fit the spring clip.
70. Fit the piston damper.
71. Using a new joint washer, fit the air intake adaptor and secure with the two nuts and spring washers.

72. Fit the carburetters to the inlet manifold ensuring that the joint washers, deflector and insulator are fitted in the sequence illustrated. The insulator must be fitted with the arrow head uppermost and pointing inwards towards the manifold. Secure with the four nuts and spring washers and tighten evenly to the correct torque.

    A. Joint washer.
    B. Deflector-teeth pointing inwards.
    C. Joint washer.
    D. Insulator.
    E. Joint washer.

73. Connect the linkages, tune and adjust the carburetters.



ST1880M

TUNE AND ADJUST - SU HIF 44 CARBURETTERS

Special tools:

Carburetter balancer 605330 or B89 Non - dispersive infra - red exhaust gas analyser.

General Requirements Prior To Tuning Carburetters.

Accurate engine speed is essential during carburetter tuning, therefore the distributor pick up air gap and ignition timing must be checked together with the vacuum advance system.

Whenever possible the ambient air temperature of the tuning environment should be between 15° to 26° C (60° to 80° F). When checking engine speed, use an independent and accurate tachometer.

Idling adjustments should be carried out on a fully warmed up engine, that is, at least 5 minutes after the thermostat has opened. This should be followed by a run of one minute duration at an engine speed of approximately 2,500 rev/min before further adjustments or checks are carried out. This cycle may be repeated as often as required. It is important that the above cycle is adhered to, otherwise overheating may result and settings may be incorrect. The piston dampers must always be kept topped-up with the correct grade of oil.

Before any attempt is made to check settings a thorough check should be carried out to ensure that the throttle linkage between the pedal and carburetters is free and has no tendency to stick. Ensure that the choke control lever is is pushed fully down.

NOTE: References to left and right hand are as from the drivers seat.

TAMPER - PROOFING

To comply with E.C.E regulations the idle speed and mixture adjusting screws must be tamper - proofed following any adjustments. A red blanking plug; **Part number - JZX 1258** must be fitted into the mixture screw recess and a red cap; **Part number - JZX 1197** fitted over the idle adjustment screw (throttle adjustment screw).

TUNE AND ADJUST

The following instructions apply to both carburetters unless otherwise stated.

CARBURETTER BALANCE

Using **balancer 605330**

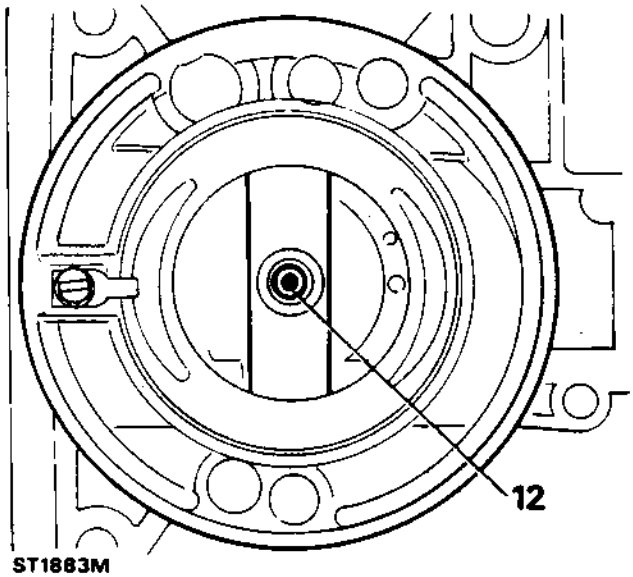
1. Disconnect the inter connecting link between the two carburetters, fit the balancer to the carburetter intakes and ensure that there are no air leaks, if necessary, zero the gauge with the adjustment screw.
2. Start the engine, and if necessary allow it to reach normal operating temperature. If the needle moves to the right, decrease the air flow through the the left hand carburetter by unscrewing the idle screw. Alternatively, increase the air flow through the right hand carburetter by screwing down the idle screw. Reverse the procedure if the pointer moves to the left. When the desired setting has been achieved reconnect the inter connecting link between the two carburetters.

Using **balancer B89**

3. Disconnect the inter-connecting throttle link between the two carburetters.
4. Back-off the idle adjusting screw on each carburetter, clear of the throttle lever.
5. Turn each throttle adjusting screw so that it just touches the throttle lever, then turn the screws by equal amounts to achieve an approximate idle speed of 700 to 800 rev/min.
6. Press the balancer firmly over the carburetter intake. Press or withdraw the control on the side of the balancer to adjust the meter needle reading to approximately half scale, and note the reading.
7. Without altering the position of the balancer control, place the balancer on the second carburetter intake and adjust the idle screw as necessary to achieve the same reading.
8. Alternately, adjust and check the balance of both carburetters until an idle speed of 700 to 800 rev/min is obtained.
9. Reconnect the throttle inter connecting link, and again check the idle speed and balance.

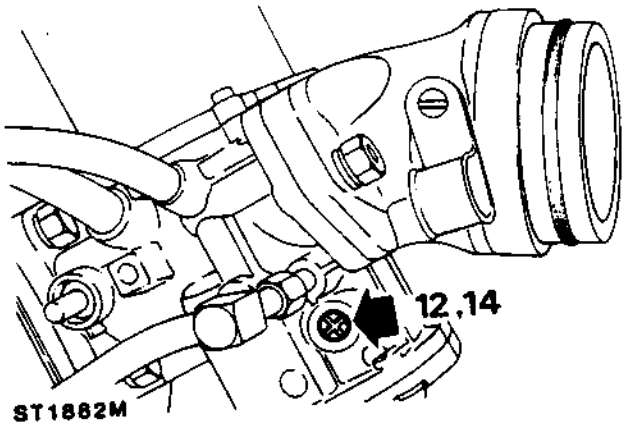
MIXTURE SETTING

10. Ensure that the engine is at normal operating temperature. Remove the air cleaner, air intake elbows and mixture adjustment screw blanking plugs.
11. Mark the relationship of the suction chamber to the carburetter body, remove the retaining screws and lift off the suction chamber complete with pistons.
12. To achieve a datum setting for the mixture screw, turn it anti - clockwise until the jet is level with the carburetter bridge. Check by placing a straight edge across the bridge and adjust as necessary so that the jet just touches the straight edge.



ST1883M

13. Refit the suction chamber and piston, evenly tighten the retaining screws. Check that the piston moves freely without sticking. Top - up the piston damper.
14. Turn the mixture adjustment screw three and one-half turns.



15. Insert the probe of an infra - red exhaust gas analyser as far as possible up the exhaust pipe, start the engine and allow a one and one half minute stabilisation period.
16. Adjust the mixture screw on both carburetters by equal amounts, rich or weak to achieve a CO reading of 0.5 to 2.5%.
17. If after approximately two minutes the CO level is not satisfactory run the engine at 2000 rev/min for one minute to stabilise the equipment, continue the setting procedure until a stable CO reading of 0.5 to 2.5% at an idle speed of 700 - 800 rev/min is obtained.

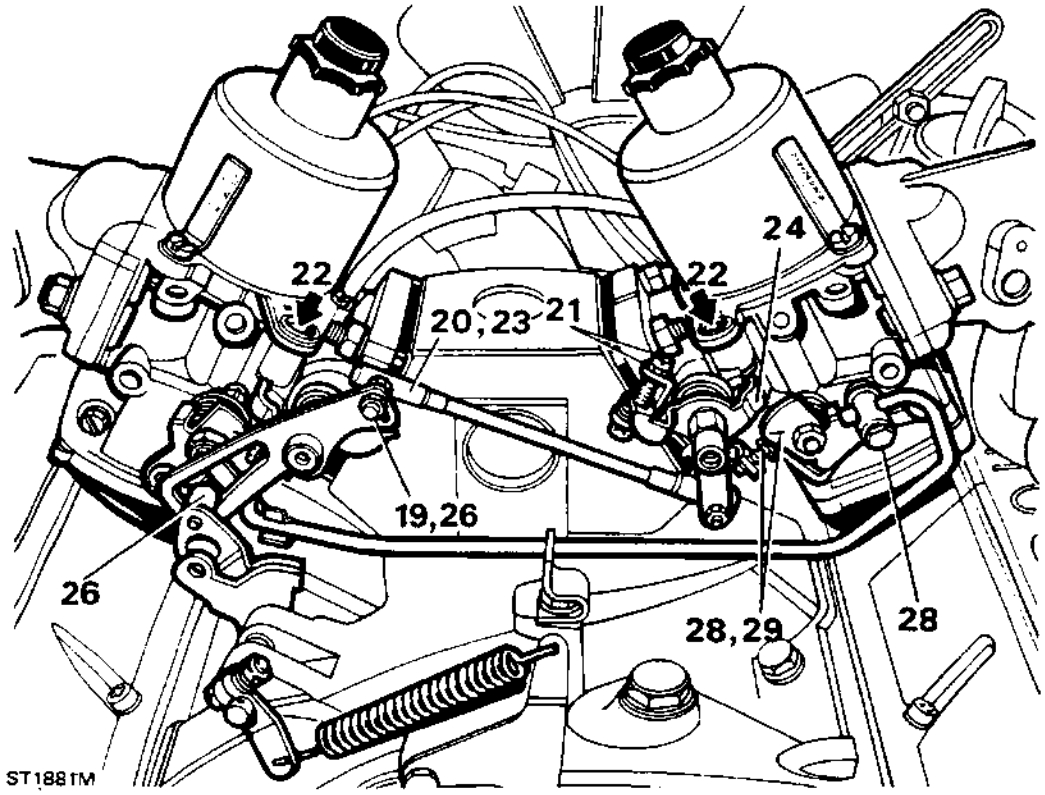
IDLE SPEED AND LINKAGE ADJUSTMENT

18. Check that the engine is at normal operating temperature.
19. **Manual gearbox models-** Slacken the nut, at the left hand carburetter securing the inter-connecting link ball to the throttle cam lever. **Automatic gear box models-** Slacken the lower nut, securing the inter - connecting link ball to the throttle lever at the right hand carburetter.
20. Disconnect the inter - connecting link between the carburetters at the left hand carburetter.
21. At the right hand carburetter, release the lock nut and slacken off the lost motion adjustment screw, until it is well clear of the spring loaded pad.
22. If necessary adjust the idle screw to maintain the correct idle speed. Check the CO level and carburetter balance, adjust if required.
23. Re - connect the inter - connecting link to the left hand carburetter.
24. Hold the right hand throttle lever against the idle screw stop and adjust the lost motion screw until contact is made with the spring loaded pad, tighten the lock nut.
25. Check the idle speed and balance. Adjust the lost motion screw to restore balance if necessary.
26. **Manual gearbox models-**Ensuring that the roller is firmly seated in the lower corner of the cam lever, tighten the nut which secures the inter - connecting link ball to the cam lever.
    Automatic gearbox models-Ensuring that the kick down cable linkage is firmly on its idle stop, tighten the inter - connecting link ball securing nut at the right hand carburetter.

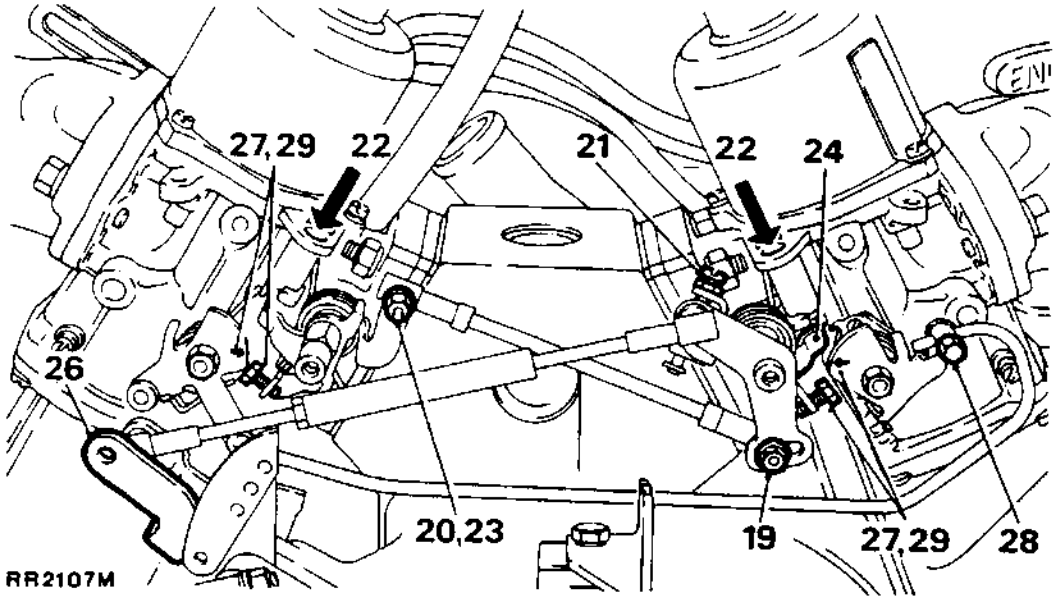
FAST IDLE ADJUSTMENT

27. Pull out the cold start control (choke) until the scribed line on the left hand fast idle cam is in-line with the centre of the fast idle screw head.
28. Check that the scribed line on the right hand fast idle cam is similarly in-line with the fast idle screw head. If there is mis-alignment, slacken the fast idle cam link rod screw at the right hand carburetter and move the cam until the scribed line coincides with the centre of the screw head. Tighten the cam rod screw.
29. Turn each fast idle screw clockwise until just clear of the cam.
30. Turn the fast idle screw of the leading (left-hand) carburetter down (clockwise) until a slight change in engine speed is noted.
31. Similarly turn the fast idle screw of the second carburetter (right-hand) down until a further slight change of engine speed is noted.
32. Adjust the fast idle screws of both carburetters by equal amounts to achieve a fast idle speed of 1100 to 1150 rev/min.
33. Push the cold start (choke) fully home then pull it out again to its full extent and re-check the fast idle speed.

MANUAL GEARBOX MODELS



AUTOMATIC GEARBOX MODELS



34. Fit the appropriate blanking plug and cap to the mixture screw recess and idle adjusting screw.

35. Fit the carburetter air intake elbows and air cleaner.

FUEL PIPE LAYOUT

Fuel injection, Carburetter and Diesel models.

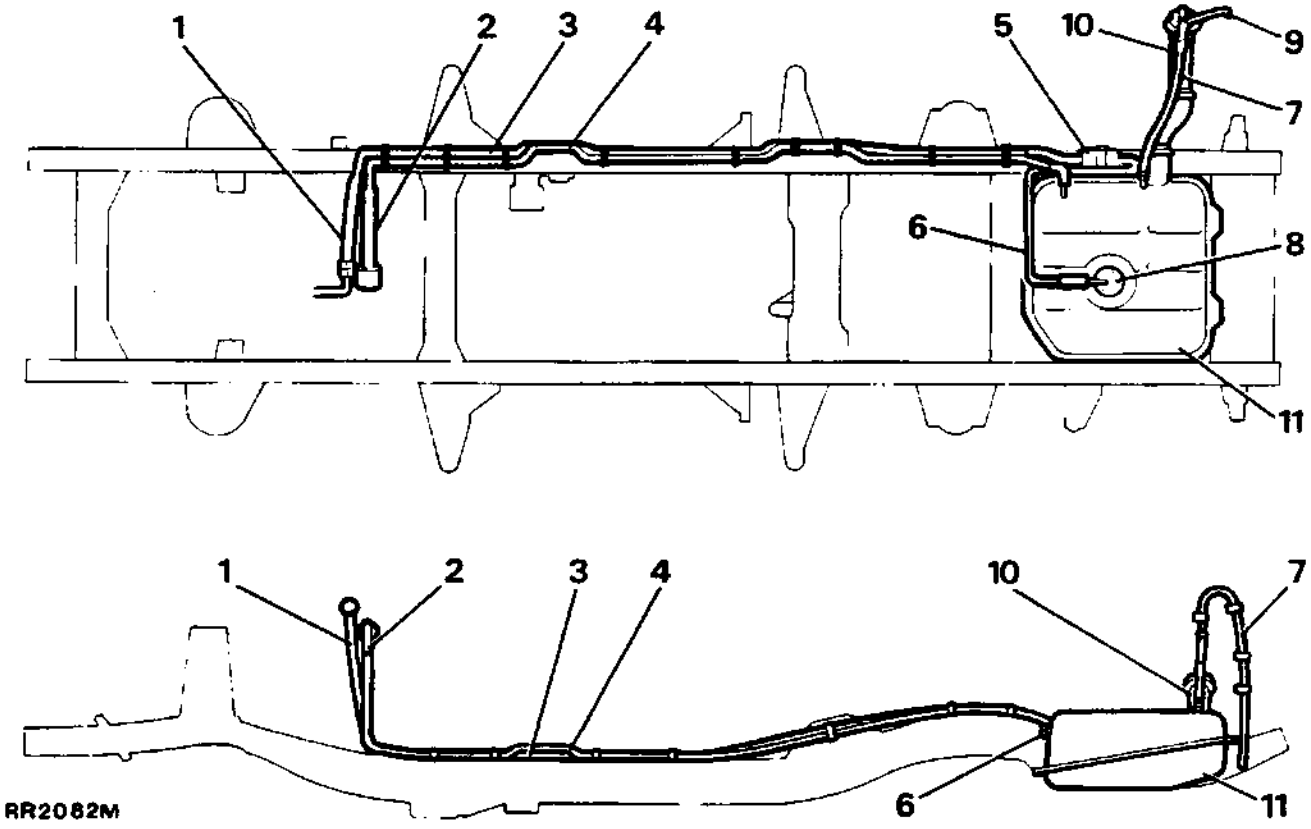
WARNING: The spillage of fuel during the disconnection of any of the pipes in the fuel system is unavoidable, ensure that all necessary precautions are taken to prevent fire or explosion.

FUEL INJECTION MODELS

NOTE: Depressurise the fuel system before attempting to disconnect any pipes within the fuel system.

KEY

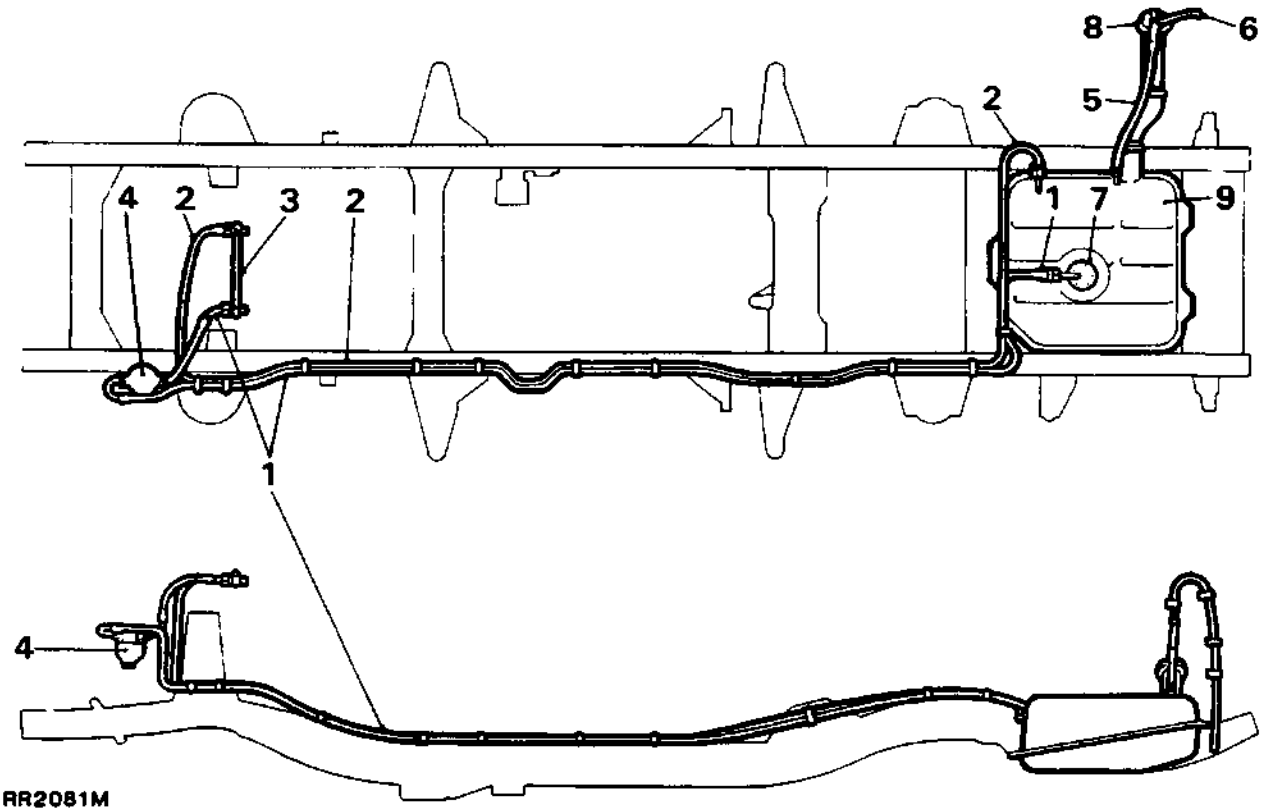
1. Fuel feed hose to fuel rail.
2. Spill return hose to fuel tank.
3. Rigid fuel feed pipe.
4. Rigid spill return pipe.
5. Fuel filter.
6. Rigid fuel feed pipe to filter.
7. Breather hose.
8. In-tank fuel pump.
9. Breather valve and pipes (To evaporative loss system - when system fitted).
10. Fuel filler neck.
11. Fuel tank.



CARBURETTER MODELS

KEY

1. Fuel feed pipe.
2. Spill return pipe.
3. Fuel feed balance pipe.
4. Fuel filter.
5. Breather hose.
6. Breather valve and pipes (To evaporative loss system - when system fitted).
7. In-tank fuel pump.
8. Fuel filler neck.
9. Fuel tank.

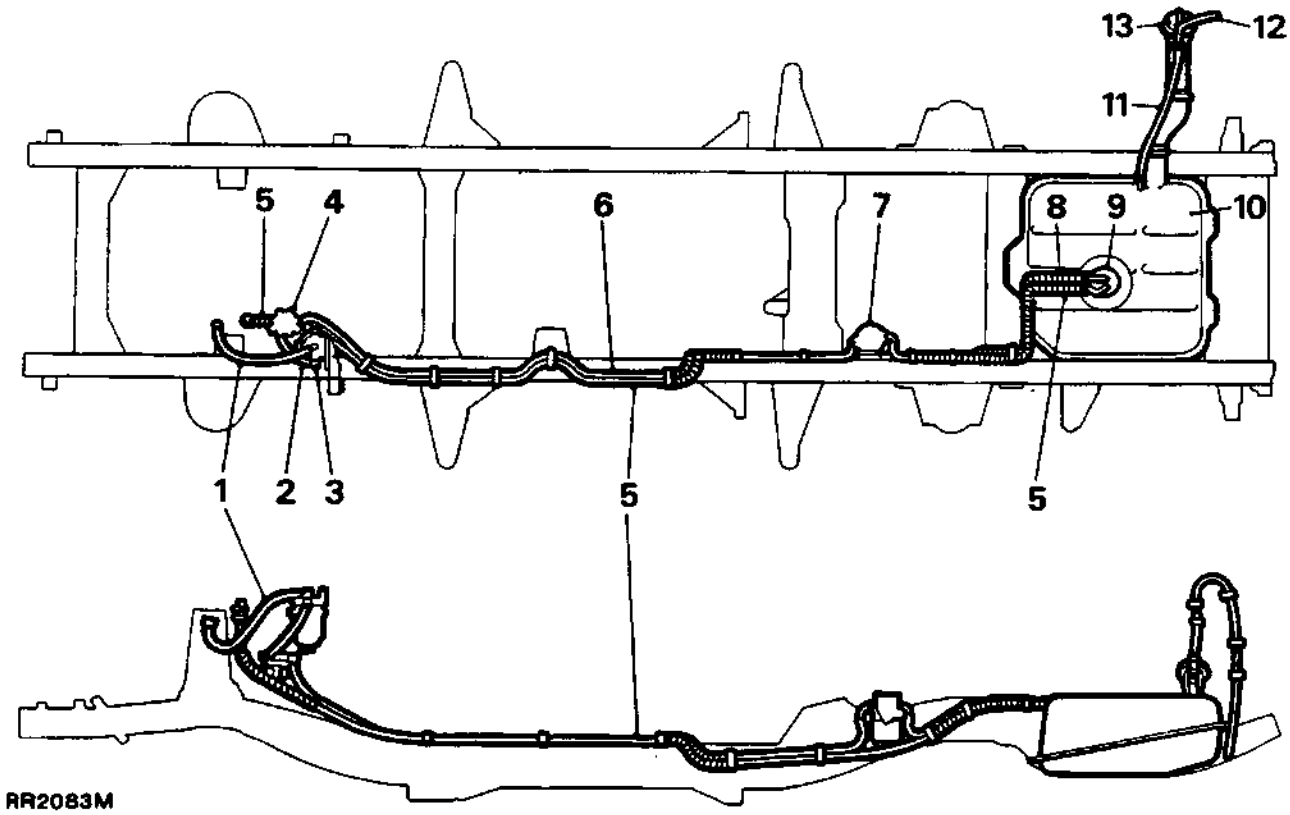


RR2081M

DIESEL MODELS

KEY

1. Fuel feed pipe to distributor pump.
2. Fuel feed pipe - lift pump to filter.
3. Fuel filter.
4. Lift pump.
5. Spill return pipe.
6. Fuel feed - sedimenter to lift pump.
7. Sedimenter.
8. Fuel feed pipe - fuel tank to sedimenter.
9. Assembly - fuel pick-up pipes.
10. Fuel tank.
11. Breather hose.
12. Breather valve and pipes.
13. Fuel filler neck.



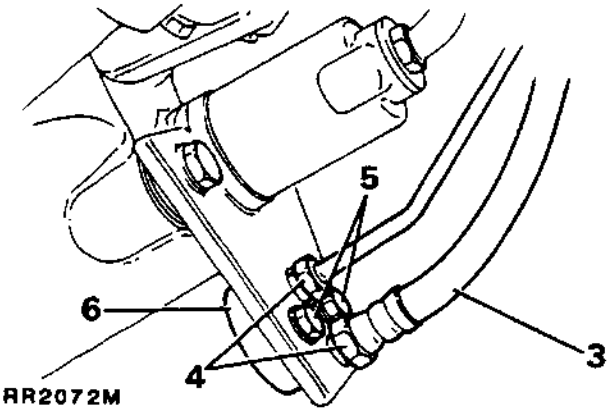
RR2083M

HYDRAULIC DAMPER
(Diesel models only)

Remove and refit

Removing

1. Raise the vehicle on a suitable hydraulic ramp.
2. Thoroughly clean the area around the slave cylinder and damper.
3. Using a recognised hose clamp, clamp the flexible hose to prevent excessive loss of hydraulic fluid.
4. Remove the flexible hose and rigid fluid pipe from the damper.
5. Remove the two bolts securing the damper to the mounting bracket.
6. Withdraw the damper.



Refitting

7. Reverse the removal procedure.
8. Bleed the clutch hydraulic system. (Refer to main workshop manual).
9. Inspect for fluid leaks around hose and pipe connections.

STEERING WHEEL

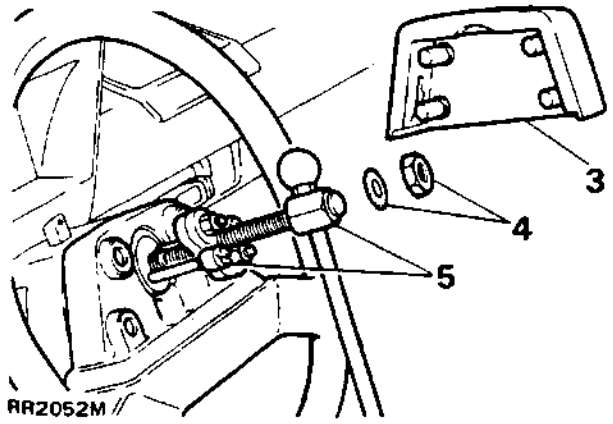
Remove and refit

Removing

Service Tools:
18G 1014 Steering wheel remover
18G 1014-2 Adaptor pins

NOTE: The steering column is of a 'safety' type and incorporates shear pins. Therefore do not impart shock loads to the steering column during removing and refitting the steering wheel or at any time.

1. Disconnect the battery negative lead.
2. Ensure the road are in the straight ahead position to enable the steering wheel to be fitted in its correct location on re-assembly.
3. Carefully ease the centre trim pad off the steering wheel.
4. Restraining the steering wheel remove retaining nut and serrated washer.
5. Extract the steering wheel using service tool 18G 1014. Ensure the extractor pins are inserted in the threads up to the shoulder of the pins.



Refitting

6. Ensure the road wheels are in the straight ahead position.

CAUTION: Do not apply shock loads to the steering wheel to ensure that it is firmly fitted in position.

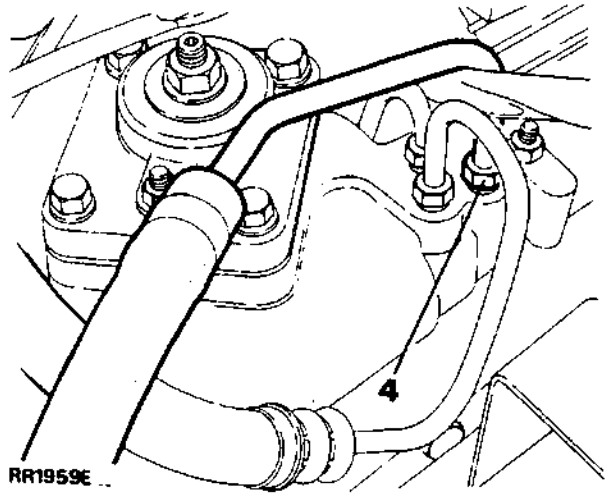
7. Place the steering wheel on the column splines, fit the nut and washer and tighten to the specified torque.
8. Refit the steering wheel centre cover.
9. Re-connect the battery.

POWER STEERING FLUID RESERVOIR

Remove and refit

Removing

1. Place a drain tray beneath the power steering box.
2. Prop open the bonnet.
3. Remove the reservoir filler cap.
4. Disconnect the fluid return hose from the power steering box. Drain the fluid completely from the reservoir and reconnect the hose.

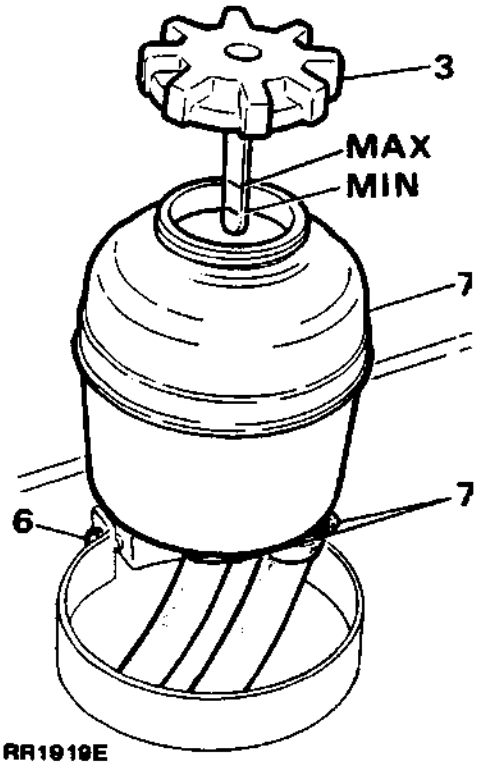


CAUTION: Power steering fluid is corrosive. Should any fluid seep onto paintwork, chassis or any other component immediately wipe clean. It is most important that any power steering fluid drained from the power steering system is not re-used.

5. Carefully dispose of unwanted fluid.
6. Release the pinch bolt and remove the reservoir from the bracket.

7. Release the hose clips and remove the flexible hoses, with draw the the reservoir from the engine compartment.

NOTE: If the reservoir is not to be refitted immediately, the hoses must be sealed to prevent the ingress of foreign matter.



RR1919E

NOTE: The reservoir contains an integral filter which is not serviceable, however, in normal use the reservoir unit should last the life of the vehicle.
Should the power steering system malfunction and under inspection it is found that the steering fluid has been contaminated by foreign matter the fluid reservoir MUST be renewed.

Refitting

8. Reconnect the flexible hoses to the reservoir. Tighten the hose clips securely.
9. Fit the reservoir to the bracket and tighten the pinch bolt securely.
10. Fill the reservoir to the prescribed level on the dipstick with the recommended fluid. Bleed the power steering system. (See recommended fluids and bleed procedure in main workshop manual).
11. Fit the reservoir filler cap.
12. Close the bonnet.

POWER STEERING PUMP DRIVE BELT (Petrol models only)

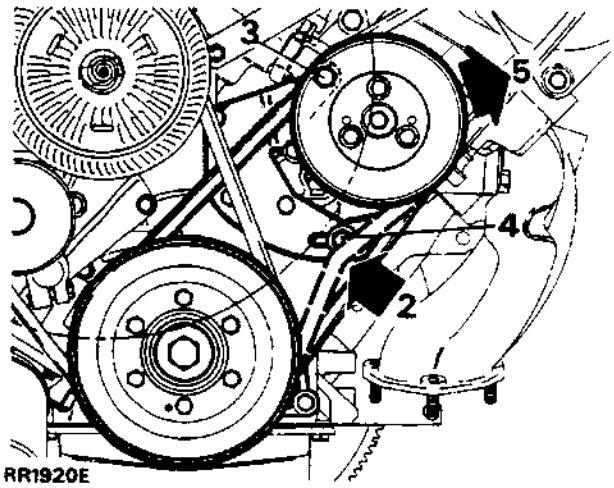
Adjust

Procedure

1. Prop open the bonnet and disconnect the battery negative lead.
2. Check, by thumb pressure, the belt tension between the crankshaft and the pump pulley. There should be a free movement of between 11 to 14mm (0.437 to 0.562 in).

CAUTION: To prevent damage occurring to the steering pump DO NOT use a lever on the outer casing of the pump when tensioning the belt.

3. Slacken the two nuts at the side of the pump to enable the pump to be pivoted.
4. Slacken the bolt securing the pump lower bracket to the slotted adjustment link.
5. Pivot the pump (in the direction of the bold arrow) as necessary and adjust until the correct belt tension is obtained.



RR1920E

6. Maintaining the tension, tighten the pump adjusting bolt and the top pivot nuts.

NOTE: Check the alternator drive belt tension after adjusting the power steering pump belt.

7. Reconnect the battery negative lead and close the bonnet.

POWER STEERING PUMP DRIVE BELT (Petrol models only)

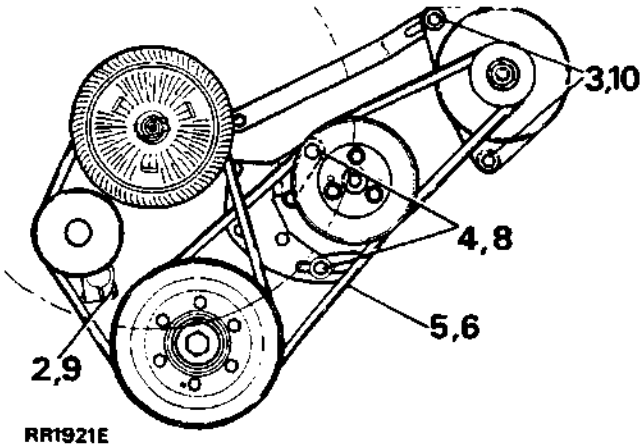
Remove and refit

Removing or preparing for the fitting of a new belt.

1. Prop open the bonnet and disconnect the battery negative lead.
2. Slacken the jockey pulley bolt and remove the fan belt.
3. Slacken the alternator mountings and remove the drive belt.
4. Slacken the power steering pump mountings.
5. Pivot the pump and remove the drive belt.

Refitting

6. Locate the driving belt over the crankshaft and pump pulleys.
7. Adjust the position of the pump to give a driving belt tension of 11 to 14mm (0.437 to 0.562 in) movement when checked by thumb pressure midway between the crankshaft and pump pulleys.



RR1921E

CAUTION: To prevent damage occurring to the steering pump DO NOT use a lever on the outer casing of the pump when tensioning the belt.

8. Maintaining the tension, tighten the pump adjusting bolt and the top pivot nut.
9. Refit the fan belt and adjust the tension to give 11 to 14mm (0.437 to 0.562 in) movement when checked by thumb pressure midway between the crankshaft and wear pump pulleys.
10. Refit the alternator drive belt and adjust to give 11 to 14mm (0.437 to 0.562 in) movement when checked midway between the power steering pump and alternator pulleys.

NOTE: Whenever a new belt is fitted, it is most important that its adjustment is rechecked after approximately 1,500 km (1,000 miles) running.

11. Reconnect the battery negative lead and close the bonnet.

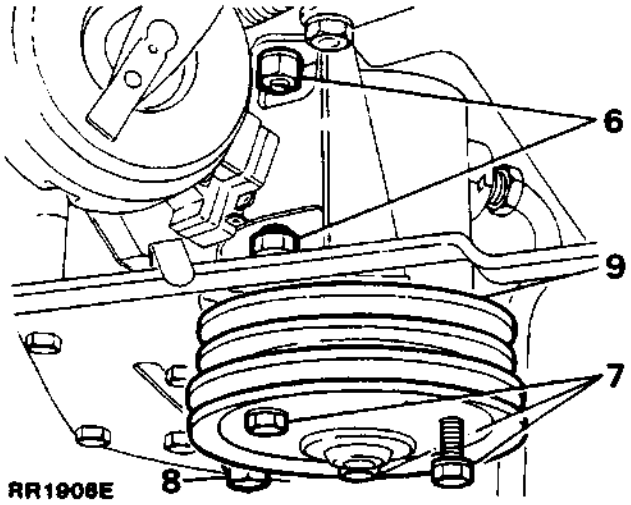
POWER STEERING PUMP
(Petrol models only)

NOTE: The power steering pump is not a serviceable item. In the event of failure or damage a new pump must be fitted.

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Slacken the alternator pivot bolts and adjustment link bolts, pivot the alternator inwards and remove the drive belt.
3. Slacken the water pump drive belt jockey pulley and remove the drive belt.
4. Remove the left hand bank spark plug leads and detach the distributor cap, place the leads and cap to one side.
5. Disconnect the electrical plug from the distributor amplifier unit.
6. Slacken the two nuts securing the power steering pump pivot bracket.
7. Release the three bolts securing the pulley to the steering pump, do not remove them at this stage.
8. Release the bottom adjustment bolt below the steering pump and pivot the pump inwards towards the water pump to enable the drive belt to be removed.



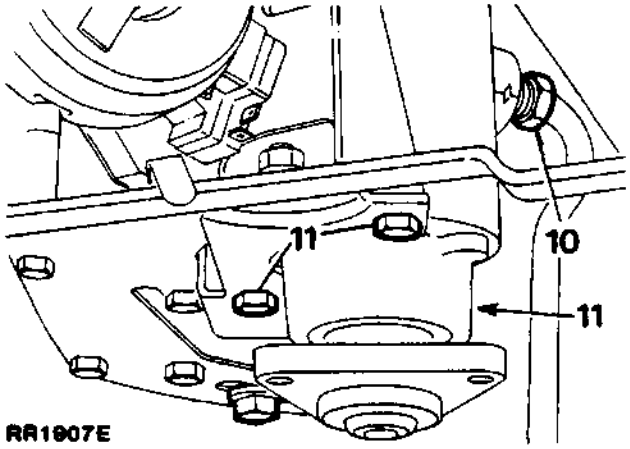
RR1908E

9. Remove the three bolts with plain washers retaining the pulley to the pump and withdraw the pulley.

NOTE: Place a drain tray under the vehicle to catch any power steering fluid which will seep from the pump when the fluid pipe is disconnected. Wipe away any fluid which comes into contact with paintwork or other components.

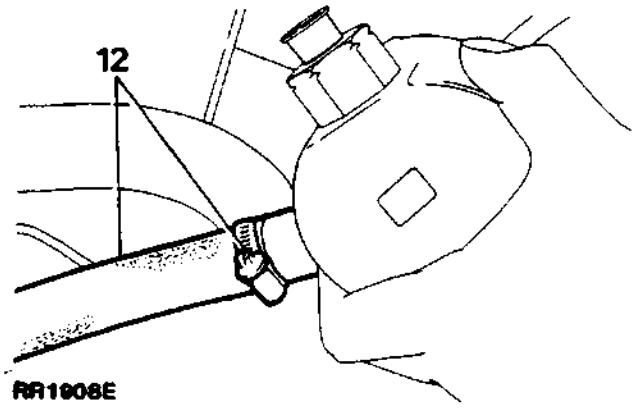
CAUTION: Under no circumstances must the fluid be re-used.

10. Disconnect the fluid pipe from the side of the pump, plug the pipe and pump apertures to prevent ingress of dirt.
11. Remove the three bolts securing the pump to the pivot bracket, manoeuvre the pump out of the bracket and withdraw it from the engine compartment as far as the remaining connected fluid hose will permit.



RR1907E

12. Release the clip securing the hose to the pump, remove the hose and plug both apertures to prevent ingress of dirt.



Refitting

13. Remove the plug from the fluid hose and secure the hose to a **NEW** pump. Tighten the hose clip securely.
14. Manoeuvre the pump into the pivot bracket and secure in position with the three retaining bolts. Tighten the bolts to the specified torque.
15. Remove the plugs from the fluid pipe and steering pump apertures and fit the pipe. Tighten the pipe securely.
16. Fit the pulley to the steering pump drive flange, coat the three bolts with Loctite and fit to the steering pump, do not fully tighten the bolts at this stage.
17. Refit the crankshaft to steering pump drive belt, pivot the steering pump outwards to tension the belt, tighten the pivot bolts securely. Check that the belt deflects approximately 11 to 14 mm (0.437 to 0.562) when checked by thumb pressure midway between the crankshaft and pump pulleys.
18. Tighten the three steering pump pulley retaining bolts to the specified torque.
19. Reverse the remaining removal instructions.
20. Bleed the power steering system.
21. Test the power steering system for leaks with the engine running, holding the steering on full lock in both directions.

CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals.

22. Close the bonnet.
23. Road test the vehicle.

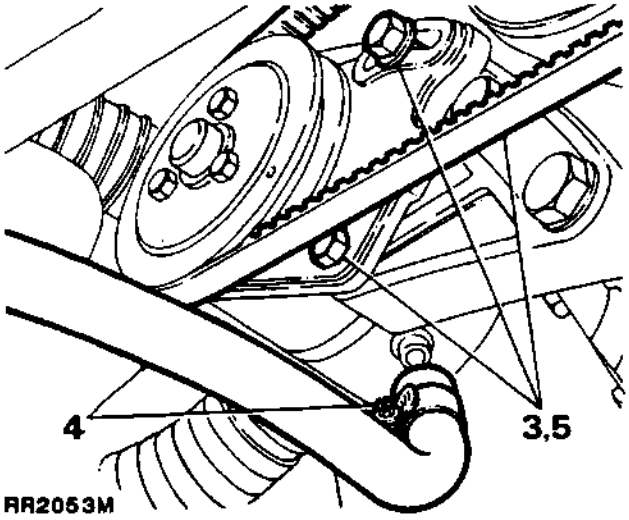
POWER STEERING PUMP
(Diesel models only)

NOTE: The power steering pump is not a serviceable component, in the event of failure or damage a new pump must be fitted.

Remove and refit

Removing

1. Access to the steering pump is gained from beneath the vehicle.
2. Install the vehicle on a suitable hydraulic ramp, apply the handbrake and disconnect the battery negative terminal.
3. Release the pump pivot and adjustment bolts, detach the drive belt.
4. Place a drain tray beneath the vehicle to catch any fluid which may seep from the pump. Release the hose clip and remove the bottom hose from the pump, quickly seal both hose and pump aperture to prevent excessive loss of fluid and ingress of foreign matter.
5. Remove the pivot and adjustment bolts, manoeuvre the pump until access is gained to the fluid pipe at the rear of the pump.



RR2053M

6. Remove the bolt and release the banjo fitting, seal both hose and pump aperture to prevent ingress of foreign matter.
7. Withdraw the pump from the vehicle.

Refitting

8. Reverse the removal instructions ensuring that the hoses are fitted securely.
9. Tension the drive belt until deflection is between 7 to 12 mm (.275 to .472 inch) at mid point on the longest run of the belt, tighten the adjustment bolts.

CAUTION: To prevent damage occurring to the steering pump DO NOT use a lever on the outer casing of the pump when tensioning the belt.

10. Replenish the steering fluid reservoir with the recommended fluid. (Refer to main workshop manual).
11. Bleed the power steering system.(Refer to main workshop manual).
12. Test the power steering system for leaks with the engine running, holding the steering on full lock in both directions.

CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute, to avoid causing the fluid to overheat, which could result in possible damage to the seals.

POWER STEERING

FAULT DIAGNOSIS

SYMPTOM	CAUSE	TEST ACTION	CURE
INSUFFICIENT POWER ASSISTANCE WHEN PARKING	(1) Lack of fluid	Check hydraulic fluid reservoir level	If low, fill and bleed the system
	(2) Driving belt	Check belt tension	Adjust the driving belt
	(3) Defective hydraulic pump	(a) Fit pressure gauge between high pressure hose and steering pump with steering held hard on full lock, see Note 1 and 'Power Steering System Test'	If pressure is outside limits (high or low) after checking items 1 and 2, see Note 2
		(b) Release steering wheel and allow engine to idle. See 'Power Steering System Test'	If pressure is greater, check box for freedom and self-centering action
POOR HANDLING WHEN VEHICLE IS IN MOTION	Lack of castor action	This is caused by over-tightening the rocker shaft backlash adjusting screw on top of steering box.	It is most important that this screw is correctly adjusted. See instructions governing adjustment
HYDRAULIC FLUID LEAKS	Damaged pipework, loose connecting unions etc.	Check by visual inspection; leaks from the high pressure lines are best found while holding the steering on full lock with engine running at fast idle speed (See Note 1).	Tighten or renew as necessary
NOTE: Leaks from the steering box tend to show up under low pressure conditions, that is, engine idling and no pressure on steering wheel.		Check 'O' rings on pipework	Renew as necessary

SYMPTOM	CAUSE	TEST ACTION	CURE
EXCESSIVE NOISE	(1) If the high pressure hose is allowed to come into contact with the body shell, or any component not insulated by the body mounting, noise will be transmitted to the car interior	Check the loose runs of the hoses	Alter hose route or insulate as necessary
	(2) Noise from hydraulic pump	Check oil level and bleed system	If no cure, change hydraulic pump

Note 1. Never hold the steering wheel on full lock for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals.

Note 2. High pressure- In general it may be assumed that excessive pressure is due to a fault in the hydraulic pump.
Low pressure- Insufficient pressure may be caused by one of the following:

1. Low fluid level in reservoir) Most usual cause of
2. Pump belt slip) insufficient pressure
3. Leaks in the power steering system
4. Hydraulic pump not delivering correct pressure
5. Fault in steering box valve and worm assembly
6. Leak at piston sealing in steering box
7. Worn components in either steering box or hydraulic pump

BRAKE SYSTEM

Description

The hydraulic braking system fitted to the Range Rover is of the dual line type, incorporating primary and secondary hydraulic circuits.

NOTE: References made to primary and secondary do not imply main service brakes or emergency brakes but denote hydraulic line identification.

The brake pedal is connected to a vacuum-assisted mechanical servo which in turn operates a tandem master cylinder. The front disc brake calipers each house four pistons, the upper pistons are fed by the primary hydraulic circuit, the lower pistons by the secondary hydraulic circuit. The rear disc brake calipers each house two pistons and these are fed by the secondary hydraulic circuit via a pressure reducing valve.

A brake failure switch incorporated in the master cylinder will illuminate a panel warning light if a failure occurs in either the primary or secondary hydraulic circuits.

The brake fluid reservoir is divided, the front section (section closest to the servo) feeds the primary circuit and the rear section feeds the secondary circuit. Under normal operating conditions both the primary and secondary hydraulic circuits operate simultaneously on brake pedal application. In the event of a failure in the primary circuit the secondary circuit will still function and operate front and rear calipers.

Alternatively, if the secondary circuit fails, the primary circuit will still function and operate the upper pistons in the front calipers.

If the servo should fail, both hydraulic circuits will still function but would require greater pedal pressure.

The handbrake is completely independent of the hydraulic circuits.

Brake pad wear sensors are incorporated into the front and rear right hand side, inboard brake pads. The sensors will illuminate a brake pad wear warning light in the instrument binnacle, when pad thickness has been reduced to approximately 3mm (0.118 in).

CAUTION: THOROUGHLY CLEAN ALL BRAKE CALIPERS, PIPES AND FITTINGS BEFORE COMMENCING WORK ON ANY PART OF THE BRAKE SYSTEM. FAILURE TO DO SO COULD CAUSE FOREIGN MATTER TO ENTER THE SYSTEM AND CAUSE DAMAGE TO SEALS, AND PISTONS WHICH WILL SERIOUSLY IMPAIR THE BRAKE SYSTEM EFFICIENCY.

To ensure the brake system efficiency is not impaired the following warnings must be adhered to:-

WARNING:

DO NOT use brake fluid previously bled from the system.

DO NOT use old or stored brake fluid.

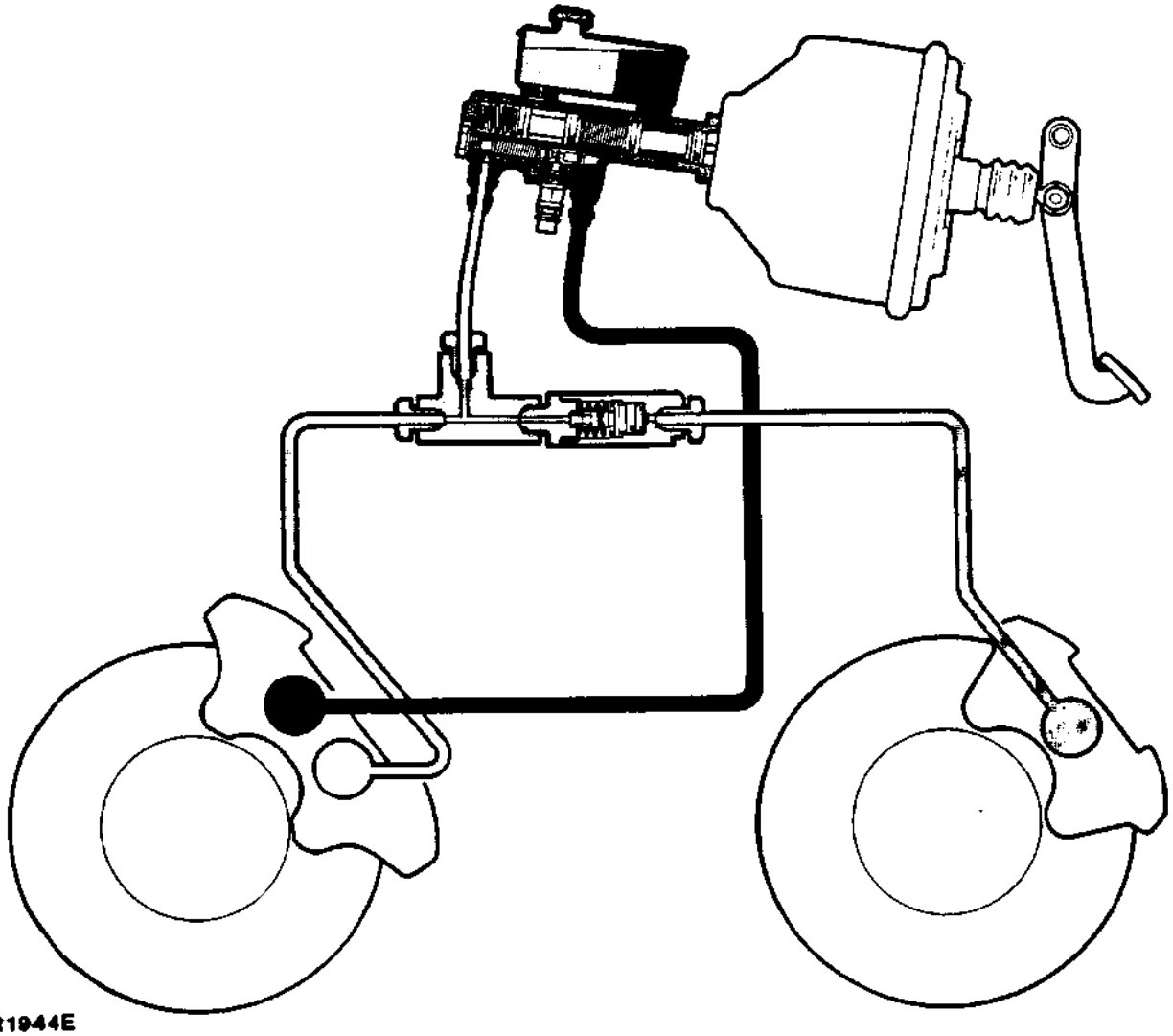
ENSURE that only new fluid is used and that it is taken from a sealed container.

DO NOT flush the brake system with any fluid other than the recommended brake fluid.

The brake system should be drained and flushed at the recommended service intervals.

PRIMARY HYDRAULIC CIRCUIT

SECONDARY HYDRAULIC CIRCUIT



RR1944E

WARNING: Some components on your vehicle, such as gaskets and friction surfaces (brake linings, clutch discs or automatic transmission brake bands), may contain asbestos. Inhaling asbestos dust is dangerous to your health and the following essential precautions must be observed:-

• Work out of doors or in a well ventilated area and wear a protective mask.

• Dust found on the vehicle or produced during work on the vehicle should be removed by extraction and not by blowing.

• Dust waste should be dampened, placed in a sealed container and marked to ensure safe disposal.

• If any cutting, drilling etc., is attempted on materials containing asbestos the item should be dampened and only hands tools or low speed power tools used.

HANDBRAKE CABLE

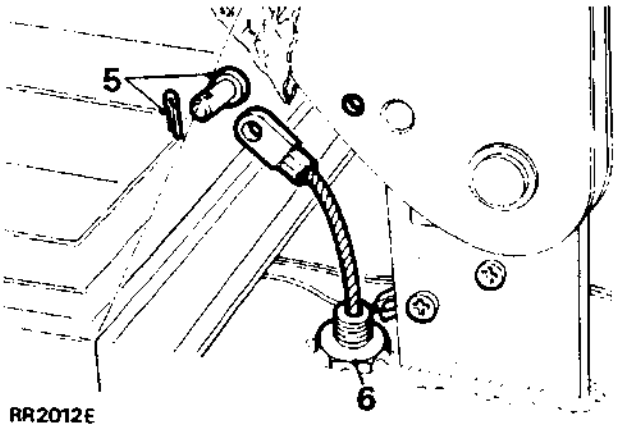
Remove and refit

Removing

1. Set the vehicle on level ground and chock the road wheels and select 'P' in the main gearbox.
2. Disconnect the battery negative terminal and release the handbrake.

From inside the vehicle

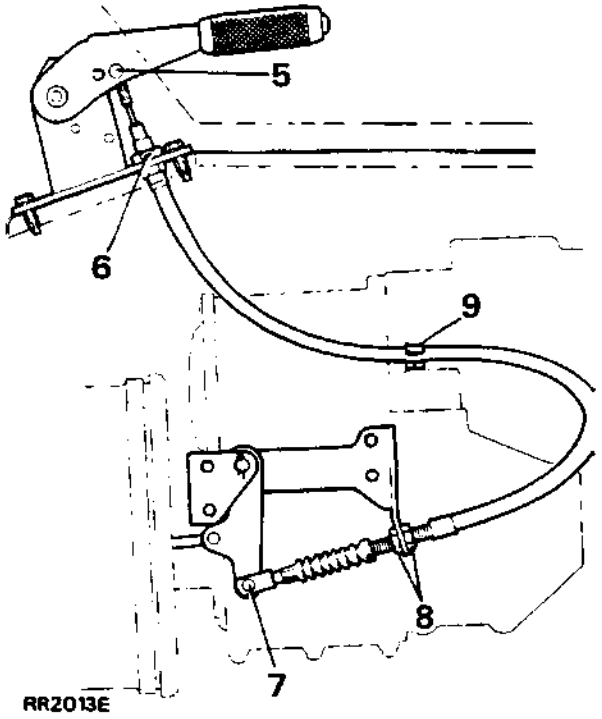
3. Remove the four screws securing the liner in the cubby box.
4. Lift out the liner to gain access to the bottom of the handbrake pivot bracket.
5. Remove the split pin and clevis pin from the handbrake lever.
6. Release the nut securing the handbrake outer cable to the top of the handbrake mounting bracket. Slide the nut up the cable and push the inner and outer cable through the floor panel to the underside of the vehicle.



RR2012E

From underneath the vehicle

7. Remove the split pin, plain washer and clevis pin securing the adjustment link to the brake drum actuating lever.
8. Release the locknuts securing the handbrake outer cable to the retaining bracket.
9. Release the outer cable from the 'P' clip located on top of the transfer gearbox, and withdraw the cable assembly from the vehicle.



RR2013E

Fit new cable

10. Feed the handbrake cable assembly through the floor aperture and secure the outer cable in position with the retaining nut.
11. Secure the cable to the handbrake lever, using a new split pin.
12. Secure the outer cable into the 'P' clip.
13. Position the outer cable into the retaining bracket bolted to the side of the transfer gearbox and loosely secure in position with the two outer cable lock nuts.
14. Reconnect the outer cable to the brake drum actuating lever. Fit the clevis pin, plain washer and new split pin.
15. Rotate the brake drum adjuster clockwise until the brake shoes are fully expanded against the drum.
16. Tighten the two brake cable outer lock nuts to secure the cable to its mounting bracket.

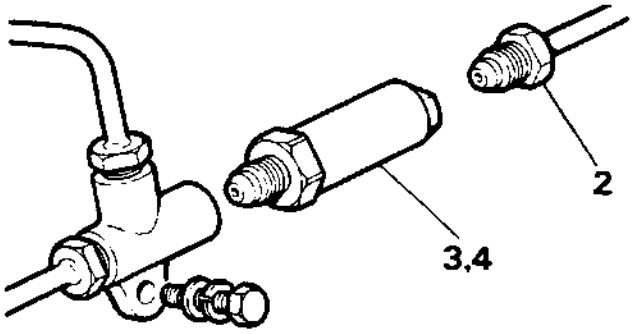
17. Apply the handbrake, and slacken the brake drum adjuster until the handbrake lever fully operates the brake shoes on the second or third notch of the handbrake ratchet.
18. Refit the cubby box liner.

BRAKE PRESSURE REDUCING VALVE

Remove and refit

Removing

1. Remove all dust, grime, etc., from the vicinity of the pressure reducing valve fluid pipe unions.
2. Disconnect the outlet fluid pipe from the pressure reducing valve. Plug the pipe and reducing valve port to prevent the ingress of foreign matter.
3. Remove the valve from the three-way connector and plug both apertures.
4. Withdraw the pressure reducing valve from the engine compartment.



RR1947E

Refitting

5. Reverse the removal instructions.
6. Bleed the brake systems.

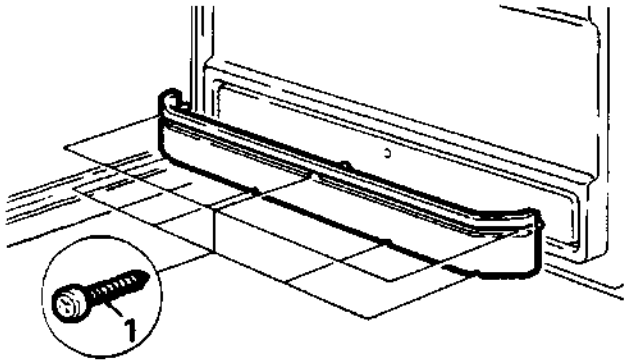
NOTE: The pressure reducing valve is not a serviceable item, in the event of failure or damage, a new unit must be fitted.

FRONT DOOR STOWAGE BINS

Remove and refit

Removing

1. Remove the seven fixings securing the stowage bin to the inner door trim pad.
2. Withdraw the stowage bin.



RR2064E

Refitting

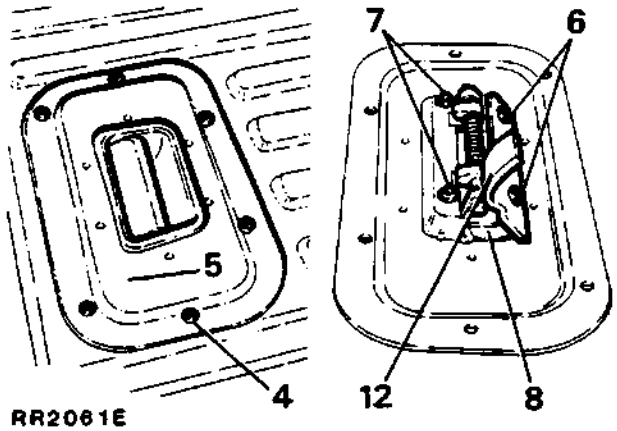
3. Reverse the removal procedure.

LOWER TAILGATE RELEASE MECHANISM

Remove and refit

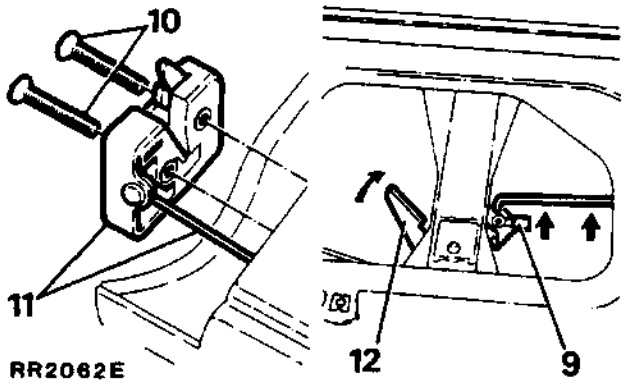
Removing

1. Open and raise the upper tailgate.
2. Release and lower, the lower tailgate.
3. Lift the trim panel off the tailgate inner panel.
4. Remove the screws securing the lock cover plate.
5. Remove the cover plate complete with handle release mechanism.
6. Remove the two screws and detach the handle release actuator lever.
7. Remove the two nyloc nuts and detach the handle release retaining bracket.
8. Withdraw the handle release mechanism from the cover plate.



RR2061E

9. Release the spring clips securing the operating rods to the internal tailgate release mechanism.
10. Remove the screws securing the exterior locks at either side of the tailgate.
11. Withdraw the exterior locks with operating rods.



RR2062E

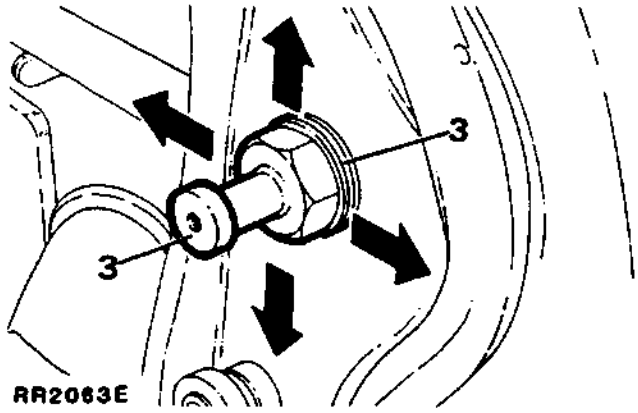
Refitting

12. Reverse the removal procedure, lightly grease the handle release actuator lever and internal tailgate operating lever.

LOWER TAILGATE STRIKER ADJUSTMENT

Adjust

1. Open and raise upper tailgate.
2. Open and lower, lower tailgate.
3. Release the striker and move in the appropriate direction, either add or subtract spacing washers between the striker and tailgate aperture.
4. Adjustment is correct when outer profile of tailgate panel aligns with both rear body corner panels.



ASSISTED BONNET LIFT

Remove and refit

Removing

CAUTION: The assisted lift mechanism of the bonnet eases the bonnet open and lift procedure. When the bonnet is fully open, secure the bonnet stay in position. The assisted lift mechanism alone WILL NOT retain the bonnet in its upright position.

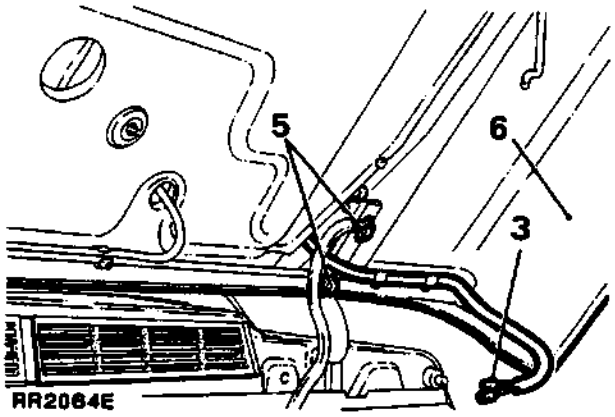
1. Carefully prise the wiper arms off the spindle bosses, noting their position for re-assembly.
2. Raise the bonnet and disconnect the battery negative terminal.
3. Disconnect the electrical lead to the bonnet illumination lamp.
4. Disconnect the screen washer fluid feed pipe at the 'T' joint, remove the feed pipe from the bonnet retaining clip.

NOTE: The removal of the bonnet will require the assistance of a second person.

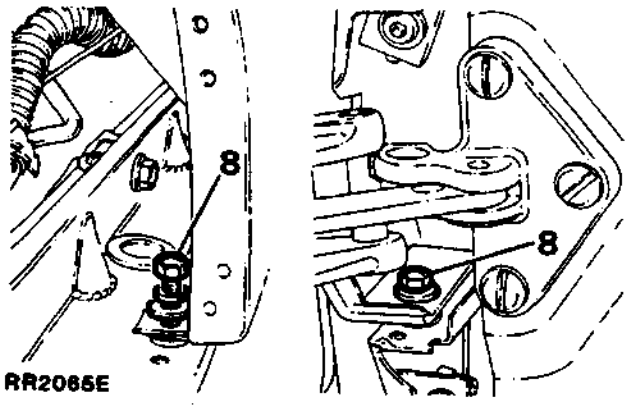
5. Release the four bolts (with plain washers) securing the bonnet to the hinges.

NOTE: Petrol Models Only:- An engine earth braid is attached to the forward bolt of the left hand hinge.

6. With assistance lift the bonnet clear of the hinges and store safely to one side, cover bonnet to protect paintwork.



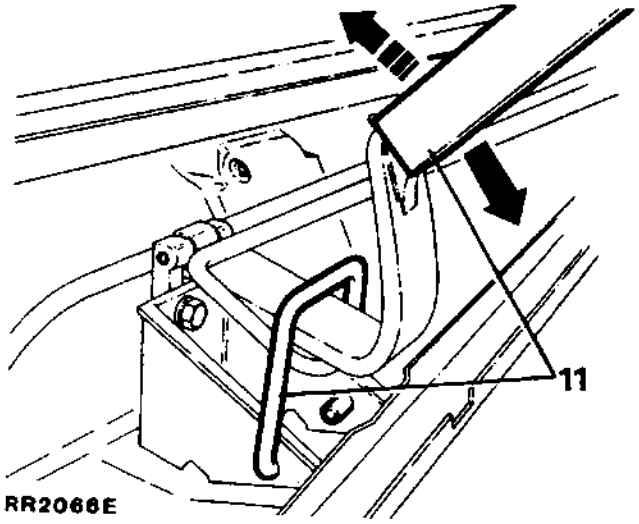
7. Remove the two wiper box wheel nuts and rubber spacers.
8. Remove the four fixings securing the decker panel to the front wings, the front two fixings are accessible from the front of the decker panel, access to the rear two fixings is gained by opening the front doors. Note the nylon spacing washers at each bolt.



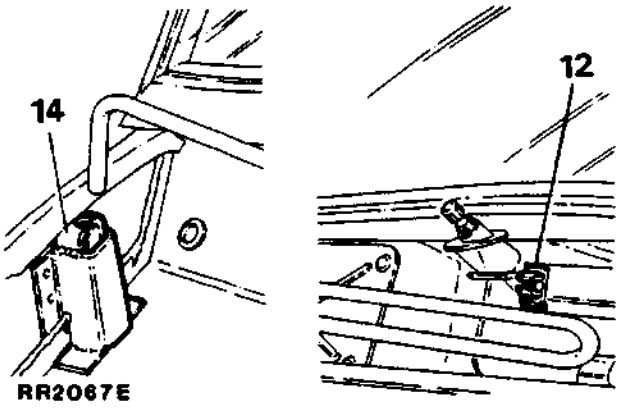
9. Remove the nine cross-head screws from the front of the decker panel water channel.
10. Place extension tubes over each bonnet hinge, with assistance lower the hinges, manoeuvre the decker panel off the wiper arm spigot bosses and along the tubes until the panel is clear of the vehicle. Place the panel to one side and cover to protect paintwork.

WARNING: Gradually let the torsion bar spring tension return the hinges to their upright position to prevent the possibility of personal injury or damage to the vehicle.

11. Place an extension tube over the hinge, lower the hinge until the stop bracket can be removed, with draw the bracket and gradually allow the hinge to return to its upright position.



12. Release the torsion bar from the retaining clip.
13. Manoeuvre the torsion bar until it can be released from the hinge.
14. Release the torsion bar from the retaining bracket.



15. Remove the two bolts (with plain washers) securing the hinge to its mounting bracket.
16. Withdraw the hinge.

Refitting

17. Fit the hinge and securely tighten the two retaining bolts (with plain washers).
18. Fit the torsion bar ensuring that it is securely located in the retaining clip and bracket.
19. Reverse the remaining removal instructions.

NOTE: Petrol Models Only:- Fit the earth braid under the forward bolt of the left hand hinge.

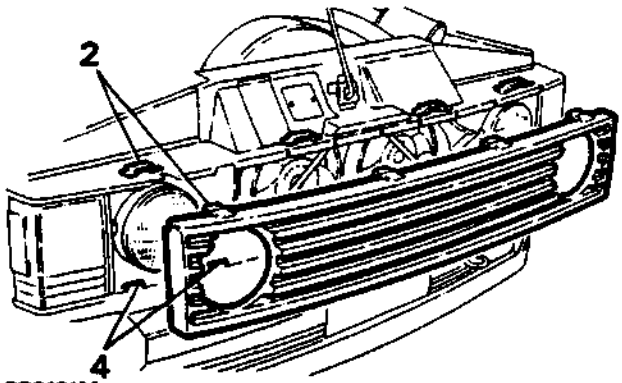
20. Using a soft blunt implement ease the bottom lip of the windscreen seal up and over onto the face of the decker panel.

RADIATOR GRILLE

Remove and refit

Removing

1. Raise the bonnet and secure the bonnet support.
2. Depress the four upper retaining lugs and ease the grille forward.
3. Lift the grille upwards and withdraw it from the vehicle.



RR2121M

Refitting

4. Fit the radiator grille ensuring that the bottom lugs of the grille locate in their respective slots below the headlamp units.
5. Ease the grille rearwards and locate the upper retaining lugs.

FUEL FILLER FLAP

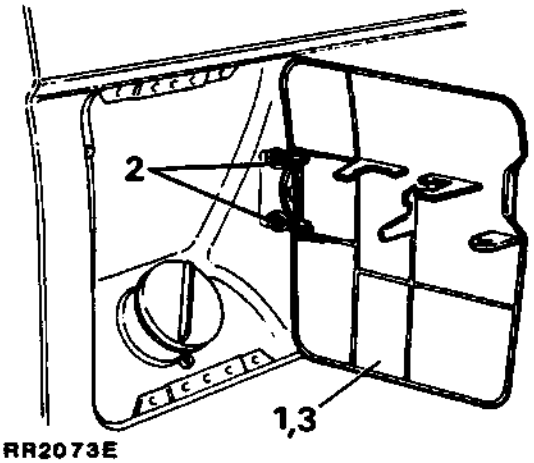
Remove and refit

Adjust

Removing

NOTE: If the vehicle has central locking ensure that the locking system has been released before attempting to open the fuel filler flap.

1. Open the fuel filler flap.
2. Release the two screws (with plain washers).
3. Withdraw the flap.



RR2073E

Refitting

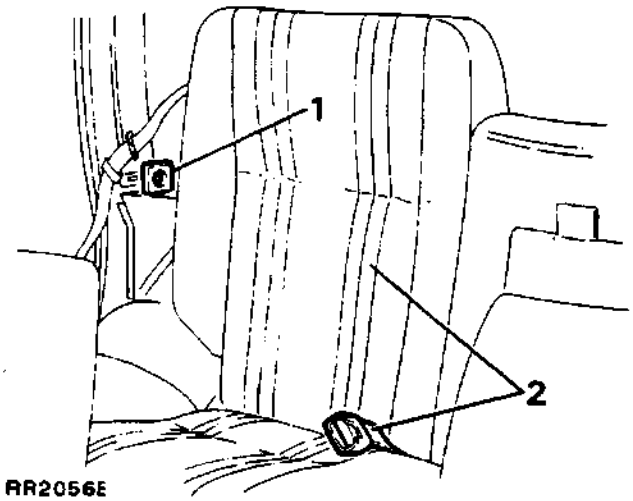
4. Fit the flap, but do not fully tighten the screws at this stage.
5. Close the flap and check that the outer profile of the flap aligns with the rear wing, adjust by easing the flap in or out of the aperture.
6. Open the flap and securely tighten the screws.

ASYMMETRIC SPLIT REAR SEAT

Remove and refit

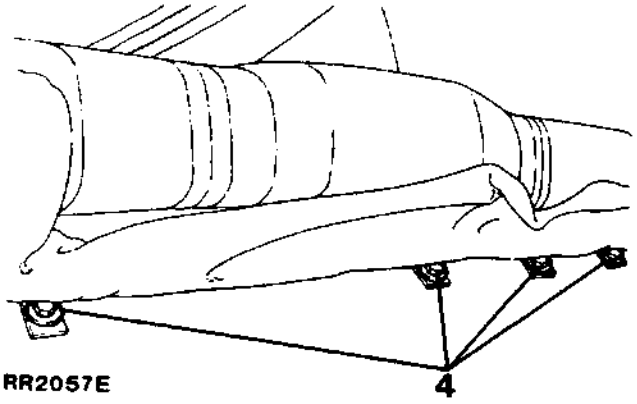
Removing

1. Lift the finger button to release the seat back rest securing catch and fold the seat forward.
2. Whilst folding the seat forward feed the rear seat lower part of the seat belt through the aperture between the seat back and squab.



RR2056E

3. Fold the seat fully forward and remove the four rear pivot bracket bolts.
4. Fold the seat back and lift the rear footwell carpet from just below the front of the seat to gain access to the four front fixings securing the pivot brackets, remove the bolts, withdraw the seat assembly from the vehicle.



RR2057E

Refitting

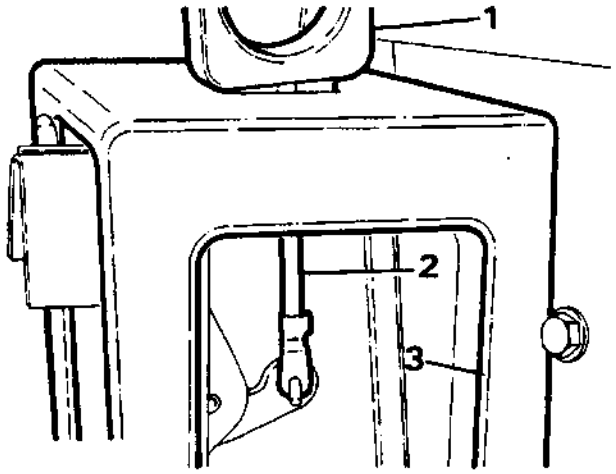
5. Reverse the removal procedure ensuring that all fixings are securely tightened.
6. Adjust the seat mechanism plate if necessary.

ASYMMETRIC SPLIT REAR SEAT-LOCKING MECHANISM

Remove and refit

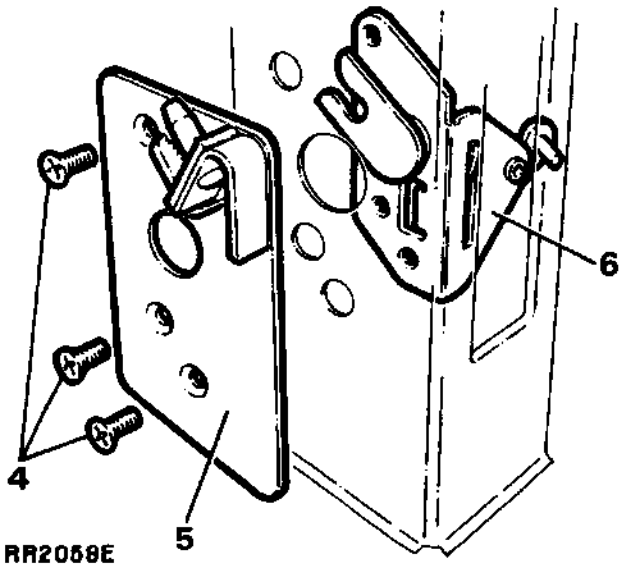
Removing

1. Lift the finger button and fold the seat back rest forward.
2. Remove the spring clip securing the finger button operating rod to the lock mechanism lever, accessible through the lock mounting bracket, withdraw the finger button.



RR2058E

3. Remove the trim covering.
4. Remove the three screws from the face of the lock catch plate.
5. Manoeuvre the catch plate off the lock mechanism.
6. Retrieve the lock mechanism from the mounting bracket aperture.



RR2059E

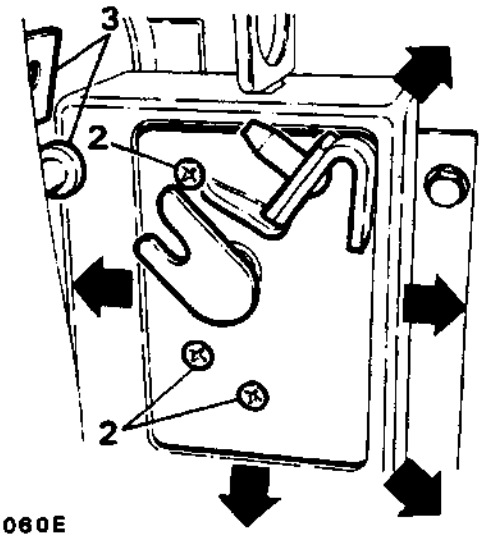
Refitting

7. Lightly grease the internal lock mechanism.
8. Reverse the removal instructions.
9. Adjust the lock catch plate to align with the seat striker.

ASYMMETRIC SPLIT REAR-SEAT LOCKING MECHANISM ADJUSTMENT

Adjust

1. Release the finger button and fold the seat back rest forward.
2. Slacken the three screws securing the catch plate to the lock mechanism.
3. Manoeuvre the lock assembly either horizontally, vertically or diagonally until the catch plate aligns with the striker at the side of the seat.
4. Securely tighten the retaining screws.



RR2060E

HEATING AND VENTILATION

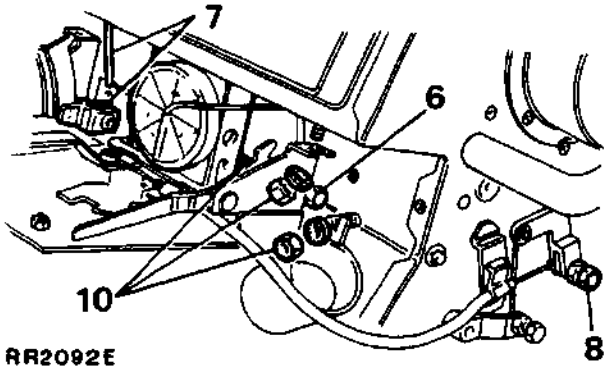
The heater/ventilation and air conditioning controls are integrated in the heater control panel.
The fresh air/recirculating flap in the heater is controlled by a solenoid operated vacuum unit.

HEATER AND AIR CONDITIONING CONTROLS

Remove and refit

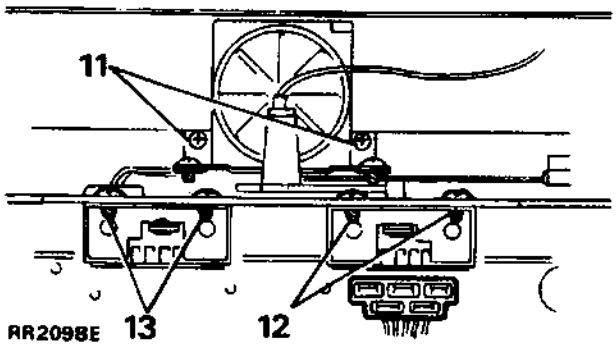
Removing

1. Disconnect the battery negative lead.
2. Remove the transmission lever surround and radio housing.
3. Remove the lower fascia panel.
4. Remove the centre fascia unit.
5. Disconnect the electrical leads from the thermostat,fan speed and recirculate/fresh air switches.
6. Disconnect the relay rod from the **'SCREEN-CAR'** lever.
7. Disconnect the relay rod from the **'VENT'** lever.
8. Disconnect the control cable from the side of the heater unit.



RR2092E

9. Remove the thermostat sensor from the fins of the evaporator.
10. Remove the four securing nuts and washers, and two screws behind the thermostat, and withdraw the heater controls assembly.
11. **Thermostat:** remove the two securing screws. Remove cable from control lever and lift thermostat over lever to remove.
12. **Fan speed switch:** drill out securing rivets, or remove fixing screws, and withdraw the switch.
13. **Air conditioning / fresh air / recirculating switch:** drill out securing rivets, or remove fixing screws and withdraw the switch.



RR2098E

Refitting

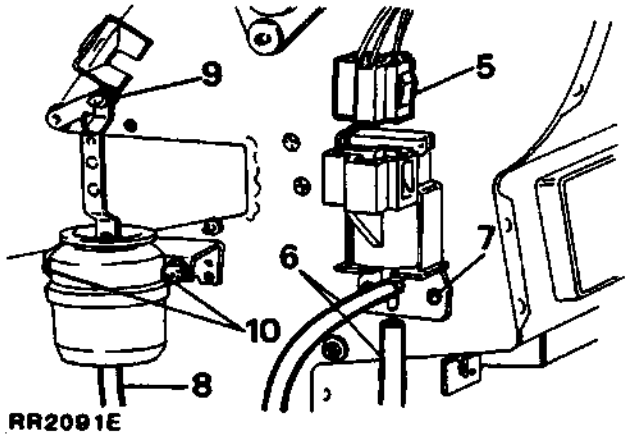
14. Reverse instructions 5 to 13.
15. Check that the control levers give full movement to the flaps. If necessary, adjust at the relay rod or cable end fixings.
16. Reverse instructions 1 to 4.

RECIRCULATING/FRESH AIR SOLENOID SWITCH

VACUUM UNIT (recirculating/fresh air flap)

Remove and refit

1. Disconnect the battery negative lead.
2. Remove the transmission lever surround.
3. Remove the radio mounting console.
4. Remove the centre fascia unit and the lower fascia panel.
5. Disconnect the electrical leads to the solenoid.



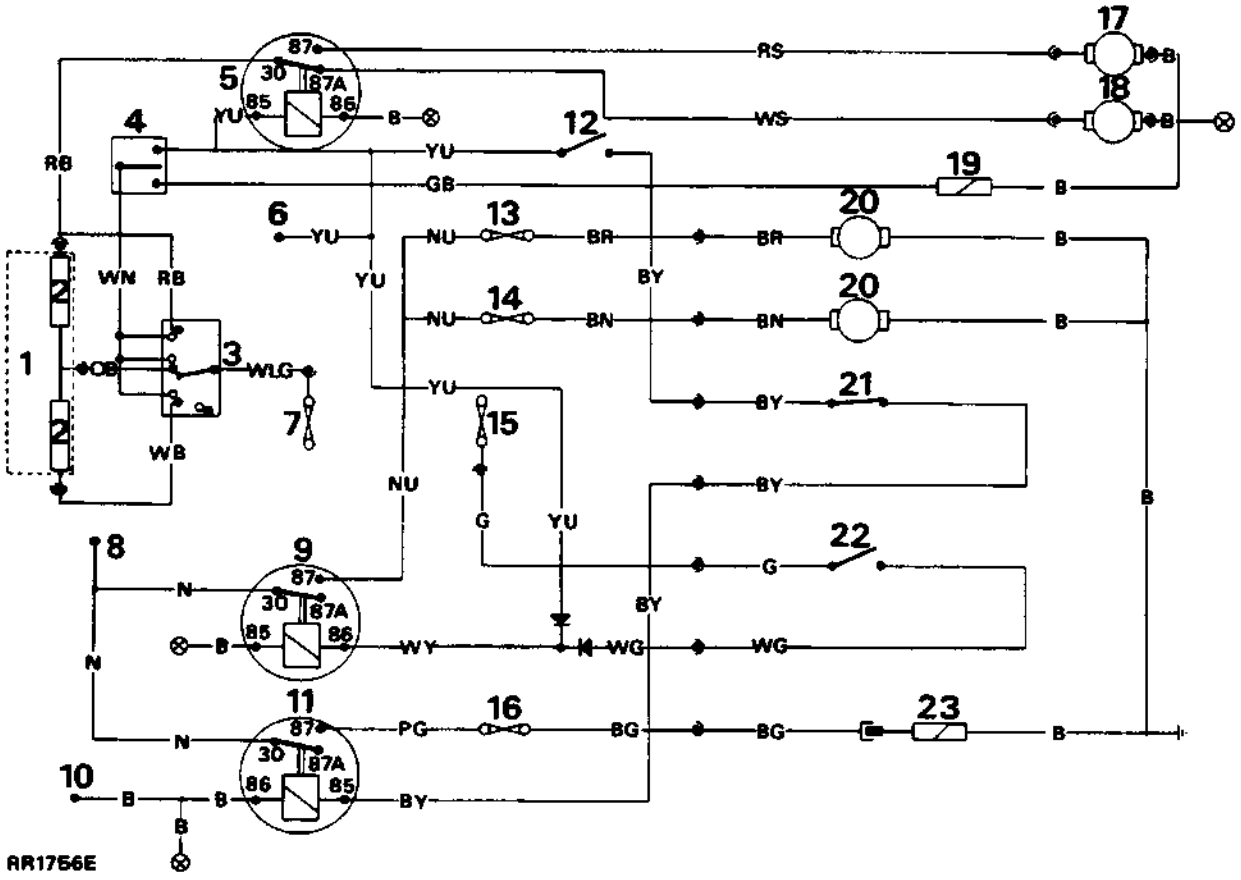
RR2091E

6. Disconnect the two vacuum pipes.
7. Remove the solenoid fixings and withdraw the solenoid.
8. Vacuum unit: remove the vacuum pipe from the vacuum unit.
9. Remove the actuating rod securing clip.
10. Remove two fixing nuts and washers and withdraw the vacuum unit.

Refitting

11. Reverse the removal procedure.

HEATER AND AIR CONDITIONING-
circuit diagram



1. Heater unit.
2. Resistors.
3. Fan speed switch
4. Air conditioning/re- circulating/fresh air-switch.
5. Air conditioning/heater relay.
6. Cable connection to ECU.
7. Fuse 8-main fuse panel.
8. Pick up point main cable connection.
9. Fan relay.
10. Ground-via main cable.
11. Compressor clutch relay.
12. Thermostat.
13. Fuse A1-auxiliary fuse panel.
14. Fuse A2-auxiliary fuse panel.
15. Fuse 13-main fuse panel.
16. Fuse A3-auxiliary fuse panel.
17. Air conditioning motor - dashboard unit.
18. Heater motor.
19. Heater recirculating solenoid.
20. Condenser fan motors.
21. High pressure switch.
22. Engine water temperature sensor.
23. Compressor clutch.

Cable colour code

B	Black
U	Blue
N	Brown
G	Green
L	Light
O	Orange
P	Purple
R	Red
S	Slate
W	White
Y	Yellow

The last letter of a colour code denotes the tracer.

AIR CONDITIONING/HEATER CONTROLS

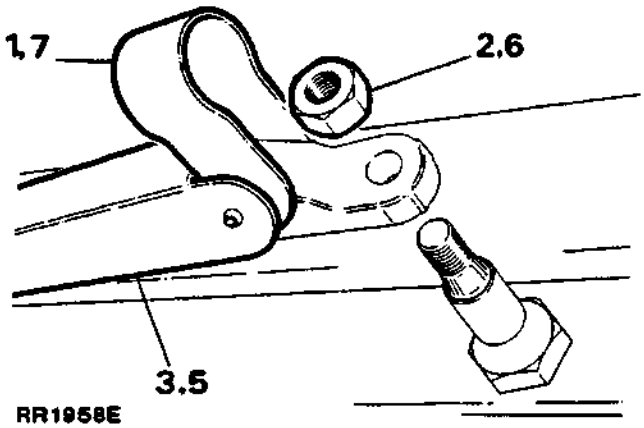
The air conditioning controls are now incorporated in the heater control panel. See Section 80 -Heating and Ventilation.

TAILGATE WIPER ARM

Remove and refit

Removing

1. Lift the wiper arm end cap to gain access to the wiper motor spindle.
2. Remove the wiper arm securing nut.
3. Withdraw the wiper arm from the spindle.



RR1958E

Refitting

4. Allow the motor to move to the 'park' position.
5. Fit the wiper arm to the spindle,locating it on the splines so that the wiper blade is just clear of the screen surround.
6. Fit and tighten the securing nut.
7. Push the end cap back into position.
8. Check the correct operation of the wiper.

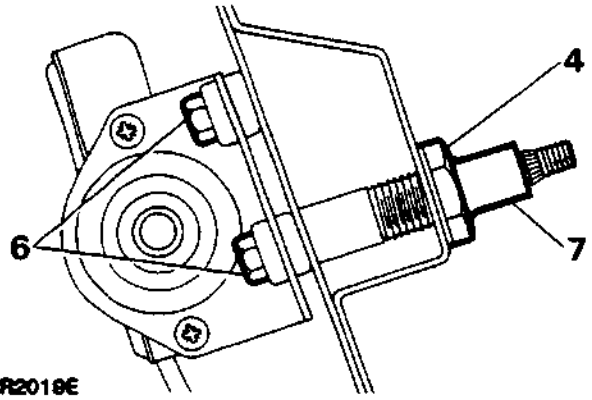
TAILGATE WIPER MOTOR

The tailgate wiper motor contains non-serviceable parts,repair is by replacement only.

Remove and refit

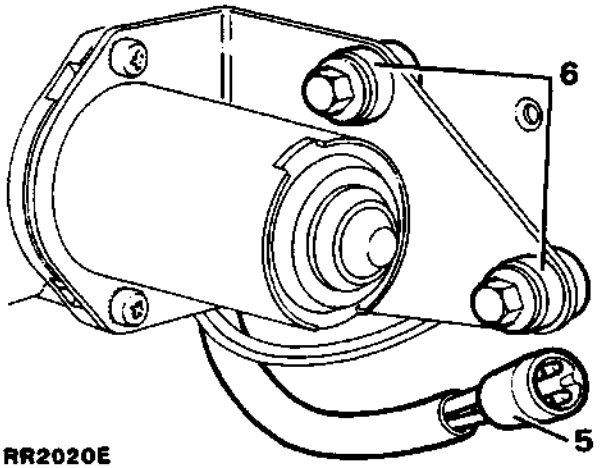
Removing

1. Disconnect the battery negative lead.
2. Lower or remove the headlining rear section to gain access to the wiper motor assembly.
3. Remove the wiper arm and blade.
4. Slacken the nut securing the wiper motor to the body. DO NOT remove at this stage.



RR2019E

5. Disconnect the electrical leads at the multi-plug.
6. Remove the two bolts securing the wiper motor to the inner body.

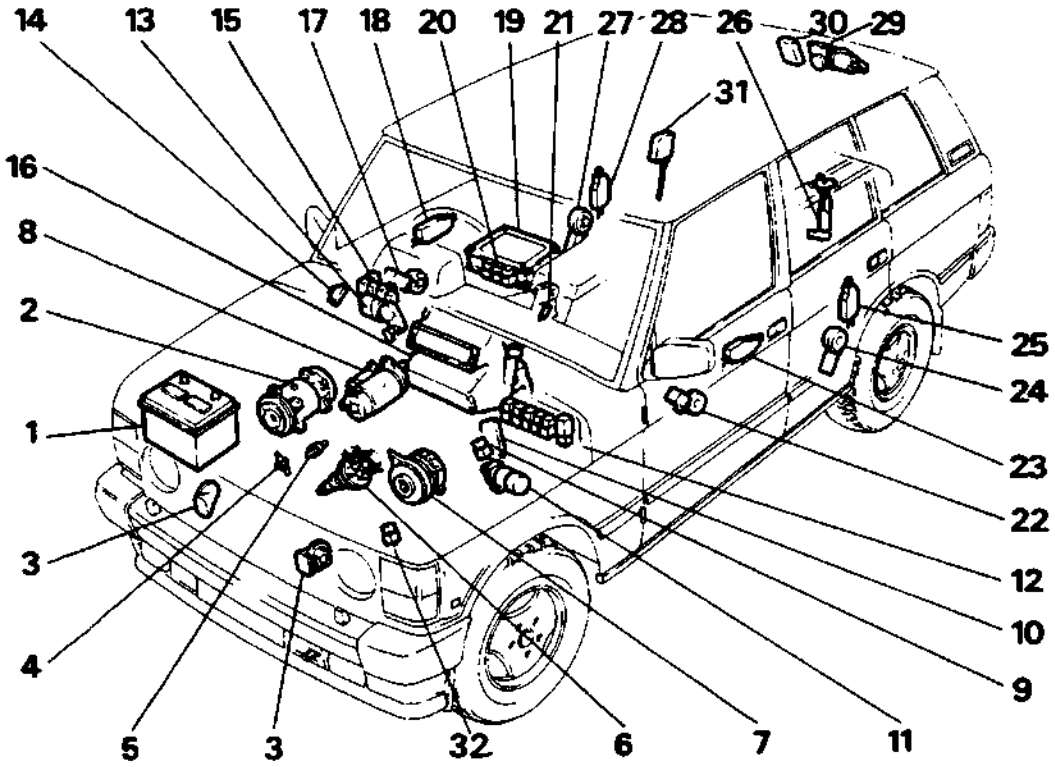


RR2020E

7. Supporting the wiper motor, remove the nut slackened at instruction 4, complete with protective cover, washer and seal. Simultaneously withdraw the wiper motor from the body.

Refitting

8. Reverse instructions 1 to 7,ensuring that the spacer is correctly positioned before fitting the motor.



RR2104M

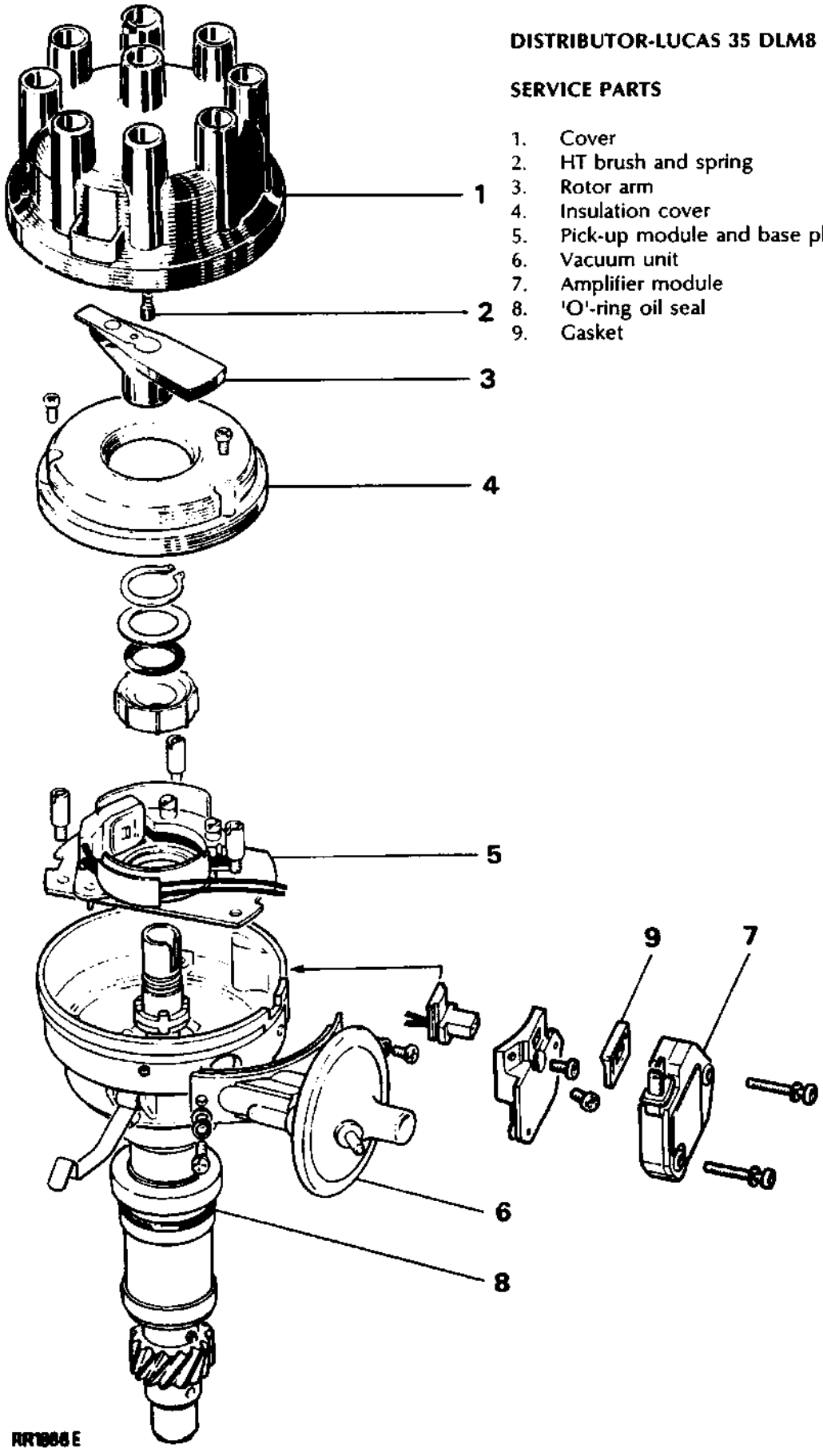
LOCATION OF ELECTRICAL EQUIPMENT

1. Battery
2. Air conditioning compressor (if fitted)
3. Horns
4. Oil pressure switch
5. Water temperature switch
6. Electronic distributor
7. Alternator
8. Starter motor
9. Fuel shut-off relay (fuel injection models only)
10. Power resistor (fuel injection models only)
11. Coil and amplifier assembly
12. Relays
13. Wiper motor-front screen
14. Choke warning light switch (carburetter models only)
15. Relays
16. Heater
17. Window lift motor (front right-hand door)
18. Door lock actuator (front right-hand door)
19. Electronic control unit (fuel injection models only)
20. Relays (fuel injection models only)
21. Handbrake warning light switch
22. Window lift motor (front left-hand door)
23. Door lock actuator (front left-hand door)
24. Window lift motor (rear left-hand door)
25. Door lock actuator (rear left-hand door)
26. Electrical in-tank fuel pump
27. Window lift motor (rear right-hand door)
28. Door lock actuator (rear right-hand door)
29. Wiper motor-rear screen
30. Radio aerial amplifier
31. Fuel filler lock actuator
32. Fuel cut-off relay (carburetter models only)

NOTE: Right-hand drive vehicle illustrated: Certain electrical components may change position on left-hand drive vehicles, but can be found in a similar location on the opposite side of the vehicle.

For full information on fuel injection related items - see Main Workshop Manual.

To identify individual relays (Items 12 and 15) see relays in Electrical Section of Manual.



DISTRIBUTOR-LUCAS 35 DLM8

SERVICE PARTS

1. Cover
2. HT brush and spring
3. Rotor arm
4. Insulation cover
5. Pick-up module and base plate assembly
6. Vacuum unit
7. Amplifier module
8. 'O'-ring oil seal
9. Gasket

ELECTRONIC IGNITION

A Lucas 35DLM8 distributor is employed. This has a conventional advance unit and centrifugal automatic advance mechanism.

A pick-up module, in conjunction with a rotating timing reluctor inside the distributor body, generates timing signals. These are applied to an electronic ignition amplifier module mounted on the side of the distributor body.

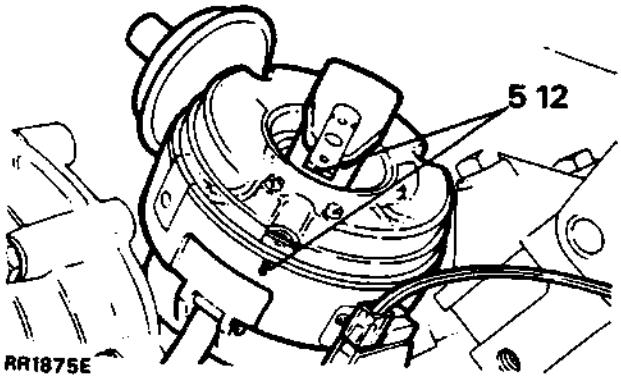
NOTE: The pick-up air gap is factory set. Do not adjust the gap unless the pick-up is being changed or the base plate has been moved. Use a non-ferrous feeler gauge to set the air gap.

DISTRIBUTOR

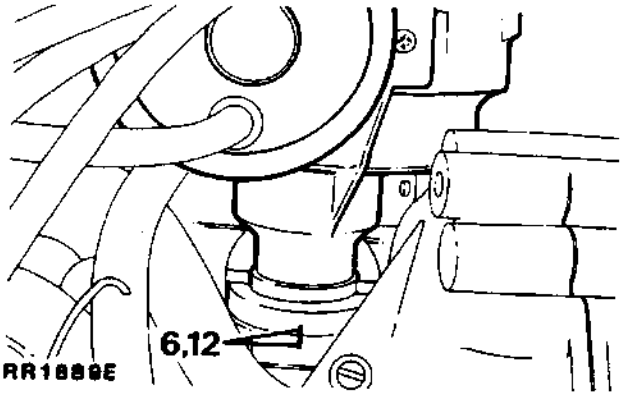
Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Disconnect the vacuum pipe.
3. Remove the distributor cap.
4. Disconnect low tension lead from the coil.
5. Mark distributor body in relation to centre line of rotor arm.



6. Add alignment marks to distributor and front cover.

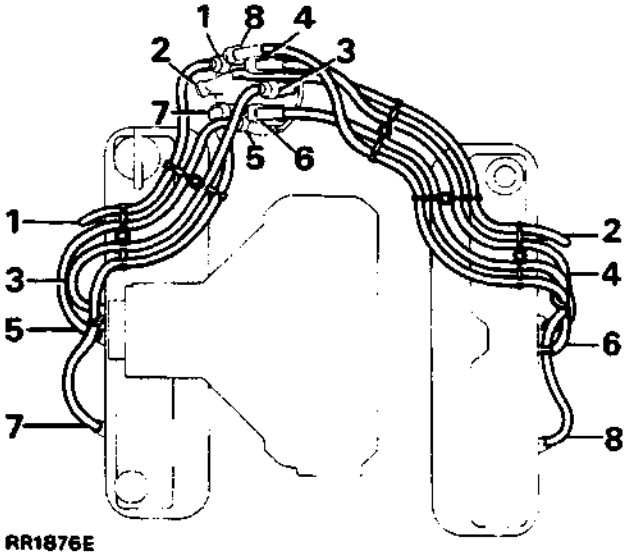


NOTE: Marking the distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

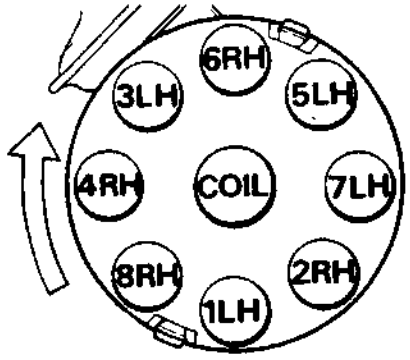
7. Release the distributor clamp and remove the distributor.

Refitting

NOTE: If a new distributor is being fitted, mark body in same relative position as distributor removed.



8. Leads for distributor cap should be connected as illustrated. Figures 1 to 8 inclusive indicate plug lead numbers. RH-Right hand side of engine, when viewed from the rear. LH-Left hand side of engine, when viewed from the rear.



RR616M

9. If engine has not been turned whilst distributor has been removed, proceed as follows (Items 10 to 17). Alternatively proceed to instruction 18.
10. Fit new 'O' ring seal to distributor housing.
11. Turn distributor drive until centre line of rotor arm is 30o anti-clockwise from mark made on top edge of distributor body.
12. Fit distributor in accordance with alignment markings.

NOTE: It may be necessary to align oil pump drive shaft to enable distributor drive shaft to engage in slot.

13. Fit clamp and bolt. Secure distributor in exact original position.
14. Connect vacuum pipe to distributor and low tension lead to coil.
15. Fit distributor cap.
16. Reconnect battery.
17. Using suitable electronic equipment, set the ignition timing, see **IGNITION TIMING-Adjust.**
18. If, with distributor removed, engine has been turned it will be necessary to carry out the following procedure.
19. Set engine-No. 1 piston to static ignition timing figure (see Engine Tuning Data- Section 05) on compression stroke.
20. Turn distributor drive until rotor arm is approximately 30o anti-clockwise from number one sparking plug lead position on cap.
21. Fit distributor to engine.
22. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
23. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
24. Fit clamp and bolt leaving both loose at this stage.
25. Set the ignition timing statically to within 2°-3° of T.D.C.
26. Connect the vacuum pipe to the distributor.
27. Fit low tension lead to coil.
28. Fit distributor cap.
29. Reconnect the battery.
30. Using suitable electronic equipment set the ignition timing, see **IGNITION TIMING-Adjust.**

DISTRIBUTOR-LUCAS 35DLM8

Overhaul

DISTRIBUTOR COVER

1. Unclip and remove the cover.
2. Renew the cover if known to be faulty.
3. Clean the cover and HT brush with a nap free cloth.

ROTOR ARM

4. Pull rotor arm from shaft.
5. Renew rotor arm if known to be faulty.

INSULATION COVER (Flash shield)

6. Remove cover, secured by three screws.
7. Renew cover if known to be faulty.

VACUUM UNIT

8. Remove two screws from vacuum unit securing bracket, disengage vacuum unit connecting rod from pick-up base plate connecting peg, and withdraw vacuum unit from distributor body.

AMPLIFIER MODULE

9. Remove two screws and withdraw the module.
10. Remove the gasket.
11. Remove two screws securing the cast heatsink and remove the heatsink.

WARNING: The amplifier module is a sealed unit containing Beryllia. This substance is extremely dangerous if handled. Do not attempt to open or crush the module.

PICK-UP AND BASE PLATE ASSEMBLY

12. Use circlip pliers to remove the circlip retaining the reluctor on rotor shaft.
13. Remove the flat washer and then the 'O' ring recessed in the top of the reluctor.
14. Gently withdraw the reluctor from the shaft, taking care not to damage the teeth.

NOTE: Coupling ring fitted beneath reluctor.

15. Remove three support pillars and cable grommet. Lift out the pick-up and base plate assembly.

NOTE: Do not disturb the two barrel nuts securing the pick-up module, otherwise the air gap will need re-adjustment.

16. Renew pick-up and base plate assembly if module is known to be faulty, otherwise check pick-up winding resistance (2k-5k ohm).

RE-ASSEMBLY

17. This is mainly a reversal of the dismantling procedure, noting the following points:

LUBRICATION

Apply clean engine oil:

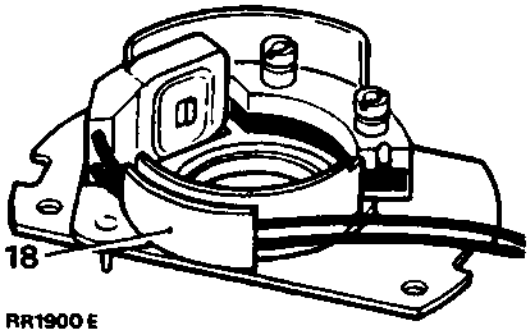
a. Three drops to felt pad reservoir in rotor shaft.

Apply Omnilube 2 (or equivalent) grease.

b. Auto advance mechanism.
c. Pick-up plate centre bearing.
d. Pre tilt spring and its rubbing area (pick-up and base plate assembly).
e. Vacuum unit connecting peg (pick-up and base plate assembly).
f. The connecting peg hole in vacuum unit connecting rod.

FITTING PICK-UP AND BASE PLATE ASSEMBLY

18. Pick-up leads must be prevented from fouling the rotating reluctor. Both leads should be located in plastic carrier as illustrated. Check during re-assembly.



RR1900E

REFITTING RELUCTOR

19. Slide reluctor as far as it will go on rotor shaft, then rotate reluctor until it engages with the coupling ring beneath the pick-up base plate. The distributor shaft, coupling ring and reluctor are 'keyed' and rotate together.

PICK-UP AIR GAP ADJUSTMENT

20. The air gap between the pick-up limb and reluctor teeth must be set within the specified limits, using a non-ferrous feeler gauge.

NOTE: When the original pick-up and base plate assembly has been refitted the air gap should be checked, and adjusted if necessary.

When renewing the assembly the air gap will require adjusting to within the specified limits.

Refer to 'Engine Tuning Data'

AMPLIFIER MODULE

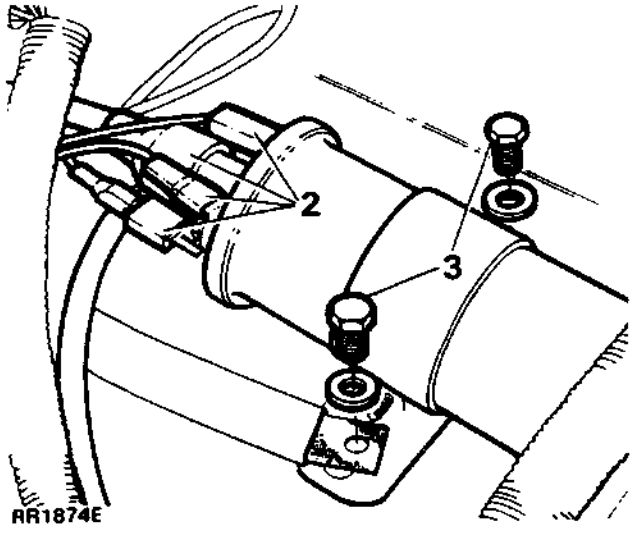
21. Before fitting the module, apply MS4 Silicone grease or equivalent heat-conducting compound to the amplifier module backplate, the seating face on distributor body and both faces of the heatsink casting.

IGNITION COIL

Remove and refit

Removing

1. Disconnect the battery negative terminal.
2. Disconnect the High Tension and Low Tension electrical leads from the ignition coil.



3. Remove the two bolts securing the coil to the valance.

NOTE: An earth braid is located under one of the bolts.

4. Remove the coil from the engine compartment.

Refitting

5. Reverse the removal instructions.

NOTE: Ensure that the bolting location for the earth braid is free from paint and grease. Coat the area around the bolt with petroleum jelly.

IGNITION TIMING

Adjust

1. It is essential that the following procedures are adhered to. Inaccurate timing can lead to serious engine damage and additionally create failure to comply with emission regulations. If the engine is being checked in the vehicle and is fitted with an air conditioning unit the compressor must be isolated.

2. On initial engine build, or if the distributor has been disturbed for any reason, the ignition timing must be set statically to within 2°-3° of T.D.C.

   (This sequence is to give only an approximation in order that the engine may be started) **ON NO ACCOUNT MUST THE ENGINE BE STARTED BEFORE THIS OPERATION IS CARRIED OUT.**

Equipment required

Calibrated Tachometer
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following the manufacturer's instructions.

4. Disconnect the vacuum pipe from the distributor.
5. Start engine, with no load and not exceeding 3,000 rev/min run engine until normal operating temperature is reached. (Thermostat open). Check that the normal idling speed falls within the tolerance specified in the data section.
6. Idle speed for timing purposes must not exceed 600 rev/min.
7. With the distributor clamping bolt slackened turn distributor until the timing flash coincides with the timing pointer and the correct timing mark on the rim of the torsional vibration damper as shown in the engine tuning section.
8. Retighten the distributor clamping bolt securely. Recheck timing in the event that retightening has disturbed the distributor position.
9. Refit vacuum pipe.
10. Disconnect stroboscopic timing lamp and tachometer from engine.

LUCAS CONSTANT ENERGY IGNITION SYSTEM 35DLM8-PRELIMINARY CHECKS

Inspect battery cables and connections to ensure they are clean and tight. Check battery state of charge if in doubt as to its condition.

Inspect all LT connections to ensure that they are clean and tight. Check the HT leads are correctly positioned and not shorting to earth against any engine components. The wiring harness and individual cables should be firmly fastened to prevent chaffing.

PICK-UP MODULE AIR GAP SETTINGS

Air gap settings vary according to vehicle application.

NOTE: The gap is set initially at the factory and will only require adjusting if tampered with or when the pick-up module is replaced.

Test Notes

(i) The ignition must be switched on for all checks.
(ii) Key to symbols used in the charts for Tests 2.

C	Correct Reading
H	High Reading
L	Low Reading

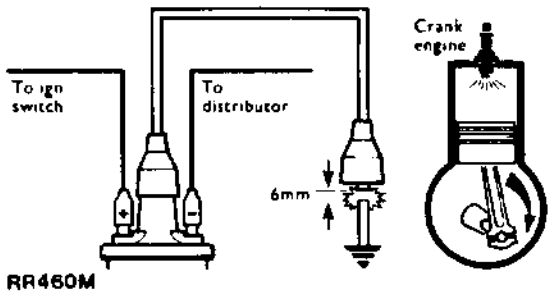
(iii) Use feeler gauges manufactured from a non-magnetic material when setting air gaps.

TEST 1:

Check HT Sparking

Remove coil/distributor HT lead from distributor cover and hold approximately 6mm (0.25 in) from the engine block. Switch the ignition 'On' and operate the starter.
If regular sparking occurs, proceed to Test 6. If no sparking proceed to Test 2.

Test 1



RR460M

TEST 2:

Amplifier Static Checks

Switch the ignition 'On'

(a) Connect voltmeter to points in the circuit indicated by the arrow heads and make a note of the voltage readings.

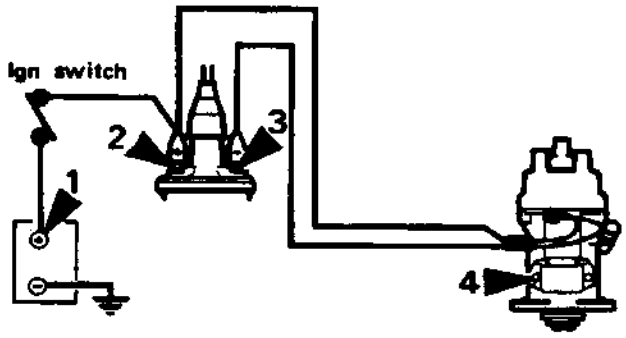
NOTE: Only move the voltmeter POSITIVE lead during tests 2,3, and 4.

(b) Compare voltages obtained with the specified values listed below:

EXPECTED READINGS

1. More than 11.5 volts.
2. 1 volt max below volts at point 1 in test circuit.
3. 1 volt max below volts at point 1 in test circuit.
4. O volt-0.1 volt.

Test 2



RR1768E

(c) If all readings are correct proceed to Test 3.
(d) Check incorrect reading(s) with chart to identify area of possible faults, i.e. faults listed under heading '**Suspect**'.

1	2	3	4	SUSPECT
L	C	C	C	DISCHARGED BATTERY
C	L	L	C	IGN. SWITCH AND/OR WIRING
C	C	L	C	COIL OR AMPLIFIER
C	C	C	H	AMPLIFIER EARTH

TEST 3:

Check Amplifier Switching

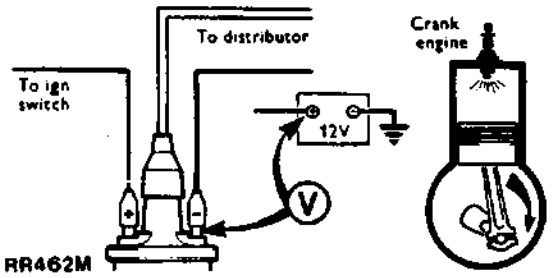
Disconnect the high tension lead between the coil and distributor.

Connect the voltmeter between positive (+ ve) terminal and H.T. coil negative (- ve) terminal, the voltmeter should register zero volts.

Switch the ignition 'On' then crank the engine. The voltmeter reading should increase when cranking, in which case proceed with Test 5.

If there is no increase in voltage during cranking proceed to Test 4.

Test 3



RR462M

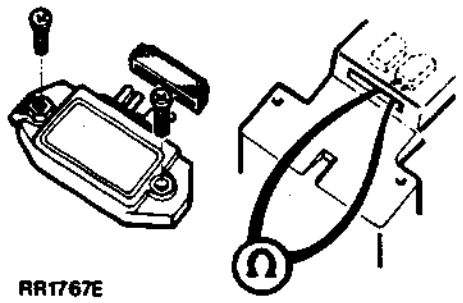
TEST 4:

Pick-Up Coil Resistance
Applications with Separate Amplifier

Disconnect the pick-up leads at the harness connector. Connect the ohmmeter leads to the two pick-up leads in the plug.

The ohmmeter should register between 2k and 5k ohm if pick-up is satisfactory. Change the amplifier if ohmmeter reading is correct. If the engine still does not start carry out Test 5.

Test 4



RR1767E

Change the pick-up if ohmmeter reading is incorrect. If the engine still does not start proceed to Test 5.

TEST 5:

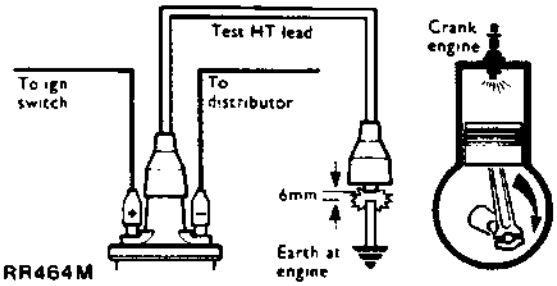
Coil H.T. Sparking

Remove existing coil/distributor H.T. lead and fit test H.T. lead to coil chimney. Hold free end about 6mm (0.25 in) from the engine block and crank the engine.

H.T. sparking good, repeat test with original H.T. lead, if then no sparking, change H.T. lead. If sparking is good but engine wil not start, proceed to Test 6.

If no sparking, replace coil. If engine will not start carry out Test 6.

Test 5



TEST 6:

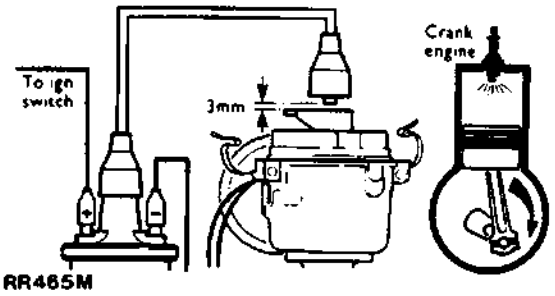
Check Rotor Arm

Remove distributor cover. Disconnect coil H.T. lead from cover and hold about 3mm (0.13 in) above rotor arm electrode and crank the engine. There should be no H.T. sparking between rotor and H.T. lead. If satisfactory carry out Test 7.

H.T. sparking, replace rotor arm.

If engine will not start carry out Test 7.

Test 6



TEST 7:

Visual and H.T. Cable Checks

	Examine:	**Should be:**
1.	Distributor Cover	Clean, dry, no tracking marks
2.	Coil Top	Clean, dry, no tracking marks.
3.	H.T. Cable Insulation	Must not be cracked, chafed or perished
4.	H.T. Cable Continuity	Must not be open circuit
5.	Sparking Plugs	Clean, dry, and set to correct gap

NOTE:

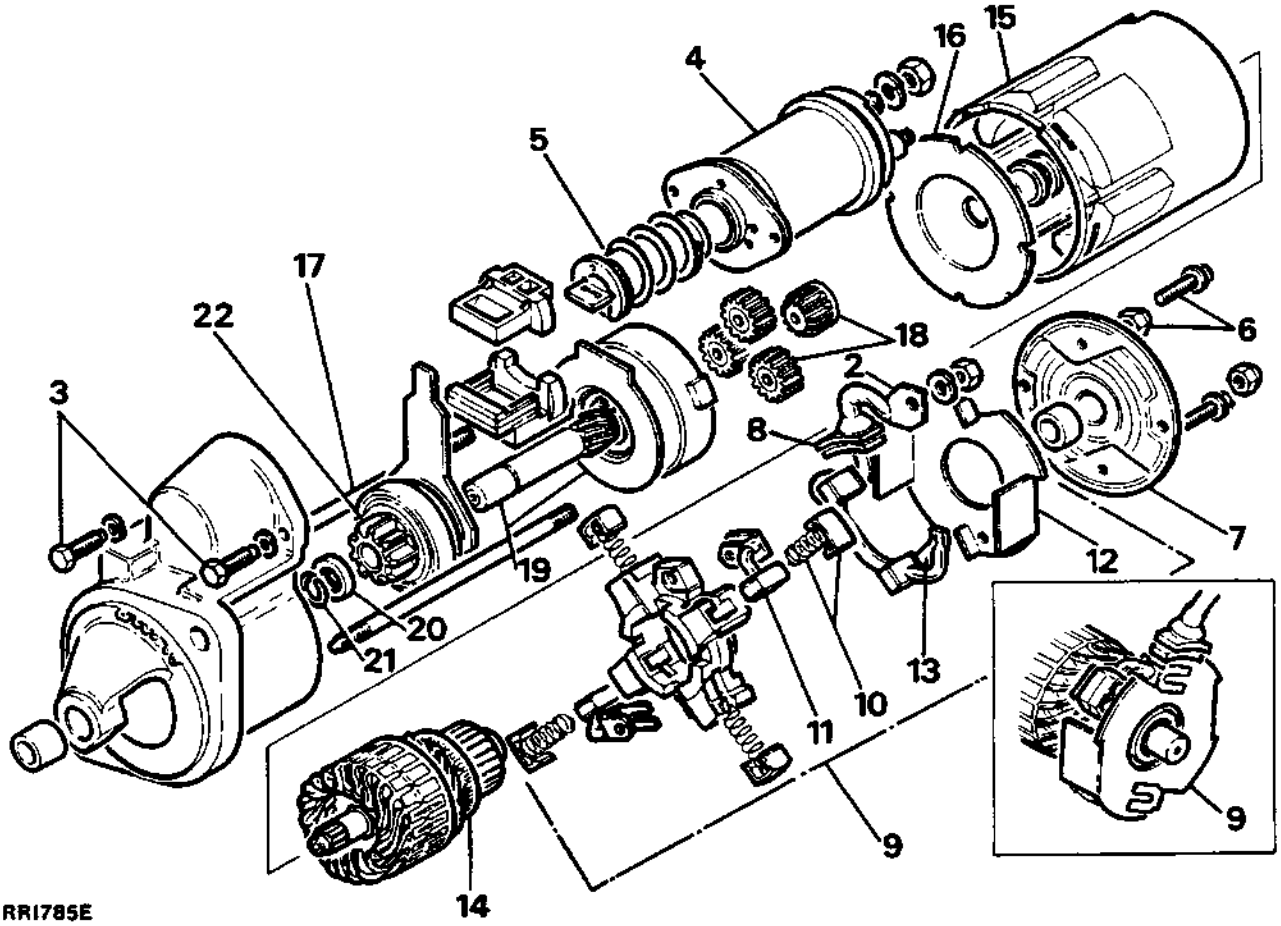
1.	Reluctor	Must not foul pick-up or leads
2.	Rotor and Insulation Cover	Must not be cracked or show signs of tracking marks

STARTER MOTOR-Lucas M78R (Petrol models)

Overhaul

Dismantling

1. Remove the starter motor.
2. Remove the braid between the starter and the solenoid terminal.
3. Remove the solenoid fixing screws.
4. Withdraw the solenoid body.
5. Lift and remove the solenoid plunger.
6. Remove two nuts and two screws from the commutator end bracket.
7. Remove the commutator end bracket.
8. Remove the grommet from the yoke.
9. Lift the brushbox assembly clear of the armature.
10. Remove the brush springs.
11. Unclip and remove the earth brushes.
12. Remove the insulating plate.
13. Withdraw the brushes and bus bar.
14. Remove the armature from the yoke.
15. Remove the yoke.
16. Remove the intermediate bracket.
17. Loosen and remove the through bolts from the drive end bracket.
18. Remove the sun and planet gears.
19. Push out the drive shaft sprocket assembly from the drive end bracket.
20. Carefully tap the thrust collar from over the jump ring back towards the drive.
21. Prise the jump ring from its locating groove.
22. Remove the drive assembly from the drive shaft.

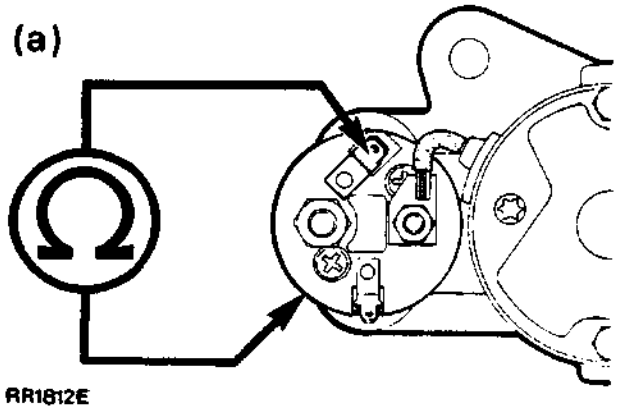


RRI785E

Inspecting

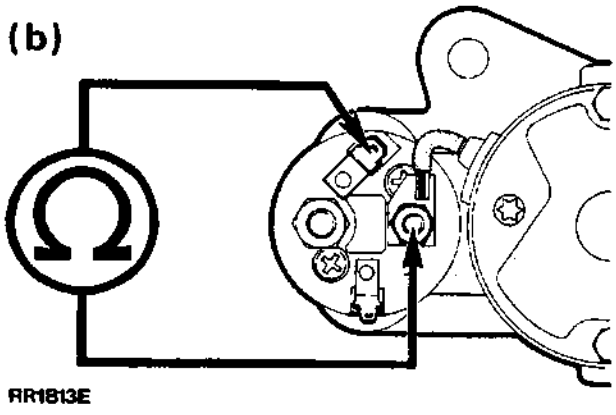
Solenoid

23. Check the continuity and resistance value of windings by connecting an ohmmeter as shown.



RR1812E

(a) Resistance value should be: 1.074 ± 0.035 ohms

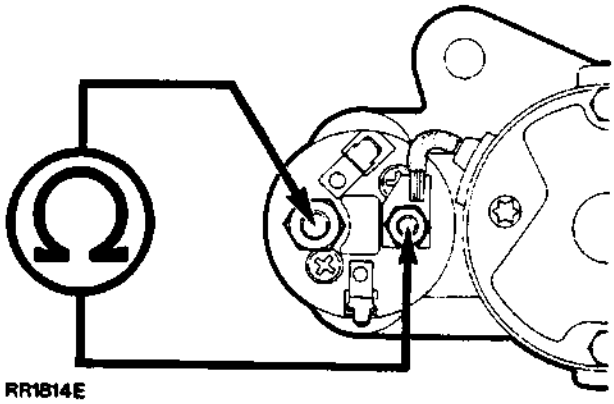


RR1813E

(b) Resistance value should be: 0.298 ± 0.015 ohms

If test results are unsatisfactory replace the solenoid.
If results are correct proceed to 24.

24. Check the contacts by connecting an ohmmeter as shown. Solenoid plunger removed, ohmmeter should read infinity.

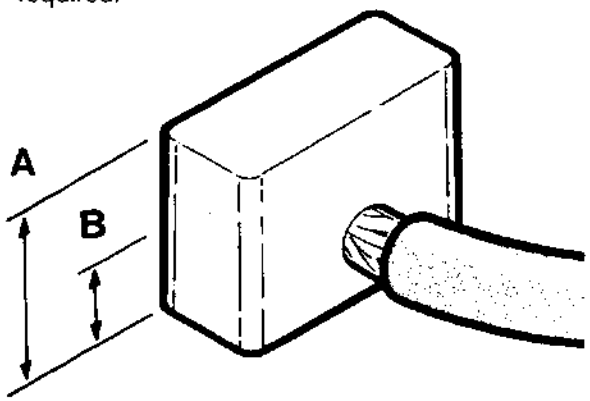

RR1814E

Solenoid plunger operated by hand, ohmmeter should read zero. If test results are unsatisfactory, replace the solenoid. If results are correct proceed to 25.

25. Check operation of spring for freedom of movement.

Brush gear

26. Check brush springs and ensure that the brushes move freely in their holders. Clean the brushes with a petrol moistened cloth, if required.

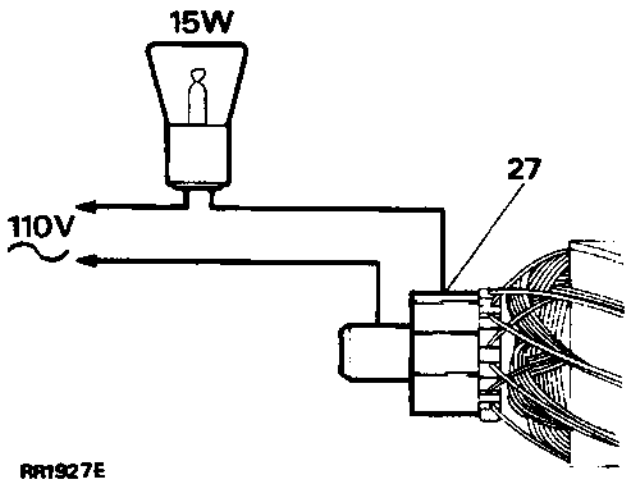


RR1815E

Brush length new, Dimension A is 9mm (0.354 in). Minimum brush length, Dimension B is 3.5mm (0.138 in).

Armature

27. Check the armature insulation using suitable test equipment. Connect the tester between any one commutator segment and the shaft. The method illustrated uses a 110V, 15W test lamp. If the lamp illuminates the armature is faulty, and a replacement component is required.



RR1927E

28. If necessary, the commutator may be machined, providing a finished surface can be obtained without reducing the diameter below 28.8mm (1.13 in), otherwise a new commutator must be fitted. Finish the surface with fine emery cloth. Do not undercut the insulation slots.

Drive assembly

29. Test the roller clutch. The pinion should rotate in one direction only, independent of the clutch body. Replace the unit if unsatisfactory or if teeth are damaged or worn.

Bearings

30. Renew the bearing bushes if there is evidence of armature fouling magnets or if there is perceptible side play between the shaft and bush.
31. Drive end/intermediate end bracket: press out the bush using a suitable press and mandrel.
32. Press the new bush in, ensuring that on the drive end bracket, the bush is flush with the casting.
33. Commutator end bracket; thread a 9/16" Whitworth or suitable similar tap firmly into the bush. Extract the bush with the tap using a power press in reverse.

NOTE: Soak new bushes in engine oil for thirty minutes before fitting.

Reassembly

34. Reverse the instructions 1 to 22. Smear the teeth and operating collar of the roller clutch with Shell Retinax 'A' grease. Smear the pivot lever of the drive assembly with Mobil 22 grease. Smear the drive shaft sun and planet gears with Rocol BRB1200 grease.

35. Tighten all the fixings to the correct torque-see Torque Wrench Settings.

STARTER MOTOR - Bosch 544
(Diesel models)

The solenoid, brushes and drive gear are the only components that can effectively be replaced on the Bosch 544 starter motor.

Should a major fault occur within the internal windings a new starter motor is to be fitted.

The starter motor is a fully water-proof unit, when dismantling care should be taken to note the location of 'O' rings and seals to ensure that they are refitted on assembly.

As a secondary precaution to ensure the complete water tightness of the starter motor, coat all threads of bolts and joint faces with a Silicon based sealing compound.

Remove, test and refit

Removing

1. Install the vehicle on an hydraulic ramp.
2. Prop open the bonnet and disconnect the two battery negative terminals.
3. Remove the single nut and bolt securing the heat shield to its mounting bracket, adjacent to the starter motor to flywheel housing lower fixing.
4. Remove the two bolts securing the heat shield and mounting bracket to the starter motor end cover.
5. Withdraw the heat shield.
6. Release the two bolts securing the starter motor mounting bracket to the side of the cylinder block, do not fully remove the bolts but allow the bracket to remain as loose as possible.
7. Remove the electrical leads from the solenoid.
8. Supporting the starter motor remove the upper and lower fixings, note that an earth braid and heat shield bracket is located under the lower nut.
9. Manoeuvre the starter motor and withdraw it from the flywheel housing, place the unit on a suitable workbench.

DISMANTLE

SOLENOID

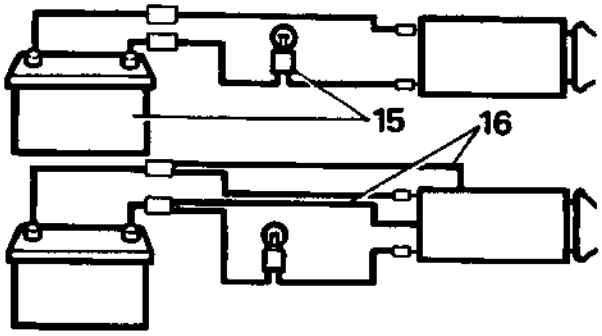
Remove and test

Remove

10. Disconnect the link lead, solenoid to starter motor.
11. Remove the three fixings and withdraw the body of the solenoid from the solenoid housing.
12. Remove the operating fork pivot bolt, withdraw the solenoid plunger from its housings.
13. Inspect the rubber boot on the solenoid for condition, if in poor condition, renew as necessary.
14. Refit the plunger to the solenoid body.

Test

15. Connect a 12 volt battery supply and a 12 volt 60 watt test lamp between the solenoid main terminals. The lamp should not light, if it does light, fit a new solenoid.
16. Leave the test lamp connected and using the same 12 volt battery supply between the small solenoid operating 'spade' terminal and a good earth point on the body.



RR2088M

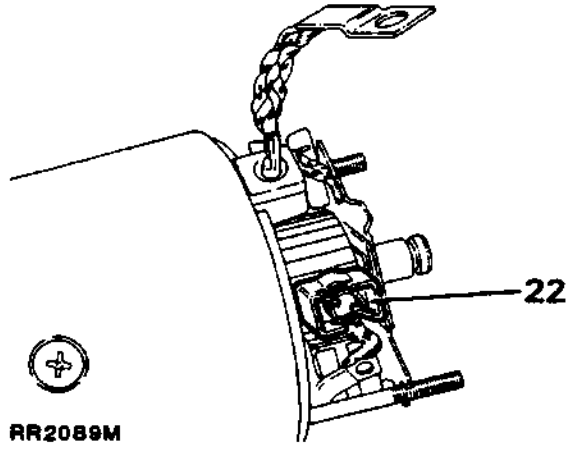
17. The plunger should pull back in the solenoid body and the test lamp should illuminate, otherwise fit a new solenoid.

BRUSHES

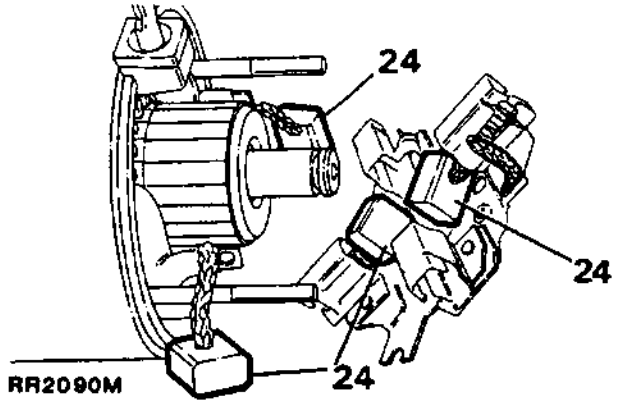
Remove and test

Remove

18. Remove the two screws securing the end cap to the starter motor end cover, note the two small 'O' rings on the screw threads.
19. Remove the 'C' clip and shims from the end of the armature shaft.
20. Remove the two nuts (with plain washers) securing the starter motor end cover, note the position of the two 'O' rings behind the nuts.
21. Withdraw the end cover.
22. Depress the field winding brush springs and open out the four retaining lugs to release the spring and brush from its holder.



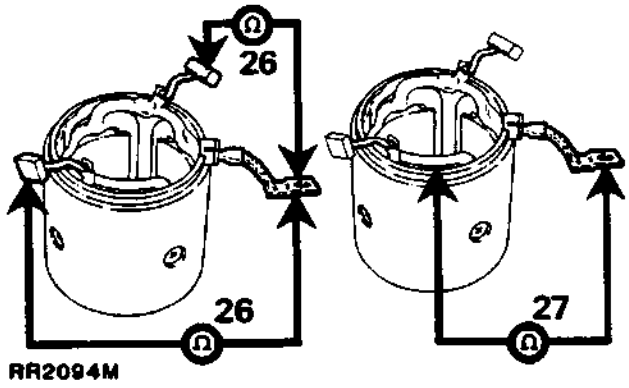
23. Withdraw the brush carrier assembly from the commutator, noting that the two negative brushes are still attached to the carrier. Care should be taken to ensure that the two negative brush springs do not jump out of the carrier.

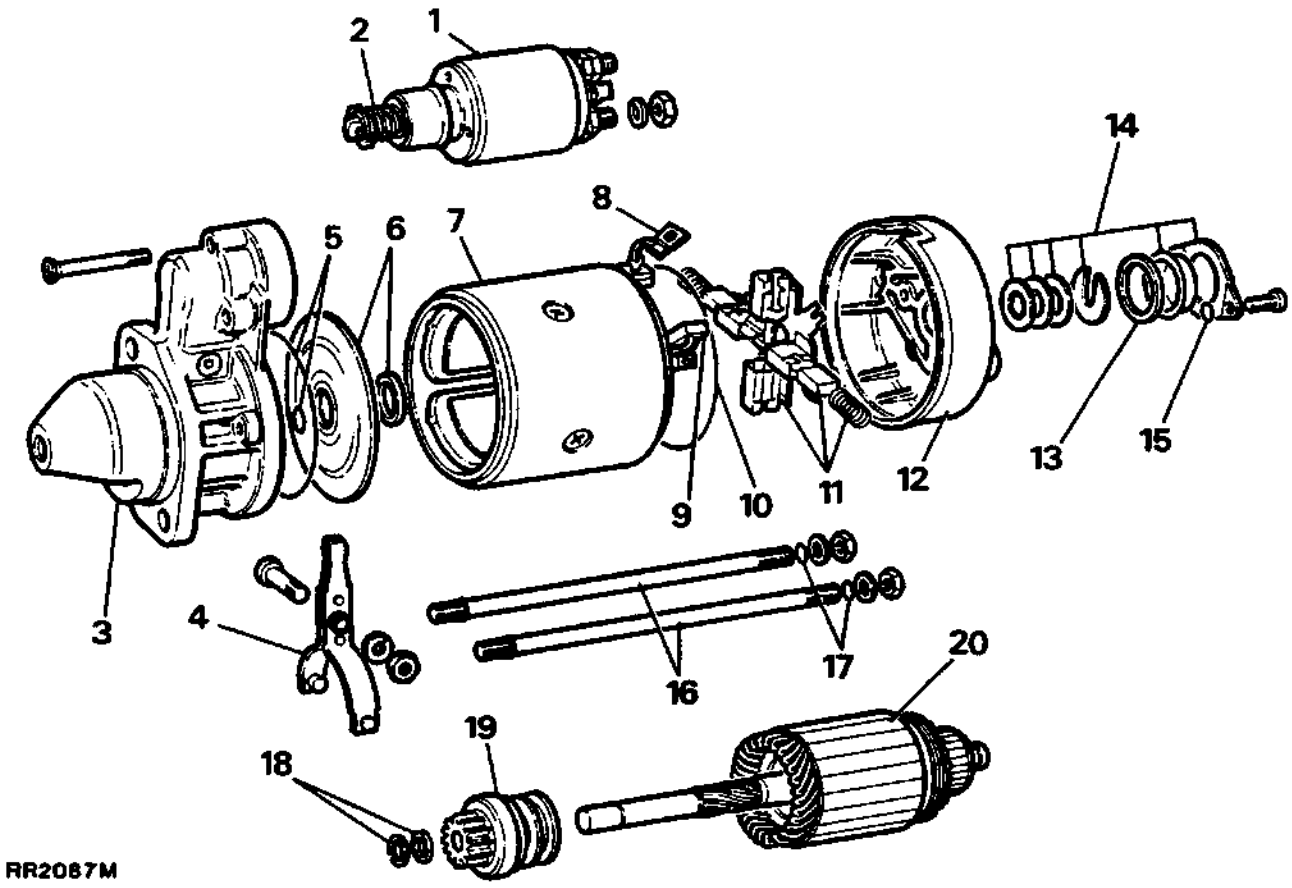


25. Withdraw the yoke of the starter motor from the drive end bearing housing. Note the position of 'O' rings for reassembly.

Test

26. Check for continuity between link lead and each brush in turn, if no continuity renew starter motor.
27. Check field winding insulation between each brush in turn to a clean paint free part of the yoke, there should be no continuity, if continuity exists renew starter motor.

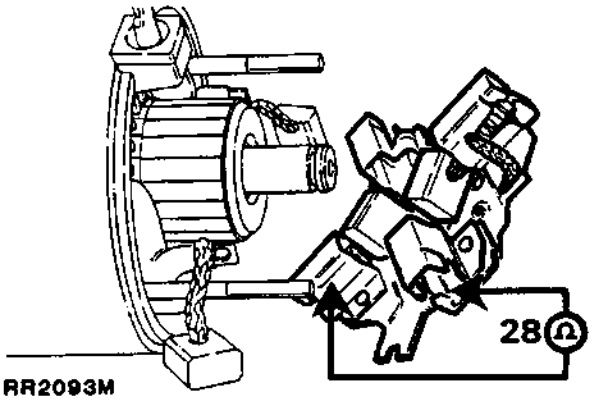




KEY TO STARTER MOTOR

1. Solenoid
2. Solenoid plunger and spring
3. Drive end - bearing housing
4. Operating fork
5. 'O' Rings - bearing housing (3 off)
6. Seal and end plate
7. Yoke
8. Link lead
9. Field winding brushes
10. 'O' Ring
11. Armature brushes and carrier assembly
12. End cover
13. 'O' Ring
14. Shims, 'C' clip and end cap
15. 'O' Rings (2 off)
16. Through studs
17. 'O' Rings (2 off)
18. Circlip and retainer
19. Drive gear assembly
20. Armature

28. Check the insulation between the brush carrier and brush holder, if continuity exists renew the carrier assembly.



RR2093M

ARMATURE

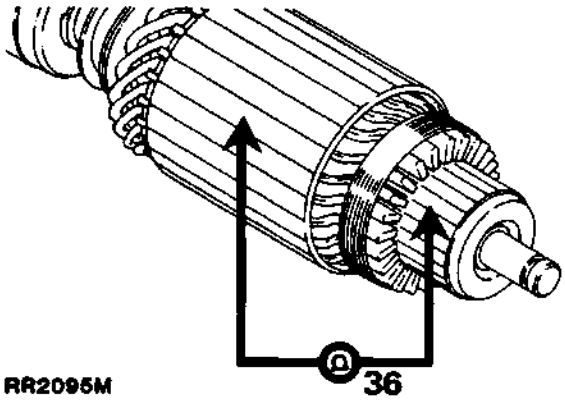
Remove and test

Remove

29. Remove the two long through studs to enable the armature to be withdrawn.
30. Ensure the drive gear is as far forward in the bearing housing as is possible.
31. Withdraw the armature until the drive gear operating fork is visible between the armature end plate and bearing housing.
32. Manoeuvre the armature assembly until the operating fork can be removed from the bearing housing and withdraw the armature. Note the position of the 'O' rings for reassembly.
33. Check the commutator, if cleaning only is necessary use a piece of very fine glass paper on a flat surface to remove any brush score marks, follow by wiping the commutator surface with a petrol moistened cloth.
34. If the commutator is heavily worn or has excessively deep score marks it may be necessary to machine the commutator surface, providing that, when all marks have been removed the finished diameter is not below 39.5mm (1.55 inch).
35. Having machined the ommutator each segment must now be undercut to reduce the insulation to a depth of 0.5mm (0.019 inch) below the surfae of the commutator.

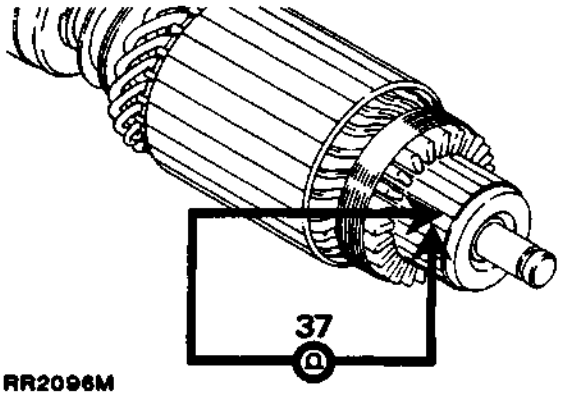
Test

36. Check to see if there is any continuity between the commutator and armature core, if continuity exists it indicates that the insulation between the windings and core have broken down, renew starter motor.



RR2095M

37. Check for continuity between each adjacent pair of commutator segments, if there is no continuity this will indicate that the armature windings have broken down, renew starter motor.

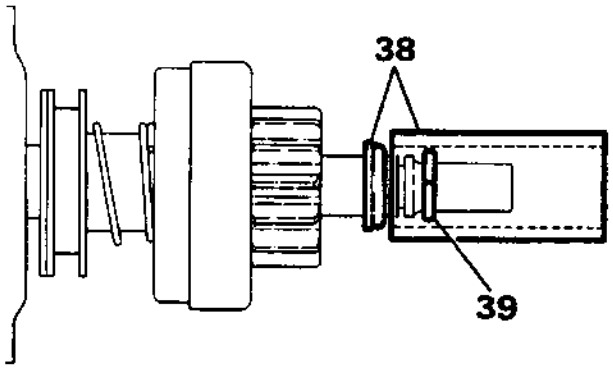


RR2096M

DRIVE GEAR

Remove

38. Using a suitable piece of tube over the armature shaft, carefully tap the circlip retainer down the shaft to expose the circlip.
39. Remove the circlip, inspect the groove to ensure that sharp edges have not been raised during the removal of the circlip, if necessary, with a smooth file remove any sharp edges before removing the drive gear assembly.



RR2097M

ASSEMBLE

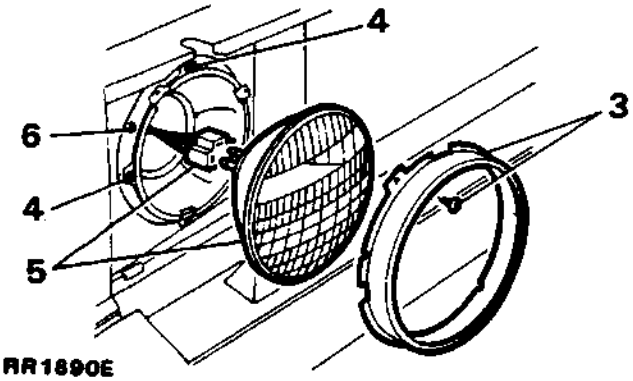
40. Coat the spiral gear on the armature shaft and the groove in the collar of the drive gear with Shell Retinax 'A' prior to assembly.
41. Ensure that all 'O' rings are in good condition and that they are fitted in their correct locations.
42. Coat all joint faces and screw threads with a Silicon based sealing compound to prevent ingress of water.
43. Reverse the dismantling instructions ensuring that all srews and nuts are securely tightened.
44. Refit the starter motor to the flywheel housing.
45. Reverse instructions 1 to 8 ensuring that the fixing bolts are tightened to the correct torque.
46. Securely tighten the nut which secures the electrical feed lead to the solenoid.
47. Lightly smear petroleim jelly around both of the terminals.

HEADLAMP ASSEMBLY/SEALED BEAM UNIT

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the radiator grill- see Body Section 76.
3. Remove three crosshead screws and the headlamp retaining rim.



RR1890E

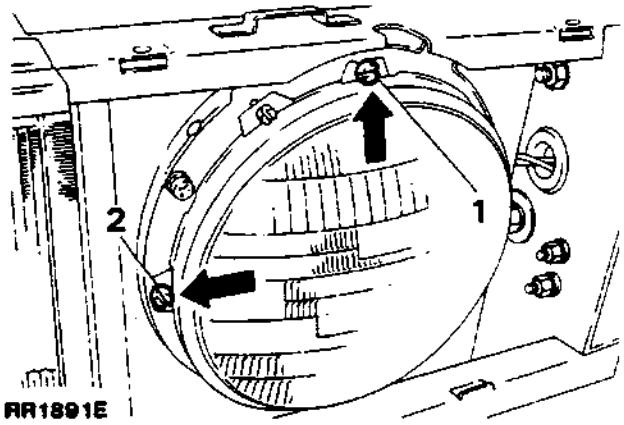
4. **DO NOT** disturb the two adjusting screws.
5. Withdraw the sealed beam unit and disconnect the wiring plug from the rear of the unit.
6. Remove three securing screws, prise away the grommet and withdraw the headlamp bowl.

Refitting

7. Reverse removal procedure.

HEADLAMP ALIGNMENT

Headlamp beam setting should only be carried out by qualified personnel using suitable beam setting equipment.



RR1891E

Adjusting

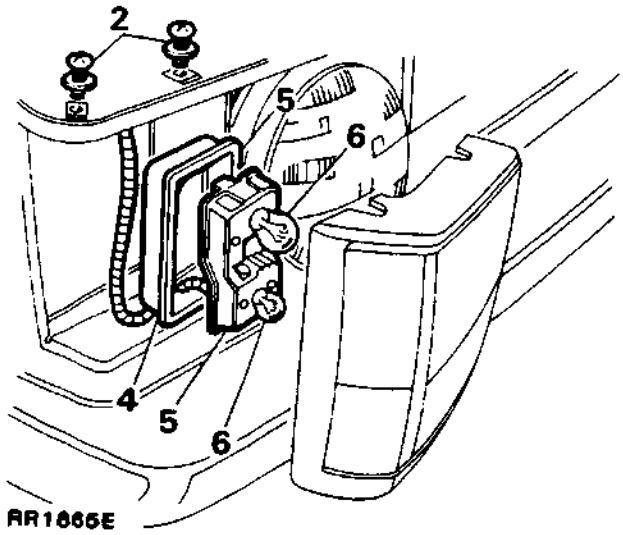
1. Turn the top adjusting screw anti-clockwise to lower the beam, clockwise to raise the beam.
2. Turn the side adjusting screw anti-clockwise to move the beam to the left, clockwise to move the beam to the right.

SIDELIGHT AND FLASHER LAMP ASSEMBLY - RH AND LH AND BULB

Remove and refit

Removing

1. Open the bonnet and disconnect the battery negative lead.
2. Remove the two screws and plain washers securing the lamp assembly.



3. Lift the assembly away sufficiently to gain access to the rear of the lamp.
4. Remove the waterproof cover.
5. Depress the two retaining clips and withdraw the bulb holder.
6. Remove the required bulb. The direction indicator bulb is located in the upper section of the bulb holder, the side lamp bulb in the lower.
7. Disconnect the multi-plug to remove the complete assembly.

Refitting

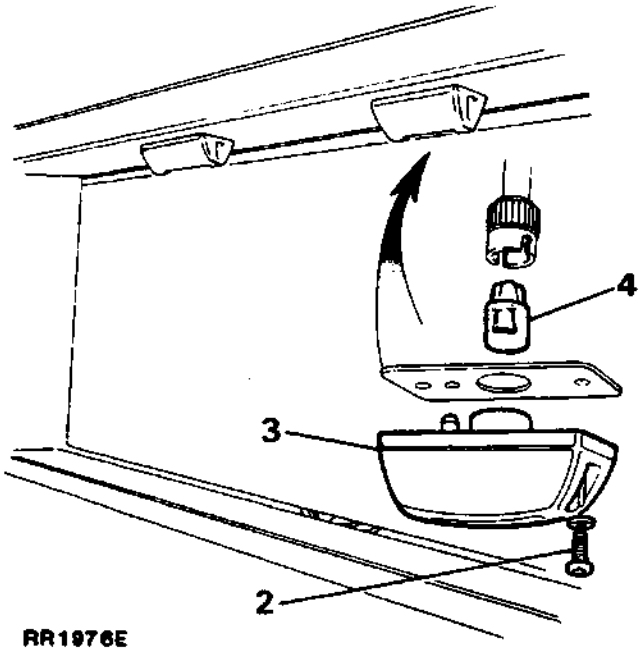
8. Reverse the removal procedure, ensuring the waterproof cover is located correctly.

NUMBER PLATE LAMP ASSEMBLY AND BULB REPLACEMENT

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the two self-tapping screws and washers.



3. Detach the lamp assembly.
4. Disconnect the bulb holder and remove the bulb.

NOTE: Carefully pull the electrical leads out of the bottom of the lower tailgate panel to reveal the snap connectors.

5. Disconnect the electrical connections located at the bottom of the lower tailgate.
6. Remove the bulb holder.
7. Carefully pull the electrical leads up through the inside of the lower tailgate panels.

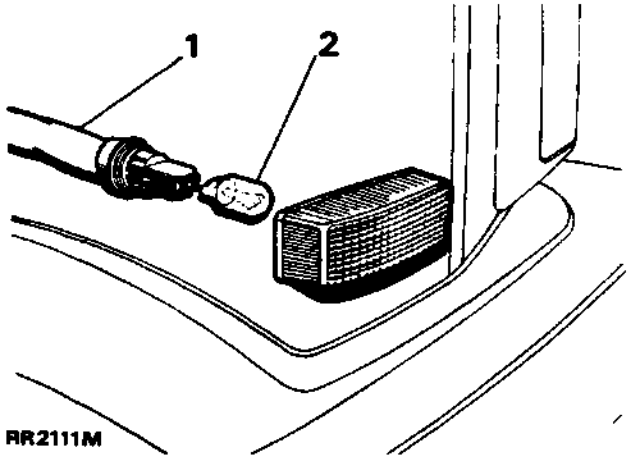
Refitting

8. Reverse the removal procedure. The correct bulb 'type' is a 12-volt, 5 watt wedge base (capless).

DIRECTION INDICATOR SIDE REPEATER LAMP BULB REPLACEMENT

Remove and refit

1. Working at the back of the lamp,through the wheel arch, slightly twist the bulb holder anti-clockwise to release it from the lamp assembly.
2. Remove the bulb.



RR2111M

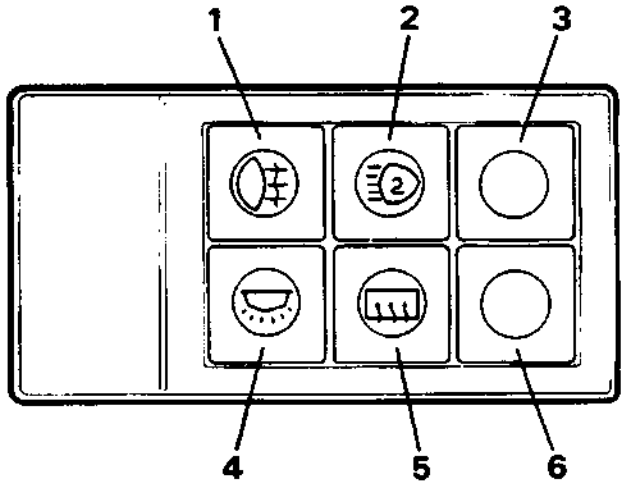
Refitting

3. Reverse the removal instructions. The correct bulb 'type' is a 12-volt, 5 watt wedge base (capless).

AUXILIARY SWITCH PANEL

The auxiliary switch panel contains four 'push-push' type switches which incorporate integral symbols for identification.
(The unused apertures are fitted with blank covers, which are removable, to facilitate the fitting of extra switches if required).
The symbols are illuminated by two bulbs which become operational when the vehicle lights are on.

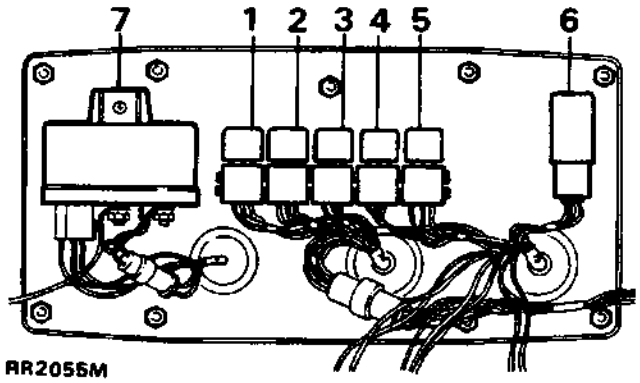
The rear fog guard lamp and heated rear screen switches (1 and 5) are also provided with individual warning lights, illuminated when the switches are operated.



RR2102M

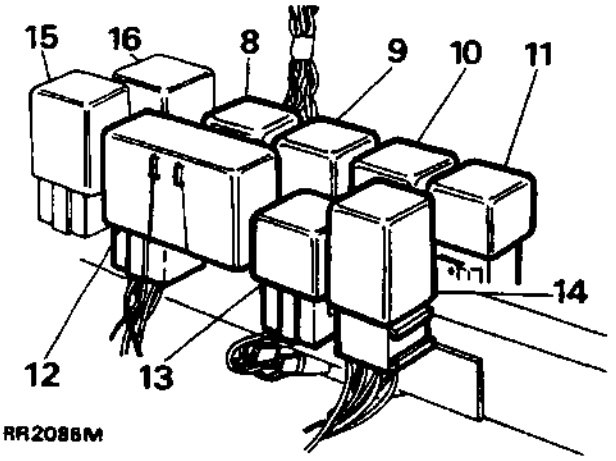
1. Rear fog guard lamps.
2. Auxiliary driving lamps.
3. Blank.
4. Interior and tailgate lamps.
5. Heated rear screen.
6. Blank.

RELAYS-Identification



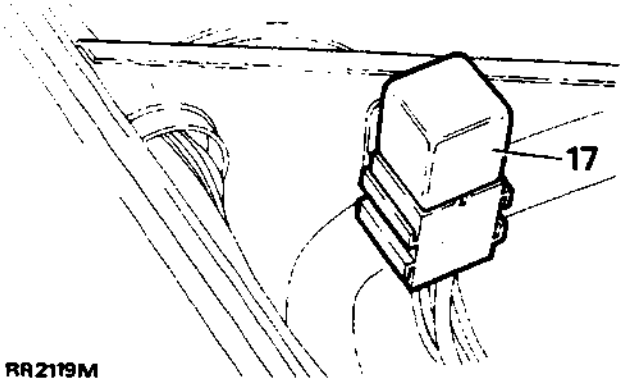
RR2055M

Closure panel viewed from the engine compartment, with protective cover removed.



RR2086M

Steering column mounted relays viewed with the lower fascia panel removed.

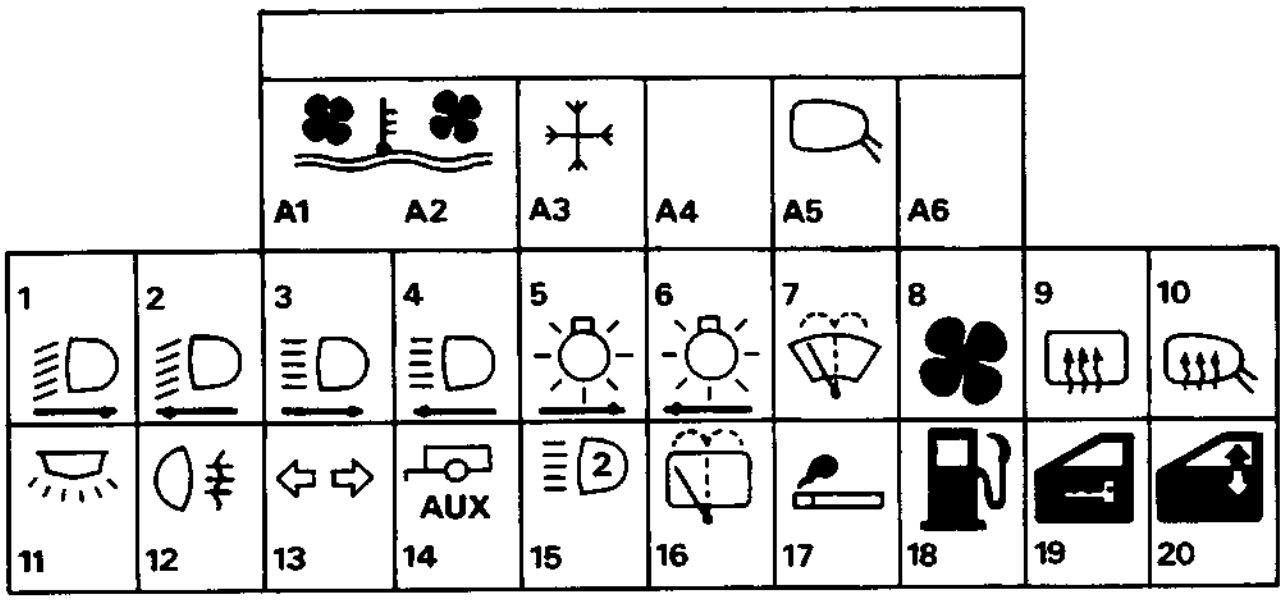


RR2119M

Fuel cut-off relay (carburetter models only) located in the engine compartment attached to the left-hand valance stiffener brackets.

Relay	Right-hand Drive Circuit Diagram Item Number	Left-hand Drive Circuit Diagram Item Number	Colour
1. Air conditioning/heater		5.	Natural
2. Condenser fan	Left and Right	9. Air conditioning	Natural
3. Compressor clutch	Hand Drive	11. circuit diagram	Natural
4. Starter solenoid relay	6.	6. Main circuit diagram	Natural
5. Heated rear window	66.	64. Main circuit diagram	Natural
6. Headlamp wash timer unit	19.	17. Main circuit diagram	Black
7. Glow plug timer (Diesel)	143.	150. Main circuit diagram	Black
8. Flasher/Hazard unit	75.	73. Main circuit diagram	Blue
9. Voltage sensitive switch	72.	70. Main circuit diagram	Yellow
10. Interior lamp delay	101.	99. Main circuit diagram	Red
11. Auxiliary lamp relay	88.	86. Main circuit diagram	Natural
12. Rear wiper delay	132.	139. Main circuit diagram	Black
13. Ignition load relay	1.	1. Main circuit diagram	Black
14. Front wiper delay	15.	14. Main circuit diagram	Red
15. Overspeed monitor) Saudi	-	132. Main circuit diagram	Green
16. Buzzer unit) only	-	133. Main circuit diagram	Black
17. Fuel cut-off relay (carburetter models only)	117.	115. Main circuit diagram	Natural

FUSE BOX



RR2101M

FUSE NO.	COLOUR CODE	FUSE VALUE	CIRCUIT SERVED	IGNITION KEY CONTROLLED
MAIN FUSE PANEL				
1	Brown	7.5 amp	RH headlamp dipped beam and power wash	
2	Brown	7.5 amp	LH headlamp dipped beam	
3	Brown	7.5 amp	RH headlamp main beam	
4	Brown	7.5 amp	LH headlamp main beam	
5	Tan	5 amp	RH parking lights and instrument illumination	
6	Tan	5 amp	LH parking lights and radio illumination	
7	Blue	15 amp	Front wash/wiper motors	AUX
8	Yellow	20 amp	Heating/air conditioning motor	AUX
9	White	25 amp	Heated rear screen	IGN
10	Violet	3 amp	Mirror heaters	IGN
11	Blue	15 amp	Headlamp flash,door, underbonnet and internal lamps, radio, clock and horns	
12	Red	10 amp	R/LH rear fog lamps	
13	Blue	15 amp	Low coolant monitor, stop and reverse lamps, direction indicators, instruments and screen wash fluid monitor	IGN
14	Blue	15 amp	Auxiliary feed trailer	
15	Blue	15 amp	Auxiliary driving lamps	
16	Red	10 amp	Rear wash/wipe motor	AUX
17	Yellow	20 amp	Cigar lighters (front and rear),automatic gear selector illumination	IGN
18	Red	10 amp	Fuel pump	IGN
19	Red	10 amp	Central locking-option	
20	White	25 amp	Window lifts-option	AUX

NOTE: Radio/Cassette combination. An in-line type 5 amp fuse is incorporated in the power input lead of the unit.

AUXILIARY FUSE PANEL-(A)

A1	Yellow	20 amp	Air conditioning fan-option	IGN
A2	Yellow	20 amp	Air conditioning fan-option	IGN
A3	Tan	5 amp	Air conditioning compressor clutch-option	IGN
A4			Spare	
A5	Violet	3 amp	Electric mirror motors-option	IGN
A6			Spare	

STEERING COLUMN CONTROLS

The steering column switch layout is as follows:

LEFT HAND CONTROLS

Lower switch-Main lighting switch
Upper switch-Main and dipped beam, direction indicators and horn.

RIGHT HAND CONTROLS

Lower switch - Rear screen programmed wash/wipe.
Upper switch - Windscreen programmed wash/wipe.

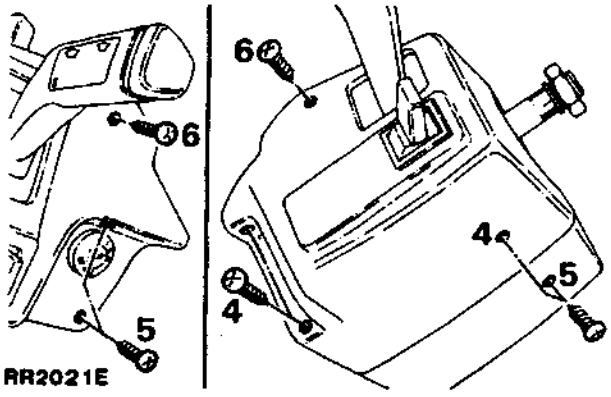
STEERING COLUMN SHROUD

Certain operations within the electrical section necessitate removal of the steering column shroud. Unless removal of both sides of the shroud assembly is required, remove ONLY the side necessary for access.

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the lower fascia panel.
3. Disconnect the electrical connections to either the master lighting switch or the rear screen wash wipe switch. (Disconnect both if removing the complete shroud).
4. Left hand shroud-remove three securing screws and remove the shroud over the indicator/main beam switch.



5. Right hand shroud-remove three securing screws and remove the shroud over the windscreen wash wipe switch.
6. To facilitate reassembly remove the screw securing the two halves of the shroud together from one side only.

Refitting

7. If both sides of the shroud have been removed ensure that the plate on the steering column is correctly located in the slot in the shroud.
8. Reverse the removal procedure.

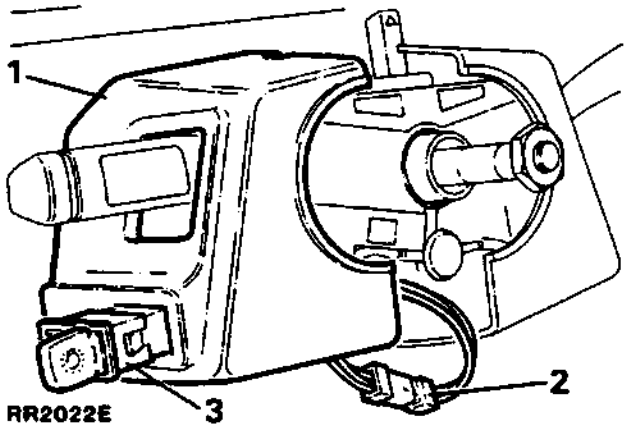
MAIN LIGHTING SWITCH

REAR SCREEN PROGRAMMED WASH WIPE SWITCH

Remove and refit

Removing

1. Remove the steering column shroud from the required side.
2. Disconnect cables at snap connectors.
3. Push the two spring clips locating the switch inwards and remove the switch from its mounting.



Refitting

4. Reverse the removal procedure.

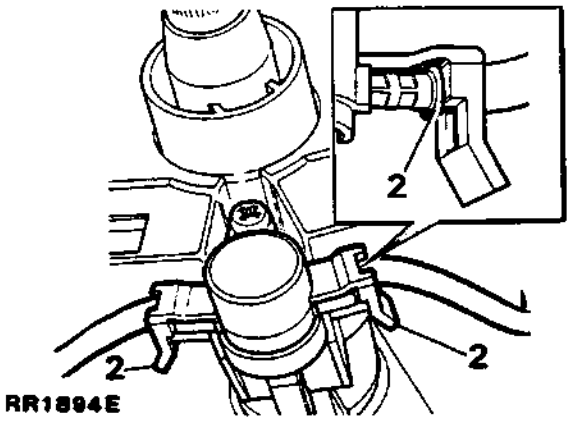
WINDSCREEN PROGRAMMED WASH WIPE SWITCH

MAIN AND DIPPED BEAM, DIRECTION INDICATORS AND HORN SWITCH

Remove and refit

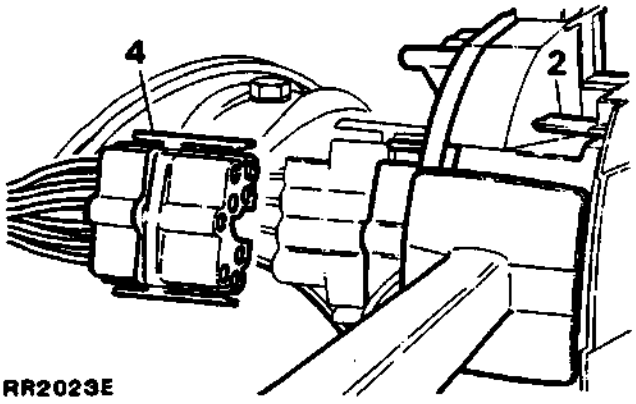
Removing

1. Remove the steering column shroud from the required side.
2. Release the appropriate retaining clip and pull the fibre optic guide from the housing.



RR1894E

3. Depress the retainers at the top and bottom of the switch and pull combined switch assembly away from the steering column switch housing.



RR2023E

4. Lighting, indicator and horn switch: release the two harness multi-plugs from the back of the switch and remove the switch assembly.

NOTE: Wiper and washer switch: release the harness multi-plug from the back of the switch and remove the switch assembly

Refitting

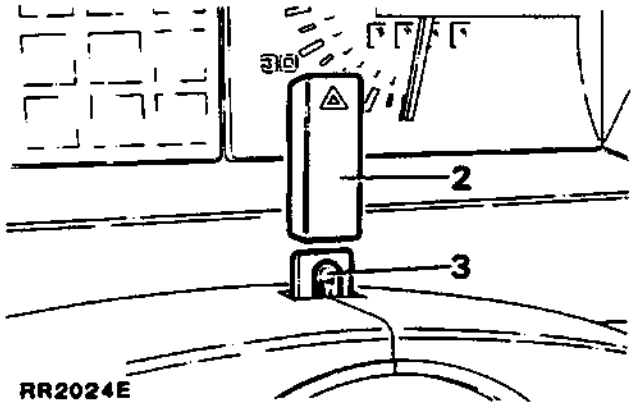
5. Reverse the removal procedure.

HAZARD WARNING SWITCH BULB REPLACEMENT

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Pull the hazard switch cover upwards and remove it to gain access to the bulb.



RR2024E

3. Remove the bulb by pulling it upwards. A piece of rubber tubing or adhesive tape attached to the bulb may facilitate removal and refitting.

Refitting

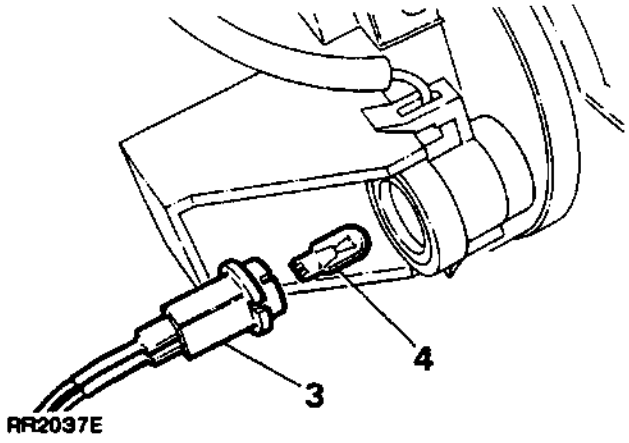
4. Locate the bulb in its holder and reverse instructions 1 and 3.
   The correct bulb is a 12V, 1.2 watt 'wedge' base (capless).

COLUMN SWITCH ILLUMINATION BULB REPLACEMENT

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the left hand side steering column shroud.
3. Working behind the column switch housing twist the bulb holder through 90° and withdraw.
4. Remove the bulb.



RR2037E

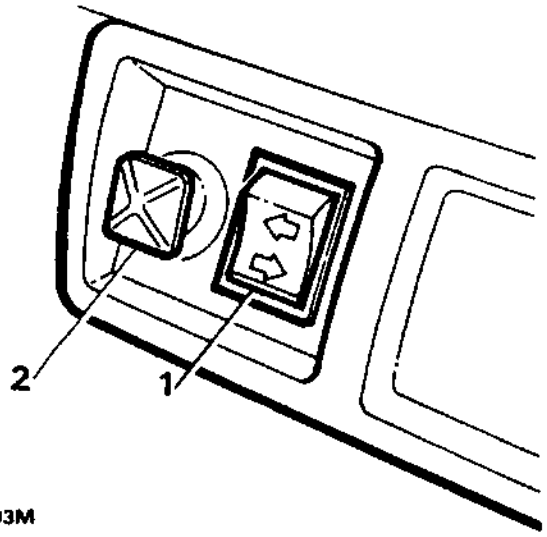
Refitting

5. Reverse the removal procedure. The correct bulb type is a 12-volt, 1.2-watt 'wedge' base (capless).

EXTERIOR DRIVING MIRRORS CONTROLS

Adjusting

1. Fine adjustment is controlled by an electric motor inside the mirror housing. This is operated by two controls fitted in the fascia panel. To adjust, select left or right hand mirror using the rocker switch.



RR2103M

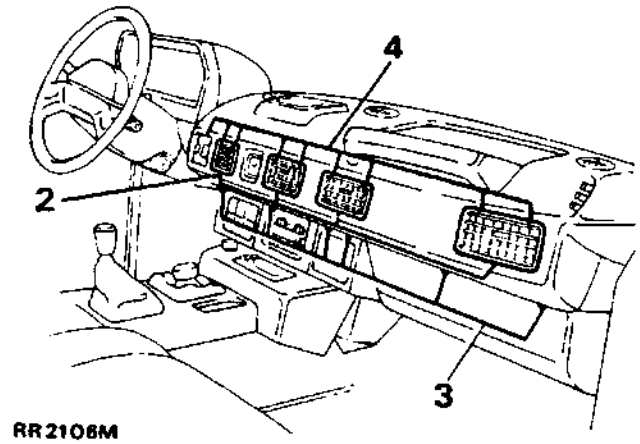
2. Move the head of the finger tip control to the left, right, up or down as required.

EXTERIOR DRIVING MIRRORS

CONTROL SWITCHES

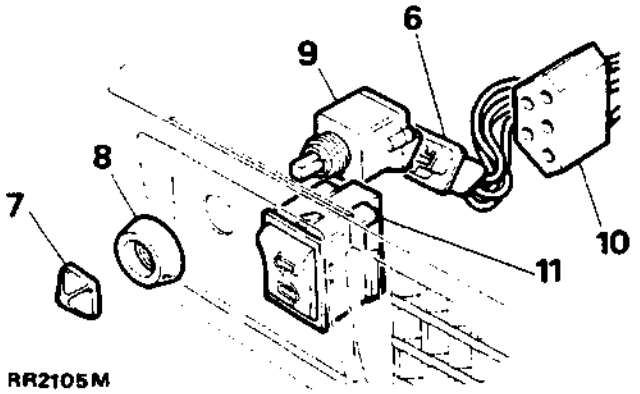
Remove and refit

1. Disconnect the battery negative lead.
2. Carefully prise the four air vents out of the fascia panel.



RR2106M

3. Remove the six screws securing the fascia to the lower panel.
4. Remove the nine screws securing the fascia to the upper panel.
5. Withdraw the panel only as far as the electrical leads will permit.
6. Pull the multi-plug from the rear of the fingertip controlled mirror switch.



RR2105M

7. Carefully prise off the fingertip button at the operating end of the switch.
8. Unscrew the black plastic retaining collar securing the switch.
9. Remove the switch from the panel.
10. Disconnect the multi-plug at the rear of the selector switch.
11. Apply pressure to the switch from the rear and remove it from the panel.

Refitting

12. Reverse operations 1 to 11.

INSTRUMENT BINNACLE WARNING LIGHT SYMBOLS

Trailer connected-flashes with direction indicators (green)

Direction indicator-left turn /right turn (green)

Seat belt (red) NOTE: The seat belt warning symbol appears on all binnacles but will only be illuminated when Territory regulations require a seat belt warning system to be fitted.

Headlamp main beam on (blue)

Engine oil pressure low (red)

Cold start control (Petrol models) engaged
Heater plugs operating (Diesel models) (amber)

Ignition on/low charge (red)

Low coolant (red)

Automatic gearbox oil temperature high (red)

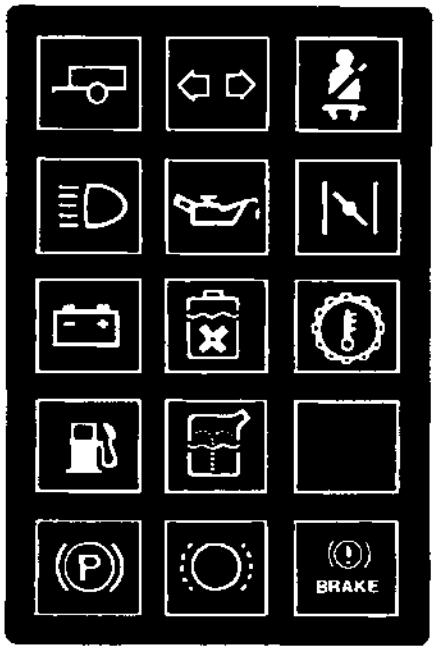
Low fuel indicator (amber)

Low wash fluid (amber)

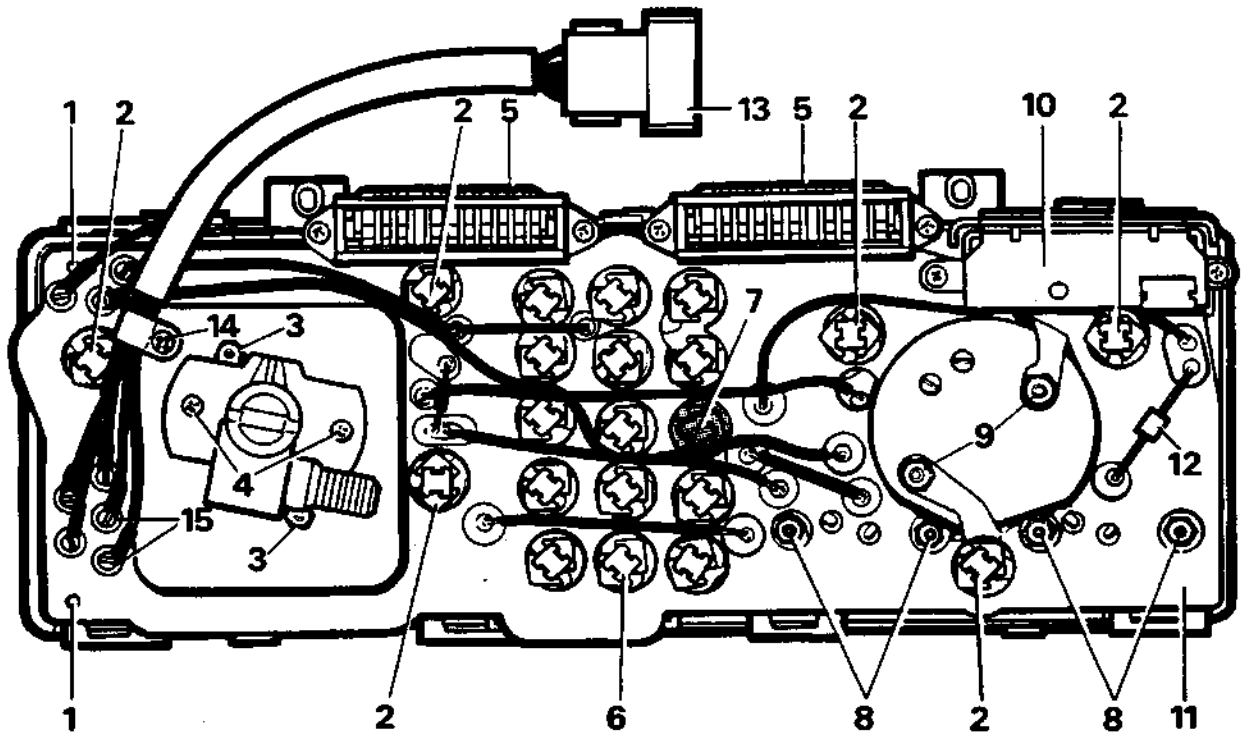
Transmission handbrake on (red)

Brake pad wear (amber)

Brake fluid pressure failure/low fluid level (red)



RR2113M



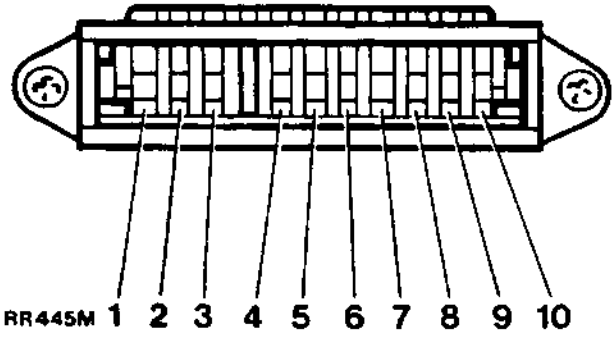
RR2109M

Instrument case (back)

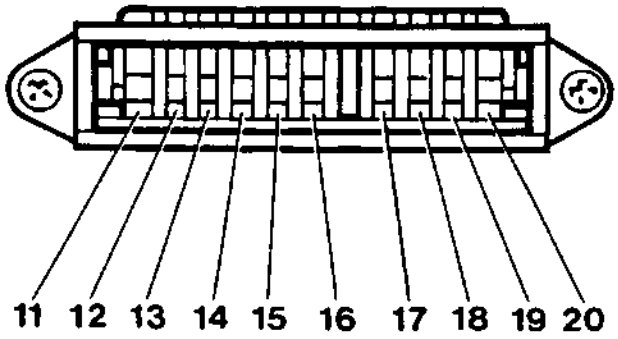
1. Locating pegs
2. Panel light bulbs
3. Speedometer securing screw
4. Speedometer drive securing screws
5. Harness connectors
6. Warning light bulbs (14)
7. No charge warning light bulb (red holder)
8. Temperature and fuel gauge unit securing nuts
9. Tachometer securing nuts
10. Multi-function unit
11. Printed circuit
12. Pull-up resistor-high temperature gearbox oil
13. Single multi-plug
14. Single multi-plug securing screw
15. Single multi-plug wiring connecting screws

PRINTED CIRCUIT HARNESS CONNECTIONS

Sequence of connections viewed from back of instrument case.



RR445M

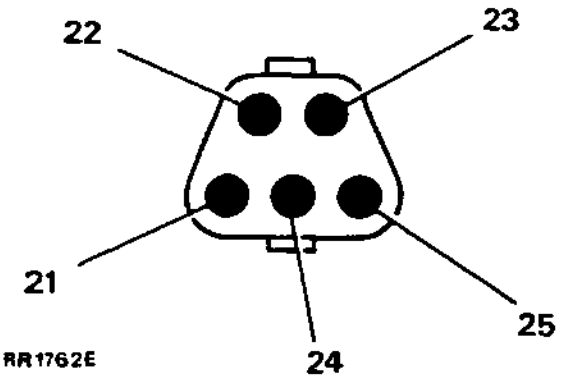


CIRCUIT SERVED

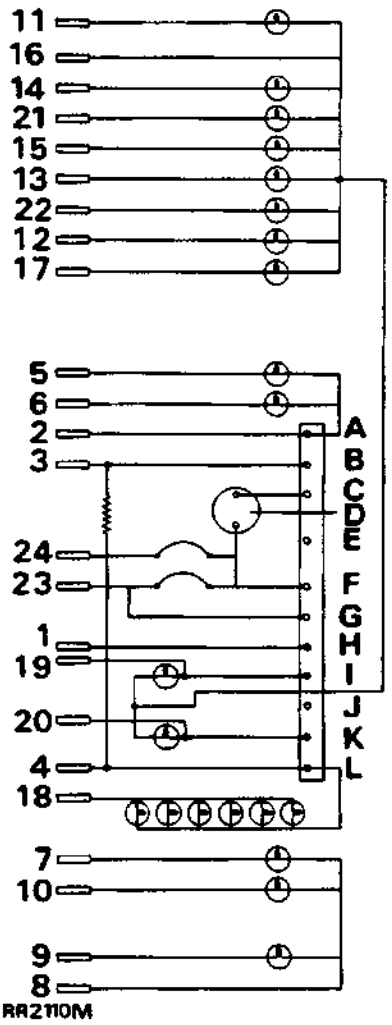
Tacho signal 1
Ignition switch 12V+ 2
Low coolant input 3
Earth-VE 4
Ignition warning light 5
Low oil and low pressure warning light 6
Main beam warning light 7
Zero volts from dimmer 8
Trailer warning light 9
Direction indicators warning light 10
Seat belts warning light 11
Cold start warning light 12
Temperature warning light
(automatic gearbox) 13
Low wash fluid warning light 14
Not used 15
12V+ from dimmer 16
Brake fail warning light 17
Panel illumination bulbs (6 off) 18
Low fuel warning light 19
Low coolant warning light 20

NOTE: The following 21 to 25 are connected at the single multi- plug located behind the binnacle

Brake pad wear warning light 21
Not used 22
Fuel tank unit and fuel gauge 23
Temperature gauge 24
Not used 25



Sequence of connections at the single multi-plug.



MULTI-FUNCTION UNIT

A. 12V+ supply
B. Input to low coolant circuit
C. Tachometer drive
D. Tachometer
E. Spare
F. 10V+ stabilised
G. Input to fuel tank unit - stabilised
H. Tachometer signal
I. Low fuel warning light
J. Spare
K. Low coolant warning light
L. Earth

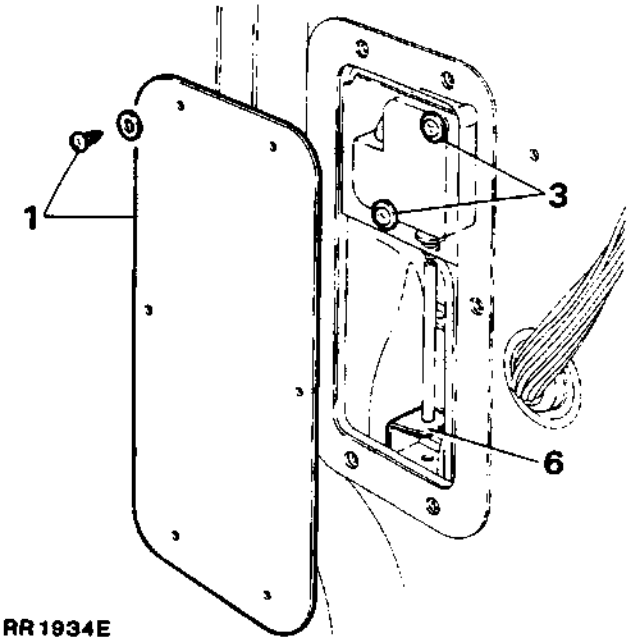
CENTRAL LOCKING-FUEL FILLER FLAP ACTUATOR UNIT

The fuel filler flap is locked when the vehicle central locking is actuated. Repair is by replacement of the actuator unit.

Remove and refit

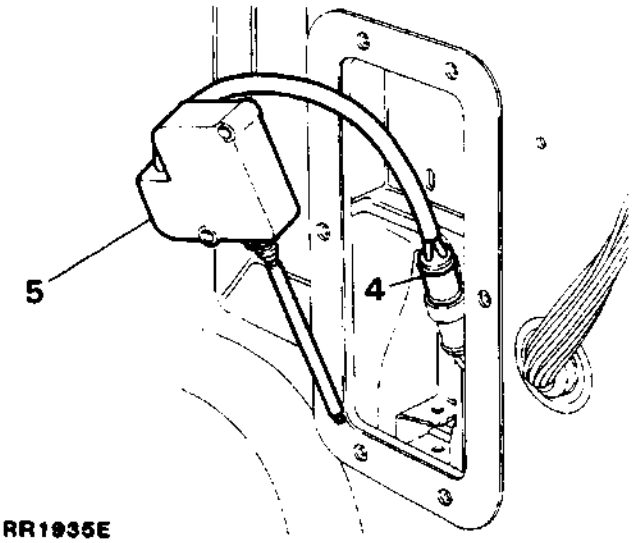
Removing

1. Remove six screws and withdraw the closure panel, situated in the tool stowage area.
2. Ensure that the actuator is in the unlocked position and the fuel filler flap is open.
3. Release two screws and manoeuvre the actuator unit clear of its mounting.



RR1934E

4. Disconnect the wiring plug.
5. Withdraw the actuator.



RR1935E

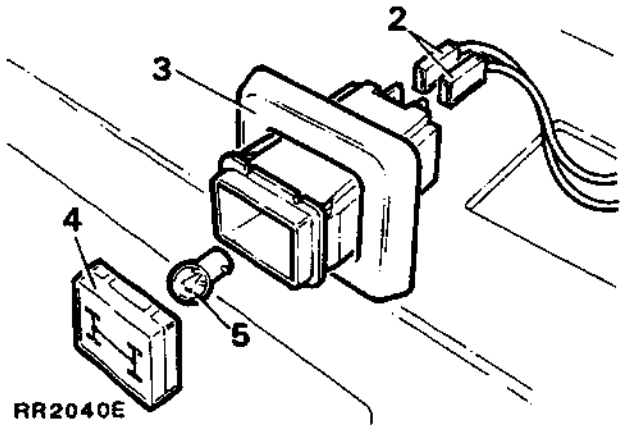
Refitting

6. Reverse the removal procedure. The actuator mounting holes in the body are elongated. Adjust the position of the actuator to ensure that the rod will pass through the guide brackets without fouling.
7. Check the operation of the central locking system.

DIFFERENTIAL LOCK WARNING LAMP ASSEMBLY/BULB REPLACEMENT

Remove and refit

1. Carefully prise the warning lamp out of the radio console.
2. Remove the two wiring connectors and withdraw the lamp assembly, if required.
3. Squeeze the sides of the lamp body to enable the lens surround to be slid back along the body.
4. Remove the amber lens.
5. Remove the bayonet fitting bulb.



Refitting

6. Reverse the removal procedure.

   The correct bulb type is a 12-volt, 2-watt bayonet fitting.

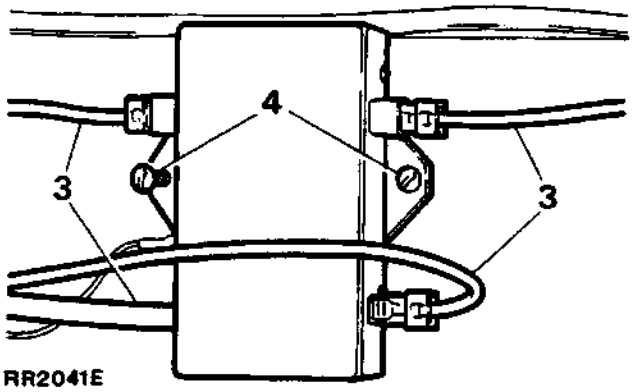
RADIO ANTENNA AMPLIFIER

The radio aerial is incorporated in the rear screen heater element. The signal to the radio is electronically boosted by the amplifier mounted at the rear of the vehicle adjacent to the tailgate screen wiper motor.

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Lower or remove the rear headlining.
3. Remove the electrical leads and the antenna lead to the radio.



Refitting

4. Reverse the removal procedure.

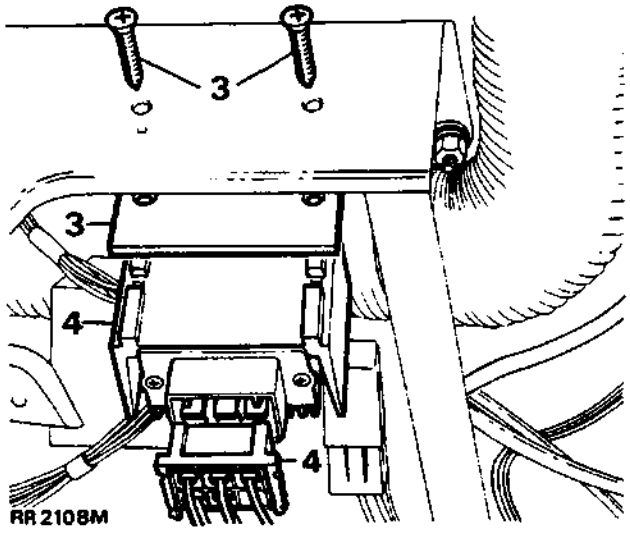
HEADLAMP DIM-DIP LIGHTING (U.K. only)

Vehicles manufactured after October 1st 1986 must comply with new lighting regulations,which prohibit such vehicles being driven on side lights only. This is achieved by the addition of an electronic control unit in the lighting system,so that when the side lights are switched on with the engine running, low voltage current is supplied to the headlamp dipped beam circuit, giving dim-dipped lighting. When the headlamps are switched on, full voltage is automatically restored, giving normal headlamp lighting.

ELECTRONIC CONTROL UNIT (DIM-DIP LIGHTING)

Remove and refit

1. Disconnect the battery negative lead.
2. Remove the lower fascia panel.
3. Remove two securing screws and retain the distance piece.
4. Disconnect the wiring connector and withdraw the electronic control unit.



Refitting

5. Reverse the removal procedure.

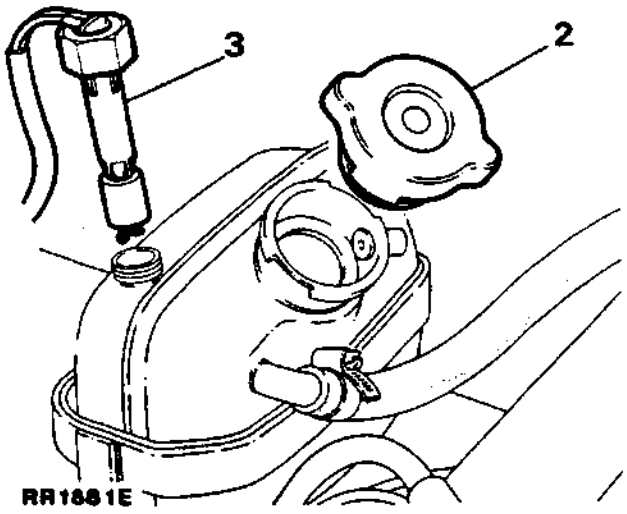
COOLANT LEVEL SENSOR

Remove and refit

Removing

WARNING: Do not remove the expansion tank filler cap when the engine is hot beause the cooling system is pressurised and personal scalding could result.

1. Disconnect the multi-plug from the sensor.
2. Remove the expansion tank filler cap by first turning it anti-clockwise a quarter of a turn to allow pressure to escape. Then turn it in the same direction and lift off.
3. Release the retaining nut and withdraw the sensor from the expansion tank and disconnect the electrical leads.



Refitting

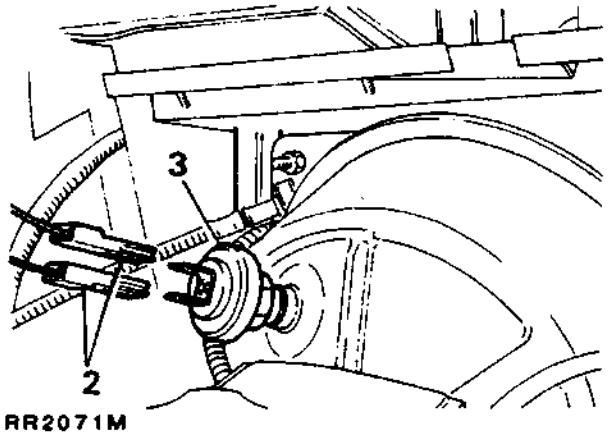
4. Reverse the removal instructions.
5. Start engine and run until normal running temperature is attained, thermostat open. Check for coolant leaks around the sensor.

VACUUM SENSOR - BRAKE SERVO
(Diesel models only)

The sensor will illuminate the brake fail warning light indicating lack of vacuum within the servo. When the engine is started the warning light will remain illuminated until the vacuum is restored.

Remove and refit

1. Disconnect the battery negative lead.
2. Remove the two wiring connectors from the sensor.
3. Slacken the sensor and remove from the servo.



RR2071M

Refitting

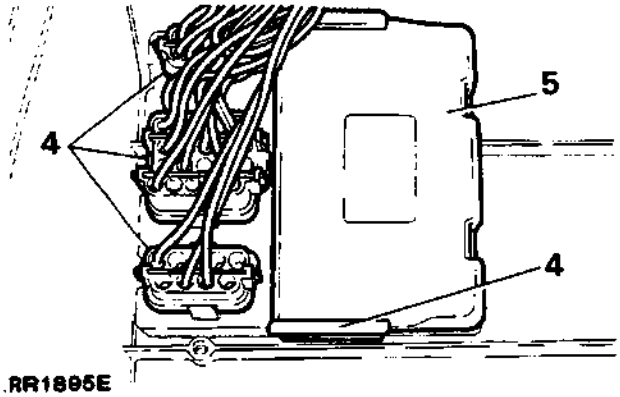
4. Reverse the removal procedure.

BRAKE CHECK UNIT

Remove and refit

Removing

1. Disconnect the battery negative terminal.
2. Release the six screws securing the lower fascia panel below the steering column.
3. Lower the fascia panel and disconnect the multi-plug from the rheostat switch.
4. Pull the brake check unit from the spring clip on the underside of the fascia panel and disconnect the three multi-plugs from the unit.
5. Remove the brake check unit from the vehicle.

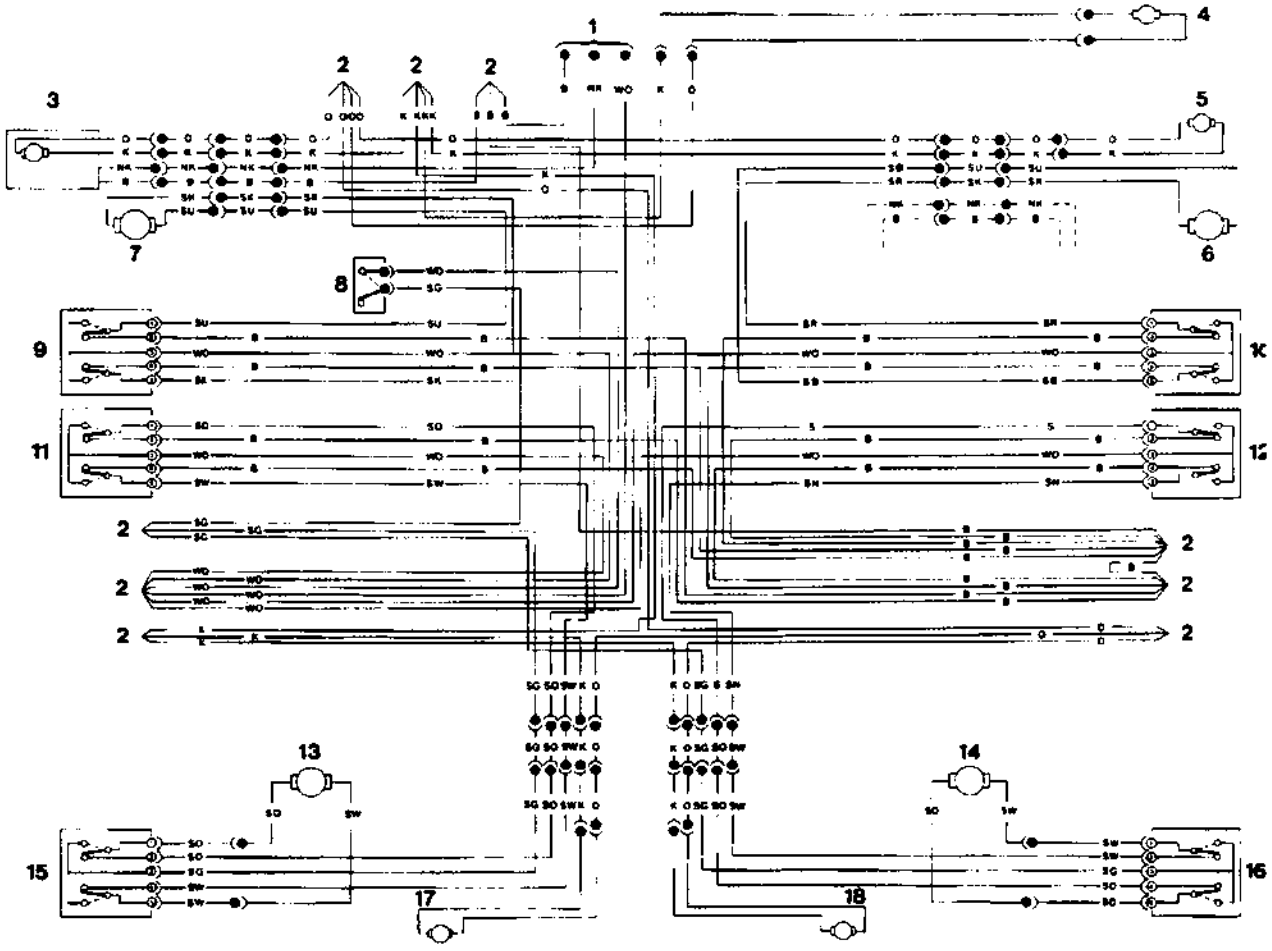


RR1895E

Refitting

6. Reverse the removal procedure ensuring that the multi-plugs and unit are securely pushed into position.

ELECTRICAL EQUIPMENT - CIRCUIT DIAGRAMS



RR1755E

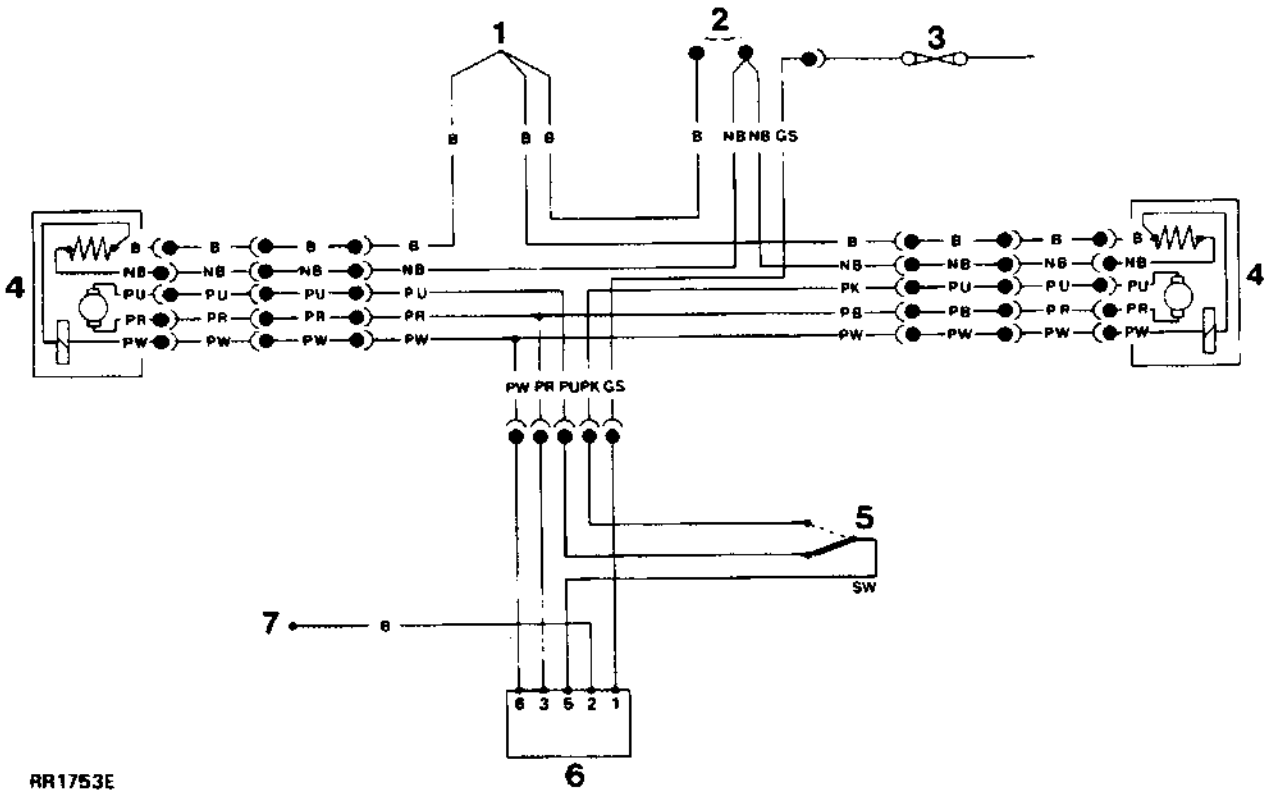
WINDOW LIFTS AND DOOR LOCKS-
Circuit diagram

1. Main cable connections
2. Clinches
3. Switch unit-central door locking (driver's door)
4. Fuel flap actuator
5. Lock unit-central door locking (front passenger door)
6. Window lift motor L/H front
7. Window lift motor R/H front
8. Isolator switch
9. Window lift switch L/H front
10. Window lift switch R/H front
11. Window lift switch L/H rear
12. Window lift switch R/H rear
13. Window lift motor L/H rear
14. Window lift motor R/H rear
15. Window lift switch L/H rear door
16. Window lift switch R/H rear door
17. Lock unit central door locking L/H rear door
18. Lock unit central door locking R/H rear door

CABLE COLOUR CODE

B	Black	**G**	Green	**K**	Pink	**S**	Slate
U	Blue	**L**	Light	**P**	Purple	**W**	White
N	Brown	**O**	Orange	**R**	Red	**Y**	Yellow

The last letter of a colour code denotes the tracer.



ELECTRIC MIRRORS -
Circuit diagram

1. Clinch
2. Main cable connections
3. Fuse 10-main fuse panel
4. Mirror motors
5. Change over switch
6. Mirror control switch
7. Earth-via main cable

CABLE COLOUR CODE

B Black
U Blue
N Brown
G Green
O Orange
P Purple
R Red
S Slate
W White
Y Yellow

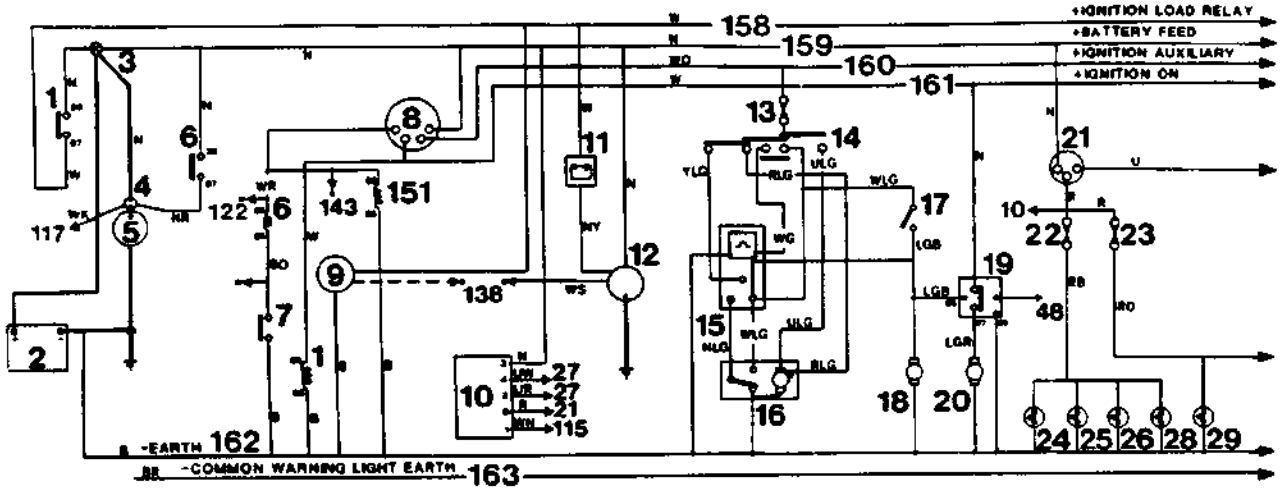
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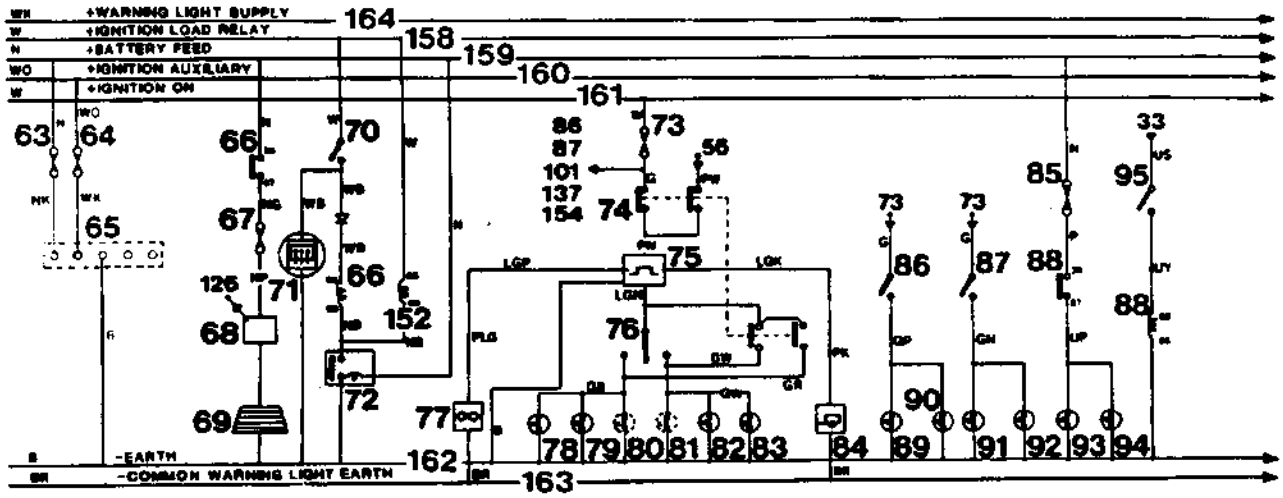
MAIN CIRCUIT DIAGRAM
Right Hand Steering - RR2343M & RR2344M

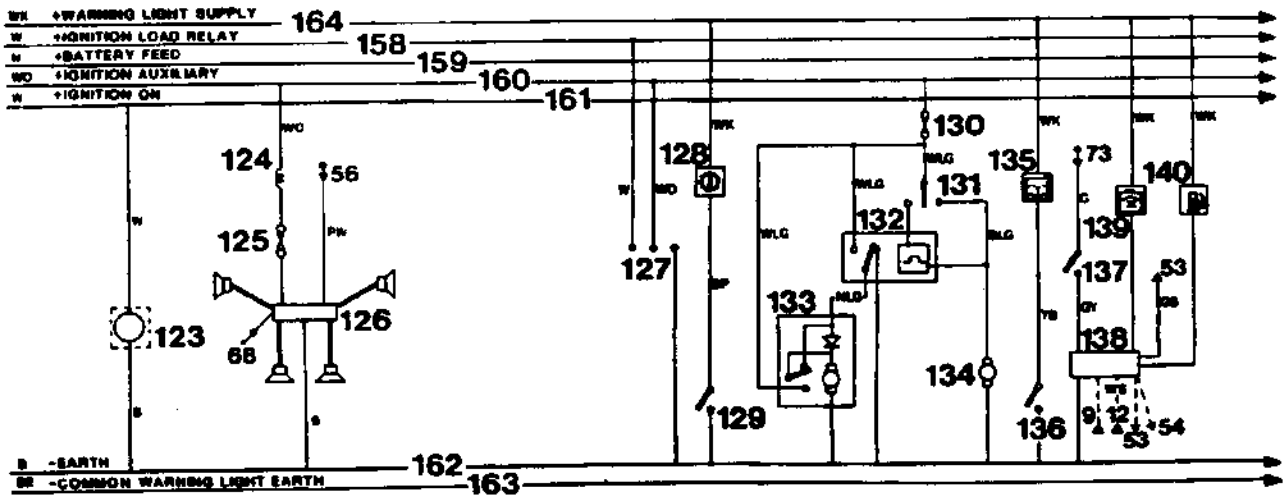
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (Automatic)
8. Ignition switch
9. Tachometer
10. Voltage transformer(dim dip)
11. Ignition warning lamp
12. Alternator
13. Fuse 7
14. Front wipe/wash switch
15. Front wipe delay unit
16. Front wiper motor
17. Front wash switch
18. Front wash pump
19. Headlamp wash timer unit (option)
20. Headlamp wash pump (option)
21. Main lighting switch
22. Fuse 6
23. Fuse 5
24. LH side lamp
25. LH tail lamp
26. Number plate lamp(2 off)
27. Main beam dip/flash switch
28. Radio illumination
29. RH side lamp
30. RH tail lamp
31. Rheostat
32. Fuse 3
33. Fuse 4
34. Fuse 1
35. Fuse 2
36. Rear fog switch
37. Fuse 12
38. Switch illumination (2 off)
39. Cigar lighter illumination (2 off)
40. Heater illumination (4 off)
41. Clock illumination
42. Automatic gear selector illumination (2 off)
43. Instrument illumination (6 off)
44. Rear fog warning lamp
45. LH rear fog
46. RH rear fog
47. LH dip beam
48. RH dip beam
49. LH main beam
50. RH main beam
51. Main beam warning lamp
52. Fuel gauge
53. Fuel gauge sender unit
54. Water temperature gauge
55. Water temperature sender unit
56. Fuse 11
57. Horn switch
58. RH horn
59. LH horn
60. Under bonnet illumination switch
61. Under bonnet light
62. Clock
63. Fuse 19
64. Fuse 20
65. Pick-up point central locking/window lift (option)
66. Heated rear window relay
67. Fuse 9
68. Radio aerial amplifier
69. Heated rear screen
70. Heated rear screen switch
71. Heated rear screen warning lamp
72. Voltage sensitive switch
73. Fuse 13
74. Hazard switch
75. Flasher unit
76. Direction indicator switch
77. Hazard/indicator warning lamp
78. LH rear indicator lamp
79. LH front indicator lamp
80. LH side repeater lamp
81. RH side repeater lamp
82. RH front indicator lamp
83. RH rear indicator lamp
84. Trailer warning lamp
85. Fuse 15
86. Stop lamp switch
87. Reverse lamp switch
88. Auxiliary lamp relay (option)
89. LH stop lamp
90. RH stop lamp
91. LH reverse lamp
92. RH reverse lamp
93. LH auxiliary lamp (option)
94. RH auxiliary lamp (option)
95. Auxiliary lamp switch (option)
96. Fuse 17
97. Dash cigar lighter
98. Cubby box cigar lighter
99. LH interior lamp
100. RH interior lamp
101. Interior lamp delay unit
102. LH door edge lamp
103. RH door edge lamp
104. LH puddle lamp
105. RH puddle lamp
106. Interior lamp switch
107. LH rear door switch
108. RH rear door switch
109. Tailgate switch
110. LH front door switch
111. RH front door switch
112. Differential lock warning lamp
113. Differential lock switch
114. Oil pressure warning lamp
115. Oil pressure switch
116. Fuse 18
117. Fuel cut off relay (carburetter models)
118. Fuel pump(petrol models)
119. Ignition coil
120. Capacitor
121. Distributor
122. EFI Harness plug
123. Fuel shut off solenoid (Diesel)
124. Radio choke
125. Radio fuse
126. Radio and four speakers
127. Ignition pick up points
128. Automatic transmission oil temperature warning lamp
129. Automatic transmission oil temperature switch
130. Fuse 16
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Multi-function unit in binnacle
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. Cold start/diesel glow plug warning lamp
142. Cold start switch - carburetter
143. Glow plug timer (diesel)
144. Glow plugs (diesel)
145. Handbrake warning lamp
146. Brake fail warning lamp
147. Handbrake warning switch
148. Brake fail warning switch
149. Brake pad wear warning lamp
150. Brake pad wear sensors
151. Brake check relay
152. Split charge relay (option)
153. Split charge terminal post (option)
154. Heater/air conditioning connections
155. Fuse 8
156. Coil negative (engine RPM input to ECU.)

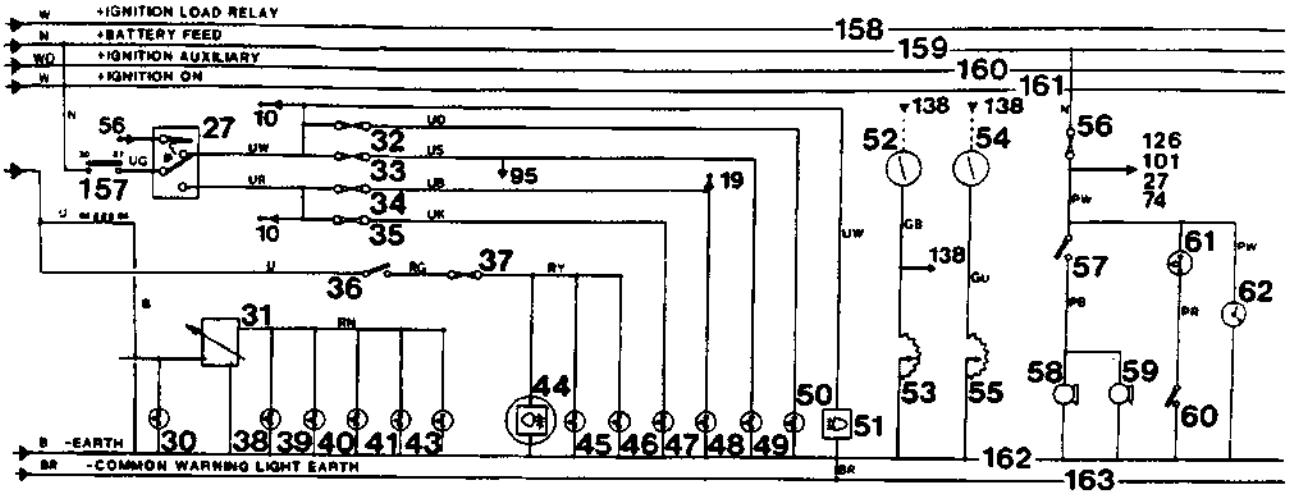
CABLE COLOUR CODE

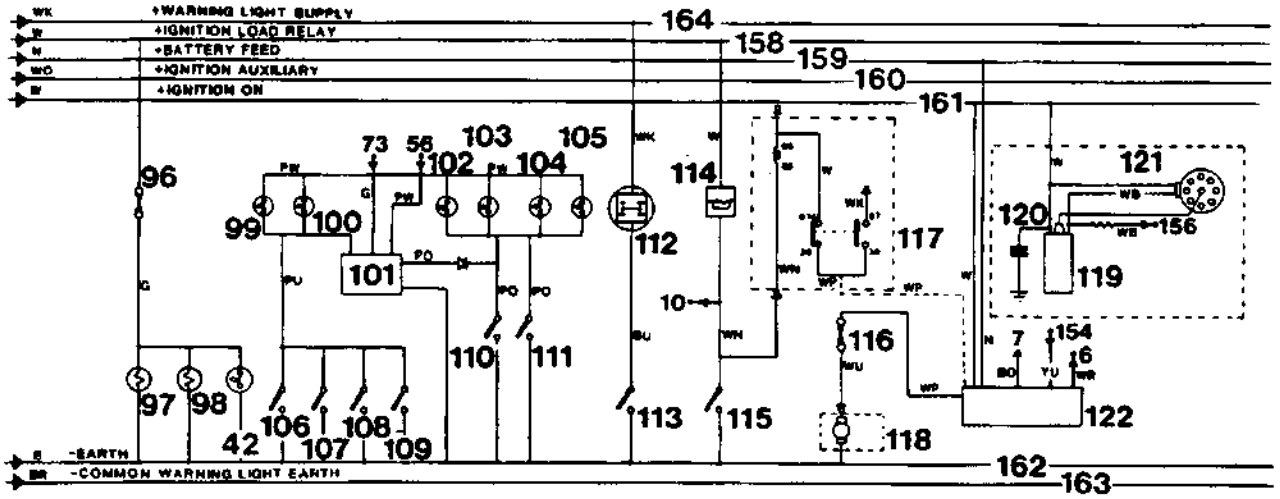
B	Black
U	Blue
N	Brown
G	Green
L	Light
O	Orange
K	Pink
P	Purple
R	Red
S	Slate
W	White
Y	Yellow

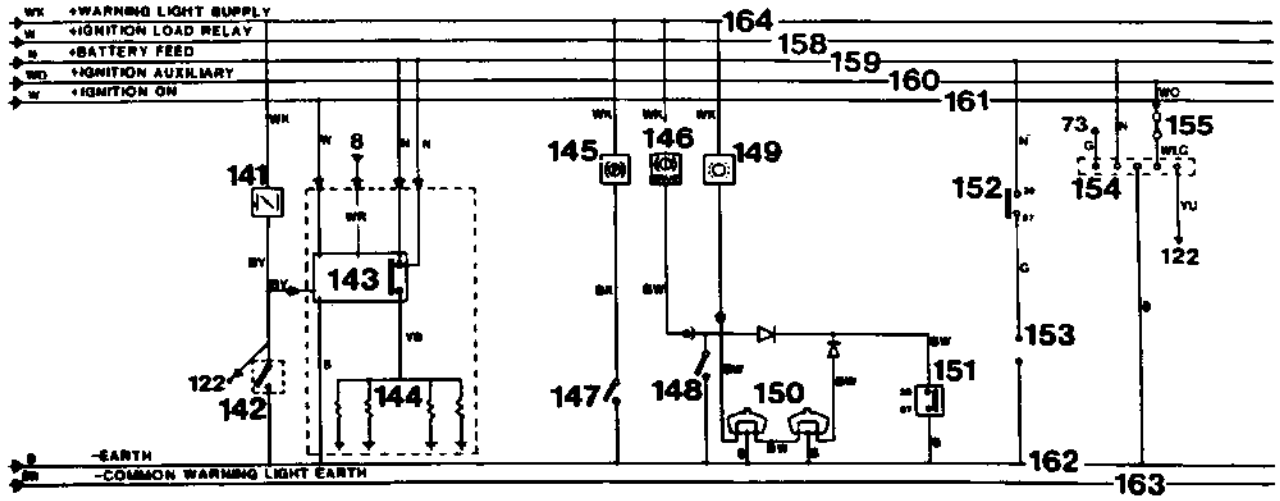

+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
158
159
160
161
-EARTH 162
-COMMON WARNING LIGHT EARTH 163


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
164
158
159
160
161
-EARTH 162
-COMMON WARNING LIGHT EARTH 163


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
164
158
159
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161
-EARTH 162
-COMMON WARNING LIGHT EARTH 163


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
158
159
160
161
162
163


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
164
158
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163


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
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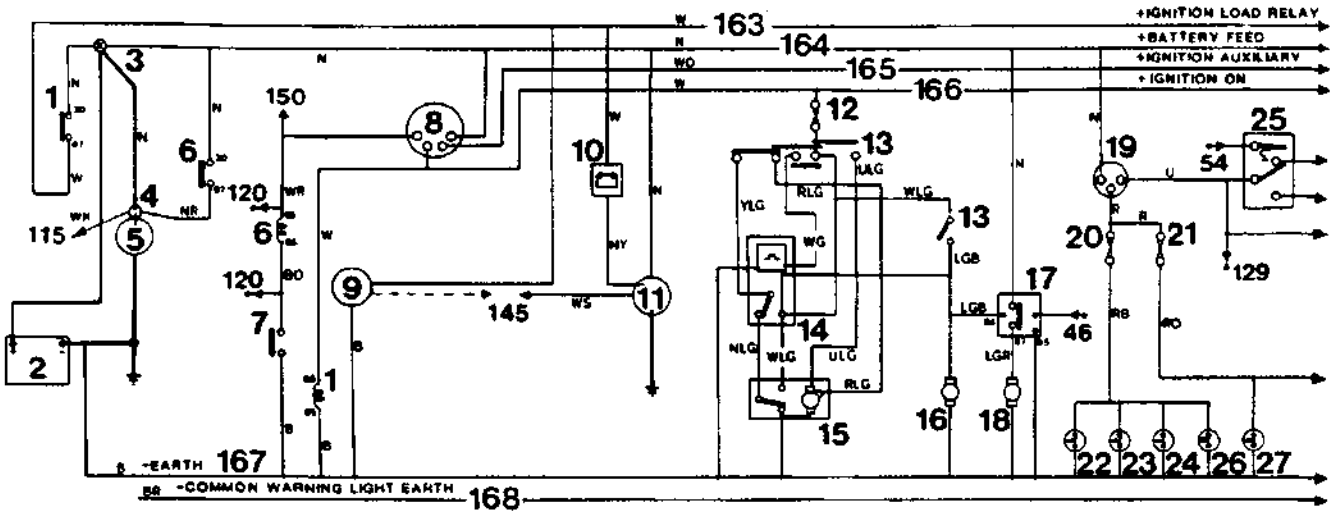
RR2344

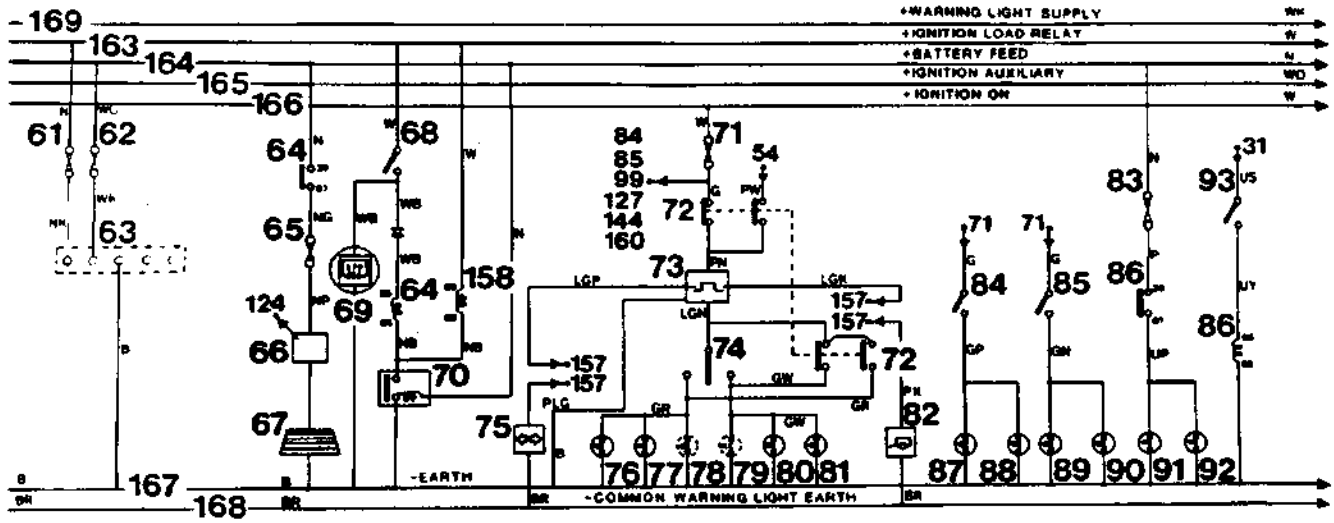
MAIN CIRCUIT DIAGRAM
Left-hand Steering - RR2345M & RR2346M

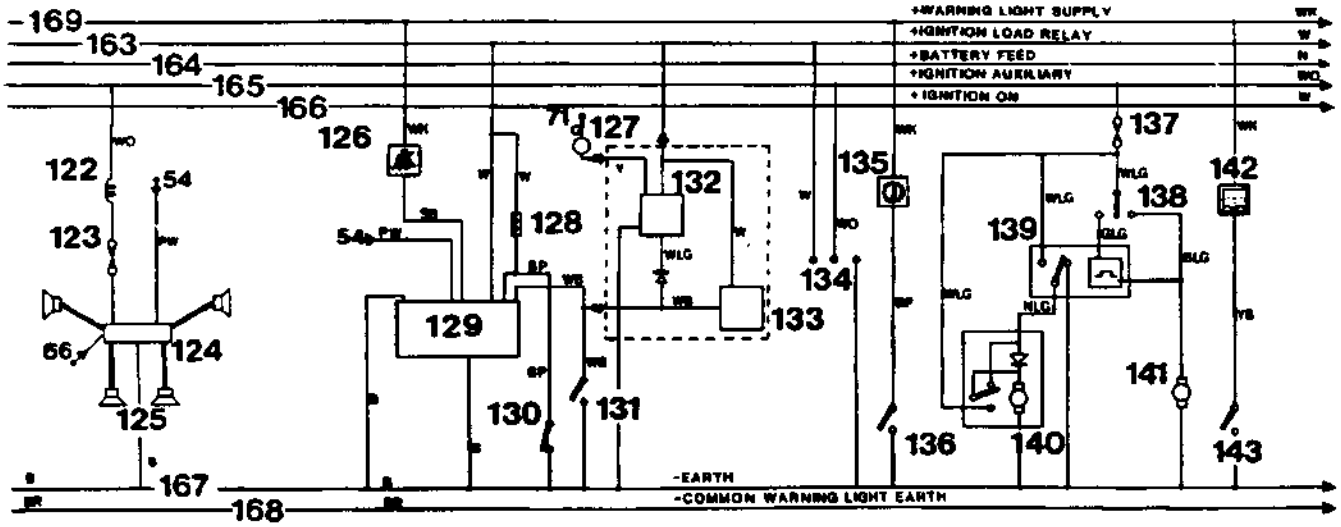
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (automatic)
8. Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse 7
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Front wash pump
17. Headlamp wash timer unit (option)
18. Headlamp wash pump (option)
19. Main lighting switch
20. Fuse 6
21. Fuse 5
22. LH side lamp
23. LH tail lamp
24. Number plate lamp (2 off)
25. Main beam dip/flash switch
26. Radio illumination
27. RH side lamp
28. RH tail lamp
29. Rheostat
30. Fuse 3
31. Fuse 4
32. Fuse 1
33. Fuse 2
34. Rear fog switch
35. Fuse 12
36. Switch illumination (2 off)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Automatic gear selector illumination (2 off)
41. Instrument illumination (6 off)
42. Rear fog warning lamp
43. LH rear fog
44. RH rear fog
45. LH dip beam
46. RH dip beam
47. LH main beam
48. RH main beam
49. Main beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53. Water temperature sender unit
54. Fuse 11
55. Horn switch
56. RH horn
57. LH horn
58. Under bonnet illumination switch
59. Under bonnet light
60. Clock
61. Fuse 19
62. Fuse 20
63. Pick-up point central locking/window lift
64. Heated rear window relay
65. Fuse 9
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse 13
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. Hazard/indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. LH side repeater lamp
79. RH side repeater lamp
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse 15
84. Stop lamp switch
85. Reverse lamp switch
86. Auxiliary lamp relay
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH auxiliary lamp (option)
92. RH auxiliary lamp (option)
93. Auxiliary lamp switch (option)
94. Fuse 17
95. Dash cigar lighter
96. Cubby box cigar lighter
97. LH interior lamp
98. RH interior lamp
99. Interior lamp delay unit
100. LH door edge lamp
101. RH door edge lamp
102. LH puddle lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110. Differential lock warning lamp
111. Differential lock switch
112. Oil pressure warning lamp
113. Oil pressure switch
114. Fuse 18
115. Fuel shut-off relay - carburetter
116. Fuel pump - petrol models
117. Ignition coil
118. Capacitor
119. Distributor
120. EFI Harness plug
121. Fuel shut-off solenoid-Diesel
122. Radio choke
123. Radio fuse
124. Radio
125. Four speakers
126. Seat belt warning lamp
127. Speed transducer, Saudi only
128. Resistor
129. Audible warning unit
130. Transfer box neutral switch
131. Seat buckle switch
132. Overspeed monitor (Saudi only)
133. Overspeed buzzer (Saudi only)
134. Ignition pick up points
135. Automatic transmission oil temperature warning lamp
136. Automatic transmission oil temperature switch
137. Fuse 16
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
141. Rear screen wash pump
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
144. Low coolant switch
145. Multi-function unit in binnacle
146. Low coolant level warning lamp
147. Low fuel level warning lamp
148. Cold start/Diesel glow plug warning lamp
149. Choke switch - carburetter
150. Glowplug timer/Diesel
151. Glowplugs/Diesel
152. Handbrake/warning lamp
153. Handbrake warning switch
154. Brake fail warning switch
154a. Brake fail warning lamp
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157. Brake check unit
158. Split charge relay (option)
159. Split charge terminal post
160. Heater/air conditioning connections
161. Fuse 8
162. Coil negative (engine RPM input to ECU)

CABLE COLOUR CODE

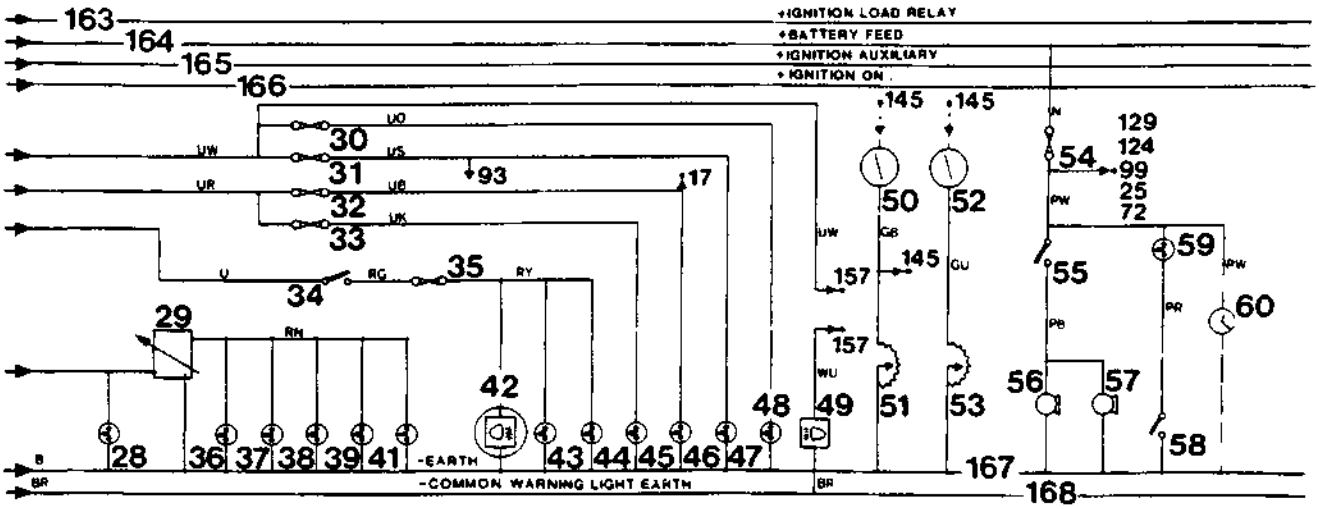
B	Black
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R	Red
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W	White
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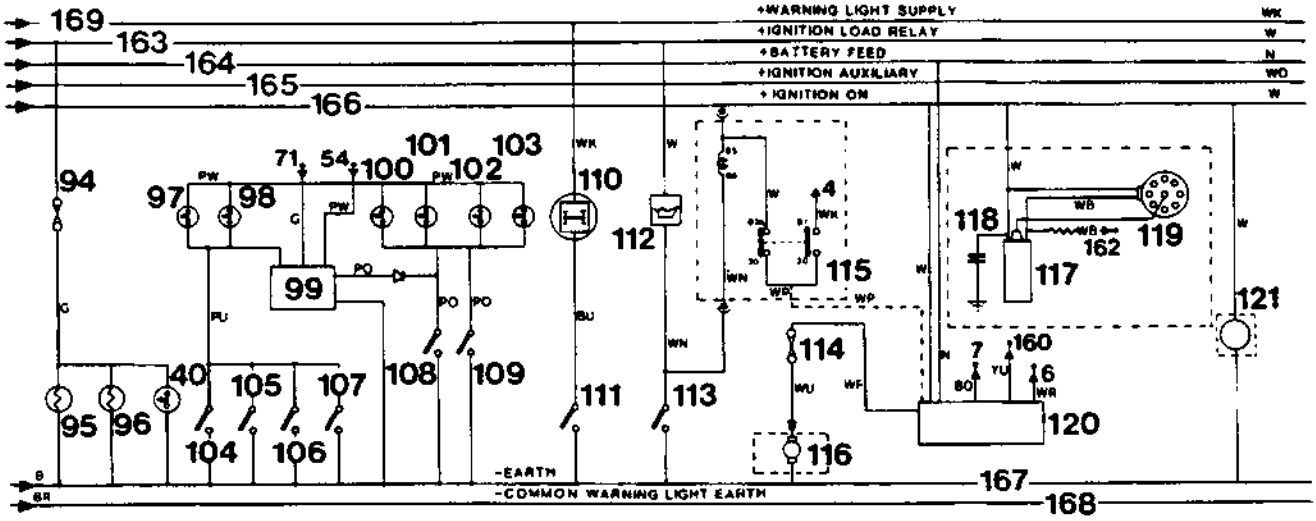

+IGNITION LOAD RELAY
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+IGNITION AUXILIARY
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-COMMON WARNING LIGHT EARTH
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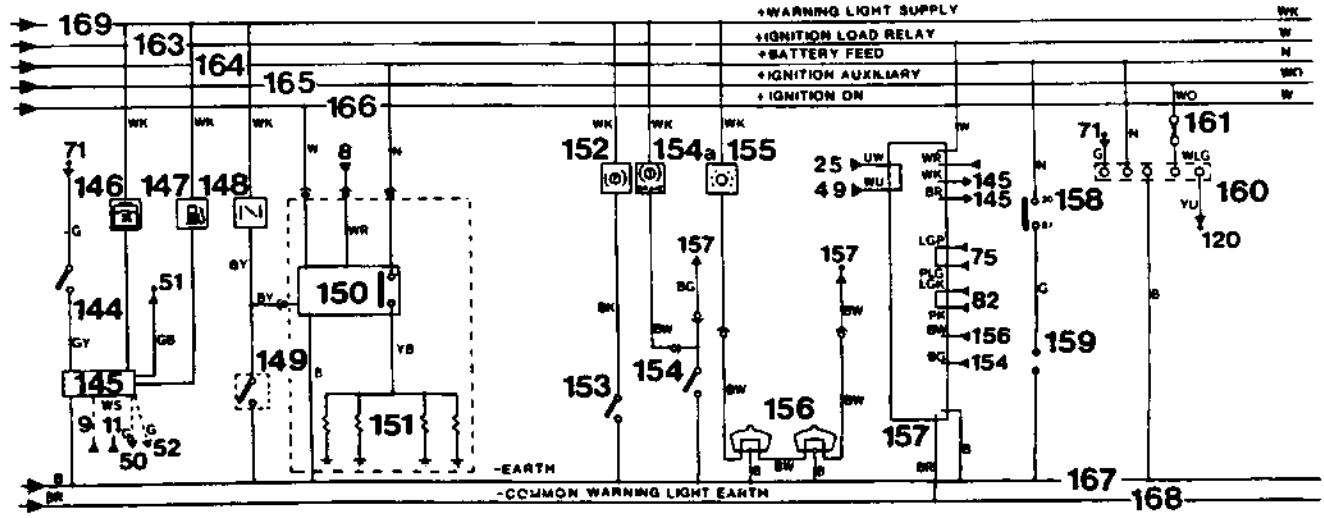

+WARNING LIGHT SUPPLY
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+IGNITION AUXILIARY
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-EARTH
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-COMMON WARNING LIGHT EARTH
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+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
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-COMMON WARNING LIGHT EARTH
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-COMMON WARNING LIGHT EARTH
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+WARNING LIGHT SUPPLY
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+IGNITION AUXILIARY
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-EARTH
-COMMON WARNING LIGHT EARTH
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+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+ IGNITION ON
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-EARTH
-COMMON WARNING LIGHT EARTH
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168

RR2348M

1988 Model Year Supplement

RANGE ROVER
1988
CATALYTIC EXHAUST SYSTEM
WORKSHOP MANUAL SUPPLEMENT

Publication Number LSM180WS2

Published by the
Technical Publications Department of

Land Rover Ltd

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INTRODUCTION

This Workshop Manual Supplement covers the introduction of Lucas 'Hot Wire' air flow sensor with microprocessor controlled fuel injection system and catalytic exhaust system.

NOTE: This supplement is designed to assist skilled operators in the effective maintenance and repair of Range Rover vehicles, and should be used in conjunction with the MAIN WORKSHOP MANUAL and SUPPLEMENT LSM180WS1.

GENERAL SPECIFICATION DATA

FUEL SYSTEM

Fuel system type	Lucas hot wire system electronically controlled
Fuel pump-make/type	AC Delco-high pressure (electrical) immersed in the fuel tank
Fuel pump delivery pressure	2.4-2.6 kgf/cm² (34-37 p.s.i.)
Fuel filter	Bosch in-line filter 'canister' type

Airflow Sensor

Make and type	Lucas 'Hot Wire' 3AM

Injectors

Make and type	Lucas 8NJ

Electronic Control Unit

Make and type	Lucas 13CU

Fuel pressure regulator

Make and type	Lucas 8RV

Fuel temperature sensor

Make and type	Lucas 6TT

Coolant temperature sensor

Make and type	Lucas 3TT

Bypass Airvalve (Stepper motor)

Make and type	Lucas 2ACM

Throttle potentiometer

Make and type	Lucas 215SA

Lambda sensor

Make and type	Lucas 3LS

Continued

TRANSMISSION

Transfer gearbox-LT230

Type	Two speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential.

Transfer gearbox ratios

High	1.222:1
Low	3.320:1

Automatic gearbox

Model	ZF4HP22
Type	Four speed and reverse epicyclic with fluid torque converter and lock up.

4th	0.728:1
3rd	1.000:1
2nd	1.480:1
1st	2.480:1
Reverse	2.086:1

Overall ratio (final drive):	High transfer	Low transfer
4th	3.15:1	8.55:1
3rd	4.32:1	11.75:1
2nd	6.40:1	17.38:1
1st	10.72:1	29.13:1
Reverse	9.02:1	24.50:1

Propeller shafts

Type	
Front	Solid bar 28.6 mm (1.125 in) diameter
Rear	51 mm (2 in) diameter
Universal joints	Open type O3EHD

SHIFT SPEED SPECIFICATION
Automatic ZF4HP22 Gearbox

OPERATION	SELECTOR POSITION	VEHICLE SPEED APPROX. MPH	VEHICLE SPEED APPROX. KPH	ENGINE SPEED APPROX. (RPM)
		KICKDOWN		
KD4-3	D	78-95	125-153	
KD3-2	3 (D)	56-61	90-98	
KD2-1	2 (D,3)	27-34	43-55	
KD3-4	D	NOT APPLICABLE		
KD2-3	D (3)	59-64	95-103	4750-5200
KD1-2	D (3,2)	34-39	55-63	4600-5250
		FULL THROTTLE		
FT4-3	D	60-66	97-106	
FT3-2	3 (D)	39-45	63-72	
FT3-4	D	73-79	117-127	3980-4330
FT2-3	D (3)	54-59	87-95	4350-4800
FT1-2	D (3,2)	29-34	47-55	3950-4650
		ZERO THROTTLE		
ZT4-3	D	19-25	31-40	
ZT3-2	D (3)	12-15	19-24	
ZT2-1	D (3,2)	6-7	10-11	
		PART THROTTLE		
PT4-3	D	46-53	74-85	
PT3-2	D (3)	29-36	47-58	
PT2-1	D (3,2)	10-12	16-19	
		LIGHT THROTTLE		
LT3-4	D	26-30	42-48	1430-1650
LT2-3	D (3)	18-22	29-35	1420-1820
LT1-2	D (3,2)	9-10	14-16	1180-1220
		TORQUE CONVERTER		
Lock Up (IN)	D	50-53	80-85	1875-2000
Unlock (OUT)	D	48-51	77-82	1825-1930

NOTE: The speeds given in the above chart are approximate and only intended as a guide. Maximum shift changes should take place within these tolerance parameters.

ELECTRICAL

Battery

Make/type ..... Chloride maintenance free 14-plate-380/120/90

Alternator

Manufacturer ..... Lucas
Type 133/80
Polarity ..... Negative ground
Brush length
New ..... 20 mm (0.78 in)
Worn, minimum free protrusion from brush box ..... 10 mm (0.39 in)
Brush spring pressure flush with brush box face ..... 136 to 279 g (5 to 10 oz)
Rectifier pack output rectification ..... 6 diodes (3 positive side and 3 ground side)
Field winding supply rectification ..... 3 diodes
Stator windings ..... 3 phase-delta connected
Field winding rotor poles 12
Maximum speed ..... 16,000 rev/min
Winding resistance at 20°C ..... 2.6 ohms
Control ..... Field voltage sensed regulation
Regulator-type ..... 15 TR
voltage ..... 13.6 to 14.4 volts
Nominal output
Condition ..... Hot
Alternator speed ..... 6000 rev/min
Control voltage ..... 14 volt
Amp ..... 80 amp

REPLACEMENT BULBS		TYPE		
Headlamps	)	12V	60/55W	(Halogen)
Auxiliary driving lamps	)	12V	55W H3	(Halogen)
Sidelamps	)	12V	5W	bayonet
Tail lamps	) Exterior	12V	5/21W	bayonet
Reverse lamps	) lights	12V	21W	bayonet
Stop lamps	)	12V	21W	bayonet
Direction indicator lamps	)	12V	21W	bayonet
Rear side marker lamps	)	12V	4W	bayonet
Number plate lamps	)	12V	5W	capless
Instrument panel lamps and warning lamps	)	12V	1.2W	bulb/holder unit
Ignition warning lamp (Instrument panel)	)	12V	2W	capless
Interior roof lamps	)	12V	10W	'Festoon'
Clock illumination	)	12V	2W	bayonet
Cigar lighter illumination	)	12V	1.2W	capless
Door edge/puddle lamps	)	12V	5W	capless
Auxiliary switch panel	) Interior			
illumination (green)	) lights	12V	1.2W	capless
Heated rear screen warning lamp (amber)	)	12V	1.2W	capless
Hazard warning lamp	)	12V	1.2W	capless
Automatic graphics illumination	)	24V	5W	capless
Heater/air conditioning graphics illumination	)	12V	1.2W	capless
Differential lock warning lamp	)	12V	2W	bayonet
Column switch illumination	)	12V	1.2W	capless

ENGINE TUNING DATA

Type V8

Firing order 1-8-4-3-6-5-7-2

Cylinder Numbers
Left bank 1-3-5-7
Right bank 2-4-6-8

No 1 Cylinder location ..... Pulley end of left bank

Timing marks ..... On crankshaft vibration damper

Spark plugs
Make/type ..... Champion RN12YC
Gap ..... 0.85-0.95mm (0.033-0.038 in)

Coil
Make/type ..... Lucas 32C5

Compression ratio 8.13:1

Fuel injection system ..... Lucas Hot-wire air flow sensor system electronically controlled

Valve Timing	**Inlet**	**Exhaust**
Opens	24° BTDC	62° BBDC
Closes	52° ABDC	14° ATDC
Duration	256°	256°
Valve peak	104° ATDC	114° BTDC

Idle speed ..... 665 to 735 rev/min

Ignition Timing at ..... 800 rev/min max

Ignition Timing
Dynamic ..... 6° ± 1° B.T.D.C.

Distributor
Make/type ..... Lucas 35DLM8 electronic
Rotation ..... Clockwise
Air gap ..... 0.20-0.35mm (0.008-0.014 in)
Despatch number 42620

Centrifugal Advance
Decelerating check-vacuum hose disconnected
Distributor rpm decelerating speeds

2300	Distributor advance	8° to 11°
1600		8° 54' to 11°
600		1° 18' to 3° 18'

No centrifugal advance below ..... 150 rev/min

Fuel
Unleaded ..... 95 octane

TORQUE WRENCH SETTINGS

Lubricants/sealants have been specified in certain applications for assembly purposes.

* These bolts must have threads coated with Loctite 572 prior to assembly. For this purpose it is necessary to use an approved dispenser to apply the sealant/lubricant to the first three threads of the bolts.
** These bolts must have threads coated in lubricant EXP16A (Marston Lubricants) prior to assembly.
*** These bolts must have threads coated in sealant Loctite 270 prior to assembly.

It is essential that all bolts are securely tightened and it is imperative that the correct torques values are adhered to.

ENGINE	Nm	ft lb
Alternator mounting bracket to cylinder head	35 - 43	26 - 32
Alternator to mounting bracket	22 - 28	16 - 21
Alternator to adjusting link	22 - 28	16 - 21
Chainwheel to camshaft	54 - 61	40 - 45
Connecting rod nut	47 - 54	35 - 40
Cylinder head:		
Outer row	54 - 61	40 - 45 *
Centre row	88 - 95	65 - 70 *
Inner row	88 - 95	65 - 70 *
Distributor clamp nut	19 - 22	14 - 16
Exhaust manifold to cylinder heads.	19 - 22	14 - 16
Fan to viscous unit	26 - 32	19 - 24
Flexible drive plate to crankshaft adaptor plate	35 - 46	26 - 34 ***
Adaptor plate to crankshaft	77 - 90	57 - 66
Intake manifold to cylinder heads	34 - 41	25 - 30
Lifting eye to cylinder heads	35 - 43	26 - 32
Main bearing cap bolts	68 - 75	50 - 55 **
Main bearing cap rear bolts	88 - 95	65 - 70 **
Manifold gasket clamp bolt	14 - 20	10 - 15
Oil pump cover to timing cover	11 - 14	8 - 10
Oil plug	24 - 30	18 - 22
Oil relief valve plug	40 - 47	30 - 35
Oil sump drain plug	40 - 47	30 - 35
Oil sump to cylinder block	7 - 11	5 - 8
Oil sump rear to cylinder block	17 - 20	13 - 15
Rocker cover to cylinder head	7 - 10	5 - 7
Rocker shaft bracket to cylinder head	34 - 40	25 - 30
Spark plug	19 - 22	14 - 16
Starter motor attachment	41 - 47	30 - 35
Damper to crankshaft	257 - 285	190 - 210
Timing cover to cylinder block	24 - 30	18 - 22 *
Viscous unit to water pump hub	40 - 50	30 - 37
Water pump pulley to water pump hub	8 - 12	6 - 9 *
Water pump timing cover to cylinder block	24 - 30	18 - 22
Water jacket to plenum chamber	11 - 14	8 - 10 *
Plenum chamber to ram housing	22 - 28	16 - 21
Ram housing to intake manifold	20 - 27	15 - 20
Thermostat housing to intake manifold	24 - 30	18 - 22

Continued

Charts below give torque values for all screws and bolts used except for those that are specified otherwise.

SIZE	METRIC		SIZE	UNC		UNF	
	Nm	ft lb		Nm	ft lb	Nm	ft lb
M5	5-7	3.7-5.2	1/4	6.8-9.5	5-7	8.1-12.2	6-9
M6	7-10	5.2-7.4	5/16	20.3-27.1	15-20	20.3-27.1	15-20
M8	22-28	16.2-20.7	3/8	35.3-43.4	26-32	35.3-43.4	26-32
M10	40-50	29.5-36.9	7/16	67.8-88.1	50-65	67.8-88.1	50-65
M12	80-100	59.0-73.8	1/2	81.3-101.7	60-75	81.3-101.7	60-75
M14	90-120	66.4-88.5	5/8	122.0-149.1	90-110	122.0-149.1	90-110
M16	160-200	118.0-147.5					

RECOMMENDED LUBRICANTS AND FLUIDS

COMPONENT	SPECIFICATION		AMBIENT TEMPERATURE
			°C: −30 −20 −10 0 10 20 30 40 50 °F: −22 −4 +14 +32 50 68 86 104 122
Engine	Use oils to API service levels SE or SF or SE/CC or SF/CC	Viscosity	
		5W/20) 5W/30) 5W/40)	
		10W/30	
		10W/40) 10W/50)	
		15W/40) 15W/50)	
		20W/40) 20W/50)	
Automatic gearbox	ATF Dexron IID		
Transfer gearbox Final drive units Swivel pin housings	APIGL4 or GL5 MIL-L-2105 or MIL-L-2105B	Viscosity	
		90 EP	
		80W EP	
Power steering	ATF Dexron IID		
Brake reservoir	Brake fluid must have a minimum boiling point of 260°C (500°F) and comply with FMVSS/116/DOT 4		
Lubrication nipples (hubs, ball joints, etc.)	NLGI-2 multipurpose lithium based grease		

Continued

Capacities (approx.)*	Litres	Imperial unit	US unit
Engine sump and filter from dry	5.68	10 pints	12.0 pints
Gearbox from dry-automatic ZF	9.1	16 pints	20 pints
Transfer gearbox from dry	2.5	4.4 pints	5.3 pints
Front axle from dry	1.7	3.0 pints	3.6 pints
Front axle swivel pin housing (each)	0.35	0.6 pints	0.7 pints
Rear axle from dry	1.7	3.0 pints	3.6 pints
Power steering box and reservoir	2.9	5.0 pints	6.0 pints
Cooling system	11.4	20 pint	24 pints
Fuel tank	76.4	16.8 gallon	20 gallons

NOTE: *** All levels must be checked by dipstick or level plugs as applicable.**

When draining oil from the ZF automatic gearbox, oil will remain in the torque converter, refill to high level on dipstick only.

LUBRICATION PRACTICE

The engine is filled with special oil to protect it during the running-in-period. The engine must be drained after 1600 km (1,000 miles) and refilled with an appropriate lubricant.

Use a high quality oil of the correct viscosity range and service classification in the engine during maintenance and when topping up. The use of oil not to the correct specification can lead to high oil and fuel consumption and ultimately to damaged components.

Oil to the correct specification contains additives which disperse the corrosive acids formed by combustion and prevent the formation of sludge which can block the oilways. Additional oil additives should not be used. Always adhere to the recommended servicing intervals.

WARNING: Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should be kept away from open wounds. These substances among others include anti-freeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL REQUIREMENTS

The engine is designed to use only unleaded fuel. Unleaded fuel must be used for the emission control system to operate properly. Its use will also reduce spark plug fouling, exhaust system corrosion and engine oil deterioration.

Using fuel that contains lead will result in damage to the emission control system. The effectiveness of the catalysts in the catalytic converters will be seriously impaired if leaded fuel is used. The vehicle is equipped with an electronic fuel injection system, which includes two oxygen sensors. Leaded fuel will damage the sensors, and will deteriorate the emission control system.

Regulations require that pumps delivering unleaded fuel be labelled **UNLEADED.** Only these pumps have nozzles which fit the filler neck of the vehicle fuel tank.

FUEL WITH A RATING OF AT LEAST 95 OCTANE SHOULD BE USED.

Using unleaded fuel with an octane rating lower than stated above can cause persistent, heavy 'spark knock' ('spark knock' is a metallic rapping noise). If severe, this can lead to engine damage. If a heavy spark knock is detected even when using fuel of the recommended octane rating, check the ignition timing system.

CAUTION: Do not use oxygenated fuels such as blends of methanol/ gasoline or ethanol/gasoline (e.g. 'Gasohol'). Take care not to spill fuel during refuelling.

RANGE ROVER MAINTENANCE - FIRST 1,600 KM SERVICE ONLY

Renew engine oil

Renew transfer box oil

Renew front axle oil

Renew rear axle oil

Renew steering swivel housing oil

Check/top up power steering fluid

Check/top up automatic transmission fluid

Check for oil/fluid leaks from:- Suspension, dampers and self levelling unit, engine and transmission units, front and rear axles

Check brake pipes/unions for security, chafing, leaks and corrosion

Check power steering system for leaks, hydraulic pipes/unions for security, chafing and corrosion

Check fuel system for leaks

Check cooling and heater systems for leaks, hoses for security and condition

Check security and operation of park brake

Check foot brake operation

Check condition and security of steering unit, joints and gaiters

Check/adjust steering box

Check front wheel alignment

Check PCV system for leaks and hoses for security and condition (Positive crankcase ventilation).

Check operation of throttle mechanical linkage and transmission cable

Check ignition wiring and HT leads for security, and fraying

Check/adjust all drive belts

Check operation of all instruments fuel and temperature gauges, warning indicators, lamps, horns and audio unit

Check operation of front and rear screen and headlamp wash/wipers

Check operation of rear view mirrors and for security, cracks and crazing

Check condition and security of seats, seat belt mountings, belts and buckles

Check exhaust system for leaks, security and damage

Check tyres comply with Manufacturers specification

Check tyres for cuts, lumps, bulges, uneven wear, tread depth and road wheels for damage

Check and adjust tyre pressures including spare

Check and tighten road wheel retaining nuts

Continued

RANGE ROVER EMISSION MAINTENANCE

MAINTENANCE INTERVALS KM X 1000	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
Renew PCV intake filter check and clean PCV system (Positive crankcase ventilation)								•								•
Renew engine oil	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Renew engine oil filter	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Renew fuel filter								•								•
Renew air cleaner element/check/clean dump valve				•				•				•				•
Renew charcoal canister								•								•
Renew spark plugs				•				•				•				•
Renew catalytic converters																•
Renew oxygen sensors								•								•
Check exhaust system for leaks, security and damage	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check condition of driving belts-adjust if required	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/top up cooling system	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check ignition wiring and HT leads for fraying, chafing and deterioration								•								•
Clean distributor cap and rotor arm, check for cracks and tracking. Lubricate rotor spindle with rotor arm removed								•								•
Check/adjust ignition timing								•								•
Check engine idle speed								•								•
Check fuel evaporative loss control system for leaks								•								•
Check fuel filler cap seal for leaks								•								•
Check fuel pipes, filler hoses and connections for leaks and security								•								•
Check engine emission control system hoses, tubes and vacuum lines for security and condition								•								•
Check operation of electronic control unit/systems								•								•
Check operation of auxiliary emission control devices								•								•

The Emission Maintenance above is necessary to keep the vehicle in compliance with the Swiss Emission regulations up to 80,000 Km or 5 years. The manufacturer of Range Rover recommends that the sequence of maintenance operations be carried out throughout the life of the vehicle in order to maintain vehicle performance and reliability.

RANGE ROVER MAINTENANCE

MAINTENANCE INTERVALS KM X 1000	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
Check/top up transfer box oil	•	•	•		•	•	•		•	•	•		•	•	•	
Renew transfer box oil				•				•				•				•
Check/top up front axle oil	•	•	•		•	•	•		•	•	•		•	•	•	
Renew front axle oil				•				•				•				•
Check/top up rear axle oil	•	•	•		•	•	•		•	•	•		•	•	•	
Renew rear axle oil				•				•				•				•
Check/top up steering swivel housing oil	•	•	•		•	•	•		•	•	•		•	•	•	
Renew steering swivel housing oil				•				•				•				•
Renew automatic transmission fluid				•				•				•				•
Renew automatic transmission fluid filter				•				•				•				•
Check/top up power steering fluid	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/top up automatic transmission fluid	•	•	•		•	•	•		•	•	•		•	•	•	
Check/top up brake fluid	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check for oil/fluid leaks from: Suspension, dampers and self levelling unit	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check foot brake operation	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check condition and security of steering unit, joints and gaiters		•		•		•		•		•		•		•		•
Check/adjust steering box		•		•		•		•		•		•		•		•
Check front wheel alignment		•		•		•		•		•		•		•		•
Check PCV system for leaks and hoses for security and condition (Positive crankcase ventilation)				•				•				•				•
Check and clean PCV system and breathers (Positive crankcase ventilation)				•				•				•				•
Check/clean air cleaner dump valve and element		•		•		•		•		•		•		•		•
Check operation of throttle mechanical linkage and transmission cable		•		•		•		•		•		•		•		•
Check battery condition		•		•		•		•		•		•		•		•
Clean and grease battery terminals	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check ignition wiring and HT leads for security, fraying, chafing, deterioration		•		•		•		•		•		•		•		•
Clean distributor cap and rotor arm, check for cracks and tracking		•		•		•		•		•		•		•		•
Lubricate distributor rotor spindle with rotor arm removed				•				•				•				•
Clean/adjust spark plugs		•				•				•				•		
Check/adjust ignition timing			•				•			•				•		

Continued

RANGE ROVER MAINTENANCE
Continued

MAINTENANCE INTERVALS KM X 1000	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
Check condition and security of seats, seat belt mountings, belts and buckles	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check tightness of propeller shaft coupling bolts		•		•		•		•		•		•		•		•
Check exhaust system for leaks, security and damage	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check tyres comply with Manufacturer's specification	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check tyres for cuts, lumps, bulges, uneven wear, tread depth and road wheels for damage	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/adjust tyre pressures including spare	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/adjust headlamp and auxiliary lamp alignment		•		•		•		•		•		•		•		•
Check operation of all instruments, fuel and temperature gauges, warning indicators, lamps, horns and audio unit	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check operation of front and rear screen and headlamp wash/wipers		•		•		•		•		•		•		•		•
Clear sun roof drain tubes	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check operation of all doors, hood, tailgate locks and window controls	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate all locks (not steering lock), hinges and door check mechanisms		•		•		•		•		•		•		•		•
Check operation of heater and air conditioning systems		•		•		•		•		•		•		•		•
Check brake pipes/unions for security, chafing, leaks and corrosion	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check power steering system for leaks, hydraulic pipes/unions for security, chafing and corrosion	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check fuel pipes for leaks	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check cooling and heater systems for leaks, hoses for security and condition		•		•		•		•		•		•		•		•
Check/top up cooling system	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Inspect brake pads for wear, calipers for leaks and discs for condition	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check security and operation of hand brake	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate hand brake mechanical linkage	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate propeller shaft universal joints	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate propeller shaft sealed sliding joints			•			•			•			•			•	

It is recommended that:

At 30,000 Km intervals or every 18 months, whichever is the sooner, the hydraulic brake fluid should be completely renewed.

At 60,000 Km intervals or every 3 years, whichever is the sooner, all hydraulic brake fluid, seals and flexible hoses should be renewed, all working surfaces of the master cylinder, wheel cylinders and caliper cylinders should be examined and renewed where necessary.

At 60,000 Km intervals remove all suspension dampers, test for correct operation, refit or renew as necessary.

At two yearly intervals or at the onset of the second winter the cooling system should be drained, flushed and refilled with the required water and anti-freeze solution.

The battery electrolyte level should be checked and topped up if required three times per year in high ambient temperatures, and once per year in moderate ambient temperatures.

NOTE: Climatic and operating conditions affect maintenance intervals to a large extent; in many cases, therefore, the determination of such intervals must be left to the good judgement of the owner or to advice from a Range Rover Authorised Dealer, but the recommendations will serve as a firm basis for maintenance work.
Vehicles operating under arduous conditions will require more frequent servicing, therefore, at a minimum, the maintenence intervals should be reduced by half.

LUBRICATION

This first part of the maintenance section covers renewal of lubricating oils for the major units of the vehicle and other components that require lubrication, as detailed in the 'Maintenance Schedules'. Refer to Section 09 for Capacities and Recommended Lubricants.

Vehicles operating under severe conditions of dust, sand, mud and water should have the oils changed and lubrication carried out at more frequent intervals than that recommended in the maintenance schedules.

Draining of used oil should take place after a run when the oil is warm. Always clean the drain and filler-level plugs before removing. In the interests of safety disconnect the vehicle battery to prevent the engine being started and the vehicle moved inadvertently, while oil changing is taking place.

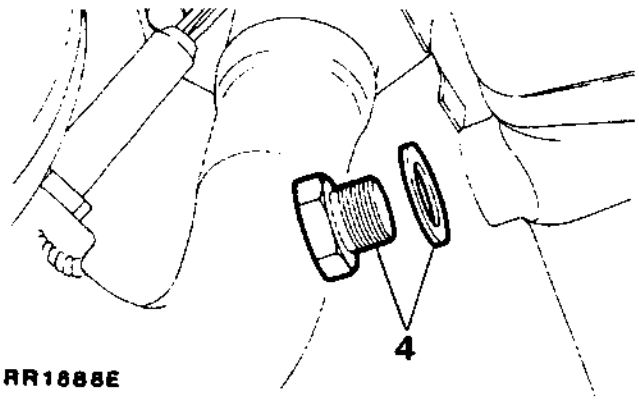
Allow as much time as possible for the oil to drain completely except where blown sand or dirt can enter the drain holes. In these conditions clean and refit the drain plugs immediately the main bulk of oil has drained.

Where possible, always refill with oil of the make and specification recommended in the lubrication charts and from sealed containers.

RENEW ENGINE OIL AND FILTER

DRAIN THE OIL

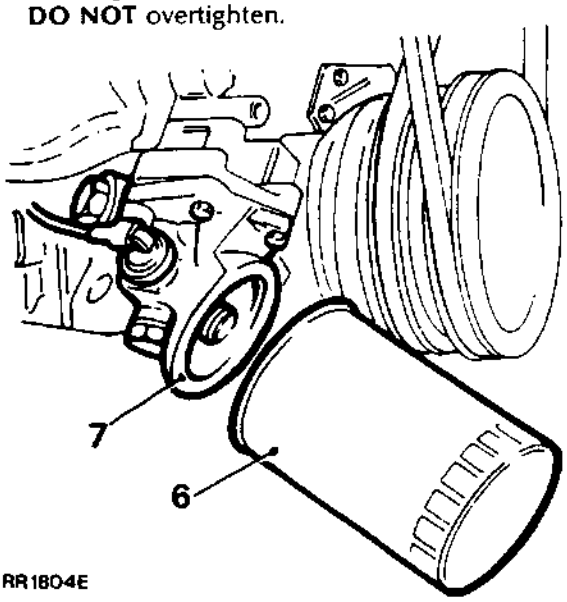
1. Before changing the oil ensure that the vehicle is level on either hoist or ground.
2. Run the engine to warm the oil; switch off the ignition and disconnect the battery for safety.
3. Place an oil tray under the drain plug.
4. Remove the drain plug in the bottom of the sump at the left-hand side. Allow oil to drain away completely. Fit new copper washer and replace the plug, tighten to the correct torque value.



RR1888E

Fit new oil filter

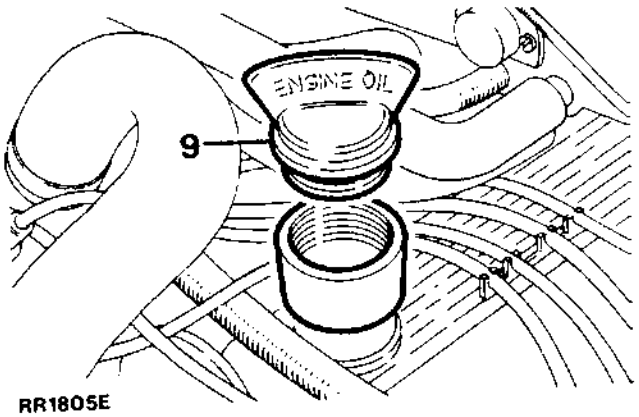
5. Place an oil tray under the engine.
6. Unscrew the filter counter -clockwise, using a strap wrench as necessary.
7. Clean the oil pump mating face and coat the rubber washer of the new filter with clean engine oil, screw the filter on clockwise until the rubber sealing ring touches the machined face, tighten a further half turn by hand only. **DO NOT** overtighten.



RR1804E

Refill sump with oil

8. Check that the drain plug is tight.
9. Clean the outside of the oil filler cap, remove it from the extension filler neck and clean the inside.



RR1805E

10. Pour in the correct quantity of new oil of the correct grade from a sealed container to the high mark on the dipstick and firmly replace the filler cap. **DO NOT FILL ABOVE 'HIGH' MARK.** Reconnect the battery.
11. Run the engine and check for leaks from the filter. Stop the engine, allow the oil to run back into the sump for a few minutes, then check the oil level again and top up if necessary.

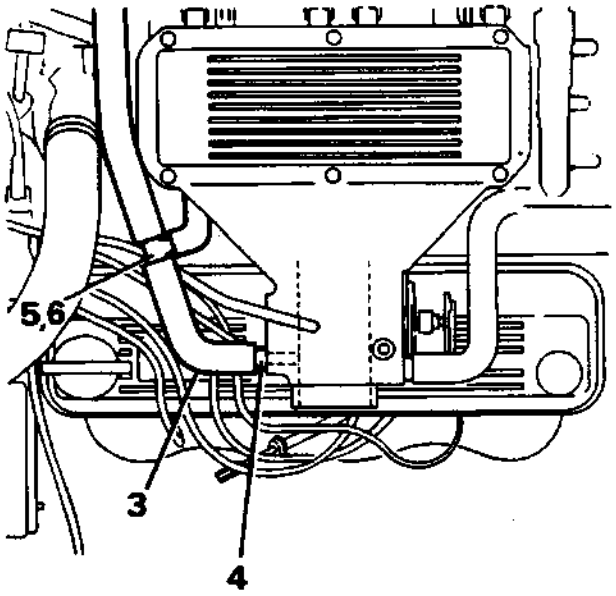
CLEAN PLENUM CHAMBER VENTILATION PASSAGEWAY

The cleaning of the plenum chamber ventilation passageway can be carried out without removing the plenum chamber from the ram housing.

CAUTION: Care must be taken to prevent debris from the passageway passing beyond the throttle valve disc.

WARNING: Safety glasses must be worn when performing this operation. Ensure that debris is not blown into the atmosphere which could be harmful to other personnel within the vicinity.

1. Disconnect the battery negative terminal.
2. Release the hose clamp and remove the hose from the plenum chamber.
3. Remove the crankcase ventilation hose from the side of the plenum chamber.



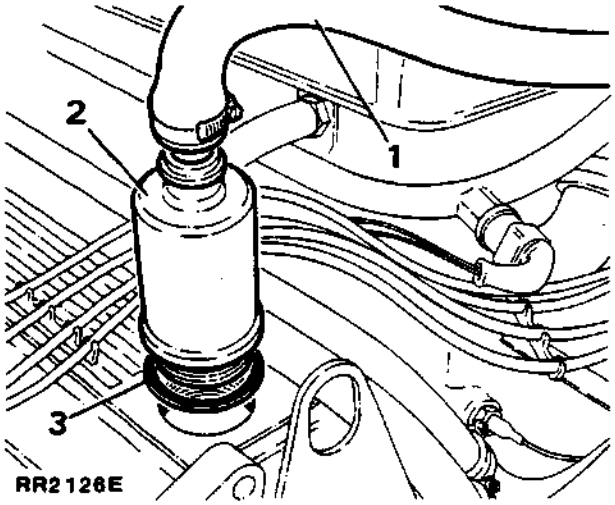
RR2337S

4. Clean out the passageway into the throttle bore.
5. Remove the small 'T' piece between the crankcase ventilation hoses and check that it is free from blockages, clean as necessary.
6. Refit the 'T' piece and hoses, tighten the hose clamps securely.

FILTERS

CLEAN POSITIVE CRANKCASE VENTILATION BREATHER FILTER

1. Release the hose clamp and pull the hose off the canister.
2. Unscrew the canister and remove if from the rocker cover.
3. Remove the large 'O' ring from the threaded end of the canister.
4. Visually inspect the condition of the wire screen within the canister, if in poor condition fit a new assembly, if in an acceptable condition clean the screen as follows:



RR2126E

5. Immerse the canister in a small amount of solvent and allow time for the solvent to dissolve and loosen any engine fume debris within the canister.
6. Remove canister from solvent bath and allow to dry out in still air.

WARNING: Do not use a compressed air line to remove any remaining solvent or particles of debris within the canister as this could cause fire or personal injury.

Refitting the breather/filter

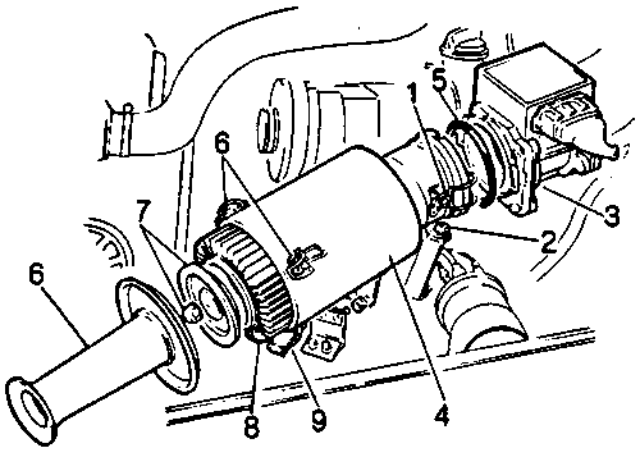
7. Fit a new rubber 'O' ring.
8. Screw the flame trap canister into the rocker cover, hand tight only.
9. Refit hose and tighten hose clamp securely.

AIR CLEANER ELEMENT

Remove and refit

Removing

1. Release the two clips securing the air cleaner to the airflow sensor.
2. Release the two nuts and bolts securing the air cleaner to the left hand valance mounting bracket.
3. Detach the airflow sensor from the air cleaner, and lay carefully to one side.
4. Detach the air cleaner from the centre mounting bracket and withdraw from the engine compartment.
5. Remove the large 'O' ring from the outlet tube of the air cleaner, inspect for condition, fit a new 'O' ring if in poor condition.
6. Unclip the three catches securing the inlet tube to the air cleaner canister and remove the inlet tube.
7. Remove the nut and end plate securing the air cleaner element in position.
8. Withdraw the air cleaner element and discard.
9. Inspect the dump valve for condition and check that it is clear of obstructions.



RR1854E

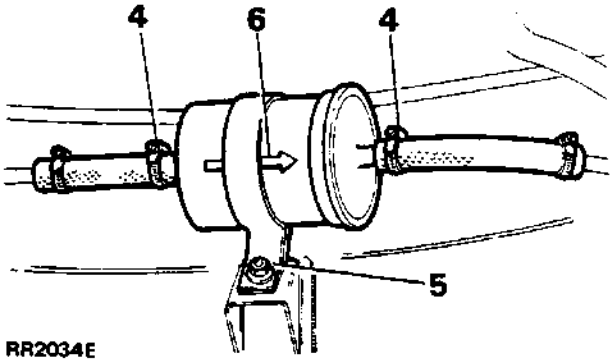
Refitting

10. Fit new element and secure in position.
11. Refit the inlet tube to the air cleaner canister.
12. Refit the air cleaner to the mounting bracket and tighten the two nuts and bolts.
13. Clip the air flow sensor to the air cleaner.

FUEL LINE FILTER

WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Depressurise the fuel system. (Refer to Fuel Injection System - Section 19)
2. The fuel line filter is located on the right hand chassis side member forward of the fuel tank filler neck. Access to the filter is gained through the right hand rear wheel arch.
3. Thoroughly clean the immediate area around the hose connections to prevent ingress of foreign matter into the fuel system.
4. Loosen the two hose clamps nearest the filter to enable the hoses to be removed from the filter canister. Plug the end of the hoses to prevent ingress of dirt.
5. Release the securing bolt and bracket and remove the filter from the chassis side member.



RR2034E

Fit new filter

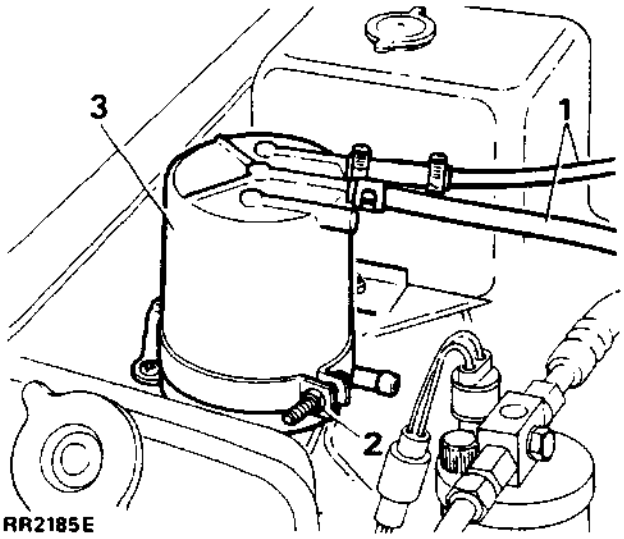
6. Fit a new filter observing the direction of flow arrows stamped on the canister.
7. Start the engine and inspect for fuel leaks around the hose connections.

CHARCOAL CANISTER

1. Disconnect from the canister:

   (i) Canister line to fuel tank.
   (ii) Canister purge line.

2. Loosen the clamp pinch bolt
3. Remove the canister.



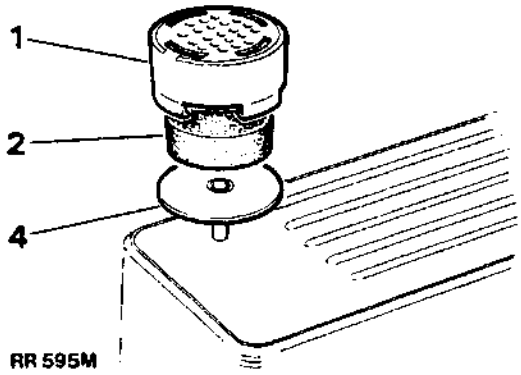
Fit new canister

4. Secure the canister in the clamp.
5. Reverse instructions 1 and 2 above.

WARNING: The use of compressed air to clean a charcoal canister or to clear a blockage in the evaporative system is highly dangerous. An explosive gas present in a fully saturated canister may be ignited by the heat generated when compressed air passes through the canister.

POSITIVE CRANKCASE VENTILATION INTAKE FILTER

1. Pry the filter holder upwards to release it from the rocker cover.
2. Discard the sponge filter.



Fit new filter

3. Insert a new filter into the plastic body.
4. Push the filter holder onto the rocker cover until it clips firmly into place.

CHECK

Check ignition wiring and high tension leads for fraying, chafing and deterioration.

CHECK

Check/adjust ignition timing. (See Engine Tuning Data/Procedure) using suitable electronic equipment.

FUEL SYSTEM

Check all hose connections for leaks and hose deterioration, fit new hoses or tighten hose clamps as necessary.

IGNITION TIMING

Adjust

1. It is essential that the following procedures are adhered to. Inaccurate timing can lead to serious engine damage and additionally create failure to comply with emission regulations. If the engine is being checked in the vehicle, the air conditioning compressor must be disengaged.
2. On initial engine build, or if the distributor has been disturbed for any reason, the ignition timing must be set statically to 6° ± 1° B.T.D.C.
   (This sequence is to give only an approximation in order that the engine may be started) **ON NO ACCOUNT MUST THE ENGINE BE STARTED BEFORE THIS OPERATION IS CARRIED OUT.**

Equipment required

Calibrated Tachometer
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following the manufacturer's instructions.
4. Disconnect the vacuum hose from the distributor.
5. Start engine, with no load and not exceeding 3,000 rev/min run engine until normal operating temperature is reached. (Thermostat open). Check that the normal idling speed falls within the tolerance specified in the data section.
6. Idle speed for timing purposes must not exceed 800 rev/min.
7. With the distributor clamping bolt loosened turn distributor until the timing flash coincides with the timing pointer and the correct timing mark on the rim of the torsional vibration damper as shown in the engine tuning section.
8. Retighten the distributor clamping bolt securely. Recheck timing in the event that retightening has disturbed the distributor position.
9. Refit vacuum hose.
10. Disconnect stroboscopic timing lamp and tachometer from engine.

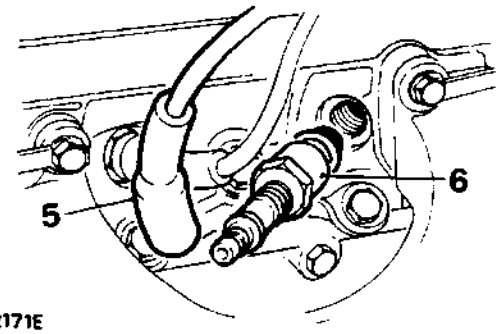
IGNITION

spark plugs

1. Take great care when fitting spark plugs not to cross-thread the plug, otherwise costly damage to the cylinder head will result.
2. Check or replace the spark plugs as applicable.
3. It is important that only the correct type of spark plugs are used for replacements.
4. Incorrect grades of plugs may lead to piston overheating and engine failure.

To remove spark plugs proceed as follows:

5. Disconnect the battery negative lead and remove the leads from the spark plugs.
6. Remove the plugs and washers.

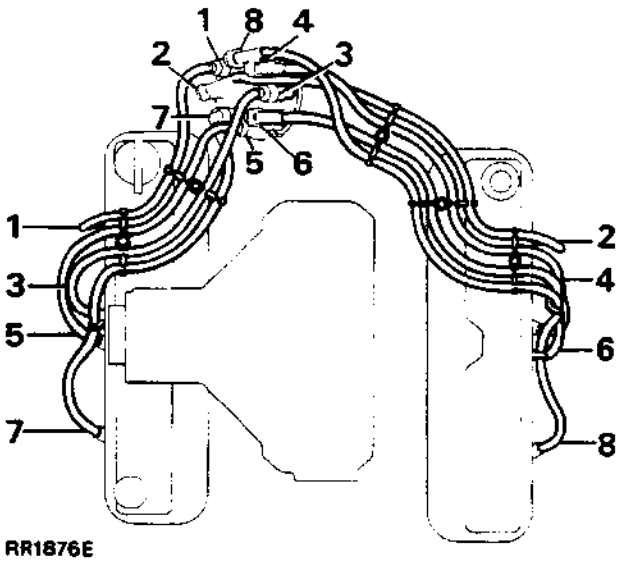


RR2171E

7. Set the electrode gap to the recommended clearance.
8. When pushing the leads onto the plugs, ensure that the shrouds are firmly seated on the plugs.

Fitting H.T. leads

9. Ensure that replacement H.T. leads are refitted in their spacing cleats in accordance with the correct layout illustrated.
   Failure to observe this instruction may result in cross-firing between two closely fitted leads which are consecutive in the firing order.



RR1876E

DISTRIBUTOR-LUCAS 35DLM8

The electronic ignition employs a Lucas 35DLM8 distributor.
The internal operating parts of the distributor are pre-set at the factory and should not normally require resetting.
Adjustments should only be made, if the unit is known to be faulty or damaged. Maintenance of the distributor consists of the following items.

1. Clean outer surfaces of distributor cap to remove dirt, grease etc.
2. Unclip the cap, check cap for signs of cracking.
3. Wipe inside cap with a lint free cloth.
4. Check rotor arm, cap and flash shield for signs of tracking.
5. Apply a spot of clean engine oil into the rotor spindle before fitting the rotor arm.

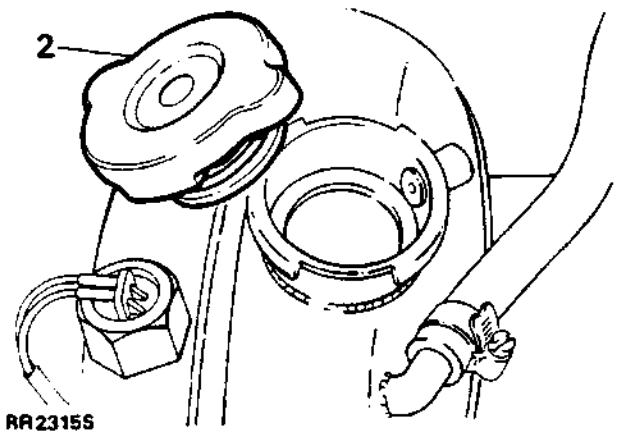
DO NOT DISTURB the clear plastic insulating cover (flash shield) which protects the magnetic pick-up module.

CHECK/TOP UP COOLING SYSTEM

1. To prevent corrosion of the aluminium alloy engine parts it is imperative that the cooling system is filled with a solution of water and phosphate free anti-freeze, winter or summer. Never fill or top up with plain water.

WARNING: Do not remove the filler cap when engine is hot because the cooling system is pressurised and personal scalding could result.

2. When removing the filler cap, first turn it anti-clockwise a quarter of a turn and allow all pressure to escape, before turning further in the same direction to lift it off.
3. With a cold engine, the correct coolant level should be up to the top of the sensor float which is approximately 1.00 inch (25 mm) below the filler neck.

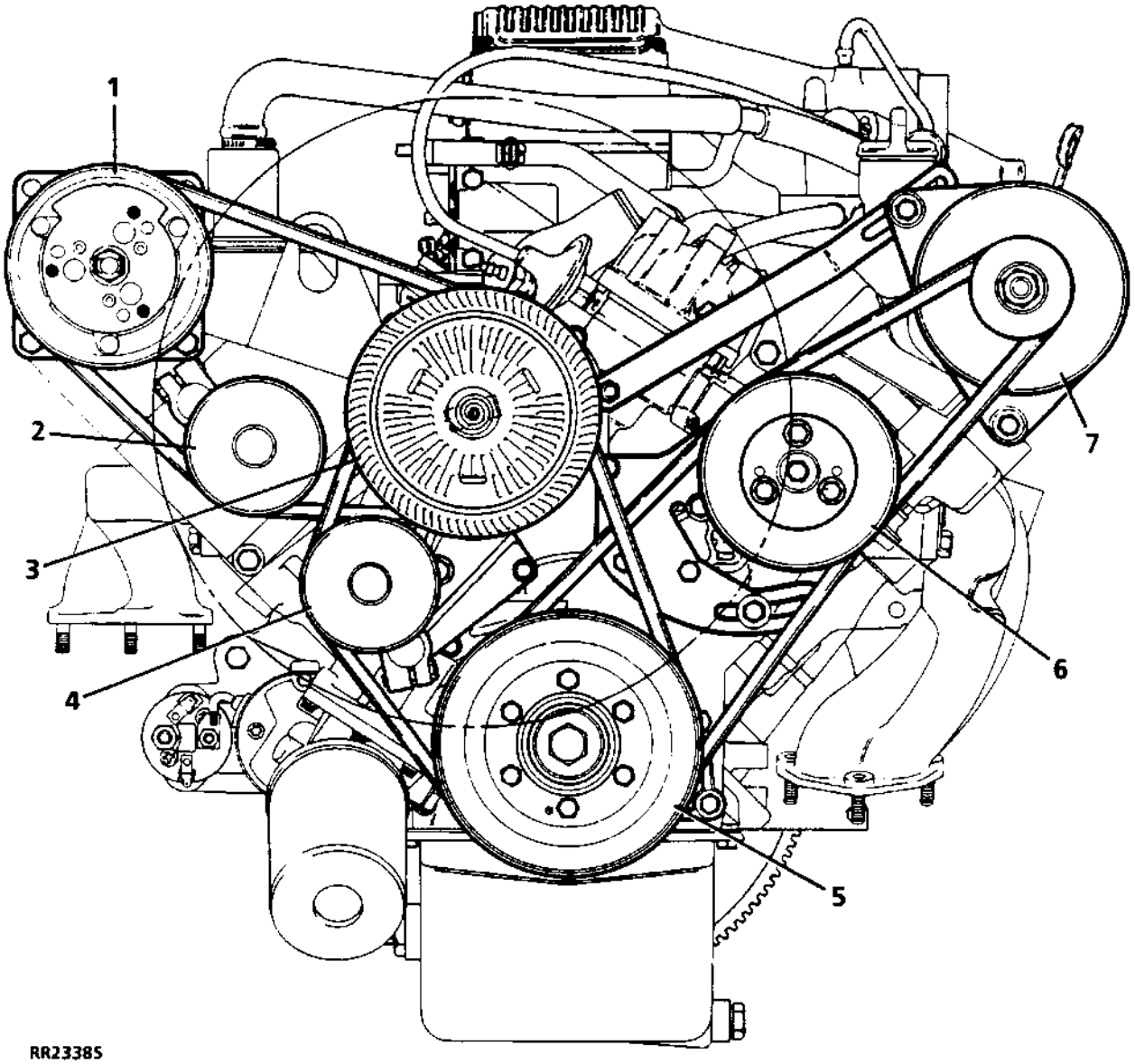


4. When replacing the filler cap it is important that it is tightened down fully, not just to the first stop. Failure to tighten the filler cap properly may result in water loss, with possible damage to the engine through over-heating. Use soft water whenever possible, if local water supply is hard, rainwater should be used.

Check cooling/heater systems for leaks and hoses for security and condition.

Cooling system hoses should be changed at the first signs of deterioration.

The cooling system should be drained and flushed at 2 year intervals or at the onset of the second winter. Refer to Coolant Requirements in the main workshop manual.



RR23385

1. Air conditioning compressor.
2. Idler pulley
3. Viscous fan-water pump unit.
4. Idler pulley
5. Crankshaft.
6. Power steering pump.
7. Alternator

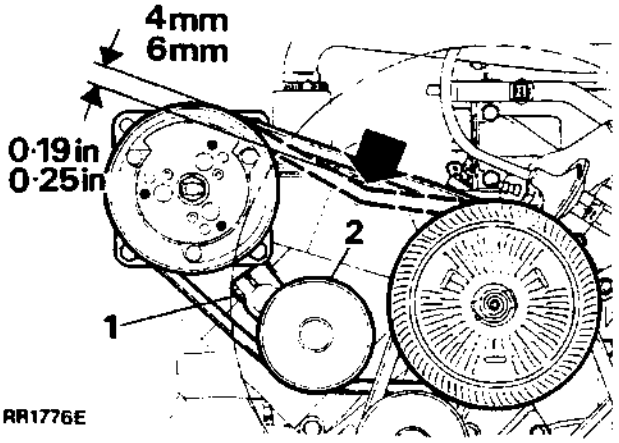
WARNING: DISCONNECT THE BATTERY NEGATIVE TERMINAL BEFORE ADJUSTING DRIVE BELTS TO AVOID THE POSSIBILITY OF THE VEHICLE BEING STARTED.

DRIVE BELTS-adjust or fit new belts

COMPRESSOR DRIVE BELT

The belt must be tight with not more than 4 to 6mm (0.19 to 0.25 in) total deflection when checked by hand midway between the pulleys on the longest run.
Where a belt has stretched beyond the limits, a noisy whine or knock will often be evident during operating, if necessary adjust as follows:

1. Loosen the idler pulley securing bolt.
2. Adjust the position of the idler pulley until the correct tension is obtained.
3. Tighten the securing bolt and recheck the belt tension.



Check driving belts, adjust or fit new belts as necessary.

1. Examine the following belts for wear and condition and fit new belts if necessary:
   (A) Crankshaft-Idler pulley-Water Pump
   (B) Crankshaft-Steering Pump
   (C) Steering Pump-Alternator

ILLUSTRATION A

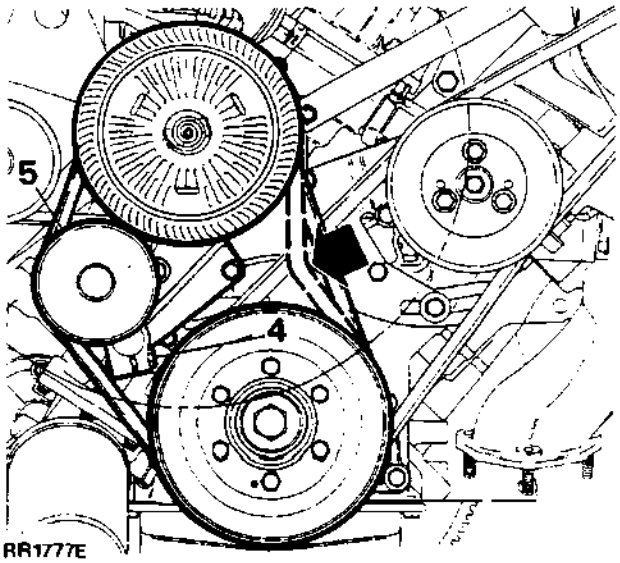


ILLUSTRATION B

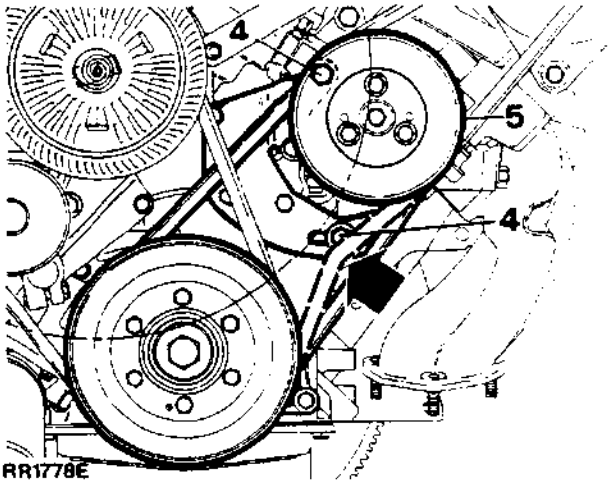
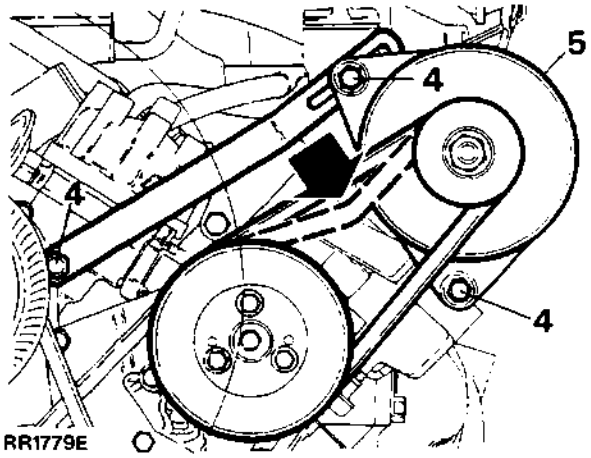


ILLUSTRATION C



2. Each belt should be sufficiently tight to drive the appropriate auxiliary without undue load on the bearings.
3. Loosen the bolts securing the unit to its mounting bracket.
4. Loosen the appropriate pivot bolt or idler pulley and the fixing at the adjustment link where applicable.
5. Pivot the unit inwards or outwards as necessary and adjust until the correct belt tension is obtained.
6. Belt deflection should be approximately 4 to 6mm (0.19 to 0.25 in) at the points denoted by the bold arrows.
7. Tighten all unit adjusting bolts.
8. When fitting a new drive belt, tension the belt as described above. Reconnect the battery, start and run the engine at fast idle for 3 to 5 minutes, after which time the belt must be re-checked and retensioned if necessary.

EMISSIONS

EMISSION AND EVAPORATIVE CONTROL

Range Rovers are fitted during manufacture with various items of emission and evaporative control equipment to ensure that they meet stringent exhaust emission regulations.

Unauthorised replacement or modification of the emission or evaporative control equipment could seriously impair the efficiency of the emission system.

EVAPORATIVE EMISSION CONTROL SYSTEM

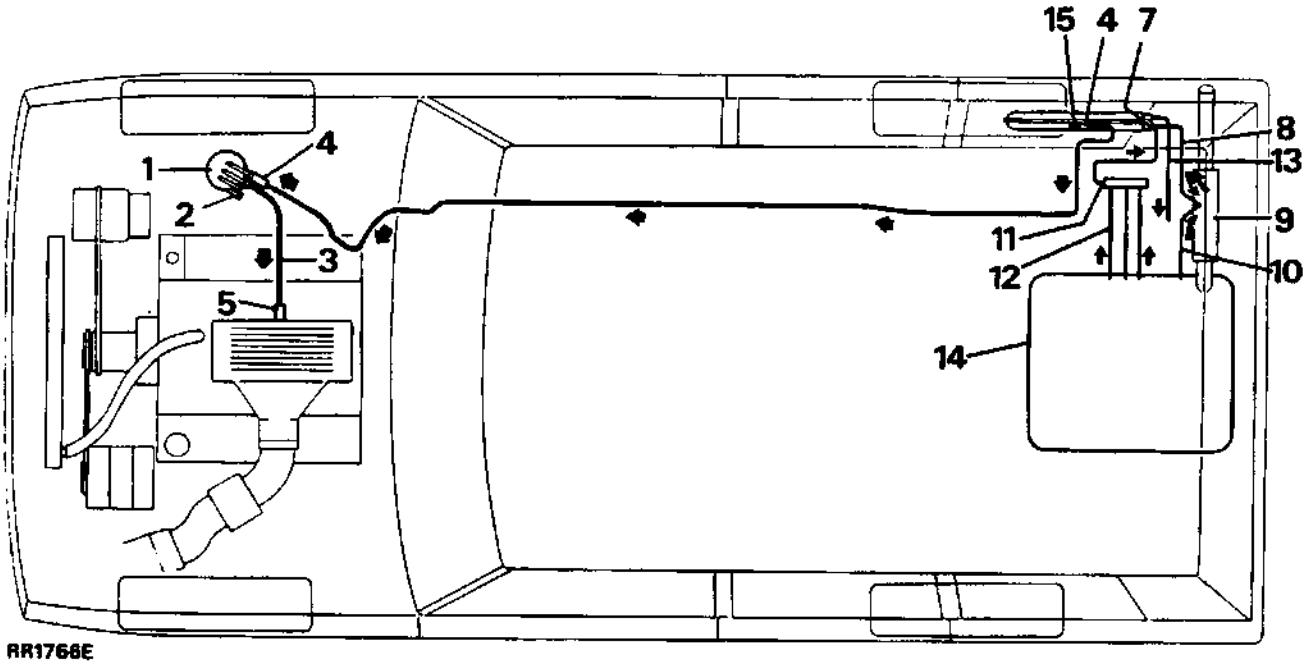
This system prevents fuel vapour from reaching the atmosphere. The system consists of a fuel expansion tank located between the inner right hand body side and rear right hand wing, and an adsorption canister located in the engine compartment attached to the front right hand valance.

When the fuel expands in the fuel tank due to temperature increase it is vented into the bottom of the expansion tank, any liquid fuel can be siphoned back into the main tank. Fuel vapour is directed as the fuel cools through the outlet pipe at the top of the expansion tank to the adsorption (charcoal) canister by means of a pipe running along the underside of the vehicle.

A restrictor located in the purge line at the plenum chamber controls purge line flow.

The adsorption canister containing activated charcoal is used to store fuel vapour from the fuel tank. Filter pads are fitted above and below the charcoal to prevent ingress of foreign matter of charcoal into the purge line. Emissions from the fuel tank enter the top of the canister and the purging air enters at the bottom. The canister is purged of its vapours by the vacuum generated within the plenum chamber, the vapour being drawn into the plenum chamber and burnt with the in-going mixture.

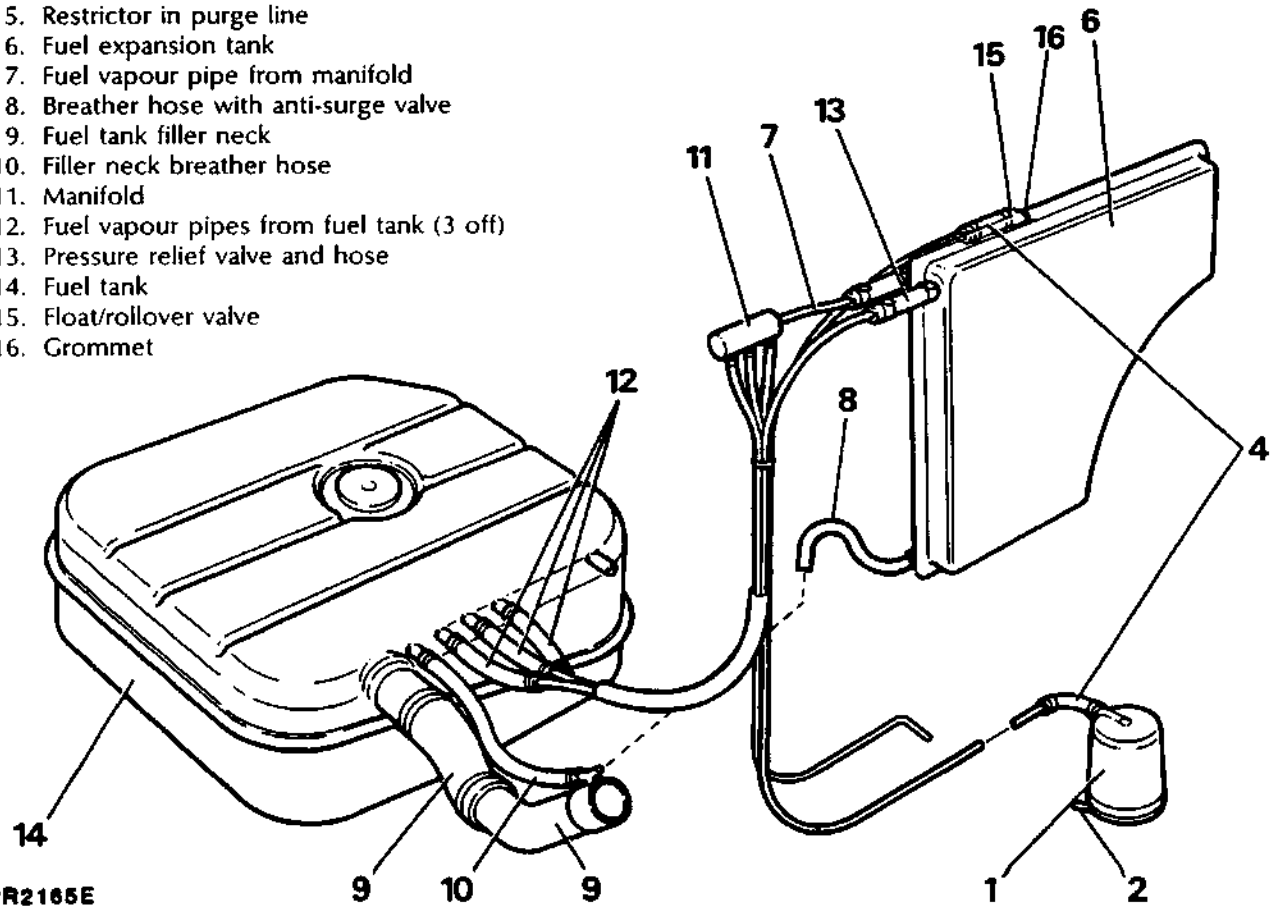
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RR1766E

KEY TO DIAGRAM

1. Charcoal canister
2. Air inlet to canister
3. Purge line to plenum chamber
4. Connector hoses with restrictors
5. Restrictor in purge line
6. Fuel expansion tank
7. Fuel vapour pipe from manifold
8. Breather hose with anti-surge valve
9. Fuel tank filler neck
10. Filler neck breather hose
11. Manifold
12. Fuel vapour pipes from fuel tank (3 off)
13. Pressure relief valve and hose
14. Fuel tank
15. Float/rollover valve
16. Grommet



RR2165E

CATALYTIC CONVERTORS

Three catalytic convertors are fitted into the exhaust system to reduce carbon monoxide, oxides of nitrogen and hydrocarbon emissions. The two down pipes from the exhaust manifolds each house an oxygen sensor located forward of the catalytic convertors.

The active constituents of the catalytic device are platinum and rhodium. In order for the device to function correctly, it is necessary to control very closely the oxygen concentration in the exhaust gas entering the catalyst. This is achieved by the use of a fuel control system which continuously monitors the oxygen content of the exhaust gas by means of the oxygen sensor and adjusts the mixture level to obtain the required oxygen content.

Unleaded fuel must be used on catalyst equipped vehicles, and labels to indicate this are displayed on the instrument panel and inside the fuel filler flap. The filler neck is designed to accommodate unleaded fuel pump nozzles only.

The emission control system fitted to this engine is designed to keep emissions within legislated limits, providing the engine is correctly maintained and is in sound mechanical condition.

ADSORPTION (CHARCOAL) CANISTER

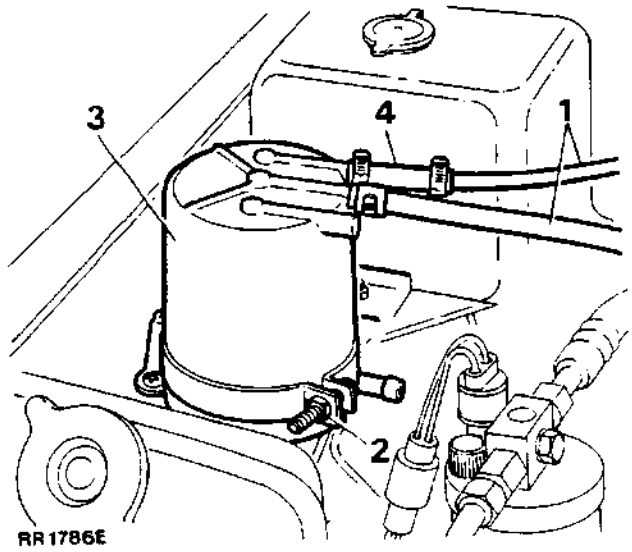
Remove and Refit

Removing

1. Disconnect from the canister:-

   (i) Canister line to expansion tank
   (ii) Canister purge line

2. Loosen the clamp nut screw.
3. Remove the canister.
4. Remove the short hose from the inlet vapour pipe and check that the restrictor is free from blockages.



Refitting

5. Secure the canister in the clamp.
6. Reverse instructions 1 and 2 above.

WARNING: The use of compressed air to clean an adsorption canister or clear a blockage in the evaporative system is very dangerous. An explosive gas present in a fully saturated canister may be ignited by the heat generated when compressed air passes through the canister.

FUEL EXPANSION TANK

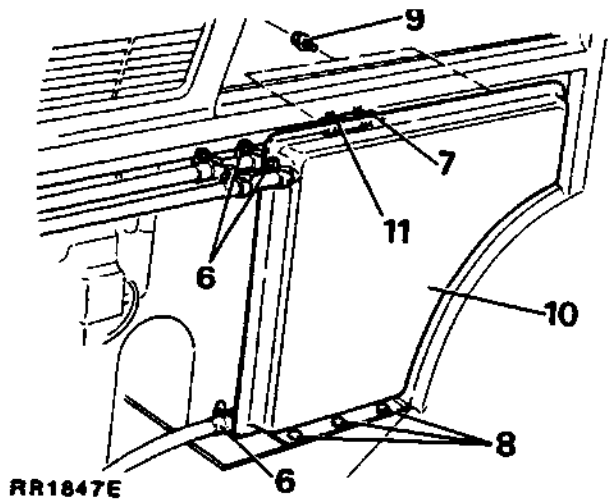
Remove and Refit

The fuel expansion tank is located between the right hand rear wing and inner body side assembly, access to the tank is gained by removing the rear wing and body corner panel.

WARNING: Ensure all necessary precautions are taken against the spillage of fuel when disconnecting the expansion tank hoses.

Removing

1. Depressurise the fuel system. (see Depressurising procedure in Fuel Injection System-section 19 page 34)
2. Disconnect negative battery terminal.
3. Remove the rear lamp cluster.
4. Remove the wrap around bumper end cap.
5. Remove the rear wing and corner panel assembly.
6. Release the three hose clamps and remove the three hoses from the expansion tank.
7. Release the hose clamp and remove the hose from the float valve located on top of the expansion tank.
8. Remove the three bolts retaining the bottom of the expansion tank.
9. Lift the trim covering the vehicle tool kit at the right hand side of the rear stowage area to gain access to the two expansion tank securing bolts located below the rear side glass and remove the two bolts.

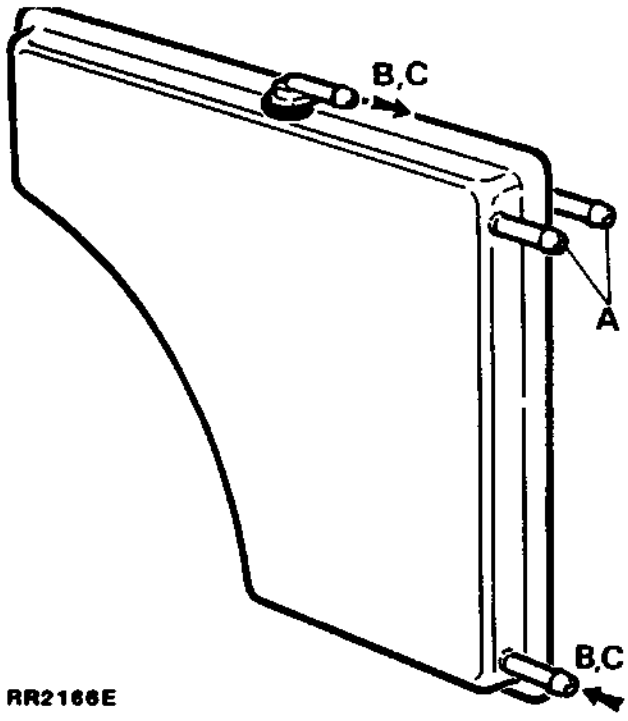


RR1847E

10. Remove the tank from the vehicle.
11. Remove the short hose connection from the top vapour hose and check that the restrictor in the hose is free from blockages.
12. While the tank is still removed from the vehicle check the operation of the float/rollover valve as follows:

    A. Seal the top two outlet pipes.
    B. Apply air pressure at 2 p.s.i to the bottom pipe. With the tank in its upright position air flow will pass through the valve. Rotate the tank 90° onto its side air flow should not pass through the valve.
    C. Disconnect the air supply to the tank. With the bottom pipe sealed fill the tank with mineral spirit, hold the tank in its upright position, the float valve should shut off and prevent fluid passing through the valve.
    D. If the valve does not operate accordingly with the above instructions; replace the float valve.

NOTE: DO NOT remove the float valve unless faulty. If a new valve is fitted ,always fit a new grommet.



RR2166E

Continued

13. Before refitting the tank remove the breather hose attached to the top of the filler neck, identify filler neck to breather hose end to aid reassembly. Vigourously shake the hose and listen for valve ball movement; no sound from the valve-replace the hose assembly.

Refitting

14. Refit the expansion tank ensuring that all hose and pipe connections are secure and that all hose clamps are securely tightened.

VACUUM DELAY VALVE

The coloured side of the vacuum delay valve should always be fitted to the hose from the distributor.

Test: Check Valve Air Flow

1. Attach a 10.00 ± .250 cu.inch vacuum tank to the coloured side of the valve.
2. Expose the black side to atmospheric pressure.
3. **Expected result:** The time required for the vacuum to drop from minus 20 inch Hg to minus 2 inch Hg will be 0.5 seconds maximum.
4. Vacuum recovery air flow: Attach a 22.75 ± .5 cu.inch vacuum tank to the black side of the valve.
5. Expose the coloured side to atmospheric pressure.
6. **Expected result:** The time required for the vacuum to drop from 16 inch Hg to 8 inch Hg will be 240 to 360 seconds.

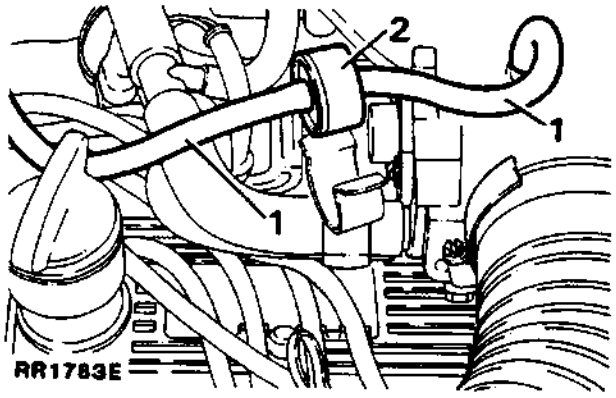
Test: External Leakage Check

1. Seal the coloured side of the valve and attach a short flexible pipe to the other end.
2. Submerge the valve in water and orally blow through the valve.
3. If any external leakage is noticeable, fit a new valve.
   If the delay valve does not comply with any of the test results, replace the unit.

Remove and Refit

Removing

1. Pull the two flexible hoses from the delay unit.
2. Remove the unit from its retaining clip and withdraw it from the engine compartment.



Refitting

3. Reverse the removal instructions ensuring that the coloured side of the valve is fitted to the longer hose from the distributor.

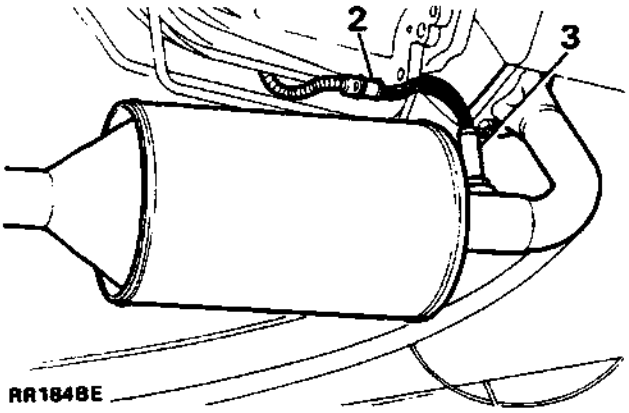
LAMBDA (OXYGEN) SENSOR

Remove and Refit

The removal of the sensors from the exhaust system must only be carried out when the engine is cold.

Removing

1. Disconnect the battery negative lead.
2. Disconnect the electrical plugs from the sensors.
3. Unscrew and remove the sensors from the two exhaust downpipes.

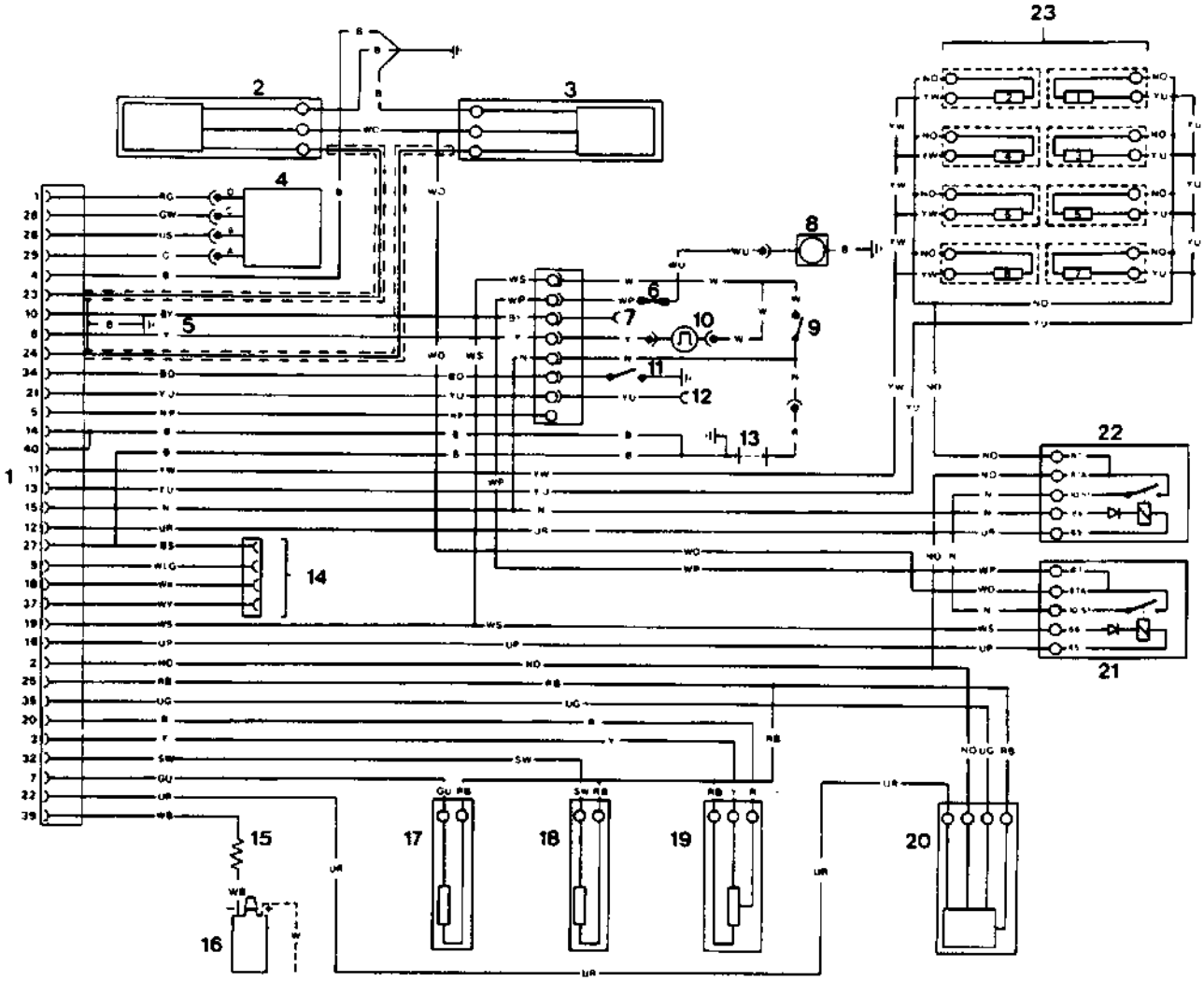


Refitting

4. Coat the threads of the sensors with anti-seize compound.

   CAUTION: To ensure that the efficiency of the sensor is not impaired, DO NOT allow anti-seize compound to come into contact with the sensor nose.

5. Reverse the removal procedure.



RR2313S

FUEL INJECTION - Circuit Diagram

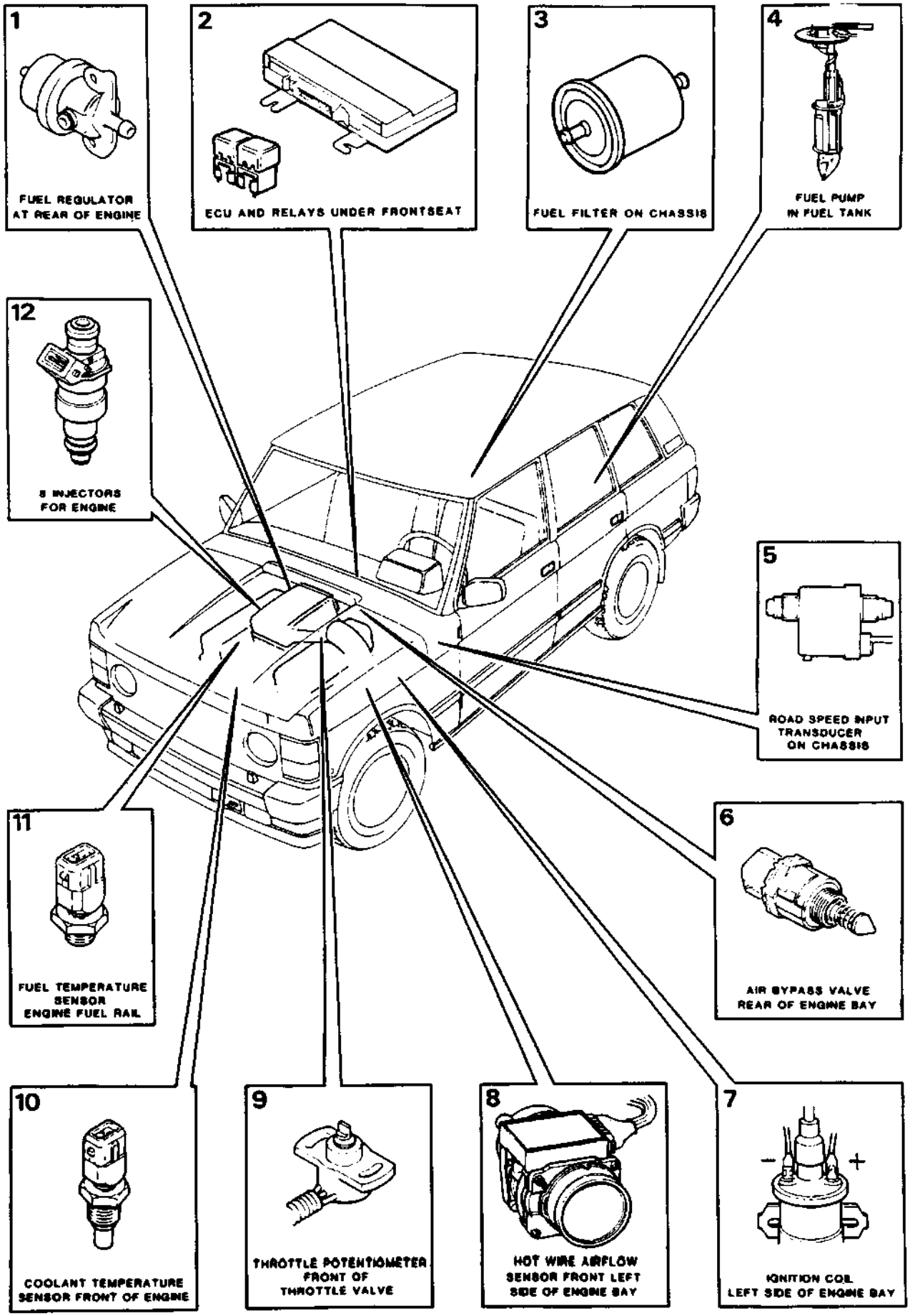
1. 40 way connector to Electronic Control Unit (ECU).
2. Lambda sensor (left side - bank A).
3. Lambda sensor (right side - bank B).
4. By-pass air valve (stepper motor) (fast idle).
5. Lambda sensor screened ground.
6. Fuse 18 - main fuse panel.
7. Pick-up point E.F.I. warning symbol (instrument binnacle).
8. Fuel pump.
9. Ignition switch.
10. Speed transducer (road speed input).
11. Neutral switch (automatic gearbox) (load input).
12. Pick-up point-air conditioning circuit (load input).
13. Battery.
14. Diagnostic plug.
15. In-line resistor.
16. Coil/-ve (engine RPM input).
17. Coolant temperature thermistor (sensor) (input).
18. Fuel temperature thermister (sensor) (input).
19. Throttle potentiometer.
20. Air flow sensor.
21. Fuel pump relay.
22. Main relay.
23. Injectors-1 to 8.

= = = Denotes screened ground.

Cable colour code

B	Black	G	Green	R	Red	S	Grey
U	Blue	O	Orange	W	White	K	Pink
N	Brown	P	Purple	Y	Yellow	LG	Light green

The last letter of a colour code denotes the tracer.


1
FUEL REGULATOR AT REAR OF ENGINE
2
ECU AND RELAYS UNDER FRONTSEAT
3
FUEL FILTER ON CHASSIS
4
FUEL PUMP IN FUEL TANK
12
8 INJECTORS FOR ENGINE
5
ROAD SPEED INPUT TRANSDUCER ON CHASSIS
11
FUEL TEMPERATURE SENSOR ENGINE FUEL RAIL
6
AIR BYPASS VALVE REAR OF ENGINE BAY
10
COOLANT TEMPERATURE SENSOR FRONT OF ENGINE
9
THROTTLE POTENTIOMETER FRONT OF THROTTLE VALVE
8
HOT WIRE AIRFLOW SENSOR FRONT LEFT SIDE OF ENGINE BAY
7
IGNITION COIL LEFT SIDE OF ENGINE BAY

INTRODUCTION

The Electronic Fuel Injection system provides a reliable and efficient microprocessor controlled fuel management system.

The function of the system is to supply the exact amount of fuel directly into the inlet manifold according to the prevailing engine operating conditions.

To monitor these conditions, various sensors are fitted to the engine to measure engine parameters. Data from the sensors is received by the Electronic Control Unit (E.C.U.), the E.C.U. will then determine the exact amount of fuel required at any condition.

The E.C.U. having received data from the sensors produces pulses, the length of which will determine the simultaneous open time of each bank of injectors in turn, which will govern the amount of fuel injected.

DESCRIPTION

ELECTRONIC CONTROL UNIT-ECU

The Electronic Fuel Injection system is controlled by the E.C.U. which is located under the front right hand seat. The control unit is a microprocessor with integrated circuits and components mounted on printed circuit boards. The E.C.U. is connected to the main harness by a 40 pin plug.

INJECTORS

The eight fuel injectors are fitted between the pressurised fuel rail and inlet manifold. Each injector comprises a solenoid operated needle valve with a movable plunger rigidly attached to the nozzle valve. When the solenoid is energised the plunger is attracted off its seat and allows pressurised fuel into the intake manifold.

ENGINE COOLANT TEMPERATURE THERMISTOR (SENSOR)

The coolant thermistor (sensor) is located by the front left hand branch of the intake manifold. The thermistor provides engine coolant information to the E.C.U. The E.C.U. on receiving the signal from the thermistor will lengthen slightly the time that the injectors are open, and reducing this time as the engine reaches normal operating temperature.

FUEL TEMPERATURE THERMISTOR (SENSOR)

The fuel temperature thermistor (sensor) is located in the fuel rail forward of the ram housing. The thermistor sends fuel temperature data to the E.C.U, the E.C.U on receiving the data will adjust the injector open time accordingly to produce good hot starting in high ambient temperatures.

BYPASS AIR VALVE (STEPPER MOTOR)

The bypass valve is screwed into a housing attached to the rear of the plenum chamber, between the plenum chamber and bulkhead. The bypass valve has two windings which enable the motor to be energised in both directions thus opening or closing the air valve as required by the E.C.U.
The bypass valve will open and allow extra air into the plenum chamber to maintain engine idle speed when the engine is under increased (Electrical and Mechanical) loads.
The bypass valve will control engine idle speed when the vehicle is stationary.

LAMBDA SENSORS (0_2 SENSORS)

The two Lambda sensors are located forward of the catalysts mounted in the exhaust downpipes.
The sensors monitor the oxygen content of the exhaust gases and provide feedback information of the air/fuel ratio to the E.C.U. Each sensor is heated by an electrical element to improve its response time when the ignition is switched on.

Continued

FUEL PRESSURE REGULATOR

The fuel pressure regulator is mounted in the fuel rail at the rear of the plenum chamber. The regulator is a mechanical device controlled by plenum chamber vacuum, it ensures that fuel rail pressure is maintained at a constant pressure difference of 2.5 bar above that of the manifold.
When pressure exceeds the regulator setting excess fuel is returned to the fuel tank.

FUEL PUMP

The electric fuel pump is located in the fuel tank, and is a self priming 'wet' pump, the motor is immersed in the fuel within the tank.

AIR FLOW SENSOR

The hot-wire air flow sensor is mounted on a bracket attached to the left hand valance, rigidly connected to the air cleaner and by hose to the plenum chamber inlet neck.
The air flow sensor consists of a cast alloy body through which air flows. A proportion of this air flows through a bypass in which two wire elements are situated: one is a sensing wire and the other is a compensating wire. Under the control of an electronic module which is mounted on the air flow sensor body, a small current is passed through the sensing wire to produce a heating effect. The compensating wire is also connected to the module but is not heated, but reacts to the temperature of the air taken in, as engine intake air passes over the wires a cooling effect takes place.

The electronic module monitors the reaction of the wires in proportion to the air stream and provides output signals in proportion to the air mass flow rate which are compatible with the requirements of the E.C.U.

THROTTLE POTENTIOMETER

The throttle potentiometer is mounted on the side of the plenum chamber inlet neck and is directly coupled to the throttle valve shaft.
The potentiometer is a resistive device supplied with a voltage from the E.C.U. Movement of the throttle pedal causes the throttle valve to open, thus rotating the wiper arm within the potentiometer which in turn varies the resistance in proportion to the valve position. The E.C.U. lengthens the injector open time when it detects a change in output voltage (rising) from the potentiometer.
In addition the E.C.U. will weaken the mixture when it detects the potentiometer output voltage is decreasing under deceleration and will shorten the length of time the injectors are open.
When the throttle is fully open, the E.C.U. will detect the corresponding throttle potentiometer voltage and will apply full load enrichment. This is a fixed percentage and is independent of temperature. Full load enrichment is also achieved by adjusting the length of the injector open time.
When the throttle is closed, overrun fuel cut off or idle speed control may be facilitated dependant on other inputs to the E.C.U.

ROAD SPEED TRANSDUCER

The road speed transducer is fitted between the upper and lower speedometer cables. It is mounted on a bracket located on the left hand chassis side member adjacent to the rear engine mounting. The transducer provides road speed data to the ECU. The ECU in turn detects vehicle movement from the road speed input and ensures that idle speed control mode is disengaged. Should the speed transducer fail in service the ECU idle speed control would become erratic.

RELAYS

The two electronic fuel injection relays are located under the front right hand seat mounted forward of the E.C.U. The main relay is energised via the E.C.U when the ignition is switched on and supplies current to the fuel injection system. The fuel pump relay is energised by the E.C.U. which in turn operates the fuel pump to pressurise the fuel system.

E.F.I. WARNING SYMBOL (Instrument binnacle)

An E.F.I. warning symbol incorporated into the instrument binnacle will illuminate when the E.C.U. detects that it cannot maintain correct air/fuel ratio due to a fault in one of the following fuel injection system components.

Air flow sensor.
Lambda sensor.
Water temperature thermistor. (sensor)
Throttle potentiometer.

If the symbol illuminates when the engine is idling or the vehicle is being driven it indicates a failure of one of the four functions, the vehicle should be driven with care, and the cause rectified, refer to test procedure for the particular functions. Should one of the functions fail, the vehicle can still be driven due to a limp home feature incorporated into the fuel injection system.

FUEL INJECTION SYSTEM

CAUTION: The fuel system incorporates fine metering components that would be affected by any dirt in the system; therefore it is essential that working conditions are scrupulously clean. If it is necessary to disconnect any part of the fuel injection system, the system MUST be depressurised. All openings left open after the removal of any component from the fuel system, MUST be sealed off to prevent ingress of dirt.

ENGINE SETTING PROCEDURE

If a major overhaul has been undertaken on the fuel injection/engine system, the following check and adjustments must be carried out before attempting to start the engine.

A. **Throttle potentiometer setting** - see 'Throttle switch - potentiometer' setting procedure.
B. **Spark plug gaps** - see 'section 04 General Specification'.
C. **Throttle levers** - see 'Throttle lever setting procedure'.
D. **Ignition timing** - static - see 'Section 86 Electrical'.

CAUTION: IF THE ENGINE IS MISFIRING, IT SHOULD BE IMMEDIATELY SHUT DOWN AND THE CAUSE RECTIFIED. FAILURE TO DO SO WILL RESULT IN IRREPARABLE DAMAGE TO THE CATALYSTS.

NOTE: If the previous checks and adjustments are satisfactory but the engine will not start the ignition and fuel injection electrical circuitory must be checked using the appropriate recommended equipment.

Recommended Equipment -

Lucas 'Electronic Ignition Analyser'
Lucas Part Number - YWB 119.

Lucas 'E.F.I. Throttle Potentiometer Adjustment Gauge'
Lucas Part Number - YWB 121

Lucas Diagnostic Equipment
Lucas Part Number - 60600965 (complete kit)

Individual part numbers for the above kit are as follows:

Hand held test unit	**- Model 2HHT**
Lucas Part Number	**- 84772**
Interface unit	**- Model 2IU**
Lucas Part Number	**- 84773**
Serial link lead	
Lucas Part Number	**- 54744753**
Memory card	
Lucas Part Number	**- 54744Z54**
Operating manual	
Lucas Part Number	**- XXB825**
Plastic case	
Lucas Part Number	**- 54744755**

NOTE: The Lucas diagnostic equipment can be connected to the diagnostic plug located by the E.C.U.

Use in conjunction with the Lucas Operating Instruction Manuals.

If the above equipment is unavailable the tests can be carried out using a multi-meter, following the instructions given in the charts.

CAUTION: Ensure the multi-meter is correctly set to volts or ohms, dependent upon which test is being undertaken.

Carry out the following static checks before undertaking the continuity procedure:-

A. **Fuse 18** - in main fuse panel - is intact.
B. **Fuel** - ample fuel in fuel tank.
C. **Battery Condition** - state of charge.
D. **Air Leaks** - no unmetered air entering engine system.
E. **Electrical Connections** - dry, clean and secure.

CONTINUITY TEST PROCEDURE

The continuity procedure and instructions on the following pages must be followed precisely to prevent damage occurring to any of the fuel system components.

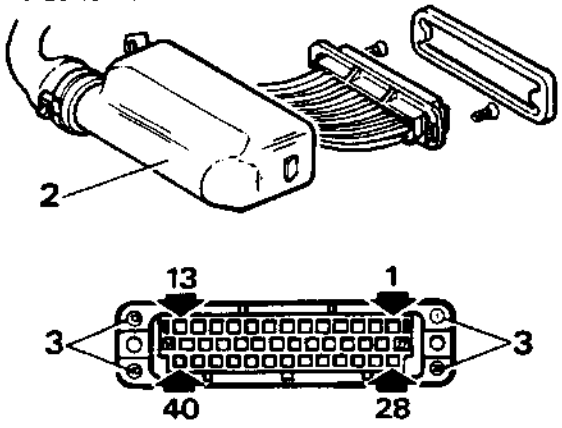
To enable the tests to be carried out when the 40 way multi-plug is connected to the E.C.U., it is necessary to remove the two screws securing the shroud to the plug to enable the multi-meter probes to be inserted into the back of the appropriate pin.

CAUTION: Tests that require the plug to be removed from the E.C.U., must also have the meter probes inserted into the back of the plug. If the probes are inserted into the plug sockets, damage will occur to the sockets resulting in poor connections when the plug is reconnected.

TESTING

1. Remove the E.C.U., and harness plug from beneath the front right hand seat, access is gained through the rear opening of the seat base.
2. Remove the seal and two retaining screws from the front of the plug. Maneouver the plug shroud along the harness until there is enough clearance enabling meter probes to be inserted into the back of the plug.
3. There are 6 pin numbers, 1, 13, 14, 27, 28, 40 moulded onto the rear of the plug for pin position identification as shown in the illustration below, (for clarity the electrical leads have been omitted).

Pins 1 to 13 top row.
Pins 14 to 27 centre row.
Pins 28 to 40 bottom row.



RR2320E

PIN NOS. CABLE COLOUR

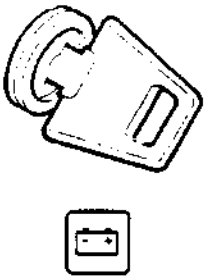
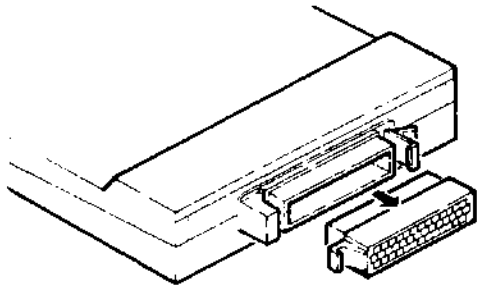
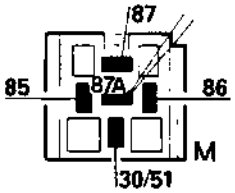
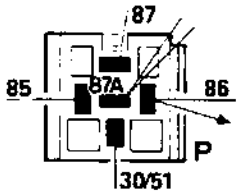
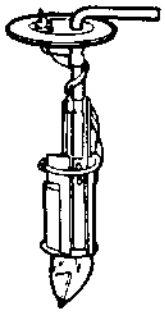
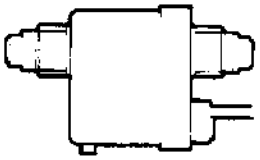
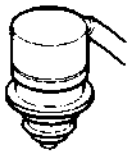
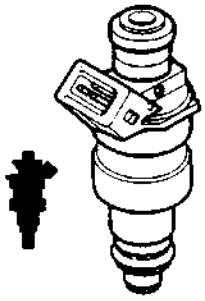
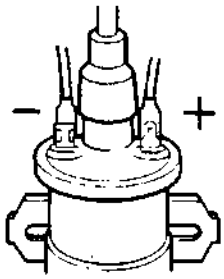
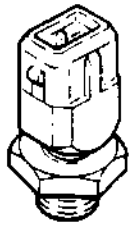
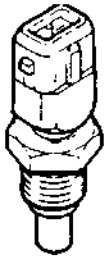
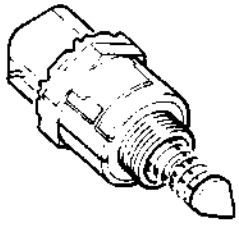
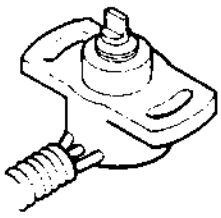
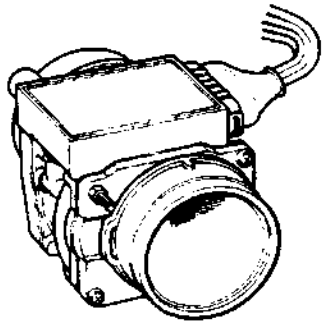
1. Red/green
2. Brown/orange
3. Yellow
4. Black
5. Brown/purple
6. Yellow
7. Green/blue
8. Not used
9. White/light green
10. Black/Yellow
11. Yellow/white
12. Blue/red
13. Yellow/blue
14. Black
15. Brown
16. Blue/purple
17. Not used
18. White/pink
19. White/grey
20. Red
21. Yellow/blue
22. Blue/red
23. Blue
24. Blue
25. Red/black
26. Green/white
27. Black/grey
28. Blue/grey
29. Orange
30. Not used
31. Not used
32. Grey/white
33. Not used
34. Black/orange
35. Blue/green
36. Not used
37. White/yellow
38. Not used
39. White/black
40. Black

The last colour denotes the wire tracer colour.

Continued

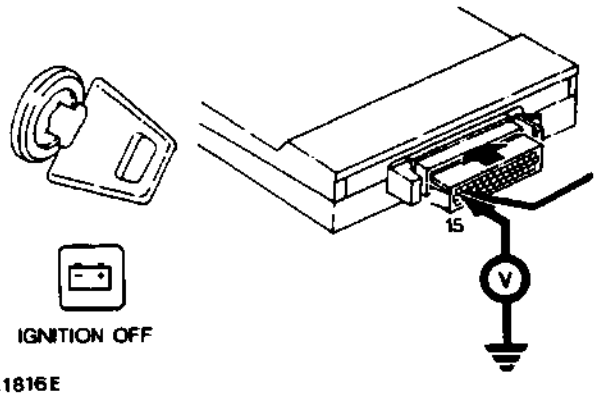
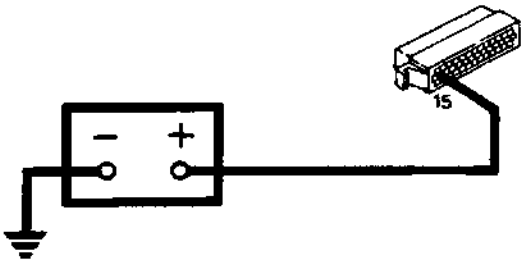
TESTS - Using a Multi-Meter

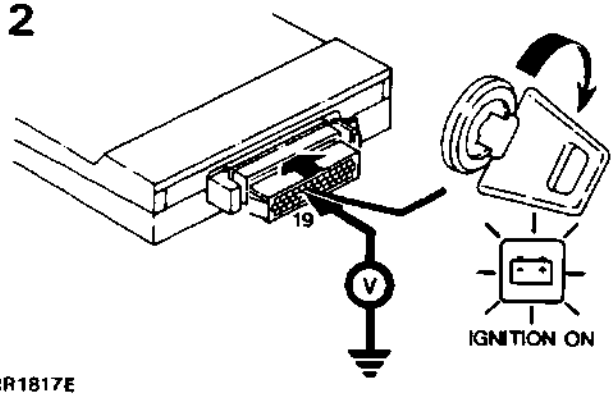
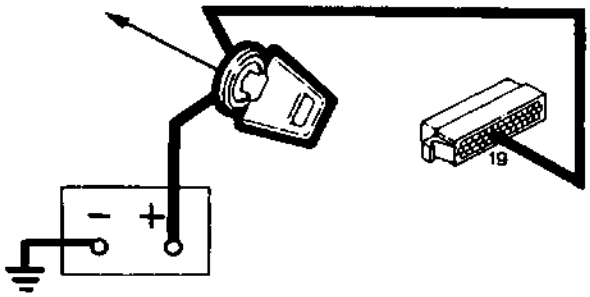
The following continuity tests are intended as a guide to identifying where a fault may be within a circuit; reference should be made to the fuel injection circuit diagram for full circuit information.

<table>
<tr><td>KEY
TO SYMBOLS</td><td> 
IGNITION SWITCH</td><td colspan="2"> 
ELECTRONIC CONTROL UNIT
AND MULTIPLUG</td><td> 
TEMPORARY
CONNECTION</td></tr>
<tr><td> 
OHMMETER
CONNECTIONS</td><td> 
VOLTMETER
CONNECTIONS</td><td> 
MAIN RELAY</td><td> 
PUMP RELAY</td><td> 
FUEL PUMP</td></tr>
<tr><td> 
ROAD SPEED
INPUT (SPEED
TRANSDUCER)</td><td> 
GEAR
INPUT SWITCH
(INHIBITOR
SWITCH)</td><td> 
INJECTOR</td><td> 
IGNITION COIL</td><td> 
FUEL
TEMPERATURE
SENSOR</td></tr>
<tr><td> 
COOLANT
TEMPERATURE
SENSOR</td><td> 
AIR BYPASS
VALVE</td><td> 
THROTTLE
POTENTIOMETER</td><td colspan="2"> 
HOT WIRE AIRFLOW SENSOR</td></tr>
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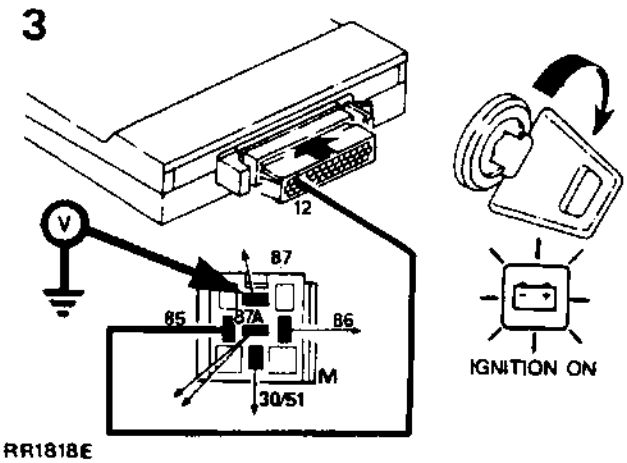
RR1782E

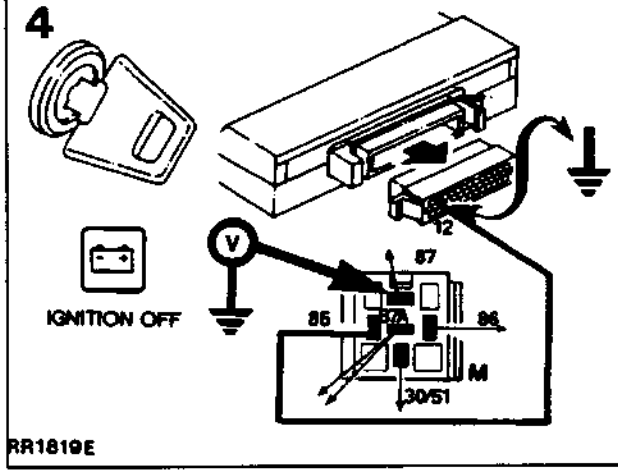
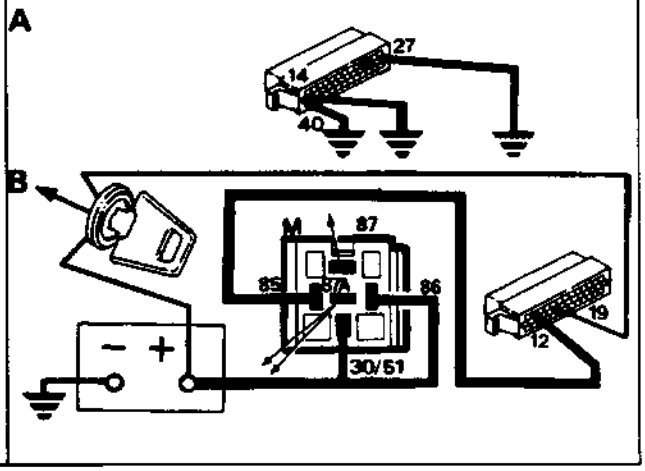
NOTE: All tests are carried out from the electronic control unit (ECU) harness multi-plug unless stated otherwise in the test procedure.

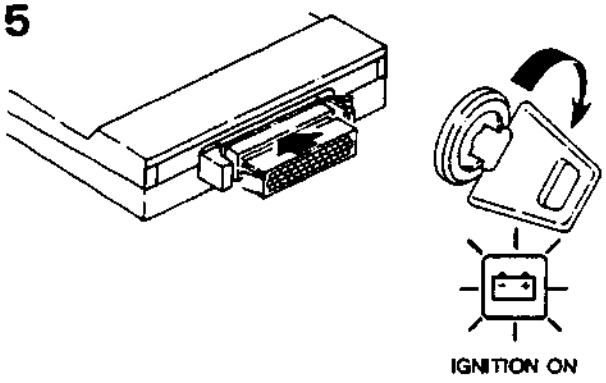
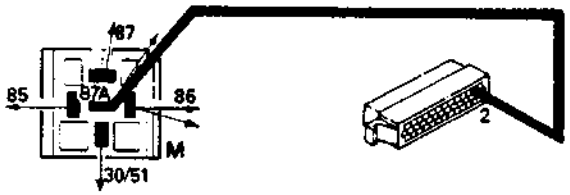
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
1. **Check battery supply to ECU**	Voltmeter reading of battery volts - (mimimum battery voltage 10 volts) Proceed to Test 2 Voltmeter reading of zero volts Check:-
1  RR1816E	

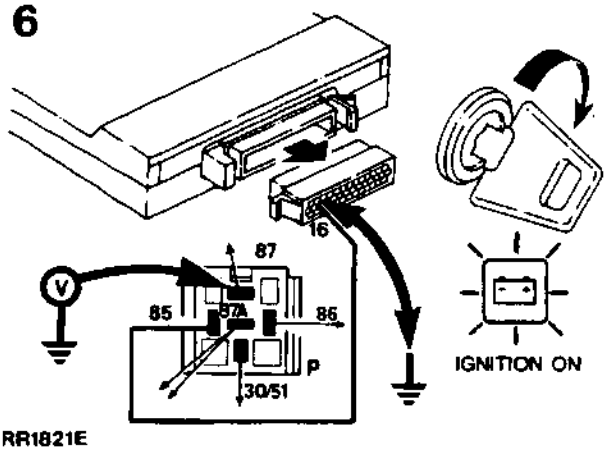
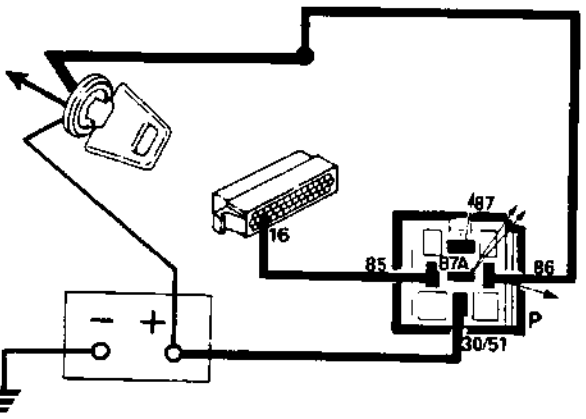
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
2. **Check ignition supply to ECU**	Voltmeter reading of battery volts - (minimum battery voltage 10 volts) Proceed to Test 3 Incorrect reading check:-
2  RR1817E	

Continued

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
3. **Check operation of Main relay**	Voltmeter reading of battery volts - Proceed to Test 5
	Voltmeter reading of zero volts - Proceed to Test 4
	

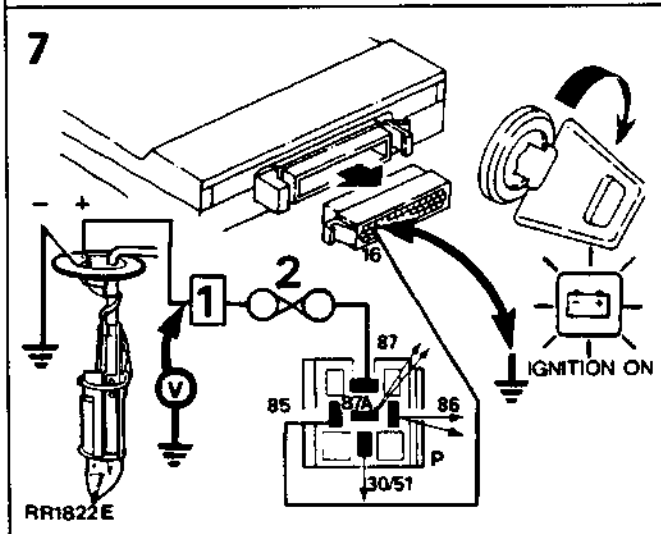
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
4. **Fault Diagnosis Main relay circuits**	A. Voltmeter reading of battery volts - Check:- If OK Suspect ECU
	B. Voltmeter reading of zero volts Check:-
	

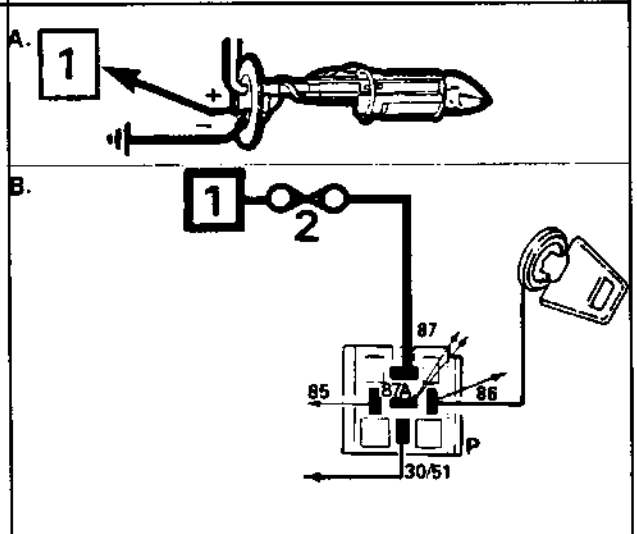
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
5. **Check operation of pump relay**	Listen for audible 'click' from pump relay. If O.K - Proceed to Test 7
	No audible 'click' from pump relay Check:- If OK proceed to Test 6.
5  RR1820E	

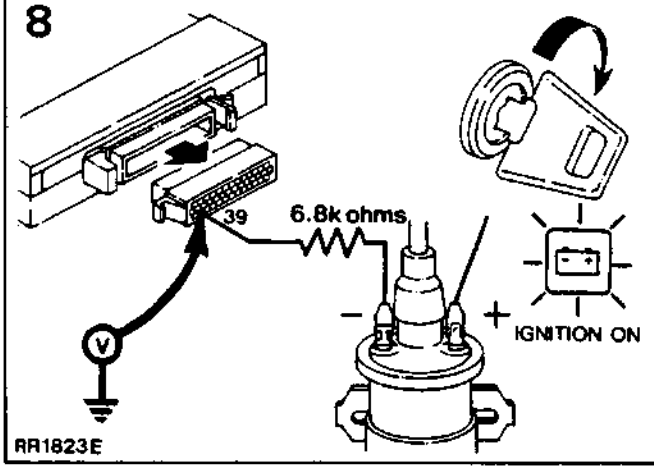
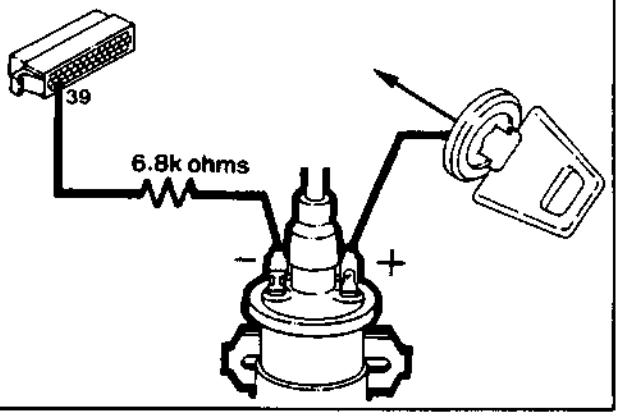
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
6. **Fault diagnosis Pump relay circuits**	Voltmeter reading of battery volts - Suspect ECU
	Voltmeter reading of zero volts Check:-
6  RR1821E	

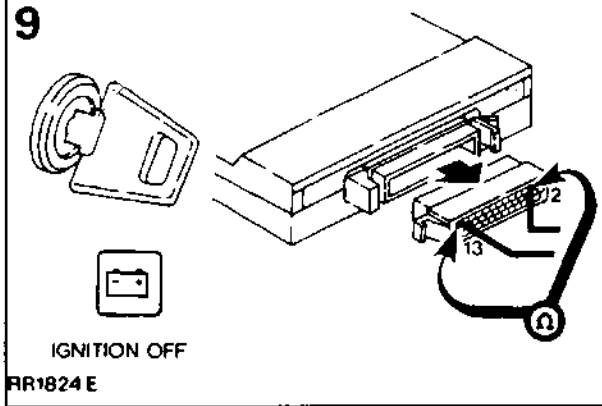
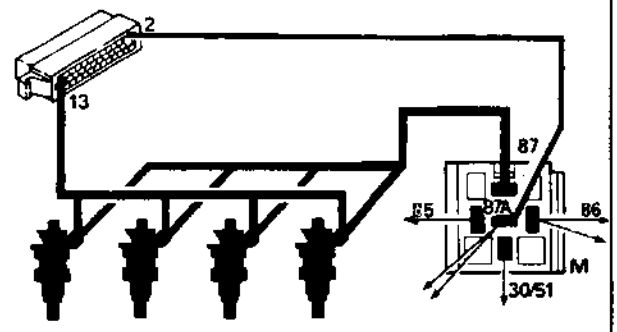
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TEST PROCEDURE	RESULTS - Check cables and units shown in bold
7. **Check operation of Fuel pump** **NOTE: It is not possible to place the multi-meter probes directly onto the pump terminals. A link lead attached to the pump is accessible behind the rear left hand wheel located between the chassis and stowage area floor panel.** **KEY:** **1. Harness plug - link lead** **2. Fuse 18**	Voltmeter reading of battery volts - Pump operating - Proceed to Test 8 (A) Voltmeter reading of battery volts - Pump not operating Check:- (B) Voltmeter reading of zero volts Check:-

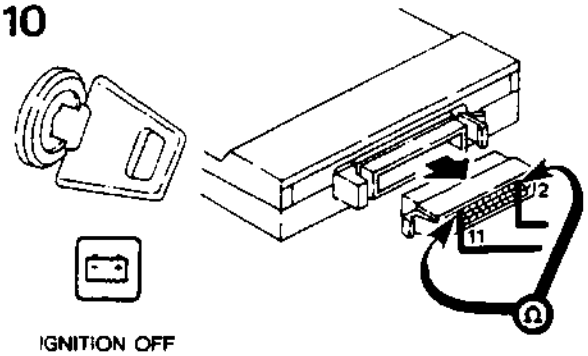
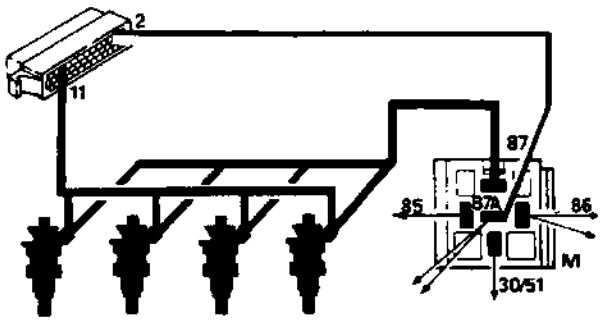


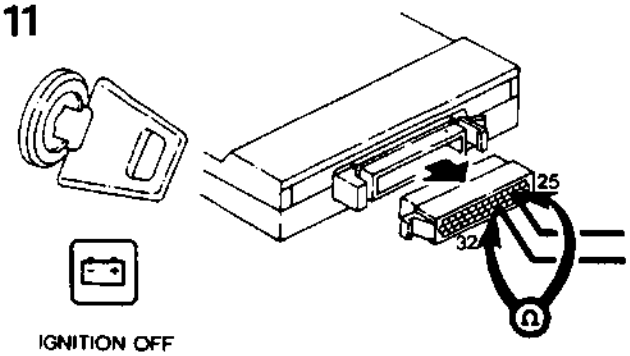


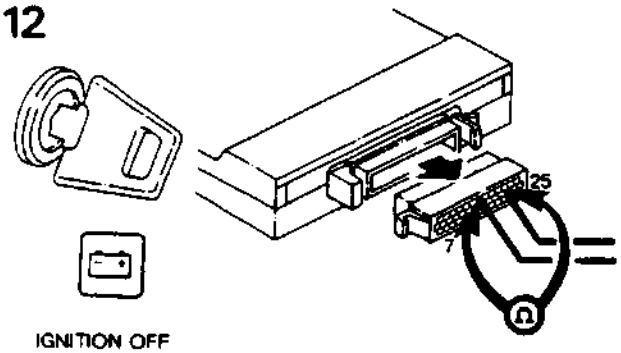
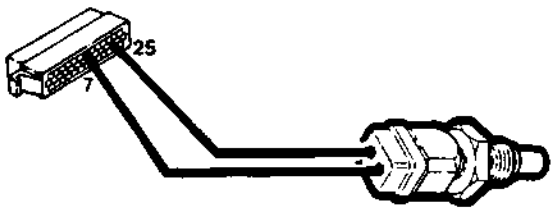
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
8. **Check engine speed signal Cable and resistor**	Voltmeter reading of battery volts - Proceed to Test 9
	Voltmeter reading of zero volts Check:-
8  	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
9. **Check injectors, Injector circuit** **(Pin 13 left bank injectors 1,3,5,7).**	Ohm-meter reading of 4-5 Ohms - Proceed to Test 10
	Ohm-meter reading of 5-6 Ohms - Suspect 1 injector Ohm-meter reading of 8-9 Ohms - Suspect 2 injectors Ohm-meter reading of 16-17 Ohms - Suspect 3 injectors Check for open circuit injector(s) or wiring faults.
	Ohm-meter reading of Infinity Check:
9  	

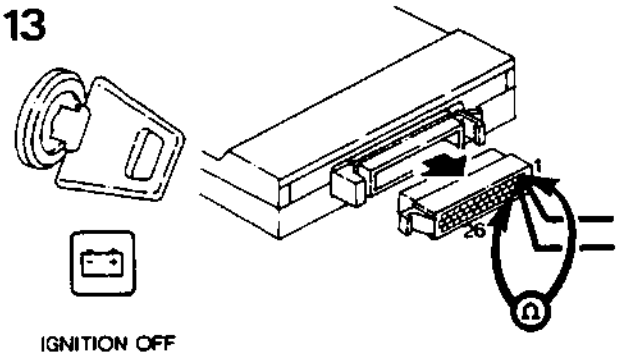
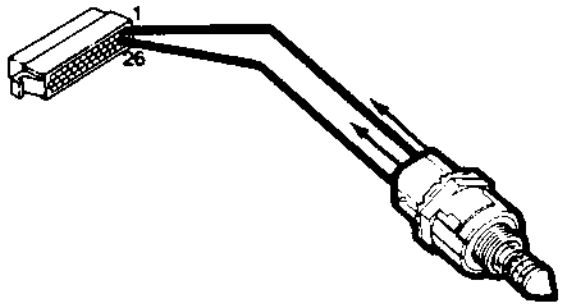
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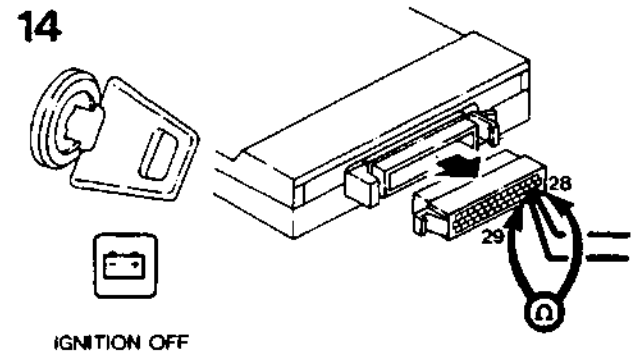
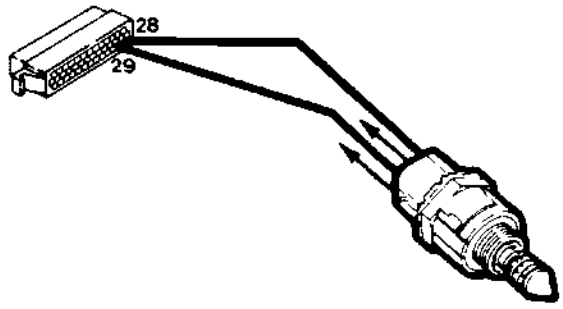
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
10. **Check injectors** **Injector circuit** **(Pin 11 rightbank injectors 2,4,6,8)**	Ohm-meter reading of 4-5 Ohms - Proceed to Test 11.
	Ohm-meter reading of 5-6 Ohms - Suspect 1 injector Ohm-meter reading of 8-9 Ohms - Suspect 2 injectors Ohm-meter reading of 16-17 Ohms - Suspect 3 injectors Check for open circuit injector(s) or wiring faults.
	Ohm-meter reading of Infinity Check:
10  IGNITION OFF RR1825E	

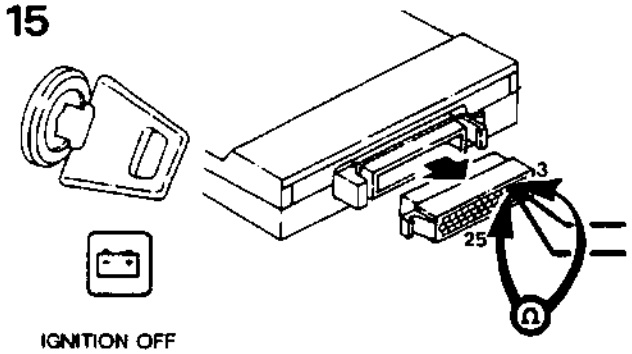
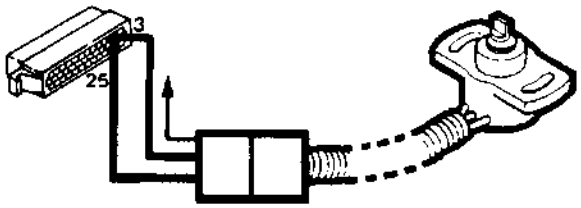
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
11. **Check fuel temperature thermistor (sensor)**	Correct reading-temperature to resistance - Proceed to Test 12 (Refer to Temperature Conversion Charts in Test 12
	Incorrect Ohm-meter reading Check
11  IGNITION OFF RR1826E	

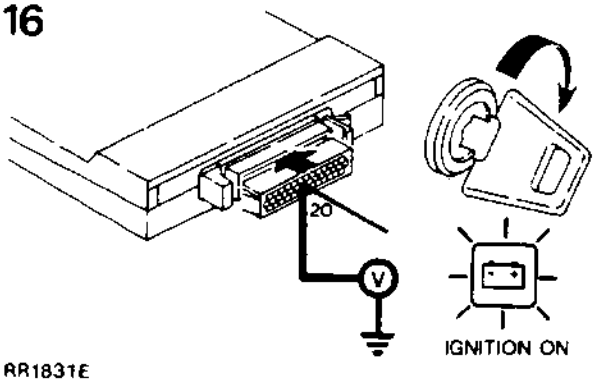
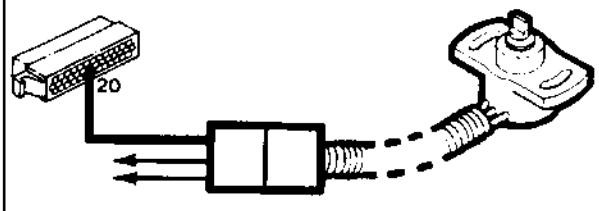
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
12. Check coolant temperature thermistor (sensor)	Correct reading-Temperature to resistance - Proceed to Test 13 (Refer to Temperature Conversion Chart below).
	Fuel and Coolant Temperature °C / °F — Ohm-meter Reading Should be Ohms: -10° / 14° — 9100 - 9300 0° / 32° — 5700 - 5900 20° / 68° — 2400 - 2600 40° / 104° — 1100 - 1300 60° / 140° — 500 - 700 80° / 176° — 300 - 400 100° / 212° — 150 - 200
	Incorrect Ohm-meter reading Check:-
12  IGNITION OFF RR1827E	

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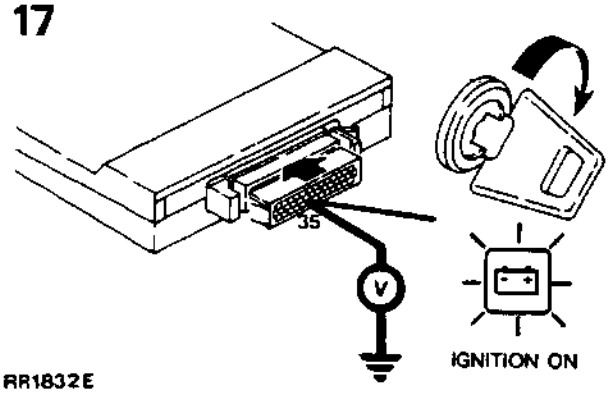
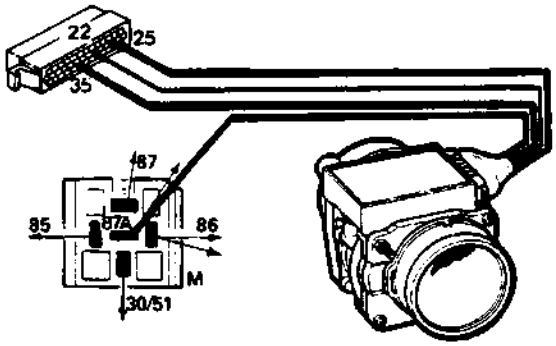
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
13. Check air bypass valve - Part 1	Ohm-meter reading of 48-58 Ohms - Proceed to Test 14
	Incorrect reading Check:-
13  IGNITION OFF RR1828E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
14. Check air bypass valve - Part 2	Ohm-meter reading of 48-58 Ohms - Proceed to Test 15
	Incorrect reading Check:-
14  IGNITION OFF RR1829E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
15. Check throttle potentiometer - Part 1	Ohm-meter reading of 5000 Ohms - Proceed to Test 16
	Incorrect reading of Infinity Check:-
15  IGNITION OFF RR1830E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
16. Check throttle potentiometer - Part 2	Correct voltmeter readings- Proceed to Test 17 Throttle closed — Throttle open 0.29) — (4.6 Volts) smooth ( ) ---------- (0.36) swing (5.0 Volts
	Incorrect voltmeter readings Check:-
16  RR1831E	

Continued

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
17. **Check output of Airflow sensor**	Voltmeter reading of 0.3-0.6 volts- Proceed to Test 18
	Incorrect voltmeter reading Check:-
17  RR1832E	

PRECAUTION:

Depressurise the fuel system when fitting the fuel pressure gauge or disconnecting/replacing fuel system components.

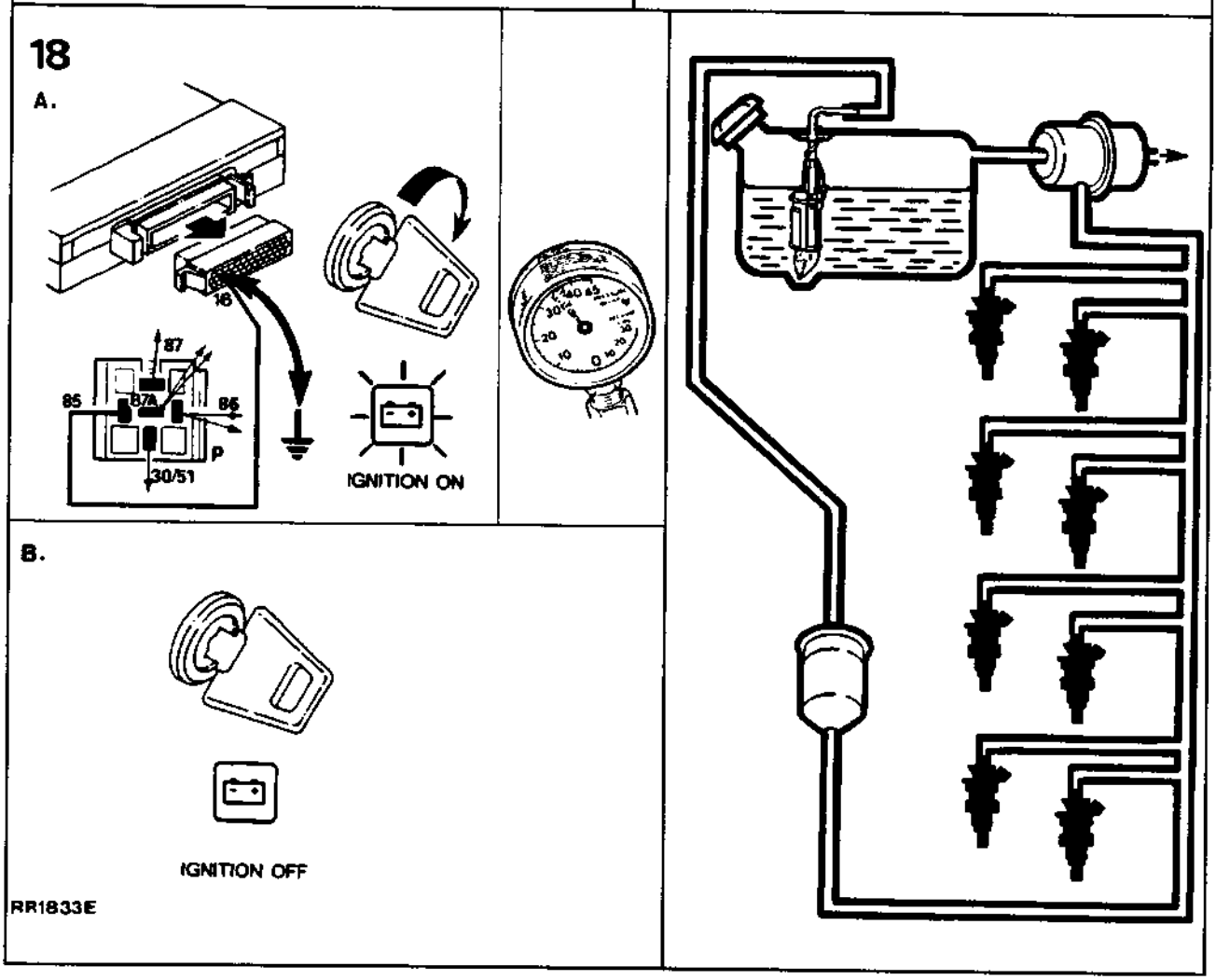
CAUTION: Thoroughly clean the immediate area around the fuel filter and hose connections before disconnecting the fuel feed line from the filter. Failure to do so could cause foreign matter to be present in the fuel system which would be detrimental to the fuel system components.

WARNING: The spillage of fuel from the fuel filter is unavoidable when disconnecting the fuel feed line, ensure that all necessary precautions are taken to prevent fire and explosion due to fuel vapour and fuel seepage.

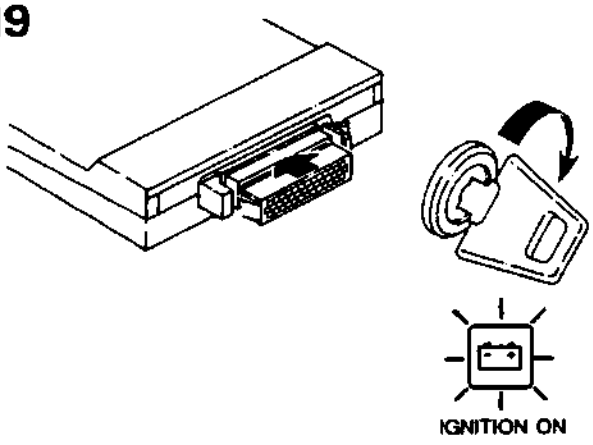
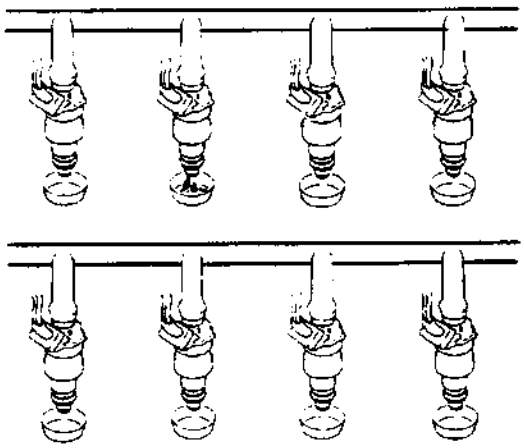
DEPRESSURISING PROCEDURE

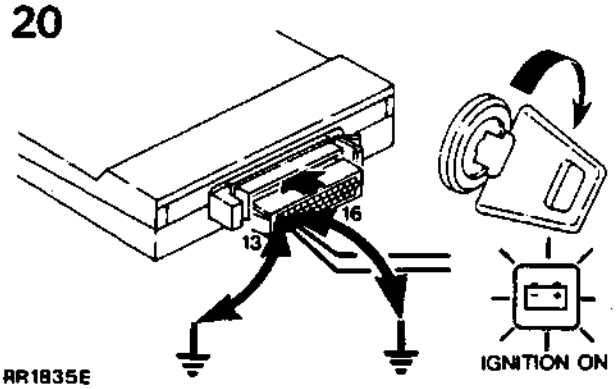
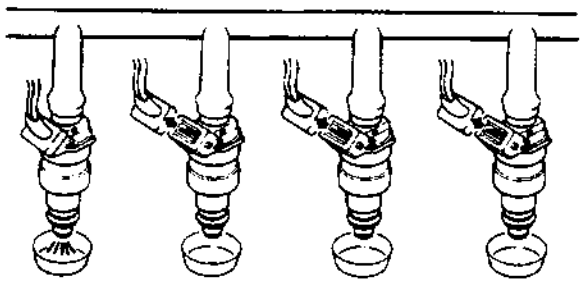
a) Ignition off, pull pump relay off its terminal block.
b) Crank engine for a few seconds - engine may fire and run until fuel pressure is reduced.
c) Switch off the ignition.
d) Connect fuel pressure gauge in the fuel supply line between the fuel rail and the fuel filter, adjacent to the filter (see Test 18).
e) Reconnect the pump relay.

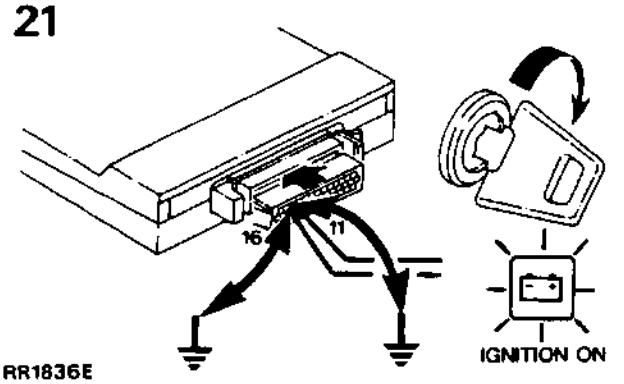
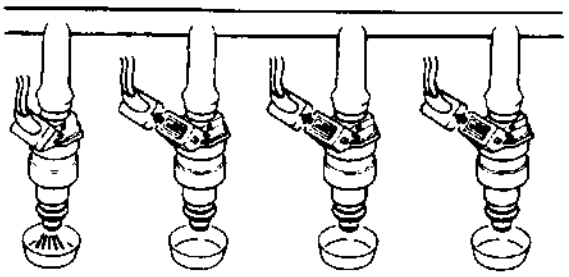
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
18. Check fuel system pressure **Service tool 18G 1500** **NOTE: Insert the pressure gauge in the fuel feed line immediately after the fuel line filter. The filter is located beneath the right hand rear wheel arch attached to the chassis**	(A) Expected reading 2,4-2,6 kgf/cm² (34.0-37.0 p.s.i.) (B) Pressure drop-max 0.7 kgf/cm² (10 p.s.i.) in one minute



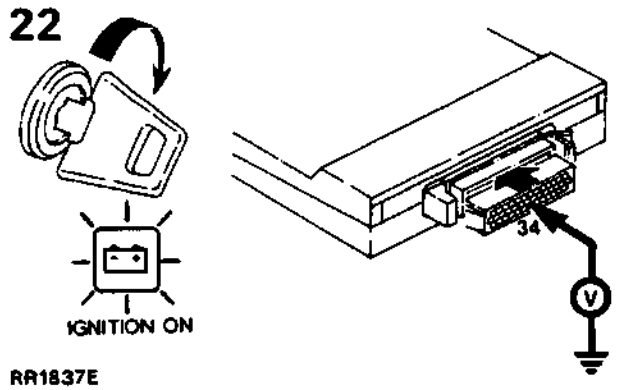
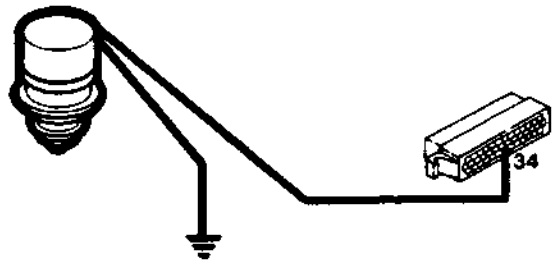
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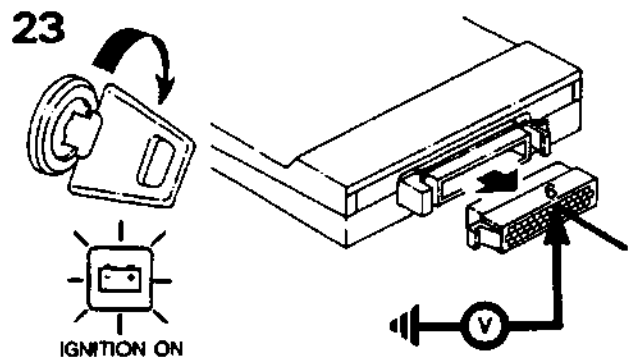
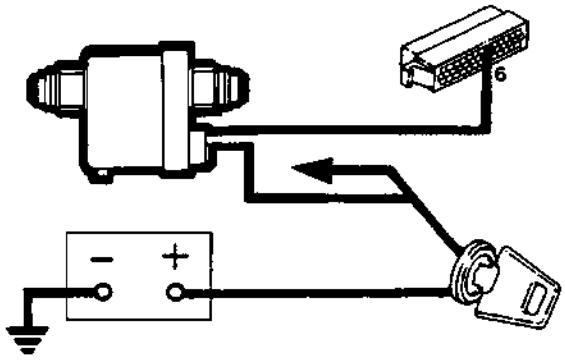
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
19. **Check for leaking injector** **NOTE: Before removing any of the injectors, remove and examine the spark plugs, check for consistent colouration of plugs. A leaking injector will result in the appropriate spark plug being 'sooted up'.** **Remove all injectors from manifold but do not disconnect from fuel rail**	**WARNING: Ensure that all necessary precautions are taken to prevent fire and explosion.** Replace any injector which leaks more than 2 drops of fuel per minute.
19  RR1834E	

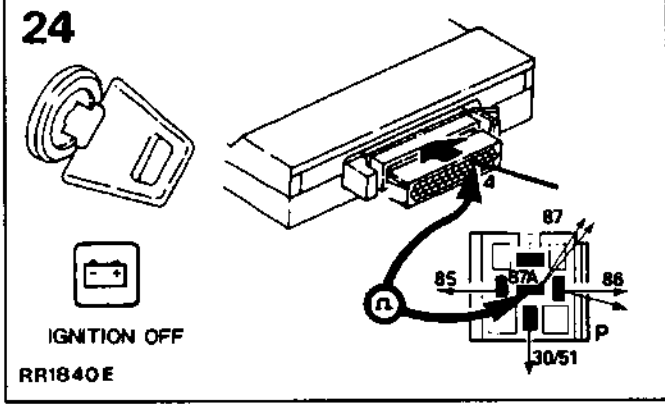
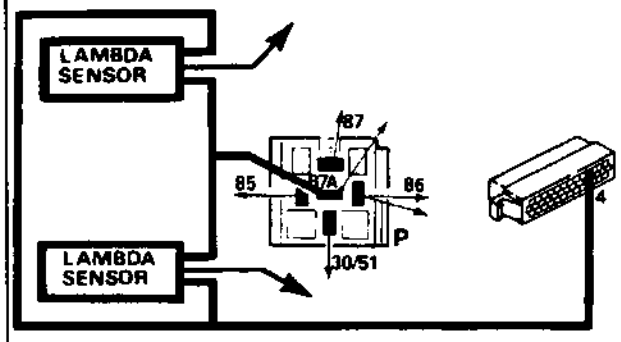
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
20. **Check for injector operation** **Left bank injectors 1,3,5,7**	**WARNING: Ensure that all necessary precautions are taken to prevent fire and explosion.** Repeat test for other injectors Replace any injector which does not operate. **NOTE: Fuel flow is 167cc minimum per minute per injector**
20  RR1835E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
21. **Right bank injectors 2,4,6,8**	**WARNING: Ensure that all necessary precautions are taken to prevent fire and explosion** Repeat test for other injectors Replace any injector which does not operate **NOTE: Fuel flow is 167cc minimum per minute per injector**
21  RR1836E	

Continued

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
22. Check gear switch input	Voltmeter reading of zero volts- Neutral and park
	Voltmeter reading of 4.5-5.0 Volts -R.D.3.2.1 - Proceed to Test 23
	Incorrect reading Check:
 RR1837E	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
23. Check road speed input **NOTE: Raise and rotate the left hand rear road wheel slowly**	Voltmeter reading of 0 to 12V fluctuating 6 times per revolution - Proceed to Test 24 Incorrect reading Check:
	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
24. Check Lambda sensor heater coils **NOTE: Remove pump relay from its connector**	Ohm-meter reading of 2.65-3.35 Ohms Incorrect reading Check: **NOTE: A reading of 5.3 to 6.7 Ohms indicates a faulty Lambda sensor**
	

After completing the tests with either the 'Diagnostic' equipment or multi-meter, re-test the vehicle to ensure the faults have been rectified. If faults still persist, recheck using the Lucas diagnostic equipment.

ENGINE TUNING PROCEDURE

Before carrying out 'Engine Tuning' on fuel injection vehicles, it is important that all other engine related setting procedures are undertaken first; air flow sensor to air cleaner correctly fitted, ignition and throttle potentiometer correcty set; all hoses correctly fitted and secured.

These checks should be carried out with the engine coolant temperature beween 80° to 95°C (176° to 203°F).

CHECK AND ADJUST IGNITION TIMING

1. Check that ignition timing is at 6° ± 1° BTDC.
2. Timing to be checked when engine speed is less than 800 rev/min using a stroboscopic lamp.
3. If adjustment is necessary, loosen the distributor clamp nut and rotate clockwise to retard or counter -clockwise to advance. When the required setting has been attained, tighten the clamp nut and re-check the setting.

   NOTE: Timing to be checked with vacuum hose connected.

IDLE SPEED is preset at the factory and should not normally require adjustment.

CAUTION:

A. If engine fails to start within a maximum time of 12 seconds the cause must be rectified. Following rectification the engine must be run at 1500 rpm (no load) for 3 minutes to clear any accumulation of fuel in the catalysts.

B. If the engine is misfiring, it should be immediately shut down and the cause rectified.

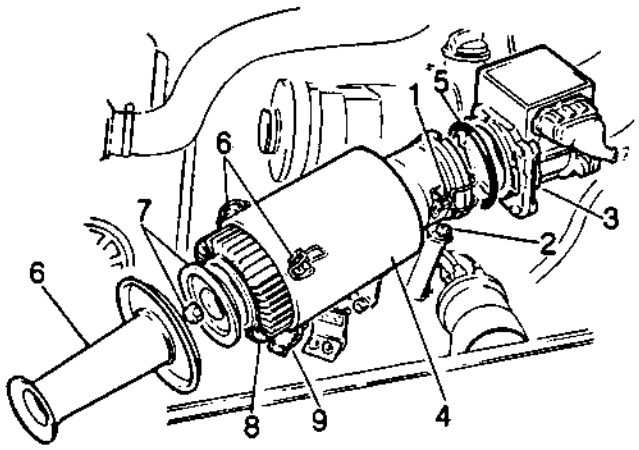
Failure to comply with A or B will result in irreparable damage to the catalysts.

AIR CLEANER

Remove and Refit

Removing

1. Release the two clamps securing the air cleaner to the airflow sensor.
2. Release the two nuts and bolts securing the air cleaner to the left hand valance mounting bracket.
3. Detach the airflow sensor from the air cleaner, and lay carefully to one side.
4. Detach the air cleaner from the centre mounting bracket and withdraw from the engine compartment.
5. Remove the large 'O' ring from the outlet tube of the air cleaner, inspect for condition, fit a new 'O' ring if in poor condition.
6. Unclip the three catches securing the inlet tube to the air cleaner canister and remove the inlet tube.
7. Remove the nut and end plate securing the air cleaner element in position.
8. Withdraw the air cleaner element and discard.
9. Inspect the dump valve for condition and that it is clear of obstructions.



RR1854E

Refitting

10. Fit a new element and secure in position.
11. Refit the inlet tube to the air cleaner canister.
12. Refit the air cleaner to the mounting bracket and tighten the two nuts and bolts.
13. Clip the air flow sensor to the air cleaner.

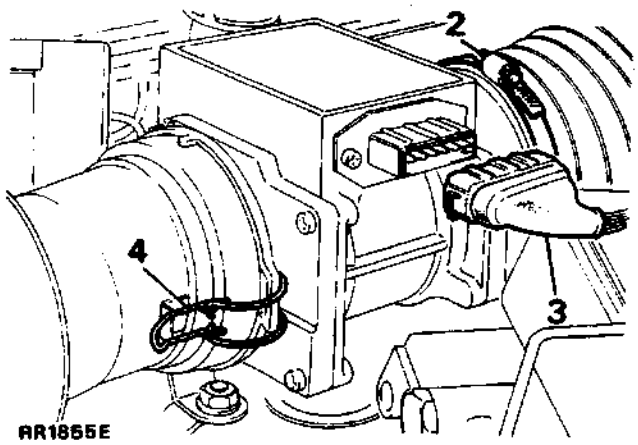
AIR FLOW SENSOR

Remove and refit

Removing

NOTE: The air flow sensor is not a serviceable item. In the event of failure or damage the complete unit is to be replaced.

1. Disconnect the battery negative terminal.
2. Release the large hose clamp at the rear of the air flow meter and disconnect the hose from the sensor.
3. Disconnect the multi-plug.
4. Release the two clips securing the air flow sensor to the air cleaner case detach the sensor from the case and withdraw it from the engine compartment.



AR1855E

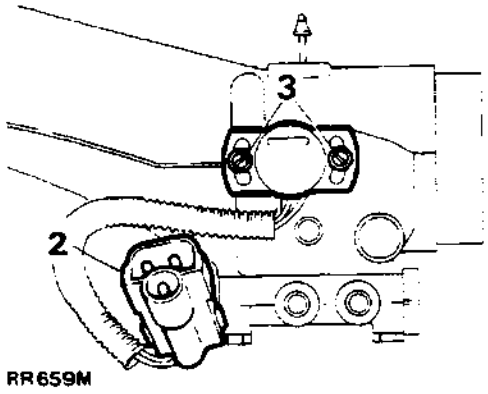
Refitting

5. Reverse the removal procedure ensuring that the multi-plug is firmly reconnected to the air flow sensor and that the hose clamp at the rear of the sensor is securely tightened, to prevent un-metered air entering the engine.

THROTTLE POTENTIOMETER

Remove

1. Disconnect the battery negative terminal.
2. Disconnect the electrical three-pin plug.
3. Remove the two screws securing the switch to the plenum chamber and carefully pull the switch off the throttle valve shaft.



4. Remove the old gasket.

Refit

5. Fit a new gasket between the throttle switch and plenum chamber.
6. Align the switch and shaft flats; slide the switch on to the throttle shaft and secure the switch to the plenum chamber.
7. The throttle potentiometer must be reset using a potentiometer adjustment gauge.

Setting the potentiometer

CAUTION: The throttle mechanism must not be operated while the potentiometer is loosely fitted, otherwise damage may be caused to the potentiometer wiper track.

Equipment required:-

Lucas throttle potentiometer adjustment gauge - **Lucas Part Number YWB121.**

8. Loosen the potentiometer securing screws.
9. Disconnect the three-pin plug from the potentiometer electrical lead. Connect the adjustment gauge plug to the potentiometer.
10. Connect the two alligator clamps from the throttle potentiometer gauge to the appropriate battery terminals and select position 'R' on the gauge.
11. Rotate the potentiometer clockwise or counter-clockwise until only the middle lamp of the three indication lamps is illuminated.
12. Tighten the potentiometer securing screws.
13. Re-check the potentiometer setting by operating the throttle levers.
14. Disconnect the adjustment gauge from the potentiometer and battery terminals.
15. Re-connect the harness three-pin plug to the potentiometer.

NOTE: If a potentiometer adjustment gauge is unavailable, the setting procedure can be carried out using a multi meter.

IF A MULTI METER IS USED TO CARRY OUT THIS CHECK-ENSURE IT IS SET TO VOLTS. A MULTI METER SETTING OTHER THAN VOLTS WILL RESULT IN DAMAGE TO THE POTENTIOMETER.

Setting the Potentiometer using a multi meter.

16. Loosen the potentiometer securing screws.
17. Switch on the ignition.
18. Connect the multi meter between the red and green leads at the potentiometer electrical plug.
19. Rotate the potentiometer clockwise or counter-clockwise, until the multi meter reads 325 $\pm$ 35 mV.
20. Tighten the potentiometer securing screws.
21. Re-check the multi-meter reading. Check also for a 'smooth swing' of the meter needle between minimum and maximum throttle opening between the voltage reading of 4.6 - 5.0 volts

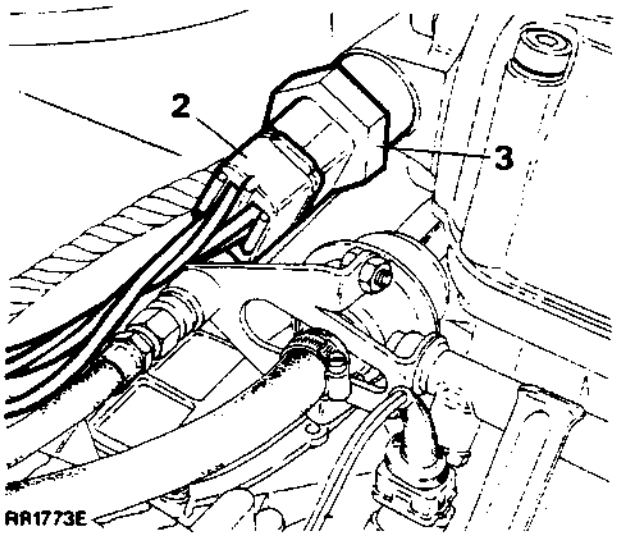
NOTE: After setting the potentiometer, lock and tamperproof each screw head by coating them with yellow paint.

BY-PASS AIR VALVE (STEPPER MOTOR)

Remove and refit

Removing

1. Disconnect the battery negative terminal.
2. Remove the multi-plug from the unit.
3. Unscrew the valve from its location at the rear of the plenum chamber.
4. Remove the captive washer.



Refitting

5. Fit a **NEW** sealing washer.

   NOTE: If the same by-pass valve is being refitted clean any previous sealing compounds from the threads. Apply Loctite 241 to threads of the valve before reassembly.

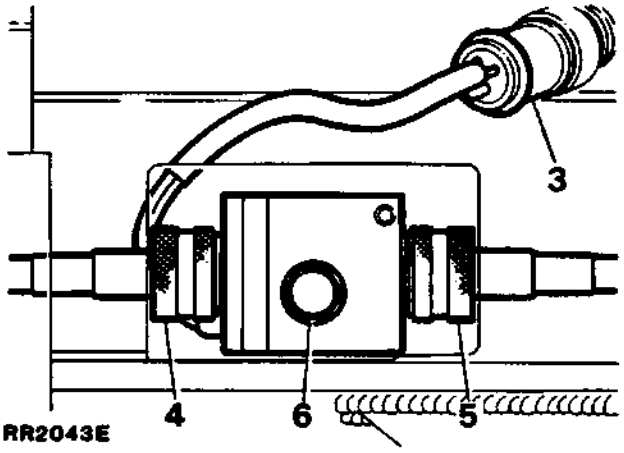
6. Tighten the valve to the specified torque (see Torque values-section 06).
7. Reverse the remaining removal instructions.

SPEED TRANSDUCER

Remove and refit

Removing

1. Place the vehicle on a hydraulic hoist and apply the parking brake.
2. Disconnect the battery negative terminal.
3. Raise the hoist and disconnect the speed transducer electrical plug.
4. Disconnect the speedometer cable from the transducer to the binnacle at the transducer.
5. Disconnect the speedometer cable from the transducer to the speedometer housing at the transducer.
6. Remove the single bolt securing the transducer to its mounting bracket and withdraw the unit from the vehicle.



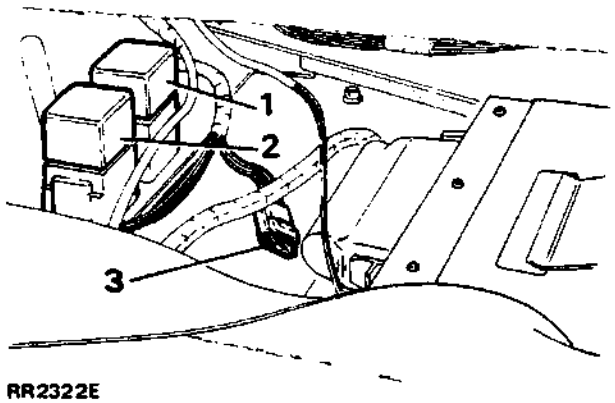
Refitting

7. Reverse the removal instructions.

ELECTRONIC FUEL INJECTION RELAYS

Incorporated into the fuel injection electrical circuits are two relays. The relays are located beneath the front right-hand seat, adjacent to the E.C.U.

1. **Fuel pump relay (mounted on a blue terminal block).**
2. **Main relay (mounted on a black terminal block).**
3. **Diagnostic plug.**



RR2322E

Remove and refit

Removing

1. Disconnect the battery negative terminal.
2. Pull the relay(s) from the multi-plug(s).

Refitting

3. Reverse the removal procedure.

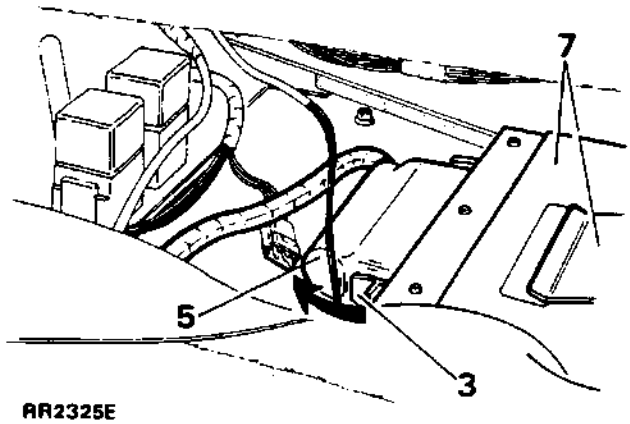
ELECTRONIC CONTROL UNIT-ECU

NOTE: The ECU is not itself a serviceable item, in the event of a unit failure, the ECU must be replaced.

Remove and refit

Removing

1. Disconnect the battery negative terminal.
2. The ECU is located under the front right hand seat and is accessible through the rear opening of the seat base when the seat is in its most forward position.
3. Release the E.C.U plug retaining clip.
4. Pull the rear of the multi-plug out of the ECU.
5. Maneouver the front of the plug (in the direction of the bold arrow) to release the hooked rear end of the plug from the retaining peg.
6. Release the screws securing the ECU to the mounting bracket.
7. Withdraw the ECU from the spring clip and remove it from the vehicle.



RR2325E

Refitting

8. Refit the E.C.U. securely in the spring clip and tighten the two screws.
9. Re-connect the E.C.U. harness plug, ensure the plug is firmly pushed into its location and that the retaining clip secures the plug in position.

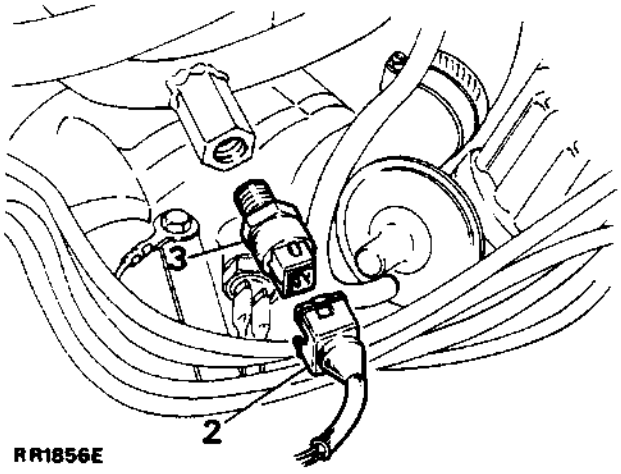
FUEL TEMPERATURE THERMISTOR (SENSOR)

Remove and refit

Removing

NOTE: No fuel leakage will occur when the thermistor is removed from the fuel rail therefore it is not necessary to depressurise the fuel system before removal.

1. Disconnect the battery negative terminal.
2. Remove the electrical multi - plug from the thermistor.
3. Release the thermistor from the fuel feed rail.



RR1856E

Refitting

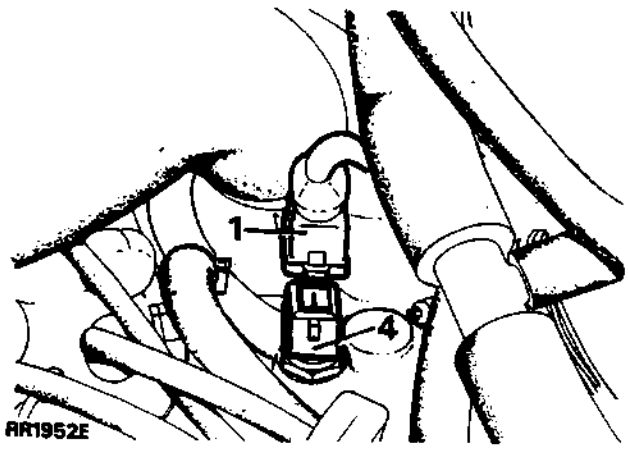
4. Reverse the removal procedure, ensuring that the thermistor is tightened securely in the fuel rail.

COOLANT TEMPERATURE THERMISTOR (SENSOR)

Remove and refit

Removing

1. Remove the multi-plug from the thermistor.
2. Release the radiator bottom hose and partially drain the cooling system.
3. Refit the hose and tighten the clamp securely.
4. Remove the thermistor from the left hand front branch of the intake manifold.
5. Remove the copper washer.



RR1952E

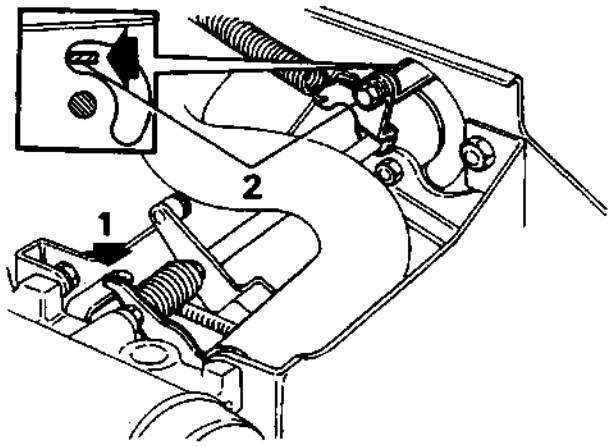
Refitting

6. Fit a NEW copper washer to the thermistor.
7. Fit the thermistor to the intake manifold and tighten securely.
8. Refill the cooling system.
9. Run the engine, check for water leaks around the coolant temperature thermistor.

RESETTING THROTTLE LEVERS

NOTE: The setting procedure outlined is applicable at minimum throttle condition only.

1. Ensure that the throttle valve is retained at its 90° vertical setting by holding down the lever denoted by the bold arrow while adjusting the throttle operating levers.
2. Release the throttle operating lever securing screw and adjust the lever until contact is made with the top end of the slot in the throttle lever mounting bracket; retaining the lever in this position retighten the screw.
3. Lightly grease all throttle lever bearing surfaces and torsion spring with Admax 13 grease or a suitable equivalent.



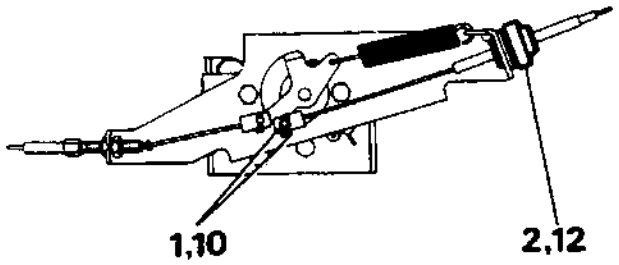
RR2339S

THROTTLE CABLE

Remove and refit

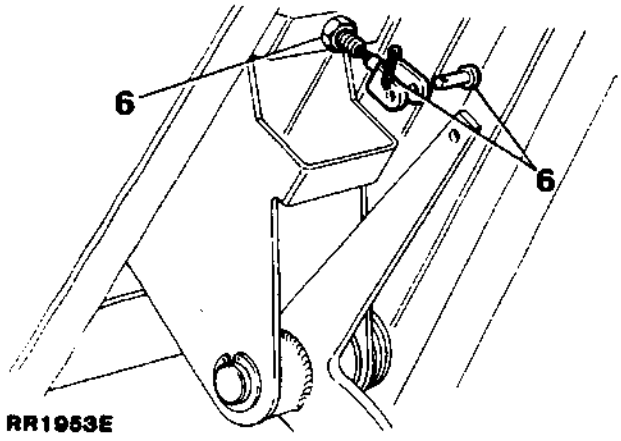
Removing

1. Remove the cotter pin and clevis pin securing the cable to the lever.
2. Carefully pry the throttle cable adjustment nut out of the linkage mounting bracket.
3. Withdraw the cable from the mounting bracket.



RR2340S

4. Release the outer cable from the retaining clips within the engine compartment.
5. Remove the lower dash panel from beneath the steering column.
6. Disconnect the cable from the throttle pedal and release the cable locknut.
7. Feed the cable through the bulkhead grommet and into the engine compartment.



RR1953E

FIT NEW THROTTLE CABLE

8. Feed the new cable from the engine compartment through the bulkhead grommet.
9. Connect the cable to the throttle pedal.
10. Connect the cable to the throttle linkage, fit a new cotter pin and secure in position.
11. Clip the outer cable adjustment nut into the mounting bracket.
12. Adjust the outer cable to give 1.57 mm (0.062 in) free play in the throttle cable and check the throttle operation.

THROTTLE PEDAL

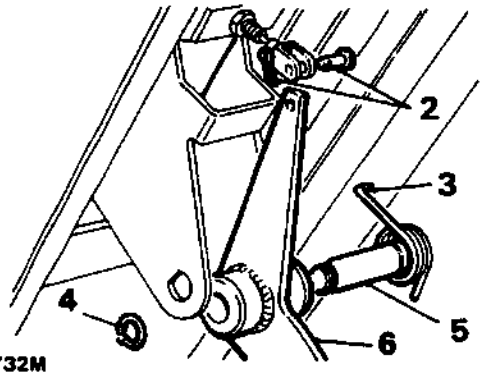
Remove and refit

Remove

1. Release the six screws securing the lower dash panel, lower the panel and disconnect the two electrical leads to the rheostat switch, detach the bulb check unit from the spring clip and remove the dash panel from the vehicle.
2. Remove the cotter pin and clevis pin securing the throttle cable to the throttle pedal.
3. Release the tension from the pedal return spring.
4. Remove the circlip from the pedal pivot pin.
5. Withdraw the pivot pin.

NOTE: It may be necessary to remove the steering column fixings enabling the column to be lowered to gain access to the pedal pivot pin circlip.

6. Withdraw the throttle pedal.



RR 732M

Refitting

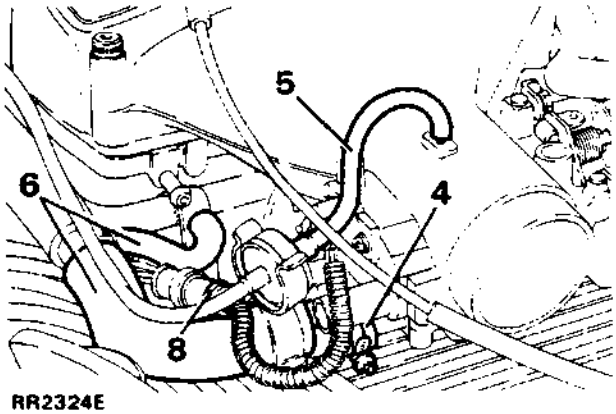
7. Lightly grease the pivot pin and clevis pin before re-assembly.
8. Fit a **NEW** cotter pin to the clevis pin.
9. Reverse the remaining removal instructions.

PLENUM CHAMBER

Remove and refit

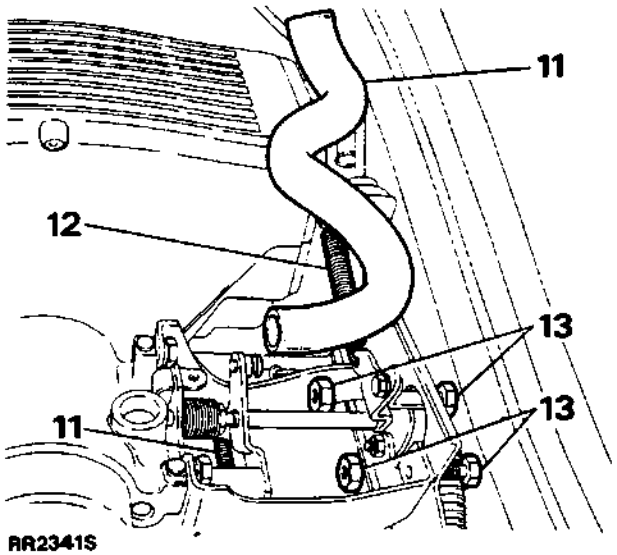
Removing

1. Disconnect the battery negative terminal.
2. Release the radiator bottom hose and partially drain the cooling system, reconnect the hose to the radiator.
3. Release the two large hose clamps from the neck of the plenum chamber and outlet bore of the airflow sensor and remove the hose from its location.
4. Release the clamps and remove the two coolant hoses from the bottom of the plenum chamber inlet neck. Identify each hose to aid re-assembly.
5. Remove the distributor vacuum hose.
6. Remove the positive crankcase ventilation breather filter hose.
7. Remove the servo hose.
8. Disconnect the throttle potentiometer multi-plug.



RR2324E

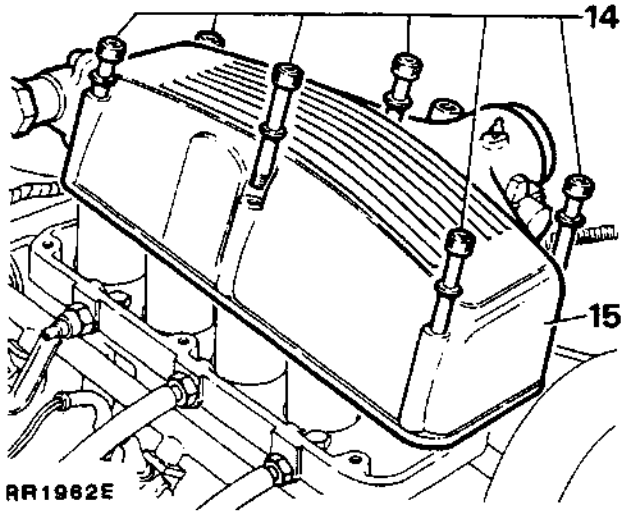
9. Disconnect the multi-plug from the air by-pass valve.
10. Disconnect the small vacuum hose at the rear of the plenum chamber, located below the air by-pass valve.
11. Remove the hose from the air by-pass valve to plenum chamber to enable the small return spring located below the throttle levers to be unhooked.
12. Release the two throttle return springs.
13. Remove the two bolts (with spring washers) securing the throttle cable and kick-down cable anchor bracket to the throttle lever support bracket, lay the assembly to one side.



RR2341S

14. Remove the six socket head bolts (with plain washers) securing the plenum chamber to the ram housing.
15. Maneouver the plenum chamber and remove it from the ram housing.

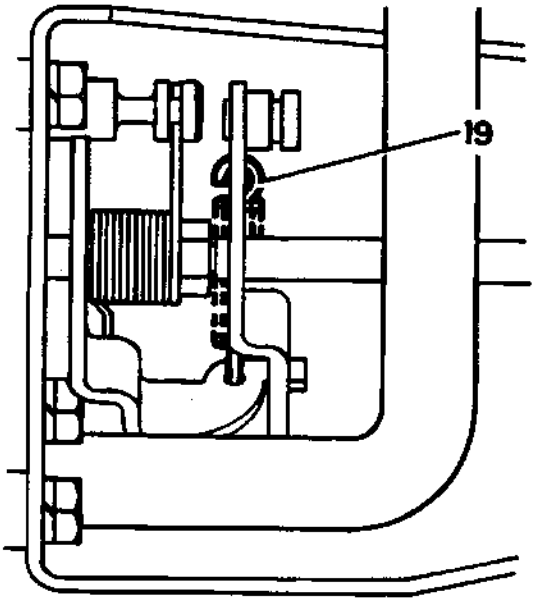
NOTE: To prevent ingress of dirt into the ram tubes, place a protective cover over the ram tube openings.



RR1962E

Refitting

16. Ensure that all mating faces are free from any previous sealing compounds.
17. Coat the mating faces of the plenum chamber and ram housing with 'Hylomar' sealant.
18. Refit the plenum chamber and tighten the six bolts to the specified torque (see torque values-section 06).
19. When refitting the small return spring, item 11 in the removal procedure, it must be noted that the 'hooked' open end of the spring **MUST** face the plenum chamber as shown in illustration RR2292E below.



RR2342S

20. Reverse the remaining removal instructions.

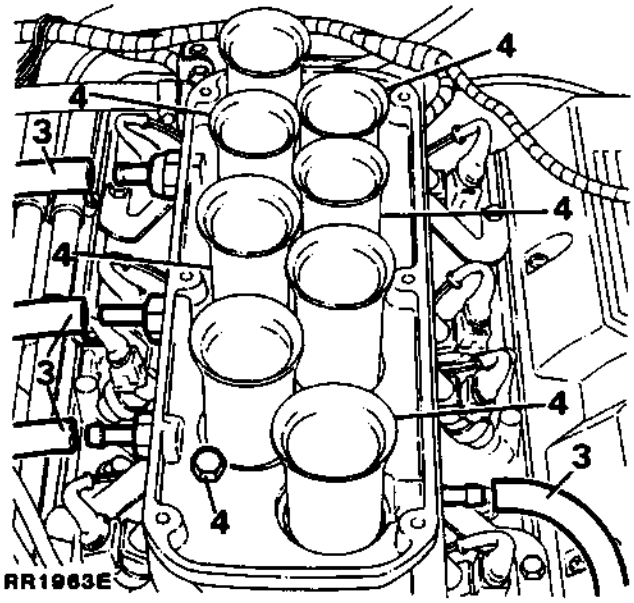
NOTE: Ensure that all hoses are connected securely to prevent un-metered air entering the engine.

RAM HOUSING

Remove and refit

Removing

1. Disconnect the battery negative terminal.
2. Remove the plenum chamber (see Plenum Chamber remove and refit).
3. Release the hoses from around the outer edges of the ram housing.
4. Remove the six through bolts (with plain washers) securing the ram housing to the intake manifold.



RR1963E

5. Lift the ram housing off the intake manifold and remove it from the engine compartment.
6. Place a protective cover over the top of the intake manifold inlet bores to prevent ingress of dirt.

Refitting

7. Ensure that all mating faces are clean and free from dirt and any previous sealing compounds.
8. Apply 'Hylomar' sealant to the intake manifold face before refitting the ram housing.
9. Fit the ram housing and retighten the bolts, working from the two centre bolts, diagonally towards the outer four bolts.
10. Tighten to the correct torque (See section 06-Torque values).

DEPRESSURISING THE FUEL SYSTEM

WARNING: Under normal operating conditions the fuel injection system is pressurised by a high pressure fuel pump, operating at 2.4 to 2.6 kgf/cm² (34 to 37 p.s.i.). When the engine is stationary this pressure is maintained within the system. To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise the fuel injection system before any service operations are carried out.

NOTE: If the vehicle has not been run there will still be a small amount of residual pressure in the fuel line. The depressurising procedure must still be carried out before disconnecting the component within the fuel system.

1. The fuel pump relay is located under the front right hand seat.
2. Pull the fuel pump relay off its multi-plug (see Electronic Fuel Injection Relays-Section 19, Page 28).
3. Start and run the engine.
4. When sufficient fuel has been used up causing the fuel line pressure to drop, the injectors will become inoperative, resulting in engine stall. Switch the ignition off.
5. Disconnect the battery negative terminal.

NOTE: Fuel at low pressure will remain in the system. To remove this low pressure fuel, place an absorbent cloth around the fuel feed hose at the fuel rail and release the fuel feed hose compression nut.

Refitting

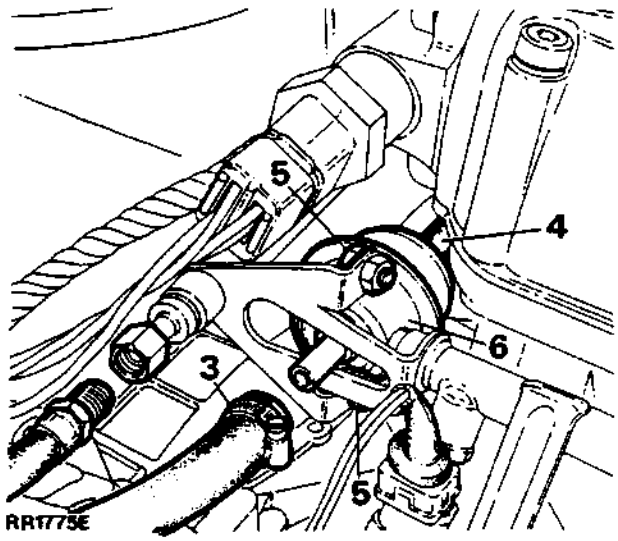
6. Refit the fuel feed hose.
7. Refit the fuel pump relay, reconnect the battery.
8. Crank the engine (engine will fire within approximately 6 to 8 seconds).

FUEL PRESSURE REGULATOR

Remove and refit

Removing

1. Depressurise the fuel system.
2. Disconnect the negative battery terminal.
3. Release the hose clamp securing the fuel return hose to the regulator and remove the hose.
4. Pull the vacuum hose from the rear of the regulator.
5. Remove the two nuts and bolts securing the regulator to the fuel rail, carefully ease the regulator fuel inlet pipe out of the fuel rail.
6. Withdraw the regulator from the engine compartment.



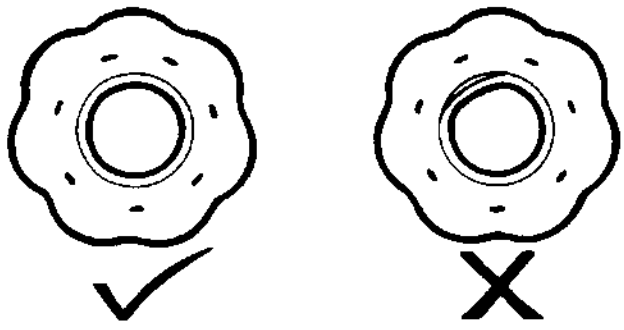
NOTE: If the original regulator is being refitted, fit a NEW 'O' ring to the fuel inlet pipe.

Refitting

7. Lightly coat the 'O' ring with silicon grease 300 before fitting the regulator to the fuel rail.
8. Reverse the removal procedure.
9. Reconnect the battery and pressurise the fuel system and check that there are no fuel leaks around the regulator connections.

FUEL SYSTEM HOSES

CAUTION: All fuel hoses are made up of two laminations, an armoured rubber outer sleeve and an inner viton core. If any of the fuel system hoses have been disconnected, it is imperative that the internal bore is inspected to ensure that the viton lining has not become separated from the armoured outer sleeve. If separation is evident, the hose must not be refitted. A new hose must be fitted.



RR2302M

FUEL RAIL-INJECTORS R/H AND L/H

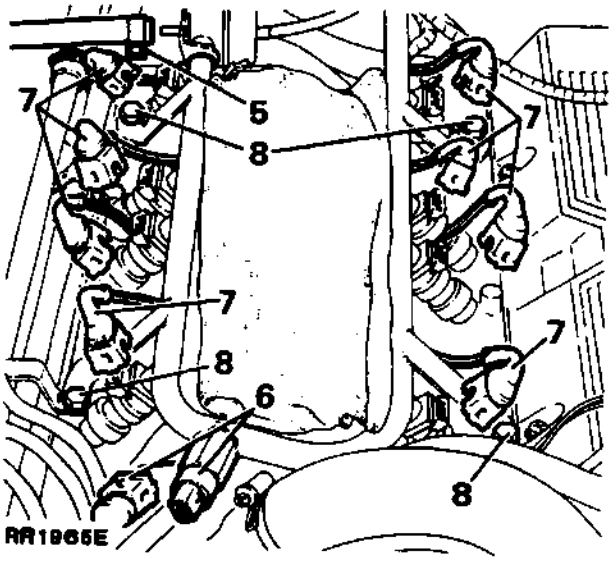
Remove and refit

Removing

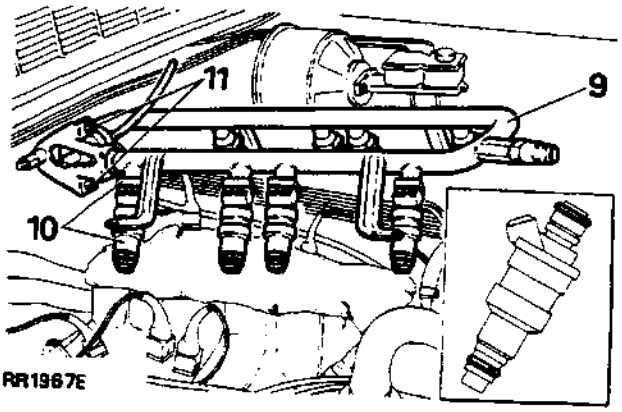
1. Depressurise the fuel system.
2. Disconnect the negative battery terminal.
3. Remove the plenum chamber. (See Plenum Chamber, remove and refit).
4. Remove the ram housing. (See Ram Housing remove and refit).

   NOTE: Place a cloth over the ram tube openings to prevent ingress of dirt into the engine.

5. Release the hose clamp and remove the fuel return hose from the pressure regulator.
6. Disconnect the multi-plug from the fuel temperature thermistor (sensor).
7. Disconnect the multi-plugs from the eight injectors.
8. Remove the five bolts securing the fuel rail support and heater pipe brackets to the intake manifold. Lay the heater pipes to one side.



9. Remove the fuel rail, complete with injectors, from the intake manifold.
10. Remove the retaining clips securing the injectors to the fuel rail, ease the injectors from the rail.
11. If necessary, remove the two nuts and bolts securing the regulator to the fuel rail, and carefully pull the regulator away from the rail.



Refitting

12. Fit **NEW** 'O' rings, protective cap and supporting disc to the injectors, lightly coat the 'O' rings with silicon grease 300 and insert the injectors into the fuel rail, multi-plug connections facing outwards.
13. Refit the retaining clips.

CAUTION: Care must be taken when refitting the fuel rail and injectors to the intake manifold to prevent damage occurring to the 'O' rings.

14. Fit a **NEW** 'O' ring to the pressure regulator lightly coat the 'O' ring with silicon grease 300 and secure the regulator to the fuel rail.
15. Fit the fuel rail and heater pipe assemblies to the intake manifold, secure the rail and pipes in position with the five bolts.
16. Reverse the remaining removal instructions.
17. Pressurise the fuel system and check for fuel leaks around the injectors and pressure regulator.

INTAKE MANIFOLD

Remove and refit

Removing

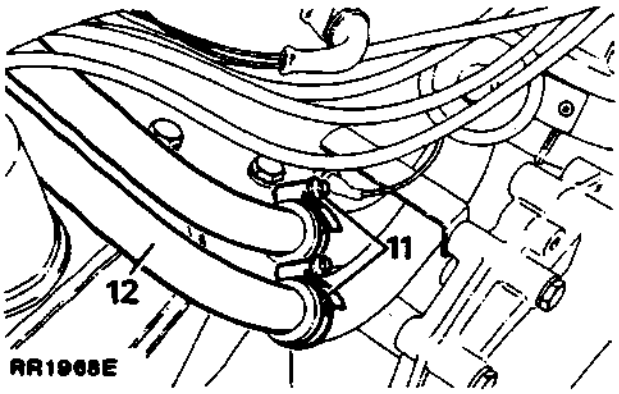
1. Depressurise the fuel system.
2. Disconnect the battery negative terminal.
3. Release the hose clamp and remove the radiator bottom hose to enable the cooling system to be partially drained, so that coolant level is below the thermostat housing, refit the hose and secure in position with the hose clamp.
4. Remove the plenum chamber (see Plenum Chamber, remove and refit).
5. Remove the ram housing (see ram housing remove and refit).

CAUTION: Place a protective cover over the intake manifold openings to prevent ingress of dirt.

6. Disconnect the electrical multi-plugs to the fuel temperature thermistor (sensor), coolant temperature thermistor (sensor) and injectors.
7. Remove the two nuts and bolts securing the pressure regulator to the fuel rail, ease the regulator out of the rail, seal the end of the fuel rail with suitable plastic plugs to prevent ingress of dirt.

   NOTE: The intake manifold can be removed from the cylinder block without removing the fuel rail and injectors.

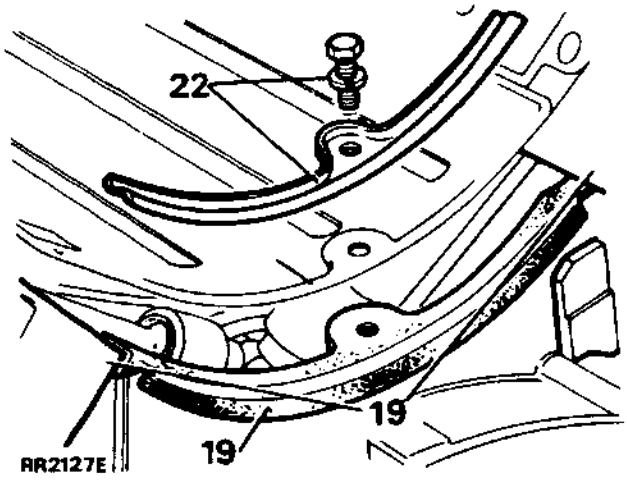
8. Disconnect the electrical leads from the air-conditioning engine coolant sensor located on the thermostat elbow.
9. Disconnect the electrical leads to the coolant temperature transmitter (sensor) located at the front of the intake manifold.
10. Remove the injector harnesses from behind the fuel rail and lay to one side.
11. Release the hose clamps securing the two heater hoses to the rigid heater pipes at the front of the right hand rocker cover.
12. Remove the two bolts securing the rigid heater pipes to the intake manifold and ease the pipes out of the hoses.



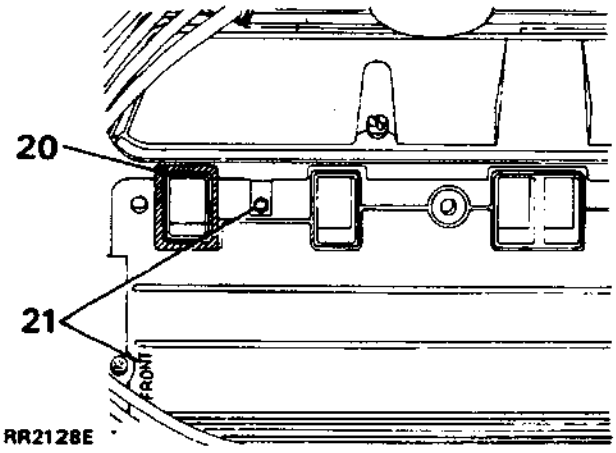
13. Lay the heater pipe assembly to one side.
14. Release the twelve bolts securing the intake manifold to the cylinder heads.
15. Lift the manifold off the cylinder heads and remove from the engine compartment.
16. Remove the two gasket clamps from the top of the cylinder block.
17. Lift off the gasket and remove the gasket seals.
18. Remove previous sealing compound from around the water passage openings of the cylinder heads.

Refitting

19. Locate the NEW seals in position with their ends engaged in the notches formed between the cylinder heads and block.



20. Lightly apply 'Hylomar' SQ32M sealant around the outside of the water passage openings on the cylinder heads, manifold gasket and intake manifold.



21. Fit the manifold gasket with the word **'FRONT'** to the front and the open bolt hole to the front right hand side.
22. Fit the gasket clamps but **DO NOT** fully tighten the bolts at this stage.
23. Locate the intake manifold onto the cylinder heads, clean the threads of the manifold securing bolts.
24. Fit all manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre outwards.
25. Tighten to correct torque (see section 06 Torque values).
26. Tighten the gasket clamps to the correct torque (see section 06 Torque values).
27. Reverse remaining removal instructions.
28. Replenish the cooling system.
29. Start the engine, check for water and fuel leaks.

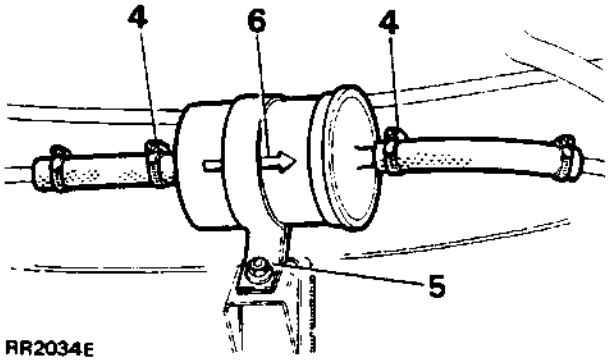
FUEL LINE FILTER

Remove and refit

Refitting

WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Depressurise the fuel system.
2. The fuel line filter is located on the right hand chassis side member forward of the fuel tank filler neck. Access to the filter is gained through the right hand rear wheel arch.
3. Thoroughly clean the immediate area around the hose connections to prevent ingress of foreign matter into the fuel system.
4. Loosen the two hose clamps nearest the filter to enable the hoses to be removed from the filter canister. Plug the end of the hoses to prevent ingress of dirt.
5. Release the securing bolt and bracket and remove the filter from the chassis side member.



Refitting

6. Fit a new filter observing the direction of flow arrows stamped on the canister.
7. Start the engine and inspect for fuel leaks around the hose connections.

FUEL TANK

Remove and refit

Removing

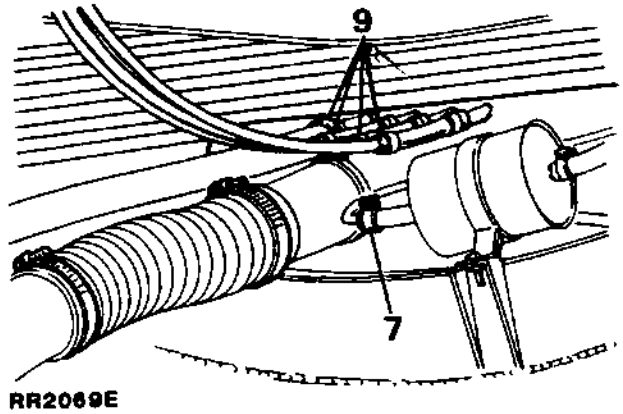
WARNING: Ensure that all the necessary precautions are taken against fuel spillage and fuel vapour to prevent fire or explosion.

CAUTION: Before disconnecting any part of the fuel system it is imperative that all dust, dirt and debris is removed from around the components to be removed to prevent ingress of foreign matter into the fuel system.

1. Drive the vehicle onto a suitable hoist.
2. Depressurise the fuel system. (see depressurising procedure-page 34)
3. Disconnect the battery negative terminal.
4. Disconnect the electrical leads to the fuel tank sender unit. Disconnect the fuel pump electrical multiplug, access to which is gained through the left hand rear wheel arch, the plug is located between the underside of the body and chassis side member.
5. Raise the hoist.
6. Remove the drain plug from the bottom of the fuel tank and drain the fuel into a suitable container that can be sealed afterwards, refit the drain plug. (Refer to Warning at start of procedure).

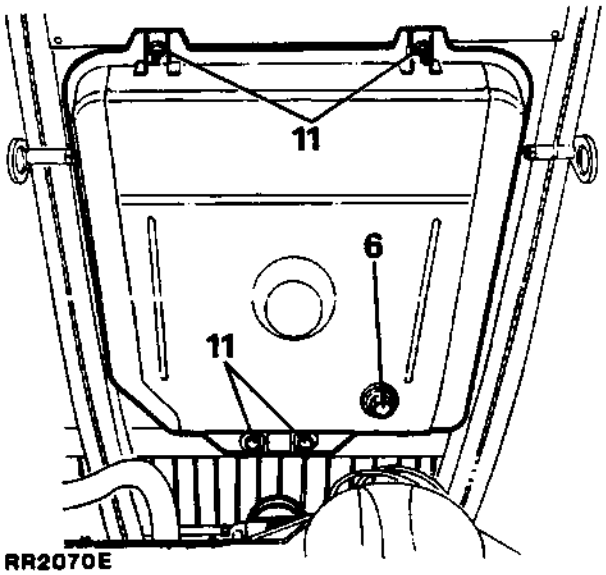
From underneath the vehicle

7. Disconnect the fuel hose from the inlet side of the fuel filter.
8. Disconnect the fuel return pipe to the fuel tank.
9. Remove the breather hose and three evaporative loss hoses from the fuel tank, seal all hose and pipe openings to prevent ingress of foreign matter.



RR2069E

10. Release the two large hose clamps, securing the inter-connecting hose to tank and filler tube, maneouver the hose up the outside of the filler tube to enable it to be withdrawn from the tank filler neck.
11. With assistance from a second person supporting the fuel tank, remove the four tank fixings.



RR2070E

12. Tilt the left hand side of the tank downwards and maneouver it out of the chassis frame. Care should be taken to ensure that the fuel feed pipe to filter is not damaged when lowering the tank.
13. Place the tank in a safe area and ensure that all necessary precautions are undertaken to make all personnel within the vicinity aware that the tank will give off residual fuel fumes.
14. If necessary remove the fuel pump from the tank. (See Fuel Pump remove and refit).

Refitting

15. Refit the fuel tank to the chassis, taking care to relocate the fuel feed pipe grommets between the fuel tank and chassis.
16. Reverse the removal procedure, ensuring that all hose and pipe connections are securely tightened.
17. Re-pressurise the fuel system.
18. Inspect for fuel leaks from around the fuel filter, hose and pipe connections.

FUEL PUMP

Remove and refit

Removing

WARNING: Ensure that all necessary precautions are taken against fuel spillage and fuel vapour to prevent fire or explosion.

1. Drive the vehicle onto a suitable hoist.
2. Depressurise the fuel pump system. (see depressurising procedure-page 34)
3. Disconnect the battery negative terminal.
4. Remove the fuel tank from the chassis frame. (see fuel tank remove and refit-page 38)
5. Place the tank in a safe area.
6. Disconnect the fuel supply hose from the pump.
7. Remove any previous sealant from the top of the pump flange.
8. Remove the five screws and withdraw the pump from the tank.

Refitting

9. Clean the immediate area around the pump opening in the fuel tank.
10. Fit a **NEW** pump seal.
11. Secure the pump to the tank and tighten the screws securely.
12. Liberally coat the heads of the screws and flange of the fuel pump with Sikaflex 221 flexible adhesive sealant.
13. Refit the tank to the vehicle.

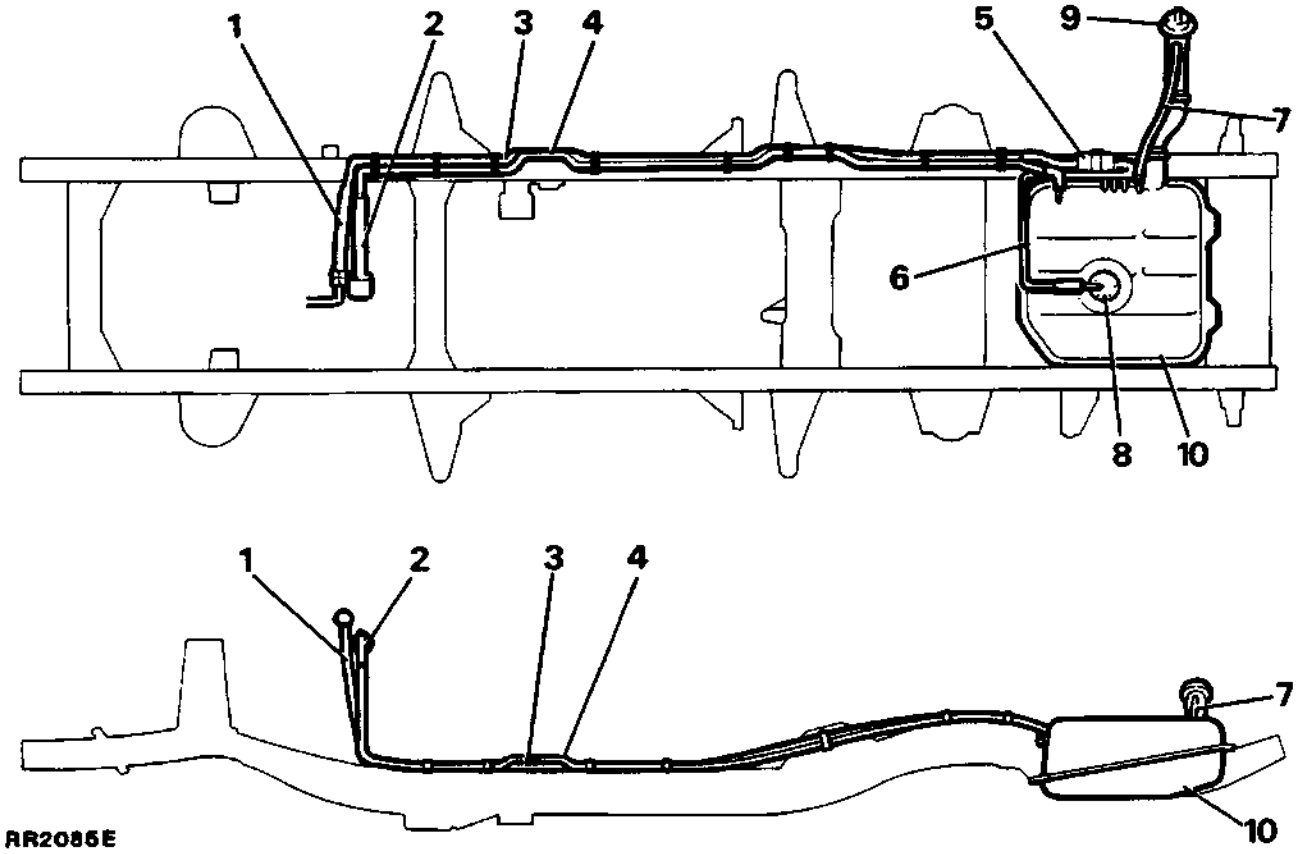
Continued

FUEL PIPES

WARNING: Depressurise fuel system before disconnecting any of the fuel pipes and ensure that all necessary precautions are taken against fuel spillage.

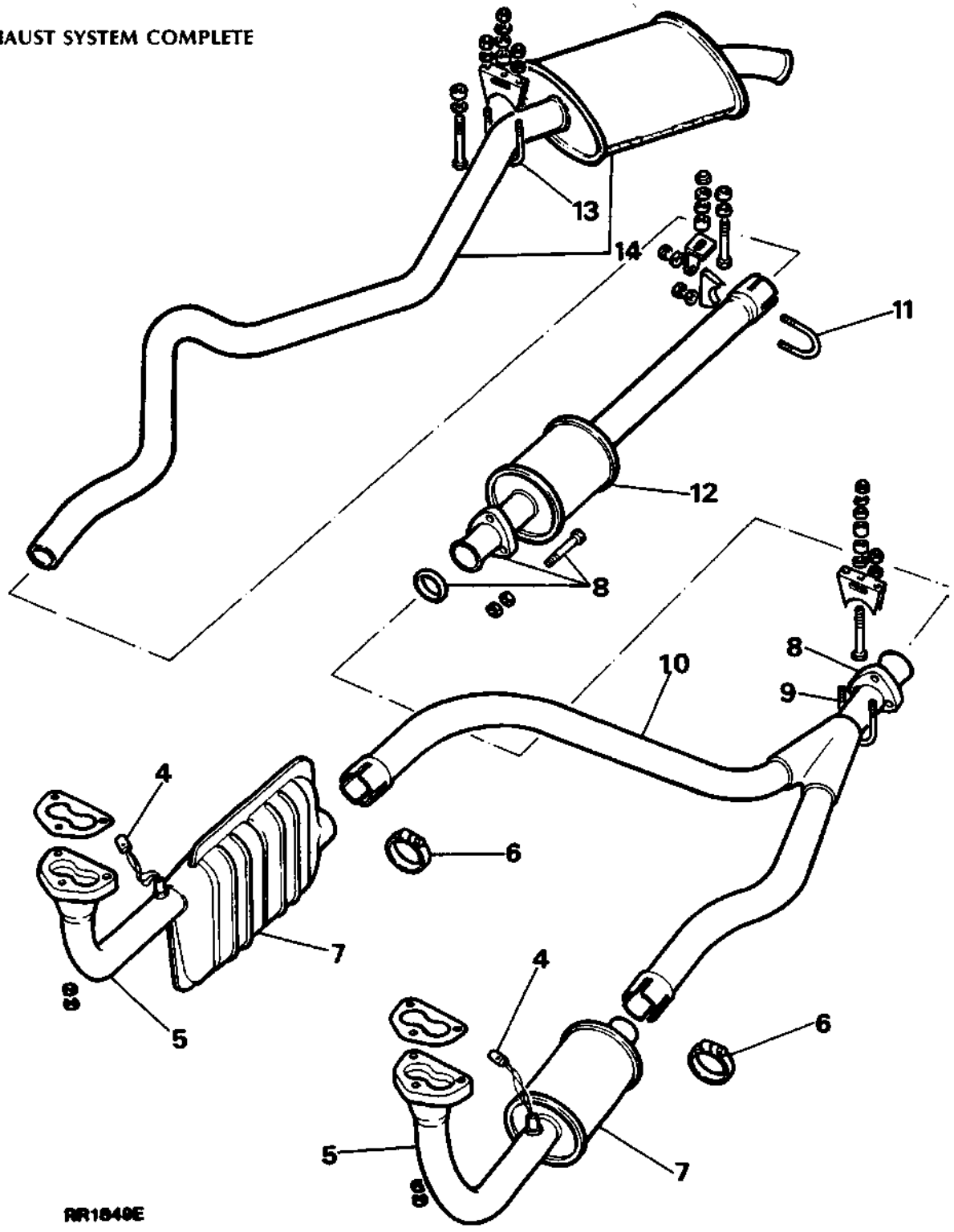
KEY

1. Fuel feed hose to fuel rail.
2. Fuel return hose to fuel tank.
3. Rigid fuel feed pipe.
4. Rigid fuel return pipe.
5. Fuel filter.
6. Rigid fuel feed pipe to filter.
7. Breather hose.
8. In-tank fuel pump.
9. Fuel filler neck.
10. Fuel tank.



AR2086E

EXHAUST SYSTEM COMPLETE



EXHAUST SYSTEM COMPLETE

NOTE: Ensure that no exhaust leaks are evident in either a new or an old exhaust system, as this will affect vehicle performance, and could contravene local emission regulations.

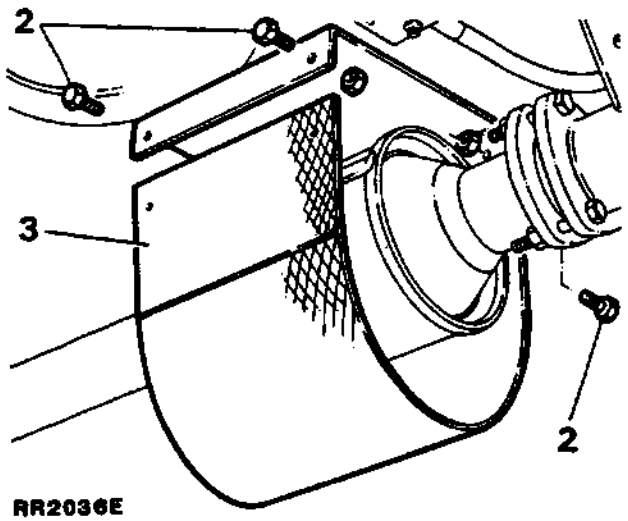
WARNING: To prevent personal injury occurring from a hot exhaust system, DO NOT attempt to disconnect any of the components until ample time has elapsed to allow the exhaust system to cool.

Continued

Remove and refit

Removing

1. Raise the vehicle on a suitable hoist and apply the parking brake.
2. If fitted, remove the four fixings securing the grass shield to the mounting bracket at the centre catalyst.
3. Withdraw the grass shield from the bracket.



RR2036E

4. Disconnect the electrical plugs from the Lambda sensors.
5. Remove the nuts and disconnect the front pipe(s) from the manifold(s) and remove the gaskets.
6. Loosen the pinch bolt clamps securing the front pipe to the intermediate pipe.
7. Withdraw the front pipe(s) with catalysts.
8. Remove three bolts securing the intermediate pipe to the centre catalyst and withdraw the doughnut.
9. Remove the U-bolt from the pipe mounting bracket.
10. Withdraw the intermediate pipe.
11. Remove the U-bolt securing the centre catalyst to the main muffler.
12. Withdraw the catalyst.
13. Remove the U-bolt from the tail pipe mounting bracket.
14. Withdraw the tail pipe and rear muffler.

Refitting

NOTE: Apply Firegum Putty, Part No. 15608 to all exhaust system joints with the exception of the exhaust flange to manifold flange where new gaskets should be fitted.

15. Reverse the removal instructions.

EXHAUST MANIFOLD

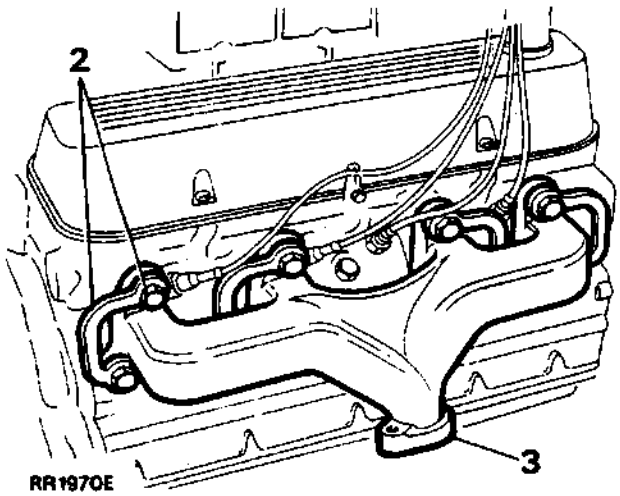
Remove and refit

Left hand

Right hand

Removing

1. Disconnect the front exhaust pipe(s) from the manifold(s).
2. Tap back the bolt locking tabs and remove the eight bolts, lock tabs and washers.
3. Remove the manifold(s) and old gaskets.



RR1970E

Refitting

4. Ensure that the mating surfaces of the cylinder head and exhaust manifold are clean and smooth.
5. Coat the threads of each bolt with anti-seize compound.
6. Place the manifold and new gaskets in position on the cylinder head and fit the securing bolts, new lockplates and plain washers. The plain washers are fitted between the manifold and lockplates.
7. Evenly tighten the manifold bolts to the correct torque, see torque values-section 06, and bend over the lockplate tabs.
8. Reconnect the front exhaust pipe, using new exhaust flange gaskets.

INTAKE MANIFOLD

The removal and refit of the intake manifold is incorporated in the Fuel Injection System, Section 19.

Propeller shafts

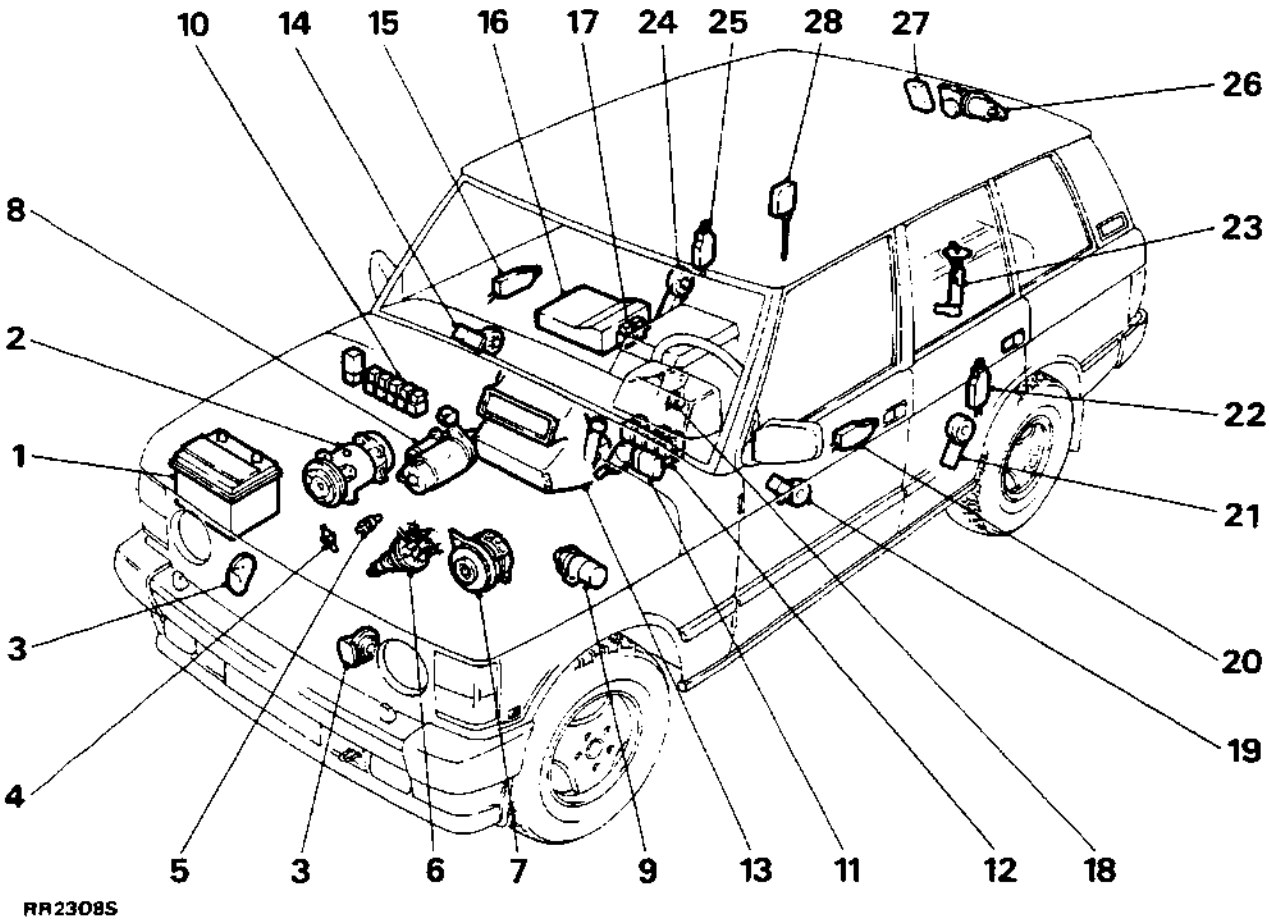
Front propeller shaft

The front propeller shaft fitted to catalytic exhaust vehicles is of the solid bar type.

NOTE: The front propeller shaft MUST be fitted with the sliding joint end of the shaft fitted to the drive flange at the front end of the transfer gearbox.

Rear propeller shaft

NOTE: The rear propeller shaft MUST be fitted with the sliding joint end of the shaft fitted to the brake drum at the rear end of the transfer gearbox.



LOCATION OF ELECTRICAL EQUIPMENT

1. Battery
2. Air conditioning compressor
3. Horns
4. Oil pressure switch
5. Water temperature switch
6. Electronic distributor
7. Alternator
8. Starter motor
9. Coil
10. Relays
11. Wiper motor-front screen
12. Relays
13. Heater
14. Window lift motor (front right hand door)
15. Door lock actuator (front right hand door)
16. Electronic control unit
17. Relays
18. Hand brake warning light switch
19. Window lift motor (front left hand door)
20. Door lock actuator (front left hand door)
21. Window lift motor (rear left hand door)
22. Door lock actuator (rear left hand door)
23. Electrical in-tank fuel pump
24. Window lift motor (rear right hand door)
25. Door lock actuator (rear right hand door)
26. Wiper motor-rear screen
27. Radio aerial amplifier
28. Fuel filler flap lock actuator

For full information on fuel injection related items-see fuel injection section of manual.

To identify individual relays (items 10, 12, and 17) see relays in Electrical Section of Manual.

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A-Battery in low state of charge	1. Broken or loose connection in alternator circuit 2. Current voltage regulator not functioning correctly 3. Slip rings greasy or dirty. 4. Brushes worn, not fitted correctly or wrong type 5. Fan belt broken	1. Examine the charging and field circuit wiring. Tighten any loose connections, repair/replace broken leads. Examine the battery connection. 2. Check/fit new unit 3. Clean 4. Fit new brushes 5. Fit new belt
B-Battery overcharging leading to burnt out bulbs and frequent need for topping-up	1. Current voltage regulator not functioning correctly	1. Fit new unit
C-Lamps giving insufficient illumination	1. Battery discharged 2. Bulbs discoloured through prolonged use 3. Fan belt broken	1. Charge the battery from independent supply or by a long period of daylight running. 2. Fit new bulb 3. Fit new belt
D-Lamps light when switched on but fade out	1. Battery discharged	1. Charge the battery from an independent supply or by a long period of daylight running
E-Lights flicker	1. Loose connection	1. Tighten/clean
F-Failure of lights	1. Battery discharged 2. Loose broken connection 3. Fan belt broken	1. Charge the battery from an independent supply or by a long period of daylight running 2. Locate and rectify 3. Fit new belt

SYMPTOM	POSSIBLE CAUSE	CURE
G-Starter motor lacks power or fails to turn engine	1. Stiff engine 2. Battery discharged 3. Broken or loose connection in starter circuit 4. Greasy or dirty slip rings. 5. Brushes worn, not fitted correctly or wrong type 6. Brushes sticking in holders or incorrectly tensioned. 7. Starter pinion jammed in mesh with flywheel	1. Locate cause and remedy 2. Charge the battery either by a long period of daytime running or from independent electrical supply 3. Check and tighten all battery, starter and starter switch connections and check the cables connecting these units for damage 4. Clean 5. Fit new brushes 6. Rectify 7. Remove starter motor and investigate
H-Starter noisy	1. Starter pinion or flywheel teeth chipped or damaged 2. Starter motor loose on engine 3. Armature shaft bearing	1. Fit new components 2. Rectify, checking pinion and the flywheel for damage 3. Fit new bearing
J-Starter operates but does not crank the engine	1. Pinion of starter does not engage with the flywheel	1. Check operation of starter solenoid. If correct, remove starter motor and investigate
K-Starter pinion will not disengage from the flywheel when the engine is running	1. Starter pinion jammed in mesh with the flywheel	1. Remove starter motor and investigate

SYMPTOM	POSSIBLE CAUSE	CURE
L-Engine will not start	1. The starter will not turn the engine due to a discharged battery	1. Recharge battery by running the car for a long period during daylight or from an independent electrical supply
	2. The starter will not turn due to incorrect gear selection.	2. Select 'P' or 'N'
	3. Sparking plugs faulty, dirty or incorrect plug gaps	3. Rectify/ fit new plugs
	4. Defective coil or distributor	4. Carry out ignition checks. Fit a new coil or distributor
	5. A fault in the low tension wiring circuit	5. Examine all the ignition cables and check that the terminals are secure and not corroded.
	6. Faulty amplifier	6. Check/fit new component if necessary.
	7. Air gap out of adjustment	7. Adjust
	8. Fuel system fault	8. See Fuel System Section.
M-Engine misfires/ stalls	1. Faulty sparking plugs	1. Rectify
	2. Air gap incorrectly set	2. Adjust
	3. Distributor cap cracked	3. Fit new cap
	4. Faulty pick-up or reluctor	4. Fit new components
	5. Excessive wear in distributor shaft brushes, etc.	5. Fit a new components
	6. Rotor arm and flash shield cracked or showing signs of tracking	6. Fit new component

SYMPTOM	POSSIBLE CAUSE	CURE
N-Frequent recharging of the battery necessary	1. Alternator inoperative	1. Check the brushes, cables and connections or fit a new alternator
	2. Loose or corroded connections	2. Examine all connections especially the battery terminals and ground cables
	3. Slipping fan belt	3. Adjust
	4. Voltage regulator faulty	4. Fit new component
	5. Excessive use of the starter motor	5. In the hands of the operator, advise
	6. Vehicle operation confined largely to night driving	6. In the hands of the operator, advise
	7. Abnormal accessory load	7. Superfluous electrical fittings such as extra lamps, etc.
	8. Internal discharge of the battery	8. Fit new battery
P-Alternator not charging correctly	1. Slipping fan belt	1. Adjust
	2. Voltage control not operating correctly	2. Rectify/ fit new component
	3. Greasy, charred or glazed slip rings	3. Clean
	4. Brushes worn, sticking or oily	4. Rectify/fit new brushes
	5. Shorted, open or burnt -out field coils	5. Fit new field coils
Q-Alternator noisy	1. Worn, damaged or defective bearings	1. Fit new bearings
	2. Cracked or damaged pulley	2. Fit new pulley
	3. Alternator out of alignment	3. Rectify
	4. Alternator loose in mounting	4. Rectify
	5. Excessive brush noise	5. Check for rough or dirty slip rings, badly seating brushes, incorrect brush tension, loose brushes and loose field magnets. Rectify/fit new components
R-Poor performance of horns	1. Low voltage due to discharged battery	1. Recharge
	2. Bad connections in wiring	2. Carefully inspect all connections and horn push
	3. Loose mounting nut	3. Rectify
	4. A faulty horn	4. Fit new horn

SYMPTOM	POSSIBLE CAUSE	CURE
S-Central door locking does not operate (on all doors)	1. Battery discharged 2. Control unit in driver's door lock actuator faulty 3. Loose or broken connection in driver's door 4. Blown fuse	1. Recharge 2. Fit new unit 3. Locate and rectify 4. Rectify
T-Central door locking does not operate (on one door only)	1. Loose or broken connection 2. Lock actuator failure 3. Faulty lock 4. Mechanical linkages disconnected	1. Locate and rectify 2. Fit new actuator 3. Rectify 4. Locate and rectify
U-Window lift will not operate	1. Motor failure 2. Loose or broken connection 3. Faulty switch 4. Mechanical linkage faulty	1. Fit new motor 2. Locate and rectify 3. Fit new switch 4. Rectify
V-Exterior mirrors fail to operate	1. Loose or broken connection 2. Faulty switch 3. Mirror motor failure	1. Locate and rectify 2. Fit new switch 3. Fit new motor

ELECTRICAL EQUIPMENT

DESCRIPTION

The electrical system is Negative ground, and it is most important to ensure correct polarity of the electrical connections at all times. Any incorrect connections made when reconnecting cables may cause irreparable damage to the semi-conductor devices used in the alternator and regulator. Incorrect polarity would also seriously damage any transistorised equipment such as radio and tachometer etc.

Before carrying out any repairs or maintenance to an electrical component, always disconnect the battery negative lead.

ALTERNATOR - LUCAS A133/80

The alternator is a three phase, field sensed unit. The rotor and stator windings produce three phase alternating current, AC, which is rectified to direct current, DC. The electronic voltage regulator unit controls the alternator output voltage by high frequency switching of the rotor field circuit. Use only the correct Range Rover replacement fan belt. Occasionally check that the engine and alternator pulleys are accurately aligned.

It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.

Do not disconnect battery cables while the engine is running or damage to the semi-conductor devices may occur. It is also inadvisable to break or make any connections in the alternator charging and control circuits while the engine is running.

The Model 15TR electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse effects of temperature, dust, and moisture etc.

The regulating voltage is set during manufacture to give the required regulating voltage range of 14.2 $\pm$ 0.2 volts, and no adjustment is necessary. The only maintenance needed is the occasional check on terminal connections and wiping with a clean dry cloth.

The alternator system provides for direct connection of a charge (ignition) indicator warning light, and eliminates the need for a field switching relay or warning light control unit. As the warning lamp is connected in the charging circuit, lamp failure will cause loss of charge. Lamp should be checked regularly and a spare carried.

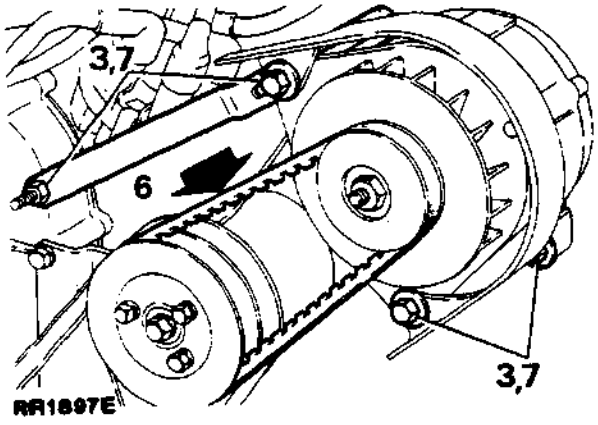
When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.

ALTERNATOR

Remove and refit

Removing

1. Disconnect battery ground lead
2. Disconnect leads from alternator.



3. Loosen alternator fxings, pivot alternator inwards and remove drive belt.
4. Remove three mounting bolts and lift the alternator clear of the engine.

Refitting

5. Fit the alternator and mounting bolts.

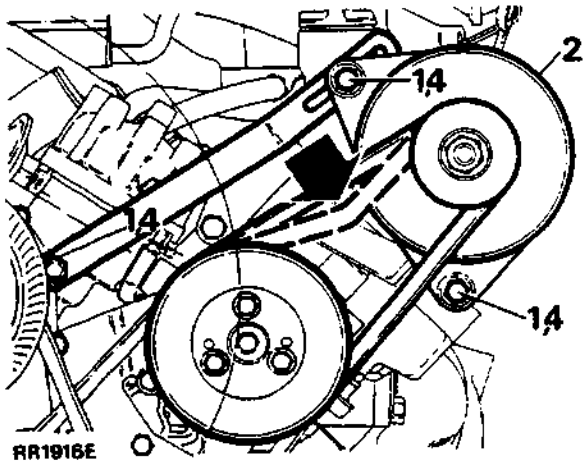
   NOTE: The fan guard is attached to the front fixing and the adjustment bracket bolt.

6. Fit the drive belt and adjust the belt tension.
7. Tighten the mounting bolts and the adjustment bracket securing nut
8. Connect the wiring leads to the alternator.
9. Connect the battery.

ALTERNATOR DRIVE BELT

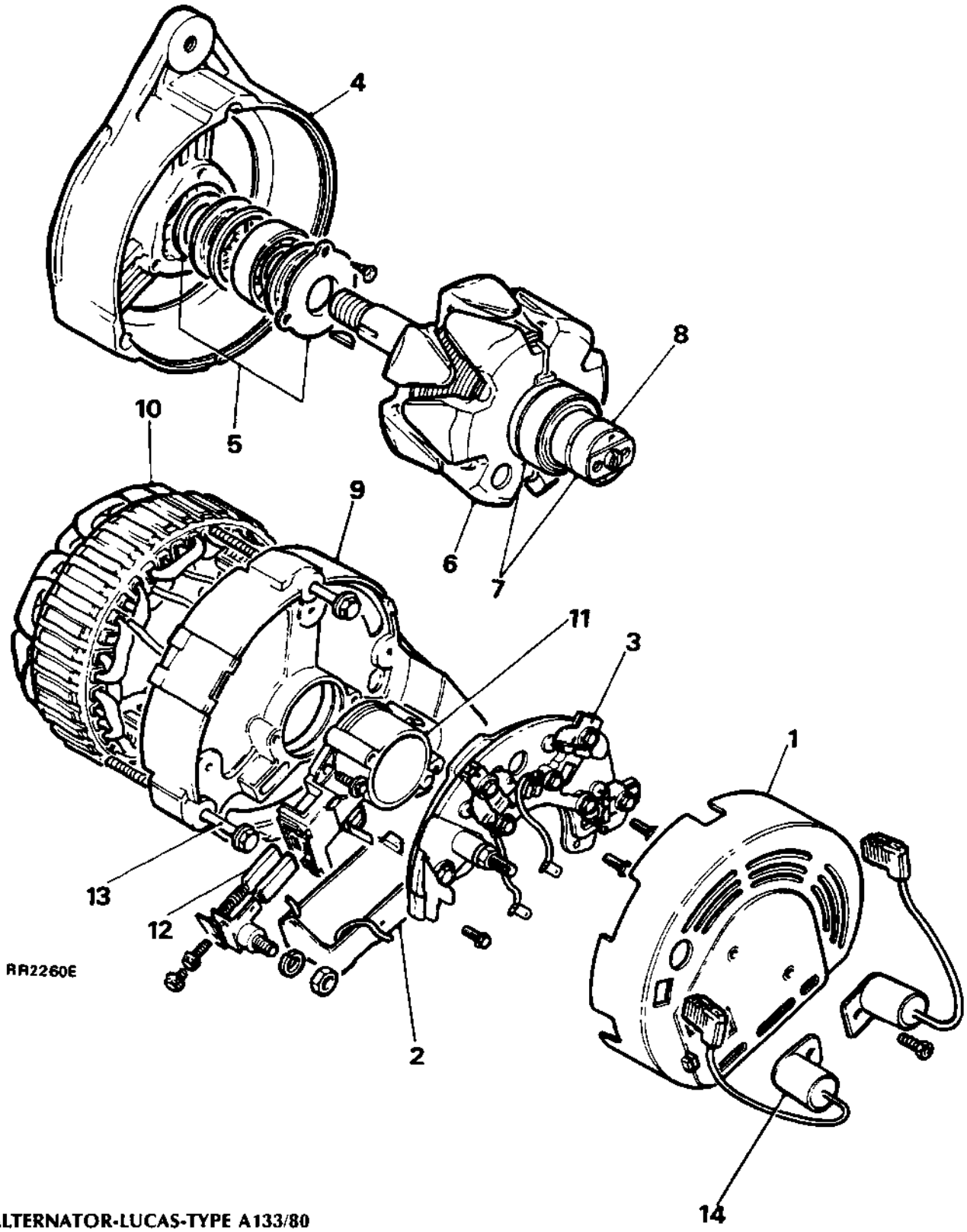
Adjust

1. Loosen the alternator fixings and the adjustment link.
2. Pivot the alternator to give the required belt tension.
3. Belt tension should be 4 to 6mm (0.19 to 0.25 in) at the point indicated by the bold arrow.



4. Tighten the alternator fixing bolts and the adjustment link.

   NOTE: Check adjustment after running the engine at fast idle for 3 to 5 minutes, if a new belt has been fitted.



ALTERNATOR-LUCAS-TYPE A133/80

1. Cover
2. Regulator
3. Rectifier
4. Drive and bracket
5. Bearing assembly
6. Rotor
7. Slip ring end bearing
8. Slip rings
9. Slip ring end bracket
10. Stator
11. Brush box
12. Brushes
13. Through bolt
14. Suppressors

ALTERNATOR-LUCAS-TYPE A133/80

Overhaul

Including Test (Bench)

NOTE: Alternator charging circuit-The ignition warning light is connected in series with the alternator field circuit. Bulb failure would prevent the alternator charging, except at very high engine speeds, therefore, the bulb should be checked before suspecting an alternator failure.

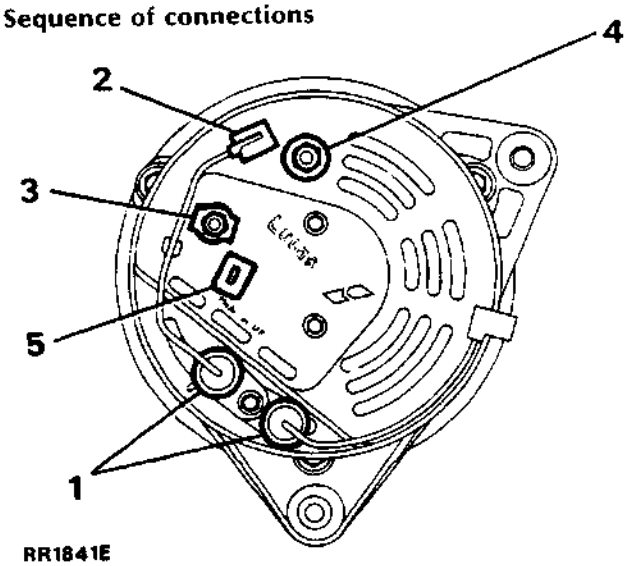
Precautions

Battery polarity is **NEGATIVE GROUND**, which must be maintained at all times.

No separate control unit is fitted; instead a voltage regulator of micro-circuit construction is incorporated on the slip ring end bracket, inside the alternator cover.

Battery voltage is applied to the alternator output cable even when the ignition is switched off, the battery must be disconnected before commencing any work on the alternator. The battery must also be disconnected when repairs to the body structure are being carried out using electric welding equipment.

Sequence of connections



RR1841E

1. Suppression capacitors (two)
2. Positive suppression terminal
3. IND terminal
4. + output terminal
5. Sensing terminal

ALTERNATOR TESTING

Charging system check

1. Check the battery is in good condition, with an open circuit voltage of at leats 12.6 V. Recharge or fit a charged substitute battery to carry out test.
2. Check drive belt adjustment and condition. Rectify as necessary.
3. Check battery connections are clean and tight.
4. Check alternator connections are clean and tight.
5. Ensure that there is no continuous drain on battery due, for example, to interior, underhood or door edge lamps being left on.

Alternator test

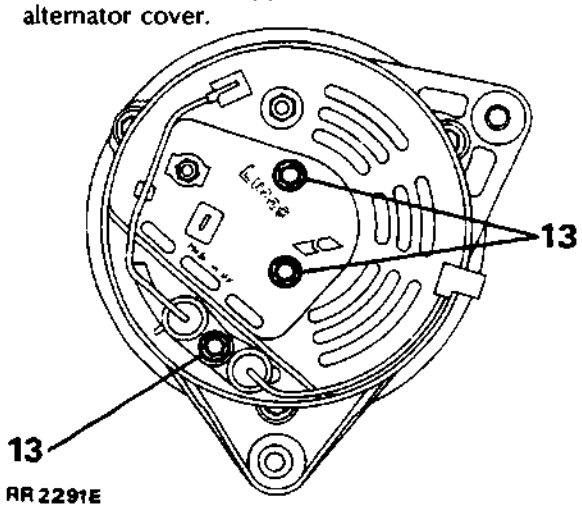
The following instructions refer to the use of suitable test equipment using a carbon pile rheostat.

6. Connect test equipment referring to the manufacturer's instructions.
7. Start engine and run at 3000 rev/min without accesory load.
8. Rotate the carbon pile load control to achieve the greatest output (amps) without allowing voltage to fall below 12.0 V. A reading of 80 amps, minus 10% to allow for EFI and Ignition loss, should be obtained.
9. Run engine at 3000 rev/min, switch selector to regulator test, read voltmeter. A reading of 13.6 to 14.4 V should be obtained.
10. Switch selector to diode/stator test, switch on headlamps to load alternator. Raise engine speed to 3000 rev/min, read voltmeter. The needle must be within the 'OK' range.

Note: See also "Testing in position" - Section 86, page 13.

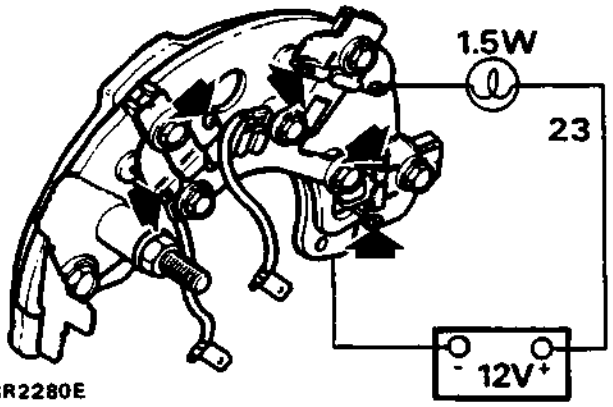
Testing-alternator removed

11. Withdraw the connectors from the alternator.
12. Remove the alternator.
13. Disconnect the suppressor and remove the alternator cover.



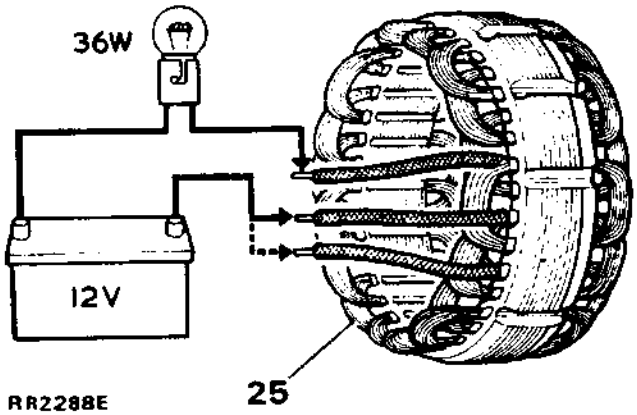
14. Disconnect the lead and remove the rectifier assembly.
15. Note the arrangement of the brush box connections and remove the screws securing the regulator to the brush box and withdraw. This screw also retains the inner brush mounting plate in position.
16. Remove the screw retaining the outer brush box in position and withdraw both brushes.
17. Check brushes for wear by measuring length of brush protruding beyond brush box moulding. If length is 10mm (0.4 in) or less, fit new brushes.
18. Check that brushes move freely in holders. If brush is sticking, clean with a mineral spirit moistened cloth or polish sides of brush with fine file.
19. Check brush spring pressure using push-type spring gauge. Gauge should register 136 to 279g (5 to 10 oz) when brush is pulled back until face is flush with housing. If reading is outside these limits, fit a new brush assembly.
20. Remove the two screws securing the brush box to the slip ring end bracket and lift off the brush box assembly.
21. Securely clamp alternator in a vice and release the stator winding cable ends from the rectifier by applying a hot soldering iron to the terminal tags of the rectifier. Pry out the cable ends when the solder melts.

22. Remove the two remaining screws securing the rectifier assembly to the slip ring end bracket and lift off the rectifier assembly. Further dismantling of the rectifier is not required.
23. Check the diodes. Connect the test equipment as shown and test each diode in turn, note whether lamp lights, then reverse test lead connections. The lamp should light in one direction only. Renew the rectifier assembly if a faulty diode is diagnosed.



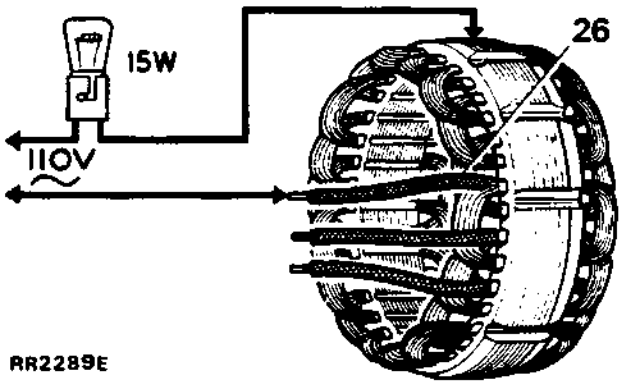
RR2280E

24. Remove the slip ring end bracket bolts and lift off the bracket.
25. Connect a 12 volt battery and a 36 watt test lamp to two of the stator connections. Repeat the test replacing one of the two stator connections with the third. If test lamp fails to light in either test, fit a new stator.



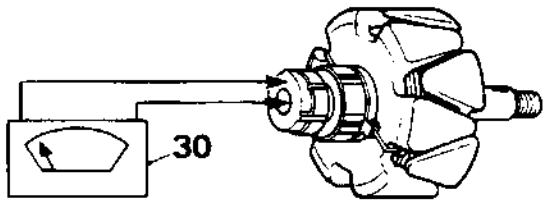
RR2288E

26. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between any one of the three stator connections and stator laminations. If test lamp lights, fit a new stator.



RR2289E

27. Clean surfaces of slip rings using a solvent moistened cloth.
28. Inspect slip ring surfaces for signs of burning; remove burn marks using very fine sandpaper. On no account should emery cloth or similar abrasives be used, or any attempt made to machine the slip rings.
29. Note the position of the stator output leads in relation to the alternator fixing lugs, and lift the stator from the drive end bracket.
30. Connect an ohmmeter to the slip rings. A reading of 2.6 ohms should be recorded.



RR2290E

31. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between one of the slip rings and one of the rotor poles. If the test lamp lights, fit a new rotor.

32. To separate the drive end bracket and rotor, remove the shaft nut, washers, woodruff key and spacers from the shaft.
33. Remove bearing retaining plate by removing the three screws. Using a press, drive the rotor shaft from the drive end bearing.
34. If necessary, to remove the slip rings or the slip ring end bearing on the rotor shaft, unsolder the outer slip ring connection and gently pry the slip ring off the shaft, repeat the procedure for the inner slip ring connection. Using a suitable extraction tool, withdraw the slip ring bearing from the shaft.

Reassembling

35. Reverse the dismantling procedure, noting the following points.

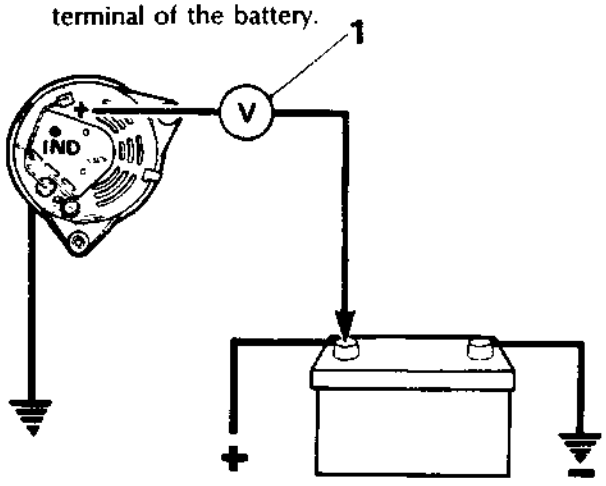
    (a) Use Shell Alvania 'RA' to lubricate bearings.
    (b) When refitting slip ring end bearing, ensure it is fitted with open side facing rotor.
    (c) Use Fry's H.T.3 solder on slip ring field connections.
    (d) When refitting rotor to drive end bracket, support inner track of bearing. Do not use drive end bracket to support bearing when fitting rotor.
    (e) Tighten through-bolts evenly.
    (f) Fit brushes into housings before fitting brush moulding.
    (g) Tighten shaft nut to the correct torque, see Torque Values.
    (h) Refit regulator pack to brush moulding.

36. Reconnect the leads between the regulator, brush box and rectifier, as illustrated.
37. Refit the alternator.

Testing in position

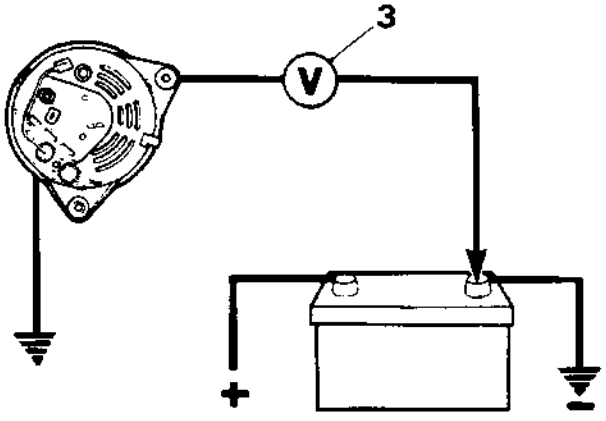
Charging circuit resistance test

1. Connect a low range voltmeter between the alternator terminal marked + and the positive terminal of the battery.



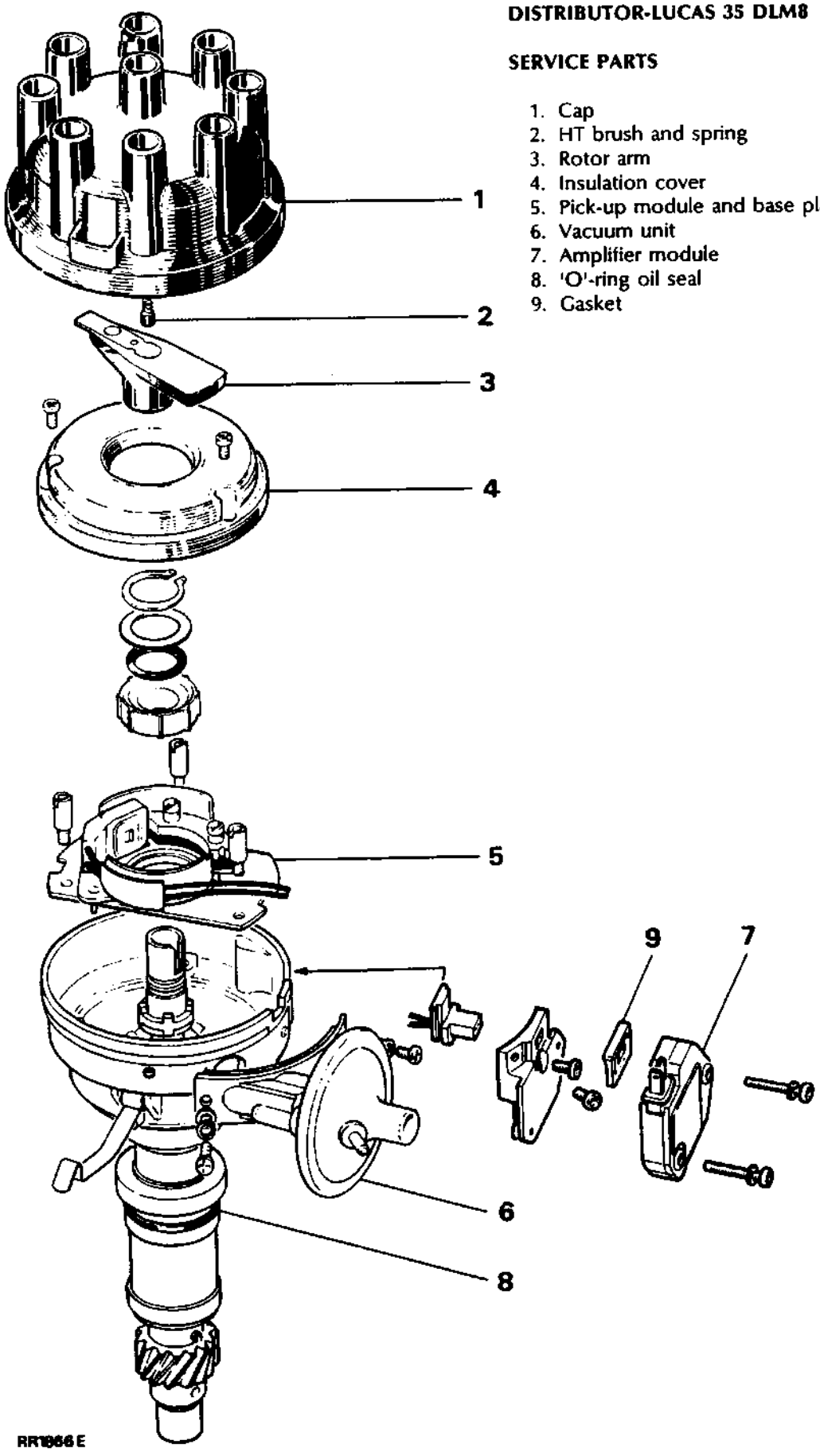
RR2317E

2. Switch on the headlamps and start the engine. Set the throttle to run at approximately 3000 rev/min. Note the voltmeter reading.
3. Transfer the voltmeter connections to the frame of the alternator and the negative terminal of the battery, and again note the voltmeter reading.



RR2318E

4. If the reading exceeds 0.5 volt on the positive side or 0.25 volt on the negative side, there is a high resistance in the charging circuit which must be traced and remedied.



DISTRIBUTOR-LUCAS 35 DLM8

SERVICE PARTS

1. Cap
2. HT brush and spring
3. Rotor arm
4. Insulation cover
5. Pick-up module and base plate assembly
6. Vacuum unit
7. Amplifier module
8. 'O'-ring oil seal
9. Gasket

ELECTRONIC IGNITION

A Lucas 35DLM8 distributor is employed. This has a conventional vacuum advance unit and centrifugal automatic advance mechanism.

A pick-up module, in conjunction with a rotating timing reluctor inside the distributor body, generates timing signals. These are applied to an electronic ignition amplifier module mounted on the side of the distributor body.

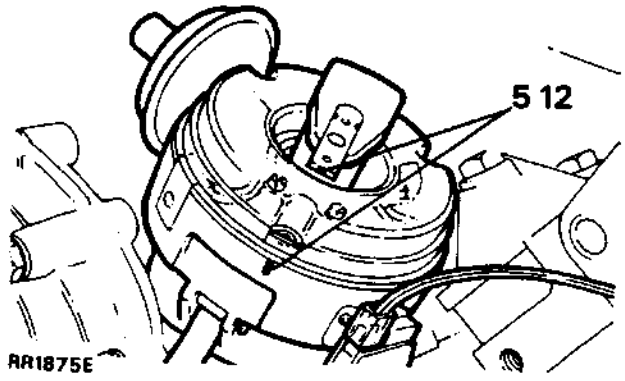
NOTE: The pick-up air gap is factory set. Do not adjust the gap unless the pick-up is being changed or the base plate has been moved. Use a non-ferrous feeler gauge to set the air gap.

DISTRIBUTOR

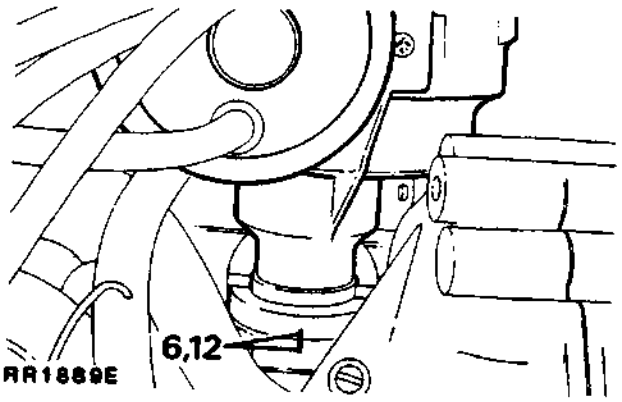
Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Disconnect the vacuum hose.
3. Remove the distributor cap.
4. Disconnect low tension lead from the coil.
5. Mark distributor body in relation to centre line of rotor arm.



6. Add alignment marks to distributor and front cover.

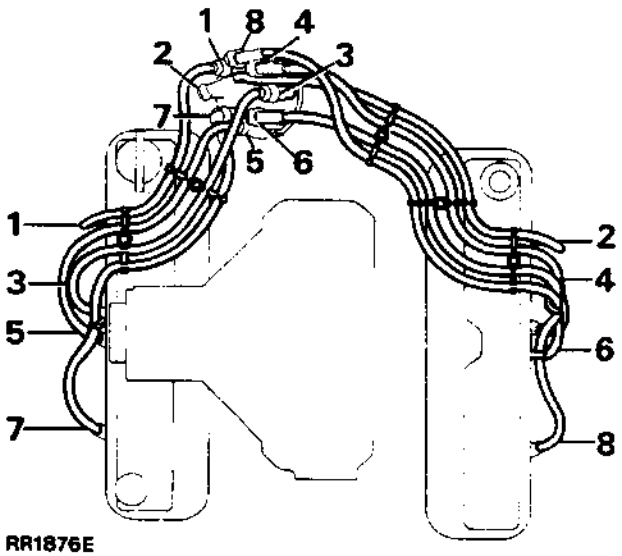


NOTE: Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

7. Release the distributor clamp and remove the distributor.

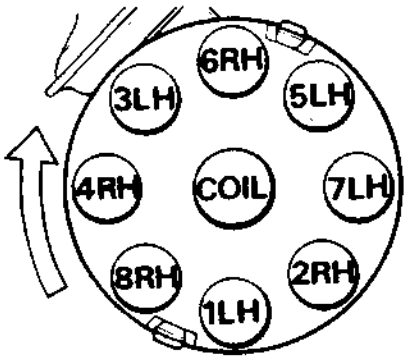
Refitting

NOTE: If a new distributor is being fitted, mark body in same relative position as distributor removed.



8. Leads for distributor cap should be connected as illustrated.
   Figures 1 to 8 inclusive indicate plug lead numbers.
   RH-Right hand side of engine, when viewed from the rear.
   LH-Left hand side of engine, when viewed from the rear.

Continued



RR616M

9. If engine has not been turned while distributor has been removed, proceed as follows (items 10 to 17). Alternatively proceed to instruction 18.
10. Fit new 'O' ring seal to distributor housing.
11. Turn distributor drive until centre line of rotor arm is 30° counter- clockwise from mark made on top edge of distributor body.
12. Fit distributor in accordance with alignment markings.

    NOTE: It may be necessary to align oil pump drive shaft to enable distributor drive shaft to engage in slot.

13. Fit clamp and bolt. Secure distributor in exact original position.
14. Connect vacuum hose to distributor and low tension lead to coil.
15. Fit distributor cap.
16. Reconnect battery.
17. Using suitable electronic equipment, set the ignition timing, see **IGNITION TIMING-Adjust.**
18. If, with distributor removed, engine has been turned it will be necessary to carry out the following procedure.
19. Set engine-No. 1 piston to static ignition timing figure (see Engine Tuning Data- Section 05) on compression stroke.
20. Turn distributor drive until rotor arm is approximately 30° counter-clockwise from number one sparking plug lead position on cap.
21. Fit distributor to engine.
22. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
23. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
24. Fit clamp and bolt leaving both loose at this stage.
25. Set the ignition timing statically to within 2°-3° of T.D.C.
26. Connect the vacuum hose to the distributor.
27. Fit low tension lead to coil.
28. Fit distributor cap.
29. Reconnect the battery.
30. Using suitable electronic equipment set the ignition timing, see **IGNITION TIMING-Adjust.**

DISTRIBUTOR-LUCAS 35DLM8

Overhaul

DISTRIBUTOR CAP

1. Unclip and remove the cap
2. Fit a new cap if known to be faulty.
3. Clean the cap and HT brush with a lint free cloth.

ROTOR ARM

4. Pull rotor arm from shaft.
5. Fit a new rotor arm if known to be faulty.

INSULATION COVER (Flash shield)

6. Remove cover, secured by three screws.
7. Fit a new cover if known to be faulty.

VACUUM UNIT

8. Remove two screws from vacuum unit securing bracket, disengage vacuum unit connecting rod from pick-up base plate connecting peg, and withdraw vacuum unit from distributor body.

AMPLIFIER MODULE

9. Remove two screws and withdraw the module.
10. Remove the gasket.
11. Remove two screws securing the cast heatsink and remove the heatsink.

WARNING: The amplifier module is a sealed unit containing Beryllia. This substance is extremely dangerous if handled. Do not attempt to open or crush the module.

PICK-UP AND BASE PLATE ASSEMBLY

12. Use circlip pliers to remove the circlip retaining the reluctor on rotor shaft.
13. Remove the flat washer and then the 'O' ring recessed in the top of the reluctor.
14. Gently withdraw the reluctor from the shaft, taking care not to damage the teeth.

NOTE: Coupling ring fitted beneath reluctor.

15. Remove three support pillars and cable grommet. Lift out the pick-up and base plate assembly.

NOTE: Do not disturb the two barrel nuts securing the pick-up module, otherwise the air gap will need re-adjustment.

16. Fit a new pick-up and base plate assembly if module is known to be faulty, otherwise check pick-up winding resistance (2k-5k ohm).

RE-ASSEMBLY

17. This is mainly a reversal of the dismantling procedure, noting the following points:

LUBRICATION

Apply clean engine oil:

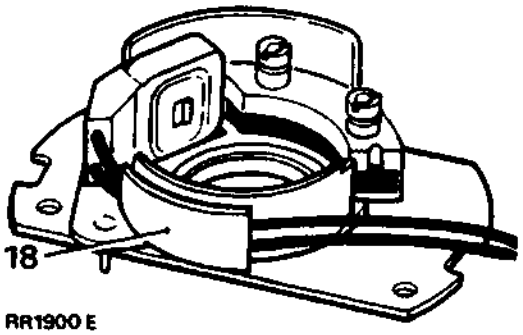
a. A spot into the rotor spindle before fitting rotor arm.

Apply Omnilube 2 (or equivalent) grease.

b. Auto advance mechanism.
c. Pick-up plate centre bearing.
d. Pre tilt spring and its rubbing area (pick-up and base plate assembly).
e. Vacuum unit connecting peg (pick-up and base plate assembly).
f. The connecting peg hole in vacuum unit connecting rod.

FITTING PICK-UP AND BASE PLATE ASSEMBLY

18. Pick-up leads must be prevented from fouling the rotating reluctor. Both leads should be located in plastic guide as illustrated. Check during re-assembly.



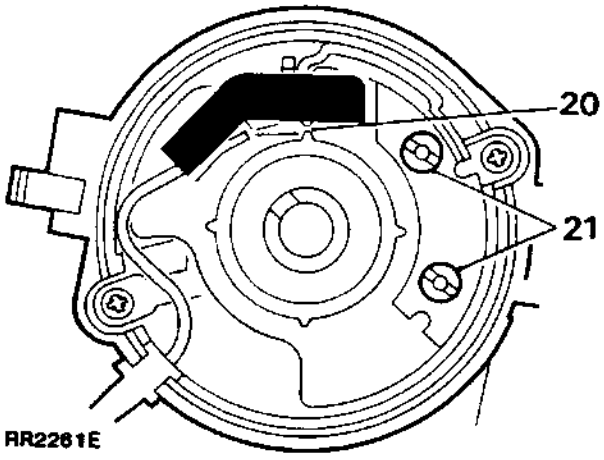
RR1900E

REFITTING RELUCTOR

19. Slide reluctor as far as it will go on rotor shaft, then rotate reluctor until it engages with the coupling ring beneath the pick-up base plate. The distributor shaft, coupling ring and reluctor are 'keyed' and rotate together. Fit the 'O' ring, flat washer and retaining circlip.

PICK-UP AIR GAP ADJUSTMENT

20. The air gap between the pick-up limb and reluctor teeth must be set within the specified limits, using a non-ferrous feeler gauge.



RR2261E

21. If adjustment is necessary, slacken the two barrel nuts to set the air gap. See Engine Tuning Data.

Continued

NOTE: When the original pick-up and base plate assembly has been refitted the air gap should be checked, and adjusted if necessary.

When fitting a new assembly the air gap will require adjusting to within the specified limits.

AMPLIFIER MODULE

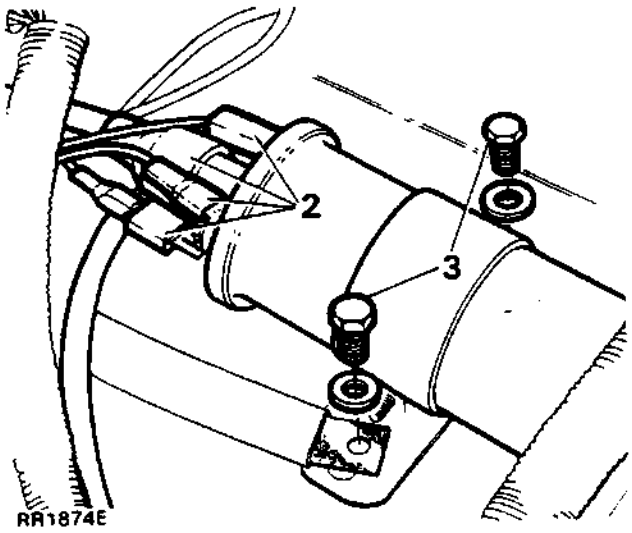
22. Before fitting the module, apply MS4 Silicone grease or equivalent heat-conducting compound to the amplifier module backplate, the seating face on distributor body and both faces of the heatsink casting.

IGNITION COIL

Remove and refit

Removing

1. Disconnect the battery negative terminal.
2. Disconnect the High Tension and Low Tension electrical leads from the ignition coil.



3. Remove the two bolts securing the coil to the valance.

   NOTE: A ground strap is located under one of the bolts.

4. Remove the coil from the engine compartment.

Refitting

5. Reverse the removal instructions.

   NOTE: Ensure that the bolting location for the ground strap is free from paint and grease. Coat the area around the bolt with Petroleum Jelly.

IGNITION TIMING

Adjust

1. It is essential that the following procedures are adhered to. Inaccurate timing can lead to serious engine damage and additionally create failure to comply with emission regulations. If the engine is being checked in the vehicle, the air conditioning compressor must be disengaged.
2. On initial engine build, or if the distributor has been disturbed for any reason, the ignition timing must be set statically to 6° B.T.D.C. (This sequence is to give only an approximation in order that the engine may be started) **ON NO ACCOUNT MUST THE ENGINE BE STARTED BEFORE THIS OPERATION IS CARRIED OUT.**

Equipment required

Calibrated Tachometer
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following the manufacturer's instructions.
4. Disconnect the vacuum hose from the distributor.
5. Start engine, with no load and not exceeding 3,000 rev/min run engine until normal operating temperature is reached. (Thermostat open). Check that the normal idling speed falls within the tolerance specified in the data section.
6. Idle speed for timing purposes must not exceed 800 rev/min.
7. With the distributor clamping bolt loosened turn distributor until the timing flash coincides with the timing pointer and the correct timing mark on the rim of the torsional vibration damper as shown in the engine tuning section.

8. Retighten the distributor clamping bolt securely. Recheck timing in the event that retightening has disturbed the distributor position.
9. Refit vacuum hose.
10. Disconnect stroboscopic timing lamp and tachometer from engine.

LUCAS CONSTANT ENERGY IGNITION SYSTEM 35DLM8-PRELIMINARY CHECKS

Inspect battery cables and connections to ensure they are clean and tight. Check battery state of charge if in doubt as to its condition.

Inspect all LT connections to ensure that they are clean and tight. Check the HT leads are correctly positioned and not shorting to ground against any engine components. The wiring harness and individual cables should be firmly fastened to prevent chaffing.

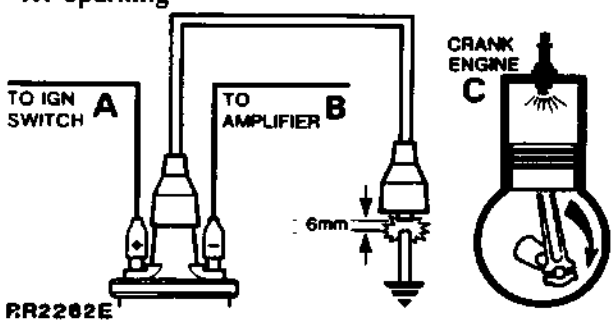
PICK-UP AIR GAP

Check the air gap between pick-up limb and reluctor teeth, using a non-ferrous gauge, see 'Engine Tuning Data'.

NOTE: The gap is set initiallt at the factory and will only require adjusting if tampered with or when the pick-up module is replaced.

TEST 1:

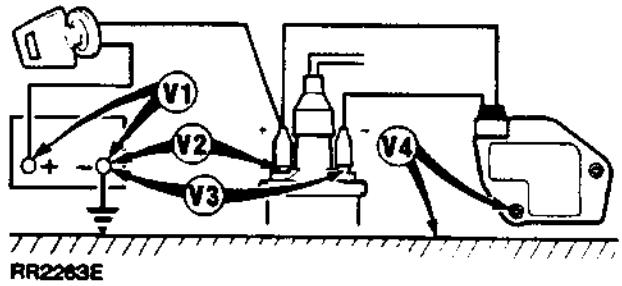
HT Sparking



Remove coil/distributor HT lead from distributor cover and hold approximately 6mm (0.25 in) from the engine block, using suitable insulated pliers. Switch the ignition 'On' and operate the starter. Regular sparking indicates fault in HT distribution, plugs, timing or fuelling, proceed to Test 6. If no spark or weak spark occurs proceed to Test 2.

Test 2:

LT Voltage



Swith the igintion 'On' - engine stationary.

(a) Connect voltmeter to points in the circuit indicated by V1 to V4 and make a note of the voltage readings.

(b) Compare voltages obtained with the specified values listed below:

EXPECTED READINGS

V1 More than 12 volts.
V2 1 volt maximum below volts at V1.
V3 1 volt maximum below volts at V1.
V4 0 volt - 0.1 volt.

(c) If all readings are correct proceed to Test 3.
(d) Check incorrect reading(s) with chart to identify area of possible faults, i.e. faults listed under heading SUSPECT and rectify.
(e) If coil and amplifier is suspected, disconnect LT lead at coil, repeat V3. If voltage is still incorrect, fit new coil. If voltage is now correct, check LT lead, if satisfactory fit new amplifier.
(f) If engine will not start proceed to Test 3.

Continued

1	2	3	4	SUSPECT
L	*	*	*	DISCHARGED BATTERY
*	L	L	*	IGN. SWITCH AND/OR WIRING
*	*	L	*	COIL OR AMPLIFIER
*	*	*	H	AMPLIFIER GROUND

KEY

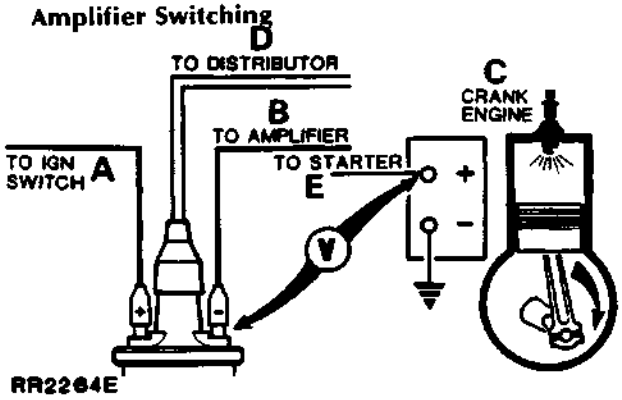
* Expected Voltage

H Voltage higher than expected

L Voltage lower than expected

TEST 3:

Amplifier Switching



RR2264E

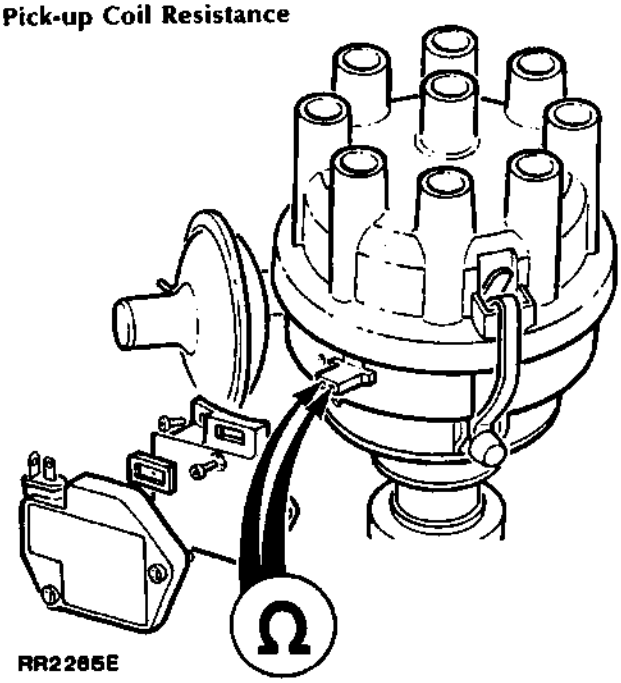
Connect the voltmeter between battery positive (+ve) terminal and H.T. coil negative (-ve) terminal, the voltmeter should register 0 volts.

Switch the ignition 'On' then crank the engine. The voltmeter reading should increase when cranking, in which case proceed to Test 5.

If there is no increase in voltage during cranking proceed to Test 4.

TEST 4:

Pick-up Coil Resistance



RR2265E

Remove the amplifier.

Connect the ohmmeter leads to the two pick-up terminals in the body of the distributor.

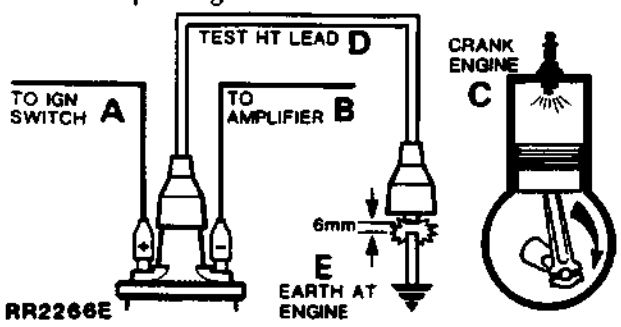
The ohmmeter should register between 2k and 5k ohm if pick-up is satisfactory. If ohmmeter reading is correct, check all connections between pick-up and amplifier, if satisfactory, fit new amplifier. If the engine still does not start carry out Test 5.

Change the pick-up if ohmmeter reading is incorrect. If the engine still does not start proceed to Test 5.

Continued

TEST 5:

Coil H.T. Sparking



Remove existing coil/distributor H.T. lead and fit test H.T. lead to coil tower. Using suitable insulated pliers, hold free end about 6mm (0.25 in) from the engine block and crank the engine. There should be good H.T. sparking.

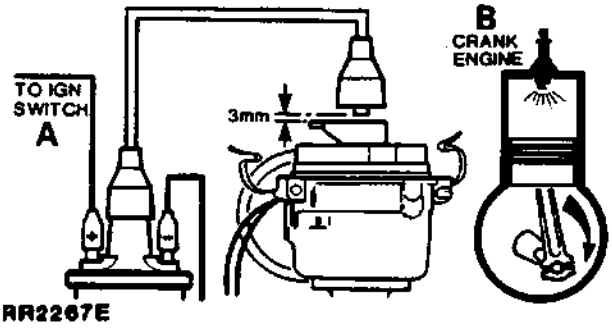
If weak or no sparking, fit new coil, repeat test.

H.T. sparking good, repeat test with original H.T. lead. If sparking is good carry out Test 6.

If weal or no sparking, fit new H.T. lead, if engine will not start carry out Test 6.

TEST 6:

Rotor Arm



Remove distributor cover. Disconnect coil H.T. lead from cover, using insulated pliers hold about 3mm (0.13 in) above rotor arm electrode and crank the engine.

There should be no H.T. sparking between rotor and H.T. lead. If satisfactory carry out Test 7.

If H.T. sparking occurs, an earth fault on rotor arm is indicated. Fit new rotor arm. If engine will not start carry out Test 7.

TEST 7:

Visual and H.T. Cable Checks

	Examine:	**Should be:**
1.	Distributor Cover	Clean, dry, no tracking marks
2.	Coil Top	Clean, dry, no tracking marks.
3.	HT Cable Insulation	Must not be cracked, chafed or perished
4.	HT Cable Continuity	Must not be open circuit
5.	Sparking Plugs	Clean, dry, and set to correct gap

NOTE:

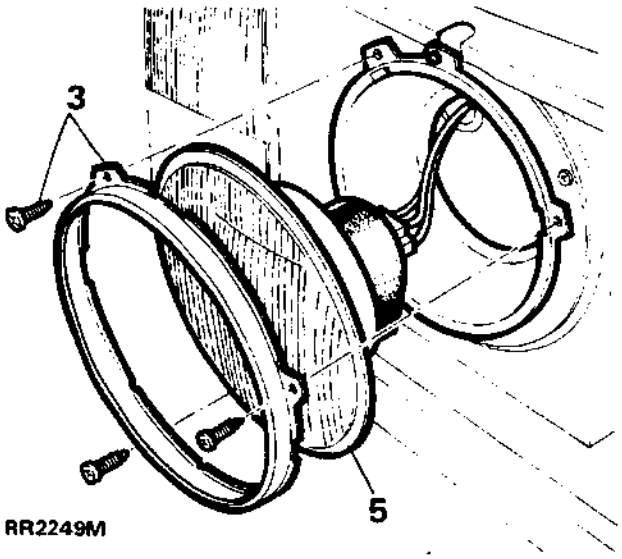
1.	Reluctor	Must not foul pick-up or leads
2.	Rotor and Insulation Cover	Must not be cracked or show signs of tracking marks

HEADLAMP ASSEMBLY/BULB REPLACEMENT

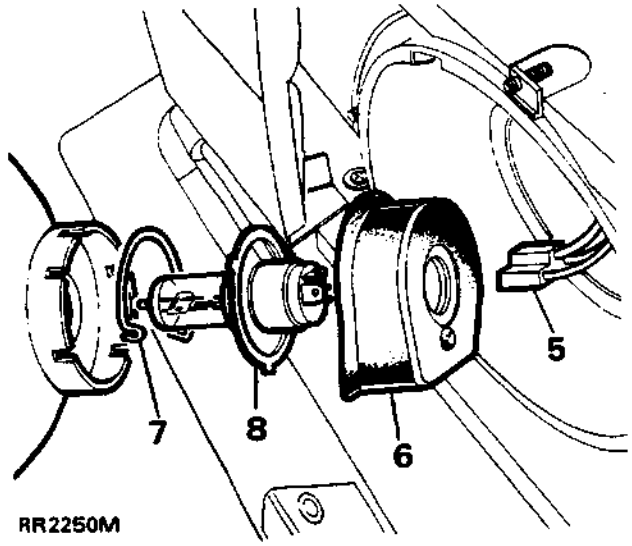
Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the radiator grille - see Body Section 76 in LSM 180 WS 1.
3. Remove three crosshead screws and the headlamp retaining rim.



4. **DO NOT** disturb the two adjusting screws.
5. Withdraw the headlamp unit and disconnect the wiring plug from the rear of the unit.



6. Remove the rubber dust cover.
7. To remove bulb: release the bulb retaining clips and withdraw the halogen bulb.
8. Remove three securing screws, prise away the grommet and withdraw the headlamp bowl.

Refitting

9. Reverse removal procedure ensuring that the quartz envelope of the bulb is not touched. Wipe the bulb gently using methylated spirits if contact does occur.

INSTRUMENT BINNACLE WARNING LIGHT SYMBOLS

Trailer connected-flashes with direction indicators (green)

Direction indicator- left turn / right turn (green)

Seat belt (red)

Headlamp high beam on (blue)

Engine oil pressure, low (red)

Electronic fuel injection warning lamp (red) indicates failure of air flow sensor, throttle potentiometer, water temperature thermistor, or Lambda sensor

Ignition on (red)

Low coolant (red)

Automatic gearbox oil temperature high (red)

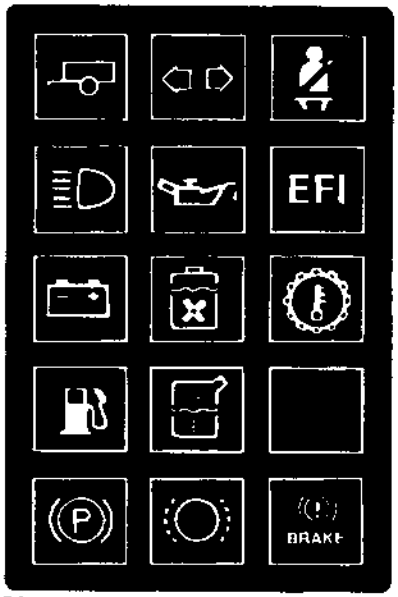
Fuel indicator, low (amber)

Low wash fluid (amber)

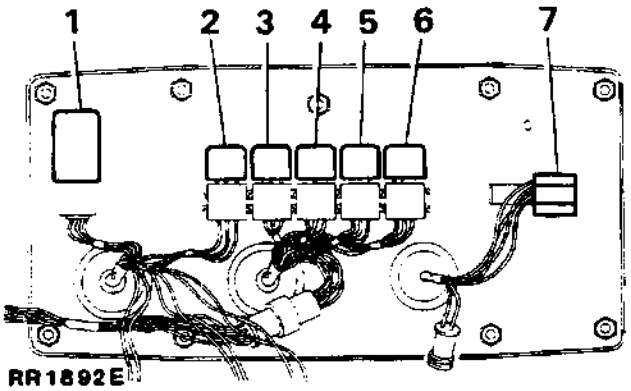
Transmission hand brake on (red)

Brake pad wear (amber)

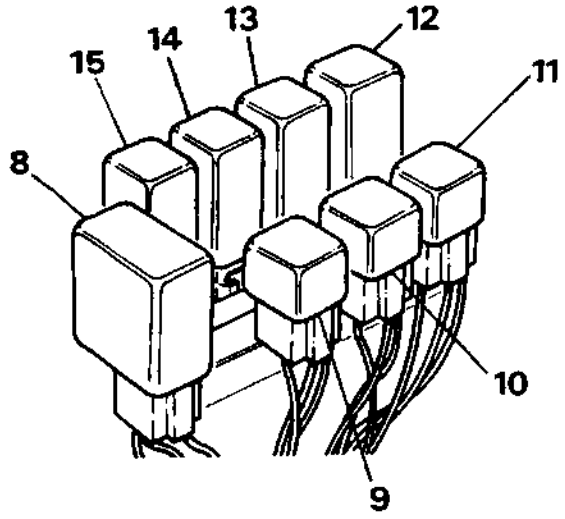
Brake fluid level low (red)



RR2044E

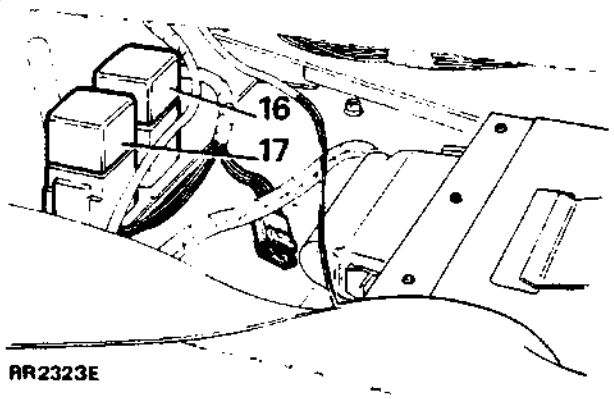


Closure panel viewed from the engine compartment, with protective cover removed.



Steering column mounted relays viewed with the lower dash panel removed.

Relay	Circuit Diagram Item Number	Colour
1. Headlamp wash timer unit	17. Main circuit diagram	Black
2. Heated rear window	67. Main circuit diagram	Natural
3. Starter solenoid relay	6. Main circuit diagram	Natural
4. Compressor clutch	11. Air conditioning diagram	Natural
5. Condenser fan	9. Air conditioning diagram	Natural
6. Air conditioning/heater	5. Air conditioning diagram	Natural
7. Stowage position	Not used	-------
8. Rear wiper delay	132. Main circuit diagram	Black
9. Ignition load relay	1. Main circuit diagram	Black
10. Window lift relay	63A. Main circuit diagram	Natural
11. Auxiliary lamp relay	86. Main circuit diagram	Natural
12. Front wiper delay	14. Main circuit diagram	Red
13. Voltage sensitive switch	70. Main circuit diagram	Yellow
14. Interior lamp delay	99. Main circuit diagram	Red
15. Flasher/Hazard unit	73. Main circuit diagram	Blue
16. Main EFI relay	22. EFI circuit diagram	Natural
17. Fuel pump relay	21. EFI circuit diagram	Natural



AR2323E

Main EFI (black terminal block) and fuel pump relays (blue terminal block) mounted beneath right hand front seat.

NOTE: Refer to fuel injection section of manual for full information on E.F.I. relays.

RELAYS-(Mounted on the engine compartment closure panel).

Remove and refit

Removing

1. Lift the hood.
2. Disconnect the battery negative lead.
3. Remove the bolt securing the relay protective cover, located on the front of the engine compartment closure panel.
4. Remove the cover.
5. Pull the appropriate relay off its multi-plug.

Refitting

6. Reverse the removal procedure.

RELAYS-(Mounted on the steering column support bracket)

Remove and refit

Removal.

1. Disconnect the battery negative lead.
2. Remove the six screws securing the lower fascia panel.
3. Lower the dash panel, disconnect the electric leads from the dimming control switch and remove the fascia panel.
4. Locate the appropriate relay on the relay mounting bracket, carefully pull the relay off the multi-plug.

Refitting

5. Reverse the removal procedure.

RELAYS-(Floor mounted beneath front seat)

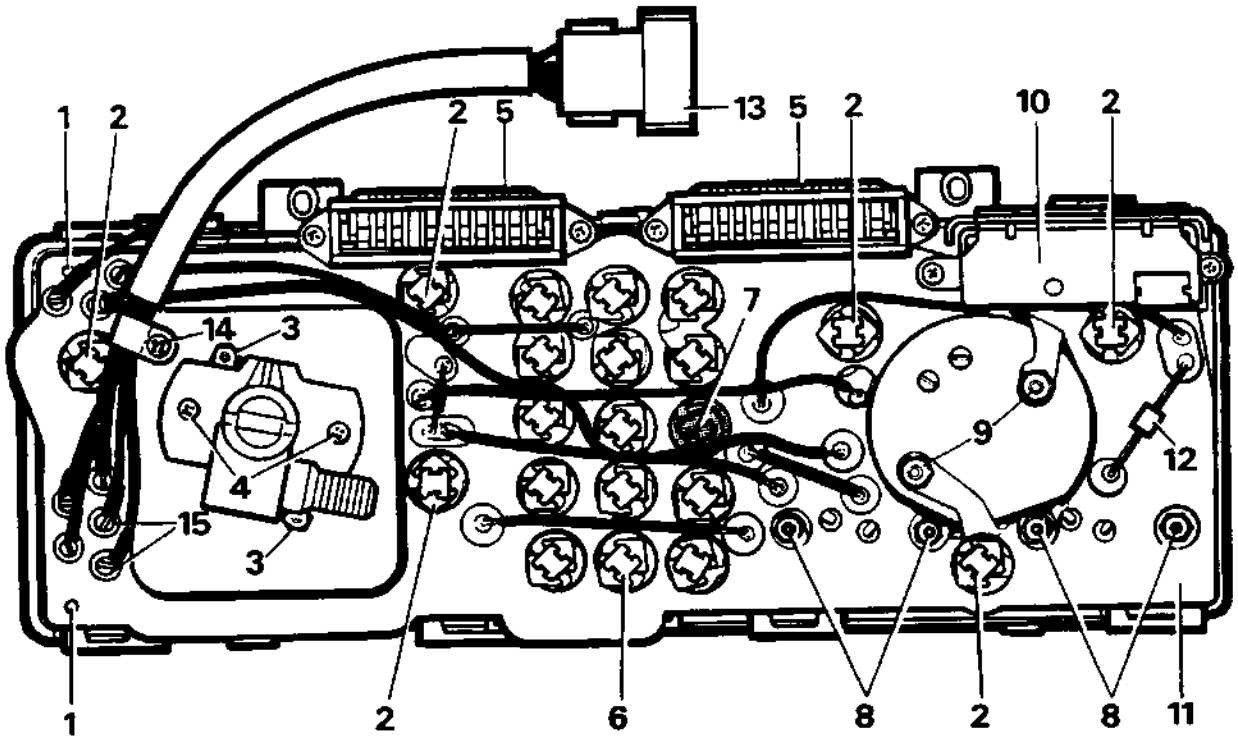
Remove and refit

Removing

1. Position seat to gain access to the required relay.
2. Disconnect the battery negative lead.
3. Carefully pull the relay off the multi-plug.

Refitting

4. Reverse the removal procedure.

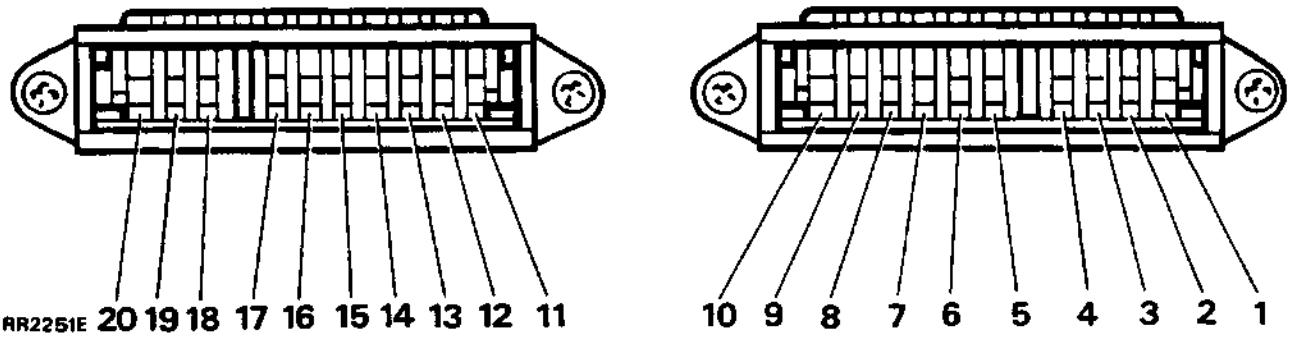


RR2109M

Instrument case (back)

1. Locating pegs
2. Panel light bulbs
3. Speedometer securing screw
4. Speedometer drive securing screws
5. Harness connectors
6. Warning light bulbs (14)
7. No charge warning light bulb (red holder)
8. Temperature and fuel gauge unit securing nuts
9. Tachometer securing nuts
10. Multi-function unit
11. Printed circuit
12. Pull-up resistor-high temperature gearbox oil
13. Single multi-plug
14. Single multi-plug securing screw
15. Single multi-plug wiring connecting screws (5)

PRINTED CIRCUIT HARNESS CONNECTIONS



RR2251E

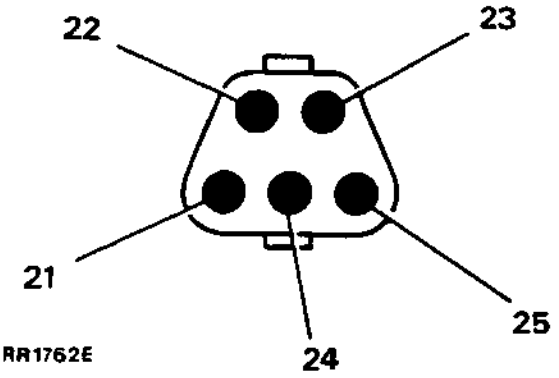
Sequence of connections looking towards the back of instrument case.

CIRCUIT SERVED

Tacho signal	1
Ignition switch 12V+	2
Low coolant input	3
Ground-VE	4
Ignition warning light	5
Low oil level/pressure warning light	6
High beam warning light	7
Zero volts from dimmer	8
Trailer warning light	9
Direction indicators warning light	10
Seat belts warning light	11
E.F.I. warning light	12
Temperature warning light (automatic gearbox)	13
Low wash fluid warning light	14
Not used	15
12V+ from dimmer	16
Brake fail warning light	17
Panel illumination bulbs (6 off)	18
Low fuel warning light	19
Low coolant warning light	20

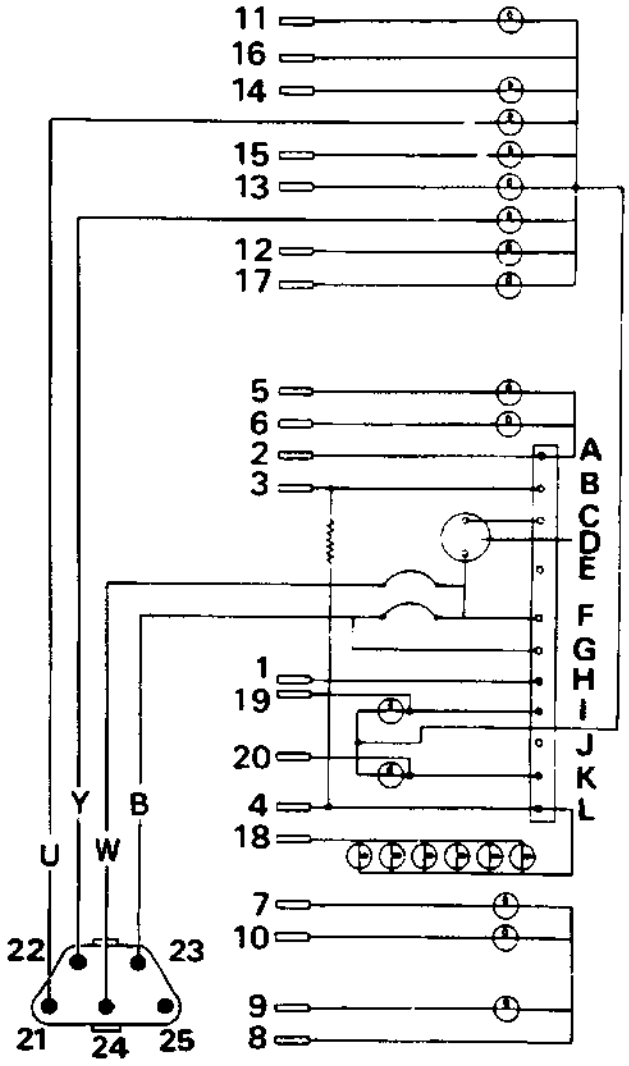
NOTE: The following 21 to 25 are connected at the single multi- plug located behind the binnacle

Brake pad wear warning light	21
Hand brake warning light	22
Fuel tank unit and fuel gauge	23
Temperature gauge	24
Not used	25



RR1762E

Sequence of pin connections viewed on the binnacle harness plug.

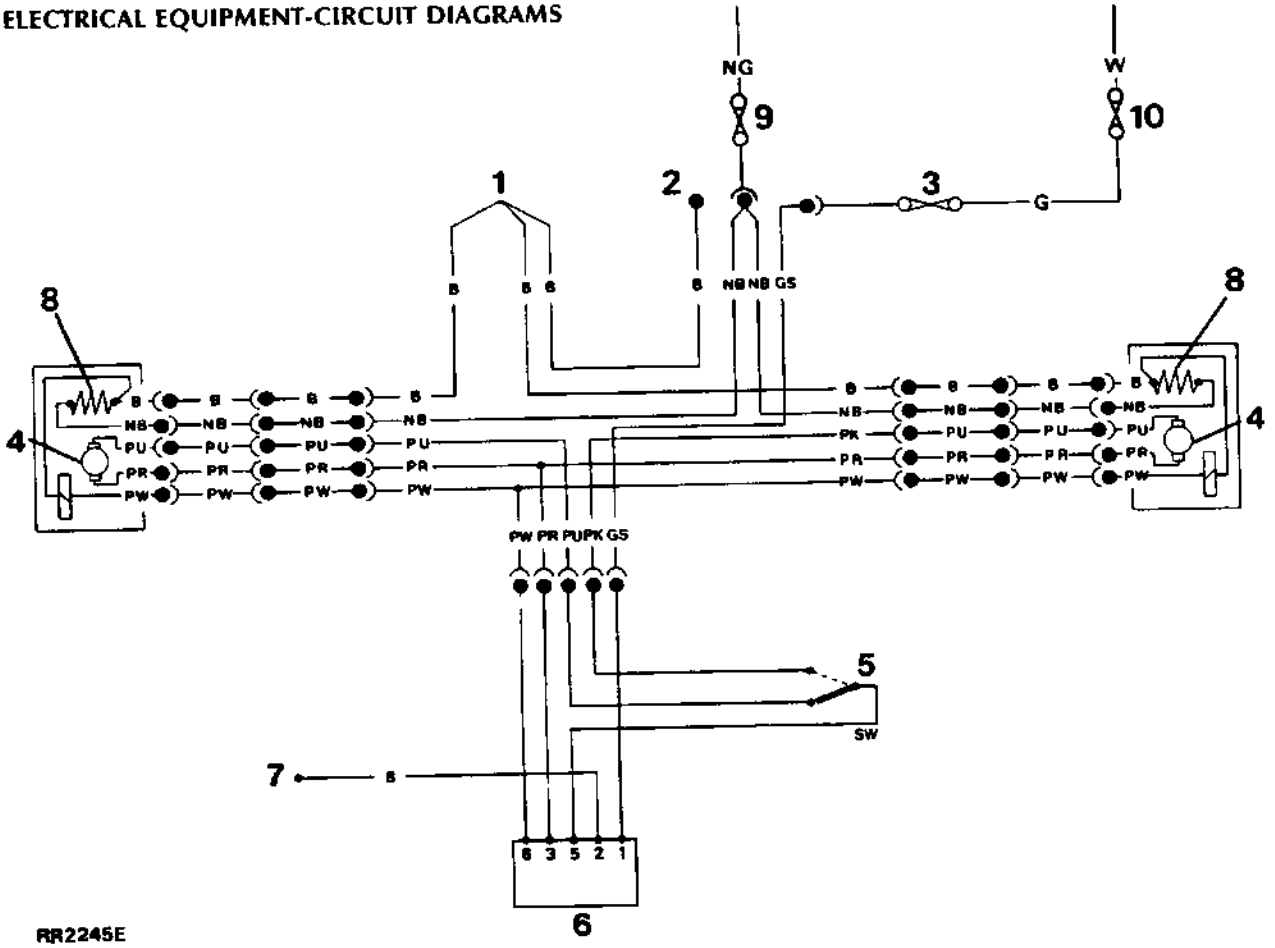


RR2310S

MULTI-FUNCTION UNIT

A. 12V+ supply
B. Input to low coolant circuit
C. Tachometer drive
D. Tachometer
E. Spare
F. 10V+ stabilised
G. Input to fuel tank unit - stabilised
H. Tachometer signal
I. Low fuel warning light
J. Spare
K. Low coolant warning light
L. Ground

ELECTRICAL EQUIPMENT-CIRCUIT DIAGRAMS



RR2245E

ELECTRIC MIRRORS - Circuit diagram - RR2245E

1. Clinch
2. Main cable connections
3. Fuse A5 - mirror motors
4. Mirror motors
5. Change over switch
6. Mirror control switch
7. Ground - via main cable
8. Mirror heating elements - active with heated rear screen
9. Fuse 10 - heating elements
10. Fuse 13

WINDOW LIFTS AND DOOR LOCKS - Circuit diagram - RR2282E

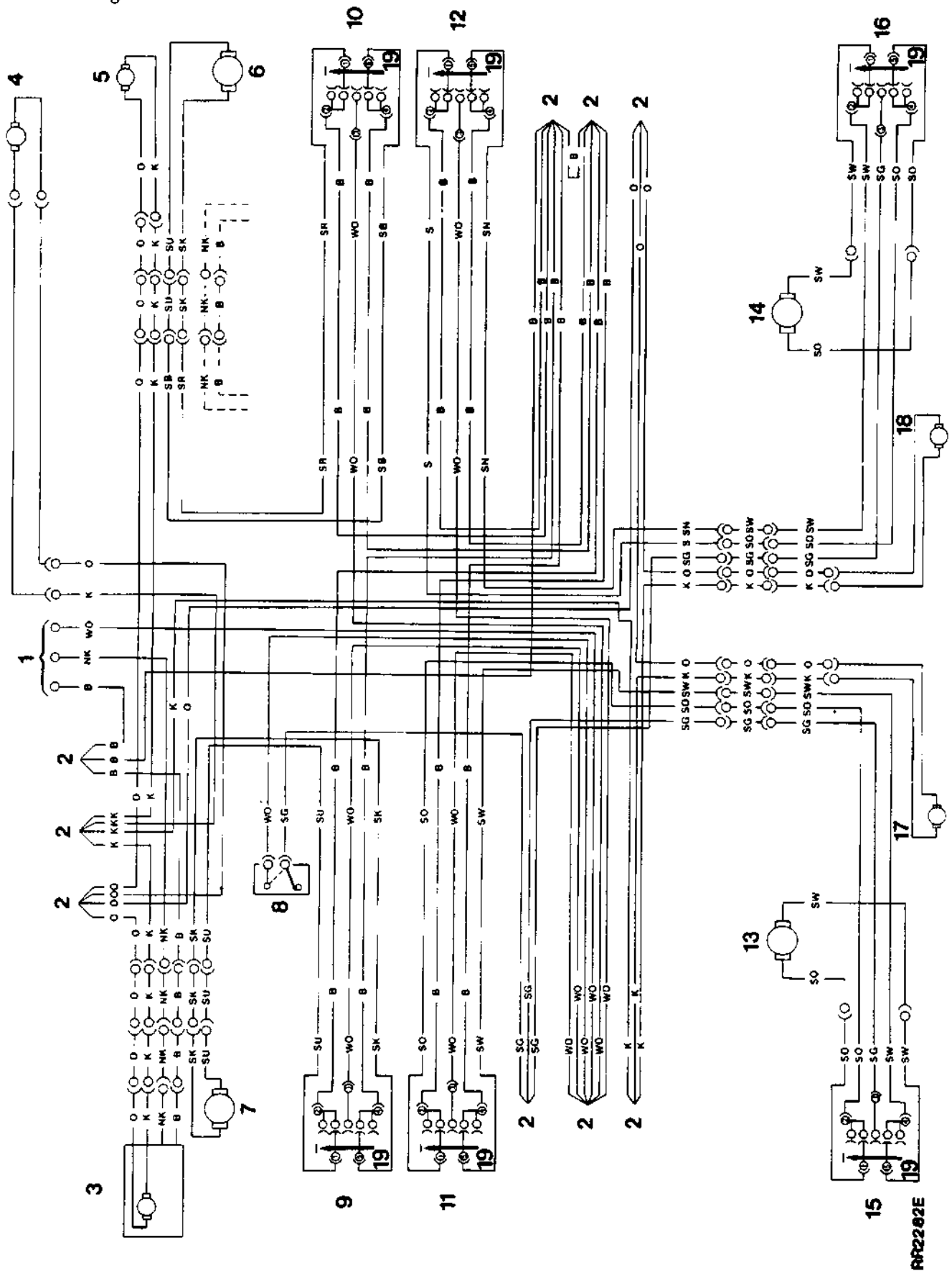
1. Main cable connections
   NK: (+) Battery feed - central locking
   WO: (+) Key position 1 - window lift
   B: (-) Ground
2. Clinches
3. Switch unit-central door locking (drivers door)
4. Fuel flap actuator
5. Lock unit-central door locking (front passenger door)
6. Window lift motor L/H front
7. Window lift motor R/H front
8. Isolator switch
9. Window lift switch L/H front
10. Window lift switch R/H front
11. Window lift switch L/H rear
12. Window lift switch R/H rear
13. Window lift motor L/H rear
14. Window lift motor R/H rear
15. Window lift switch L/H rear door
16. Window lift switch R/H rear door
17. Lock unit central door locking L/H rear door
18. Lock unit central door locking R/H rear door
19. Rocker switch operating levers

CABLE COLOUR CODE

B	Black	**N**	Brown	**R**	Red	**W**	White
G	Green	**O**	Orange	**S**	Grey	**Y**	Yellow
K	Pink	**P**	Purple	**U**	Blue		

The last letter of a colour code denotes the tracer.

Window lifts and door locks
Circuit diagram



MAIN CIRCUIT DIAGRAM
Left hand steering - RR2334S and RR2335S

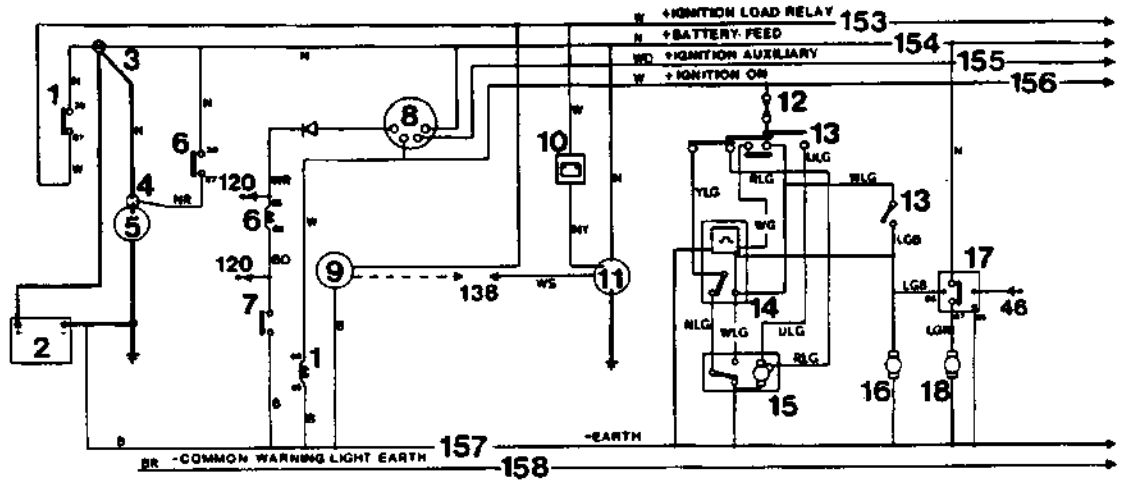
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (automatic)
8. Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse 7
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Front wash pump
17. Headlamp wash timer unit (option)
18. Headlamp wash pump (option)
19. Main lighting switch
20. Fuse 6
21. Fuse 5
22. LH side lamp
23. LH tail lamp
24. Number plate lamp (2 off)
25. Main beam dip/flash switch
26. Radio illumination
27. RH side lamp
28. RH tail lamp
29. Rheostat
30. Fuse 3
31. Fuse 4
32. Fuse 1
33. Fuse 2
34. Rear fog switch
35. Fuse 12
36. Switch illumination (2 off)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Automatic gear selector illumination (2 off)
41. Instrument illumination (6 off)
42. Rear fog warning lamp
43. LH rear fog
44. RH rear fog
45. LH dip beam
46. RH dip beam
47. LH main beam
48. RH main beam
49. Main beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53. Water temperature sender unit
54. Fuse 11
55. Horn switch
56. RH horn
57. LH horn
58. Under bonnet illumination switch
59. Under bonnet light
60. Clock
61. Fuse 19
62. Fuse 20
63. Pick-up point central locking/window lift
63 (a). Window lift relay
64. Heated rear window relay
65. Fuse 9
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse 13
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. Hazard/indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. LH side repeater lamp
79. RH side repeater lamp
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse 15
84. Stop lamp switch
85. Reverse lamp switch
86. Auxiliary lamp relay
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH auxiliary lamp
92. RH auxiliary lamp
93. Auxiliary lamp switch
94. Fuse 17
95. Dash cigar lighter
96. Cubby box cigar lighter
97. LH interior lamp
98. RH interior lamp
99. Interior lamp delay unit
100. LH door edge lamp
101. RH door edge lamp
102. LH puddle lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110. Differential lock warning lamp
111. Differential lock switch
112. Oil pressure warning lamp
113. Oil pressure switch
114. Fuse 18
115. Speed transducer
116. Fuel pump
117. Ignition coil
118. Capacitor
119. Distributor
120. EFI Harness plug
121. Coil negative (engine RPM input to ECU)
122. Radio choke
123. Radio fuse
124. Radio
125. Four speakers
126. Not used
126 (a). Not used
127. Sunroof connection point
128. Automatic transmission oil temperature warning lamp
129. Automatic transmission oil temperature switch
130. Fuse 16
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Multi-function unit in binnacle
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. E.F.I. warning lamp
142. Handbrake warning lamp
143. Handbrake warning switch
144. Brake fluid level warning switch
145. Brake fluid level warning lamp
146. Brake pad wear warning lamp
147. Brake pad wear sensors
148. Brake check unit
149. Split charge relay (option)
150. Split charge terminal post (option)
151. Heater/air conditioning connections
152. Fuse 8
153. Ignition load relay (+)
154. Battery feed (+)
155. Ignition auxiliary (+)
156. Ignition on (+)
157. Earth (-)
158. Warning lights common earth (-)
159. Warning lights supply (+)

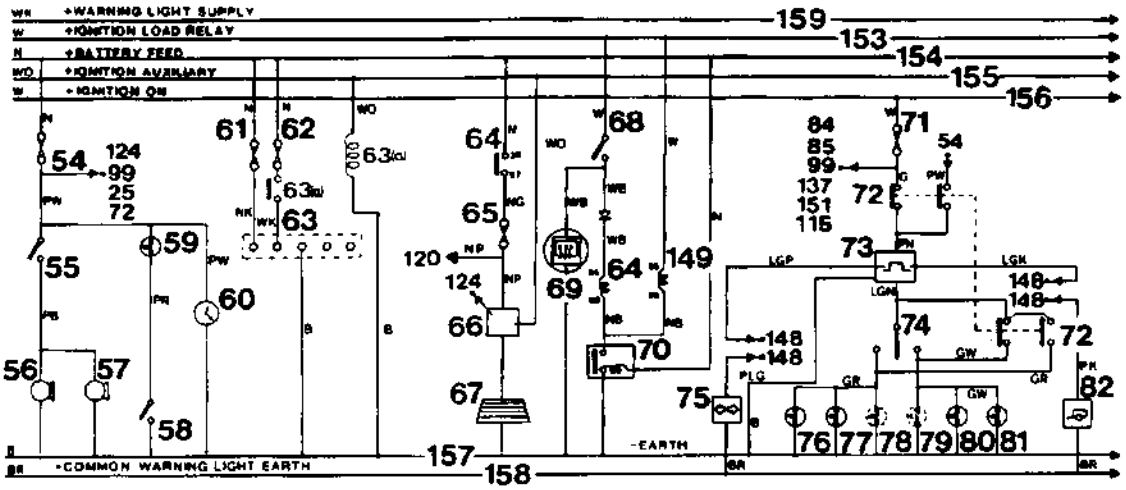
CABLE COLOUR CODE

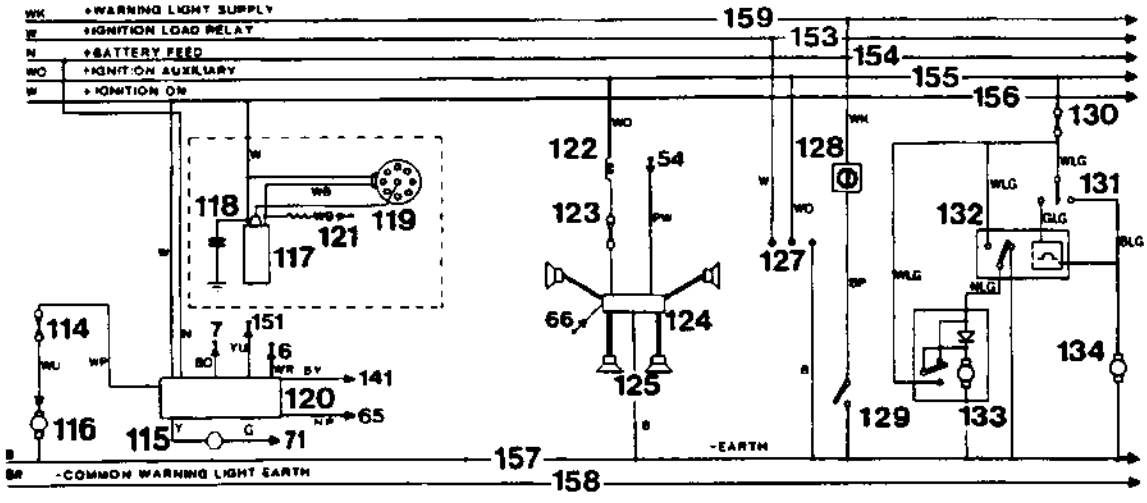
B	Black	**N**	Brown	**R**	Red	**W**	White
G	Green	**O**	Orange	**S**	Grey	**Y**	Yellow
K	Pink	**P**	Purple	**U**	Blue		

The last letter of a colour code denotes the tracer.

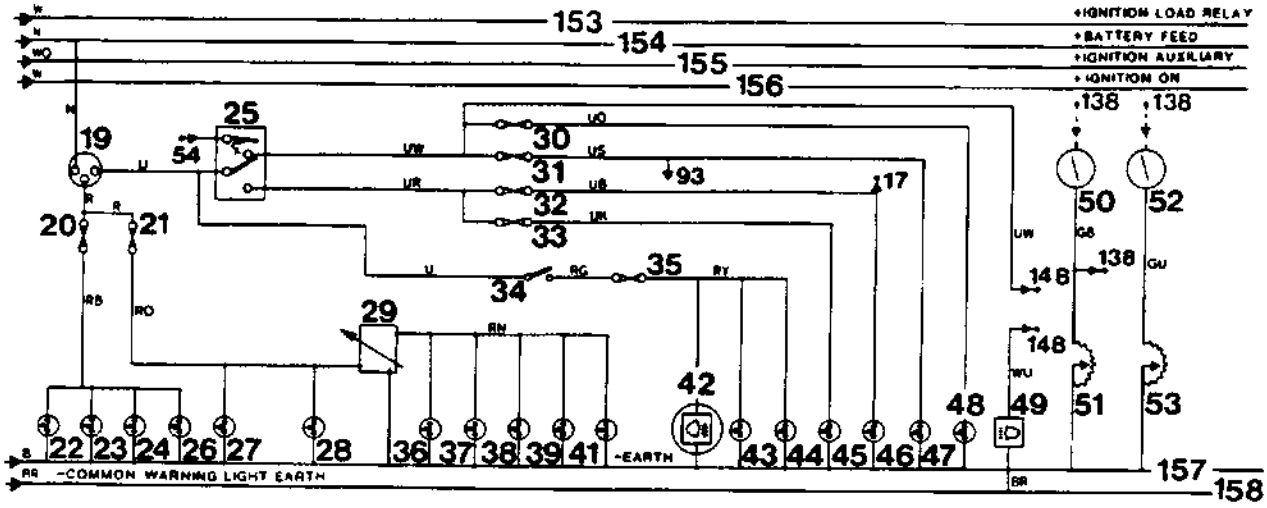
MAIN CIRCUIT DIAGRAM
Left hand steering - RR2334S and RR2335S

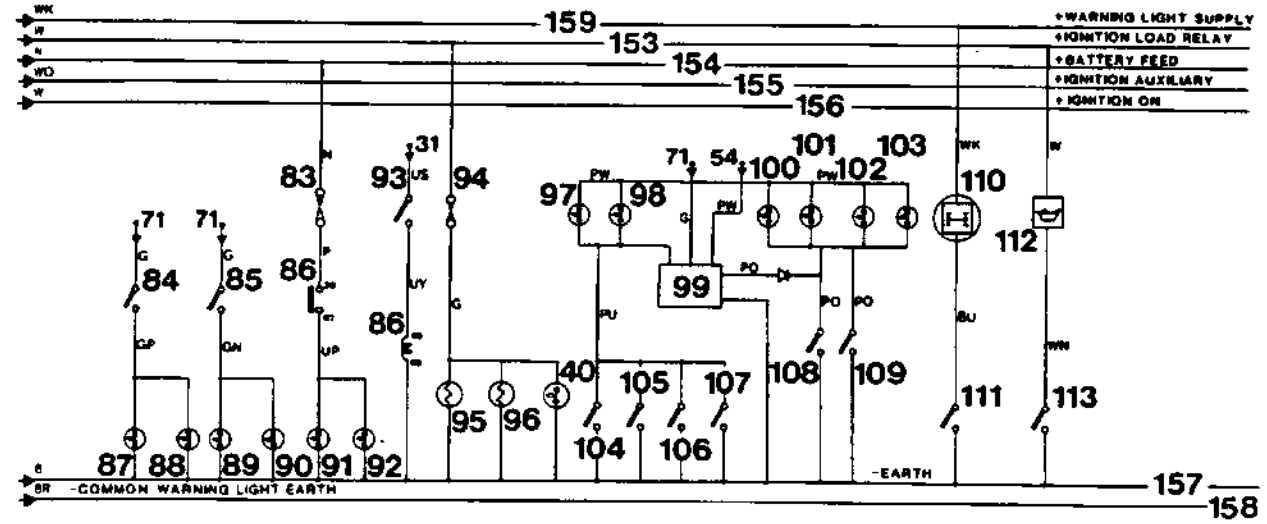


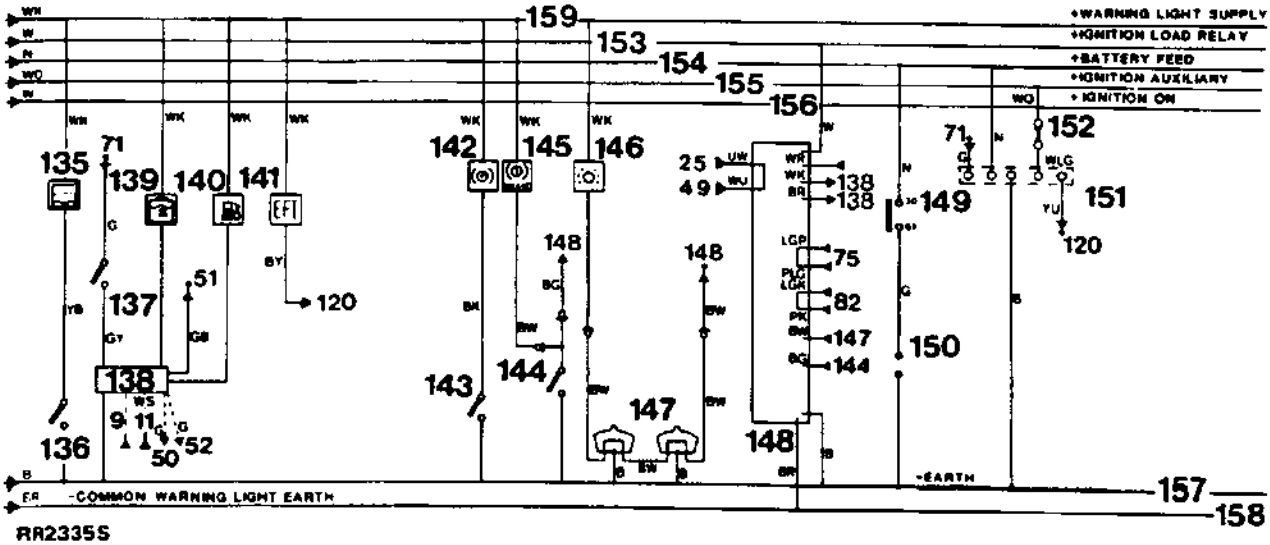




RR2334S


153
154
155
156
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-COMMON WARNING LIGHT EARTH
-EARTH
157
158


159
153
154
155
156
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-COMMON WARNING LIGHT EARTH
-EARTH
157
158


159
153
154
155
156
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-COMMON WARNING LIGHT EARTH
-EARTH
157
158

RR2335S

Land Rover
Range Rover

Workshop Bulletin

JUNE 1987

BULLETIN No. LSM180WB1

RANGE ROVER

LUCAS A127/65 AMP ALTERNATOR

Alternator Bulletin

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INTRODUCTION 01

RANGE ROVER

1987 MODEL YEAR IMPROVEMENTS

INTRODUCTION

As part of the 1987 model year programme Land Rover Ltd is continually looking at ways to improve the quality and characteristics of its products. This bulletin contains servicing details of the Lucas A127/65 alternator now fitted to Range Rover models.

The A127 alternator incorporates a combined regulator and brush box assembly readily detachable from the rear of the alternator body.

This bulletin also includes the latest main circuit diagrams for both left and right hand drive models plus a revised electric mirror circuit diagram.

04 GENERAL SPECIFICATION DATA

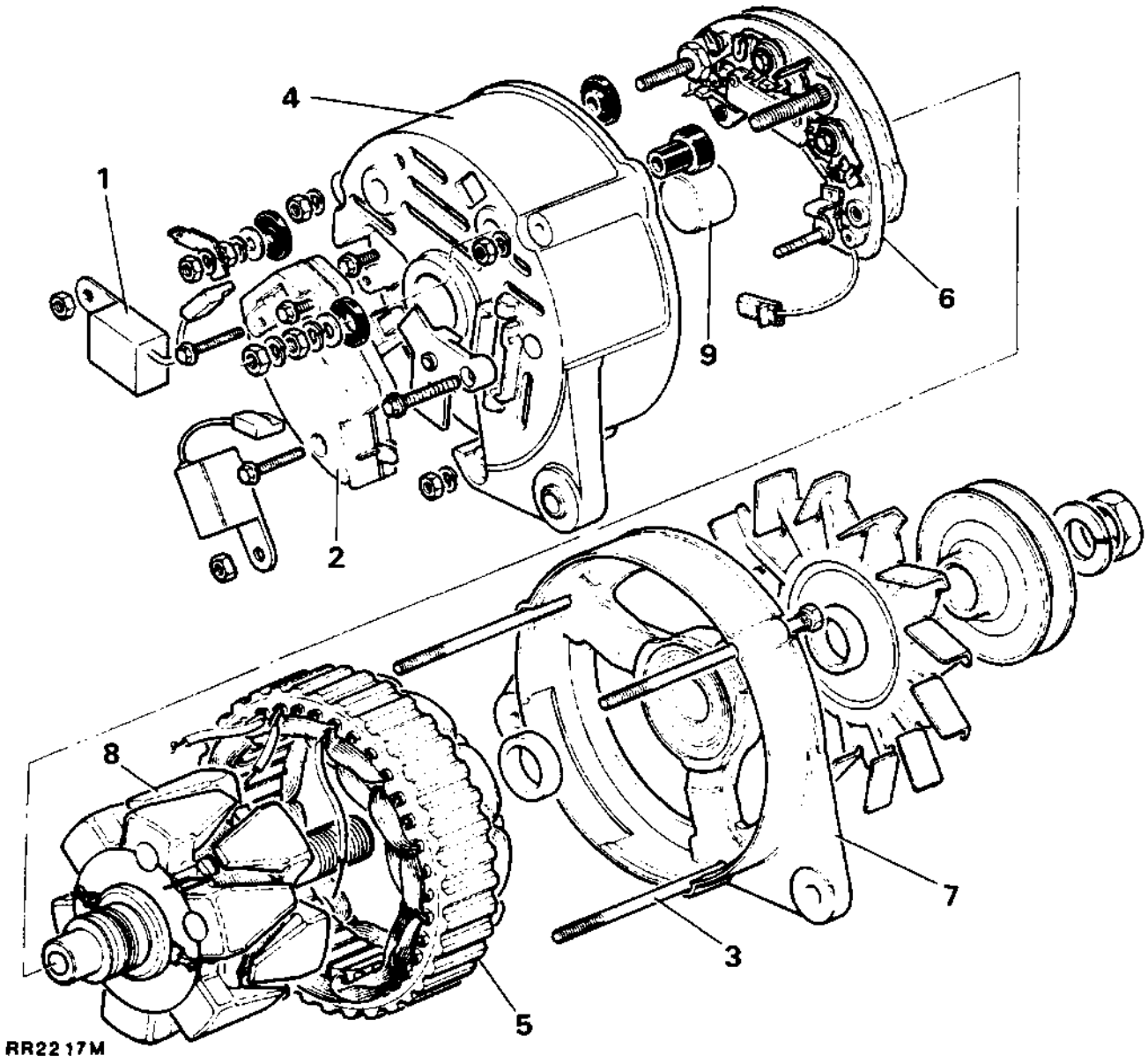
ALTERNATOR

Manufacturer	Lucas
Type	A127/65
Polarity	Negative earth
Maximum operating speed	15000 rev/min
Maximum DC output at 6000 rev/min	65 amp
Stator windings	3 phase
Stator winding resistance	0.15 ohm/phase
Regulator type	21TR
Regulator controlled voltage	13.6-14.4V
Field winding rotor poles	12
Rotor winding resistance	3.2 ohms
Brush length - new	17 mm(0.67 in))From
Renew regulator/brushbox assembly at	5 mm(0.20 in))moulding
Brush spring pressure	
- flush with brushbox moulding	1.3-2.7N(4.7-9.8oz)

06 TORQUE WRENCH SETTINGS

ALTERNATOR	Nm	lbf ft
Alternator shaft nut	50-70	37-52
Alternator through bolts	5.5	4.0
Alternator rectifier screws	3.5	2.5
Regulator/brushbox screws	2.5	2.0
Terminal nut - main output	4.0	3.0
Terminal nut - phase	4.0	3.0

ALTERNATOR - LUCAS - A127-65



Service parts

1. Suppression capacitors - 2 off
2. Regulator/Brushbox assembly
3. Through bolts
4. Slip ring end (SRE) bracket
5. Stator
6. Rectifier
7. Drive end bracket (DRE)/bearing assembly
8. Rotor
9. Slip ring end bearing

ALTERNATOR - LUCAS - A127-65

Description

The model A127 alternator is a three phase, field sensed unit, the rotor and stator windings generate three phase alternating current (AC) which is rectified to direct current (DC). The electronic voltage regulator unit controls the alternator output voltage by high frequency switching of the rotor field circuit.

It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.

Do not disconnect battery cables while the engine is running or damages to the semi-conductor devices may occur. It is also inadvisable to break or make any connections in the alternator charging and control circuits while the engine is running.

The Model 21TR electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse effects of temperature, dust, and moisture etc.

The brushbox assembly is incorporated in the regulator unit.

Surge protection is incorporated in the regulator unit.

The regulating voltage is set during manufacture to give the required regulating voltage range of 13.6 to 14.4 volts, and no adjustment is necessary. The only maintenance needed is the occasional check on terminal connections and wiping with a clean dry cloth.

The alternator system provides for direct connection of a charge (ignition) indicator warning light, and eliminates the need for a field switching relay or warning light control unit. As the warning lamp is connected in the charging circuit, lamp failure will cause loss of charge. Lamp should be checked regularly and a spare carried.

When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.

Dismantle, Overhaul, Test components

NOTE: Alternator charging circuit - The ignition warning light is connected in series with the alternator field circuit. Bulb failure would prevent the alternator charging, except at very high engine speed, therefore, the bulb should be checked before suspecting an alternator failure.

Precautions

Battery polarity is NEGATIVE EARTH, which must be maintained at all times.

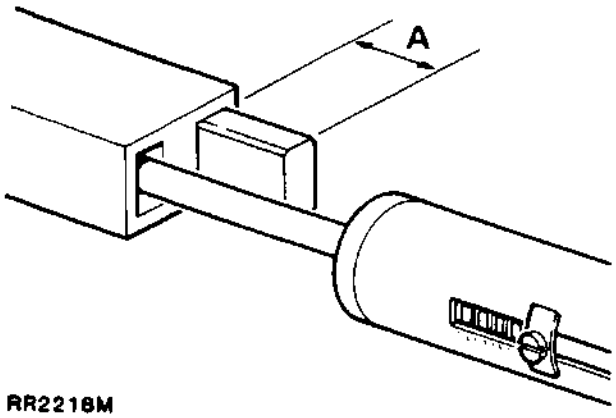
No separate control unit is fitted; instead a voltage regulator of micro-circuit construction is mounted on the slip ring end bracket.

Battery voltage is applied to the alternator output cable even when the ignition is switched off, the battery must be disconnected before commencing any work on the alternator. The battery must also be disconnected when repairs to the body structure are being done by arc welding.

Dismantle

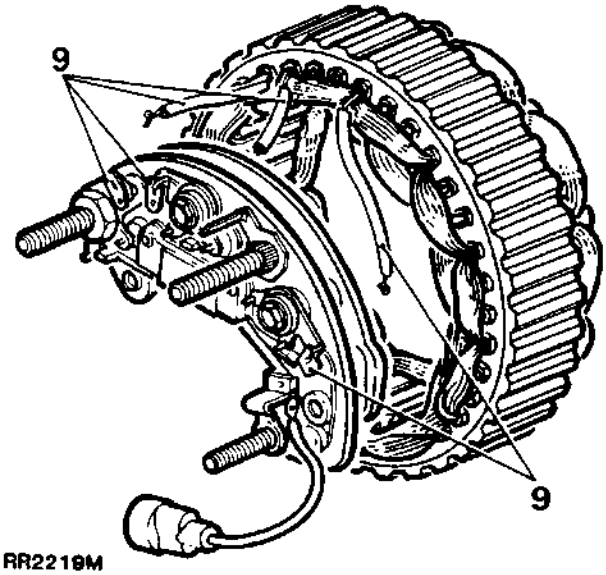
1. Withdraw the connectors from the alternator.
2. Remove the alternator
3. Remove the nuts from the through bolts, disconnect the connectors and remove two suppression capacitors.
4. Remove three screws, disconnect one lead and withdraw the regulator and brushbox assembly.

5. Check the brush lengths by measuring length of protrusion from moulding. If dimension A is 5mm (0.20in) or less, change the assembly.



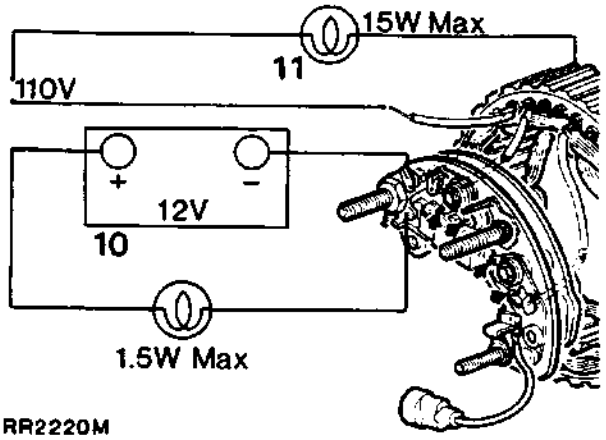
RR2218M

6. Check brush spring pressure using a push type spring gauge. Gauge should register 136 to 279 g (5 to 10 oz) when brush is pressed until face is flush with housing. If reading is outside these limits, renew assembly.
7. Mark the relative positions of the end brackets and stator. Remove through bolts and withdraw slip ring end bracket and stator assembly. Carefully tap the mounting lugs with a mallet if necessary.
8. Remove nuts, washers and insulators from stud terminals noting their position for reassembly. Remove two screws and insulation cover and withdraw rectifier and stator from slip ring end bracket.



RR2219M

9. Release the stator winding cable ends from the rectifier by applying a hot soldering iron to the terminal tags of the rectifier. Prise out the cable ends when the solder melts, and separate the rectifier and stator. Further dismantling of the rectifier is not required.
10. Check the diodes. Connect the test equipment as shown and test each diode in turn, note whether lamp lights, then reverse test lead connections. The lamp should light in one direction only. Renew the rectifier assembly if a faulty diode is diagnosed.

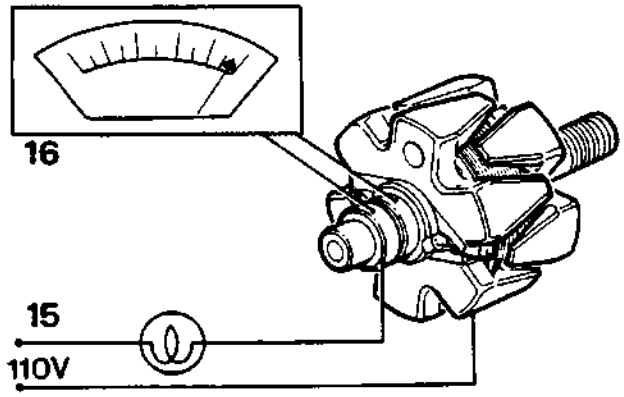


RR2220M

11. Visually inspect the stator windings for signs of damage or burning. Check the stator insulation using a suitable 110 volt test lamp. Connect the test leads to the laminated yoke and to each of the three leads in turn. If test lamp lights, fit a new stator.
12. Remove the fan and pulley assembly. Push out the rotor shaft from the bearing using a suitable press and remove the spacer from the shaft.

Continued

13. Clean surfaces of slip rings using a solvent moistened cloth.
14. Inspect slip ring surfaces for signs of burning, remove burn marks using extra fine glasspaper. On no account should emery cloth or similar abrasives be used, or any attempt made to machine the slip rings.
15. Check the insulation of the rotor field windings, using a suitable 110 volt test lamp connected between one of the slip rings and one of the rotor poles. If the test lamp lights, the rotor must be renewed.

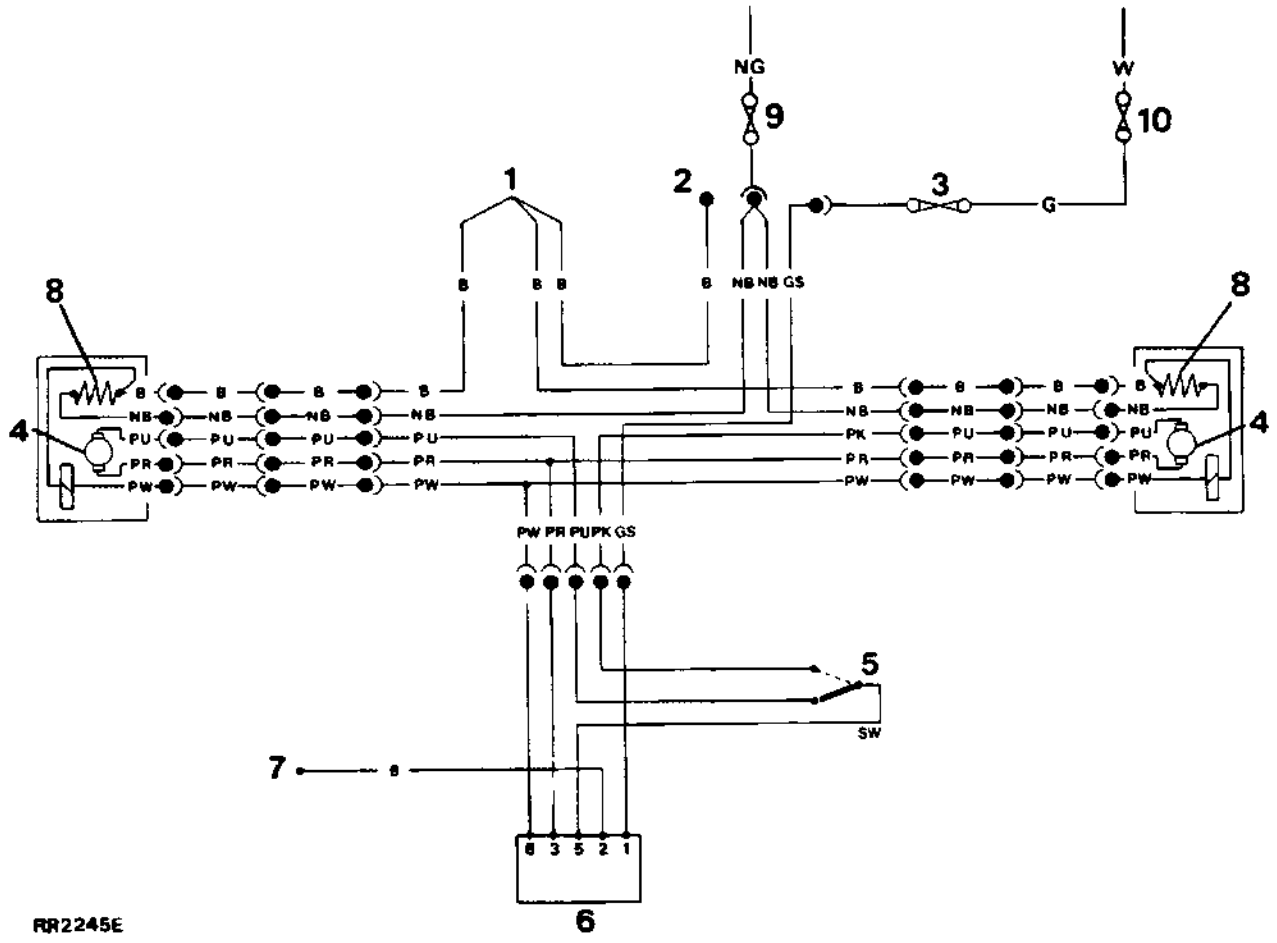


RR2221M

16. Check the resistance/continuity of the rotor field windings by connecting an ohmmeter to the slip rings as shown. A reading of 3.2 ohms should be obtained.
17. Check condition of bearings. If signs of rubbing between rotor poles and stator is evident, both bearings are excessively worn, and must be renewed.
18. Use a suitable press, applying pressure from the rear of the slip ring end bracket, to withdraw or refit the bearing. Note that the drive end bracket and bearing are only supplied as a unit.

Reassembling

19. Fit the spacer and press the rotor into the drive end bracket. Insert the through bolts. Fit the spacer, fan, pulley and spring washer to the shaft. Fit and tighten the pulley nut to the correct torque.
20. Fit the stator and rectifier assembly to the drive end bracket in the position previously marked.
21. Fit the slip ring end bracket in the position previously marked, locating the regulator lead through its aperture. Fit the insulation cover and tighten two rectifier securing screws.
22. Fit and tighten the through bolt nuts evenly and to the correct torque.
23. Connect the lead to the regulator, locate the brushes on the slip rings and secure the regulator/brushbox assembly, taking care not to damage the brushes.
24. Fit both suppression capacitors.
25. Refit the alternator.



ELECTRIC MIRRORS -
Circuit diagram

1. Clinch
2. Main cable connections
3. Fuse A5-mirror motors
4. Mirror motors
5. Change over switch
6. Mirror control switch
7. Earth-via main cable
8. Mirror heating elements-active with heated rear screen
9. Fuse 10-heating elements
10. Fuse 13

CABLE COLOUR CODE

B	Black
U	Blue
N	Brown
G	Green
O	Orange
P	Purple
R	Red
S	Slate
W	White
Y	Yellow

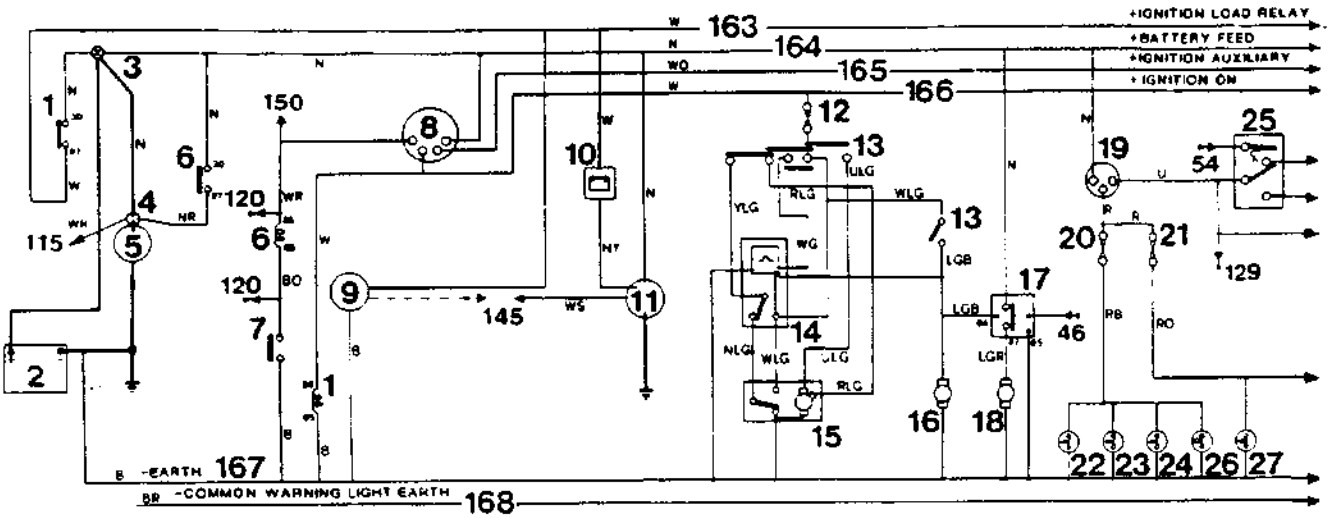
The last letter of a colour code denotes the tracer.

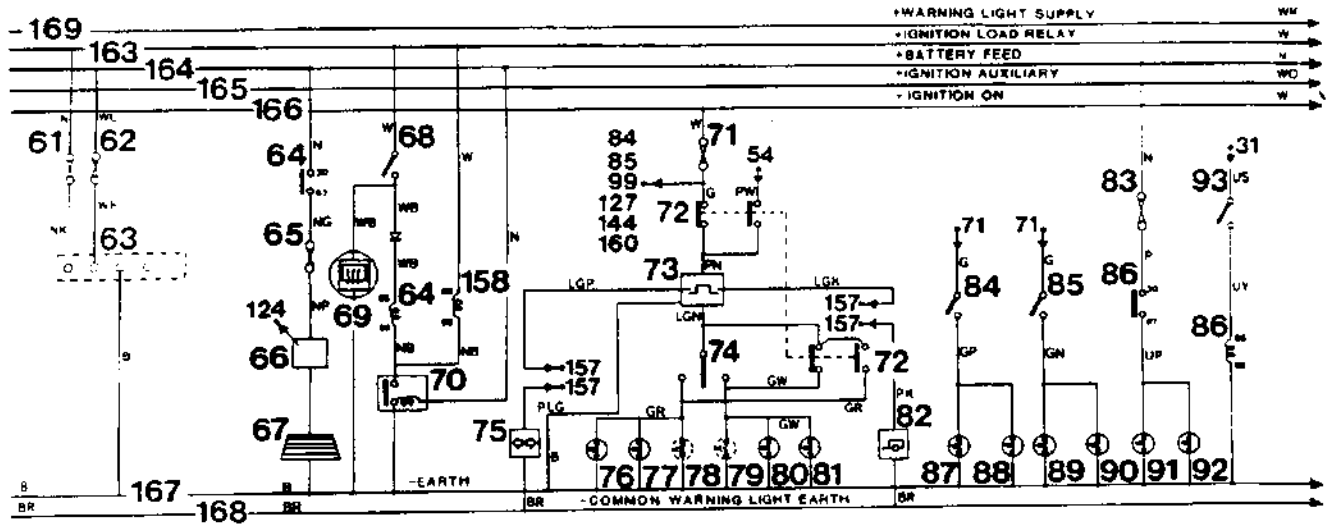
MAIN CIRCUIT DIAGRAM
Right Hand Steering - RR2343M & RR2344M

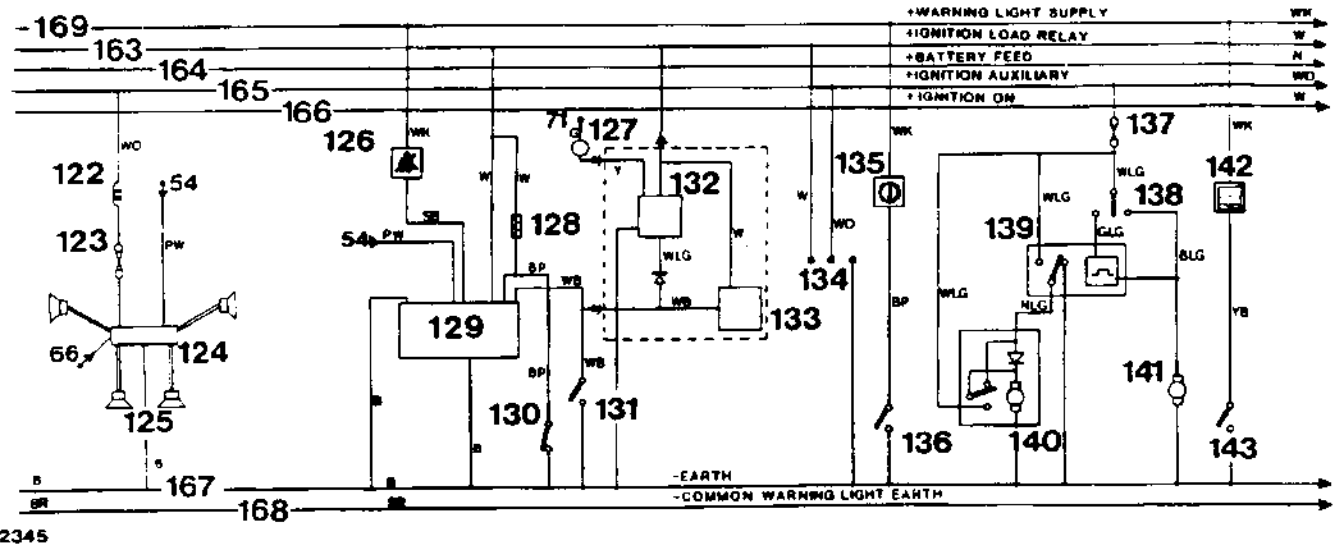
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (Automatic)
8. Ignition switch
9. Tachometer
10. Voltage transformer/dim dip)
11. Ignition warning lamp
12. Alternator
13. Fuse 7
14. Front wipe/wash switch
15. Front wipe delay unit
16. Front wiper motor
17. Front wash switch
18. Front wash pump
19. Headlamp wash timer unit (option)
20. Headlamp wash pump (option)
21. Main lighting switch
22. Fuse 6
23. Fuse 5
24. LH side lamp
25. LH tail lamp
26. Number plate lamp(2 off)
27. Main beam dip flash switch
28. Radio illumination
29. RH side lamp
30. RH tail lamp
31. Rheostat
32. Fuse 3
33. Fuse 4
34. Fuse 1
35. Fuse 2
36. Rear fog switch
37. Fuse 12
38. Switch illumination (2 off)
39. Cigar lighter illumination (2 off)
40. Heater illumination (4 off)
41. Clock illumination
42. Automatic gear selector illumination (2 off)
43. Instrument illumination (6 off)
44. Rear fog warning lamp
45. LH rear fog
46. RH rear fog
47. LH dip beam
48. RH dip beam
49. LH main beam
50. RH main beam
51. Main beam warning lamp
52. Fuel gauge
53. Fuel gauge sender unit
54. Water temperature gauge
55. Water temperature sender unit
56. Fuse 11
57. Horn switch
58. RH horn
59. LH horn
60. Under bonnet illumination switch
61. Under bonnet light
62. Clock
63. Fuse 19
64. Fuse 20
65. Pick-up point central locking/window lift (option)
66. Heated rear window relay
67. Fuse 9
68. Radio aerial amplifier
69. Heated rear screen
70. Heated rear screen switch
71. Heated rear screen warning lamp
72. Voltage sensitive switch
73. Fuse 13
74. Hazard switch
75. Flasher unit
76. Direction indicator switch
77. Hazard/indicator warning lamp
78. LH rear indicator lamp
79. LH front indicator lamp
80. LH side repeater lamp
81. RH side repeater lamp
82. RH front indicator lamp
83. RH rear indicator lamp
84. Trailer warning lamp
85. Fuse 15
86. Stop lamp switch
87. Reverse lamp switch
88. Auxiliary lamp relay (option)
89. LH stop lamp
90. RH stop lamp
91. LH reverse lamp
92. RH reverse lamp
93. LH auxiliary lamp (option)
94. RH auxiliary lamp (option)
95. Auxiliary lamp switch (option)
96. Fuse 17
97. Dash cigar lighter
98. Cubby box cigar lighter
99. LH interior lamp
100. RH interior lamp
101. Interior lamp delay unit
102. LH door edge lamp
103. RH door edge lamp
104. LH puddle lamp
105. RH puddle lamp
106. Interior lamp switch
107. LH rear door switch
108. RH rear door switch
109. Tailgate switch
110. LH front door switch
111. RH front door switch
112. Differential lock warning lamp
113. Differential lock switch
114. Oil pressure warning lamp
115. Oil pressure switch
116. Fuse 18
117. Fuel cut off relay (carburetter models)
118. Fuel pump(petrol models)
119. Ignition coil
120. Capacitor
121. Distributor
122. EFI Harness plug
123. Fuel shut off solenoid (Diesel)
124. Radio choke
125. Radio fuse
126. Radio and four speakers
127. Ignition pick up points
128. Automatic transmission oil temperature warning lamp
129. Automatic transmission oil temperature switch
130. Fuse 16
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Multi-function unit in binnacle
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. Cold start/diesel glow plug warning lamp
142. Cold start switch - carburetter
143. Glow plug timer (diesel)
144. Glow plugs (diesel)
145. Handbrake warning lamp
146. Brake fail warning lamp
147. Handbrake warning switch
148. Brake fail warning switch
149. Brake pad wear warning lamp
150. Brake pad wear sensors
151. Brake check relay
152. Split charge relay (option)
153. Split charge terminal post (option)
154. Heater/air conditioning connections
155. Fuse 8
156. Coil negative (engine RPM input to ECU)

CABLE COLOUR CODE

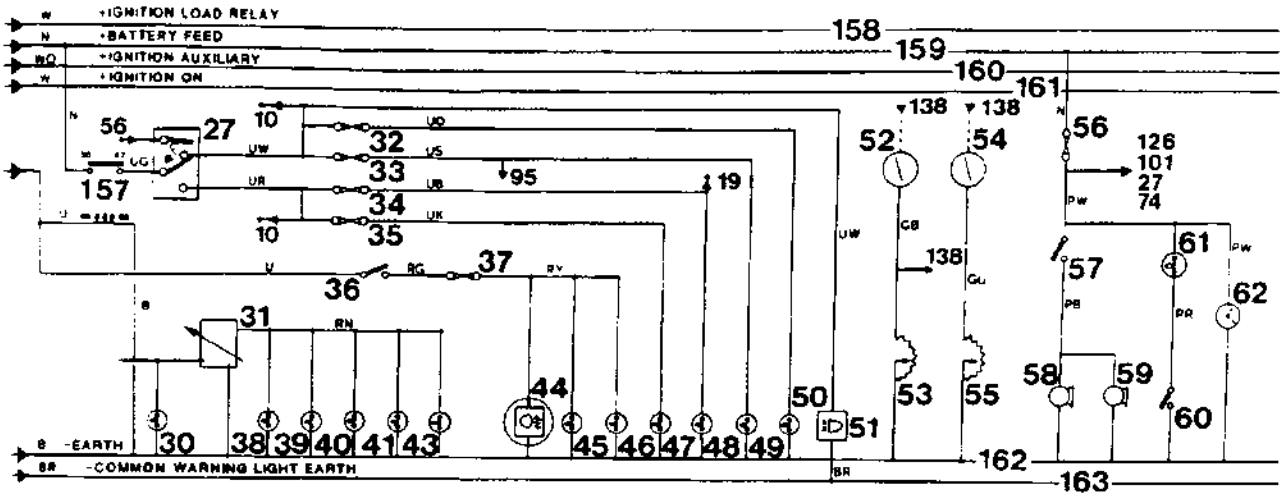
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G	Green
L	Light
O	Orange
K	Pink
P	Purple
R	Red
S	Slate
W	White
Y	Yellow

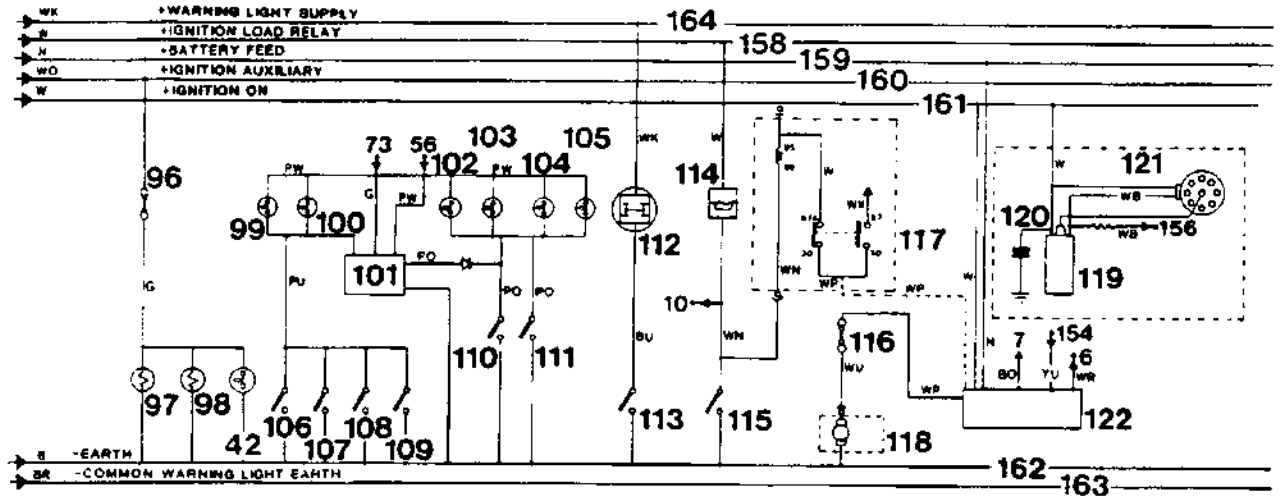

+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
163
164
165
166
-EARTH 167
-COMMON WARNING LIGHT EARTH 168

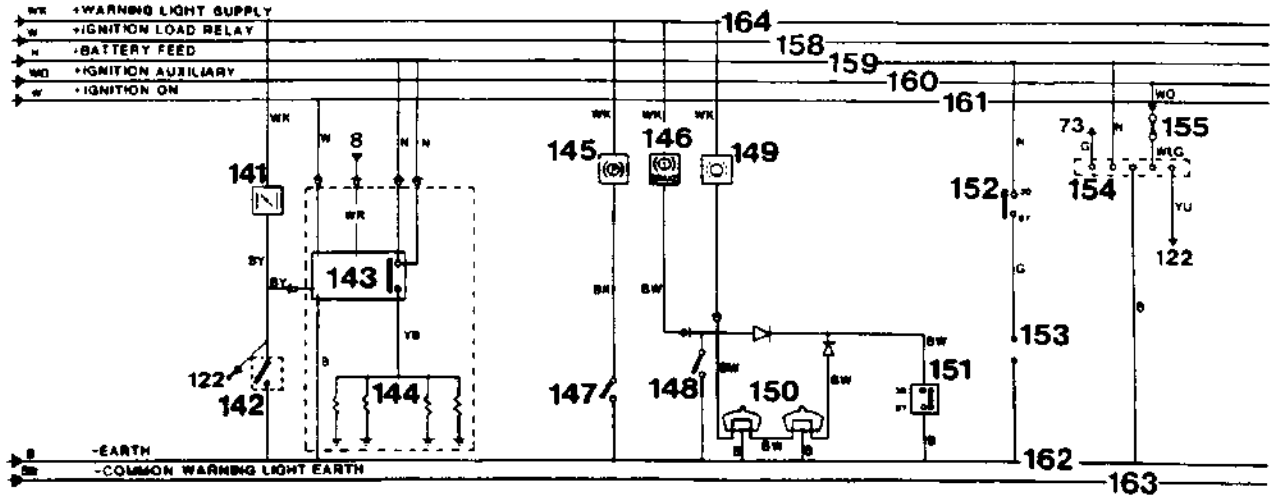

+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
169
163
164
165
166
-EARTH
-COMMON WARNING LIGHT EARTH
167
168


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
169
163
164
165
166
-EARTH
-COMMON WARNING LIGHT EARTH
167
168

RR2345


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH


+WARNING LIGHT SUPPLY
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+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH

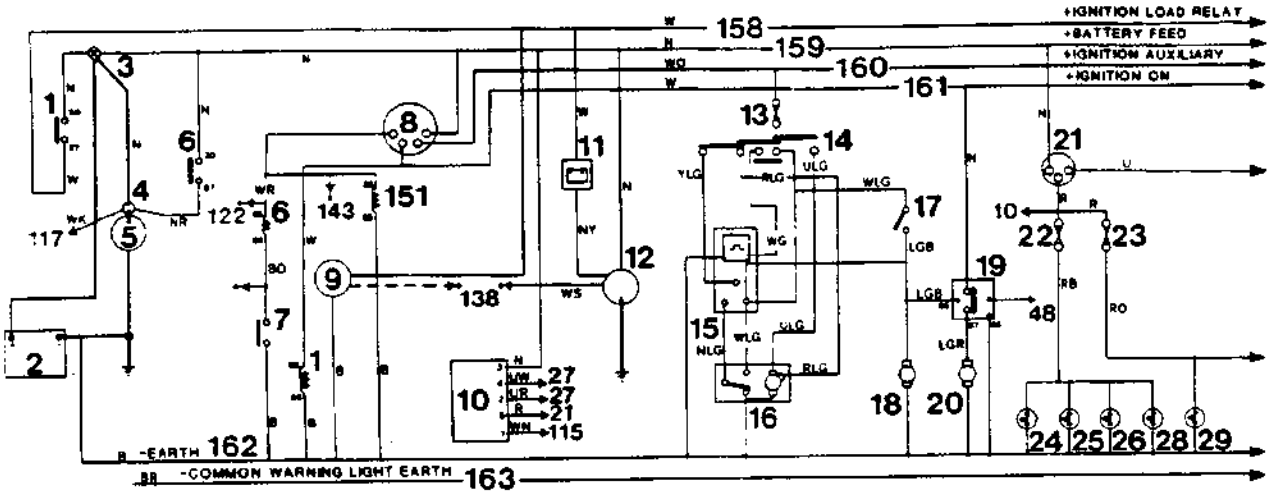
RR2344

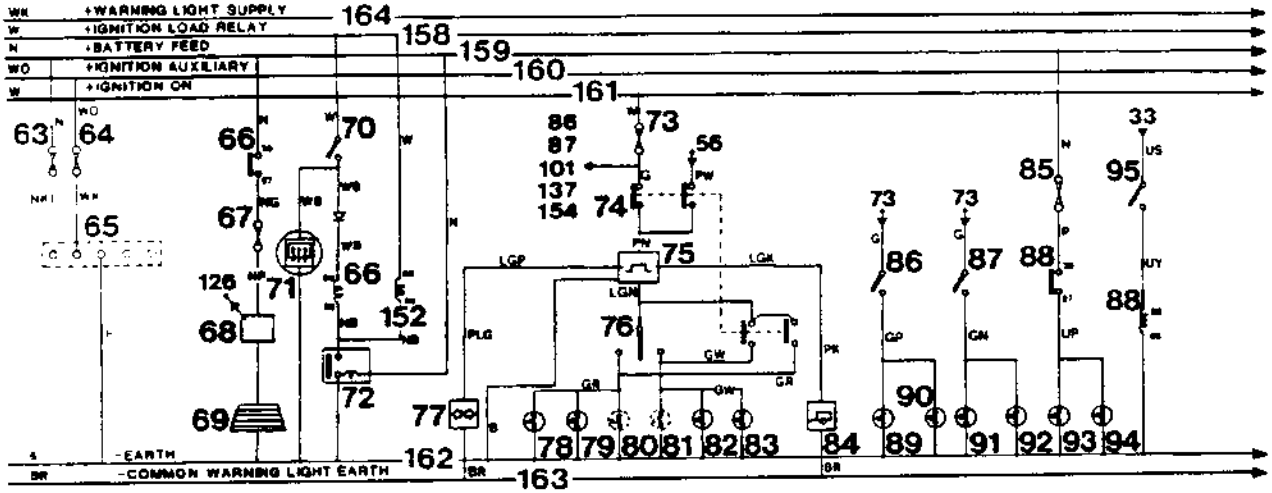
MAIN CIRCUIT DIAGRAM
Left-hand Steering - RR2345M & RR2346M

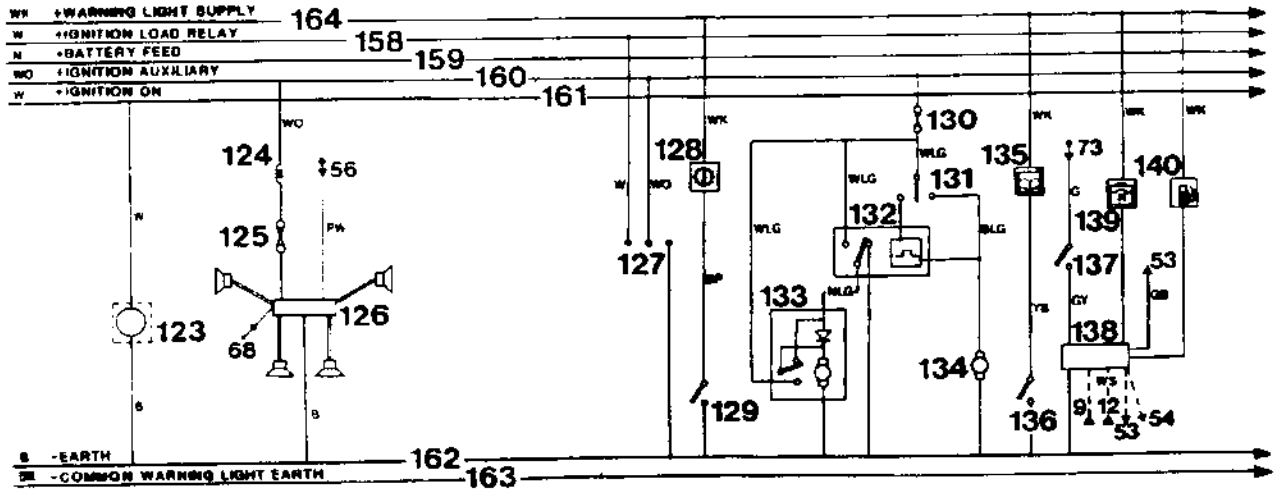
1 Ignition load relay
2 Battery
3 Terminal post
4 Starter solenoid
5 Starter motor
6 Starter relay
7 Starter inhibit switch (automatic)
8 Ignition switch
9 Tachometer
10 Ignition warning lamp
11 Alternator
12. Fuse 7
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16 Front wash pump
17 Headlamp wash timer unit (option)
18 Headlamp wash pump (option)
19 Main lighting switch
20 Fuse 6
21 Fuse 5
22 LH side lamp
23. LH tail lamp
24 Number plate lamp (2 off)
25 Main beam dip-flash switch
26 Radio illumination
27 RH side lamp
28 RH tail lamp
29 Rheostat
30 Fuse 3
31 Fuse 4
32 Fuse 1
33 Fuse 2
34. Rear fog switch
35. Fuse 12
36 Switch illumination (2 off)
37 Cigar lighter illumination (2 off)
38 Heater illumination (4 off)
39 Clock illumination
40. Automatic gear selector illumination (2 off)
41 Instrument illumination (6 off)
42 Rear fog warning lamp
43 LH rear fog
44 RH rear fog
45 LH dip beam
46 RH dip beam
47 LH main beam
48 RH main beam
49 Main beam warning lamp
50. Fuel gauge
51 Fuel gauge sender unit
52 Water temperature gauge
53. Water temperature sender unit
54 Fuse 11
55 Horn switch
56 RH horn
57 LH horn
58 Under bonnet illumination switch
59 Under bonnet light
60. Clock
61 Fuse 19
62 Fuse 20
63 Pick-up point central locking window lift
64 Heated rear window relay
65 Fuse 9
66 Radio aerial amplifier
67 Heated rear screen
68 Heated rear screen switch
69 Heated rear screen warning lamp
70 Voltage sensitive switch
71 Fuse 13
72 Hazard switch
73 Flasher unit
74 Direction indicator switch
75 Hazard indicator warning lamp
76 LH rear indicator lamp
77 LH front indicator lamp
78 LH side repeater lamp
79 RH side repeater lamp
80 RH front indicator lamp
81 RH rear indicator lamp
82 Trailer warning lamp
83 Fuse 15
84 Stop lamp switch
85 Reverse lamp switch
86 Auxiliary lamp relay
87 LH stop lamp
88 RH stop lamp
89 LH reverse lamp
90 RH reverse lamp
91 LH auxiliary lamp (option)
92 RH auxiliary lamp (option)
93. Auxiliary lamp switch (option)
94. Fuse 17
95. Dash cigar lighter
96 Cubby box cigar lighter
97 LH interior lamp
98 RH interior lamp
99 Interior lamp delay unit
100. LH door edge lamp
101. RH door edge lamp
102. LH puddle lamp
103 RH puddle lamp
104 Interior lamp switch
105 LH rear door switch
106. RH rear door switch
107 Tailgate switch
108. LH front door switch
109 RH front door switch
110. Differential lock warning lamp
111. Differential lock switch
112 Oil pressure warning lamp
113 Oil pressure switch
114 Fuse 14
115 Fuel shut-off relay - carburetter
116 Fuel pump - petrol models
117 Ignition coil
118 Capacitor
119 Distributor
120. EFI Harness plug
121 Fuel shut-off solenoid-Diesel
122. Radio choke
123. Radio fuse
124 Radio
125. Four speakers
126 Seat belt warning lamp
127 Speed transducer. Saudi only
128 Resistor
129. Audible warning unit
130 Transfer box neutral switch
131. Seat buckle switch
132. Overspeed monitor (Saudi only)
133. Overspeed buzzer (Saudi only)
134 Ignition pick up points
135 Automatic transmission oil temperature warning lamp
136 Automatic transmission oil temperature switch
137. Fuse 16
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
141 Rear screen wash pump
142. Low screen wash fluid level warning lamp
143 Low screen wash switch
144 Low coolant switch
145 Multi-function unit in binnacle
146 Low coolant level warning lamp
147 Low fuel level warning lamp
148. Cold start Diesel glow plug warning lamp
149 Choke switch - carburetter
150 Glowplug timer-Diesel
151 Glowplugs Diesel
152 Handbrake-warning lamp
153 Handbrake warning switch
154 Brake fail warning switch
154a. Brake fail warning lamp
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157 Brake check unit
158 Split charge relay (option)
159 Split charge terminal post
160 Heater air conditioning connections
161 Fuse 8
162 Coil negative (engine RPM input to ECU)

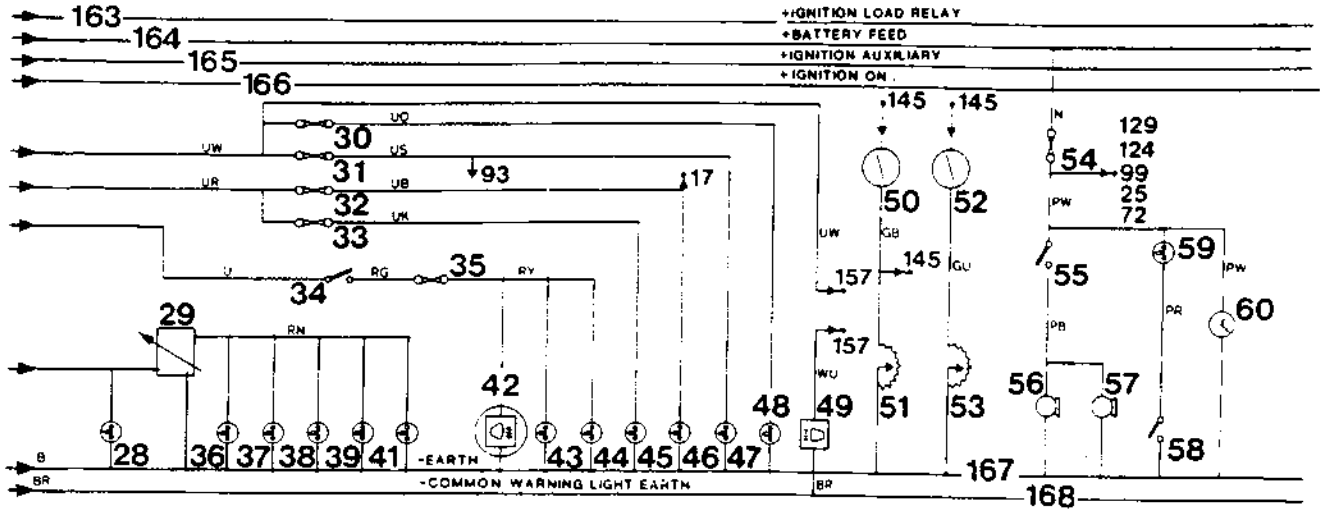
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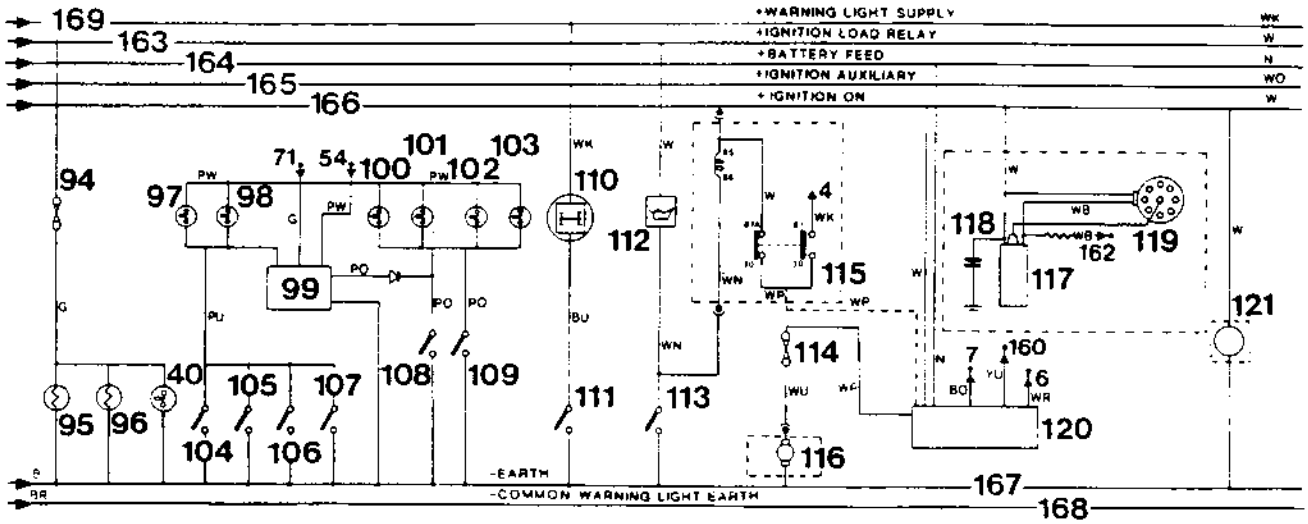
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U	Blue
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L	Light
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K	Pink
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S	Slate
W	White
Y	Yellow

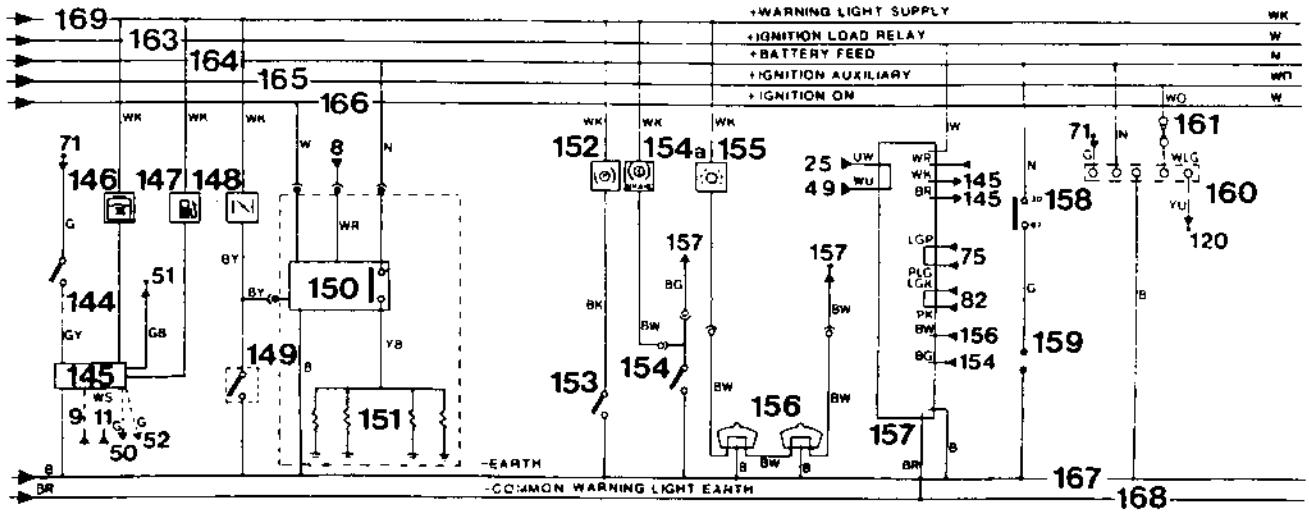

+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
158
159
160
161
-EARTH 162
-COMMON WARNING LIGHT EARTH 163


+WARNING LIGHT SUPPLY 164
+IGNITION LOAD RELAY 158
+BATTERY FEED 159
+IGNITION AUXILIARY 160
+IGNITION ON 161
-EARTH 162
-COMMON WARNING LIGHT EARTH 163


+WARNING LIGHT SUPPLY 164
+IGNITION LOAD RELAY 158
+BATTERY FEED 159
+IGNITION AUXILIARY 160
+IGNITION ON 161
-EARTH 162
-COMMON WARNING LIGHT EARTH 163


163
164
165
166
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
167
168


169
163
164
165
166
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
167
168


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163
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165
166
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
167
168

RR2346M

JUNE 1987
BULLETIN NUMBER LSM180 WB2

RANGE ROVER

LUCAS GIRLING-TYPE 115 SERVO AND MASTER CYLINDER ASSEMBLY

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Introduction 1

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INTRODUCTION 01

RANGE ROVER

1987 MODEL YEAR IMPROVEMENTS

INTRODUCTION

As part of the 1987 model year programme Land Rover Ltd are continually looking at ways to improve the quality and characteristics of its products, the introduction of the following components to Range Rover will improve the brake system and also reduce service costs.

The braking system is uprated with the introduction of a new type-115 Lucas Girling servo and master cylinder assembly which gives improved brake pedal feel and response by reducing brake pedal effort. The effectiveness of the braking system is now controlled by brake pedal travel.

04 GENERAL SPECIFICATION DATA

BRAKING SYSTEM
Servo/master cylinder

Manufacturer	Lucas Girling
Servo type	LSC 115
Boost ratio	5.6:1
Master cylinder type	25.4mm AS/AS (steel tube construction)
Fluid displacement - Primary	5.16 cm^3
- Secondary	9.17 cm^3
Nominal split	36/64
Unit weight	3.75 Kg
Maximum bleed pressure	2,76 bar (40 lbf/in^2)

06 TORQUE WRENCH SETTINGS

BRAKING SYSTEM	Nm	lbf ft
Servo assembly to pedal box	22 to 25	16 to 19
Brake pipes to master cylinder	9 to 11	7 to 8
Master cylinder to servo	21 to 29	15 to 22

09 LUBRICANTS, FLUIDS AND CAPACITIES

		AMBIENT TEMPERATURE
COMPONENT	SPECIFICATION	°C -30 -20 -10 0 10 20 30 40 50 °F -22 -4 +14 +32 50 68 86 104 122
Brake Reservoir	Brake fluid must have a minimum boiling point of 260°C (500°F) and comply with FMVSS/116/DOT4.	

Approved fluids

Castrol/Girling	K624 DOT4
Automotive Products	429S Super DOT4

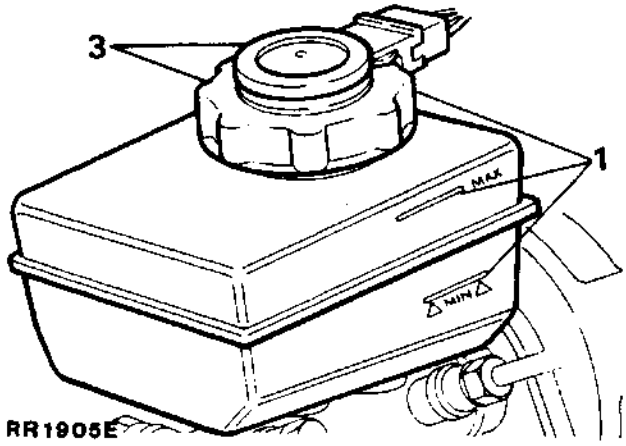
MAINTENANCE SCHEDULE

The fitting of the new Servo and master cylinder does not necessitate the issue of additional Maintenance Schedules, therefore existing schedules should be used and the service intervals adhered to.

CHECK AND TOP UP BRAKE FLUID RESERVOIR

1. Visually check the brake fluid level against the **'MIN'** and **'MAX'** level markings on the side of the reservoir.
2. If necessary top up with the recommended grade of fluid (refer to section 09 lubricants fluidsand capacities) **DO NOT OVERFILL.**
3. Release the cap with combined fluid level switch by rotating anti- clockwise. Withdraw the cap and switch, top up the reservoir.

CAUTION : When topping up the reservoir care should be taken to ensure that the brake fluid does not come into contact with any of the vehicle paintwork. Should this occur, wash the affected area IMMEDIATELY with copious amounts of water.



BRAKE SYSTEM

Description

The hydraulic braking system fitted to Range Rovers is the dual line type, incorporating primary and secondary hydraulic circuits.

NOTE: References made to primary or secondary do not imply main service brakes or emergency brakes but denote hydraulic line identification.

The brake pedal is connected to a vacuum assisted mechanical servo which in turn operates a tandem master cylinder. The front disc brake calipers each house four pistons, the upper pistons are fed by the primary hydraulic circuit, the lower pistons by the secondary hydraulic circuit. The rear disc brake calipers each house two pistons, these are fed by the secondary hydraulic circuit via a pressure reducing valve.

A brake fluid level switch is incorporated into the reservoir cap assembly, the switch having detected either low or sudden fluid loss will immediately illuminate a warning light in the instrument binnacle

The brake fluid reservoir is divided, the section closest to the servo feeds the primary circuit and the section furthest away from the servo feeds the secondary circuit. Under normal operating conditions both the primary and secondary circuits operate simultaneously on brake pedal application. In the event of a failure in the primary circuit the secondary circuit will still function and operate front and rear calipers. Alternatively, if the secondary circuit fails the primary circuit will still function and operate the upper pistons in the front calipers, allowances should be made and vehicle speed adjusted accordingly to allow for the lack of full braking efficiency.

If the servo should fail, both hydraulic circuits will still function but would require greater pedal effort due to the lack of vacuum assistance.

The hand operated transmission brake acts on a brake drum at the rear of the transfer gearbox and is completely independant of the hydraulic circuits.

Brake pad wear sensors are incorporated in the front and rear right hand side inboard brake pads. The sensor will illuminate a brake pad wear warning light in the instrument binnacle, when pad thickness has been reduced to approximately 3mm (0.118 in)

CAUTION: THOROUGHLY CLEAN ALL BRAKE CALIPERS, PIPES AND FITTINGS BEFORE COMMENCING WORK ON ANY PART OF THE BRAKE SYSTEM. FAILURE TO DO SO COULD CAUSE FOREIGN MATTER TO ENTER THE SYSTEM AND CAUSE DAMAGE TO SEALS AND PISTONS WHICH WILL SERIOUSLY IMPAIR THE EFFICIENCY OF THE BRAKE SYSTEM.

To ensure the brake system efficiency is not impaired the following warnings must be adhered to :-

DO NOT use any petroleum (gasoline) based cleaning fluids or any proprietary fluids containing petroleum (gasoline). The preferred fluids are clear methylated spirits or industrial alcohol.

DO NOT use brake fluid previously bled from the system.

DO NOT use old or stored brake fluid.

ENSURE that only new fluid is used and that it is taken from a sealed container.

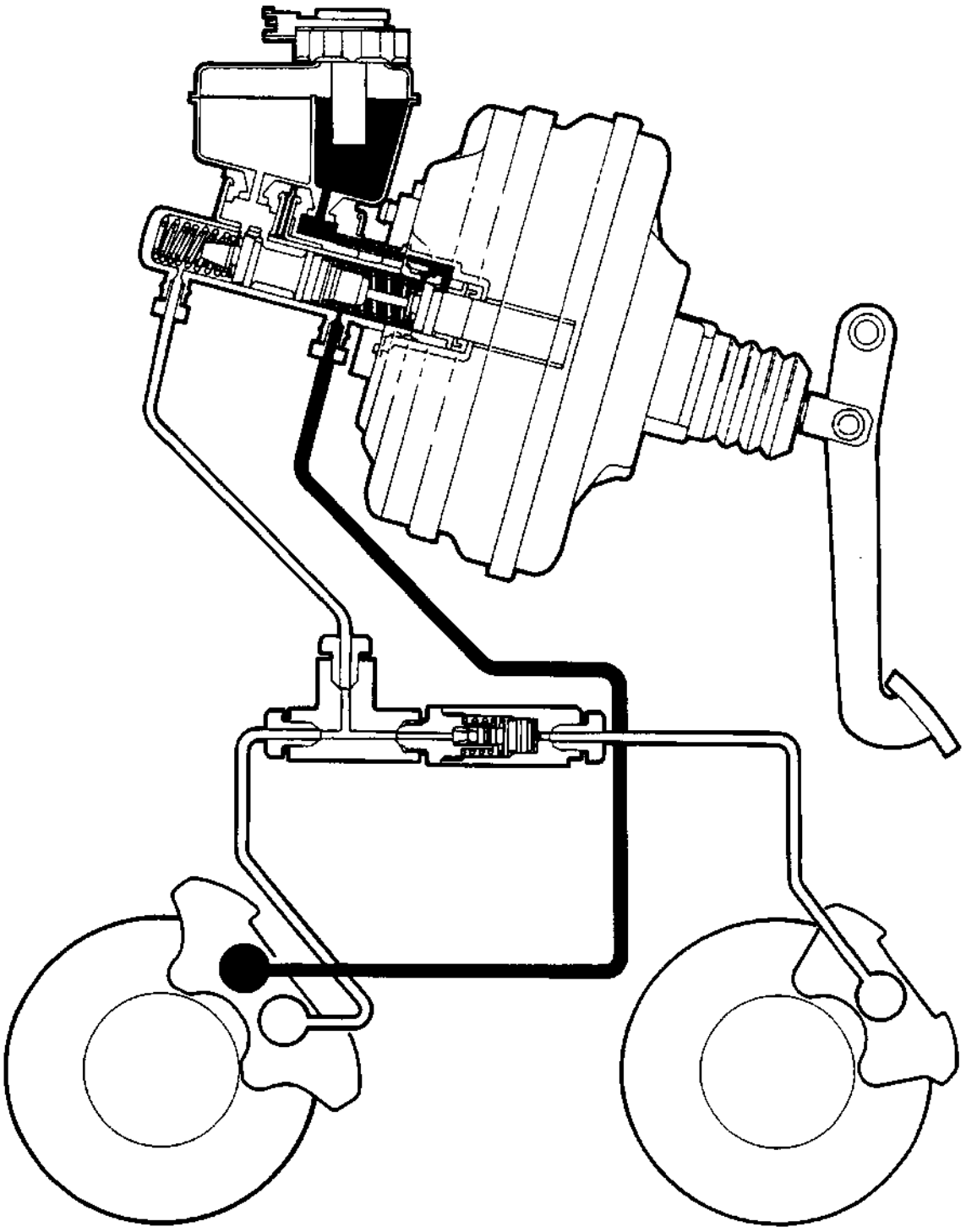
DO NOT flush the brake system with any fluid other than the recommended brake fluid.

The brake system should be drained and flushed at the recommended service intervals.

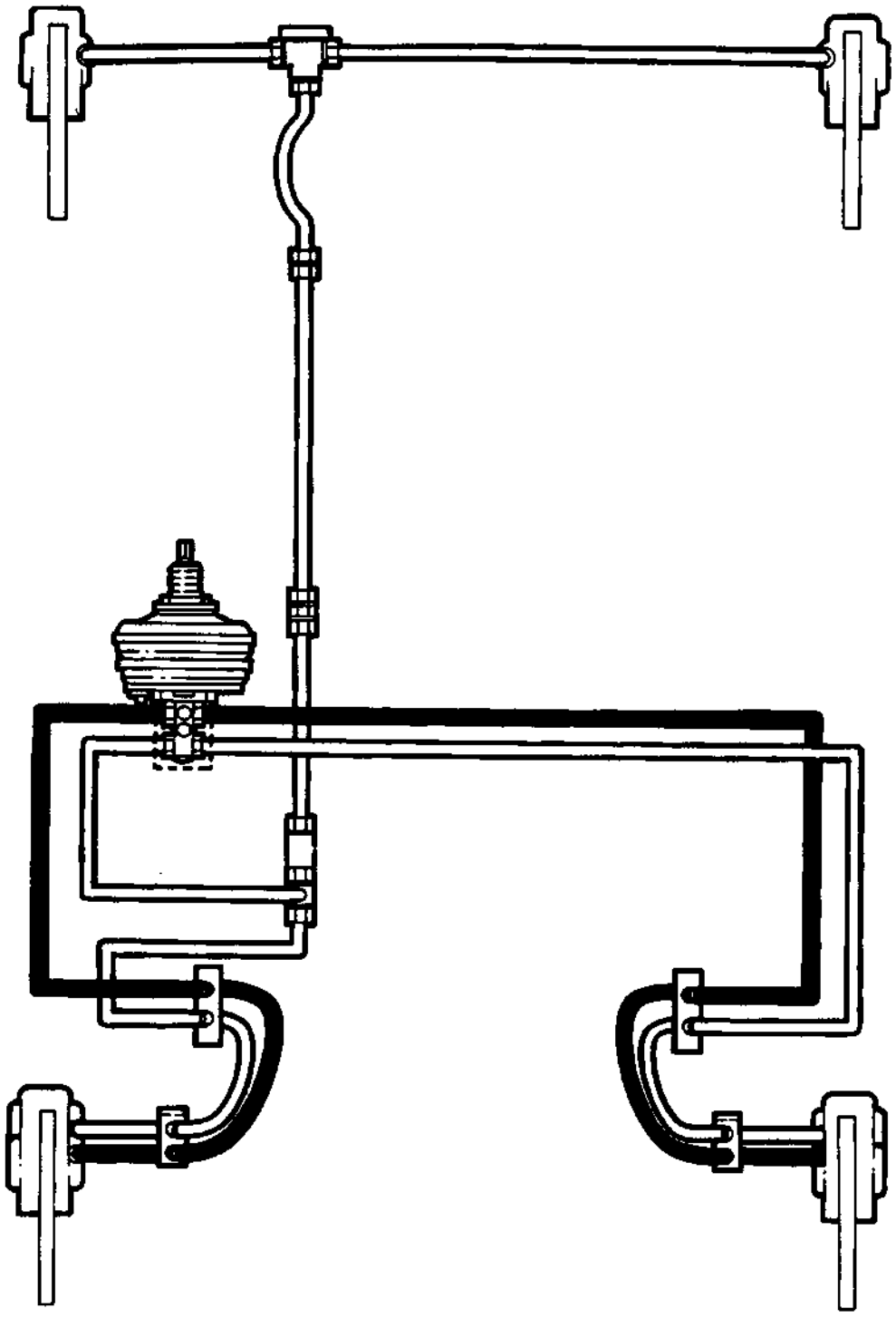
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PRIMARY HYDRAULIC CIRCUIT

SECONDARY HYDRAULIC CIRCUIT



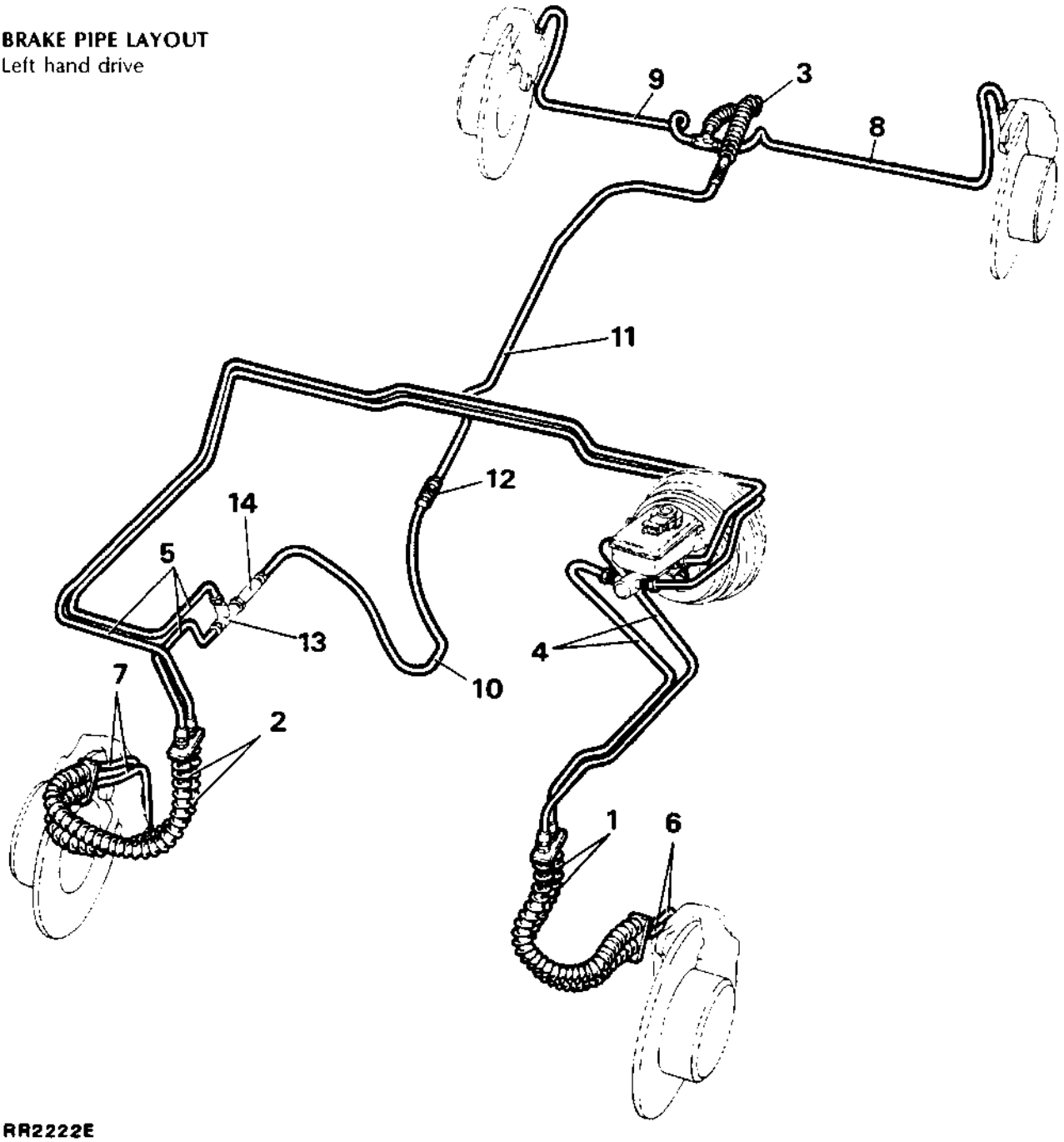
RR2225M



IR2226M

Right hand drive brake circuit illustrated, left hand drive circuit is a mirror image of the right hand drive circuit.

BRAKE PIPE LAYOUT
Left hand drive



RR2222E

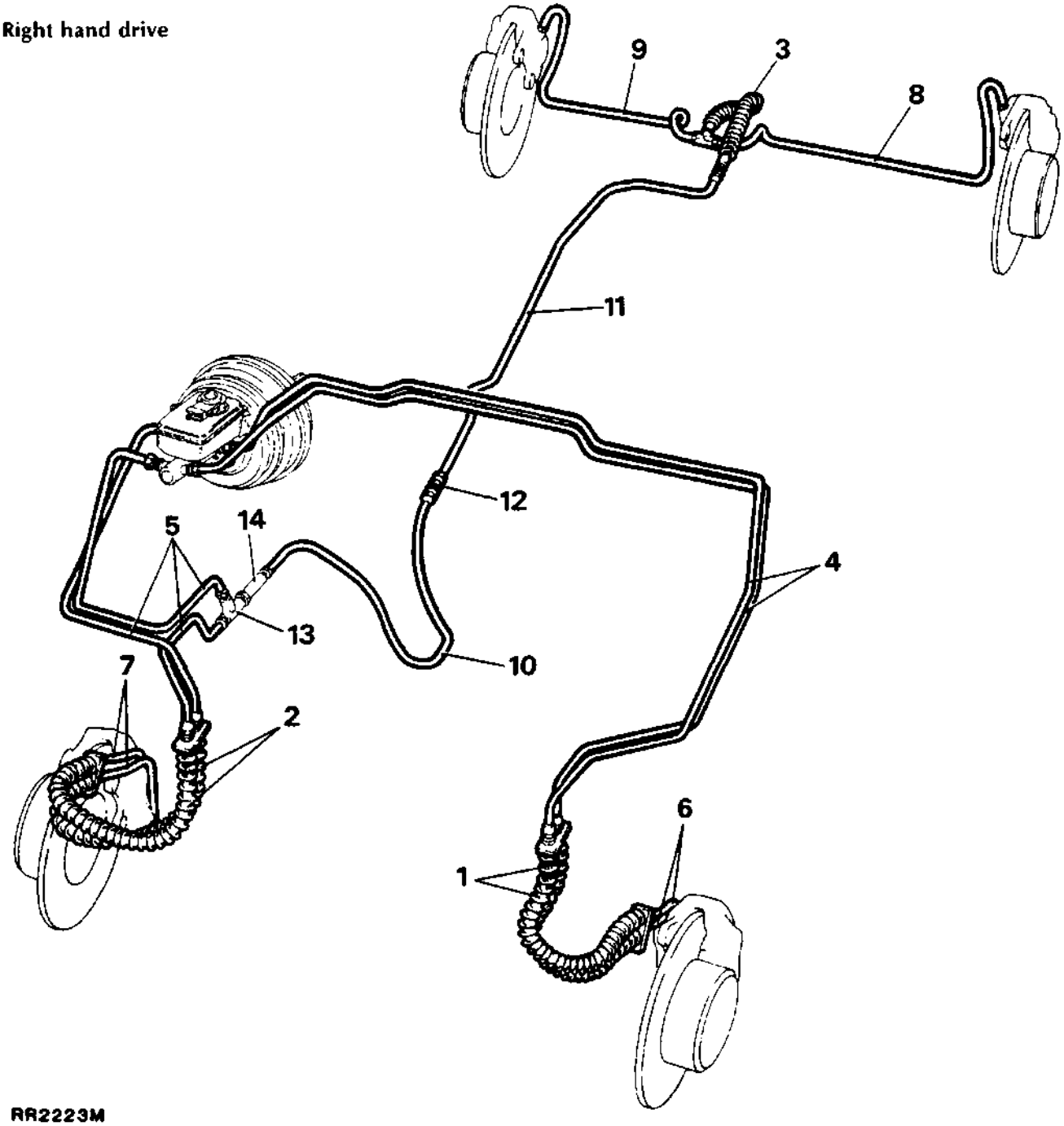
HOSES

1. Front left hand flexible hoses.
2. Front right hand flexible hoses.
3. Intermediate flexible hose.

PIPES

4. Feed to front left hand hose connector.
5. Feed to front right hand hose connector.
6. Feed to front left hand caliper.
7. Feed to front right hand caliper.
8. Feed to rear left hand caliper.
9. Feed to rear right hand caliper.
10. Feed to two way connector.
11. Feed to intermediate hose.
12. Two way connector.
13. Three way connector.
14. Pressure reducing valve.

Right hand drive



RR2223M

WARNING: Some components on the vehicle such as gaskets and friction surfaces (brake linings, clutch discs, or automatic transmission brake bands), may contain asbestos. Inhaling asbestos dust is dangerous to your health and the following essential precautions must be observed :-

* Work out of doors or in a well ventilated area and wear a protective mask.
* Dust found on the vehicle or produced during work on the vehicle should be removed by vacuuming or by using a well dampened cloth and not by blowing.
* Dust waste should be dampened, placed in a sealed container and marked to ensure safe disposal.
* If any cutting, drilling etc, is attempted on materials containing asbestos the item should be dampened and only hand tools or low speed power tools used.

Bleed

The hydraulic system comprises two completely independent circuits. The rear calipers and the lower pistons in the front calipers form the secondary circuit, while the upper pistons in the front calipers form the primary circuit. The following procedure covers bleeding the complete system, but it is permissible to bleed one circuit only if disconnections are limited to that circuit.

Bleeding will be assisted if the engine is run or a vacuum supply is connected to the servo.

WARNING: IF THE ENGINE IS RUNNING DURING THE BRAKE BLEEDING PROCESS ENSURE THAT NEUTRAL GEAR IS SELECTED AND THAT THE HANDBRAKE IS APPLIED.

When bleeding any part of the secondary circuit, almost full brake pedal travel is available. When bleeding the primary circuit only, brake pedal travel will be restricted to approximately half.

NOTE: When bleeding the system commence with the caliper furthest from the master cylinder and bleed from the screw on the same side as the fluid inlet pipes, then close the screw and bleed from the screw on the opposite side of the same caliper. Tighten the bleed screws to the correct torque. See section 06

Bleeding

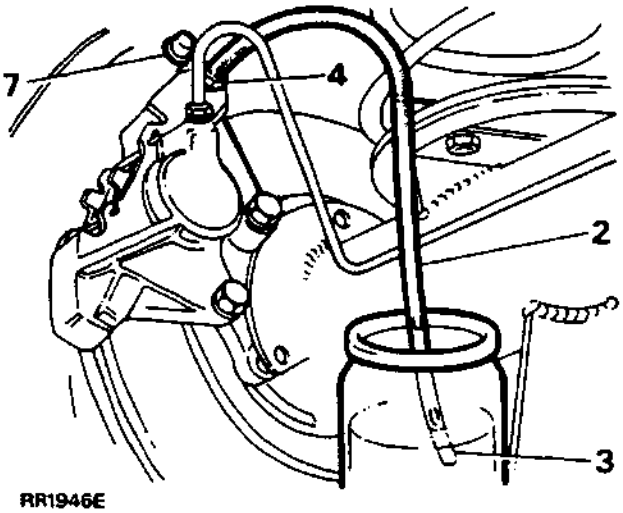
1. Fill the fluid reservoir with the correct fluid, see section 09 lubricants and fluids.

   NOTE: The correct fluid level must be maintained throughout the procedure of bleeding.

2. Connect a bleed tube to the bleed screw on the rear caliper furthest from the master cylinder.
3. Submerge the free end of the bleed tube in a container of clean brake fluid.
4. Slacken the bleed screw 1/2-3/4 turn.
5. Operate the brake pedal fully and allow to return.

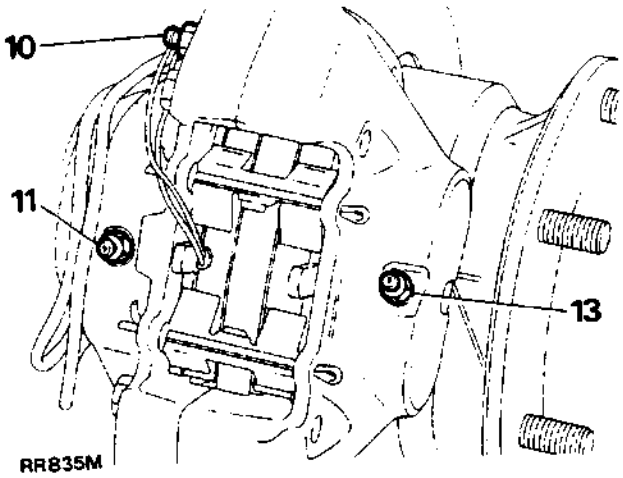
   NOTE: Allow at least five seconds to elapse with the foot right off the pedal to ensure that the pistons fully return before operating the pedal again.

6. Repeat 5 until fluid clear of air bubbles appears in the container, then keeping the pedal fully depressed, tighten the bleed screw.
7. Remove the bleed tube and replace the dust cap on the bleed screw.



RR1946E

8. Repeat 1 to 7 for the other rear caliper.
9. Remove the front wheel on the side furthest from the master cylinder.
10. Connect a bleed tube to the primary bleed screw on the front caliper furthest from the master cylinder.
11. Connect a bleed tube to the secondary bleed screw on the same side of the caliper as the primary screw.



RR835M

Continued

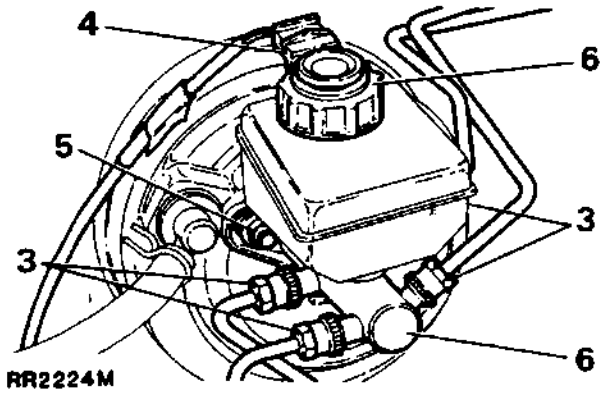
12. Repeat 3 to 7 for the front caliper, bleeding from the two screws simultaneously.
13. Connect a bleed tube to the other screw on the front caliper furthest from the master cylinder.
14. Repeat 3 to 7 for the second secondary screw on the front caliper.
15. Refit the front wheel.
16. Repeat 9 to 15 for the front caliper nearest the master cylinder.

MASTER CYLINDER- Lucas Girling -Type 25.4mm AS/AS

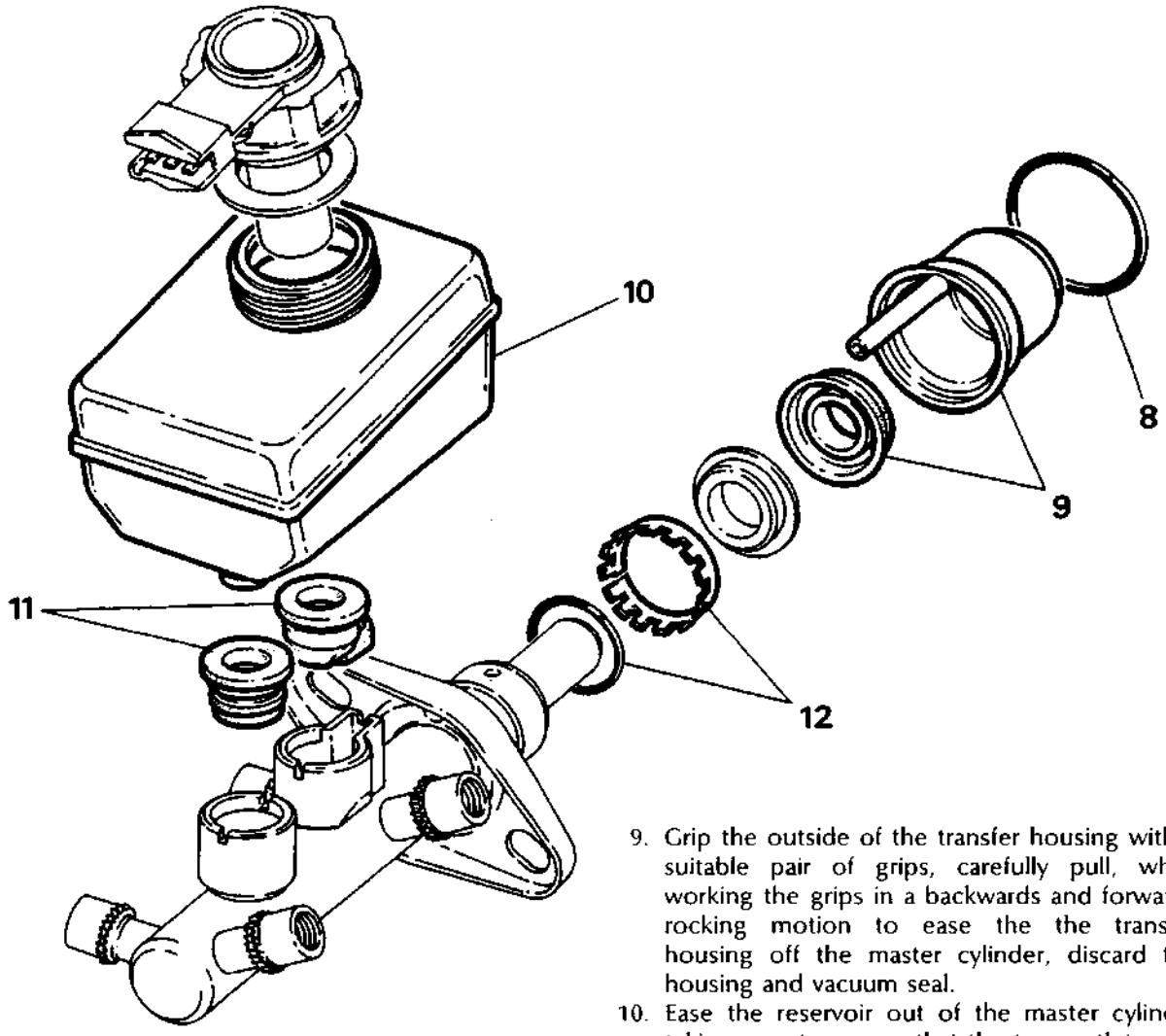
Remove, overhaul and refit

Removing

1. Disconnect the battery negative terminal.
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.
3. Thoroughly clean the immediate area around all outlet ports. Remove each of the brake pipes from the master cylinder in turn, sealing each pipe and outlet port with suitable plugs as they are disconnected, to prevent ingress of foreign matter and excessive fluid loss.
4. Disconnect the electrical plug from the low fluid switch located on the reservoir cap.
5. Remove the two nuts securing the master cylinder to the servo unit remove also the spring and plain washers.
6. Detach the the master cylinder from the servo, remove the reservoir cap and drain the brake fluid into a suitable container.



WARNING: Do not use brake fluid previously drained or bled from the system. Carefully dispose of unwanted fluid, if stored in a sealed container, ensure that the container is marked USED BRAKE FLUID.



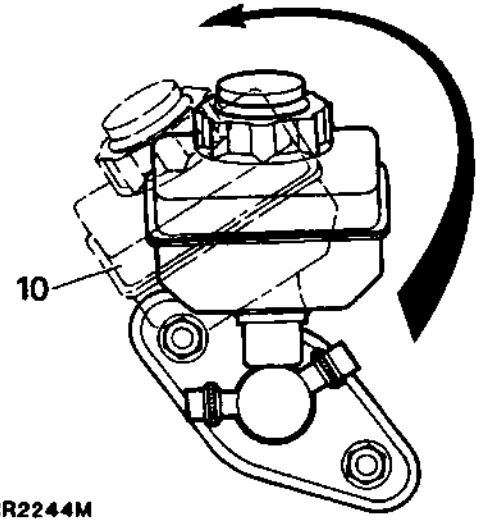
RR2237M

9. Grip the outside of the transfer housing with a suitable pair of grips, carefully pull, while working the grips in a backwards and forwards rocking motion to ease the the transfer housing off the master cylinder, discard the housing and vacuum seal.
10. Ease the reservoir out of the master cylinder taking care to ensure that the two outlet ports on the bottom of the reservoir do not become damaged during this process.

Overhaul

WARNING: Use only clear methylated spirits or unused brake fluid to clean any part of the brake system. DO NOT use petrol, paraffin or other mineral based fluids.

7. Before commencing the overhaul procedure thoroughly clean the master cylinder and inspect the outer surfaces for damage and condition, renew the complete assembly if necessary.
8. Using two slave spacers, one either side of the master cylinder flange, clamp the flange in a suitable engineers vice. Remove the water ingress 'O' ring seal from the master cylinder to servo flange and discard.

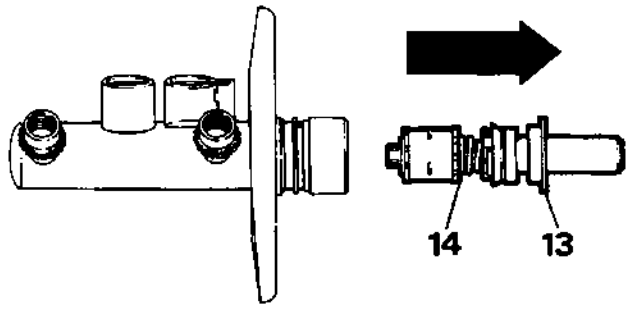


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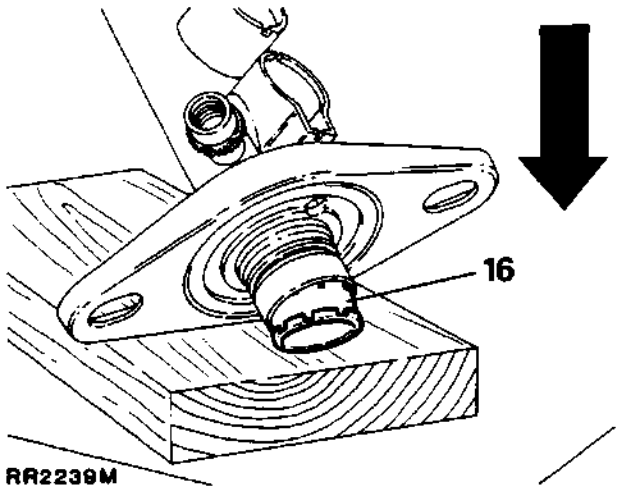
11. Withdraw the two reservoir seals from the master cylinder inlet ports, the seals are different and should be noted for assembly,discard both of the seals.
12. Remove the retaining ring and 'O' ring seal from the machined outer surface of the master cylinder, discard both the seal and retaining ring.
13. Remove the guide ring 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.
14. Pull the primary plunger assembly out of the master cylinder.

NOTE: The primary plunger assembly cannot be stripped down any further and is serviced as a complete unit. Discard the assembly.



RR2238M

15. 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.
16. If the swirl tube was not expelled at the same time as the secondary plunger, repeat the above operation to expel it from the bottom of the master cylinder bore and discard.



RR2239M

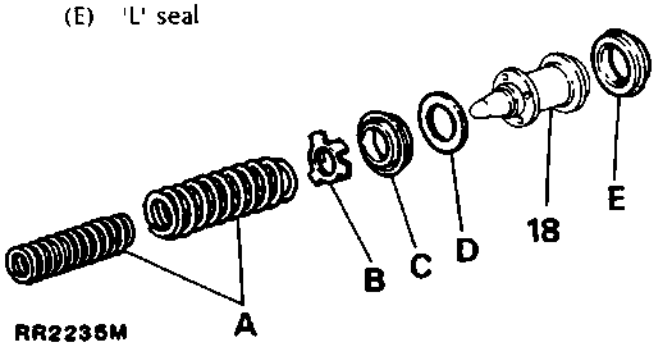
17. Clean all parts with Girling cleaning fluid or unused brake fluid and place the cleaned parts onto a sheet of clean paper. Inspect the cylinder bores and plungers for signs of corrosion, ridges and score marks. Provided the working surfaces are in perfect condition, new seals from a Girling Service Kit may be used.

Renewing secondary plunger seals

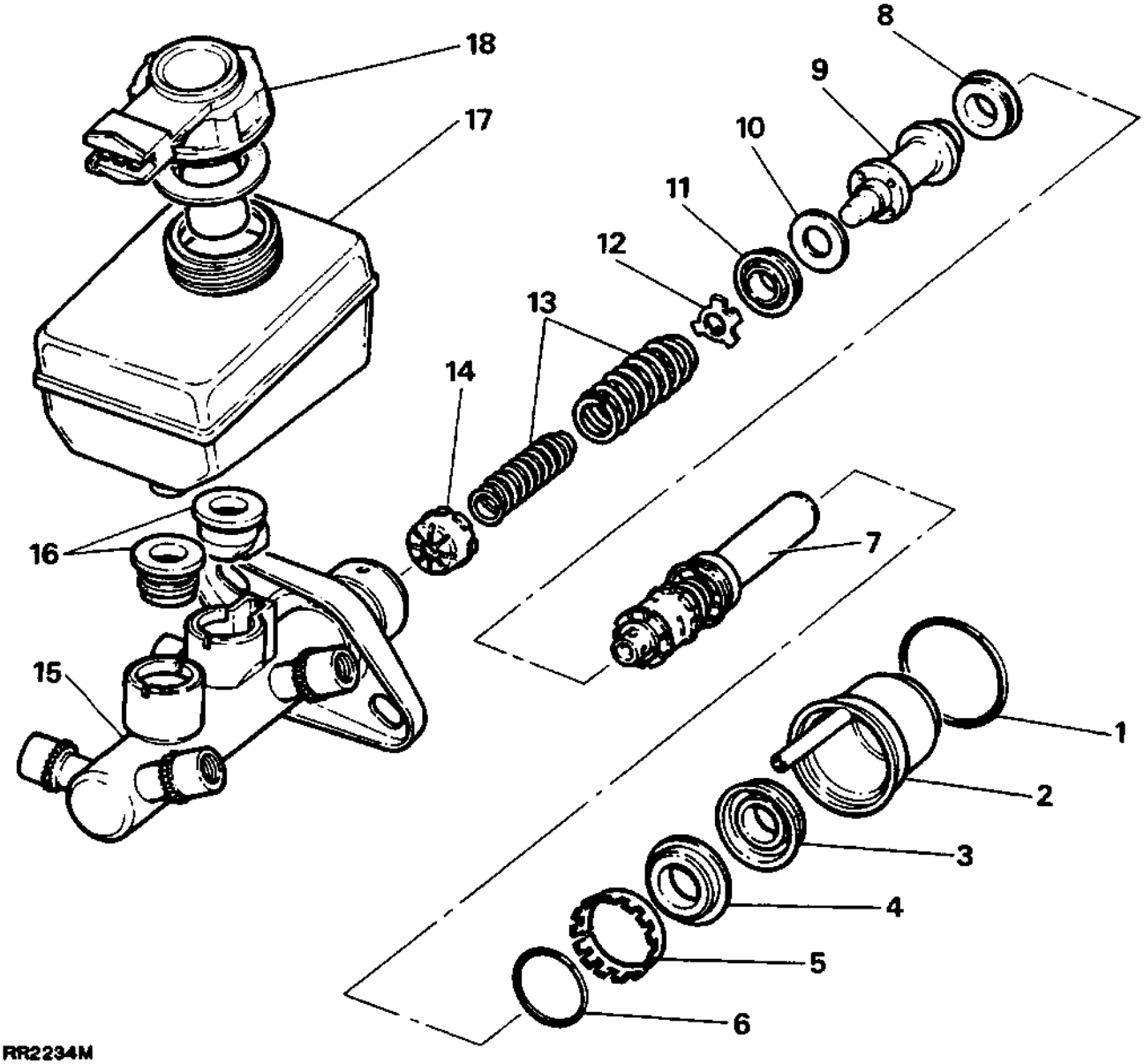
18. Remove from the following components from the secondary plunger and discard:

NOTE: A small screwdriver with the end rounded off and polished is required to remove the 'L' seal. DO NOT damage the secondary plunger.

(A) Springs
(B) Seal retainer
(C) Recuperating seal
(D) Washer
(E) 'L' seal



RR2236M



RR2234M

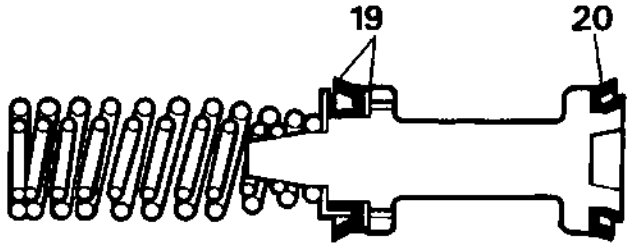
KEY TO MASTER CYLINDER

1. Water ingress seal
2. Transfer housing
3. Vacuum seal
4. Guide ring
5. Retaining ring
6. 'O' ring seal
7. Primary plunger assembly
8. 'L' seal
9. Secondary plunger
10. Washer
11. Recuperating seal
12. Seal retainer
13. Springs (2 off)
14. Swirl tube
15. Master cylinder body
16. Reservoir seals
17. Reservoir
18. Low fluid level switch and cap

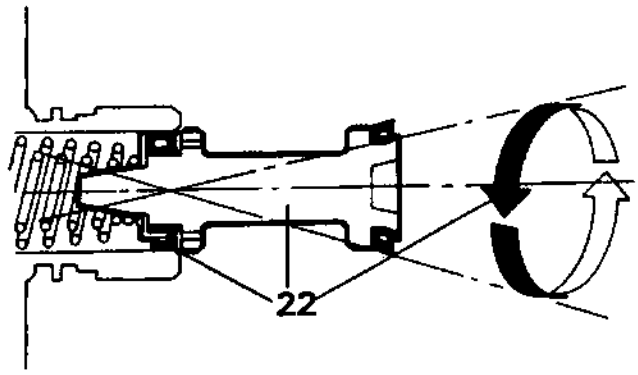
NOTE: Thoroughly check that no debris of any description is lodged in any of the fluid passageways and drillings. If debris is found, carefully remove, re-clean the cylinder and re-check.

Continued

19. Coat the new seals in unused brake fluid and firstly fit the 'L' seal to the plunger.
20. Fit the washer followed by the recuperating seal. Fit the seal retainer and springs, ensure the springs are correctly seated.



RR2236M



RR2240M

23. Fit the primary plunger assembly using the same method as for the secondary plunger, push the plunger down the bore.
24. Fit the original guide ring to support the primary plunger.
25. Coat a new 'O' ring with brake fluid and fit to its respective groove on the outer location surface of the master cylinder.

NOTE: The 'O' ring should not 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.

26. Fit a new retaining ring on the outer surface of the master cylinder ensuring that the serrations of the ring are facing the mounting flange.
27. Fit the two new reservoir seals in their respective ports.
28. 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.
29. Lubricate the vacuum seal with brake fluid, fit the transfer housing to the master cylinder, push the housing fully upto the cylinder mouting flange, **DO NOT ADJUST THE TRANSFER HOUSING AFTER FITTING.**
30. Lubricate a new water ingress seal with brake fluid, slightly stretch the seal and ease it down the housing until the seal is in the correct position between the housing and flange.
31. Roll the reservoir into the top of the master cylinder. (Reverse the operation described in instruction 10 illustration RR2244M).

ASSEMBLING THE MASTER CYLINDER

CAUTION: 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 the parts during assembly. Never use old fluid or any other form of cleaning and lubricating material. Cleanliness throughout is essential.

21. Fit the new swirl tube to the bottom of the cylinder bore.
22. Lubricate the secondary plunger and cylinder bore. Offer the plunger assembly to the cylinder until the recuperation seal is resting centrally in the mouth of the bore. Gently introduce the plunger with a circular rocking motion, as illustrated. 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.

32. Fit the master cylinder to the servo fit the plain and spring washers and secure in position with the two nuts. Tighten to the specified Torque- see section 06.
33. Fit the brake pipes to the master cylinder and tighten to the specified Torque- see section 06
34. Top-up the master cylinder with the correct grade of brake fluid (see section 09) bleed the brake systems.

    WARNING: Do not use brake fluid previously drained or bled from the system. Carefully dispose of unwanted fluid, if stored in a sealed container, ensure that the container is marked USED BRAKE FLUID.

35. Fit the cap with combined low level fluid switch and refit the electrical plug. Re-connect the battery.

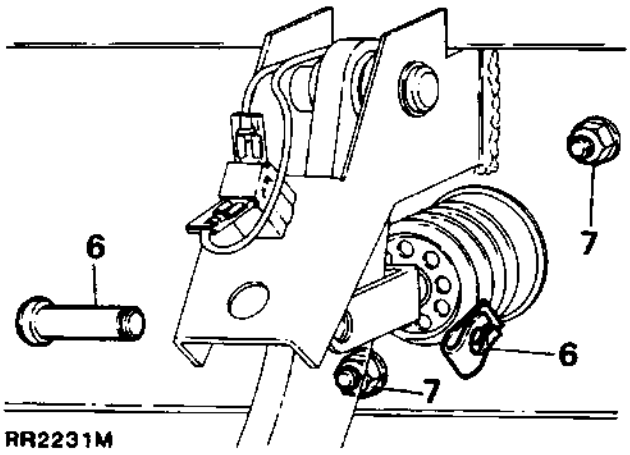
SERVO ASSEMBLY

Remove and refit

NOTE: Other than replacing the filter, non-return valve and gromet the servo is not a serviceable component, in the event of failure or damage fit a new unit.

Removing

1. Disconnect the battery negative terminal.
2. Disconnect the electrical plug to the low fluid level switch.
3. Thoroughly clean the immediate area around all master cylinder outlet ports. Remove each of the brake pipes from the master cylinder in turn, sealing each pipe and outlet port as they are disconnected with suitable plugs, to prevent ingress of foreign matter and excessive fluid loss.
4. Disconnect the vacuum supply hose to the servo.
5. From inside the vehicle remove the lower fascia panel to gain access to the spring clip securing the servo push rod to the brake pedal assembly.
6. Release the spring clip and remove the clevis pin securing the servo push rod to the brake pedal.
7. Remove the two nuts and plain washers securing the servo to the bulkhead pedal box.



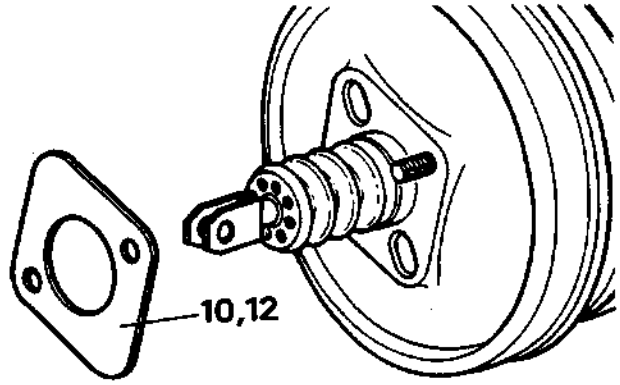
RR2231M

Continued

8. From within the engine compartment withdraw the servo and master cylinder assembly.
9. Remove the cap from the reservoir and drain the brake fluid into a suitable container if the master cylinder can be kept horizontal it will not be necessary to drain the fluid.

WARNING: Do not use brake fluid previously drained or bled from the system. Carefully dispose of unwanted fluid, if stored in a sealed container, ensure that the container is marked USED BRAKE FLUID.

10. Detach the spacer from the pedal box mounting face of the servo, it is important that the spacer is fitted to the mounting face of the new servo to ensure that stringent pedal to servo operating dimensions are maintained.



RR2233M

11. If a new servo is being fitted it will be necessary to remove the master cylinder from the existing servo and refitted to the new unit.

Refitting

12. Fit the spacer previously removed from the old servo, to the new servo.
13. Fit the servo to the pedal box assembly.
14. From inside the vehicle lightly grease the brake pedal around the area that the servo push rod pivots.
15. Fit the push rod to the brake pedal and secure in position with the clevis pin and clip.
16. Fit the plain washers and secure the servo with the two nuts. Tighten the nuts to the specified torque-see section 06.
17. Refit the lower fascia panel.
18. Fit the master cylinder to the servo, refit the plain and spring washers and secure the master cylinder to the servo with the two nuts. Tighten the nuts to the specified torque-see section 06.
19. Remove the sealing plugs, fitted to the master cylinder outlet ports during the removal procedure and refit the brake pipes to their respective ports. Tighten the brake pipes to the correct torque-see section 06.
20. Refit the vacuum supply hose.
21. Fill the master cylinder to between the **'MAX'** and **'MIN'** level markings with the correct grade of brake fluid-see section 09.
22. Bleed the brake systems.

PEDAL ASSEMBLY

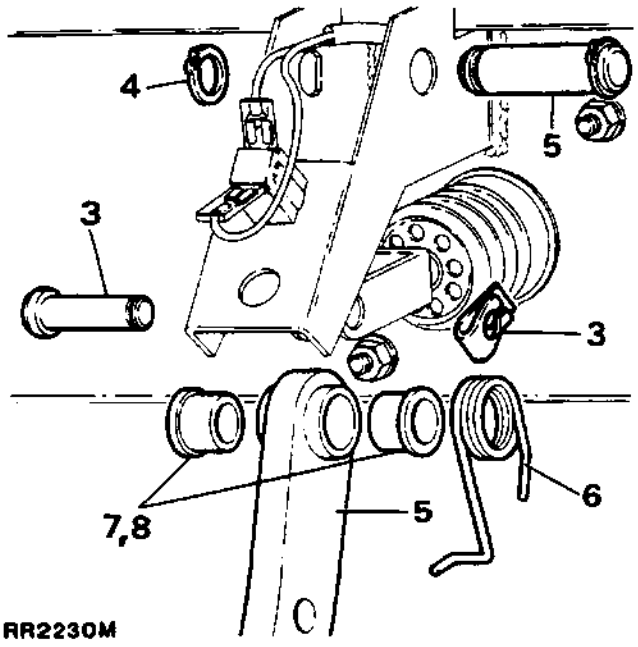
Remove, overhaul and refit

Remove

1. Disconnect the battery negative terminal.
2. From inside the vehicle remove the lower fascia panel to gain access to the pedal assembly.
3. Release the spring clip and remove the clevis pin securing the servo push rod to the brake pedal.
4. Remove the circlip from the 'D' shaped end of the pedal shaft.
5. Remove the pedal shaft from the pedal assembly and withdraw the pedal from the pedal box.
6. Remove the return spring from the pedal.

Overhaul

7. Remove the bushes from the pedal pivot tube.
8. Press new bushes into the pedal pivot tube. If necessary ream out the bushes to 15.87mm plus 0.05mm (.625 in plus .002in).
9. Lightly grease the bushes.



RR2230M

Refitting

10. Fit the return spring to the pedal.
11. Fit the pedal to the pedal box assembly and refit the pedal shaft. Secure the pedal assembly in position with the circlip.
12. Lightly grease the servo push rod and secure in position with the clevis pin and clip.
13. Refit the lower fascia panel and reconnect the battery.

Land Rover
Range Rover

Workshop Bulletin

AUGUST 1987

BULLETIN No. LSM180WB3

RANGE ROVER

TUDOR WEBASTO ELECTRICALLY OPERATED SUNSHINE ROOF

Sunshine Roof Bulletin

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INTRODUCTION 01

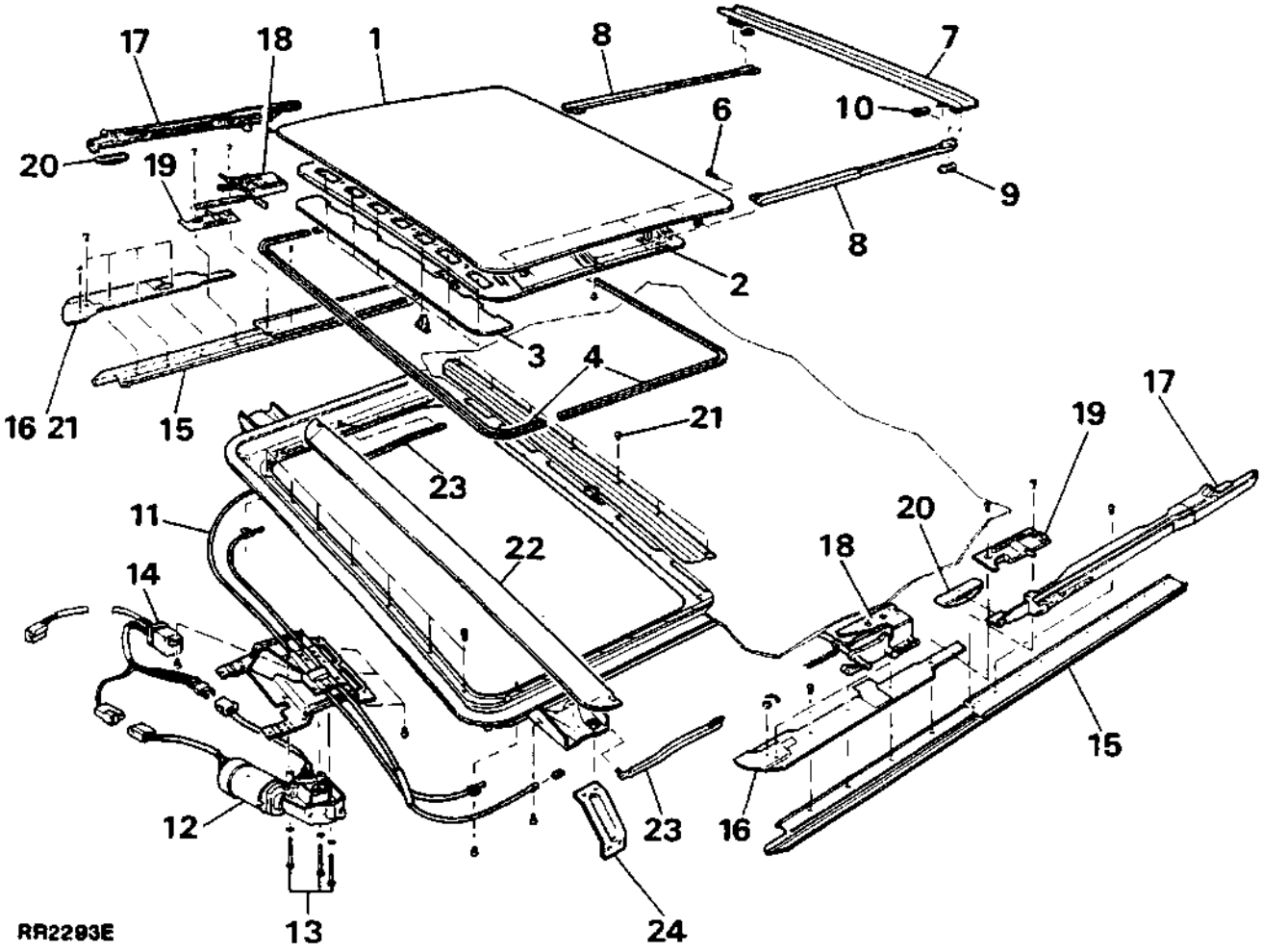
RANGE ROVER

1987 MODEL YEAR IMPROVEMENTS

INTRODUCTION

As part of the 1987 model year programme Land Rover Ltd is continually looking at ways to improve the quality and characteristics of its products. This bulletin contains details of the electrically operated sunshine roof which will further enhance the specification of the Range Rover. A further model improvement is the introduction of a one piece headlining.

ELECTRICALLY OPERATED SUNSHINE ROOF



SUNROOF ASSEMBLY

1. Roof panel
2. Blind
3. Insulation pad
4. Roof seals (front and rear)
5. Blind retaining clips (6 off)
6. Roof panel retaining screws (6 off)
7. Water channel
8. Water channel connectors
9. Support bracket-water channel
10. Slide shoe-water channel
11. Motor bracket/guide tube assembly
12. Operating motor
13. Motor retaining screws
14. Relay
15. Lower guide rails
16. Front guide rails
17. Slide mechanism
18. Rear guide
19. Pivot bracket
20. Slide shoe
21. Rear edge trim finisher
22. Wind deflector assembly
23. Wind deflector operating arms
24. Support bracket (6 off)

OPERATION

The sunroof operates in a tilt and slide action controlled by the rocker switch adjacent to the interior roof lamp, with ignition switched **'ON'**.

1. Depress front of switch to lift rear edge of sunroof into **'Tilt'** position.
2. Depress rear edge of switch to close roof.
3. Depress rear of switch to slide sunroof into **'Open'** position.
4. Depress front of switch to slide sunroof into **'Close'** position.

NOTE: The electric drive cuts out automatically in the closed, tilt and open positions. If the switch is operated in the wrong direction in one of these positions, press the switch once to reset and again to operate roof.

EMERGENCY OPERATION

If the sun roof fails in the open position carry out the following procedure:

1. Lower the interior lamp mounting panel by releasing two turnbuckles.
2. Remove the emergency handle from the vehicle tool kit.
3. Engage handle in motor drive spindle and turn to close roof.

MAINTENANCE

At each service blow drain tubes out to ensure they are not blocked or kinked. Blow upwards to clear rear drain tubes which are clipped to the rear mud flap supports. Blow downwards to clear front drain tubes which run down each 'A' post and exit at back of engine bay.
Annually: Clean sunroof opening thoroughly.

Note: Where the vehicle is operated in extremely dusty conditions more frequent cleaning is recommended.

OPERATING MOTOR, MICRO-SWITCH AND RELAY

Remove and refit

Removing

1. Ensure sunroof is fully closed. Disconnect the battery negative lead.
2. Remove interior lamp mounting panel by loosening two turnbuckles to gain access to the motor.
3. Disconnect two wiring connectors.
4. Remove three securing screws and withdraw motor.
5. Remove securing screw and withdraw relay.
6. Remove micro-switch from motor by drilling out securing rivets, if required.

Refitting

7. Secure new micro-switch usingsuitable nuts and bolts to replace rivets. Tighten nuts and apply a spot of paint to threads.
8. Ensure motor is in the 'park' position, i.e. hole on driven gear aligned with drive spindle.
9. Reverse removal procedure.
10. Check operation of sunroof in all positions.

ROOF PANEL SEALS

Remove and refit

Removing

1. Position sunroof in the tilt position and disconnect battery negative terminal.
2. Unclip blind from roof panel front and slide the blind back fully.
3. Remove three roof panel fixing screws from each side and remove panel.
4. Place the roof panel on a suitable surface to avoid damage, and remove both seals.

Refitting

5. Position front seal to front edge of panel, ensuring that there is an equal length of seal each side of the centre point. Secure seal using a rubber mallet.
6. Position the rear seal on one side immediately to rear of the front seal. Secure seal around panel edge ensuring a good fit around corners. Trim off excess seal at joint with front seal using suitable snips, ensuring that the joint is closed.
7. Refit the roof panel.

SUNROOF ASSEMBLY

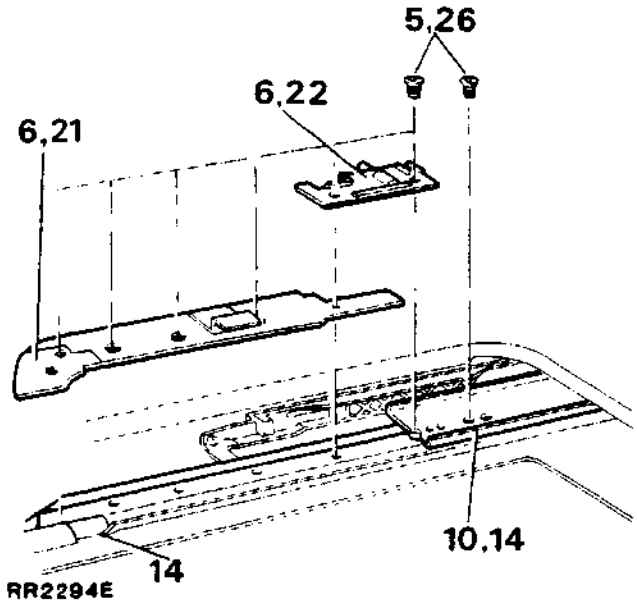
Remove and refit

- including roof panel, sliding mechanism, wind deflector, motor mounting bracket and guide tubes.

Removing

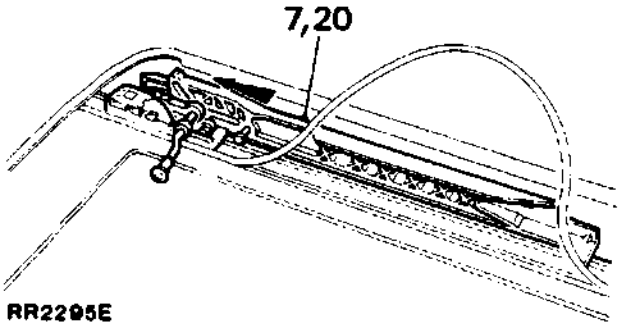
NOTE: Lower vehicle headlining ONLY if removing motor mounting bracket and guide tubes. Note that the headlining is secured around the roof opening using an adhesive tape. Remove edge trim and eight edge clips, carefully peel back headlining to remove.

1. Partially open sunroof rearwards and carefully unclip blind from roof panel front. Slide the blind back fully.
2. Position sunroof in the tilt position and disconnect battery negative terminal.
3. Remove three roof panel fixing screws from each side and remove panel.
4. Remove motor securing screws and withdraw motor.
5. Remove the guide rail screws, seven each side.
6. Remove the pivot bracket and remove front guide rail.



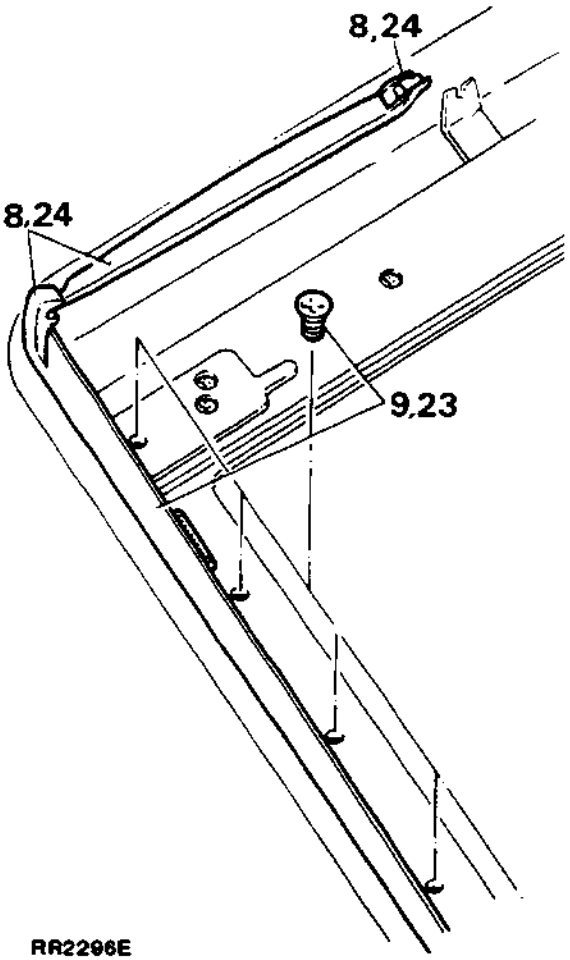
RR2294E

7. Remove the slide and tilt mechanism complete with flexible drive cable from both sides. Do not strip these assemblies unless replacement parts are required.



RR2295E

8. Unclip both wind deflector operating arms from rear mounting brackets. Remove arms from deflector, if required.



RR2296E

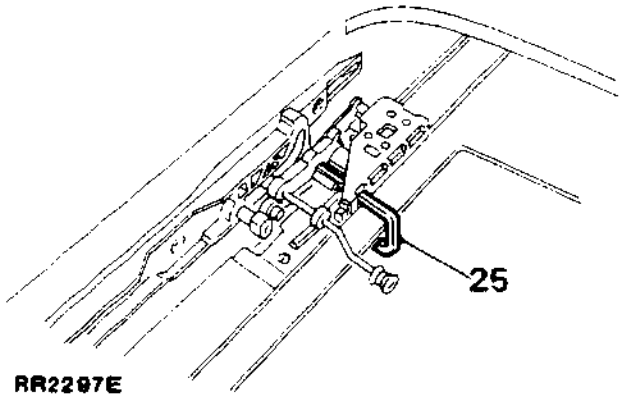
Continued

9. Remove seven fixing screws, and withdraw wind deflector.
10. Remove lower guide rails and rear edge finisher, seven screws, if required.
11. Remove fixing screws from guide tubes, two each side. Remove five fixing screws and withdraw motor mounting bracket.
12. Pull blind assembly forward and remove.

Refitting

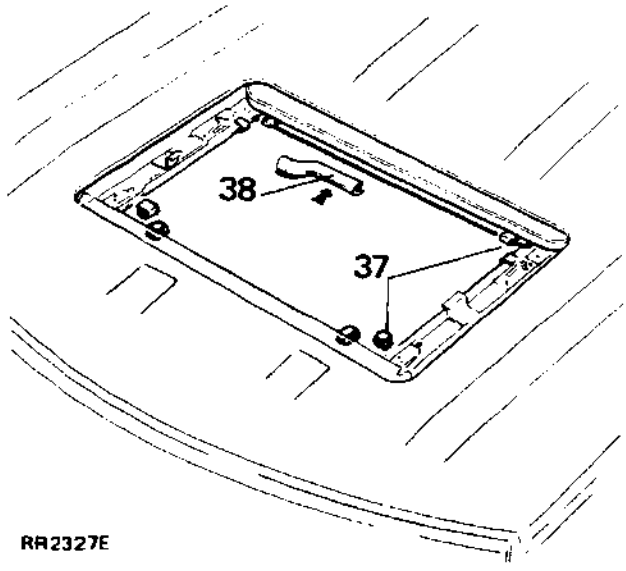
NOTE: During assembly lightly lubricate all sliding parts using a silicon spray.

13. Position motor bracket and guide tube assembly. Fit and tighten the securing screws.
14. Position right hand guide rail in rear retaining bracket, push rearwards fully and locate leading edge under drive cable opening. Repeat operation for left hand guide rail.
15. Align fixing holes, and loosely fit screw in seventh hole from the front.
16. Position finisher to rear edge of sun roof opening and secure using seven screws.
17. Position blind assembly into outer guide runners, and push fully rearwards.
18. Lightly lubricate drive cables. Ensure that the slide and tilt mechanism is fully assembled.
19. Push the cable fully into the right hand side guide tube. Loop remaining cable and enter the rear end into the right hand inner side runner.
20. Repeat operation 19. for left hand side. Push both assemblies rearwards to take up slack in the cables, and push a further 75 mm (3 in) to the rear.
21. Position both front guide rails, aligning with the four forward holes. Secure with screws, do not tighten.
22. Position both pivot brackets, fit but do not tighten fixing screws.
23. Fit the wind deflector and fully tighten fixings.
24. Position right hand operating arm in locating slot in deflector. Secure opposite end in frame bracket. Repeat for left hand side.
25. Pull right hand slide and tilt mechanism forward, align with pivot bracket and secure in position using setting key. Repeat operation for left hand side.



RR2297E

26. Tighten screws to guide rails, seven each side.
27. Fit and secure relay.
28. Ensure operating motor is in the park position i.e. hole on driven gear aligned with drive spindle. Fit and secure to mounting bracket.
29. Remove setting keys. Temporarily connect operating switch and reconnect wiring including battery.
30. Operate switch sequence to 'tilt' position.
31. Position roof panel into roof opening and secure with six fixing screws, do not tighten.
32. Put roof into 'closed' position and adjust roof profile. The panel profile should be 0.5 mm low at forward edge, 1 mm high at rear edge.
33. Tighten roof panel screws.
34. Tilt sunroof, pull blind forward and locate rear brackets in tilt mechanism. Align front six clips and push to secure.
35. Check operation of sunroof in all operating modes.



RR2327E

36. Refit vehicle headlining. The headlining is secured around the sunroof opening with '3M' adhesive tape.
37. Refit the eight edge clips as shown.
38. Finally fit the edging finisher.

SUNROOF BLIND ASSEMBLY

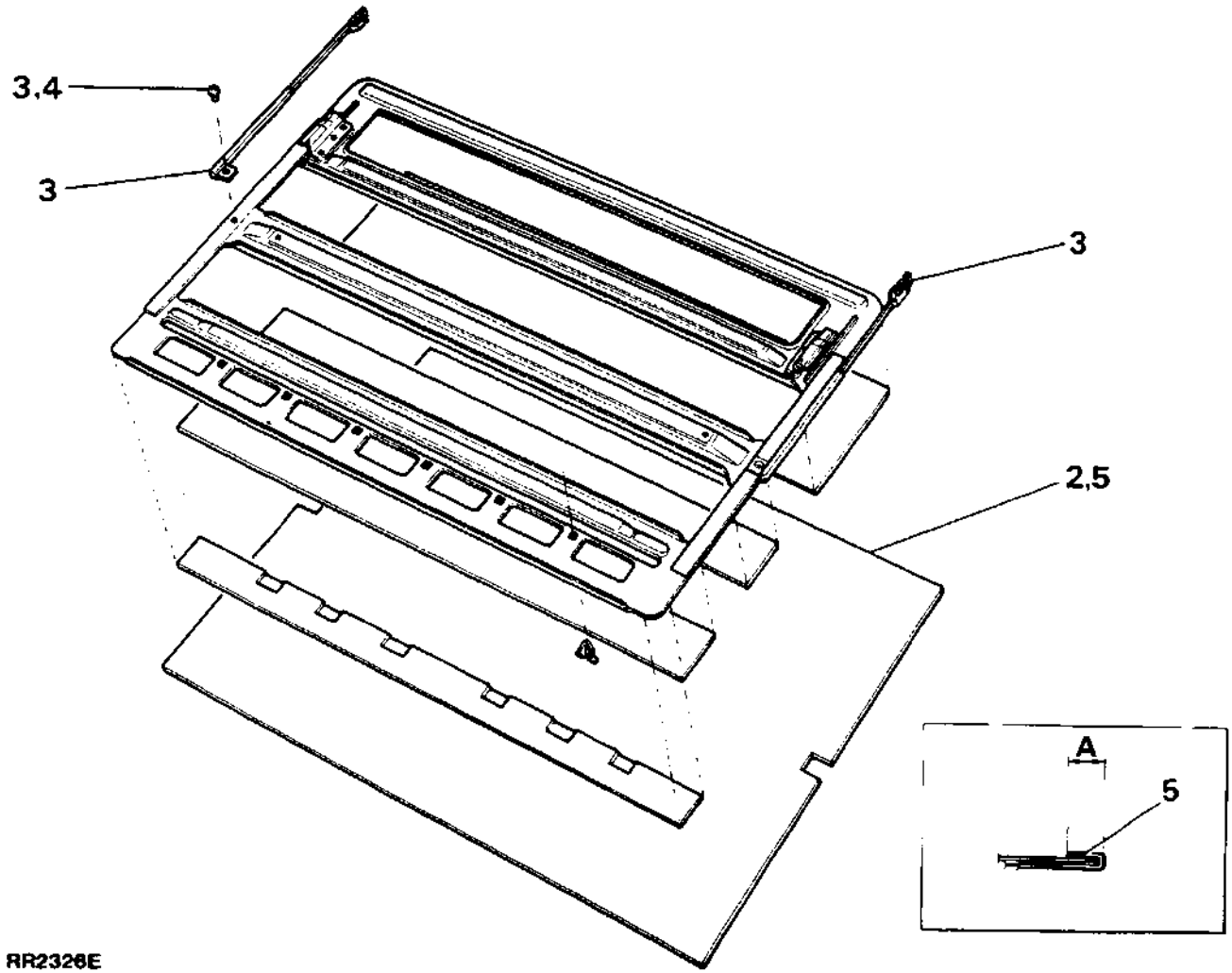
Remove, retrim and refit

Removing and retrimming

1. Remove sunroof blind assembly as detailed in Sunroof Assembly - remove and refit.
2. Remove trim covering from frame assembly. Note that it is not normally necessary to remove the three pads and insulation pad shown in illustration.
3. If required: remove water channel by unclipping connecting arms. Drill out rivets securing connecting arms to frame.
4. Secure connecting arms to frame using suitable rivets before retrimming frame.
5. Retrim frame using a new blind cover. Inset shows section through frame indicating where adhesive is applied. Dimension 'A' should be radially constant.

Refitting

6. Refit blind assembly and reassemble sunroof.



RR2326E

HEADLINING (One piece)

Remove and refit

Removing

1. Remove spare wheel from the vehicle.
2. Remove the rear seat belt upper guide brackets and inertia reel assemblies.
3. Fold the rear seat backrest forward and recline the front seats as far as possible.
4. Disconnect the battery negative lead.
5. Remove the two roof lamp assemblies. (Lower and remove the interior lamp mounting panel if the vehicle has a sunroof)
6. Remove the rear view mirror and mounting bracket.
7. Remove the two sun visors and centre retaining bracket.
8. Remove the front and rear passenger grab handles. **Sunroof vehicles:** Remove edge trim and eight edge clips from roof opening, and carefully peel back headlining to remove.
9. With assistance support the front of the headlining, while removing the two plastic retaining clips above the rear quarter light glass.
10. While the headlining is still being supported, remove the two plastic retaining clips securing the rear end of the headlining, located adjacent to the upper tailgate hinges.
11. Pull the headlining forward to clear the rear quarter trim. Lower the headlining and disconnect the electrical leads from the roof mounted speakers.
12. Remove the headlining through the tailgate.

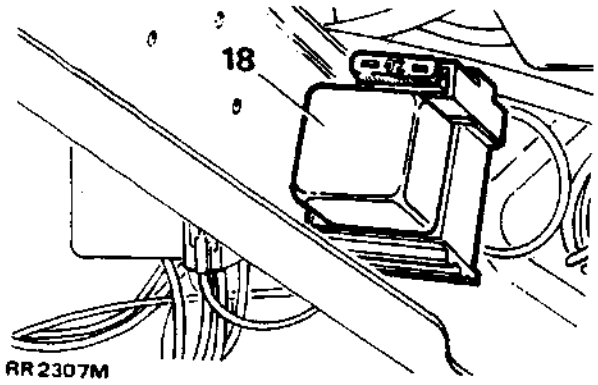
CAUTION: To assist removal tilt the headlining at an angle. DO NOT flex the headlining as damage may occur.

Refitting

8. Reverse the removal procedure. **Sunroof vehicles:** The headlining is secured around the roof opening with '3M' adhesive tape. Refit the eight edge clips and fit the edging finisher. See also Sunroof assembly, remove and refit.

RELAYS

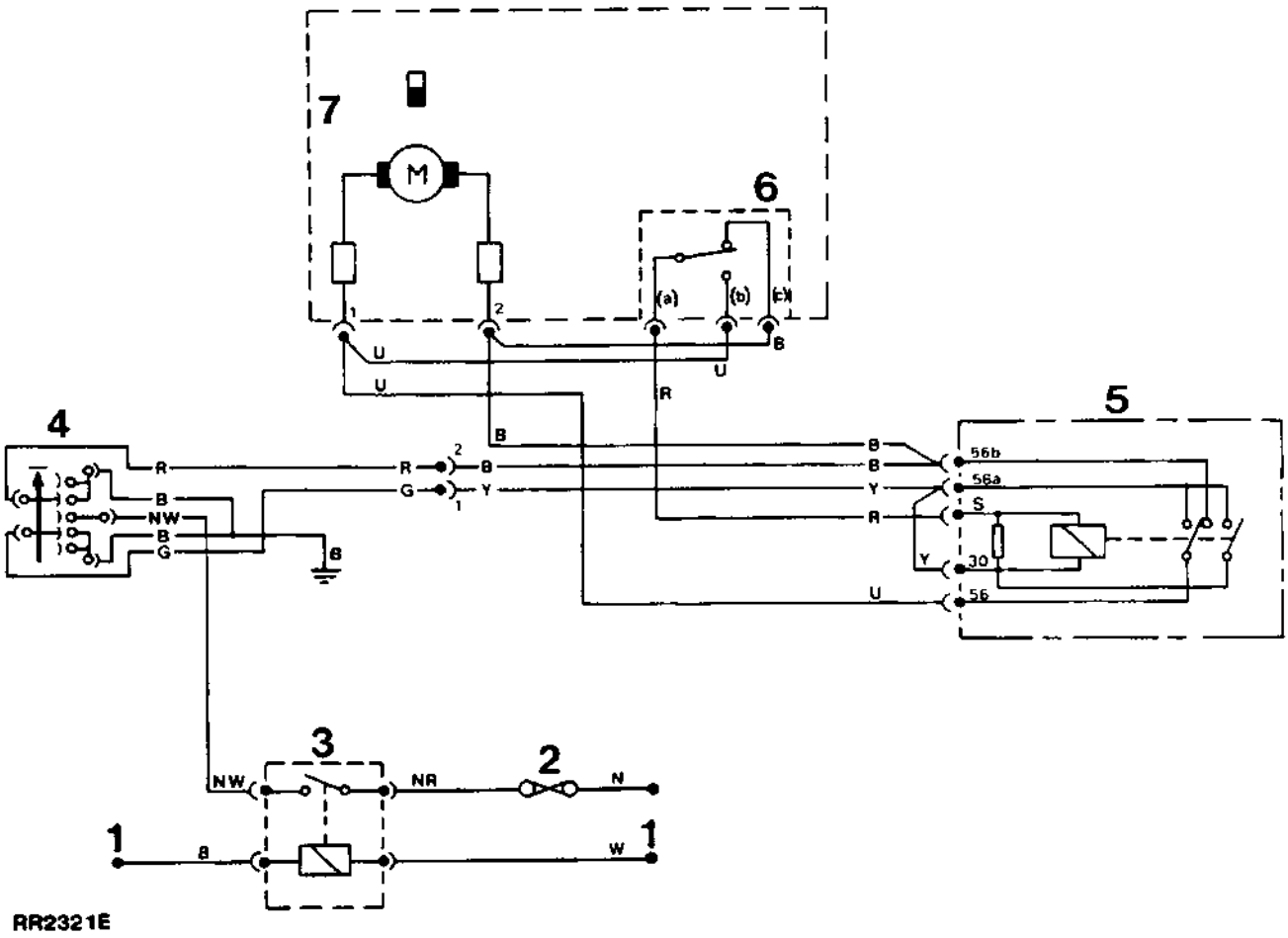
Stepper relay: mounted on motor mounting bracket, accessible by lowering interior lamp mounting bracket.



Auxiliary relay (18): mounted on side of pedal box. Accessible by removing lower fascia panel.

Fuse: 20 amp located on side of auxiliary relay.

Continued



RR2321E

SUNSHINE ROOF - Circuit diagram

RR2321E

1. Main harness connections
   Brown - live positive feed
   White - ignition positive feed
   Black - earth
2. Fuse
3. Auxiliary relay
4. Operating switch
5. Stepper relay
6. Micro-switch - motor switching:
   Contact (a) and (c)-CLOSED
   Contact (a) and (b)-OPEN/TILT
7. Drive motor

CABLE COLOUR CODE

B	**Black**
U	**Blue**
N	**Brown**
G	**Green**
R	**Red**
W	**White**
Y	**Yellow**

The last letter of a colour code denotes the tracer.

(08/87)

Land Rover
Range Rover

Workshop Bulletin

MARCH 1988

BULLETIN No. LSM180WB4

RANGE ROVER VOGUE SE

Vogue SE Bulletin

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INTRODUCTION 01

RANGE ROVER VOGUE SE

INTRODUCTION

Land Rover Ltd introduce the addition of a Vogue SE version of Range Rover to complement the existing model range. The Vogue SE will be fitted with, as standard equipment;

Automatic Transmission
Air Conditioning
Electric Sunroof
Leather Seats - Electrically Operated
Polished Burr Walnut door Cappings and Door Pulls
Body Colour Paint to Alloy Wheels
Coach Line
Premium In-car Entertainment
A133/80 Alternator

This bulletin contains servicing details for the Lucas A133/80 Alternator and Electrically operated seats, and includes up to date wiring diagrams for the complete Range Rover model range.

04 GENERAL SPECIFICATION DATA

ELECTRICAL

System ..... 12 volt, negative ground

Alternator

Manufacturer ..... Lucas
Type 133/80
Polarity ..... Negative ground
Brush length
  New ..... 20 mm (0.78 in)
  Worn, minimum free protrusion
  from brush box ..... 10 mm (0.39 in)
Brush spring pressure flush with brush box face ..... 136 to 279 g (5 to 10 oz)
Rectifier pack output rectification ..... 6 diodes (3 positive side and 3 ground side)
Field winding supply rectification ..... 3 diodes
Stator windings ..... 3 phase-delta connected
Field winding rotor poles 12
  Maximum speed ..... 16,000 rev/min
  Winding resistance at 20°C ..... 2.6 ohms
Control ..... Field voltage sensed regulation
Regulator-type ..... 15 TR
  voltage ..... 13.6 to 14.4 volts
Nominal output
  Condition ..... Hot
  Alternator speed ..... 6000 rev/min
  Control voltage ..... 14 volt
  Amp ..... 80 amp

06 TORQUE WRENCH SETTINGS

ELECTRICAL

	Nm	lbf/ft
Alternator mounting bracket to cylinder head	34	25
Alternator to mounting bracket	24	17
Alternator to adjusting link	24	17
Alternator shaft nut	27.2 to 47.5	20 to 35
Alternator through bolts	4.5 to 6.2	3.3 to 4.6
Alternator rectifier bolts	3.4 to 3.96	2.5 to 2.9

Charts below give torque values for all screws and bolts used-except for those that are specified.

SIZE	METRIC		SIZE	UNC		UNF	
	Nm	ft lb		Nm	ft lb	Nm	ft lb
M5	5-7	3.7-5.2	1/4	6.8-9.5	5-7	8.1-12.2	6-9
M6	7-10	5.2-7.4	5/16	20.3-27.1	15-20	20.3-27.1	15-20
M8	22-28	16.2-20.7	3/8	35.3-43.4	26-32	35.3-43.4	26-32
M10	40-50	29.5-36.9	7/16	67.8-88.1	50-65	67.8-88.1	50-65
M12	80-100	59.0-73.8	1/2	81.3-101.7	60-75	81.3-101.7	60-75
M14	90-120	66.4-88.5	5/8	122.0-149.1	90-110	122.0-149.1	90-110
M16	160-200	118.0-147.5					

FRONT SEAT

Remove and refit

Removing

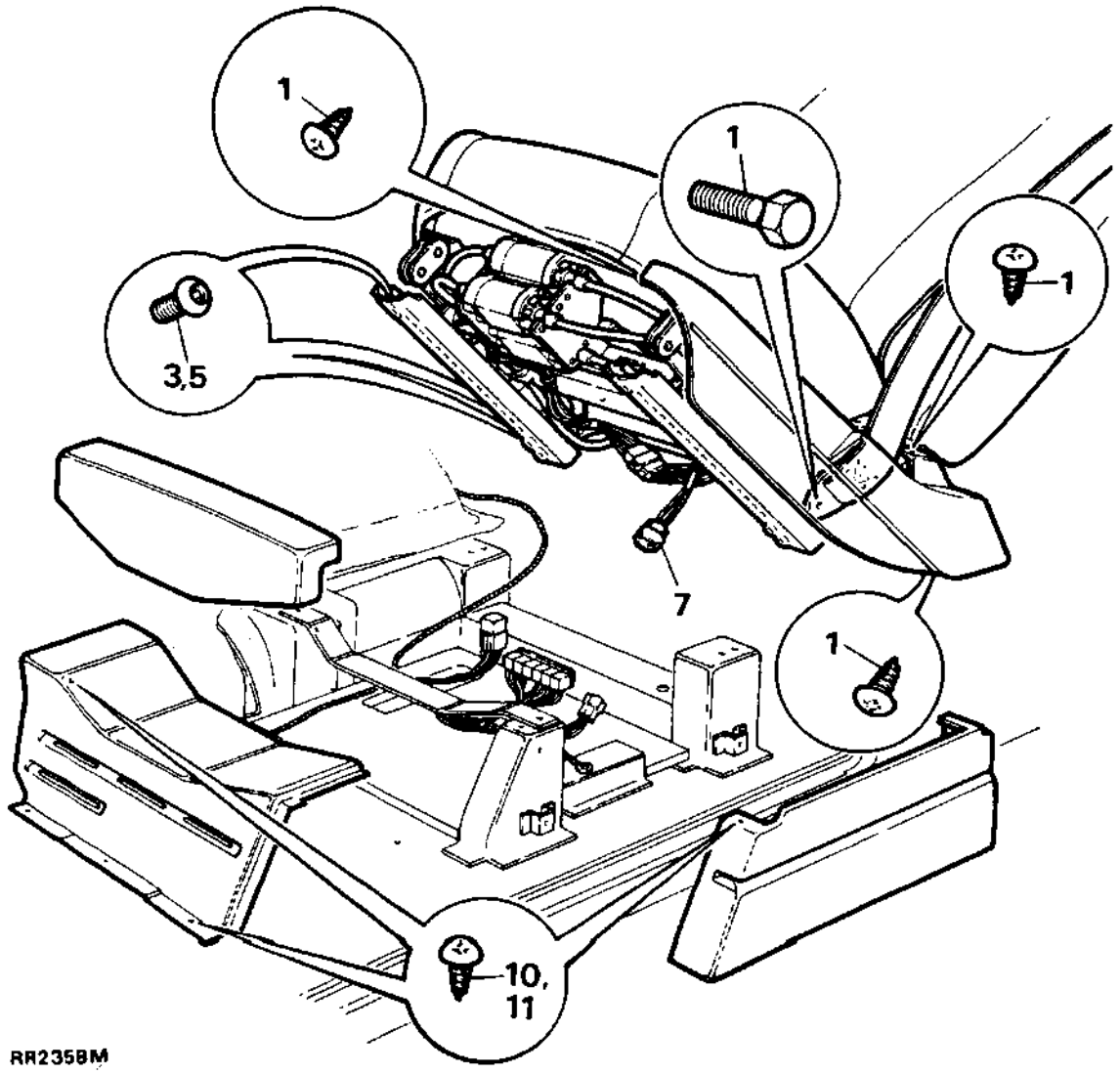
1. Remove the three fixings securing the seat cushion side trim panel and withdraw the panel. Remove the bolt securing the seat belt to the side of the seat.
2. Move the seat until it is in its most rearward position.
3. Remove the two fixings securing the front of the seat located in each seat slide channel.
4. Move the seat until it is in its most forward position.
5. Remove the four fixings securing the rear of the seat located inside each seat slide channel.
6. Disconnect the battery negative terminal.
7. Disconnect the electrical multi-plugs to the seat motors and seat control switch.

Note: Certain models may be fitted with a seat belt warning system depending upon territory requirements. If the system is fitted disconnect the electrical connector at the seat belt buckle.

8. Withdraw the seat from the vehicle.
9. If necessary the seat motors and operating switch can be removed. (Refer to Section 86 Electrical).
10. Remove the single screw securing the seat base side trim panel and withdraw the panel.
11. Remove the three screws securing the seat base front trim panel to the front footwell, remove the single screw securing the top of the front trim panel to the seat base located under the seat base cushion, and withdraw the panel.

Refitting

12. Reverse the removal instructions.
13. Arrange the electrical leads beneath the seat to ensure that they do not become trapped by the seat slide mechanism.



ELECTRICAL EQUIPMENT

DESCRIPTION

The electrical system is Negative ground, and it is most important to ensure correct polarity of the electrical connections at all times. Any incorrect connections made when reconnecting cables may cause irreparable damage to the semi-conductor devices used in the alternator and regulator. Incorrect polarity would also seriously damage any transistorized equipment such as radio and tachometer etc.

WARNING: During battery removal or before carrying out any repairs or maintenance to electrical components always disconnect the battery negative lead first. If the positive lead is disconnected with the negative lead in place, accidental contact of the wrench to any grounded metal part could cause a severe spark, possibly resulting in personal injury. Upon installation of the battery the positive lead should be connected first.

ALTERNATOR - LUCAS A133/80

The alternator is a three phase, field sensed unit. The rotor and stator windings produce three phase alternating current, AC, which is rectified to direct current, DC. The electronic voltage regulator unit controls the alternator output voltage by high frequency switching of the rotor field circuit. Use only the correct Range Rover replacement fan belt. Occasionally check that the engine and alternator pulleys are accurately aligned.

It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.

Do not disconnect battery cables while the engine is running or damage to the semi-conductor devices may occur. It is also inadvisable to break or make any connections in the alternator charging and control circuits while the engine is running.

The Model 15TR electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse effects of temperature, dust, and moisture etc.

The regulating voltage is set during manufacture to give the required regulating voltage range of 14.2 $\pm$ 0.2 volts, and no adjustment is necessary. The only maintenance needed is the occasional check on terminal connections and wiping with a clean dry cloth.

The alternator system provides for direct connection of a charge (ignition) indicator warning light, and eliminates the need for a field switching relay or warning light control unit. As the warning lamp is connected in the charging circuit, lamp failure will cause loss of charge. Lamp should be checked regularly and a spare carried.

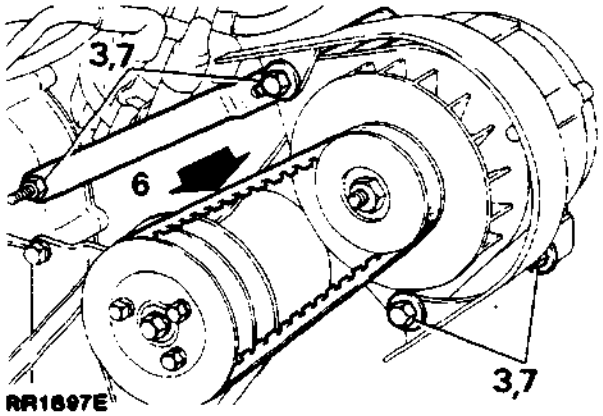
When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.

ALTERNATOR

Remove and refit

Removing

1. Disconnect battery ground lead.
2. Disconnect leads from alternator.



3. Loosen alternator fixings, pivot alternator inwards and remove drive belt.
4. Remove three mounting bolts and lift the alternator clear of the engine.

Refitting

5. Fit the alternator and mounting bolts.

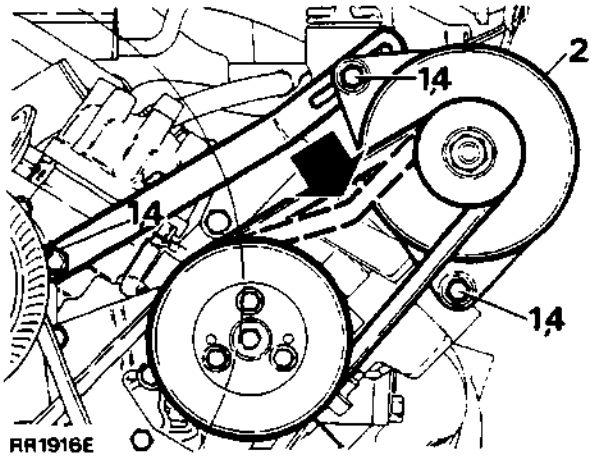
   NOTE: The fan guard is attached to the front fixing and the adjustment bracket bolt.

6. Fit the drive belt and adjust the belt tension.
7. Tighten the mounting bolts and the adjustment bracket securing nut.
8. Connect the wiring leads to the alternator.
9. Connect the battery.

ALTERNATOR DRIVE BELT

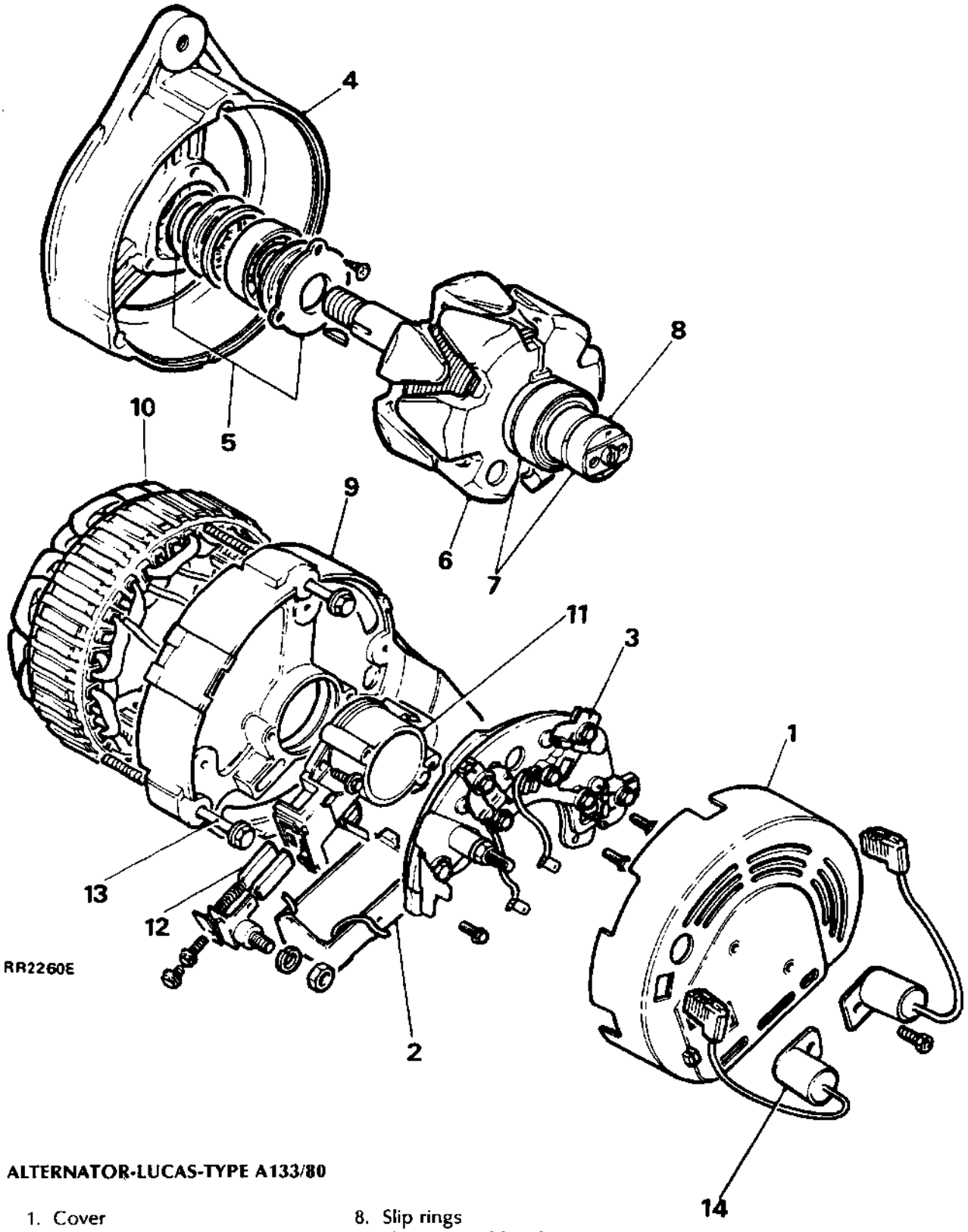
Adjust

1. Loosen the alternator fixings and the adjustment link.
2. Pivot the alternator to give the required belt tension.
3. Belt tension should be 4 to 6mm (0.19 to 0.25 in) at the point indicated by the bold arrow.



4. Tighten the alternator fixing bolts and the adjustment link.

   NOTE: Check adjustment after running engine at fast idle speed for 3 to 5 minutes if a new belt has been fitted.



ALTERNATOR-LUCAS-TYPE A133/80

1. Cover
2. Regulator
3. Rectifier
4. Drive and bracket
5. Bearing assembly
6. Rotor
7. Slip ring end bearing
8. Slip rings
9. Slip ring end bracket
10. Stator
11. Brush box
12. Brushes
13. Through bolt
14. Suppressors

ALTERNATOR-LUCAS-TYPE A133/80

Overhaul

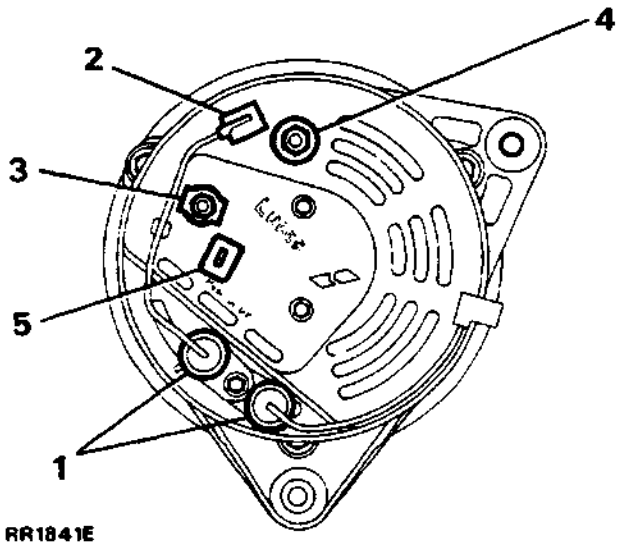
Including Test (Bench)

NOTE: Alternator charging circuit-The ignition warning light is connected in series with the alternator field circuit. Bulb failure would prevent the alternator charging, except at very high engine speeds, therefore, the bulb should be checked before suspecting an alternator failure.

Precautions

Battery polarity is **NEGATIVE GROUND**, which must be maintained at all times.
No separate control unit is fitted; instead a voltage regulator of micro-circuit construction is incorporated on the slip ring end bracket, inside the alternator cover.
Battery voltage is applied to the alternator output cable even when the ignition is switched off, the battery must be disconnected before commencing any work on the alternator. The battery must also be disconnected when repairs to the body structure are being carried out using electric welding equipment.

Sequence of connections



RR1841E

1. Suppression capacitors (two)
2. Positive suppression terminal
3. IND terminal
4. + output terminal
5. Sensing terminal

ALTERNATOR TESTING

Charging system check

1. Check the battery is in good condition, with an open circuit voltage of at least 12.6 V. Recharge or fit a charged substitute battery to carry out test.
2. Check drive belt adjustment and condition. Rectify as necessary.
3. Check battery connections are clean and tight.
4. Check alternator connections are clean and tight.
5. Ensure that there is no continuous drain on battery due, for example, to interior, underbonnet or door edge lamps being left on.

Alternator test

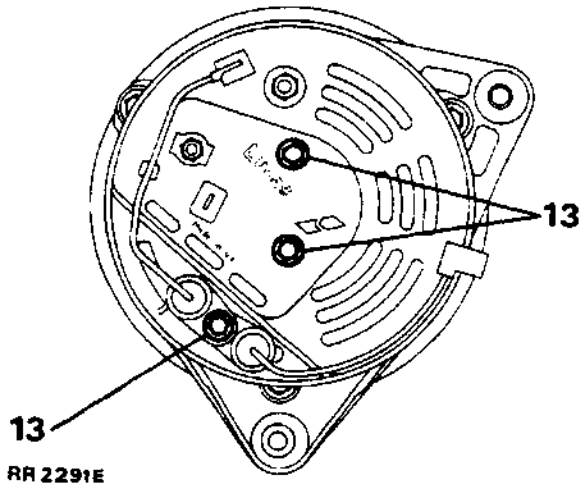
The following instructions refer to the use of suitable test equipment using a carbon pile rheostat.

6. Connect test equipment referring to the manufacturer's instructions.
7. Start engine and run at 3000 rev/min without accesory load.
8. Rotate the carbon pile load control to achieve the greatest output (amps) without allowing voltage to fall below 12.0 V. A reading of 80 amps, minus 10% to allow for EFI and Ignition loss, should be obtained.
9. Run engine at 3000 rev/min, switch selector to regulator test, read voltmeter. A reading of 13.6 to 14.4 V should be obtained.
10. Switch selector to diode/stator test, switch on headlamps to load alternator. Raise engine speed to 3000 rev/min, read voltmeter. The needle must be within the 'OK' range.

NOTE: See also charging circuit resistance test, page 7.

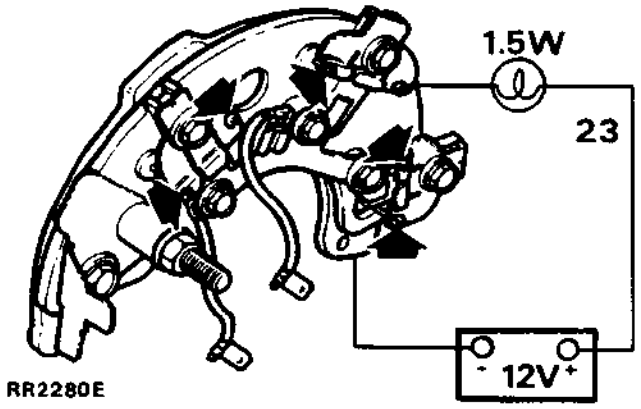
Testing-alternator removed

11. Withdraw the connectors from the alternator.
12. Remove the alternator.
13. Disconnect the suppressor and remove the alternator cover.



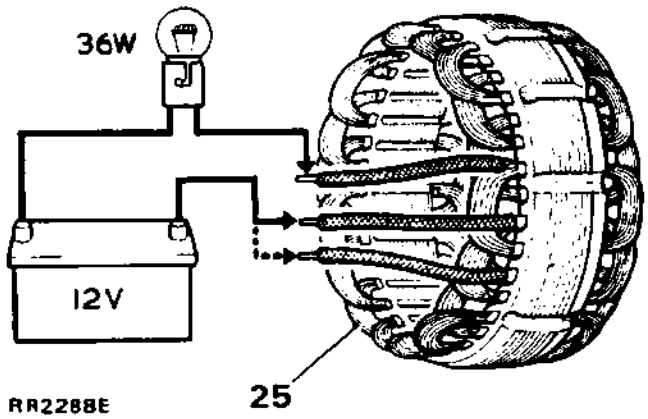
14. Disconnect the lead and remove the rectifier assembly.
15. Note the arrangement of the brush box connections and remove the screws securing the regulator to the brush box and withdraw. This screw also retains the inner brush mounting plate in position.
16. Remove the screw retaining the outer brush box in position and withdraw both brushes.
17. Check brushes for wear by measuring length of brush protruding beyond brush box moulding. If length is 10mm (0.4 in) or less, fit new brushes.
18. Check that brushes move freely in holders. If brush is sticking, clean with a mineral spirit moistened cloth or polish sides of brush with fine file.
19. Check brush spring pressure using push-type spring gauge. Gauge should register 136 to 279g (5 to 10 oz) when brush is pulled back until face is flush with housing. If reading is outside these limits, fit a new brush assembly.
20. Remove the two screws securing the brush box to the slip ring end bracket and lift off the brush box assembly.
21. Securely clamp alternator in a vice and release the stator winding cable ends from the rectifier by applying a hot soldering iron to the terminal tags of the rectifier. Pry out the cable ends when the solder melts.

22. Remove the two remaining screws securing the rectifier assembly to the slip ring end bracket and lift off the rectifier assembly. Further dismantling of the rectifier is not required.
23. Check the diodes. Connect the test equipment as shown and test each diode in turn, note whether lamp lights, then reverse test lead connections. The lamp should light in one direction only. Renew the rectifier assembly if a faulty diode is diagnosed.



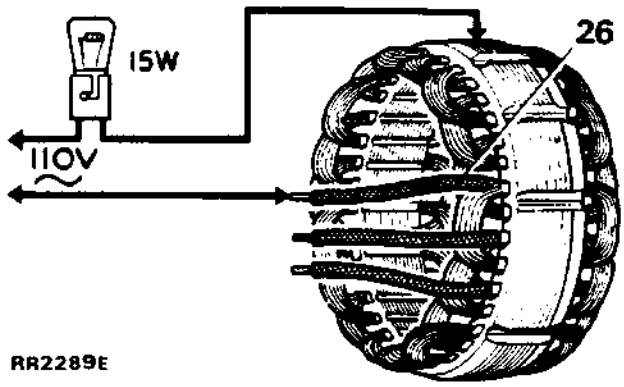
RR2280E

24. Remove the slip ring end bracket bolts and lift off the bracket.
25. Connect a 12 volt battery and a 36 watt test lamp to two of the stator connections. Repeat the test replacing one of the two stator connections with the third. If test lamp fails to light in either test, fit a new stator.



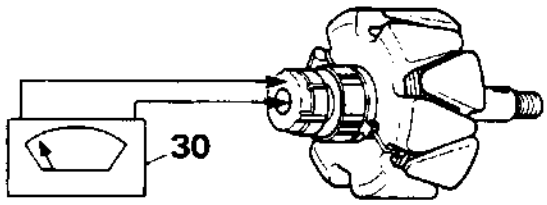
RR2288E

26. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between any one of the three stator connections and stator laminations. If test lamp lights, fit a new stator.



RR2289E

27. Clean surfaces of slip rings using a solvent moistened cloth.
28. Inspect slip ring surfaces for signs of burning; remove burn marks using very fine sandpaper. On no account should emery cloth or similar abrasives be used, or any attempt made to machine the slip rings.
29. Note the position of the stator output leads in relation to the alternator fixing lugs, and lift the stator from the drive end bracket.
30. Connect an ohmmeter to the slip rings. A reading of 2.6 ohms should be recorded.



RR2290E

31. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between one of the slip rings and one of the rotor poles. If the test lamp lights, fit a new rotor.

32. To separate the drive end bracket and rotor, remove the shaft nut, washers, woodruff key and spacers from the shaft.
33. Remove bearing retaining plate by removing the three screws. Using a press, drive the rotor shaft from the drive end bearing.
34. If necessary, to remove the slip rings or the slip ring end bearing on the rotor shaft, unsolder the outer slip ring connection and gently pry the slip ring off the shaft, repeat the procedure for the inner slip ring connection. Using a suitable extraction tool, withdraw the slip ring bearing from the shaft.

Reassembling

35. Reverse the dismantling procedure, noting the following points.

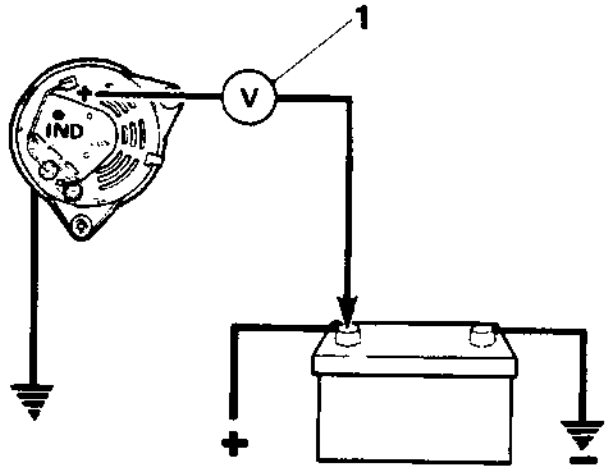
    (a) Use Shell Alvania 'RA' to lubricate bearings.
    (b) When refitting slip ring end bearing, ensure it is fitted with open side facing rotor.
    (c) Use Fry's H.T.3 solder on slip ring field connections.
    (d) When refitting rotor to drive end bracket, support inner track of bearing. Do not use drive end bracket to support bearing when fitting rotor.
    (e) Tighten through-bolts evenly.
    (f) Fit brushes into housings before fitting brush moulding.
    (g) Tighten shaft nut to the correct torque, see Torque Values.
    (h) Refit regulator pack to brush moulding.

36. Reconnect the leads between the regulator, brush box and rectifier.
37. Refit the alternator.

Testing in position

Charging circuit resistance test.

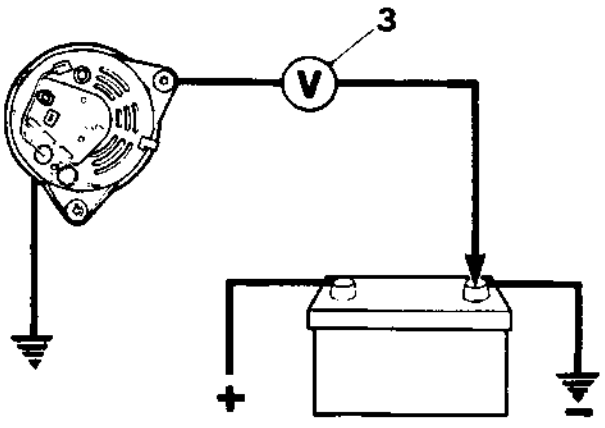
1. Connect a low range voltmeter between the alternator terminal marked + and the positive terminal of the battery.



RR2317E

2. Switch on the headlamps and start the engine. Set the throttle to run at approximately 3000 rev/min. Note the voltmeter reading.

3. Transfer the voltmeter connections to the frame of the alternator and the negative terminal of the battery, and again note the voltmeter reading.



RR2318E

4. If the reading exceeds 0.5 volt on the positive side or 0.25 volt on the negative side, there is a high resistance in the charging circuit which must be traced and remedied.

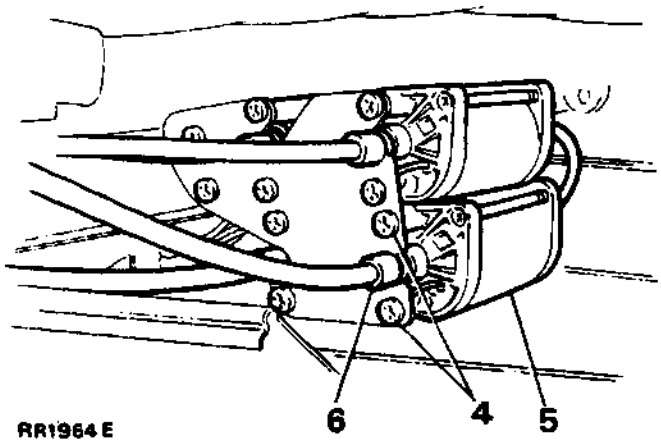
FRONT SEAT ADJUSTMENT MOTORS

Remove and refit

Four electric motors mounted beneath each front seat control the fore and aft movement, the cushion height front and rear, and the angle of recline of the seat. Adjustment is possible with either front door open, or with ignition switched **ON.**

Removing

1. Position the seat to give access to the motors.
2. Disconnect the battery negative lead.
3. Remove the seat base trim.
4. Remove two securing screws from each side of the required motor.



RR1964E

5. Withdraw the motor from its mounting.
6. Disconnect the drive cables by unscrewing the ferrule.
7. Disconnect the wires from the multi-plug and remove the motor.

Refitting

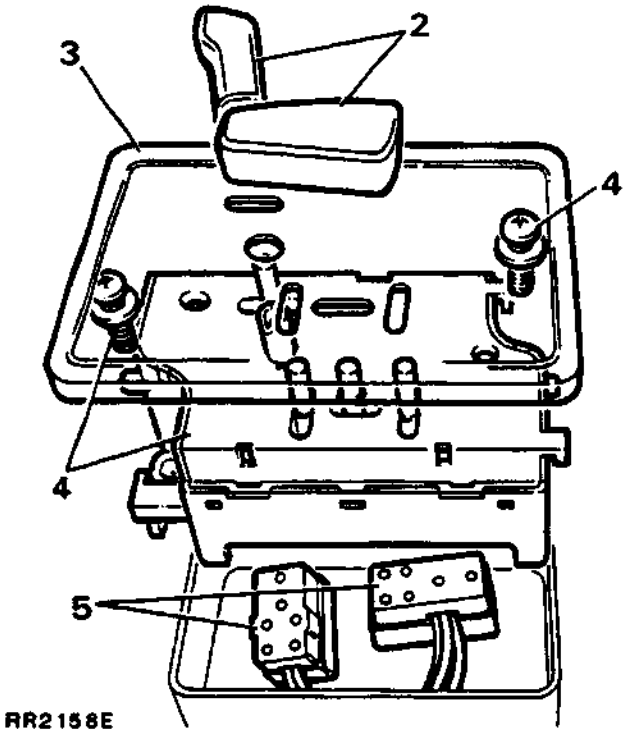
8. Reverse the removal procedure.
9. Check the seat adjustment for correct operation.

SEAT ADJUSTMENT CONTROL SWITCH

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Pry the two finger tip controls from the top of the switch housing.
3. Removing the switch housing cover by lightly depressing the sides of the cover to disengage the clips.
4. Remove two crosshead screws and washers and lift the switch assembly to gain access to the two multiplugs.
5. Disconnect the multiplugs and withdraw the switch assembly.

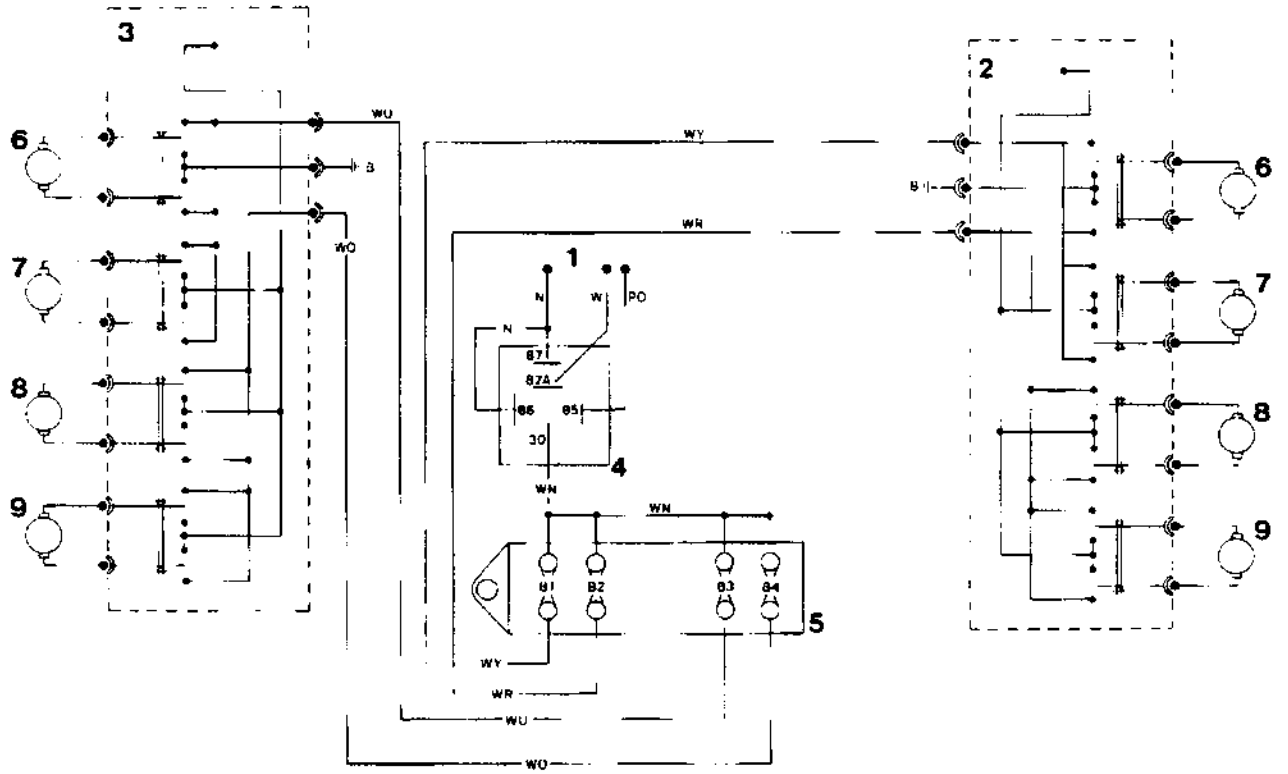


RR2158E

Refitting

6. Reverse instructions 1 to 5.

NOTE: If switch housing removal is required it is necessary to remove the seat to gain access to the two securing screws- see Body Section 76.



RR1929E

SEAT ADJUSTMENT - Circuit diagram

1. Main connections - Item 126 on main circuit diagram left hand steer catalyst vehicles.
   - item 170 on main circuit diagram - left hand steer non - catalyst vehicles.
   - item 165 on main circuit diagram - right hand steer vehicles.

   Brown - Live positive feed
   White - Ignition positive feed
   Purple/Orange - Door switch
2. Left hand seat control.
3. Right hand seat control.
4. Load control relay.
5. Auxiliary fuse box (B).
6. Seat recline motor.
7. Seat height (rear) motor.
8. Seat base adjust motor.
9. Seat height (front) motor.

CABLE COLOUR CODE

B	Black
U	Blue
N	Brown
G	Green
O	Orange
P	Purple
R	Red
W	White
Y	Yellow

The last letter of a colour code denotes the tracer.

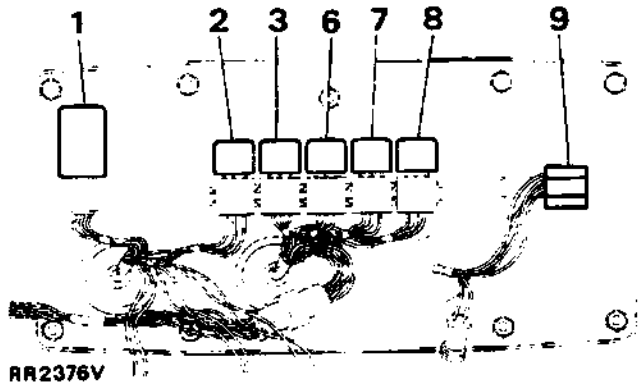
Relay	Main Circuit Diagram Item Number		
	Right hand steer	Left hand steer Non-catalyst	Left hand steer Catalyst
1. Headlamp wash timer unit	19. M	17. M	17. M
2. Heated rear window	66. M	64. M	64.M
3. Starter solenoid relay	6. M	6. M	6.M
4. Brake check relay	151. A	Not fitted	Not fitted
5. Headlamp relay	157. A	Not fitted	Not fitted
6. Compressor clutch	11. A	11. A	11. A
7. Condenser fan	9. A	9. A	9. A
8. Air conditioning/heater	5. A	5. A	5. A
9. Stowage position	Not used	Not used	Not used
10. Rear wiper delay	132. M	139. M	132. M
11. Ignition load relay	1. M	1. M	1. M
12. Window lift relay (if fitted)	65a. M	63a. M	63a. M
13. Seat adjustment relay (if fitted)	165a M	170a. M	126a. M
14. Auxiliary lamp relay (if fitted)	88. M	86. M	86. M
15. Flasher/hazard unit	74. M	72. M	72. M
16. Interior lamp delay	101. M	99. M	99. M
17. Voltage sensitive switch (air conditioning)	72. M	70. M	70. M
18. Front wiper delay	15. M	14. M	14. M
19. Seat adjustment relay (load control - if fitted)	4. S	4. S	4. S
20. Main EFI relay	10. E	10. E	22. E
21. Fuel pump relay	11. E	11. E	21. E
22. Sunshine roof auxiliary relay (if fitted)	3. SR	3. SR	3. SR

M = Main circuit diagram
A = Air conditioning circuit diagram
S = Seat adjustment circuit diagram
E = EFI circuit diagram
SR = Sunroof circuit diagram

NOTE: This relay chart applies to ALL petrol model Range Rovers. Vogue SE models have electric seat adjustment, window lift, air conditioning, auxiliary lamps and sunshine roof fitted as standard equipment.
Saudi vehicles are fitted with two extra relays, an overspeed monitor and buzzer, located immediately below the instrument binnacle.
Access to the two units is gained by removing the lower dash panel and steering column shroud.

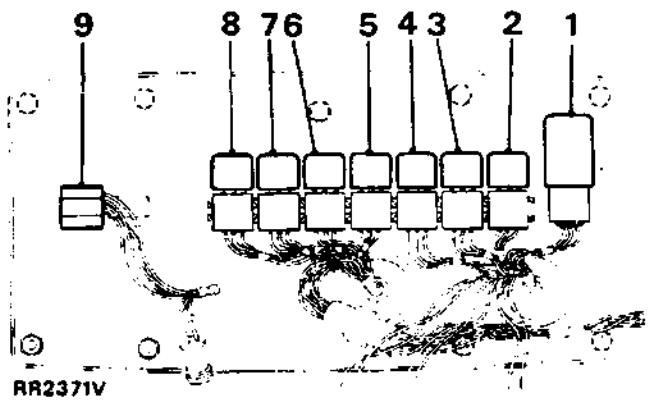
RELAYS-Identification

RR2376V shows left hand drive configuration of relays.

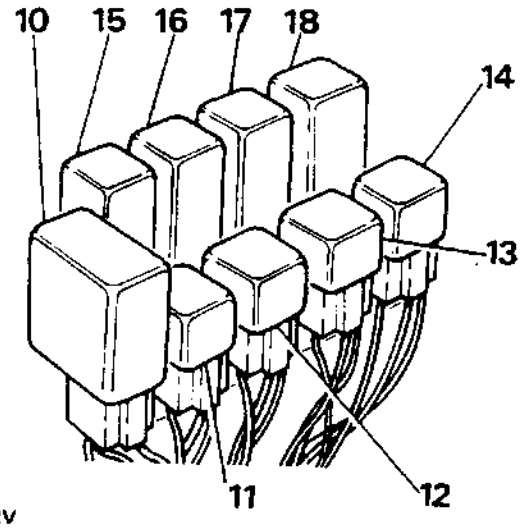


Closure panel viewed from the engine compartment, with protective cover removed.

RR2371V shows right hand drive configuration of relays.



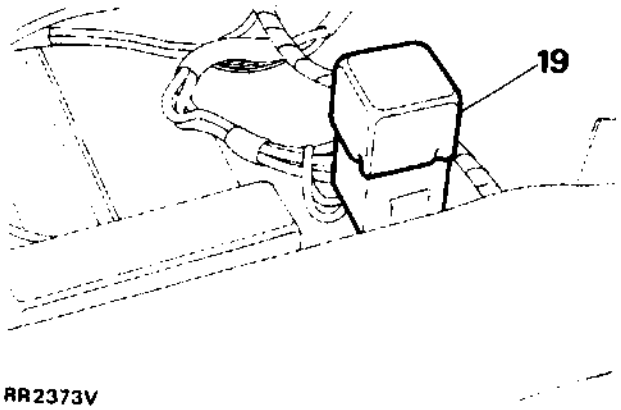
Closure panel viewed from the engine compartment, with protective cover removed.



RR2372V

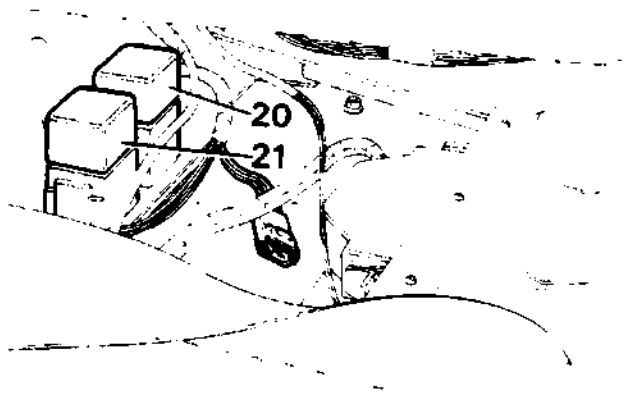
Steering column mounted relays viewed with the lower dash panel removed.

NOTE: Left hand drive configuration of relays illustrated above.
Unit 10, on right hand drive vehicles is located at the right hand side of the bank of relays.



RR2373V

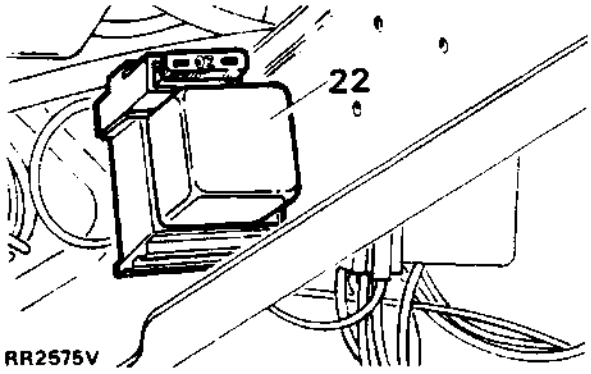
Seat adjustment relay (load control) located beneath the left hand front seat adjacent to fuse box (B).



RR2374V

Main EFI (black terminal block) and fuel pump relays (blue terminal block) mounted beneath right hand front seat.

NOTE: Refer to fuel injection section of manual for full information on E.F.I. relays.



RR2575V

Sunshine roof auxiliary relay located on side of the steering column support bracket located behind the lower dash panel. (Left hand drive shown).

RELAYS - (Mounted on the engine compartment closure panel).

Remove and refit

Removing

1. Lift the hood.
2. Disconnect the battery negative lead.
3. Remove the bolt securing the relay protective cover, located on the front of the engine compartment closure panel.
4. Remove the cover.
5. Pull the appropriate relay off its multi-plug.

Refitting

6. Reverse the removal procedure.

Continued

RELAYS - (Mounted on the steering column support bracket)

Remove and refit

Removal.

1. Disconnect the battery negative lead.
2. Remove the six screws securing the lower fascia panel.
3. Lower the dash panel, disconnect the electric leads from the dimming control switch and remove the fascia panel.
4. Locate the appropriate relay on the relay mounting bracket, carefully pull the relay off the multi-plug.

Refitting

5. Reverse the removal procedure.

RELAYS - (Floor mounted beneath front seats)

Remove and refit

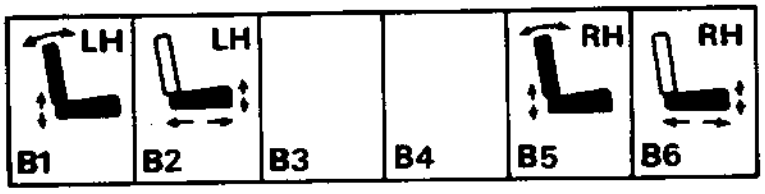
Removing

1. Position seat to gain access to the required relay.
2. Disconnect the battery negative lead.
3. Carefully pull the relay off the multi-plug.

Refitting

4. Reverse the removal procedure.

AUXILIARY FUSE BOX



RR1760E

AUXILIARY FUSE BOX (B)-Located under the front left-hand seat

FUSE NO	COLOUR CODE	FUSE VALUE	CIRCUIT SERVED
B1	Green	30 amp	Seat recline
B2	Green	30 amp	Seat base
B3	----	----	Spare
B4	----	----	Spare
B5	Green	30 amp	Seat recline
B6	Green	30 amp	Seat base

AUXILIARY FUSE BOX

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Remove the clip-on fuse box cover.
3. Remove the fuses from auxiliary fuse box.
4. Remove the single screw securing the top auxiliary.
5. Remove the leads from the fuse box, by inserting a small screwdriver into each fuse socket to depress the small retaining tab on the back of the lucar connections, withdraw the leads from the rear of the fuse box.

Refitting

6. Reverse the removal instructions ensuring that all leads are refitted to the correct fuse socket (refer to circuit diagram).

NOTE: When refitting the leads to the fuse box, the retaining tabs on the back of the lucar connectors must be in their raised position to prevent the leads being pushed out of the rear of the fuse box when the fuse is refitted.

MAIN CIRCUIT DIAGRAMS

NOTE:- Right and left hand drive non-catalyst wiring diagrams cover the full Range Rover model range, therefore it will be noted that references are made to Diesel Components on both circuit diagrams, these references should be ignored when using the diagrams for Vogue SE models.

MAIN CIRCUIT DIAGRAM
Right Hand Steering - RR2378M & RR2379M

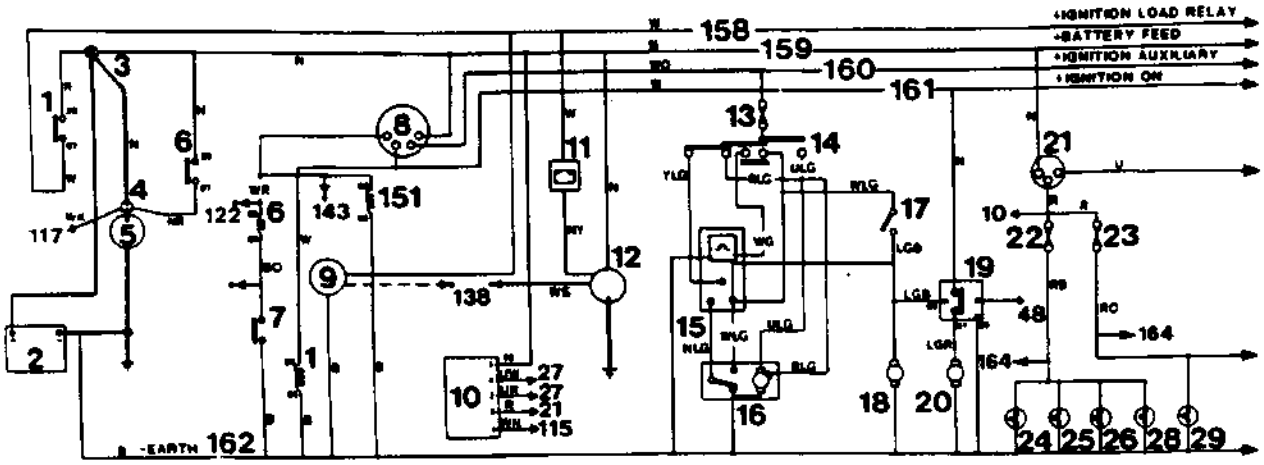
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (Automatic)
8. Ignition switch
9. Tachometer
10. Voltage transformer(dim dip)
11. Ignition warning lamp
12. Alternator
13. Fuse 7
14. Front wipe/wash switch
15. Front wipe delay unit
16. Front wiper motor
17. Front wash switch
18. Front wash pump
19. Headlamp wash timer unit (option)
20. Headlamp wash pump (option)
21. Main lighting switch
22. Fuse 6
23. Fuse 5
24. LH side lamp
25. LH tail lamp
26. Number plate lamp(2 off)
27. Main beam dip/flash switch
28. Radio illumination
29. RH side lamp
30. RH tail lamp
31. Rheostat
32. Fuse 3
33. Fuse 4
34. Fuse 1
35. Fuse 2
36. Rear fog switch
37. Fuse 12
38. Switch illumination (2 off)
39. Cigar lighter illumination (2 off)
40. Heater illumination (4 off)
41. Clock illumination
42. Automatic gear selector illumination (2 off)
43. Instrument illumination (6 off)
44. Rear fog warning lamp
45. LH rear fog
46. RH rear fog
47. LH dip beam
48. RH dip beam
49. LH main beam
50. RH main beam
51. Main beam warning lamp
52. Fuel gauge
53. Fuel gauge sender unit
54. Water temperature gauge
55. Water temperature sender unit
56. Fuse 11
57. Horn switch
58. RH horn
59. LH horn
60. Under bonnet illumination switch
61. Under bonnet light
62. Clock
63. Fuse 19
64. Fuse 20
65. Pick-up point central locking/window lift (option)
65 (a) Window lift relay (option)
66. Heated rear window relay
67. Fuse 9
68. Radio aerial amplifier
69. Heated rear screen
70. Heated rear screen switch
71. Heated rear screen warning lamp
72. Voltage sensitive switch
73. Fuse 13
74. Hazard switch
75. Flasher unit
76. Direction indicator switch
77. Hazard/indicator warning lamp
78. LH rear indicator lamp
79. LH front indicator lamp
80. LH side repeater lamp
81. RH side repeater lamp
82. RH front indicator lamp
83. RH rear indicator lamp
84. Trailer warning lamp
85. Fuse 15
86. Stop lamp switch
87. Reverse lamp switch
88. Auxiliary lamp relay (option)
89. LH stop lamp
90. RH stop lamp
91. LH reverse lamp
92. RH reverse lamp
93. LH auxiliary lamp (option)
94. RH auxiliary lamp (option)
95. Auxiliary lamp switch (option)
96. Fuse 17
97. Dash cigar lighter
98. Cubby box cigar lighter
99. LH interior lamp
100. RH interior lamp
101. Interior lamp delay unit
102. LH door edge lamp
103. RH door edge lamp
104. LH puddle lamp
105. RH puddle lamp
106. Interior lamp switch
107. LH rear door switch
108. RH rear door switch
109. Tailgate switch
110. LH front door switch
111. RH front door switch
112. Differential lock warning lamp
113. Differential lock switch
114. Oil pressure warning lamp
115. Oil pressure switch
116. Fuse 18
117. Fuel cut off relay (carburetter models)
118. Fuel pump(petrol models)
119. Ignition coil
120. Capacitor
121. Distributor
122. EFI Harness plug
123. Fuel shut off solenoid (Diesel)
124. Radio choke
125. Radio fuse
126. Radio and four speakers
127. Sun roof (option) pick up points
128. Automatic transmission oil temperature warning lamp
129. Automatic transmission oil temperature switch
130. Fuse 16
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Multi-function unit in binnacle
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. Cold start/diesel glow plug warning lamp
142. Cold start switch - carburetter
143. Glow plug timer (diesel)
144. Glow plugs (diesel)
145. Handbrake warning lamp
146. Brake fail warning lamp
147. Handbrake warning switch
148. Brake fail warning switch
149. Brake pad wear warning lamp
150. Brake pad wear sensors
151. Brake check relay
152. Split charge relay (option)
153. Split charge terminal post (option)
154. Heater/air conditioning connections
155. Fuse 8
156. Coil negative (engine RPM input to ECU.)
157. Headlamp relay
158. Ignition load relay (+)
159. Battery feed (+)
160. Ignition auxiliary (+)
161. Ignition on (+)
162. Earth (-)
163. Fuse 14
164. Trailer pick up point
165. Electric seats pick up point (option)
165 (a) Electric seats relay (option)
166. Fuse 10
167. Electric mirrors pick up point (option)

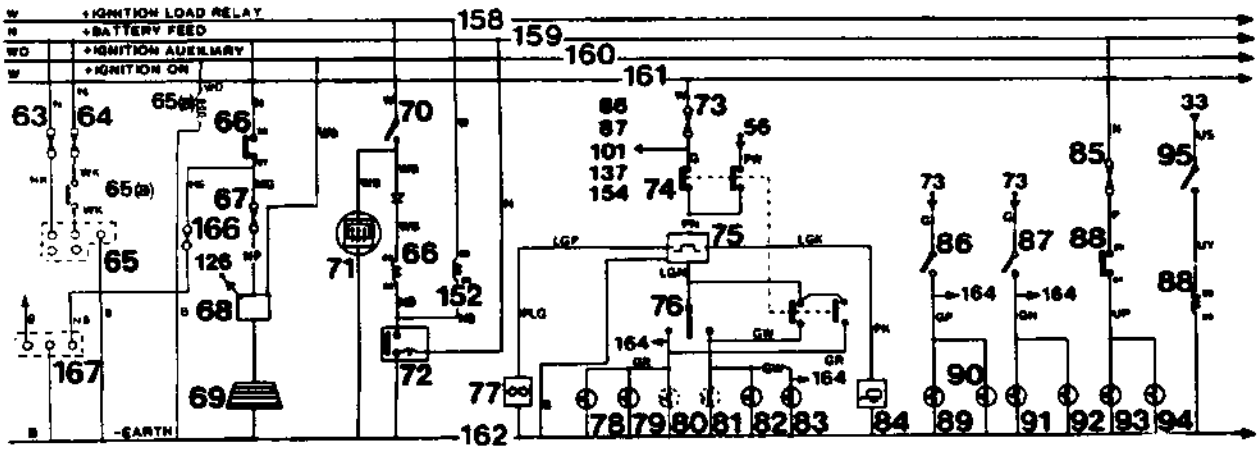
CABLE COLOUR CODE

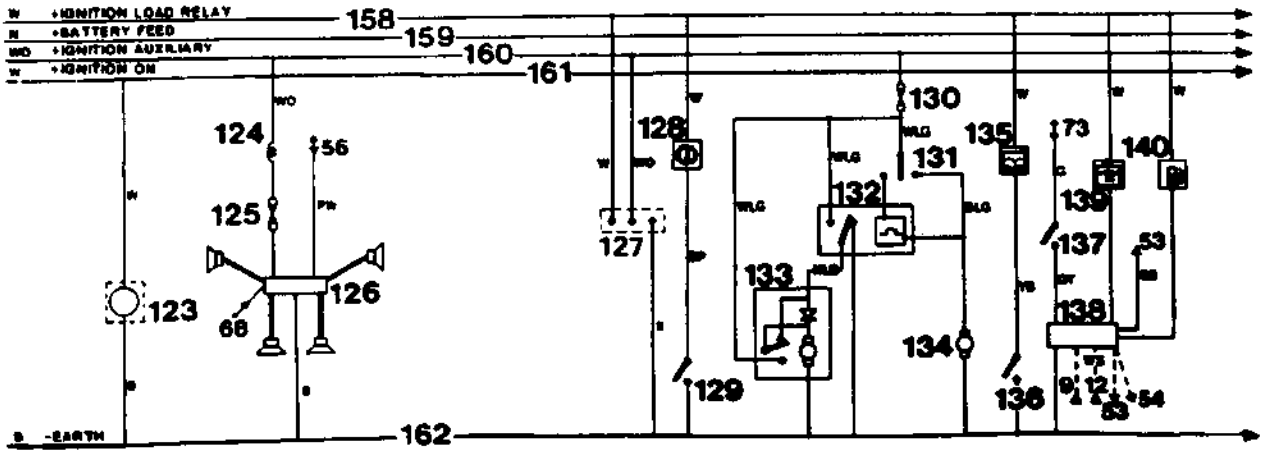
B	Black	**N**	Brown	**R**	Red	**W**	White
G	Green	**O**	Orange	**S**	Grey	**Y**	Yellow
K	Pink	**P**	Purple	**U**	Blue		

The last letter of a colour code denotes the tracer.

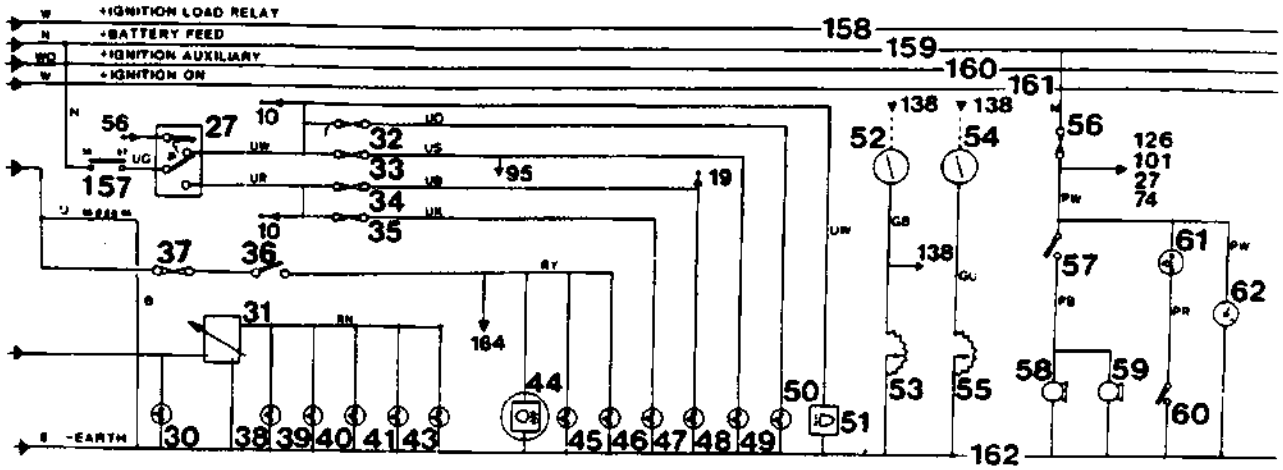
MAIN CIRCUIT DIAGRAM
Right hand steering - RR2378M & RR2379M

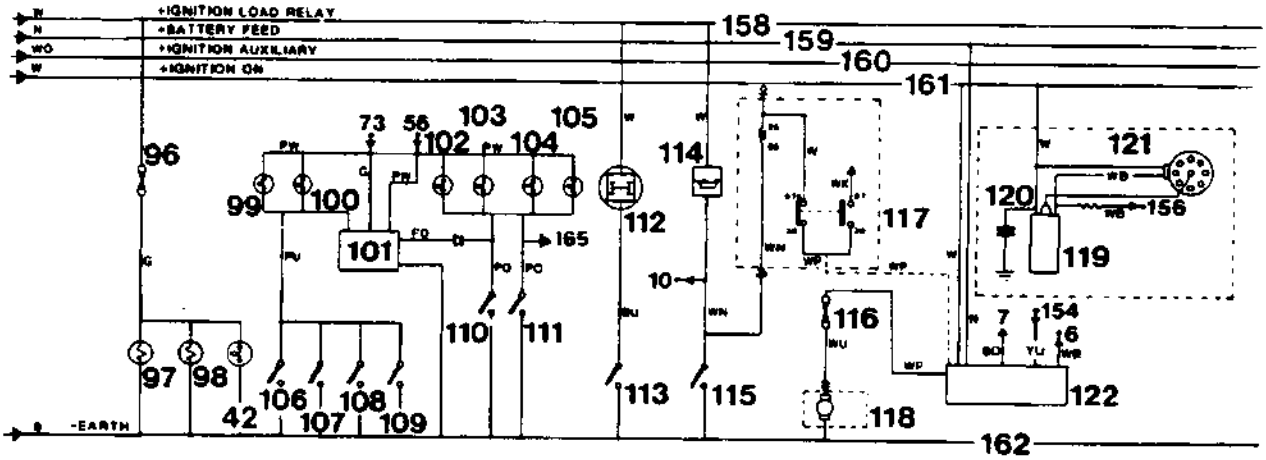


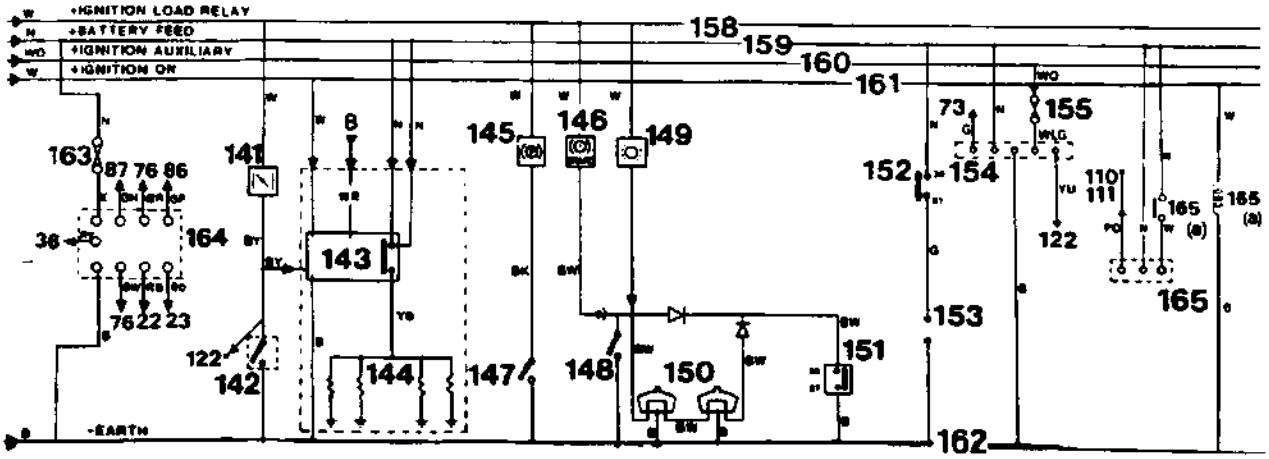




RR2378M


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
158
159
160
161
162


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
158
159
160
161
162


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
158
159
160
161
162

RR2379M

MAIN CIRCUIT DIAGRAM - NON CATALYST VEHICLES
Left-hand Steering - RR2380M & RR2381M

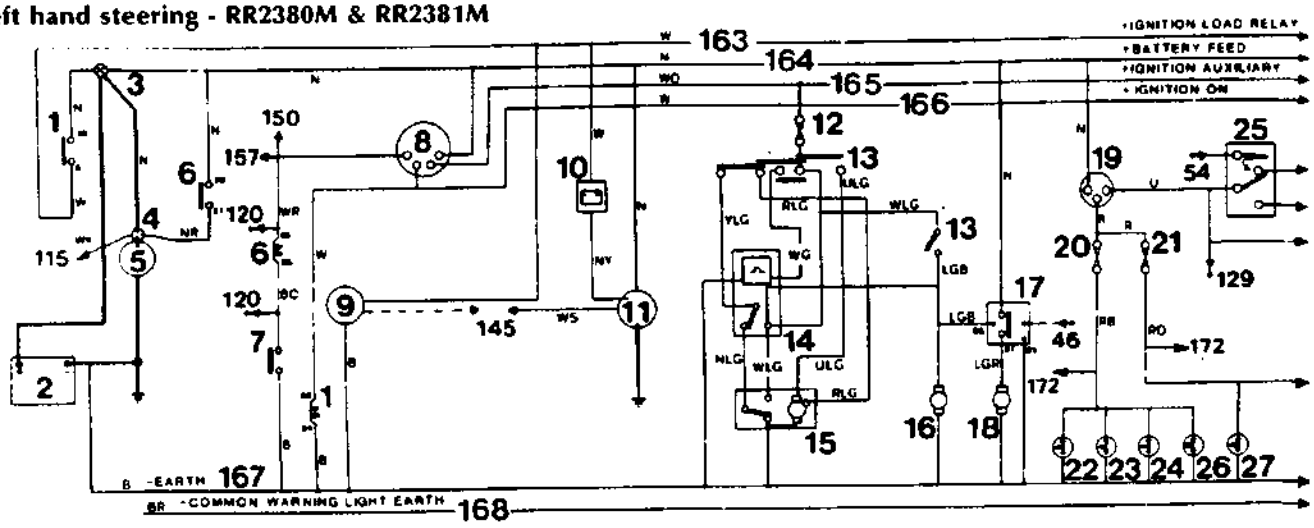
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (automatic)
8. Ignition switch
9 Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse 7
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Front wash pump
17. Headlamp wash timer unit (option)
18. Headlamp wash pump (option)
19. Main lighting switch
20. Fuse 6
21. Fuse 5
22. LH side lamp
23 LH tail lamp
24. Number plate lamp (2 off)
25. Main beam dip/flash switch
26. Radio illumination
27. RH side lamp
28 RH tail lamp
29. Rheostat
30. Fuse 3
31. Fuse 4
32. Fuse 1
33. Fuse 2
34. Rear fog switch
35. Fuse 12
36. Switch illumination (2 off)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Automatic gear selector illumination (2 off)
41. Instrument illumination (6 off)
42. Rear fog warning lamp
43. LH rear fog
44. RH rear fog
45. LH dip beam
46. RH dip beam
47. LH main beam
48. RH main beam
49. Main beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53 Water temperature sender unit
54 Fuse 11
55 Horn switch
56. RH horn
57 LH horn
58. Under bonnet illumination switch
59. Under bonnet light
60. Clock
61. Fuse 19
62. Fuse 20
63 Pick-up point central locking/window lift
63 (a). Window lift relay (option)
64. Heated rear window relay
65. Fuse 9
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse 13
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. Hazard/indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. LH side repeater lamp
79. RH side repeater lamp
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse 15
84. Stop lamp switch
85. Reverse lamp switch
86. Auxiliary lamp relay
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH auxiliary lamp (option)
92. RH auxiliary lamp (option)
93. Auxiliary lamp switch (option)
94. Fuse 17
95. Dash cigar lighter
96. Cubby box cigar lighter
97. LH interior lamp
98. RH interior lamp
99 Interior lamp delay unit
100 LH door edge lamp
101. RH door edge lamp
102. LH puddle lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107 Tailgate switch
108. LH front door switch
109. RH front door switch
110. Differential lock warning lamp
111. Differential lock switch
112. Oil pressure warning lamp
113. Oil pressure switch
114. Fuse 18
115 Fuel shut-off relay - carburetter
116. Fuel pump - petrol models
117. Ignition coil
118. Capacitor
119. Distributor
120. EFI Harness plug
121. Fuel shut-off solenoid-Diesel
122. Radio choke
123. Radio fuse
124. Radio
125. Four speakers
126. Seat belt warning lamp
127. Speed transducer, Saudi only
128. Resistor
129. Audible warning unit
130. Transfer box neutral switch
131. Seat buckle switch
132. Overspeed monitor (Saudi only)
133 Overspeed buzzer (Saudi only)
134. Sun roof pick up point (option)
135. Automatic transmission oil temperature warning lamp
136. Automatic transmission oil temperature switch
137. Fuse 16
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
141. Rear screen wash pump
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
144. Low coolant switch
145. Multi-function unit in binnacle
146. Low coolant level warning lamp
147. Low fuel level warning lamp
148. Cold start/Diesel glow plug warning lamp
149. Choke switch - carburetter
150. Glowplug timer/Diesel
151. Glowplugs/Diesel
152. Handbrake/warning lamp
153. Handbrake warning switch
154. Brake fail warning lamp
154 (a). Brake fail warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157. Brake check unit
158. Split charge relay (option)
159. Split charge terminal post
160. Heater/air conditioning connections
161. Fuse 8
162. Coil negative (engine RPM input to ECU)
163. Ignition load relay (+)
164. Battery feed (+)
165. Ignition auxiliary (+)
166. Ignition on (+)
167. Earth (-)
168. Warning lights common earth (-)
169. Warning lights supply (+)
170. Electric seats pick up point (option)
170 (a) Electric seats relay (option)
171. Fuse 14
172. Trailer pick up point
173. Fuse 10
174 Electric mirrors pick up point (option)

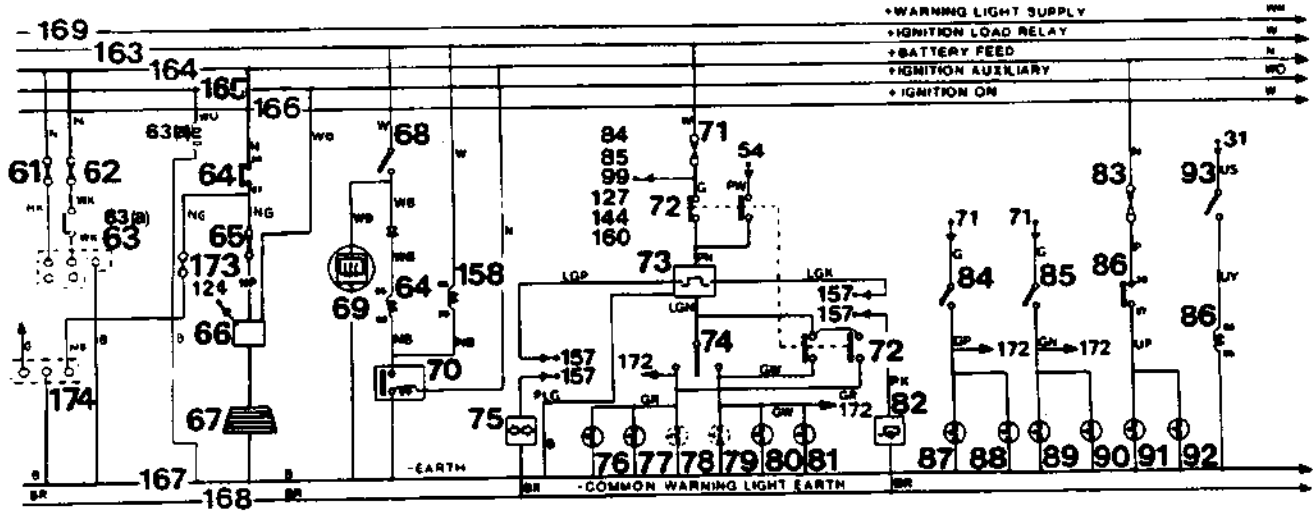
CABLE COLOUR CODE

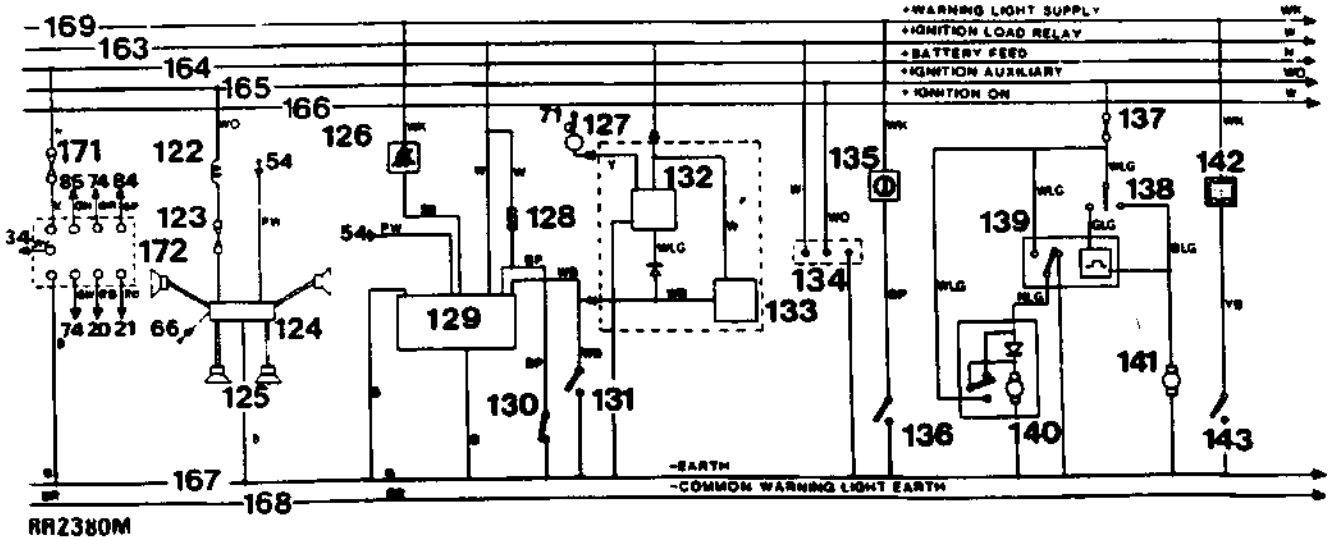
B	Black	**N**	Brown	**R**	Red	**W**	White
G	Green	**O**	Orange	**S**	Grey	**Y**	Yellow
K	Pink	**P**	Purple	**U**	Blue		

The last letter of a colour code denotes the tracer.

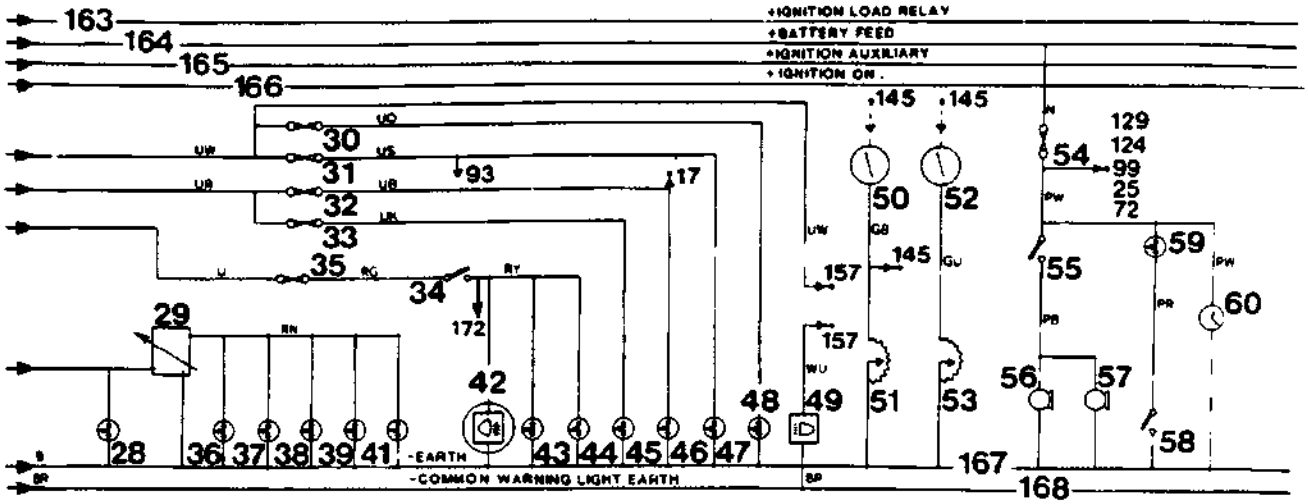
MAIN CIRCUIT DIAGRAM - NON CATALYST
Left hand steering - RR2380M & RR2381M

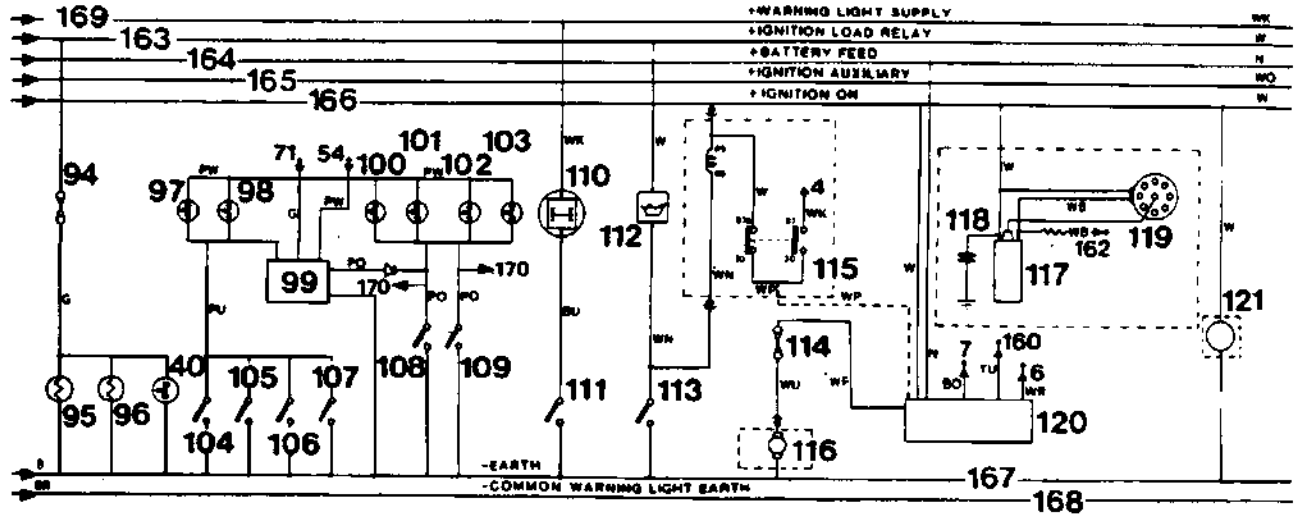


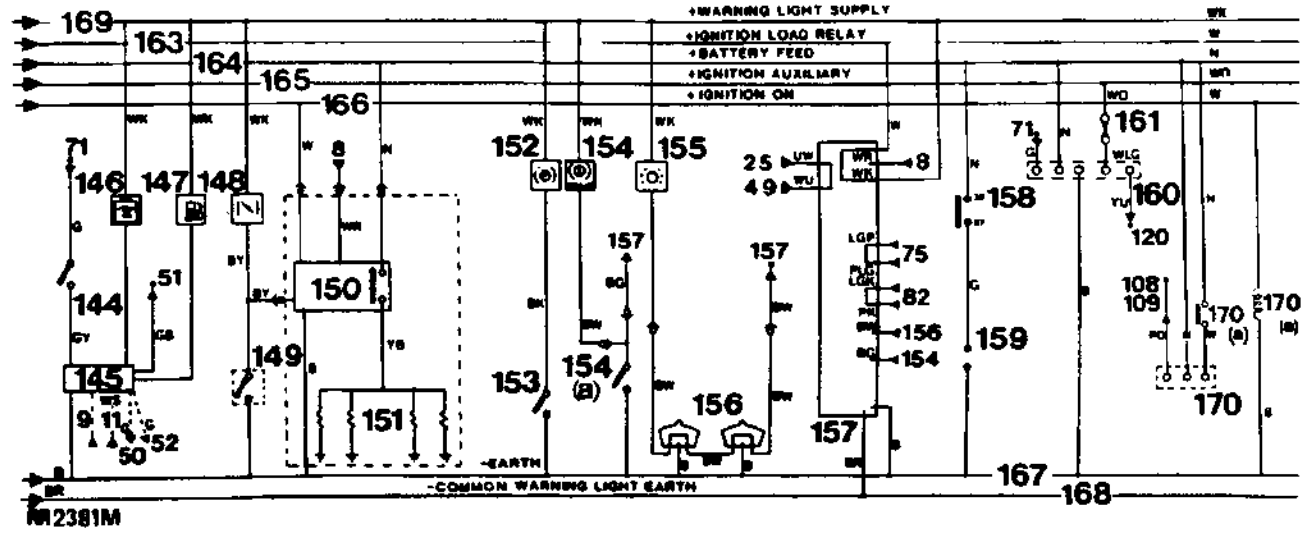




RR2380M


163
164
165
166
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
167
168


169
163
164
165
166
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
167
168


169
163
164
165
166
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
-COMMON WARNING LIGHT EARTH
167
168
M2381M

MAIN CIRCUIT DIAGRAM - CATALYST VEHICLES
Left hand steering - RR2382S and RR2383S

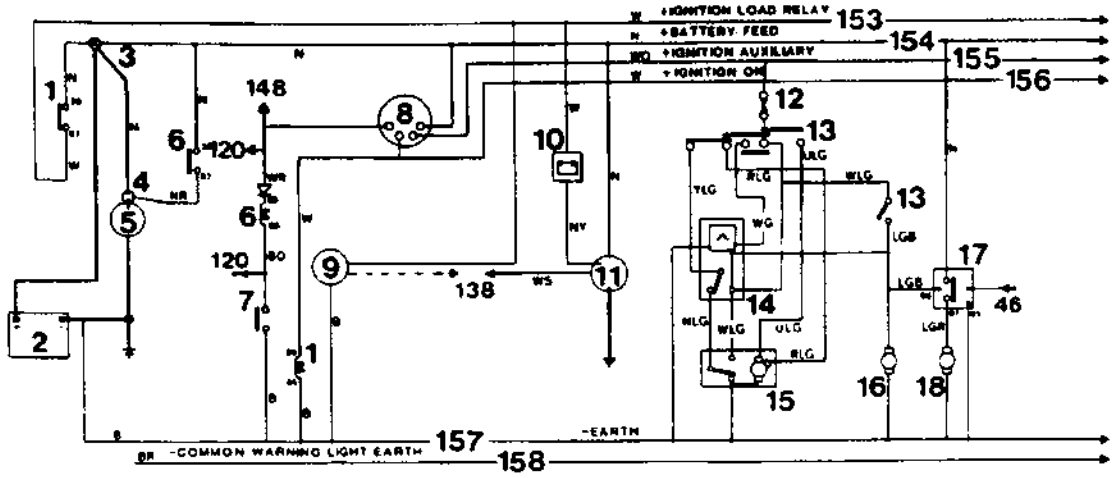
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (automatic)
8. Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse 7
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Front wash pump
17. Headlamp wash timer unit (option)
18. Headlamp wash pump (option)
19. Main lighting switch
20. Fuse 6
21. Fuse 5
22. LH side lamp
23. LH tail lamp
24. Number plate lamp (2 off)
25. Main beam dip/flash switch
26. Radio illumination
27. RH side lamp
28. RH tail lamp
29. Rheostat
30. Fuse 3
31. Fuse 4
32. Fuse 1
33. Fuse 2
34. Rear fog switch
35. Fuse 12
36. Switch illumination (2 off)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Automatic gear selector illumination (2 off)
41. Instrument illumination (6 off)
42. Rear fog warning lamp
43. LH rear fog
44. RH rear fog
45. LH dip beam
46. RH dip beam
47. LH main beam
48. RH main beam
49. Main beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53. Water temperature sender unit
54. Fuse 11
55. Horn switch
56. RH horn
57. LH horn
58. Under bonnet illumination switch
59. Under bonnet light
60. Clock
61. Fuse 19
62. Fuse 20
63. Pick-up point central locking/window lift
63 (a). Window lift relay
64. Heated rear window relay
65. Fuse 9
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse 13
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. Hazard/indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. LH side repeater lamp
79. RH side repeater lamp
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse 15
84. Stop lamp switch
85. Reverse lamp switch
86. Auxiliary lamp relay
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH auxiliary lamp
92. RH auxiliary lamp
93. Auxiliary lamp switch
94. Fuse 17
95. Dash cigar lighter
96. Cubby box cigar lighter
97. LH interior lamp
98. RH interior lamp
99. Interior lamp delay unit
100. LH door edge lamp
101. RH door edge lamp
102. LH puddle lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110. Differential lock warning lamp
111. Differential lock switch
112. Oil pressure warning lamp
113. Oil pressure switch
114. Fuse 18
115. Speed transducer
116. Fuel pump
117. Ignition coil
118. Capacitor
119. Distributor
120. EFI Harness plug
121. Coil negative (engine RPM input to ECU)
122. Radio choke
123. Radio fuse
124. Radio
125. Four speakers
126. Electric seats pick up point (option)
126 (a). Electric seat relay (option)
127. Sunroof connection point (option)
128. Automatic transmission oil temperature warning lamp
129. Automatic transmission oil temperature switch
130. Fuse 16
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Multi-function unit in binnacle
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. E.F.I. warning lamp
142. Handbrake warning lamp
143. Handbrake warning switch
144. Brake fluid level warning switch
145. Brake fluid level warning lamp
146. Brake pad wear warning lamp
147. Brake pad wear sensors
148. Brake check unit
149. Split charge relay (option)
150. Split charge terminal post (option)
151. Heater/air conditioning connections
152. Fuse 8
153. Ignition load relay (+)
154. Battery feed (+)
155. Ignition auxiliary (+)
156. Ignition on (+)
157. Earth (-)
158. Warning lights common earth (-)
159. Warning lights supply (+)
160. Fuse 14
161. Trailer pick up point
162. Fuse 10
163. Electric mirrors pick up point (option)

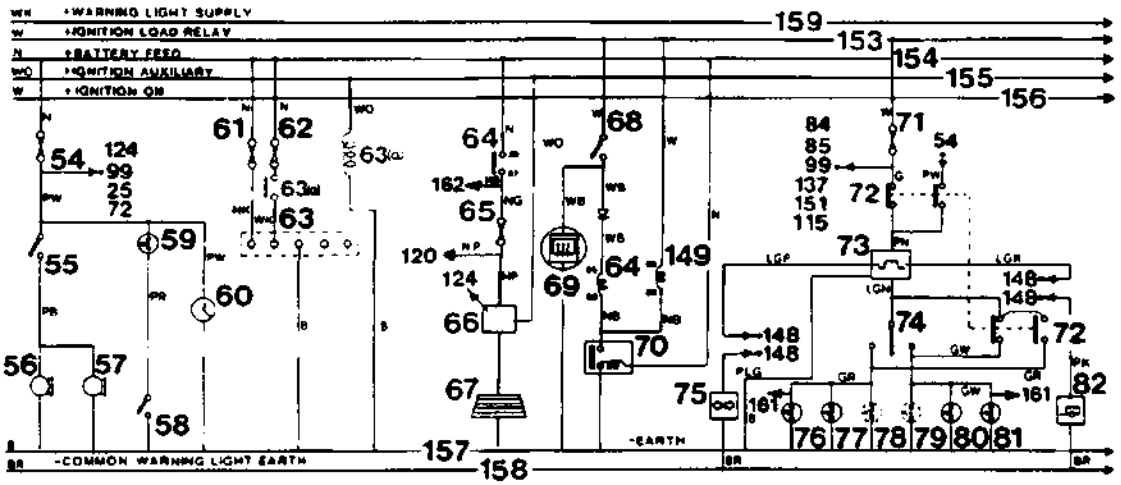
CABLE COLOUR CODE

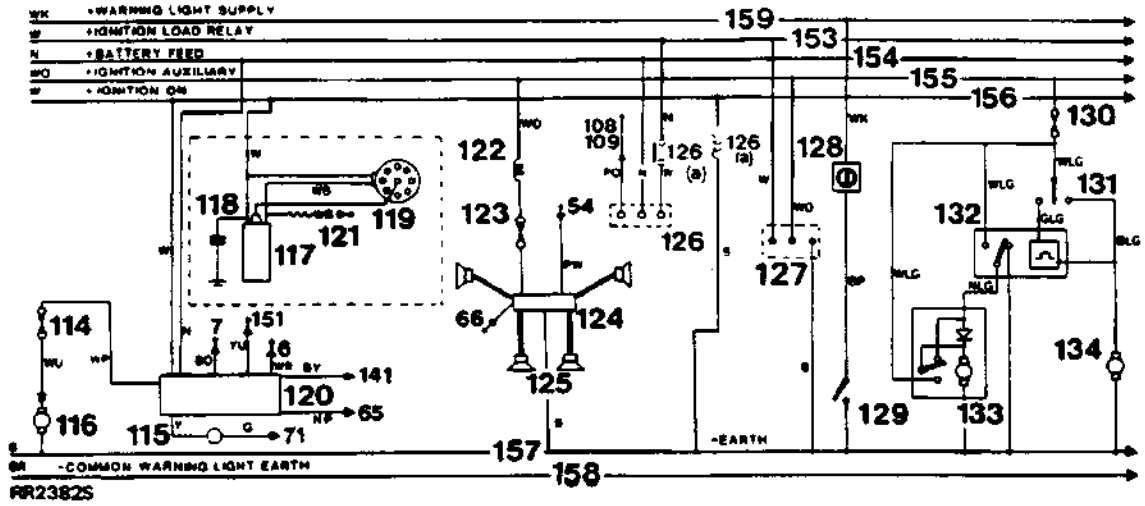
B	Black	**N**	Brown	**R**	Red	**W**	White
G	Green	**O**	Orange	**S**	Grey	**Y**	Yellow
K	Pink	**P**	Purple	**U**	Blue		

The last letter of a colour code denotes the tracer.

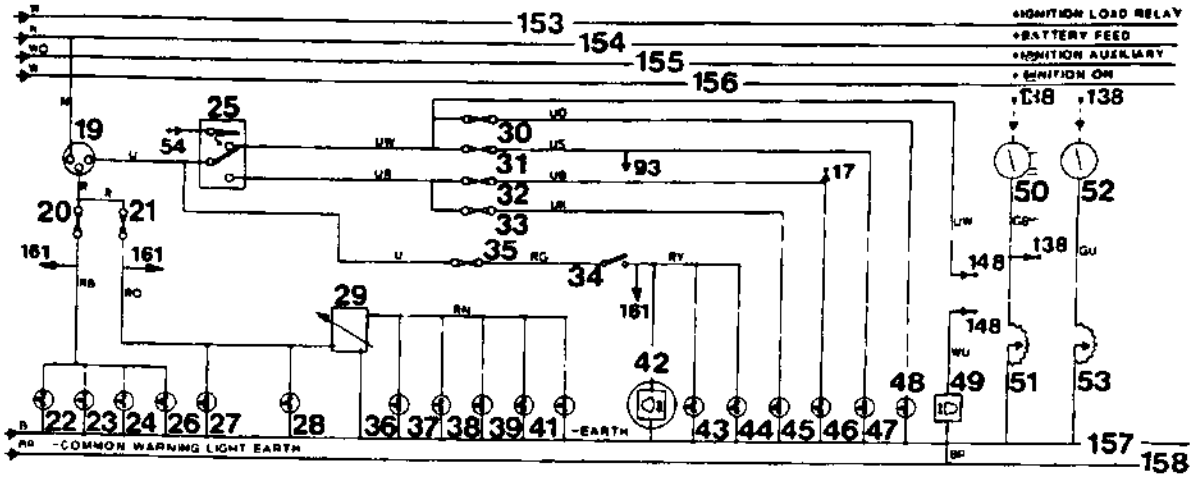
MAIN CIRCUIT DIAGRAM - CATALYST VEHICLES
Left hand steering - RR2382S & RR2383S

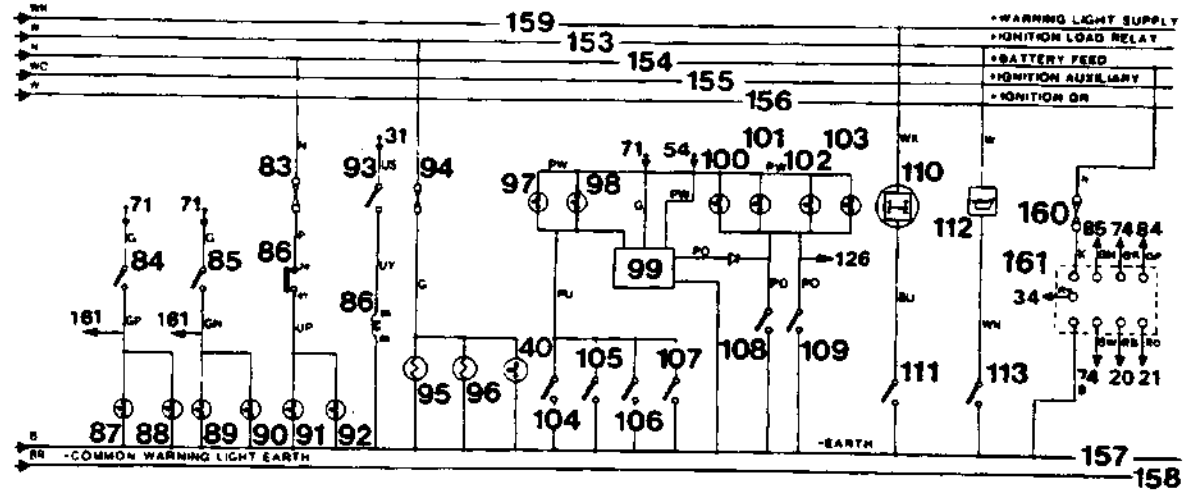


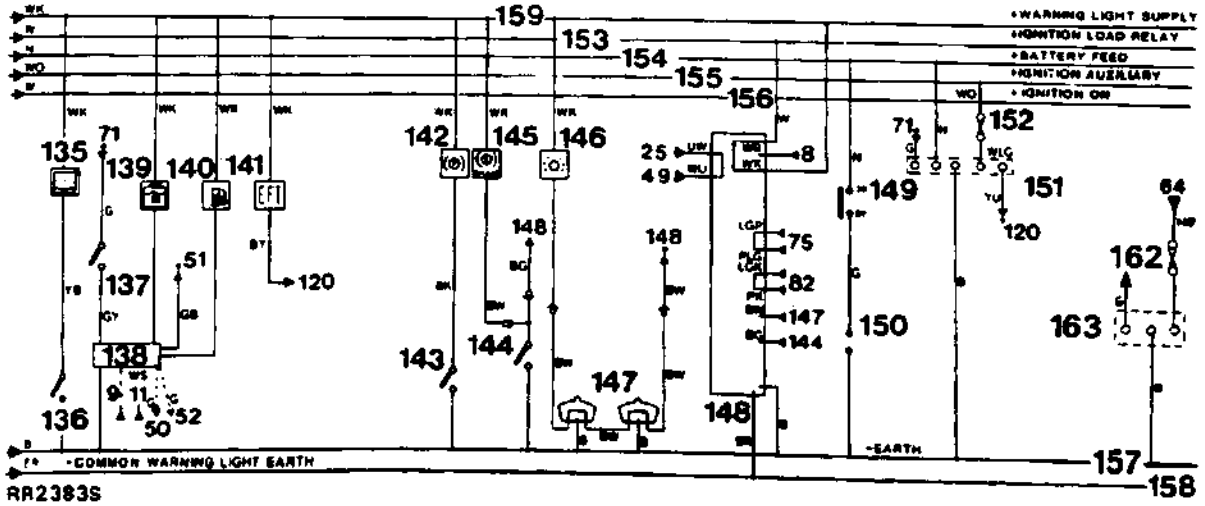




RR2382S


153
154
155
156
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-COMMON WARNING LIGHT EARTH
-EARTH
157
158


159
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156
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-COMMON WARNING LIGHT EARTH
-EARTH
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158


159
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156
+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-COMMON WARNING LIGHT EARTH
-EARTH
157
158

RR2383S

1989 Model Year Supplement

RANGE ROVER

1989 MODEL YEAR

WORKSHOP MANUAL SUPPLEMENT

Publication number LSM 180 WS3

Published by the
Technical Publications Department of

Land Rover Ltd

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INTRODUCTION - 1989 MODEL YEAR

A number of model improvements are introduced on all Range Rover models for the 1989 Model Year.

Specifications for individual vehicles may vary, but all will include some of the new features and options summarised below.

- Borg Warner transfer gearbox incorporating viscous coupling
- Revised LT77 five speed manual gearbox
- Revised handbrake linkage
- Rear asymmetric seat locking mechanism
- Interior door trim panels
- Central locking on upper tailgate
- Revised heater distribution and controls
- Single touch electric window lift (Drivers door only)
- Heated screen washer jets
- Variable delay windscreen wipers
- Ignition override of headlamps

Service and repair information is included in this supplement, which should be used in conjuction with the main Range Rover Workshop Manual.

This Workshop Manual Supplement is designed to assist skilled technicians in the efficient repair and maintenance of Range Rover vehicles.

Individuals who undertake their own repairs should have some skill and training, and limit repairs to components which could not affect the safety of the vehicle or its passengers. Any repairs required to safety critical items such as steering, brakes, or suspension should be carried out by a Range Rover Dealer. Repairs to such items should NEVER be attempted by untrained individuals.

Continued

ENGINE OIL HANDLING PRECAUTIONS

Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities should be provided.

WARNING:

1. Avoid prolonged and repeated contact with oils, particularly used engine oils.
2. Wear protective clothing, including impervious gloves where practicable.
3. Do not put oily rags in pockets.
4. Avoid contaminating clothes, particularly underwear, with oil.
5. Overalls must be cleaned regularly. Discard unwashable clothing and oil impregnated footwear.
6. First aid treatment must be obtained immediately for open cuts and wounds.
7. Use barrier creams, before each work period, to help the removal of oil from the skin.
8. Wash with soap and water to ensure all oil is removed (skin cleansers and nail brushes will help). Preparations containing lanolin replace the natural skin oils which have been removed.
9. Do not use petrol, kerosene, diesel fuel, gas oil, thinners or solvents for washing the skin.
10. If skin disorders develop, obtain medical advice as soon as possible.
11. Where practicable, degrease components prior to handling.
12. Where there is a risk of eye contact, eye protection must always be worn, for example, goggles or face shields; in addition an eye wash facility should be provided.

DISPOSING OF USED OILS

Enviromental protection precautions

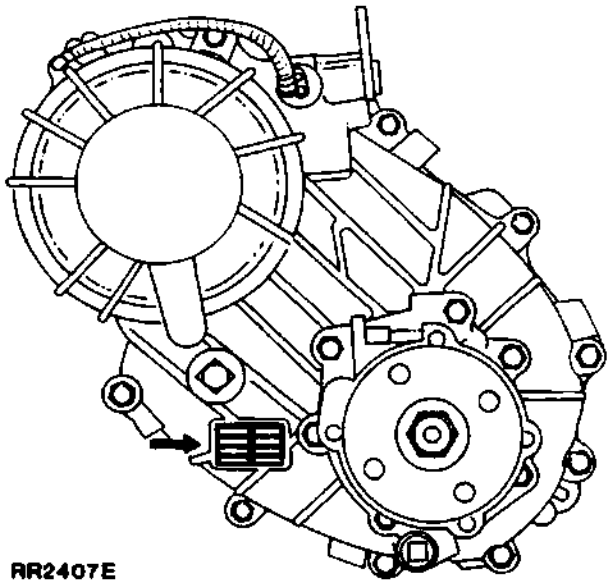
It is illegal to pour used oil on to the ground, down sewers or drains, or into water courses.

The burning of used engine oil in small space heaters or boilers is not recommended unless emission control equipment is fitted.

Dispose of used oil through authorised waste disposal contractors to licensed waste disposal sites, or to the waste oil reclamation trade. If in doubt, contact the Local Authority for advice on disposal facilities.

TRANSFER GEARBOX - BORG WARNER
- 1989 MODEL YEAR

The gearbox serial number is stamped on a plate which is attached to the gearbox casing and is located between the filler/level and drain plugs adjacent to the rear output housing.



RR2407E

TRANSMISSION

Borg Warner transfer gearbox

Type ..... Two speed reduction on main gearbox output, front and rear drive permanently engaged via a centre differential controlled by a Viscous unit giving a 50/50 nominal front and rear torque split.

Transfer gearbox ratios

High	1.206:1
Low	3.244:1

Automatic gearbox ratios

4th	0.728:1
3rd	1.000:1
2nd	1.480:1
1st	2.480:1
Reverse	2.086:1

Overall ratios (final drive):	High transfer	Low transfer
4th	3.11:1	8.36:1
3rd	4.27:1	11.48:1
2nd	6.32:1	17.00:1
1st	10.59:1	28.50:1
Reverse	8.91:1	23.96:1

Manual gearbox LT77 ratios

5th	0.770:1
4th	1.000:1
3rd	1.397:1
2nd	2.132:1
1st	3.321:1
Reverse	3.429:1
Diesel models - low 1st gear	3.692:1

Overall ratios (final drive):	High transfer	Low transfer
5th	3.29:1	8.84:1
4th	4.27:1	11.48:1
3rd	5.97:1	16.04:1
2nd	9.10:1	24.48:1
1st	14.18:1	38.14:1
Reverse	14.64:1	39.38:1
Diesel models - low 1st gear	15.76:1	42.40:1

SHIFT SPEED SPECIFICATION
Automatic ZF4HP22 Gearbox

OPERATION	SELECTOR POSITON	VEHICLE SPEED APPROX		ENGINE SPEED APPROX (RPM)
		KICKDOWN		
		MPH	**KPH**	
KD4 - 3	D	79 - 96	127 - 155	
KD3 - 2	3(D)	57 - 62	91 - 99	
KD2 - 1	2(D,3)	27 - 34	44 - 56	
KD3 - 4	D	N/A	N/A	
KD2 - 3	D(3)	60 - 63	96 - 104	4750 - 5200
KD1 - 2	D(3,2)	34 - 40	56 - 64	4600 - 5250
		FULL THROTTLE		
FT4 - 3	D	61 - 67	98 - 108	
FT3 - 2	3(D)	40 - 46	64 - 73	
FT3 - 4	D	74 - 80	119 - 129	3980 - 4330
FT2 - 3	D(3)	55 - 60	88 - 96	4350 - 4800
FT1 - 2	D(3,2)	29 - 34	48 - 56	3950 - 4650
		PART THROTTLE		
PT4 - 3	D	47 - 54	75 - 86	
PT3 - 2	D(3)	29 - 37	48 - 59	
PT2 - 1	D(3,2)	10 - 12	16 - 19	
		LIGHT THROTTLE		
LT3 - 4	D	26 - 30	43 - 49	1430 - 1650
LT2 - 3	D(3)	18 - 22	29 - 35	1420 - 1820
LT1 - 2	D(3,2)	9 - 10	14 - 16	1180 - 1220
		ZERO THROTTLE		
ZT4 - 3	D	19 - 25	31 - 41	
ZT3 - 2	D(3)	12 - 15	19 - 24	
ZT2 - 1	D(3,2)	6 - 7	10 - 11	
		TORQUE CONVERTER		
Lock up (IN)	D	51 - 54	81 - 86	1875 - 2000
Unlock (OUT)	D	49 - 52	78 - 83	1825 - 1930

NOTE: The speeds given in the above chart are approximate and only intended as a guide. Maximum shift changes should take place within these tolerance parameters.

BORG WARNER TRANSFER GEARBOX	Nm	lb ft	lb in
Brake drum back plate to rear output housing	65 - 80	48 - 59	-
Brake drum to drive flange	22 - 28	16 - 21	-
Centre differential (front to rear)	55 - 64	40 - 47	-
Drive flanges to transfer gearbox	203 - 244	150 - 180	-
Driven gear to centre differential	41 - 61	30 - 45	-
Front cover to rear cover - main case	30 - 49	22 - 36	-
Front output housing to main case	24 - 41	18 - 30	-
Gearbox mounting brackets to chassis	40 - 50	29 - 37	-
Mounting bracket to gearbox	92 - 112	68 - 83	-
Neutral warning switch	34 - 47	25 - 35	-
Oil drain plug	19 - 30	14 - 22	-
Oil filler/level plug	19 - 30	14 - 22	-
Oil pump fixings	4 - 8.5	- -	35 - 75
Propeller shafts to drive flanges	41 - 52	30 - 38	-
Rear output housing to main case	30 - 49	22 - 36	-
Selector lever shaft - Torx screw	7 - 9	5 - 7	60 - 84
Selector fork operating arm - Torx screw	7 - 9	5 - 7	60 - 84

LT77 MAIN GEARBOX (FIVE - SPEED)	Nm	lb ft.
Bottom cover to clutch housing	7 - 10	5 - 7
Oil pump body to extension case	7 - 10	5 - 7
Clip to clutch release lever	7 - 10	5 - 7
Attachment plate to gearcase	7 - 10	5 - 7
Extension case to gearcase	22 - 28	16 - 21
Pivot - clutch lever to bell housing	22 - 28	16 - 21
Guide clutch release sleeve	22 - 28	16 - 21
Slave cylinder to clutch housing	22 - 28	16 - 21
Front cover to gearcase	22 - 28	16 - 21
5th support bracket	22 - 28	16 - 21
Clutch housing to gearbox	65 - 80	48 - 59
Oil drain plug	40 - 47	30 - 35
Oil filter plug	65 - 80	48 - 59
Breather	14 - 16	10 - 12
Oil level plug	25 - 35	19 - 26
Upper gear lever to lower gear lever	22 - 28	16 - 21
Upper gear lever to lower gear lever - pinch bolt	22 - 28	16 - 21
5th layshaft gear retaining nut	204 - 231	150 - 170
Attachment plate to gear change housing	7 - 10	5 - 7
Gear change housing to extension case	22 - 28	16 - 21
Plunger housing to gear change housing	22 - 28	16 - 21
Adjustment plate to gear change housing	22 - 28	16 - 21
Cover to gear change housing	7 - 10	5 - 7
Bell housing to cylinder block bolts	36 - 45	27 - 33
Yoke to selector shaft	22 - 28	16 - 21

SEAT BELT FIXINGS	Nm	lb ft
Front and rear seat belt fixings (all)	20.3	15

Recommended Lubricants and fluids - 1989 Model year

Use only the recommended grades of oil set out below.

These recommendations apply to climates where operational temperatures are above - 10°C (14°F)

COMPONENTS	BP	CASTROL	DUCKHAM	ESSO	MOBIL	PETROFINA	SHELL	TEXACO
Petrol engine sump Carburetter Dashpots Oil can	BP Visco 2000 (15W/40) or BP Visco Nova (10W/40)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube plus (15W/40)	Mobil Super (10W/40) or Mobil 1 Rally Formula	Fina Supergrade Motor Oil (15W/40) or (10W/40)	Shell Super Motor Oil (15W/40) or (10W/40)	Havoline Motor Oil (15W/40) or Eurotex HD (10W/30)
Diesel engine sump **	BP Vanellus C3 Extra (15W/40)	Castrol Turbomax (15W/40)	Duckhams Fleetmaster SHPD (15W/40)	Esso Super Diesel Oil TD (15W/40)	Mobil Delvac 1400 Super (15W/40)	Fina Kappa LDO (15W/40)	Shell Myrina (15W/40)	Texaco URSA Super TD (15W/40)
	The following list of oils to MIL - L - 2104D or CCMC D2 or API Service levels CD or SE/CD are for emergency use only if the above oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes.							
	BP Vanellus C3 Multigrade 15W/40)	Castrol Deusol RX Super (15W/40)	Duckhams Hypergrade (15W/50)	Esso Essolube XD - 3 plus (15W/40)	Mobil Delvac Super (15W/40)	Fina Dilano HPD (15W/40)	Shell Rimula X (15W/40)	Texaco URSA Super Plus (15W/40)
Automatic gearbox	BP Autran DX2D	Castrol TQ Dexron IID	Duckhams Fleetmatic CD or Duckhams D - Matic	Esso ATF Dexron IID	Mobil ATF 220D	Fina Dexron IID	Shell ATF Dexron IID	Texamatic Fluid 9226
Manual gearbox	BP Autran G	Castrol TQF	Duckhams Q - Matic	Esso ATF Type G	Mobil ATF 210	Fina Purfimatic 33G	Shell Donax TF	Texamatic Type G or Universal
Front and Rear differential Swivel pin housings and LT230 Transfer gear box	BP Gear Oil SAE 90EP	Castrol Hypoy SAE 90EP	Duckhams Hypoid 90	Esso Gear Oil GX (85W/90)	Mobil Mobilube HD90	Fina Pontonic MP SAE (80W/90)	Shell Spirax 90EP	Texaco Multigear Lubricant EP (85W/90)
Propeller shaft Front and Rear	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All Purpose Grease
Power steering box and fluid Reservoir Borg Warner Transfer Gearbox	BP Autran OX2D or BP Autran G	Castrol TQ Dexron IID or Castrol TQF	Duckhams Fleetmatic CD or Duckhams Q - matic	Esso ATF Dexron IID or Esso ATF Type G	Mobil ATF 220D or Mobil ATF 210	Fina Dexron IID or Fina purifimatic 33G	Shell ATF Dexron IID or Shell Donax TF	Texamatic Fluid 9226 or Texamatic Type G or 4291A Universal
Brake and clutch reservoirs	Brake fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT4							
Lubrication nipples (hubs, ball joints etc.)	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All Purpose Grease
Ball joint assembly Top Link	Dextragrease Super GP							
Seat slides Door lock striker	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All purpose grease
	NLGI - 2 Multi - purpose Lithium - based Grease							

** **Other approved oils include:** Agip Sigma Turbo, Aral OL P327, Autol Valve - SHP, Aviation Turbo, Caltex RPM Delo 450, Century SHPD, Chevron Delo 450 Multigrade, Divinol Multimax Extra, Ecubsol CD Plus, Elf Multiperformance, Esso Special Diesel, Fanal Indol X, Fuchs Titan Truck 1540, Gulf Superfleet Special, IP Taurus M, Total Rubia TIR, Valvoline Super HD LD.

RECOMMENDED LUBRICANTS AND FLUIDS - ALL CLIMATES AND CONDITIONS - 1989 Model year

COMPONENTS	SERVICE CLASSIFICATION		AMBIENT TEMPERATURE °C
	Specification	SAE Classification	- 30 - 20 - 10 0 10 20 30 40 50
Petrol models Engine sump Carburetter	Oils must meet BLS.22.OL.07 or	5W/30 5W/40) 5W/50)	
Dashpots Oil can	CCMC G3 or API service levels SF	10W/30 10W/40) 10W/50)	
	Oils must meet BLS.22.OL.02	15W/40) 15W/50)	
	or CCMC G1 or G2	20W/40) 20W/50)	
	or API service levels SE or SF	25W/40) 25W/50)	
Diesel models engine sump	SHPD oils meeting CCMC D3	10W/30 15W/40	
	* **Emergency only:** Oils meeting MIL - L - 2104D or CCMCD2 or API CD		
Main Gearbox Automatic	ATF Dexron IID		
Main Gearbox manual	ATF M2C33 (F or G)		
Transfer gearbox Final drive units Swivel pin housings	API GL4 or GL5 MIL - L - 2105 or MIL - L - 2105B	90 EP 80W EP	
Power steering Borg Warner Transfer Gearbox	ATF M2C 336 or ATF Dexron IID		

* Diesel Models - Engine Sump

Oils for emergency use only if the SHPD oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes. (See * * on previous page)

CAPACITIES

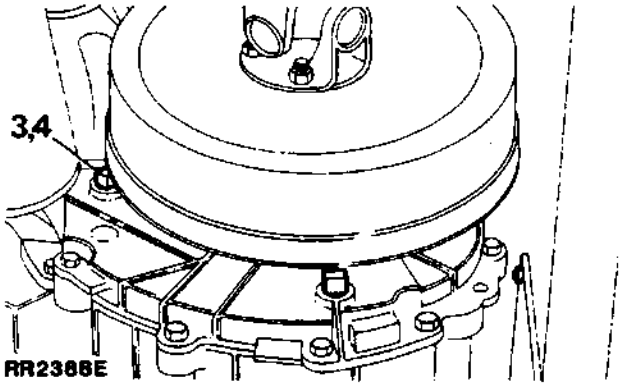
Transfer gearbox capacity - 2.1 Litres
- 3.7 UK Pints
- 4.4 US Pints

Check/top up transfer gearbox oil every - 6,000 miles (10,000 Km)
Renew transfer gearbox oil every - 24,000 miles (40,000 Km)

TOP UP TRANSFER GEARBOX OIL
- Borg Warner gearbox

NOTE: The existing maintenance intervals for the LT230 are also applicable to the Borg Warner transfer gearbox.

1. Before topping up the oil ensure that the vehicle is level, either on a hoist or on the ground.
2. Disconnect the battery negative terminal.
3. Clean the immediate area around the filler/level plug.
4. Remove the plug and fill the gearbox with the recommended grade of oil, until oil starts to seep from the filler/level hole.
5. Clean any previously applied sealant from the filler/level plug.
6. Apply Hylomar sealant to the threads of the plug and refit the plug. Tighten to the specified torque.



7. Wipe away any surplus oil.
8. Reconnect the battery.

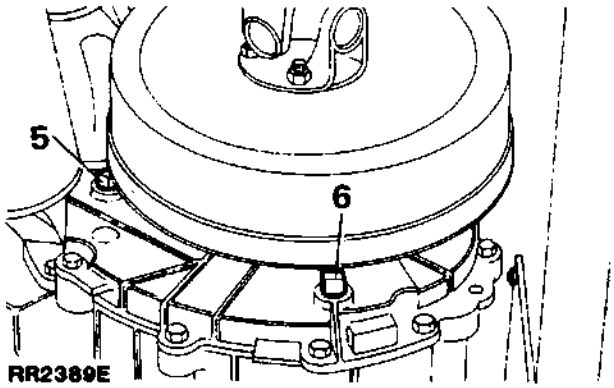
RENEW TRANSFER GEARBOX OIL
- Borg Warner gearbox

NOTE: The existing maintenance intervals for the LT230 are also applicable to the Borg Warner transfer gearbox.

1. Before renewing the oil ensure that the vehicle is level, either on a hoist or on the ground.
2. Disconnect the battery negative terminal.
3. Clean the immediate area around the filler/level and drain plugs.

   WARNING: When draining the gearbox care should be taken to ensure that the oil is not hot as personal scalding could result.

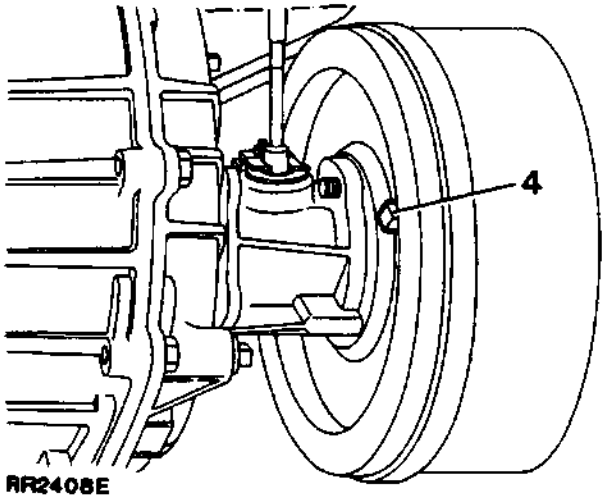
4. Place a container under the gearbox to drain the oil into.
5. Remove the filler/level plug to vent the gearbox and assist draining.
6. Remove the drain plug and allow the oil to drain.



7. Thoroughly clean the drain plug threads prior to applying fresh 'Hylomar' sealant. Fit and tighten the plug to the specified torque.
8. Fill the gearbox with the correct quantity and grade of oil until oil seeps from the filler level hole. Wipe away any surplus oil.
9. Thoroughly clean the filler/level plug threads prior to applying fresh 'Hylomar' sealant. Fit and tighten the plug to the specified torque.
10. Reconnect the battery.

ADJUST HANDBRAKE

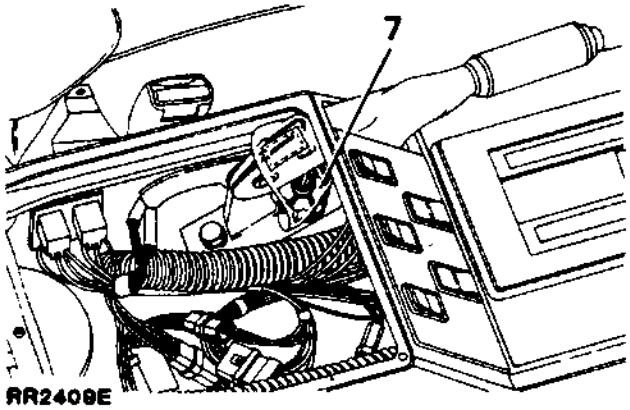
1. Set the vehicle on level ground and select 'P' in automatic gearbox or neutral in manual gearbox. Disconnect the battery negative terminal.
2. Chock the road wheels.
3. Fully release the handbrake lever.
4. From underneath the vehicle, rotate the adjuster on the brake drum back plate clockwise until the brake shoes are fully expanded against the brake drum.



RR2408E

5. Back off the adjuster until the drum is free to rotate.
6. Release the four screws and remove the glove box liner.
7. Rotate the adjustment thumbwheel below the handbrake lever until the handbrake is fully operational on the third notch of the ratchet.

   NOTE: The handbrake adjustment thumbwheel must only be used for initial setting and to compensate for cable stretch, it must not be used to take up brake shoe wear, which must continue to be adjusted at the brake drum.



RR2409E

8. Operate the handrake once or twice to settle the brake shoes, recheck that the handbrake is fully operational on the third notch of the ratchet. Readjust as necessary.
9. Refit the glove box liner.
10. Reconnect the battery and remove the wheel chocks.

ROLLING ROAD TESTING OF PERMANENT FOUR WHEEL DRIVE VEHICLES

NOTE: THIS INFORMATION APPLIES TO VEHICLES FITTED WITH BORG WARNER TRANSFER GEARBOX WITH VISCOUS COUPLING

These vehicles are identified by the absence of the diff-lock position on the transfer gearbox lever.

Viscous coupling

The front and rear axles cannot be driven independently due to the viscous coupling. This eliminates the need for the differential lock by progressively locking the centre differential automatically if any slip occurs at any wheel.

WARNING: DO NOT attempt to drive individual wheels with the vehicle supported on floor jacks or stands.

Four wheel rolling roads

Provided that the front and rear rollers are rotating at identical speeds and that normal workshop safety standards are applied, there is no speed restriction during testing except for any that may apply to the tyres.

Two wheel rolling roads

IMPORTANT: Use a four wheel rolling road for brake testing if possible.

If brake testing on a single axle rig is necessary it must be carried out with the propeller shaft to the rear axle removed, AND neutral selected in BOTH main gearbox and transfer gearbox. When checking brakes, run engine at idle speed to maintain servo vacuum.
If checking engine performance, the transfer box must be in high range and the propeller shaft to the stationary axle must be removed.

TOWING

Note the towing procedure for previous models applies to vehicles fitted with Borg Warner transfer gearbox. The main gearbox and transfer gearbox must be in neutral when the vehicle is being towed.

BORG WARNER TRANSFER GEARBOX

VISCOUS UNIT (Front output housing)
• In vehicle check

The viscous unit is located in the front output housing and its integrity can be checked while the unit is installed in the transfer gearbox as follows.

Remove either the front or rear propeller shaft from the vehicle to eliminate drive to one of the axles. If the viscous unit is operating effectively drive will be transfered to the axle that is still connected via the propeller shaft to the gearbox and the vehicle should remain driveable.

If the viscous unit has failed drive will not be transmitted to the axle.

A partially failed unit will be identified by excessively high engine revs and little vehicle movement when attempting to drive the vehicle.

IN - SITU OPERATIONS

The following operations can be carried out with the gearbox in the vehicle which for ease of working, should be raised on a ramp or placed over a pit. Disconnect the battery negative terminal

NOTE: The front and rear output housings can also be removed while the gearbox is in the vehicle. Reference should be made to the Overhaul procedure for the removal of these assemblies.

RENEW SPEEDOMETER DRIVE PINION

NOTE: Driven gear identification: •
Non catalyst vehicles: RED
Catalyst vehicles : BLACK

1. Remove the nut securing speedometer drive clamp and withdraw the cable. Prise the drive pinion assembly from the output housing.
2. Push in a new assembly, fit the speedometer cable and secure with the clamp and nut.

RENEW REAR OUTPUT SHAFT OIL SEAL

Service tool: 18G1422

1. Disconnect the rear propeller shaft from the output drive flange and tie the shaft to one side.
2. Ensuring that the handbrake is applied to restrain the drive flange, release the drive flange nut.
3. Release the handbrake and remove the two screws which secure the brake drum and withdraw the drum.

   NOTE: While the brake drum is removed from the rear output housing the transmission brake assembly can be overhauled, the procedure for this operation is the same as the LT230, therefore reference should be made to Section 70 Brakes, of the main Workshop Manual.

4. Remove the bottom two bolts which secure the oil catcher to the back plate and withdraw the oil catcher.
5. Remove the output shaft nut, steel washer, rubber seal and withdraw the flange.
6. Carefully tap the dust cover from the housing and prise out the oil seal.
7. Lubricate and carefully install the new seal using service tool 18G1422 with the spring side of the seal abuting the circlip.
8. Fit the dust cover.
9. If necessary release the circlip from the drive flange to allow new bolts to be installed.
10. Examine the flange for damage or wear particularly the seal running surface, if the surface is corroded or a groove has been worn by the previous seal discard the flange.
11. Lubricate the seal running surface of the flange. Fit the flange, if necessary fit a new rubber seal, steel washer and secure with a new nut. Do not tighten the nut at this stage.
12. Seal the oil catcher to the back plate using silicone rubber sealant and secure the assembly with the two bolts.
13. Fit the brake drum and secure with the two screws. Apply the handbrake to restrain the drum and tighten the new drive flange nut to the specified torque.
14. Reconnect the propeller shaft and secure with new nuts, tighten to the specified torque.

Continued

RENEW FRONT OUTPUT SHAFT OIL SEAL

Service tool: 18G1422

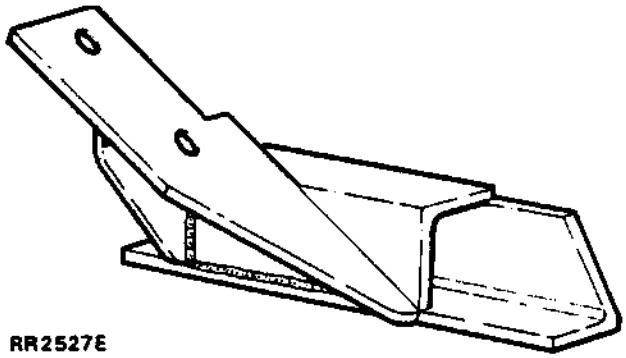
1. Disconnect the front propeller shaft from the flange and tie the shaft to one side.
2. Ensuring that the handbrake is applied to restrain the transmission release the drive flange nut.
3. Remove the output shaft nut, steel washer, rubber seal and withdraw the flange.
4. Prise out the oil seal.
5. Lubricate and carefully install the new seal using service tool 18G1422 with the spring side of the seal abuting the circlip.
6. Examine the flange for damage or wear, particularly the seal running surface, if the surface is corroded or a groove has been worn by the previous seal discard the flange.
7. Lubricate the seal running surface of the flange.
8. Fit the flange, if necessary fit a new rubber seal, steel washer and secure with a new nut, tighten to the specified torque.
9. Refit the propeller shaft and secure with new nuts tightened to the specified torque.

REMOVE TRANSFER GEARBOX

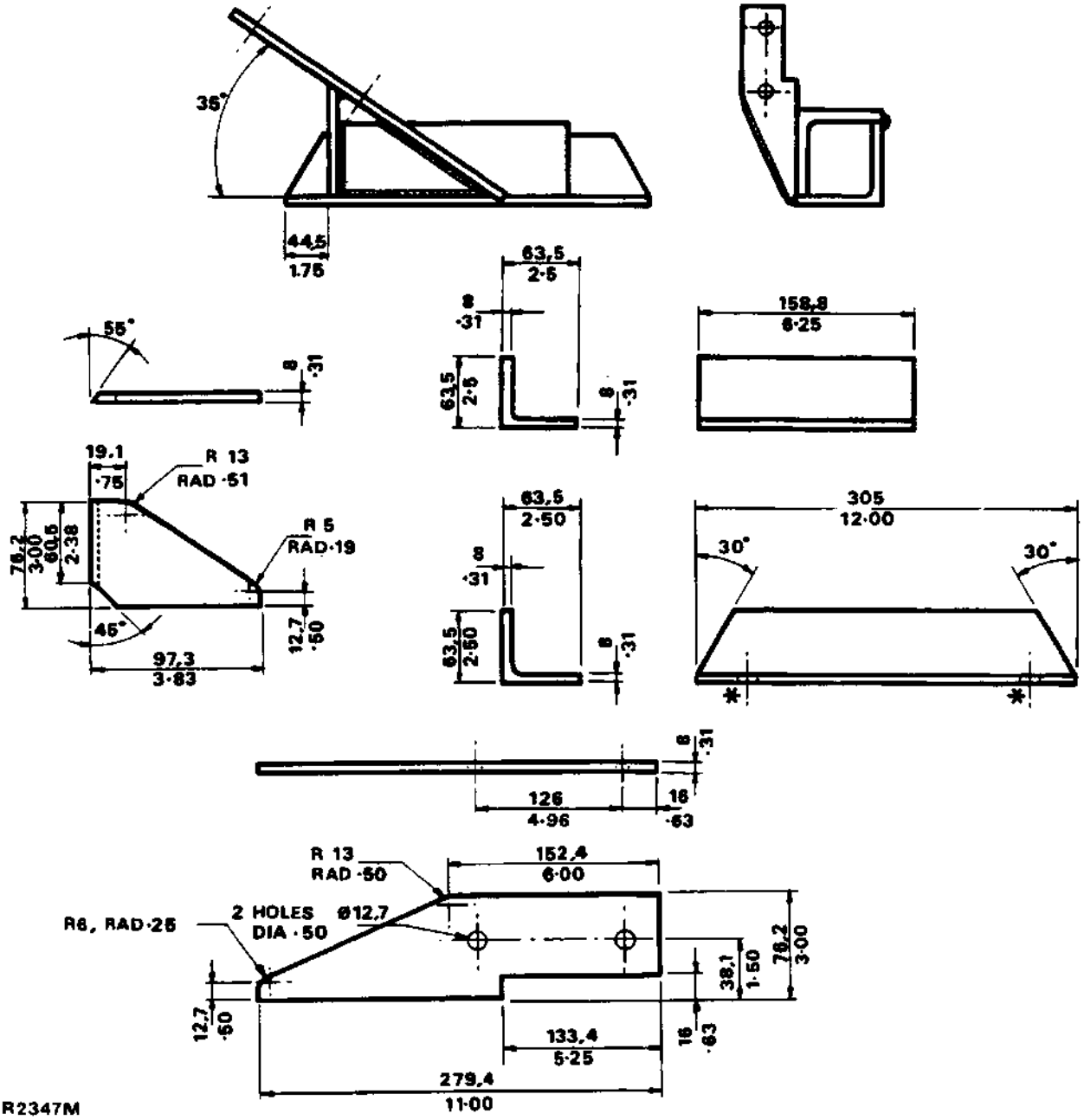
Adaptor plate for removing transfer gearbox

The transfer gearbox should be removed from underneath the vehicle, using a hydraulic transmission hoist. An adaptor plate for locating the transfer gearbox onto the hoist can be manufactured locally to the drawing below.

Material: Steel plate BS 1449 Grade 4 or 14.
Holes marked thus * to be drilled to fit hoist being used.

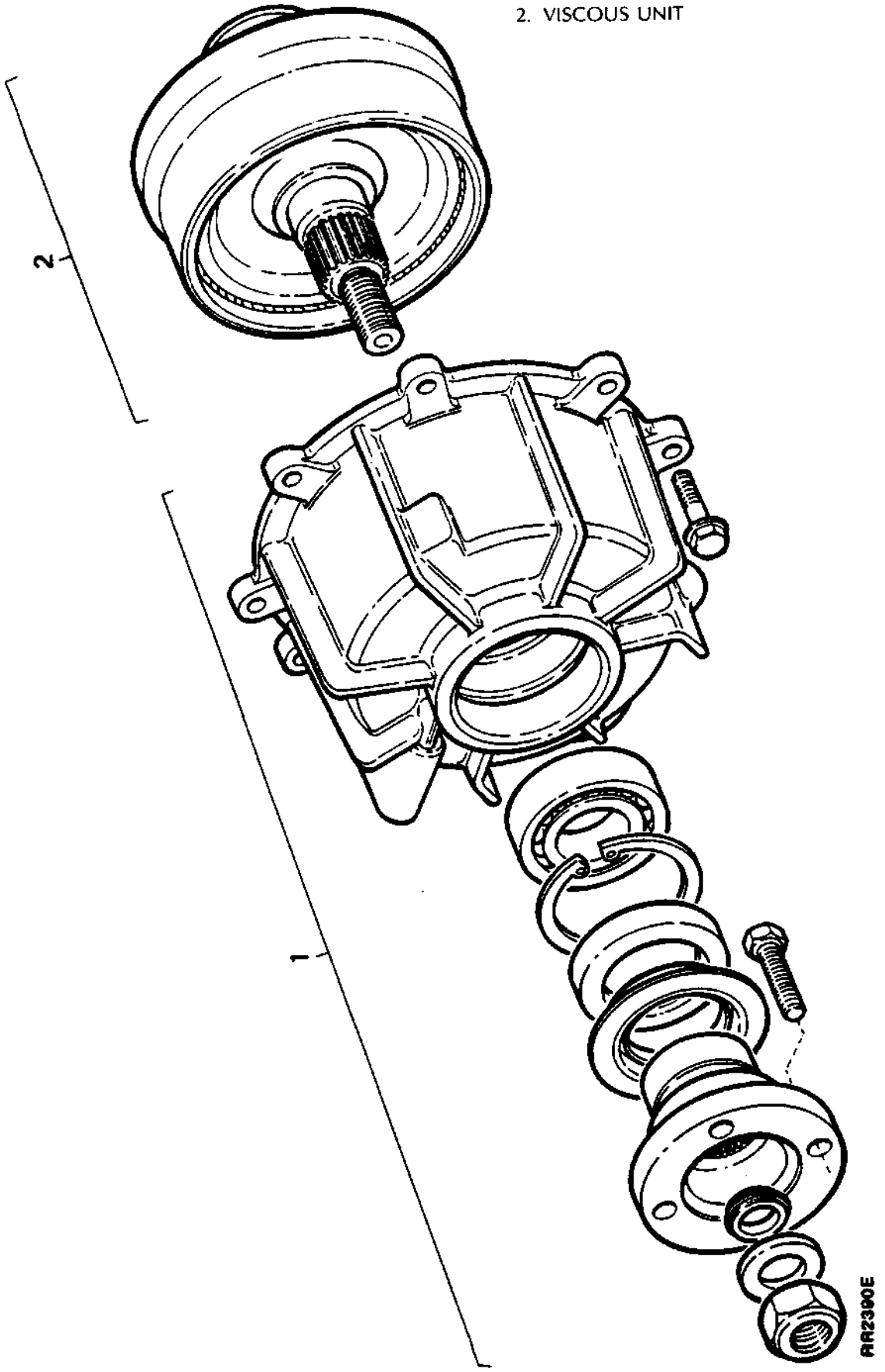


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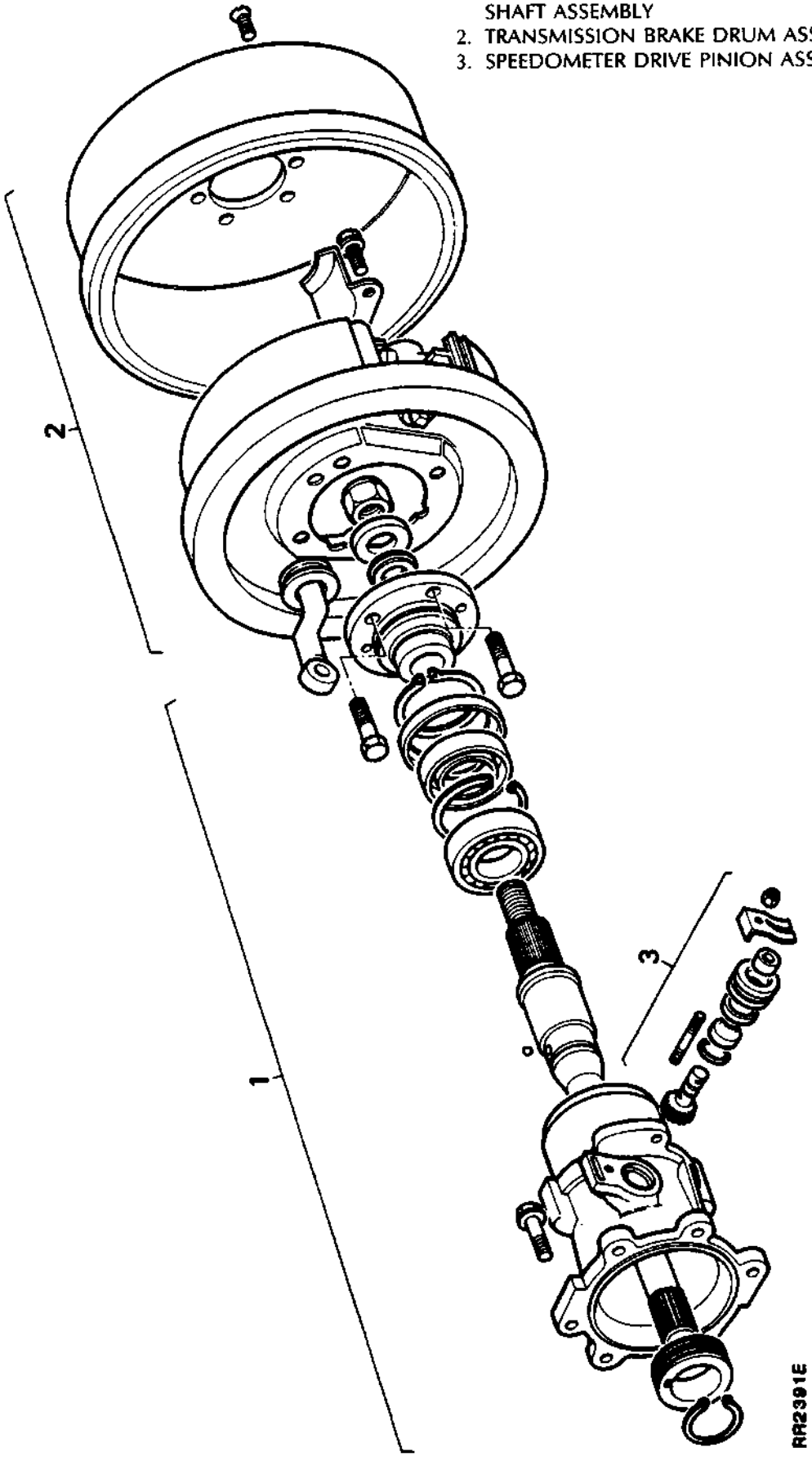


RR2347M

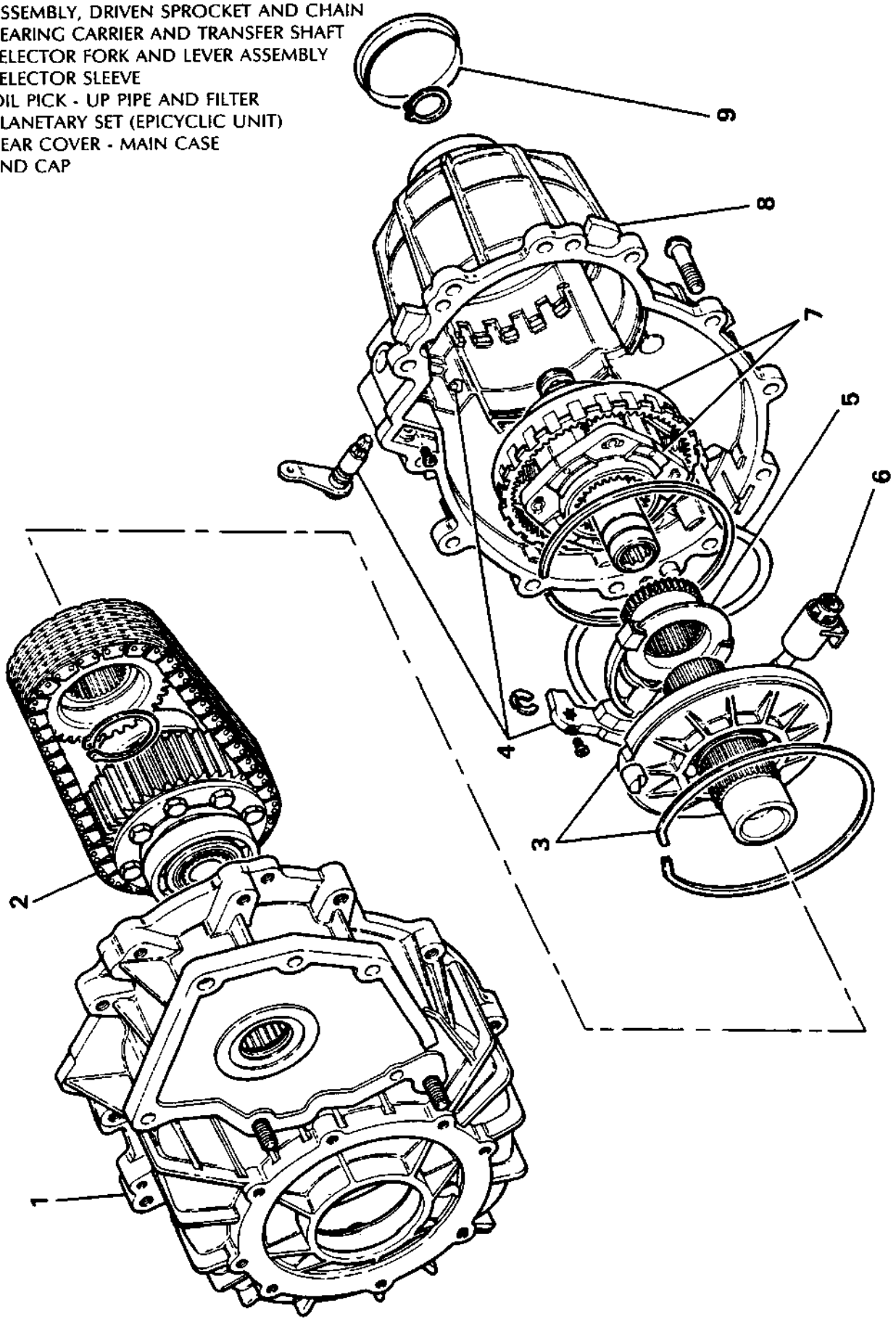
1. FRONT OUTPUT HOUSING ASSEMBLY
2. VISCOUS UNIT



1. REAR OUTPUT HOUSING AND OUTPUT SHAFT ASSEMBLY
2. TRANSMISSION BRAKE DRUM ASSEMBLY
3. SPEEDOMETER DRIVE PINION ASSEMBLY



1. FRONT COVER - MAIN CASING
2. TRANSFER SPROCKET, CENTRE DIFFERENTIAL ASSEMBLY, DRIVEN SPROCKET AND CHAIN
3. BEARING CARRIER AND TRANSFER SHAFT
4. SELECTOR FORK AND LEVER ASSEMBLY
5. SELECTOR SLEEVE
6. OIL PICK - UP PIPE AND FILTER
7. PLANETARY SET (EPICYCLIC UNIT)
8. REAR COVER - MAIN CASE
9. END CAP



REMOVE TRANSFER GEARBOX

NOTE: The following preparation work is necessary prior to the removal of the gearbox to avoid unnecessary damage to associated components.

WARNING: Where the use of a transmission hoist is necessary, it is ABSOLUTELY ESSENTIAL to follow the hoist manufacturer's instructions to ensure safe and effective use of the equipment.

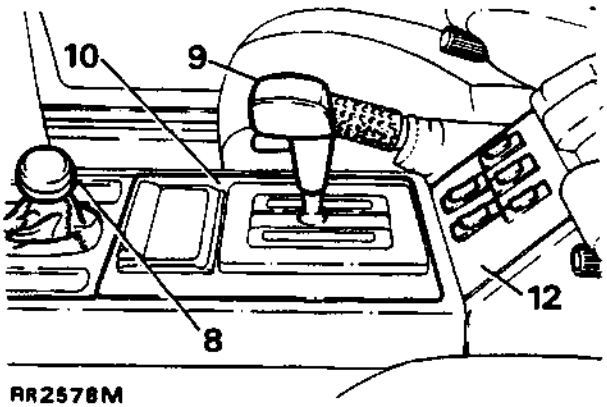
Preparation

Outside the vehicle

1. Install the vehicle on a ramp and chock the wheels. Disconnect the battery negative terminal.
2. Fuel Injection models only - release the airflow meter to plenum chamber hose.
3. Carburetter models only - Remove the air intake elbows and withdraw the air cleaner from its location.
4. Release and remove the fan blade assembly noting that the fan blade has a left hand thread, removing the fan blade assembly will enable the engine to be tipped rearwards when the transmission is ready to be removed.

Inside the vehicle

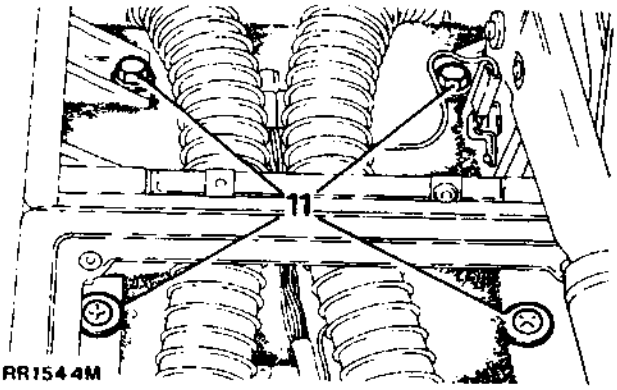
5. Remove the four screws securing the glove box liner to the glove box and lift out the liner. Detach the two relay mounting blocks from the clip on the side of the glove box.
6. Disconnect the electrical leads to the rear cigar lighter.
7. Carefully prise the window lift, switch panel away from the front of the glove box, manoeuvre the switch panel complete with switches back inside the glove box and allow to lie loose on the gearbox tunnel.
8. Select low range, unscrew and remove the transfer lever knob.
9. **Automatic gearbox models only** - Unclip the top cover of the main gearbox selector and remove the circlip, withdraw the detent button. Remove the circlip above the selector knob retention nut, remove the nut, serrated washer and withdraw the selector knob. **Manual gearbox models only** - Unscrew and remove the main gear lever knob.
10. Carefully prise the centre panel out of the floor mounted console (**Automatic models only** - disconnect the electrical leads to the graphics panel on the underside of the centre panel) and remove it from the vehicle.



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Automatic version illustrated

11. Release the two bolts and two screws securing the console assembly to the gearbox tunnel.



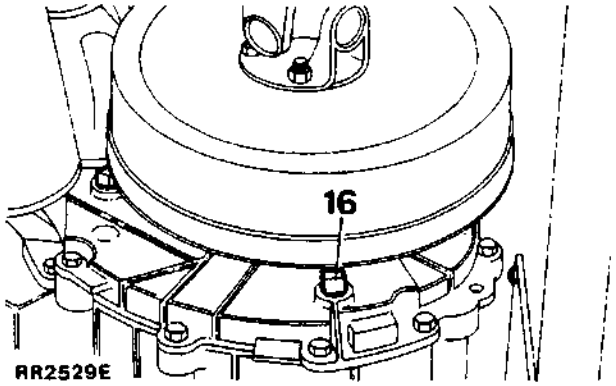
RR1544M

12. Release the handbrake, pull the gaiter forward to gain access to the clevis pin. Remove the split pin, clevis pin and washer securing the handbrake cable to the handbrake lever.
13. Detach the console locating tab from the radio housing by easing the console slightly rearwards.
14. Carefully manoeuvre the glove box assembly rearwards (while raising the handbrake lever to its uppermost position) away from the radio housing and remove the glove box assembly from the vehicle.

15. Remove the sound deadening material from the top of the gearbox tunnel. **Manual gearbox models only** - slacken the pinch bolt and remove the upper gear lever. Remove the four screws and detach the retaining plate securing the rubber gaiter to the top of the main gearbox.

Underneath the vehicle

16. Raise the the vehicle on the ramp and remove the transfer gearbox drain plug and allow the oil to drain into a suitable container, meanwhile continue with the preparation operations.

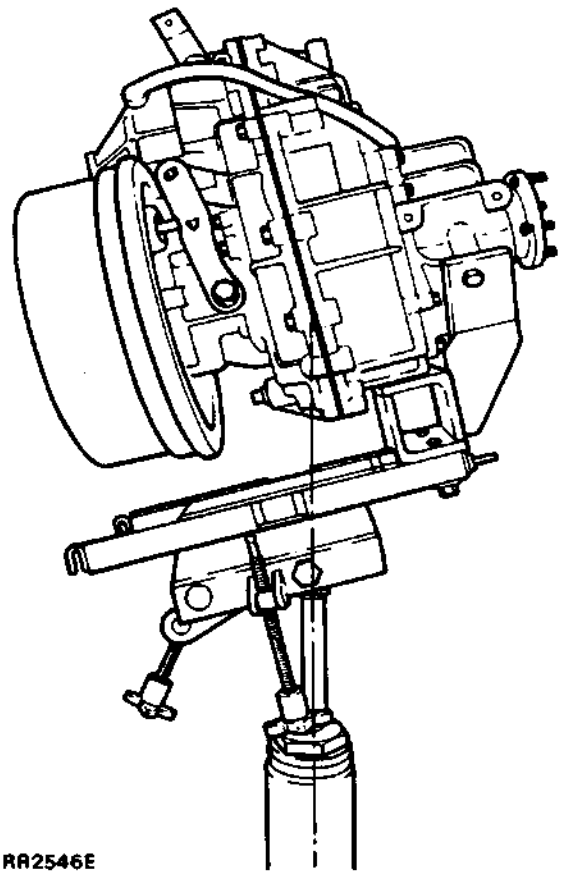


17. Refit the oil drain plug.
18. **Catalyst models only** - Disconnect the multi - plugs to the Lambda sensors.
19. Remove the crossmember from below the main gearbox.
20. Remove the front exhaust down pipes and intermediate pipe complete with centre silencer (or catalyst).

    NOTE: Operation 19 will require the assistance of a second operator to support the exhaust system while the various fixings are released.

21. Remove the underbody floor mounted centre silencer heat shield.
22. Mark each drive flange with an identification line to aid reassembly. Remove the nuts securing the front and rear propeller shafts to the transfer gearbox and tie both shafts clear of the working area.
23. Release the clamp and withdraw the speedometer cable from the rear output housing, also free the cable from the clip at the left hand side of the transfer gearbox.
24. **Automatic models only** - Remove the three fixings securing the tie bar to the transmission.
25. Secure the adaptor plate to the gearbox hoist with two nuts and bolts.

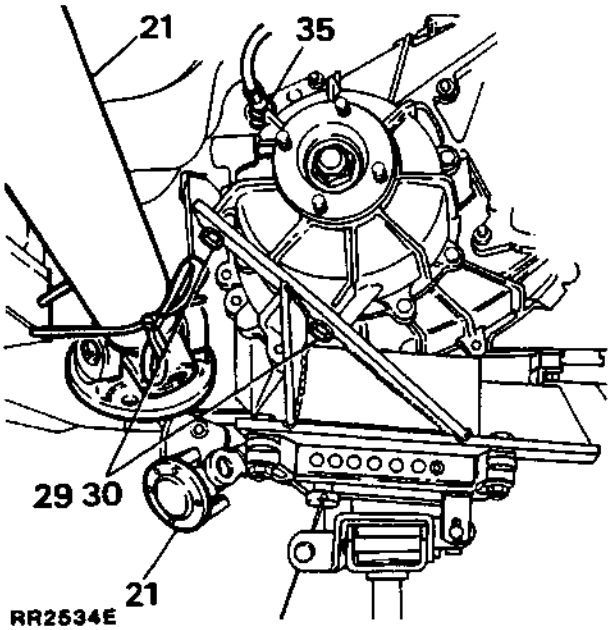
    NOTE: To ensure that the weight of the transfer gearbox is centralised on the hoist, fit the adaptor plate on the hoist platform so that the split line of the gearbox is aligned with the centre line of the ram.



Remove the transfer gearbox

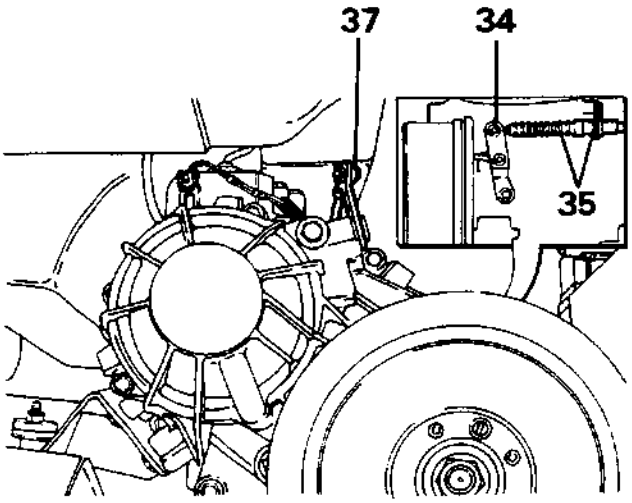
26. Using a suitable hydraulic hoist, support the main gearbox.

27. Slacken the transfer gearbox right hand mounting rubber, upper nut and remove the lower nut. Remove the fixings and withdraw the transfer gearbox to chassis outer half of the mounting bracket.
28. Remove the inner half of the mounting bracket from the transfer gearbox.
29. Adjust the height of the hoist and place in position under the transfer gearbox so that the adaptor plate holes align with the transfer gearbox mounting bracket location.
30. Using the two short bolts previously removed from the right hand gearbox mounting bracket, secure the adaptor plate to the gearbox.



RR2534E

31. Remove the fixings securing the left hand mounting bracket to chassis.
32. Lower the front hoist to allow the transmission to be lowered.
33. Lower the transmission assembly until the top of the transfer gearbox clears the rear passenger footwell.
34. Remove the split pin, clevis pin and washer securing the handbrake cable to the brake drum actuating lever and disconnect the cable.
35. Remove the clip that secures the handbrake cable to the support bracket, feed the cable through the bracket and tie the cable to one side.
36. Remove the breather pipe from the top of the transfer gearbox.
37. Release the spring clip retaining the clevis pin, withdraw the clevis pin and clip assembly, remove the high/low rod from the transfer gearbox selector lever.



RR2537E

38. Support the main gearbox with the previously removed hoist before detaching the transfer gearbox.
39. Remove the upper and lower bolts and two nuts securing the transfer box to the main gearbox.
40. Manoeuvre the transfer gearbox rearwards to detach it from the main gearbox.
41. Thoroughly clean the exterior of the transfer gearbox before undertaking the overhaul procedure.

Continued

Transfer Gearbox - Refitting

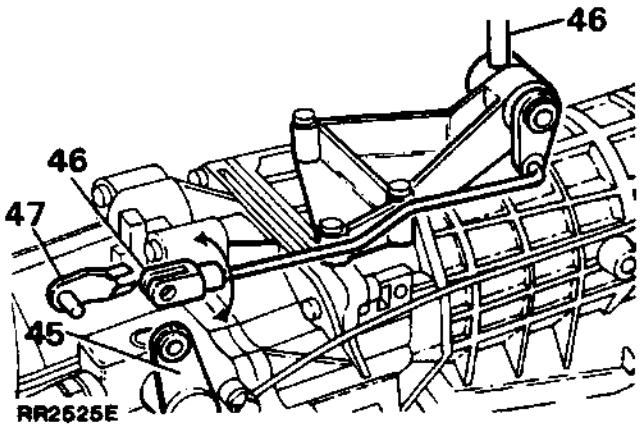
42. Ensure that the joint faces of the transfer gearbox and main gearbox extension case are clean.
43. Lubricate the oil seal in the joint face of transfer gearbox, secure the transfer gearbox to the adaptor plate on the lifting hoist and raise the hoist until the input shaft enters the transfer gearbox.

    CAUTION: CARE MUST BE TAKEN DURING THIS OPERATION TO ENSURE THAT THE INPUT SHAFT SPLINES DO NOT DAMAGE THE OIL SEAL IN THE TRANSFER GEARBOX.

    During this process it may be necessary to rotate either one of the drive flanges to engage the input shaft splines.
44. Secure the transfer gearbox to the main gearbox by fitting the nuts to the two studs. Fit the remaining bolts noting that the longest bolt is fitted to the upper left hand fixing that locates the ring dowel and tighten all fixings to the correct torque.

Transfer gearbox high/low link adjustment

45. Ensure that the selector lever at the gearbox is in the neutral position.
46. Set the transfer gearbox lever in a vertical position (at right angles to the centre line of the main gearbox), rotate the clevis on the end of the rod clockwise or counter clockwise which will shorten or lengthen the operating rod until the hole in the clevis aligns with the hole in the selector lever.
47. Fit the clevis pin and retaining clip assembly. Select high and low transfer to ensure full engagement is occurring. Repeat the above procedure if full engagement is not evident.



Refitting (continued)

48. Complete the refitting procedure by reversing the removal sequence, noting the following important points.
49. After removing the lifting hoist and adaptor plate from the transfer gearbox, clean the threads of the bolts for the transfer gearbox and fit them together with the mounting bracket to the gearbox. Tighten to the specified torque.
50. Fit the three fixings which secure the right hand mounting bracket to the chassis. Tighten to the specified torque.
51. Fit the propeller shafts and tighten to the specified torque.
52. Remove the transfer gearbox combined oil filler and level plug, refill the transfer gearbox with the correct grade and quantity of oil until the oil starts to seep from the filler/level hole. Coat the plug with Hylomar sealant and refit the combined filler and level plug. Tighten to the specified torque, wipe away any surplus oil.
53. Check, and if necessary top - up the oil level in the main gearbox. Use the correct grade oil.
54. Check the operation of the handbrake and adjust as necessary.

BORG WARNER TRANSFER GEARBOX

DISMANTLING, OVERHAUL AND REASSEMBLY

Service Tools:

18G1422 - Oil seal replacer
18G1205 - Adjustable flange holding wrench
18G134 - Bearing and oil seal replacer
LST550 - 6 - Input shaft oil seal replacer

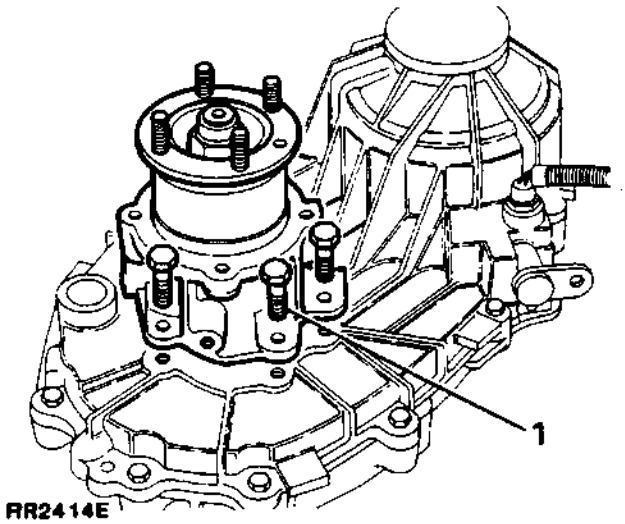
NOTE: Before commencing the overhaul procedure thorougly clean the exterior of the transfer gearbox. If the gearbox oil has not previously been drained, drain the oil into a suitable container.

DISMANTLING

NOTE: Before commencing the dismantling procedure remove the brake drum assembly (refer to section 70 - Brakes, of the main Workshop Manual).

Rear output housing

1. Remove the six bolts and withdraw the rear output housing complete with output shaft.

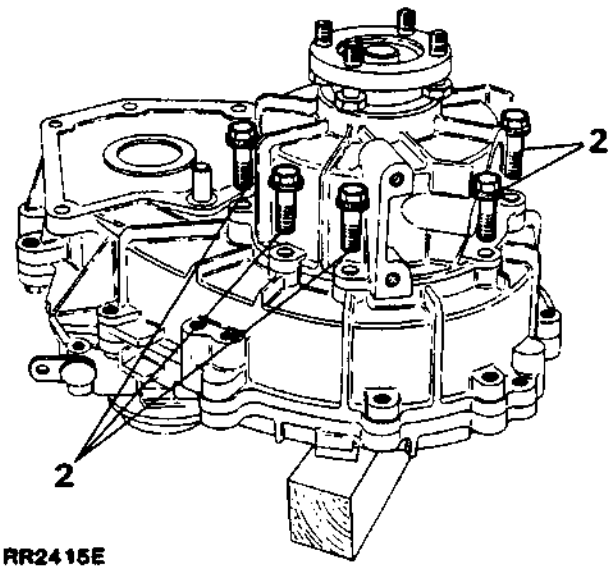


RR2414E

Front output housing

NOTE: Invert the gearbox. Level up the assembly by placing wooden blocks under the transfer gearbox to main gearbox joint face.

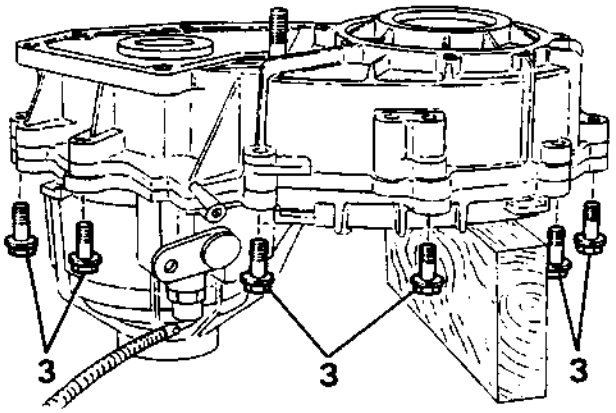
2. Remove the eight bolts and withdraw the front output housing complete with viscous unit.



RR2415E

Front cover - main casing

3. Remove the eleven bolts securing the front and rear cover (main case) together.



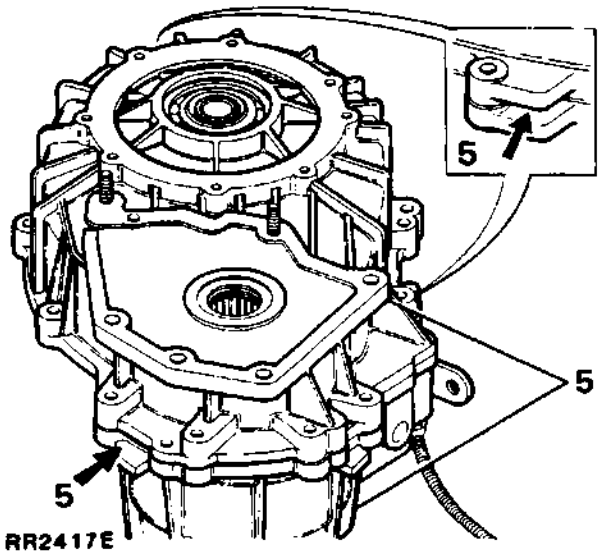
RR2416E

4. Clean any previous sealant from the threads of the bolts.

Continued

5. Using two levers between the cast lugs on the outer edges of the casing, to assist in separating the gearbox, carefully prise the front cover from the rear cover.

CAUTION: DO NOT LEVER BETWEEN THE MATING FACES.

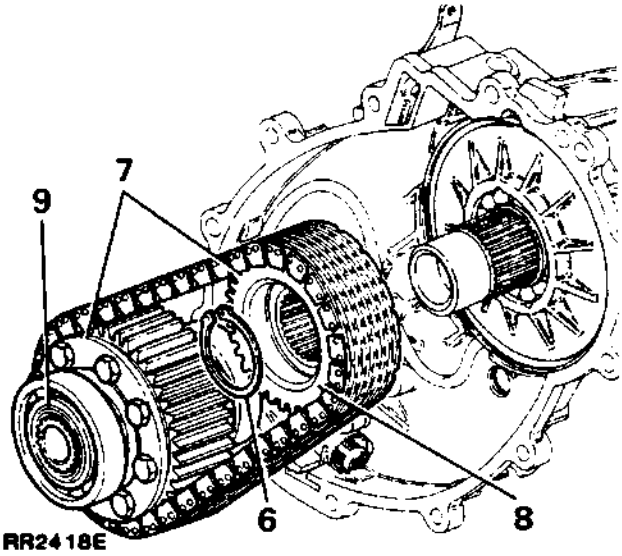


RR2417E

Transfer sprocket, centre differential, assembly and chain

NOTE: Before dismantling, mark one chain link and corresponding tooth on the transfer sprocket with an identification line. This is to ensure that the balance of the unit is maintained when reassembled with original components and that the chain is fitted the correct way up.

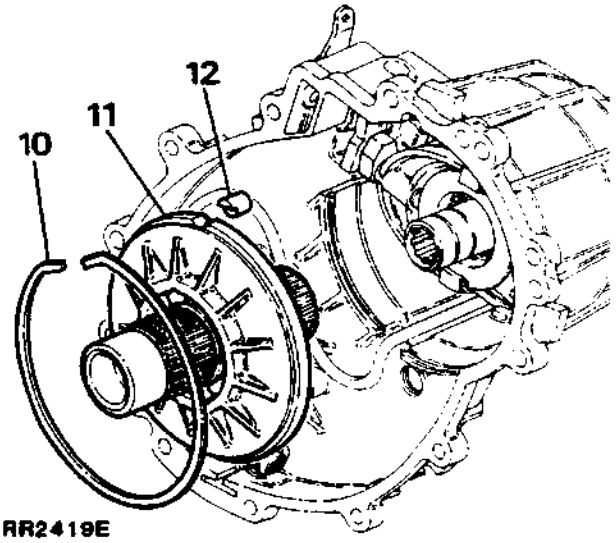
6. Remove the circlip retaining the transfer sprocket to the transfer shaft.
7. Place two thin pieces of wood on the joint face to prevent damage and using two levers behind the differential assembly carefully lever the differential bearing from its bore while simultaneously easing the transfer sprocket off the transfer shaft to maintain alignment during removal.
8. Remove the transfer sprocket from the chain.
9. Remove the differential assembly from the chain.



RR2418E

Bearing carrier and transfer shaft

10. Insert a screw driver between the anti - rotation dowel and snap ring gently prise the snap ring out of the groove.
11. Withdraw the carrier complete with transfer shaft.
12. Withdraw the anti - rotation dowel.

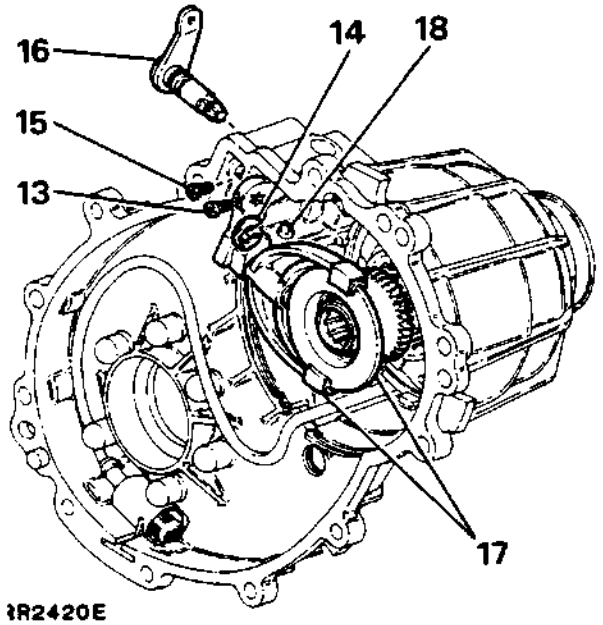


RR2419E

Selector fork assembly

13. Using Torx bit 25 remove the screw securing the selector arm to the selector lever shaft.
14. Remove the retaining clip securing the selector fork arm to the selector lever shaft.

15. Using Torx bit 25 remove the screw retaining the selector lever.
16. Remove the selector lever shaft from the case and fork assembly.
17. Withdraw the selector fork assembly and selector sleeve.

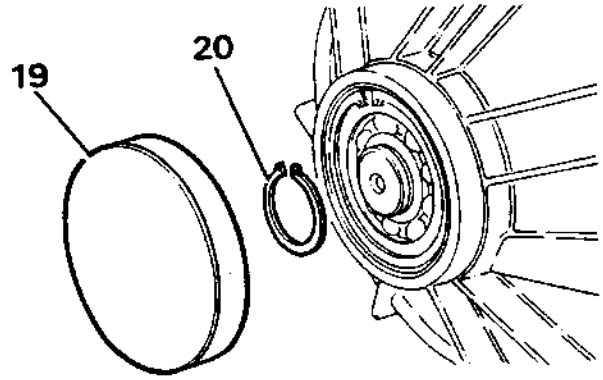


RR2420E

18. Retrieve the selector plunger and spring from the rear cover.

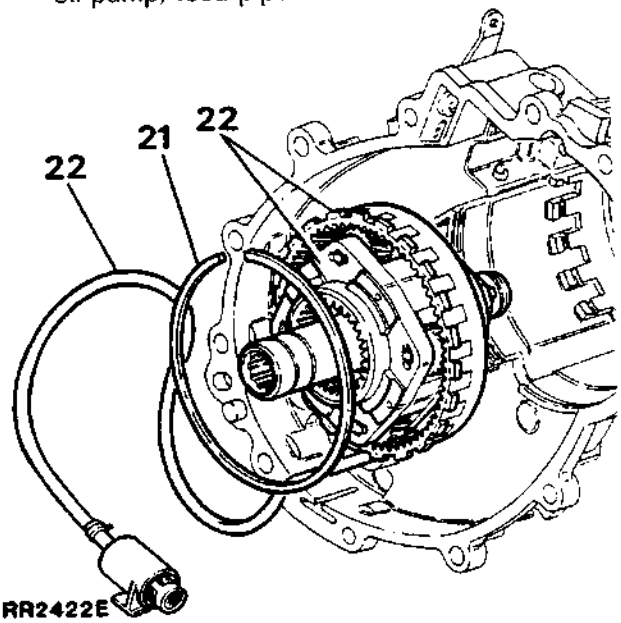
Planetary set (Epicyclic unit)

19. Turn the case over and prise the end cap off the planetary set housing.
20. Remove the circlip retaining the sun gear shaft.



RR2421E

21. Turn the casing over and remove the large snap ring retaining the planetary set.
22. Withdraw the annulus and planetary assembly from the planetary set housing, complete with oil pump, feed pipe and filter.

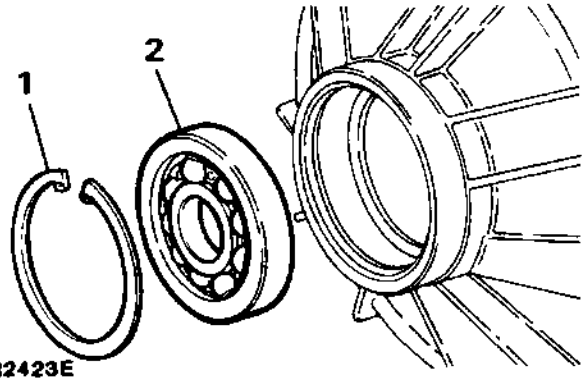


RR2422E

DISMANTLE, INSPECTION AND OVERHAUL

Rear cover main case
- Dismantle and inspection

1. Remove the circlip retaining the bearing in the rear cover.
2. Drive or press the bearing from the cover and discard the bearing.



RR2423E

Continued

3. Remove any previous sealant evident on the rear cover joint faces.
4. Using a suitable solvent thoroughly clean the cover.
5. Examine the cover for damage, cracks and porosity, renew if necessary.
6. Check the selector lever shaft bore, for ovality and wear. If worn renew the cover.

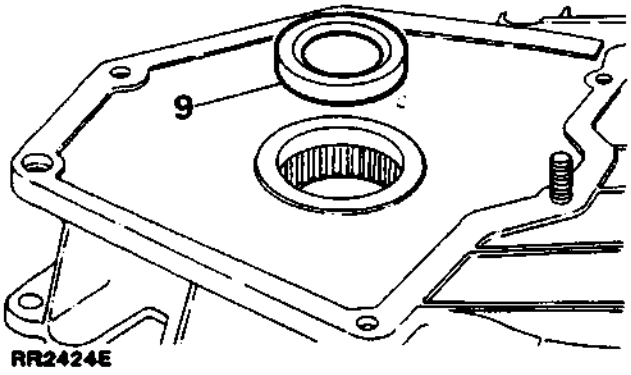
Rear cover main case - Assemble

7. Drive or press a new bearing into the cover and secure in position with the circlip.

8. Place the cover aside until the gearbox is ready to be assembled.

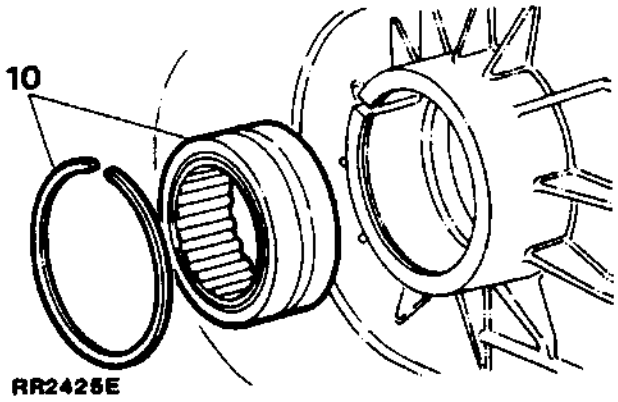
Front cover main case - Dismantle and inspection

9. Prise the input shaft oil seal from the front cover and discard the oil seal.



RR2424E

10. Remove the snap ring retaining the needle roller bearing, withdraw the bearing and discard.

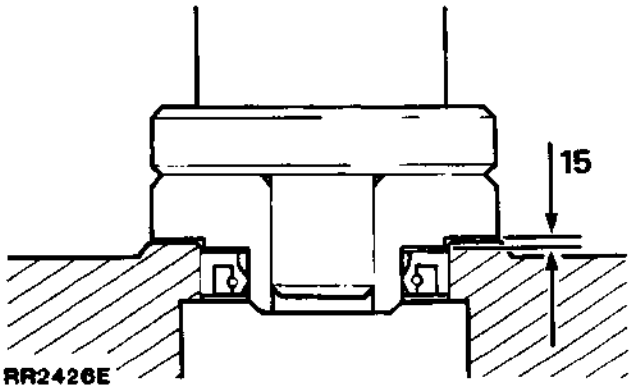


RR2425E

11. Remove any previous sealant from the joint faces of the front cover.
12. Thoroughly clean the cover using a suitable solvent.
13. Examine the cover for damage, cracks and porosity, renew if necessary.
14. Check the inside edges of the case for witness marks which may indicate a chain that has stretched.

Front cover main case - Assemble

15. Lubricate a new oil seal. Using service tool LST 550 - 6 in conjunction with bearing and oil seal replacer 18G134 fit the seal, open side of the seal leading, until the face of the seal is 1 mm (0.039 in) below the surface of the boss.



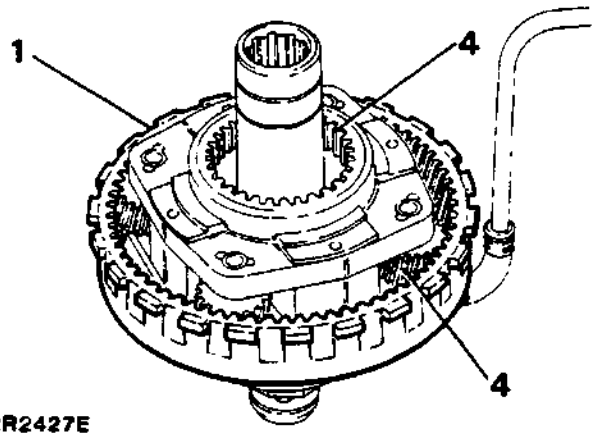
RR2426E

16. Lubricate a new needle roller bearing and drive or press the bearing into its recess until contact is made with the shoulder at the bottom of the bore.
17. Fit the snap ring to retain the bearing.
18. Place the cover aside until the gearbox is ready to be assembled.

Planetary set (Epicyclic unit) and oil pump - Dismantle and inspection

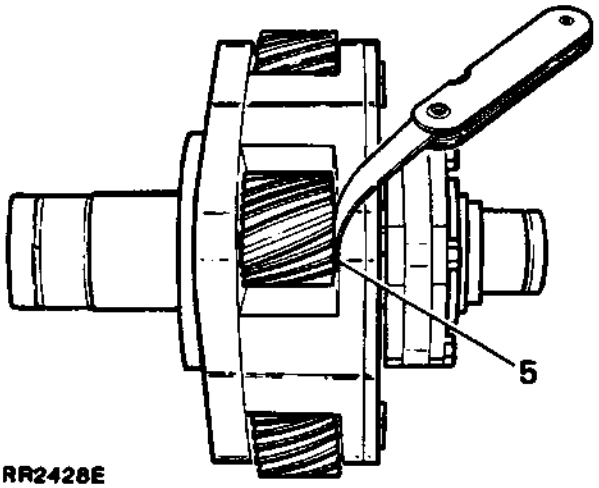
NOTE: The Epicyclic unit and oil pump are serviced as a complete assembly, if after inspection either of the units is found to be worn a complete new assembly must be fitted.

1. Remove the annulus from the planetary set.



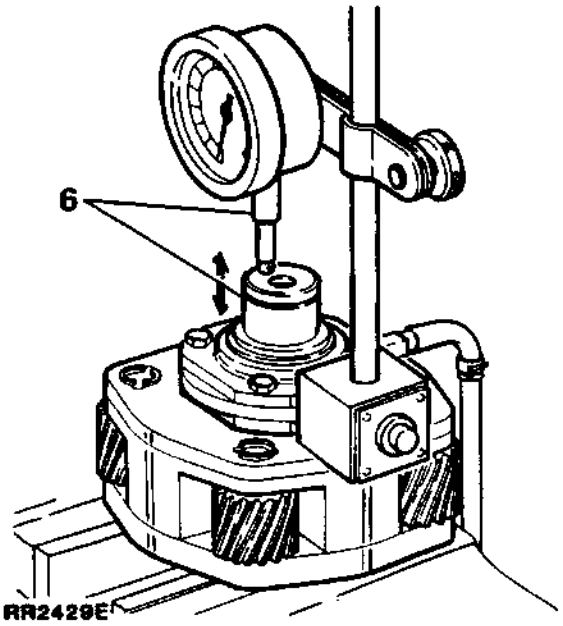
RR2427E

2. Thoroughly clean all components using a suitable solvent.
3. Examine the helical teeth of the annulus for wear or damage. If damage is evident it will be necessary to renew both the annulus and planetary set.
4. Examine the planetary gears and high/low gear teeth for wear or damage. If damaged renew both the annulus and planetary set.
5. Check the end float of the four planet gears, between the end of the gear and planetary set carrier. End float of each planet gear should not exceed 0.83 mm (0.033 in) if any one of the planet gears is out of limits renew the planetary set assembly.



RR2428E

6. Check the end float of the sun gear to the planetary set carrier by supporting the body of the assembly on the top of a vice. Using a dial test indicator attached to a magnetic base, position the base on top of the assembly and zero the indicator on the end of the sun gear shaft, lift the shaft and check the end float. End float should not exceed 0.83 mm (0.033 in). Fit a new planetary set assembly if out of limits.



RR2429E

NOTE: If the previous inspection instructions prove the assembly to be in an acceptable condition carry out the following examination of the oil pump.

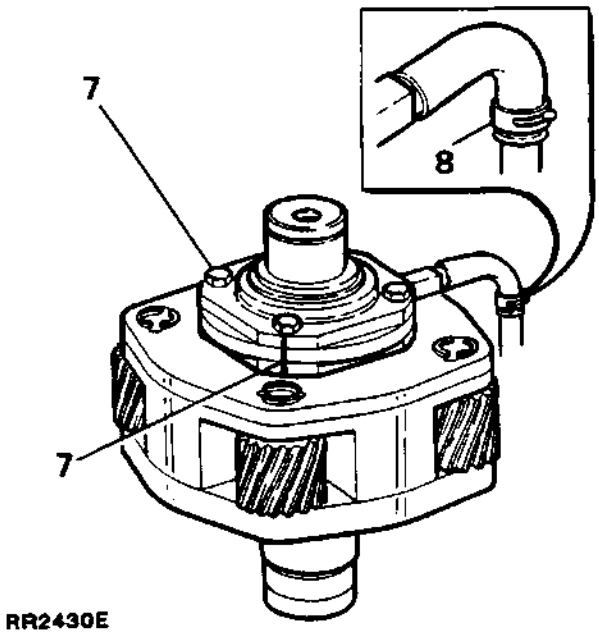
Continued

Oil pump and filter
- Dismantle and inspection

7. To aid re - assembly mark an identification line on the edges of the oil pump plates. Remove the four bolts securing the pump front and rear plates, separate the pump by removing the plungers, spring and bearing plate.

   NOTE: The front plate of the oil pump is stamped 'TOP', the centre bearing plate is stamped 'REAR' and the rear plate is stamped 'TOP REAR'. The fixing holes of the plates and body are also offset to ensure correct re - assembly of the pump.

8. Depress the retaining clips, remove the oil pick - up pipe and rubber connection tubes. Examine the tubes and pipe for damage or fractures, renew as necessary.

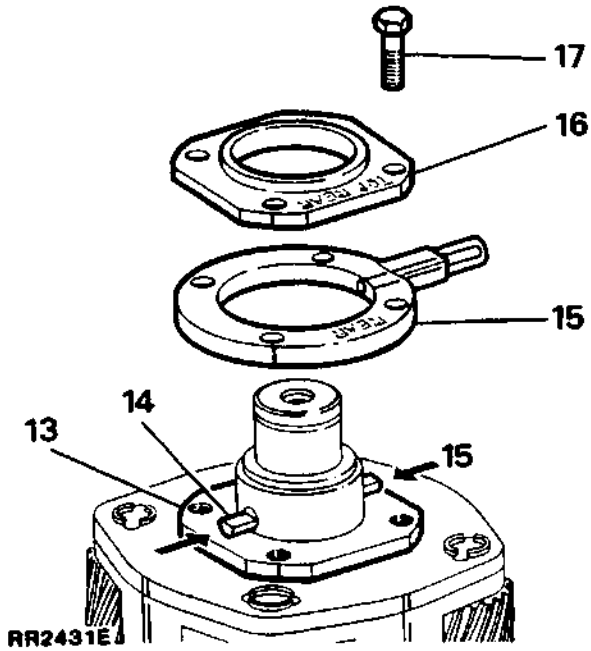


RR2430E

9. Clean the pump components and check for damage and wear, ie: blueing of the pump plungers, scoring of the centre bearing plate, if any wear is evident a new planetary set must be fitted, as the pump is part of the complete assembly.
10. Thoroughly clean the oil pick - up filter, examine the filter screen for damage and blockage, renew or clean the filter as necessary.

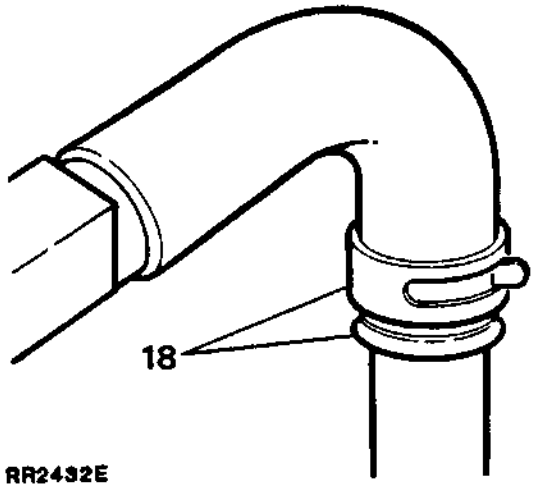
Oil pump and filter - Assemble

11. Clean the sealant from the oil pump securing screws.
12. Prior to assembly lubricate the pump components with clean oil.
13. Fit the plate stamped **'TOP'** to the sun gear shaft with the word **'TOP'** facing the planetary assembly.
14. Fit the plungers and spring noting that the flats on the plungers must be uppermost to enable the **'TOP REAR'** plate to be fitted.
15. Compress the plungers and fit the middle bearing plate with the word **'REAR'** uppermost. Align the offset fixing holes and also noting the previously marked identification line.
16. Fit the top rear plate with the words **'TOP REAR'** uppermost.
17. Apply Loctite 242 to the threads of the four screws and fit the screws, tighten to the specified torque.



RR2431E

18. Fit the rubber connection tube and oil pick - up pipe to the oil pump, fit the retaining clip. Note that the clip securing the tube to the pick - up pipe is positioned in front of the flare on the pipe.

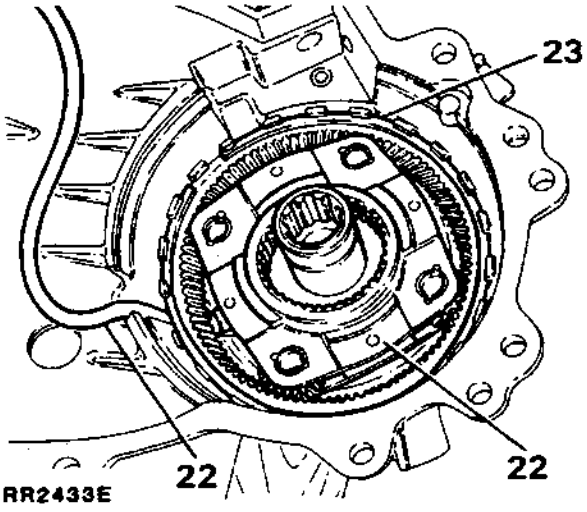


RR2432E

19. Fit the rubber connection tube to the filter end of the pipe, fit the clip ensuring that the tube is clamped by the clip in front of the flare on the pipe.
20. Push the filter into the tube. The radial position of the filter to pipe at this stage is unimportant.

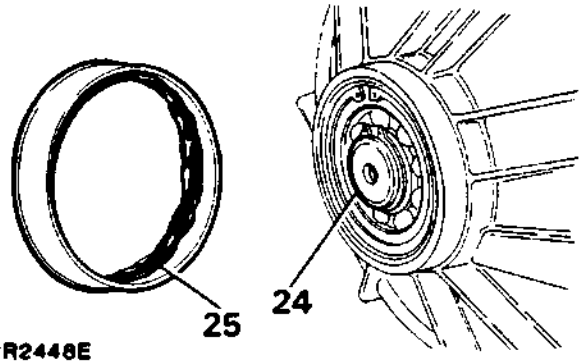
Planetary set (Epicyclic unit) and annulus - Assemble

21. Lubricate the planetary set and annulus with clean oil.
22. Position the annulus around the planetary set, fit the assembly to the rear cover locating the oil pump inlet port in the groove at the bottom of the planetary set housing, the sun gear shaft in the bearing and the lugs on the outer edge of the annulus in the anti - rotation lugs. It may be necessary to tap the sun gear shaft into the bearing to enable the large ring gear snap ring to be fitted.



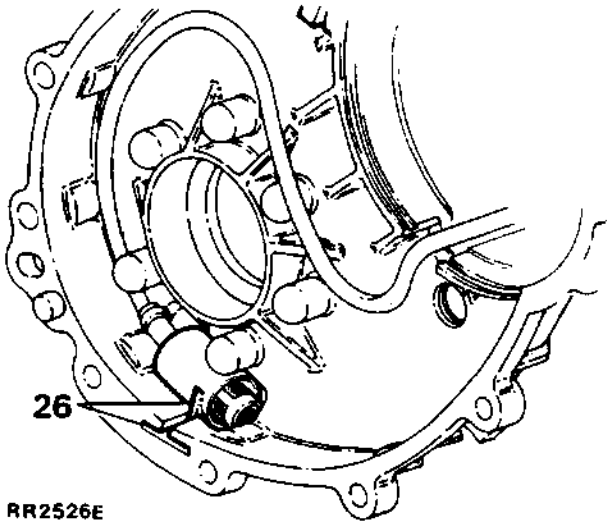
RR2433E

23. Fit the snap ring with the stepped ends adjacent to the selector shaft bore.
24. Turn the rear cover over and fit the circlip to retain the sun gear shaft.
25. Remove any previous sealant from the end cap. Apply Dow Corning 732 silicon sealant or a suitable equivalent to the inner edges of the cap, evenly tap the cap into position.



RR2448E

26. If necessary re - position the filter on the oil pick - up pipe until the lug on the filter can be pushed into the slot in the rear cover.

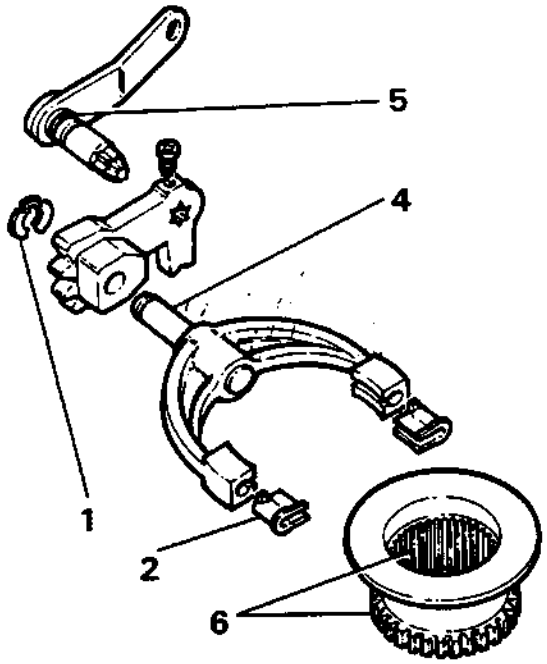


RR2526E

Continued

Selector fork
- Dismantle and inspection

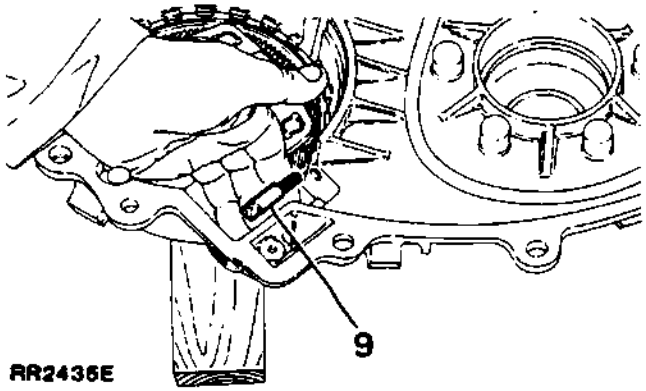
1. Remove the retaining clip and separate the fork from the arm.
2. Detach the two nylon slippers from the selector fork feet and discard.
3. Thoroughly clean all components.
4. Examine the fork, arm and pivot pin for wear. Renew as necessary.
5. Remove the 'O' ring and discard. Examine the shaft and lever for wear and damage, renew as necessary.
6. Examine the selector sleeve teeth and internal splines for damage and wear. Renew as necessary.



RR2434E

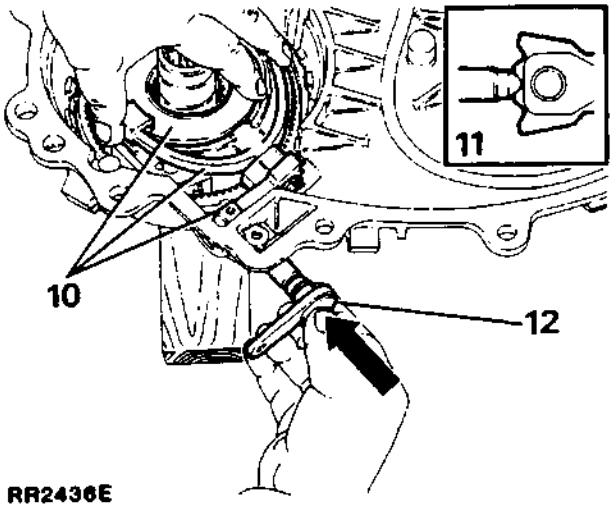
Selector fork - Assemble

7. Fit new nylon slippers to the fork.
8. Assemble the fork to the selector arm and secure in position using a new retaining clip.
9. Lightly lubricate and fit the spring and selector plunger.



RR2435E

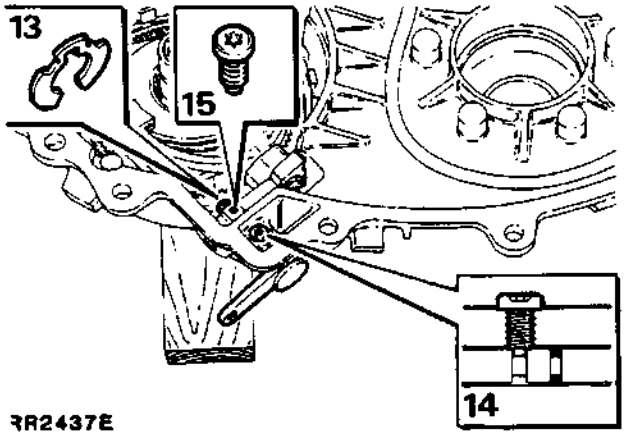
10. While compressing the plunger and spring, fit the selector fork, operating arm assembly and selector sleeve simultaneously.
11. Select neutral gear position at the operating arm.
12. Fit a new 'O' ring to the selector lever shaft. Lubricate the 'O' ring and fit the lever assembly to the rear cover, noting that when fully assembled the lever should lie parallel with the joint face of the rear cover.



RR2436E

13. Fit a new retaining clip to secure the selector fork operating arm to the selector lever s haft.
14. Remove any previous sealant from the Torx screw. Align the selector lever shaft groove to the retaining screw hole, apply a small amount of Loctite 242 to the screw threads and using Torx bit 25 fit and tighten the screw to the specified torque. Ensure that the screw locates in the groove of the shaft.

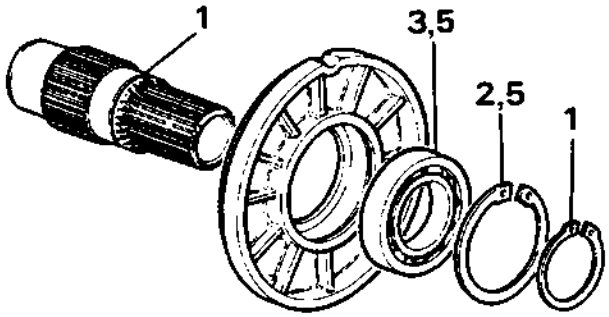
15. Clean any previous sealant from the Torx screw. Apply a small amount of Loctite 242 to the threads of the screw and fit to the selector fork operating arm, tighten using Torx bit 25 to the specified torque.



RR2437E

Bearing carrier
- Dismantle, inspection and assemble

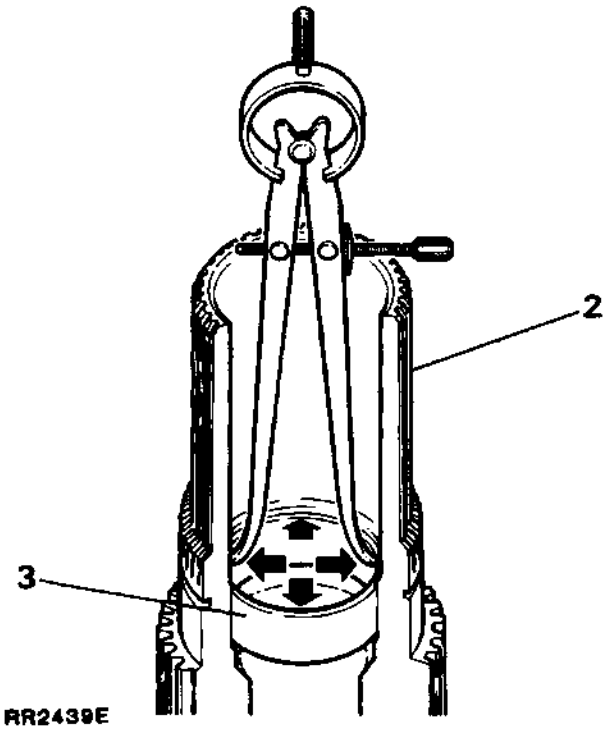
1. Remove the circlip and drive or press the transfer shaft from the bearing.
2. Remove the circlip retaining the bearing in the carrier.
3. Drive or press the bearing from the carrier and discard the bearing.
4. Clean and examine the carrier for cracks and general condition. Renew as necessary.
5. Press or drive a new bearing into the carrier and secure with the circlip.



RR2438E

Transfer shaft
- Inspection and assemble

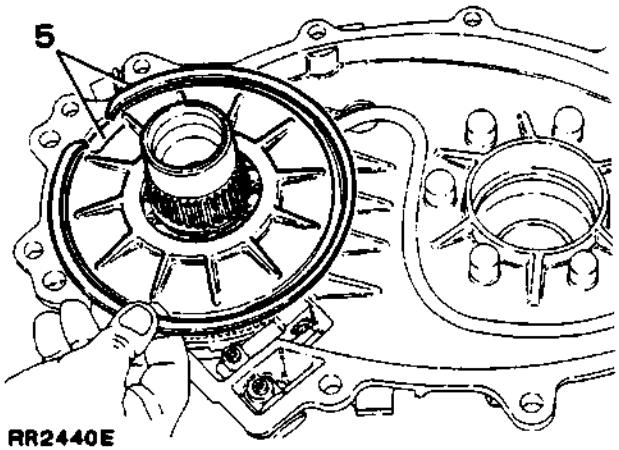
1. Clean the transfer shaft.
2. Visually examine the external splines for damage and wear, if worn fit a new the component.
3. Check the phospher bronze bush for wear by measuring the internal diameter of the bush with internal calipers and a micrometer or with an internal micrometer. The bush diameter must not exceed 38.515 mm (1.516 in) fit a new transfer shaft if the bush has worn above the figure given.



RR2439E

Continued

4. Drive or press the transfer shaft into the bearing in the carrier. Secure the shaft with the circlip.
5. Fit the carrier to the rear cover, fit the anti - rotation dowel and secure the assembly with the snap ring, noting that the open ends of the snap ring must be positioned by the cast relief in the bearing carrier upper face.



RR2440E

Transfer sprocket - Inspection

1. Examine the sprocket teeth and splines for wear and damage, if either are evident discard the sprocket, otherwise clean and place to one side.

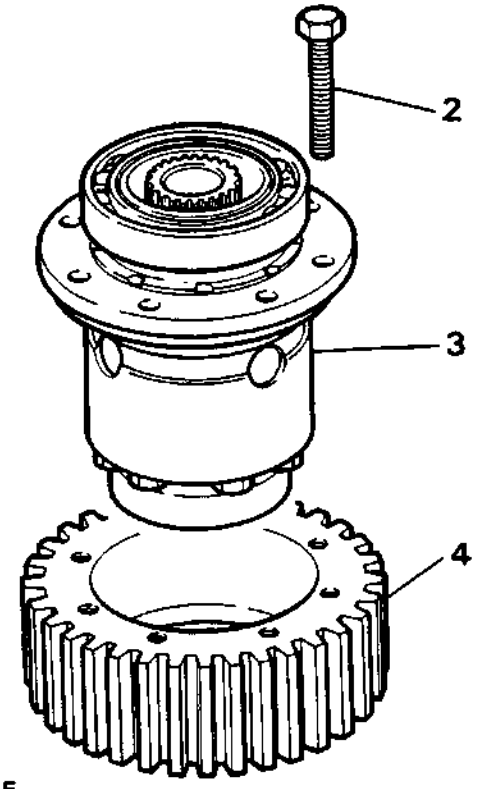
Chain - Inspection

NOTE: A stretched chain can be identified by either excessive noise when the gearbox is operational or by witness marks on the inside edges of the case. If either is evident, renew the chain.

1. Using a suitable solvent thoroughly clean the chain.
2. Check the chain links for wear and damage, if necessary renew the chain.
3. Place the chain to one side.

Centre differential and sprocket - Dismantle and inspection

1. Place the differential unit in a vice fitted with soft jaws. If the original components are to be refitted mark an identification line on the sprocket and differential unit.
2. Remove the bolts securing the sprocket to the differential.
3. Lift the differential assembly from the sprocket.

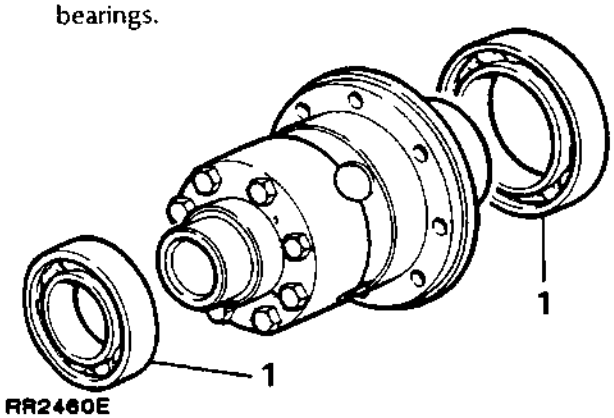


RR2441E

4. Examine the sprocket teeth for wear and damage, if either are evident renew the sprocket. Place the sprocket aside until the differential is ready to be assembled.

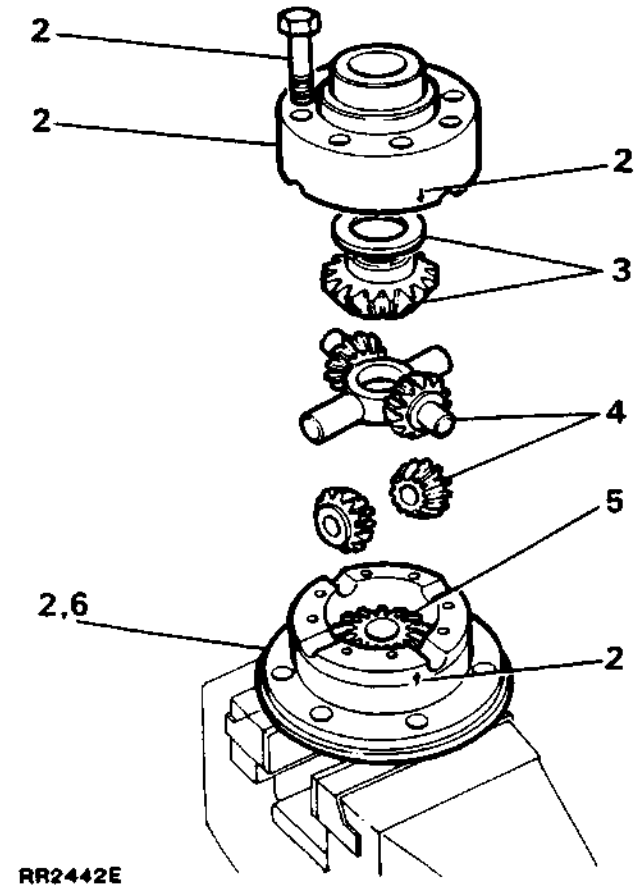
Centre differential
· Dismantle and inspection

1. Using a two legged puller, ease the bearings from the differential assembly and discard the bearings.



RR2460E

2. Secure the front half of the differential unit in a vice fitted with soft jaws, remove the eight retaining bolts securing the front and rear halves of the assembly together, lift off the rear part of the differential unit. Note the identification marks on the exterior of the differential unit.

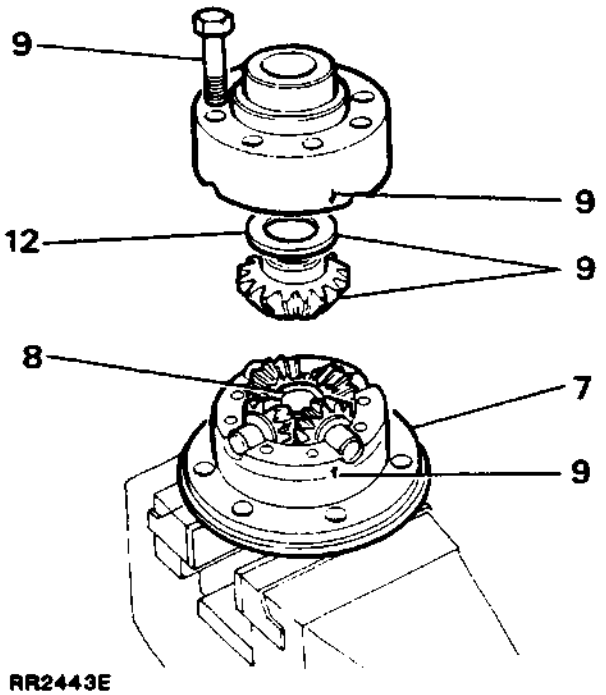


RR2442E

3. Remove the rear upper bevel gear and thrust washer.
4. Remove the pinion gears and dished washers along with the cross shaft.
5. Remove the front lower bevel gear and thrust washer from the front half of the differential unit.
6. Remove the front half of the differential unit from the vice and clean all components. Examine for wear or damage, renew if necessary.

Differential pinions · rolling resistance

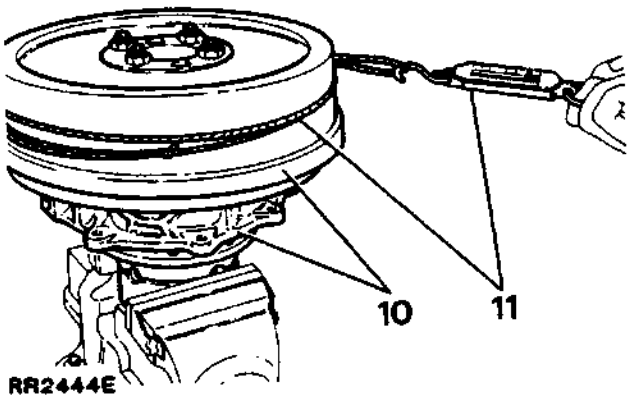
7. Using soft jaws secure the front half of the differential unit in the vice.
8. Fit the front bevel gear without the thrust washer. Lightly lubricate and fit the cross shaft, pinion gears and new dished washers.
9. Fit the rear bevel gear together with the thinnest thrust washer to the rear half of the differential. Assemble both halves of the differential noting the identification marks. Fit the bolts and tighten to the specified torque.



RR2443E

Continued

10. Invert the differential unit in the vice, fit the front output housing to the differential, locating the viscous unit splines on the front bevel gear. Fit the drive flange to the viscous unit and place the brake drum on top of the drive flange, secure with the nut. Check that the gears are free to rotate.
11. Tie a length of string around the brake drum, attach a spring balance to the free end and carefully tension the string until a load to turn is achieved. Alternatively use a torque wrench applied to the drive flange nut. Rotate the brake drum slowly by hand to overcome the initial load when using either method.



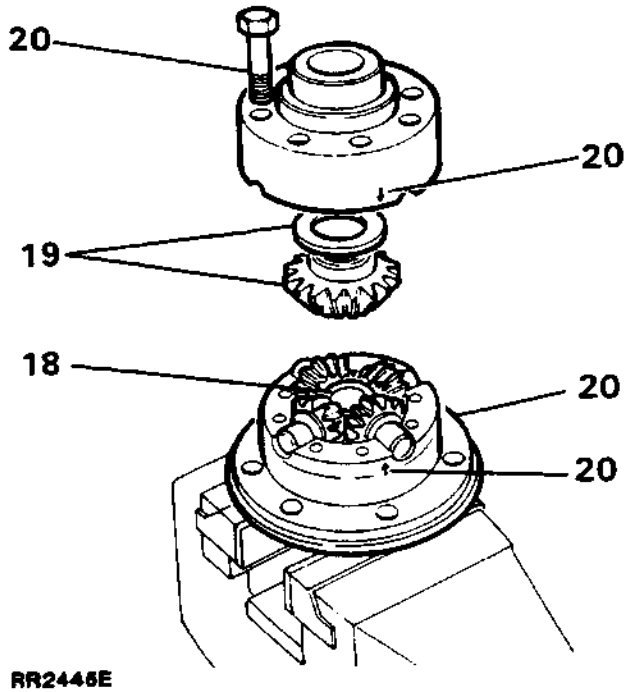
RR2444E

NOTE: Gears that have been run will rotate smoothly and will require a torque of 0.56 Nm (5 in lb), equivalent force using a spring balance 0.45 kg (1 lb). New gears will rotate with a notchy feel and will require a torque of not more than 2.26 Nm (20 in lb), equivalent force using a spring balance 7.72 Kg (3.8 lb). Keep all components lubricated when carrying out these adjustments.

12. Change the thrust washer for a thicker one if the torque reading is too low and re - check the torque. Five thrust washers are available in 0.10mm steps ranging from 1.05 to 1.45mm.
13. Dismantle the unit when the rear bevel gear thrust washer has been selected.
14. Remove and retain the rear bevel gear and thrust washer combination.
15. Repeat the procedure to obtain the correct thrust washer for the front bevel gear, it is not necessary to fit the rear bevel gear when checking the front bevel gear rolling resistance.
16. When the thrust washer has been selected for the front bevel gear, again dismantle the differential unit and retain the thrust washer and front bevel gear combination.

Centre differential - Assemble

17. Fit the thrust washer and front bevel gear into the front half of the differential unit.
18. Fit the pinion gears with dished washers to the cross shaft and fit the assembly to the differential unit.
19. Fit the thrust washer and rear bevel gear to the rear half of the differential unit.
20. Align both halves of the differential noting the identification marks. Secure both halves together with the eight bolts. Tighten the bolts to the specified torque.

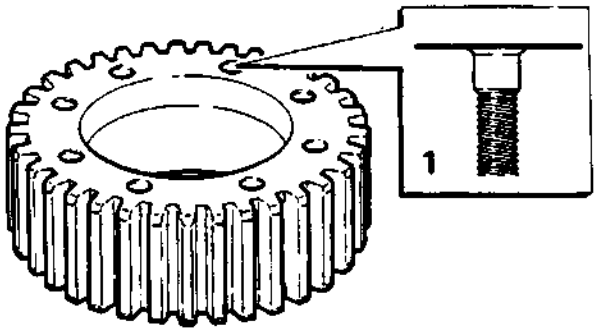


RR2446E

21. Check the overall torque required to turn the differential, this should be approximately equal to both bevel gears added together.
22. Drive or press new bearings onto the differential, noting that the smaller of the two bearings is fitted to the rear half of the differential.

Centre differential sprocket - Assemble

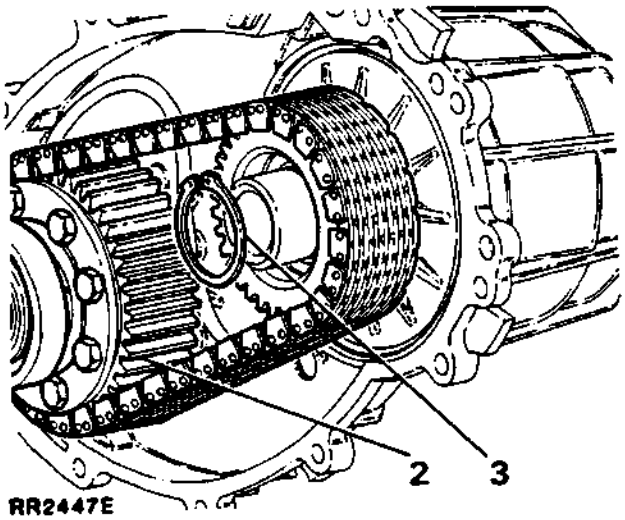
1. Fit the sprocket to the differential noting that the face of the sprocket with the relieved threads must contact the flange of the differential housing. Observe the previously marked identification lines if the original components are being refitted.
2. Fit new bolts and tighten evenly to the specified torque.



RR2446E

Transfer sprocket, centre differential assembly and chain - Assemble

1. Place the differential assembly and transfer sprocket inside the chain. If the original components are being refitted observe the identification marks previously applied to the chain and transfer sprocket. Fit the complete assembly simultaneously.
2. Carefully tap the differential bearing into its bore while easing the transfer sprocket onto the transfer shaft.



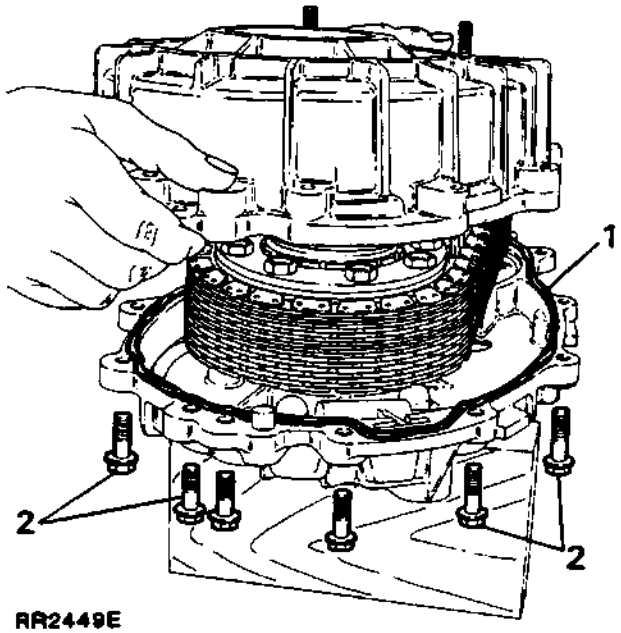
RR2447E

3. Ensuring that the transfer sprocket is fully down, secure the sprocket to the transfer shaft with the circlip.

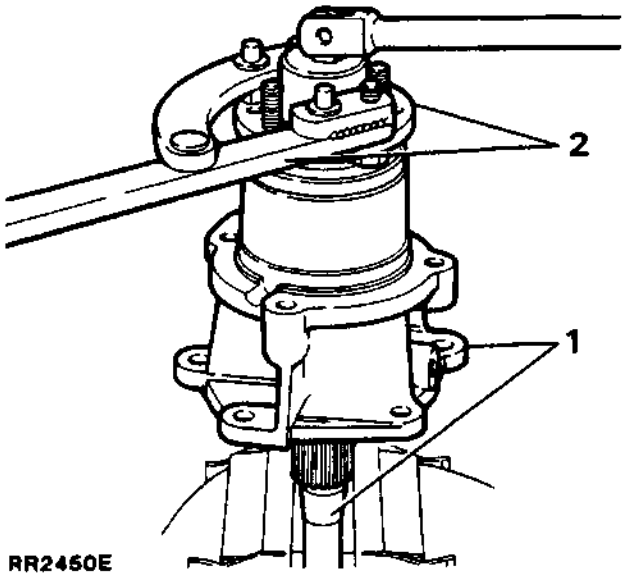
Continued

Front and rear cover - main casing - Assemble

1. Ensuring that the joint faces of the front and rear covers are clean, apply a bead of Dow Corning 732 or a suitable equivalent silicone sealant to the joint face of the rear cover and evenly spread the sealant over the face. Do not over apply the sealant.
2. Fit the front cover, secure with the eleven bolts, tightening evenly to the specified torque. Do not wipe away the surplus sealant which is forced out of the joint.



RR2449E



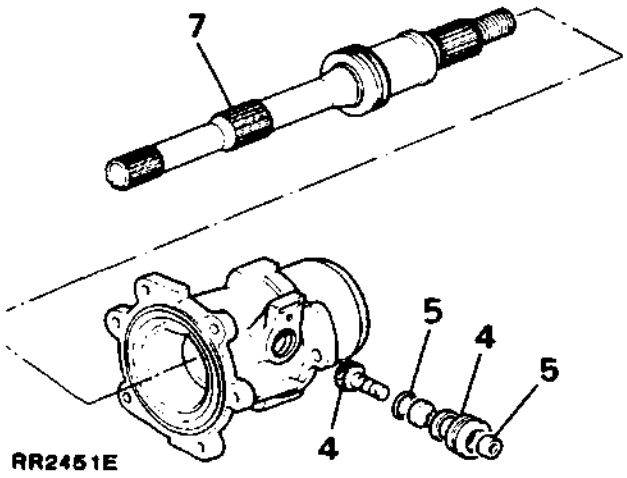
RR2450E

3. Remove the drive flange from the output shaft. Examine the flange for damage or wear particularly the seal running surface, if the surface is corroded or a groove has been worn by the previous seal discard the flange.
4. Prise the speedometer sleeve and driven gear from the housing. Examine the gear teeth for wear, if worn discard the gear.
5. Prise the oil seal from the sleeve and remove the 'O' ring, discard both the seal and 'O' ring.
6. Clean the sleeve and place to one side.
7. Drive or press the output shaft from the housing.

Rear output housing
· Dismantle and inspection

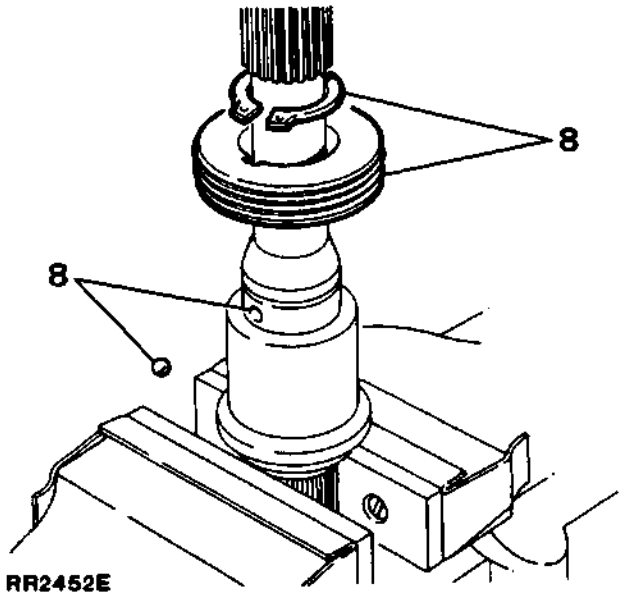
Service tools:
18G1422 - Oil seal replacer
18G1205 · Adjustable flange holding wrench

1. Support the rear output housing by the output shaft in a vice fitted with soft jaws.
2. Using service tool 18G1205 to restrain the drive flange, release and remove the nyloc nut and plain washer securing the drive flange to the output shaft, withdraw the rubber seal. Discard the nut and seal.



RR2451E

8. Clean and examine the splines and speedometer drive gear for wear or damage. The output shaft can be further dismantled if either the speedometer drive gear or output shaft is worn: remove the circlip and slide the gear from the shaft, retrieve the ball bearing from the indent in the shaft. Discard the worn component.

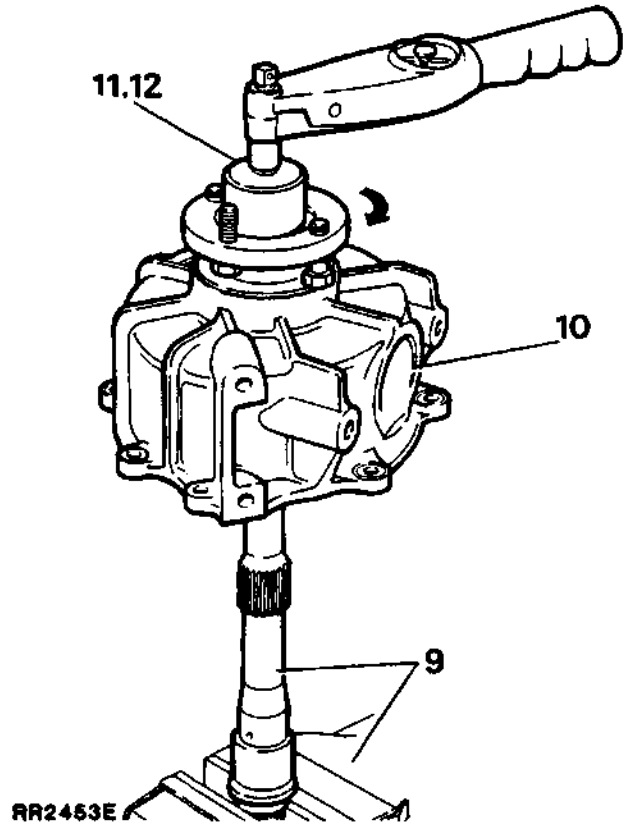


NOTE: While the output shaft is removed from the rear output housing, the shaft can be utilised for checking the rolling resistance of the viscous unit as follows.

Viscous unit - rolling resistance
Bench check

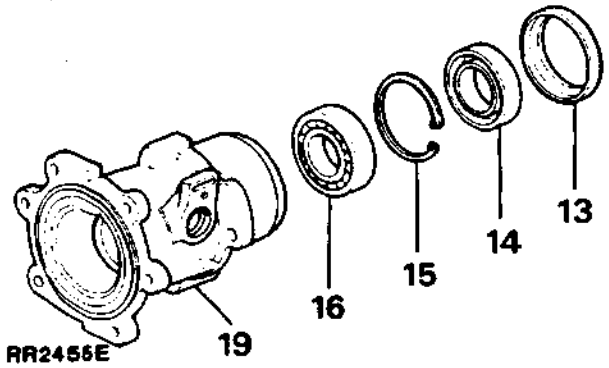
NOTE: Testing should be carried out in an ambient of 20 °C.

9. Secure the output shaft in a vice fitted with soft jaws, gripping the shaft on the drive flange splines.
10. With the viscous unit still installed in the front output housing place the assembly on the rear output shaft spline.
11. Apply a torque of 27 Nm (20lb ft) to the output flange nut, if no resistance to turn is felt, the viscous unit requires replacing.
12. If resistance to turn is felt, apply a torque of 20 Nm (20lb ft), to the output flange nut for 1 minute, this should result in a rotation of approximately 25° - 30°. If this does not occur, the unit requires replacing.



Rear output housing (continued)

13. Lever off the dust shield.
14. Prise the oil seal from the housing and discard the seal.
15. Remove the circlip retaining the bearing.
16. Drive or press the bearing from the housing. Discard the bearing.
17. Remove any previous sealant from the housing joint face.



Continued

18. Thoroughly clean all components with a suitable solvent.
19. Examine the housing for damage and wear. Renew as necessary.

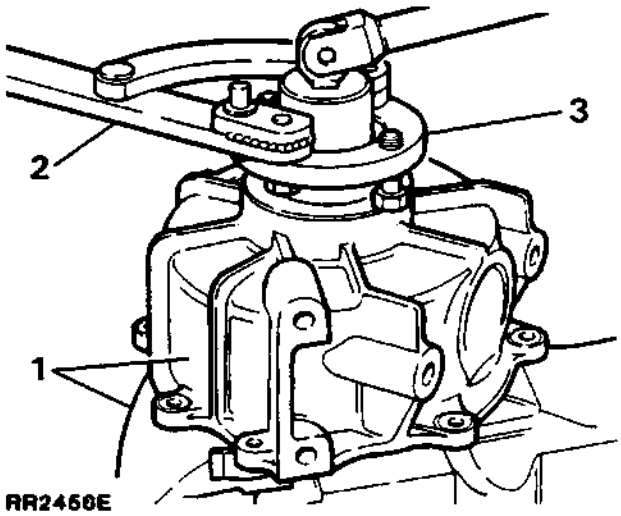
Rear output housing - Assemble

20. Drive or press a new bearing into the housing until the bearing contacts the shoulder.
21. Fit the circlip.
22. Lubricate a new oil seal. Using oil seal replacer 18G1422 fit the seal, lip side leading until it contacts the circlip.
23. Fit the dust shield.
24. Place the ball bearing in the indent on the output shaft, fit the speedometer drive gear to the shaft, secure together with the circlip.
25. Press or drive the output shaft into the housing until the shoulder of the shaft contacts the bearing.
26. Lubricate the oil seal bearing surface of the drive flange and fit the flange followed by a new rubber seal. Fit the steel washer and secure the flange to the shaft using a new nut. Tighten to the specified torque.
27. Lubricate a new speedometer sleeve oil seal, press the seal into the top of the sleeve.
28. Fit a new 'O' ring to the outside of the sleeve, push the driven gear spindle into the sleeve.
29. Lubricate the 'O' ring and push the sleeve and gear assembly into the housing. It may be necessary to rotate the output shaft to ensure that the driven gear engages with the drive gear on the shaft.
30. Apply Dow Corning 732 or a suitable equivalent silicone sealant to the rear output housing joint face on the main casing. Evenly spread the sealant on the face to ensure a good seal.
31. Fit the housing to the main casing and secure with the six bolts tightened to the specified torque.

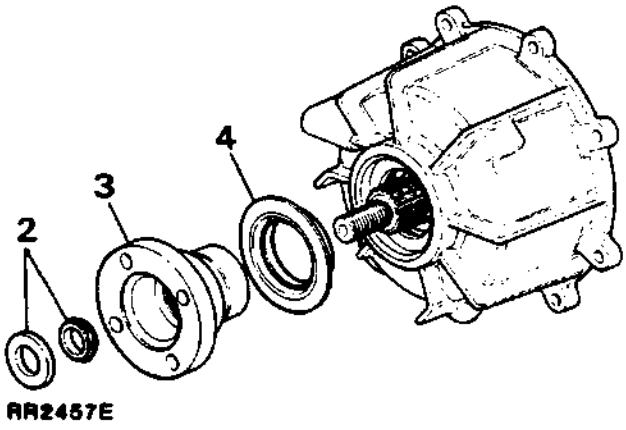
Front output housing
- Dismantle and Inspection

Service tools:
18G1422 - Oil seal replacer.
18G1205 - Adjustable flange holding wrench

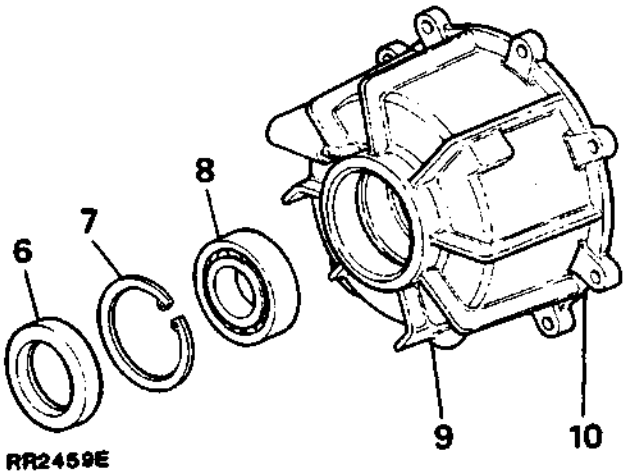
1. Support the viscous unit and front output housing in a vice fitted with soft jaws gripping on the two flats of the viscous unit.
2. Using service tool 18G1205 to restrain the drive flange, release and remove the nyloc nut and plain washer securing the drive flange to the output shaft, withdraw the rubber seal. Discard the nut and seal.
3. Remove the drive flange from the viscous unit. Examine the flange for damage or wear particularly the seal running surface. If the surface is corroded or a groove has been worn by the previous seal discard the flange.



4. If necessary the oil catcher can be carefully pressed from the drive flange, if either a new oil catcher or bolts are being fitted.

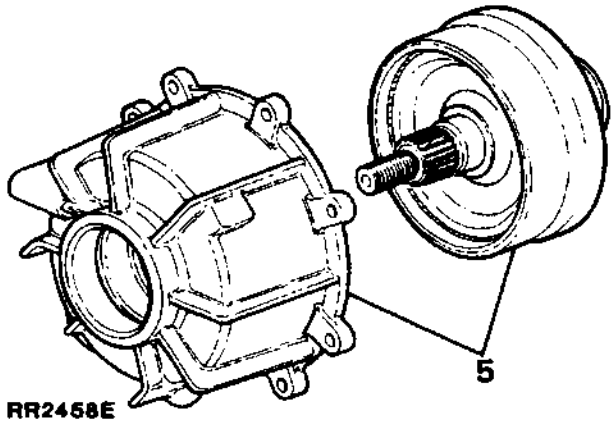


RR2457E



RR2459E

5. Carefully tap the viscous unit out of the housing. If the original unit is being refitted wipe clean with a clean cloth.



RR2458E

NOTE: The viscous unit is a sealed assembly and cannot be further dismantled, a new unit should be fitted if the unit is damaged or if the torque to turn is out of limits.

6. Prise the oil seal out from the front output housing and discard.
7. Remove the circlip retaining the bearing.
8. Drive or press the bearing from the housing and discard.
9. Clean the housing with a suitable solvent.
10. Remove any previous sealant from the joint face of the housing.
11. Examine the housing for damage and wear, renew the housing if necessary.

Front output housing - Assemble

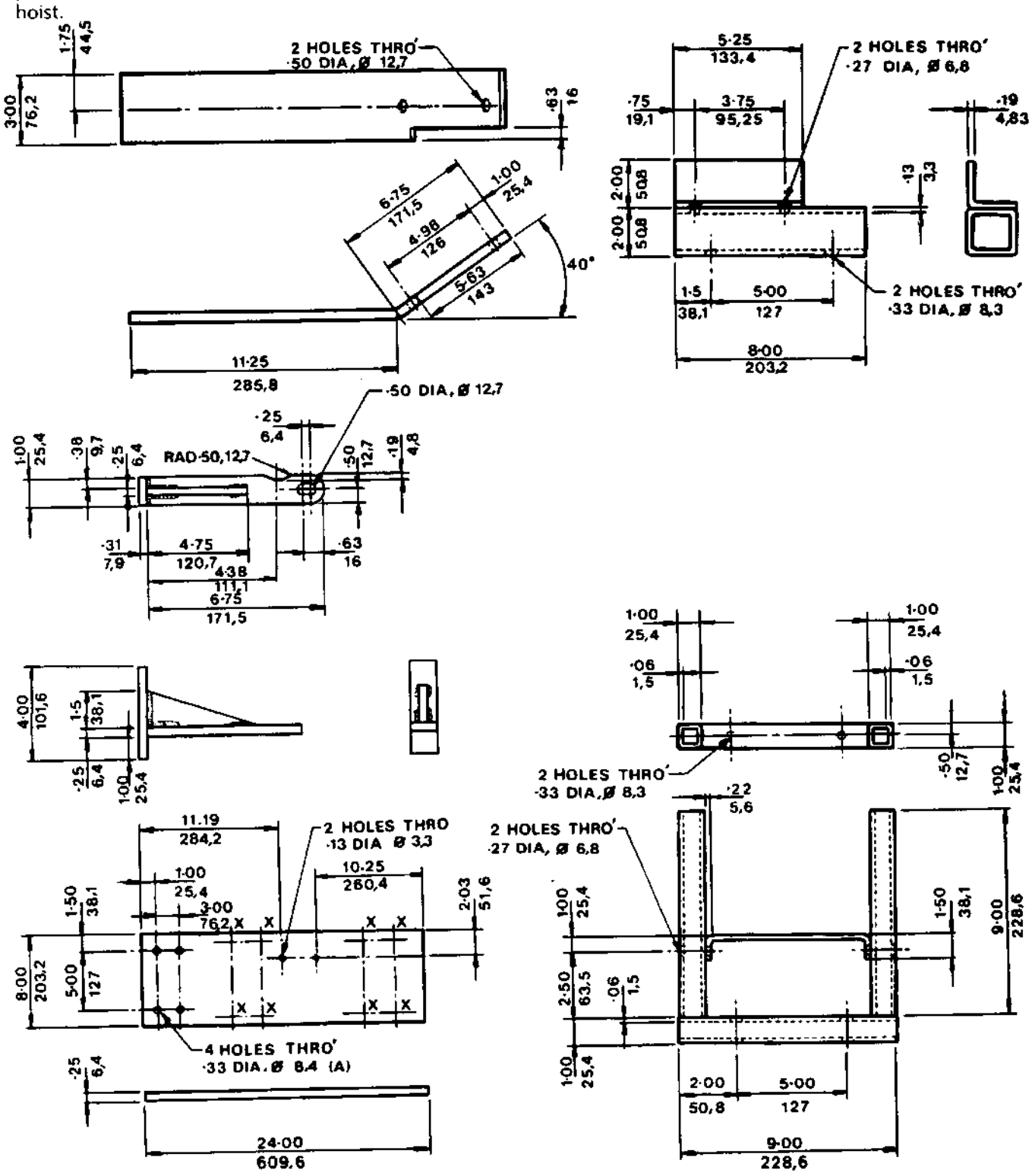
12. Drive or press a new bearing into the housing
13. Fit the circlip to retain the bearing.
14. Lubricate a new oil seal. Using oil seal replacing tool 18G1422 fit the seal, lip side of the seal leading until it contacts the circlip.
15. Carefully tap the original or new viscous unit into the housing until contact is made with the face of the bearing.
16. Lubricate the lips of the seal and fit the flange followed by a new rubber seal; fit the steel washer and secure the flange with a new nut. Tighten to the specified torque.
17. Apply Dow Corning 732 or a suitable equivalent silicone sealant to the output housing joint face of the main casing. Evenly spread the sealant on the face to ensure a good seal.
18. Fit the housing to the main casing and secure in position with the eight bolts tightened evenly to the specified torque.
19. Refit the gearbox to the vehicle. (Refer to transfer gearbox remove and refit).

LT77 FIVE SPEED GEARBOX AND BORG WARNER TRANSFER BOX

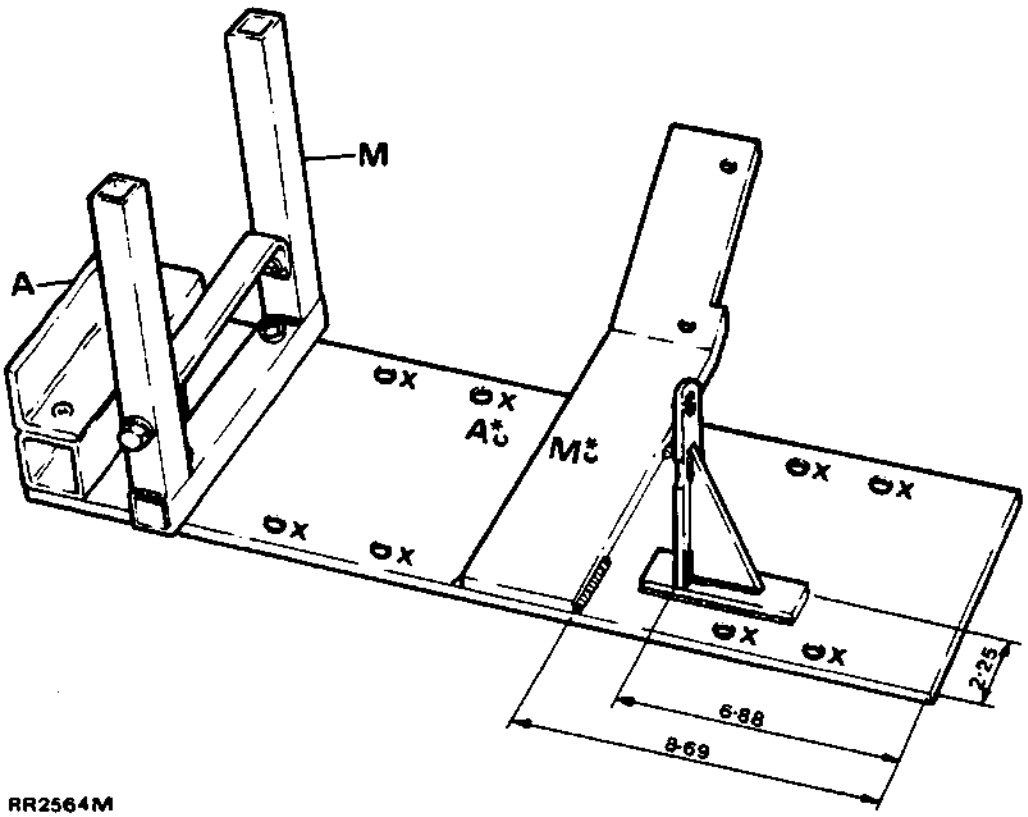
Remove and refit

To assist in the removal of the transmission assembly it is necessary to manufacture an adaptor plate to use in conjunction with a transmission hoist.

NOTE: Four holes (A) to be countersunk on underside suit hoist.



RR2563M



RR2564M

A: Automatic gearbox models
M: Manual gearbox models
A*: Centre of lifting hoist(automatic models)
M*: Centre of the lifting hoist (manual models)
X: Drill fixing holes to suit hoist table

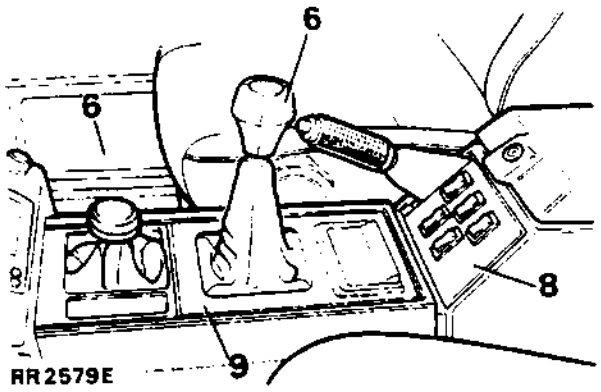
Material: Steel plate BS1449 Grade 4 or 14.

Preparation-under bonnet

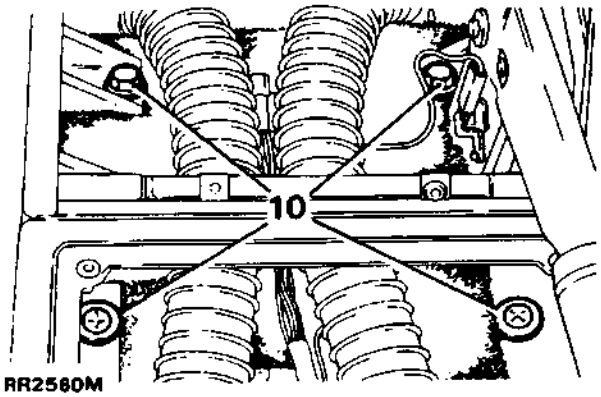
1. Install the vehicle on a ramp and chock the wheels.
2. Disconnect the battery negative lead.
3. Release and remove the fan blade assembly. Note that the nut securing the viscous unit has a left hand thread, released by turning clockwise when viewed from the front.
4. **Fuel injection models** - Disconnect the airflow meter to plenum chamber hose.
5. **Carburetter models only** - Remove the air cleaner from its location.

Inside vehicle

6. Remove the main gear lever knob, select low range and remove transfer gear lever knob.



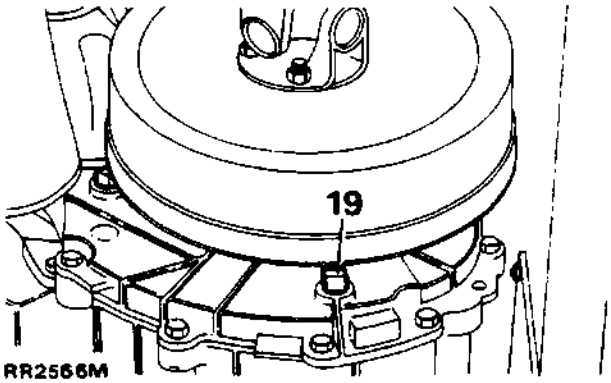
7. Release four screws and remove the glove box liner.
8. Carefully prise the window lift switch panel from the front of the glove box. Push the panel complete with switches back throught the panel aperture and place on transmission tunnel.

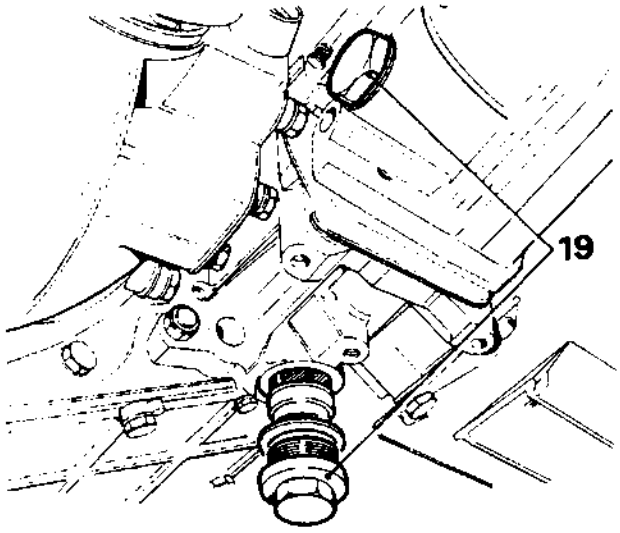


9. Carefully prise the centre panel around the main gear lever out of the floor mounted console.
10. Release the two bolts and two screws securing the glove box/console assembly to the transmission tunnel.
11. Detach the two relay blocks from their mounting inside the glove box.
12. Disconnect the leads to the rear cigar lighter.
13. Release the handbrake, pull the gaiter forward to gain access to the clevis pin. Remove split pin, washer and clevis pin to release inner cable from handbrake lever.
14. Carefully manoeuvre the glove box assembly rearwards (while raising the handbrake lever to its uppermost postion) away from the radio housing and remove the glove box assembly from the vehicle.
15. Remove the sound deadening pad from the top of the transmission tunnel.
16. Slaken the pinch bolt and remove the upper gear lever.
17. Remove the screws and detach the high low lever and main gearlever retaining plates.

Underneath vehicle

18. Raise the ramp.
19. Place a suitable container under the transmission, remove the transfer gearbox, main gearbox and extension housing drain plugs, allow the oil to drain and refit the plugs. Clean the filter on the extension housing plug before refitting.





RR2565M

20. Remove the eight nuts and bolts securing the chassis cross member and remove the cross member. Use a suitable means of spreading the chassis, if necessary.
21. Remove the front exhaust downpipes and intermediate pipe with centre silencer.

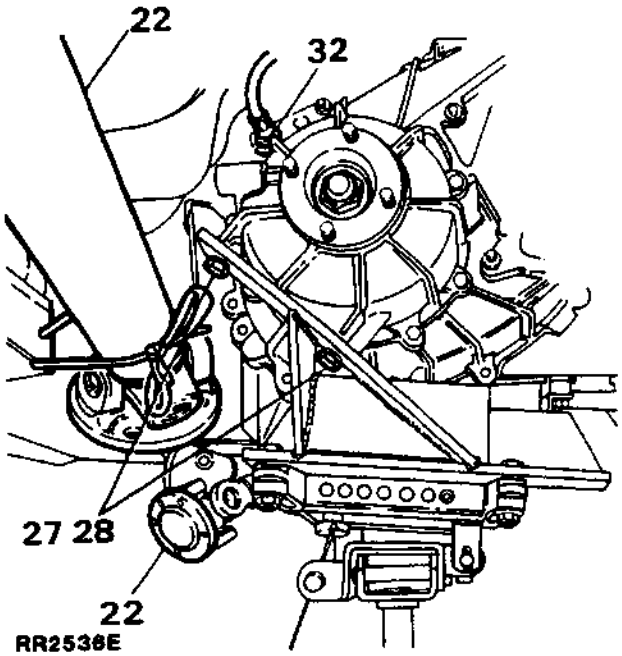
    NOTE: Operation 21 will require the assistance of a second operator to support the exhaust system while the fixings are released.

22. Mark each drive flange for reassembly and disconnect the front and rear propeller shafts from the transfer box. Tie the shafts to one side.
23. Release the clamp and disconnect the speedometer cable from the rear output housing, also free the cable from its clip at the left hand side of the transfer gearbox. Tie the cable to one side.
24. Remove the two bolts and withdraw the clutch slave cylinder from the bell housing.

Remove the transmission assembly

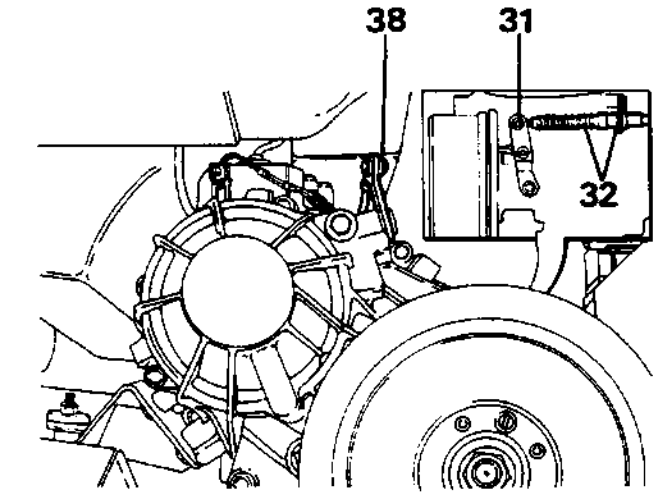
WARNING: Where the use of a transmission hoist is necessary, it is ABSOLUTELY ESSENTIAL to follow the hoist manufacturer's instructions to ensure safe and effective use of the equipment.

25. Position a suitable transmission hoist on the rear output housing or brake drum to support the weight of the transmission assembly.
26. Remove the fixings and wihdraw the transfer gearbox mountings.



RR2536E

27. Secure the previously manufactured fixture to a transmission hoist, raise the hoist and position the fixture under the transfer box mounting points.
28. Secure the fixture to the transfer box mounting points using the original mounting bolts.
29. Remove the transmission hoist from the rear of the transfer box.
30. Carefully lower the transmission until the top of the transfer gearbox clears the rear passenger floor.
31. Disconnect the handbrake cable by removing the split pin, washer and clevis pin.
32. Remove the clip securing the handbrake outer cable to the support bracket, feed the cable through the bracket, and tie cable to one side.
33. Position the transmission hoist under the engine to support the weight while removing bellhousing bolts.
34. Remove the bolts from the bell housing.
35. Ensuring all connections to the engine and chassis are released, withdraw the transmission.



RR2558E

Separating the transfer box from gearbox

36. Remove the transmission assembly from the hoist and cradle and install it safely on a bench.
37. Place a sling round the transfer box and attach to a hoist.
38. Detach the high low link from the transfer gearbox selector lever and remove the breather pipe.
39. Remove the upper and lower bolts and two nuts retaining the transfer box to the extension housing and withdraw the transfer box.

Assembling transfer box to main gearbox

40. Stand the gearbox vertically on the bell housing face on two pieces of wood to prevent damage to the primary pinion which protrudes beyond the bell housing face. Lower the transfer gearbox onto the main gearbox, care should be taken to prevent any damage to seals. Secure the transfer gearbox to the main gearbox and tighten all bolts to the correct torque.
41. Refit the breather pipe and selector link.

Transfer gearbox high/low link adjustment

42. Ensure that the selector lever at the transfer gearbox is in the neutral position.
43. Set the transfer gearbox lever in a vertical position (at right angles to the centre line of the main gearbox). Rotate the fork end of the rod until the holes align with the hole in the selector lever.
44. Fit the clevis pin and retaining clip. Select high and low transfer to ensure full engagement is obtained. Repeat the adjustment procedure if full engagement is not evident.

Refitting

45. Fit the cradle to the transmission hoist and the transmission to the cradle. Smear Hylomar on bell housing mating face with engine.
46. Select any gear in the main and transfer gearbox to facilitate entry of the input shaft. Ensure that the clutch centre plate is in alignment.
47. Position and raise the hoist to line up with the engine, feed the handbrake cable through the aperture in the tunnel, ensure that any pipes or electrical leads do not become trapped.
48. Fit the transmission assembly to the engine and tighten the securing bolts.
49. Reverse the removal procedure noting the following points.
50. Tighten all fixings to the correct torque.
51. Check that the three drain plugs are tight and remove the main gearbox and transfer box filler level plugs. Fill both the main and transfer gearboxes with the recommended oil up to the level of the filler hole. Apply Hylomar sealant to the threads and fit the level plugs and wipe away any surplus oil.
53. Finally road test vehicle.

LT77 FIVE SPEED GEARBOX

OVERHAUL

The following overhaul procedure covers existing gearboxes and also the latest modified version. Improvements include increased capacity layshaft bearings and a new upper gearlever and gear knob. These modifications will improve durability and gearchange quality.

NOTE: Modified gearboxes are identified by the serial number prefix 'F'.

Service Tools:

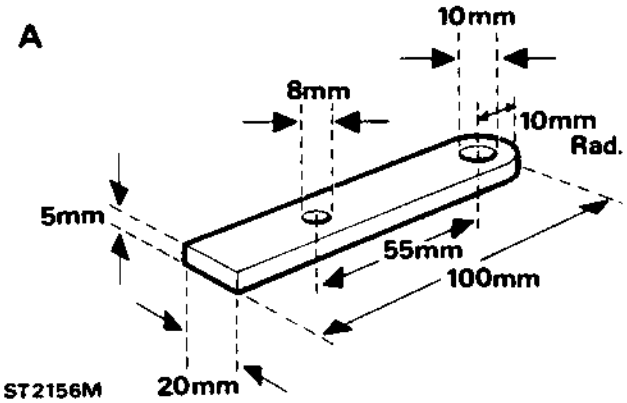
18G705	**- Puller - Bearing remover**
18G705	**- 1A - Adaptor for mainshaft**
18G705	**- 5 - Adaptor for layshaft**
18G705	**- 7 - Adaptor for layshaft - increased capacity bearings**
18G1400	**- Remover for synchromesh hub and gear cluster**
18G1400	**- 1 - Adaptor mainshaft fifth gear**
MS47	**- Hand press**
18G47BA	**- Adaptor, input shaft bearing**
18G47BAX	**- Conversion kit**
18G284	**- Impulse extractor**
18G284AAH	**- Adaptor for input shaft pilot bearing track**
18G1422	**- Mainshaft rear oil seal replacer**
18G1431	**- Mainshaft fifth gear and oil seal collar replacer**
18G1205	**- Flange holder**

Locally manufactured tools

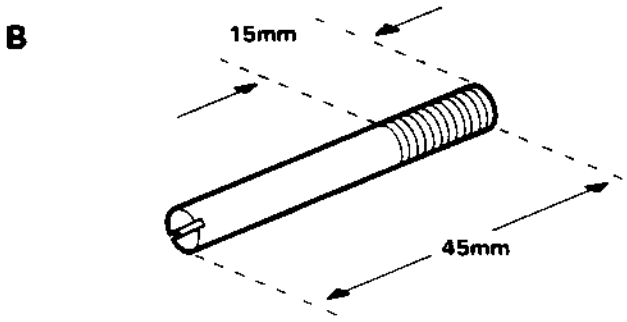
In addition to the service tools, the following items should be manufactured locally to facilitate overhauling the gearbox.

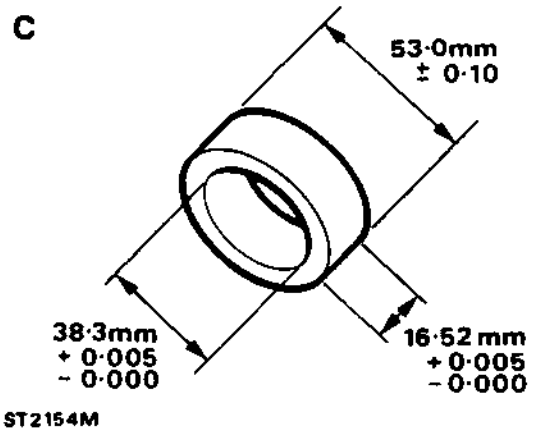
A. Dummy centre bearing, used for selection of first gear bush, material mild steel.

B. Reverse shaft/layshaft fifth gear retainer, used to prevent reverse shaft falling out of gearcase during overhaul, also used to prevent layshaft fifth gear rotation when removing/refitting stake nut. Manufacture using 5mm mild steel. A suitable spacer 20mm diameter, 23mm long with a 8mm diameter hole is required when retaining layshaft fifth gear.

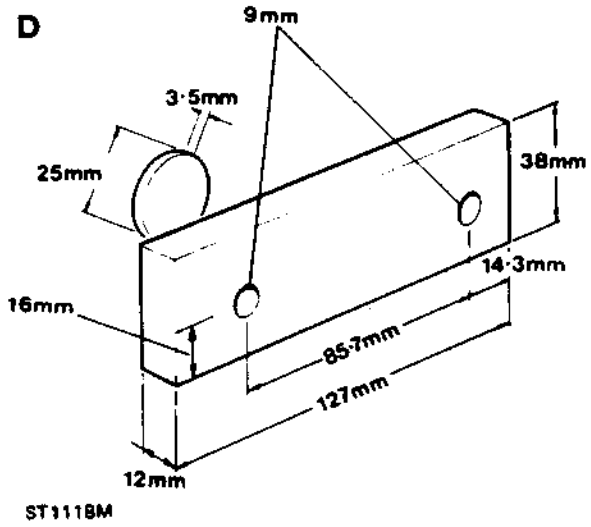


C. Pilot studs, 4 off, threaded 8mm, used when separating centre plate from main gearcase.



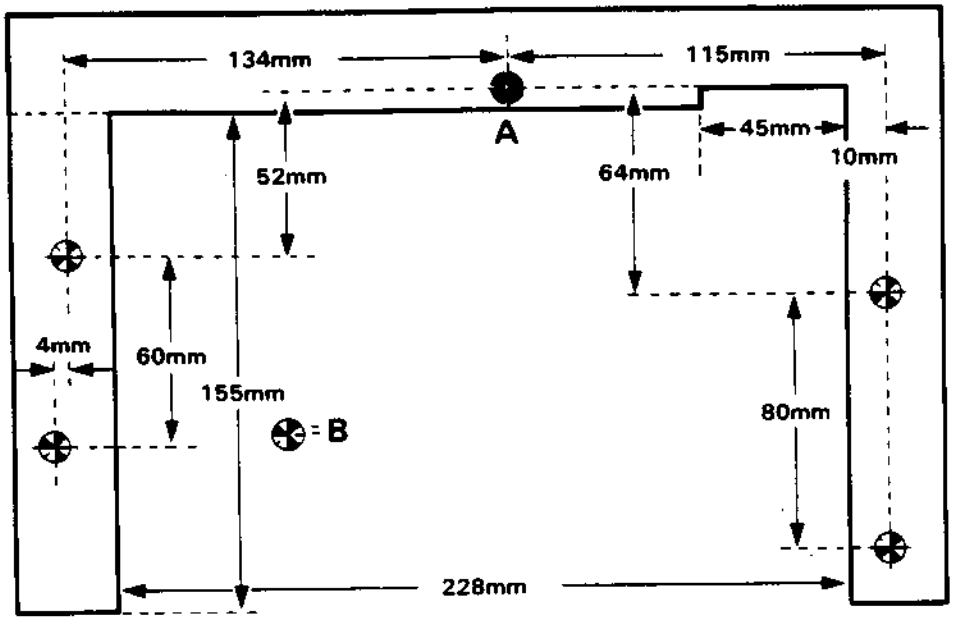


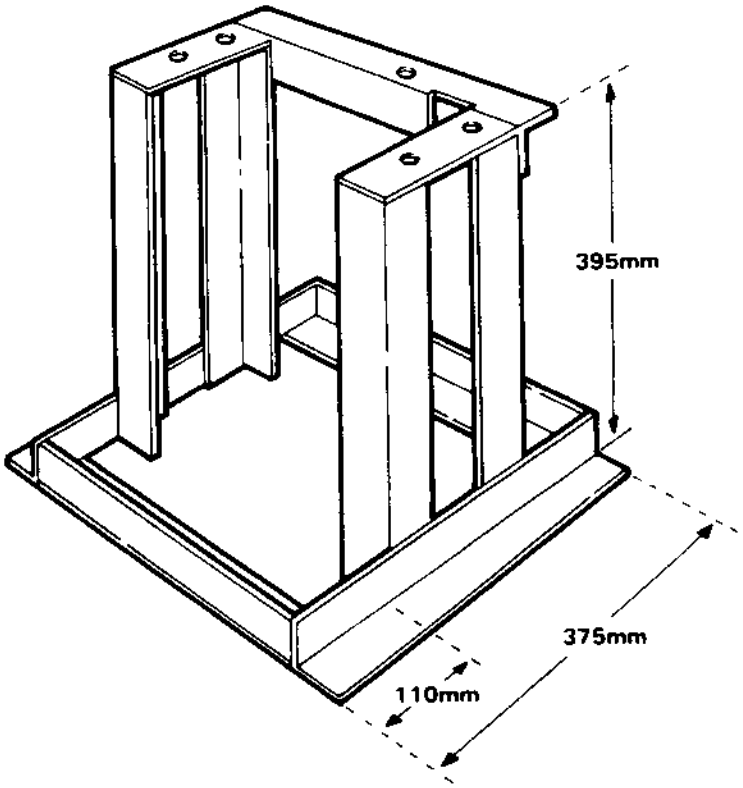
D. Layshaft support plate is fitted using two 8 x 25mm bolts and washers to the front of the gearbox case, it also supports the input shaft bearing outer track.



Continued

E. Gearbox workstand, securely locates gearbox unit during overhaul. Manufacture from 30mm x 30mm angle iron. Plan view of top is half scale. Gearbox security hole (**A**) is drilled 10mm through material. Four countersunk holes (**B**) are for gearbox location. Countersink using a 10mm drill, DO NOT drill through material.

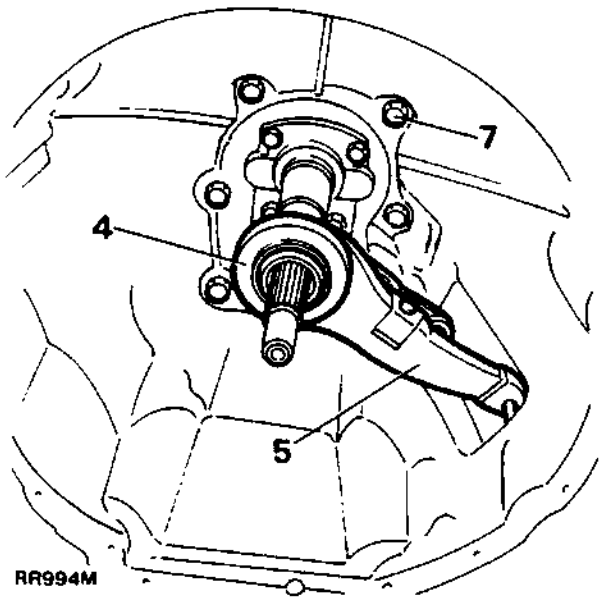




ST2153M

Dismantle

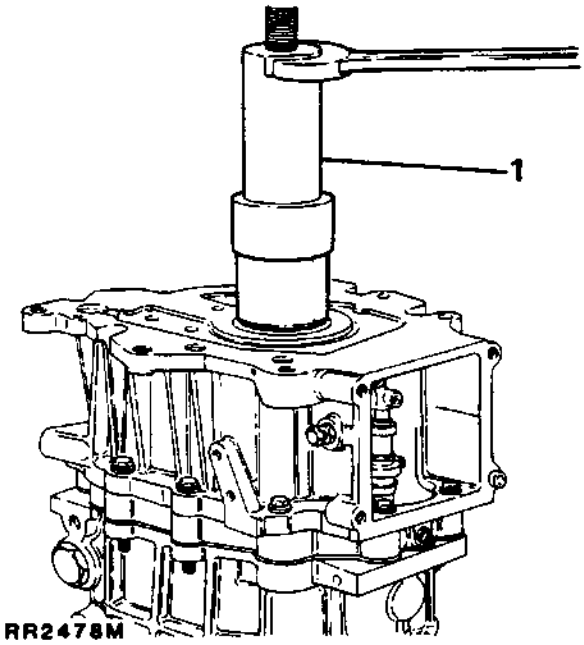
1. Place gearbox on a bench with the transfer gearbox removed, ensuring the oil is first drained. Thoroughly clean the exterior of the gearbox case.
2. Remove the two pan head screws securing the gear change housing top cover. Raise the cover to give access to the gear change housing to extension case securing bolt adjacent to the reverse plunger assembly, and remove the bolt.
3. Remove the three remaining gear change housing to extension case securing bolts, remove the housing complete with transfer gear change assembly.
4. Remove the clutch release bearing plastic staple and remove the clutch release bearing.



5. Release the single bolt and remove the spring clip from the clutch release lever. Pull the lever off the clutch release pivot.
6. If necessary: Remove the clutch release pivot and single bolt retaining the clutch release bearing guide. Withdraw the guide from the input shaft.
7. Remove the six bolts and washers securing the bell housing.
8. Carefully ease the bell housing off the dowels and withdraw it from the gearbox.
9. Remove two dowel tubes from the front of the casing and secure the gearbox unit to the workstand by one nut and bolt.

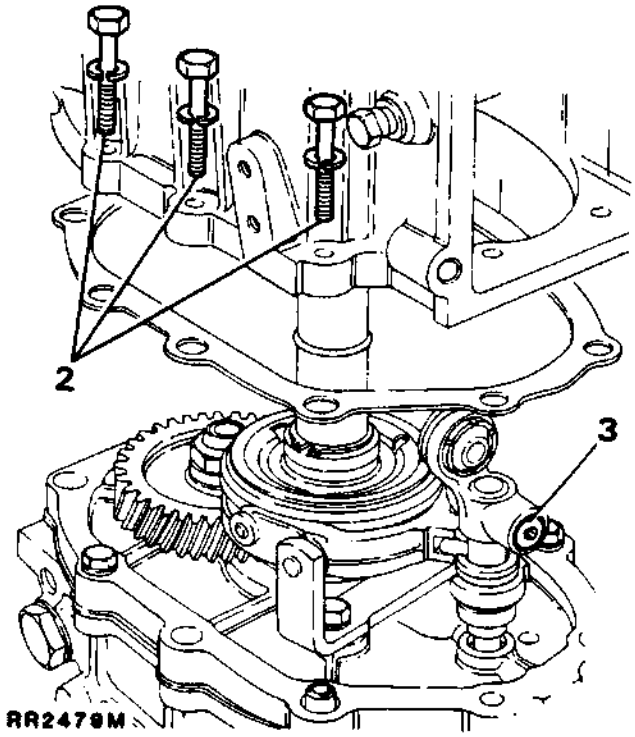
Extension housing

1. Remove the circlip which retains the mainshaft oil seal collar located at the rear of the gearbox. Using tools 18G705 and 18G705 - 1A remove the oil seal collar.



2. Remove the ten bolts and spring washers securing the fifth gear extension case to the gearcase. Carefully withdraw the extension case ensuring that the centre plate does not separate from the main case. Discard the gasket.

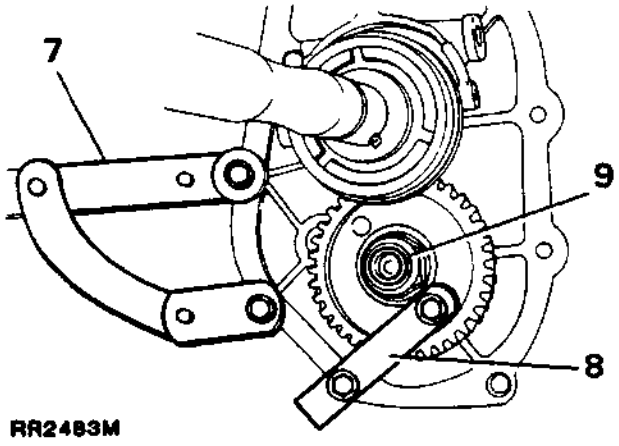
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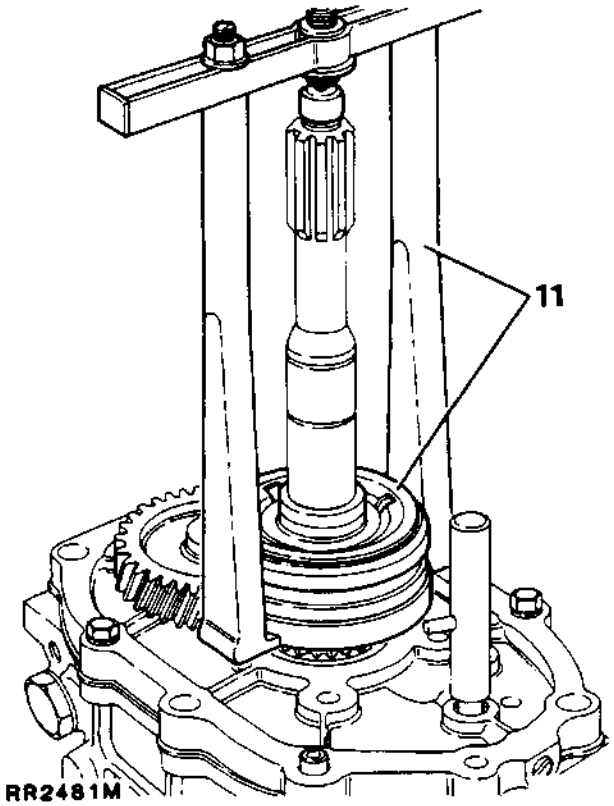
3. Slacken the socket head screw and remove the selector yoke from the selector shaft.

Fifth gear

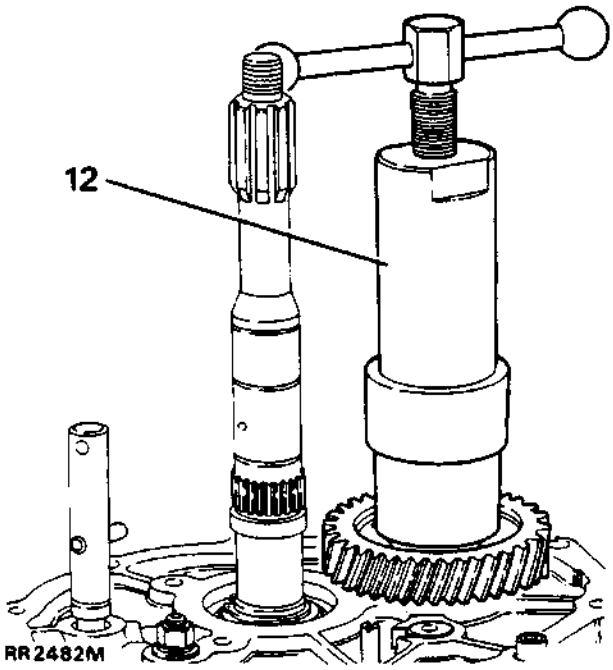
1. Fit two slave bolts (8 X 35 mm) to the casing to retain the centre plate to the main case.
2. Remove the oil seal collar 'O' ring from the mainshaft.
3. Withdraw the oil pump drive shaft.
4. Remove the two 'E' clips from the selector fork pivot pins retaining the 5th selector fork to its bracket and remove the pins, fork and pads.
5. Withdraw the fifth gear selector spool.
6. Remove the two bolts and spring washers and withdraw the fifth gear selector fork bracket.
7. Secure the flange holder 18G1205 to left hand side of gearcase.
8. Bolt the layshaft fifth gear retainer to the gearcase using the spacer. Insert a suitable length of bar, or a 10 mm bolt, through pierced hole in gear to prevent rotation.



9. De - stake the nut securing fifth layshaft gear and remove the nut.
10. Release the circlip retaining the fifth gear synchromesh assembly to the mainshaft.
11. Using tools 18G1400 - 1 and 18G1400 withdraw the selective washer, fifth gear synchromesh hub and baulk ring, fifth gear (driven), spacer and split roller bearing from the mainshaft.

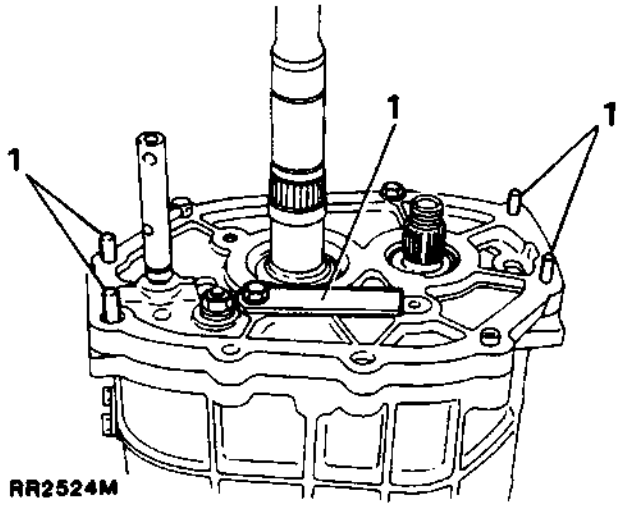


12. Using tools 18G705 and 18G705 - 1A, remove the layshaft fifth gear.

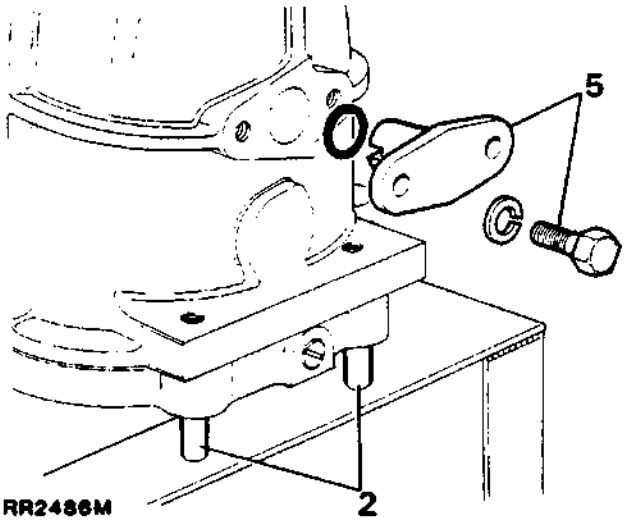


Main gearbox case

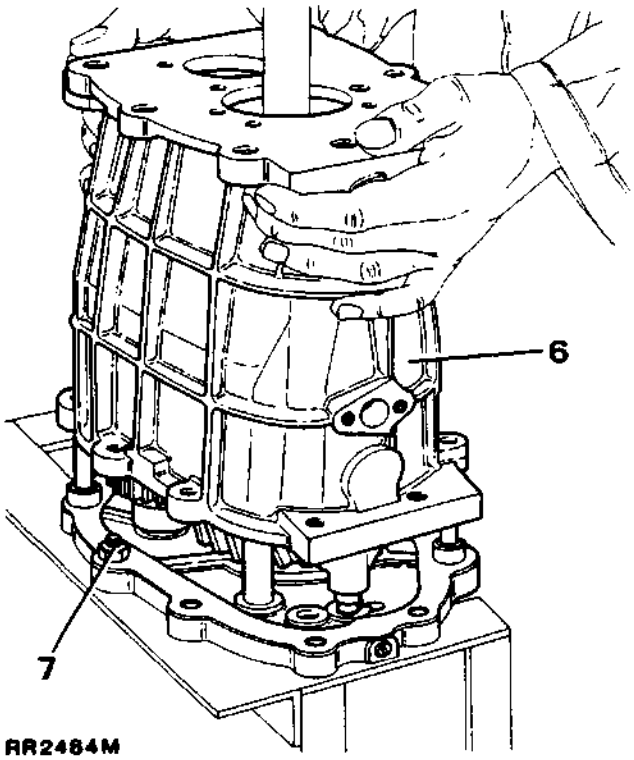
1. Fit the reverse shaft retainer using one of the fifth gear bracket mounting bolts. Fit the four guide studs to the main gearbox case to locate in the workstand.



2. Release the gearbox from the workstand, invert the assembly and locate the four studs on the workstand.



3. Remove the six bolts and spring washers from the front cover, withdraw the cover and discard the gasket.
4. Retrieve the input shaft and layshaft selective washers from the gearcase.
5. Remove the two bolts and washers and withdraw the retainer for the selector shaft front spool. Note that later models have an 'O' ring with a counterbore in the gearcase.

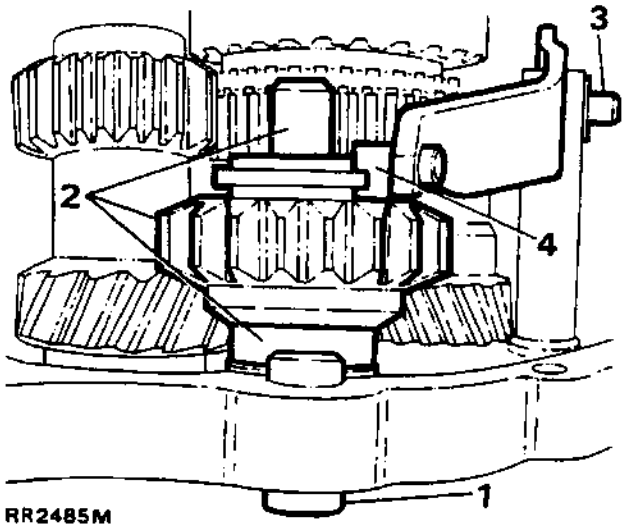


6. Remove the slave bolts and carefully lift the gearcase, leaving the centre plate and gear assemblies in position.

7. Secure the centre plate to the workstand with a nut and bolt when the plate and casing have separated. Discard the gasket.

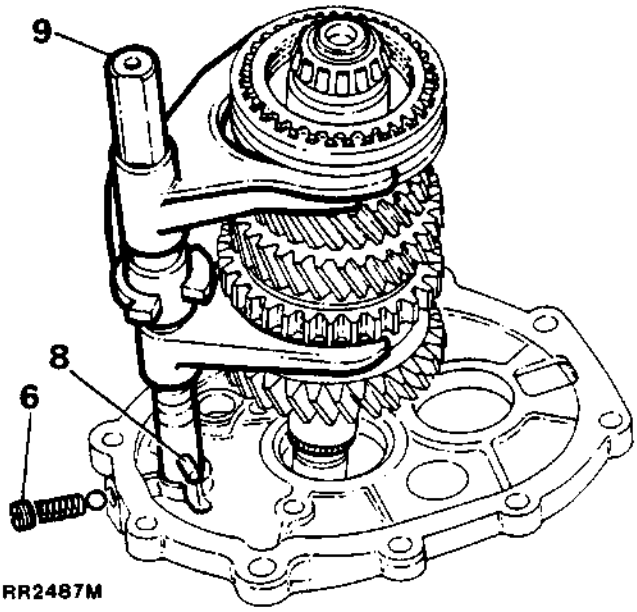
Reverse shaft, layshaft and mainshaft

1. Release the reverse shaft retainer and remove the shaft.
2. Lift off the thrust washer, reverse gear and spacer from the centre plate.
3. Remove the pivot pin securing the reverse lever without removing the 'E' clip.
4. Remove the reverse lever and slipper pad.



RR2485M

5. Remove the input shaft and fourth gear baulk ring.
6. Withdraw the selector plug, spring and detent ball from the centre plate.
7. Lift off the layshaft cluster by tilting it away from the mainshaft, simultaneously lifting the mainshaft slightly to clear the rear layshaft bearing.
8. Rotate the fifth gear selector shaft anti - clockwise (viewed from above) to align the fifth gear selector pin with the slot in the centre plate.

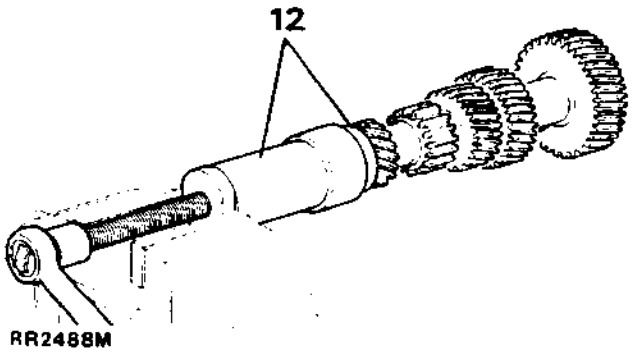


RR2487M

9. Remove the mainshaft and selector fork assemblies from the centre plate together.
10. Detach the selector fork assembly from the mainshaft gear cluster.
11. Remove the nut and bolt and release the centre plate from the workstand.

Layshaft

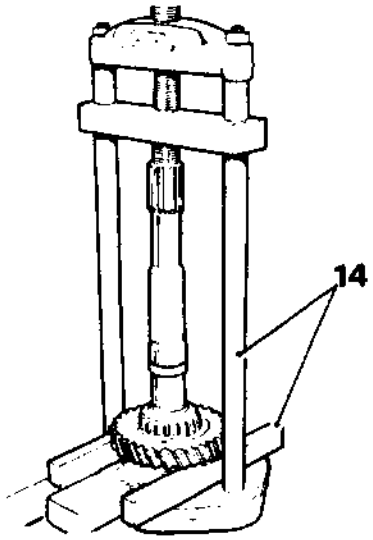
12. Using press 18G705 and tool 18G705 - 5 (18G705 - 7 if the increased capacity bearings are fitted) remove the layshaft bearings.



RR2488M

Mainshaft

13. Remove the centre bearing circlip.
14. Using press MS47 and two suitable metal bars to support first gear, remove the centre bearing, first gear bush, first gear and needle bearings and first gear baulk ring.



RR2489M

15. If a difficulty is experienced in removing the first and second gear synchromesh hub, support the second gear with the bars, and operate the press to release the first/second synchromesh unit, second gear, baulk ring and needle bearings.
16. Turn the mainshaft through 180° and repeat the operation using press MS47 and a suitable extension. Support third gear, press the mainshaft through the pilot bearing spacer, third and fourth synchromesh unit, third gear baulk ring, third gear and needle bearings.

INSPECT AND PREPARE FOR REBUILDING

NOTE: It is essential that all components are thoroughly cleaned and inspected before the rebuild is commenced. During the rebuild it is recommended that new bearings are fitted.

Main gearbox casing

1. Remove the mainshaft and layshaft bearing tracks from the main casing.
2. Remove the plastic oil trough from the front of the casing.
3. Clean gearcase thoroughly using a suitable solvent. Inspect case for cracks, stripped threads in the various bolt holes, and machined mating surfaces for burrs, nicks or any condition that would render the gearcase unfit for further service. If threads are stripped, install Helicoil, or equivalent inserts.
4. Insert a new plastic oil scoop inside the front of the casing, ensuring that the scoop side faces the top of the casing.

Front cover

1. Remove and discard the oil seal from the front cover. Do not fit a new oil seal at this stage.

Centre plate

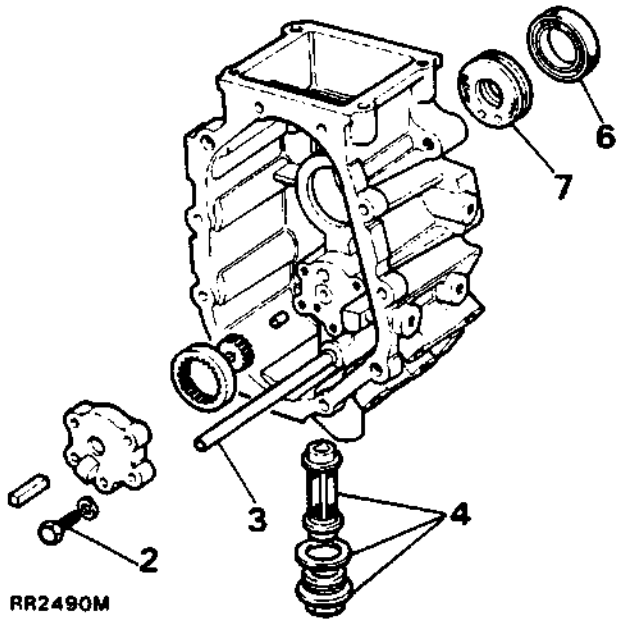
1. Remove the layshaft and mainshaft bearing tracks from the centre plate. If required remove the reverse pivot post.
2. Inspect the bearing plate for damage and check the selector rail bore hole for wear.

Continued

Extension case

1. Examine the extension case for obvious signs of damage to threads and joint faces.
2. Remove the three oil pump housing bolts, spring washers and oil pump gears and housing. Inspect gears, renew if necessary
3. Do not withdraw oil pick - up pipe.
4. Remove the plug, washer and filter.
5. Ensure that the oil pick - up pipe is free of contamination or blockage.
6. Invert casing and extract the oil seal.
7. Press out the ferrobestos bush from the casing.

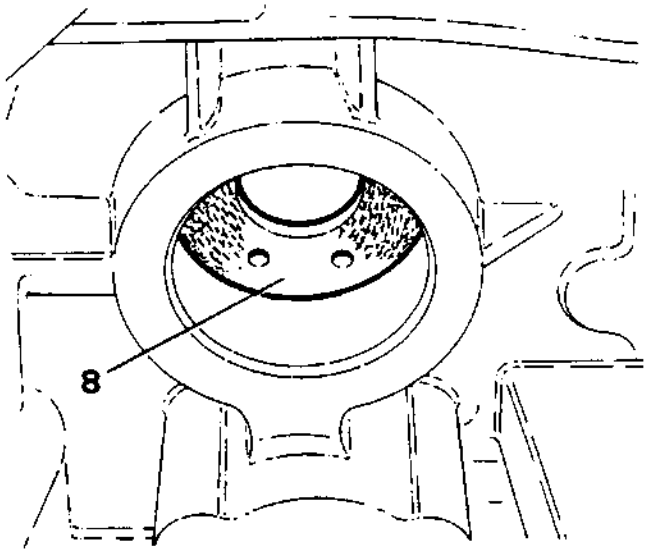
WARNING: This component contains asbestos DO NOT use an air line when cleaning, as breathing asbestos dust is dangerous to your health. Use methylated spirit or denatured alcohol to clean asbestos components.



RR2490M

8. Press a new ferrobestos bush fully into position, ensuring the two drain holes are towards the bottom of the case.

NOTE: If a new extension case is fitted, it is essential that a grub screw is securely fitted in the main oilway located in the rear of the case.



RR2491M

9. With the aid of tool 18G1422, fit a new oil seal to the rear of the extension case. Ensure the seal lips are towards the ferrobestos bush. Lubricate the seal lips with a suitable SAE 140 oil.
10. Assemble and fit the fibre oil pump gears to the oil pump cover, whilst ensuring the centre rotor square drive faces the layshaft.
11. Fit the three bolts and spring washers to secure the oil pump cover, and tighten to the correct torque.
12. Fit a new oil filter, fibre gasket and tighten plug to the correct torque.

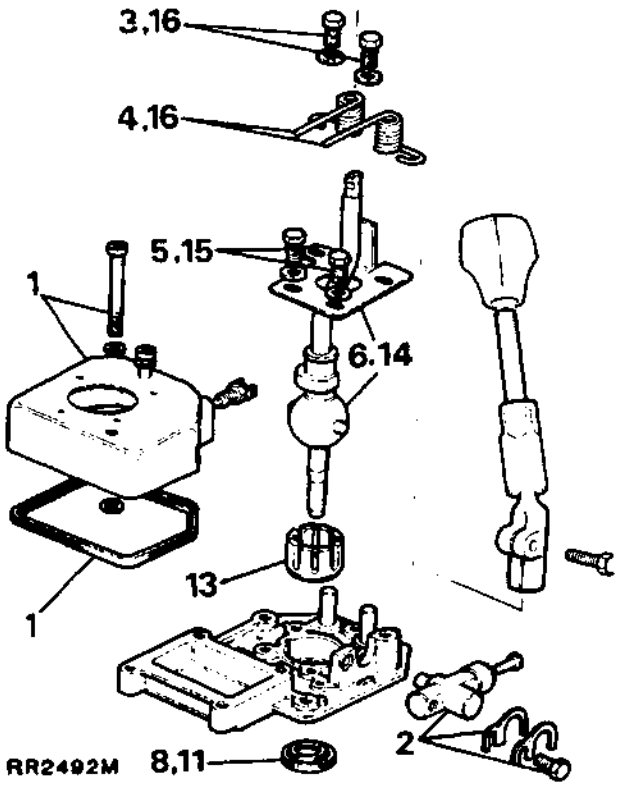
Gear change housing

NOTE: The upper and lower gear levers are loctited together on vehicles produced from late 1985 onwards. If difficulty is experienced in separating these two components, a complete new assembly should be fitted.

LATER VEHICLES: To eliminate this problem a new upper gear lever, using a pinch bolt fixing to lower lever, is now fitted. The top of the lower gearlever is grooved to locate upper lever pinch bolt.

1. Release the single bolt with plain washer securing the reverse plunger to the gear change housing.
2. Withdraw the plunger and retain the shims.

3. Remove the two bolts and washers anchoring the bias springs.
4. Release the springs from the register at the gear lever and remove them from the dowels. Restrain the springs using suitable grips whilst releasing bolts.
5. Remove the remaining two bolts securing the bias adjustment plate to the housing.
6. Remove the lower gear lever and bias plate from the housing.
7. Check the security of the spool guide bolts, located on the underside of the gear change housing.
8. Prise the seal from the bottom of the gear change housing.
9. Examine the gear change housing, ensuring that the cross pin location slots are not worn.
10. Inspect the condition of the bias springs renew if necessary.

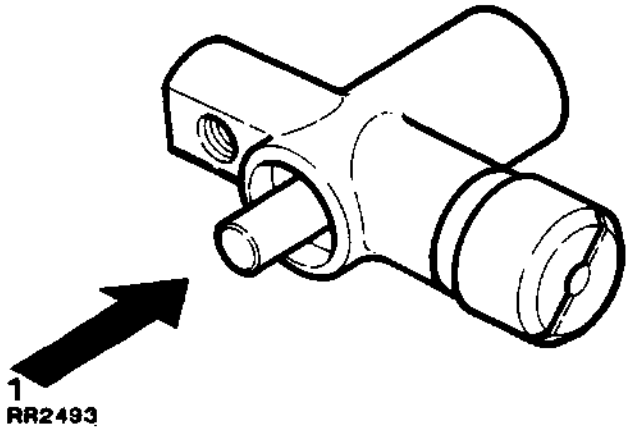


11. Fit a new seal to the bottom of the housing, lips of the seal uppermost.
12. Lightly grease the lower gear lever ball with Shell Alvania R3.
13. Fit a new railko bush.
14. Fit the assembly to the housing locating the two pegs on the ball in the recesses of the ball seat.
15. Locate the bias adjustment plate, coat two of the retaining bolts with Hymolar PL32 or Loctite 290 and fit them forward of the gear lever. Do not tighten the bolts at this stage.
16. Fit the springs onto the posts, coat the remaining two bolts with Hylomar PL32 or Loctite 290 and fit to the housing to secure the springs in position. Do not tighten the bolts at this stage.
17. Carefully lever the free end of the springs around the rear of the gear lever until they are retained by the stop on the adjustment plate.
18. Do not fit the top cover at this stage.

Reverse gear plunger assembly

NOTE: The plunger assembly is not a serviceable item. To check that the unit is operating correctly proceed as follows.

1. Apply a load of between 45 to 55 kg (100 to 120 lb) to the plunger nose. If the plunger is operational within these limits the unit is satisfactory. If the plunger operates outside the limits renew the plunger assembly.



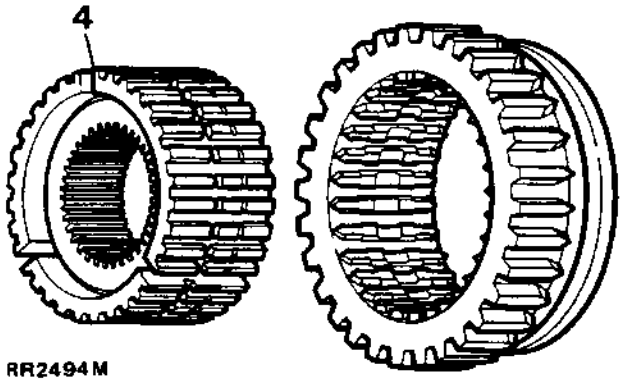
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Synchromesh assemblies

1. Mark the hub and sleeve to aid reassembly. Lever the backing plate off the fifth gear synchromesh assembly. Remove the slipper springs from the front and rear of each synchromesh assembly.
2. Withdraw the slippers and hub from the sleeve.
3. Inspect the springs and slippers for wear or breakage, fit new components where necesary. Inspect all the synchromesh components and fit new parts if there is evidence of chipped teeth or excess wear.

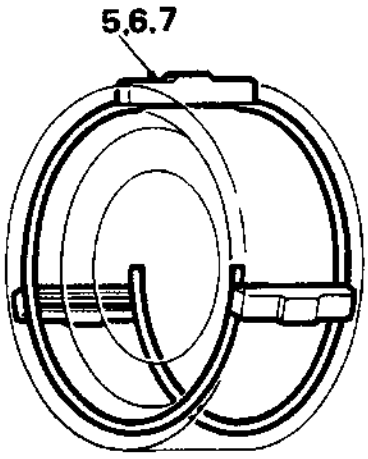
   NOTE: With the outer sleeve held, a push - through load applied to the outer face of the synchromesh hub should register 8,2 to 10 kgf m (18 to 22 lbf ft) to overcome the spring detent in either direction.

4. Assemble the first and second synchromesh assembly by locating the shorter splines on inner member towards the second gear. Note that the outer member selector fork groove is to the rear of the gearbox



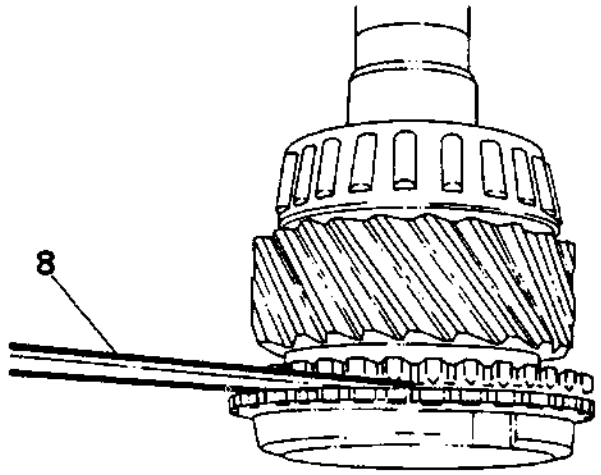
RR2494M

5. Refit the slippers and locate the slipper springs to each side of the assembly, ensuring that the hooked ends of both slipper springs are located in the same slipper, but running in opposite directions and fully located against the other two slippers.



RR2495M

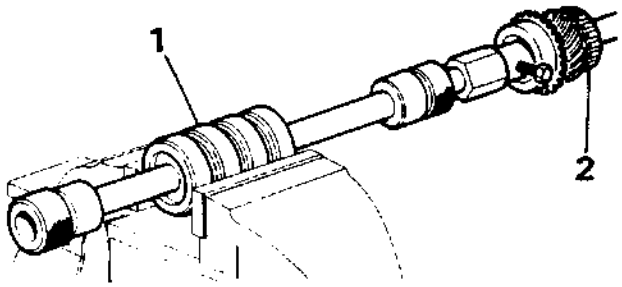
6. Assemble the third and fourth synchromesh assembly. Refit the slippers and locate the slipper springs to each side of the assembly, ensuring that the hooked ends of both slipper springs are located in the same slipper, but running in opposite directions and fully located against the other two slippers.
7. Assemble the fifth synchromesh hub assembly again ensuring the hooked ends of both slipper springs are located in the same slipper, but running in opposite directions. Fit the backplate onto the rear of the synchromesh hub assembly. Ensure the tag on the backplate locates in the slot on the hub.
8. Check the wear between all the baulk rings and gears by pushing the baulk ring against the gear and measuring the gap between the gear and baulk ring. The minimum clearance (earlier vehicles) is 0,64 mm (0.025 in). Molybdenum coated baulk rings are fitted to later boxes which may be used on all gears on any LT77 gearbox, in which case the minimum clearance is 0,38mm (0.015 in). If required clearance is not met, fit new baulk rings.



RR2496M

Input shaft

1. With the aid of tools 18G284AAH and 18G284, extract the pilot bearing track.
2. Using tools MS47 and 18G47BA, remove the input shaft bearing.



RR2497M

3. Inspect the shaft for wear or damage, and polish the oil seal track using fine emery cloth if required.
4. Using tool MS47 and a suitable tube, fit a new pilot bearing track to the input shaft.
5. Fit a new input shaft bearing using tools MS47, 18G47BA and 18G47BA - X.

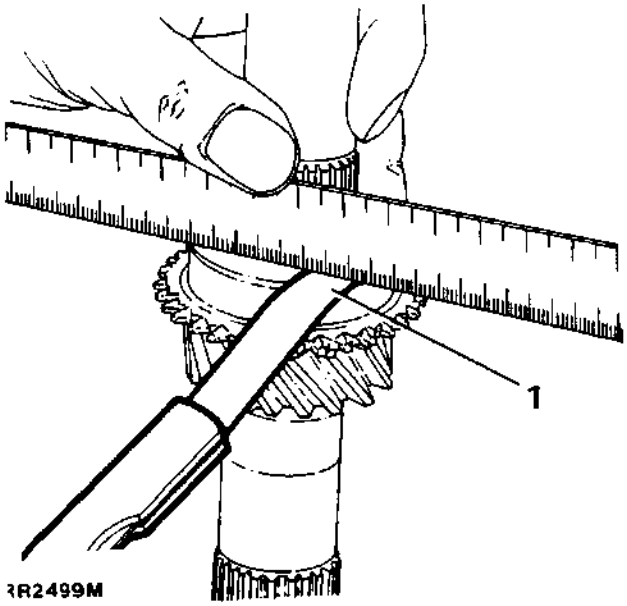
Mainshaft

1. Examine each roller bearing surface for wear, and check the condition of the circlip grooves. Inspect the mainshaft splines, especially if any of the synchromesh units were found to be a loose fit during dismantling.
2. Ensure the oilways are free from sludge or contamination. Thoroughly clean with compressed air, observing the necessary safety requirements.
3. Check that the roll pins, pressed into the oil outlets to restrict oil flow to the bearings, are fitted below the bearing surface.

Mainshaft end float checks

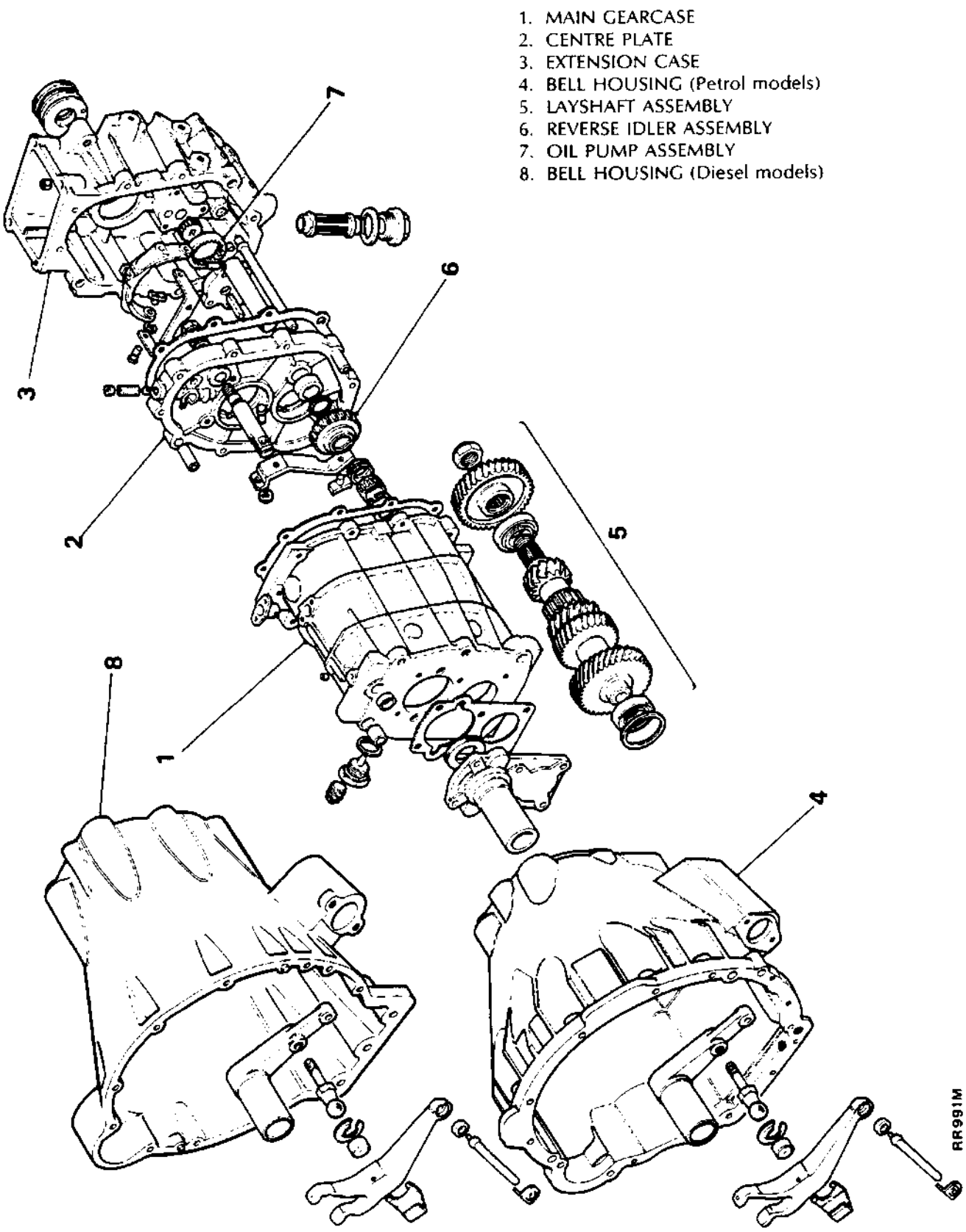
Fifth gear

1. Fit the thrust washer, split roller bearing and fifth gear to the mainshaft, place a straight edge on the shoulder and using feeler gauges check the end float between gear and shoulder. End float should not be in excess of 0,20 mm (0.008 in) maximum. If end float is outside limit inspect the washer and gear faces for wear.

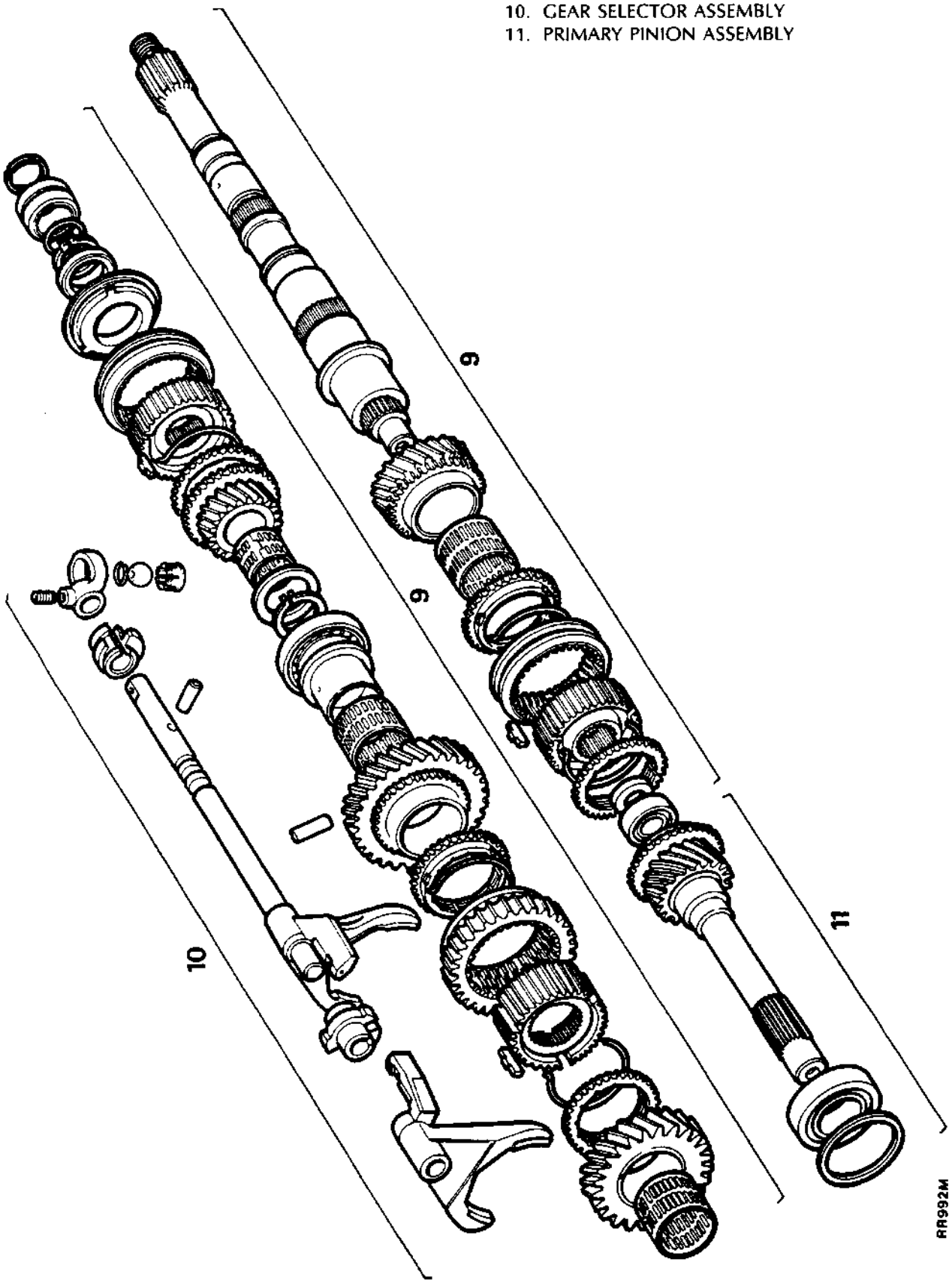


RR2499M

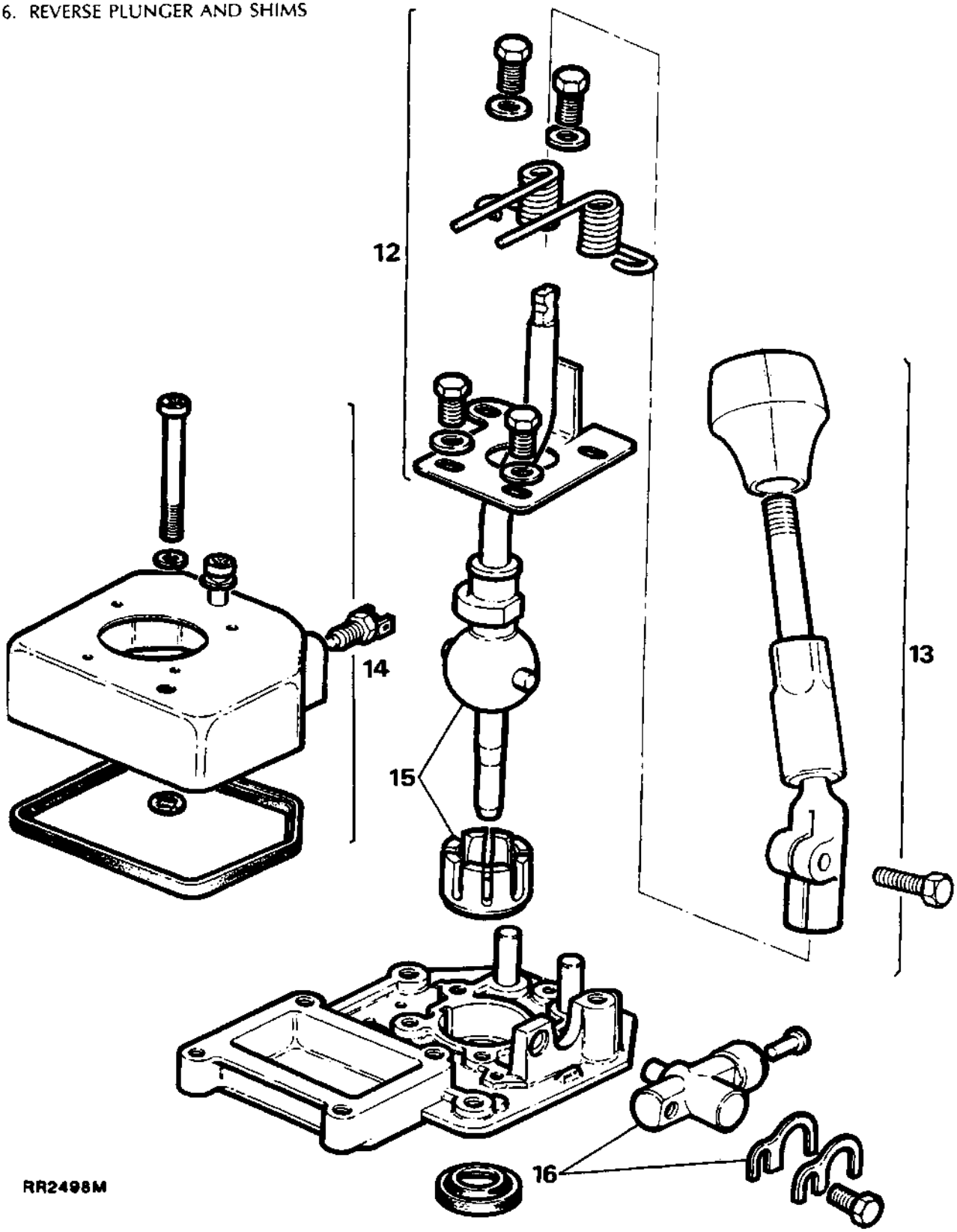
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1. MAIN GEARCASE
2. CENTRE PLATE
3. EXTENSION CASE
4. BELL HOUSING (Petrol models)
5. LAYSHAFT ASSEMBLY
6. REVERSE IDLER ASSEMBLY
7. OIL PUMP ASSEMBLY
8. BELL HOUSING (Diesel models)
RR991M

9. MAINSHAFT AND GEAR ASSEMBLY
10. GEAR SELECTOR ASSEMBLY
11. PRIMARY PINION ASSEMBLY

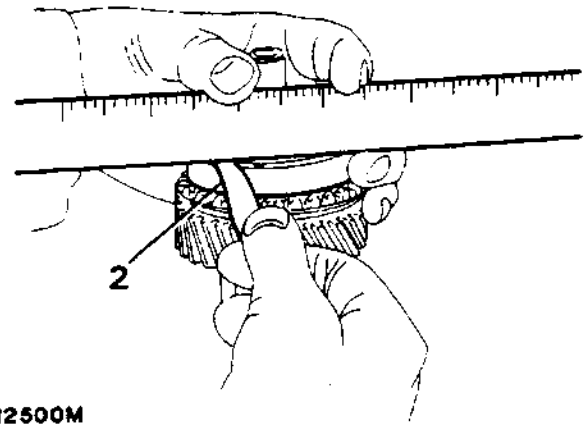


12. BIAS PLATE ASSEMBLY
13. UPPER GEAR LEVER ASSEMBLY
14. GEARBOX TOP COVER AND SEAL
15. LOWER GEAR LEVER AND BUSH
16. REVERSE PLUNGER AND SHIMS



Third gear

2. Refit the third gear and roller bearing to the mainshaft. Check third gear end float, by placing a staight edge on the mainshaft and checking the clearance between the gear and flange on the mainshaft, between the gear face and mainshaft flange. The end float should not be in excess of 0,20 mm (0.008 in) maximum. If end float is outside specified limit check flange and gear faces for wear.

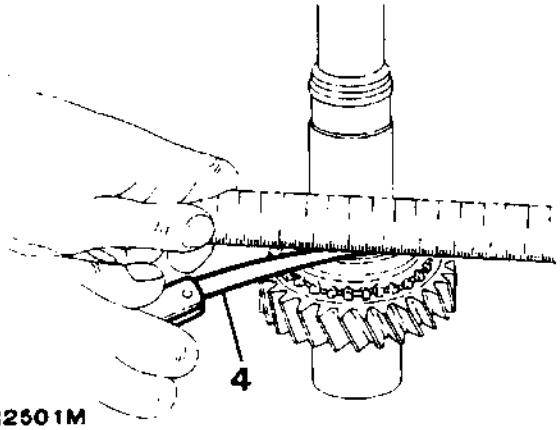


RR2500M

1

Second gear

3. Lubricate the second gear needle bearing with a light oil and fit the bearing and second gear to the mainshaft.
4. Check the second gear end float, by placing a staight edge on the mainshaft and checking the clearance between the gear and flange on the mainshaft, end float should not be in excess of 0,20 mm (0.008 in) maximum. If end float is outside limit inspect the flange and gear faces for wear.

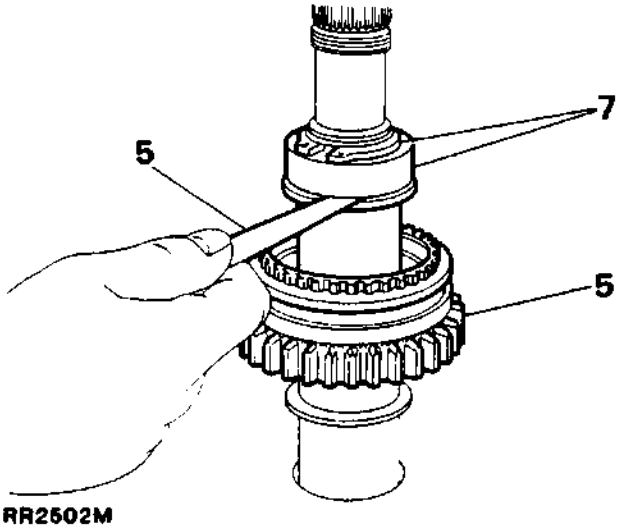


RR2501M

First gear bush end float

NOTE: It is essential to select first gear bush before checking first gear end float.

5. Fit the first and second synchromesh hub assembly with the selector fork groove to the rear of the mainshaft.



RR2502M

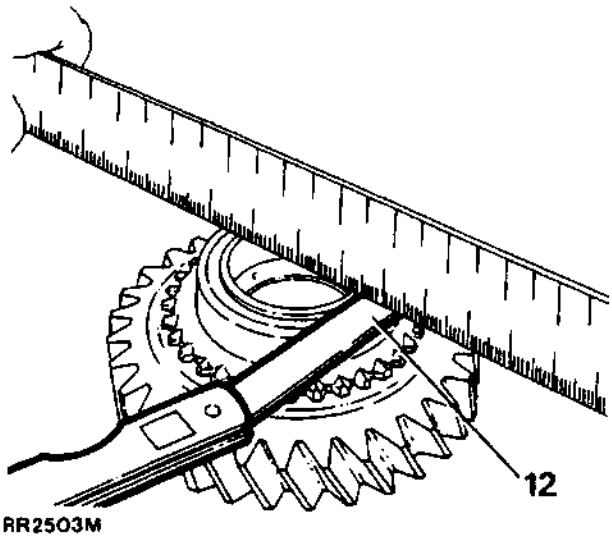
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6. Manufacture a spacer to the dimensions provided in the illustration at the beginning of this section, this will represent a slave bearing.
7. Fit the first gear bush and slave bearing spacer and a new circlip to the mainshaft. When fitting the circlip, care must be taken to ensure it is not opened (stretched) beyond the minimum necessary to pass over the shaft.
8. Press the slave bearing spacer back against the circlip to allow the bush maximum end float. Measure the clearance between the rear of the first gear bush and front face of the slave bearing spacer with a feeler gauge. The clearance should be within 0,075 mm (0.003 in) maximum. The first gear bush is available with flanges of different thickness. Select a bush with a flange to give the required end float. The bush must be free to rotate easily with the required end float.
9. Remove the circlip, slave bearing spacer and first gear bush from the mainshaft.
10. First gear bushes are available in the following sizes:

Part No.	Length (mm)
FRC5243	40,16 - 40,21
FRC5244	40,21 - 40,26
FRC5245	40,26 - 40,31
FRC5246	40,31 - 40,36
FRC5247	40,36 - 40,41

First gear end float

11. Fit the selected first gear bush to the first gear, place the gear and bush on a clean, flat surface so that the gear is sitting firmly on the shoulder of the bush.
12. Place a straight - edge across the bush and measure the clearance between bush and gear, this should not be in excess of 0,20 mm (0.008 in) maximum.



RR2503M

13. If the clearance is in excess of the maximum permissible limit, inspect gear faces for wear.

Layshaft

1. Examine layshaft for excessive wear, or damaged teeth. Renew as necessary.
2. Fit new bearings fully onto the layshaft using MS47 and a suitable tube.

Reverse gear and shaft

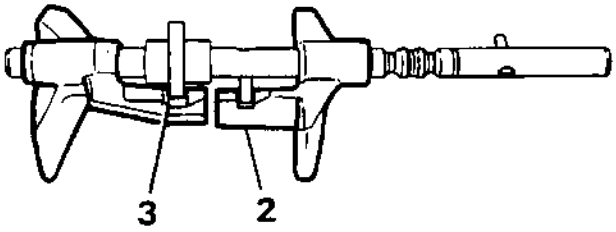
1. Remove the circlip from the reverse idler gear.
2. Remove both needle roller bearings and remaining circlip from the gear.
3. Check the condition of the reverse idler gear and its mating teeth on the layshaft and synchromesh outer unit.
4. Examine the reverse shaft for wear and renew if necessary.
5. Fit a new circlip to the rear of the reverse idler gear.
6. Lubricate with light oil and fit two new needle roller bearings. The needle roller bearings may be fitted either way round.
7. Fit a new circlip to the front of the reverse idler gear.

Selectors

1. Check the selector rail for worn or loose pins. Note that the selector rail is only supplied complete with first and second selector fork, renew the assembly if necessary.

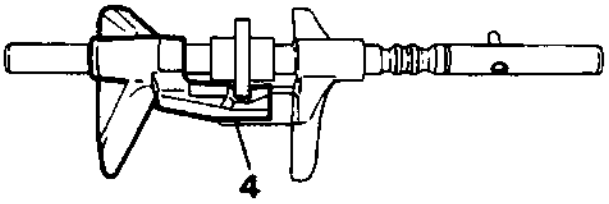
Selector assembly

2. Place the first/second selector fork and rail assembly on a flat surface, locate the selector pin in the jaw of the fork.
3. Fit the front spool and third/fourth selector fork, engaging the spool in the jaw of the fork.



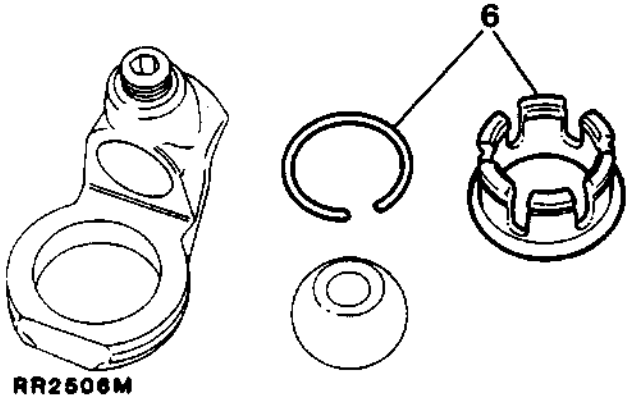
RR2504M

4. Slide the spool and fork towards the first/second selector until the slot in the spool locates over the selector pin and the spool remains engaged in the third/fourth selector fork jaw.



RR2505M

5. Examine the remaining selector components for wear, renew as necessary.
6. Examine the selector yoke components. If necessary remove the nylon seating by releasing the snap ring from the yoke.



RR2506M

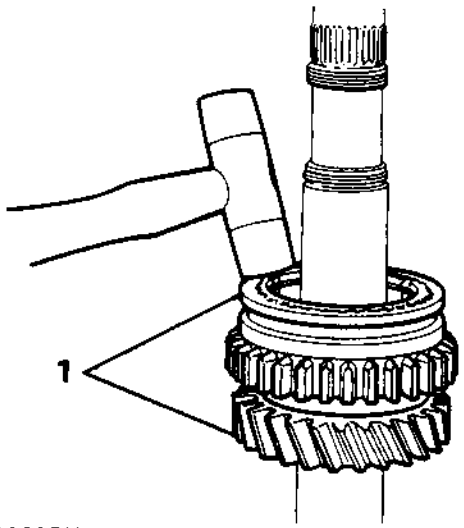
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ASSEMBLY

Mainshaft - rear end

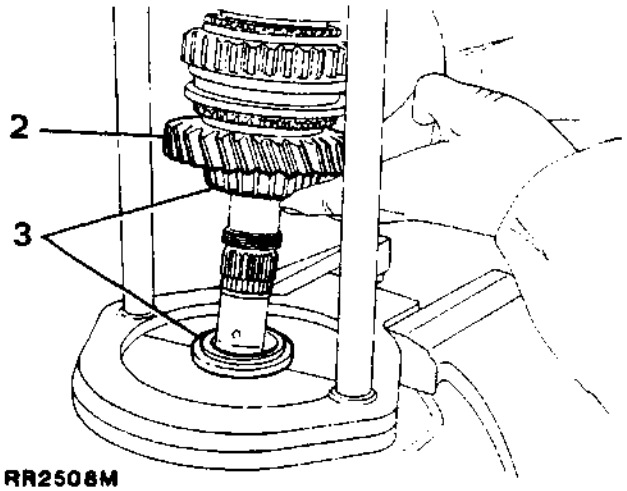
NOTE: Lubricate all the needle roller bearings with a light oil before assembly.

1. Fit second gear and needle roller bearing to the mainshaft followed by the baulk ring and first/second synchromesh assembly. The synchromesh assembly may require gently tapping onto the splines using a plastic hammer.



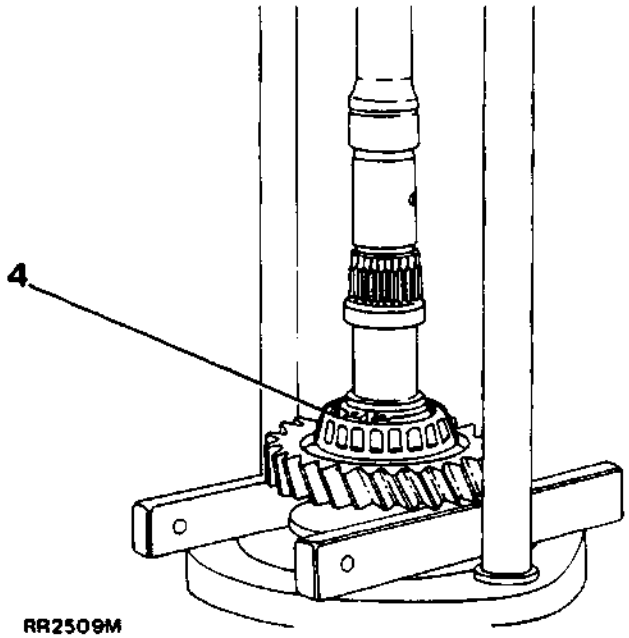
RR2507M

2. Fit the first gear baulk ring, first gear, needle roller bearing and selected bush to the mainshaft.
3. Using tools MS47, 18G47BA and 18G47BA - X refit the centre bearing to the mainshaft. Note that the larger spigot diameter of 18G47BA - X locates in the bearing cage. Ensure that the slots in the baulk ring align with the slipper blocks when pressing bearing.



RR2508M

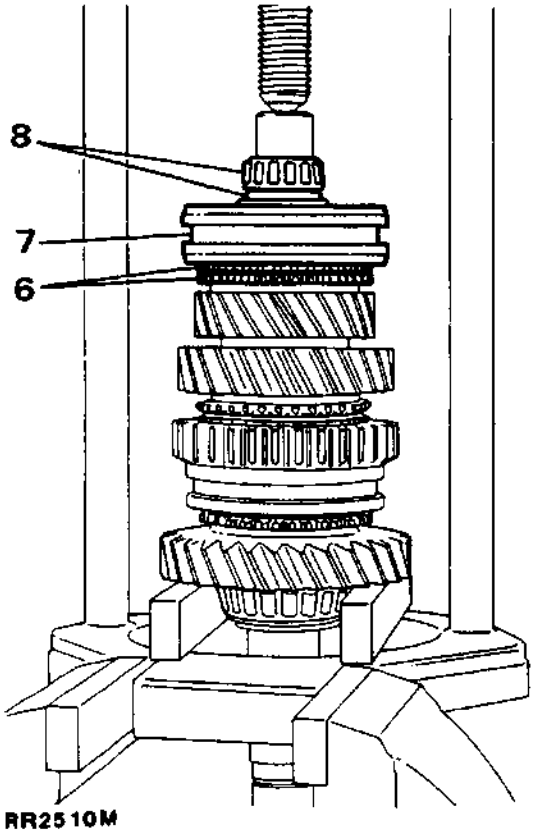
4. Fit the circlip, ensuring that the bearing, gear and circlip are in their rearmost position on the mainshaft. This is achieved by placing two bars under the 1st gear and carefully pressing the assembly rearwards on the mainshaft using press MS47. Check that there is no clearance between circlip and bearing, and that the bush is free to turn.



RR2509M

Mainshaft - front end

5. Invert the mainshaft, lubricate the third gear needle roller bearing with light oil, fit to the front end of the mainshaft.
6. Fit the third gear to the mainshaft; and locate the third gear baulk ring to the third gear.
7. Fit the third/fourth synchromesh assembly (with the raised centre boss of the synchromesh hub to the front of the gearbox) to the mainshaft.
8. Fit the spacer and press the pilot bearing to the front of the mainshaft.

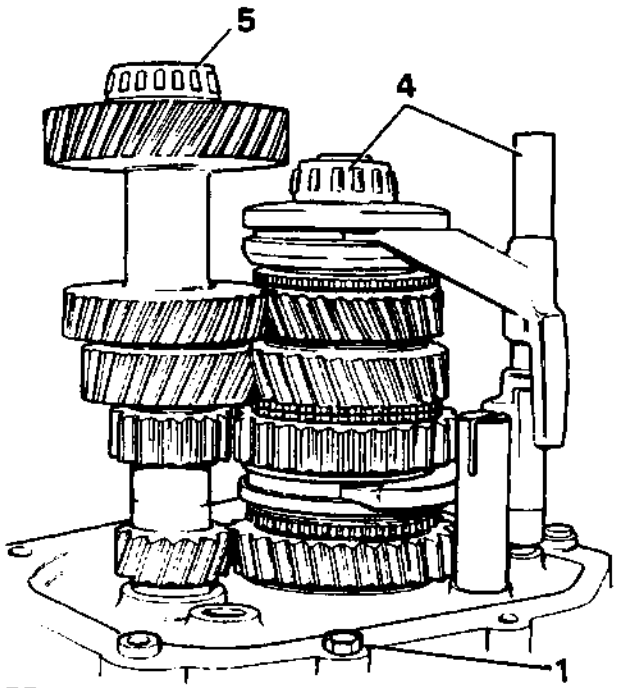


RR2510M

WARNING: The mainshaft assembly MUST be supported on 1st gear when fitting the pilot bearing.

Centre plate

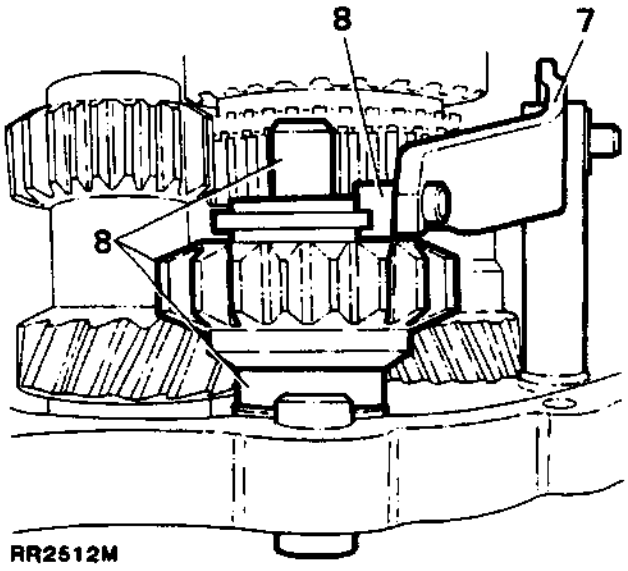
1. Fit the centre plate to the workstand and secure with a nut and bolt.
2. Place the new mainshaft and layshaft bearing tracks in the centre plate.
3. Ensure both synchromesh units are in neutral. Fit the selector shaft assembly complete, engaging both selector forks in their respective synchromesh sleeves on the mainshaft.
4. Lubricate the selector shaft with a light oil. Engage the selector shaft and mainshaft assemblies in the centre plate, whilst rotating the fifth gear selector pin to align with the slot in the centre plate.
5. Fit the layshaft assembly to the centre plate, lifting the mainshaft assembly slightly to clear the rear layshaft bearing.



RR2511M

6. Rotate the selector shaft and spool to enable the reverse crossover lever forks to correctly align to the selector pin. Reposition the selector shaft and locate the lever into the slot of the reverse gear pivot shaft.
7. Insert pivot pin and fit a new circlip (earlier models only), ensuring that it is not opened beyond the minimum necessary to pass over the shaft.

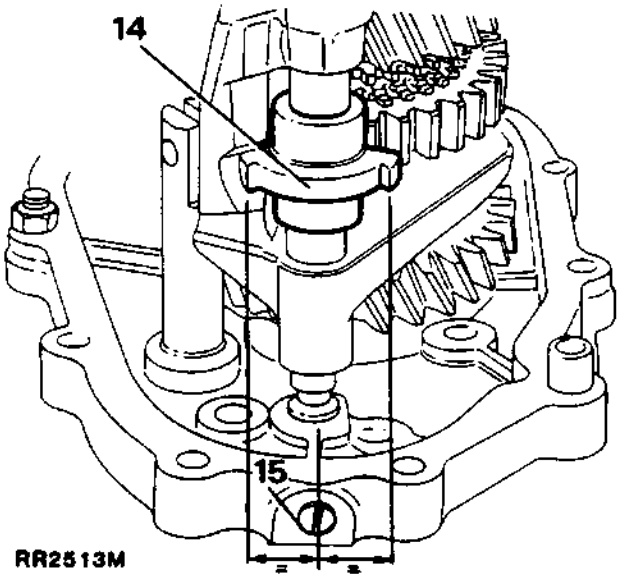
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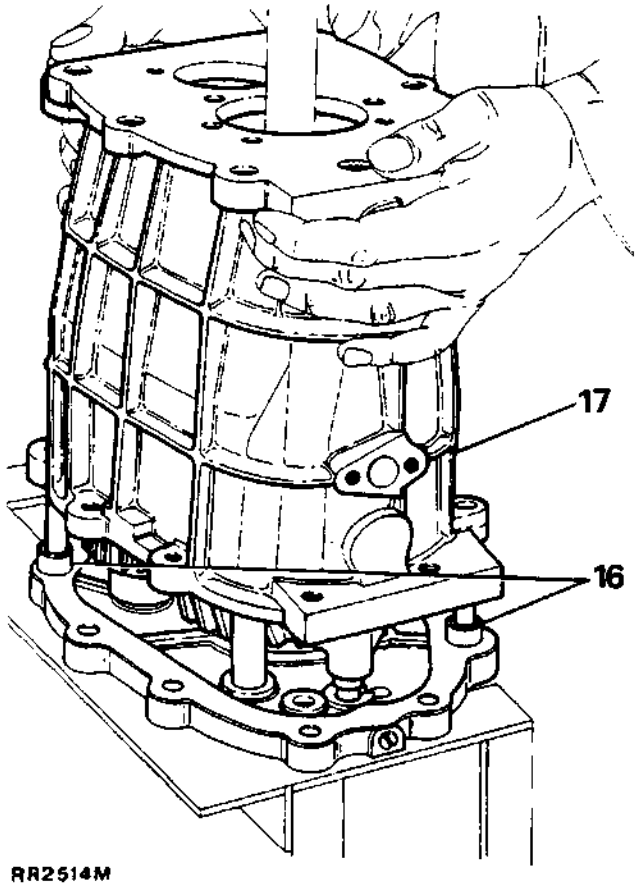
8. Fit the slipper pad to the reverse lever. Fit the reverse gear spacer and reverse gear assembly, locating the slipper pad lip to the reverse gear groove. Engage the reverse gear shaft from the underside of the centre plate, ensuring the roll pin is aligned with the slot in the centre plate casing. Secure the reverse shaft using the retaining plate.
9. Check that a running clearance exists between the slipper pad and lever, with a maximum clearance of 0,725mm (0,025in).
10. Fit the reverse gear thrust washer to the reverse gear shaft.
11. Locate the fourth gear baulk ring to the third/fourth synchromesh assembly.
12. Fit the input shaft to the mainshaft.
13. Release the bolt securing the centre plate to the workstand and fit a new gasket to the centre plate.

Main gearbox casing

14. Ensure that the selector rail and spool are in the neutral position.
15. Lubricate the detent ball and spring with light oil, and fit to the top of centre plate. Fit and tighten the plug fully to ensure the selector rail does not move when the gearcase is fitted.



16. Fit the two guide studs into the casing, one each side.
17. Carefully lower the gearcase into position over the gear assemblies. DO NOT USE FORCE. Ensure the centre plate dowels and selector shaft are engaged in their respective locations.
18. Resecure the assembly to the workstand. Using two 8 X 35 mm slave bolts, with plain washers to prevent damage to the rear face of the centre plate, temporarily secure the gear case to the centre plate.
19. Fit the front spool retainer (with new 'O' ring if fitted) to the top of the gearcase using Hylomar PL32 on the joint face, if 'O' ring is not fitted. Smear Hylomar PL32 on the bolt threads, fit bolts and spring washers. Finally tighten to the correct torque.



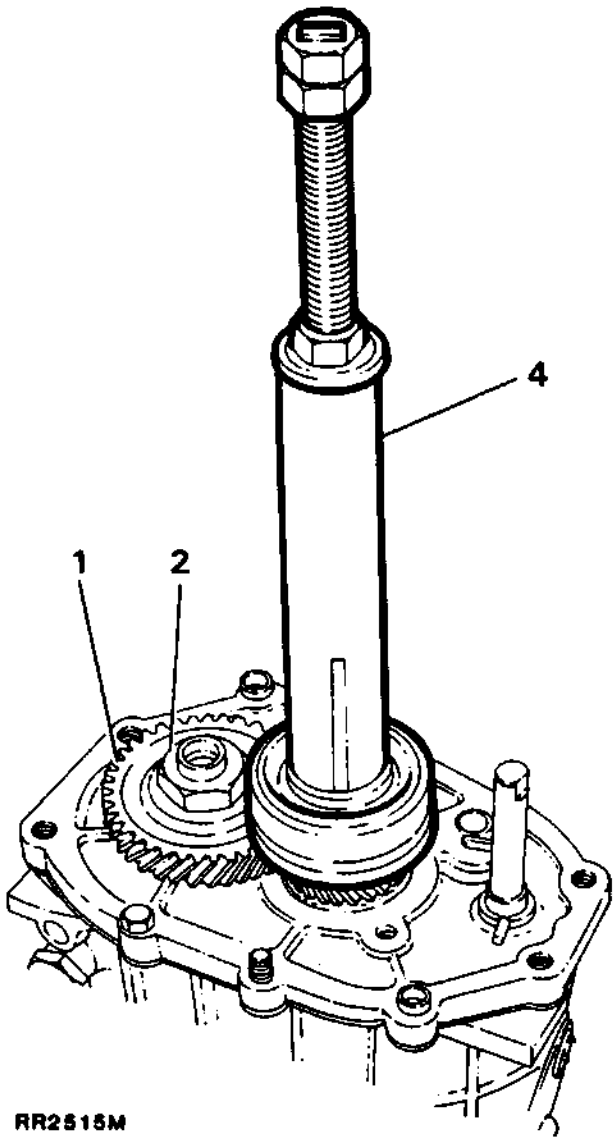
RR2514M

NOTE: Do not use force when fitting spool retainer. Provided the spool has not been disturbed the retainer will slide into position. If the selector rail is rotated or disturbed during assembly remove the main gearbox casing and dismantle the centre plate to rectify.

20. Remove the detent retaining plug, smear the threads with Loctite 290 or Hylomar PL32, and screw in until flush with case. Stake the plug to prevent rotation using a suitable centre punch.
21. Fit the layshaft and input shaft bearing outer tracks.
22. Fit the layshaft support plate using two 8 X 25 mm bolts and washers to the front of the gearbox, with the plain washer situated between the support plate and layshaft. The plate also retains the input shaft bearing outer track.
23. Remove the assembly from the workstand and invert, resecuring to the workstand. Remove the reverse retainer plate.

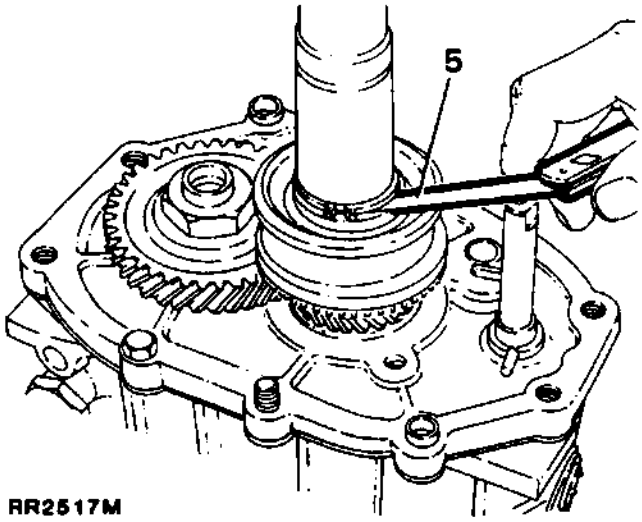
Fifth gear

1. Press or drive the fifth gear onto the layshaft, using 18G1422, ensuring that the annular extraction groove is to the rear.
2. Fit a new 22 mm stake nut and tighten sufficiently to retain.
3. Fit the fifth speed thrust washer, roller bearing, fifth gear and baulk ring to the mainshaft.
4. Press fifth gear synchromesh hub assembly fully onto the shaft using tool 18G1431, ensuring that the slipper pads locate in the three slots in the baulk ring.



RR2515M

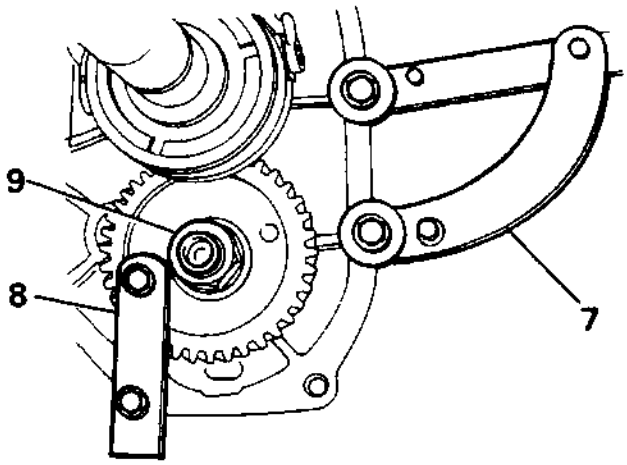
5. Fit a dummy selective washer which has an oversize bore for ease of fitting. It is recommended that the thinnest washer (FRC 5284) is used. Locate the circlip in its groove. Measure the clearance between the washer and circlip, which should be 0,005 to 0,055 mm,(0.0002 - 0.002in) maximum. The washers are available in ten sizes to obtain the correct clearance.



RR2517M

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FRC5284	5,10	FRC5294	5,40
FRC5286	5,16	FRC5296	5,46
FRC5288	5,22	FRC5298	5,52
FRC5290	5,28	FRC5300	5,58
FRC5292	5,34	FRC5302	5,64

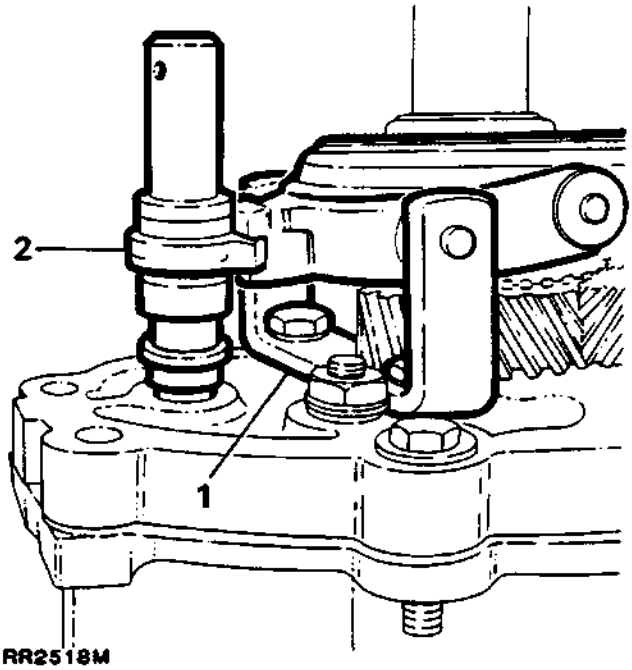
6. Fit the correct selective washer and new circlip.
7. Secure the flange holder 18G1205 to the gearcase.
8. Fit fifth gear retainer to case and fifth layshaft gear.
9. Tighten the staked nut securing layshaft fifth gear to the correct torque. Stake the nut using a suitable punch to secure. Remove flange holder and gear retainer.



RR2516M

Fifth gear selector fork assembly

1. Fit the fifth gear selector fork bracket to the centre plate with the bolts and spring washers and tighten to the correct torque.
2. Fit fifth gear spool to the selector shaft, the longer shoulder of the spool fitted towards the front of the gearbox.



RR2518M

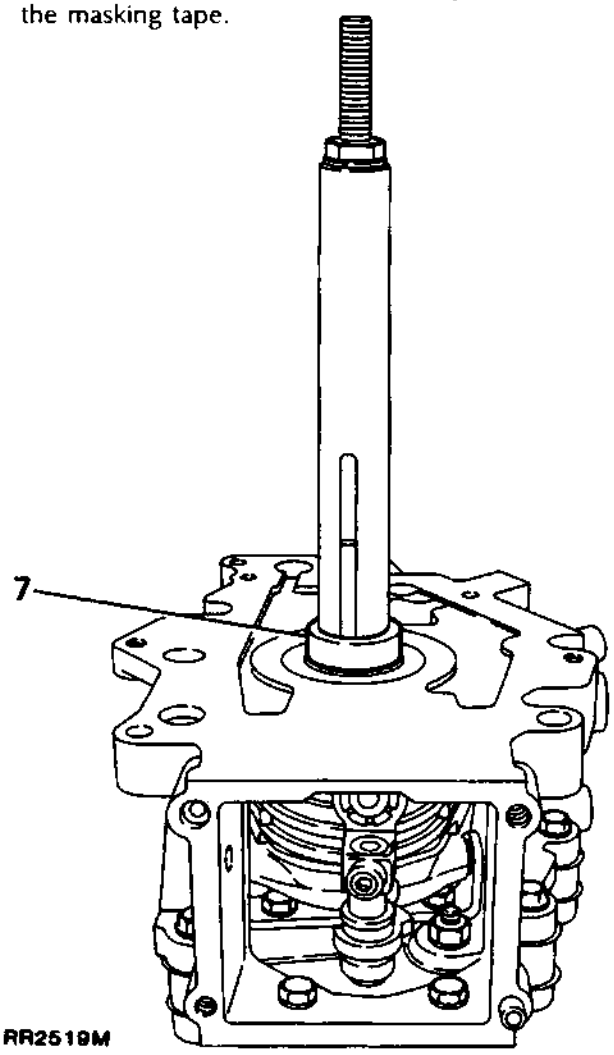
3. Fit the bronze pads to the 5th gear selector fork (retain with vaseline), engage the fork, ensuring that the larger side of the selector jaw faces to the rear, with the spool, bracket and synchromesh sleeve. Insert the two dowel pins and secure in position with the two 'E' clips.

Extension case

1. Remove the two bolts securing the centre plate and fit a new gasket to the joint face.
2. Fit the oil pump drive shaft to layshaft and align the pump gears.
3. Secure the selector yoke to the selector shaft with a NEW 10 mm grub screw tightened to the correct torque.

   NOTE: The NEW grub screw is encapsulated with loctite during manufacture.

4. Carefully lower the extension casing into position. DO NOT use force, if difficulty is encountered, remove the case and align oil pump gears and drive shaft.
5. Remove the guide studs and fit the extension case bolts and spring washers, tighten to correct torque.
6. Cover the mainshaft splines with masking tape and fit a new oil seal collar 'O' ring. Remove the masking tape.

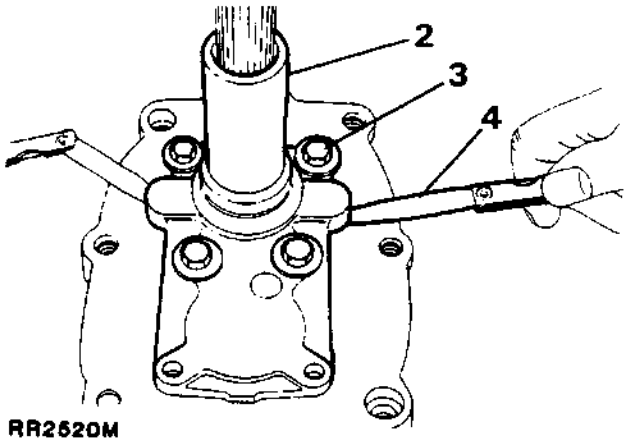


RR2519M

7. Using tool 18G1431 fit a NEW oil seal collar to the mainshaft, ensuring the collar is pushed on the shaft with sufficient clearance to allow the circlip to engage in its groove. The groove may be observed through the slot in the tool.

Input/mainshaft bearing adjustment

1. Invert the assembly on the workstand, and remove the layshaft retaining plate.
2. Fit the original selective washer to the input shaft bearing and fit the front cover without the gasket. Do not fit the layshaft washer at this stage.
3. Retain the cover with four bolts, with plain washers only, around the input shaft. Secure evenly, finger tight.



RR2520M

4. Check the clearance between the cover and the gearcase using two feeler gauges as shown. If necessary change the selective washer to obtain a clearance of 0,20 to 0,26 mm (0.008 to 0.010 in). This will ensure the end float is within tolerance when the gasket is fitted and the cover tightened to the correct torque.

Continued

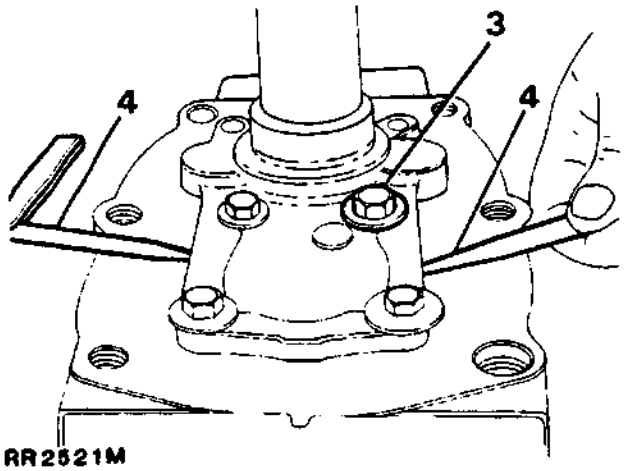
Input/main shaft selective washers

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FRC4327	1,51	FRC4349	2,17
FRC4329	1,57	FRC4351	2,23
FRC4331	1,63	FRC4353	2,29
FRC4333	1,69	FRC4355	2,35
FRC4335	1,75	FRC4357	2,41
FRC4337	1,81	FRC4359	2,47
FRC4339	1,87	FRC4361	2,53
FRC4341	1,93	FRC4363	2,59
FRC4343	1,99	FRC4365	2,65
FRC4345	2,05	FRC4367	2,71
FRC4347	2,11	FRC4369	2,77

5. Remove the cover and retain selective washer for final assembly.

Layshaft bearing adjustment

1. The correct adjustment for the layshaft bearing is 0,025mm (0,001m) end float, and zero to 0,025 mm (0.001 in) preload. The following operation will ensure a preload figure within these tolerances. The input bearing selective washer must not be fitted during this operation.
2. Measure the thickness of a new cover gasket and the original selective washer.
3. Fit the original layshaft selective washer, and secure the cover (without gasket) with four bolts and plain washers, finger tight, around the layshaft.



4. Check the clearance using two sets of feeler gauges and select a washer to give a clearance equal to the thickness of the new gasket.

Layshaft selective washers:

Part No.	Thickness (mm)	Part No.	Thickness (mm)
TKC4633	1,69	TKC4649	2,17
TKC4635	1,75	TKC4651	2,23
TKC4637	1,81	TKC4653	2,29
TKC4639	1,87	TKC4655	2,35
TKC4641	1,93	TKC4657	2,41
TKC4643	1,99	TKC4659	2,47
TKC4645	2,05	TKC4661	2,53
TKC4647	2,11	TKC4663	2,59

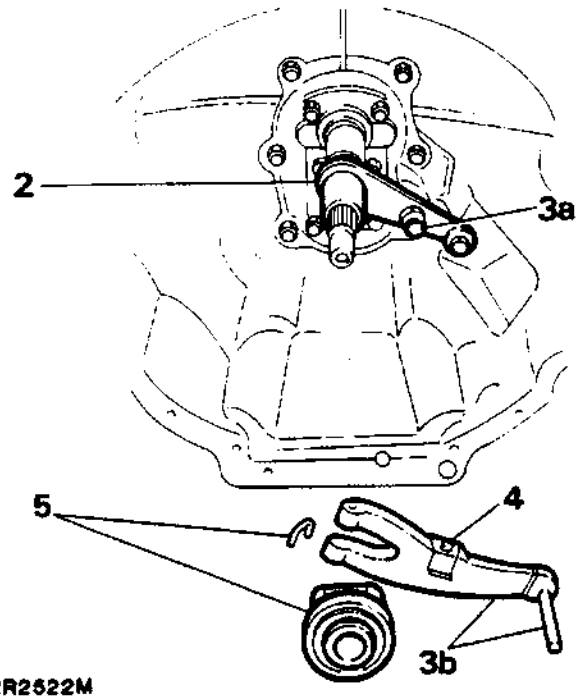
Layshaft selective washers - increased capacity bearings:

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FTC0262	1,36	FTC0280	1,90
FTC0264	1,42	FTC0282	1,96
FTC0266	1,48	FTC0284	2,02
FTC0268	1,54	FTC0286	2,08
FTC0270	1,60	FTC0288	2,14
FTC0272	1,66	FTC0290	2,20
FTC0274	1,72	FTC0292	2,26
FTC0276	1,78	FTC0294	2,32
FTC0278	1,84	FTC0296	2,38

5. Remove the front cover. Having ascertained the mainshaft and layshaft end float, fit the appropriate mainshaft and layshaft selective washers to the mainshaft and layshaft bearing tracks.
6. Fit a new oil seal to the front cover, ensuring the seal lips face towards the gearbox. Lubricate the seal lips with SAE 140 gear oil.
7. Mask the splines with masking tape to protect the oil seal, refit the front cover and remove the spline masking tape.
8. Refit the bolts and spring washers having applied Hylomar PL32 to the bolt threads. Tighten to the specified torque.

Bell housing

1. Refit the dowels, and locate the bell housing on the dowels and fit the two long bolts (12 X 45 mm) with spring and plain washers to the dowel positions. The remaining four bolts (12 X 30 mm) are fitted with spring washers only. Tighten to the correct torque.
2. Slide the release bearing guide over the input shaft, and secure in position with the single bolt and clutch release pivot post, tighten to the correct torque.



RR2522M

3. Prior to assembly, lubricate the following items with a thin film of molybdenum disulphide grease.
   (a) Clutch release pivot post and locating socket in release lever.
   (b) Ball end of the clutch operating push rod.

NOTE: Do not lubricate the bearing guide.

4. Locate the clutch release bearing lever on the pivot ball and secure in position with the spring clip, tighten the clip securing bolt to the correct torque.
5. Slide the clutch release bearing over the bearing guide. Fit a new plastic staple to clutch release lever and bearing to prevent the bearing sliding off the guide.

Gear change housing

1. Remove the gearbox from the stand and place on the bench.
2. Refit the gearchange housing to the extension housing using a new gasket. Ensure that the gear lever engages with the selector yoke, and the spool and guide engage correctly.
3. Fit and tighten the securing bolts.

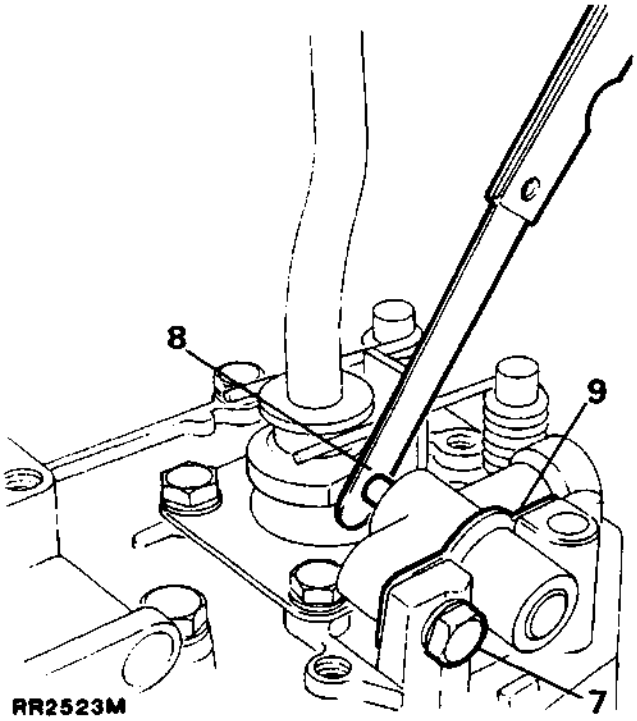
Bias adjustment plate setting

4. Ensure that the bias plate is free to slide. Select fourth gear and load the gear lever fully to the right hand side of the gearbox.
5. Tighten the four adjustment plate bolts to the correct torque.
6. Check the adjustment by testing third and fourth gear selection. After adjustment the lever should lie centrally in the third and fourth plane, with no dog leg into gears. Equal side movement should exist in third and fourth gears.

Continued

Reverse plunger assembly setting

7. Fit the assembly to the housing and secure in position with the single bolt and washer.
8. Select first gear. Using feeler gauges, check the gap between the reverse plunger nose and the side of the gear lever.

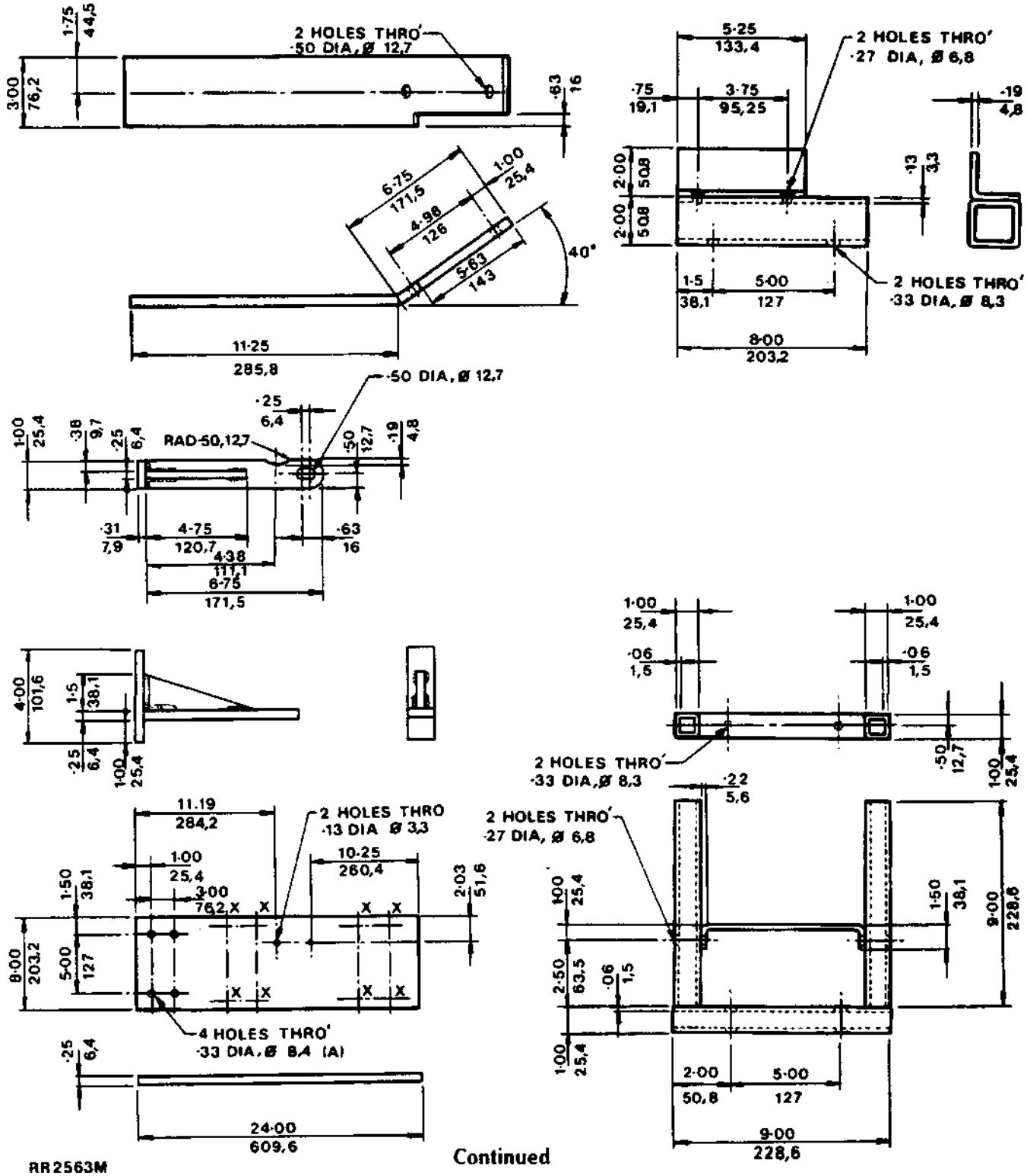


9. The required setting is 0,6 to 0,85 mm (0.024 to 0.034 in) clearance. Adjust the gap by adding or removing the shims behind the plunger assembly.
10. Ensure that the reverse light operating plunger is fitted to the reverse plunger. Fit the top cover and sealing rubber and tighten the securing screws. Refit and adjust reverse light switch.
11. Fit a new fibre washer to the oil drain plug, fit the plug to the gearbox and tighten to the correct torque.
12. Refill the gearbox with the correct quantity and grade of oil as specified in the 'Recommended Lubricants' section.
14. Refit the gearbox oil level plug, and tighten to the correct torque.
15. Refit the transfer gearbox and fit the assembly to the vehicle.

ZF MAIN GEARBOX AND BORG WARNER TRANSFER GEARBOX - ADAPTOR PLATE

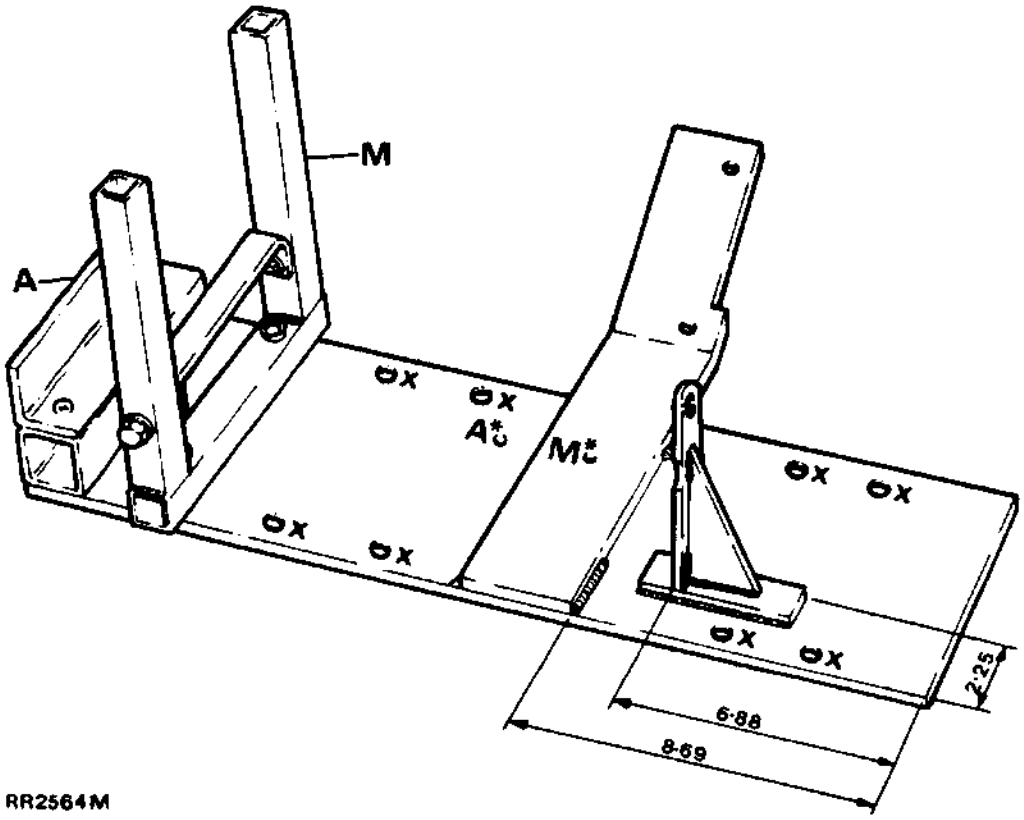
To assist in the removal of the transmission assembly from the vehicle it is necessary to locally manufacture an adaptor plate to use in conjunction with a transmission hoist.

NOTE: Four holes (A) to be countersunk on underside to suit hoist.



RR2563M

Continued



RR2564M

A: Automatic gearbox models
M: Manual gearbox models
A*: Centre of the lifting hoist (Automatic models)
M*: Centre of the lifting hoist (Manual models)
X: Drill fixing holes to suit hoist table

Material: Steel plate BS 1449 Grade 4 or 14

ZF MAIN GEARBOX AND BORG WARNER TRANSFER GEARBOX

Remove and refit

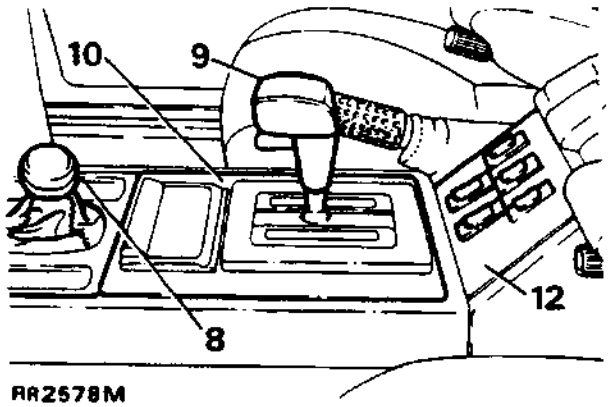
Preparation - under bonnet

WARNING: Where the use of a transmission hoist is necessary, it is ABSOLUTELY ESSENTIAL to follow the hoist manufacturer's instructions to ensure safe and effective use of the equipment.

1. Install the vehicle on a hydraulic ramp and chock the road wheels.
2. Disconnect the battery negative terminal.
3. Release and remove the fan blade assembly. Note the assembly has a left hand thread.
4. **Fuel injection models** - Release the clamp and remove the air intake hose from the neck of the plenum chamber.
   Carburetter models - Remove the air cleaner and elbows.
5. Disconnect the kickdown cable from the throttle linkage.
6. Release the two gearbox breather pipes from the clip located on the lifting eye at the rear of the right hand cylinder head.
7. Remove the gearbox dipstick.

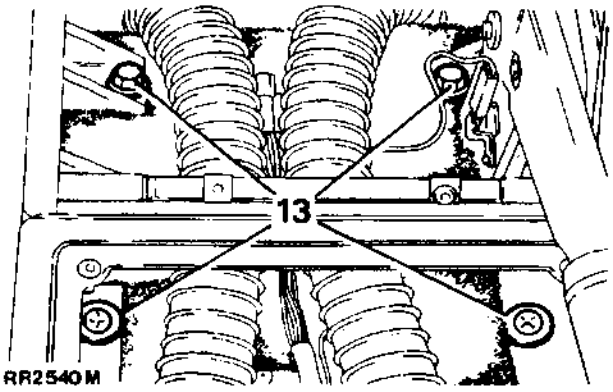
Inside the vehicle

8. Select low range, unscrew and remove the transfer gearbox knob.
9. Unclip the top cover of the main gearbox selector and remove the circlip, withdraw the detent button. Remove the circlip above the selector knob retention nut, remove the nut, serrated washer and withdraw the selector knob.
10. Carefully prise the inset panel out of the floor mounted console, complete with gear selector illumination panel and ashtray. Disconnect the electrical multi - plug to the graphics panel, and remove the inset panel.
11. Release the four screws and remove the glove box liner.
12. Carefully prise the window lift switch panel from the front of the glove box. Push the panel complete with switches back through the panel opening and place on the gearbox tunnel.



RR2578M

13. Release the two bolts and two screws securing the glove box/console assembly to the gearbox tunnel.



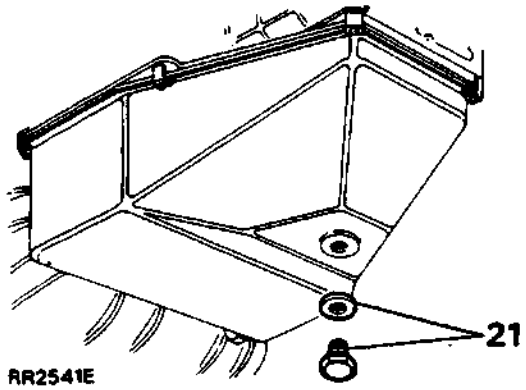
RR2540M

14. Detach the two relays from the inner side of the glove box.
15. Disconnect the electrical leads to the rear cigar lighter.
16. Disconnect the handbrake cable from the handbrake lever. Raise the lever while simultaneously detaching the glove box/console assembly from the lower dash. Remove the assembly from the vehicle.
17. Remove the retaining clip and pull the handbrake adjustment thumb wheel from the outer sleeve. Push the inner sleeve to the underside of the vehicle.
18. Remove the sound deadening trim from the top of the gearbox tunnel.
19. Remove the screws and detach the retaining plate from around the transfer gearbox lever.

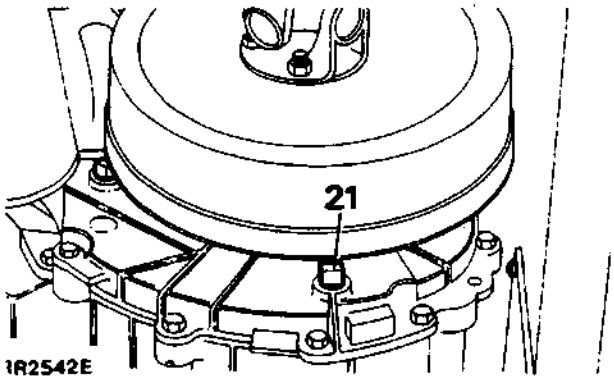
Continued

Under the vehicle

20. Raise the hydraulic ramp.
21. Remove the main and transfer gearbox oil drain plugs. Where applicable remove the filler plug to assist draining and drain the oil into suitable containers. While the oil is draining continue with the following operations.



RR2541E



1R2542E

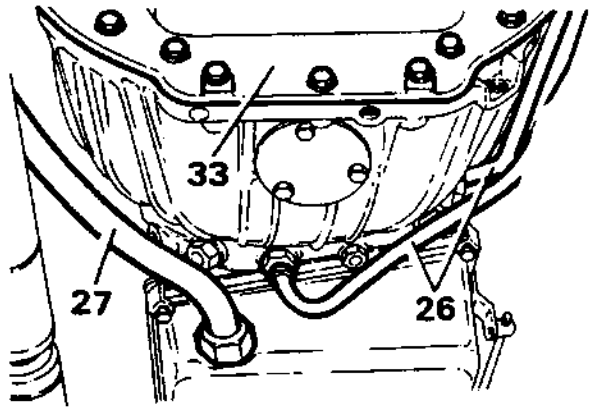
22. **Catalyst models only** - Disconnect the multi - plugs to the Lambda sensors.
23. Remove the eight fixings securing the cross member. Note it may be necessary to spread the chassis to enable the cross member to be withdrawn.

    NOTE: The above operation will require the assistance of a second operator to support the exhaust system while the various fixings are released.

24. Remove the front exhaust down pipes and intermediate pipe complete with centre silencer (or catalyst).
25. Release the two clamps at the side of the engine sump that secure the two gearbox oil cooler feed and return pipes.
26. Place a suitable container below the gearbox, disconnect the oil cooler feed and return pipes from the bottom and side of the gearbox. Plug the pipes and openings to prevent ingress of foreign matter.
27. Disconnect the dipstick tube from the front of the gearbox oil pan.
28. Mark each propeller shaft drive flange at the transfer gearbox with an identification line to aid re - assembly, remove the fixings and disconnect the propeller shafts at the output flanges. Tie the shafts to one side.
29. Release the nut and disconnect the speedometer cable from the rear output housing, tie the cable to one side.
30. Disconnect the main gearbox selector cable and rod from the left side of the gearbox. Lay the cable aside.
31. Disconnect the main gearbox inhibitor switch multi - plug from the main harness.
32. If fitted disconnect the speed transducer multi - plug from the main harness.

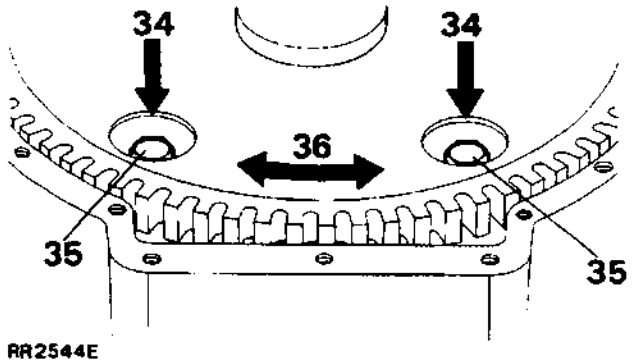
Remove the transmission assembly

33. Remove the nine front cover plate bolts from the bottom of the gearbox bellhousing, detach the cover plate to gain access to the four torque converter fixing bolts.



RR2543E

34. Rotate the engine using the crankshaft pulley until two of the access holes in the drive plate/ring gear assembly are visible through the bell housing bottom cover opening.
35. Remove the two bolts that are visible through the access holes, which secure the drive plate to the torque converter. Mark one of the access holes and a bolt hole in the converter with an identification line to aid re - assembly and to maintain original build setting.
36. Rotate the crankshaft 180° until the remaining access holes are visible, remove the remaining two bolts.



RR2544E

37. Position a suitable transmission floor jack on the rear output housing or brake drum to support the weight of the transmission assembly.
38. Remove the fixings and withdraw the transfer gearbox mountings.
39. Fit the previously manufactured fixture on a transmission hoist, raise the hoist and position the fixture and hoist under the transfer gearbox mounting points.
40. Using the original gearbox mounting bolts secure the fixture to the gearbox.
41. Remove the transmission floor jack from the rear of the transfer gearbox.
42. Carefully lower the transmission until the top of the transfer gearbox clears the rear passenger footwell.
43. Position the transmission floor jack under the engine to support the weight while the bellhousing bolts are removed.
44. Remove the bellhousing bolts noting that one of the bolts also secures the gearbox dipstick tube.
45. Withdraw the transmission assembly from the engine, ensuring that the torque convertor is removed with the gearbox and does not stay on engine.

Refitting

46. Refitting the gearbox is a reversal of the removal procedure noting the following points.
47. The flexible drive plate to torque converter bolts are to be coated with Loctite 270 prior to assembly.
48. Tighten all fixings to the specified torque. Refer to torque charts in main Workshop Manual.
49. New gaskets are to be fitted to the exhaust flanges, all joints other than those fitted with doughnuts, to be coated with 'Firegum Putty'. Check the system, if any leaks are evident reseal as necessary.

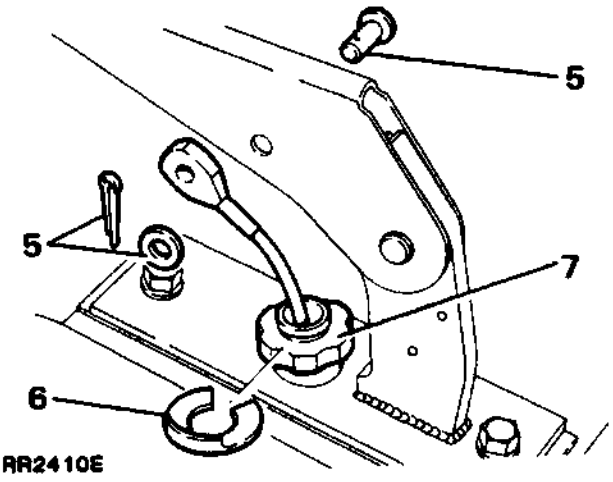
HANDBRAKE CABLE

Remove and refit

Removing

Inside the vehicle

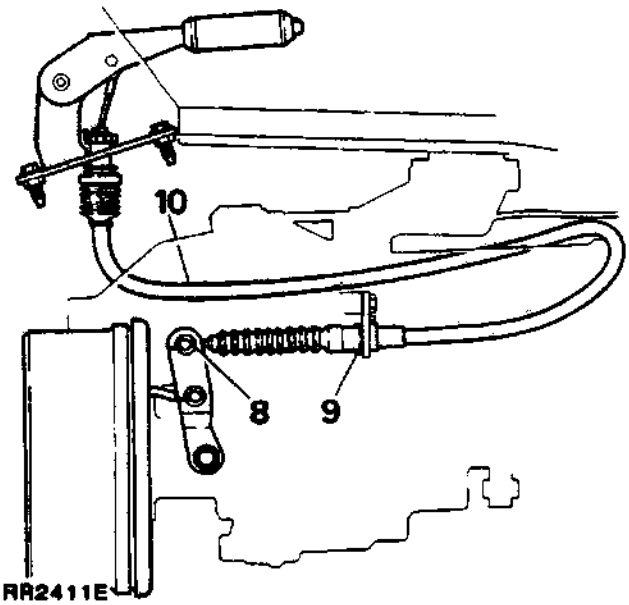
1. Set the vehicle on level ground or install on a hoist, select 'P' in automatic gearbox and neutral in manual gearbox. Disconnect the battery negative terminal.
2. Chock the road wheels.
3. Fully release the handbrake lever.
4. Remove the four retaining screws and lift out the glove box liner to gain access to the bottom of the handbrake lever.
5. Remove the split pin and withdraw the clevis pin and washer securing the cable to the handbrake lever.
6. Remove the clip from above the adjustment thumbwheel, push the inner and outer cable to the underside of the vehicle.
7. Pull the thumbwheel from the outer sleeve.



RR2410E

Underneath the vehicle

8. Remove the split pin and withdraw the clevis pin and washer.
9. Detach the retaining clip securing the outer cable to the support bracket located on the front cover of the transfer gearbox.
10. Release the cable from the 'P' clip located on the left hand side of the transfer gearbox.



RR2411E

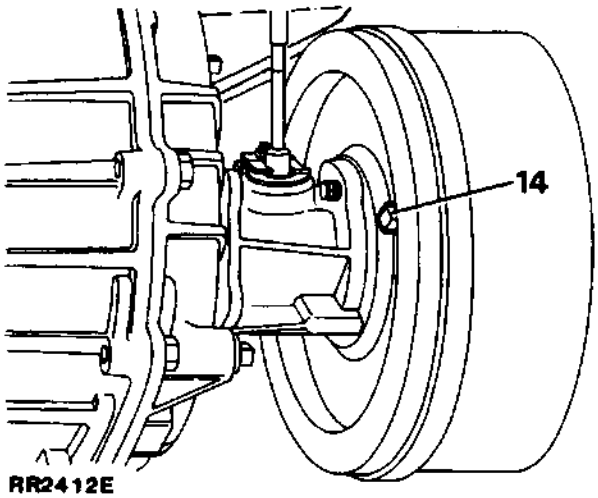
11. Withdraw the cable.

Fit new cable

12. Reverse instructions 5 to 11 when fitting a new cable.

Adjust handbrake

13. Ensure that the handbrake lever is fully released.
14. From underneath the vehicle, rotate the adjuster on the brake drum back plate clockwise until the brake shoes are fully expanded against the brake drum.

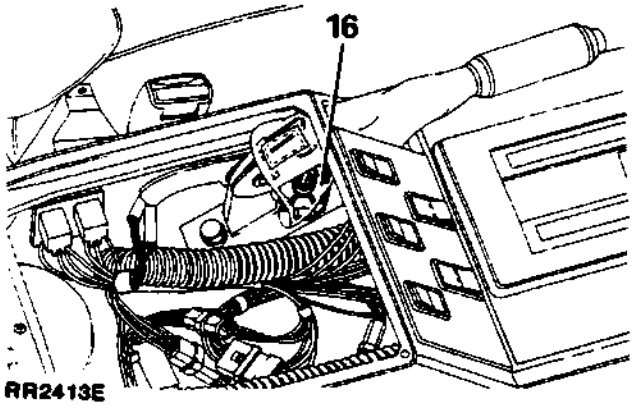


RR2412E

Continued

15. Back off the adjuster until the drum is free to rotate.
16. Rotate the adjustment thumbwheel below the handbrake lever until the parking brake is fully operational on the third notch of the ratchet.

    NOTE: The handbrake adjustment thumbwheel must only be used for initial setting and to compensate for cable stretch, it must not be used to take up brake shoe wear, which must continue to be adjusted at the brake drum.



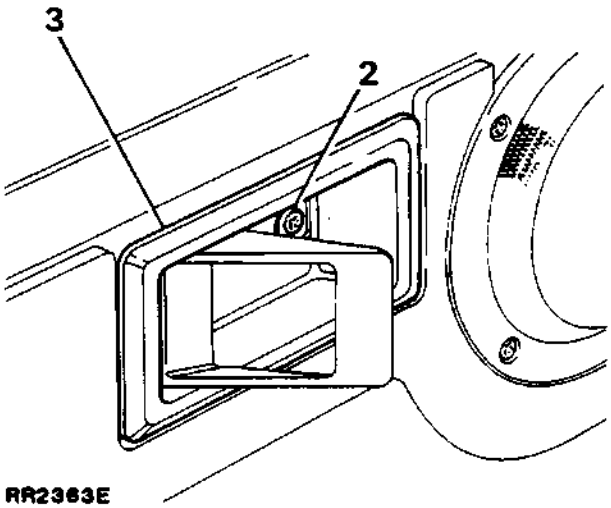
17. Operate the handbrake once or twice to settle the brake shoes, recheck that the handrake is fully operational on the third notch of the ratchet. Re - adjust as necessary.
18. Refit the glove box liner.
19. Reconnect the battery and remove the wheel chocks.

FRONT DOOR - TRIM PANEL - 4 Door models

Remove and refit

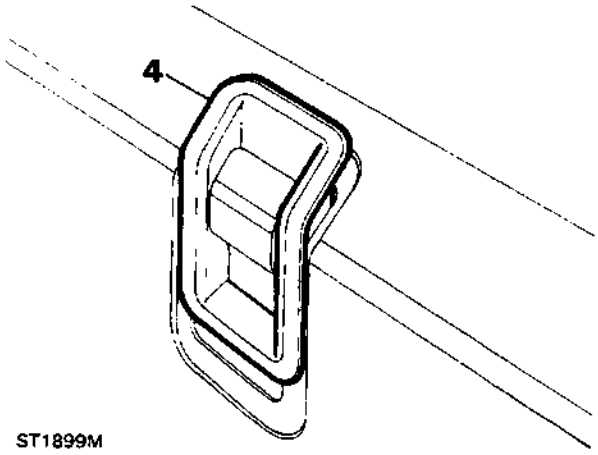
Removing

1. Disconnect the battery negative terminal.
2. Remove the screw securing the handle bezel.
3. Remove the bezel.



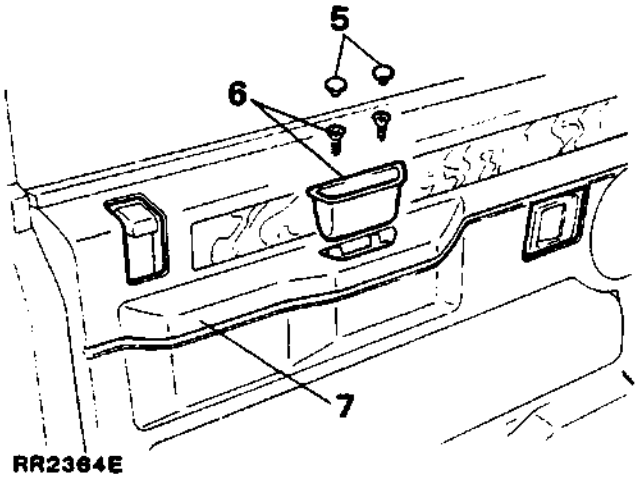
RR2363E

4. Carefully prise the sill locking button bezel from the trim panel.



ST1899M

5. Remove the two finisher buttons from the bottom of the door pull pocket to reveal the securing screws.
6. Remove the screws and withdraw the pocket from the trim panel.



RR2364E

7. Using a screwdriver, carefully prise the trim panel away from the door.

   NOTE: Support the trim panel while the speaker leads are disconnected.

8. If necessary the stowage bin front panel can be removed by releasing the screws at the rear of the trim panel.

Refitting

9. Reverse the removal procedure.

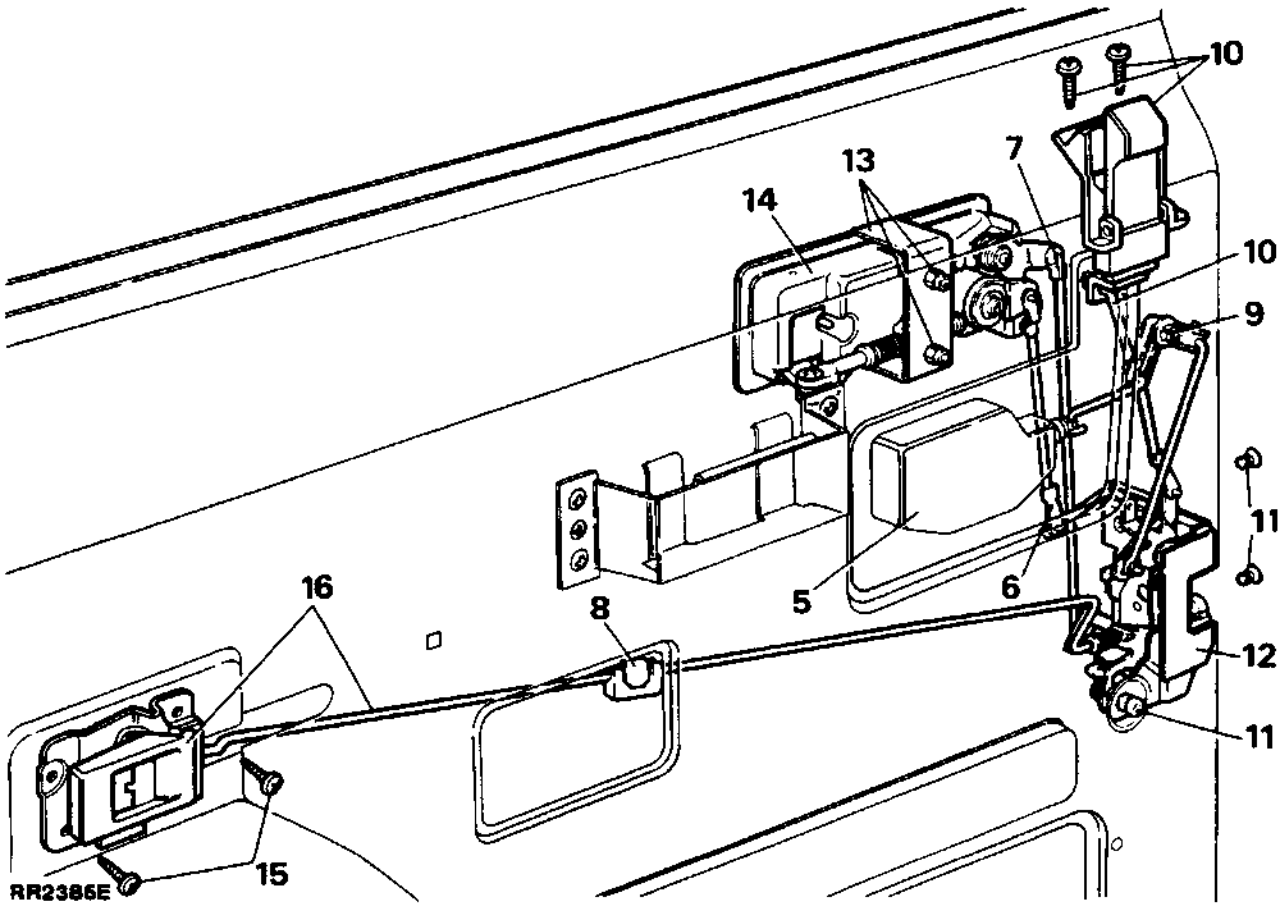
Continued

FRONT DOOR LOCK, OUTSIDE AND INSIDE DOOR RELEASE HANDLES - 4 Door models

Remove and refit

Removing

1. Remove the interior door release handle bezel and sill locking button bezel.
2. Remove the two screws from the bottom of the door pull pocket remove the pocket and prise the door trim panel from the door. Disconnect the electrical leads to the door speaker and remove the plastic barrier sheet. Remove the window lift motor. (Refer to the electrical section in main Workshop Manual).
4. Remove the door glass and regulator. (Refer to door glass and regulator remove and refit in main Workshop Manual).
5. Remove the door lock actuator. (Refer to electrical section in main Workshop Manual).
6. Disconnect the control rod from the private key operated lock by releasing the metal clip at the bottom of the rod.
7. Disconnect the control rod from the outside door release handle by pulling it out of the plastic ferrule.
8. Disconnect the control rod connector between the inside door release handle and the door lock by releasing the metal clip and pulling one of the control rods out of the plastic connecting block. This is accessible through the small centre cut - out in the door panel. (The control rod also passes through a guide bracket on the inside of the inner door panel).
9. From inside the door panel push out the small pin which secures the quadrant to the inner door panel. Push the quadrant out of the panel.
10. Remove the two screws securing the sill locking button to the door. Manoeuvre the sill button and remove it from the control rod.
11. Release the door lock by removing the two countersunk screws from the door edge and the single screw with shakeproof washer on the inner door panel.



12. Withdraw the lock through the lower rear cut - out on the inner door panel.

NOTE: If necessary the following items can be removed.

13. Remove the two nuts (with shakeproof washers) and retaining bracket securing the **outside release handle** to the outer door panel, accessible through the upper rear cut - out on the inner door panel.
14. Carefully detach the door release handle from the outer door panel.
15. Remove the two screws securing the **inside door release handle** to the inner door panel.
16. Withdraw the handle from its location with half of the connecting rod attached.

Refitting

17. Reverse the removal procedure items 1 to 16.

NOTE: When refitting the door glass frame, ensure that it is positioned to suit the door opening before fully tightening the frame securing bolts.

ADJUSTMENT - FRONT DOOR LOCK AND HANDLE ASSEMBLY - 4 Door models

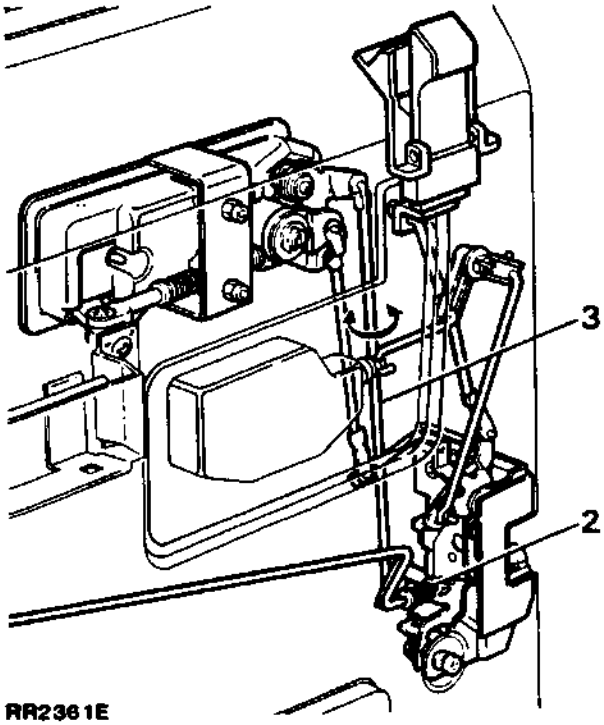
Inside door release handle to lock

1. Refit the inside door release handle bezel before any adjustment is made, allowing the handle to be set for the correct operating position.
2. Rotate the spring tensioned nyloc nut at the door lock clockwise or counter - clockwise to shorten or extend the operating length of the rod as required.

Outside door release handle to lock

3. Disconnect the connecting rod at the rear of the outer door release handle by releasing the the rod from the plastic ferrule, rotate the rod clockwise or counter - clockwise to shorten or extend the operating length, refit the rod to the ferrule.

NOTE: Door release should be effective before the total handle movement is exhausted to provide a small overthrow movement.



RR2361E

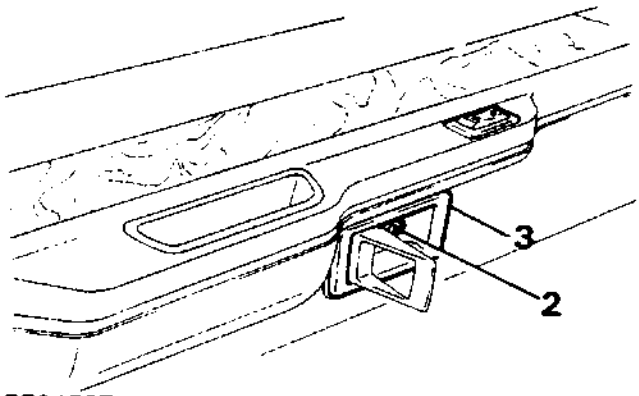
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REAR DOOR - TRIM PANEL - 4 Door models

Remove and refit

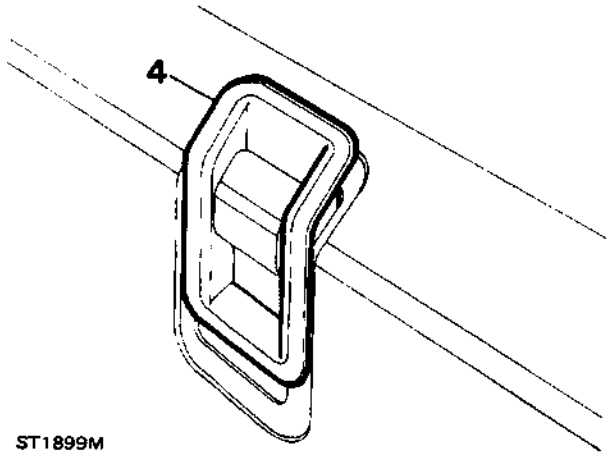
Removing

1. Disconnect the battery negative terminal.
2. Remove the screw securing the handle bezel.
3. Remove the bezel.



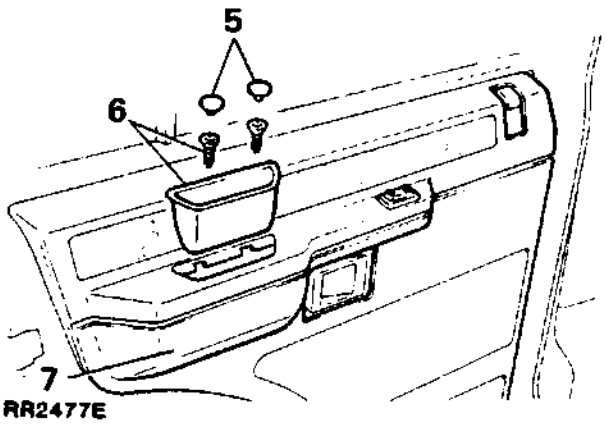
RR2478E

4. Prise the door locking button bezel from the trim panel.



ST1899M

5. Remove the two finisher buttons from the bottom of the door pull pocket to reveal the securing screws.
6. Remove the screws and withdraw the pocket from the trim panel.
7. Using a taped screwdriver, carefully prise the trim panel away from the door.
8. Disconnect the electrical plug from the window lift switch.
9. Remove the window lift switch by pushing from behind the trim panel.



RR2477E

Refitting

10. Reverse the removal instructions.

REAR DOOR LOCK, OUTSIDE AND INSIDE DOOR RELEASE HANDLES - 4 Door models

Remove and refit

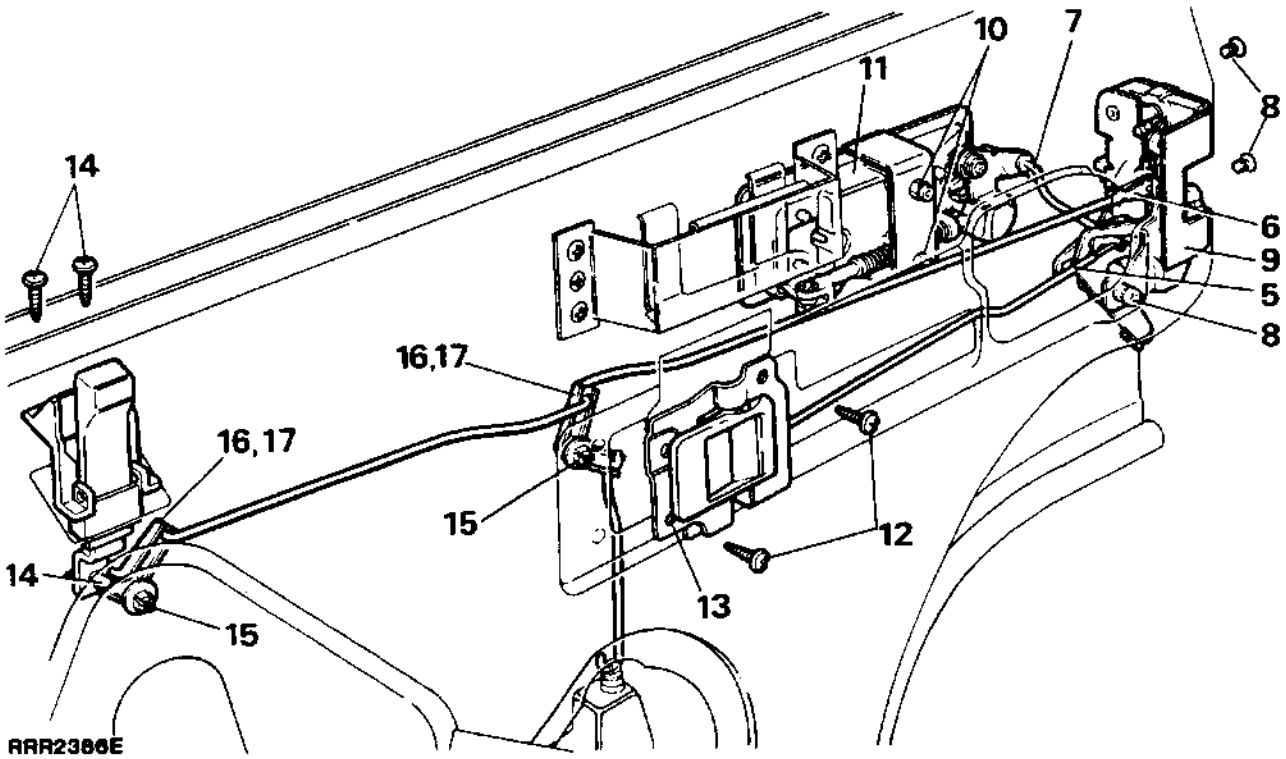
Removing

1. Ensure the window is fully closed position and disconnect the battery.
2. Remove the interior door handle bezel, prise the window lift switch from the trim panel and disconnect the electrical multi - plug.
3. Prise the sill button from the trim panel.
4. Remove the two screws from the bottom of the door pull pocket accessible after removing the two buttons and detach the trim panel from the door panel. Remove the plastic barrier sheet.
5. Disconnect the control rod from the inside door release handle by pulling the rod out of its location at the door lock.
6. Disconnect the sill locking control rod from the door lock by releasing the metal clip.
7. Disconnect the control rod from the outside door release handle by pulling it out of the plastic ferrule.
8. Release the door lock by removing the two countersunk screws from the door edge and the single screw (with shakeproof washer) on the inside of the door. Retrieve any spacing washers which may be fitted between the inner door panel and lock.
9. Withdraw the lock through the upper rear opening in the inner door panel.

NOTE: If necessary the following items can also be removed.

10. Remove the two nuts (with shakeproof washers) and retaining bracket securing the outside door release handle accessible through the upper rear cut - out on the inner door panel.
11. Carefully detach the outside door release handle from the outer door panel.
12. Remove the two screws (with plain washers) securing the inside door release handle to the inner door panel.
13. Withdraw the handle from its location with the connecting rod attached.

Continued



14. Remove the two screws securing the sill locking button to the inner door panel and detach the sill button from the quadrant.

Sill locking quadrants

15. Using a small screwdriver, or 3.175 mm diameter rod, press the plastic locking pins through the respective square inserts in the inner door panel, until they can be retrieved from inside the door.
16. Release the quadrants from the inner door panel and unhook the respective connecting rods.
17. Withdraw the quadrant from the inner door panel.

NOTE: When refitting the quadrants the locking pins are entered into the square insert from outside and pressed in flush.

Refitting

18. Reverse the removal procedure items 1 to 17.

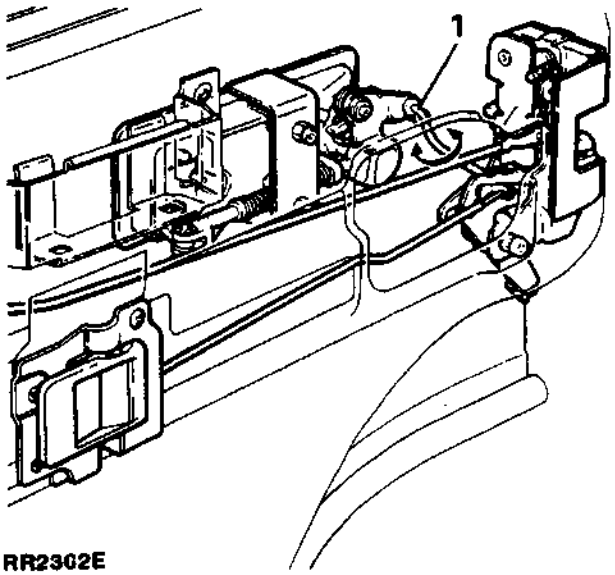
NOTE: When refitting the door glass frame, ensure that it is positioned to suit the door opening before fully tightening the frame securing bolts.

ADJUSTMENT - REAR DOOR LOCK AND HANDLE ASSEMBLY - 4 Door models

Outside door release handle to lock

1. Disconnect the short offset connecting rod at the rear of the door outer release handle, rotate the rod clockwise or counter - clockwise to shorten or extend the operating length of the rod.

NOTE: Door release should be effective before the total handle movement is exhausted to provide a small overthrow movement.



RR2302E

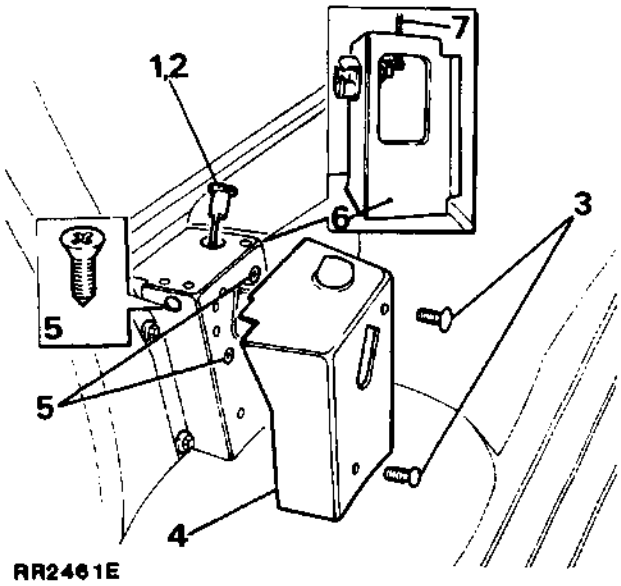
ASYMMETRIC SPLIT REAR SEAT - LOCKING MECHANISM

NOTE: 1989 Model Year vehicles have a revised seat locking mechanism which incorporates a push button release in place of a finger lift button. The revised latch and striker give the seat an improved positive location.

Remove and refit

Removing

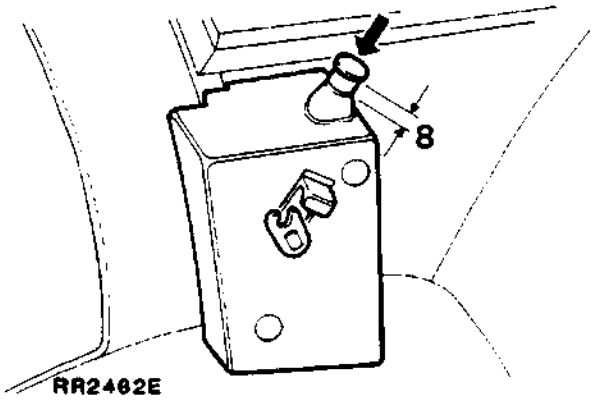
1. Depress the seat release button and fold the seat back forward.
2. Unscrew and remove the seat release button.
3. Prise out the two trim buttons securing the trim covering to the latch tower.
4. Manoeuvre the trim covering from the tower.
5. Remove the three screws securing the latch to the tower, noting that access to the single screw is gained through the hole in the front of the tower.
6. Retrieve the latch from the opening at the rear of the tower, also if necessary retrieve the single screw.
7. The operating rod can be removed from the latch by releasing the rod at the plastic clip.



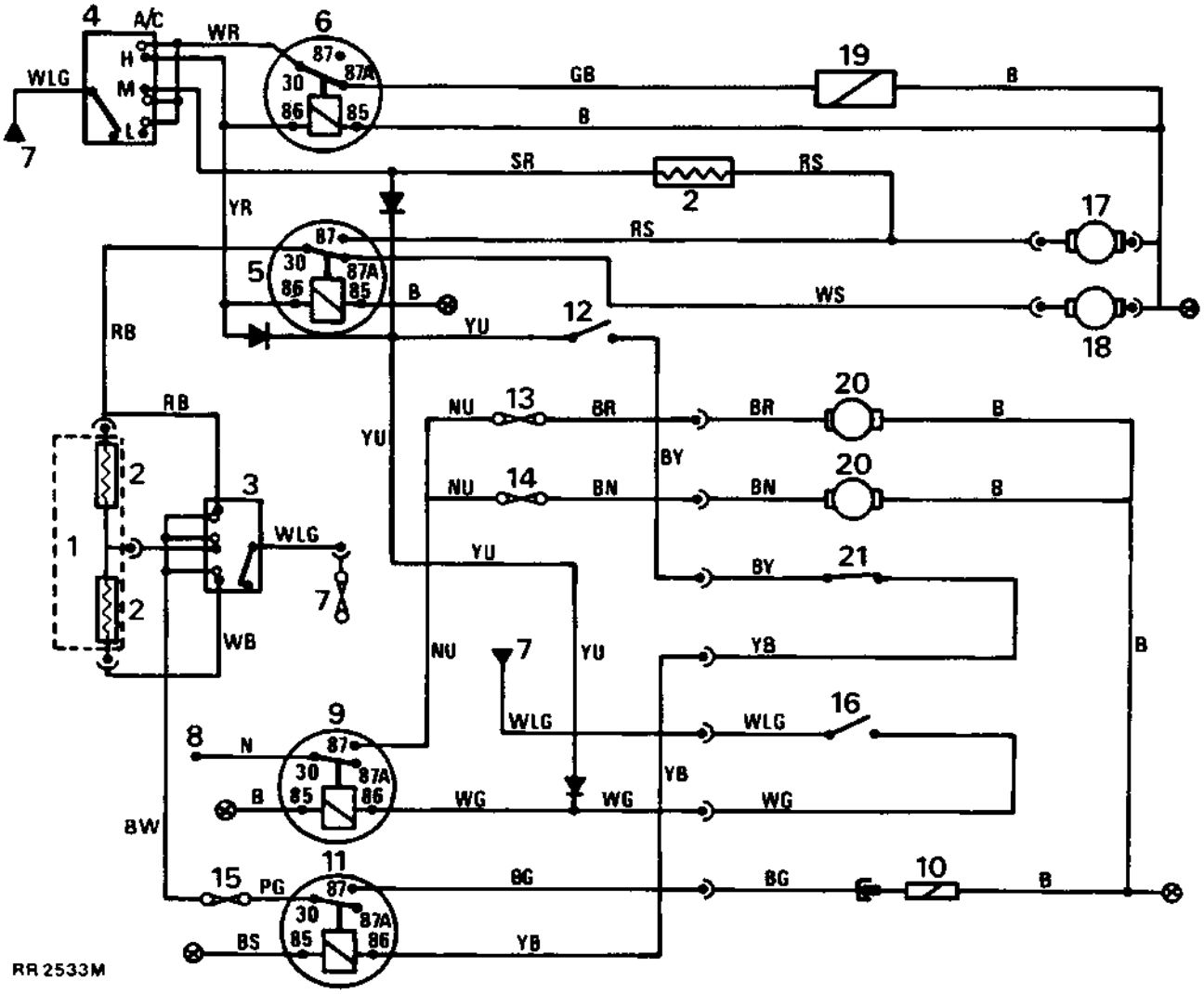
RR2461E

Refitting

8. Refitting is a reversal of the removal procedure noting that when the seat release button is screwed onto the operating rod there must be a gap of 5 - 8 mm (0.196 - 0.312 inch) between the head of the button and lip of the trim covering after the button has been depressed.



RR2462E



HEATER AND AIR CONDITIONING - circuit diagram

1. Heater unit.
2. Resistors.
3. Fan speed switch.
4. Air conditioning/re-circ/fresh air switch.
5. Air conditioning/heater relay.
6. Fresh air solenoid relay.
7. Fuse 8-main fuse panel.
8. Main cable connection.
9. Fan relay.
10. Compressor clutch.
11. Compressor clutch relay.
12. Thermostat.
13. Fuse A1-auxiliary fuse panel A.
14. Fuse A2-auxiliary fuse panel A.
15. Fuse A3-auxiliary fuse panel A.
16. Engine water temperature sensor.
17. Air conditioning motors-(2)-dashboard unit.
18. Heater motor.
19. Fresh air solenoid.
20. Condenser fan motors.
21. High pressure switch.

Cable colour code

B	Black	**N**	Brown	**R**	Red	**W**	White
G	Green	**O**	Orange	**S**	Grey	**Y**	Yellow
L	Light	**P**	Purple	**U**	Blue		

The last letter of a colour code denotes the tracer.

HEATED WINDSCREEN WASHER JETS

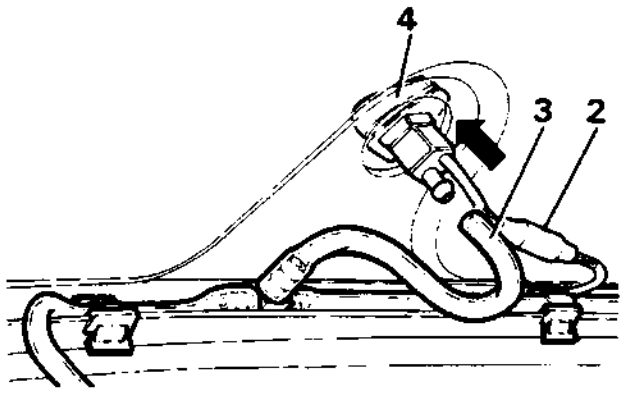
1989 model year vehicles feature electrically heated windscreen washer jets. The operating thermostat fitted on the righthand headlamp mounting panel senses temerature and will operate the jet heaters at a temperature of 4°C ± 3° C.

Washer jets

Remove and refit

Removing

1. Disconnect the battery negative lead.
2. Disconnect the electrical connection at the plug.
3. Withdraw the washer tube from the jet.
4. Push the jet upwards to remove from its mounting.
5. Remove the washer jet mounting from the bonnet, if necessary.



RR2549M

Refitting

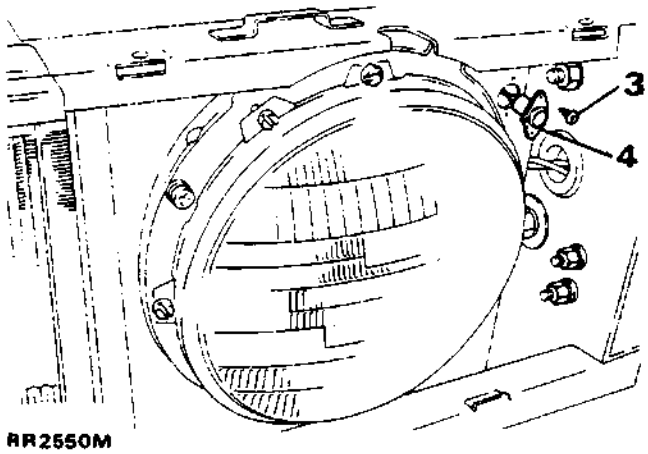
6. Reverse the removal procedure.

Thermostat

The thermostat will operate (close) at 4°C ± 3° C, and re-open at 10°C ± 3° C.

Remove

1. Disconnect the battery negative lead.
2. Remove the radiator grill.
3. Remove two screws securing the thermostat to the right hand headlamp mounting panel.
4. Withdraw the thermostat, disconnecting the electrical connector.

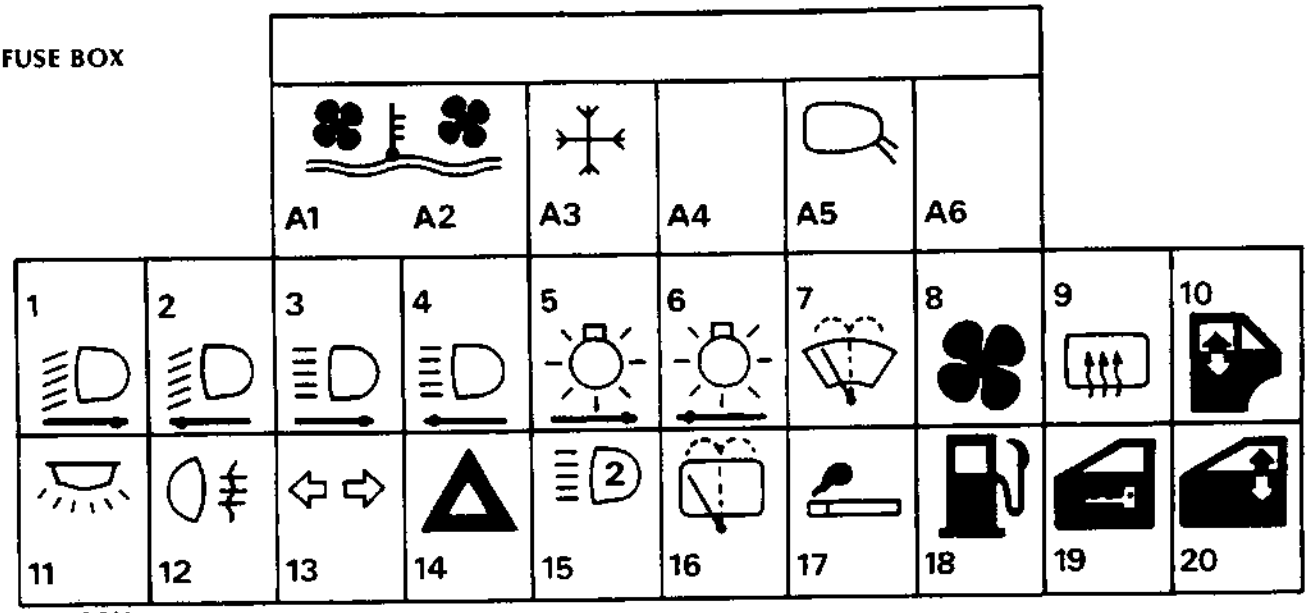


RR2550M

Refitting

5. Reverse the removal procedure.

FUSE BOX



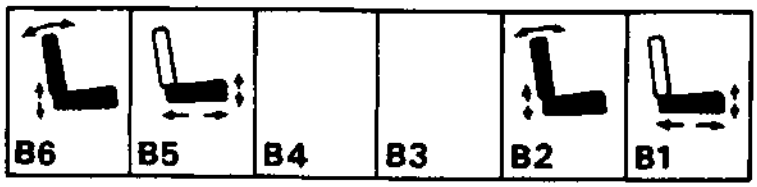
RR2475M

FUSE NO.	COLOUR CODE	FUSE VALUE	CIRCUIT SERVED	IGNITION KEY CONTROLLED
MAIN FUSE PANEL				
1	Brown	7.5 amp	RH headlamp low beam and power wash	
2	Brown	7.5 amp	LH headlamp low beam	
3	Brown	7.5 amp	RH headlamp high beam	
4	Brown	7.5 amp	LH headlamp high beam, auxiliary lamp switch	
5	Tan	5 amp	RH parking lights and instrument illumination	
6	Tan	5 amp	LH parking lights and radio illumination	
7	Blue	15 amp	Front wash/wiper motors, seat relay, window lift relay, antennae amplifier	Aux
8	Green	30 amp	Heater/air con. motor	Aux
9	White	25 amp	Heated rear screen	Ign
10	Green	30 amp	Window lifts rear-option	Aux
11	Blue	15 amp	Interior light delay, clock, radio, under bonnet illumination	Aux
12	Red	10 amp	Rear fog guard (from dipped-headlamps)	
13	Blue	15 amp	Direction indicators, stop lights, reverse lights, electric mirror pick up point, low coolant, heated jets, interior lamp delay, heater/air con relay	Ign
14	Yellow	20 amp	Hazard lights, horn, headlamps flash	
15	Blue	15 amp	Auxiliary driving lamps	
16	Red	10 amp	Rear wash/wipe motor, heated rear screen switch	Ign
17	Yellow	20 amp	Cigar lighters (front and rear)	Ign
18	Red	10 amp	Fuel pump	Ign
19	Red	10 amp	Central door locking-option	
20	Green	30 amp	Electric window lifts front-option	Aux

NOTE: Radio Cassette combination. An in-line 5 amp fuse is incorporated in the power input lead of the unit.

AUXILIARY FUSE PANEL - (A)				
A1	Yellow	20 amp	Air conditioning fan	IGN
A2	Yellow	20 amp	Air conditioning fan	IGN
A3	Tan	5 amp	Air conditioning compressor clutch	IGN
A4			Spare	
A5	Violet	3 amp	Electric mirror motors	IGN
A6			Spare	

AUXILIARY FUSE BOX



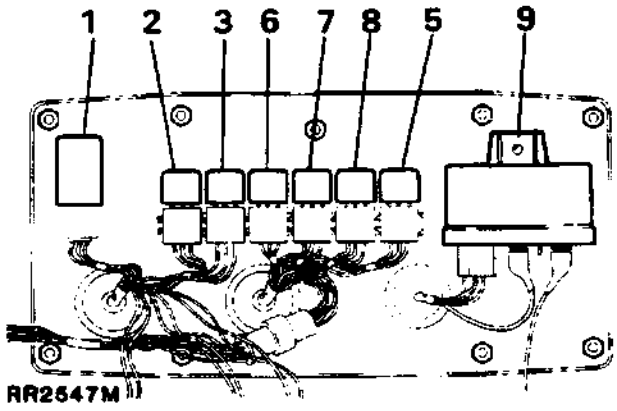
RR2575E

AUXILIARY FUSE BOX (B) - Located under the front left-hand seat

FUSE NO	COLOUR CODE	FUSE VALUE	CIRCUIT SERVED
B1	Green	30 amp	Drivers seat base/height front
B2	Green	30 amp	Drivers seat recline/height rear
B3	----	----	Spare
B4	----	----	Spare
B5	Green	30 amp	Passengers seat base/height front
B6	Green	30 amp	Passengers seat recline/height rear

RELAYS-Identification

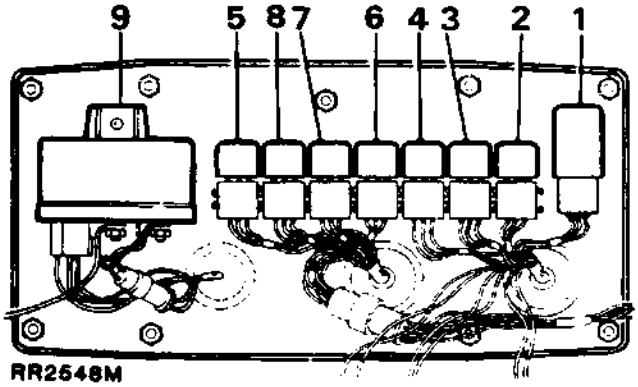
RR2547M shows left hand drive configuration of relays.



RR2547M

Closure panel viewed from the engine compartment, with protective cover removed.

RR2548M shows right hand drive configuration of relays.



RR2548M

Relay/delay/timer unit	Main Circuit Diagram Item Number	
	Right hand steer	Left hand steer Non-catalyst
1. Headlamp wash timer unit	19. M	17. M
2. Heated rear window relay	66. M	64. M
3. Starter solenoid relay	6. M	6. M
4. Brake check relay	151. M	157. M
5. Fresh air solenoid relay	6. A	6. A
6. Compressor clutch relay	10. A	10. A
7. Condenser fan relay	9. A	9. A
8. Air conditioning/heater	5. A	5. A
9. Glow plug timer unit (Diesel models)	143. M	150. M
10. Rear wiper delay	132. M	139. M
11. Auxiliary lamp relay (if fitted)	88. M	86. M
12. Ignition load relay	1. M	1. M
13. Headlamp relay	157. M	26. M
14. Heater/air con. relay	163 M	175. M
15. Interior lamp delay	101. M	99. M
16. Flasher/hazard unit	75. M	73. M
17. Voltage sensitive switch (air conditioning)	72. M	70. M
18. Front wiper delay	15. M	14. M
19. Seat adjustment relay, two (if fitted)	5/6. S	5/6. S
20. Main EFI relay	10. E	10. E
21. Fuel pump relay	11. E	11. E
22. Sunshine roof auxiliary relay (if fitted)	3. SR	3. SR
23. Rear window lift relay (if fitted)	13. W	13. W
24. Front window lift relay (if fitted)	14. W	14. W
25. Window lift one touch unit (if fitted)	1. W	1. W

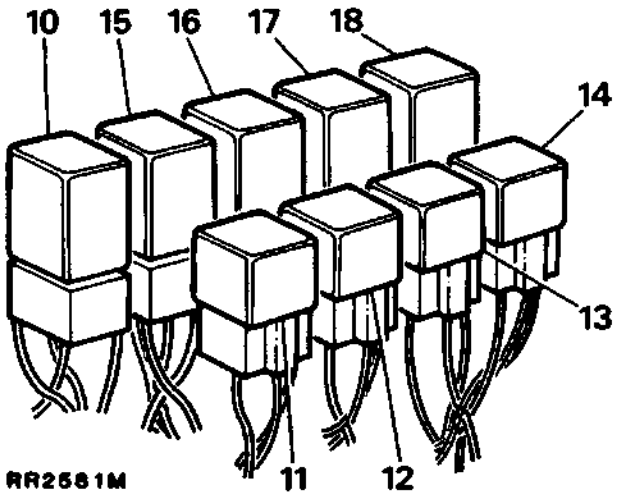
M = Main circuit diagram
A = Air conditioning circuit diagram
S = Seat adjustment circuit diagram
E = EFI circuit diagram
SR = Sunroof circuit diagram
W = Window lift circuit diagram

NOTE: The brake check relay on left hand drive vehicles is situated inside the lower fascia panel.

NOTE: Refer to fuel injection section of manual for full information on E.F.I. relays.

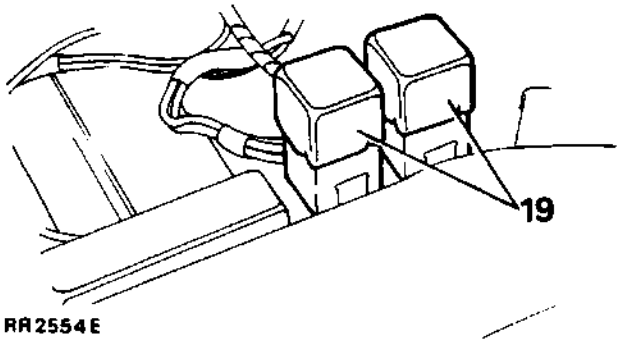
Saudi vehicles are fitted with two extra relays, an overspeed monitor and buzzer, located immediately below the instrument binnacle.

Access to the two units is gained by removing the lower dash panel and steering column shroud.



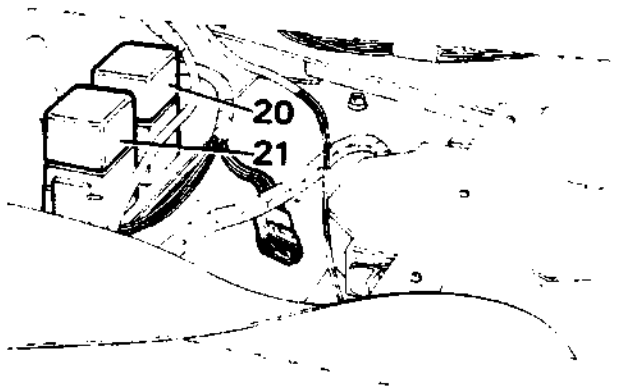
RR2561M

Steering column mounted relays viewed with the lower dash panel removed.



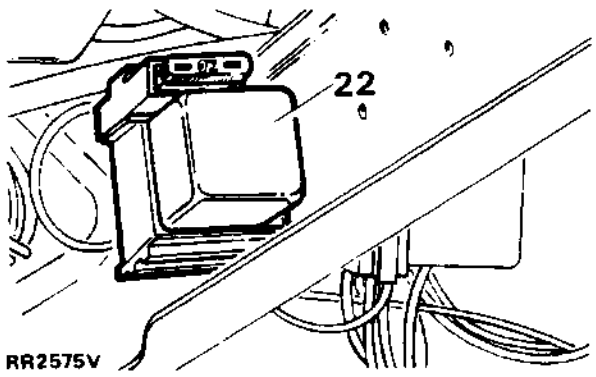
RR2554E

Seat adjustment relay (load control) located beneath the left hand front seat adjacent to fuse box (B).



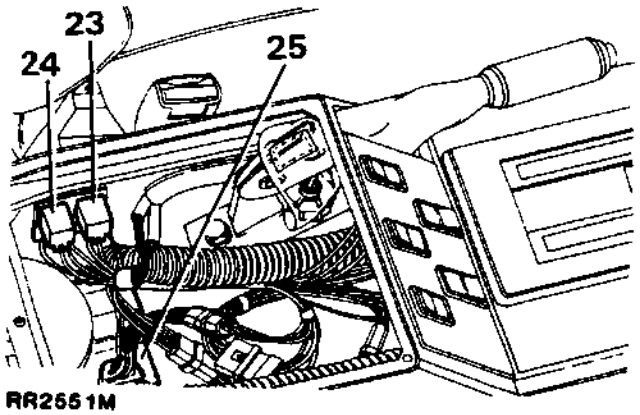
RR2374V

Main EFI (black terminal block) and fuel pump relays (blue terminal block) mounted beneath right hand front seat.



RR2575V

Sunshine roof auxiliary relay located on side of the steering column support bracket located behind the lower dash panel. (Left hand drive shown).



RR2551M

Front (black terminal block) and rear (blue terminal block) window relays. One touch control unit (25) is located inside the glove box, accessible by removing glove box liner.

ELECTRICALLY OPERATED CENTRAL DOOR LOCKING SYSTEM

The optional central door locking system now includes an actuator unit to lock the upper tailgate.

Locking or unlocking the drivers door from outside by key operation, or from inside by sill knob automatically locks or unlocks all four doors, the upper tailgate and the fuel filler flap.

Front and rear passenger doors can be independently locked or unlocked from inside the vehicle by sill knob operation but can be overidden by further operation of the driver locking control.

On rear doors only a child safety lock is provided which can be mechanically pre-set to render the interior door handles inoperative.

Failure of an actuator will not affect the locking of the remaining three doors, tailgate or fuel filler flap. The door/tailgate with the inoperative actuator can still be locked or unlocked manually, but not the fuel filler flap.

It is also possible to override the tailgate central locking by use of the key.

NOTE: The door lock actuator units contain non-serviceable parts. If a fault should occur replace the unit concerned with a new one.

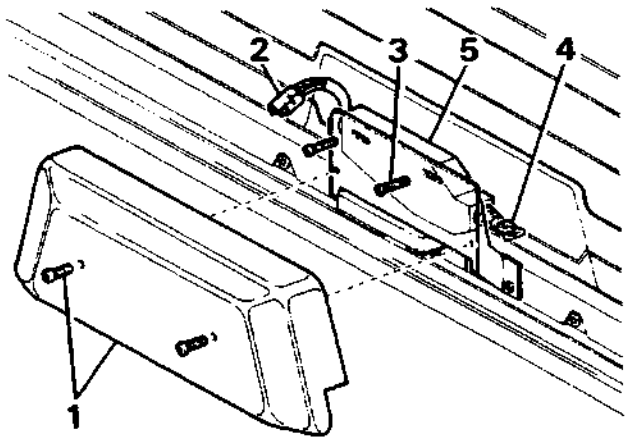
Before carrying out any maintenance work disconnect the battery.

UPPER TAILGATE ACTUATOR UNIT

Remove and refit

Removing

1. Remove two screws and the trim covering to gain access to the actuator.
2. Disconnect the electrical connection.
3. Remove the two actuator retaining screws.
4. Manoeuvre the actuator assembly to detach the operating rod 'eye' from the actuator link to the lock.
5. Withdraw the tailgate actuator unit.

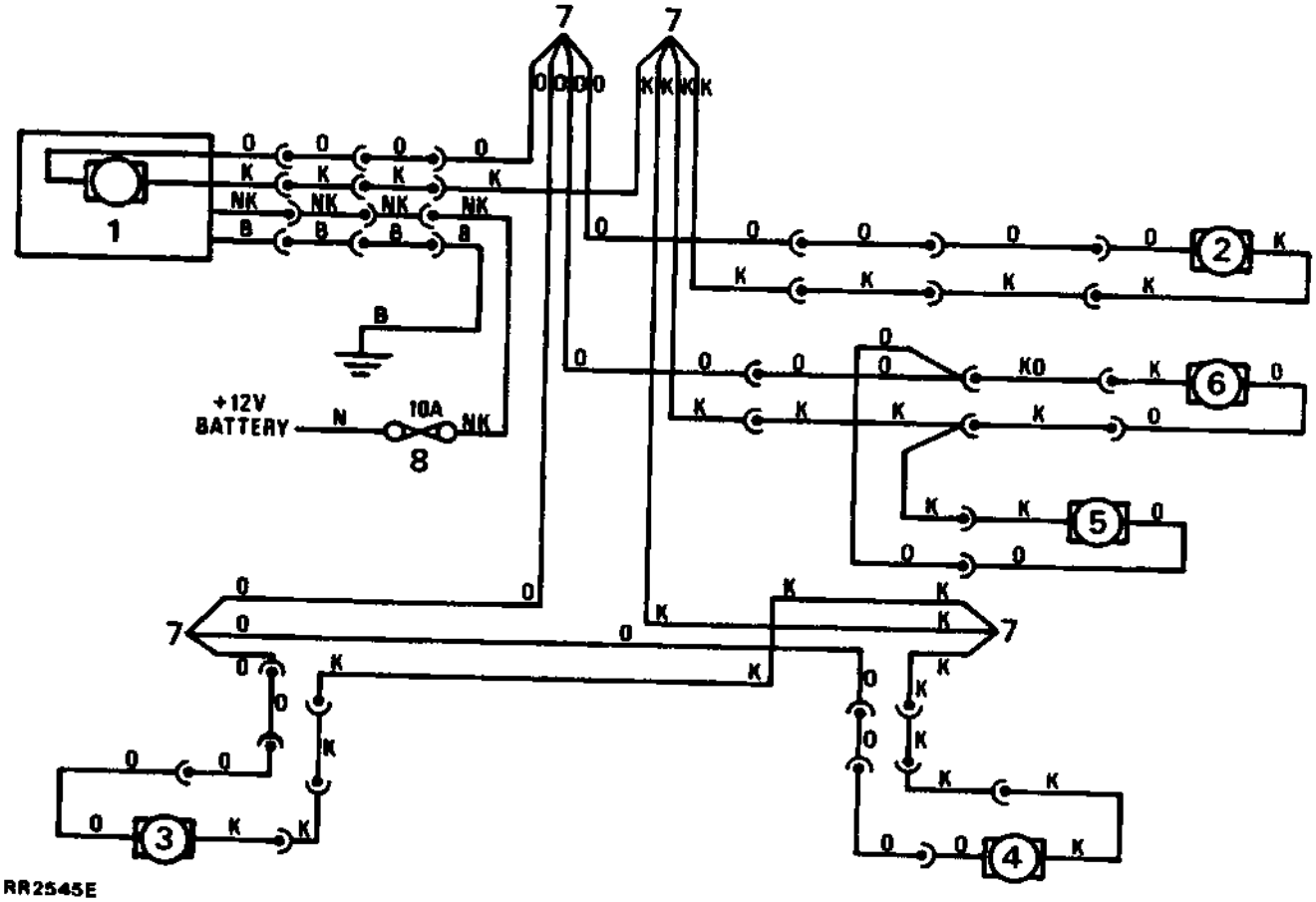


RR2670E

Refitting

6. Reverse the removal procedure.
7. Check the operation of the central locking system.

ELECTRICAL EQUIPMENT - CIRCUIT DIAGRAMS
- 1989 Model year



CENTRAL DOOR LOCKING
- Circuit diagram RR2545E

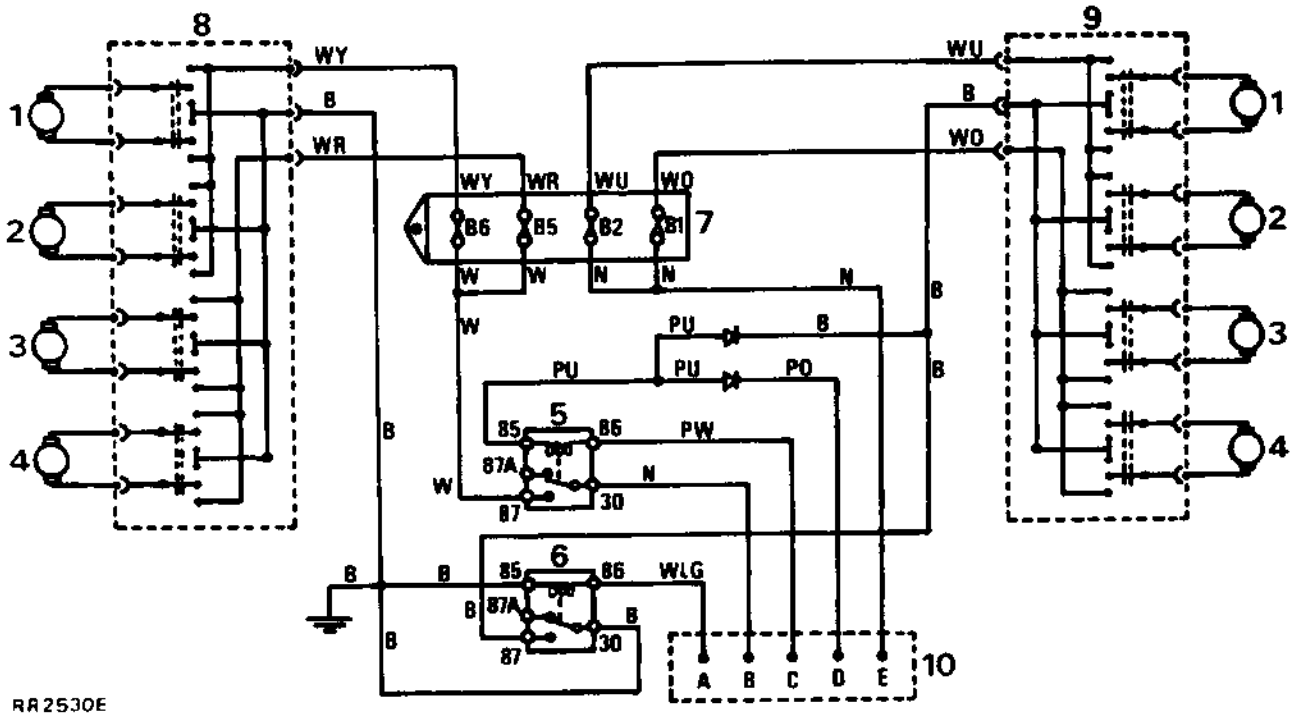
1. Switch/lock unit drivers door
2. Lock unit front passenger door
3. Lock unit-left hand rear door
4. Lock unit-right hand rear door
5. Fuel flap actuator
6. Lock unit-tailgate
7. Clinches
8. Fuse 19

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour code denotes the tracer.

ELECTRIC SEAT ADJUSTMENT



Circuit diagram - RR2530E

1. Seat recline motor
2. Seat height (rear) motor
3. Seat base adjust motor
4. Seat height (front) motor
5. Load relay-from driver's door courtesy switch
6. Load relay-fused auxiliary feed controled
7. Auxiliary fuse box (B)
8. Driver's seat control
9. Passenger's seat control
10. Main cable connections:
    - A: Fused auxiliary feed
    - B: Battery feed
    - C: Fused 12 volt
    - D: Courtesy switch earth
    - E: Battery feed

Cable colour code

B	Black	**G**	Green	**P**	Purple	**Y**	Yellow
U	Blue	**S**	Grey	**R**	Red	**L**	Light
N	Brown	**O**	Orange	**W**	White		

The last letter of a colour code denotes the tracer.

ELECTRIC WINDOW LIFT

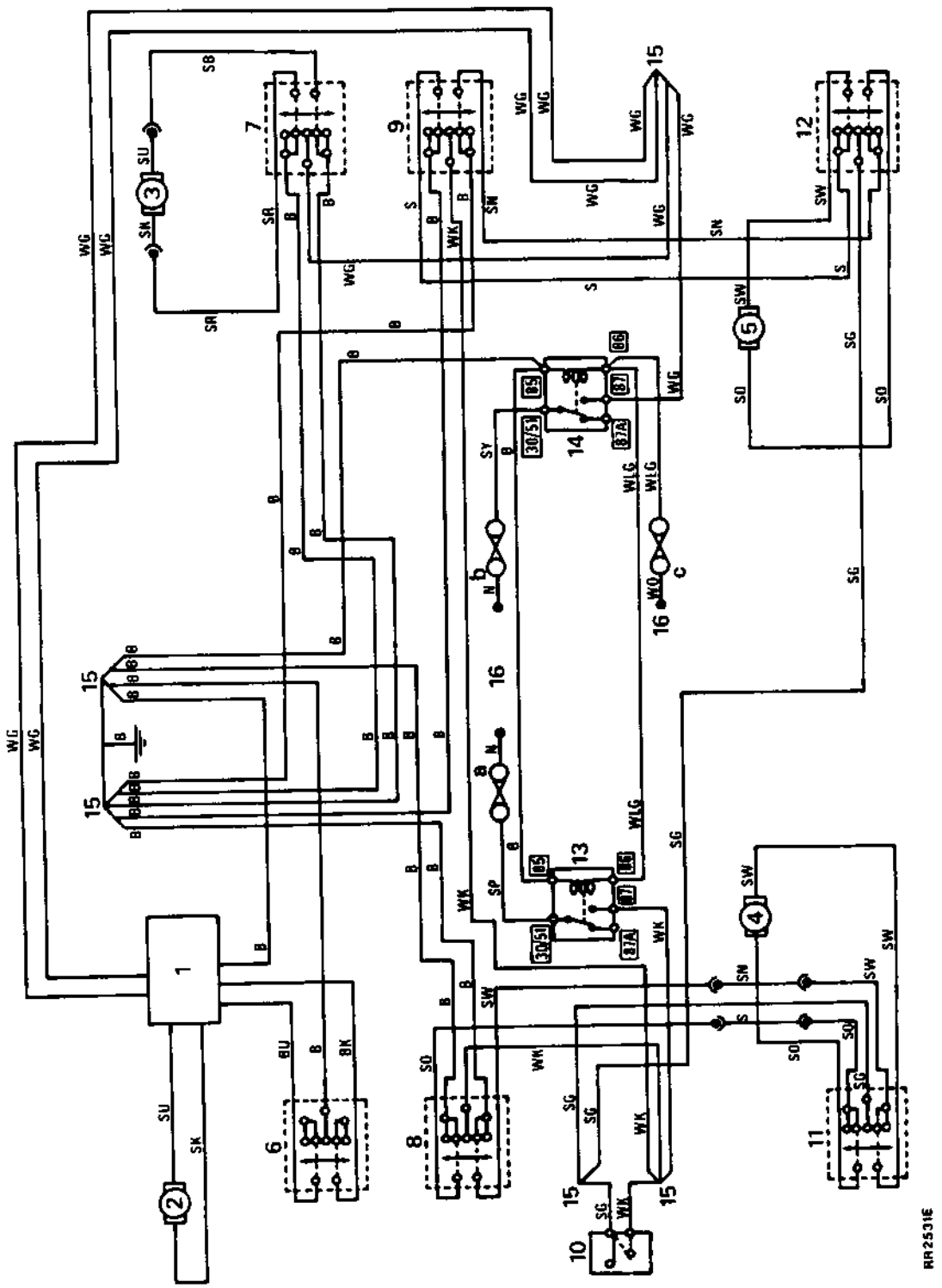
Circuit diagram - RR2531E

1. One touch control unit-drivers window
2. Window lift motor-drivers window
3. Window lift motor-front passengers side
4. Window lift motor LH rear
5. Window lift motor RH rear
6. Window lift switch drivers window
7. Window lift switch front passengers window
8. Window lift switch LH rear door
9. Window lift switch RH rear door
10. Isolator switch
11. Window lift switch in LH rear door
12. Window lift switch in RH rear door
13. Relay-rear windows
14. Relay-front windows
15. Clinches
16. Main cable fuses
    - a: Fuse 10
    - b: Fuse 20
    - c: Fuse 7

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour code denotes the tracer.


RR2531E

MAIN CIRCUIT DIAGRAM
Right Hand Steering - RR2571M & RR2572M

Numerical key

1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (Automatic)
8. Ignition switch
9. Tachometer
10. Voltage transformer(dim dip)
11. Ignition warning lamp
12. Alternator
13. Fuse 7
14. Front wipe/wash switch
15. Front wipe delay unit
16. Front wiper motor
17. Front wash switch
18. Front wash pump
19. Headlamp wash timer unit (option)
20. Headlamp wash pump (option)
21. Main lighting switch
22. Fuse 6
23. Fuse 5
24. LH side lamp
25. LH tail lamp
26. LH number plate lamp
26b. RH number plate lamp
27. Main beam dip/flash switch
28. Fuse 14
29. RH side lamp
30. RH tail lamp
31. Rheostat
32. Fuse 3
33. Fuse 4
34. Fuse 1
35. Fuse 2
36. Rear fog switch
37. Fuse 12
38. Switch illumination (2 off)
39. Cigar lighter illumination (2 off)
40. Heater illumination (4 off)
41. Clock illumination
42. Automatic gear selector illumination (2 off)
43. Instrument illumination (6 off)
43b. Column switch illumination
44. Rear fog warning lamp
45. LH rear fog
46. RH rear fog
47. LH dip beam
48. RH dip beam
49. LH main beam
50. RH main beam
51. Main beam warning lamp
52. Fuel gauge
53. Fuel gauge sender unit
54. Water temperature gauge
55. Water temperature sender unit
56. Fuse 11
57. Horn switch
58. RH horn
59. LH horn
60. Under bonnet light switch
61. Under bonnet light
62. Clock
63. Fuse 19
64. Fuse 20
65. Pick-up point central locking/window lift (option)
66. Heated rear window relay
67. Fuse 9
68. Radio aerial amplifier
69. Heated rear screen
70. Heated rear screen switch
71. Heated rear screen warning lamp
72. Voltage sensitive switch
73. Fuse 13
74. Hazard switch
75. Flasher unit
76. Direction indicator switch
77. Hazard/indicator warning lamp
78. LH rear indicator lamp
79. LH front indicator lamp
80. LH side repeater lamp
81. RH side repeater lamp
82. RH front indicator lamp
83. RH rear indicator lamp
84. Trailer warning lamp
85. Fuse 15
86. Stop lamp switch
87. Reverse lamp switch
88. Auxiliary lamp relay (option)
89. LH stop lamp
90. RH stop lamp
91. LH reverse lamp
92. RH reverse lamp
93. LH auxiliary lamp (option)
94. RH auxiliary lamp (option)
95. Auxiliary lamp switch (option)
96. Fuse 17
97. Dash cigar lighter
98. Cubby box cigar lighter
99. Front interior lamp
100. Rear interior lamp
101. Interior lamp delay unit
102. LH door edge lamp
103. LH puddle lamp
104. RH door edge lamp
105. RH puddle lamp
106. Interior lamp switch
107. LH rear door switch
108. RH rear door switch
109. Tailgate switch
110. LH front door switch
111. RH front door switch
112. Heated jets
113. Thermostat heated jets
114. Oil pressure warning lamp
115. Oil pressure switch
116. Fuse 18
117. Fuel cut off relay (carburetter models)
118. Fuel pump (petrol models)
119. Ignition coil (petrol models)
120. Capacitor (petrol models)
121. Distributor (petrol models)
122. EFI harness plug
123. Fuel shut off solenoid (Diesel)
124. Not used
125. Radio fuse
126. Radio and four speakers
    - LF-left hand front speaker
    - LR-left hand rear speaker
    - RF-right hand front speaker
    - RR-right hand rear speaker
127. Sun roof pick up point (option)
128. Automatic transmission oil temperature warning lamp
129. Automatic transmission oil temperature switch
130. Fuse 16
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Multi-function unit in binnacle
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. Cold start/diesel glow plug warning lamp
142. Cold start switch (carburetter)
143. Glow plug timer (diesel)
144. Glow plugs (diesel)
145. Handbrake warning lamp
146. Brake fail warning lamp
147. Handbrake warning switch
148. Brake fluid level warning switch
149. Brake pad wear warning lamp
150. Brake pad wear sensors
151. Brake check relay
152. Split charge relay (option)
153. Split charge terminal post (option)
154. Heater/air conditioning connections
155. Fuse 8
156. Coil negative (engine RPM input to ECU)
157. Headlamp relay
158. Ignition load relay (+)
159. Battery feed (+)
160. Ignition auxiliary (+)
161. Ignition on (+)
162. Earth (-)
163. Heater/air con relay
164. Trailer pick up point
165. Electric seats pick up point (option)
166. Fuse 10
167. Electric mirrors pick up point (option)
168. Alarm connection (dealer fit)

CABLE COLOUR CODE

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

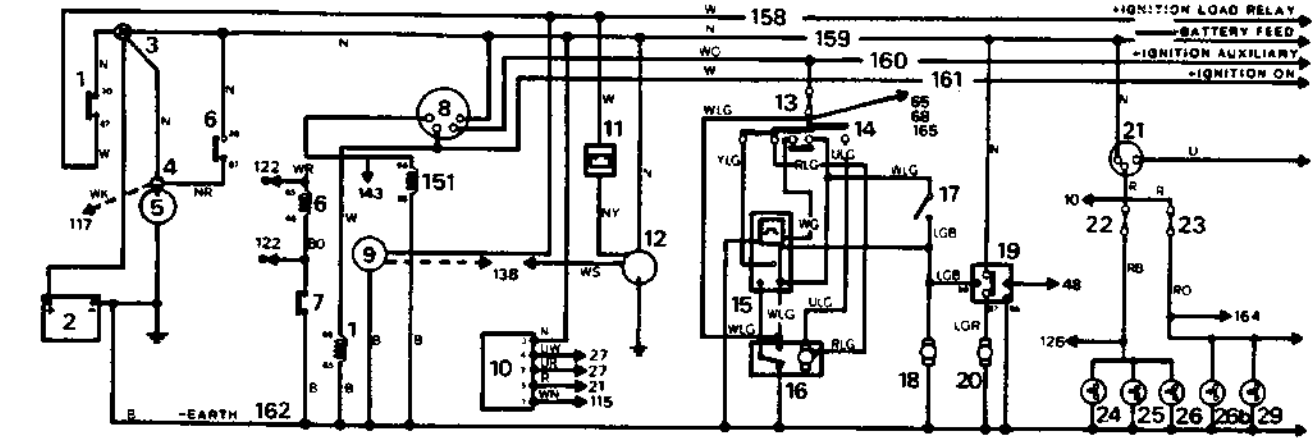
The last letter of a colour code denotes the tracer.

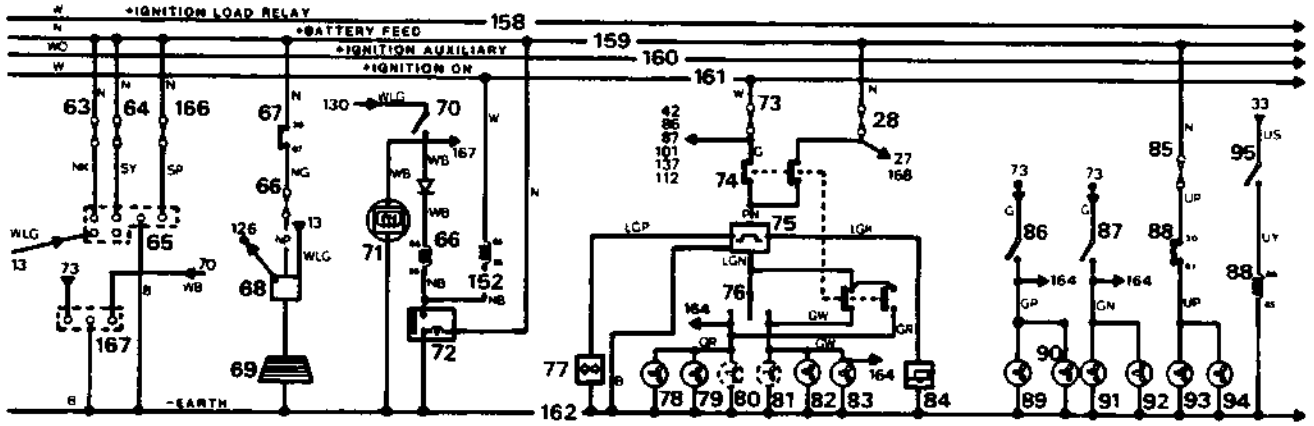
MAIN CIRCUIT DIAGRAM
Right Hand Steering - RR2571M & RR2572M

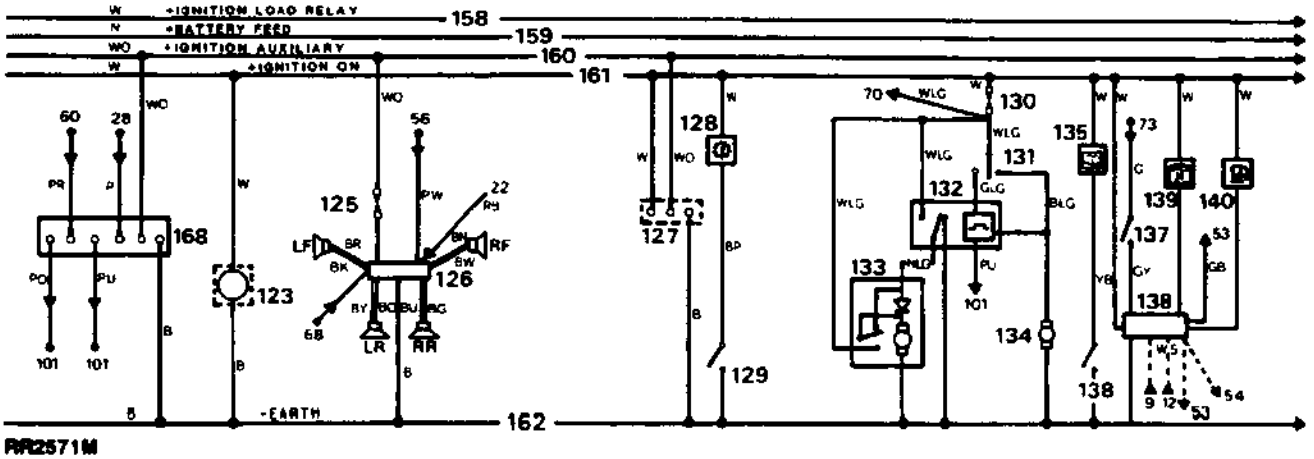
Alphabetical key

168. Alarm connection (dealer fit)
12. Alternator
42. Automatic gear selector illumination (2 off)
129. Automatic transmission oil temperature switch
128 Automatic transmission oil temperature warning lamp
88. Auxiliary lamp relay (option)
95. Auxiliary lamp switch (option)
2 Battery
159 Battery feed (+)
151 Brake check relay
146 Brake fail warning lamp
148. Brake fluid level warning switch
150. Brake pad wear sensors
149 Brake pad wear warning lamp
120 Capacitor (petrol models)
39. Cigar lighter illumination (2 off)
62. Clock
41 Clock illumination
156. Coil negative (engine RPM input to ECU)
141 Cold start/diesel glow plug warning lamp
142 Cold start switch (carburetter)
43b Column switch illumination
98 Cubby box cigar lighter
97 Dash cigar lighter
76 Direction indicator switch
121. Distributor (petrol models)
162 Earth (-)
122. EFI harness plug
167 Electric mirrors pick up point (option)
165. Electric seats pick up point (option)
75 Flasher unit
99 Front interior lamp
17 Front wash switch
18. Front wash pump
15 Front wipe delay unit
16 Front wiper motor
14 Front wipe/wash switch
117 Fuel cut off relay (carburetter models)
34 Fuse 1
35 Fuse 2
32 Fuse 3
33 Fuse 4
23 Fuse 5
22 Fuse 6
13. Fuse 7
155 Fuse 8
67 Fuse 9
166. Fuse 10
56 Fuse 11
37 Fuse 12
73 Fuse 13
28 Fuse 14
85 Fuse 15
130. Fuse 16
96. Fuse 17
116. Fuse 18
63. Fuse 19
64. Fuse 20
52. Fuel gauge
53. Fuel gauge sender unit
118. Fuel pump (petrol models)
123. Fuel shut off solenoid (Diesel)
144. Glow plugs (diesel)
143. Glow plug timer (diesel)
145 Handbrake warning lamp
147 Handbrake warning switch
77. Hazard/indicator warning lamp
74. Hazard switch
157. Headlamp relay
20. Headlamp wash pump (option)
19. Headlamp wash timer unit (option)
112 Heated jets
69. Heated rear screen
70. Heated rear screen switch
71 Heated rear screen warning lamp
66 Heated rear window relay
154 Heater/air conditioning connections
163 Heater/air con relay
40. Heater illumination (4 off)
57 Horn switch
160 Ignition auxiliary (+)
119 Ignition coil (petrol models)
43. Instrument illumination (6 off)
101. Interior lamp delay unit
106. Interior lamp switch
1. Ignition load relay
158. Ignition load relay (+)
161 Ignition on (+)
8. Ignition switch
11. Ignition warning lamp
139 Low coolant level warning lamp
137. Low coolant switch
140. Low fuel level warning lamp
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
93 LH auxiliary lamp (option)
47 LH dip beam
102 LH door edge lamp
110. LH front door switch
79 LH front indicator lamp
59. LH horn
49 LH main beam
26. LH number plate lamp
103 LH puddle lamp
107 LH rear door switch
45. LH rear fog
78. LH rear indicator lamp
91 LH reverse lamp
24 LH side lamp
80 LH side repeater lamp
89. LH stop lamp
25 LH tail lamp
27 Main beam dip/flash switch
51. Main beam warning lamp
21. Main lighting switch
138. Multi-function unit in binnacle
115. Oil pressure switch
114. Oil pressure warning lamp
65. Pick-up point central locking/window lift (option)
68. Radio aerial amplifier
126. Radio and four speakers
125. Radio fuse
36. Rear fog switch
44. Rear fog warning lamp
100. Rear interior lamp
134. Rear screen wash pump
131. Rear wash wipe switch
132. Rear wipe delay unit
133 Rear wiper motor
87 Reverse lamp switch
31 Rheostat
94. RH auxiliary lamp (option)
48. RH dip beam
104. RH door edge lamp
111 RH front door switch
82 RH front indicator lamp
58 RH horn
50 RH main beam
26b RH number plate lamp
105 RH puddle lamp
108 RH rear door switch
46. RH rear fog
83 RH rear indicator lamp
92. RH reverse lamp
29. RH side lamp
81. RH side repeater lamp
90 RH stop lamp
30. RH tail lamp
152. Split charge relay (option)
153. Split charge terminal post (option)
7 Starter inhibit switch (Automatic)
5 Starter motor
6 Starter relay
4 Starter solenoid
86 Stop lamp switch
127 Sun roof pick up point (option)
38. Switch illumination (2 off)
9 Tachometer
109 Tailgate switch
3. Terminal post
113 Thermostat heated jets
164 Trailer pick up point
84 Trailer warning lamp
61. Under bonnet light
60 Under bonnet light switch
72. Voltage sensitive switch
10. Voltage transformer(dim dip)
54 Water temperature gauge
55 Water temperature sender unit

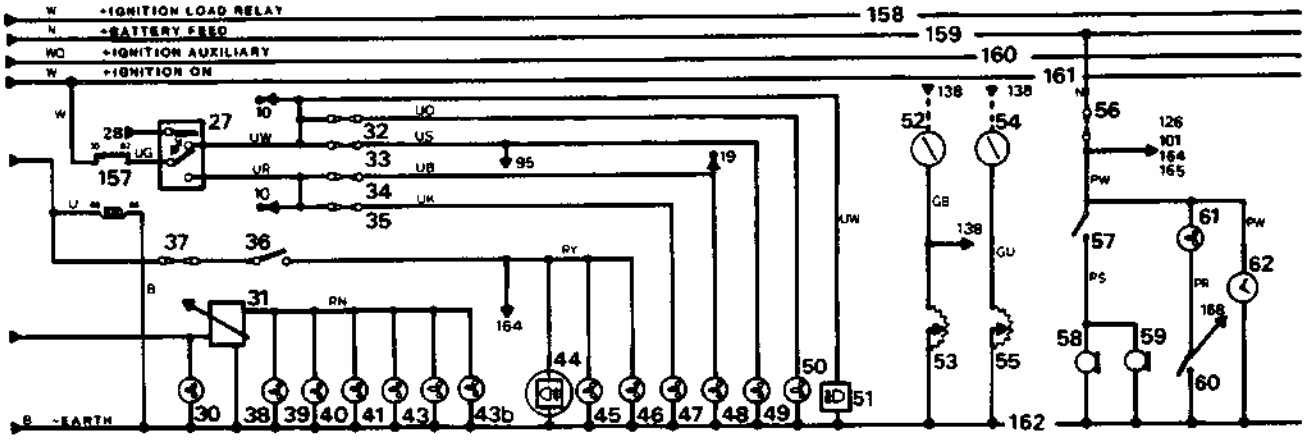
MAIN CIRCUIT DIAGRAM
Right hand steering - RR2571M & RR2572M

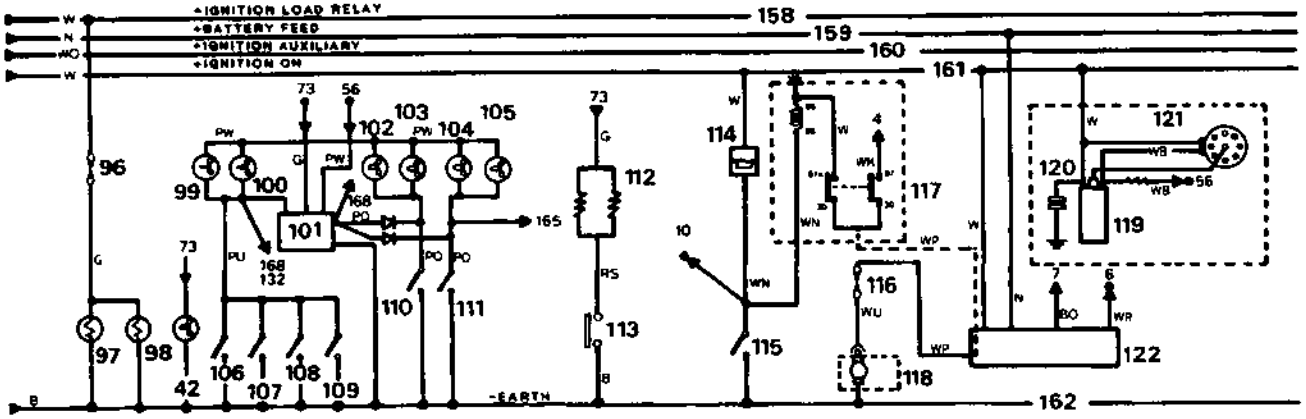


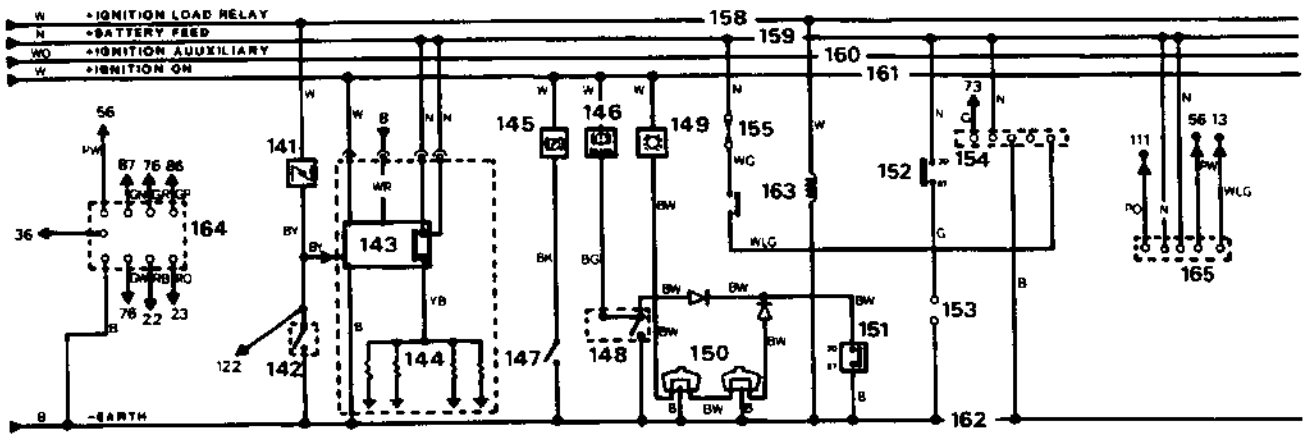




RR2571M


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
158
159
160
161
162


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
158
159
160
161
162


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
-EARTH
158
159
160
161
162

RR2572M

MAIN CIRCUIT DIAGRAM - NON CATALYST VEHICLES
Left hand Steering - RR2573M & RR2574M

Numerical key

1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (automatic)
8 Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse 7
13 Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16 Front wash pump
17 Headlamp wash timer unit (option)
18 Headlamp wash pump (option)
19 Main lighting switch
20 Fuse 6
21. Fuse 5
22. LH side lamp
23. LH tail lamp
24. LH number plate lamp
24.(a) RH number plate lamp
25 Main beam dip/flash switch
26. Headlamp relay
27 RH side lamp
28 RH tail lamp
29 Rheostat
30 Fuse 3
31. Fuse 4
32. Fuse 1
33. Fuse 2
34. Rear fog switch
35. Fuse 12
36. Switch illumination (2 off)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Automatic gear selector illumination (2 off)
41. Instrument illumination (6 off)
41 (a) Column switch illumination
42 Rear fog warning lamp
43. LH rear fog
44. RH rear fog
45 LH dip beam
46. RH dip beam
47 LH main beam
48. RH main beam
49. Main beam warning lamp
50. Fuel gauge
51 Fuel gauge sender unit
52. Water temperature gauge
53 Water temperature sender unit
54 Fuse 11
55. Horn switch
56 RH horn
57 LH horn
58. Under bonnet illumination switch
59 Under bonnet light
60. Clock
61. Fuse 19
62. Fuse 20
63 Pick-up point central locking/window lift
64. Heated rear window relay
65. Fuse 9
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71 Fuse 13
72. Hazard switch
73. Flasher unit
74 Direction indicator switch
75 Hazard/indicator warning lamp
76. LH rear indicator lamp
77 LH front indicator lamp
78. LH side repeater lamp
79. RH side repeater lamp
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse 15
84. Stop lamp switch
85. Reverse lamp switch
86. Auxiliary lamp relay
87 LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH auxiliary lamp (option)
92. RH auxiliary lamp (option)
93. Auxiliary lamp switch (option)
94. Fuse 17
95. Dash cigar lighter
96. Cubby box cigar lighter
97. LH interior lamp
98. RH interior lamp
99. Interior lamp delay unit
100. LH door edge lamp
101. LH puddle lamp
102. RH door edge lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110 Heated jets
111. Thermostat-heated jets
112. Oil pressure warning lamp
113 Oil pressure switch
114. Fuse 18
115. Fuel shut-off relay - carburetter
116. Fuel pump - petrol models
117. Ignition coil
118. Capacitor
119. Distributor
120. EFI Harness plug
121. Fuel shut-off solenoid-Diesel
122. Trailer pick up point
123. Radio fuse
124. Radio
125. Four speakers
126. Alarm pick up point
127. Speed transducer, (Saudi only)
131. Seat buckle switch
132. Overspeed monitor (Saudi only)
133. Overspeed buzzer (Saudi only)
134. Sun roof pick up point (option)
135. Automatic transmission oil temperature warning lamp
136. Automatic transmission oil temperature switch
137 Fuse 16
138. Rear wash wipe switch
139 Rear wipe delay unit
140. Rear wiper motor
141. Rear screen wash pump
142 Low screen wash fluid level warning lamp
143. Low screen wash switch
144. Low coolant switch
145. Multi-function unit in binnacle
146. Low coolant level warning lamp
147 Low fuel level warning lamp
148 Cold start/Diesel glow plug warning lamp
149. Choke switch - carburetter
150. Glowplug timer/Diesel
151. Glowplugs/Diesel
152. Handbrake/warning lamp
153. Handbrake warning switch
154. Brake fluid level warning lamp
154.(a) Brake fluid level warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157. Brake check unit
158. Split charge relay (option)
159 Split charge terminal post
160. Heater/air conditioning connections
161 Fuse 8
162. Coil negative (engine RPM input to ECU)
163. Ignition load relay (+)
164. Battery feed (+)
165. Ignition auxiliary (+)
166. Ignition on (+)
167. Earth (-)
168. Warning lights common earth (-)
169 Warning lights supply (+)
170. Electric seats pick up point (option)
171. Fuse 14
173. Fuse 10
174. Electric mirrors pick up point (option)
175 Heater air/con relay

CABLE COLOUR CODE

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

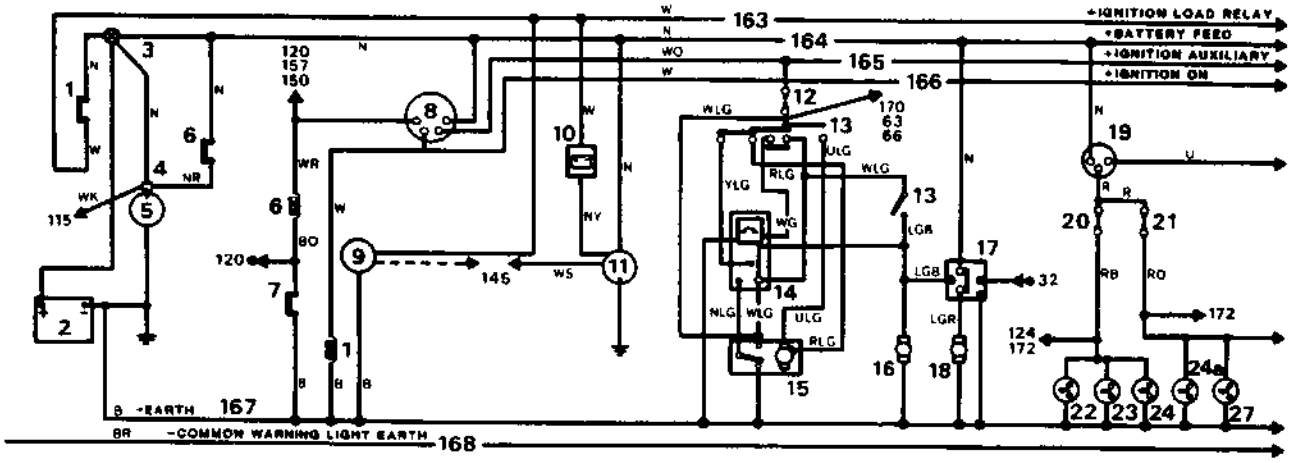
The last letter of a colour code denotes the tracer.

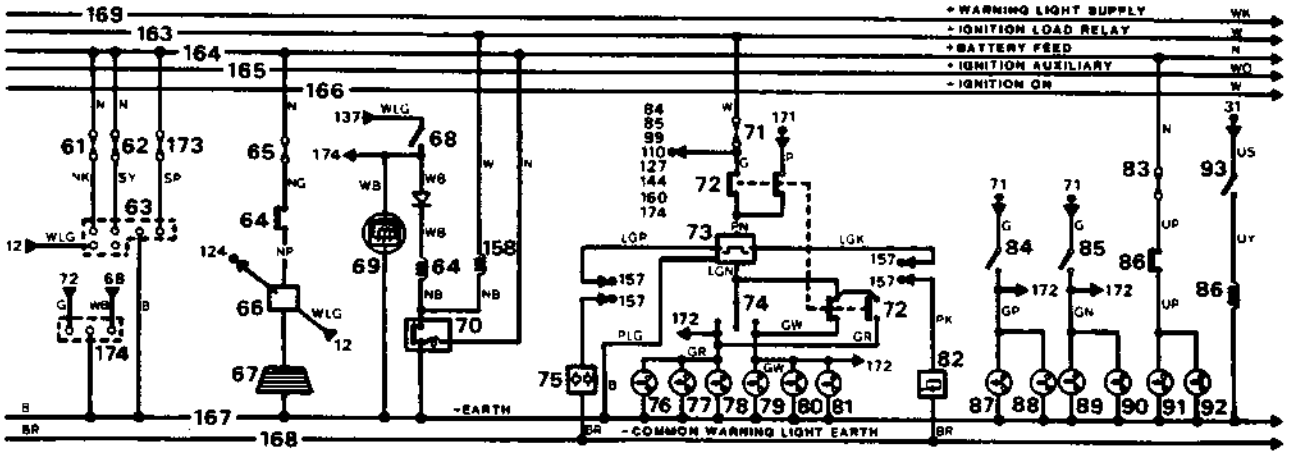
MAIN CIRCUIT DIAGRAM - NON CATALYST VEHICLES
Left Hand Steering - RR2573M & RR2574M

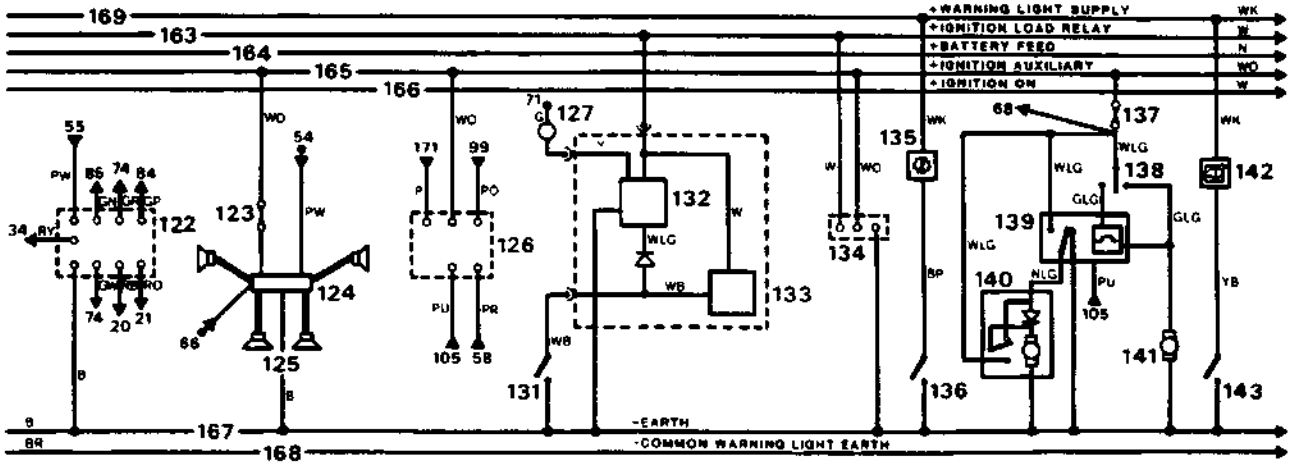
Alphabetical key

126. Alarm pick up point
11. Alternator
40. Automatic gear selector illumination (2 off)
135. Automatic transmission oil temperature warning lamp
136. Automatic transmission oil temperature switch
86. Auxiliary lamp relay
93. Auxiliary lamp switch (option)
2. Battery
164. Battery feed (+)
157. Brake check unit
154. Brake fluid level warning lamp
154.(a). Brake fluid level warning switch
156. Brake pad wear sensors
155. Brake pad wear warning lamp
118. Capacitor
149. Choke switch - carburetter
37. Cigar lighter illumination (2 off)
60. Clock
39. Clock illumination
162. Coil negative (engine RPM input to ECU)
148. Cold start/Diesel glow plug warning lamp
41.(a) Column switch illumination
96. Cubby box cigar lighter
95 Dash cigar lighter
74. Direction indicator switch
119. Distributor
120. EFI Harness plug
167 Earth (-)
174. Electric mirrors pick up point (option)
170. Electric seats pick up point (option)
73. Flasher unit
125. Four speakers
16. Front wash pump
14. Front wipe delay unit
13. Front wipe/wash switch
15. Front wiper motor
50. Fuel gauge
51. Fuel gauge sender unit
116. Fuel pump - petrol models
115. Fuel shut-off relay - carburetter
121. Fuel shut-off solenoid-Diesel
32. Fuse 1
33. Fuse 2
30. Fuse 3
31. Fuse 4
21. Fuse 5
20. Fuse 6
12. Fuse 7
161. Fuse 8
65. Fuse 9
173. Fuse 10
54 Fuse 11
35. Fuse 12
71. Fuse 13
171. Fuse 14
83. Fuse 15
137. Fuse 16
94. Fuse 17
114. Fuse 18
61. Fuse 19
62. Fuse 20
150. Glowplug timer/Diesel
151. Glowplugs/Diesel
153. Handbrake warning switch
152. Handbrake/warning lamp
72. Hazard switch
75. Hazard/indicator warning lamp
26. Headlamp relay
18. Headlamp wash pump (option)
17. Headlamp wash timer unit (option)
110. Heated jets
67 Heated rear screen
68 Heated rear screen switch
69. Heated rear screen warning lamp
64 Heated rear window relay
175. Heater air/con relay
38. Heater illumination (4 off)
160. Heater/air conditioning connections
55. Horn switch
165. Ignition auxiliary (+)
117 Ignition coil
1 Ignition load relay
163 Ignition load relay (+)
166. Ignition on (+)
8. Ignition switch
10 Ignition warning lamp
41. Instrument illumination (6 off)
99. Interior lamp delay unit
104. Interior lamp switch
91. LH auxiliary lamp (option)
45. LH dip beam
100. LH door edge lamp
108. LH front door switch
77. LH front indicator lamp
57. LH horn
97 LH interior lamp
47 LH main beam
24. LH number plate lamp
101. LH puddle lamp
105. LH rear door switch
43. LH rear fog
76. LH rear indicator lamp
89. LH reverse lamp
22. LH side lamp
78 LH side repeater lamp
87 LH stop lamp
23 LH tail lamp
146. Low coolant level warning lamp
144. Low coolant switch
147. Low fuel level warning lamp
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
25. Main beam dip/flash switch
49. Main beam warning lamp
19. Main lighting switch
145. Multi-function unit in binnacle
113 Oil pressure switch
112. Oil pressure warning lamp
133. Overspeed buzzer (Saudi only)
132. Overspeed monitor (Saudi only)
63. Pick-up point central locking/window lift
92. RH auxiliary lamp (option)
46. RH dip beam
102. RH door edge lamp
109. RH front door switch
80. RH front indicator lamp
56. RH horn
98. RH interior lamp
48. RH main beam
24.(a) RH number plate lamp
103. RH puddle lamp
106. RH rear door switch
44. RH rear fog
81. RH rear indicator lamp
90. RH reverse lamp
27 RH side lamp
79. RH side repeater lamp
88. RH stop lamp
28. RH tail lamp
124. Radio
66. Radio aerial amplifier
123. Radio fuse
34. Rear fog switch
42. Rear fog warning lamp
141. Rear screen wash pump
138. Rear wash wipe switch
139 Rear wipe delay unit
140. Rear wiper motor
127. Speed transducer, (Saudi only)
158. Split charge relay (option)
159. Split charge terminal post
7. Starter inhibit switch (automatic)
5. Starter motor
6. Starter relay
4. Starter solenoid
84. Stop lamp switch
134 Sun roof pick up point (option)
36. Switch illumination (2 off)
9. Tachometer
107 Tailgate switch
3. Terminal post
111 Thermostat-heated jets
122. Trailer pick up point
82. Trailer warning lamp
58. Under bonnet illumination switch
59. Under bonnet light
70. Voltage sensitive switch
168. Warning lights common earth (-)
169. Warning lights supply (+)
52. Water temperature gauge
53. Water temperature sender unit

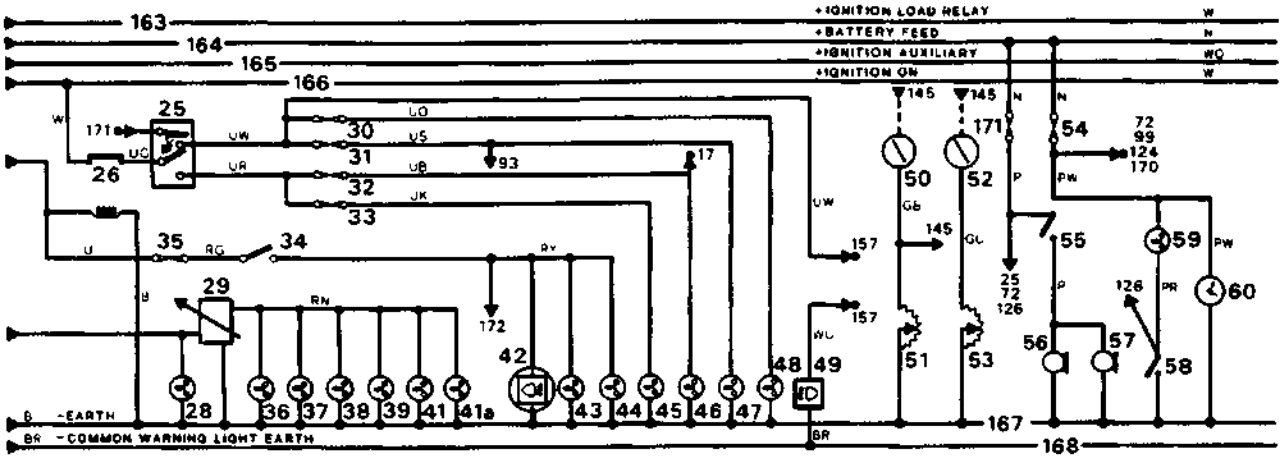
MAIN CIRCUIT DIAGRAM - NON CATALYST
Left hand steering - RR2573M & RR2574M

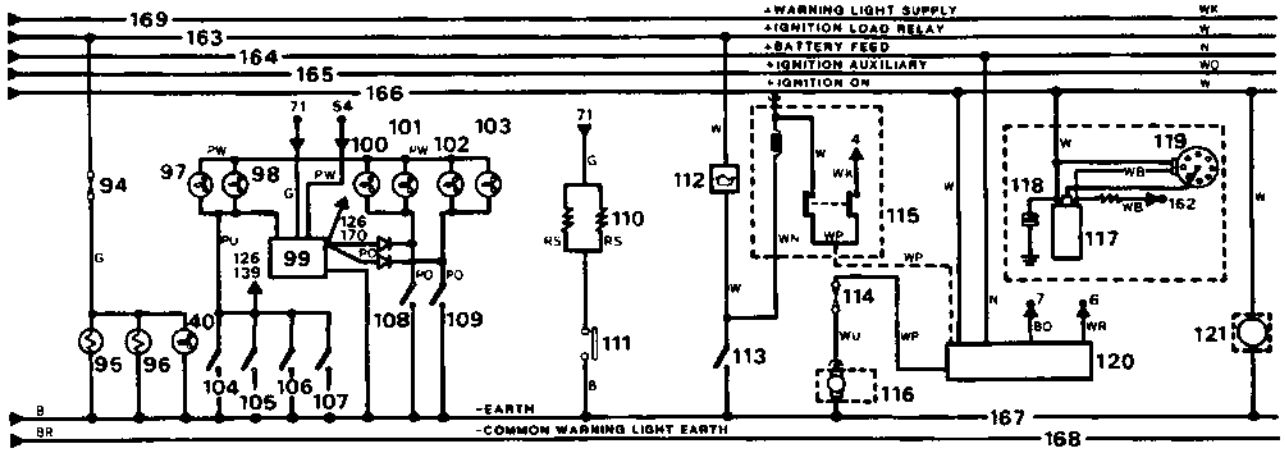


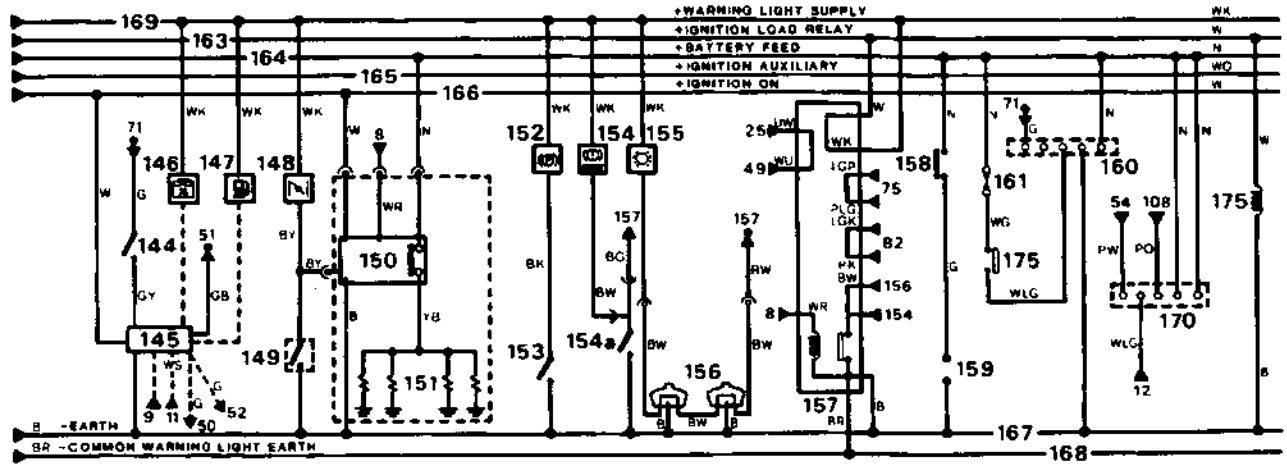




RR2573M


+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
163
164
165
166
-EARTH
-COMMON WARNING LIGHT EARTH
167
168


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
169
163
164
165
166
-EARTH
-COMMON WARNING LIGHT EARTH
167
168


+WARNING LIGHT SUPPLY
+IGNITION LOAD RELAY
+BATTERY FEED
+IGNITION AUXILIARY
+IGNITION ON
169
163
164
165
166
-EARTH
-COMMON WARNING LIGHT EARTH
167
168

RR2574M

WORKSHOP BULLETIN

MARCH 1989

BULLETIN No. LSM180WB8

RANGE ROVER - FOUR DOOR
CONCEALED DOOR HINGES
1989 MODEL YEAR

CONTENTS

Section Number — Page

01 INTRODUCTION

-Introduction 1

06 TORQUE WRENCH SETTINGS

-Body 1

09 RECOMMENDED LUBRICANTS, FLUIDS AND CAPACITIES

-Recommended lubricants and fluids - 1989 Model Year 1

10 MAINTENANCE

-Drive belts - Adjust or Renew 1

76 CHASSIS AND BODY

-Front door - remove, refit and adjust 1
-Rear passenger door - remove refit and adjust 2
-Decker panel - remove and refit 3

INTRODUCTION

A model enhancement for 1989 model year four door Range Rovers is the introduction of concealed door hinges.
This bulletin contains service details of the new door hinges and the decker panel.
This bulletin also contains a revised list of recommended lubricants deleting reference to LT230 Transfer gearbox. Note that the Borg Warner Transfer Gearbox is fitted to ALL 1989 model year Range Rovers.
In Section 10 Maintance, the correct procedure for tensioning all drive belts is given. If a new drive belt is fitted the engine must be run as instructed before retensioning the belt.

BODY	Nm	lbf ft
Front and rear seat belt fixings (ALL)	20.3	15
Front door hinges to door and body	25	19
Rear passenger door hinges to door and body	25	19

Recommended Lubricants and Fluids - 1989 Model year

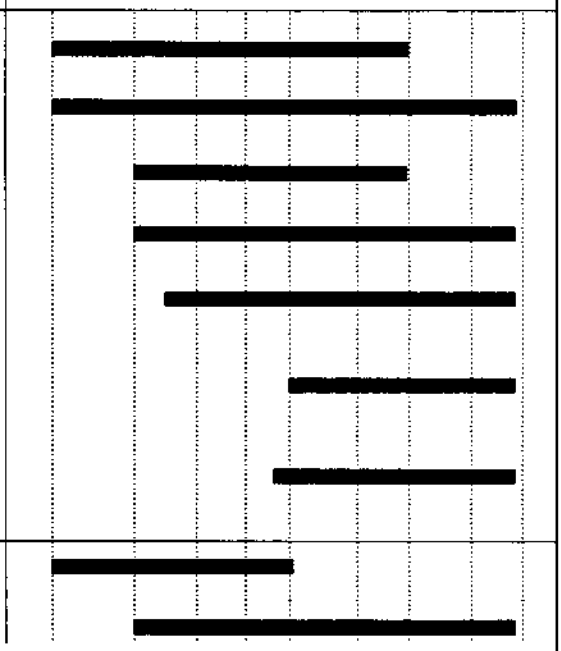
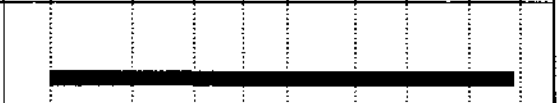
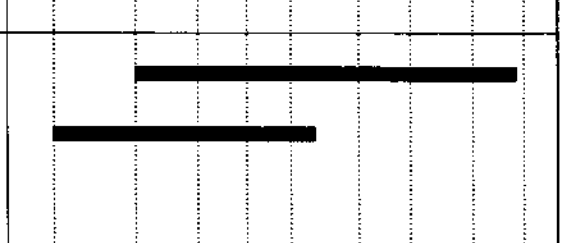
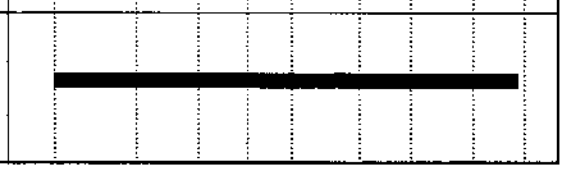
Use only the recommended grades of oil set out below.

These recommendations apply to climates where operational temperatures are above - 10°C (14°F)

COMPONENTS	BP	CASTROL	DUCKHAM	ESSO	MOBIL	PETROFINA	SHELL	TEXACO
Petrol engine sump Carburetter Dashpots Oil can	BP Visco 2000 (15W/40) or BP Visco Nova (10W/40)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube plus (15W/40)	Mobil Super (10W/40) or Mobil 1 Rally Formula	Fina Supergrade Motor Oil (15W/40) or (10W/40)	Shell Super Motor Oil (15W/40) or (10W/40)	Havoline Motor Oil (15W/40) or Eurotex HD (10W/30)
Diesel engine sump **	BP Vanellus C3 Extra (15W/40)	Castrol Turbomax (15W/40)	Duckhams Fleetmaster SHPD (15W/40)	Esso Super Diesel Oil TD (15W/40)	Mobil Delvac 1400 Super (15W/40)	Fina Kappa LDO (15W/40)	Shell Myrina (15W/40)	Texaco URSA Super TD (15W/40)
	The following list of oils to MIL - L - 2104D or CCMC D2 or API Service levels CD or SE/CD are for emergency use only if the above oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes.							
	BP Vanellus C3 Multigrade 15W/40)	Castrol Deusol RX Super (15W/40)	Duckhams Hypergrade (15W/50)	Esso Essolube XD - 3 plus (15W/40)	Mobil Delvac Super (15W/40)	Fina Dilano HPD (15W/40)	Shell Rimula X (15W/40)	Texaco URSA Super Plus (15W/40)
Automatic gearbox	BP Autran DX2D	Castrol TQ Dexron IID	Duckhams Fleetmatic CD or Duckhams D - Matic	Esso ATF Dexron IID	Mobil ATF 220D	Fina Dexron IID	Shell ATF Dexron IID	Texamatic Fluid 9226
Manual gearbox	BP Autran G	Castrol TQF	Duckhams Q - Matic	Esso ATF Type G	Mobil ATF 210	Fina Purfimatic 33G	Shell Donax TF	Texamatic Type G or Universal
Front and Rear differential Swivel pin housings	BP Gear Oil SAE 90EP	Castrol Hypoy SAE 90EP	Duckhams Hypoid 90	Esso Gear Oil GX (85W/90)	Mobil Mobilube HD90	Fina Pontonic MP SAE (80W/90)	Shell Spirax 90EP	Texaco Multigear Lubricant EP (85W/90)
Propeller shaft Front and Rear	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All Purpose Grease
Power steering box and fluid Reservoir Borg Warner Transfer Gearbox	BP Autran DX2D or BP Autran G	Castrol TQ Dexron IID or Castrol TQF	Duckhams Fleetmatic CD or Duckhams Q - matic	Esso ATF Dexron IID or Esso ATF Type G	Mobil ATF 220D or Mobil ATF 210	Fina Dexron IID or Fina purifimatic 33G	Shell ATF Dexron IID or Shell Donax TF	Texamatic Fluid 9226 or Texamatic Type G or 4291A Universal
Brake and clutch reservoirs	Brake fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT4							
Lubrication nipples (hubs, ball joints etc.)	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All Purpose Grease
Ball joint assembly Top Link	Dextragrease Super GP							
Seat slides Door lock striker	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi - purpose Grease H	Mobil Grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All purpose grease
	NLGI - 2 Multi - purpose Lithium - based Grease							

** **Other approved oils include:** Agip Sigma Turbo, Aral OL P327, Autol Valve - SHP, Aviation Turbo, Caltex RPM Delo 450, Century SHPD, Chevron Delo 450 Multigrade, Divinol Multimax Extra, Ecubsol CD Plus, Elf Multiperformance, Esso Special Diesel, Fanal Indol X, Fuchs Titan Truck 1540, Gulf Superfleet Special, IP Taurus M, Total Rubia TIR, Valvoline Super HD LD, Veedol Turbostar.

RECOMMENDED LUBRICANTS AND FLUIDS - ALL CLIMATES AND CONDITIONS - 1989 Model year

COMPONENTS	SERVICE CLASSIFICATION		AMBIENT TEMPERATURE °C
	Specification	SAE Classification	- 30 - 20 - 10 0 10 20 30 40 50
Petrol models Engine sump Carburetter Dashpots Oil can	Oils must meet BLS.22.OL.07 or CCMC G3 or API service levels SF Oils must meet BLS.22.OL.02 or CCMC G1 or G2 or API service levels SE or SF	5W/30 5W/40) 5W/50) 10W/30 10W/40) 10W/50) 15W/40) 15W/50) 20W/40) 20W/50) 25W/40) 25W/50)	
Diesel models engine sump	SHPD oils meeting CCMC D3	10W/30 15W/40	
	* **Emergency only:** Oils meeting MIL - L - 2104D or CCMCD2 or API CD		
Main Gearbox Automatic	ATF Dexron IID		
Main Gearbox manual	ATF M2C33 (F or G)		
Final drive units Swivel pin housings	API GL4 or GL5 MIL - L - 2105 or MIL - L - 2105B	90 EP 80W EP	
Power steering Borg Warner Transfer Gearbox	ATF M2C 336 or ATF Dexron IID		

* Diesel Models - Engine Sump

Oils for emergency use only if the SHPD oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes. (See * * on previous page)

CAPACITIES

Transfer gearbox capacity - 2.1 Litres
- 3.7 UK Pints
- 4.4 US Pints

DRIVE BELTS - adjust or renew

Illustration A

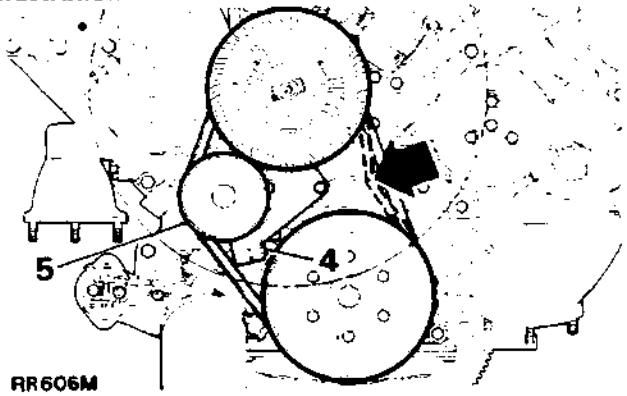


Illustration B

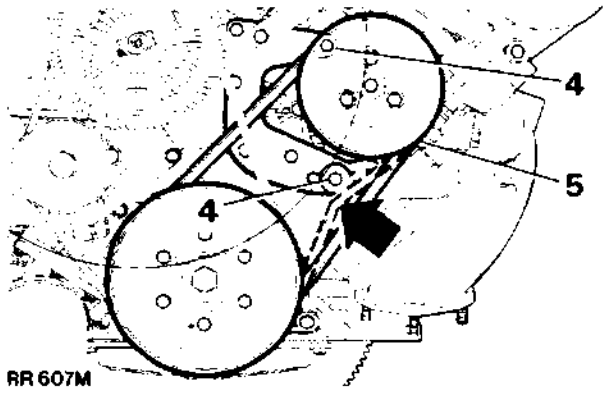


Illustration C

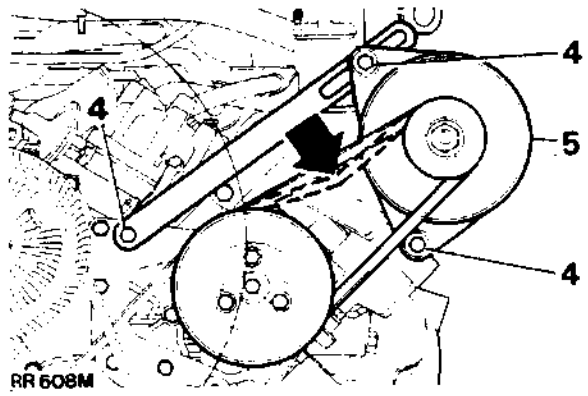
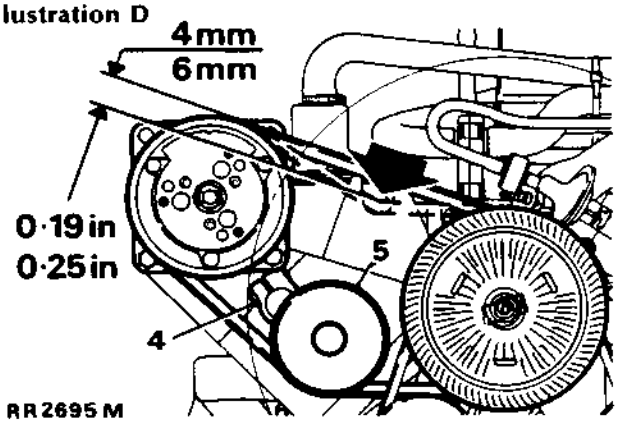


Illustration D



Check driving belts, adjust or renew

1. Examine the following belts for wear and condition and renew if necessary:
   (A) Crankshaft-Jockey Pulley-Water Pump
   (B) Crankshaft-Steering Pump
   (C) Steering Pump-Alternator
   (D) Compressor-Jockey Pulley-Water Pump
2. Each belt should be sufficiently tight to drive the appropriate auxiliary without undue load on the bearings.
3. Slacken the bolts securing the unit to its mounting bracket.
4. Slacken the appropriate pivot bolt or jockey wheel and the fixing at the adjustment link where applicable.
5. Pivot the unit inwards or outwards as necessary and adjust until the correct belt tension is obtained.
6. Belt tension should be approximately 4 to 6 mm (0.19 to 0.25 in) at the points denoted by the bold arrows.
7. Tighten all unit adjusting bolts. Check adjustment again.

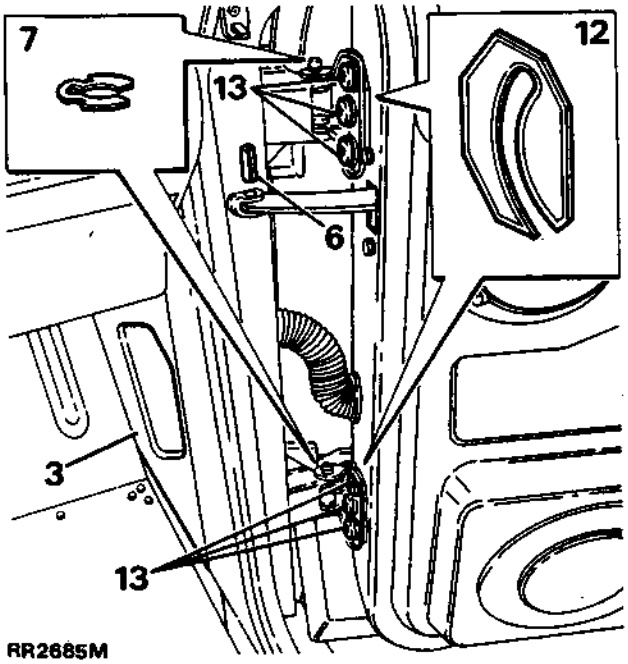
CAUTION: When fitting a new drive belt, tension the belt as described above. Reconnect the battery and start and run the engine for 3 to 5 minutes at fast idle, after which time the belt must be re-checked, retension the belt if necessary.

FRONT DOOR

Remove, refit and adjust.

Removing

1. Disconnect the battery negative lead.
2. Open the door to be removed.
3. Remove the trim panel from side of footwell by carefully levering under the trim and prising out the two plastic clips.



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4. Locate and disconnect all door wiring plugs.
5. Disengage the grommets either side of 'A' post and feed wiring out.
6. Drive out the roll pin from the door check link.
7. Remove 'C' clips from grooves in hinge pins.

WARNING: Instruction 8. MUST BE carried out with assistance.

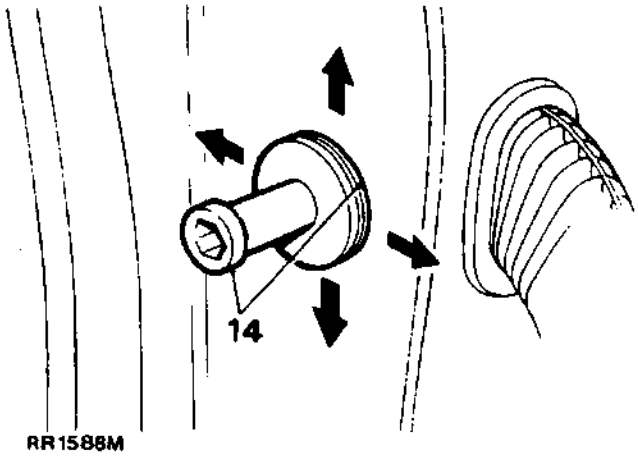
8. Carefully lift the opened door off the hinge pins.

Refitting

9. Reverse the removal procedure. Renew the'C' clips if worn or distorted.
10. With door fully open reconnect wiring plugs ensuring they are located above the trim panel.
11. Check the operation of the door and lock. If necessary, adjust the door and striker plate.

Adjusting

12. Adjust the door by means of shims between the hinge and door to move the door forward or rearward in the opening.
13. Loosen the six Torx screws securing the hinges to the door to adjust the door up and down or in and out of the opening. Retighten the screws to the specified torque settings.
14. The door lock striker can be adjusted by loosening the striker and moving it in the appropriate direction or adding and subtracting spacing washers between the striker and 'B' post.



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15. Note: If it is necessary to remove hinges from 'A' post they should be refitted in exactly the same position using the same thickness of shims.

REAR PASSENGER DOOR

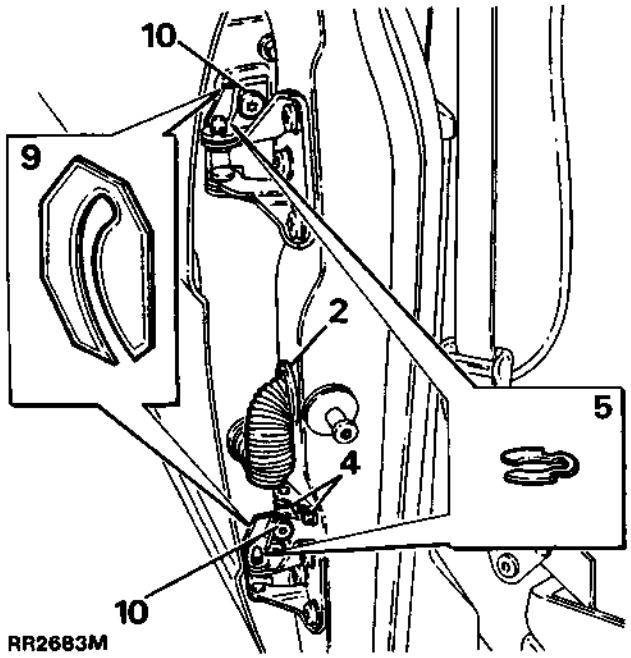
Remove, refit and adjust.

Removing

1. Disconnect the battery negative lead.
2. Remove wiring grommet from the 'B' post.
3. Withdraw the door wiring plugs from the 'B' post and disconnect them.
4. Remove the two bolts securing the check strap to 'B' post.
5. Remove 'C' clips from grooves in the hinge pins.

   WARNING: Instruction 6. MUST BE carried out with assitance.

6. Carefully lift the opened door off the hinge pins.



Refitting

7. Reverse the removal procedure. Renew 'C' clips if worn or distorted.
8. Check the operation of the door and lock. If necessary, adjust the door and striker plate.

Adjusting

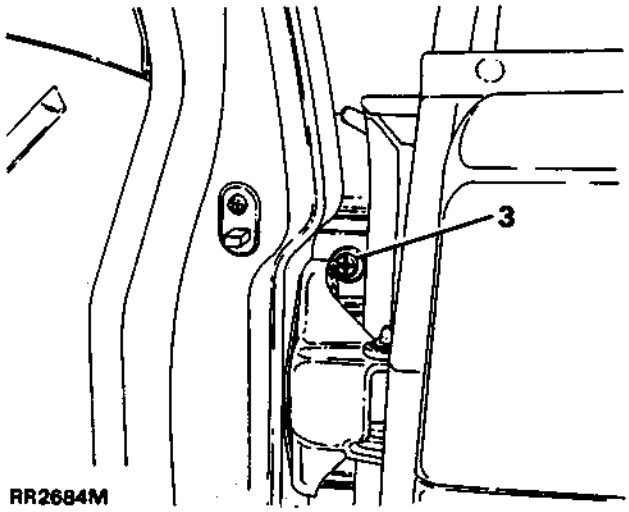
9. Adjust the door by means of shims between the hinge and door to move the door forward or rearward in the opening.
10. Loosen the six Torx screws securing the hinges to the door to adjust the door up and down or in and out of the opening. Retighten the screws to the specified torque settings.
11. Adjustment to the door striker is identical to front doors.
12. Note: If it is necessary to remove hinges from 'B' post they should be refitted in exactly the same position using the same thickness of shims.

DECKER PANEL

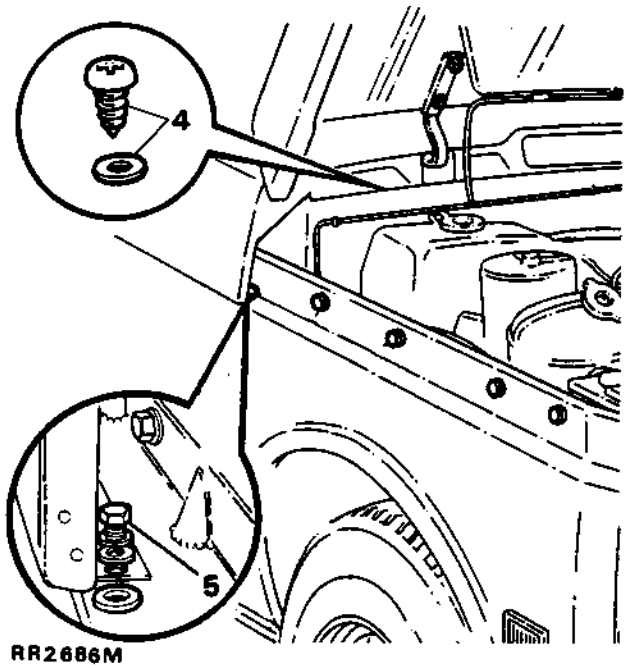
Remove and Refit

Removing

1. Remove bonnet.
2. Remove the wiper arms and two nuts securing the wheel boxes to the decker panel and remove the two sealing rubbers.
3. Remove the two cross-head screws retaining the panel to the 'A' post mounting brackets located above the front door hinges.



4. Remove the nine cross-head screws securing the front of the decker panel.
5. Remove the four bolts with spring and plain washers securing decker panel to front wings accessible from the front of the decker panel.



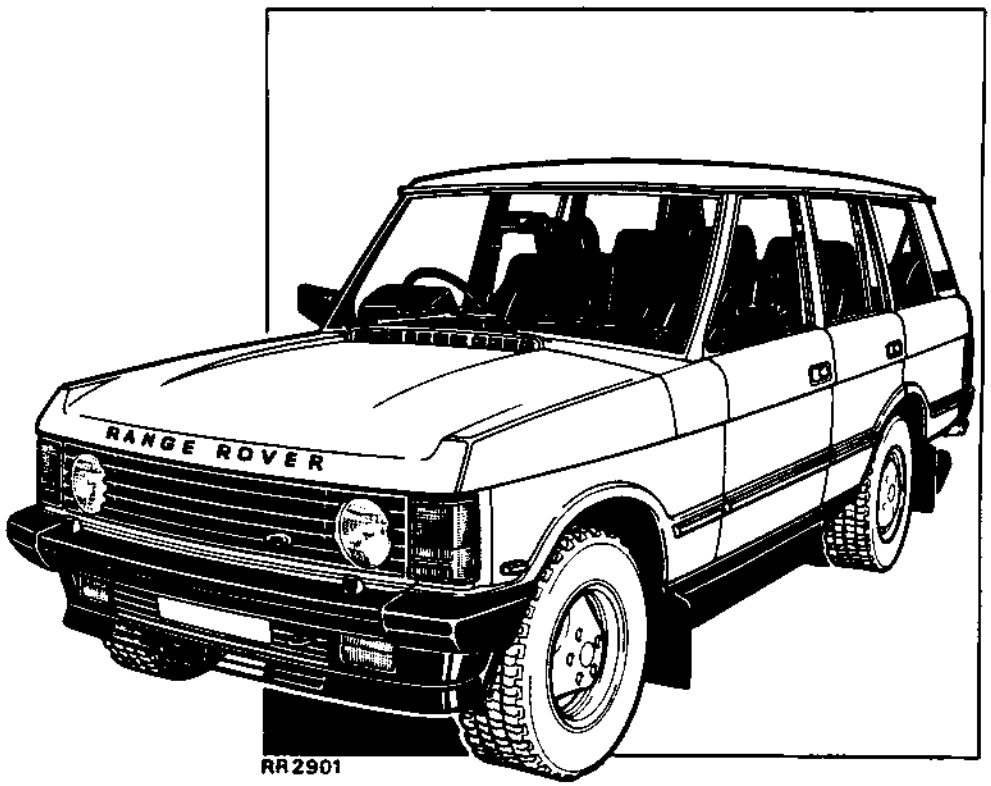
6. With assistance place a tube over each of the hinges and lower to enable the decker panel to be fed over the hinges, gradually return the hinges to their upright position.

WARNING: Gradually let the torsion bar spring tension return the hinges to their upright position to prevent the possibility of personal injury or damage to the vehicle.

Refittng

7. Reverse the decker panel removal instruction.
8. Using a soft blunt implement ease the windscreen rubber up onto the top of the decker panel.

RANGE ROVER



RR2901

RANGE ROVER WORKSHOP MANUAL

PUBLICATION NUMBER LHA WM EN A02

This manual covers all 1990 to 1994 model year Range Rovers, powered by 3.9 and 4.2 V8 petrol engines and 200 Tdi and 2.5 Litre (VM) diesel engines.

01 - INTRODUCTION

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INTRODUCTION

This workshop manual covers Range Rover vehicles from 1990 to 1994 model year onwards. Amendments and additional pages will be issued to ensure that the manual covers latest models. Amendments and additions will be identified by the addition of a dated footer at the bottom of the page.

This Workshop Manual is designed to assist skilled technicians in the efficient repair and maintenance of Range Rover vehicles.

Individuals who undertake their own repairs should have some skill and training, and limit repairs to components which could not affect the safety of the vehicle or its passengers. Any repairs required to safety critical items such as steering, brakes, suspension or supplementary restraint system should be carried out by a Range Rover Dealer. Repairs to such items should NEVER be attempted by untrained individuals.

WARNINGS, **CAUTIONS** and **NOTES** are given throughout this Manual in the following form:

WARNING: Procedures which must be followed precisely to avoid the possibility of personal injury.

CAUTION: This calls attention to procedures which must be followed to avoid damage to components.

NOTE: This calls attention to methods which make a job easier or gives helpful information.

DIMENSIONS

The dimensions quoted are to design engineering specification. Alternative unit equivalents, shown in brackets following the dimensions, have been converted from the original specification.

REFERENCES

References to the left or right hand side in the manual are made when viewing the vehicle from the rear. With the engine and gearbox assembly removed, the water pump end of the engine is referred to as the front.

To reduce repetiton, some operations covered in this Manual do not include reference to testing the vehicle after repair.

It is essential that work is inspected and tested after completion and if necessary a road test of the vehicle is carried out particularly where safety related items are concerned.

REPAIRS AND REPLACEMENTS

When replacement parts are required it is essential that Range Rover parts are used.
Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories: Safety features embodied in the vehicle may be impaired if other than Range Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque spanner values given in the Workshop Manual must be strictly adhered to. Locking devices, where specified, must be fitted. If the efficiency of a locking device is impaired during removal it must be replaced with a new one. Certain fasteners must not be re-used. These fasteners are specified in the Workshop Manual.

POISONOUS SUBSTANCES

Many liquids and other substances used are poisonous and should under no circumstances be consumed and should be kept away from open wounds. These substances among others include anti-freeze, brake fluid, fuel, windscreen washer additives, air conditioning refrigerant, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if fuel is to be handled safely. It also outlines the other areas of risk which must not be ignored.
This information is issued for basic guidance only, and in any case of doubt, appropriate enquiries should be made of your local Fire Officer or Fire Department.

Fuel vapor is highly flammable and in confined spaces is also very explosive and toxic.
When fuel evaporates it produces 150 times its own volume in vapor, which when diluted with air becomes a readily ignitable mixture. The vapor is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of fuel is very dangerous.

Always have a fire extinguisher containing **FOAM CO^2 GAS,** or **POWDER** close at hand when handling fuel, or when dismantling fuel systems and in areas where fuel containers are stored.

WARNING: It is imperative that the battery is not disconnected during fuel system repairs as arcing at the battery terminal could ignite fuel vapour in the atmosphere. Always disconnect the vehicle battery BEFORE carrying out work on the fuel system.

Whenever fuel is being handled, transferred or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any leadlamps used must be flame proof and kept clear of spillage.

No one should be permitted to repair components associated with fuel without first having had fuel system training.

Hot fuel handling precautions

WARNING: Before commencing any operation requiring fuel to be drained from the fuel tank, the following procedure must be adhered to:

1. Allow sufficient time for the fuel to cool, thus avoiding contact with hot fuels.
2. Vent the system by removing the fuel filler cap in a well ventilated area. Refit the filler cap until the commencement of fuel drainage.

Fuel transfer

WARNING: Fuel must not be extracted or drained from any vehicle while it is standing over a pit.

The transfer of fuel from the vehicle fuel tank must be carried out in a well ventilated area. An approved transfer tank must be used according to the transfer tank manufacturer's instructions and local regulations, including attention to grounding of tanks.

Fuel tank removal

A **FUEL VAPOR** warning label must be attached to the fuel tank upon removal from the vehicle.

Fuel tank repair

Under no circumstances should a repair to any tank be attempted.

SYNTHETIC RUBBER

Many O-ring seals, flexible pipes and other similar items which appear to be natural rubber are made of synthetic materials called Fluoroelastomers. Under normal operating conditions this material is safe, and does not present a health hazard. However, if the material is damaged by fire or excessive heat, it can break down and produce highly corrosive Hydrofluoric acid which can cause serious burns on contact with skin. Should the material be in a burnt or overheated condition handle only with seamless industrial gloves. Decontaminate and dispose of the gloves immediately after use.
If skin contact does occur, remove any contaminated clothing immediately and obtain medical assistance without delay. In the meantime, wash the affected area with copious amounts of cold water or limewater for fifteen to sixty minutes.

RECOMMENDED SEALANTS

A number of branded products are recommended in this manual for use during maintenance and repair work.
These items include: **HYLOMAR GASKET AND JOINTING COMPOUND** and **HYLOSIL RTV SILICON COMPOUND.**
They should be available locally from garage equipment suppliers. If there is any problem obtaining supplies, contact the following company for advice and the address of the nearest supplier.

MARSTON LUBRICANTS LTD.
Hylo House,
Cale lane,
New Springs,
Wigan WN2 1JR.

Tel 01942 824242

USED ENGINE OIL

WARNING: Prolonged and repeated contact with engine or motor oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis.

Used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities should be provided.

Handling precautions

1. Avoid prolonged and repeated contact with oils, particularly used engine oils.
2. Wear protective clothing, including impervious gloves where applicable.
3. Do not put oily rags in pockets.
4. Avoid contaminating clothes, particularly underwear, with oil.
5. Overalls must be cleaned regularly. Discard unwashable clothing and oil impregnated footwear.
6. First aid treatment must be obtained immediately for open cuts and wounds.
7. Use barrier creams, before each work period, to help the removal of oil from the skin.
8. Wash with soap and water to ensure all oil is removed (skin cleansers and nail brushes will help). Prepartions containing lanolin replace the natural skin oils which have been removed.
9. Do not use gasoline, kerosene, diesel fuel, petrol, thinners or solvents for washing the skin.
10. If skin disorders develop, obtain medical advice.
11. Where practicable, degrease components prior to handling.
12. Where there is a risk of eye contact, eye protection should be worn, for example, goggles or face shields; in addition an eye wash facility should be provided.

Disposing of used oils

Environmental protection precaution

It is illegal to pour used oil onto the ground, down sewers or drains, or into waterways.

Dispose of used oil through authorised waste disposal contractors. If in doubt contact your Local Authority for advice on disposal facilities.

ACCESSORIES AND CONVERSIONS

DO NOT FIT unnapproved accessories or conversions, as they could affect the safety of the vehicle.
Land Rover will not accept liability for death, personal injury, or damage to property which may occur as a direct result of the fitment of non-approved conversions to the Range Rover.

WHEELS AND TYRES

WARNING: DO NOT replace the road wheels with any type other than genuine Range Rover wheels which are designed for multi-purpose on and off road use and have very important relationships with the proper operation of the suspension system and vehicle handling. Replacement tyres must be of the make and sizes recommended for the vehicle, and all tyres must be the same make, ply rating and tread pattern.

STEAM CLEANING

To prevent consequential rusting, any steam cleaning within the engine bay **MUST** be followed by careful re-waxing of the metallic components affected. Particular attention must be given to the steering column, engine water pipes, hose clips and ignition coil clamp.

SPECIFICATION

The specification details and instructions set out in this Manual apply only to a range of vehicles and not to any one. For the specification of a particular vehicle purchasers should consult their Dealer.
The Manufacturers reserve the right to vary their specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

While every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer or Dealer, by whom this Manual is supplied, shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

SPECIAL SERVICE TOOLS

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently and safely. Where special tools are specificed, **only these tools should be used to avoid the possibility of personal injury or damage to the components.** Also the amount of time which they save can be considerable.

Every special tool is designed with the close co-operation of Land Rover, and no tool is put into production which has not been tested and approved by us. New tools are only introduced where an operation cannot be satisfactorily carried out using existing tools or standard equipment. The user is therefore assured that the tool is necessary and that it will perform accurately, efficiently and safely.

Special tools bulletins will be issued periodically giving details of new tools as they are introduced.

All orders and enquiries from the United Kingdom should be sent direct to V. L. Churchill. Overseas orders should be placed with the local V. L. Churchill distributor, where one exists. Countries where there is no distributor may order direct from:
V. L. Churchill Limited,
PO Box 3,
Daventry,
Northants,
England, NN11 4NF.

The tools recommended in this Workshop Manual are listed in a multi-language illustrated catalogue, quote publication number SMR 681 MI., obtainable from:
Messers. V. L. Churchill at the above address,
or from:
Land Rover Merchandising Service,
PO Box 534,
Erdington,
Birmingham, B24 0Q5

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JACKING

The following instructions must be carried out before raising the vehicle off the ground.

1. Use a solid level ground surface.
2. Apply parking brake.
3. Select 'P' or 1st gear in main gearbox.
4. Select Low range in transfer gearbox.

CAUTION: To avoid damage occurring to the under body components of the vehicle the following jacking procedures must be adhered to.

DO NOT POSITION JACKS OR AXLE STANDS UNDER THE FOLLOWING COMPONENTS.

Body structure
Bumpers
Fuel lines
Brake lines
Front radius arms
Panhard rod
Steering linkage
Rear trailing links
Fuel tank
Engine sump
Gearbox bell housing

Jack or support vehicle by axles only.

Vehicle jack

The jack provided with the vehicle is only intended to be used in an emergency, for changing a tyre. Do **NOT** use the jack for any other purpose. Refer to Owner's Manual for vehicle jack location points and procedure. Never work under a vehicle supported by the vehicle jack.

Hydraulic jack

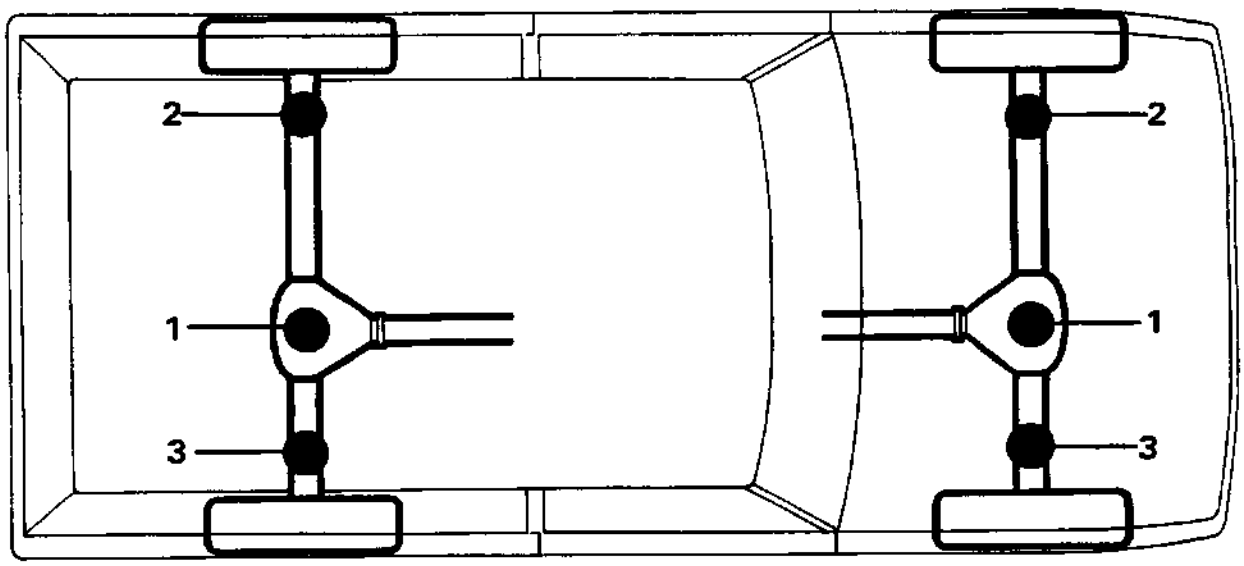
A hydraulic jack with a minimum 3,300 lbs load capacity must be used.

CAUTION: Do not commence work on the underside of the vehicle until suitable axle stands have been positioned under the axle.

Raise the front of the vehicle

1. Position cup of hydraulic arm under differential casing.

NOTE: The differential casing is not central to the axle. Care should be taken when raising the front road wheels off the ground as the rear axle has less sway stiffness.



RR1839E

2. Raise front road wheels to enable an axle stand to be installed under left hand axle tube.
3. Position an axle stand under right hand axle tube, carefully lower jack until axle sits securely on both axle stands, remove trolley jack.
4. Before commencing work on underside of vehicle re-check security of vehicle on stands.
5. Reverse procedure when removing vehicle from stands.

Raise rear of vehicle

1. Position cup of hydraulic arm under differential casing.
2. Raise vehicle to enable axle stands to be installed under left and right hand axle tubes.
3. Lower jack until axle sits securely on axle stands, remove trolley jack.
4. Before commencing work on underside of vehicle re-check security of vehicle on stands.
5. Reverse procedure when removing vehicle from stands.

HYDRAULIC VEHICLE RAMP (FOUR POST)

Use only a 'drive on' type ramp which supports vehicle by its own road wheels. If a 'wheel-free' condition is required, use a 'drive on' ramp incorporating a 'wheel-free' system that supports under axle casings. Alternatively, place vehicle on a firm, flat floor and support on axle stands.

TWO POST VEHICLE RAMPS

The manufacturer of RANGE ROVER VEHICLES DOES NOT recommend using 'Two Post' ramps that employ four adjustable support arms. These are NOT considered safe for Range Rover vehicles.
If vehicle is installed on a Two Post ramp responsibility for safety of vehicle and personnel performing service operations is in the hands of the Service Provider.

DYNAMOMETER TESTING - NON ANTI-LOCK BRAKE VEHICLES

Viscous coupling

The front and rear axles cannot be driven independently due to the viscous coupling. This eliminates the need for differential lock by progressively locking the centre differential automatically if slip occurs at any wheel.

WARNING: DO NOT attempt to drive individual wheels with vehicle supported on floor jacks or stands.

Four wheel dynamometers

Provided that front and rear dynamometer rollers are rotating at identical speeds and that normal workshop safety standards are applied, there is no speed restriction during testing except any that may apply to the tyres.

Two wheel dynamometers

IMPORTANT: Use a four wheel dynamometer for brake testing if possible.

If brake testing on a single axle rig is necessary it must be carried out with propeller shaft to rear axle removed, AND neutral selected in BOTH main gearbox and transfer gearbox. When checking brakes, run engine at idle speed to maintain servo vacuum. If checking engine performance, the transfer box must be in high range and propeller shaft to stationary axle must be removed.

DYNAMOMETER TESTING - VEHICLES WITH ANTI-LOCK BRAKES (ABS)

WARNING: Do not attempt to test ABS function on a dynamometer

Four wheel dynamometers

NOTE: Before testing a vehicle on a four wheel dynamometer disconnect the valve relay - *See ETM,*
The ABS function will not work, the ABS warning light will illuminate. Normal braking will be available.

Provided that front and rear rollers are rotating at identical speeds and that normal workshop safety standards are applied, there is no speed restriction during testing except any that may apply to the tyres.

Two wheel dynamometers

IMPORTANT: Use a four wheel dynamometer for brake testing if possible.

NOTE: ABS will not function on a two wheel dynamometer. The ABS light will illuminate during testing. Normal braking will be available.

If brake testing on a single rig is necessary it must be carried out with propeller shaft to the rear axle removed, AND neutral selected in BOTH main and transfer boxes.

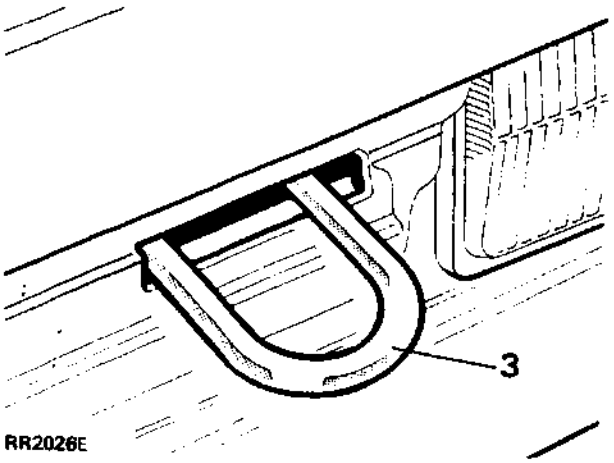
If checking engine performance, the transfer box must be in high range and drive shaft to stationary axle removed.

TOWING

CAUTION: Range Rovers have permanent four-wheel drive. The following towing instructions must be adhered to:

Towing the vehicle on all four wheels with driver operating steering and brakes.

1. Turn ignition key turn to position '1' to release steering lock.
2. Select neutral in main gearbox and transfer gearbox.



3. Secure tow rope, chain or cable to towing eye.
4. Release the parking brake.

CAUTION: The brake servo and power assisted steering system will not be functional without the engine running. Greater pedal pressure will be required to apply the brakes, the steering system will require greater effort to turn the front road wheels.
The vehicle tow connection should be used only in normal road conditions, 'snatch' recovery should be avoided.

Suspended tow by breakdown vehicle

CAUTION: To prevent vehicle damage, front or rear propeller shaft MUST BE removed, dependent upon which axle is being trailed.

1. Mark propeller shaft drive flanges at transfer gearbox and axles with identification lines to enable the propeller shaft to be refitted in its original position.
2. Remove the propeller shaft fixings, remove the shaft from the vehicle.
3. If the front axle is to be trailed, turn ignition key to position '1' to release steering lock.

CAUTION: The steering wheel and/or linkage must be secured in a straight ahead position. DO NOT use the steering lock mechanism for this purpose.

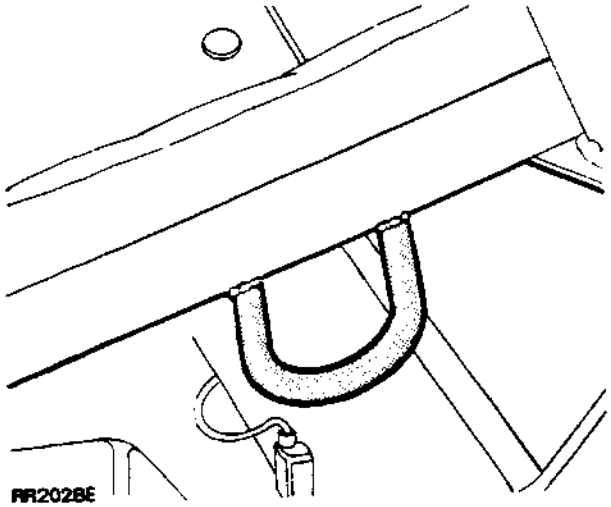
TRANSPORTING THE VEHICLE BY TRAILER

Lashing eyes are provided on front and rear of the chassis side members, to facilitate the securing of the vehicle to a trailer or other means of transportation.

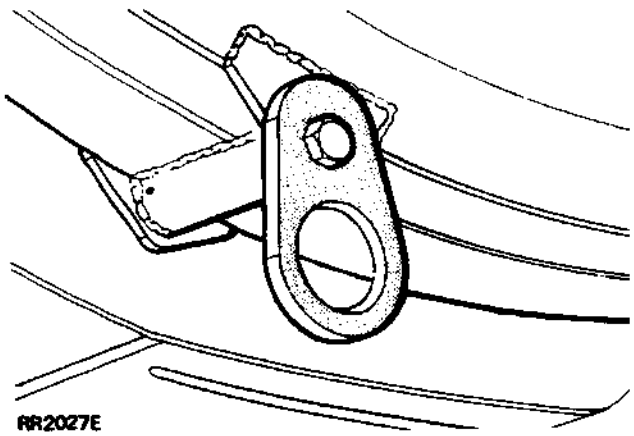
CAUTION: Underbody components must not be used as lashing points.

Install vehicle on trailer and apply park brake. Select neutral in main gearbox. Selecting 'N' will prevent damage to parking pawl of the automatic gearbox.

FRONT OF CHASSIS



REAR OF CHASSIS



JUMP STARTING

WARNING: Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames, sparks or lighted tobacco are brought near battery. When charging or using a battery in an enclosed space, always provide ventilation and shield your eyes.

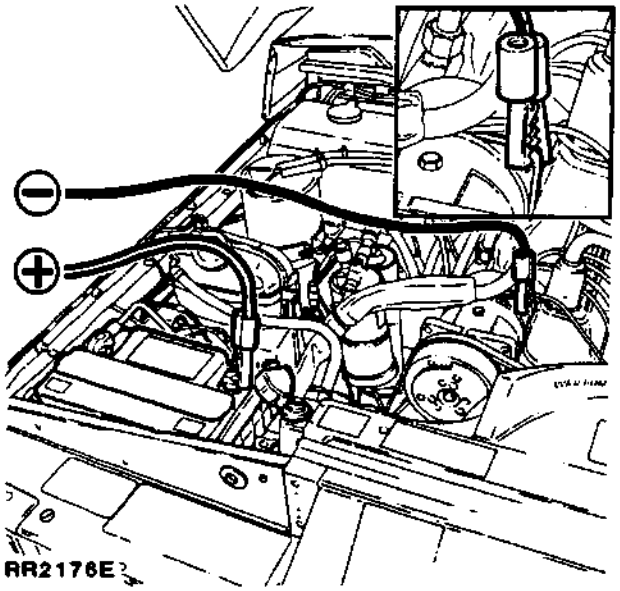
Keep out of reach of children. Batteries contain sulphuric acid. Avoid contact with skin, eyes, or clothing. Also, shield eyes when working near battery to protect against possible splashing of acid solution. In case of acid contact with skin, eyes, or clothing, flush immediately with water for a minimum of fifteen minutes. If acid is swallowed, drink large quantities of milk or water, followed by milk of magnesia, a beaten egg, or vegetable oil. SEEK MEDICAL AID IMMEDIATELY.

To Jump Start - Negative Ground Battery

WARNING: To avoid any possibility of injury use particular care when connecting a booster battery to a discharged battery.

1. Position vehicles so that jump leads will reach, ensuring that vehicles **DO NOT TOUCH,** alternatively a fully charged slave battery may be positioned on floor adjacent to vehicle.
2. Ensuring that ignition and all electrical accessories are switched off, that parking brake is applied and neutral (N) or park (P) is selected in main gearbox, connect jump leads as follows;

A. Connect one end of first jumper cable to positive (+) terminal of booster battery.
B. Connect other end of first jumper cable to positive (+) terminal of discharged battery.
C. Connect one end of second jumper cable to negative terminal of booster battery.



D. Connect other end of second jumper cable to rear lug of air conditioning compressor. **NOT TO NEGATIVE TERMINAL OF DISCHARGED BATTERY.** Keep jumper lead away from moving parts, pullies, drive belts and fan blade assembly.

WARNING: Making final cable connection could cause an electrical arc which if made near battery could cause an explosion.

3. If booster battery is installed in another vehicle, start engine and allow to idle.
4. Start engine of vehicle with discharged battery, following starting procedure in Owner's Manual.

CAUTION: If vehicle fails to start within a maximum time of 12 seconds, switch ignition off and investigate cause. Failing to follow this instruction could result in irrepairable damage to catalysts.

5. Remove negative (-) jumper cable from the air conditioning compressor and then terminal of booster battery.
6. Remove positive (+) jumper cable from positive terminals of booster battery and discharged battery.

ABBREVIATIONS AND SYMBOLS USED IN THIS MANUAL

Across flats (bolt size)	AF
After bottom dead centre	ABDC
After top dead centre	ATDC
Alternating current	a.c.
Ampere	amp
Ampere hour	amp hr
Before bottom dead centre	BBDC
Before top dead centre	BTDC
Bottom dead centre	BDC
Brake horse power	bhp
British Standards	BS
Carbon monoxide	CO
Centimetre	cm
Centigrade (Celsius)	C
Cubic centimetre	cm^3
Cubic inch	in^3
Degree (angle)	deg or °
Degree (temperature)	deg or °
Diameter	dia.
Direct current	d.c.
Electronic Control Unit	E.C.U.
Electronic Fuel Injection	E.F.I.
Fahrenheit	F
Feet	ft
Feet per minute	ft/min
Fifth	5th
First	1st
Fluid ounce	fl oz
Foot pounds (torque)	lbf ft
Fourth	4th
Gramme (force)	gf
Gramme (mass)	g
Gallons	gal
Gallons (US)	US gal
High tension (electrical)	H.T.
Internal diameter	I.D.
Inches of mercury	in. Hg
Inches	in
Kilogramme (force)	kgf
Kilogramme (mass.)	kg
Kilogramme centimetre (torque)	kgf.cm
Kilogramme per square millimetre	kgf/mm^2
Kilogramme per square centimetre	kgf/cm^2
Kilogramme metres (torque)	kgf.m
Kilometres	km
Kilometres per hour	km/h
Kilovolts	kV
Left-hand	LH
Left-hand steering	LHStg
Left-hand thread	LHThd
Litres	litre
Low tension	l.t.
Maximum	max.
Metre	m
Millilitre	ml
Millimetre	mm
Miles per gallon	mpg
Miles per hour	mph
Minute (angle)	'
Minus (of tolerance)	-
Negative (electrical)	-
Newton meters (torque)	Nm
Number	No.
Ohms	ohm
Ounces (force)	ozf
Ounces (mass)	oz
Ounce inch (torque)	ozf.in.
Outside diameter	O.D.
Part number	Part No.
Percentage	%
Pints	pt
Pints (US)	US pt
Plus (tolerance)	+
Positive (electrical)	+
Pound (force)	lbf
Pounds inch (torque)	in.lbf.
Pound (mass)	lb
Pounds per square inch	P.S.I.
Ratio	:
Reference	ref.
Revolution per minute	rev/min
Right-hand	RH
Second (angle)	"
Second (numerical order)	2nd
Specific gravity	sp.gr.
Square centimetres	cm^2
Square inches	in^2
Standard wire gauge	s.w.g.
Synchroniser/Synchromesh	synchro.
Third	3rd
Top dead centre	TDC
United Kingdom	UK
Vehicle Identification Number	VIN
Volts	V
Watts	W

SCREW THREADS

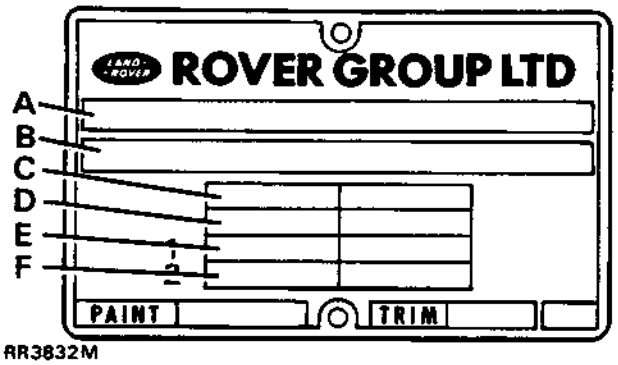
American Standard Taper Pipe	NPTF
British Standard Pipe	BSP
Unified Coarse	UNC
Unified Fine	UNF

VEHICLE IDENTIFICATION NUMBER (VIN)

The Vehicle Identification Number and the recommended maximum vehicle weights are stamped on a plate located under the bonnet rivetted to the top of the front grille at the front of the engine compartment.
The number is also stamped on the right side of the chassis forward of the spring mounting turret.

Key to vehicle identification number plate (UK, Australia, R.O.W., Europe)

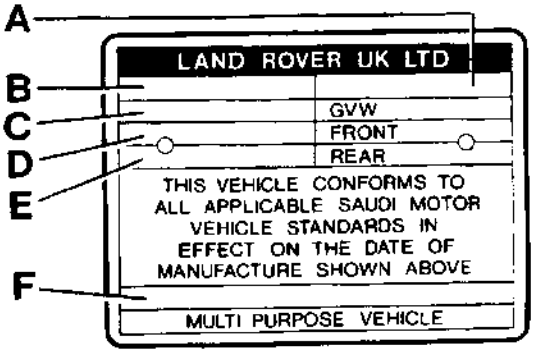
A. Build date (Australia).Type approval
B. VIN (minimum of 17 digits)
C. Maximum permitted laden weight for vehicle
D. Maximum vehicle and trailer weight
E. Maximum road weight-front axle
F. Maximum road weight-rear axle



RR3832M

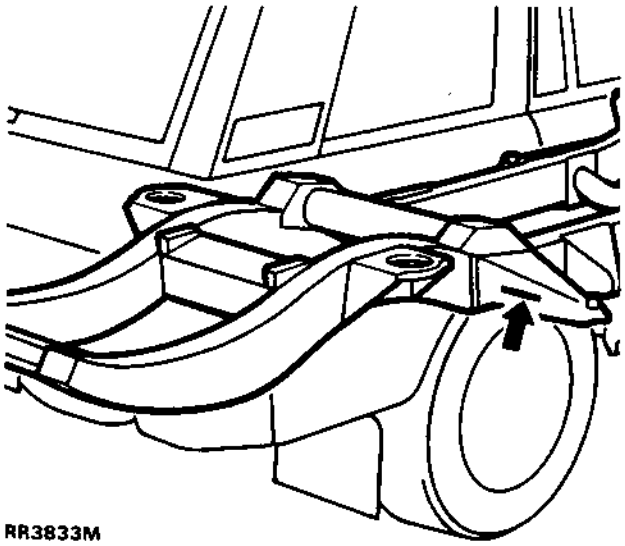
Key to vehicle identification number plate (Saudi Arabia)

A. Year of manufacture
B. Month of manufacture
C. Maximum vehicle weight
D. Maximum road weight-front axle
E. Maximum road weight-rear axle
F. VIN (minimum of 17 digits)



RR466M

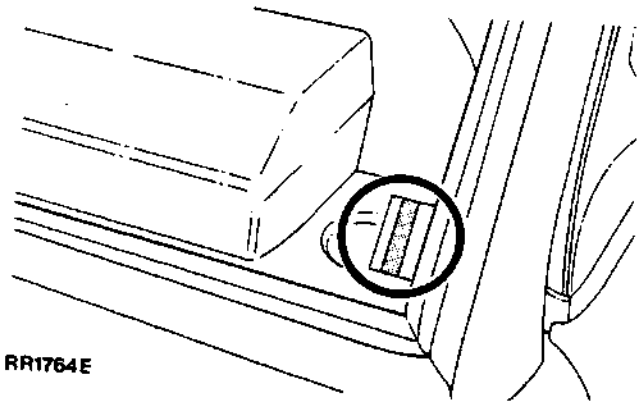
European vehicle identification number (VIN)



RR3833M

Stamped on the right hand side chassis forward of rear wheel.

Federal (USA) vehicle identification number



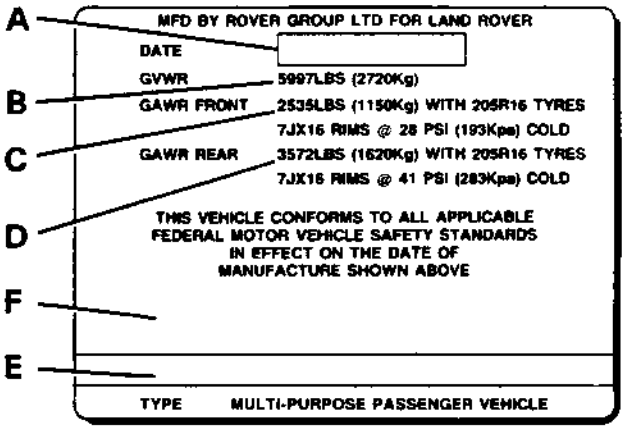
RR1764E

Stamped on a plate rivetted to the upper left hand A - post, visible through the front screen of the vehicle.

Vehicle identification number (VIN)

An adhesive label containing the Vehicle Identification Number, date of manufacture and gross axle weight ratings is fixed to the lock face of the front left hand door. The information includes wheel and tyre sizes and tyre pressures at gross axle weight ratings.

Key to vehicle identification label



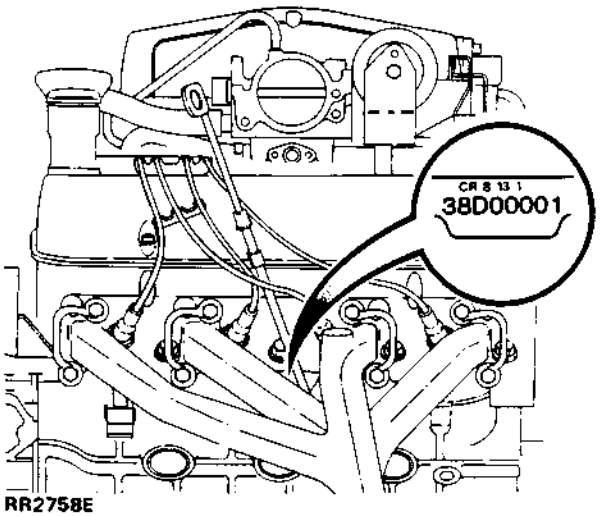
RR2944E

A. Month and year of manufacture
B. Gross vehicle weight rating
C. Gross axle weight rating for front axle
D. Gross axle weight rating for rear axle
E. Vehicle identification number (minimum of seventeen digits)
F. Vehicle identification number - bar code

LOCATION OF IDENTIFICATION NUMBERS

Engine serial number - V8 engine

Stamped on a cast pad on the cylinder block, between numbers 3 and 5 cylinders.



RR2758E

Engines are identified by the prefix:

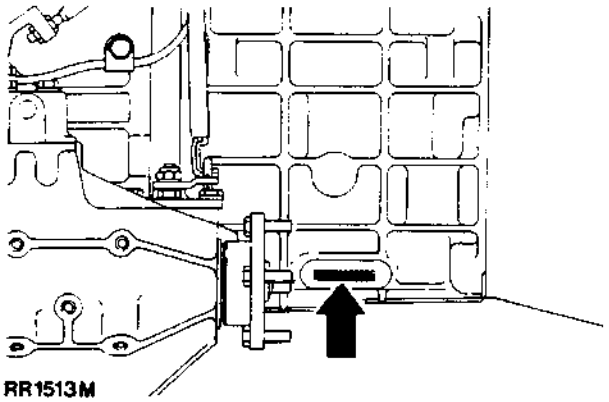
3.9 Litre:
35D. - 9.35:1 compression, manual transmission
36D. - 9.35:1 compression, automatic transmission
37D. - 8.13:1 compression, manual transmission
38D. - 8.13:1 compression, automatic transmission
4.2 Litre:
40D. - 8.94:1 compression, automatic transmission

Engine serial number - 2.5 Diesel engine
Stamped on LH side of cylinder block adjacent to fuel lift pump.

Engine serial number - 200 Tdi Diesel engine
Stamped on the RH side of cylinder block above the camshaft front cover plate.

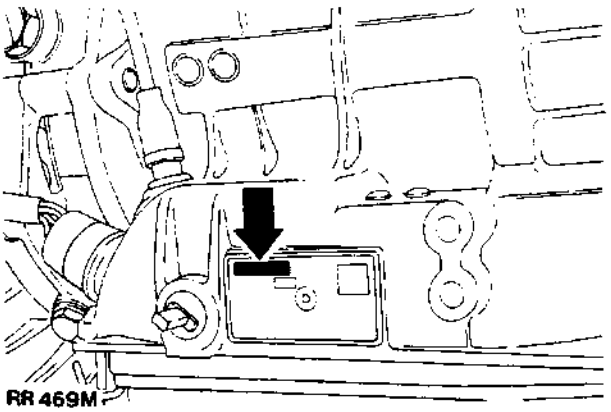
Main gearbox LT77 - 5 speed

Stamped on a cast pad on the bottom right hand side of the gearbox.


RR1513M

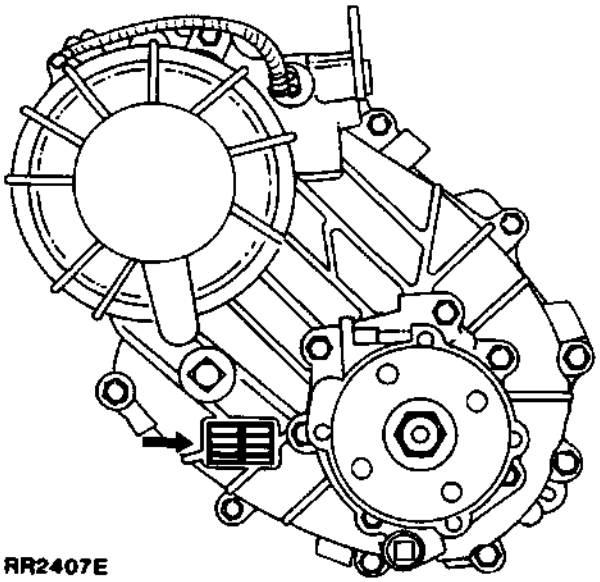
Automatic gearbox ZF4HP22

Stamped on a plate rivetted to the bottom left hand side of the gearbox casing.


RR469M

Transfer gearbox-Borg Warner

Stamped on a plate attached to the gearbox casing, between filler/level and drain plug.



RR2407E

Front and rear axle

Stamped on the top of the left hand axle tubes.

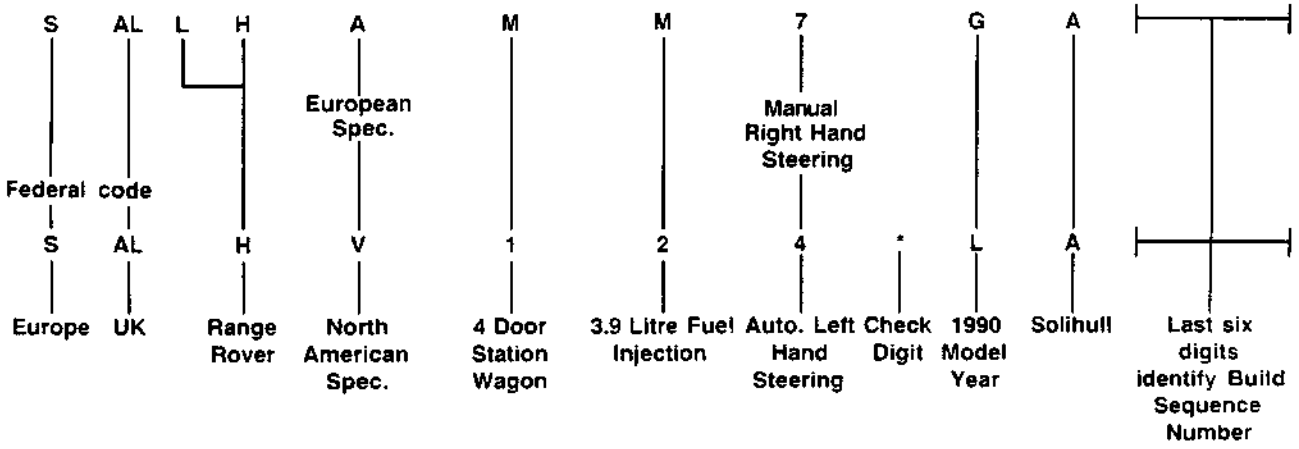
Vehicle identification number (VIN)

Made up of a minimum of 17 digits, these numbers are used to identify manufacturer, model range, specification, body type, engine, transmission/steering, model year, plant and build sequence number and serve to identify the vehicle.

This example shows the sequence:

1990 Model Year

European code



Notes

04 - GENERAL SPECIFICATION DATA

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Notes

ENGINE 3.9 V8

Type		V8
Number of cylinders		Eight, two banks of four
Bore		94.00 mm
Stroke		71.12 mm
Capacity		3950 cc
Valve operation		Overhead by push-rod
Compression ratio		8.13:1 or 9.35:1
Maximum power	- 8.13:1	127 kW at 4550 rev/min
	- 9.35:1	134 kW at 4750 rev/min

Crankshaft

Main journal diameter	58.409-58.422 mm
Minimum regrind diameter	57.393-57.406 mm
Crankpin journal diameter	50.800-50.812 mm
Minimum regrind diameter	49.784-49.797 mm
Crankshaft end thrust/(end float)	Taken on thrust washers of centre main bearing 0.10-0.20 mm

Main bearings

Number and type	5, Vandervell shells
Material	Lead-indium
Diametrical clearance	0.010-0.048 mm
Undersize bearing shells	0.254 mm, 0.508 mm

Connecting rods

Type	Horizontally split big-end, plain small-end
Length between centres	143.81-143.71 mm

Big-end bearings

Type and material	Vandervell VP lead-indium
Diametrical clearance	0.015-0.055 mm
End-float crankpin	0.15-0.36 mm
Undersize bearing shells	0.254 mm, 0.508 mm

Piston pins

Length	72.67-72.79 mm
Diameter	22.215-22.220 mm
Fit-in connecting rod	Press fit
Clearance in piston	0.002-0.007 mm

Pistons

Clearance in bore, measured at bottom of skirt at right angles to piston pin	0.018-0.041 mm

Piston rings

Number of compression rings	2
Number of control rings	1
No 1 compression ring	Molybdenum barrel faced
No 2 compression ring	Tapered and marked 'T' or 'TOP'
Width of compression rings	1.478-1.49 mm
Compression ring gap	0.40-0.65 mm
Oil control ring type	Hepworth and Grandage
Oil control ring width	3.0 mm
Oil control ring rail gap	0.38-1.40 mm

Camshaft

Location	Central
Bearings	Non serviceable
Number of bearings	5
Drive	Chain 9.52 mm pitch x 54 pitches.

Tappets	Hydraulic-self-adjusting

Valves

Length:	Inlet	116.59-117.35 mm
	Exhaust	116.59-117.35 mm
Seat angle:	Inlet	45° to 45 1/2°
	Exhaust	45° to 45 1/2°
Head diameter:	Inlet	39.75-40.00 mm
	Exhaust	34.226-34.480 mm
Stem diameter:	Inlet	8.664-8.679 mm
	Exhaust	8.651-8.666 mm
Stem to guide clearance:	Inlet	0.025-0.066 mm
	Exhaust	0.038-0.078 mm
Valve lift (Inlet and Exhaust)		9.49 mm
Valve spring length fitted		40.4 mm at pressure of 29.5 kg

Lubrication

System type	Wet sump, pressure fed
Oil pump type	Gear
Oil pressure	2.11 to 2.81 kg/cm^2 (30 to 40 p.s.i) at 2400 rev/min with engine warm
Oil filter-internal	Wire screen, pump intake filter in sump
Oil filter-external	Full flow, self-contained cartridge

DIESEL ENGINE 2.5L

Type	95 A VM type Hr 4924 HI
Number of cylinders	Four
Bore	92.00 mm
Stroke	94.00 mm
Capacity	2500 cm^3
Valve operation	Overhead by push-rod
Injection order	1 - 3 - 4 - 2
Compression ratio	22.5:1 (±0.5)

Crankshaft

Front main journal diameter	62,995 to 63,010 mm
Clearance in main bearing	0,05 to 0,115mm
Minimum regrind diameter	62,495 mm
Central main journal diameter	63,005 to 63,020 mm
Clearance in main bearing	0,03 to 0,088 mm
Minimum regrind diameter	62,52 mm
Rear main journal diameter	69,985 to 70,00 mm
Clearance in main bearing	0,040 to 0,070 mm
Minimum regrind diameter	69,485 mm
Crankpin journal diameter	53,94 to 53,955 mm
Clearance in big-end bearing	0,022 to 0,076 mm
Minimum regrind diameter	53,44 mm
End float	0,153 to 0,304 mm
Adjustment	Thrust washers
Thrust washers available	2,311 to 2,362 2,411 to 2,462 mm 2,511 to 2,562 mm

Thrust spacer

Thickness	7,9 to 8,1 mm
Diameter	89,96 to 90 mm

Main bearings

Standard
Internal diameter:

Front	63,060 to 63,11 mm
Centre	63,050 to 63,09 mm
Rear	70,040 to 70,055 mm

Bearing undersizes:
0,25 mm and 0,5 mm less than the dimensions given.

Main bearing carriers

Internal diameter:

Front	67,025 to 67,050 mm
Centre	66,67 to 66,687 mm
Rear	75,005 to 75,030 mm
Piston oil jet opening pressure	1,5 to 2,0 kg/cm^2

Liners

Internal diameter:

White	
Standard	92,000 to 92,010 mm
Red	
Standard	92,010 to 92,020 mm
Protrusion	0,01 to 0,06 mm
Adjustment	Shims
Shims available	0,15 mm
	0,20 mm
	0,23 mm
Maximum ovality	0,100 mm
Maximum taper	0,100 mm

Cylinder heads

Minimum thickness	89,95 to 90,05 mm

Gaskets

Free thickness	Identity	
Part No. STC 0810	No notch	1,51 to 1,59 mm
Part No. STC 0812	1 notch	1,75 to 1,83 mm
Part No. STC 0811	2 notches	1,65 to 1,73 mm
Fitted thickness		
Part No. STC 0810		1,42 mm ± 0,04
Part No. STC 0812		1,62 mm ± 0,04
Part No. STC 0811		1,52 mm ± 0,04

End plates

Height	91,26 to 91,34 mm

Connecting rods

Weights (connecting rod with small end bush, big end cap and bolts, but without big end shell).

Letter Code		
L	1156 to 1172 gr	Fully machined balanced



Pistons

Skirt diameter:
(measured approximately 15 mm above bottom of skirt).

Class A	91,92 to 91,93 mm
Class B	91,93 to 91,94 mm
Piston skirt wear limit	0,05 mm
Maximum ovality of gudgeon pin bore	0,05 mm

Piston clearance:

Top of piston to cylinder head	0,95 to 1,04 mm

Piston protrusion above crankcase:

0,38 to 0,47mm	Fit gasket 1,42 mm
0,58 to 0,67mm	Fit gasket 1,62 mm
0,48 to 0,57mm	Fit gasket 1,52 mm
Maximum piston to liner clearance	0,15 mm

Small end bush

Internal diameter:

Minimum	30,030 mm
Maximum	30,045 mm
Wear limit between bush and gudgeon pin	0,100 mm

Connecting rod bearings

Standard:

Internal diameter	53,977 to 54,016 mm

Bearing undersizes:
0,25 mm and 0,5 mm less than dimension given.

Piston rings

Clearance in groove:

Top	0,080 to 0,130 mm
Second	0,070 to 0,102 mm
Oil control	0,040 to 0,072 mm

Fitted gap:

Top	0,25 to 0,50 mm
Second	0,25 to 0,45 mm
Oil control	0,25 to 0,58 mm

Gudgeon Pins

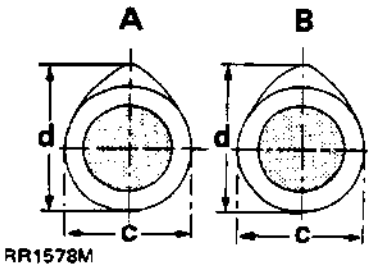
Type	Fully floating
Diameter	29,990 to 29,996 mm
Clearance in connecting rod	0,034 to 0,055 mm
Wear limit between gudgeon pin and connecting rod bush	0,100 mm

Camshaft

Journal diameter:

Front	53,495 to 53,51 mm
Bearing clearance	0,030 to 0,095 mm
Centre	53,45 to 53,47 mm
Bearing clearance	0,07 to 0,14 mm
Rear	53,48 to 53,50 mm
Bearing clearance	0,04 to 0,11 mm

Cam lobe minimum dimensions:



Inlet (A)

(c)	38,5 mm
(d)	45,7 mm

Exhaust (B)

(c)	37,5 mm
(d)	45,14 mm

Thrust plate thickness ..... 3,95 to 4,05 mm

Tappets

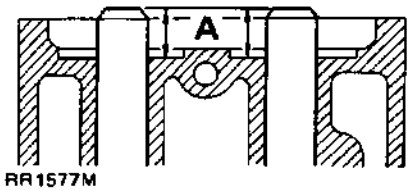
Outside diameter ..... 14,965 to 14,985 mm

Rocker gear

Shaft diameter	21,979 to 22,00 mm
Bush internal diameter	22,020 to 22,041 mm
Assembly clearance	0,020 to 0,062 mm
Wear limit between bush and shaft	0,2 mm

Valves

Face angle:	Inlet	55° 30'
	Exhaust	45° 30'
Head diameter:	Inlet	40,05 to 40,25 mm
	Exhaust	33,80 to 34,00 mm
Head stand down:	Inlet	0,80 to 1,20 mm
	Exhaust	0,79 to 1,19 mm
Stem diameter:	Inlet	7,940 to 7,960 mm
	Exhaust	7,920 to 7,940 mm
Clearance in guide:	Inlet	0,040 to 0,075 mm
	Exhaust	0,060 to 0,095 mm



Valve guides

Inside diameter ..... 8 to 8,015 mm
Fitted height **A**(above spring)
plate counterbore) ..... 13,5 to 14 mm

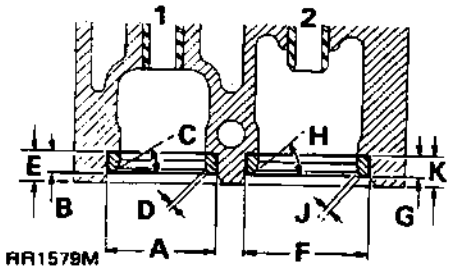
Valve seat inserts

Machining dimensions
Exhaust (1)

A ..... 36,066 to 36,050 mm
B ..... 7,00 to 7,05 mm
C ..... 44°30'
D ..... 1,65 to 2,05 mm
E ..... 10,15 to 10,25 mm

Inlet (2)

F ..... 42,070 to 42,086 mm
G ..... 7,14 to 7,19 mm
H ..... 34° 30'
J ..... 1,8 to 2,2 mm
K ..... 10,3 to 10,4 mm



Valve springs

Free length	44,65 mm
Fitted length	38,6 mm
Load at fitted length	34 ± 3% Kg
Load at top of lift	92,5 ± 3% Kg
Number of coils	5,33

Valve timing

Rocker clearance:		
Timing:	Inlet	0,30 mm
	Exhaust	0,30 mm
Inlet valve:	Opens	22° ± 5° B.T.D.C.
	Closes	48° ± 5° A.B.D.C.
Exhaust valve:	Opens	60° ± 5° B.B.D.C.
	Closes	24° ± 5° A.T.D.C.

Lubrication

System pressure with oil at 90-100°C at 4,000 rev/min	3,5 to 5,0 kgf/cm^2
Pressure relief valve opens	6.38 kgf/cm^2
Pressure relief valve spring - free length	57,5 mm
Oil pump:	
Outer rotor end float	0,04 to 0,087 mm
Inner rotor end float	0,04 to 0,087 mm
Outer rotor to body diametrical clearance	0,130 to 0,230 mm
Rotor body to drive gear Clearance (pump not fitted)	0,15 to 0,25 mm

FUEL SYSTEM - V8

Fuel system type ..... Lucas 14CUX hot wire system electronically controlled
Fuel pump-make/type ..... High pressure electrical, immersed in the fuel tank
Fuel pump delivery pressure ..... 2.4-2.6 kgf/cm ^{2} (34-37 p.s.i.)
Fuel filter ..... Bosch in-line filter 'canister' type

Airflow Sensor

Make and type ..... Lucas 'Hot Wire' 3AM

Injectors

Make and type ..... Lucas 8NJ

Electronic Control Unit

Make and type ..... Lucas 14CUX

Fuel pressure regulator

Make and type ..... Lucas 8RV

Fuel temperature sensor

Make and type ..... Lucas 6TT

Coolant temperature sensor

Make and type ..... Lucas 3TT

Bypass Airvalve (Stepper motor)

Make and type ..... Lucas 2ACM

Throttle potentiometer

Make and type ..... Lucas 215SA

Lambda sensor - catalyst vehicles

Make and type ..... Lucas 3LS

FUEL SYSTEM - 2.5 DIESEL ENGINE

Fuel lift pump	Mechanical, driven by camshaft
Turbo charger:	
Shaft radial clearance	0,35 mm
Shaft axial clearance	0,10 mm
Waste gate valve:	
Opening pressure	0,9 kgf/cm^2

COOLING SYSTEM

Type	Pressurized system with cross- flow radiator and remote header tank, thermostat control, pump and fan assisted
Type of pump	Centrifugal
Thermostat - V8	88°C
Thermostat - Diesel	80°C

TRANSMISSION

Clutch	
Make and type - V8	Borg and Beck diaphragm type
Clutch plate diameter	266.5 mm
Make and type - Diesel	Valeo, diaphragm
Diameter	235 mm

Borg Warner transfer gearbox

Type	Two speed reduction on main gearbox output, front and rear drive permanently engaged via a centre differential controlled by a viscous unit giving a 50/50 nominal front and rear torque split.

Transfer gearbox ratios

High	1.206:1
Low	3.244:1

Manual gearbox

Model	LT77
Type	Five speed, single helical constant mesh with synchromesh on all forward gears



Manual gearbox ratios

5th	0.731:1
4th	1.000:1
3rd	1.397:1
2nd	2.132:1
1st	3.321:1
Reverse	3.429:1

Diesel models low first gear 3.692:1

Overall ratio (final drive):	**High transfer**	**Low transfer**
5th	3.119:1	8.39:1
4th	4.267:1	11.476:1
3rd	5.959:1	16.027:1
2nd	9.095:1	24.462:1
1st	14.172:1	38.115
Reverse	14.629:1	39.346:1
Diesel models low 1st gear	15.750:1	42.362

Automatic gearbox

Model	ZF4HP22
Type	Four speed and reverse epicyclic with fluid torque converter and lock up.

Automatic gearbox ratios

4th	0.728:1
3rd	1.000:1
2nd	1.480:1
1st	2.480:1
Reverse	2.086:1

Overall ratio (final drive):	**High transfer**	**Low transfer**
4th	3.11:1	8.36:1
3rd	4.27:1	11.48:1
2nd	6.32:1	17.00:1
1st	10.59:1	28.50:1
Reverse	8.91:1	23.96:1

SHIFT SPEED SPECIFICATION - AUTOMATIC ZF4HP22 GEARBOX

OPERATION	SELECTOR POSITON	VEHICLE SPEED APPROX		ENGINE SPEED APPROX (RPM)
		KICKDOWN		
		MPH	KPH	
KD4 - 3	D	84 - 92	136 - 150	
KD3 - 2	3(D)	57 - 62	91 - 99	
KD2 - 1	2(D,3)	27 - 34	44 - 56	
KD3 - 4	D	N/A	N/A	
KD2 - 3	D(3)	60 - 63	96 - 104	4750 - 5200
KD1 - 2	D(3,2)	34 - 40	56 - 64	4600 - 5250
		FULL THROTTLE		
FT4 - 3	D	61 - 67	98 - 108	
FT3 - 2	3(D)	40 - 46	64 - 73	
FT3 - 4	D	74 - 80	119 - 129	3980 - 4330
FT2 - 3	D(3)	55 - 60	88 - 96	4350 - 4800
FT1 - 2	D(3,2)	29 - 34	48 - 56	3950 - 4650
		PART THROTTLE		
PT4 - 3	D	47 - 54	75 - 86	
PT3 - 2	D(3)	29 - 37	48 - 59	
PT2 - 1	D(3,2)	10 - 12	16 - 19	
		LIGHT THROTTLE		
LT3 - 4	D	26 - 30	43 - 49	1430 - 1650
LT2 - 3	D(3)	18 - 22	29 - 35	1420 - 1820
LT1 - 2	D(3,2)	9 - 10	14 - 16	1180 - 1220
		ZERO THROTTLE		
ZT4 - 3	D	19 - 25	31 - 41	
ZT3 - 2	D(3)	12 - 15	19 - 24	
ZT2 - 1	D(3,2)	6 - 7	10 - 11	
		TORQUE CONVERTER		
Lock up (IN)	D	51 - 54	81 - 86	1875 - 2000
Unlock (OUT)	D	49 - 52	78 - 83	1825 - 1930

NOTE: The speeds given in the above chart are approximate and only intended as a guide. Maximum shift changes should take place within these tolerance parameters.



Propeller shafts

Type	
Front	Tubular 51 mm diameter
Front - Catalyst vehicles	Solid bar 28.6 mm diameter
Rear	Tubular 51 mm diameter
Universal joints	Open type Hookes O3EHD

Rear axle

Type	Spiral bevel, fully floating shafts
Ratio	3.54:1

Front axle

Type	Spiral bevel, enclosed constant velocity joints, fully floating shafts
Angularity of universal joint on full lock	32°
Ratio	3.54:1

STEERING

Power steering box

Make/type	Adwest Varamatic - worm and roller box
Ratio	Variable: straight ahead 19.3:1 on lock 17.2:1
Steering wheel turns, lock-to-lock	3.375

Steering pump

Make/type	Hobourn-Eaton series 200
Operating pressure - straight ahead position - at idle	7 kgf/cm^2 (100 p.s.i.) maximum
Full lock (left or right) at idle	28 kgf/cm^2 (400 p.s.i.) minimum
Full lock (left or right) 1000 rev/min	70-77 kgf/cm^2 (1000-1100 p.s.i.)

Steering geometry

Steering wheel diameter	406.4 mm	
Toe-out measurement	0 to 2 mm toe-out	
Toe-out included angle	0° to 0° 16'	
Camber angle	0°	Check with vehicle in static unladen condition, that is, vehicle with water, oil and five gallons of fuel. Rock the vehicle up and down at the front to allow it to take up a position
Castor angle	3°	
Swivel pin inclination-static	7°	

SUSPENSION

Type	Coil springs controlled by telescopic dampers front and rear
Front	Transverse location of axle by Panhard rod, and fore and aft location by two radius arms
Rear	Fore and aft movement inhibited by two tubular trailing links. Lateral location of axle by a centrally positioned 'A' bracket bolted at the apex to a ball joint mounting. A levelling unit is positioned between the ball joint and upper cross member.

ROAD SPRING DATA

Specification	Part Number	Colour Code	Rating	Free length	No. of Working Coils
A	572315	Blue Stripe	2375.1 kg/m (133 lb/in)	391.16 mm (15.4 in)	7.18
B	NRC4306	Blue & White Stripe	2375.1 kg/m (133 lb/in)	417.57 mm (16.44 in)	7.55
C	NTC8476	White, Blue & Pink Stripe	2678.7 kg/m (150 lb/in)	420.3 mm (16.55 in)	7
D	NRC8477	Green, Blue & Yellow Stripe	3182.1 kg/m (178.2 lb/in)	461.67 mm (18.176 in)	8.75
E	NRC2119	Green stripe	2678.7 kg/m (150 lb/in)	409.70 mm (16.13 in)	7.63
F	NRC4305	Red & Yellow Stripe	2678.7 kg/m (150 lb/in)	436.4 mm (17.18 in)	7.65

Standard Suspension	Specification		Heavy Duty Suspension	Specification	
	Right Side	Left Side		Right Side	Left Side
RHD Front	A	A	RHD Front	D	D
LHD Front	A	B	LHD Front	D	C
RHD Rear	E	E			
LHD Rear	E	F			
* Vehicles with anti-roll bars					
RHD Rear	E	E			
LHD Rear	E	F			

* Anti-roll bars 1991 model introduction.

△ **NOTE: Both right and left hand drive Diesel models are fitted with heavy duty front suspension.**

SHOCK ABSORBERS

Type	Telescopic, double-acting non-adjustable
Bore diameter	35.47 mm

BRAKES

Front service brake

Type	Outboard discs with four piston calipers
Operation	Hydraulic, servo assisted self-adjusting
Disc diameter	298.17 mm
Total pad area	98.1 cm^2 per brake
Total swept area	816 cm^2 per brake
Pad material	Ferodo 3440 non asbestos
Pad wear indicator	Inboard pad right hand caliper

Rear service brake

Type	Outboard discs with two piston calipers
Operation	Hydraulic, servo assisted, self-adjusting
Disc diameter	290.0 mm
Total pad area	65.81 cm^2 per brake
Total swept area	717 cm^2 per brake
Pad material	Ferodo 3440 non asbestos
Pad wear indicator	Inboard pad right hand caliper

Parking brake

Type	Mechanical-cable operated drum brake on the rear of the transfer gearbox output shaft
Drum diameter	254 mm
Width	70 mm
Lining material	Ferodo 3611 non asbestos

Servo/master cylinder

Manufacturer	Lucas Girling
Servo type	LSC 115
Boost ratio	5.6:1
Master cylinder type	25.4 mm AS/AS (steel tube construction)
Fluid displacement - Primary	5.16 cm^3
- Secondary	9.17 cm^3
Nominal split	36/64
Unit weight	3.75 Kg
Maximum bleed pressure	2,76 bar (40 lbf/in^2)

Anti-lock brake system

Manufacturer/type	Wabco LRC M15 - 4 channel, 4 wheel sensed integrated anti-lock brake system.



WHEELS AND TYRES

Type and size	Alloy 7.00J X 16
Tyre size	205R16 (tubeless)
Type and size	Steel 6.00JK X 16
Tyre size	205R16 (tubed)



NOTE: Petrol vehicles must be fitted with 'S' or 'T' rated tyres.

AIR CONDITIONING

System	A.R.A.
Compressor	Sanden SD709

WIPER MOTORS

Tailgate wiper motor

Make/type	IMOS (non-serviceable)
Running current, wet screen at 20°C ambient	1.0 to 2.8 amps
Wiper speed, wet screen at 20°C ambient	37 to 43 cycles per minute

Windscreen wiper motor

Make/type	Lucas 28W 2-speed
Running current (Link disconnected)	1.5 amps at 39 to 45 rev/min (normal speed)
Rotary link speed	60 to 73 rev/min (high speed)

ELECTRICAL

System	12 volt, negative ground
Battery	
Make/type - basic	Land Rover Parts and Equipment/Chloride maintenance free 9-plate-210/85/90
Make/type - heavy duty	Land Rover Parts and Equipment/Chloride maintenance free 14-plate-380/120/90

Alternator - basic

Manufacturer	Magnetti Marelli
Type	A127 - 65A
Polarity	Negative ground
Brush length	
New	17 mm
Worn, minimum free protrusion from moulding	5 mm
Brush spring pressure flush with moulding	1.3N to 2.7 Ng
Rectifier pack output rectification	6 diodes (3 positive side and 3 ground side)
Field winding supply rectification	3 diodes
Stator windings	3 phase-delta connected
Field winding rotor poles	12
Maximum speed	15,000 rev/min
Winding resistance at 20°C	2.6 ohms
Control	Field voltage sensed regulation
Regulator-type	21 TR
voltage	13.6 to 14.4 volts
Nominal output	
Condition	Hot
Alternator speed	6000 rev/min
Control voltage	14 volt
Amp	65 amp

Alternator - heavy duty

Manufacturer	Magnetti Marelli
Type	A133 - 80A
Polarity	Negative ground
Brush length	
New	20 mm
Worn, minimum free protrusion from brush box	10 mm
Brush spring pressure flush with brush box face	136 to 279 g
Rectifier pack output rectification	6 diodes (3 positive side and 3 ground side)
Field winding supply rectification	3 diodes
Stator windings	3 phase-delta connected
Field winding rotor poles	12
Maximum speed	16,000 rev/min
Winding resistance at 20°C	2.6 ohms
Control	Field voltage sensed regulation
Regulator-type	15 TR
voltage	13.6 to 14.4 volts
Nominal output	
Condition	Hot
Alternator speed	6000 rev/min
Control voltage	14 volt
Amp	80 amp

Coil

Make/type ..... Bosch 0221 122 392

Distributor

Make/type ..... Lucas 35 DLM8
Firing angles ..... 0°-45°-90° (every 45°) ± 1°
Application ..... 12V Negative ground
Pick-up air gap adjustment
(Pick-up limb/reluctor tooth) ..... 0.20 mm to 0.35 mm
Pick-up winding resistance ..... 2k to 5k ohms

Fuses

Type ..... Autofuse (blade type)
blow ratings to suit individual circuits

Horns

Make/type ..... Klamix (Mixo) TR99

Ignition module

Make/type ..... Lucas 9EM amplifier module, distributor mounted

Spark plugs

Make/type(8.13:1 Compression) ..... Champion RN12YC
Gap ..... 0.84 to 0.96 mm

Make/type(9.35:1 Compression) ..... Champion RN9YC
Gap ..... 0.84 to 0.96 mm

Starter motor - U8

Make/type ..... Lucas M78R pre-engaged
Minimum brush length ..... 3.5 mm
Minimum commutater diameter ..... 28.8 mm

Starter motor - Diesel

Make and type ..... Bosch 0.001.362.092

REPLACEMENT BULBS	TYPE		
Exterior lights			
Headlamps	12V	60/55W	(Halogen)
Headlamps - France amber	12V	60/55W	(Halogen)
Auxiliary driving lamps	12V	55W H3	(Halogen)
Sidelamps	12V	5W	bayonet
Tail lamps	12V	5/21W	bayonet
Reverse lamps	12V	21W	bayonet
Stop lamps	12V	21W	bayonet
Direction indicator lamps	12V	21W	bayonet
Rear side marker lamps	12V	4W	bayonet
Number plate lamps	12V	5W	capless
Interior lights			
Instrument panel lamps and warning lamps	12V	1.2W	bulb/holder unit
Ignition warning lamp (Instrument panel)	12V	2W	capless
Interior roof lamps	12V	10W	'Festoon'
Clock illumination	12V	2W	bayonet
Cigar lighter illumination	12V	1.2W	capless
Door shut face/puddle lamps	12 V	5W	capless
Auxiliary switch panel illumination (green)	12V	1.2W	capless
Heated rear screen warning lamp (amber)	12V	1.2W	capless
Hazard warning lamp	12V	1.2W	capless
Automatic graphics illumination	24V	5W	capless
Heater/air conditioning graphics illumination	12V	1.2W	capless
Differential lock warning lamp	12V	2W	bayonet
Column switch illumination	12V	1.2W	capless

CAUTION: The fitting of new bulbs with wattages in excess of those specified will result in damage to vehicle wiring and switches.



VEHICLE WEIGHTS AND PAYLOAD

When loading a vehicle to its maximum (Gross Vehicle Weight), consideration must be taken of the vehicle kerb weight and the distribution of the payload to ensure that axle loadings do not exceed the permitted maximum values. It is the customer's responsibility to limit the vehicle's payload in an appropriate manner such that neither maximum axle loads nor Gross Vehicle Weight are exceeded.

Petrol-engined models		Front Axle kg	Rear Axle kg	Total kg
Manual				
2 door	EEC Kerb weight	955	969	1924
	Gross Vehicle Weight*	1100	1510	2510
4 door	EEC Kerb weight	967	993	1960
	Gross Vehicle Weight*	1100	1510	2510
Catalytic model	EEC Kerb weight	973	994	1967
	Gross Vehicle Weight*	1100	1510	2510
Automatic				
2 door	EEC Kerb weight	982	973	1955
	Gross Vehicle Weight*	1100	1510	2510
4 door	EEC Kerb weight	983	1021	2004
	Gross Vehicle Weight*	1100	1510	2510
Catalytic model	EEC Kerb weight	989	1022	2011
	Gross Vehicle Weight*	1100	1510	2510
Long wheelbase models	EEC Kerb weight	1070	1080	2150
	Gross Vehicle Weight*	1200	1620	2620

△ **NOTE: EEC KERB WEIGHT is the minimum vehicle specification, plus full fuel tank and 75 kg driver. GROSS VEHICLE WEIGHT is the maximum all-up weight of the vehicle including driver, passengers, and equipment. This figure is liable to vary according to legal requirements in certain countries.**

When **air conditioning** is fitted, 42 kg must be added to the above front axle weights and total weights.

VEHICLE DIMENSIONS

Overall length ..... 4.45 m
- Long wheelbase vehicles ..... 4.65 m
Overall width ..... 1.82 m
Overall height ..... 1.80 m
Wheelbase ..... 2.54 m
- Long wheelbase vehicles ..... 2.74 m
Track: front and rear ..... 1.49 m
Ground clearance: under differential ..... 190 mm
Turning circle ..... 11.89 m
- Long wheelbase vehicles ..... 13.64 m
Loading height ..... 749 mm
Maximum cargo height ..... 1.028 m
Rear opening height ..... 0.87 m
Usable luggage capacity, rear seat folded ..... 2.00 m^3
Usable luggage capacity, rear seat in use
- four door vehicles ..... 1.03 m^3
- two door vehicles ..... 1.17 m^3
Maximum roof rack load ..... 75 kg

TYRE PRESSURES

Pressures: Check with tyres cold	Normal on and off-road use. All speeds and loads		Off-road 'emergency' soft use maximum speed of 40 kph (25 mph)	
	Front	Rear (*)	Front	Rear
bars	1.9	2.4 (2.6)	1.2	1.8
lbf/in^2	28	35 (38)	17	25
kgf/cm^2	2.0	2.5 (2.7)	1.2	1.8

(*) Long wheelbase vehicles (108")

The pressure of tyres must be increased by 2.8 bars (3 lbf in ^{2} 0.2 kgf/cm^2). For use with sustained driving speeds above 160 km/hr (100 miles/hour) or with heavy axle loads.
Normal operating pressures should be restored as soon as reasonable road conditions or hard ground is reached. After any usage off the road, tyres and wheels should be inspected for damage particularly if high cruising speeds are subsequently to be used.

Towing: When the vehicle is used for towing, the reduced rear tyre pressures for extra ride comfort are not applicable.

WARNING: Vehicles fitted with tubeless alloy road wheels as original equipment, note that these wheels DO NOT accept inner tubes and tubed tyres MUST NOT be fitted.

1993 MODEL YEAR - ENGINE 4.2 V8

Type	V8
Number of cylinders	Eight, two banks of four
Bore	94.00 mm
Stroke	77.00 mm
Capacity	4275 cc
Valve operation	Overhead by push-rod
Compression ratio	8.94:1
Maximum power	149 kW at 4850 rev/min

Crankshaft

Main journal diameter	58.409-58.422 mm
Minimum regrind diameter	57.393-57.406 mm
Crankpin journal diameter	50.800-50.812 mm
Minimum regrind diameter	49.784-49.797 mm
Crankshaft end thrust/(end float)	Taken on thrust washers of centre main bearing 0.10-0.20 mm

Main bearings

Number and type	5, Vandervell shells
Material	Lead-indium
Diametrical clearance	0.010-0.048 mm
Undersize bearing shells	0.254 mm, 0.508 mm

Connecting rods

Type	Horizontally split big-end, plain small-end
Length between centres	143.81-143.71 mm

Big-end bearings

Type and material	Vandervell VP lead-indium
Diametrical clearance	0.015-0.055 mm
End-float crankpin	0.15-0.36 mm
Undersize bearing shells	0.254 mm, 0.508 mm

Piston pins

Diameter	22.215-22.220 mm
Fit-in connecting rod	Press fit
Clearance in piston	0.002-0.007 mm

Pistons

Clearance in bore, measured at bottom of skirt at right angles to piston pin ..... 0.018-0.041 mm

Piston rings

Number of compression rings 2
Number of control rings 1
No 1 compression ring ..... Molybdenum barrel faced
No 2 compression ring ..... Tapered and marked 'T' or 'TOP'
Width of compression rings ..... 1.478-1.49 mm
Compression ring gap ..... 0.40-0.65 mm
Oil control ring type ..... Hepworth and Grandage
Oil control ring width ..... 3.0 mm
Oil control ring rail gap ..... 0.38-1.40 mm

Camshaft

Location ..... Central
Bearings ..... Non serviceable
Number of bearings 5
Drive ..... Chain 9.52 mm pitch x 54 pitches.

Tappets ..... Hydraulic-self-adjusting

Valves

Length:	Inlet	116.59-117.35 mm
	Exhaust	116.59-117.35 mm
Seat angle:	Inlet	45° to 45 1/2°
	Exhaust	45° to 45 1/2°
Head diameter:	Inlet	39.75-40.00 mm
	Exhaust	34.226-34.480 mm
Stem diameter:	Inlet	8.664-8.679 mm
	Exhaust	8.651-8.666 mm
Stem to guide clearance:	Inlet	0.025-0.066 mm
	Exhaust	0.038-0.078 mm

Valve lift (Inlet and Exhaust) ..... 9.49 mm
Valve spring length fitted ..... 40.4 mm at pressure of 29.5 kg

Lubrication

System type ..... Wet sump, pressure fed
Oil pump type ..... Gear
Oil pressure ..... 2.11 to 2.81 kg/cm^2 (30 to 40 p.s.i) at 2400 rev/min with engine warm
Oil filter-internal ..... Wire screen, pump intake filter in sump
Oil filter-external ..... Full flow, self-contained cartridge



200Tdi ENGINE

Type	Direct injection, turbocharged, intercooled
Number of cylinders	4
Bore	90,47 mm (3.562 in)
Stroke	97,00 mm (3.822 in)
Capacity	2495 cc
Compression ratio	19.5:1 ± 0.5
Valve operation	O.H.V. pushrod operated
Turbo charger	Garrett T25

Crankshaft

Main bearing journal diameter	63,475 - 63,487 mm (2.499 - 2.4993 in)
Regrind dimensions	63,2333 - 63,246 mm (2.4895 - 2.490 in) Use 0.010 in U/S bearings
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Regrind dimensions	58,4708 - 58,48985 mm (2.30200 - 2.30275 in) Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells with oil grooves
Diametrical clearance	0,0792 - 0,0307 mm (0.0031 - 0.0012 in)

Connecting rods

Length between centres	175,38 - 175,43 mm (6.905 - 6.907 in)
Diametrical clearance (big-end bearings)	0,025 - 0,075 mm (0.001 - 0.003 in)
End float on crankpin	0,15 - 0,356 mm (0.006 - 0.014 in)

Pistons

Type	Aluminium alloy, combustion chamber in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025 - 0,05 mm (0.001 - 0.002 in)
Maximum height above combustion face	0,8 mm (0.031 in)

Gudgeon pins

Type	Floating
Fit in piston	Hand push fit
Diameter	30,1564 - 30,1625 mm (1.18726 - 1.18750 in)
Clearance in connecting rod	0,0036 - 0,0196 mm (0.00014 - 0.00077 in)

Piston rings

Type:	
Top	Chamfered friction edge, chrome plated
Second	Taper faced
Oil control	Expander and rails
Gap in bore:	
Top	0,40 - 0,65 mm (0.0157 - 0.0255 in)
Second	0,30 - 0,50 mm (0.0118 - 0.0196 in)
Oil control	0,3 - 0,6 mm (0.011 - 0.023 in)
Clearance in piston grooves:	
Top	0,167 - 0,232 mm (0.0065 - 0.0091 in)
Second	0,05 - 0,08 mm (0.0019 - 0.0031 in)
Oil control	0,05 - 0,08 mm (0.0019 - 0.0031 in)

Camshaft

Drive	30 mm (1.2 in) wide dry toothed belt
Location	Right hand side (thrust side)
End float	0,1 - 0,2 mm (0.004 - 0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined

Valves

Tappet clearance:	
Inlet and exhaust	0,20 mm (0.008 in)
Seat angle:	
Inlet	30°
Exhaust	45°
Head diameter:	
Inlet	39,35 - 39,65 mm (1.549 - 1.560 in)
Exhaust	36,35 - 36,65 mm (1.431 - 1.443 in)
Stem diameter:	
Inlet	7,960 - 7,975 mm (0.313 - 0.314 in)
Exhaust	7,940 - 7,960 mm (0.212 - 0.313 in)
Valve lift:	
Inlet	9,93 mm (0.401 in)
Exhaust	10,26 mm (0.404 in)
Cam lift:	
Inlet	6,81 mm (0.268 in)
Exhaust	7,06 mm (0.278 in)
Valve head stand down	
Inlet and exhaust	0,9 - 1,1 mm (0.035 - 0.040 in)

Valve springs

Type	Single coil
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)



Lubrication

System	Wet sump, pressure fed
Pressure, engine warm at normal operating speeds	1.76 - 3.86 kgf/cm² (25 - 55 p.s.i.)
Oil pump:	
Type	Double gear 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
Radial clearance of gears	0,025 - 0,075 mm (0.0008 - 0.0025 in)
Backlash of gears	0,1 - 0,2 mm (0.0034 - 0.0067 in)
Oil pressure relief valve	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2.58 kg (5.7 lb) load	61,23 mm (2.450 in)
Oil filter	Screw-on disposable canister
Engine oil cooler	Combined with coolant radiator and intercooler

FUEL SYSTEM 200Tdi engine

Injection pump type	Bosch rotary VE4/11F (see section 05)
Injection pump timing	1.54 mm lift at T.D.C.
Injectors	(see section 05)
Heater plugs	(see section 05)
Fuel lift pump type	Mechanical with hand primer
Fuel lift pump pressure	42 - 55 kpa at 1800 rev/min
Fuel filter	Paper element in disposable canister
Air cleaner	Paper element type
Turbocharger	Garrett T25 (see section 05)

COOLING SYSTEM 200Tdi engine

System type	Pressurised, spill return, thermostatically controlled water and anti freeze mixture. Pump assisted thermo syphon. Coolant radiator combined with oil cooler and turbo intercooler.
Cooling fan	7 blade axial flow 395 mm (15.5 in) diameter. 1.1:1 drive ratio. Viscous coupling.
Pump type	Centrifugal, impellor, belt driven.
Thermostat opening	82°
Expansion tank cap pressure	1.05 kgf/cm² (15 p.s.i. system pressure)

CLUTCH - 200Tdi engine

Type	Valeo diaphragm spring
Centre plate diameter	235 mm (9.25 in)
Facing material	Verto F202 grooved
Number of damper springs	8
Damper spring colour	2 off white/green - suffix 'C' 2 off pigeon blue - suffix 'A' 4 off ruby red - suffix 'B'
Release bearing	Ball journal

TRANSMISSION - 200Tdi engine

Main gearbox manual

Type LT77	Single helical constant mesh
Speeds	5 forward 1 reverse
Synchromesh	All forward speeds
Ratios:	
Fifth	0.770:1
Fourth (direct)	1.000:1
Third	1.397:1
Second	2.132:1
First	3.692:1
Reverse	3.429:1

05 - ENGINE TUNING DATA

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ENGINE 3.9 V8

Type ..... 3.9 Litre V8

Firing order 1-8-4-3-6-5-7-2

Cylinder Numbers
Left bank 1-3-5-7
Right bank 2-4-6-8

No 1 Cylinder location ..... Pulley end of left bank

Timing marks ..... On crankshaft vibration damper

Spark plugs
Make/type(8.13:1 Compression) ..... Champion RN12YC
Gap ..... 0.84-0.96 mm (0.033-0.038 in)
Make/type(9.35:1 Compression) ..... Champion RN9YC
Gap ..... 0.84-0.96 mm (0.033-0.038 in)

Coil
Make/type ..... Bosch 0-221-122-392, (ETC 6574)

Compression ratio ..... 8.13:1 or 9.35:1

Fuel injection system ..... Lucas 14 CUX Hot-wire air flow sensor system electronically controlled

Valve Timing	**Inlet**	**Exhaust**
Opens	32° BTDC	70° BBDC
Closes	73° ABDC	35° ATDC
Duration	285°	285°
Valve peak	104° ATDC	114° BTDC

Idle speed - controlled by EFI system
all loads off in neutral ..... 665 to 735 rev/min
auto gearbox in gear, air con operating 650±28 rev/min
auto gearbox in gear, air con off ..... 600±28 rev/min
manual gearbox ..... 700±28 rev/min
manual gearbox, air con operating ..... 750±28 rev/min

Base idle speed ..... See setting procedure - 525 ± 25 rev/min.

Ignition Timing - dynamic at 800 rev/min max, vacuum disconnected
8.13:1 compression, non catalyst ..... 2° BTDC ± 1°
8.13:1 catalyst ..... 6° BTDC ± 1°
9.35:1 compression, non catalyst ..... 4° BTDC ± 1°
1993 Model Year
9.35:1 compression, catalyst ..... 5° BTDC ± 1°

Exhaust gas
CO content at idle ..... 0.5 to 1.0% max.

Distributor

Make/type	Lucas 35DLM8 electronic
Rotation	Clockwise
Air gap	0.20-0.35mm

Part number	Lucas	Rover
8.13:1, non catalyst	42518A	ERR 1250
8.13:1, catalyst	42648	ETC 6268
9.35:1, non catalyst	42510A	ERR 0744
9.35:1, catalyst	42543A	ERR 2986

Centrifugal Advance

Decelerating check-vacuum hose disconnected
Distributor rev/min decelerating speeds

8.13:1 non catalyst

2000	Distributor advance	5° 30' to 8° 30'
1400		6° 18' to 8° 30'
800		2° to 4°

8.13:1 catalyst

1600 - 2300	Distributor advance	8° 54' to 11°
1400		8° 36' to 10° 36'
600		1° 18' to 3° 18'

9.35:1 non catalyst

2200	Distributor advance	7° to 10°
1400		7° 48' to 10°
650		1° to 3°

9.35:1 catalyst

2200	Distributor advance	5° 30' to 8° 30'
1400		6° 18' to 8° 30'
800		2° to 4°

Fuel

8.13:1, non catalyst	91 RON minimum unleaded
8.13:1, catalyst	95 RON minimum unleaded
9.35:1, non catalyst	95 RON minimum unleaded
9.35:1, catalyst	95 RON minimum unleaded
USA-Premium unleaded (PUG)	CLC or AKI 90 octane minimum 95 RON minimum

Australian market variations

Fuel	91 RON minimum unleaded
Compression ratio	8.13:1
Spark plug	Champion RN12YC
Spark plug gap	0.84-0.96 mm (0.033-0.038 in)
Ignition Timing at 800 rev/min max (vacuum pipe disconnected)	2° BTDC ± 1°
Exhaust gas idle CO	1% max (hot)

DIESEL ENGINE 2.5

Type ..... 95A VM Type HR 4924 HI

Capacity ..... 2500 cm^3

Compression pressure ..... 24 to 26 kgf/cm^2

Injection order ..... 1 - 3 - 4 - 2

Idling speed
At running temperature ..... 750 - 800 rev/min
At cold start ..... 1000 - 1100 rev/min

Maximum light running speed ..... 4700 to 4730 rev/min

Maximum governed road speed ..... 4200 rev/min

Valve rocker clearances (cold)
Inlet ..... 0,30 mm
Exhaust ..... 0,30 mm

Fuel injection pump
Make and type ..... Bosch Rotary VE 4 10F 2100 L269
Injection pump timing ..... 3° ± 1° B.T.D.C.

Injectors
Make and type ..... Bosch KBE 58 S 4/4
Nozzle type ..... DNO SD263 or SDV 4011379
Opening pressure ..... 150 +8, -0 Bar

Heater plugs
Make and type ..... Bosch 0.250.201.012
Nominal voltage ..... 11 volts

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ENGINE 4.2 V8

Type ..... 4.2 Litre V8

Firing order 1-8-4-3-6-5-7-2

Cylinder Numbers
Left bank 1-3-5-7
Right bank 2-4-6-8

No 1 Cylinder location ..... Pulley end of left bank

Timing marks ..... On crankshaft vibration damper

Spark plugs
Make/type ..... Champion RN11YCC
Gap ..... 0.84-0.96 mm (0.033-0.038 in)

Coil
Make/type ..... Bosch 0-221-122-392, (ETC 6574)

Compression ratio 8.94:1

Fuel injection system ..... Lucas 14 CUX Hot-wire air flow sensor system electronically controlled

Valve Timing	**Inlet**	**Exhaust**
Opens	28° BTDC	72° BBDC
Closes	64° ABDC	20° ATDC
Duration	272°	272°
Valve peak	108° ATDC	116° BTDC

Idle speed - controlled by EFI system
- all loads off in neutral ..... 665 to 735 rev/min
- auto gearbox in gear, air con operating ..... 650±28 rev/min
- auto gearbox in gear, air con off ..... 600±28 rev/min
- manual gearbox ..... 700±28 rev/min
- manual gearbox, air con operating ..... 750±28 rev/min

Base idle speed ..... **See setting procedure - 525 ± 25 rev/min.**

Ignition Timing - dynamic at 800 rev/min max, vacuum disconnected
8.94:1, catalyst ..... 8° BTDC ± 1°

Exhaust gas
CO content at idle ..... 0.5 to 1.0% max.

Distributor

Make/type	Lucas 35DLM8 electronic
Rotation	Clockwise
Air gap	0.20-0.35 mm

Part number	**Lucas**	**Rover**
8.94:1, catalyst	42510A	ERR 0744

Centrifugal Advance

Decelerating check-vacuum hose disconnected
Distributor rev/min decelerating speeds

8.94:1 catalyst

2200	Distributor advance	7° to 10°
1400		7° 48' to 10°
800		1° to 3°

Fuel

8.94:1, catalyst	95 RON minimum unleaded
USA vehicles - Premium unleaded (PUG)	CLC or AKI 90 octane minimum 95 RON minimum

200Tdi ENGINE

ENGINE

Firing order	1-3-4-2	
Injection timing	1,54 mm lift at T.D.C.	
Timing marks:		
Valve timing	Slot for peg in flywheel and TDC mark on front pulley	
Injection timing	Special tool inserted in D.P.S. pump hub	
Tappet clearances inlet and exhaust	0,20 mm (0.008 in) cold	
Valve timing:	Inlet	Exhaust
- Opens	16° B.T.D.C.	51° B.B.D.C.
- Closes	42° A.B.D.C.	13° A.T.D.C.
- Peak	103° A.T.D.C.	109° B.T.D.C.
- Lift	9,93 mm (0.401 in)	10,26 mm (0.404 in)
Maximum governed speeds:		
- Full load (speed cut-off starts)	4000 rev/min	
- No load (flight speed)	4600 + 40 - 120 rev/min	
- Idle speed	720 ± 20 rev/min	
- Die-down time	4 seconds	

INJECTION PUMP

Make/type	Bosch rotary VE 4/11F type with boost control and two speed mechanical governor with auto advance and solenoid electrical shut-off. Tamper proof sealing on flight speed and fuel adjustment screws
Direction of rotation	Clockwise, viewed from drive end
Advance box (two stage)	7° advance with 3° start retard
Back leakage rate 150-100 Atm:	
- New nozzle	7 seconds
- Original nozzle	5 seconds
- Despatch nozzle	8520A290A

INJECTORS

Make/type	Bosch KBEL 98 P52 200 bar
Nozzle size	BDNO/SPC 6209
Opening pressure (working pressure)	Initial pressure 200 atmospheres Secondary 280 atmospheres
Injector pipe type	High pressure multi-bundy
Injector pipe size	1,94 - 2,06 mm

HEATER PLUGS

Make/type	Probe type, Beru 11 volts
Time to reach operating temperature of 850°C	8 seconds

TURBOCHARGER

Make/type	Garrett T25
Maximum boost pressure	0.78 bar (11.3 P.S.I.G.) measured at wastegate actuator 'T' piece
Fuel specification	Diesel BS2869 (certain levels down to 45 with adjustment

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07 - GENERAL FITTING REMINDERS

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GENERAL FITTING REMINDERS

WORKSHOP SAFETY IS YOUR RESPONSIBILITY!

The suggestions, cautions and warnings in the section are intended to serve as reminders for trained and experienced mechanics. This manual is not a course in automotive mechanics or workshop safety.

Shop equipment, shop environment, and the use and disposal of solvents, fluids, and chemicals are subject to government regulations which are intended to provide a level of safety. It is your responsibility to know and comply with such regulations.

PRECAUTIONS AGAINST DAMAGE

1. Always fit covers to protect fenders before commencing work in engine compartment.
2. Cover seats and carpets, wear clean overalls and wash hands or wear gloves before working inside vehicle.
3. Avoid spilling hydraulic fluid or battery acid on paint work. Wash off with water immediately if this occurs. Use Polythene sheets to protect carpets and seats.
4. Always use a recommended Service Tool, or a satisfactory equivalent, where specified.
5. Protect temporarily exposed screw threads by replacing nuts or fitting plastic caps.

SAFETY PRECAUTIONS

1. Whenever possible use a lift or pit when working beneath vehicle, in preference to jacking. Chock wheels as well as applying parking brake.

WARNING: Do not use a pit when removing fuel system components.

2. Never rely on a jack alone to support vehicle. Use axle stands carefully placed at jacking points to provide rigid support.
3. Ensure that a suitable form of fire extinguisher is conveniently located.
4. Check that any lifting equipment used has adequate capacity and is fully serviceable.
5. Disconnect the battery negative lead.

WARNING: Do not disconnect any pipes in air conditioning refrigeration system, unless trained and instructed to do so. A refrigerant is used which can cause blindness if allowed to contact eyes.

6. Ensure that adequate ventilation is provided when volatile degreasing agents are being used.
7. Do not apply heat in an attempt to free stiff nuts or fittings; as well as causing damage to protective coatings, there is a risk of damage to electronic equipment and brake linings from stray heat.

PREPARATION

1. Before removing a component, clean it and its surrounding areas as thoroughly as possible.
2. Blank off any openings exposed by component removal, using greaseproof paper and masking tape.
3. Immediately seal fuel, oil or hydraulic lines when separated, using plastic caps or plugs, to prevent loss of fluid and entry of dirt.
4. Close open ends of oilways, exposed by component removal, with tapered hardwood plugs or readily visible plastic plugs.
5. Immediately a component is removed, place it in a suitable container; use a separate container for each component and its associated parts.
6. Before dismantling a component, clean it thoroughly with a recommended cleaning agent; check that agent is suitable for all materials of component.
7. Clean bench and provide marking materials, labels, containers and locking wire before dismantling a component.

DISMANTLING

1. Observe scrupulous cleanliness when dismantling components, particularly when brake, fuel or hydraulic system parts are being worked on. A particle of dirt or a cloth fragment could cause a dangerous malfunction if trapped in these systems.
2. Blow out all tapped holes, crevices, oilways and fluid passages with an air line. Ensure that any O-rings used for sealing are correctly replaced or renewed, if disturbed.
3. Use marking ink to identify mating parts, to ensure correct reassembly. If a centre punch or scriber is used they may initiate cracks or distortion of components.
4. Wire together mating parts where necessary to prevent accidental interchange (e.g. roller bearing components).
5. Wire labels on to all parts which are to be renewed, and to parts requiring further inspection before being passed for reassembly; place these parts in separate containers from those containing parts for rebuild.
6. Do not discard a part due for renewal until after comparing it with a new part, to ensure that its correct replacement has been obtained.

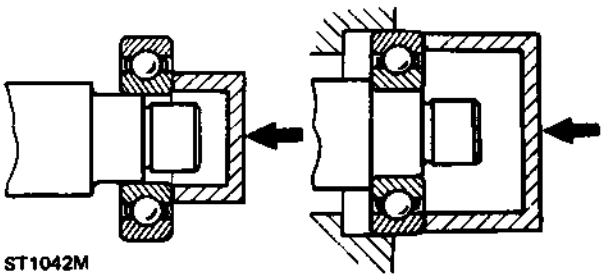
INSPECTION - GENERAL

1. Never inspect a component for wear or dimensional check unless it is absolutely clean; a slight smear of grease can conceal an incipient failure.
2. When a component is to be checked dimensionally against figures quoted for it, use correct equipment (surface plates, micrometers, dial gauges, etc.) in serviceable condition. Makeshift checking equipment can be dangerous.
3. Reject a component if its dimensions are outside limits quoted, or if damage is apparent. A part may, however, be refitted if its critical dimension is exactly limit size, and is otherwise satisfactory.
4. Use 'Plastigauge' 12 Type PG-1 for checking bearing surface clearances. Directions for its use, and a scale giving bearing clearances in 0,0025 mm steps are provided with it.

BALL AND ROLLER BEARINGS

CAUTION: Never refit a ball or roller bearing without first ensuring that it is in a fully serviceable condition.

1. Remove all traces of lubricant from bearing under inspection by washing in a suitable degreaser; maintain absolute cleanliness throughout operations.
2. Inspect visually for markings of any form on rolling elements, raceways, outer surface of outer rings or inner surface of inner rings. Reject any bearings found to be marked, since any marking in these areas indicates onset of wear.
3. Holding inner race between finger and thumb of one hand, spin outer race and check that it revolves absolutely smoothly. Repeat, holding outer race and spinning inner race.
4. Rotate outer ring gently with a reciprocating motion, while holding inner ring; feel for any check or obstruction to rotation, and reject bearing if action is not perfectly smooth.
5. Lubricate bearing generously with lubricant appropriate to installation.
6. Inspect shaft and bearing housing for discoloration or other marking suggesting that movement has taken place between bearing and seatings. (This is particularly to be expected if related markings were found in operation 2).
7. Ensure that shaft and housing are clean and free from burrs before fitting bearing.
8. If one bearing assembly of a pair shows an imperfection it is generally advisable to replace both with new bearings; an exception could be made if the faulty bearing had covered a low mileage, and it could be established that damage was confined to it only.
9. When fitting bearing to shaft, apply force only to inner ring of bearing, and only to outer ring when fitting into housing. (Refer to ST1042M).



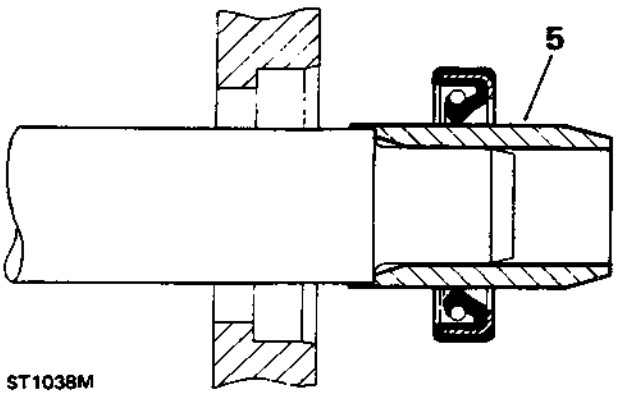
ST1042M

10. In the case of grease lubricated bearings (e.g. hub bearings) fill space between bearing and outer seal with recommended grade of grease before fitting seal.
11. Always mark components of separable bearings (e.g. taper roller bearings) in dismantling, to ensure correct reassembly. Never fit new rollers in a used outer ring, always fit a complete new bearing assembly.

OIL SEALS

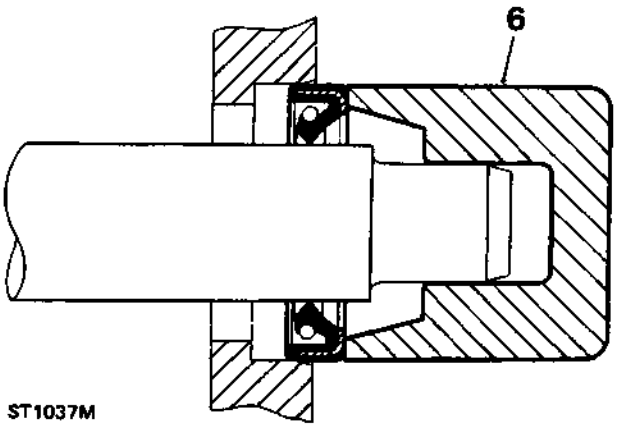
△ **NOTE: Ensure that the seal running track is free from pits, scores, corrosion and general damage prior to fitting replacement seal.**

1. Always fit new oil seals when rebuilding an assembly.
2. Carefully examine seal before fitting to ensure that it is clean and undamaged.
3. Coat the sealing lips with clean grease; pack dust excluder seals with grease, and heavily grease duplex seals in cavity between sealing lips.
4. Ensure that seal spring, if provided, is correctly fitted.
5. Place lip of seal towards fluid to be sealed and slide into position on shaft, using fitting sleeve when possible to protect sealing lip from damage by sharp corners, threads or splines. If fitting sleeve is not available, use plastic tube or tape to prevent damage to sealing lip.



ST1038M

6. Grease outside diameter of seal, place square to housing recess and press into position, using great care and if possible a 'bell piece' to ensure that seal is not tilted. (In some cases it may be preferable to fit seal to housing before fitting to shaft). Never let weight of unsupported shaft rest in seal.



ST1037M

7. If correct service tool is not available, use a suitable drift approximately 0.4mm (0.015 in) smaller than outside diameter of seal. Use a hammer **VERY GENTLY** on drift if a press is not suitable.
8. Press or drift seal in to depth of housing if housing is shouldered, or flush with face of housing where no shoulder is provided. Ensure that the seal does not enter the housing in a tilted position.

△ **NOTE: Most cases of failure or leakage of oil seals are due to careless fitting, and resulting damage to both seals and sealing surfaces. Care in fitting is essential if good results are to be obtained. NEVER use a seal which has been improperly stored or handled, such as hung on a hook or nail.**

JOINTS AND JOINT FACES

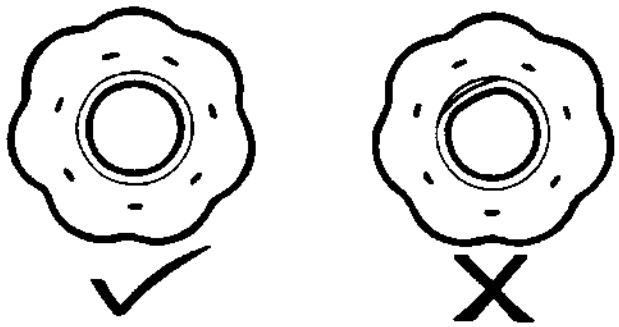
1. Always use correct gaskets where they are specified.
2. Use jointing compound only when recommended. Otherwise fit joints dry.
3. When jointing compound is used, apply in a thin uniform film to metal surfaces; take great care to prevent it from entering oilways, pipes or blind tapped holes.
4. Remove all traces of old jointing materials prior to reassembly. Do not use a tool which could damage joint faces.
5. Inspect joint faces for scratches or burrs and remove with a fine file or oil stone; do not allow removed material or dirt to enter tapped holes or enclosed parts.
6. Blow out any pipes, channels or crevices with compressed air, fit new 'O' rings or seals displaced by air blast.

FLEXIBLE HYDRAULIC PIPES, HOSES

1. Before removing any brake or power steering hose, clean end fittings and area surrounding them as thoroughly as possible.
2. Obtain appropriate plugs or caps before detaching hose end fittings, so that ports can be immediately covered to exclude dirt.
3. Clean hose externally and blow through with airline. Examine carefully for cracks, separation of plies, security of end fittings and external damage. Reject any hose found faulty.
4. When refitting hose, ensure that no unnecessary bends are introduced, and that hose is not twisted before or during tightening of union nuts.
5. Containers for hydraulic fluid must be kept absolutely clean.
6. Do not store brake fluid in an unsealed container. It will absorb water, and fluid in this condition would be dangerous to use due to a lowering of its boiling point.
7. Do not allow brake fluid to be contaminated with mineral oil, or use a container which has previously contained mineral oil.
8. Do not re-use brake fluid bled from system.
9. Always use clean brake fluid to clean hydraulic components.
10. Fit a cap to seal a hydraulic union and a plug to its socket after removal to prevent ingress of dirt.
11. Absolute cleanliness must be observed with hydraulic components at all times.
12. After any work on hydraulic systems, inspect carefully for leaks underneath the vehicle while a second operator applies maximum pressure to the brakes (engine running) and operates the steering.

FUEL SYSTEM HOSES

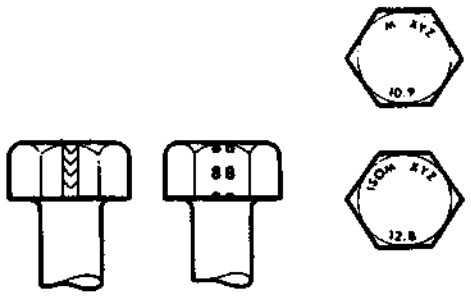
CAUTION: All fuel hoses are made up of two laminations, an armoured rubber outer sleeve and an inner viton core. If any of the fuel system hoses have been disconnected, it is imperative that the internal bore is inspected to ensure that the viton lining has not become separated from the armoured outer sleeve. A new hose must be fitted f separation is evident.



RR2302M

METRIC BOLT IDENTIFICATION

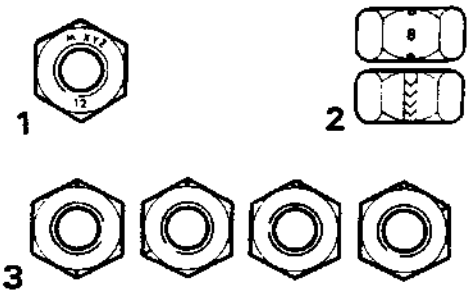
1. An ISO metric bolt or screw, made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the head.
2. In addition to marks to identify the manufacture, the head is also marked with symbols to indicate the strength grade, e.g. 8.8, 12.9 or 14.9, where the first figure gives the minimum tensile strength of the bolt material in tens of kgf/mm^2.
3. Zinc plated ISO metric bolts and nuts are chromate passivated, a gold-bronze colour.



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METRIC NUT IDENTIFICATION

1. A nut with an ISO metric thread is marked on one face or on one of the flats of the hexagon with the strength grade symbol 8, 12 or 14. Some nuts with a strength 4, 5 or 6 are also marked and some have the metric symbol M on the flat opposite the strength grade marking.
2. A clock face system is used as an alternative method of indicating the strength grade. The external chamfers or a face of the nut is marked in a position relative to the appropriate hour mark on a clock face to indicate the strength grade.
3. A dot is used to locate the 12 o'clock position and a dash to indicate the strength grade. If the grade is above 12, two dots identify the 12 o'clock position.



ST1036M

KEYS AND KEYWAYS

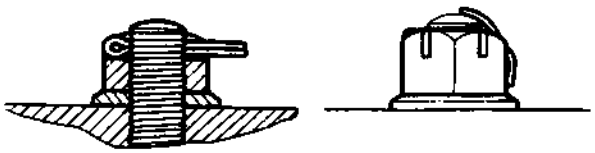
1. Remove burrs from edges of keyways with a fine file and clean thoroughly before attempting to refit key.
2. Clean and inspect key closely; keys are suitable for refitting only if indistinguishable from new, as any indentation may indicate the onset of wear.

TAB WASHERS

1. Fit new washers in all places where they are used. Always fit a new tab washer.
2. Ensure that the new tab washer is of the same design as that replaced.

COTTER PINS

1. Fit new cotter pins throughout when replacing any unit.
2. Always fit cotter pins where cotter pins were originally used. Do not substitute spring washers: there is always a good reason for the use of a cotter pin.
3. All cotter pins should be fitted as shown unless otherwise stated.



ST1030M

NUTS

1. When tightening a slotted or castellated nut never loosen it back to insert cotter pin or locking wire except in those recommended cases where this forms part of an adjustment. If difficulty is experienced, alternative washers or nuts should be selected, or washer thickness reduced.
2. Where self-locking nuts have been removed it is advisable to replace them with new ones of the same type.

△ **NOTE: Where bearing pre-load is involved, nuts should be tightened in accordance with special instructions.**

LOCKING WIRE

1. Fit new locking wire of the correct type for all assemblies incorporating it.
2. Arrange wire so that its tension tends to tighten the bolt heads, or nuts, to which it is fitted.

SCREW THREADS

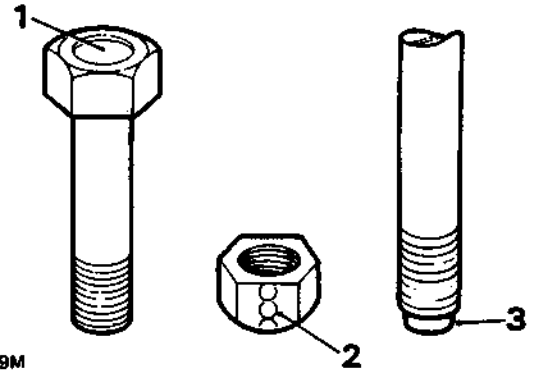
1. Both UNF and Metric threads to ISO standards are used. See below for thread identification.
2. Damaged threads must always be discarded. Cleaning up threads with a die or tap impairs the strength and closeness of fit of the threads and is not recommended.
3. Always ensure that replacement bolts are at least equal in strength to those replaced.
4. Do not allow oil, grease or jointing compound to enter blind threaded holes. The hydraulic action on screwing in the bolt or stud could split the housing.
5. Always tighten a nut or bolt to the recommended torque value. Damaged or corroded threads can affect the torque reading.
6. To check or re-tighten a bolt or screw to a specified torque value first loosen a quarter of a turn, then re-tighten to the correct value.
7. Oil thread lightly before tightening to ensure a free running thread, except in the case of threads treated with sealant/lubricant (see section 06 - Torque Values), and self-locking nuts.

UNIFIED THREAD IDENTIFICATION

1. **Bolts**
   A circular recess is stamped in the upper surface of the bolt head.

2. **Nuts**
   A continuous line of circles is indented on one of the flats of the hexagon, parallel to the axis of the nut.

3. **Studs, Brake rods, etc.**
   The component is reduced to the core diameter for a short length at its extremity.



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Notes

09 - LUBRICANTS, FLUIDS AND CAPACITIES

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RECOMMENDED LUBRICANTS AND FLUIDS - ALL CLIMATES AND CONDITIONS

			AMBIENT TEMPERATURE °C
COMPONENT	**SPECIFICATION**	**VISCOSITY**	-30 -20 -10 0 10 20 30 40 50
Petrol models Engine sump Oil can	Oils must meet: RES.22.OL.G-4 or CCMC G-4 or API SG API CD	5W/30 5W/40 5W/50 10W/30 10W/40 10W/50 15W/40 15W/50 20W/40 20W/50 25W/40 25W/50	
VM Diesel models Engine sump * **Tdi Diesel Models** Engine sump	RES.22.OL.D-5 CCMC D-5 API CE RES.22.OL.PD-2 CCMC PD-2 API CD	15W/40 10W/30 15W/40	
Main Gearbox Automatic	ATF Dexron IID		
Main Gearbox manual	ATF M2C33 F or G		
Final drive units Swivel pin housings	API GL4 or GL5 MIL - L - 2105 or MIL - L - 21-05B C or D	90 EP 80W EP	
Power steering	ATF M2C 33 F or G ATF Dexron IID		
Transfer box	ATFM2C33 F or G ATF DEXRON IID Texaco 4291A Universal		

* VM - Diesel Models - Engine Sump - Emergency only - MIL - L - 2104D, CCMC D2 or API CD

RECOMMENDED LUBRICANTS AND FLUIDS - USA VEHICLES

			AMBIENT TEMPERATURE °C
COMPONENT	SPECIFICATION	VISCOSITY	-30 -20 -10 0 10 20 30 40 50
Engine	Use oils to API service level S G	5W/20) 5W/30) 5W/40)	
		10W/30	
		10W/40) 10W/50)	
		15W/40) 15W/50)	
		20W/40) 20W/50)	
Automatic gearbox	ATF Dexron IID		
Final drive units Swivel pin housings	API GL4 or GL5 MIL - L - 2105 or MIL - L - 21-05B	90 EP 80W EP	
Power steering	ATF Dexron IID		
Borg Warner transfer gearbox	ATF Dexron IID ATF M2C 33G ATF Texaco 4291A Universal		
Brake reservoir	Brake fluid must have a minimum boiling point of 260°C (500°F) and comply with FMVSS/116/DOT 4		
Lubrication nipples (hubs, ball joints, etc.)	NLGI-2 multipurpose lithium based grease		

See table on page 3 for remaining vehicle components

Oils for emergency use only if the SHPD oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes. (See previous page).

Propeller shaft front and rear Lubrication nipples (hubs, ball joints etc.) Seat slides Door lock striker	NLGI - 2 Multi-purpose Lithium based GREASE
Brake and clutch reservoirs	Brake fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT4
Engine cooling system	Use an ethylene glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors suitable for use in aluminium engines to ensure the protection of the cooling system against frost and corrosion in all seasons. Use one part anti-freeze to one part water for protection down to -36°C (-33°F). **IMPORTANT: Coolant solution must not fall below proportions one part anti-freeze to three parts water, i.e. minimum 25% anti-freeze in coolant otherwise damage to engine is liable to occur.**
Battery lugs, Earthing surfaces where paint has been removed	Petroleum jelly. **NOTE: Do not use Silicone Grease**
Air conditioning system refrigerant	**METHYLCHLORIDE REFRIGERANTS MUST NOT BE USED** Use only with refrigerant 12. This includes 'Freon 12' and 'Arcton 12'
Compressor oil	Shell Clavus 68 BP Energol LPT68 Sunisco 4GS Texaco Capella E Wax/Free 68. Castrol Icematic 99
ABS Sensor bush-rear	Silicone grease: Staborags NBU - Wabco 830 502,0634 Wacker chemie 704 - Wabco 830 502,0164 Kluber GL301

LUBRICATION PRACTICE

The engine is filled with special oil to protect it during the running-in-period. The engine must be drained after 1600 km (1,000 miles) and refilled with an appropriate lubricant.
Use a high quality oil of the correct viscosity range and service classification in the engine during maintenance and when topping up. The use of oil not to the correct specification can lead to high oil and fuel consumption and ultimately to damaged components.

Oil to the correct specification contains additives which disperse the corrosive acids formed by combustion and prevent the formation of sludge which can block the oilways. Additional oil additives should not be used. Always adhere to the recommended servicing intervals.

WARNING: Many liquids and other substances used in motor vehicles are poisonous. They must not be consumed and must be kept away from open wounds. These substances, among others, include anti-freeze, windscreen washer additives, lubricants and various adhesives.

CAPACITIES

The following capacity figures are approximate and provided as a guide only. All oil levels must be set using dipstick or filler plugs as applicable. Refer to Section 10 for correct checking procedure for oil levels.

Capacities (approx.)*	Litres	Imperial unit	US unit
Engine sump and filter from dry			
- petrol	6.66	11.7 pints	14.2 pints
- diesel - Tdi	7.00	12 pints	-
- diesel - VM	8.00	14 pints	-
Manual gearbox	2.67	4.7 pints	5.6 pints
Automatic gearbox	9.10	16 pints	20 pints
Transfer gearbox from dry	1.70	3.0 pints	3.6 pints
Front axle from dry	1.70	3.0 pints	3.6 pints
Front axle swivel pin housing (each)	0.35	0.6 pints	0.7 pints
Rear axle from dry	1.70	3.0 pints	3.6 pints
Power steering box and reservoir	2.90	5.0 pints	6.0 pints
Cooling system	11.40	20 pints	24 pints
Fuel tank	76.40	16.8 gallons	20 gallons
Fuel tank (91 model year onwards)	81.80	18 gallons	21.4 gallons

△ **NOTE: * All levels must be checked by dipstick or level plugs as applicable.**

When draining oil from the ZF automatic gearbox, oil will remain in the torque converter, refill to high level on dipstick only.

ANTI-FREEZE

ENGINE TYPE	MIXTURE STRENGTH	PERCENTAGE CONCENTRATION	PROTECTION LOWER TEMPERATURE LIMIT
V8 Engine VM Diesel Tdi Diesel	One part anti-freeze One part water	50%	
Complete protection Vehicle may be driven away immediately from cold			- 33°F - 36°C
Safe limit protection Coolant in mushy state. Engine may be started and driven away after warm-up period			- 41°C - 42°F
Lower protection Prevents frost damage to cylinder head, block and radiator. Thaw out before starting engine			- 47°C - 53°F

FUEL REQUIREMENTS

Catalyst vehicles

Vehicles equipped with catalytic converter are designed to use ONLY unleaded fuel. Unleaded fuel must be used for the emission control system to operate properly. Its use will also reduce spark plug fouling, exhaust system corrosion and engine oil deterioration.

Using fuel that contains lead will result in damage to the emission control system and could result in loss of warranty coverage. The effectiveness of the catalysts in the catalytic converters will be seriously impaired if leaded fuel is used. The vehicle is equipped with an electronic fuel injection system, which includes two oxygen sensors. Leaded fuel will damage the sensors, and will deteriorate the emission control system.

Regulations require that pumps delivering unleaded fuel be labelled **UNLEADED.** Only these pumps have nozzles which fit the filler neck of the vehicle fuel tank.

RECOMMENDED FUEL

Petrol engines

- with catalytic converter	unleaded only, 95 RON (USA 90 CLC or AKI)
- non catalytic, 9.35:1 compression ratio	leaded 97 RON/unleaded 95 RON
- non catalytic, 8.13:1 compression ratio	leaded 90 RON/unleaded 95 RON
- Australia	minimum 91 RON unleaded

Diesel engines

- 22,5:1 and 19,5:1 compression ratio	Diesel fuel oil, distillate, diesel fuel, automotive gas or Derv to British standard 2869, (1983) class A1 or A2.

Using fuel with an octane rating lower than stated above could seriously impair vehicle performance.

CAUTION: Do not use oxygenated fuels such as blends of methanol/ gasoline or ethanol/gasoline (e.g. 'Gasohol'). Take care not to spill fuel during refuelling.

Notes

10 - MAINTENANCE

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MAINTENANCE

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RECOMMENDED SERVICE ITEMS 27
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Notes

SERVICE SCHEDULE

The following section describes, in order, the service schedule procedure. Where required, instructions are given for carrying out each service procedure, or a cross reference is given, where the procedure can be found in this manual.
Intervals are shown in Kms x 1000/Miles x 1000 or months. For example **10/6** where **10** represents 10,000 kilometers and **6** represents 6,000 miles or 6 months

Check seat belts - 20/12

Check condition and security of seats, seat belt mountings, seat belts, buckles and opertion of inertia seat belts.

Check operation of foot brake and clutch - 20/12

If pedal feels 'spongy' bleed system. ***See BRAKES, Repair, Brake System Bleed (ABS) See BRAKES, Repair, brake system bleed*** or ***See CLUTCH, Repair, bleed hydraulic system***
Check all hoses and pipes for security, fractures and leaks. Fit new hoses and pipes as necessary.

Check operation of lamps - 20/12

Check operation of all lamps, horns and warning indicators.

Check operation of wipers - 20/12

Check operation of front/rear screen wipers and washers and condition of wiper blades.

Check security and operation of park brake - 10/6

The park brake should be fully operational on third notch of ratchet.

Check/adjust headlamp alignment - 20/12

Check/adjust headlamp and auxiliary alignment. ***See ELECTRICAL, Repair, Headlamp alignment***

Check headlamp levelling system - 20/12

Check system for correct operation.

Check/adjust front wheel alignment - 20/12

Use recognised wheel alignment equipment to perform this check and adjustment. ***See STEERING, Adjustment, front wheel alignment***

Remove wheels, check tyres - 10/6

Check tyres (including spare) for compliance with manufacturers' specification.

Check visually for cuts, lumps, bulges, uneven tread wear and tread depth. Check road wheels for damage.

Check/adjust tyre pressures.

Inspect brake pads for wear, calipers for leaks and condition - 10/6

Check thickness of brake pads, fit new pads if minimum thickness is less than 3,0 mm. Check brake pads for oil contamination. If new brake pads required. ***See BRAKES, Repair, front brake pads*** or ***See BRAKES, Repair, rear brake pads***

WARNING: When renewing brake pads, it is essential that only genuine components with correct grade of lining are used. Always fit new pads as complete axle sets, NEVER individually or as a single wheel set. Serious consequences could result from out of balance braking due to mixing of linings.

Refit road wheels - 10/6

Fit road wheels in original hub position. Secure in position with wheel nuts, do not fully tighten wheel nuts at this stage, lower vehicle and finally tighten wheel nuts to correct torque.

Alloy wheels: ***125 Nm.***

Steel wheels: ***110 Nm.***

Check operation of doors, bonnet and tailgate locks - 20/12

Lubricate all hinges, door check mechanisms, bonnet catches and fuel filler flap - 10/6

UNDER BONNET MAINTENANCE

Check cooling/heater systems - 20/12

Check cooling/heater systems for leaks and hoses for security and condition.

Cooling system hoses should be changed at first signs of deterioration.

Check brake servo hose for security and condition - 20/12

Check condition of heater plug wiring for fraying, chafing and deterioration - diesel only - 20/12

Check ignition wiring - 20/12

Check ignition wiring and high tension leads for fraying, chafing and deterioration.

Clean distributor cap - 20/12

The electronic ignition employs a Lucas 35DLM8 distributor.
Internal operating parts of distributor are pre-set at factory and do not normally require resetting.
Adjustments should only be made if unit is known to be faulty or damaged. Distributor maintenance consists of following items.

1. Clean outer surfaces of distributor cap to remove dirt, grease etc.
2. Unclip cap, check cap for cracks.
3. Wipe inside cap with lint free cloth.
4. Check rotor arm, cap and flash shield tracking.

   DO NOT DISTURB clear plastic insulating cover (flash shield) which protects magnetic pick-up module.

Lubricate distributor rotor spindle - 40/24

Apply a spot of clean engine oil into rotor spindle after rotor arm has been removed.

Clean/adjust - 10/6, renew - 20/12 spark plugs

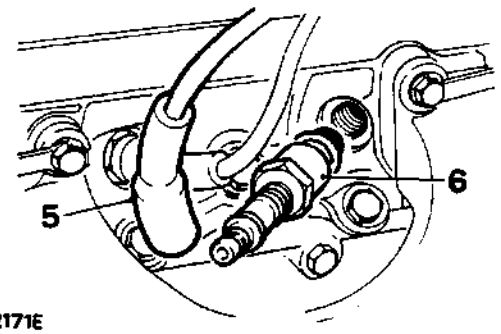
Spark plugs

Clean, adjust and renew

1. Take great care when fitting spark plugs not to cross-thread plug, otherwise costly damage to cylinder head will result.
2. Clean or replace spark plugs as applicable.
3. It is essential that correct type of spark plugs are fitted.
4. Incorrect grade of plugs may lead to piston overheating and engine failure.

Remove

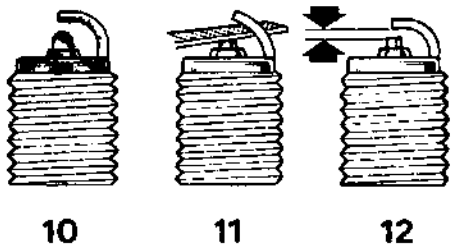
5. Disconnect the battery negative lead. Remove H.T. leads from spark plugs.
6. Remove plugs and washers.



RR2171E

Clean spark plugs

7. Fit plug into 14 mm adaptor of approved spark plug cleaning equipment. Wobble plug in adaptor with circular motion for three or four seconds only with abrasive blast in operation.
   Important: Excessive abrasive blasting will lead to severe erosion of insulator nose. Continue to wobble plug in adaptor with air only, blasting plug for a minimum of 30 seconds: this will remove abrasive grit from plug cavity.
8. Wire-brush plug threads; open gap slightly, and vigorously file electrode sparking surfaces using a point file. This operation is important to ensure correct plug operation by squaring electrode sparking surfaces.
9. Set electrode gap to recommended clearance.
10. Shows dirty plug.
11. Filing plug electrodes.
12. Clean plug, set to correct gap: 0.84 to 0.96mm.

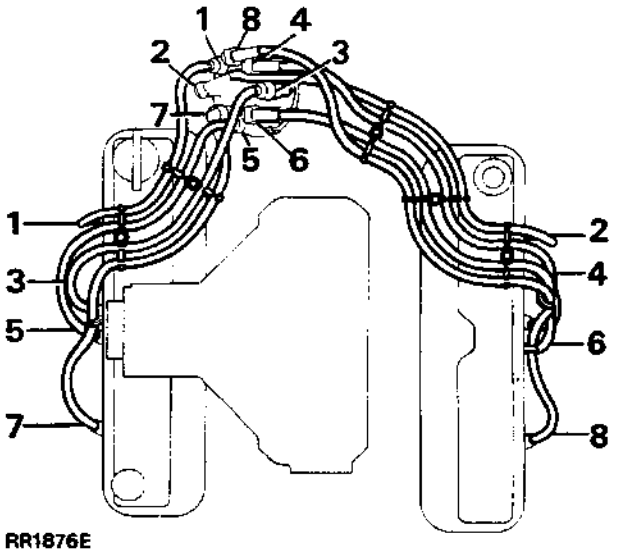


RR740M

13. Test plugs in accordance with plug cleaning machine manufacturer's recommendations.
14. Satisfactory plugs can be refitted.
15. When pushing leads onto plugs, ensure that shrouds are firmly seated.

Fitting H.T. leads

16. Ensure replacement H.T. leads are correctly refitted as illustrated.
    Failure to observe this instruction may result in cross-firing between two closely fitted leads which are consecutive in firing order.



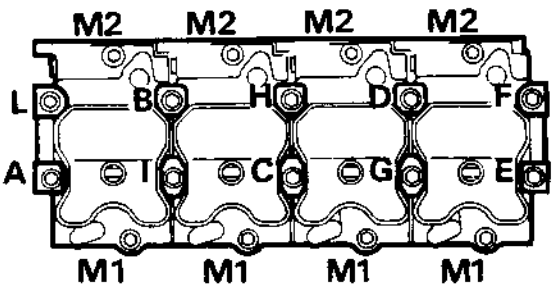
RR1876E

Retorque cylinder heads-diesel

First 40,000Km (24,000 miles) service

△ **NOTE: These instructions must be carried out at the first 40,000 km (24,000 miles) service.**

1. Centre bolts: without slackening bolts, start with bolt A, tighten each bolt in sequence shown through 10 - 15°.
2. Side bolts: Without slackening bolts check that torque of each bolt is ***85 - 90 Nm.*** (First M1 then M2).



RR3804M

Check diesel injectors for correct spray pattern - 40/24

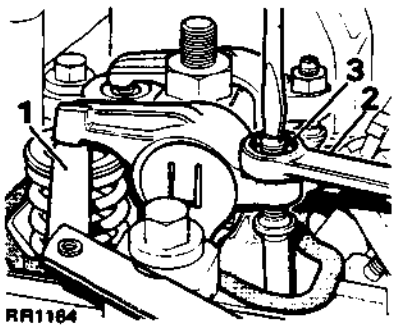
Check/adjust valve clearances, - diesel - 40/24

Remove rocker cover
Remove centre retaining bolts and remove rocker covers for each cylinder, taking care not to lose seals from top of rocker cover.

Tappet adjustment - Fig. RR1164
Tappet clearance engine cold:
Inlet and exhaust 0,30 mm.

Check and adjust tappets
Turn engine over until number 1 valve (counting from front of engine) is fully open.

Using a 0,30 mm feeler gauge (1) check clearance between valve tip and rocker pad of number 7 valve.



RR1164

Adjust clearance by slackening lock nut (2) and turning adjusting screw (3) clockwise to reduce clearance and anti-clockwise to increase clearance. Recheck clearance after tightening lock nut.

Continue to check and adjust remaining tappets in following sequence:

With No.1 valve fully open adjust No.7 valve.
With No.8 valve fully open adjust No.2 valve.
With No.5 valve fully open adjust No.3 valve.
With No.4 valve fully open adjust No.6 valve.
With No.7 valve fully open adjust No.1 valve.
With No.2 valve fully open adjust No.8 valve.
With No.3 valve fully open adjust No.5 valve.
With No.6 valve fully open adjust No.4 valve.

Refitting rocker covers
Clean rocker cover gasket seating face.

Inspect rocker cover gaskets, renew if damaged.

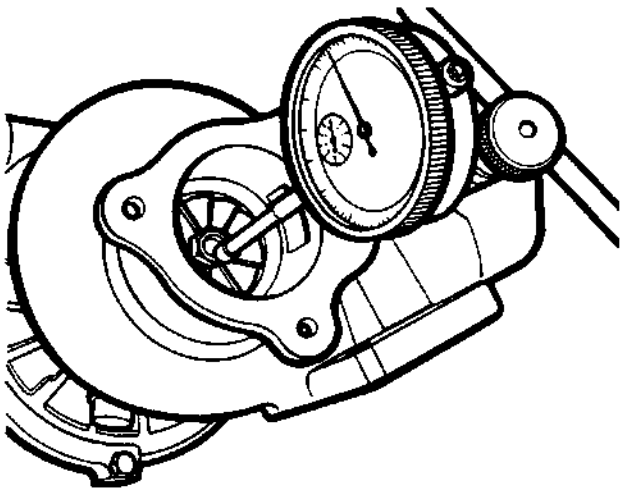
Position rocker cover with oil filler cap on No.1 cylinder, and rocker cover with breather pipe to No.3 cylinder

Check that collars and seals are located on top of rocker covers. Fit rocker covers and tighten retaining bolts.

Check turbocharger impellor shaft axial and radial clearances - diesel - 100/60

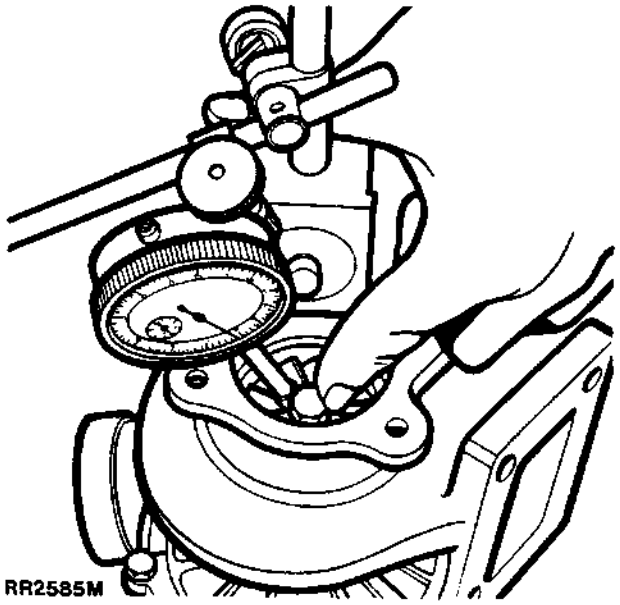
Axial clearance

Use a dial test gauge as shown in RR2584M. Set gauge to zero on turbine wheel. By moving shaft in a linear motion the axial clearance may be established. Maximum axial clearance is 0,15 mm.


RR2584M

Radial clearance

Use a dial test gauge as shown in RR2585M. Push turbine wheel to the extreme side position and set dial test gauge to zero. Check side clearance of turbine shaft by observing total radial movement. Maximum radial clearance is 0,42 mm.



RR2585M

Renew fuel filter element - diesel - 10/6

Drain off water and sediment

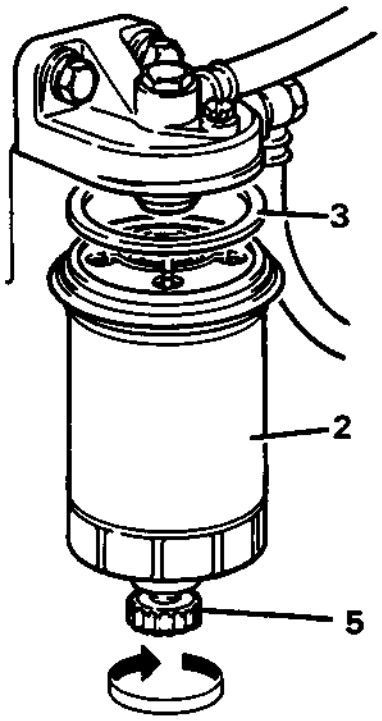
⚠ **CAUTION: It is essential that any water and sediment in fuel filter is drained off, as water in fuel can result in damage to injection pump.**

1. Hold a small receptacle beneath drain cock. Unscrew the drain cock half a turn, (item 5 RR3700M).
2. Drain off water and sediment.
3. Tighten the drain cock immediately fuel starts to flow from drain cock.

△ **NOTE: Any delay in tightening drain cock when fuel starts to flow could possibly mean bleeding fuel system.**

Renew fuel filter element

1. Clean area around filter, place a container beneath.
2. Unscrew filter, a quantity of fuel will be released, and discard filter. A hexagon on base of filter allows use of a spanner.



RR3700M

3. Wet seal of new filter with fuel.
4. Screw new filter into position, tighten using a spanner.
5. Ensure that drain cock at bottom of filter is securely tightened.

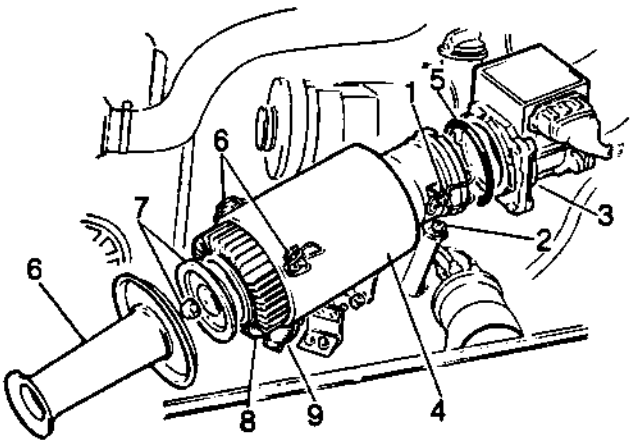
Check positive crankcase ventilation (pcv) system for leaks and hoses for security and condition - V8 - 20/12

Renew air cleaner element - 20/12

Air cleaner element - V8

Remove

1. Release two clips securing air cleaner to airflow sensor.
2. Release two nuts and bolts securing air cleaner to mounting bracket.
3. Detach airflow sensor from air cleaner, place carefully to one side.
4. Detach air cleaner from centre mounting bracket and withdraw from engine compartment.
5. Remove large 'O' ring from outlet tube of air cleaner, inspect and fit a new 'O' ring if necessary.
6. Unclip three catches and remove inlet tube.
7. Remove nut and end plate securing air cleaner element.
8. Withdraw air cleaner element and discard.
9. Inspect dump valve for condition, check it is clear of obstructions.



RR1854E

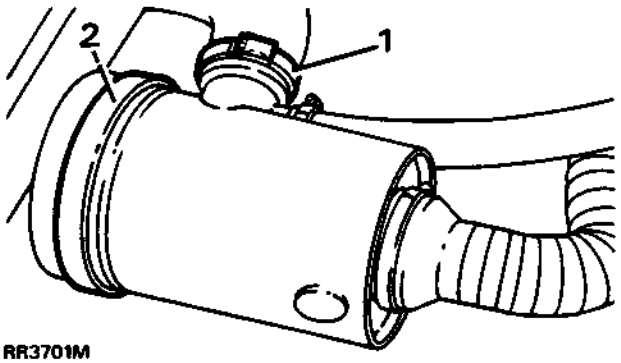
Refit

10. Fit new element, secure in position.
11. Refit inlet tube to air cleaner canister.
12. Refit air cleaner to mounting bracket, tighten two nuts and bolts.
13. Clip air flow sensor to air cleaner.

Renew air cleaner element - diesel - 20/12

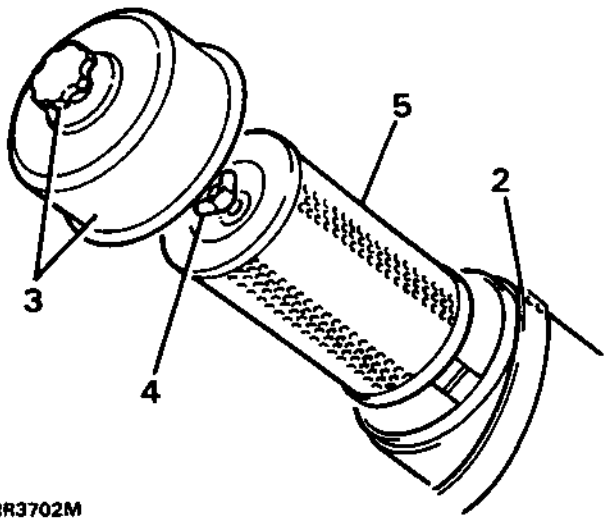
Remove

1. Disconnect hose from air cleaner.
2. Release retaining strap, lift up air cleaner assembly.



RR3701M

3. Unscrew knob, remove end cover from air cleaner casing.
4. Remove wing nut.
5. Remove element, wipe clean casing and cover.



RR3702M

Refit

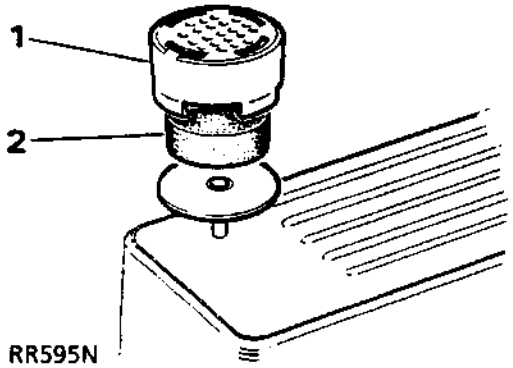
6. Fit new element, secure in position.
7. Reverse removal procedure

Check air cleaner dump valve clean or renew - 20/12

Squeeze open dump valve and check that interior is clean. Also, check that rubber is flexible and in good condition. If necessary, remove dump valve to clean interior. Fit a new valve if in poor condition

Renew engine crankcase intake filter - V8 - 40/24

1. Pry filter holder upwards to release it from rocker cover.
2. Discard sponge filter.

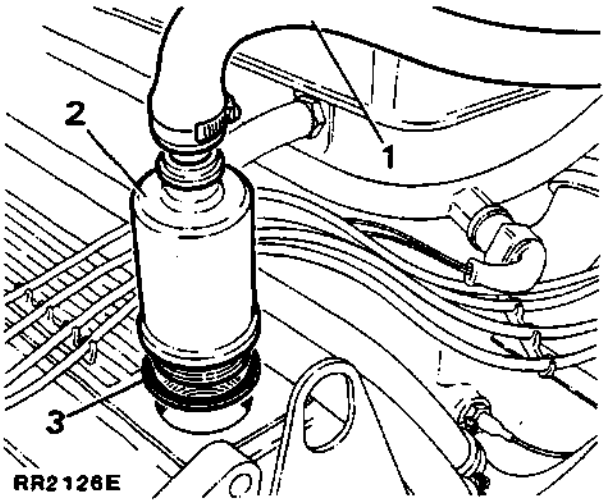


Fit new filter

1. Insert new filter into plastic body.
2. Push filter holder onto rocker cover until it clips firmly into place.

Clean engine breather filter - V8 - 20/12

1. Release hose clamp and pull hose off canister.
2. Unscrew canister and remove it from rocker cover.
3. Remove large 'O' ring from threaded end of canister.
4. Visually inspect condition of wire screen within canister, if in poor condition fit new assembly, if in acceptable condition clean screen as follows:
5. Immerse canister in small amount of solvent and allow solvent to dissolve and loosen any debris.
6. Remove canister from solvent and dry in still air.



WARNING: Do not use compressed air line to remove remaining solvent or debris in canister, this could cause fire or personal injury.

Refitting breather/filter

7. Fit new 'O' ring.
8. Screw canister into rocker cover, hand tight only.
9. Refit hose, tighten clamp securely.

Clean plenum chamber ventilation passageway - V8 - 40/24

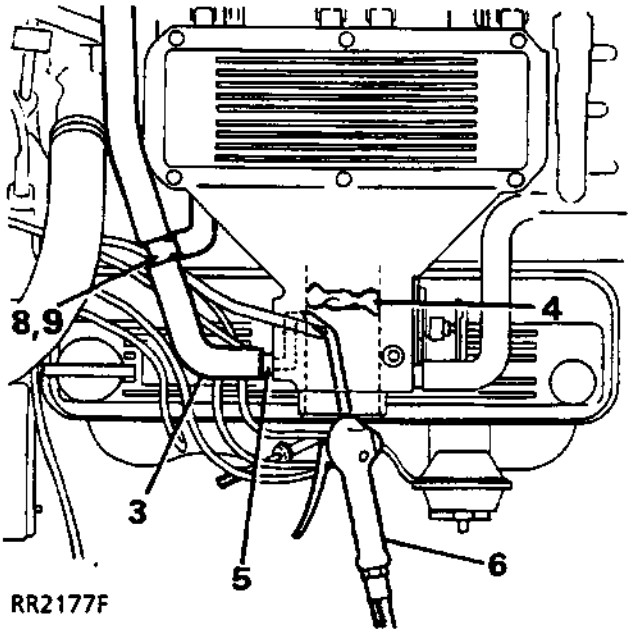
Cleaning plenum chamber ventilation passageway can be carried out without removing plenum chamber from ram housing.

CAUTION: Care must be taken to prevent debris from passageway passing beyond throttle butterfly disc.

WARNING: Safety glasses must be worn when performing this operation. Ensure that debris is not blown into atmosphere which could be harmful to other persons close by.

1. Disconnect the battery negative lead.
2. Release hose clamp and remove hose from plenum chamber inlet.

3. Remove crankcase ventilation hose from side of plenum chamber.
4. Insert a piece of lint free cloth down throttle butterfly bore to prevent debris passing throttle butterfly.
5. Place a cloth over tube protruding from side of plenum from which ventilation hose was removed to prevent debris from passageway being blown into atmosphere.



RR2177F

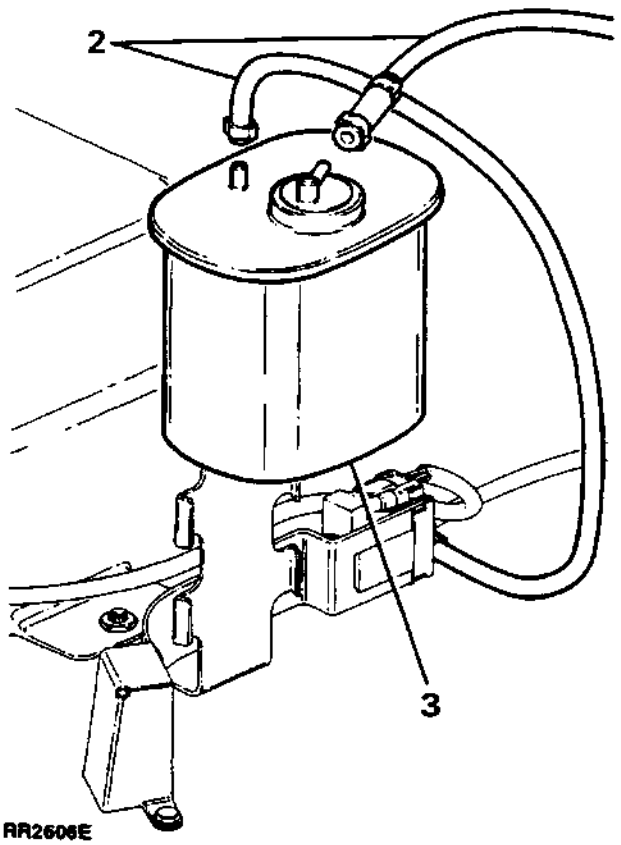
6. Use a compressed air line with a slim bent nozzle to enable passageway to be cleaned out from within throttle butterfly bore.
7. Any remaining matter can be dislodged using soft bent wire or pipe cleaner. Finally blow out passageway again to remove remaining debris.
8. Remove small 'T' piece between crankcase ventilation hoses and check it is free from blockages, clean as necessary.
9. Refit 'T' piece and hoses, tighten hose clamps securely.

Renew charcoal canister - V8 - 80/48

Charcoal canister

Remove

1. Disconnect the battery negative lead.
2. Disconnect both purge lines.
3. Release canister from mounting braket.



RR2606E

Refit

4. Reverse removal procedure, ensuring canister is securely located in mounting bracket and both purge lines are fitted correctly to canister.

WARNING: DO NOT use compressed air to clean charcoal canister or to clear a blockage in evaporative system. Explosive gas present in a fully saturated canister may be ignited by heat generated when compressed air passes through canister.

Check condition - adjust - renew drive belts - V8 - 10/6

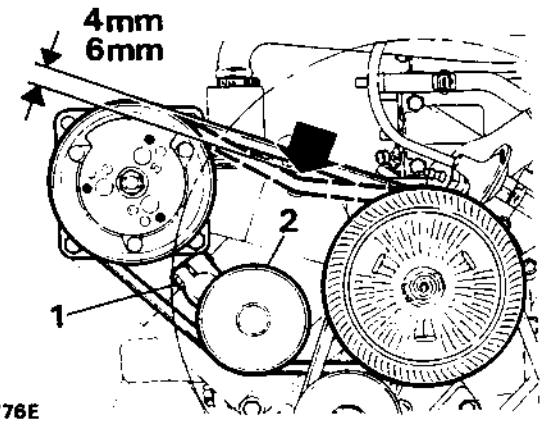
WARNING: Disconnect battery negative terminal before adjusting drive belts to avoid possibility of vehicle being started.

Compressor drive belt

Belt must be tight with not more than 4 to 6mm total deflection when checked by hand midway between pulleys on longest run.

Where belt has stretched beyond limits, a noisy whine or knock will often be evident during operating, adjust as follows:

1. Loosen idler pulley securing bolt.
2. Adjust position of idler pulley until correct tension is obtained.
3. Tighten securing bolt and recheck belt tension.



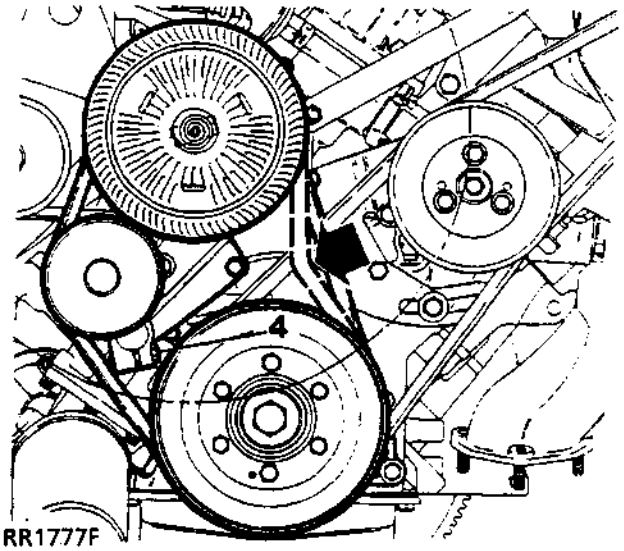
RR1776E

Check driving belts, adjust or fit new belts as necessary.

4. Examine following belts for wear and condition, fit new belts if necessary:

   (A) Crankshaft-Idler pulley-Water Pump
   (B) Crankshaft-Steering Pump
   (C) Steering Pump-Alternator

Illustration A



RR1777F

Illustration B

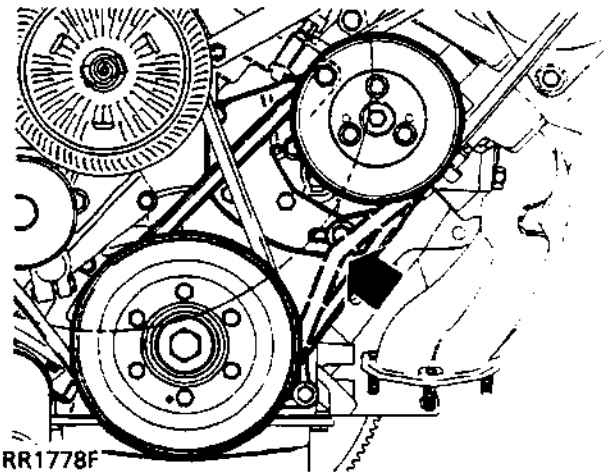
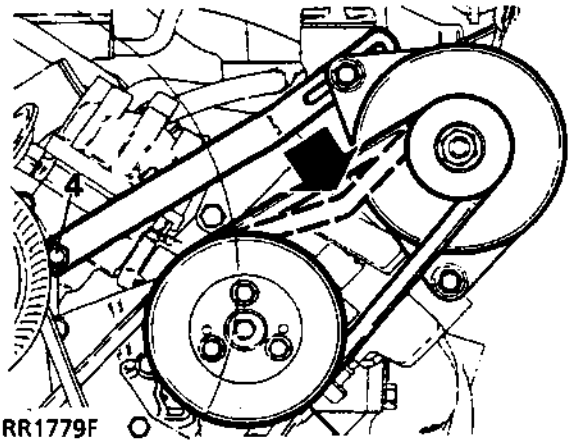

RR1778F

Illustration C



RR1779F

1. Each belt should be sufficiently tight to drive appropriate auxiliary without undue load on bearings.
2. Loosen bolts securing unit to its mounting bracket.
3. Loosen appropriate pivot bolt or idler pulley and fixing at adjustment link where applicable.
4. Pivot unit inwards or outwards as necessary and adjust until correct belt tension is obtained.

CAUTION: When tensioning power steering pump drive belt DO NOT use pump casing as a point of leverage. Failure to comply may result in damage to pump casing and distortion to seal face causing fluid leakage.

5. Belt deflection should be approximately 4 to 6mm at points denoted by bold arrows.
6. Tighten all unit adjusting bolts. Check adjustment again.

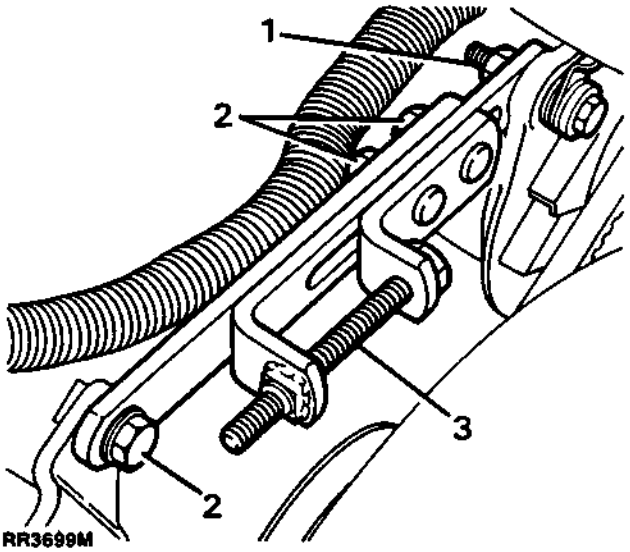
CAUTION: When fitting a new drive belt, tension belt as described above. Reconnect battery and start and run engine for 3 to 5 minutes at fast idle, after which time belt must be re-checked, re-tension belt if necessary.

Alternator drive belt/power steering belt - vehicles after VIN 602813

Adjust

NOTE: A positive drive tensioner is fitted to these vehicles to provide greater accuracy when setting power steering and alternator drive belts. The tensioner eliminates the need to lever both power steering pump and alternator when adjusting belt tension.

1. Loosen alternator pivot bolt and bolt securing alternator to tensioner.
2. Loosen two tensioner nuts and bolt securing tensioner to water pump bracket.
3. Rotate tensioner lead screw anti-clockwise, remove drive belt.
4. Loosen power steering pump adjuster bolt and pump pivot nuts.
5. Remove power steering belt.



6. Ensure pump is free to rotate on its mounting, DO NOT lever pump, further loosen fixings if necessary.
7. Check both drive belts, renew if necessary.
8. Fit power steering and alternator drive belts.
9. Rotate tensioner lead screw clockwise until alternator belt is tensioned to specified figure, see table.
10. Check steering belt is tensioned to specified figure.
11. Tighten all fixings on tensioner, steering pump and alternator.
12. Run engine at fast idle speed for 3 to 5 minutes if a new belt has been fitted. Repeat above steps 1 to 6 and 9 to 11 without removing belts.
13. Adjust position of top radiator hose to give 20 to 30 mm clearance between hose and alternator fan guard.

Belt tension

Fitting alternator or steering belt

Tension or retension belts to:

Alternator	Steering
110 - 120 lbf	85 - 105 lbf
470 - 500 N	380 - 465 N

Refitting used belts

90 - 95 lbf	75 - 95 lbf
400 - 420 N	335 - 420 N

Check drive belts diesel - adjust or renew

Right-hand steering - Fig. RR1162

Left-hand steering - Fig. RR1163

WARNING: Disconnect battery to prevent any possibility of starter motor being operated.

The procedure for checking and adjusting all drive belts is similar.

1. Alternator
2. Air conditioning compressor (option),
3. Power steering pump

Examine all belts for wear and renew if necessary.

NOTE: Any marks on outside of air conditioning drive belt, caused by belt slipper bracket, can be ignored.

Using a recognised drive belt tensioning gauge, check tension of each drive belt, at mid-point between pulleys on longest side of belt.

Adjust belt tensions as follows:-

'V' type drive belts:-
12,7mm wide belts ..... 45N ..... 95 lbf

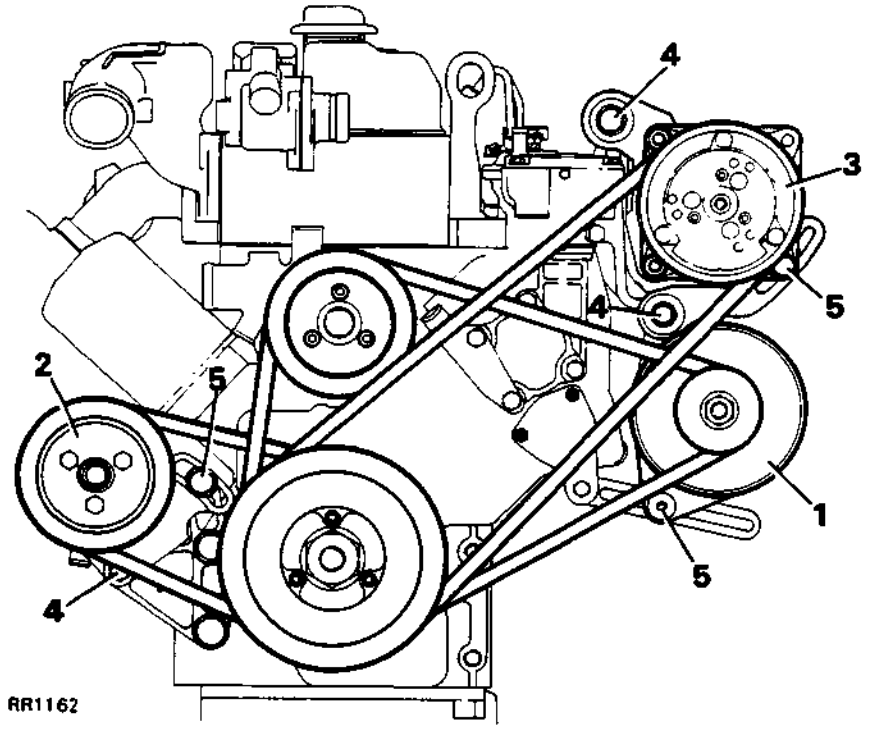
Poly 'V' drive belts:-
Power steering pump ..... 40N ..... 90 lbf
Alternator/water pump..... 49N ..... 110 lbf

"In field" Tensioning - No gauge available

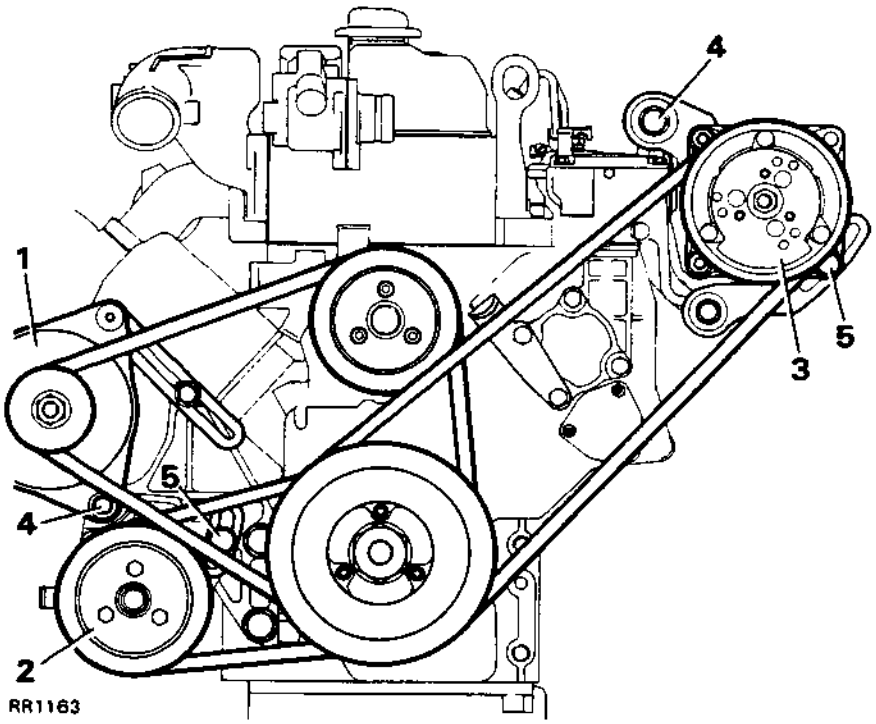
Use normal hand pressure to check deflection, tension belt to give a deflection of 0,5 mm per 25 mm of belt run between belt centres.

If any of drive belts require adjustment, slacken applicable pivot bolt (4) and adjusting bracket nut and screw (5), pull driven unit away from engine until belt is tight. Tighten adjusting bracket, tighten pivot bolt. Check belt tension and readjust if necessary.

CAUTION: When fitting a new drive belt, tension belt as described above. Reconnect battery, start engine and run for 3 to 5 minutes at fast idle, after which time belt must be re-checked. Retension belt if necessary.



Right hand steering



Left hand steering

Check throttle and automatic transmission cable operation - 20/12

Check/top up automatic transmission fluid level - 10/6 (not 40/24)

NOTE: Transmission fluid level is checked when fluid is cold with engine idling in neutral.

1. Ensure vehicle is on level ground.
2. Check fluid level registers between MAX and MIN marking on dipstick.

Check/top up engine oil - V8 - 10/6 then each 20/12 after

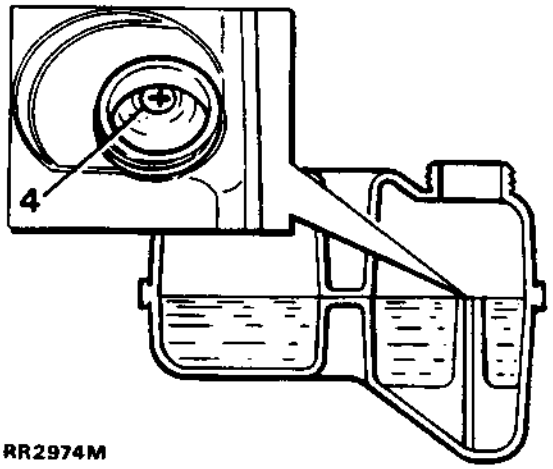
1. Ensure vehicle is on level ground. Allow oil to drain back into sump.
2. Remove dipstick, wipe clean, reinsert to full depth.
3. Remove dipstick, check oil level.
4. Add oil as necessary.

Check/top up cooling system - 10/6

1. To prevent corrosion of aluminium alloy engine parts it is imperative that cooling system is filled with a solution of water and phosphate free anti-freeze, winter or summer. Never fill or top up with plain water.

WARNING: Do not remove filler cap when engine is hot because cooling system is pressurised and personal scalding could result.

2. When removing filler cap, turn cap slowly anti-clockwise, pause and allow all pressure to escape.
3. Continue to turn until cap is removed.
4. When engine is cold, expansion tank coolant should be level with top of indicator post, visible inside tank through filler hole.
5. If necessary, top up cooling system with premixed coolant. Use soft water whenever possible, if local water supply is hard, rainwater should be used.



RR2974M

6. When replacing filler cap it is important that it is tightened down fully. Failure to tighten filler cap properly may result in water loss, with possible damage to engine

The cooling system should be drained and flushed at 2 year intervals or at onset of second winter. Refer to Coolant Requirements. ***See COOLING SYSTEM, Adjustment, Coolant Requirements***

Top up power steering fluid reservoir - 10/6

1. Remove fluid reservoir cap. Check that fluid is up to high mark on dipstick.

Top up clutch and brake reservoirs - 10/6

Brake fluid absorbs water and in time boiling point of fluid will be lowered sufficiently to cause fluid to be vapourised by heat generated when vehicle brakes are applied.
This will result in loss of braking efficiency or in extreme cases brake failure.
Therefore, all fluid in brake system should be changed at service intervals quoted in recommended maintenance schedules.

Fluid should also be changed before touring in mountainous areas if not changed in previous nine months.

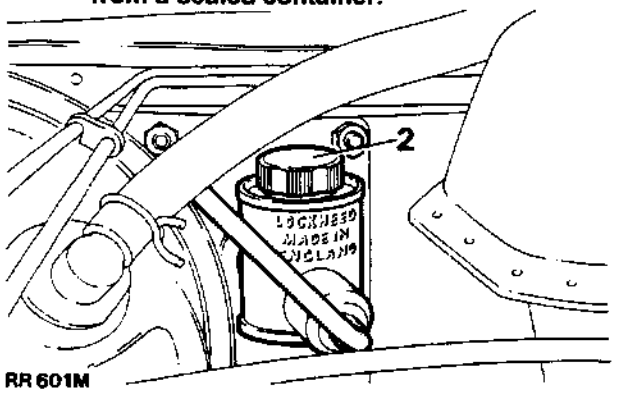
Care must be taken always to observe following points:

(a) At all times use recommended brake fluid.
(b) Never leave fluid in unsealed containers as it absorbs moisture quickly and can be dangerous if used in braking system in this condition.
(c) Fluid drained from system or used for bleeding should be discarded.
(d) The necessity for absolute cleanliness throughout cannot be over emphasised.

Check/top up clutch fluid reservoir

1. Park vehicle on level ground.
2. Remove cap, if necessary top up to bottom of filler neck using correct fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids - All climates and conditions***

WARNING: Clean reservoir body and filler cap before removing cap. Use only fluid from a sealed container.

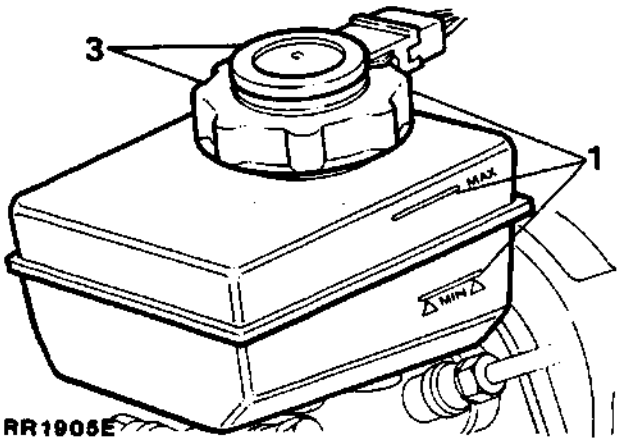


RR 601M

Check/top up brake fluid reservoir - Lucas Girling master cylinder

1. Visually check brake fluid level against 'MIN' and 'MAX' level markings.
2. If necessary top up using correct grade of fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids - All climates and conditions DO NOT OVERFILL***
3. Release cap with combined fluid level switch by rotating anti-clockwise. Withdraw cap and switch, top up reservoir.

CAUTION: Brake fluid can damage paintwork. If spillage occurs, wash affected area IMMEDIATELY with a large quantity of water.



RR1905E

Check/top up ABS brake fluid reservoir

1. Park vehicle on level ground.
2. Turn ignition ON, to activate hydraulic pump. If pump does not activate depress brake pedal several times until it is heard to operate.
3. When pump stops, check that level is between 'MIN' and 'MAX' marks.
4. If level is below 'MIN' mark on reservoir, top-up using correct fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids - All climates and conditions***

WARNING: Clean reservoir body and filler cap before removing cap. Use only fluid from a sealed container.

Check/top up washer reservoir - 10/6

Top up washer reservoir to within 25 mm of bottom of filler neck. Use a screen washer solvent/anti-freeze solution to assist removing mud, flies and road film and protect against freezing.

Lubricate accelerator control linkages and pedal pivot - 20/12

Check ignition timing - 10/6

Check/adjust ignition timing. ***See ELECTRICAL, Adjustment, ignition timing***

Check engine idle speed - diesel - 20/12

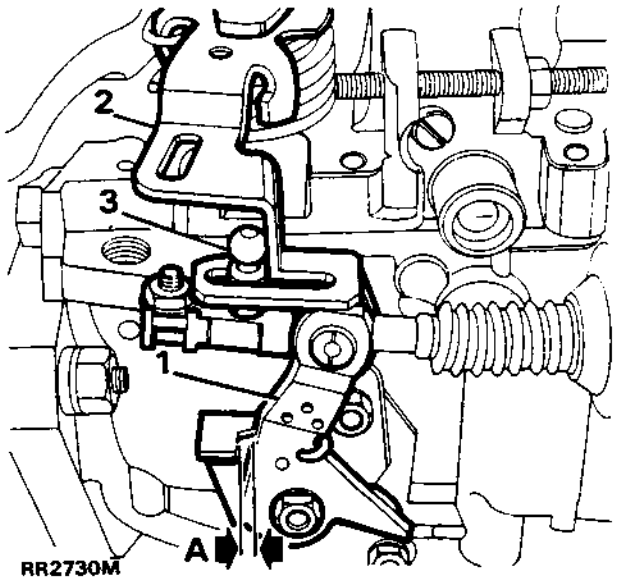
Check/adjust engine cold idle speed, visually check for excessive exhaust smoke.

Check - adjust fast idle setting.

△ **NOTE: It is important that these checks are carried-out when engine is warm - coolant above 40°C.**

Fast idle adjustment

1. Dimension 'A' should be 4.5 mm. Adjust lever inserting a 4.5 mm distance piece into gap to hold this dimension.
2. Move accelerator lever to achieve engine speed 1000 to 1100 rev/min (no load).
3. Release and move lever stop until it rests against stop tab on accelerator lever. Retighten lever stop. Remove distance piece.



RR2730M

Check/adjust steering box - 60/36

Check steering box for fluid leaks.

Check that there is no backlash in steering box in straight ahead position. Adjust steering box if necessary. ***See STEERING, Adjustment, Power steering box***

Clean battery connections - 20/12

Remove battery terminals, clean and coat with petroleum jelly.

⚠ **WARNING: Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames or sparks are brought near battery. When charging or using battery in an enclosed space, always provide ventilation and shield your eyes.**

Batteries contain sulphuric acid. Avoid contact with skin, eyes, or clothing. Wear eye protection to protect against acid splashes. If acid contacts skin, eyes, or clothing, flush immediately with water for fifteen minutes. If acid is swallowed, drink large quantities of milk or water. SEEK MEDICAL AID IMMEDIATELY.

A low maintenance battery is installed in vehicle. Dependent upon climate conditions electrolyte levels should be checked as follows:

Temperate climates every three years.
Hot climates every year.

The exterior of battery should be occasionally wiped clean to remove any dirt or grease.

Periodically remove battery terminals to clean and coat with petroleum jelly.

△ **NOTE: If a new battery is fitted to vehicle it should be same type as fitted to vehicle when new. Alternative batteries may vary in size and terminal positions and this could be a possible fire hazard if terminals or leads come into contact with battery clamp assembly. When fitting a new battery ensure that terminals and leads are clear of battery clamp assembly.**

Check intercooler - diesel - 20/12

Visually check intercooler for external obstructions

Clean intercooler element - diesel - 80/48

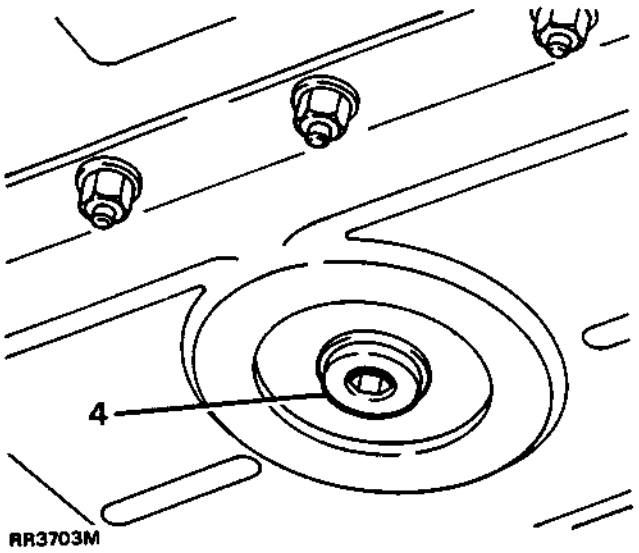
UNDER VEHICLE MAINTENANCE

This section covers renewal of lubricating oils for vehicle major units and other components requiring lubrication, as detailed in Service Schedule. Refer to Section 09 for Capacities and Recommended Lubricants.
Vehicles operating under severe conditions of dust, sand, mud and water should have oils changed and lubrication carried out at more frequent intervals than is recommended in maintenance schedules.
Draining of used oil should take place when oil is warm. Always clean drain and filler-level plugs before removing. Disconnect vehicle battery to prevent engine being started and vehicle being moved inadvertently, while oil changing is taking place.
Allow oil to drain completely, except where blown sand or dirt can enter drain holes. In these conditions clean and refit drain plugs immediately main bulk of oil has drained.
Always refill with oil of make and specification recommended in lubrication charts and from sealed containers.

Renew engine oil and filter - diesel - 10/6

Draining oil

1. Before changing oil ensure that vehicle is level on either ramp or ground.
2. Run engine to warm oil, switch off ignition and disconnect battery.
3. Place drain tray of at least 7 litres under drain plug.

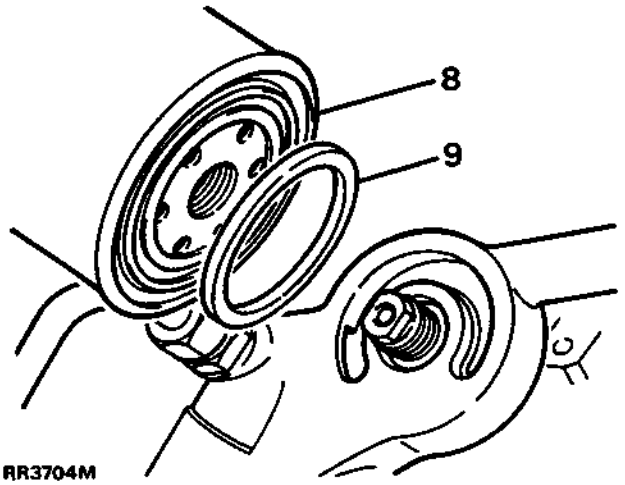


RR3703M

4. Remove drain plug from sump. Allow oil to drain completely.
5. Fit new sealing washer, replace plug. Tighten to ***79 Nm.***

Fit new oil filter

6. Loosen clip and disconnect air intake hose from turbo-charger.
7. Clean area around filter, place a container beneath engine.
8. Unscrew oil filter cartridge and discard.



RR3704M

9. Coat seal of new oil filter with engine oil.
10. Screw new filter into position, using hand force only.
11. Refit air intake hose to turbo-charger, tighten clip.
12. Fill engine with correct quantity of new oil, check level.
13. Run engine at idle and check for leaks.

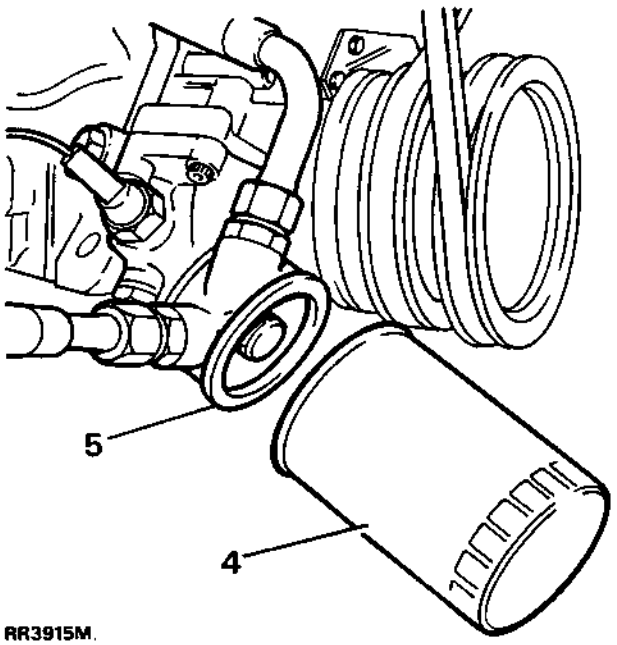
⚠ **CAUTION: Serious damage to the turbocharger will result if engine is run above idling speed before oil pressure is restored.**

14. Stop engine, wait a few minutes, check oil level and top-up if necessary.

Renew engine oil and filter - V8 - 20/12

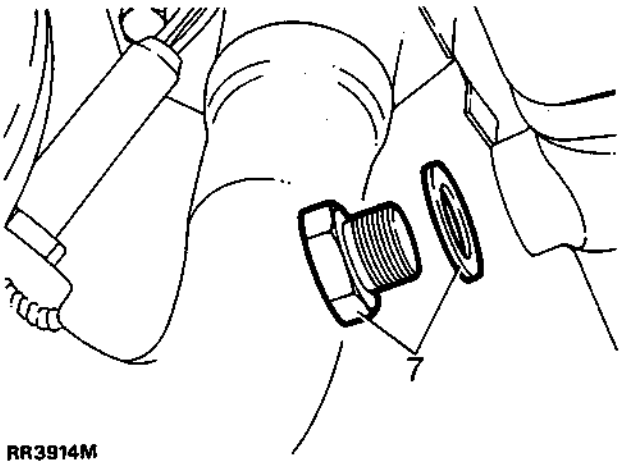
1. Before changing oil ensure that vehicle is level on either ramp or ground.
2. Run engine to warm oil; switch off ignition and disconnect battery.
3. Remove engine undertray if fitted. ***See CHASSIS AND BODY, Repair, engine undertray*** Place an oil tray under engine.

⚠ **CAUTION: To prevent an airlock occurring after removing filter, fill new filter with oil and fit immediately after removing old filter. If airlock does occur fill oil pump with petroleum jelly.** ***See ENGINE, Overhaul, Remove and Overhaul oil pump***



RR3915M

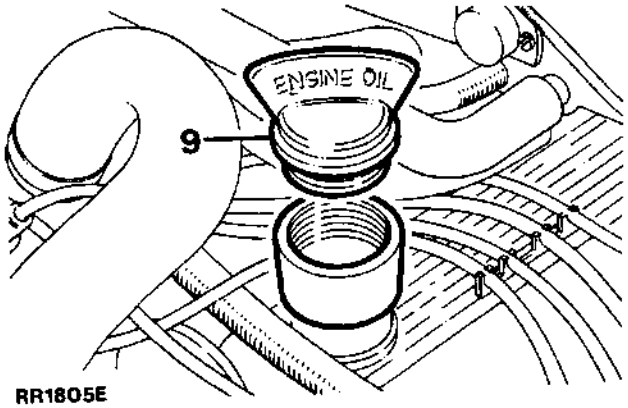
4. Unscrew filter anti-clockwise.
5. Clean oil cooler adaptor mating face and coat rubber washer of new filter with clean engine oil. Fill filter with new engine oil. Screw filter on clockwise until rubber sealing ring touches machined face, tighten a further half turn by hand only. **DO NOT** overtighten.
6. Place oil tray under drain plug.
7. Remove drain plug from sump. Allow oil to drain completely. Fit new copper washer. Refit plug, tighten to ***45 Nm.***



RR3914M

Refill sump with oil

8. Check that drain plug is tight.
9. Clean outside of oil filler cap, remove it from extension filler neck and clean inside.

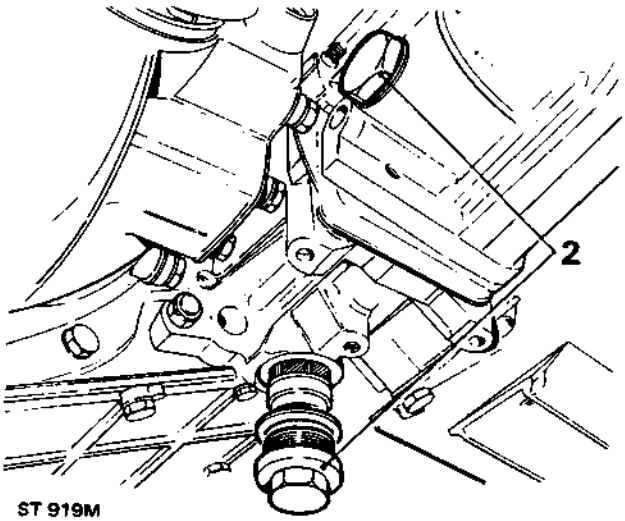


RR1805E

10. Pour in correct quantity of new oil of correct grade from a sealed container to high mark on dipstick and firmly replace filler cap. **DO NOT FILL ABOVE 'HIGH' MARK.** Reconnect battery.
11. Run engine and check for leaks from filter. Stop engine, allow oil to run back into sump for a few minutes, check oil level again and top up if necessary.

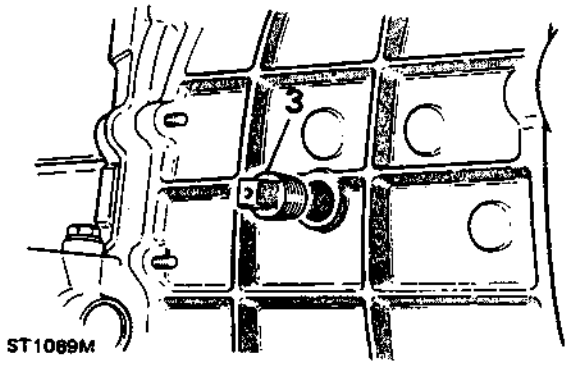
Renew manual gearbox oil - 40/24

1. Place vehicle on ramp or level ground. Place suitable container to drain gearbox oil. Disconnect battery.
2. Remove gearbox and extension case drain plugs and allow oil to drain completely. Wash extension case filter in kerosene and refit plugs with new washers. Tighten extension case plug to ***75 Nm, gearbox plug to 45 Nm.***



ST 919M

3. Remove oil filler level plug and inject new oil into the gearbox until it runs out of filler hole. Fit and tighten plug to ***30 Nm.***



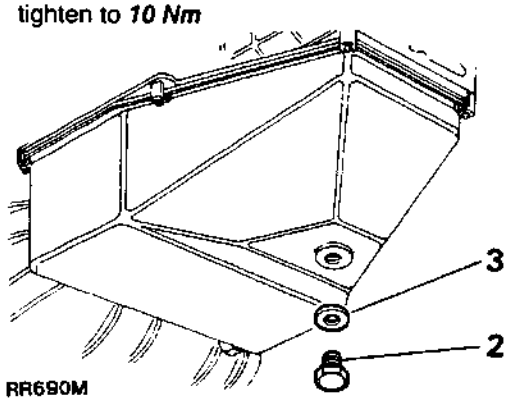
ST1089M

Check/top up manual gearbox oil - 10/6

1. Place vehicle on ramp or level ground.
2. Remove oil filler level plug. If necessary, inject new oil into the gearbox until it runs out of filler hole. Fit and tighten plug to ***30 Nm.***

Renew automatic gearbox fluid and oil screen - 40/24

1. Place vehicle on either ramp or level ground. Place suitable container to drain gearbox fluid. Disconnect battery.
2. Remove gearbox dipstick, located at rear of right hand rocker cover, to aid oil drainage. Release plug from bottom of sump and allow fluid to drain completely.
3. Refit plug using a new sealing washer and tighten to ***10 Nm***

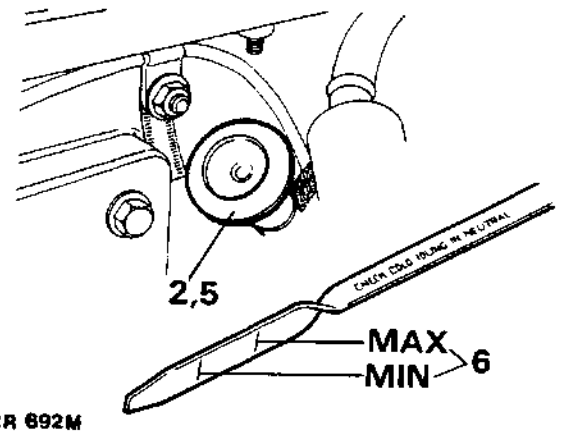


RR690M

Refill ZF automatic gearbox and check fluid level.

△ **NOTE: The fluid level must checked when fluid is cold and engine idling in neutral gear.**

4. Ensure vehicle is on level ground.
5. Refill or top-up with correct quantity and grade of fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
6. Reconnect battery, start and run engine. Check fluid level, this must be between two markings on the dipstick.



RR 692M

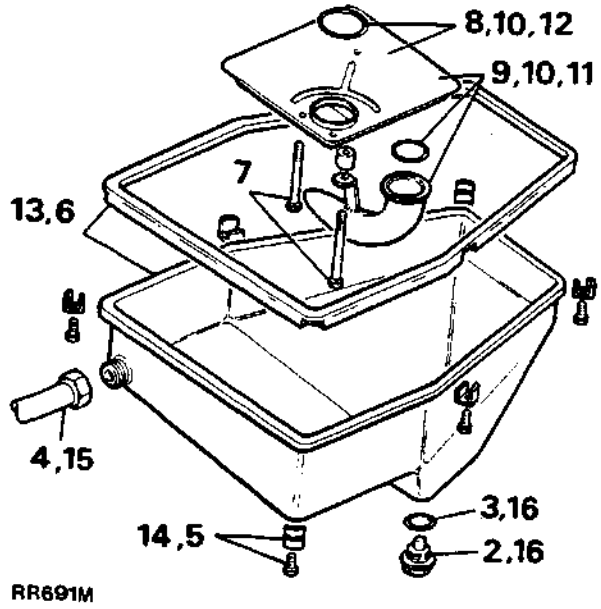
Oil screen replacement ZF automatic gearbox

Remove

1. Place vehicle on ramp or over pit, disconnect battery lead.
2. Drain gearbox using a suitable container.
3. Discard sealing ring.
4. Remove filler/level tube from oil pan.
5. Remove six retaining plates and bolts.
6. Remove oil pan, discard gasket.
7. Using TX27 Torx bit remove three screws securing oil screen.
8. Remove oil screen, discard 'O' rings.
9. Separate oil screen from suction tube, discard 'O' ring and oil screen.

Refit

10. Fit two new 'O' rings to oil screen using a light grease to ease assembly.
11. Fit suction tube to oil screen.



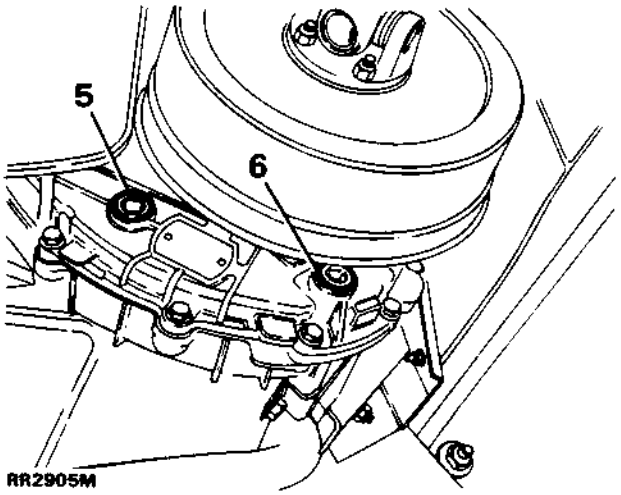
12. Fit oil screen to control unit, fit and tighten three bolts to ***8 Nm.***
13. Refit oil pan using new gasket.
14. Secure using six retaining plates and bolts (two straight and corner plates), tighten to ***8 Nm.***
15. Reconnect oil level/filler tube.
16. Fit oil pan plug and new seal.
17. Reconnect the battery negative lead.
18. Fill gearbox with correct oil through filler/level tube located within engine bay. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
19. Check oil level while engine is running at idle with neutral selected.

Renew transfer gearbox oil - 40/24

1. Before renewing oil ensure that vehicle is level, either on a ramp or on ground.
2. Disconnect the battery negative lead.
3. Clean immediate area around filler/level and drain plugs.

WARNING: When draining gearbox care should be taken to ensure that oil is not hot as personal scalding could result.

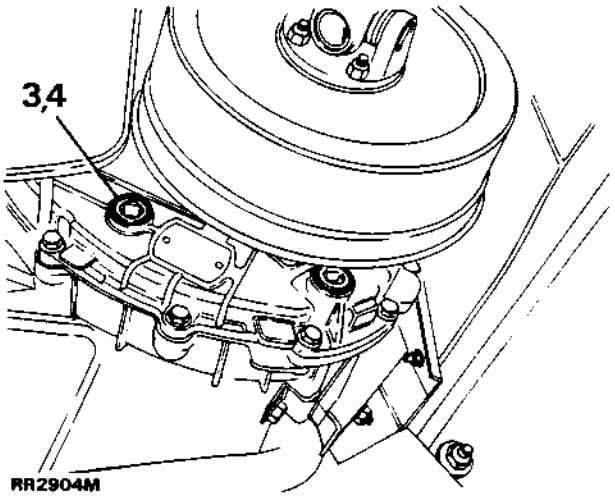
4. Place a container under gearbox to drain oil into.
5. Remove filler/level plug to vent gearbox and assist draining.
6. Remove drain plug and allow oil to drain.



7. Thoroughly clean drain plug threads prior to applying fresh 'Hylomar' sealant. Fit and tighten plug to ***25 Nm.***
8. Fill gearbox with correct quantity and grade of oil until oil seeps from filler/level hole. Wipe away any surplus oil.
9. Thoroughly clean filler/level plug threads prior to applying fresh 'Hylomar' sealant. Fit and tighten plug to ***25 Nm.***
10. Reconnect battery.

Check/top up transfer gearbox oil - 10/6

1. Before topping up oil ensure that vehicle is level, either on a ramp or on ground.
2. Disconnect the battery negative lead.
3. Clean immediate area around filler/level plug.
4. Remove plug and fill gearbox with recommended grade of oil, until oil starts to seep from filler/level hole.
5. Clean any previously applied sealant from filler/level plug.
6. Apply Hylomar sealant to threads of plug and refit plug. Tighten to ***25 Nm.***

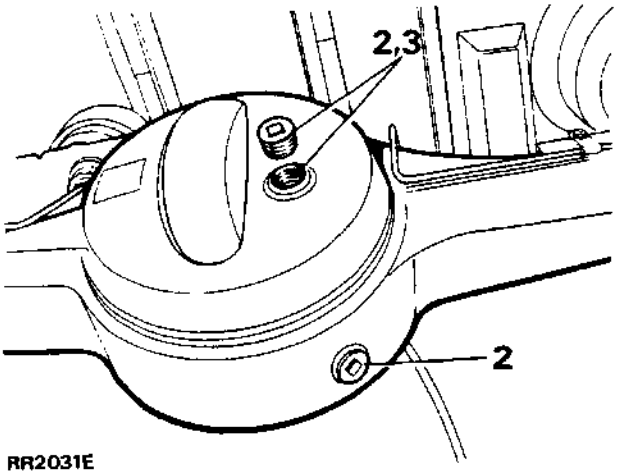


RR2904M

7. Wipe away any surplus oil.
8. Reconnect battery.

Renew front axle oil - 40/24

1. Vehicle must be level. Place container under axle to be drained.
2. Using a 13 mm square drive spanner, remove drain and filler/level plugs from axle. Allow oil to drain completely. Clean and refit drain plug.
3. Inject new oil of recommended make and grade until it reaches level hole. Clean and refit filler/level plug and wipe away surplus oil.



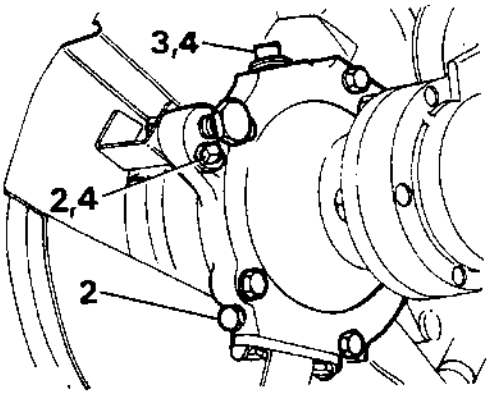
RR2031E

Check/top up front axle oil - 10/6

1. Vehicle must be level.
2. Using a 13 mm square drive spanner, remove filler/level plug from axle.
3. If necessary inject new oil of recommended make and grade until it reaches level hole. Clean and refit filler/level plug and wipe away surplus oil.

Renew swivel pin housing oil - 40/24

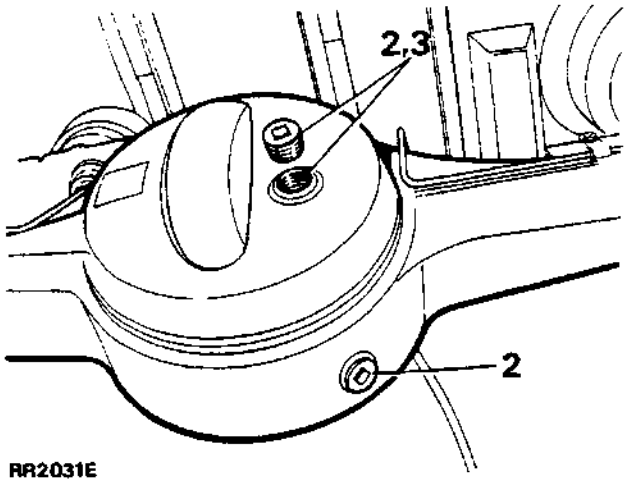
1. Vehicle must be level. Place container under swivel to be drained.
2. Remove drain and level plugs, allow oil to drain completely, clean and refit drain plug.
3. Remove filler plug and inject recommended make and grade of oil it reaches level hole.
4. Clean and refit level and filler plugs, wipe away any surplus oil.



RR2032E

Renew rear axle oil - 40/24

1. Vehicle must be level. Place container under axle to be drained.
2. Using a 13 mm square drive spanner, remove drain and filler/level plugs from axle. Allow oil to drain completely. Clean and refit drain plug.
3. Inject new oil of recommended make and grade until it reaches level hole. Clean and refit filler/level plug and wipe away surplus oil.



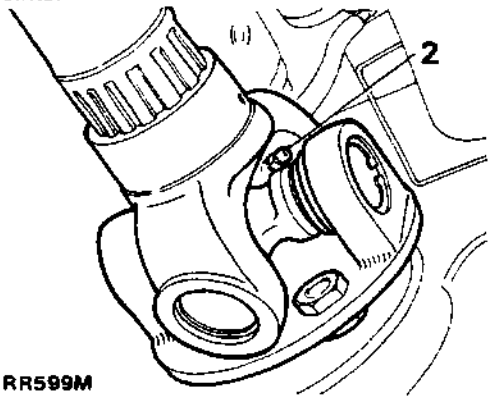
RR2031E

Check/top up rear axle oil - 10/6

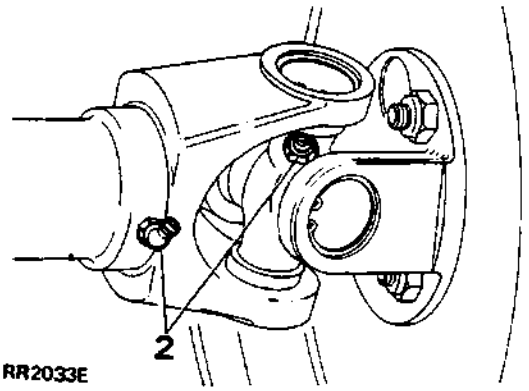
1. Vehicle must be level.
2. Using a 13 mm square drive spanner, remove filler/level plug from axle.
3. If necessary inject new oil of recommended make and grade until it reaches level hole. Clean and refit filler/level plug and wipe away surplus oil.

Lubricate propeller shaft sliding - 40/24, and universal joints - 20/12

1. Clean all grease nipples on front and rear propeller shafts.
2. Using a low pressure hand grease gun, apply recommended grease, to grease nipples at front and rear propeller shaft universal and sliding joints.



RR599M



RR2033E

Lubricate parkbrake mechanical linkage - 20/12

Check visually brake, fuel, clutch pipes/unions for chafing leaks and corrosion - 20/12

Check exhaust system for leaks, security and damage - 20/12

Check for fluid leaks from power steering and suspension systems, hydraulic pipes and unions for chafing and corrosion - 10/6

Check/tighten steering unit and steering rod ball joint fixings, check condition of ball joints and dust covers - 20/12

Ball joints are lubricated for their normal life during manufacture and require no further lubrication. This applies ONLY if rubber boot has not been dislodged or damaged. Joints should be checked at specified mileage intervals but more frequently if vehicle is used under arduous conditions.

1. Check for wear in joints by moving ball joint up and down vigorously. If free movement is apparent fit a new joint assembly.

Check tightness of propeller shaft coupling bolts - 20/12

Tighten propellor shaft nuts to *47 Nm.*

Ensure front and rear axle breathers are free from obstruction - 20/12

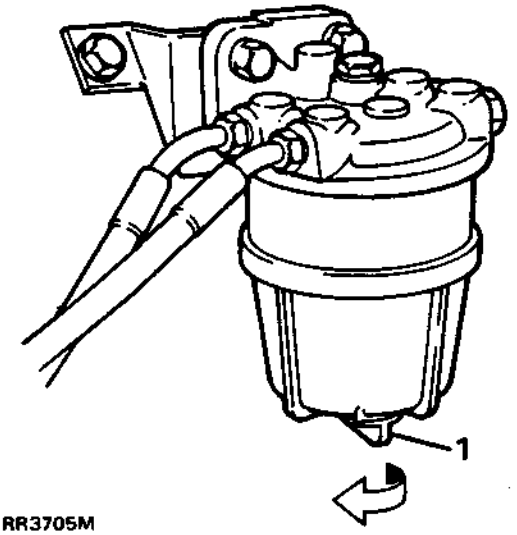
Check/tighten front and rear axle suspension link fixings, check condition of mounting rubbers - 20/12

Clean fuel sedimenter - diesel - 10/6

Fuel sedimenter
The sedimenter is attached to left-hand side of chassis frame near fuel tank. It increases the working life of the fuel filter by removing larger droplets of water and larger particles of foreign matter from fuel.

Drain off water

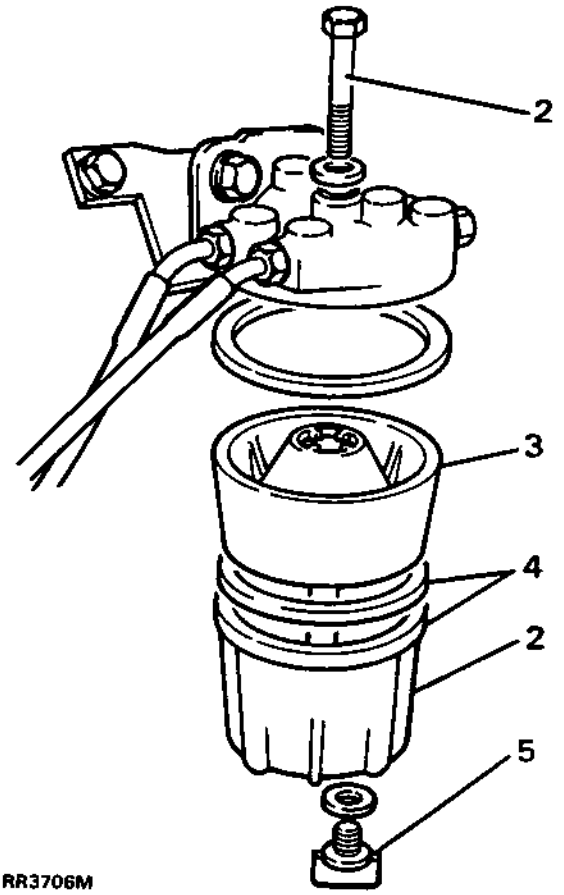
1. Loosen drain plug, allow water to run out. Tighten plug immediately pure diesel fuel starts to flow.



RR3705M

Clean element

1. Disconnect fuel inlet pipe from sedimenter and raise pipe above level of fuel tank. Support in this position to prevent fuel draining from tank.
2. Support sedimenter bowl, loosen bolt on top of unit and remove bowl.
3. Remove sedimenter element, clean all parts in kerosene.



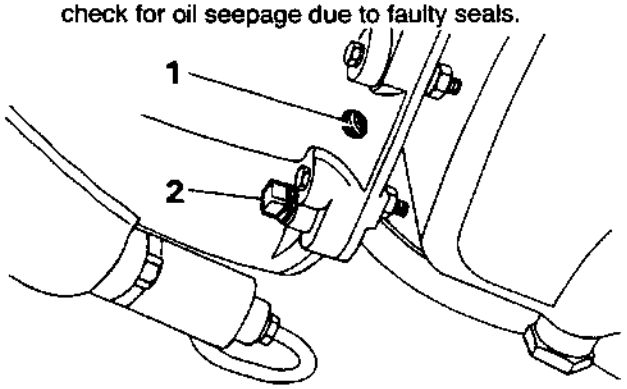
RR3706M

4. Fit new seals, reassemble sedimenter.
5. Loosen drain plug, when pure diesel fuel runs out, tighten plug.
6. Start engine and check sedimenter for leaks.

Check for oil leaks from engine and transmission - 20/12

Drain flywheel housing if drain plug is fitted - 20/12

1. The flywheel housing can be completely sealed to exclude mud and water by fitting a plug into flywheel/converter housing drain hole.
2. The plug should only be fitted when vehicle is used for wading or very muddy work.
3. If plug is fitted, it must be removed periodically to check for oil seepage due to faulty seals.



RR105M

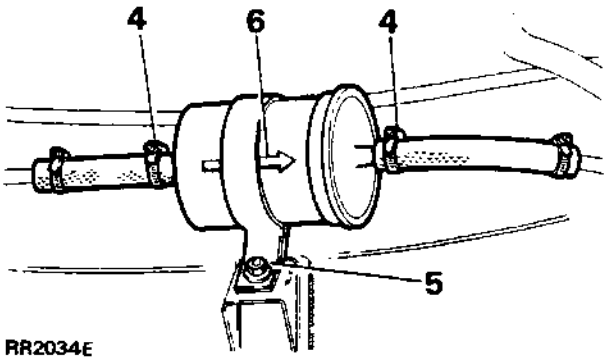
Check/tighten fuel tank fixings - 20/12

Renew fuel filter - V8 - 80/48

WARNING: Ensure that fuel handling precautions given in Section 01 - Introduction regarding fuel handling are strictly adhered to when carrying out following instructions. ***See INTRODUCTION, Information, fuel handling precautions***

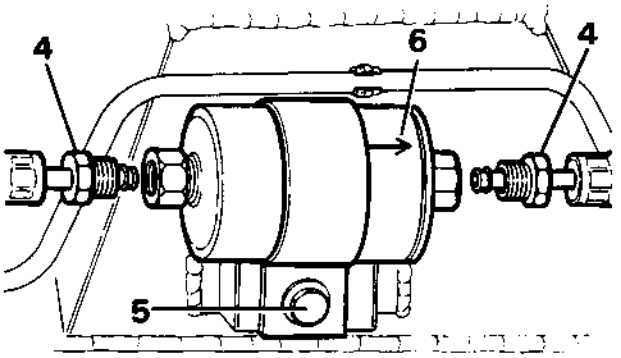
WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Depressurise fuel system. ***See FUEL SYSTEM, Repair, depressurising fuel system***
2. The fuel line filter is located on right hand chassis side member forward of fuel tank filler neck. Access to filter is gained through right hand rear wheel arch.
3. Thoroughly clean area around hose connections to prevent ingress of foreign matter into fuel system. 1991 models - clamp inlet and outlet hoses to prevent fuel spillage when disconnecting hoses.
4. Pre 1991 - loosen two hose clamps nearest filter, remove hoses from filter canister. Plug hoses to prevent ingress of dirt.



RR2034E

4. 1991 onwards - loosen two fuel unions and remove hoses from filter canister.



RR2966E

5. Release securing bolt and bracket, remove filter from chassis side member.

Fit new filter

6. Fit a new filter observing direction of flow arrow on canister.
7. Fit inlet and outlet hoses. 1991 models - Tighten unions to ***30 Nm.***
8. Refit fuel pump relay. Reconnect battery and recode radio.
9. Start engine and inspect hose connections for fuel leaks.

ABS vehicles - check road wheel speed sensor electrical harness for damage - 10/6

Renew oxygen sensors - 80/48

See EMISSION CONTROL, Repair, Lambda (oxygen) sensor

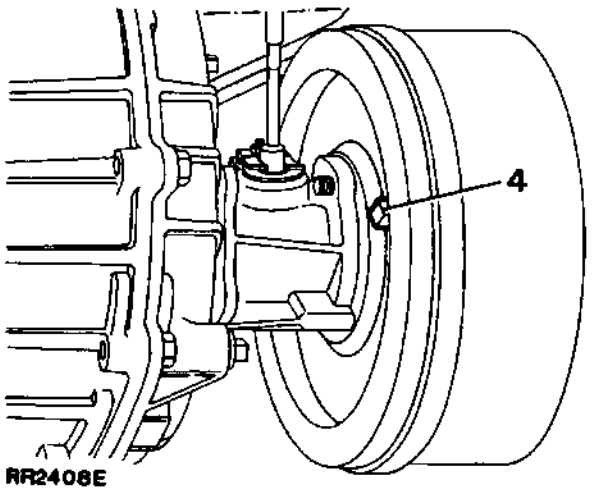
Renew catalytic converters, - 160/100

See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust system complete

Adjust park brake if required - 20/12

The park brake should be fully operational on third notch of ratchet. Readjust if necessary. The park brake lever acts on a brake drum at rear of transfer box.

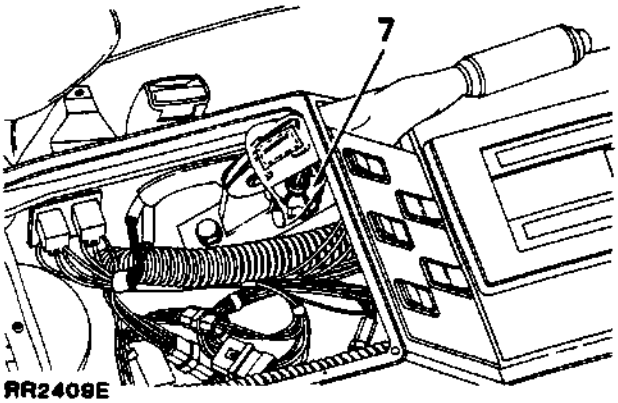
1. Park vehicle on level ground and select 'P' in automatic gearbox or 1st in manual gearbox. Disconnect the battery negative lead.
2. Chock road wheels.
3. Fully release park brake lever, ensure cable is not pre-loading brake.
4. From underneath vehicle, rotate adjuster on brake back plate clockwise until brake drum will not rotate.



RR2408E

5. Back off adjuster until drum is free to rotate.
6. Release four screws and remove glove box liner.
7. Rotate adjustment thumbwheel below park brake lever until park brake is fully operational on third notch of ratchet.

NOTE: The park brake adjustment thumbwheel must only be used for initial setting and to compensate for cable stretch, it must not be used to take up brake shoe wear, which MUST be adjusted at brake drum.



RR2409E

8. Operate park brake to settle brake shoes, recheck park brake is fully operational on third notch of ratchet. Readjust as necessary.

CAUTION: DO NOT over adjust park brake, drum must be free to rotate when parking brake is released, otherwise serious damage will result.

9. Refit glove box liner.
10. Reconnect battery and remove wheel chocks.

Carry out road or roller test - 10/6

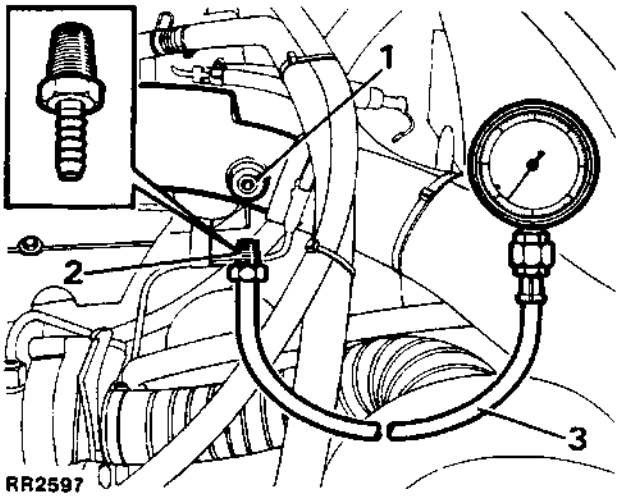
Check following items:

1. Inhibitor switch only operates in P and N.
2. Engine for excessive noise.
3. Clutch for slip, judder or spin.
4. Automatic gear selection/shift speeds.
5. Gear selection/noise - high/low range.
6. Steering for abnormal noise/effort.
7. Steering for free play.
8. All instruments, gauges and warning indicators.
9. Heater and air conditioning systems.
10. Heated rear screen.
11. Shock absorbers - ride irregularities.
12. Foot brake, on emergency stop, pulling to one side, binding, pedal effort.
13. Parkbrake efficiency.
14. Seat reclining and latching.
15. Fully extend seat belt, check operation of retraction and latching. Inertia belts lock when snatched or vehicle on slope.
16. Road wheel balance.
17. Transmission for vibrations.
18. Body noises, squeaks and rattles.
19. Excessive exhaust smoke.
20. Engine idle speed.
21. Endorse service record.
22. Report any unusual features of vehicle condition and additional work required.

Check turbocharger boost pressure - 40/24

Service tools:
LRT-12-012 Pressure test adaptor

1. Remove the grub screw, located in the inlet manifold.



2. Insert adaptor (18G.1116-1) into the grub screw orifice.
3. Attach a suitable pressure gauge, with sufficient length of tube to reach from the inlet manifold to the cab of the vehicle.
4. Drive the vehicle in 3rd gear at 3800 rev/min to give a satisfactory reading of 0,9 kg/cm.

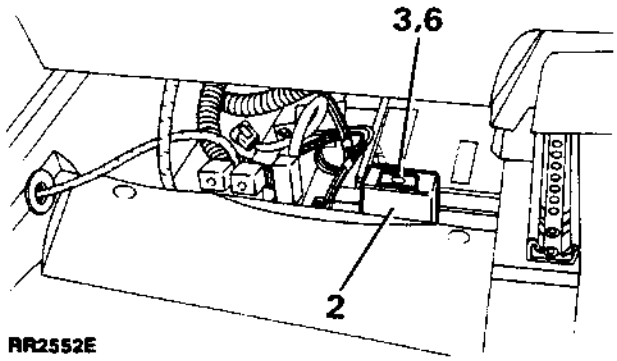
Reset emission maintenance reminder - USA models

The emission maintenance reminder is designed to activate at 52,500 and 105,000 miles respectively and will illuminate a 'Service Engine' red warning light in instrument binnacle.

The emission maintenance reminder must be reset after required maintenance has been carried out and a new tamperproof label fitted by a Range Rover of North America dealer. This Emission maintenance reminder is part of Emission Control System, - see Emission maintenance reminder.

Reset

1. The control unit is located under rear of right hand front seat.
2. Identify control unit and remove from plug.
3. Remove tamperproof label to reveal access hole for resetting.



RR2552E

4. Place a thin metallic probe into access hole and momentarily electrically short between reset pins inside unit.

RECOMMENDED SERVICE ITEMS

At 6,000 mile (10,000 km) intervals clean sunroof drain tubes, clean and lubricate guide rails and slides.

At 12,000 mile (20,000 km) intervals or every 12 months clean sunroof drain tubes and channels.

At 18,000 mile (20,000 km) intervals or every 18 months, whichever is the sooner, the hydraulic brake fluid should be completely renewed. ***See BRAKES, Repair, Brake system bleed***

At 36,000 mile (60,000 km) intervals or every 3 years, whichever is the sooner, all hydraulic brake fluid, seals, brake servo filter and flexible hoses should be renewed.

All working surfaces of the master cylinder and caliper cylinders should be examined and renewed where necessary.

A.B.S. vehicles only - renew hydraulic brake fluid and flexible hoses; examine the working surfaces of the caliper cylinders and renew the seals or cylinders where necessary.

At two yearly intervals or at the onset of the second winter, the cooling system should be drained, flushed and refilled with the required water and anti-freeze solution.

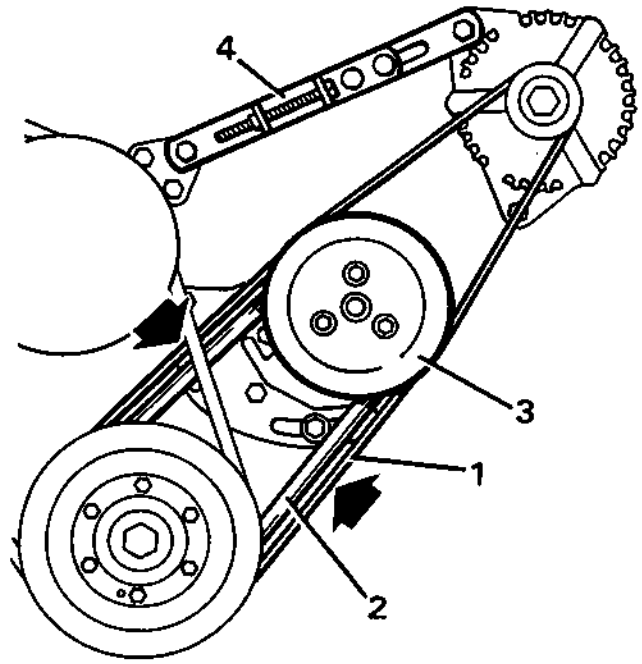
The battery electrolyte level should be checked and topped up, if required, every three years in temperate climates and once a year in high ambient temperatures.

Air cleaner - When the vehicle is used in dusty or field conditions or deep wading, frequent attention to the air cleaner may be required.

A.B.S. vehicles used extensively in arduous off-road conditions - check the rear wheel road speed sensor for abrasive wear at 1000 mile (1600 km) intervals.

1993 MODEL YEAR MAINTENANCE

Alternator and steering pump drive belts.



RR3909M

1. Alternator drive belt
2. Steering pump drive belt
3. Steering pump and guide pulley
4. Alternator drive belt tensioner

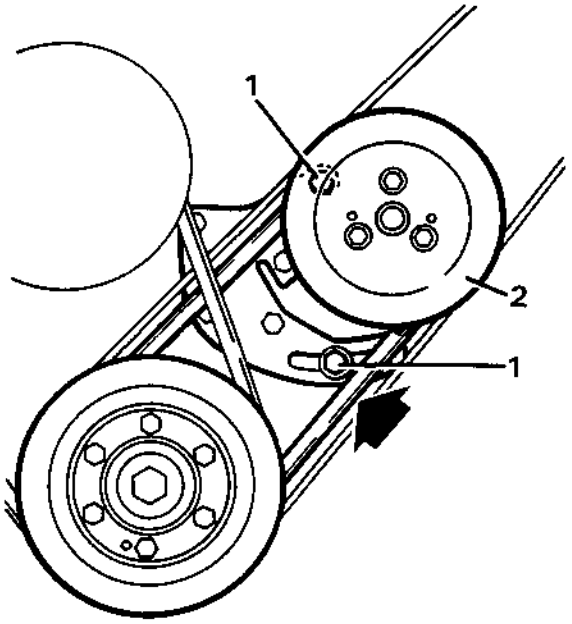
A new alternator drive belt is used, driven from the crankshaft pulley. A guide pulley on the power steering pump guides the belt in this area. Alternator and power steering belts have individual adjustment, but PAS belt must be adjusted before alternator belt.

Steering pump drive belt -10/6

Adjust

NOTE: Loosen alternator drive belt to facilitate accurate adjustment of the PAS drive belt.

1. Loosen steering pump adjuster bolt and pivot nuts.
2. Ensure pump is free to rotate on mounting. **DO NOT** lever pump, loosen fixings further if necessary.



RR3910M

3. Carefully lever against pump bracket to tension belt. On left hand drive models, where access is restricted, a lever with one end cranked at 5° to 10°, may be fed down between water pump and distributor. Place lever against steering pump bracket, carefully levering from water pump/front cover.

CAUTION: DO NOT lever against steering pump casing. Damage to casing may result in oil leaks.

4. Check tension using a recognised belt tensioning gauge.

   Belt tension using a Clavis gauge:
   - 142 - 152 Hz.

When checked with normal hand pressure at the mid-point of the longest span, the belt should deflect 0,5 mm per 25 mm of belt run between pulley centres.

5. Tighten steering pump fixings.
6. Recheck belt tension.
7. Adjust alternator belt.

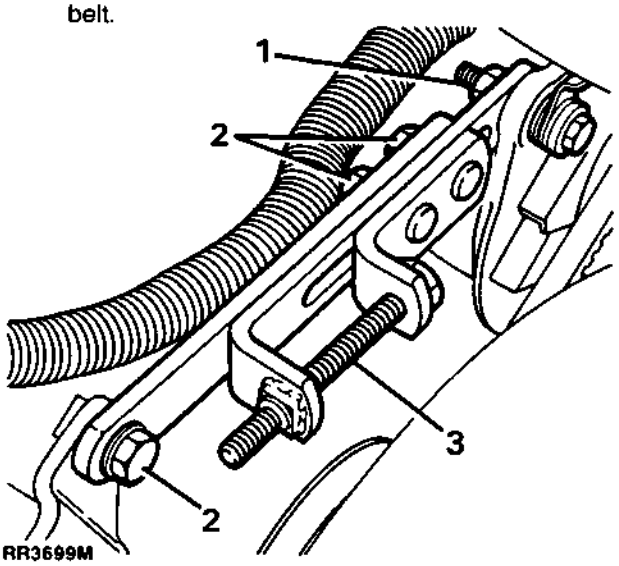
CAUTION: When fitting a new drive belt, tension belt as described above. Reconnect battery and start and run engine for 3 to 5 minutes at fast idle, after which time belt must be re-checked, re-tension belt if necessary.

Alternator drive belt - 10/6

Adjust

NOTE: The steering pump pulley is used as a guide pulley for the alternator belt. Adjust steering belt before adjusting alternator belt.

1. Loosen alternator pivot bolt and bolt securing alternator to tensioner.
2. Loosen two tensioner nuts and bolt securing tensioner to water pump bracket.
3. Rotate tensioner lead screw clockwise to tension belt.



4. Check tension using a recognised belt tensioning gauge applied midway between crank and slider pulley.

   Belt tension using a Clavis gauge:
   - 152 - 158 Hz.

When checked with normal hand pressure at the mid-point of the longest span, the belt should deflect 0,5 mm per 25 mm of belt run between pulley centres.

5. Tighten alternator fixings.
6. Recheck belt tension.

CAUTION: When fitting a new drive belt, tension belt as described above. Reconnect battery and start and run engine for 3 to 5 minutes at fast idle, after which time belt must be re-checked, re-tension belt if necessary.

AIR SUSPENSION MAINTENANCE

Depressurise air suspension system - 40/24. ***See AIR SUSPENSION, Repair, depressurise system***

Renew compressor inlet filter - 40/24. ***See AIR SUSPENSION, Repair, compressor inlet filter***

Remove air compressor drain plug - 40/24. ***See AIR SUSPENSION, Repair, air reservoir - drain***

Repressurise air suspension system - 40/24.

Check air harness pipes for security and damage - 20/12.

Check air springs for security and damage - 20/12.

Check shock absorbers, height sensors and harness assemblies for leakage and damage - 20/12.

200Tdi ENGINES

If the vehicle is operated on fuel with a high sulphur content (over 1%) the engine oil change intervals must not exceed 5000 km (3000 miles).

Camshaft drive belt - 200Tdi engines

The engine timing gears are driven by a flexible rubber belt which must be renewed at intervals determined by the severity of operating conditions.
In reasonable, temperate climate operation, renew the belt every 100,000 km (60,000 miles) or every five years whichever occurs earlier.
In adverse operating conditions such as work in dusty atmospheres, high ambient temperatures and desert and tropical zones, renew the belt every 50,000 km (30,000 miles) or every two and a half years whichever occurs earlier.

CAUTION: If the drive belt is not renewed at the correct interval, it could fail, resulting in serious engine damage.

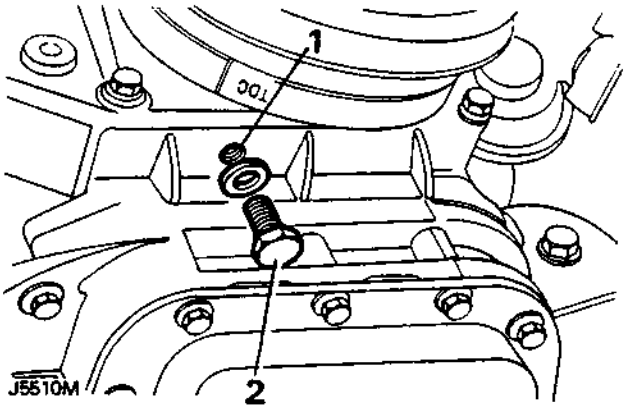
Air cleaner

When the vehicle is used in dusty or field conditions or deep wading, frequent attention to the air cleaner may be required.

Drain engine timing cover - 20/12

1. The timing cover can be completely sealed to exclude mud and water by fitting a plug.
2. The sealing plug should be fitted when vehicle is used for wading and very muddy work only.
3. Periodically remove plug to check for oil seepage.

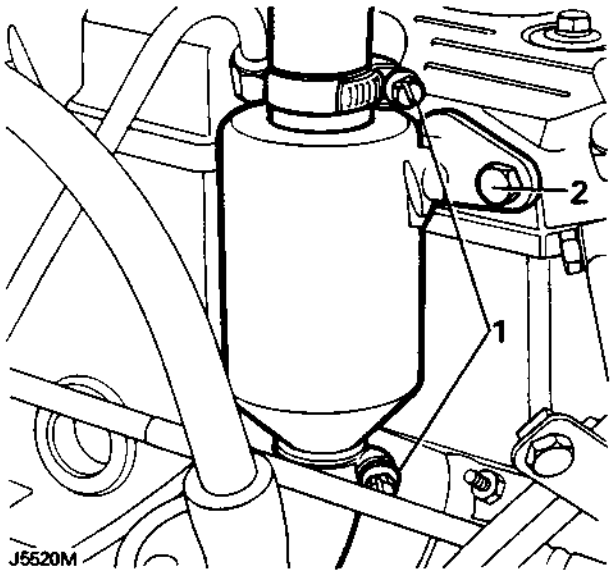
NOTE: There should no oil in the timing cover. If there is, the cause should be investigated as soon as possible. The timing belt will deteriorate if contaminated with oil.



4. When not in use, store drain plug in vehicle tool kit.

Clean cyclone engine breather cleaner - 20/12

1. Slacken hose clips securing hoses to cleaner body. Remove hoses.
2. Remove two bolts securing cleaner to rocker cover.

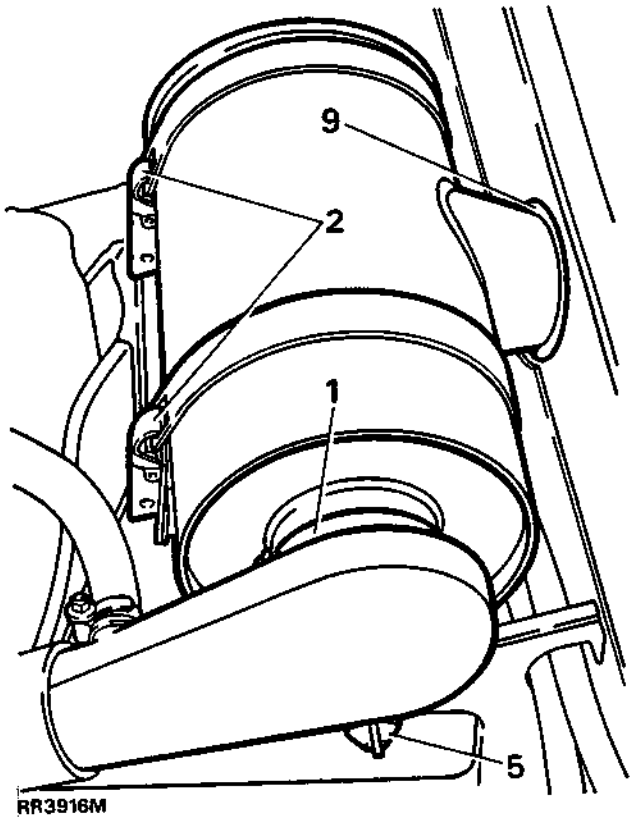


3. Remove cleaner from rocker cover, taking care not to tear sealing gasket.
4. Immerse cleaner in a small container of kerosene to dissolve oily deposits.
5. When cleaner is free of deposits, remove from solvent and dry completely.

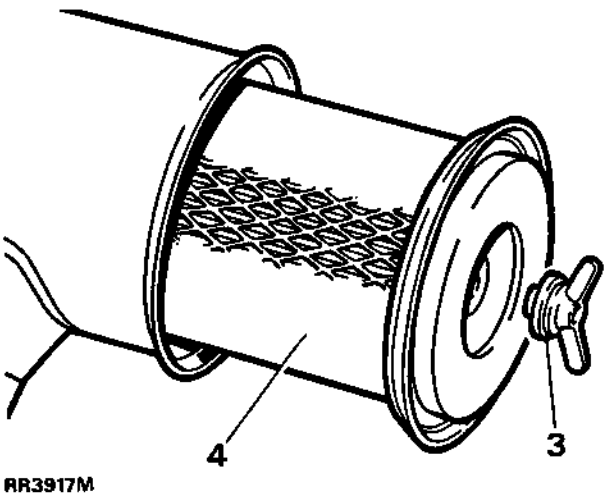
⚠ **CAUTION: The cleaner must be completely dry before it is refitted, otherwise overspeeding of the engine may result.**

Renew the air cleaner element - 20/12

1. Slacken clip and pull elbow from cleaner.
2. Release two over-centre clips securing air cleaner body. Pull cleaner away from its supports, easing inlet side of cleaner away from intake baffle plate.



3. Unscrew wing nut at end of case.
4. Remove filter element from main body.



Check air cleaner dump valve

5. Squeeze open dump valve, check interior is clean. Also check that rubber is flexible and in good condition.
6. If necessary, remove dump valve to clean the interior. Fit a new valve if original is in poor condition.

Refit the element

7. Fit a new element to air cleaner body.
8. Refit wing nut and tighten.
9. Fit cleaner assembly to vehicle, engaging intake in the baffle plate. Ensure 'O' ring is located in baffle plate.
10. Fit cleaner outlet elbow onto cleaner case.

△ **NOTE: A location cut out in cleaner case flange corresponds to a moulding on elbow.**

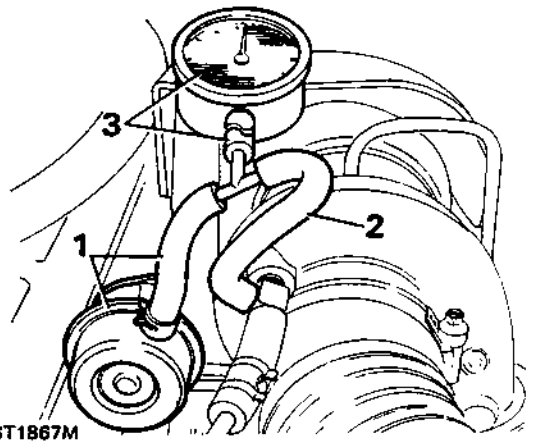
11. Tighten clip. Secure air cleaner with the two over-centre clips.

Check turbocharger boost pressure - 40/24

Maximum boost pressure
- 61 cm Hg (11.8 p.s.i.g.)

Minimum boost pressure
- 56 cm Hg (10.9 p.s.i.g.)

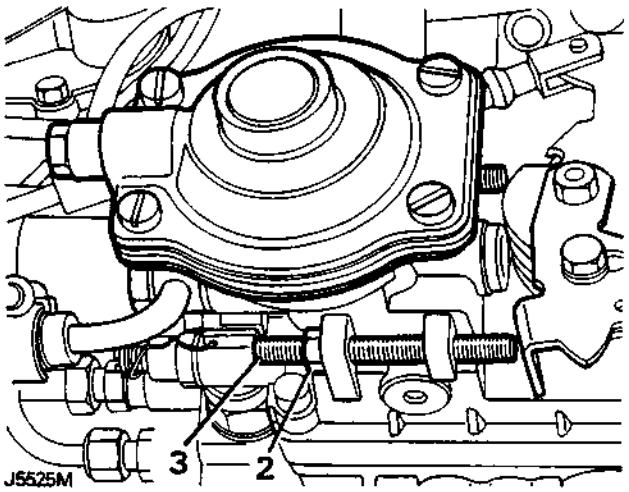
1. Disconnect, from turbocharger, hose to actuator. Insert into a suitable "T" piece.
2. Connect a short length of suitable hose to turbocharger and connect other end to "T" piece.
3. Connect a further length of hose to third leg of the "T" piece and other end to a pressure gauge capable of reading in excess of 61 cm Hg. The pressure gauge hose must be capable of reaching passenger compartment so that gauge may be observed.
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 2,500 and 3,000 r.p.m. The boost pressure should be between 56 to 61 cmHg (10.9 to 11.8 p.s.i.g.).



Engine slow running - 20/12

1. Using a suitable tachometer, check engine slow running speed is 720 ± 20 rev/min. The engine should be at normal operating temperature for this check. If tachometer is not available, adjust engine speed until slowest even running is achieved.
2. If adjustment is necessary, slacken locknut on injector pump.
3. Screw adjuster clockwise to increase engine speed or anticlockwise to decrease speed. Run engine at increased speed for a few seconds, check slow running speed again.
4. When correct speed has been achieved, hold adjuster screw steady while tightening locknut.

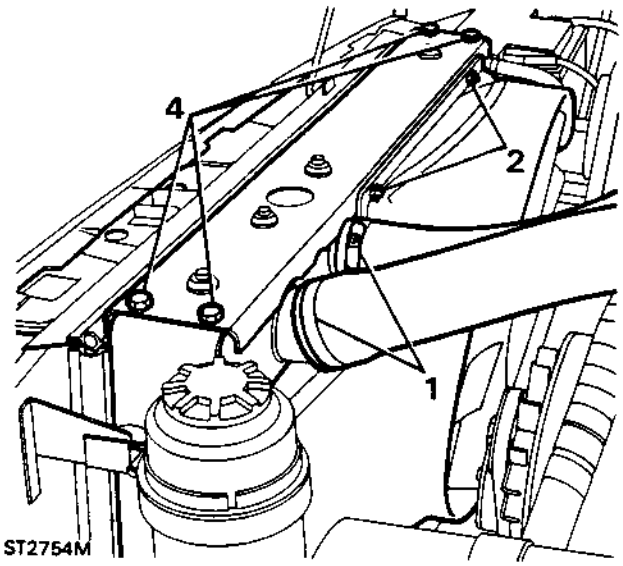
△ **NOTE: Slow running control is the only permitted adjustment in service. Any additional adjustments required must be entrusted to authorised Bosch agents.**



Intercooler element clean - 80/48

Remove

1. Loosen upper and lower intercooler hose securing clips at element. Carefully pull hoses from inlet/outlet pipes.
2. Remove two nuts and washers securing fan cowl upper to radiator assembly.
3. Ease fan cowl upwards to disengage from fastening clips. Move cowl towards rear of vehicle, over fan blades.
4. Remove radiator assembly frame top by removing two bolts on either side and lifting top off element location dowels.
5. Lift intercooler element from support frame.



Flush

6. Flush element with ICI "GENKLENE" proprietry cleaner, following manufacturers instructions.
7. Dry element completely and check it for damage or deterioration. Renew the element if necessary.

Refit

8. Refit intercooler to support frame. Refit frame top, ensuring that the element dowels are correctly located in rubber seats.
9. Refit other components in reverse order.

Drive belts Check and adjust - 20/12
(Not 200Tdi camshaft belt)

General procedure

Before each belt is checked for correct tension, it must be inspected for damage or wear and replaced as necessary. The drive pulleys must also be inspected for dirt and grit trapped in the "V" grooves and cleaned if necessary to prevent damage to the belts.
Whenever a new belt is fitted, it must be tensioned and run at light load for 3 to 5 minutes before it is tensioned again. During light loading;
If the steering pump belt has been changed, leave the steering wheels in the straight ahead position.
If the air conditioning pump belt has been changed, leave the air conditioning switched off.
If the alternator belt has been changed, do not operate heavy consumption electrical components.
For all belts, do not speed the engine.

New drive belts should additionally be retightened after approximately 1,000 miles (1,500 km).

The tension of each belt must be checked at the points arrowed, midway between the belt centres, by a proprietry belt tension gauge. The belts should be tensioned, if necessary, to within the figures given for each belt.

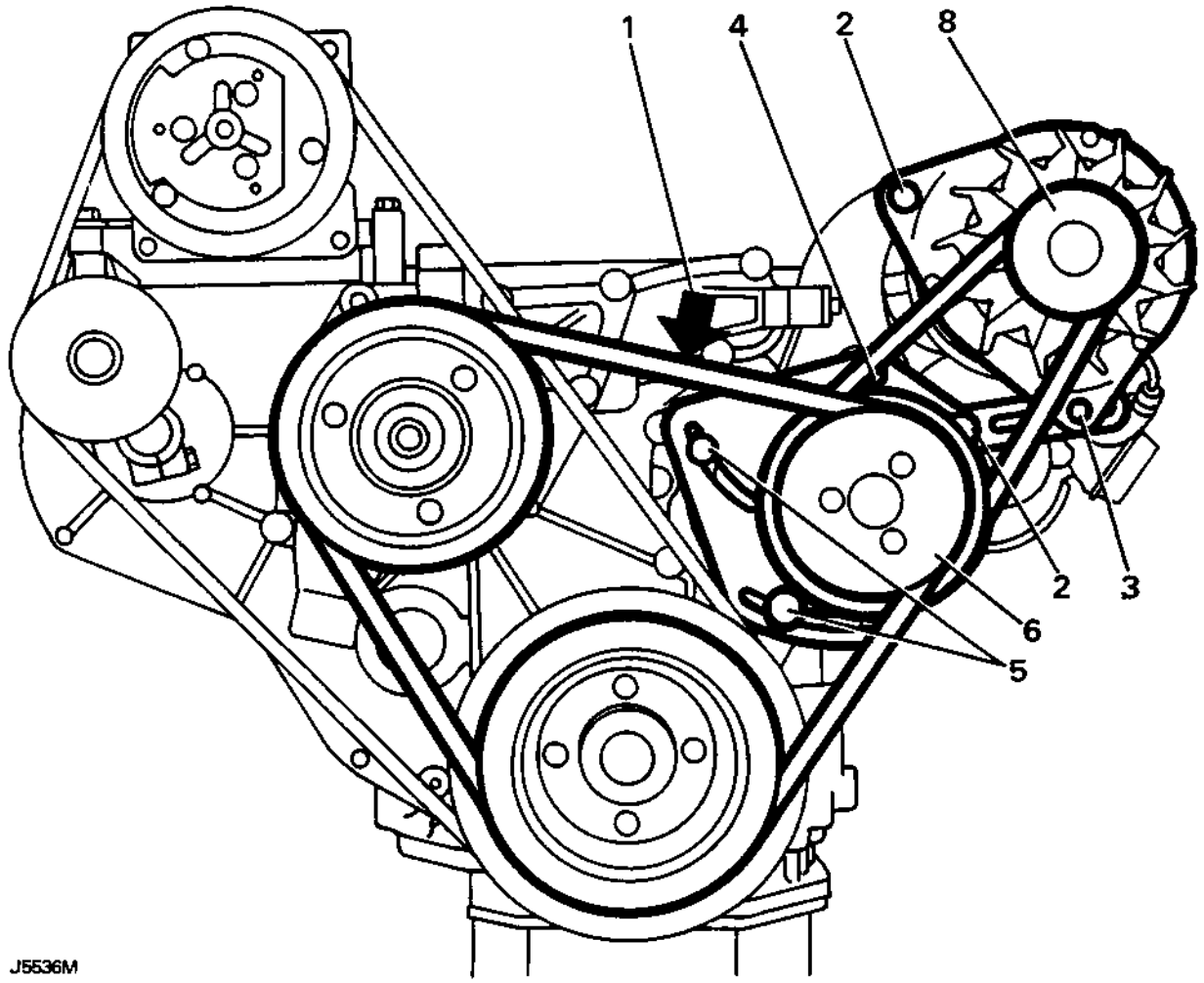
A: Water pump drivebelt
355 to 400 Nm (80 to 90 lbf)

B: Steering pump drivebelt (V8 only)
355 to 400 Nm (80 to 90 lbf)

C: Air conditioning pump drivebelt
355 to 400 Nm (80 to 90 lbf)

D: Alternator drivebelt
335 to 380 Nm (75 to 85 lbf)

In exceptional circumstances, where a belt tension gauge is not available, the belt tension may be checked at the points shown by measuring the deflection of the belt under normal hand pressure. There should be a deflection of 0,5 mm per 25 mm of belt run between belt centres. Adjust the belts if necessary. The belts should be retensioned in conjunction with a belt tension gauge as soon as possible.



Water pump/power steering drivebelt

Check

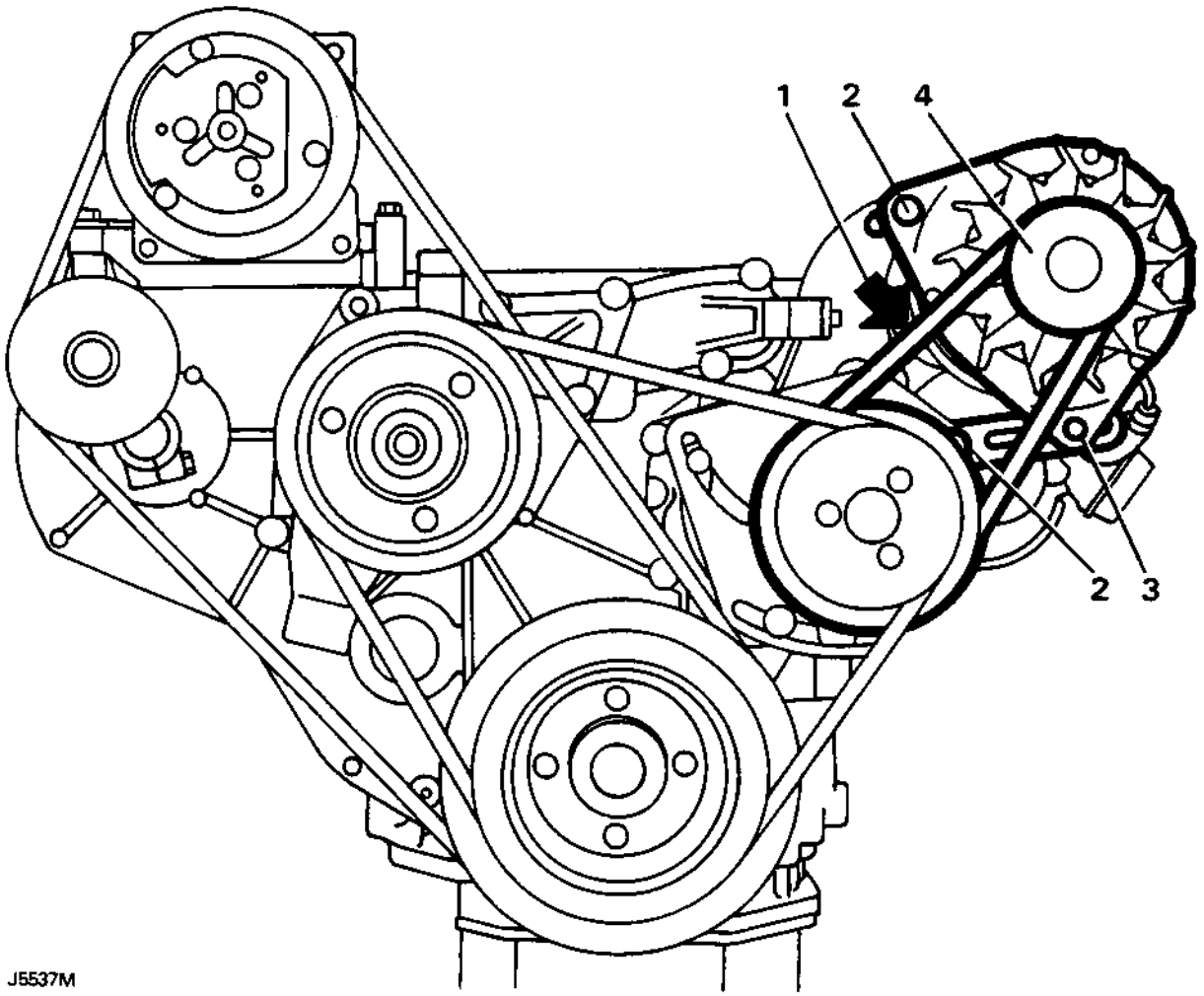
1. Check belt tension at point shown.

Adjust

2. Slacken front and rear alternator mounting bolts and adjustment link mounting bolt at power steering pump plate.
3. Slacken adjustment link clamp bolt at the alternator.
4. Slacken mounting bolt at power steering pump plate.
5. Slacken clamp bolts at power steering pump plate.
6. Move power steering pump in or out as required to correct belt tension.

△ **NOTE: DO NOT lever against the pump body to move it.**

7. Tighten clamp bolts and mounting bolt at power steering pump plate and re-check the belt tension. Slacken pump plate bolts and re-tension if necessary.
8. Adjust alternator drivebelt tension to "200Tdi Alternator Drivebelt: Check and adjust". ***See SECTION 10, Maintenance, Under Bonnet Maintenance***



A.C. Generator drivebelt

Check

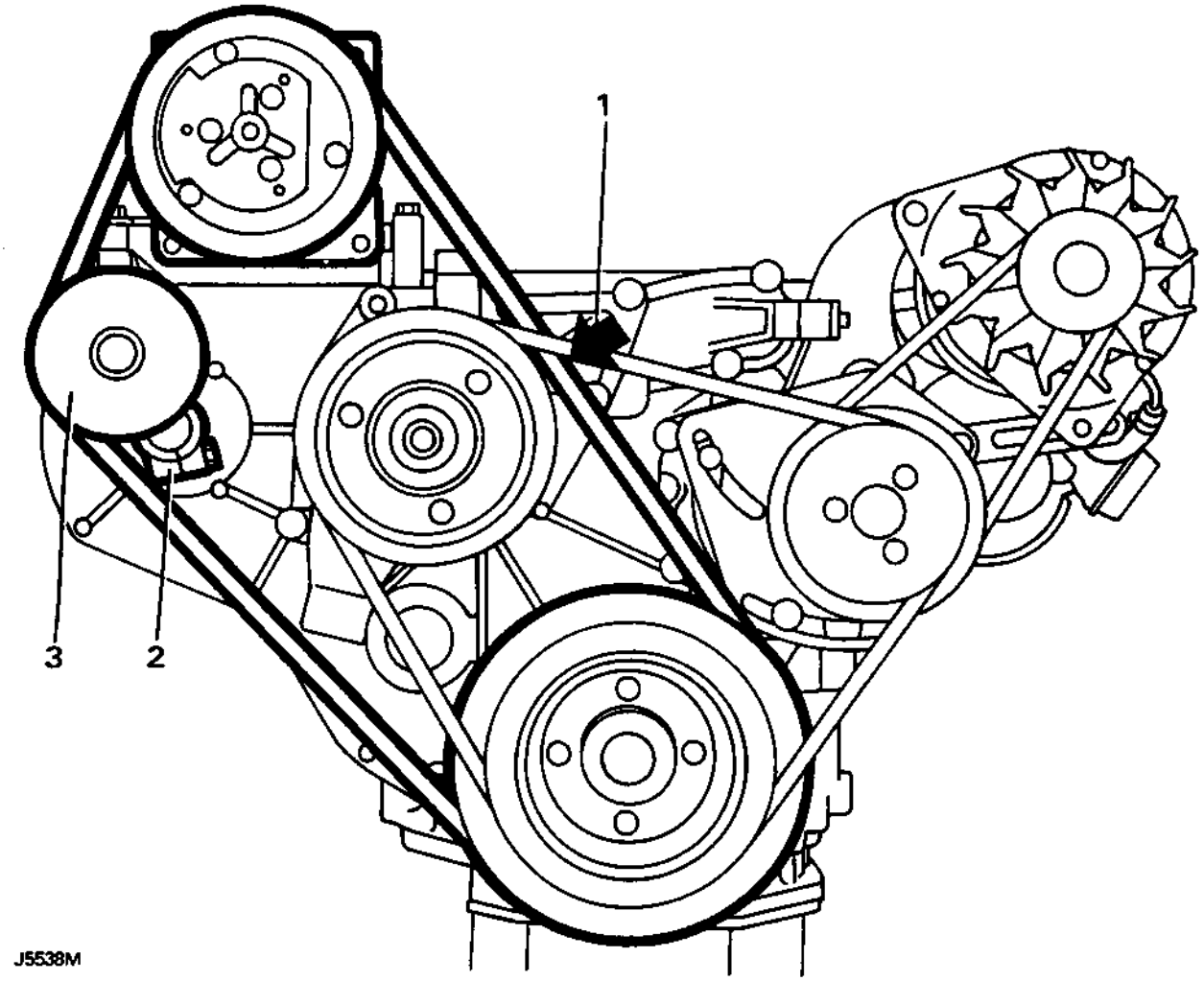
1. Check belt tension at point shown.

Adjust

2. Slacken front and rear A.C. generator mounting bolts and adjustment link bolt at power steering pump plate.
3. Slacken adjustment link clamp bolt at A.C. generator.
4. Move A.C. generator to correct drivebelt tension.

△ **NOTE: DO NOT lever against the A.C. generator slip ring end or the stator to move the A.C. generator.**

5. Tighten adjustment link clamp bolt and re-check belt tension. If correct, tighten A.C. generator mounting bolts.



Air conditioning compressor drivebelt

Check

1. Check belt tension at point shown.

Adjust

2. Slacken jockey wheel clamp bolt.
3. Move jockey wheel either in or out to correct the tension. Ensure that compressor mount bolts are tight.
4. Tighten clamp bolt and re-check tension. Adjust if necessary.

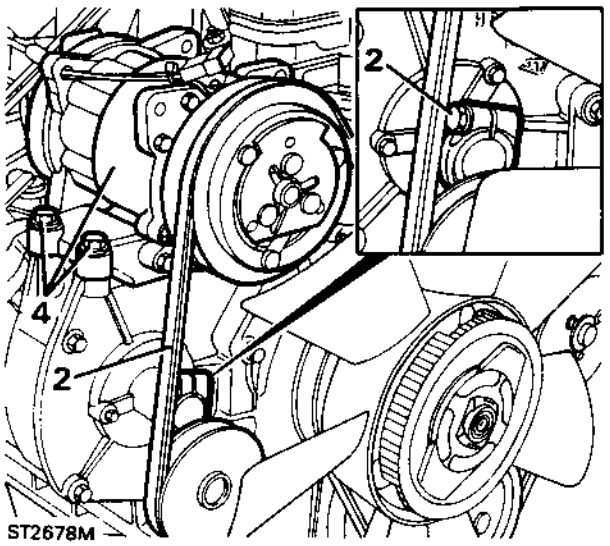
Renew camshaft drive belt - 100/60

Special tools:-

Crankshaft damper restrainer	LST 127
Injection pump timing pin (part of LST 129)	LST 129/2
Flywheel timing pin	LST 128

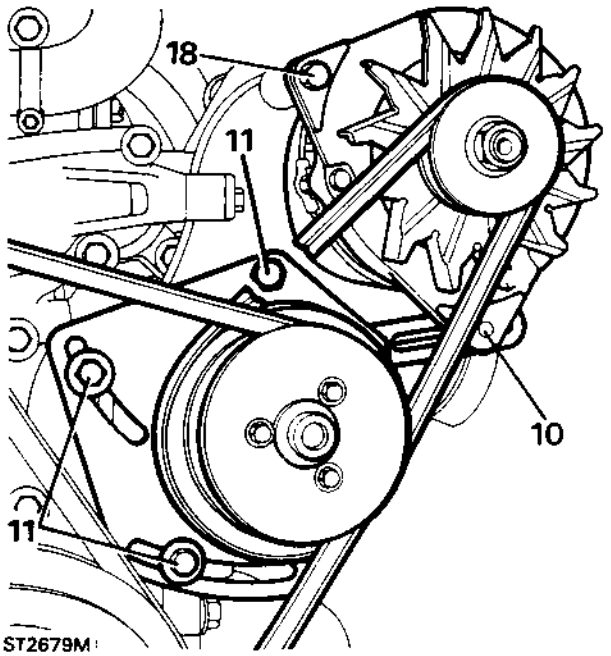
Air conditioning models - to gain access.

1. Disconnect the battery negative lead.
2. Release compressor drive belt tensioning pulley. Remove belt from compressor pulley.
3. Disconnect the two electrical leads from thermostat housing sensor.
4. Remove the four bolts securing compressor to engine and move compressor aside taking care not to strain hoses.

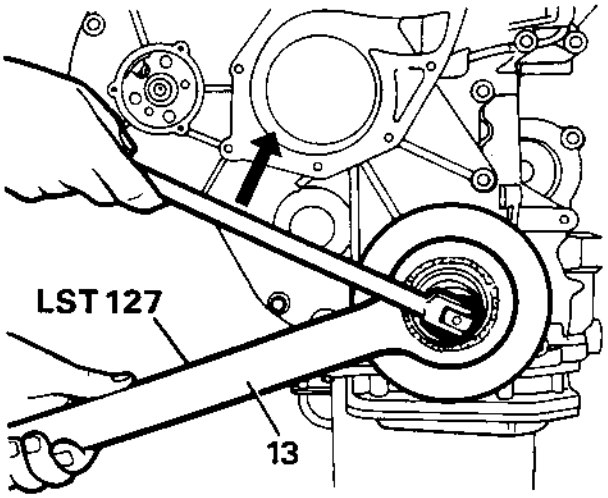


All models - to gain access

5. Disconnect battery and drain cooling system by removing bottom hose from radiator and allowing coolant to drain into a suitable container.
6. Remove viscous coupling and fan assembly, noting that coupling is secured to water pump shaft with a left hand thread.
7. Disconnect intercooler to manifold hose at the manifold.
8. Remove top hose.
9. Remove two nuts securing fan cowl to top of radiator and lift-out cowl.
10. Loosen alternator belt adjustment bolt.
11. Loosen PAS pump belt adjustment bolts and remove both belts.

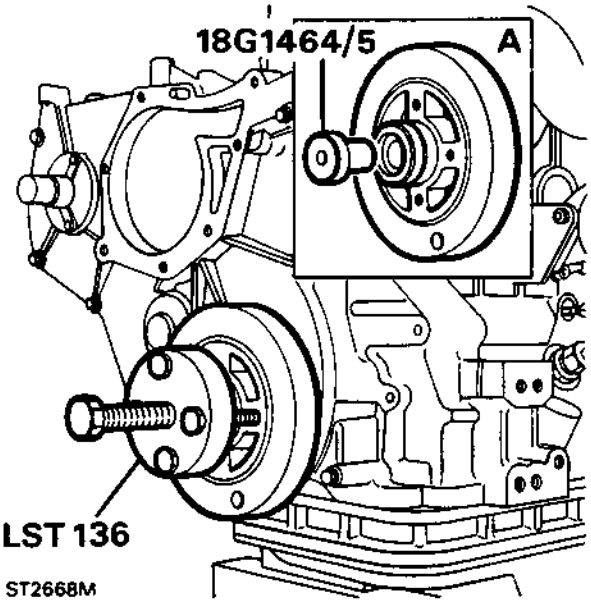


12. Remove four screws. Remove the crankshaft pulley from damper.
13. Restrain damper with special tool LST 127. Using a 30 mm socket, remove damper retaining bolt and spacer. Since this bolt is retained with Loctite and tightened to a very high torque considerable effort will be required to release it.



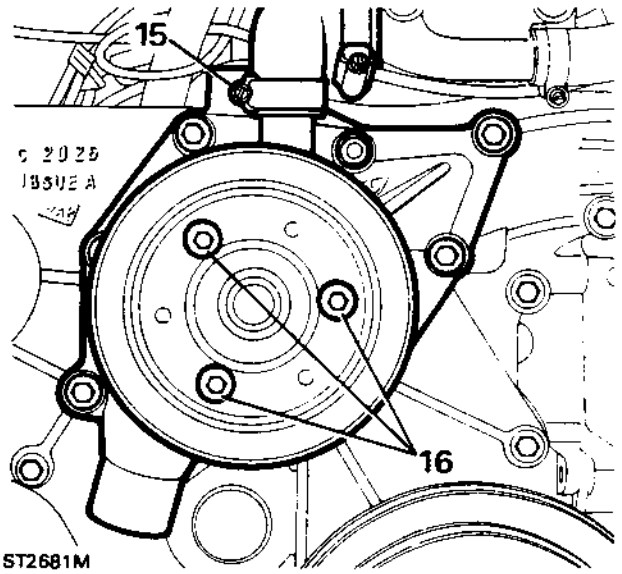
ST2680M

14. Since damper is also retained with loctite, use special tool LST 136 to withdraw it from the crankshaft.



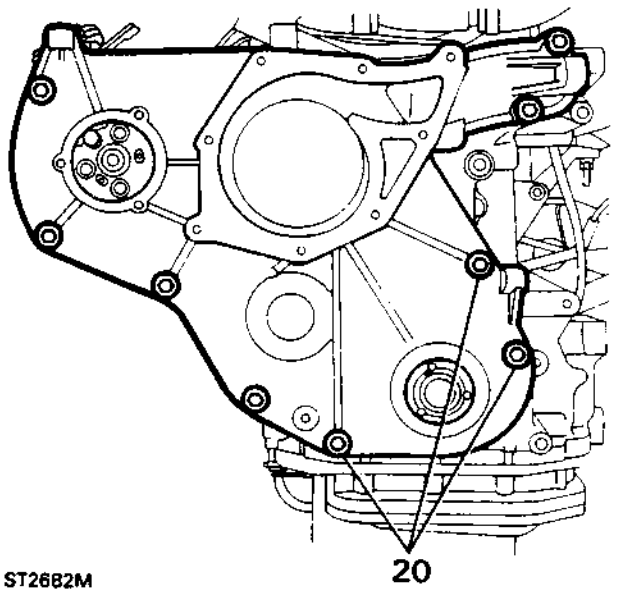
ST2668M

15. Disconnect bottom and by-pass hoses from water pump.
16. Remove three screws to remove water pump pulley. Remove seven bolts to remove water pump.



ST2681M

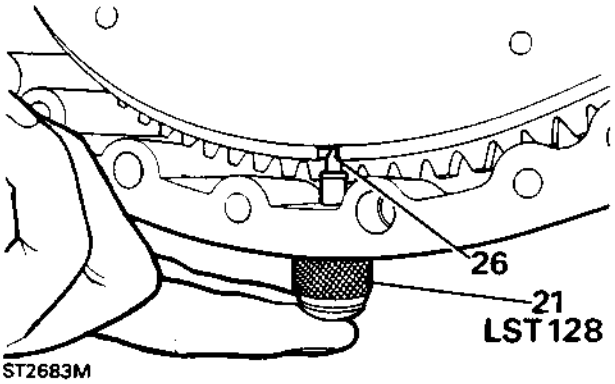
17. Remove air cleaner to turbo charger hose.
18. Withdraw pivot bolt, and remove the alternator. Similarly, remove PAS pump.
19. Remove five bolts to release common bracket.
20. Remove nine bolts and carefully remove cover plate from front cover.



ST2682M

To renew the drive belt

21. Screw body of flywheel timing pin into flywheel housing location.



ST2683M

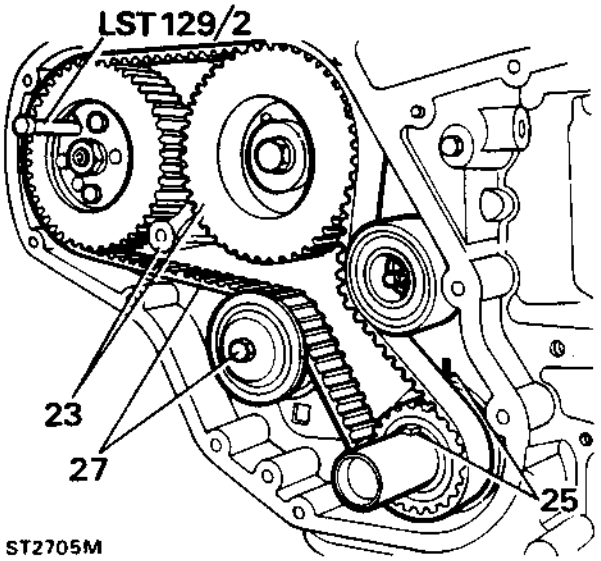
22. Temporally fit crankshaft damper, and with special service tool LST 127, turn crankshaft in a clockwise direction until following conditions are achieved:-
23. Timing dot on camshaft gear aligns with front cover web.
24. Injector pump timing pin LST 129/2 can be fully and easily inserted into pump hub hole.
25. Crankshaft key aligns with arrow on front cover.
26. Flywheel timing pin LST 128 can be inserted cleanly into appropriate slot in flywheel.

NOTE: That flywheel has two timing slots, one narrower than the other. The narrowest slot determines T.D.C for this direct injection engine. Provided that instructions 23 to 26 are achieved, correct slot in flywheel will be correctly positioned. Remove damper.

27. Remove single bolt and withdraw drive belt tensioning pulley assembly complete, from engine. Carefully remove drive belt.

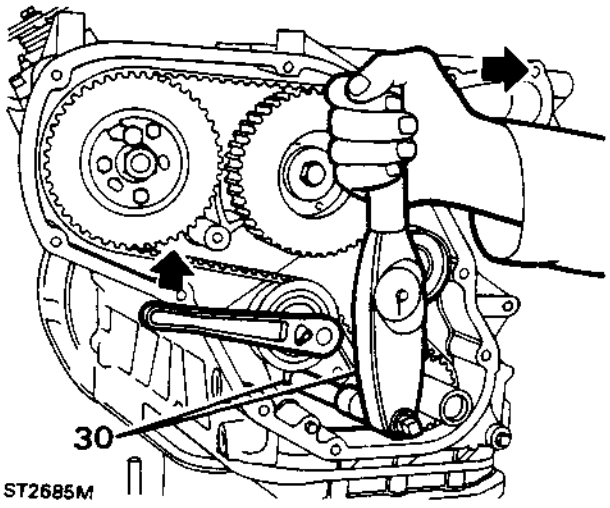
CAUTION: Before fitting a new drive belt, examine the gear wheels for wear and damage. Cleanliness and accuracy are vital when carrying out the following instructions. The gear wheels must be free from oil and grease. Drive belts which have not been stored and treated in the following manner should not be used.
Drive belts must be stored on edge on a clean flat surface and in such a manner that bends are not less than 50 mm (2 in) radius.

When a belt is handled, it must not be bent at an acute angle or an arc of less than 25 mm (1 in) in diameter, as damage may be caused to the glass fibre reinforcement and premature failure could result.
During use, a belt develops a wear pattern, therefore, if it has to be re-used, before removal, mark the direction of rotation, using soft chalk or a similar marker, and refit the belt so that it runs in the original direction.
Belts must be dry and FREE FROM ANY OIL OR OTHER CONTAMINATION.
Do not turn the crankshaft by applying leverage to the camshaft pulley or its retaining bolt.
To remove a belt always use clean hands, or a recommended tool - NEVER use a lever.



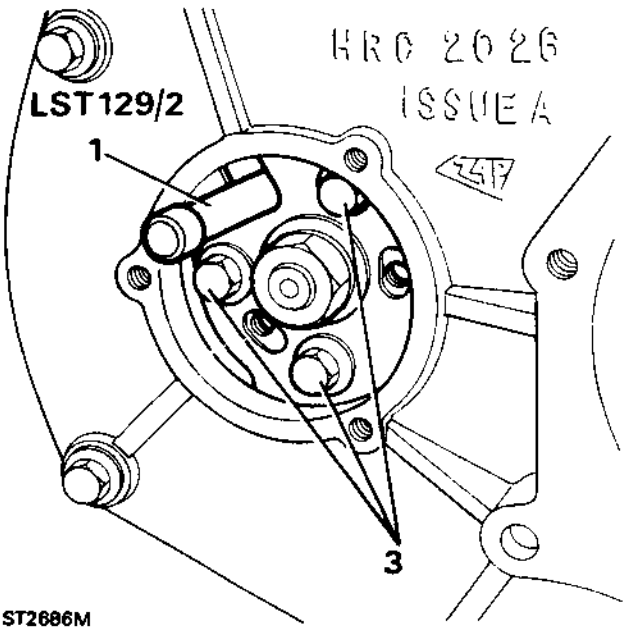
ST2705M

28. Slacken three bolts securing injector pump drive gear to hub. Without moving the gears, carefully feed the drive belt over gears keeping it tight on the drive side.
29. Fit tensioner assembly ensuring that round hole in pulley mounting plate locates over dowel in front cover.
30. Insert a 13 mm (0.5 in) square drive extension into hole in mounting plate and with a dial type torque wrench, held vertically, tension belt to 18 to 20 Nm (13 to 15 lbf.ft.). Tighten tensioner clamp bolt to ***45 Nm.*** Do not use a "break" type wrench.



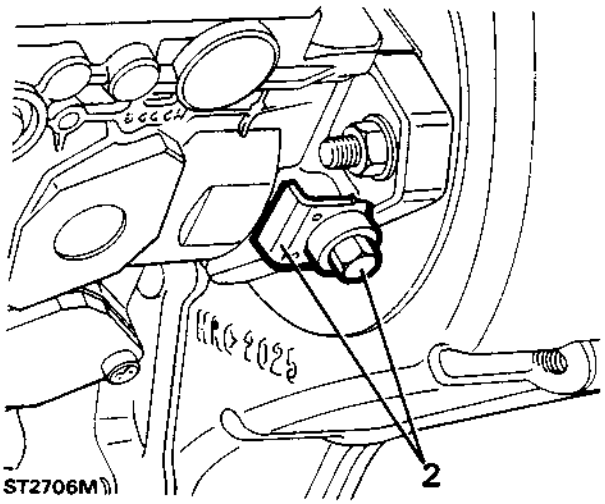
31. Tighten three pump gear securing bolts to ***25 Nm***. Remove timing pin from pump hub and check that flywheel timing pin is clear of slot. Temporarily fit damper and with special tool LST 127 rotate crankshaft two complete revolutions. Slacken tensioner clamp bolt and tension belt again as in instruction 30.

⚠ **CAUTION: The double tensioning procedure is vital otherwise the belt could fail resulting in serious damage to the engine.**



32. Turn crankshaft again, in a clockwise direction until all timing marks and pins align as in instructions 23 to 26. If timing pin cannot be inserted into pump hub, it will be necessary to adopt following procedure:-

(1) Turn crankshaft small amount necessary to enable timing pin to be inserted into the pump.
(2) Remove the keeper plate and lock the pump.



(3) Slacken three pump gear retaining bolts.
(4) Turn crankshaft to TDC.
(5) Check that timing pin is an easy fit in pump.
(6) Tighten pump gear securing bolts to ***25 Nm.***
(7) Unlock pump, fit keeper plate and tighten bolt. Remove timing pin from pump and timing pin tool from flywheel housing.

Reassemble

33. Clean front cover and cover plate mating faces. Fit a new gasket and secure with nine bolts. Tighten to ***25 Nm.***
34. Reassembling of the remaining components is mainly a reversal of the dismantling sequence. Fitting of these components is described in "Engine dismantle and overhaul" section 12. It is important that reference is made to this section at each stage of assembly to ensure that the correct procedure is followed. It is essential that the instructions concerning the fitting of the crankshaft damper are observed. **It is absolutely vital that the bolt is tightened to *340 Nm.***

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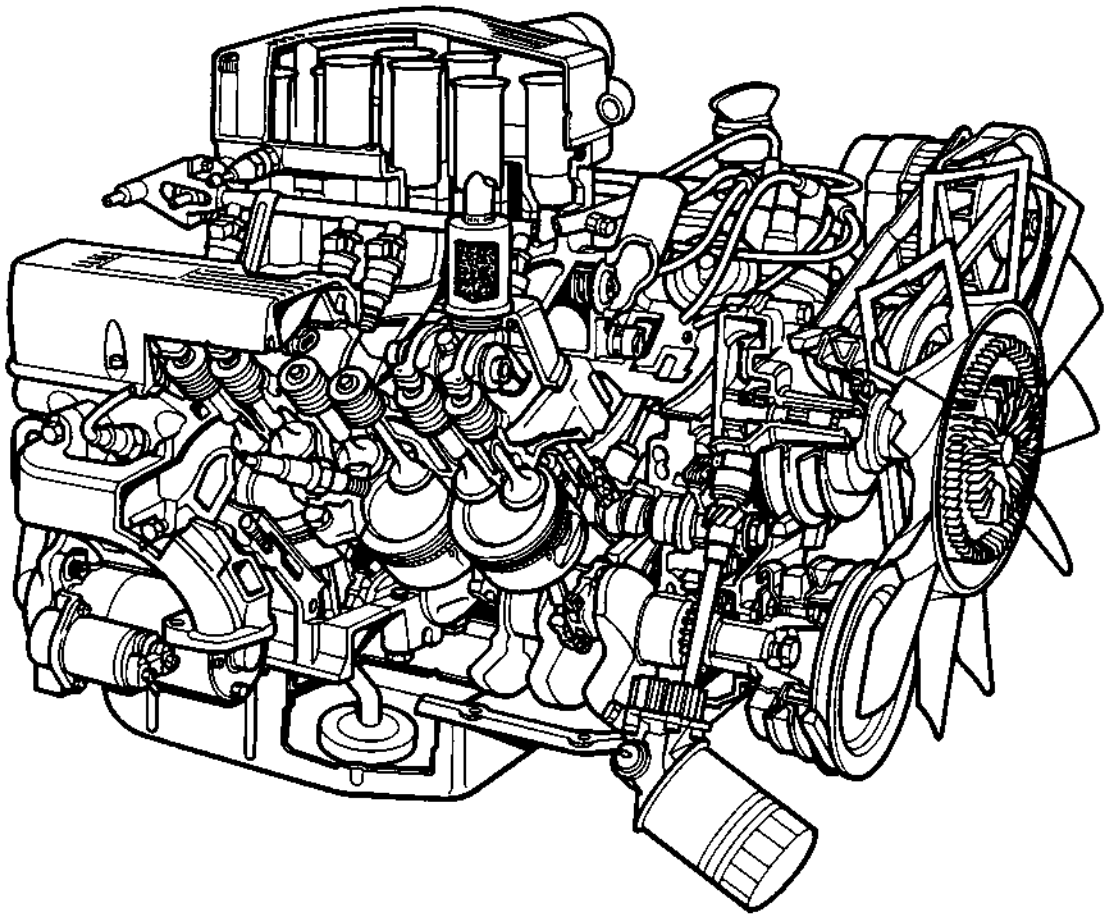
TORQUE VALUES 1

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DESCRIPTION

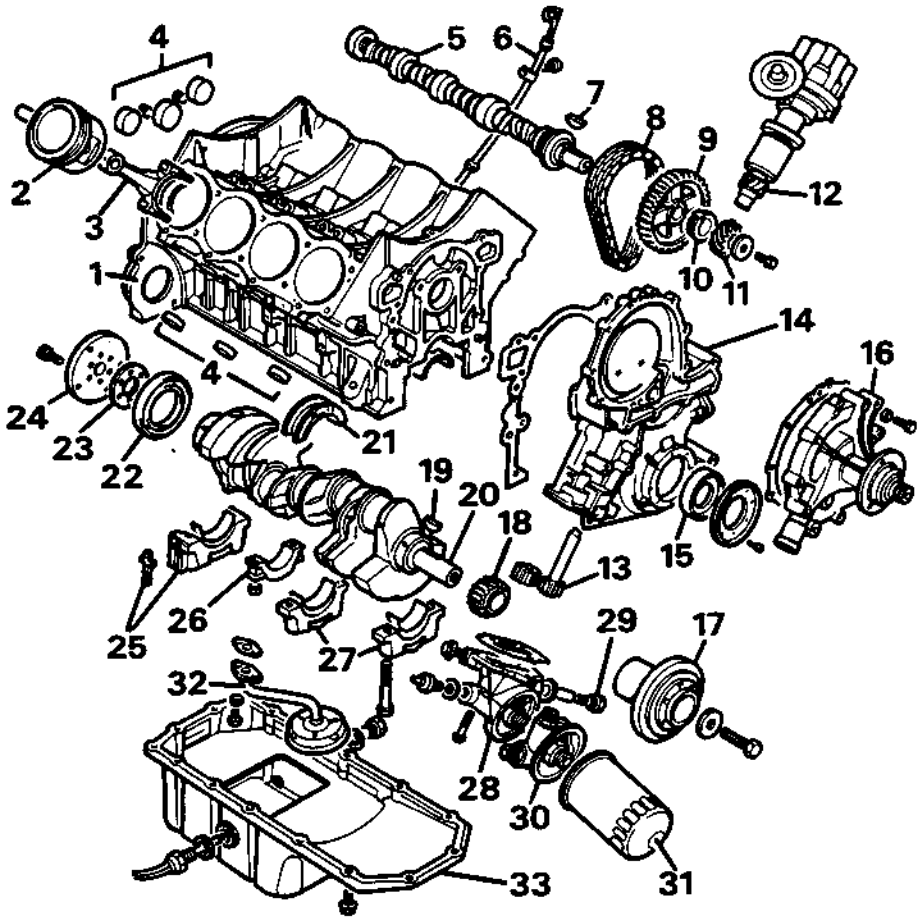
The V8 engine has cast aluminium cylinder heads and cylinder block. The two banks of steel cylinder liners which are pressed down to stops in the block, are set at 90° to one another. The three ringed aluminium pistons transmit the power through the connecting rods to a cast iron five bearing crankshaft, which drives the centrally located camshaft via an inverted tooth chain.



RR3523M

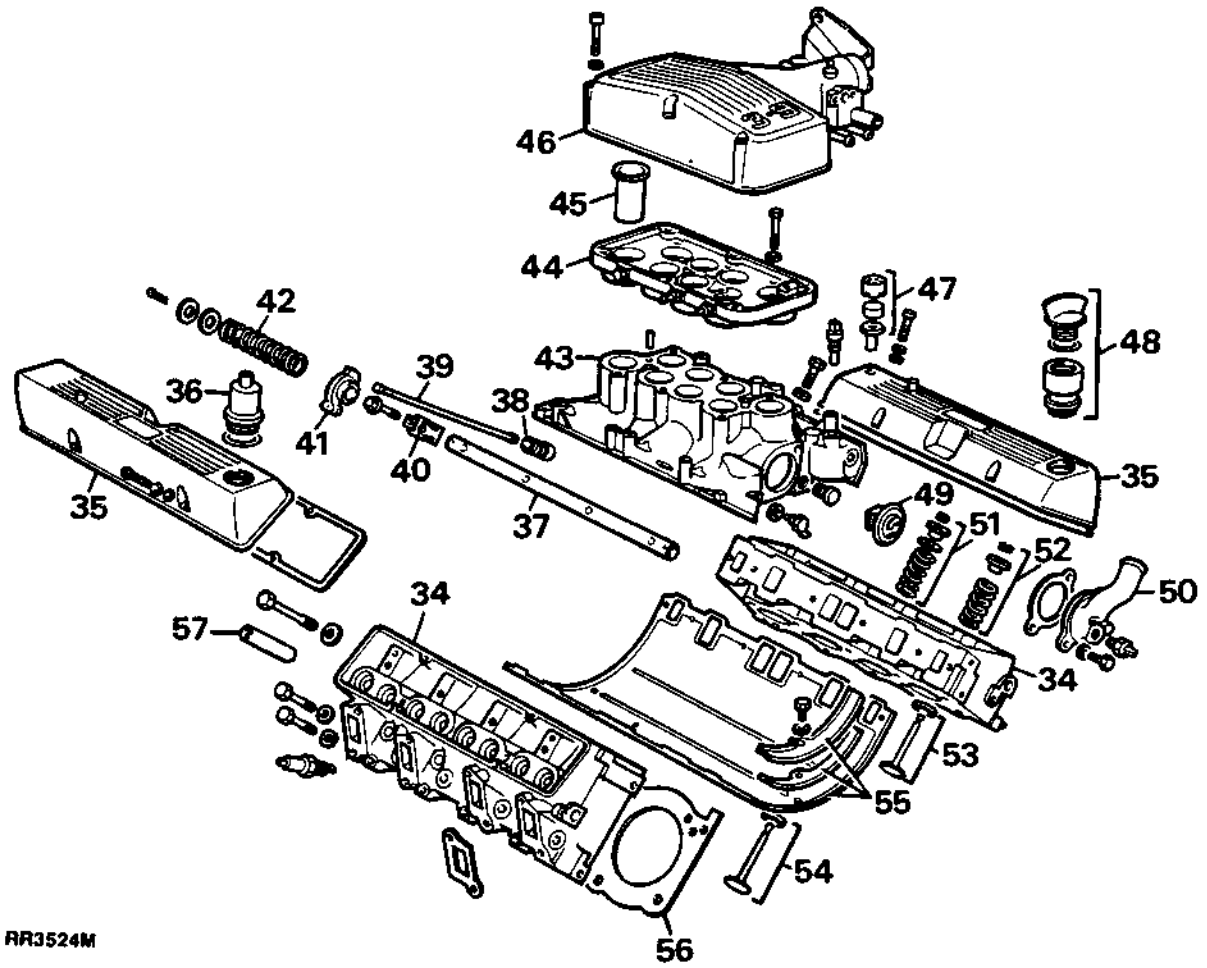
The electronic ignition distributor and lubrication oil pump are driven by a skew gear off the front of the camshaft. The overhead inlet and exhaust valves are operated by rocker shafts, pushrods and self adjusting hydraulic tappets.

Electronic fuel injection ensures that engine performance, economy and exhaust emissions are automatically correct for the demands of highway and off road operation.



RR3627M

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2. Pistons and gudgeon pins (8)
3. Connecting rods (8)
4. Core plugs
5. Camshaft
6. Dipstick
7. Camshaft key
8. Timing chain
9. Camshaft sprocket
10. Distance piece
11. Distributor/oil pump drive gear
12. Distributor
13. Oil pump gears
14. Front cover
15. Front cover oil seal
16. Water pump
17. Crankshaft damper/pulley
18. Crankshaft sprocket
19. Crankshaft sprocket key
20. Crankshaft
21. Centre main bearing shells (2)
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23. Spacer
24. Adaptor plate
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28. Oil pump cover
29. Oil pressure refief valve
30. Oil cooler/filter adaptor
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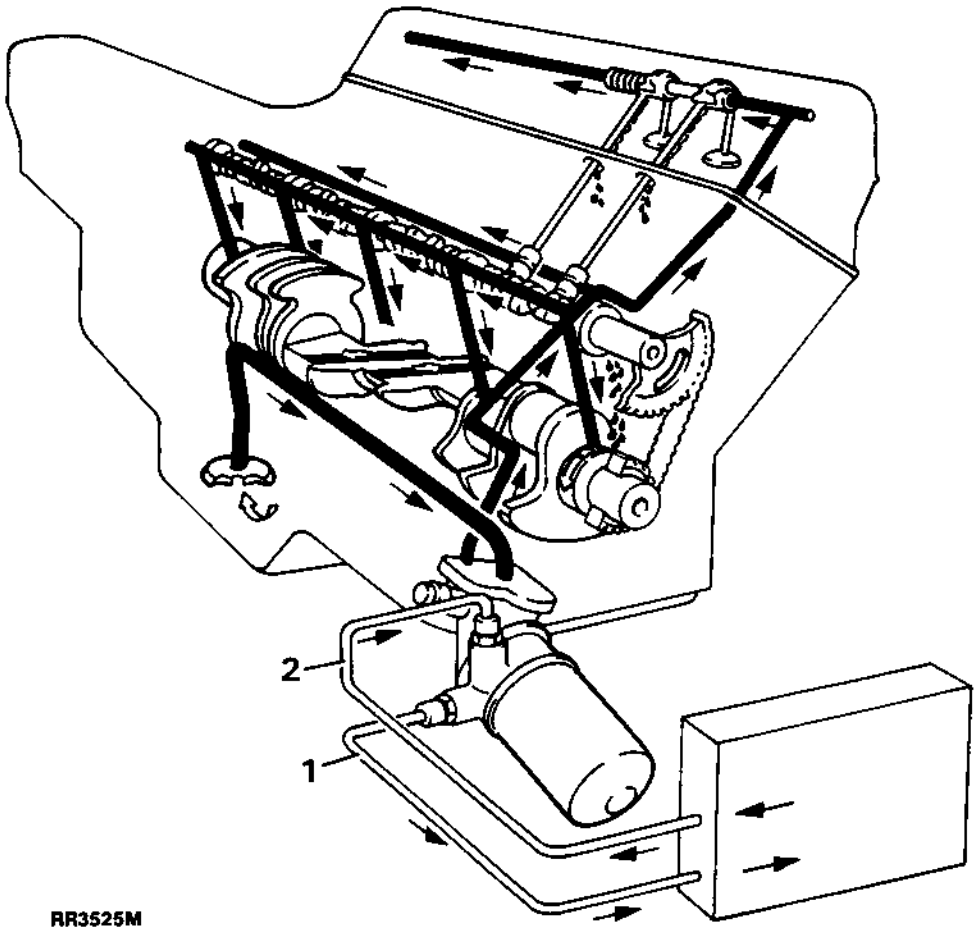
34. Cylinder heads (2)
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Lubrication system

The V8 full flow lubrication system uses an external gear pump which is driven from the front of the camshaft via the distributor drive shaft. The oil pump gears are housed in the timing cover and the pressure relief valve, warning light switch and filter are fitted to the gear cover.

Oil drawn through the centrally located steel gauze strainer in the sump, is pumped under pressure through an oil cooler located in the lower half of the main coolant radiator. The cooled oil then passes through the filter, before being distributed from the main gallery via drillings, to the various components in the engine.

Lubrication to the thrust side of the cylinders is by oil grooves machined in each connecting rod big end joint face, which are timed to align with holes in the big end journals on the power and exhaust strokes.



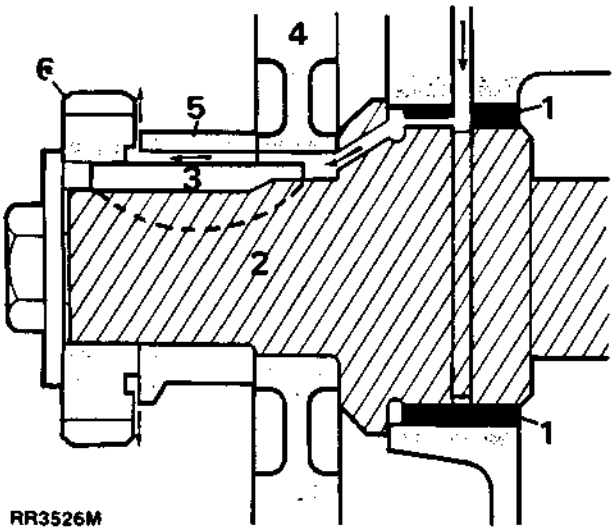
RR3525M

Lubrication system

1. Oil to cooler
2. Oil from cooler

Distributor/oil pump drive and timing chain lubrication

The distributor/oil pump drive, and timing chain are lubricated from the camshaft front bearing. The feed to the timing chain is channelled along the camshaft sprocket, key and spacer where it sprays onto the chain.

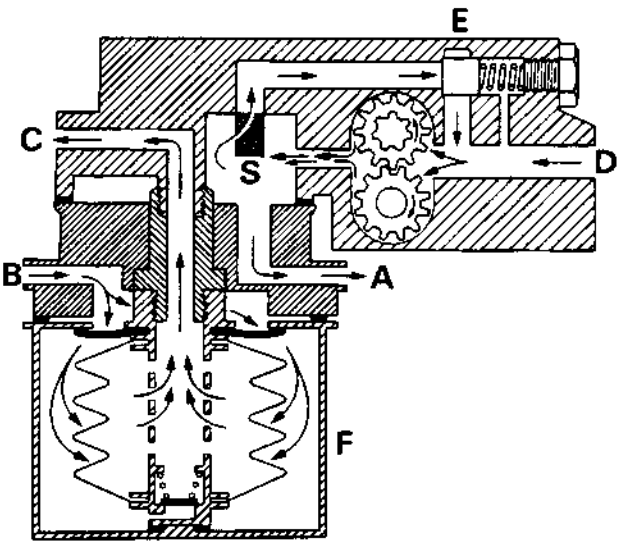


RR3526M

1. Bearing
2. Camshaft
3. Key
4. Cam gear
5. Spacer
6. Distributor/oil pump drive gear

Filtered oil

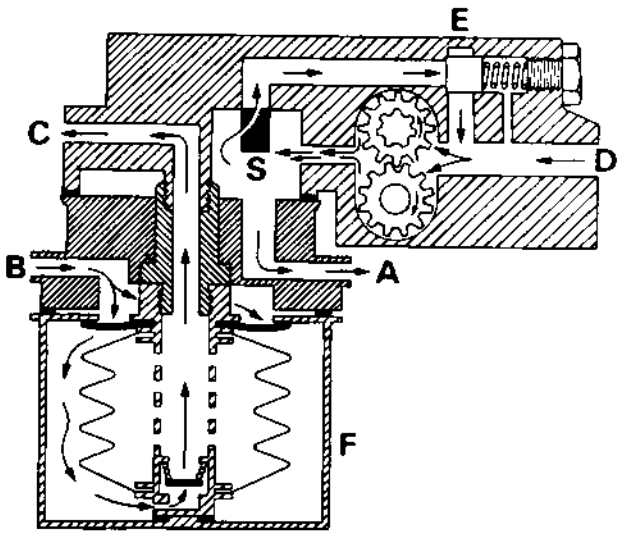
Lubrication pressure is controlled by the pressure relief valve E which allows excess pressure to escape into the pump suction gallery D. The oil is then pumped through the cooler via connections A and B before passing through the anti-siphon valve and into the filter. Filtered oil is supplied to the engine bearings by port C.



RR3528M

Unfiltered oil

Any blockage of the filter element will open the by-pass valve and maintain an un-filtered oil supply to the bearings.



RR3529M

Hydraulic tappets

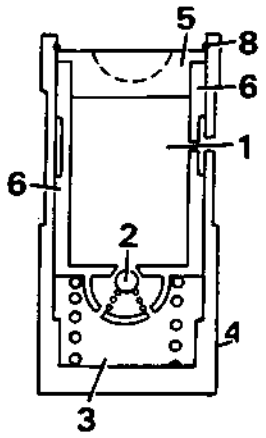
The purpose of the hydraulic tappet is to provide maintenance free and quiet operation of the inlet and exhaust valves. It achieves its designed purpose by utilizing engine oil pressures to eliminate the mechanical clearance between the rockers and the valve stems.

Operation

During normal operation, engine oil pressure present in the upper chamber 1, passes through the non-return ball valve 2 and into the lower (high pressure) chamber 3.

When the cam begins to lift the outer sleeve 4, the resistance of the cylinder valve spring felt through the push rod and seat 5, causes the inner sleeve 6, to move downwards inside the outer. This slight downward movement of the inner sleeve 6, closes the ball valve 2 and increases the hydraulic pressure in the high pressure chamber 3 , sufficient to ensure that the push rod opens the cylinder valve fully.

As the tappet assembly moves off the peak of the cam to the closing side, the ball valve 2 opens to equalize the pressure in both chambers which ensures that the cylinder valve fully closes when the tappet is on the back of the cam.



RR3531M

1. Upper chamber
2. Non-return ball valve
3. Lower chamber (high pressure)
4. Outer sleeve
5. Pushrod seat
6. Inner sleeve
7. Spring
8. Clip

ENGINE OIL PRESSURE TEST

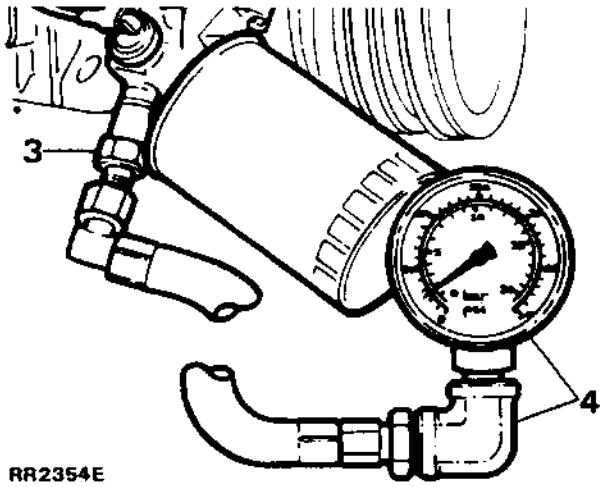
Service tools:
LRT-12-052: Pressure test equipment

WARNING: Use suitable exhaust extraction equipment, if test is being carried out in workshop.

WARNING: If vehicle has been running, engine oil will be hot, care must be taken when fitting equipment to prevent personal injury due to scalding.

Test

1. Check lubricant is to correct level.
2. Place vehicle on a ramp.
3. Disconnect the battery negative lead. Remove oil pressure switch.
4. Fit the test gauge.
5. Reconnect the battery negative lead.
6. Start and run engine to normal operating temperature.
7. At a steady engine speed of 2400 rev/min - minimum engine oil pressure reading should be - 1.76 kg/cm^2.
8. If there is no oil pressure, check for air lock in system. ***See SECTION 10, Maintenance, Service schedule***
9. If the pressure is low. ***See Overhaul, Remove and overhaul oil pump***



RR2354E

NOTE: Excessive lubrication pressure can effect engine performance by over-pressurising the hydraulic tappets causing the valves to be held open. ***See Description and operation, Description***

CYLINDER COMPRESSION - TEST

Equipment:
Compression pressure gauge

Test

1. Start and run engine until normal engine operating temperature is achieved (thermostat open).
2. Remove all spark plugs.
3. Disconnect both coil negative (WB) leads
4. Insert compression gauge, crank engine until reading stabilises.
5. Expected readings, throttle fully open, battery fully charged - 8.13:1 compression ratio: 150 - 160 psi 9.35:1 compression ratio: 170 - 180 psi
6. If compression is appreciably less than correct figure, or varies by more than 10%, piston rings or valves may be faulty.
7. Low pressure in adjoining cylinders may indicate a faulty head gasket.

ENGINE NOISES

Excessive or obtrusive noise from the engine compartment originates from three main sources:

A. The exhaust system, which makes an unmistakable and easy to diagnose noise.
B. External components emit the greatest variety of noises, but are also easy to diagnose by simply disconnecting the appropriate drive belt.
C. Engine internal mechanical noises which can vary in volume and pitch and may be a combination of, tapping - knocking or rumbling, are the most difficult to diagnose. The following is therefore a guide to diagnosis of engine internal mechanical noises only.

Engine internal mechanical noises.

Single or multiple, light tapping noise, particularly when engine is cold. ***See Description and operation, Description***

1. Is engine oil level correct?
   NO - Top up to correct level. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
   YES - Continue.

2. Is the lubricating oil pressure correct?
   NO - ***See Engine oil pressure test***
   YES - Suspect valve operating mechanism.

3. To confirm diagnosis, remove the rocker covers and with the engine idling, insert a feeler gauge of 0,015 mm between each rocker and valve stem. A faulty valve operating mechanism will emit a different noise when the feeler gauge is inserted. ***See Repair, Rocker shaft renew***

Heavy knocking noise (particularly on load and when engine is hot). ***See Description and operation, Description***

1. Is engine oil level correct?
   NO - Top up to correct level. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
   YES - Continue.

2. Is the lubricating oil pressure correct?
   NO - ***See Engine oil pressure test***
   YES - Drain engine oil and filter, and examine for metallic contamination.

3. Is the oil contaminated with metal particles?
   YES - Suspect faulty big end bearings. To confirm diagnosis, short out the ignition to each spark plug in turn. The noise will disappear or be reduced when the cylinder with the faulty big end is shorted out.

4. If noise is not conclusively diagnosed, check the security of the flywheel and crankshaft front pulley. Temporarily release the drive belts to reduce general noise level and use a stethoscope to locate source of noise.

Heavy rumbling noise (particularly during hard acceleration). ***See Description and operation, Description***

1. Is engine oil level correct?
   NO - Top up to correct level. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
   YES - Continue.

2. Is the lubricating pressure correct?
   NO - ***See Engine oil pressure test***
   YES - Drain engine oil and filter, and examine for metallic contamination.

3. Is the oil contaminated with metal particles?
   YES - Suspect faulty main bearings. If noise is not conclusively diagnosed, check the security of the flywheel and crankshaft front pulley. Temporarily release the drive belts to reduce general noise level and use a stethoscope to locate source of noise.

ENGINE STARTING PROBLEMS

Engine fails to crank in park or neutral (Automatic Transmission)

1. Is battery in good state of charge?
   NO - ***See INTRODUCTION, Information, Jump starting***
   YES - Continue.

2. Is automatic transmission inhibitor switch faulty or gear selection linkage incorrectly adjusted?
   YES - ***See AUTOMATIC GEARBOX, Repair, Inhibitor switch See AUTOMATIC GEARBOX, Repair, Gear lever selector cable setting***
   NO - ***See ETM, B1***
   If problem is not diagnosed repeat tests, starting at 1.

Engine fails to crank (Manual Transmission)

1. Is battery in good state of charge?
   NO - ***See INTRODUCTION, Information, Jump starting***
   YES - ***See ETM, B1***
   If problem is not diagnosed repeat tests, starting at 1.

Engine cranks but fails to start

1. Is the cranking speed fast enough (120 rev/min)?
   NO - ***See INTRODUCTION, Information, Jump starting***
   If necessary also ***See ETM, B1***
   YES - Continue.

2. Is there combustion in any cylinder?
   NO - ***See ELECTRICAL, Fault diagnosis, Lucas constant energy ignition system 35DLM8-preliminary checks See ETM, A1***
   YES - Continue.

3. Are the fuel supply, tank, pump, ventilation and emission control systems in correct working order or the fuel contaminated?
   NO - ***See FUEL SYSTEM, Repair, Fuel filter See FUEL SYSTEM, Repair, Fuel tank - 1991 onwards See FUEL SYSTEM, Repair, Fuel pump - Pre 1991 See EMISSION CONTROL, Description and operation, Emission control***
   If problem is not diagnosed repeat tests, starting at 2.

ENGINE RUNNING PROBLEMS

Engine runs at high speed but will not idle (stops)
Engine idle speed erratic. Engine starts but stops immediately
Engine stalls. Engine misfires/hesitation

1. Electronic fuel injection. ***See ETM, A1 See ELECTRICAL, Fault diagnosis, Lucas constant energy ignition system 35DLM8-preliminary checks***
   Check brake vacuum connections. ***See BRAKES, Description and operation, Brake servo unit***
   Check heater/ventilation unit vacuum connections. ***See HEATING AND VENTILATION, Description and operation, Heating and ventilation unit***
   If problem is not diagnosed continue.

2. Are HT leads correctly routed and clipped?
   NO - ***See ELECTRICAL, Repair, Distributor***
   YES - Continue.

3. Is fuel supply, tank, pump, ventilation and emission control systems in correct working order or the fuel contaminated?
   NO - ***See FUEL SYSTEM, Repair, Fuel filter See FUEL SYSTEM, Repair, Fuel tank - 1991 onwards See FUEL SYSTEM, Repair, Fuel pump - Pre 1991 See EMISSION CONTROL, Description and operation, Emission control***
   If problem is not diagnosed repeat tests, starting at 1.

Engine lacks power/poor performance

1. Is throttle travel restricted or cable incorrectly adjusted?
   YES - Check thickness of carpets. ***See FUEL SYSTEM, Repair, Throttle cable See FUEL SYSTEM, Repair, Throttle pedal***
   NO - Continue.

2. Are the Ignition and Electronic Fuel Injection systems in order?
   NO - ***See ETM, A1 See ELECTRICAL, Fault diagnosis, Lucas constant energy ignition system 35DLM8-preliminary checks See ELECTRICAL, Repair, Distributor***
   YES - Continue.

3. Are fuel supply, tank, pump, ventilation and emission control systems in correct working order or the fuel contaminated?
   NO - ***See FUEL SYSTEM, Repair, Fuel filter See FUEL SYSTEM, Repair, Fuel tank - 1991 onwards See FUEL SYSTEM, Repair, Fuel pump - Pre 1991 See EMISSION CONTROL, Description and operation, Emission control***
   YES - Suspect valves held open by hydraulic tappets due to high oil pressure. ***See Engine oil pressure test***

4. Is oil pressure high?
   YES - Remove oil filter and cooler adaptor and check pressure relief valve strainer gauze for blockage and that the relief valve is not stuck closed. ***See Description and operation, Description***
   NO - Carry out cylinder compression tests to determine condition of head gaskets and valves. ***See Cylinder compression - test***

5. Are cylinder compressions satisfactory?
   NO - For overhaul ***See Overhaul, Remove and overhaul cylinder heads***
   YES - Check brake vacuum connections. ***See BRAKES, Description and operation, Brake servo unit***

Check heater/ventilation unit vacuum connections. ***See HEATING AND VENTILATION, Description and operation, Heating and ventilation unit***
If problem is not diagnosed - Continue.

6. Are the brakes binding?
   YES - Investigate cause of binding.
   NO - Continue.

7. Automatic Transmission only. Is the Torque Converter and Transmission operating correctly? Carry out Road test, Static tests and Stall tests to determine condition of Automatic transmission. If problem is not diagnosed; repeat tests starting at 1.

Engine backfires into exhaust system

1. Are there any leaking joints/connections or holes in the exhaust system?
   YES - ***See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust system complete***
   NO - Continue.

2. Is distributor fitted correctly, HT leads in correct firing order and routed correctly?
   NO - ***See ELECTRICAL, Repair, Distributor***
   YES - Continue.

3. Is air/fuel ratio correct?
   NO - Check electronic fuel injection. ***See ETM, A1***
   Check brake vacuum connections. ***See BRAKES, Description and operation, Brake servo unit***
   Check heater/ventilation unit vacuum connections. ***See HEATING AND VENTILATION, Description and operation, Heating and ventilation unit***
   Check the crankcase and fuel tank ventilation system. ***See EMISSION CONTROL, Description and operation, Emission control***
   YES - Continue.

4. Are cylinder compressions satisfactory?
   NO - Carry out compression test to check for leaking gaskets, valves etc. ***See Cylinder compression - test***
   For overhaul. ***See Overhaul, Remove and overhaul cylinder heads***
   If problem is not diagnosed; repeat tests starting at 1.

Engine backfires into inlet system

1. Is the Distributor, HT connections and routing correct?
   NO - ***See ELECTRICAL, Repair, Distributor***
   YES - Continue.

2. Is air fuel ratio correct?
   NO - Check electronic fuel injection. ***See ETM, A1***
   Check brake vacuum connections. ***See BRAKES, Description and operation, Brake servo unit***
   Check heater/ventilation unit vacuum connections. ***See HEATING AND VENTILATION, Description and operation, Heating and ventilation unit***
   Check the crankcase and fuel tank ventilation system. ***See EMISSION CONTROL, Description and operation, Emission control***
   YES - Continue.

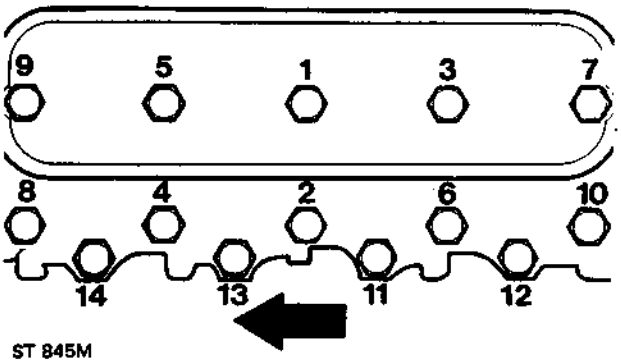
3. Are cylinder compressions satisfactory?
   NO - Carry out compression test to check for leaking gaskets valves etc. ***See Cylinder compression - test***
   For overhaul ***See Overhaul, Remove and overhaul cylinder heads***
   If problem is not diagnosed: repeat tests starting at 1.

Notes

CYLINDER HEAD GASKETS - RENEW

Service repair no - 12.29.01

1. Drain cooling system. ***See COOLING SYSTEM, Adjustment, Coolant***
2. Remove inlet manifold. ***See FUEL SYSTEM, Repair, Intake manifold***
3. Remove alternator. ***See ELECTRICAL, Repair, Alternator***
4. Remove rocker shafts. ***See rocker shaft renew***
5. Remove push rods.
6. Remove power steering pump belt.
7. Remove alternator bracket.
8. Remove both exhaust manifolds.
9. Remove air cleaner assembly. ***See FUEL SYSTEM, Repair, Air cleaner***
10. Remove air flow meter. ***See FUEL SYSTEM, Repair, Air flow sensor***
11. Remove earth leads from rear of left hand cylinder head
12. Right hand cylinder head - remove breather pipe from lifting bracket.
13. Loosen cylinder head bolts, reversing tightening sequence.
14. Remove cylinder heads.
15. Remove cylinder head gaskets.
16. Clean exhaust mating faces.
17. Clean head and block faces.
18. Fit new cylinder head gaskets, word TOP uppermost. DO NOT use sealant.
19. Oil cylinder bores.
20. Clean threads of head bolts and coat with Loctite 572.
21. Locate cylinder heads on block.
22. Locate cylinder head bolts in position illustrated.
    Long bolts - 1, 3, and 5.
    Medium bolts - 2, 4, 6, 7, 8, 9 and 10
    Short bolts - 11, 12, 13, and 14



ST 845M

NOTE: Left hand cylinder head illustrated, arrow points to front of vehicle.

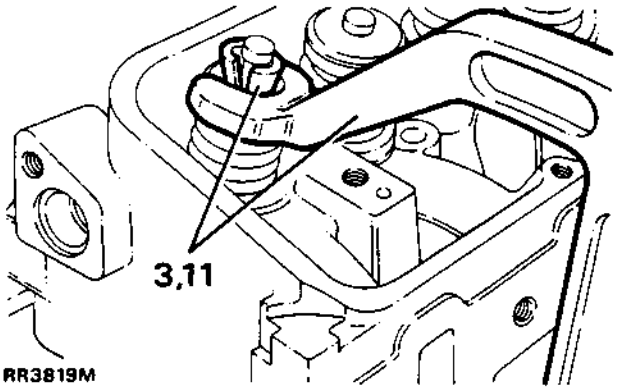
23. Tighten bolts progressively in sequence, see illustration number ST845M. Finally tighten to torque:
    Outer row ***60 Nm***
    Centre row ***90 Nm***
    Inner row ***90 Nm.***

24. When all bolts have been tightened, re-check for correct torque.
25. Reverse removal procedure. Operations 12 to 1.

CYLINDER HEADS - RENEW

Service repair no - 12.29.15

1. Remove cylinder heads and gaskets. ***See cylinder head gaskets - renew***
2. Remove spark plugs.
3. Using spring compressor 18G 106A, remove valves, collets, springs and caps.



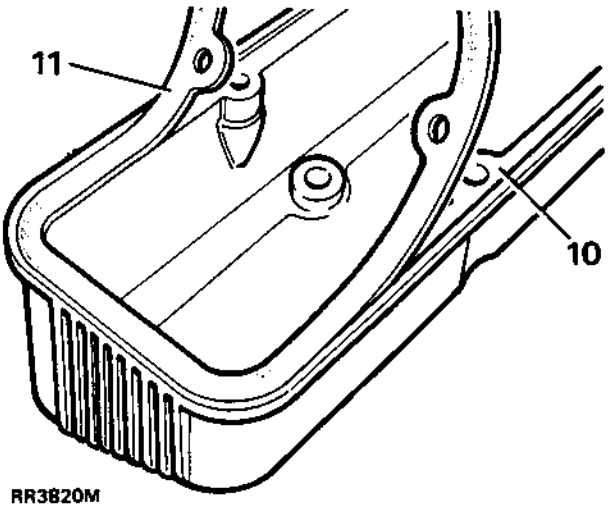
4. From left hand cylinder head, remove earth lead studs.
5. Remove PAS pump pivot stud.
6. Right hand cylinder head, remove rear lifting bracket.
7. Fit lifting bracket to new right hand cylinder head.
8. Fit PAS pump pivot stud, earth lead studs to new left hand cylinder head.
9. Regrind valves.
10. Lubricate valve stems, fit valves, springs, and caps. Fit new seals to inlet valve stems only.
11. Using spring compressor 18G 106A, compress springs, fit collets. Tap valve to check correct collet seating.
12. Fit spark plugs.
13. Fit cylinder heads with new gaskets. ***See cylinder head gaskets - renew***

ROCKER COVER - RIGHT HAND - RENEW

Service repair no - 12.29.41

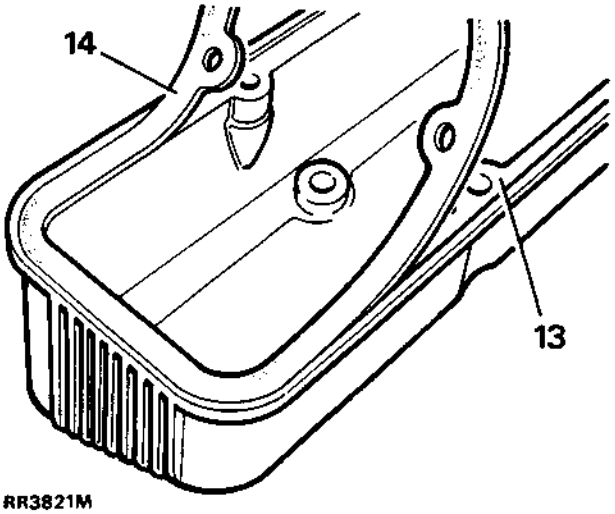
1. Disconnect the battery negative lead.
2. Disconnect purge pipe from charcoal canister at plenum.
3. Remove breather pipe from rocker cover.
4. Remove coolant pipes from inlet manifold.
5. Remove spark plug leads from plugs and retaining clips.
6. Remove four rocker cover bolts. Moving fuel pipes aside, remove rocker cover.
7. Discard rocker cover gasket.
8. Remove plug lead retaining clips from rocker cover, fit to new rocker cover.
9. Clean and dry rocker cover and cylinder head mating faces, using Bostik cleaner 6001.

△ **NOTE: Gasket fits one way round only. It must be fitted accurately, first time. Subsequent movement will destroy bonding.**



10. Apply Bostik 1775 impact adhesive to rocker cover seal face and gasket, using a brush to ensure an even film. Allow adhesive to become touch dry.

11. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.
12. Allow cover to stand for thirty minutes before fitting.
13. Fit rocker cover to cylinder head with four screws, short screws inboard, tighten to ***8 Nm.***
14. Position fuel pipes.
15. Fit breather pipe to rocker cover, tighten clip.
16. Fit coolant pipes to inlet manifold, tighten bolts.
17. Fit spark plug leads to plugs and retaining clips.
18. Connect purge pipe from charcoal canister at plenum, tighten clip.



RR3821M

ROCKER COVER - LEFT HAND - RENEW

Service repair no - 12.29.40

1. Remove air flow sensor. ***See FUEL SYSTEM, Repair, Air flow sensor***
2. Remove plenum chamber. ***See FUEL SYSTEM, Repair, Plenum chamber***
3. Remove dipstick.
4. Remove spark plug leads from plugs and retaining clips.
5. Disconnect HT lead from coil.
6. Remove alternator heat shield from rocker cover.
7. Remove air flow meter harness clip.
8. Remove dipstick tube clip.
9. Remove four rocker cover bolts, remove rocker cover.
10. Discard gasket
11. Remove plug lead retaining clips from rocker cover, fit to new rocker cover.
12. Clean and dry rocker cover and cylinder head mating faces, using Bostik cleaner 6001.

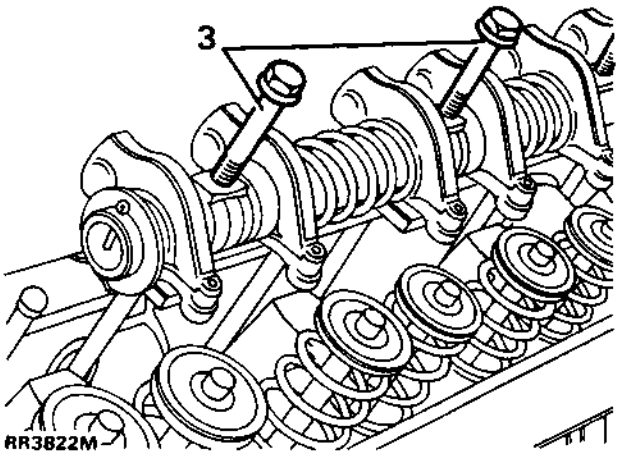
△ **NOTE: Gasket fits one way round only. It must be fitted accurately, first time. Subsequent movement will destroy bonding.**

13. Apply Bostik 1775 impact adhesive to rocker cover seal face and gasket, using a brush to ensure an even film. Allow adhesive to become touch dry, approximately fifteen minutes.
14. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.
15. Allow cover to stand for thirty minutes before fitting.
16. Fit rocker cover to cylinder head with four screws, short screws inboard. Tighten to ***8 Nm.***
17. Locate and tighten dipstick tube clip.
18. Fit and tighten air flow meter harness clip.
19. Fit alternator heat shield to rocker cover.
20. Connect HT lead to coil.
21. Connect spark plug leads to plugs and retaining clips.
22. Fit dipstick.
23. Fit plenum chamber.
24. Fit air flow meter.

ROCKER SHAFT RENEW

Service repair no - 12.29.29

1. Remove rocker covers as required. ***See rocker cover - right hand - renew*** or ***See Rocker cover - left hand - renew***
2. Loosen four rocker shaft fixings



3. Remove rocker shaft assembly.

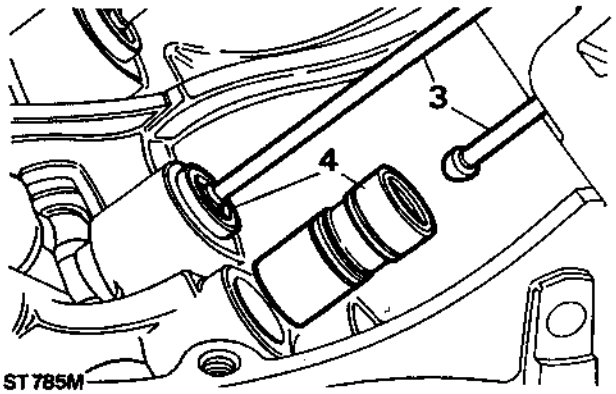
NOTE: Each rocker shaft is notched at ONE end. Notch must be uppermost and towards front of engine on right hand side, towards rear on left hand side.

4. Clean rocker pedestal locations on cylinder head.
5. Fit rocker shaft assembly, locating push rods to rockers.
6. Tighten rocker shaft fixings to ***38 Nm.***
7. Fit rocker covers.

HYDRAULIC TAPPETS RENEW

Service repair no - 12.29.57

1. Remove rocker shafts. ***See rocker shaft renew***
2. Remove inlet manifold. ***See FUEL SYSTEM, Repair, intake manifold***
3. Remove push rods, retain in removal sequence.



4. Remove hydraulic tappets
5. Fit tappets, push rods and rocker assemblies. ***See Overhaul, fit tappets, push rods and rocker assemblies***
6. Fit inlet manifold.
7. Reverse removal procedure.

CRANKSHAFT PULLEY ASSEMBLY

Service repair no - 12.21.01

1. Remove viscous coupling. ***See COOLING SYSTEM, Repair, viscous coupling, fan blades, pulley and fan cowl***
2. Remove water pump drive belt.
3. Remove alternator drive belt.
4. Remove power steering pump drive belt.
5. Raise vehicle on ramp.
6. Remove bell housing bottom cover.
7. Remove engine undertray. ***See CHASSIS AND BODY, Repair, engine undertray***
8. With assistance to stop flywheel rotation, remove crankshaft pulley assembly retaining bolt.
9. Remove crankshaft pulley assembly.
10. If required: Place assembly in vice and remove pulleys.
11. Fit pulleys to torsional vibration damper.
12. Lubricate seal face of assembly.
13. Fit pulley assembly.
14. With assistance to stop flywheel rotation, fit retaining bolt, tighten to ***280 Nm.***
15. Reverse removal procedure 1 to 7.

FRONT COVER OIL SEAL - RENEW

Service repair no - 12.21.14

1. Remove crankshaft pulley. ***See crankshaft pulley assembly***

Do not remove pulleys.

2. Remove eight screws and remove mud excluder.
3. Fit button of 18G1328 to crankshaft, fit extractor to seal.
4. Turn centre bolt of extractor to remove seal.
5. Remove seal from extractor.
6. Clean seal seating.
7. Lubricate outside diameter of seal.
8. Locate seal in front cover.
9. Fit adaptor 18G1291/5 to 18G1291/4.
10. Fit tool to seal.
11. Fit and tighten centre bolt to crankshaft, tighten centre locknut to seat seal.
12. Slacken locknut and remove tool.
13. Lubricate seal lip.
14. Fit mud excluder and tighten screws.
15. Fit crankshaft pulley assembly.

FRONT COVER GASKET

Service repair no - 12.65.04

Remove and refit

Remove

1. Remove crankshaft pulley. ***See crankshaft pulley assembly***
   Do not remove pulleys.
2. Remove water pump pulley.
3. Release distributor cap clips.
4. Release plug leads from plugs and clips.
5. Place cap and leads to one side.
6. Turn engine until No. 1 piston is at T.D.C.
7. Check position of rotor arm.
8. Remove fixings securing power steering pump bracket to water pump bracket.
9. Remove power steering pump bracket from water pump.
10. Remove clips securing wiring to alternator tensioner.
11. Disconnect distributor feed wire.
12. Pivot power steering pump away from front cover, tighten pivot to retain in position.
13. Disconnect vacuum pipe from distributor.
14. Remove water pump bottom hose.
15. Disconnect oil pressure switch.
16. Disconnect heater hose at water pump.
17. Remove alternator tensioner from water pump, move tensioner aside.
18. Mark distributor position to front cover.
19. Remove distributor clamp, remove distributor.
20. Remove fixings sump to front cover.
21. Loosen four adjacent sump fixings.
22. Remove alternator support strut from front cover, move strut aside.
23. Loosen remaining front cover fixings and remove front cover.
24. Remove front cover gasket.

Refit

25. Clean timing cover, clean block face.
26. Lightly grease gasket faces.
27. Fit new gasket to block face.
28. Apply Hylosil to sump gasket.
29. Clean threads of cover fixing bolts, apply Loctite 372 to threads.
30. Fit timing cover, fit fixing bolts. Tighten to ***28 Nm.***
31. Fit alternator support strut to front cover.
32. Tighten sump to timing cover fixings to ***10 Nm.***
33. Tighten sump fixings to ***10 Nm.***
34. Lubricate distributor 'O' ring.
35. Fit distributor in position marked.
36. Align oil pump drive, if distributor does not seat correctly.
37. Fit distributor clamp. Tighten to ***20 Nm.***
38. Locate alternator tensioner on water pump bracket.
39. Connect heater hose, tighten clip.
40. Connect oil pressure switch.
41. Connect bottom hose, tighten clip.
42. Connect vacuum pipe to distributor.
43. Loosen power steering pump pivot, lower pump.
44. Connect distributor feed wire.
45. Connect wire ties to alternator tensioner.
46. Fit power steering pump bracket to water pump. Tighten to ***28 Nm.***
47. Fit power steering pump to bracket.
48. Position distributor cap. Fit plug leads to plugs and clips.
49. Clip distributor cap in position.
50. Fit water pump pulley. Tighten to ***10 Nm.***
51. Fit crankshaft pulley. ***See crankshaft pulley assembly***
52. Tension drive belts correctly.
53. Check ignition timing.
54. Refill cooling system.

TIMING CHAIN AND CHAINWHEELS

Service repair no - 12.65.12

Remove and refit

Remove

1. Remove front cover. ***See front cover gasket***
2. Remove retaining bolt and washer, remove distributor drive gear and spacer.
3. Ensure number one piston is at TDC.
4. Remove chainwheels and chain as an assembly.

Refit

5. Clean chainwheels and chain.
6. Fit chainwheels to chain, aligning timing marks.
7. Ensure camshaft key is fitted parallel to shaft axis to ensure adequate lubrication to distributor drive gear.
8. Engage chainwheel assembly on camshaft and crankshaft keys, ensure chain wheels are fully located.
9. Check alignment of timing marks with straight edge.
10. Fit spacer with flange to front,
11. Fit distributor drive gear with groove towards spacer.
12. Fit retaining bolt and washer. Tighten to ***58 Nm.***
13. Fit front cover. ***See front cover gasket***

FLYWHEEL

Service repair no - 12.53.07

Remove and refit

Remove

1. Remove gearbox and clutch. ***See CLUTCH, Repair, clutch assembly***
2. Slacken starter motor bolts.
3. Lock flywheel, remove flywheel bolts and flywheel.

Refit

4. Clean components for reassembly.
5. Fit flywheel.
6. Lock flywheel, fit flywheel bolts. Tighten to ***80 Nm.***

FLEXIBLE DRIVE PLATE AND RING GEAR

Service repair no - 12.53.13

Remove and refit

Remove

1. Remove transmission ***See AUTOMATIC GEARBOX, Repair, ZF Auto with Borg Warner Transfer Gearbox***
2. Remove flexible drive plate and ring gear assembly. ***See Overhaul, remove flexible drive plate and ring gear assembly***

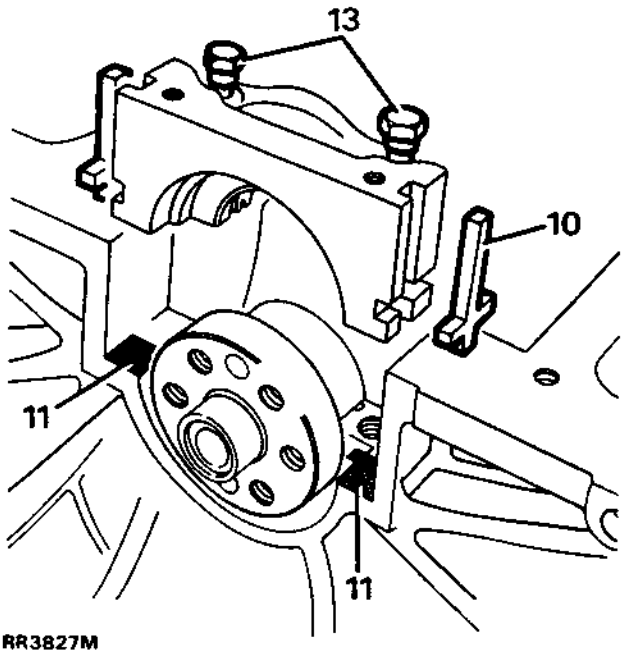
Refit

3. Clean all components for reassembly.
4. Fit ring gear and flexible drive plate assembly. ***See Overhaul, fit ring gear and flexible drive plate assembly***
5. Fit transmission.

CRANKSHAFT REAR OIL SEAL

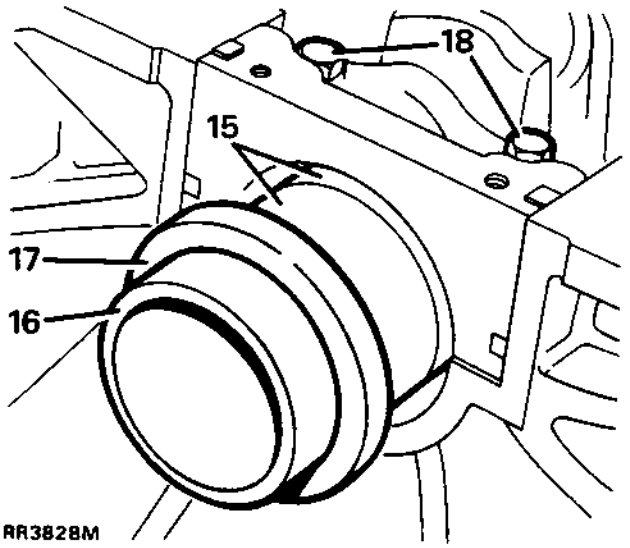
Service repair no - 12.21.20

1. Remove engine. ***See Overhaul, engine removal***
2. Automatic transmission, remove drive plate. ***See Overhaul, Remove flexible drive plate and ring gear assembly***
   OR manual transmission, remove flywheel. ***See Overhaul, Remove and overhaul flywheel - manual gearbox models only***
3. Remove dipstick.
4. With assistance, invert engine, support on blocks.
5. Remove sump.
6. Remove rear main bearing cap.
7. Remove cross seals from cap.
8. Remove crankshaft rear oil seal.
9. Clean main bearing cap and oil seal area of block.
10. Fit new cross seals to bearing cap.
11. Apply Hylomar SQ32M to block as illustrated.



RR3827M

12. Lubricate bearing shell and cross seals using clean engine oil.
13. Fit bearing cap, do not tighten bolts.
14. Ensure cap is fully home and seated squarely on the block.
15. Ensure oil seal guide RO1014 and crank journal are scrupulously clean. Coat seal guide and oil seal journal with clean engine oil.



RR3828M

⚠ **CAUTION: Do not handle oil seal lip, check it is not damaged. Ensure outside diameter remains clean and dry.**

16. Position oil seal guide RO1014 on crankshaft flange.

△ **NOTE: Lubricant coating must cover seal guide outer surface completely to ensure that oil seal lip is not turned back during assembly. Position oil seal, lipped side towards engine, on seal guide. Seal outside diameter MUST be clean and dry.**

17. Push oil seal fully and squarely by hand into recess in cap and block until it contacts machined step in recess. Remove seal guide.
18. Tighten rear main bearing cap to ***90 Nm.***
19. Fit sump. ***See Overhaul, Fit sump***
20. Reposition engine, fit dipstick.
21. Fit flywheel, or automatic drive plate.
22. Fit engine to vehicle.

ENGINE REMOVAL

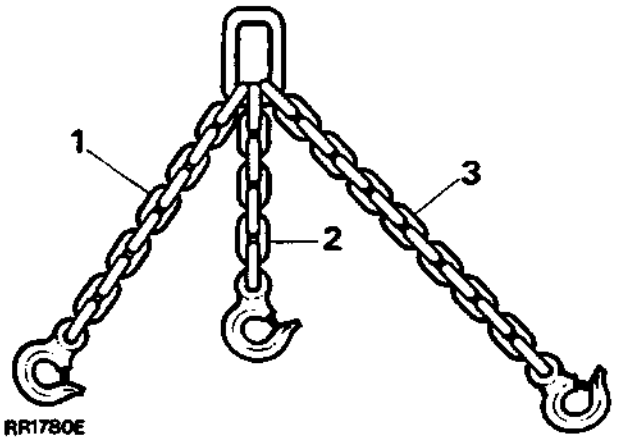
Remove and refit

Remove

1. Park vehicle on level ground and apply park brake.
2. De-pressurize fuel system. ***See FUEL SYSTEM, Repair, Depressurising fuel system***
3. Remove bonnet. ***See CHASSIS AND BODY, Repair, Bonnet***
4. Remove battery. ***See ELECTRICAL, Repair, Battery***
5. Remove radiator/oil coolers. ***See COOLING SYSTEM, Repair, Radiator/oil coolers***
6. Place an absorbent cloth around fuel feed hose at fuel rail and release compression nut. Remove feed hose from rail, seal end of pipes with masking tape to prevent ingress of dirt.
7. Release fuel return hose clamp and remove hose from pressure regulator, seal both openings with masking tape to prevent ingress of dirt.
8. Remove vacuum hose from rear of regulator.
9. Manual vehicles: Disconnect throttle cable from bracket. Automatic vehicles: Detach throttle bracket from plenum chamber and lay assembly to one side. ***See FUEL SYSTEM, Repair, Plenum chamber DO NOT DISTURB KICK DOWN CABLE SETTING.***
10. Remove ram housing. ***See FUEL SYSTEM, Repair, Ram housing***
11. Remove air flow sensor. ***See FUEL SYSTEM, Repair, Air flow sensor***
12. Remove air cleaner assembly. ***See FUEL SYSTEM, Repair, Air cleaner***
13. Remove alternator. ***See ELECTRICAL, Repair, alternator***
14. Release air conditioning compressor from its mounting and lay to one side. DO NOT discharge air conditioning system. ***See AIR CONDITIONING, Repair, compressor***

△ **NOTE: Release bolts securing compressor mounting bracket to engine and remove bracket to enable temporary lifting eye ETC 5964 to be fitted. Secure lifting eye to mounting bracket fixing points with suitable bolts of equivalent size, pitch and thread. Leave lifting eye attached until engine is reinstalled in vehicle.**

15. Place drain tray underneath vehicle.
16. Disconnect hose from reservoir to power steering pump. Secure hose end above level of fluid reservoir to avoid unnecessary loss of fluid.
17. Disconnect power steering pump to power steering box hose. Seal hose and pump openings with masking tape to prevent ingress of dirt. Wipe away any fluid spillage from chassis or steering box.
18. Disconnect fuel temperature and coolant temperature sensor multi-plugs.
19. Disconnect leads from coil.
20. Identify each injector multi-plug for re-assembly and disconnect plugs from injectors.
21. Manoeuvre harness from behind fuel rails and place to one side clear of engine assembly.
22. Remove two clamps securing gearbox oil cooler pipes to engine block.
23. Remove engine mounting fixings on both sides of cylinder block.
24. Fit lifting chains to engine lifting eyes as shown in illustration RR1780E.



RR1780E

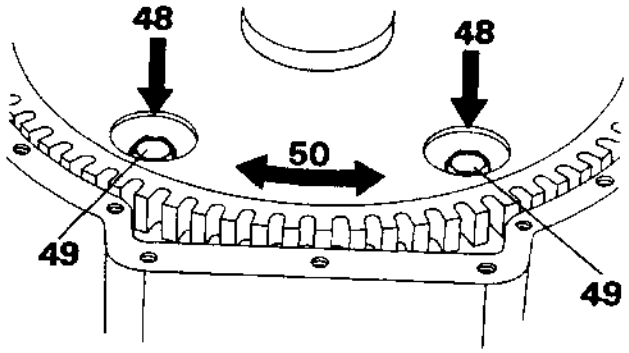
1. L/H Front chain 356 mm total overall length.
2. R/H Front chain 330 mm total overall length.
3. R/H Rear chain 457 mm total overall length.

△ **NOTE: All chain dimensions are measured from end of lifting hook to end of last link in chain.**

4. Fit chain lifting eye to a suitable engine hoist. Raise hoist high enough to enable engine mountings to be removed, and withdraw rubber mountings.
5. Lower hoist until engine rests securely on engine mounting brackets. Remove lifting chains and hoist.
6. Disconnect two heater hoses located on top of right hand rocker cover.
7. Remove ground strap from rear of left hand cylinder head. DO NOT remove from retaining clip.
8. Remove all electrical harnesses from retaining clips at rear of engine.
9. Remove transmission breather pipes from retaining clip on rear lifting eye.
10. Remove top two bolts securing bell housing to cylinder block.
11. Raise front of vehicle, lower vehicle on to axle stands.
12. Remove bell housing bottom cover. Remove gasket from bell housing face.
13. Remove nuts securing exhaust downpipes to manifolds, remove heat shield from right hand side downpipe.
14. Remove electrical leads from starter motor solenoid. Disconnect multi-plug from oil level sensor on side of sump, if fitted.

△ **NOTE: Instructions 37, 38 and 39 refer to automatic vehicles only.**

15. With assistance rotate engine at crankshaft pulley until two access holes in drive plate/ring gear assembly are visible.
16. Remove two bolts visible through access holes. Mark one access hole and one bolt hole to ensure unit is reassembled in its original position
17. Rotate crankshaft 180° until two remaining access holes are visible, remove two bolts.



RR1808E

18. Remove remaining bell housing to cylinder block bolts.
19. Remove starter motor ground strap from chassis.
20. Remove stands and lower vehicle.
21. Position hydraulic trolley jack under bell housing to support gearbox when engine and gearbox are separated.
22. Fit lifting chains to engine. Carefully raise hoist a little, ease engine and gearbox apart, steady engine on hoist.
23. Ensure no components remain that will prevent engine being removed.
24. Slowly raise engine clear of engine compartment. Move engine away from vehicle and place on a suitable engine stand.

Refit

25. Fit lifting chains to engine. Raise engine using hoist.
26. Lower engine into engine compartment. Ensure all components are clear of engine assembly.
27. Automatic vehicles: With assistance, manoeuvre engine until bottom two engine and bellhousing bolt holes align. Ensure that two cylinder block dowels locate in bell housing.
    Manual vehicles: Lower engine into position. Locate primary pinion into clutch. Engage bell housing dowels.
28. Fit two bolts and partially tighten.
29. Remove jack and lower hoist until engine rests securely on engine mounting brackets.
30. Fit top two bell housing securing bolts. Tighten to ***40 Nm.***

31. Fit remaining bell housing to cylinder block bolts. Tighten to ***40 Nm.***
32. Automatic vehicles: With assistance, rotate crankshaft pulley, line up marked holes in drive plate and torque converter. Fit two bolts. Tighten to ***40 Nm.***
33. Rotate crankshaft 180° and fit remaining two bolts tighten to correct torque, ***40 Nm.***
34. Fit new gasket and refit bottom cover, tighten bolts to ***9 Nm.***
35. Fit new exhaust flange gaskets, fit exhaust to manifold.
36. Refit all harnesses, ground straps breather pipes and hoses at rear of engine.
37. Raise engine and refit engine mounting rubbers, tighten nuts to ***20 Nm.***
38. Remove temporary lifting eye ETC 5964 and reverse instructions 1 to 23, ensuring that all electrical plugs and harnesses are fitted in correct locations.

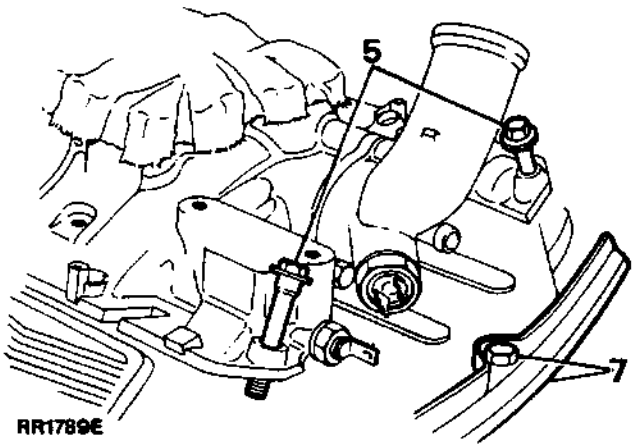
ENGINE - DISMANTLE AND OVERHAUL

Service repair no - 12.41.02

Remove engine from vehicle. ***See Engine removal***
For safe and efficient working secure engine to an approved engine stand. Drain engine oil into a suitable container.

Remove intake manifold

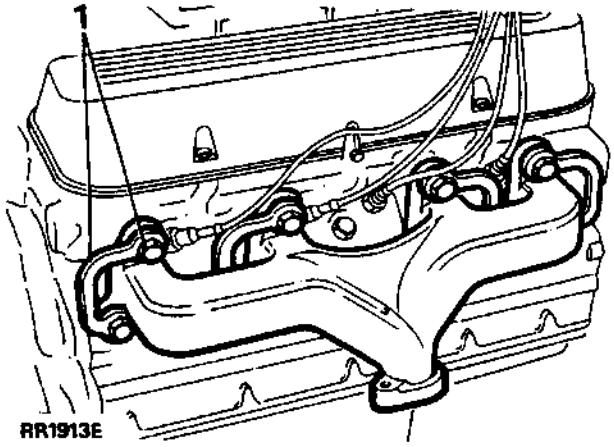
1. Release hose clamp at water pump
2. Detach retaining clips from top of injectors.
3. Remove four bolts securing fuel rail to manifold.
4. Withdraw fuel rail and injectors.



5. Evenly loosen and remove twelve bolts securing intake manifold to cylinder heads.
6. Lift intake manifold from cylinder heads.
7. Remove surplus coolant, remove gasket clamp bolts, remove clamps.
8. Lift off gasket and seals.

Remove exhaust manifolds

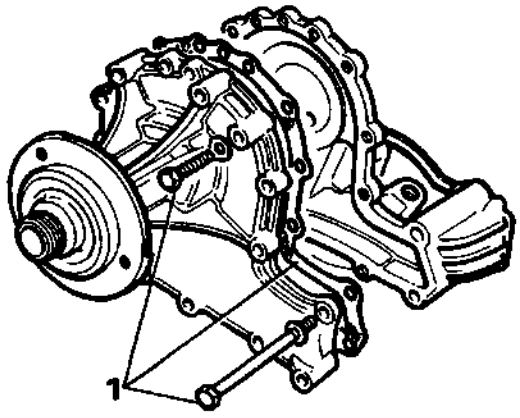
1. Bend back lock tabs, remove eight bolts securing each manifold, and withdraw manifolds and gaskets.



Remove water pump

1. Remove fifteen bolts, pump and joint washer.

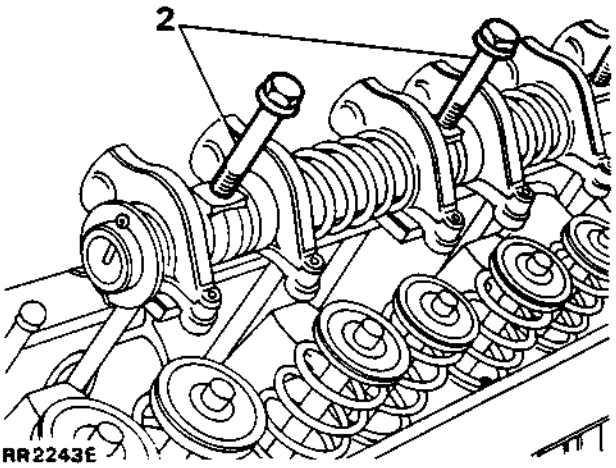
△ **NOTE: The water pump is not serviceable. In event of failure, fit a new water pump assembly.**



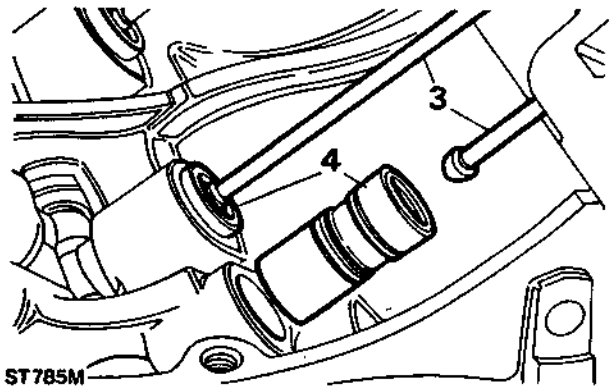
REMOVE AND OVERHAUL ROCKER SHAFTS AND VALVE GEAR

Service repair no - 12. 29. 55.

1. Remove spark plug leads from spark plugs and retaining clips. Release four screws and lift off rocker covers.
2. Remove four rocker shaft retaining bolts and lift off assembly.

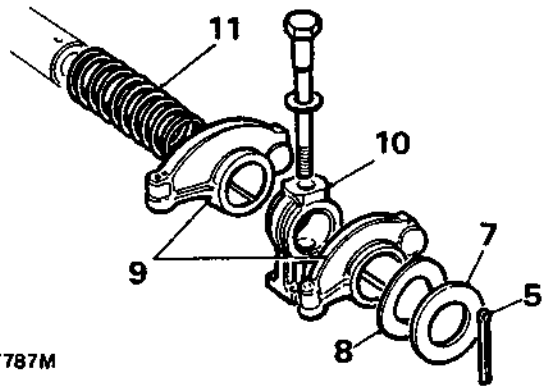


3. Withdraw pushrods and retain in sequence removed.
4. Remove hydraulic tappets. Retain with their respective pushrods. If a tappet cannot be removed leave in position until camshaft is removed.



Dismantle rocker shafts

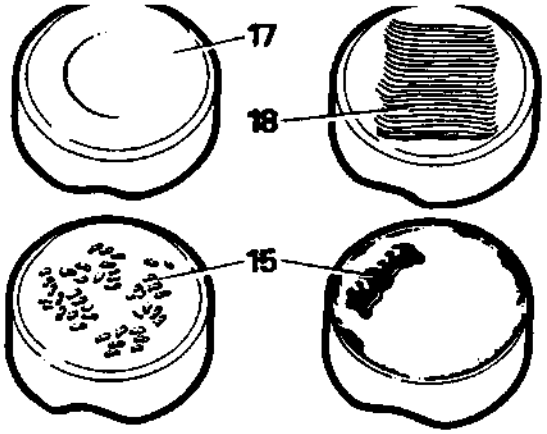
5. Remove split pin from one end of rocker shaft.
6. Withdraw following components and retain in correct sequence for re-assembly:
7. A plain washer.
8. A wave washer.
9. Rocker arms.
10. Brackets.
11. Springs.
12. Examine each component for wear, in particular rockers and shafts. Discard weak or broken springs.



ST787M

Inspect tappets and pushrods

13. Hydraulic tappet: inspect inner and outer surfaces of body for blow holes and scoring. Fit a new hydraulic tappet if body is roughly scored or grooved, or has a blow hole extending through wall in a position to permit oil leakage from lower chamber.
14. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored. It is caused by side thrust of cam against body while tappet is moving vertically in its bore.
15. Inspect cam contact surface of tappets. Fit new tappets if surface is excessively worn or damaged.
16. A hydraulic tappet body that has been rotating will have a round wear pattern. A non-rotating tappet body will have a square wear pattern with a very slight depression near centre.
17. Tappets MUST rotate, a circular wear condition is normal. Tappets with this wear pattern can be refitted provided there are no other defects.
18. If a tappet is not rotating check camshaft lobes for wear. Fit new tappet ensuring it rotates freely in cylinder block.

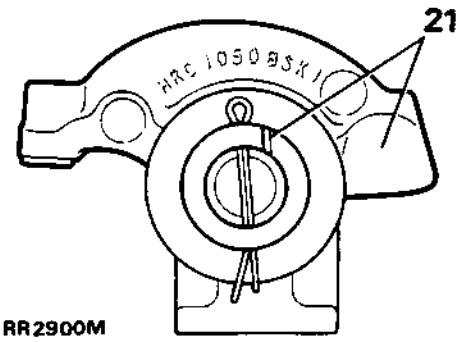


RR750M

19. Fit a new hydraulic tappet if area of pushrod contact is rough or damaged.
20. Fit a new pushrod if it is bent or has a rough or damaged ball end or seat.

Assemble rocker shafts

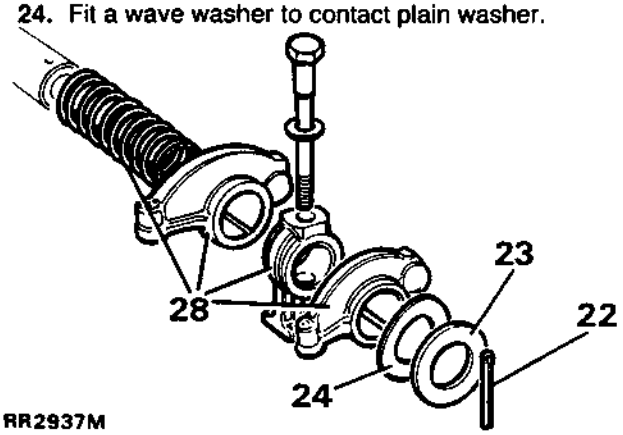
21. Assemble rocker shafts with identification groove at one o'clock position with push rod end of rockers to the right.



RR2900M

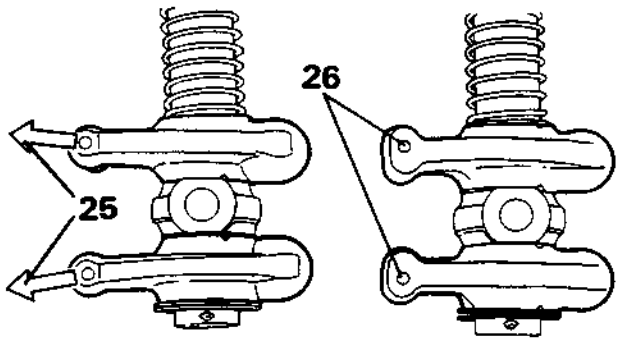
CAUTION: If incorrectly assembled shafts and rockers are fitted to engine, oil supply to rocker shafts will be restricted.

22. Fit new split pin to one end of rocker shaft.
23. Slide a plain washer over the long end of the shaft to contact the split pin.
24. Fit a wave washer to contact plain washer.



RR2937M

25. Early type rocker arms are angled. They must be fitted so that valve end of rocker arms angle away from each other as shown.
26. On later type rocker arms the valve end is offset and must be fitted as shown.
27. Early and late rocker arms are interchangeable provided complete set is changed.



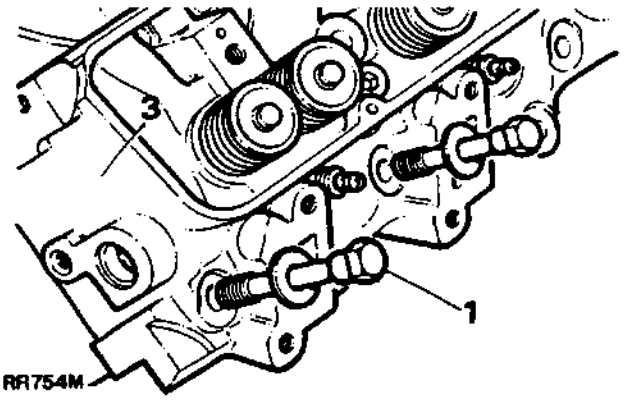
RR2899M

28. Assemble rocker arms, brackets and springs to rocker shaft.
29. Compress the springs, fit wave washer, plain washer and split pin to end of rocker shaft.
30. Fit locating bolts through brackets. Place assemblies to one side.

REMOVE AND OVERHAUL CYLINDER HEADS

Service repair no - 12.29.05.

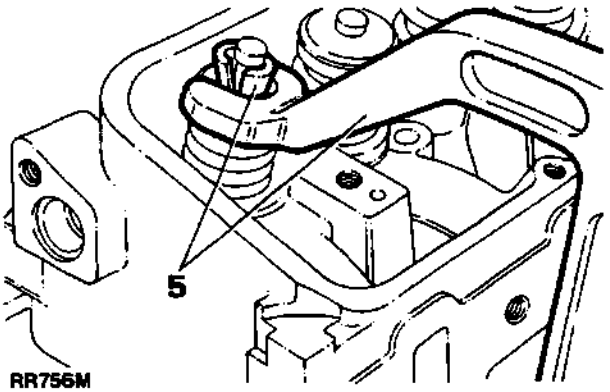
1. Evenly loosen fourteen cylinder head bolts, reversing tightening order.
2. Mark heads LH and RH for reassembly.
3. Lift off cylinder heads, discard gaskets.



RR754M

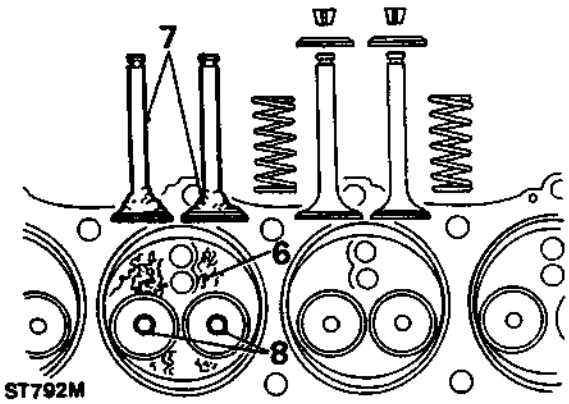
Dismantle cylinder heads

4. Remove spark plugs.
5. Using valve spring compressor 18G 106A or a suitable alternative, remove valves, springs, retain in sequence for refitting. Discard inlet valve stem seals.

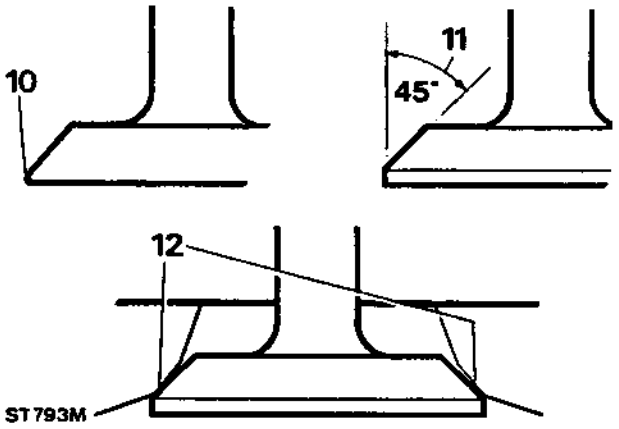


RR756M

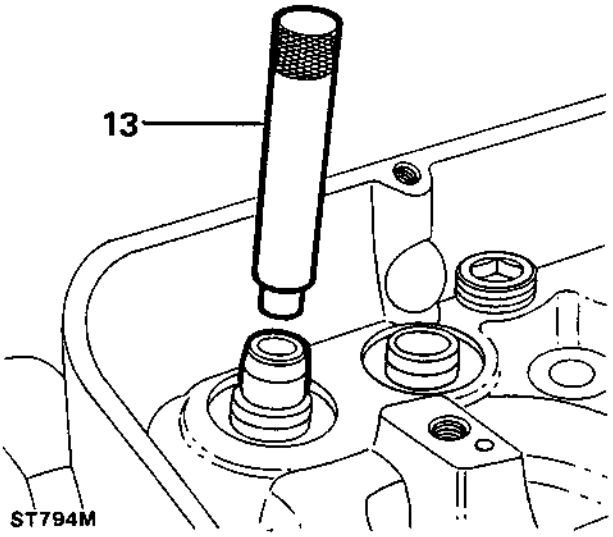
6. Clean combustion chambers using a soft wire brush.
7. Clean valves.
8. Clean valve guide bores.



9. Regrind or fit new valves as necessary.
10. If a valve has to be ground to a knife-edge to obtain a true seat, fit a new valve.
11. Correct angle for valve seating face is 45° ± 1/4.
12. Correct angle for seat is 46° ± 1/4 and seat witness towards outer edge.



13. Check valve guides and fit replacements as necessary. Using valve guide remover 274401, drive out old guides from valve spring seat face of cylinder head.

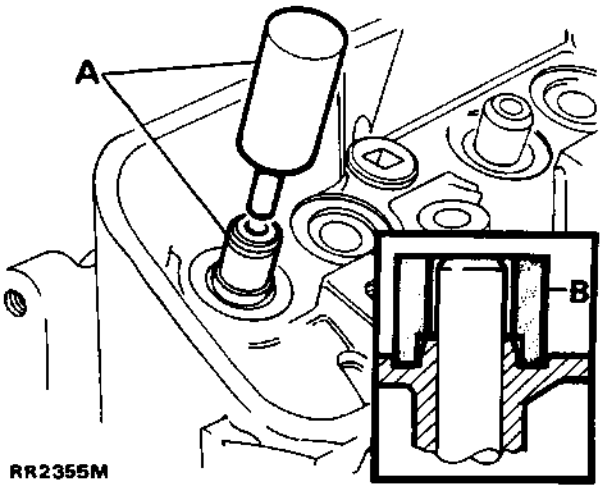


Fit new valve guides

△ **NOTE: Service valve guides are 0,025 mm larger on outside diameter than original equipment to ensure interference fit.**

14. Lubricate new valve guide and place in position.

A. Using guide drift LRT-12-038 partially drive guide into cylinder head.
B. Remove drift LRT-12-038 and place distance piece LRT-12-515 over valve guide. Drift guide into head until distance piece contacts spring seat.
C. Alternatively drift guide into cylinder head until it protrudes 19 mm above valve spring recess in head.

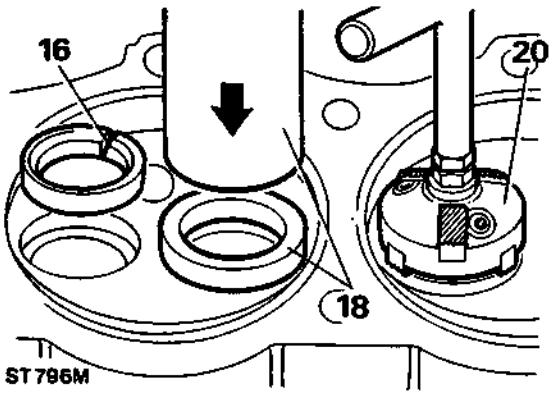


Examine and fit new valve seats

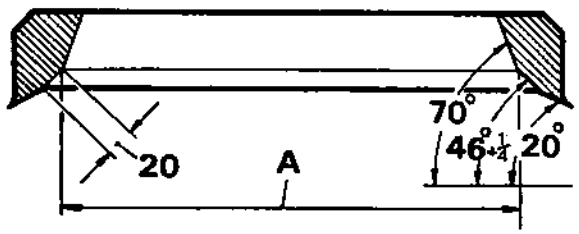
15. Check valve seats for wear, pits and burning. Fit new inserts if necessary.
16. Remove old seat inserts by grinding them until thin enough to be cracked and pried out.
17. Heat cylinder head evenly to approximately 65°C.
18. Press new insert into recess in cylinder head.

△ **NOTE: Service valve seat inserts are available in two over-sizes 0.25 and 0.50 mm larger on outside diameter to ensure interference fit.**

19. Using service tool MS621 if necessary, cut valve seats to 46° ±1/4.
20. Nominal seat width is 1,5 mm. If seat exceeds 2,0 mm it should be reduced to the specified width by the use of 20° and 70° cutters.
21. The inlet valve seat diameter: 'A' is 37,03 mm and exhaust valve seat is 31,50 mm.

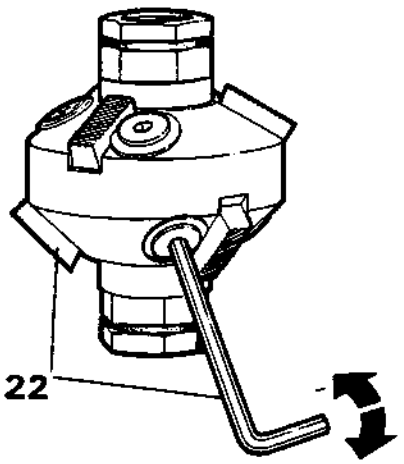


ST796M



ST797M

22. Ensure cutter blades are correctly fitted to cutter head with angled end of blade downwards, facing work, as illustrated.
Check that cutter blades are adjusted so that middle of blade contacts area of material to be cut. Use key provided in hand set MS76. Use light pressure and remove only minimum material necessary.

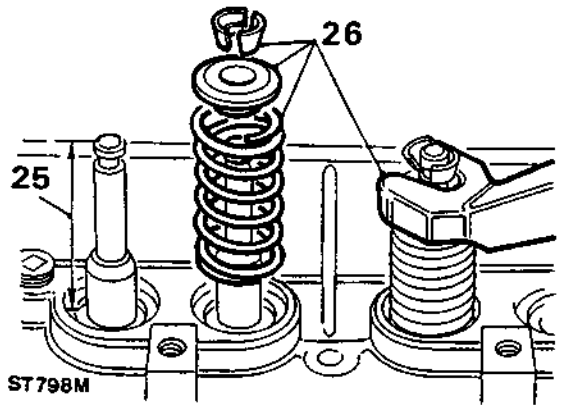


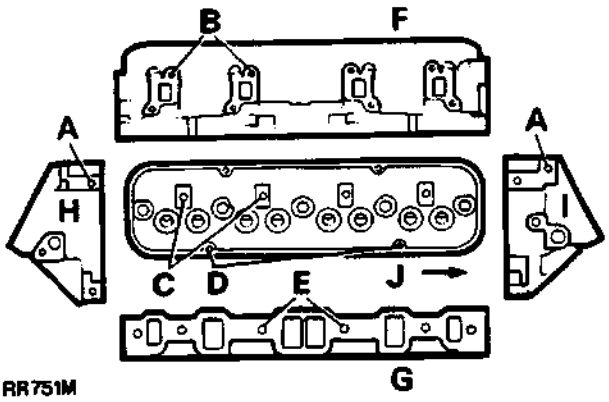
ST1024M

23. Coat valve seat with a small quantity of 'engineers' blue, revolve a properly ground valve against seat. A continuous fine line should appear round valve. If there is a gap of not more than 12 mm it can be corrected by lapping.
24. Alternatively, insert a strip of cellophane between valve and seat, hold valve down by stem, slowly pull out cellophane. If there is a drag, seal is satisfactory in that spot. Repeat in at least eight places. Lapping-in will correct a small open spot.

Re-assemble valves to cylinder head

25. Before fitting valves and springs, check height of each valve above head. Measure height of stem above valve spring seat surface, holding head firmly against seat. This dimension must not exceed 47.63 mm. If necessary fit a new valve or grind end of valve stem.
26. Lubricate valve stems. Fit new inlet valve stem seals and springs. Fit caps, compress springs using LRT-12-034 and fit collets.





NOTE: Right-hand cylinder head illustrated.

F Exhaust manifold face
G Intake manifold face
H Front face
I Rear face
J Front of engine

Reclaiming cylinder head threads

Damaged or stripped threads in cylinder head can be salvaged by fitting Helicoils as follows:

Holes A - These three holes may be drilled 0.3906 in dia. x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).

Holes B - These eight holes may be drilled 0.3906 in dia. x 0.812 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CBB 0.749 in (min) deep (3/8 UNC 1.5D insert).

Holes C - These four holes may be drilled 0.3906 in dia x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).

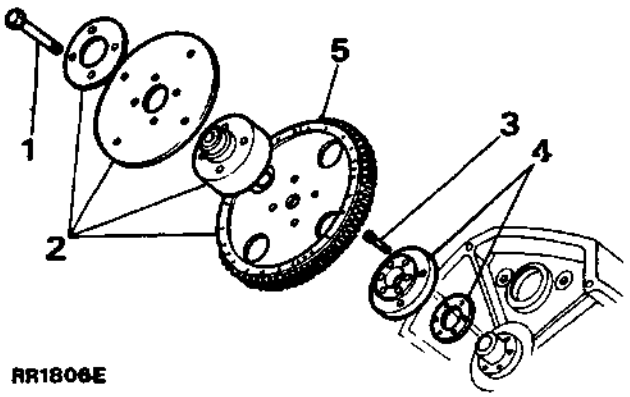
Holes D - These four holes may be drilled 0.261 in dia x 0.675 + 0.040 in deep. Tapped with Helicoil Tap No. 4 CPB or 4CS x 0.625 in (min) deep (1/4 UNC 1.5D insert).

Holes E - These six holes may be drilled 0.3906 in dia x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).

REMOVE FLEXIBLE DRIVE PLATE AND RING GEAR ASSEMBLY

NOTE: Scribe each component with an identification line to enable re-assembly in original position.

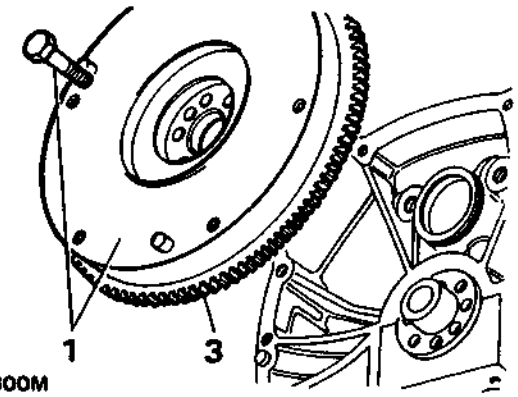
1. Remove four retaining bolts.
2. Withdraw clamp ring, flexible drive plate, hub aligner and ring gear assembly.
3. Remove six socket head bolts securing crankshaft adaptor plate and shim to crankshaft flange.
4. Withdraw crankshaft adaptor plate and shim.
5. Inspect ring gear assembly for distortion, cracks, chipped or badly worn teeth. If ring gear is in poor condition fit a new assembly.



RR1806E

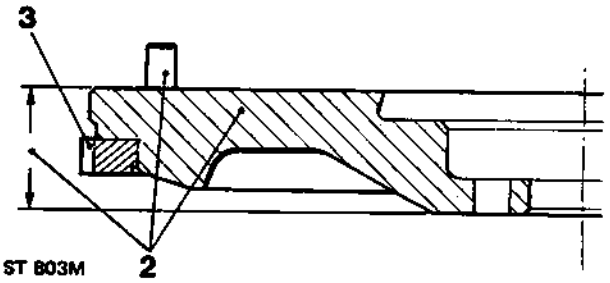
REMOVE AND OVERHAUL FLYWHEEL - MANUAL GEARBOX MODELS ONLY

1. Remove retaining bolts and withdraw flywheel from crankshaft.



ST800M

2. Examine flywheel clutch face for cracks, scores and overheating. The flywheel can be refaced provided mimnimum thickness does not go below 39.93 mm (1.572 in). Remove three dowels before machining.
3. Examine ring gear for worn, chipped and broken teeth. Renew as follows:

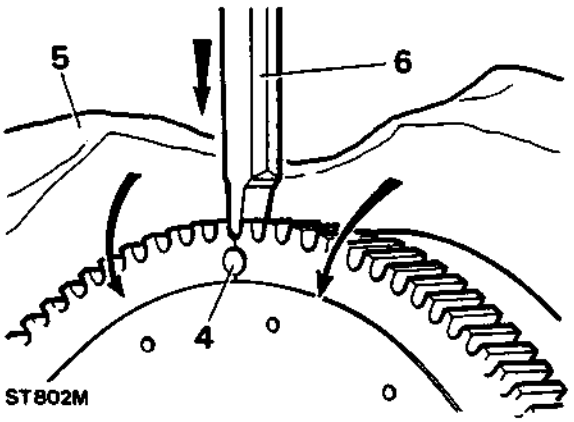


ST 803M

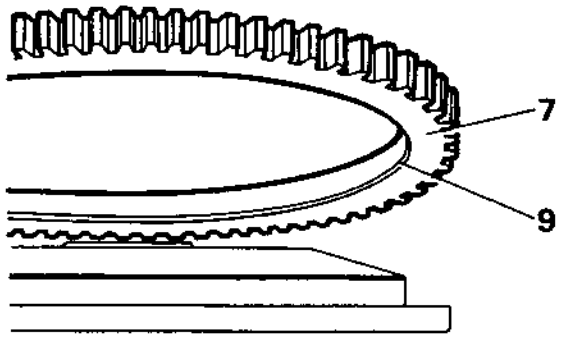
4. Drill a 10 mm diameter hole axially between roots of any tooth and inner diameter of starter ring sufficiently deep to weaken ring. DO NOT allow drill to enter flywheel.
5. Secure flywheel in a vice using soft jaws and place a cloth over flywheel to protect operator from flying fragments.

WARNING: Take adequate precautions against flying fragments when splitting ring gear.

6. Place a chisel as shown, strike it sharply to split starter ring gear.

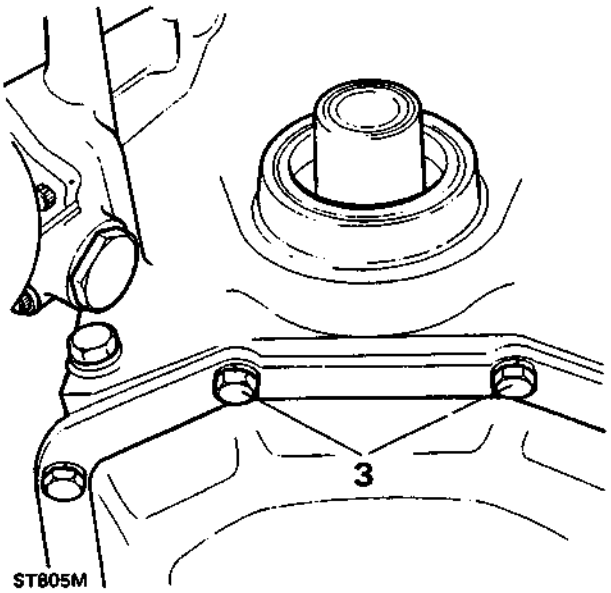


7. Heat new ring gear uniformly to between 170°C and 175°C, DO NOT EXCEED higher temperature.
8. Place flywheel, clutch side down, on flat surface.
9. Locate heated starter ring gear in position on flywheel, with chamfered inner diameter towards flywheel flange. If starter ring gear is chamfered both sides, it can be fitted either way round.
10. Press starter ring gear firmly against flange until ring contracts sufficiently to grip flywheel.
11. Allow flywheel to cool gradually. DO NOT HASTEN cooling in any way, distortion may occur.
12. Fit new clutch assembly location dowels to flywheel.

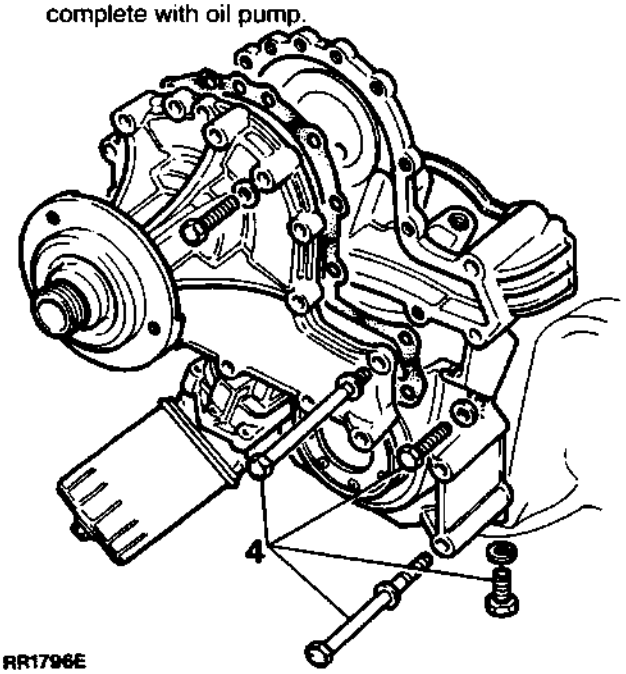


REMOVE TIMING GEAR COVER AND WATER PUMP

1. Place an oil drip-tray beneath timing cover, remove oil filter element.
2. Remove crankshaft pulley bolt and special washer, withdraw pulley.

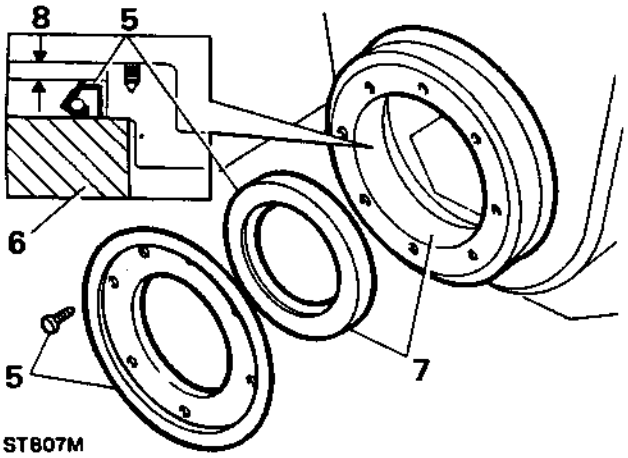


3. Remove two bolts securing sump to bottom of timing cover.
4. Remove timing cover bolts and withdraw cover complete with oil pump.



Fit new timing cover oil seal

5. Remove seven drive screws and withdraw mud shield and oil seal.
6. Position gear cover with front face uppermost and underside supported across oil seal housing bore on a suitable wooden block.
7. Enter oil seal, lip side leading, into housing bore.
8. Press in oil seal until plain face is approximately 1,5 mm below gear cover face.
9. Fit mud shield and securing screws.



ST807M

DISTRIBUTOR REMOVE

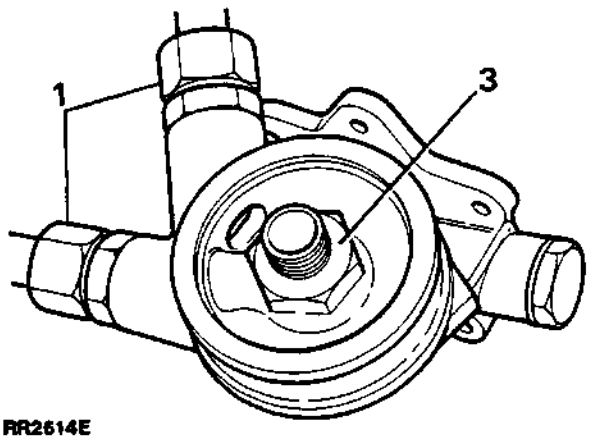
1. Release single nut securing distributor clamp.
2. Remove clamp, withdraw distributor.
3. If necessary overhaul distributor. ***See ELECTRICAL, Overhaul, Distributor-Lucas 35DLM8***

REMOVE ENGINE OIL COOLER ADAPTOR PLATE

1. Remove both oil cooler pipes.
2. Mark position of adaptor plate/oil pump cover.
3. Remove centre fixing and withdraw adaptor plate.

Refit

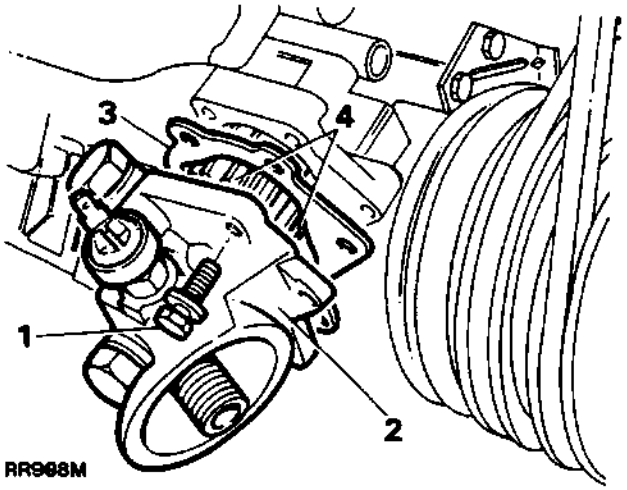
4. Reverse the removal procedure, lining up the location marks to ensure pipe runs are correct. Ensure the pipes and centre fixing are tightened to the specified torque. ***See Specifications, torque, Torque values***



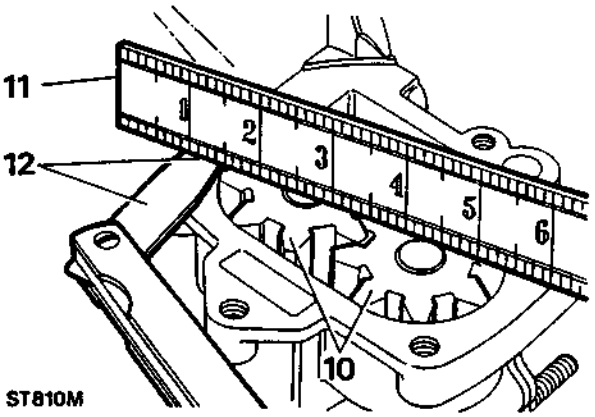
RR2614E

REMOVE AND OVERHAUL OIL PUMP

1. Remove bolts from oil pump cover.
2. Withdraw oil pump cover.
3. Lift off cover and remove gasket.
4. Withdraw oil pump gears.



RR988M

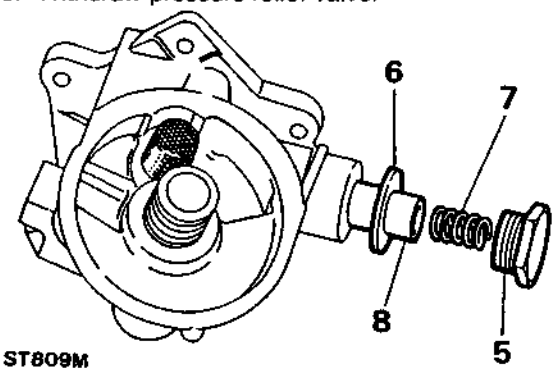


ST810M

13. Check oil pressure relief valve for wear/scoring.
14. Check sides of relief valve spring for wear or signs of collapse.
15. Clean wire screen filter for relief valve.
16. Check relief valve is an easy slide fit with no perceptible side movement in its bore.

Dismantle pump

5. Unscrew plug from pressure relief valve.
6. Remove sealing washer from plug.
7. Withdraw spring from relief valve.
8. Withdraw pressure relief valve.



ST809M

Assemble pump

17. Insert relief valve spring.
18. Locate sealing washer on relief valve plug.
19. Fit relief valve plug. Tighten to ***40 - 47 Nm.***
20. Fully pack oil pump gear housing with Petroleum Jelly. No other grease is suitable.
21. Fit oil pump gears ensuring that Petroleum Jelly is forced into every cavity between teeth of gears.

    IMPORTANT: Unless pump is fully packed with Petroleum Jelly it may not prime itself when engine is started.

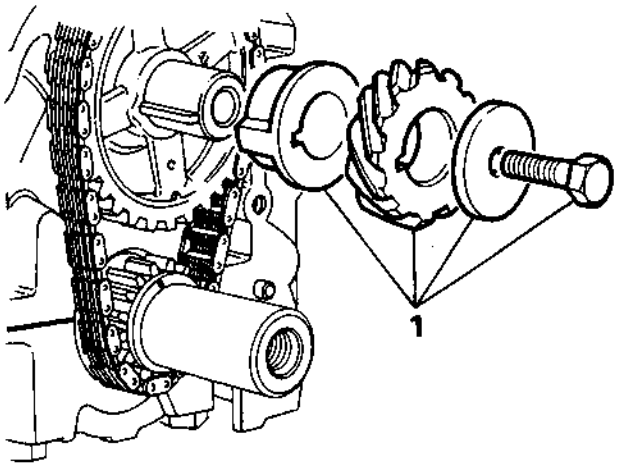
22. Place new gasket on oil pump cover.
23. Locate oil pump cover in position.
24. Fit special fixing bolts. Tighten to ***13 Nm.***

Examine pump

9. Check oil pump gears for wear/scoring.
10. Fit oil pump gears and shaft into front cover.
11. Place a straight edge across gears.
12. Check clearance between straight edge and front cover. If less than 0.05 mm, check front cover gear recess for wear.

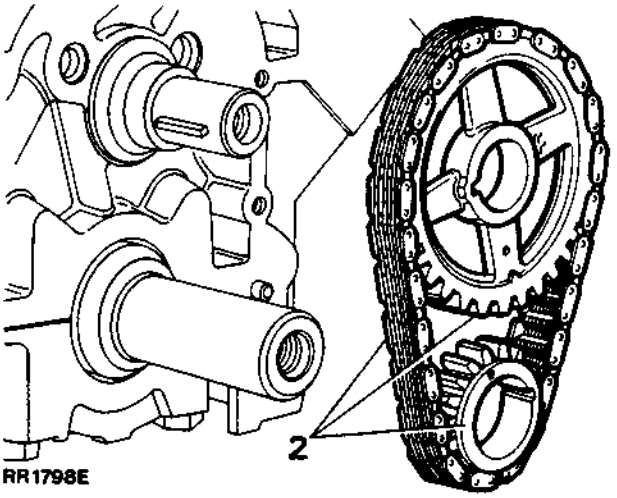
REMOVE TIMING CHAIN SPROCKET AND CAMSHAFT

1. Remove retaining bolt and washer. Withdraw distributor drive gear and spacer.



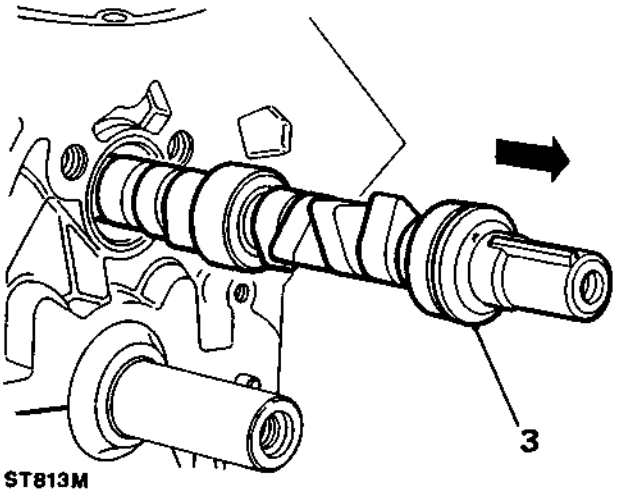
RR1797E

2. Withdraw sprocket complete with timing chain.



RR1798E

3. Withdraw camshaft, taking particular care not to damage bearings in cylinder block.



ST813M

Examine components

4. Visually examine all parts for wear. Fit a new camshaft if bearing journals and cams show signs of wear, pits, scores and overheating.
5. Examine links and pins of timing chain for wear. Compare its condition with a new chain. Inspect teeth of sprockets, if necessary fit a new sprocket.
6. Measure camshaft journals for overall wear, ovality and taper. Diameters of journals are as follows, from front of shaft:

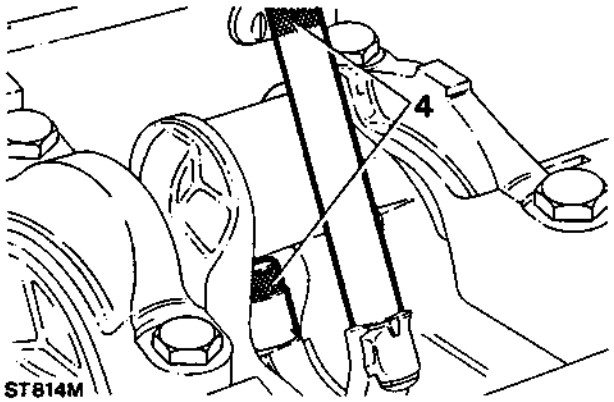
   Number 1 journal 45,4 to 45,3 mm
   Number 2 journal 44,6 to 44,5 mm
   Number 3 journal 43,84 to 43,81 mm
   Number 4 journal 43,07 to 43,05 mm
   Number 5 journal 42,31 to 42,29 mm

7. To check camshaft for straightness rest two end journals i.e. numbers 1 and 5 on 'V' blocks and mount a dial gauge on centre journal. Rotate shaft and note reading. If run out is more than 0,05 mm fit a new camshaft.

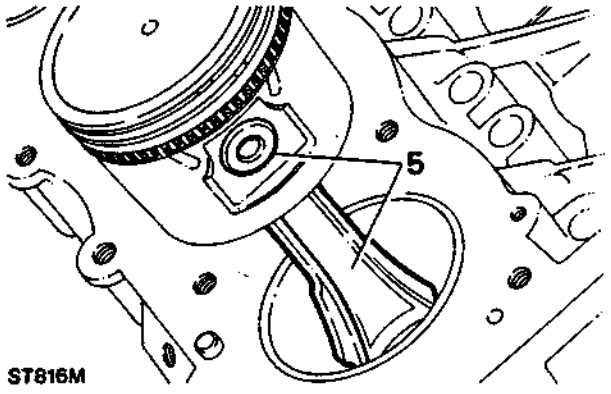
REMOVE AND OVERHAUL CONNECTING RODS AND PISTONS

Remove

1. Withdraw retaining bolts and remove sump.
2. Remove sump oil strainer.
3. Remove connecting rod caps, retain in sequence for reassembly.
4. Screw guide bolts LRT-12-041 onto connecting rods.



5. Push connecting rod and piston assembly up cylinder bore, withdraw it from top. Retain connecting rod and piston assemblies in sequence with respective caps.
6. Remove guide bolts LRT-12-041 from connecting rod.

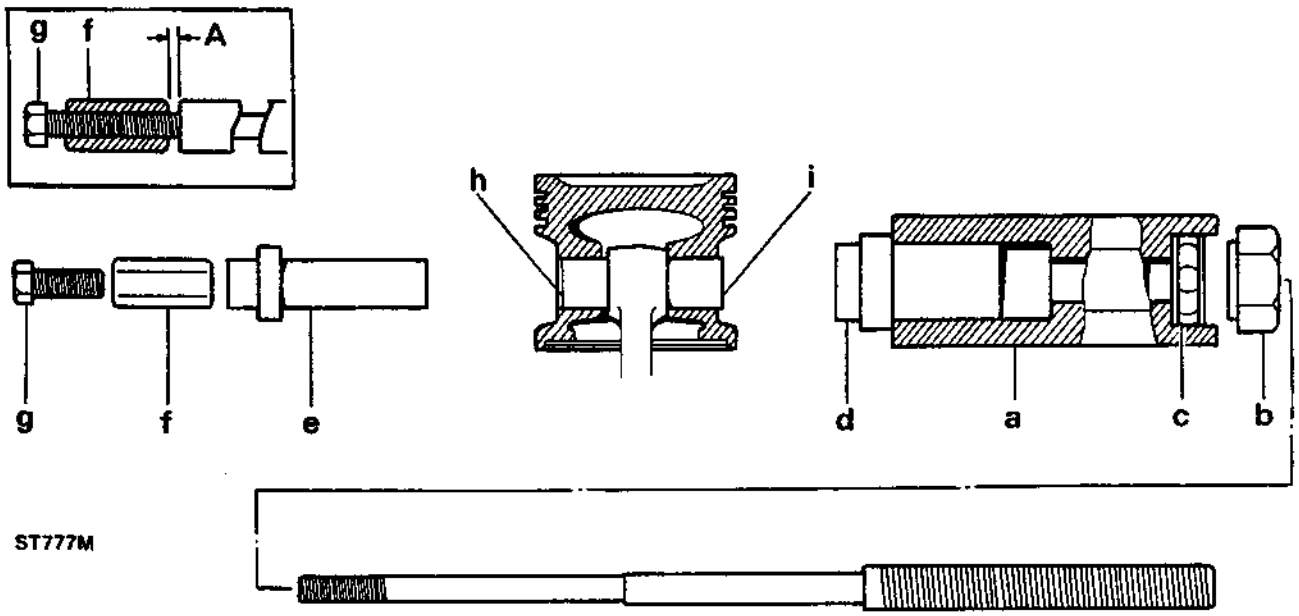


Overhaul

NOTE: Retain connecting rods, caps and bearing shells in sets, in correct sequence. Remove piston rings over crown of piston. If same piston is to be refitted, mark it relative to its connecting rod to ensure that original assembly is maintained.

7. Withdraw piston pin, using tool LRT-12-013:

   a. Clamp hexagon body of LRT-12-013 in vice.
   b. Position large nut flush with end of centre screw.
   c. Push screw forward until nut contacts thrust race.
   d. Locate piston adaptor LRT-12-013 with its long spigot inside bore of hexagon body.
   e. Fit remover/replacer bush of LRT-12-013 on centre screw with flanged end away from piston pin.
   f. Screw stop-nut about half-way onto smaller threaded end of centre screw, leaving a gap 'A' of 3 mm (1/8 in) between nut and remover/replacer bush.
   g. Lock stop-nut securely with lock screw.
   h. Check that remover/replacer bush is correctly positioned in bore of piston.
   i. Push connecting-rod to right to expose end of piston pin, which must be located in end of adaptor 'd'.
   j. Screw large nut up to thrust race.
   k. Hold lock screw and turn large nut until piston pin has been withdrawn from piston. Dismantle tool.



Original pistons

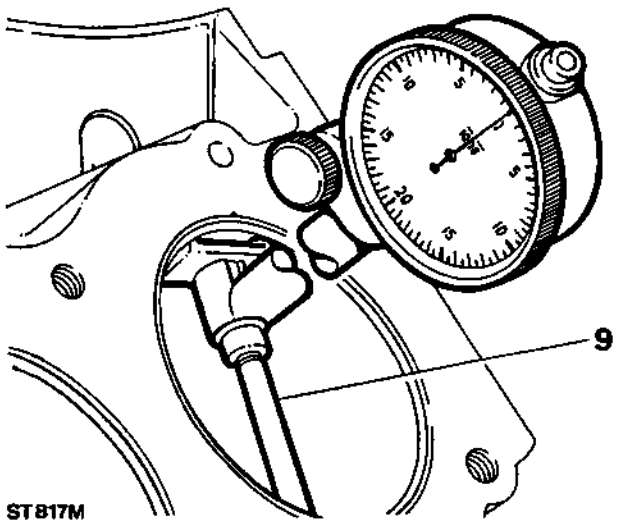
8. Remove carbon deposits, particularly from ring grooves. Examine pistons for signs of damage or excessive wear, refer to 'new pistons' for method of checking running clearance. Fit new pistons if necessary.

New pistons

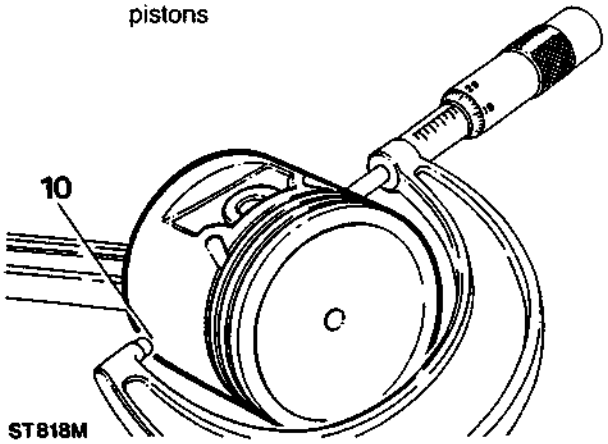
△ **NOTE: Pistons are available in sericce standard size and in oversizes of 0,25 mm (0.010 in) and 0,50 mm (0.020 in). Service standard size pistons are supplied 0,0254 mm (0.001 in) oversize. When fitting new service standard size pistons to a cylinder block, check for correct piston to bore clearance, honing th bore if necessary. Bottom of piston skirt-bore clearance should be 0,018 to 0,040 mm (0.0007 to 0.0016 in).**

△ **NOTE: Piston and cylinder block temperature must be same to ensure accurate measurement. When reboring cylinder block, crankshaft main bearing caps must be fitted and tightened to *70 Nm.***

9. Check cylinder bore dimension at right angles to piston pin 40 to 50 mm from top.



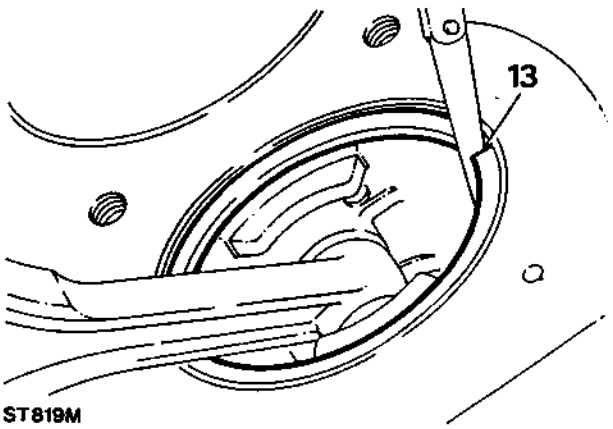
10. Check piston dimension at right angles to piston pin:
    a) At bottom of skirt on 3.5 litre pistons
    b) 62 mm from top of piston on 3.9 litre pistons
    c) 58 mm from top of piston on 4.2 litre pistons



ST818M

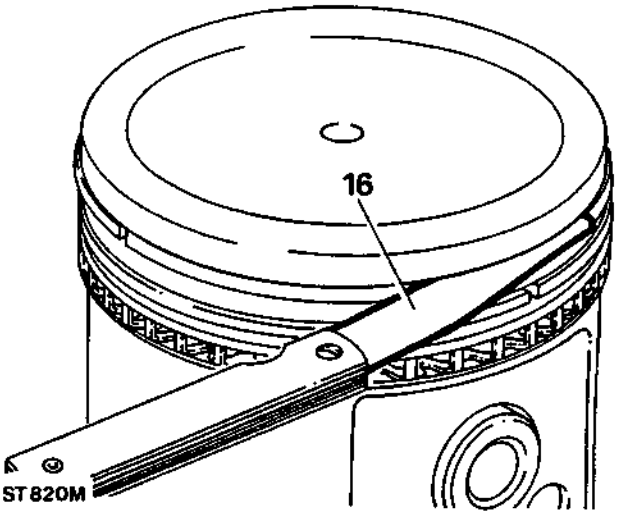
11. The piston dimension must be 0.018 to 0.033 mm smaller than cylinder.
12. If new piston rings are to be fitted without reboring, deglaze cylinder walls with a hone without increasing bore diameter, to provide a cross-hatch finish. After honing, thoroughly clean piston bores to remove all traces of foreign matter.
13. Check compression ring in applicable cylinder, held square to bore with piston. Gap limits: 0.44 to 0.56 mm. Use a fine-cut flat file to increase gap if required. Select a new piston ring if gap exceeds limit.

△ **NOTE: Gapping does not apply to oil control rings.**



ST819M

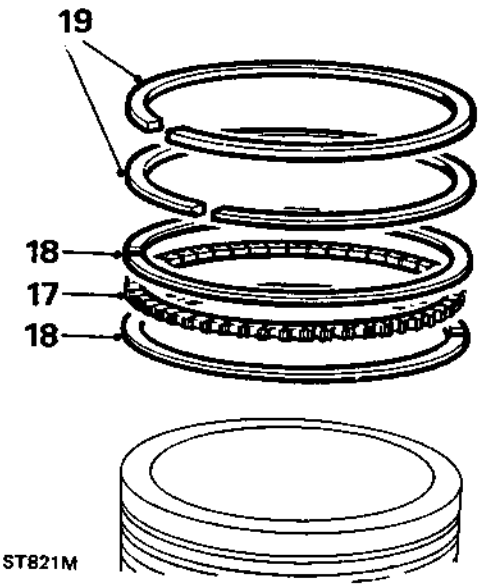
14. Temporarily fit compression rings to piston.
15. The ring marked 'TOP' must be fitted with marking uppermost into second groove. The chrome ring fits top groove and can be fitted either way round.
16. Check compression ring clearance in piston groove. Clearance limits: 0.05 to 0.10 mm.



ST820M

Fit piston rings

17. Fit expander ring into bottom groove making sure that ends butt and do not overlap.
18. Fit two ring rails to bottom groove, one above and one below expander ring.
19. Fit second compression ring with marking 'TOP' uppermost. Fit chrome ring into top groove, either way round.



ST821M

Examine connecting rods

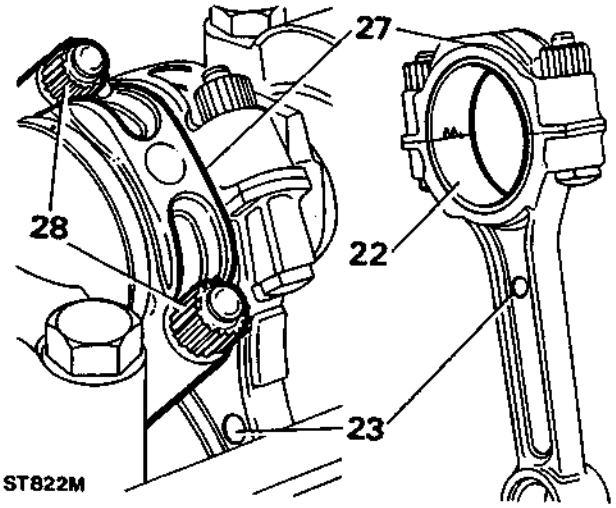
20. Check alignment of connecting rod.
21. Check connecting rod small end, piston pin must be a press fit.

Check crankshaft bearings

22. Locate bearing upper shell into the connecting rod.
23. Locate connecting rod and bearing onto its crankshaft journal.

△ **NOTE: Domed shape boss on connecting rod must face towards front of engine on right hand bank of cylinders and towards rear on left hand bank.**

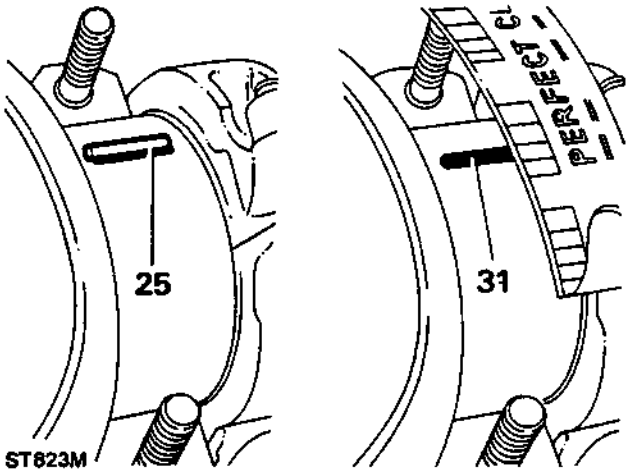
24. When both connecting rods are fitted, bosses will face inwards towards each other.



25. Place a piece of Plastigauge (P61) across centre of lower half of crankshaft journal.
26. Locate bearing lower shell into connecting rod cap.
27. Locate cap and shell onto connecting rod.

△ **NOTE: Note that rib on edge of cap must be on same side as domed shape boss on connecting rod.**

28. Secure connecting rod cap. Tighten to ***50 Nm.***
29. Do not rotate crankshaft while Plastigauge is in use.



30. Remove connecting rod cap and shell.
31. Using scale printed on Plastigauge packet, measure flattened Plastigauge at its widest point.
32. The graduation most closely corresponding to width of Plastigauge indicates bearing clearance.
33. Correct bearing clearance with new or overhauled components is 0.015 to 0.055 mm.
34. If a bearing has been in service, fit a new bearing if clearance exceeds 0.08 mm.
35. If a new bearing is being fitted, use selective assembly to obtain correct clearance.
36. Wipe off Plastigauge with an oily rag. DO NOT scrape it off.

△ **NOTE: It is important that connecting rods, caps and bearing shells be retained in sets, and in correct sequence.**

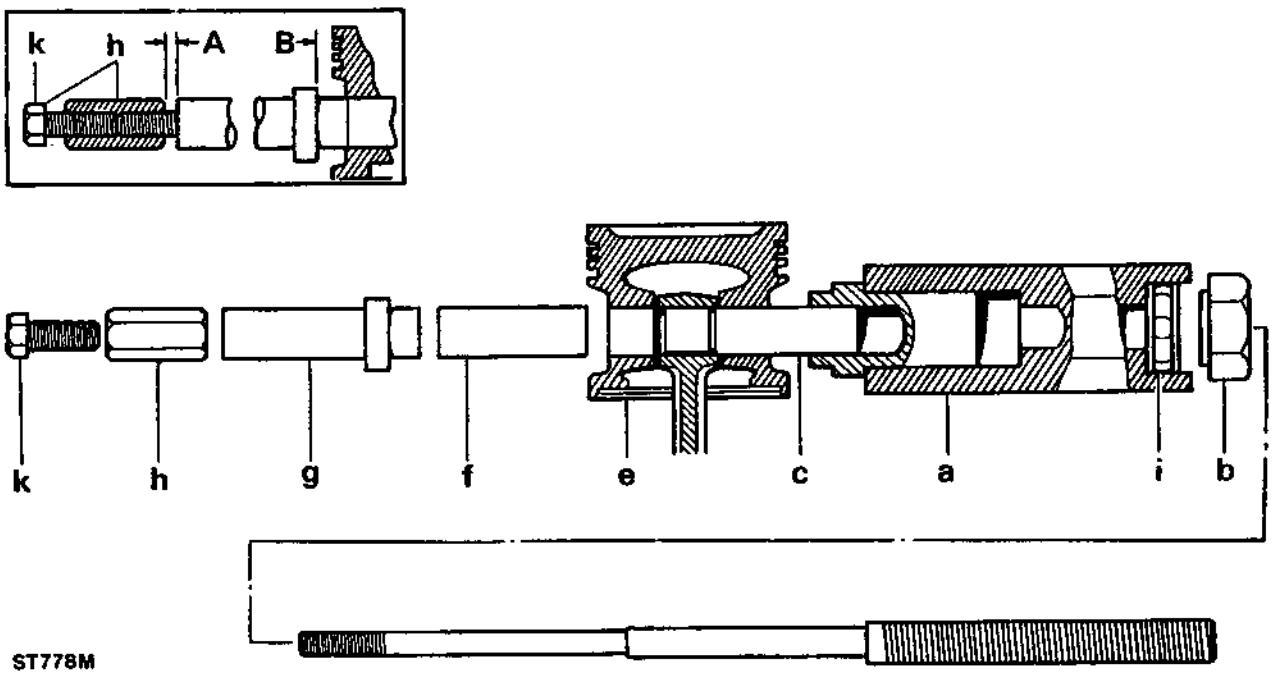
Assembling pistons to connecting rods

37. Using tool LRT-12-013 refit each piston to its connecting rod as follows:

    a. Clamp hexagon body of LRT-12-013 in a vice, with adaptor LRT-12-014 positioned as instruction 7d.
    b. Remove large nut of LRT-12-013 and push the centre screw approximately 50 mm into body until shoulder is exposed.
    c. Slide parallel guide sleeve, grooved end last, onto centre screw and up to shoulder.

d. Lubricate piston pin and bores of connecting rod and piston with graphited oil (Molykote 2). Also lubricate ball race and centre screw of LRT-12-013.
e. Fit connecting rod and piston together onto tool, with markings aligned if fitting original pair, with connecting rod around sleeve up to groove.
f. Fit piston pin into piston bore, up to connecting rod.
g. Fit remover/replacer bush LRT-12-015 with its flanged end towards piston pin.
h. Screw stop nut onto centre screw and adjust nut to obtain an 0.8 mm end float 'A' on whole assembly, and lock nut securely with screw.
i. Slide assembly back into hexagon body and screw large nut up to thrust race.
j. Set a torque spanner to ***16 Nm.*** This represents minimum load for an acceptable interference fit of piston pin in connecting rod.
k. Using torque spanner and socket on large nut, and holding lock screw, pull piston pin in until flange of remover/replacer bush is 4 mm 'B' from face of piston. This flange must not be allowed to contact piston.

⚠ **CAUTION: If torque spanner has not reached at least 16 Nm. throughout pull, fit of piston pin to connecting rod is not acceptable and necessitates fitting new components. The large nut and centre screw of tool must be kept well oiled.**



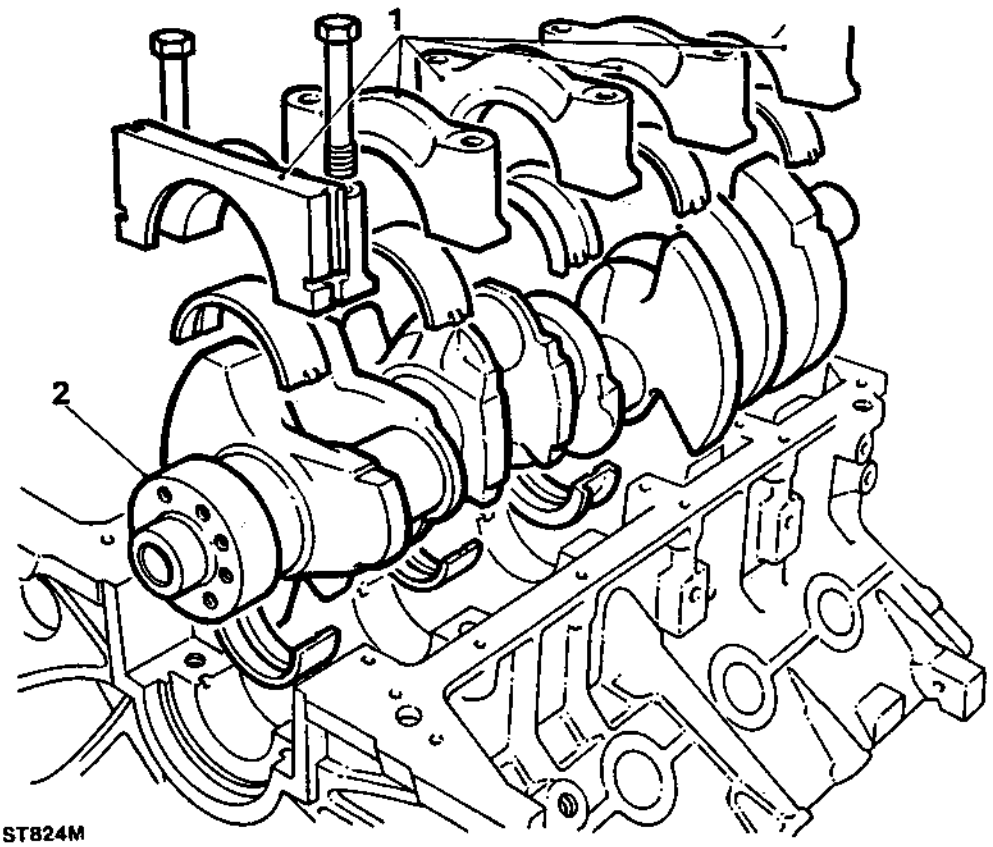
ST778M

38. Remove tool and check that piston moves freely on piston pin and that no damage has occurred during pressing.

REMOVE AND OVERHAUL CRANKSHAFT

Remove

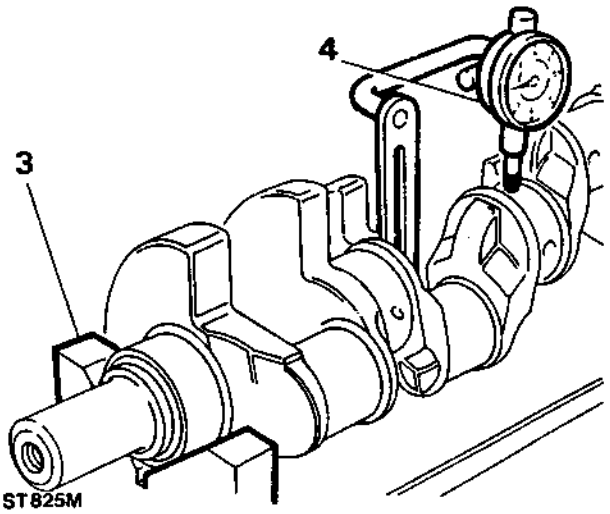
1. Remove main bearing caps and lower bearing shells. Retain in pairs and mark with number of journal until it is decided if bearing shells are to be refitted.
2. Lift out crankshaft and rear oil seal.



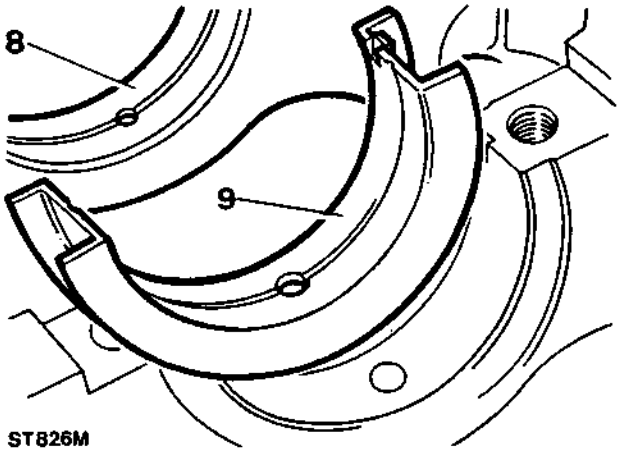
ST824M

Inspect and overhaul crankshaft

3. To check for straightness, place crankshaft on vee-blocks at numbers one and five main bearing journals.
4. Using a dial indicator, check run-out at centre main bearing journal.



5. Total run-out at each journal should not exceed 0.08 mm.
6. If crankshaft is bent it is not suitable for regrinding and should be renewed.
7. Check each crankshaft journal for ovality. If ovality exceeds 0.040 mm around crankshaft journal, regrind or fit a new crankshaft.
8. Crankshaft main and connecting rod bearings are available in following undersizes:
   0.25mm
   0.50mm



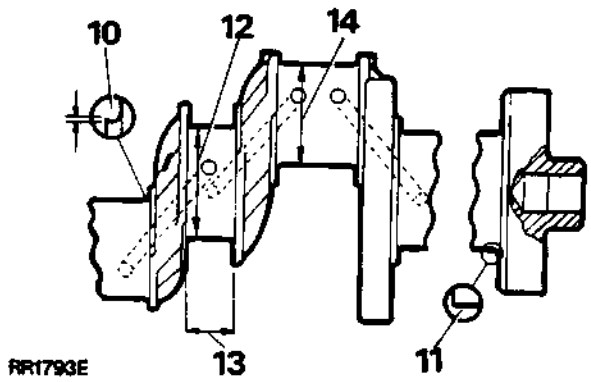
9. The centre main bearing shell, which controls crankshaft thrust, has thrust faces increased in thickness when more than 0.25 mm undersize, as shown in following chart.
10. When a crankshaft is to be reground, thrust faces on either side of centre main journal must be machined in accordance with dimensions in charts that follow:

Main bearing journal size	Thrust face width
Standard	Standard
0.25 mm undersize	Standard
0.50 mm undersize	0.25 mm oversize

11. For example: If fitting a 0.50 mm undersize bearing, 0.125 mm must be machined off each thrust face of centre journal, maintaining correct radius.

Crankshaft dimensions

12. Radius for all journals except rear main bearing is 1.90 to 2.28 mm.
13. Radius for rear main bearing journal is 3.04 mm.
14. Main bearing journal diameter, see following chart.
15. Thrust face width, and connecting rod journal diameter, see following chart.

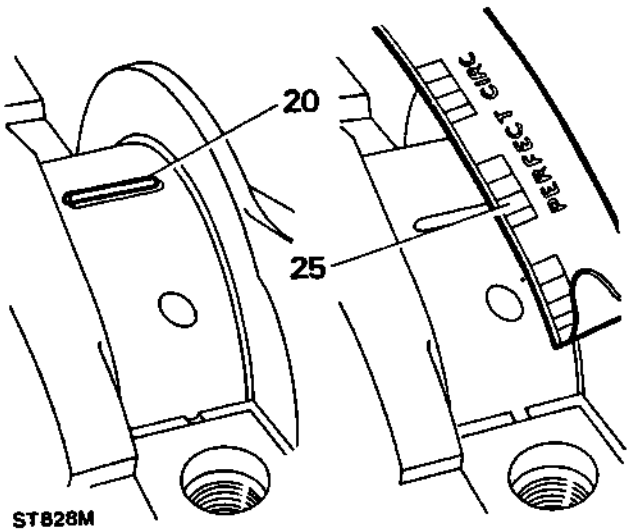


Crankshaft dimensions-millimetre

Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	58.400-58.412	26.975-27.026	50.800-50.812
0.254 U/S	58.146-58.158	26.975-27.026	50.546-50.558
0.508 U/S	57.892-57.904	27.229-27.280	50.292-50.304

Check main bearing clearance

16. Remove oil seals from cylinder block and rear main bearing cap.
17. Locate upper main bearing shells (with oil hole and oil grooves) into cylinder block.
18. Locate flanged upper centre main bearing shell.
19. Place crankshaft in position on bearings.
20. Place a piece of Plastigauge across centre of crankshaft main bearing journals.
21. Locate lower shells into main bearing caps.



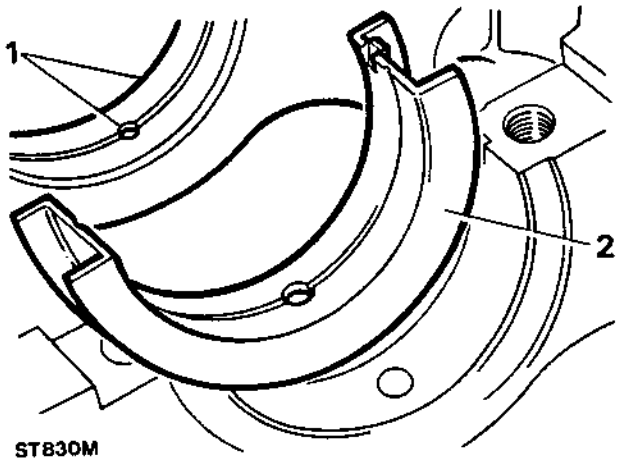
ST828M

22. Fit numbers one to four main bearing caps and shells. Tighten to ***70 Nm.***
23. Fit rear main bearing cap and shell. Tighten to ***90 Nm.*** Do not allow crankshaft to rotate while Plastigauge is in use.
24. Remove main bearing caps and shells.
25. Using scale printed on Plastigauge packet, measure flattened Plastigauge at widest point.
26. Graduation most closely corresponding to width of Plastigauge indicates bearing clearance.
27. Correct bearing clearance with new or overhauled components is 0.023 to 0.065 mm.
28. If correct clearance is not obtained initially, select a suitable bearing to give required clearance.
29. Wipe off Plastigauge with an oily rag. Do NOT scrape it off.
30. Maintain bearing shells and caps in sets, in the correct sequence.

ASSEMBLING ENGINE

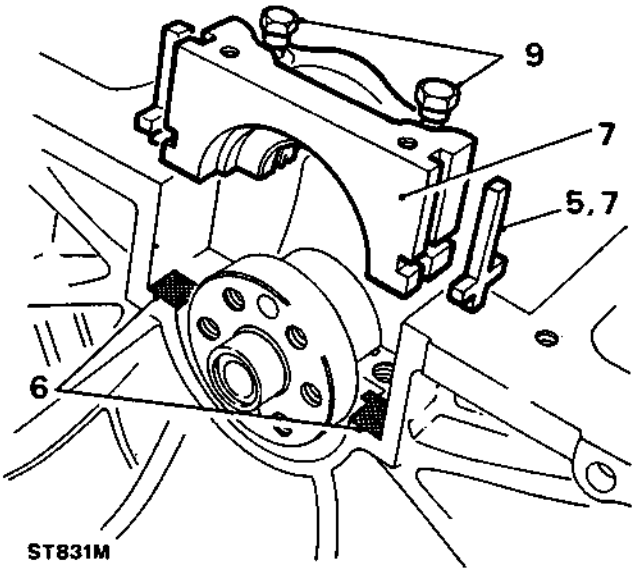
FIT CRANKSHAFT AND MAIN BEARINGS

1. Locate upper main bearing shells (with oil holes and grooves) in cylinder block.
2. Locate the flanged upper centre main bearing shell.
3. Lubricate crankshaft main bearing journals and bearing shells with clean engine oil and lower crankshaft into position.



ST830M

4. Lubricate lower main bearing shells and fit numbers one to four main bearing caps and shells only, leave the fixing bolts finger-tight.
5. Fit cross shaped side seals to grooves each side of rear main bearing cap. Do not cut side seals, they must protrude 1.5 mm approximately above bearing cap parting face.
6. Apply Hylomar SQ32M jointing compound to rearmost half of rear main bearing cap parting face or, if preferred, to equivalent area on cylinder block as illustrated.
7. Lubricate bearing half and bearing cap side seals with clean engine oil.
8. Carefully fit bearing cap assembly.
9. Do not tighten fixings, but ensure that cap is fully home and squarely seated on cylinder block.



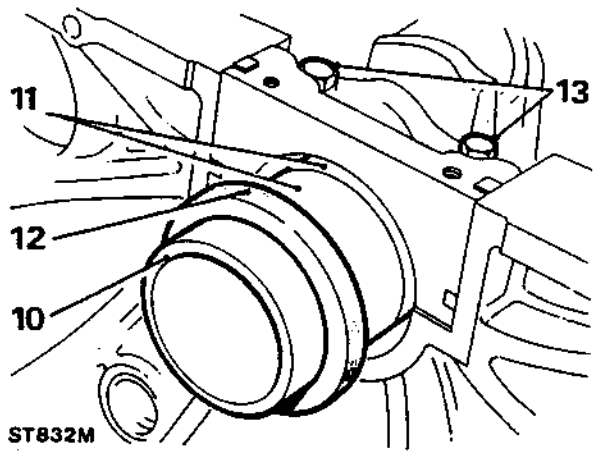
ST831M

⚠ **CAUTION: Do not handle oil seal lip, check it is not damaged and ensure that outside diameter remains clean and dry.**

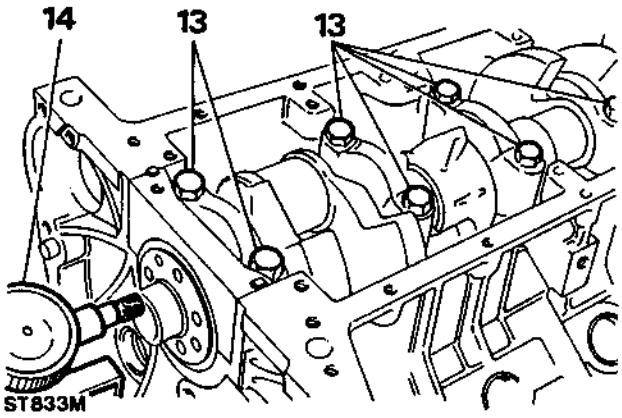
10. Position seal guide LRT-12-010 on crankshaft flange.
11. Ensure that oil seal guide and crankshaft journal are scrupulously clean. Coat seal guide and oil seal journal with clean engine oil.

△ **NOTE: Lubricant coating must cover seal guide outer surface completely to ensure that oil seal lip is not turned back during assembly.**
Position oil seal, lipped side towards the engine, on to seal guide. Seal outside diameter must be clean and dry.

12. Push oil seal fully and squarely by hand into recess formed in cap and block until it contacts machined step in recess.
Withdraw seal guide.



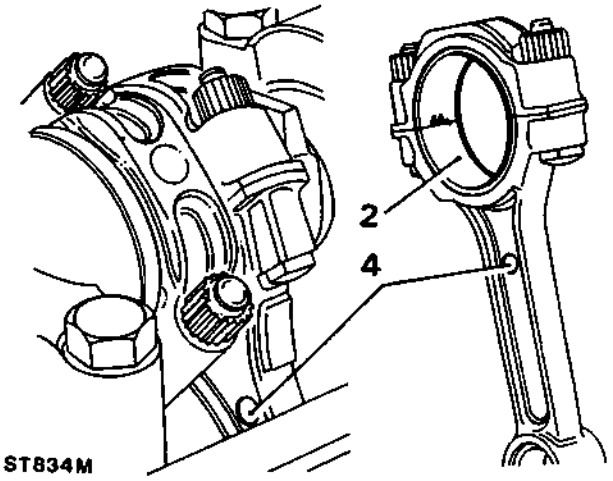
13. Tighten cap bolts to correct torque, numbers one to four bearings ***70 Nm,*** rear main bearing ***90 Nm.***
14. Check crankshaft end-float, 0.10 to 0.20 mm.



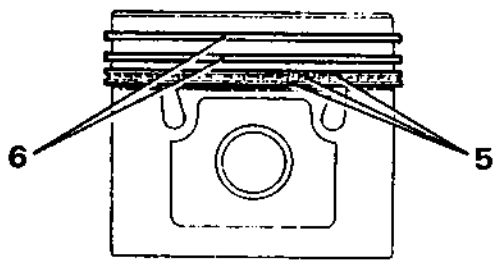
⚠ **CAUTION: Do not exceed 1,000 engine rev/min for 15 seconds when first starting engine, otherwise crankshaft rear oil seal will be damaged.**

FIT CONNECTING RODS AND PISTONS

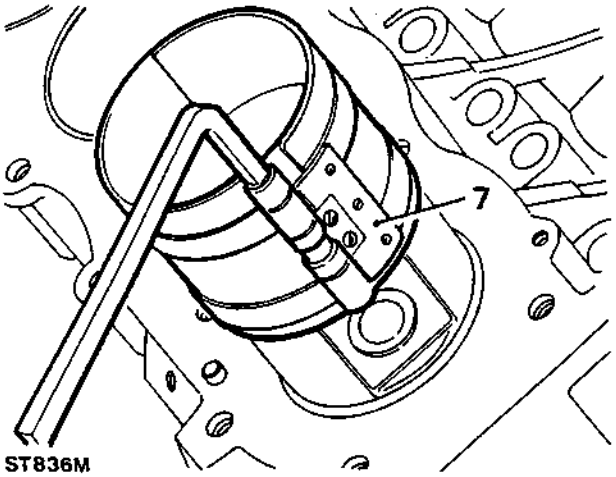
1. Locate applicable crankshaft journal at B.D.C.
2. Place bearing upper shell in connecting rod.
3. Retain upper shell by screwing guide bolts 605351 onto connecting rods.
4. Insert connecting rod and piston assembly into respective bore, noting that domed shape boss on connecting rod must face towards front of engine on right hand bank of cylinders and towards rear on left hand bank. When both connecting rods are fitted, bosses will face inwards towards each other.



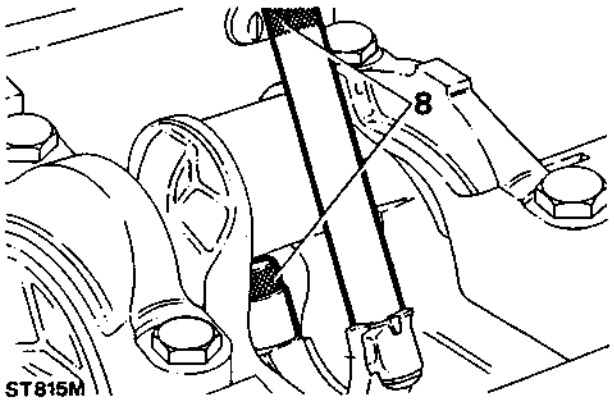
5. Position oil control piston rings with ring gaps all at one side, between piston pin and piston thrust face. Space gaps in ring rails approximately 25 mm each side of expander ring joint.
6. Position compression rings with ring gaps on opposite sides of piston between piston pin and piston thrust face.



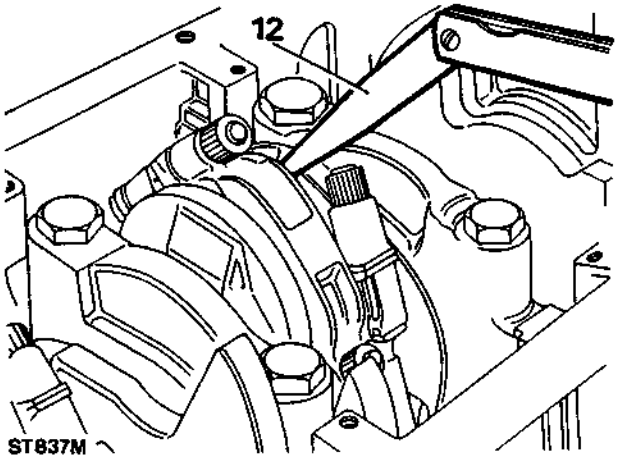
7. Using a piston ring compressor, locate piston into cylinder bore, until piston crown is just below cylinder block top face.



8. Pull connecting rods on to crankpins using the guide bolts. Use extreme care to prevent scratching crank pins.

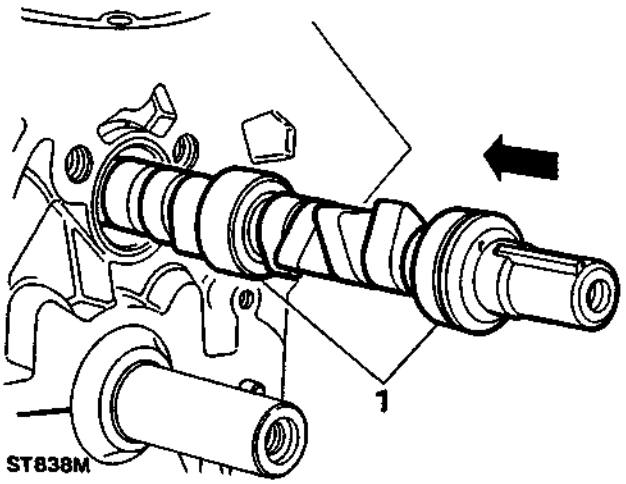


9. Place bearing lower shell in connecting rod cap.
10. Locate cap and shell onto connecting rod, noting that rib on edge of cap must be towards front of engine on right hand bank of cylinders and towards rear on left hand bank.
11. Check that connecting rods move freely sideways on the crankshaft. Tightness indicates insufficient bearing clearance or misaligned connecting rod.
12. Check end-float between connecting-rods on each crankshaft journal. Clearance limits: 0.15 to 0.37 mm.
13. Tighten connecting rod nuts to the correct torque, ***50 Nm. Fit oil strainer and joint washer.***

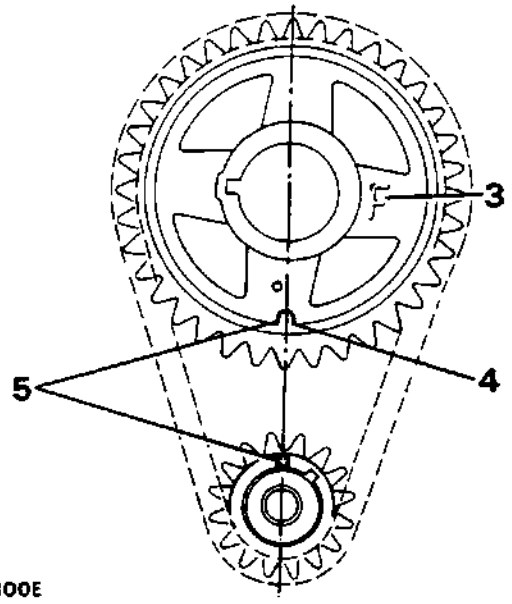


FIT CAMSHAFT TIMING CHAIN AND SPROCKET

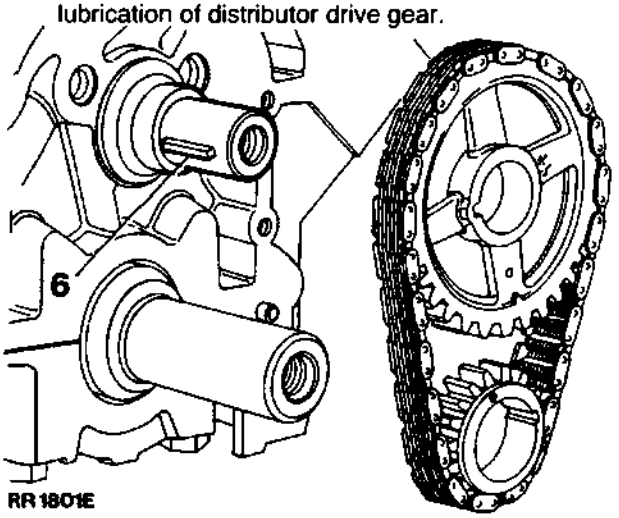
1. Lubricate camshaft journals and carefully insert camshaft into cylinder block.



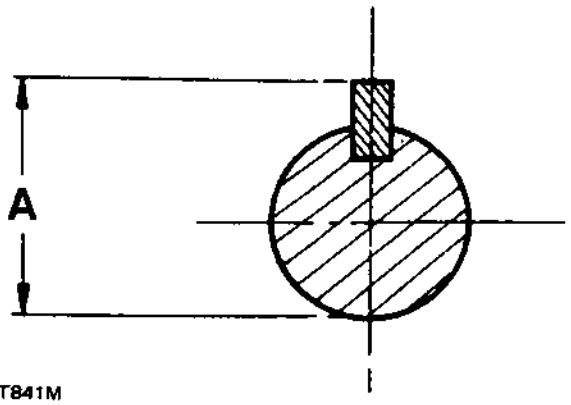
2. Turn crankshaft to bring number one piston to TDC.
3. Temporarily fit camshaft sprocket with marking 'F' or 'FRONT' outward.
4. Turn camshaft until mark on camshaft sprocket is at six o'clock position, remove sprocket without disturbing camshaft.
5. Encircle sprockets with chain keeping timing marks aligned.



6. Fit sprocket assembly to camshaft and crankshaft key locations. Check that camshaft key is parallel to shaft axis to ensure adequate lubrication of distributor drive gear.

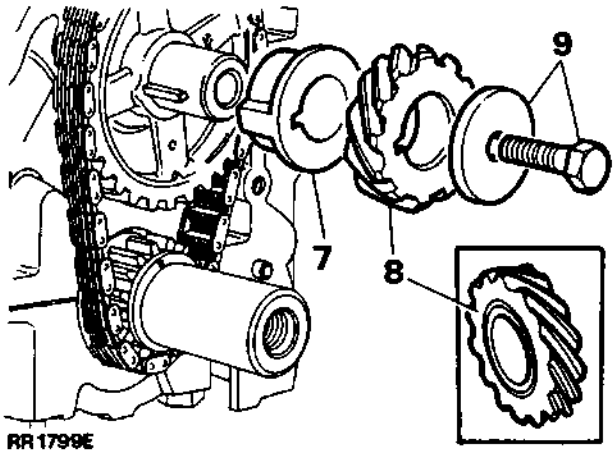


⚠ **CAUTION: The space between key and keyway acts as an oilway for lubrication of drive gear. Ensure that key is seated to full depth of keyway. Overall dimension of shaft and key must not exceed 30.15 mm, dimension A below.**



ST841M

7. Check timing marks line up, fit spacer with flange to front.
8. Fit the distributor drive gear. Ensure that annular grooved side is fitted to rear, towards spacer.
9. Fit bolt and washer, tighten to correct torque, ***60 Nm.***

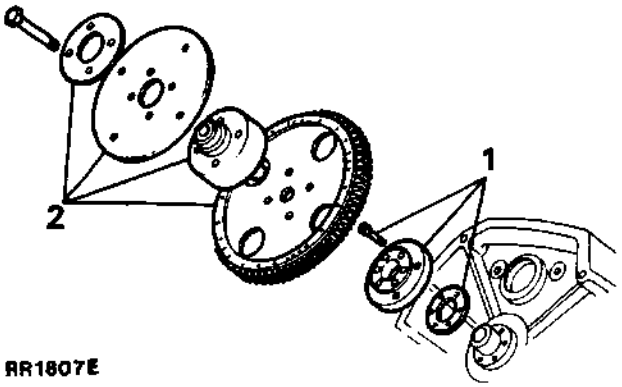


RR1799E

FIT RING GEAR AND FLEXIBLE DRIVE PLATE ASSEMBLY - AUTOMATIC VEHICLES

NOTE: Ensure components are aligned using previously scribed lines.

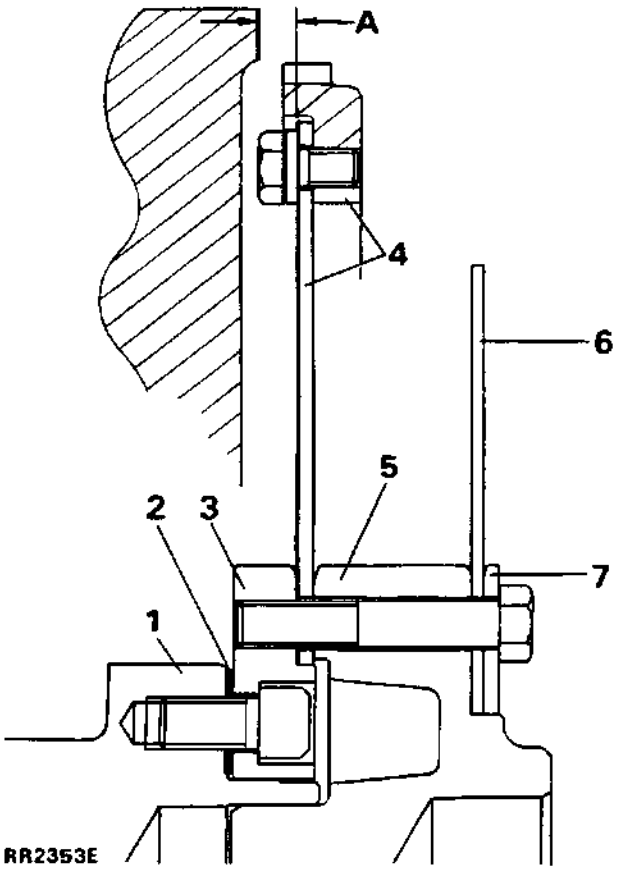
1. Fit shim and crankshaft adaptor plate. Secure with six socket head bolts, do not fully tighten.
2. Fit ring gear assembly, hub aligner and flexible drive plate. Secure with four bolts and clamping ring, do not fully tighten.



RR1807E

3. To prevent distortion to flexible drive plate when bolted to torque converter, check setting height of drive plate as follows.
4. To prevent excessive clearance, a shim is fitted between crankshaft drive flange and crankshaft adaptor plate. Setting height, dimension A, measured between front face of ring gear drive plate and engine cylinder block to gearbox mating face, should be 8.08 to 8.20 mm. Select appropriate shim to maintain dimension A, as shown.

PART NO.	DIMENSION (MM)
FRC 7084	1.20 - 1.25
FRC 7085	1.30 - 1.35
FRC 7086	1.40 - 1.45
FRC 7087	1.50 - 1.55
FRC 7088	1.60 - 1.65
FRC 7089	1.70 - 1.75
FRC 7090	1.80 - 1.85
FRC 7091	1.90 - 1.95
FRC 7092	2.00 - 2.05
FRC 7093	2.10 - 2.15

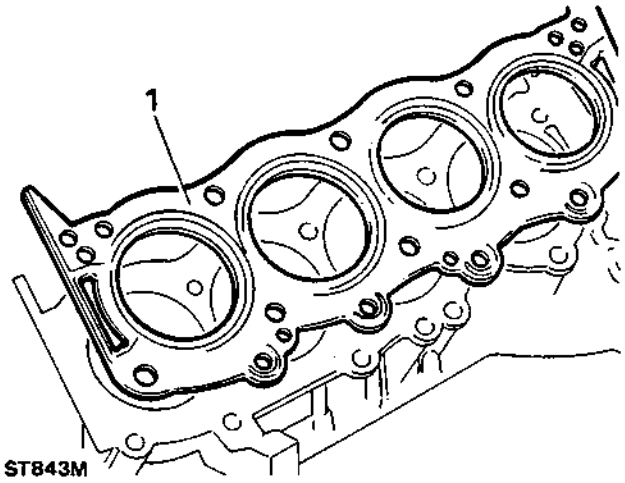


1. Crankshaft flange.
2. Shim.
3. Crankshaft adaptor flange.
4. Drive plate and ring gear assembly.
5. Hub aligner.
6. Flexible drive plate.
7. Clamp ring.

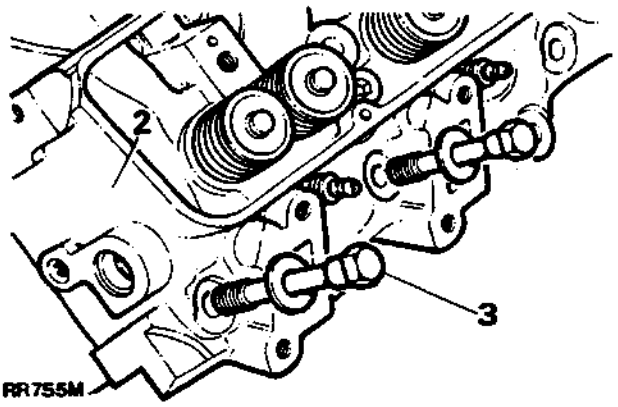
5. Remove four bolts, clamp ring, flexible drive plate, hub aligner and ring gear assembly.
6. Remove six socket head bolts and crankshaft adaptor.
7. Fit appropriate shim, refit adaptor and six socket head bolts. Tighten to ***84 Nm.***
8. Fit ring gear assembly, hub aligner, flexible drive plate and clamp ring.
9. Coat threads of four securing bolts with Loctite 270. Fit bolts and tighten to correct torque, ***40 Nm.***

FIT CYLINDER HEADS

1. Fit new cylinder head gaskets with word 'TOP' uppermost. Do NOT use sealant.



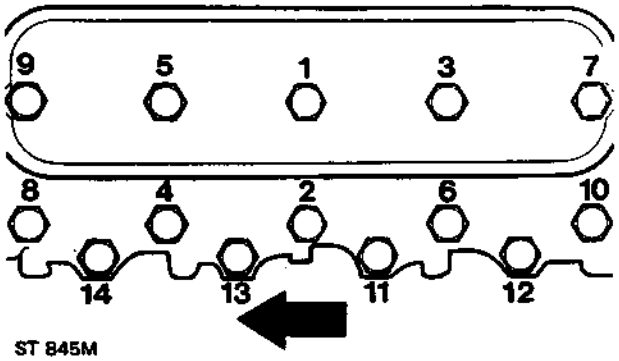
2. Locate cylinder heads on dowels.
3. Clean threads of cylinder head bolts, coat with engine oil.



4. Locate the cylinder head bolts in position illustrated and fit dipstick tube.

   Long bolts - 1, 3 and 5.
   Medium bolts - 2,4,6,7,8,9 and 10.
   Short bolts - 11,12,13 and 14.

5. Tighten head bolts progressively in sequence shown. Finally tighten to correct torque, outer row ***60 Nm*** centre and inner row ***90 Nm.***
6. Re-check torques when all bolts have been tightened.



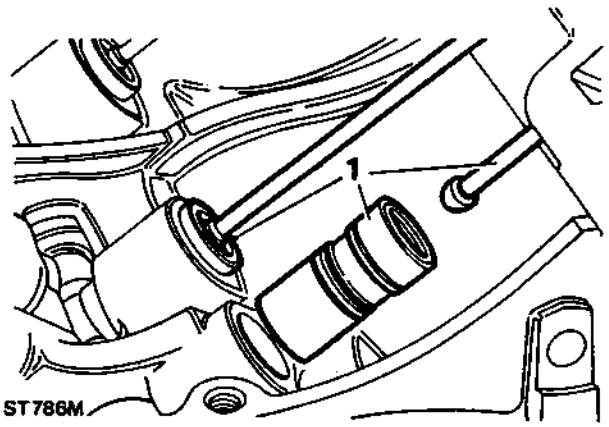
ST 845M

△ **NOTE: Left-hand cylinder head illustrated. Arrow points to front of vehicle.**

FIT TAPPETS, PUSH RODS AND ROCKER ASSEMBLIES

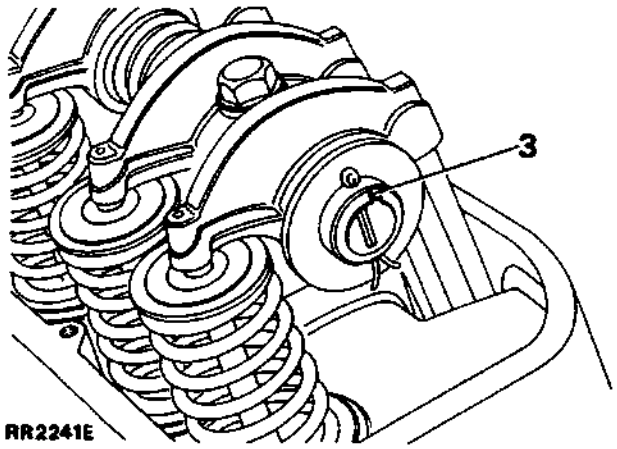
△ **NOTE: Immerse tappets in clean engine oil. Before fitting, pump inner sleeve of tappet several times using a pushrod, to reduce tappet noise when engine is started.**

1. Fit tappets and push rods in original positions. Ensure tappets move freely in bores.



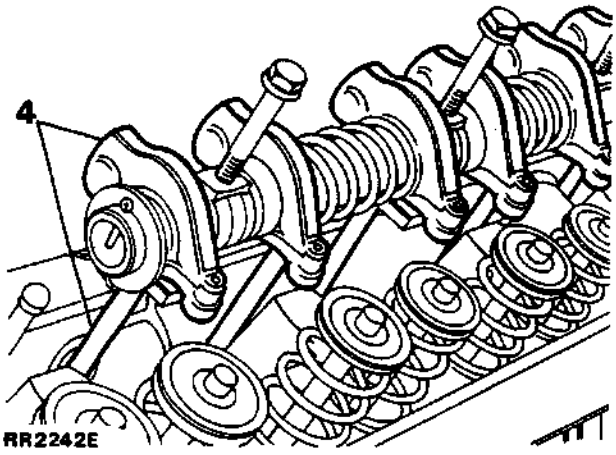
ST786M

2. Rocker shafts are handed and must be fitted correctly to align oilways.
3. Ensure each rocker shaft is fitted with notch uppermost and towards front of engine on right hand side, towards rear on left hand side.



RR2241E

4. Fit rocker shaft assemblies. Ensure pushrods engage rocker cups. Tighten bolts to correct torque, ***38 Nm.***

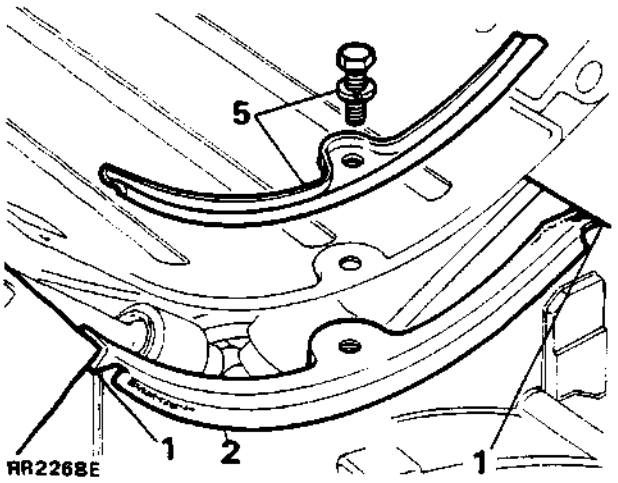


NOTE: Tappet noise can be expected on initial starting after overhaul or if vehicle has been standing a very long period. Run engine at 2,500 rev/min for a few minutes (subject to following caution), when noise should be eliminated.

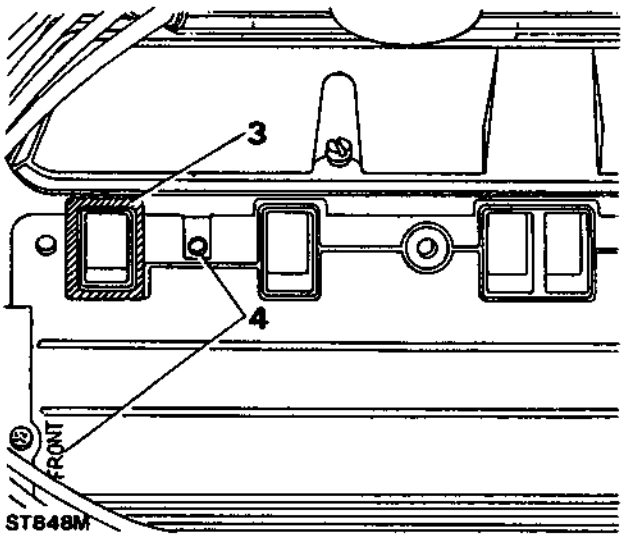
CAUTION: Do not exceed 1,000 engine rev/min for 15 seconds when first starting engine, otherwise crankshaft rear oil seal will be damaged.

FIT INTAKE MANIFOLD

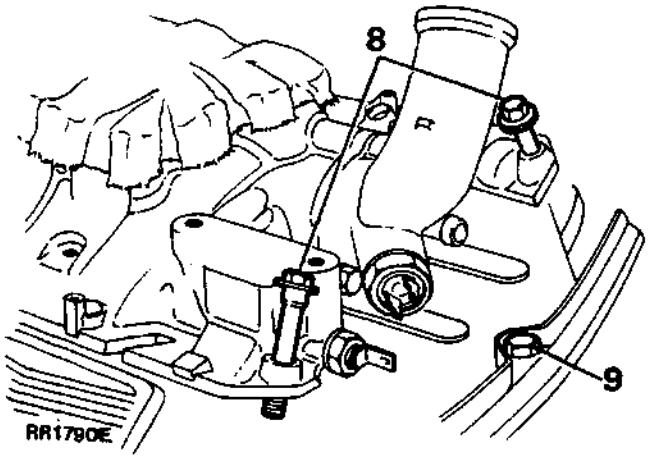
1. Apply globule of Hylomar SQ32M sealing compound to notches between cylinder head and block.
2. Locate NEW seals in position with ends engaged in notches.



3. Apply 'Hylomar' SQ32M on corners of cylinder head, manifold gasket and manifold, around water passage joints.
4. Fit manifold gasket with word 'FRONT' to front and open bolt hole at front R.H. side.
5. Fit gasket clamps, do not fully tighten bolts.

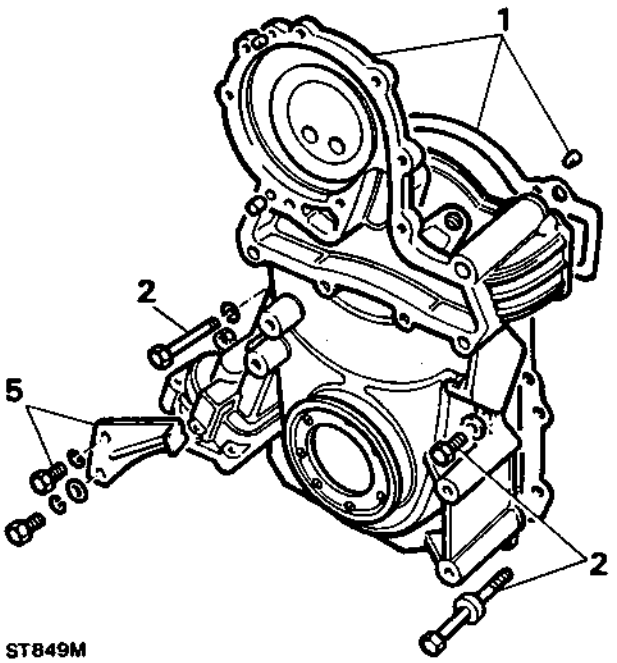


6. Locate manifold on to cylinder head.
7. Clean threads of manifold securing bolts.
8. Fit all manifold bolts, evenly tighten a little at a time, alternate sides working from centre to each end. Finally tighten to correct torque, ***40 Nm.***
9. Tighten gasket clamp bolts to correct torque, ***18 Nm.***



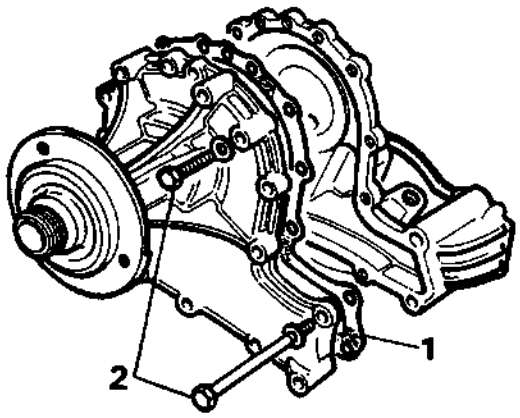
FIT TIMING COVER AND CRANKSHAFT PULLEY

1. Position a new timing cover joint washer, fit timing cover, locating it on two dowels.
2. Clean threads of timing cover securing bolts, coat them with Loctite 572.
3. Fit and evenly tighten timing cover bolts to correct torque, ***28 Nm.***
4. Fit crankshaft pulley. Tighten retaining bolt to correct torque, ***270 Nm.***
5. Fit timing pointer.



FIT WATER PUMP

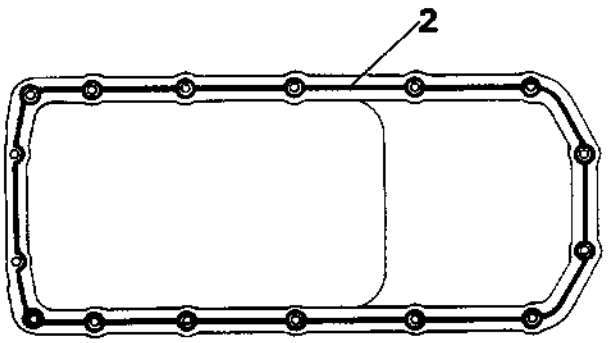
1. Lightly grease a new joint washer and place it in position on timing cover.
2. Clean threads of four long bolts and coat with Loctite 572 thread lubricant sealant. Locate water pump in position.
3. Locate alternator adjusting link on water pump.
4. Leaving alternator adjusting link loose, tighten remaining water pump housing bolts evenly to correct torque ***28 Nm.***



RR1795E

FIT SUMP

1. Remove old sealant from sump and cylinder block joint faces.
2. Apply 2 mm wide bead of Hylosil 102 to joint face of sump as shown in illustration below.

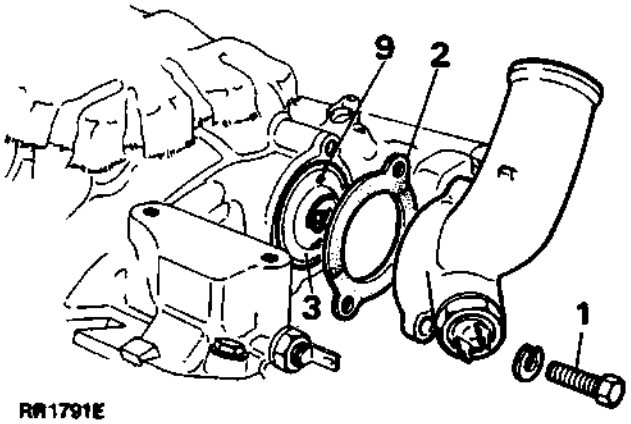


RR1867E

3. Place sump in position, fit sump bolts, evenly tighten bolts to correct torque, ***10 Nm,*** rear bolts ***19 Nm.***
4. Tighten sump plug to correct torque, ***44Nm.***
5. Allow thirty minutes sealant curing time before starting engine.

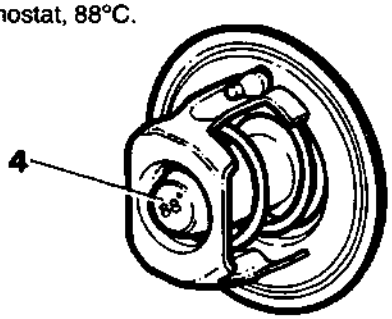
TEST AND FIT THERMOSTAT

1. Remove two bolts securing thermostat housing to intake manifold.
2. Remove housing gasket.
3. Withdraw thermostat.



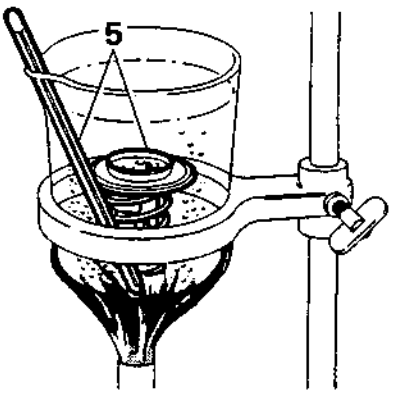
RR1791E

4. Note fully open temperature stamped on thermostat, 88°C.



RR799M

5. Place thermostat and a thermometer in a suitable container half full of water.
6. Heat water and observe temperature at which thermostat opens.
7. Discard thermostat if faulty.
8. Clean intake manifold and thermostat housing mating faces.



ST858M

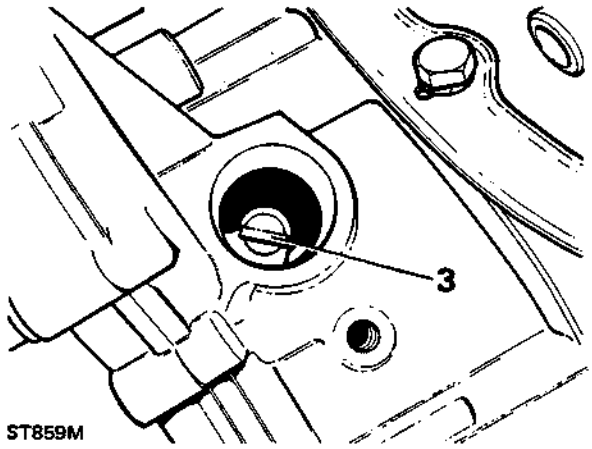
9. Fit thermostat with jiggle pin uppermost.

△ **NOTE: Airlocks may develop in cooling system if thermostat is incorrectly positioned, with consequent loss of coolant and possible overheating.**

10. Fit housing with new gasket, tighten two bolts to correct torque, ***28 Nm.***

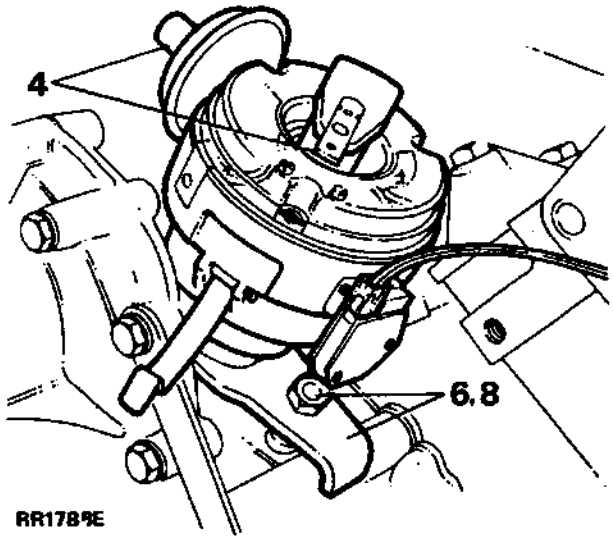
FIT DISTRIBUTOR

1. Turn crankshaft to bring number one piston to 6° BTDC on compression stroke (both valves closed number one cylinder).
2. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one spark plug lead position on cap.
3. Turn oil pump and distributor drive shaft until tongue is in approximate position illustrated.



ST859M

4. Fit distributor to engine, check that centre line of rotor arm is now in line with number one spark plug lead position in distributor cap. Reposition distributor if necessary. The vacuum capsule should be at approximately 90° to camshaft.
5. If distributor does not seat correctly, oil pump drive is not engaged. Remove distributor, reset oil pump drive tongue, repeat operation.



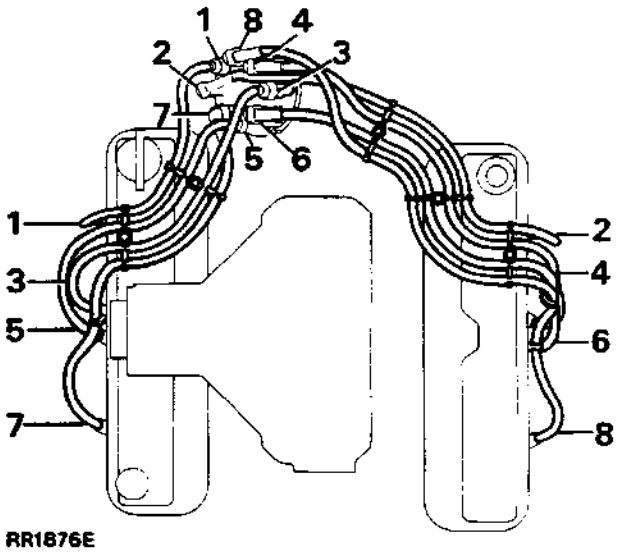
RR1784E

6. Fit clamp and nut, leave loose.
7. Rotate distributor until peak on pick-up lines up with a peak on reluctor ring. Remove rotor arm for better view.

CAUTION: On no account must engine be started before this operation is carried out.

8. Secure distributor in this position by tightening clamp nut.
9. Fit distributor cap and spark plugs. Connect H.T. leads as shown in illustration RR1876E.

NOTE: This distributor setting is to enable engine to be started. When engine is refitted the ignition timing must be set using electronic equipment. ***See ELECTRICAL, Adjustment, Ignition timing***

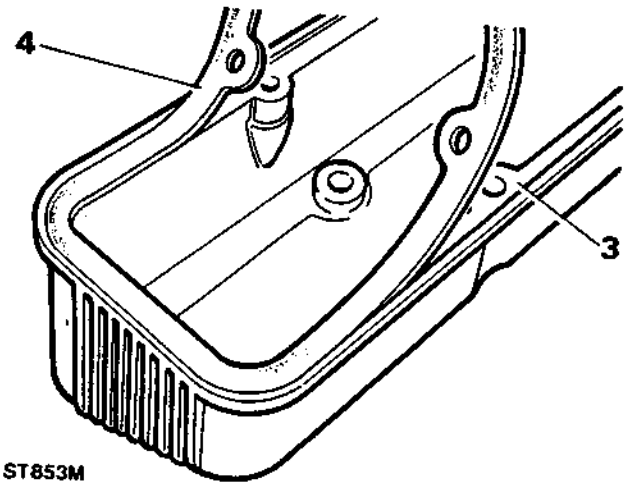


RR1876E

FIT ROCKER COVERS

1. An oil baffle is fitted inside each rocker cover. Remove two screws to remove baffle for cleaning.
2. Remove old gasket and sealant from covers and cylinder heads. Clean and dry gasket mounting face, using Bostik cleaner 6001. Apply Bostik 1775 to seal face and gasket, use a brush to ensure an even film. Allow adhesive to become touch-dry, approximately fifteen minutes.

△ **NOTE: The gasket fits one way only, it must be fitted accurately first time. Subsequent movement would destroy bond.**

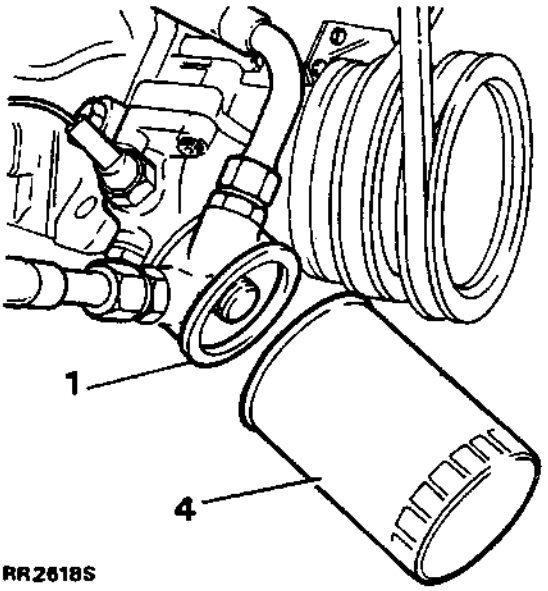


ST853M

3. Fit pilot studs in rocker cover fixing holes to guide gasket onto cover and into recess. Press gasket into place ensuring that outer edge firmly contacts recess wall.
4. Allow covers to stand for thirty minutes before fitting.
5. Secure rocker covers to cylinder heads with short screws inboard, long screws outboard. Tighten to ***9 Nm.***

FIT ENGINE OIL FILTER

1. Clean oil cooler adaptor mating face.
2. Coat sealing ring of new filter with clean engine oil.
3. Fill filter with new oil as far as possible, noting angle at which filter is to be fitted.

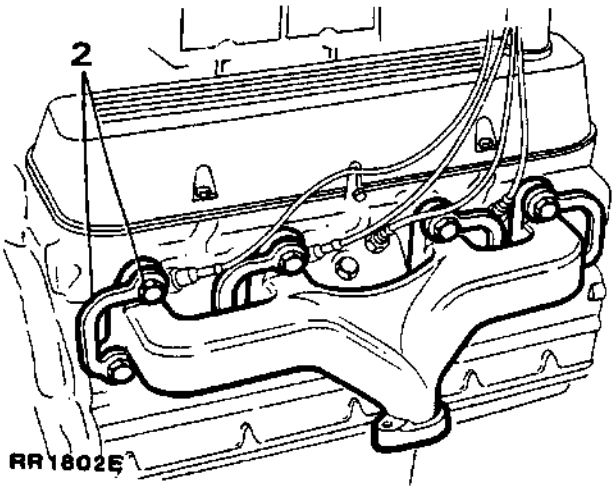


RR2618S

4. Screw on filter until sealing ring touches mating face, then tighten a further half turn by hand only. DO NOT OVERTIGHTEN.
5. Refill engine with specified grade and quantity of oil.

FIT EXHAUST MANIFOLD

1. Ensure mating surfaces of head and exhaust manifold are clean. Fit new gaskets to exhaust manifold. Coat threads of bolts with anti-seize compound.
2. Position manifold on cylinder head and fit new lockplates, securing bolts and plain washers. The plain washers are fitted between manifold and lockplates. Evenly tighten manifold bolts to correct torque, ***20 Nm***. Bend over lock tabs.



MISCELLANEOUS AND NON-STANDARD ITEMS

Fit remaining items of equipment, miscellaneous hoses, pipes, filters, clips and brackets in position.

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Adaptor plate to crankshaft	84
Alternator mounting bracket to cylinder head	39
Alternator to mounting bracket	25
Alternator to adjusting link	25
Chainwheel to camshaft	58
Connecting rod bolt	51
Cylinder head:	
Outer row	58
Centre row	92
Inner row	92
Damper to crankshaft	271
Distributor clamp nut	21
Drive plate to converter	39
Engine mountings to engine and chassis	52
Engine mounting rubbers to brackets	19
Exhaust manifold to cylinder heads	21
Fan to viscous unit	29
Flexible drive plate to crankshaft adaptor plate	41***
Intake manifold to cylinder heads	38
Lifting eye to cylinder heads	39
Main bearing cap bolts	72**
Main bearing cap rear bolts	92**
Manifold gasket clamp bolt	17
Oil pump cover to timing cover	13
Oil plug	27
Oil relief valve plug	44
Oil sump drain plug	44
Oil sump to cylinder block	9
Oil sump rear to cylinder block	18
Plenum chamber to ram housing	25
Ram housing to intake manifold	24
Rocker cover to cylinder head	9
Rocker shaft bracket to cylinder head	37
Spark plug	21
Starter motor attachment	44
Thermostat housing to intake manifold	27
Timing cover to cylinder block	27*
Viscous unit to water pump hub	45
Water pump pulley to water pump hub	10*
Water pump timing cover to cylinder block	27
Water jacket to plenum chamber	13*

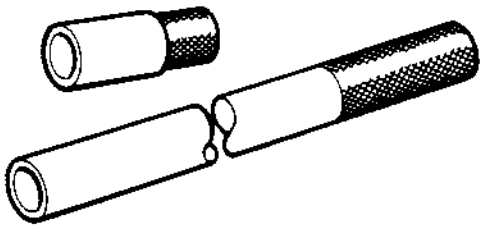
* These bolts must have threads coated with Loctite 572 before assembly.
** These bolts must have threads coated in lubricant EXP16A before assembly.
*** These bolts must have threads coated in sealant Loctite 270

It is essential that bolts are tightened to correct torque value.

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

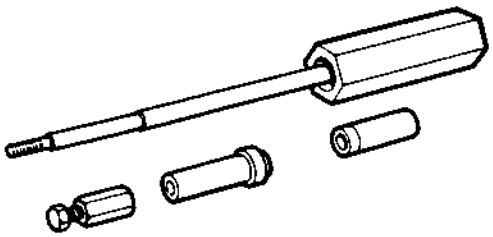
△ **NOTE: Torque values above are for all screws and bolts used except for those specified.**

V8 PETROL



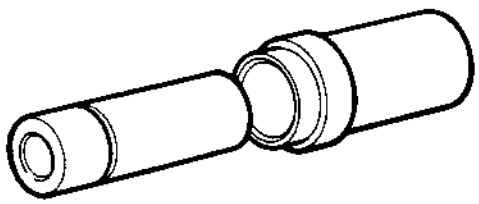
RO605351

LRT-12-041 Guide bolts
RO605351



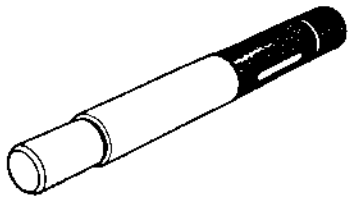
18G1150

LRT-12-013 Piston pin remover/replacer
18G1150 - Basic tool



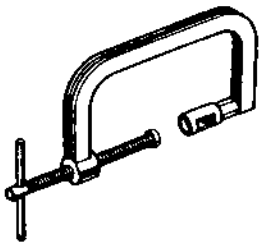
18G1150E

LRT-12-014 Adaptor remover/replacer - piston pin
18G1150E



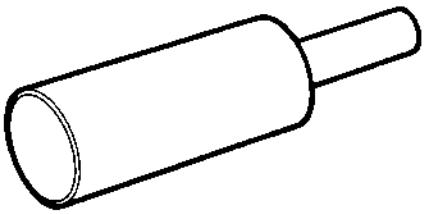
18G79

LRT-12-001 Clutch centralising tool.
18G79



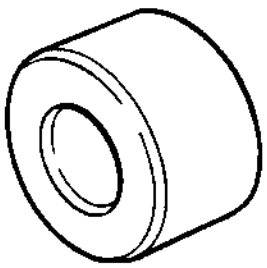
MS1519A

LRT-12-034 Spring compressor
MS1519A



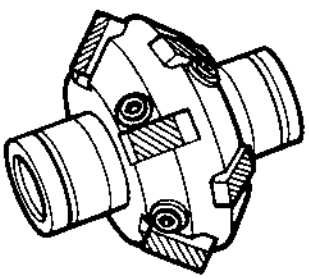
RO600959

LRT-12-038 Drift - Valve guide replacement
RO600959 - intake and exhaust



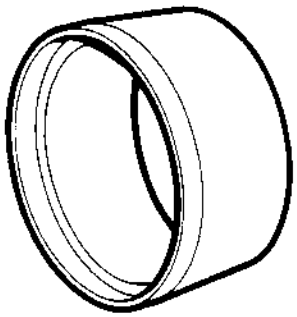
605774A

LRT-12-515 Distance piece for valve guide
RO605774A



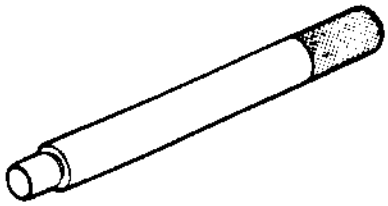
MS621

LRT-12-504 Valve seat cutter
MS621



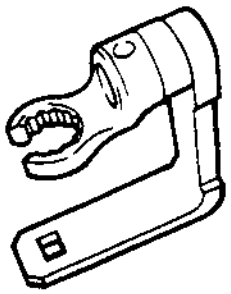
RO1014

LRT-12-010 Crankshaft rear seal sleeve
RO1014



RO 274401

LRT-12-037 Drift for valve guide removal
RO274401A - intake and exhaust



LST134

LRT-12-047 Torque adaptor lambda sensor
LST 134

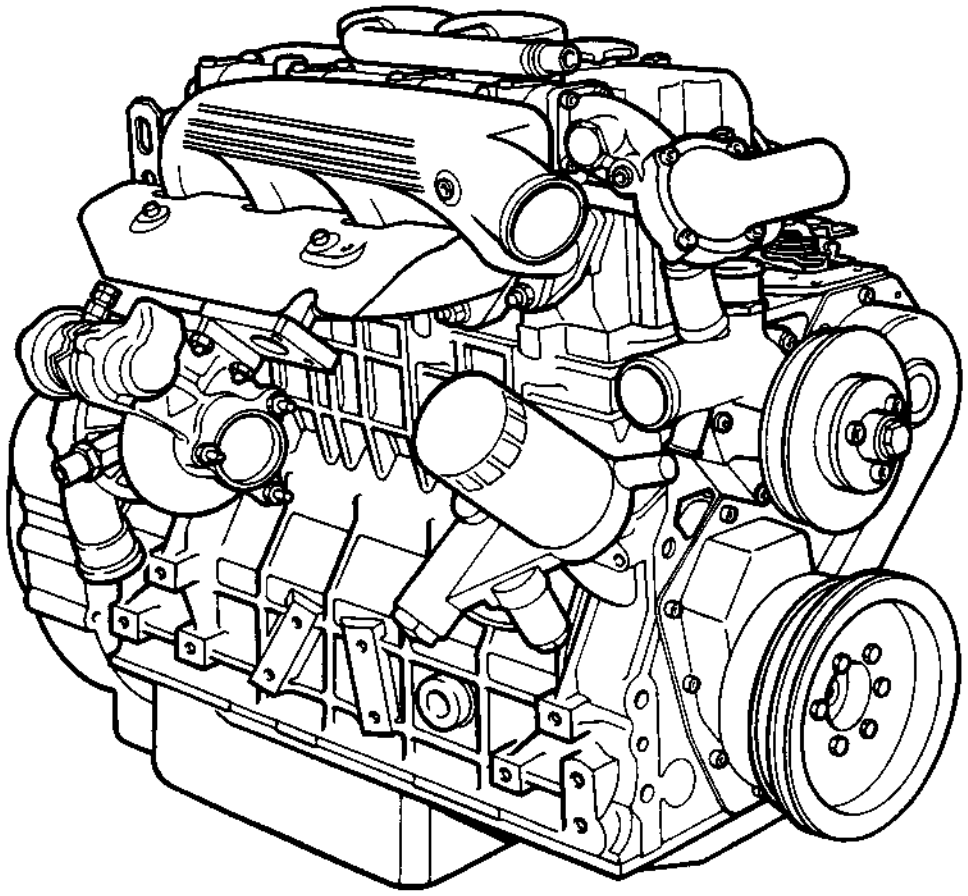
Notes

DIESEL ENGINE VM

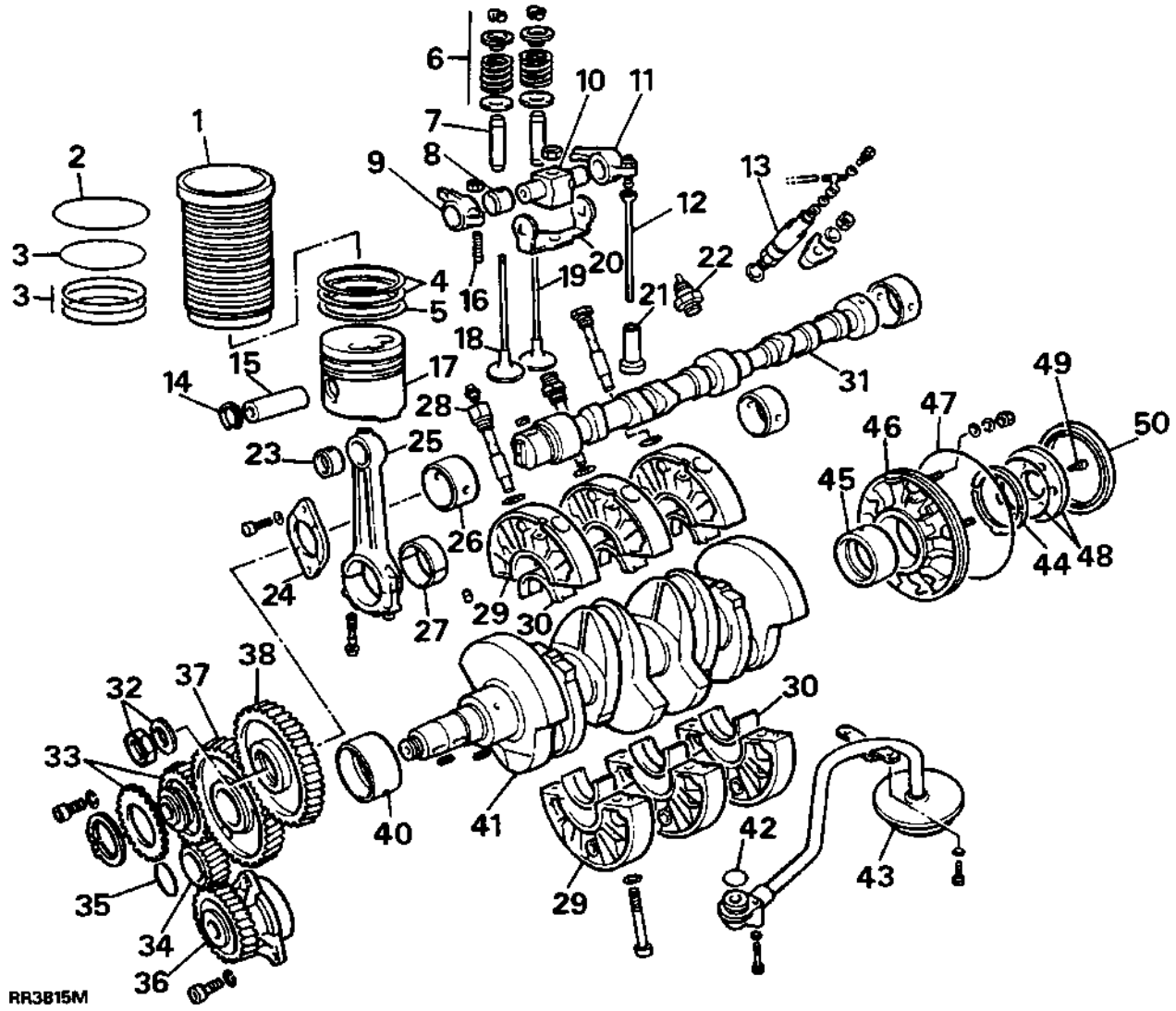
Description

The four cylinder over head valve 2.5 litre indirect injection diesel engine, has a cast iron skirted cylinder block and five main bearing cast iron crankshaft. The crankshaft main bearings are mounted in separate aluminium housings, which are a sliding fit into the cylinder block and each is locked in position by three bolts.

The three bearing camshaft, oil pump, vacuum pump and fuel injection pump are gear driven off the front of the crankshaft. Wet, cast iron cylinder liners with shims for height adjustment and 'O' ring seals are clamped in the cylinder block, by four separate aluminium cylinder heads. The 'Nimonic' alloy pre-combustion chambers which are a press fit into each cylinder head, are retained by the clamping force on the cylinder head gasket. The low expansion alloy pistons have a kidney shaped swirl recess in the crown and transmit the the combustion force to the crankshaft via forged steel connecting rods.

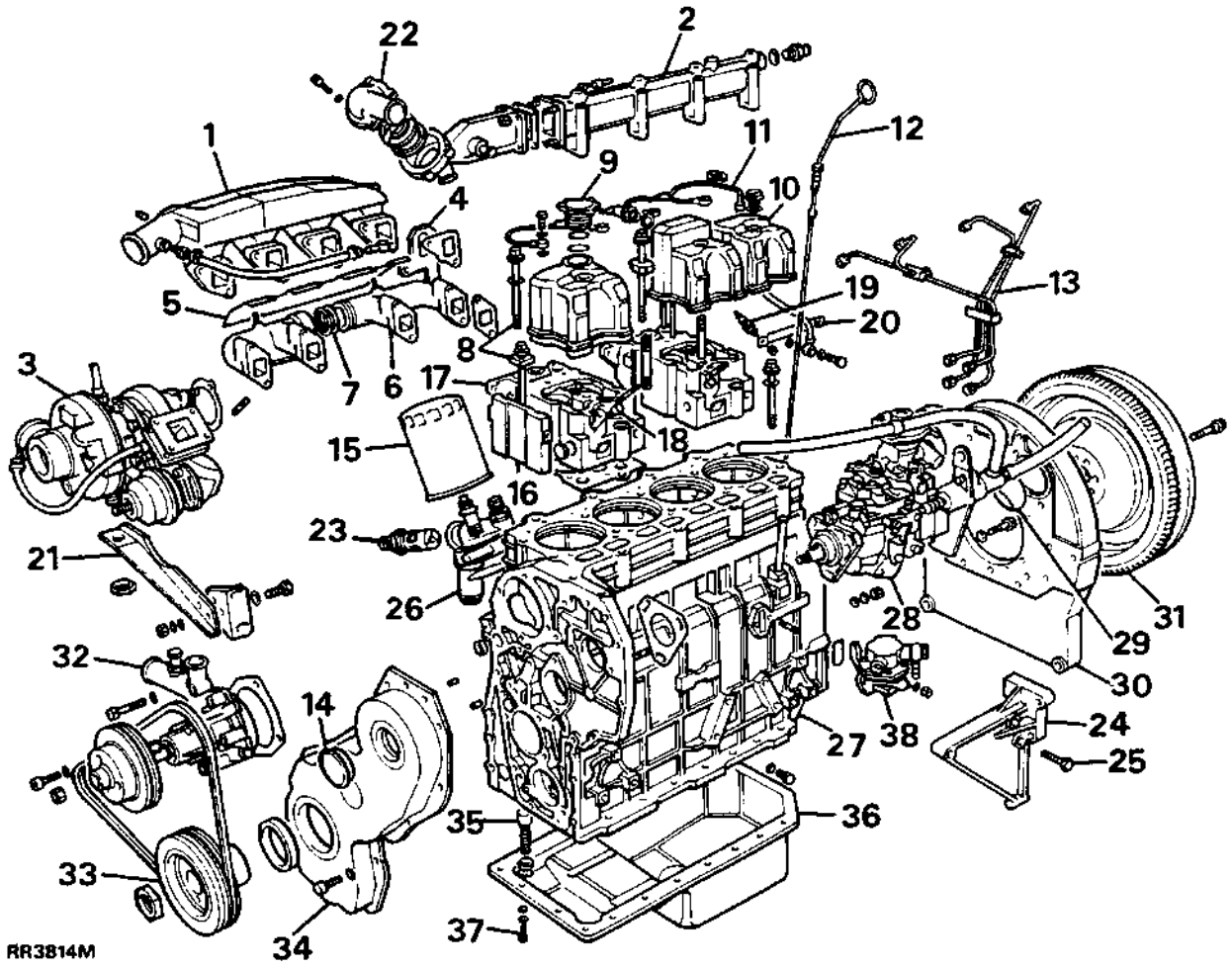


RR3764M


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RR3815M

ENGINE INTERNAL PARTS

1. Liner
2. Shim
3. 'O' ring seals
4. Compression rings
5. Oil control ring
6. Valve spring cap
7. Valve guide
8. Rocker shaft bush
9. Inlet rocker arm
10. Rocker shaft (pedestal)
11. Exhaust rocker arm
12. Push rod
13. Injector
14. Snap ring
15. Gudgeon pin
16. Valve clearance adjusting screw
17. Piston
18. Inlet valve
19. Exhaust valve
20. Spring clip
21. Tappet
22. Oil pressure switch
23. Small end bush
24. Thrust plate
25. Connecting rod
26. Camshaft bearings
27. Connecting rod bearing shell
28. Carrier location and lubrication shell
29. Central main bearing carrier
30. Central main bearing shell
31. Camshaft
32. Retaining nut and washer
33. Vacuum pump and split gear assembly
34. Crankshaft gear
35. 'O'-ring seal
36. Oil pump assembly
37. Camshaft gear
38. Fuel injection pump gear
39. N/A
40. Front main bearing
41. Crankshaft
42. 'O' ring seal
43. Oil pick-up pipe and strainer
44. Thrust washer halves
45. Rear main bearing
46. Rear main bearing carrier
47. 'O' ring seal
48. Crankshaft thrust spacer and 'O' ring seal
49. Socket headed screw
50. Crankshaft rear oil seal


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RR3814M

ENGINE EXTERNAL COMPONENTS

1. Inlet manifold
2. Engine coolant rail
3. Turbo-charger
4. Engine lifting eye
5. Heat shield
6. Exhaust manifold
7. Sealing rings
8. Cylinder head bolt and spacer block
9. Oil filler cap
10. Rocker cover
11. Valve gear oil feed pipe
12. Dipstick
13. Injector pipes
14. Screw plug
15. Oil filter element
16. Cylinder head end-plate
17. Cylinder head
18. Injector dowel
19. Heater plug
20. Heater plug copper link
21. Turbo-charger support bracket
22. Coolant thermostat
23. Oil thermostat
24. Support bracket
25. Bolt
26. Oil filter base adapter
27. Cylinder block
28. Fuel injection pump
29. 'O' ring
30. Flywheel housing
31. Flywheel
32. Water pump
33. Crankshaft pulley
34. Timing cover
35. Oil pressure relief valve
36. Sump
37. Sump pan
38. Fuel lift pump
39. Cold start device

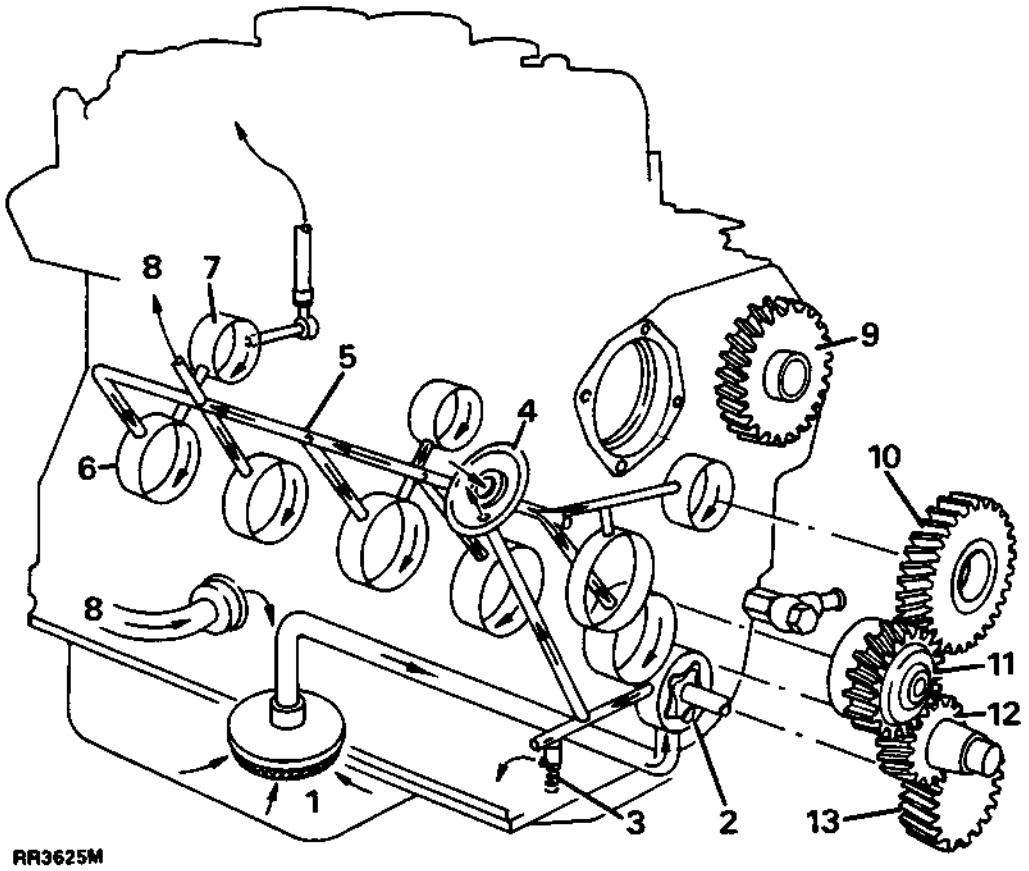
LUBRICATION SYSTEM

Description

The full flow lubrication system see in RR3625M, is supplied with oil by a 4/5 lobe rotary pump, which is located in the front of the cylinder block where it is gear driven from the crankshaft. The pressure relief valve is located in the cylinder block adjacent to the pump where it is retained with a circlip.

The oil filter adapter which is secured to the right side of the cylinder block, houses the by-pass valve and a thermostat to control the flow of oil through the cooler.

Oil flows through the cooler before filtering, after which it passes into the cylinder block oil gallery where it is distributed to the main bearings, camshaft bearings, vacuum pump and via an external hose to the rocker shafts. Filtered oil supplied from the oil gallery to the turbo, returns to the sump through a connection on the side of the cylinder block.



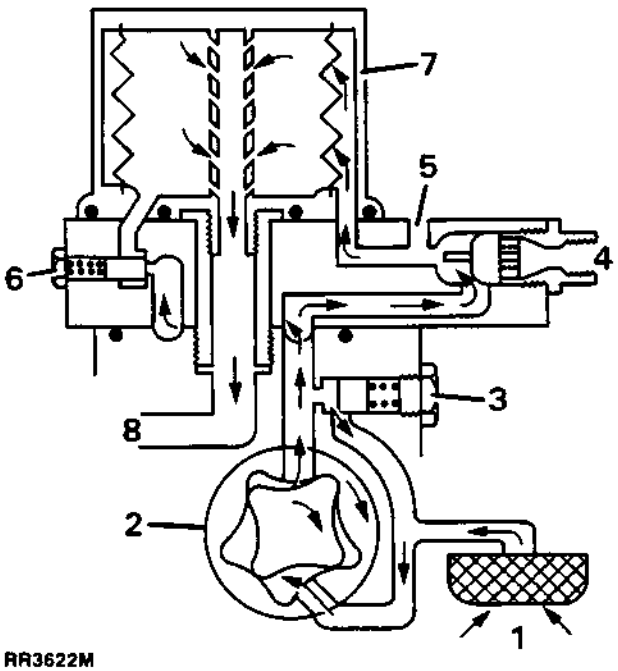
RR3625M

1. Oil pump inlet
2. Oil pump location
3. Pressure relief valve
4. Oil supply to and from filter and cooler
5. Distribution oil gallery
6. Main bearings (5)
7. Camshaft bearings (3) and supply to rocker shafts
8. Turbo feed and return
9. Injection pump gear
10. Camshaft gear
11. Vacuum pump/gear
12. Crankshaft gear

Filtered oil thermostat closed

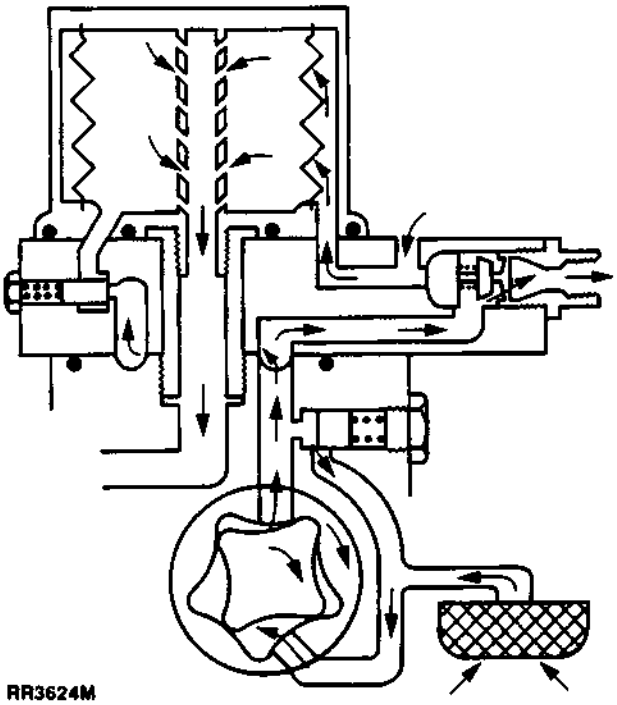
Illustration RR3622M shows oil being filtered and the thermostat closed, with no circulation through the cooler.

As the engine warms up the thermostat will open, diverting the oil through the cooler as seen in RR3624M.



RR3622M

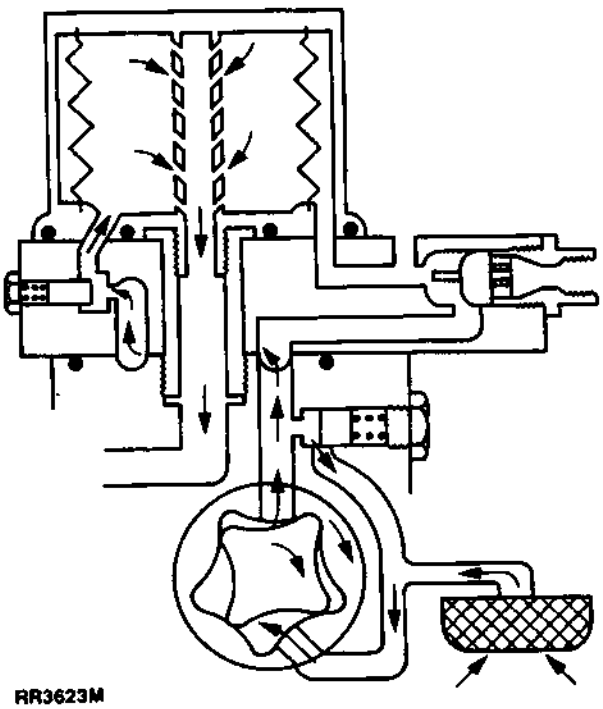
1. Oil pump inlet
2. Oil pump
3. Pressure relief valve
4. Connection to cooler
5. Connection from cooler
6. Filter by-pass valve
7. Filter
8. Oil to distribution gallery



RR3624M

Unfiltered oil

Should the filter become blocked, the by-pass valve will lift off its seating allowing the oil to reach the engine bearings without being filtered as seen in RR3623M.



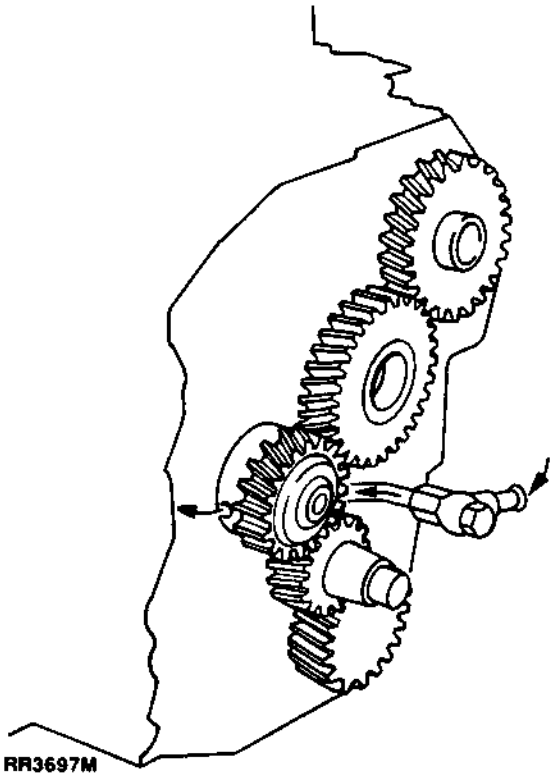
RR3623M

See Fault diagnosis, Engine oil pressure test

VACUUM PUMP

Operation

The brake servo vacuum pump is located in the front of the cylinder block where it transmits the drive from the crankshaft to the camshaft and injection pump. The pump which is lubricated from the oil gallery, draws air from the brake servo and discharges into the front cover of the engine as illustrated.
The operating efficiency of the vacuum pump depends on adequate engine lubrication pressure. The pressure is applied to the inner edge of each of the four rotor vanes to ensure that the vanes are pushed outwards and form a good seal with the pumping chamber.


RR3697M

With the engine running and during normal operation of the brakes, the pump draws only a small volume of air from the servo each time the brakes are applied. However, the pump is capable of pumping a very large volume of air and therefore it is not advisable to run the engine with the brake servo hose disconnected as this may cause pressurization of the crankcase ventilation system.

CAUTION: Do not run the engine with the brake vacuum pump brake servo hose disconnected.

For further information, ***See Fault diagnosis, Vacuum pump test***

TURBOCHARGER

Description

The turbocharger is a simple and efficient means of harnessing the residual power in the exhaust gas and using that power to force more air into the combustion chambers, to increase the power output of the engine.

An increase in engine power of up to 30% may be derived from installing a turbo charger.

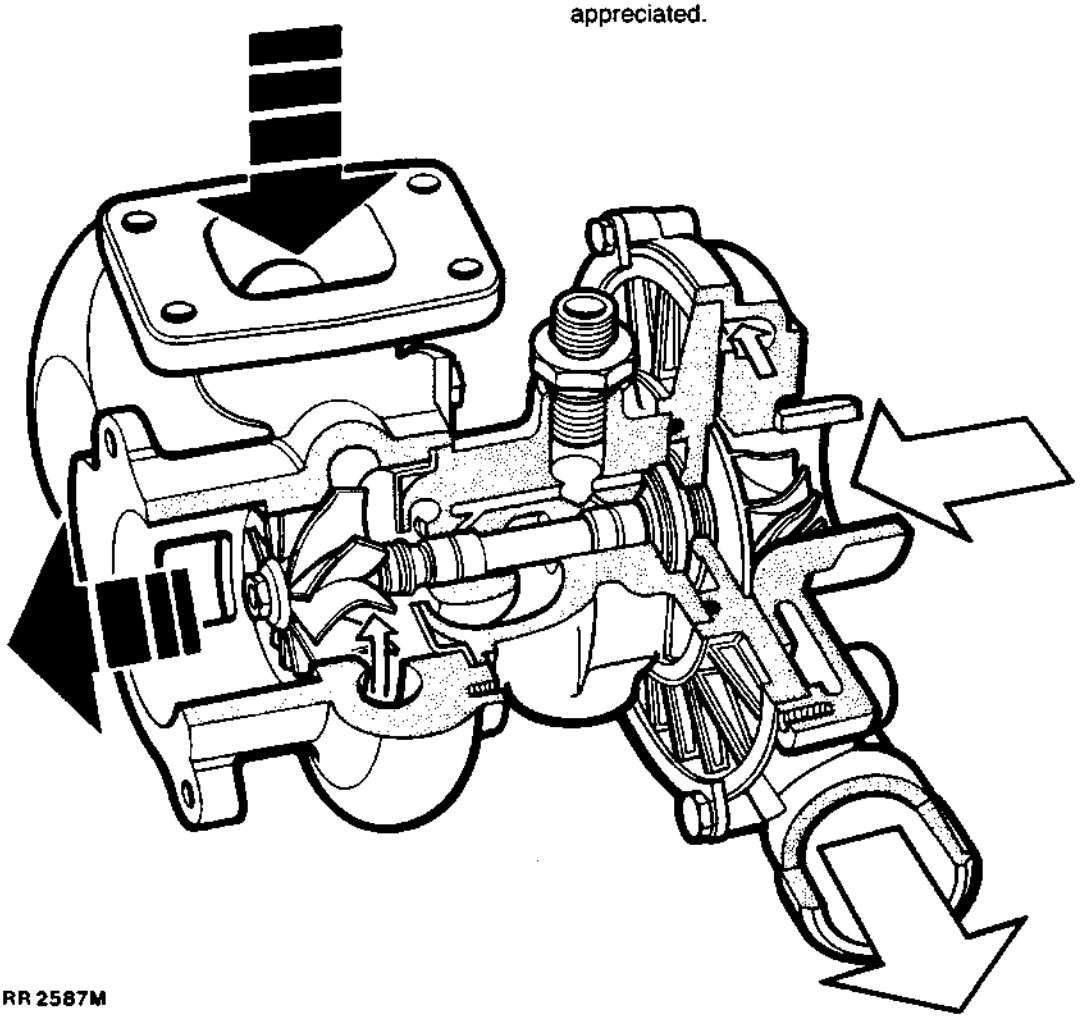
Operation

The turbocharger shown in RR3637M consists of a single shaft 1 mounted on fully floating high speed bearings 2. The shaft has an exhaust driven turbine 3 at one end and an air compressor turbine 4 at the other.

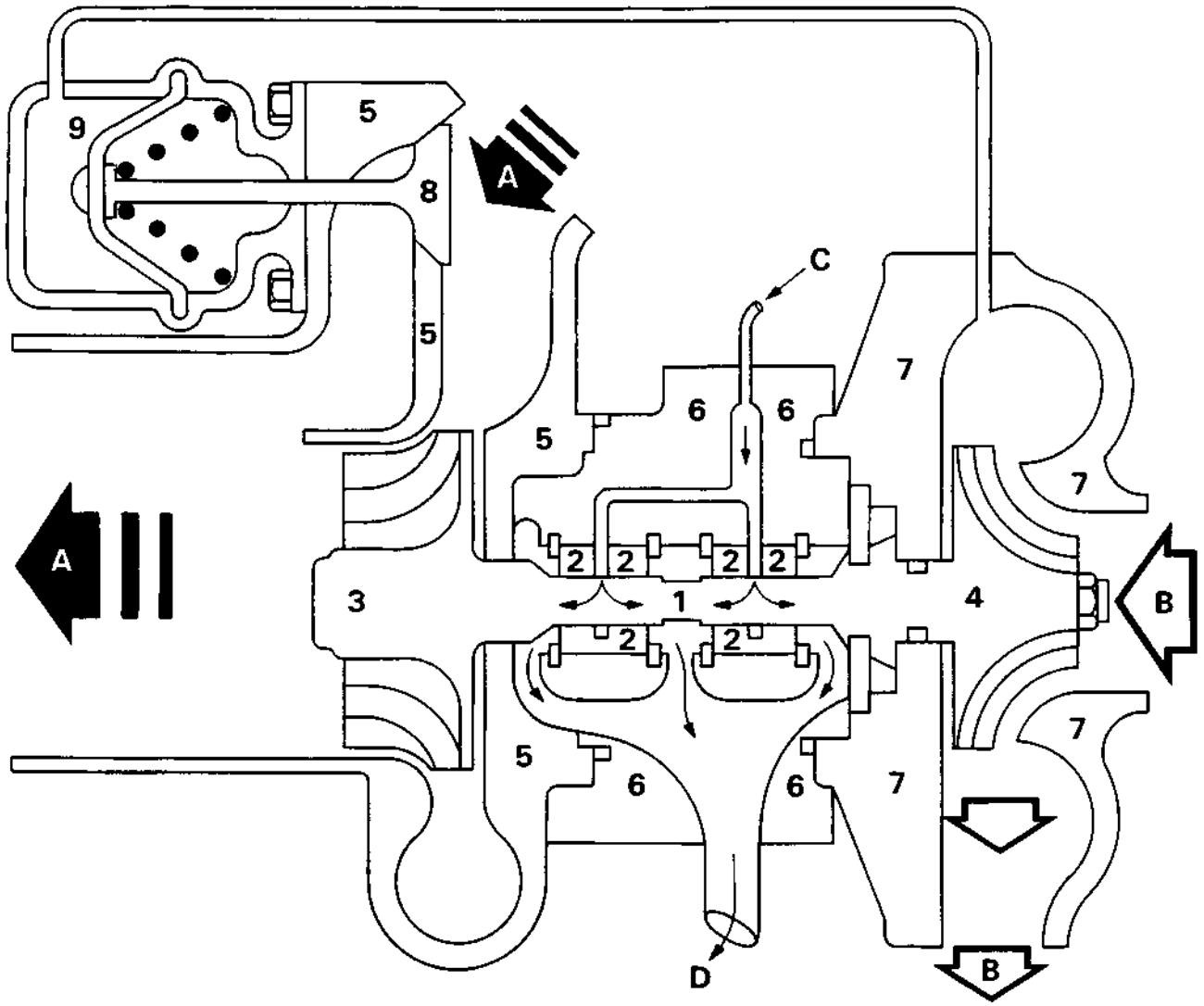
The turbo housing is made in three parts and comprises of a cast iron exhaust turbine housing 5. A cast iron bearing housing 6 and the air compressor housing 7, which because its operating temperature is lower than the other parts is usually made from aluminium.

To control the upper speed range of the turbo, a waste gate valve 8 is incorporated. The waste gate is operated by a pressure capsule 9 which is actuated by the boost pressure.

When the engine is running as seen in RR3637M, the exhaust gas A drives the turbine 3, which cause the compressor turbine 4 to accelerate the inlet air flow B to the combustion chambers. At low engine speeds the volume of extra air which the turbo provides, is usually insufficient to make a noticable improvement in engine power. It is not until the engine approaches 2000 rev/min, that the benefit of a turbo can be appreciated.

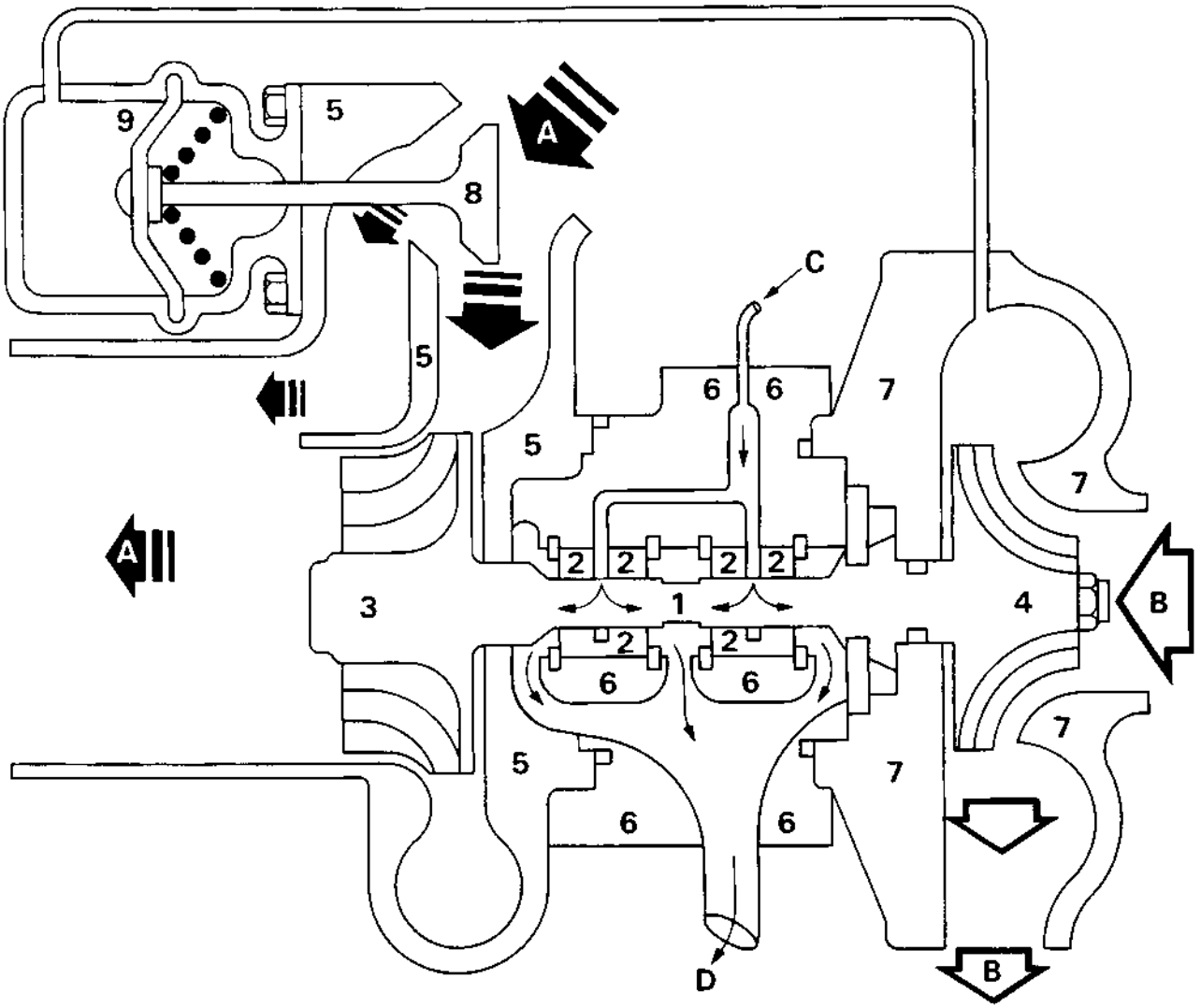


RR 2587M



RR3637M

Once the turbo begins to boost the engine rpm and power output, the improvement continues, to the extent that it becomes necessary to limit the gain. This is done automatically by the pressure capsule 9 which opens the waste gate valve 8 and diverts some of the exhaust gas away from the turbo, direct into the exhaust system, so acting as a regulator as shown in RR3638M.



RR3638M

Lubrication

The turbo charger is supplied with filtered oil C under pressure, which lubricates, cools and stabilizes the fully floating bronze bearings 2.

Oil flows at a very high rate through the turbo which has a large diameter drain D, back to the engine sump.

When in operation the turbine shaft revolves at between 1,000 and 130,000 rev/min. Therefore it is very important that the lubricant is the correct type/grade, that it is well filtered and at the correct pressure.

Intercooler

The intercooler is a cast aluminium radiator, situated in the air inlet system between, the turbo charger and the engine inlet manifold. It is located at the front of the vehicle and its purpose is to cool the air, which is heated as it is drawn through the turbo charger. Cooling the air in the inlet system, helps to recover some of the potential expansion of the air, which when it enters the combustion chambers, improves the combustion efficiency and power gain.

Notes

ENGINE OIL PRESSURE TEST

Service tools:
LRT-12-052 :-Pressure test equipment

WARNING: Use suitable exhaust extraction equipment, if test is being carried out in workshop.

WARNING: If vehicle has been running, engine oil will be hot, care must be taken when fitting equipment to prevent personal injury due to scalding.

Test

1. Check lubricant is to correct level.
2. Place vehicle on a ramp.
3. Disconnect the battery negative lead.
4. Remove oil pressure warning light switch and fit test gauge.
5. Reconnect the battery negative lead.
6. Start and run engine to normal operating temperature.
7. At a steady engine speed of 4000 rev/min, minimum oil pressure reading should be - 3.5 kgf/cm^2.

NOTE: Low oil pressure can effect performance of brake servo vacuum pump and turbocharger. ***See Description and operation, Vacuum pump See Description and operation, Turbocharger***

VACUUM PUMP TEST

If vacuum pump is suspected of producing insufficient vacuum - carry out following test:-

WARNING: Use suitable exhaust extraction equipment, if test is being carried out in workshop.

Disconnect brake servo hose at servo and connect a vacuum gauge with a maximum range of not less than 30 hg (1 bar). Start engine and check vacuum reading which should reach a minimum of 20 in hg (0,69 bar) within 30 seconds, at an engine speed of 2500 rev/min.

If there is no vacuum or reading is low, carry out following checks.

1. Check condition of brake servo hose for blockage.
2. Make a direct connection to pump and repeat test procedure.
3. Operating efficiency of vacuum pump depends on engine lubrication pressure - check pressure - if pressure is normal and pump is receiving lubricant - renew vacuum pump. ***See Engine oil pressure test***

ENGINE NOISE

Excessive or obtrusive noise from engine compartment originates from four main sources:

A. Exhaust/turbo

The turbocharger assembly and exhaust system, each emit an unmistakable and characteristic noise which is easy to diagnose when a fault develops.

B. External components

External components emit the greatest variety of noises and those which are belt driven are also easy to diagnose, by simply disconnecting the appropriate drive belt.

C. Fuel injection system

Fuel injection system mechanical and hydraulic noises are more difficult to diagnose and a fault in the system can effect combustion noise 'Diesel Knock'.

D. Engine internal mechanical

Engine internal mechanical noises which can vary in volume and pitch and may be a combination of, tapping - knocking or rumbling, are the most difficult to diagnose.

A diesel engine generally emits more noise than a petrol engine, diagnosing the specific cause is much more difficult. Therefore, the following process and list of checks are presented in a logical sequence, in two stages 'Type of noise' and 'Location of noise'

Begin all diagnosis by carrying out stage 1 and 2, then go to - Noise symptoms A,B,C,D as appropriate.

Stage 1 - Type of noise

Confirm type of noise complained of, with owner/driver.

Stage 2 - Location of noise

Use stethoscope to locate source of noise and go to - Noise symptoms A,B,C,D, as appropriate.

Noise symptoms - A

Exhaust/turbo

1. Is exhaust system or gaskets blowing?
   YES - Rectify.
   NO - Continue

2. Is turbocharger excessively noisy? ***See Description and operation, Turbocharger***
   YES - Check engine oil level. ***See SECTION 10, Maintenance, Under vehicle maintenance See Engine oil pressure test***
   If necessary renew turbocharger. ***See Turbocharger Fault Finding***
   NO - Go to Noise symptoms - B External components.

Noise symptom - B

External components

3. Does noise disappear with drive belts disconnected? ***See SECTION 10, Maintenance, Service schedule***
   YES - Renew noisy component.
   NO - Go to Noise symptoms - C. Fuel injection system noise or Noise symptoms - D. Engine internal mechanical noise.

Noise symptoms - C

Fuel injection system

4. Is noise - mechanical? Hydraulic? or combustion? See C1, C2 and C3 for noise diagnosis. If necessary carry out all checks given in C1, C2 and C3, before making a positive diagnosis.

If fuel injection system is not suspected: Go to - Noise symptoms - D. Engine internal mechanical noise.

C1. Fuel injection system - mechanical noise.

1. To confirm source of noise, check injection pump and each injector using a stethoscope. Release each injector pipe union one at a time, to cut out combustion and aid assessment of noise and its source.

2. Check fuel tank, sediment traps and filter for water and foreign matter contamination. Check fuel filter for evidence of metallic particles.

If diagnosis is not conclusive, go to - C2. Fuel injection system - hydraulic noise.

C2. Fuel injection system - hydraulic noise.

1. To confirm source of noise, check injection pump and each injector, using a stethoscope. Release each injector pipe union one at a time, to cut out combustion and aid assessment of noise and its source.
2. Check that all injection pipes are correct length and type. Also ensure all pipes are correctly routed and are not stressed by misaligned clamps.
3. Hydraulic noise is usually caused by faulty injectors or incorrect operating pressures, check these before condemning injection pump.

If diagnosis is not conclusive, go to - C3. Fuel injection system - combustion noise.

C3. Fuel injection system - combustion noise.

1. To confirm source of noise, check near each injector with stethoscope. Release each injector pipe union one at a time, to cut out combustion and aid assessment of noise source.
2. The most common causes of excessive combustion noise are, incorrect pump timing (over advanced), incorrect injector operating pressures or poor spray formation.

If diagnosis is not conclusive, repeat all checks beginning at C1 or go to:- Noise symptoms - D Engine internal mechanical noise.

Noise symptoms - D

Engine internal mechanical noise.

Single or multiple, light tapping noise, particularly when engine is cold. ***See Description and operation, Lubrication system***

1. Is engine oil level correct?
   NO - Top up to correct level. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
   YES - Continue.

2. Is lubricating pressure correct?
   NO - ***See Engine oil pressure test***
   YES - Suspect valve operating mechanism. ***See SECTION 10, Maintenance, Service schedule***

Heavy knocking noise (particularly on load and when engine is hot). ***See Description and operation, Lubrication system***

1. Is engine oil level correct?
   NO - Top up to correct level. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
   YES - Continue.

2. Is lubricating pressure correct?
   NO - ***See Engine oil pressure test***
   YES - Drain engine oil and filter, and examine for metallic contamination.

3. Is oil contaminated with metal particles?
   YES - Suspect faulty big end bearings.

To confirm diagnosis, release each injector pipe union one at a time, to cut out combustion and aid assessment of noise and its source.

If noise is not conclusively diagnosed, check security of flywheel and crankshaft front pulley. Release drive belts to reduce noise level and use a stethoscope to locate source of noise.

Heavy rumbling noise (particularly during hard acceleration) ***See Description and operation, Lubrication system***

1. Is engine oil level correct?
   NO - Top up to correct level. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
   YES - Continue.

2. Is lubricating pressure correct?
   NO - ***See Engine oil pressure test***
   YES - Drain engine oil and filter, and examine sediment for metallic contamination.

3. Is oil contaminated with metal particles?
   YES - Suspect faulty main bearings. If noise is not conclusively diagnosed, check security of flywheel and crankshaft front pulley. Temporarily release drive belts to reduce general noise level and use a stethoscope to locate source of noise.

ENGINE STARTING PROBLEMS

Symptom - Engine fails to crank

1. Is battery in good state of charge?
   NO - ***See INTRODUCTION, Information, Jump starting***
   YES - ***See ETM, B1***

2. If problem is not diagnosed repeat tests, starting at 1.

Symptom - Engine cranks but fails to start

1. Is cranking speed fast enough (120 rev/min)?
   NO - ***See INTRODUCTION, Information, Jump starting***
   If necessary ***See ETM, B1***
   YES - Continue.

2. Are heater plugs operating correctly?
   NO - ***See ETM, A5***
   YES - Continue.

3. Is fuel supply, pump, tank ventilation and air intake systems in correct working order, or fuel contaminated?
   NO - ***See FUEL SYSTEM, Repair, Fuel filter***
   See FUEL SYSTEM, Repair, Fuel tank
   See FUEL SYSTEM, Repair, Fuel pump
   YES - Continue.

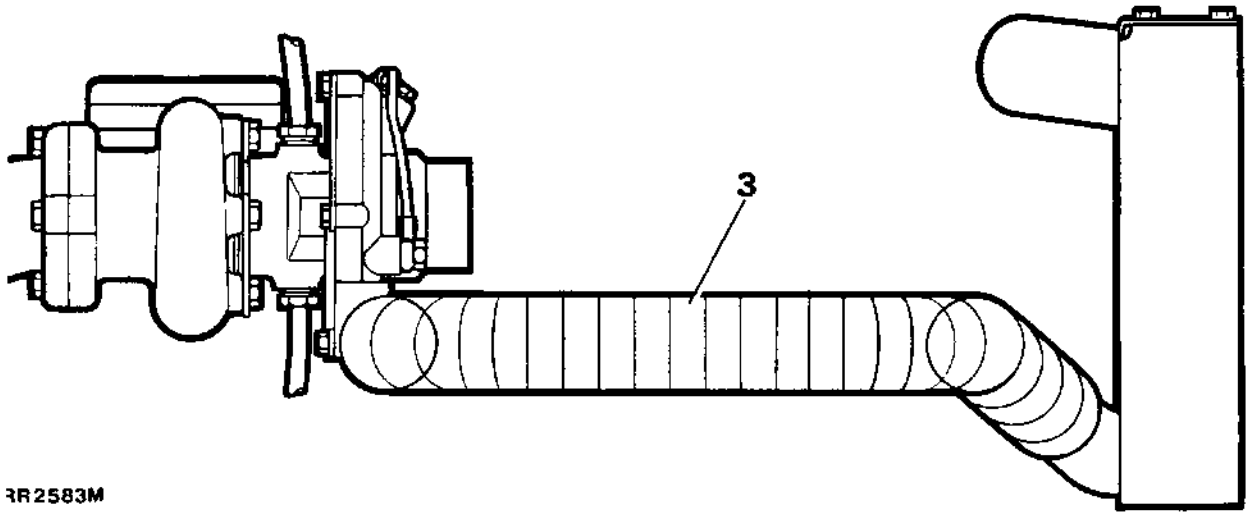
4. Is there combustion in any of cylinders?
   NO - Check cylinder compressions.
   YES - If problem is not diagnosed repeat tests, starting at 2.

TURBOCHARGER - CHECK

If the turbocharger unit is suspected of being faulty, the following simple test may be carried out. The assistance of a second operative is required to carry out this operation.

1. Open the bonnet.
2. Start the engine and allow it to idle.
3. Depress the turbocharger to intercooler feed pipe with one hand, the air pressure increase in the pipe may be detected as the second operative increases the engine revs.

△ **NOTE: Although the above test indicates the operation of the turbocharger. it does not indicate it's efficiency.**



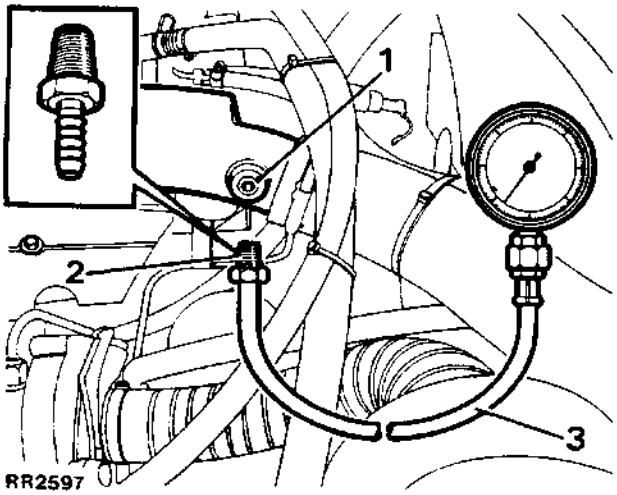
RR2583M

TURBOCHARGER BOOST PRESSURE

Service tools:
18G.1116-1 Pressure test adaptor

Check

1. Remove the grub screw, located in the inlet manifold.

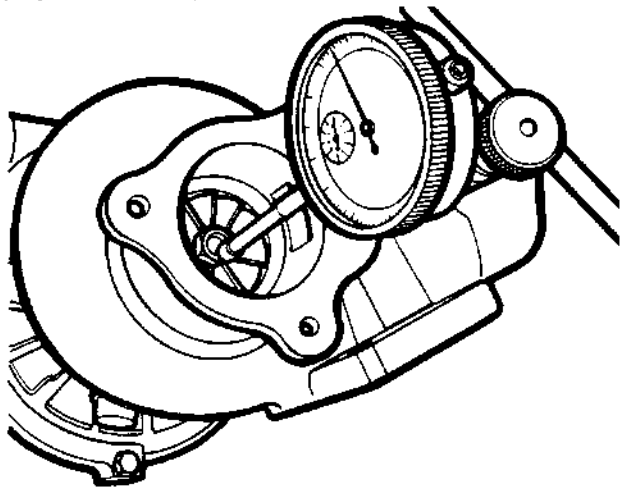


RR2597

2. Insert adaptor 18G.1116-1 into the grub screw orifice
3. Attach a suitable pressure gauge, with sufficient length of tube to reach from the inlet manifold to the cab of the vehicle.
4. Drive the vehicle in 3rd gear at 3800 rev/min to give a satisfactory reading of 0.9 kg/cm

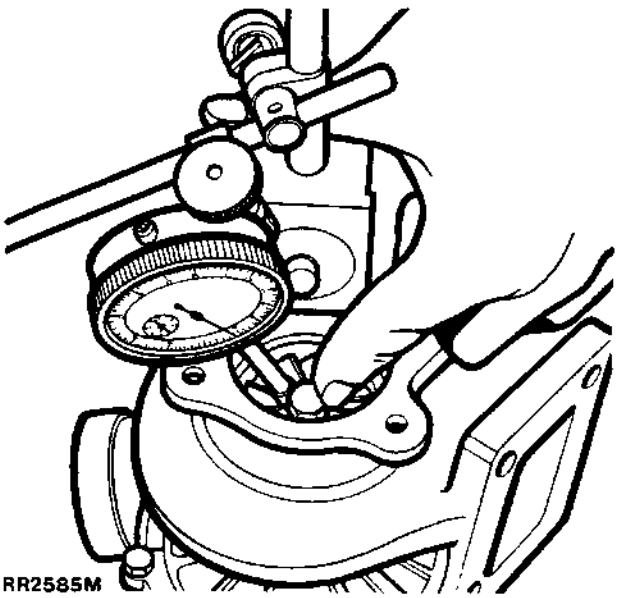
TURBOCHARGER 'END FLOAT' CHECK

Use a dial test gauge and the set up shown in the diagram. Set the gauge to zero on the turbine wheel, and by moving the shaft in a linear motion the end play may be established. The maximum allowable end play is 0,15 mm (0.006 in).


RR2584M

Radial clearance

Push the turbine wheel to the extreme side position and set the dial test gauge to zero, on the indicator, as shown in the diagram. Check the side clearance of the turbine shaft by observing total radial movement of the turbine wheel. Maximum side clearance allowable is 0,42 mm (0.016 in).


RR2585M



AIR FILTER CHECK

To ensure that the correct volume of air is supplied to the turbocharger unit, the air filter should be checked for cleanliness. Firstly remove the filter box from the securing brackets. Then remove the air filter from its housing. A visual inspection of the filter will verify its condition. Fit a new air filter if there are any signs of oil contamination or blockage of any description.

TURBOCHARGER FAULT FINDING

As the exhaust gas drives the turbocharger, it is capable of speeds up to 130,000 rev/min and temperatures of up to 650°C. In order to ensure that the bearings are lubricated and cooled, the turbocharger is connected to the normal engine lubrication system. Obviously very high quality seals must be used in the turbocharger, to prevent lubricating oil entering the inlet or exhaust system.

Should oil leak past a seal into the exhaust system, dense pale blue smoke will be emitted continuously. If however the oil leaks into the inlet system it will be burnt at a higher temperature and produce a darker shade of blue smoke. The engine speed may also be permanently higher than normal, as the engine will burn the oil as extra fuel and an excessive oil leak in to the inlet system may even cause the engine to accelerate, however for this to occur the operator would have to ignore all earlier signs of impending trouble.

Blockage of the large oil drain pipe from the turbocharger, though very unlikely, is certainly the worst condition as oil under pressure would be forced past the seals and into both inlet and exhaust systems. If grey or black smoke is being emitted, the turbocharger may be partly blocked or the shaft may not be perfectly free to spin. This will cause a restriction in the air inlet and result in grey/black exhaust smoke, which usually increases at higher engine speeds.

⚠ **CAUTION: If the driver is in the habit of accelerating the engine before switching the engine off, the turbine will continue to spin after the engine has come to rest and the lubrication to the turbine bearings ceased. It is therefore possible that this practice will cause damage or seizure of the bearings.**

Other symptoms of turbocharger faults

A change in the normal noise level is usually the first indication of a fault in the turbocharger or its hose connections. A higher pitched sound usually indicates a possible air leak into the suction side of the compressor and the inlet system, or an escape of compressed air between the compressor and the inlet manifold. Obviously an excessive escape of compressed air from the manifold is not only noisy but will also cause some loss of power.

Slight leaks from the turbine housing or exhaust manifold, whilst noisy, are easily detected and have, little effect on the power output. Cyclic sounds (e.g. a continuous rubbing noise) are an indication of air restriction to the compressor or that the compressor wheel is coated in dirt.

If the waste gate valve sticks in the open position the engine will be down on power.

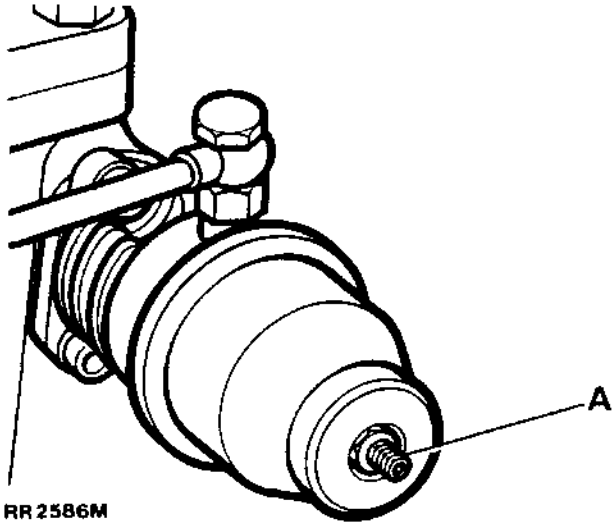
Notes

WASTE GATE VALVE

The turbocharger waste gate diverts exhaust gas flow to by-pass the turbine when the boost pressure is higher than 0.9 kg/cm.

Adjust

The boost pressure may be adjusted by loosening the lock nut and turning the screw marked 'A' in the diagram. Turn the screw clockwise to increase the spring load on the valve and consequently increase the boost pressure. Unscrew to decrease both spring load and boost pressure.



RR2586M

△ **NOTE: There is a small hole located in the waste gate housing. To ensure efficient operation of the waste gate diaphragm, it is neccessary to clean this hole. A small piece of sturdy wire, or a similar object, is a suitable tool for this operation. Take care not to insert the wire too far in to the waste gate housing, as the diaphram is made of a heat resistant rubber and is subsequently easily damaged.**

INJECTION PUMP TIMING

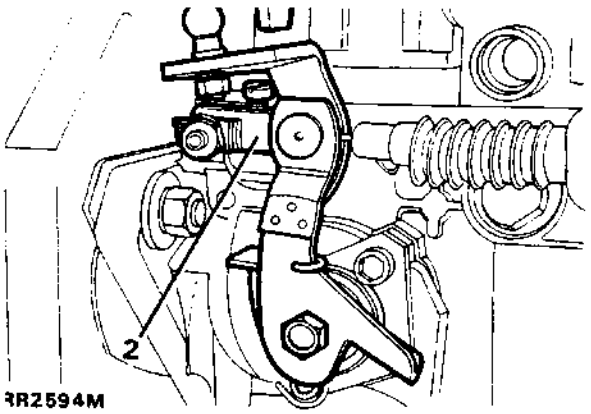
Check and adjust

Service tools:

18G.1376 Timing adaptor
18G.1369A Timing gauge

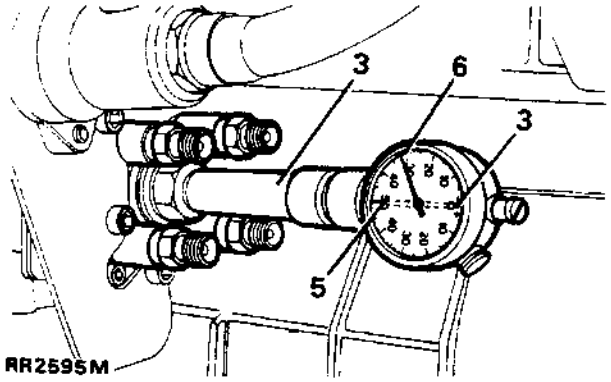
When it has been established that the injection pump requires a timing check the following procedure should be followed.

1. Attach the timing gauge 18G.1369A to the engine front cover. Rotate the engine until the mark on the crankshaft pulley lines up with the top dead centre TDC mark on the timing gauge.
2. Release the cable tensioner on the cold start mechanism to ensure an accurate result.

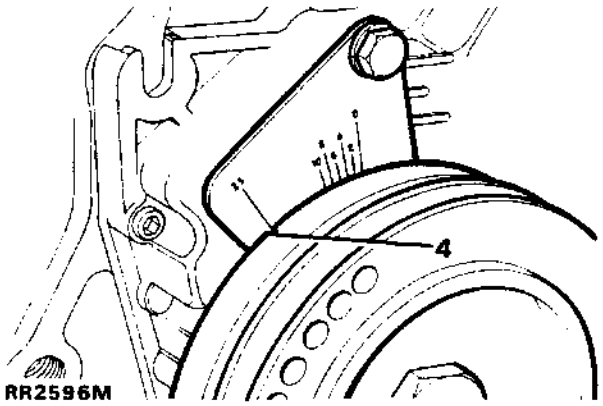


RR2594M

3. Remove the blanking plug from the rear of the pump assembly and insert adaptor 18G. 1376. Attach a dial test gauge to allow a reading to be obtained.



4. Rotate the engine again until the pulley mark is lined up with the 25° BTDC mark. The dial on the test gauge should then be zeroed. Ensure at this stage that there is sufficient pressure being applied to the stylus to give a deflection on the indicator.



5. The engine should be turned again to 3° BTDC and the needle deflection noted. A deflection of 50 (0,5 mm) should be read.

6. To adjust the dimension, slacken the three locking nuts, which secure the pump to the front cover. Then rotate the injection pump assembly until a correct reading has been established, retighten the locking nuts. As a double check the deflection on the dial test gauge should be a further 16-18 (0,16-0,18 mm) when the engine is turned to TDC.
7. When adjustment is complete remove the service tools and refit the blanking plug to injection pump and the engine front cover bolt.
8. Finally retension the cable on the cold start mechanism and tighten the retaining screw.

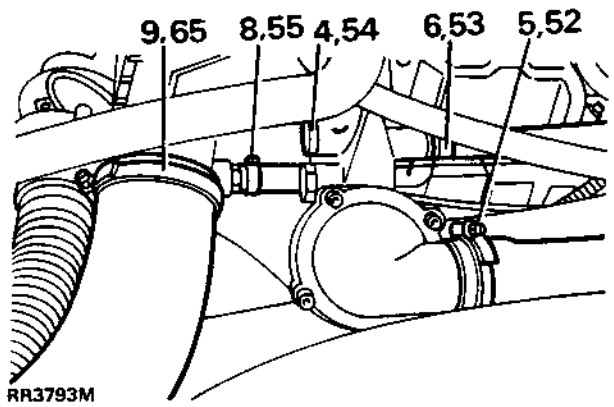
CYLINDER HEADS

Service repair no - 12.29.01.

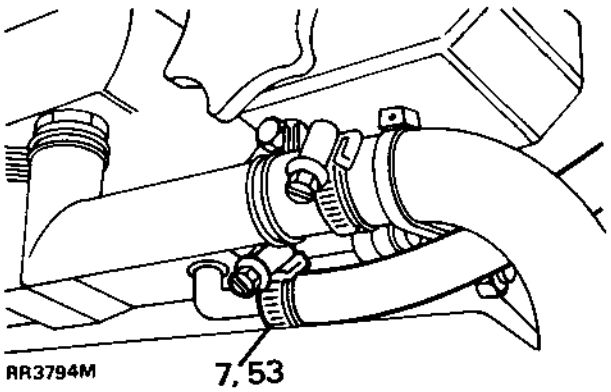
NOTE: Before removing cylinder heads check alignment of heads, evidence of head gasket or manifold gasket blowing and evidence of water leaks.

Remove

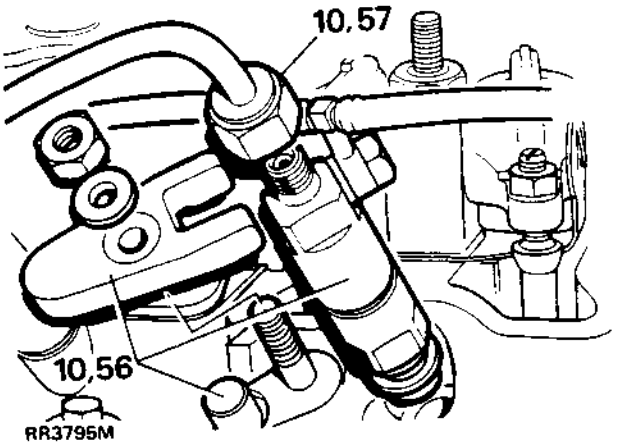
1. Disconnect the battery negative lead.
2. Remove expansion tank filler cap. Drain coolant.
3. Disconnect breather hoses from rocker covers. Disconnect brake servo hose.
4. Disconnect air conditioning temperature switch.



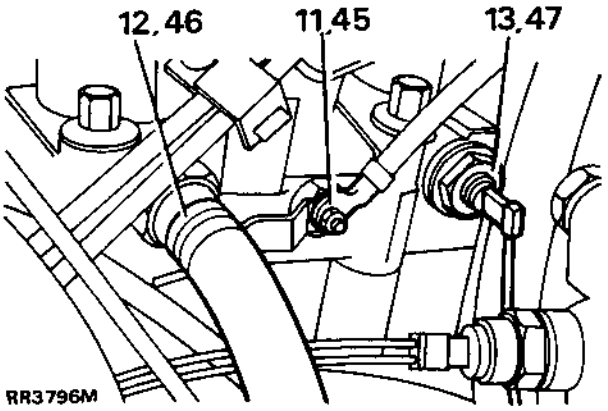
5. Disconnect by-pass hose and top hose at thermostat housing.
6. Disconnect cold start hose at water rail.
7. Disconnect bleed hose at water rail.



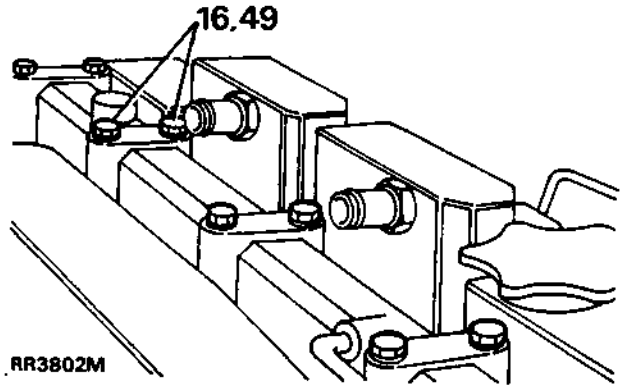
8. Disconnect vacuum pipe from inlet manifold.
9. Remove intercooler pipe.
10. Remove fuel feed pipes from injectors. Remove all injectors, with spill pipe, lay aside. Retain injector dowels.



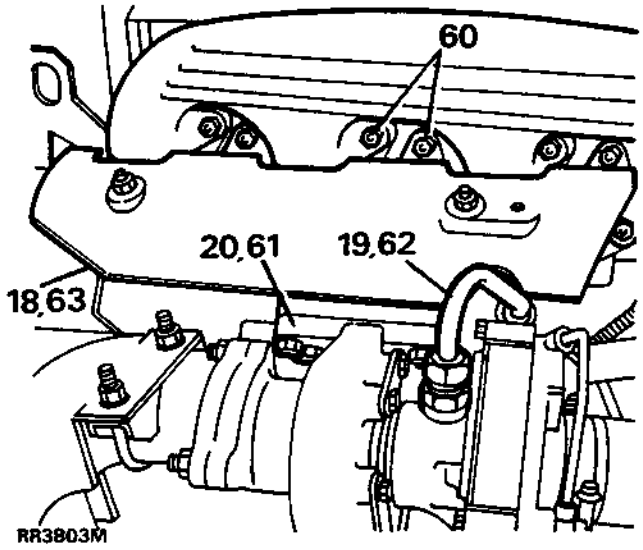
11. Remove heater plug feed wire.
12. Remove cold start hose from cylinder head.
13. Disconnect temperature sensor connector.



14. Remove rocker covers.
15. Remove rocker assemblies. Remove push rods, inspect.
16. Remove eight bolts securing water rail. Lay water rail aside on heater hose.
17. Remove oil feed banjo bolts from cylinder heads.



18. Remove exhaust heat shield.

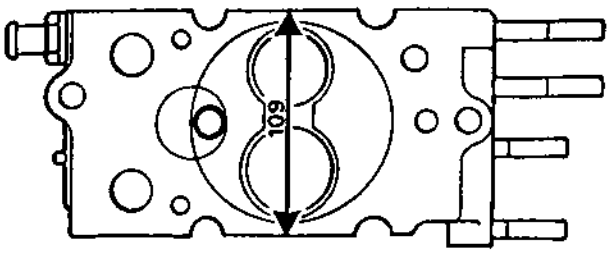


19. Remove turbocharger oil feed pipe
20. Remove four nuts securing turbocharger to exhaust manifold.
21. Remove outer cylinder head bolts.
22. Remove centre cylinder head bolts.
23. Lay cylinder head oil feed pipe against bulkhead.
24. Remove cylinder heads complete with manifolds.
25. Remove inlet and exhaust manifolds, discard gaskets. Inspect cylinder heads

INSPECT CYLINDER HEADS

Inspect cylinder heads, using the checks below. Any head that fails one or more check must be replaced with a new component, retaining those heads which pass all the checks.

a) Minimum width - 109 mm.
b) Height - 90 mm ± 0.05 mm.
c) Inspect for cracks across valve bridge.
d) Distortion of mating faces.



e) Indentation of upper face caused by clamps.
f) Coolant leakage.
g) Measure end plate height - 91,26 to 91,43 mm.

If components pass above checks they may be refitted, using latest gasket and new centre bolts.

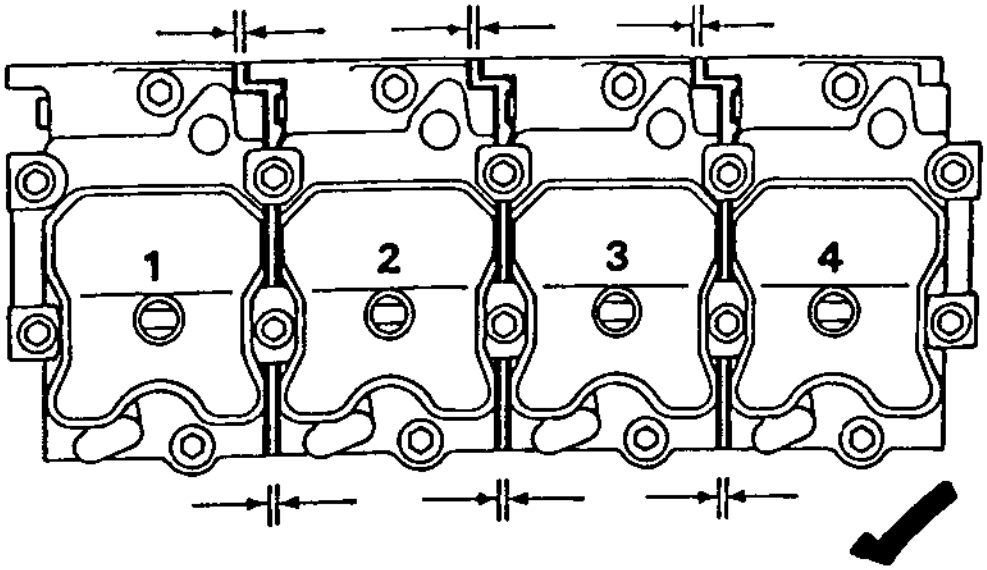
26. If new heads are being fitted, remove heater plugs, oil feed dowels, coolant adaptor and temperature transmitter. Fit these items to new cylinder heads. Fit new injector shrouds. Using an airline, check rocker oil feed drilling is free of obstruction.
27. Inspect gaskets, attempt to determine area of failure. Remove old gaskets from block. Thoroughly clean all traces of old gasket material from face of block. Check liner protrusion, ***See LINER PROTRUSION CHECK***

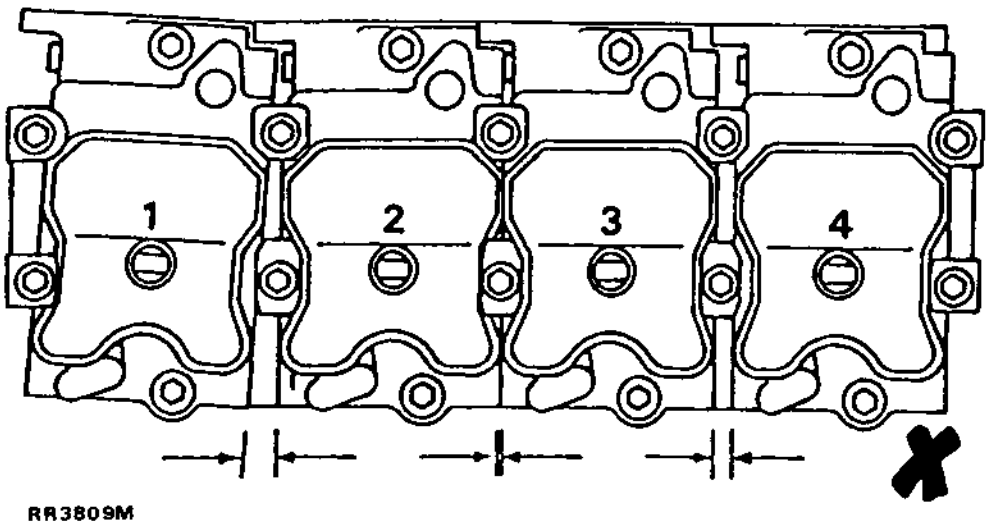
WARNING: Failure to clean block face thoroughly could lead to head gasket failure.

28. Remove oil filter, catching any oil spillage.
29. Remove fan asembly, left hand thread.

Refit

30. Fit inlet manifold loosely. Fit exhaust manifold loosely, fitting lifting eye.
31. Thoroughly clean face of new cylinder heads.
32. Determine thickness of head gasket required - ***See HEAD GASKET SELECT*** *Fit gaskets to cylinder block correctly.*

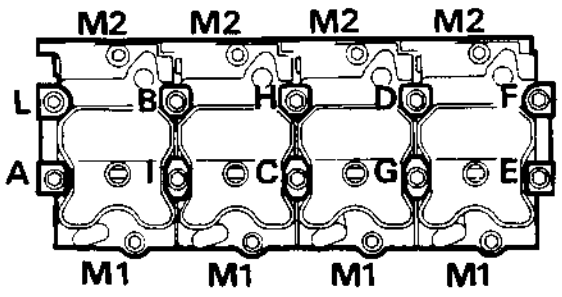




RR3809M

33. Fit cylinder head assembly to block, locating studs to turbocharger.
34. Align head assembly with gaskets.
35. Ensure head side holes align with gasket and holes in block. Gaps between heads should be parallel, see RR3809M.
36. Lubricate side bolts (without washers) with engine oil, fit loosely.
37. Ensure inlet manifold is fitted square to cylinder heads to bring heads into alignment.

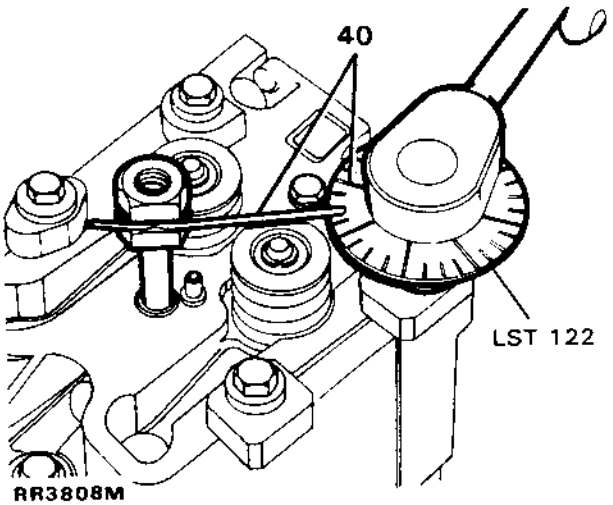
38. Lubricate threads and underside of central bolt heads with Molybdenum Disulphide. Fit centre bolts loosely, with end plates at front and rear. Align oil feed pipe.
39. Partially tighten centre bolts, holding end plates flush with cylinder heads. Ensure gasket positions are square and have not moved.



RR3804M

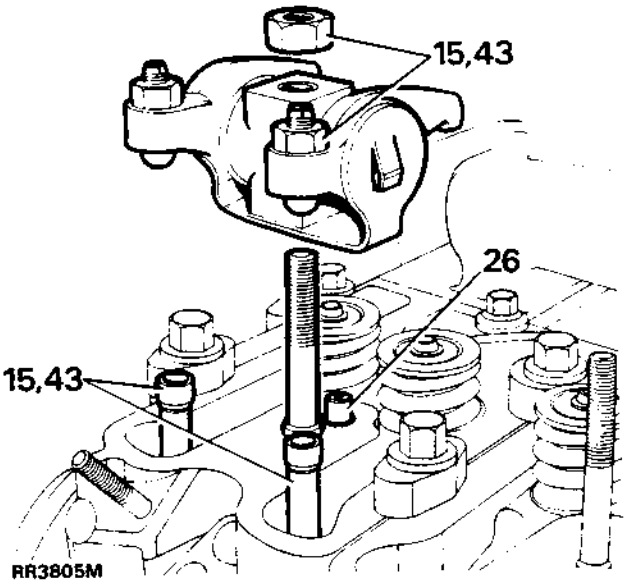
40. Centre bolts:
    a) Torque centre bolts to ***30 Nm*** in sequence shown, starting from bolt A. REPEAT procedure for each bolt.
    b) Tighten each bolt through an angle of 70°, in sequence.
    c) Tighten each bolt an additional 70° in sequence.

41. Torque side bolts to ***80 Nm, in the sequence bolts M1 then bolts M2.***
42. Fit oil feed pipe, tighten bolts to ***8 Nm.***



RR3808M

43. Fit push rods and rocker assemblies, tighten single fixing to ***108 Nm.***



RR3805M

44. Adjust tappets.
45. Fit heater plug feed wire, tighten connector plates.
46. Fit cold start hose to cylinder head.
47. Connect temperature sensor connector.
48. Fit fan assembly.
49. Fit two rear bolts to water rail. Fit water rail attaching by-pass hose. Tighten eight bolts to ***8 Nm.***
50. Tighten by pass hose clip.
51. Fit cold start hose to water rail, tighten clip.
52. Fit top hose, tighten clip.
53. Fit bleed hose to water rail, tighten clip.
54. Connect air conditioning temperature switch.
55. Connect vacuum pipe from inlet manifold, tighten clip.
56. Fit injectors with copper sealing washers. Locate dowels, tighten clamp nuts to ***26 Nm.***
57. Fit fuel supply pipes to injectors, tighten to ***19 Nm.***
58. Fit rocker covers, tighten to ***9 Nm.***
59. Fit breather pipes to rocker covers. Connect brake servo hose.
60. Tighten exhaust and inlet manifold nuts to ***32 Nm.***
61. Tighten four turbocharger to manifold nuts to ***25 Nm.***
62. Fit and tighten turbocharger oil feed pipe.
63. Fit exhaust heat shield
64. Fit oil filter.
65. Fit intercooler pipe, tighten clip.

Coolant refill

66. Remove coolant pipe from top of radiator.
67. Fill system through expansion tank until radiator is full.
68. Refit pipe to radiator and tighten.
69. Start engine, run until operating temperature is achieved, top up expansion tank as necessary.
70. Fit expansion tank filler cap, run engine for twenty minutes.

Retorque cylinder heads

71. Allow engine to cool completely.
72. Drain coolant.
73. Remove rocker covers.
74. Remove water rail.
75. Centre bolts, starting with bolt A:
    a) Loosen bolt, torque to ***30 Nm,***
    b) Tighten bolt through an angle of 120°.

△ **NOTE: 120° may be achieved by tightening through 60°, immediately followed by a further 60°. The total 120° MUST BE ACHIEVED BEFORE proceeding to next bolt.**

    c) Repeat for each bolt in sequence shown.

76. Retorque outer bolts to ***90 Nm. without loosening, first M1 then M2.***
77. Fit rocker assemblies, tighten single fixing to ***108 Nm.***
78. Adjust tappets.
79. Fit water rail using new gaskets.
80. Fit hoses, tighten clips.
81. Check top up oil.
82. Refill cooling system. Run engine until operating temperature is reached, top up if necessary.

RETORQUE CYLINDER HEADS

First 40,000Km (24,000 miles) only

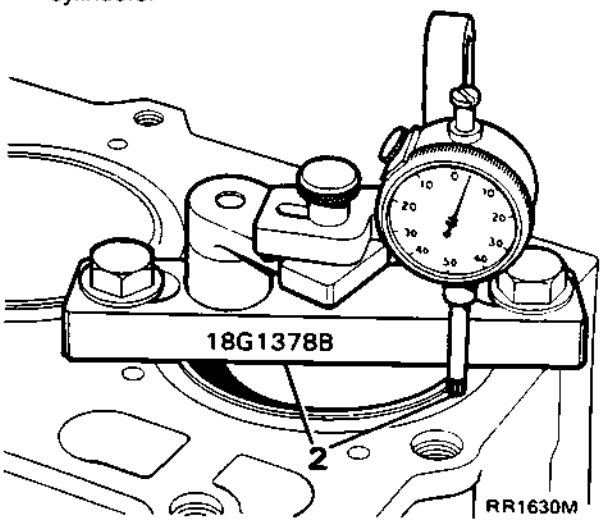
△ **NOTE: These instructions must be carried out at the first 40,000 Km (24,000 miles) service OR 40,000 Km (24,000 miles) AFTER the above procedure has been carried out. The use of new type gasket eliminates the need to retorque head bolts at 1,500 Km (1,000 miles).**

1. Centre bolts, without slackening bolts, start with bolt A, tighten each bolt in sequence through 10 - 15°.
2. Side bolts: Without slackening bolts cheque that torque of each bolt is ***85 - 90 Nm.*** First M1 then M2.

LINER PROTRUSION CHECK

1. Ensure face is clean

2. Correct reading:- 0,00 to 0,06 mm
3. To obtain the correct liner protrusion, attach special tool 18G 1378 B as illustrated, to the cylinder block and tighten the bolts to ***30 Nm.*** Fit a dial test indicator so that the stylus rests in a loaded condition on the external rim of the liner and set the dial to zero. Slide the stylus across to the cylinder block and note the reading.
   Repeat the above procedure to the remaining cylinders.



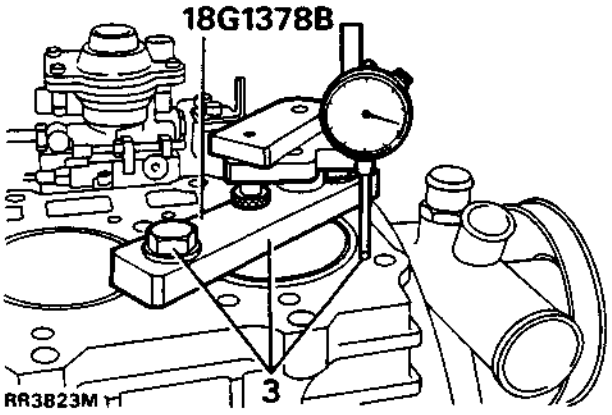
4. Remove the liners and add shims as required to achieve the protrusion.

HEAD GASKET SELECT

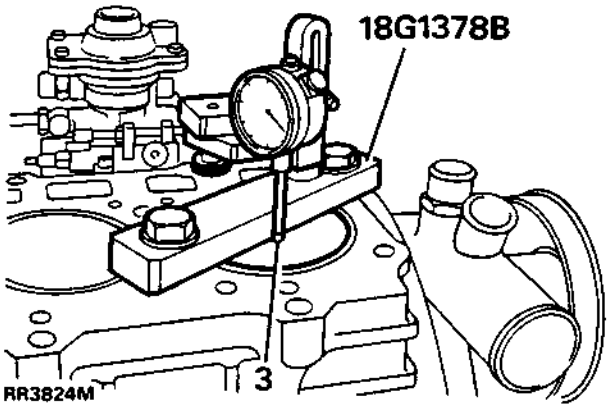
1. Before fitting the cylinder heads it is necessary to determine the thickness of gasket that must be used to achieve the correct clearance between each piston crown and cylinder head.
   Three thicknesses of gasket are available, see table below. The following procedure should be used to determine which size to fit. However, only one thickness of gasket must be used on all four cylinders, this being the one for the cylinder which calls for the thickest gasket.

Identification	Fitted thickness
No notch	1,42 mm ± 0.04
One notch	1,62 mm ± 0.04
Two notches	1,52 mm ± 0.04

2. Turn the crankshaft to bring number one piston to T.D.C.



3. Fit special tool 18G 1378B to the cylinder block and tighten the bolts to ***30 Nm***Attach the dial test indicator to the tool, as illustrated, and position the stylus, in a loaded condition, on the cylinder block and zero the gauge. Slide the indicator over so that the stylus rests on the piston crown and note the reading.



Example

Required piston clearance	0,85	to	0,94 mm
Plus measured height	0,60	to	0,60 mm
Thickness of gasket required	1,45	to	1,54 mm

The nerest compressed thickness of gasket available is 1,52 mm

4. Repeat the above instruction on the remaining cylinders. The thickest gasket required is the one which must be fitted to all cylinders.

VM ENGINE

Service repair no - 12.41.02.

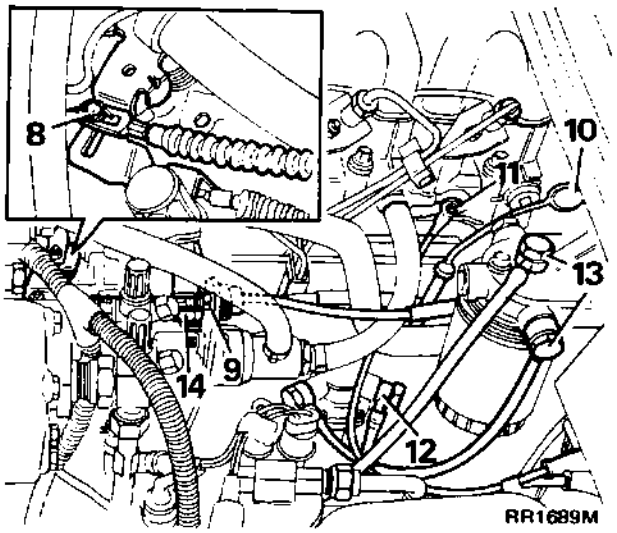
Remove and refit

Remove

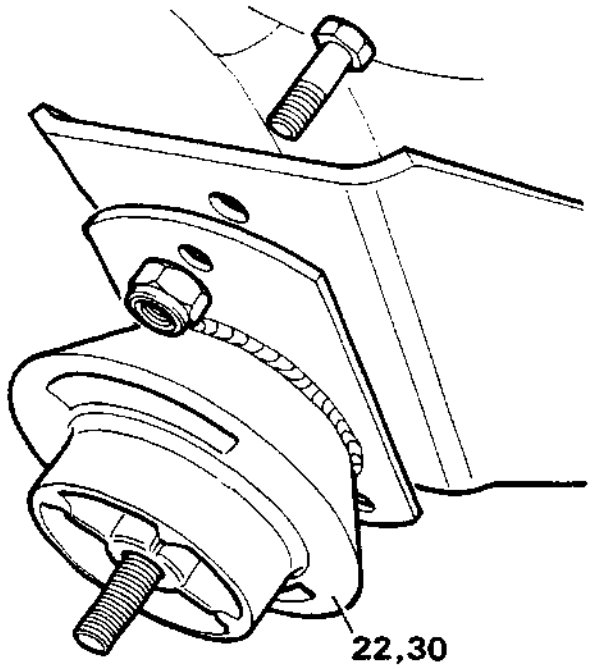
CAUTION: Seal all pipe ends against the ingress of dirt after disconnecting oil, fuel, fluid, vacuum or air conditioning pipelines.

Remove

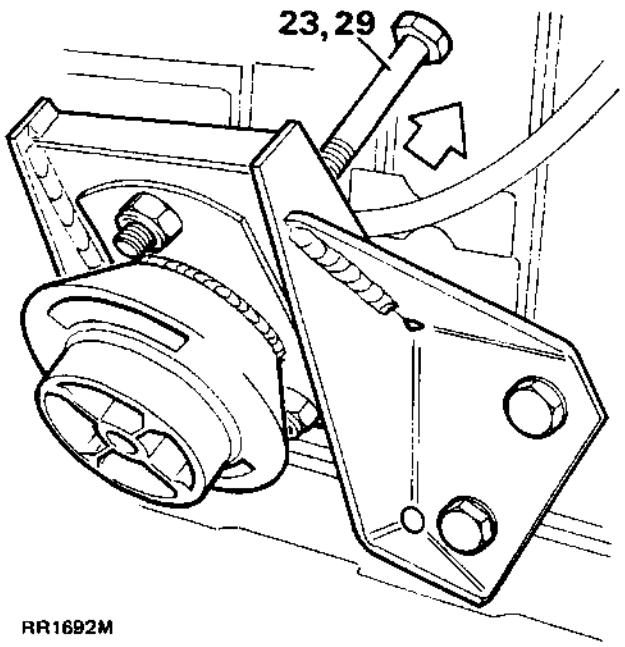
1. Remove the radiator and intercooler unit. The radiator unit has a built in engine oil cooler, access to the lower union is possible when the fan cowl is removed.
2. Remove the air cleaner assembly and connecting hoses.
3. Remove the power steering pump outlet and inlet hoses.
4. Disconnect the engine harness multiplug and, if the vehicle has air conditioning, the wiring to the compressor clutch.
5. (Air conditioning vehicles only) turn the high and low pressure compressor service valves to the OFF position (fully clockwise). Depressurise the compressor and remove the high and low pressure hoses.
6. Disconnect the heater return hose at the water pump and draw it clear.
7. Remove the heater inlet hose at the bulkhead connection.
8. Remove the split pin securing the inner throttle cable to the fuel injection pump.
9. Depress the tags on the outer cable adjusting screw to release the cable from the mounting bracket.
10. Disconnect the vacuum pipe from the vacuum pump.
11. Disconnect the glow plug feed wire.
12. Remove the main fuel line at the fuel pump, retaining the washers.



13. Remove the inlet and outlet fuel lines at the filter assembly.
14. Remove the spill return pipe union at the fuel injection pump.
15. Remove the exhaust manifold heat shield.
16. Release the exhaust flange nuts and disconnect the exhaust down pipe.
17. Remove the starter motor heat shield, wiring connections and fixings to the bell housing. Leave the starter motor attached to the engine block.
18. Remove one centre engine mounting nut from each side.
19. Remove the fixings securing the bell housing to the engine.
20. Attach a suitable lifting chain and hoist to the engine lifting hooks.
21. Raise the engine clear of the mountings and support the gearbox.
22. Remove the right hand engine mounting.



23. Remove the centre bolt from the left hand engine mounting.



RR1692M

24. Withdraw the engine from the gearbox and release the gearbox and transfer box breather pipes from their securing clip.
25. Lift the engine clear of the vehicle.

Refit

Before refitting the engine

Smear the splines of the primary pinion, the clutch centre and withdrawal unit abutment faces with molybdenum disulphide grease, Rocol MTS.1000. Smear the engine to gearbox joint faces with Hylomar jointing compound.

26. Attach a lifting chain and hoist to the engine lifting hooks.
27. Lower the engine into the engine bay and locate the gearbox and transfer box breather pipes in their securing clip.
28. Locate the primary pinion into the clutch and secure the engine to the bell housing with at least two bolts.
29. Fit the left hand centre engine mounting bolt.
30. Fit the right hand engine mounting and centre bolt.
31. Lower the engine on to the mountings.
32. Secure the fixings at both front engine mountings.
33. Remove the lifting equipment and the gearbox support.
34. Reverse removal procedure. 1 to 17.
35. Prime the fuel system.

DISMANTLING, OVERHAUL AND REASSEMBLY

Service repair no - 12.41.02

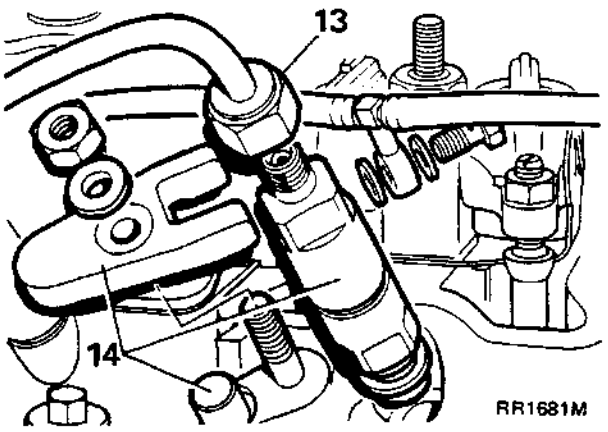
VM Diesel service tools ***See Service tools, VM service tools***

DISMANTLING

Removing ancilliary equipment

Remove the engine from the vehicle. Clean the exterior and in the interests of safety and efficient working, secure the engine to a recognised engine stand and drain the oil from the sump. Before commencing make a careful note of the position of brackets, clips, harnesses, pipes, hoses, filters and other miscellaneous items to facilitate re-assembly.

1. Remove the alternator and mounting bracket.
2. Remove the starter motor.
3. Remove the power steering pump.
4. Remove the Air Conditioning Compressor and mounting brackets.
5. Remove the oil filter cartridge.
6. Remove the oil drain pipe from the turbo-charger and engine block union.
7. Remove the two socket headed bolts securing the turbo-charger support bracket to the cylinder block.
8. Disconnect the oil feed to the turbo-charger.
9. Remove the four bolts and release the turbo-charger from the exhaust manifold.
10. Remove the inlet and exhaust manifolds.
11. Remove the special nuts and lift off the four rocker covers and joint washers.
12. Release the six bolts and remove the coolant rail, complete with thermostat housing.
13. Disconnect the injector pipes from the injectors and injector pump.
14. Release the clamp nuts and remove the injectors complete with spill rail and collect the four dowels.

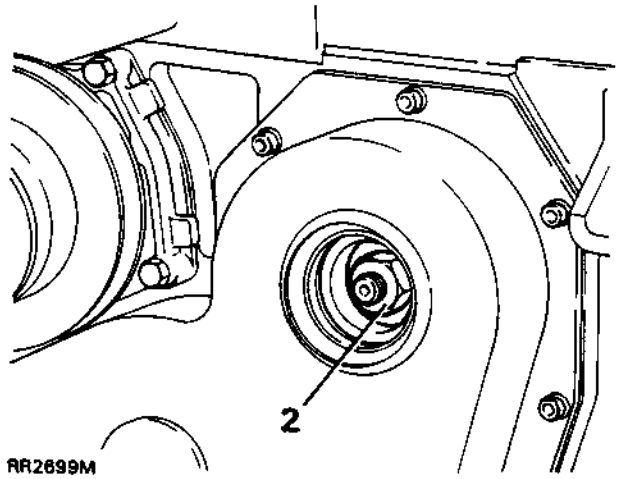


15. Turn the crankshaft in a clockwise direction to bring number one piston to T.D.C. on the firing stroke with number four cylinder valves on the "rock". This condition is necessary for removal of the injection pump at a later stage.
16. Remove the four single nuts and lift off each rocker assembly keeping them identified with their respective cylinder heads. Check that the oil feed dowels are in position in the heads and not inside the pedestals. Remove the push-rods.
17. Remove all cylinder head bolts and clamps. Lift off each cylinder head and gasket and number it according to the bore from which it was removed.
18. Withdraw the four bolts and remove the water pump complete with pulley.

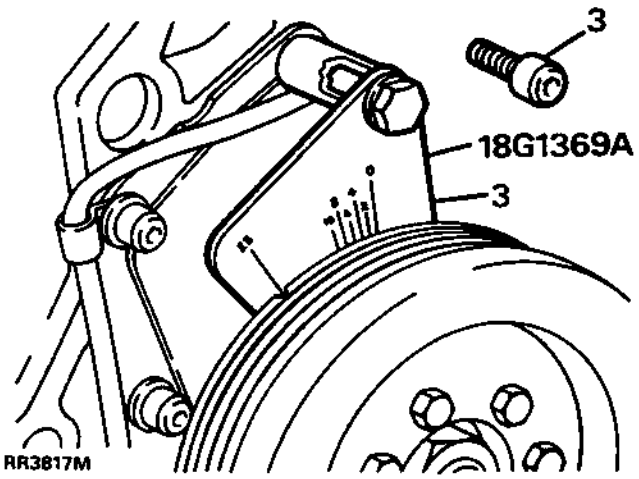
Remove injection pump

1. Using the pegged component, item 6 of special tool LST - 139 remove the injection pump drive gear access plate from front cover.
2. Remove the injection pump drive gear retaining nut and washer.

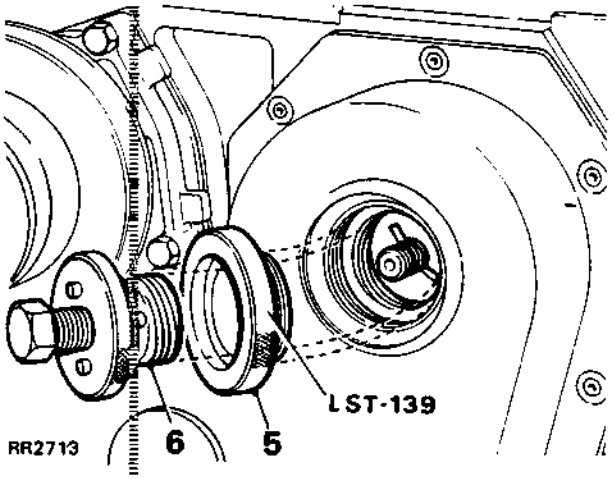
⚠ **CAUTION: Ensure the washer is removed to prevent it from dropping inside the timing cover.**



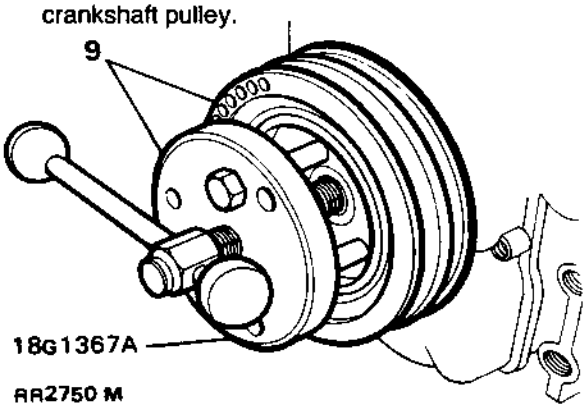
3. Remove bolt from timing cover, using a 47 mm tube spacer and M6 x 55 mm bolt, fit timing gauge 18G 1369A to front cover. The 'O' on the scale should line-up with the groove in the crankshaft pulley.



4. Turn the crankshaft anti-clockwise, beyond the 25° mark on the scale, to remove backlash, and then turn it clockwise until the groove in the crankshaft pulley is aligned with the 25° B.T.D.C. mark.
   The key on the injection pump shaft should now be at the 11 o'clock position viewed from the front of the engine.
5. Fit item 5 of special tool LST - 139 flush to the front cover. Lock the flywheel, and slacken the three nuts that secure the injection pump flange to the engine block.
6. Fit item 6 into the injection pump drive gear. Ensure a flush fit against item 5 and the centre bolt is fully retracted.
7. Turn the centre bolt of the tool until the gear releases from the taper. Retain the gear on the tool. Remove the injection pump retaining nuts and withdraw the pump complete with cold start device.



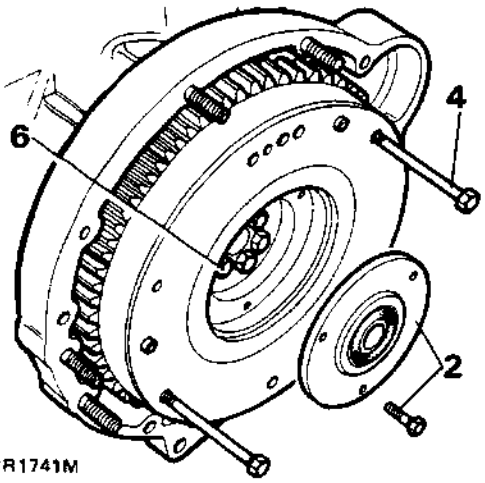
8. Lock the flywheel and remove the crankshaft pulley securing nut.
9. Using special tool 18G 1367A withdraw the crankshaft pulley.



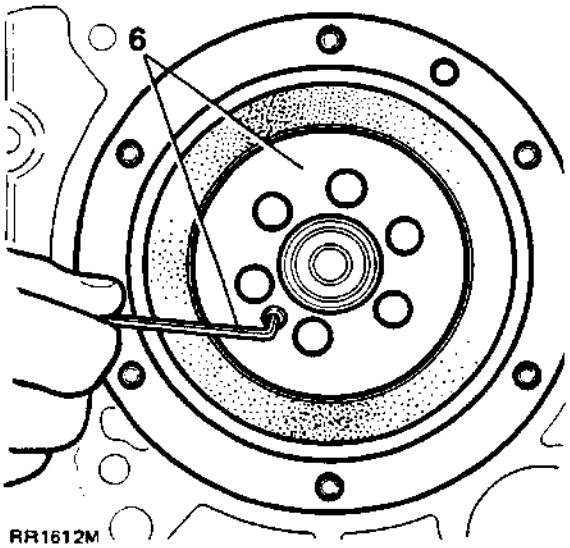
10. Remove the timing cover with injection pump drive gear.
11. Remove the special tool from the timing cover and injection pump drive gear.
12. Reassemble the special tool LST - 139.

Remove remaining components

1. Remove the clutch pressure plate and centre plate.
2. Remove the three bolts and withdraw the spigot bearing plate.
3. Remove the six bolts and lift off the flywheel.
4. To assist with the removal of the flywheel fit two 8 mm bolts approximately 100 mm (4.0") long into the clutch retaining bolt holes, diametrically opposite, and lift the flywheel from the engine.



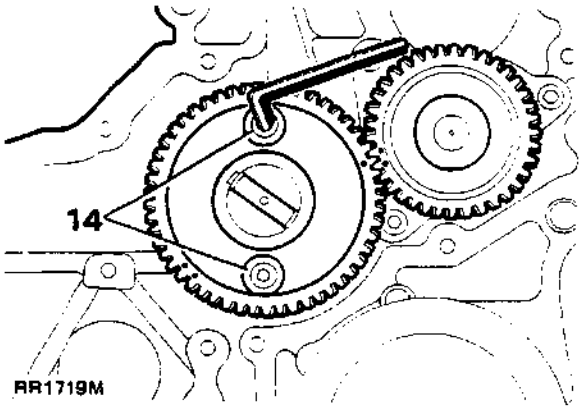
5. Remove the nine bolts and six nuts and withdraw the flywheel housing.
6. Remove the single socket-headed screw and withdraw the crankshaft thrust plate and outer thrust washer halves.



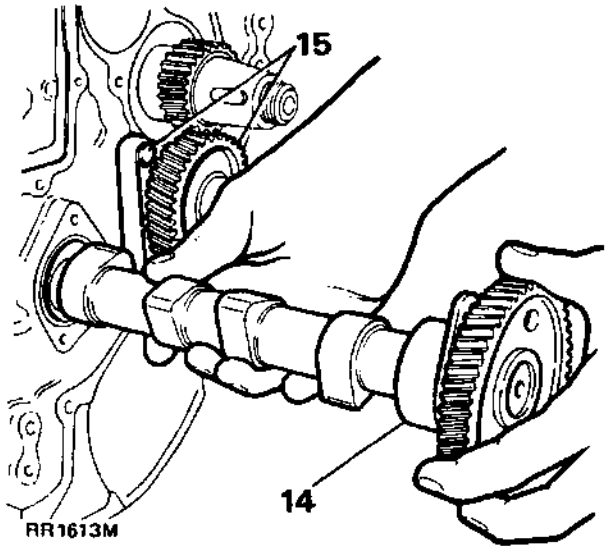
7. Remove the oil filter adaptor housing.
8. Remove the sump oil pan.
9. Remove the twenty-one screws and remove the sump.
10. Remove the three bolts and remove the oil pump pickup pipe and strainer and '0' ring.

△ **NOTE: Before performing the next instruction mark the top of each piston with the number of the bore commencing at the front of the engine. Unlike most engines the connecting rods are not numbered relative to the bores.**

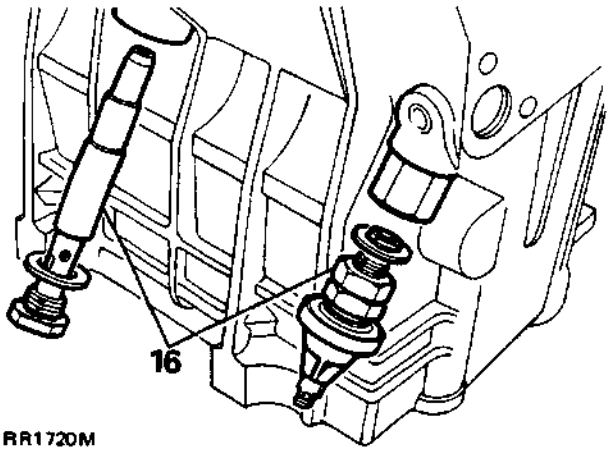
11. Turn the crankshaft to bring numbers one and four connecting rod caps to an accessible position. Remove each cap and lower bearing shell, in turn, and push the connecting rod and piston up the bore and withdraw from the top. Immediately refit the cap to the connecting rod with the number on the same side. Repeat the procedure for numbers two and three connecting rod assemblies.
12. Using a suitable piece of timber drift-out the rear main bearing carrier assembly complete with bearing shells and oil seal.
13. Remove the three screws retaining the oil pump to the crankcase and withdraw the pump complete with drive gear.
14. Position the cylinder block horizontal with the crankcase uppermost and remove the two screws securing the camshaft retaining plate to the cylinder block and carefully withdraw the camshaft complete with gear. It is necessary to have the cylinder block inverted so that the tappets will not drop, and foul the cams.



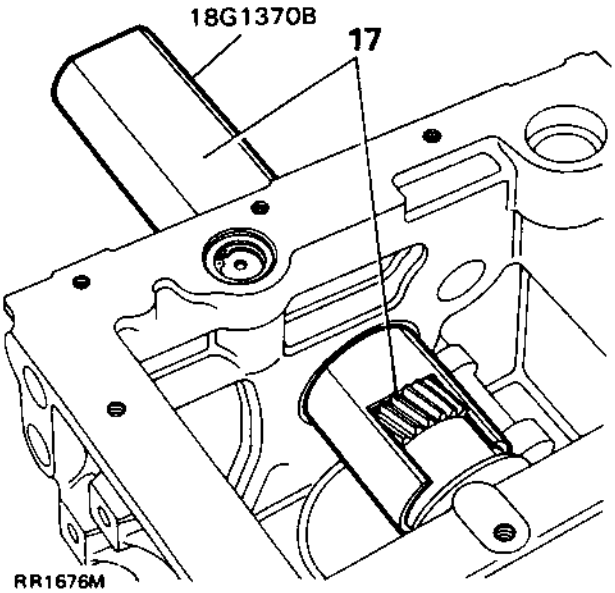
15. Remove the three screws and remove the vacuum pump and gear assembly.



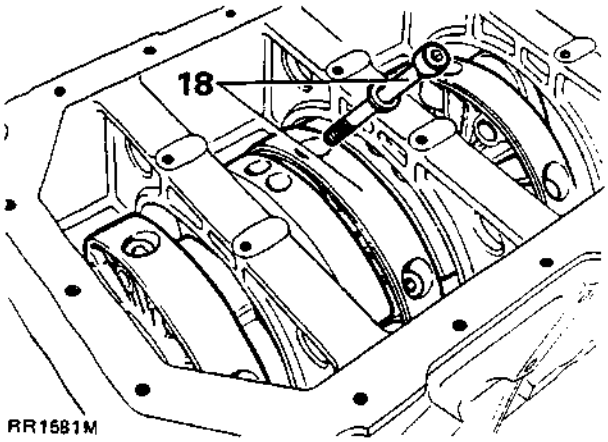
16. Mark for re-assembly and remove from the left hand side of the cylinder block the three main bearing oil feed and carrier location shafts, and identify for re-assembly. Remove the oil pressure switch.



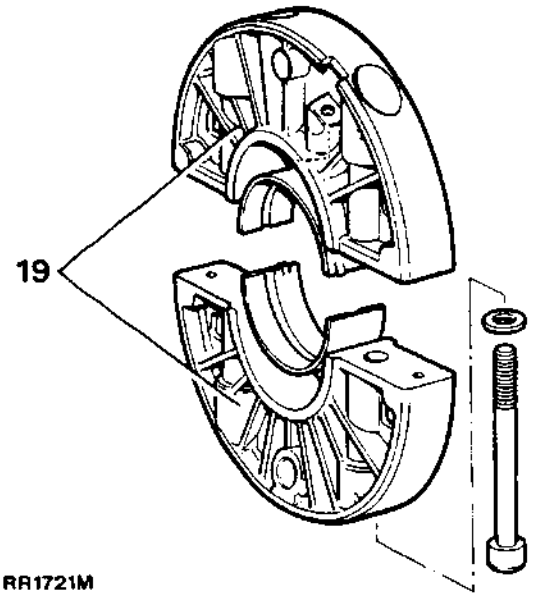
17. To remove the crankshaft and main bearing carrier assembly from the crankcase, slide special tool 18G 1370B over the crankshaft gear, as illustrated, and with assistance withdraw the complete assembly rearwards.



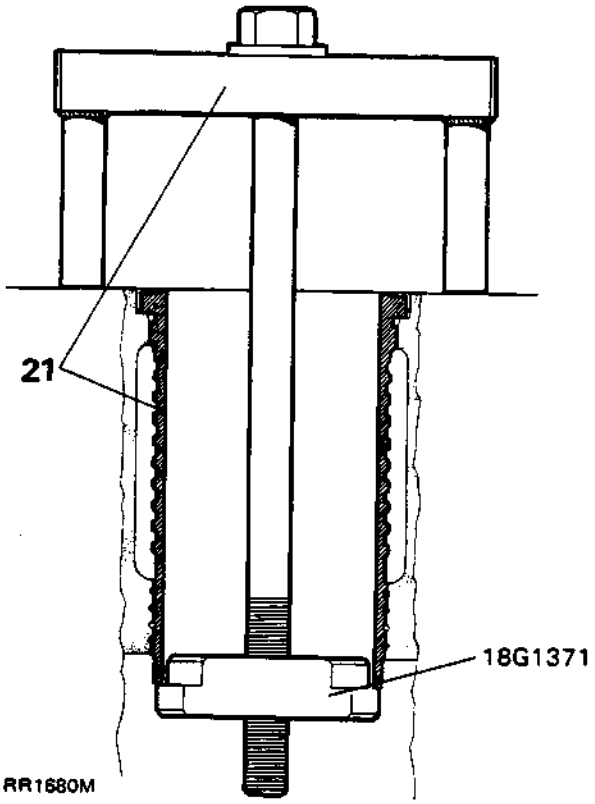
18. Should difficulty be experienced in removing the complete assembly as described above, slide the assembly rearwards sufficiently to gain access to the main bearing carrier bolts. Mark the carriers for assembly and remove the bolts, two for each carrier.



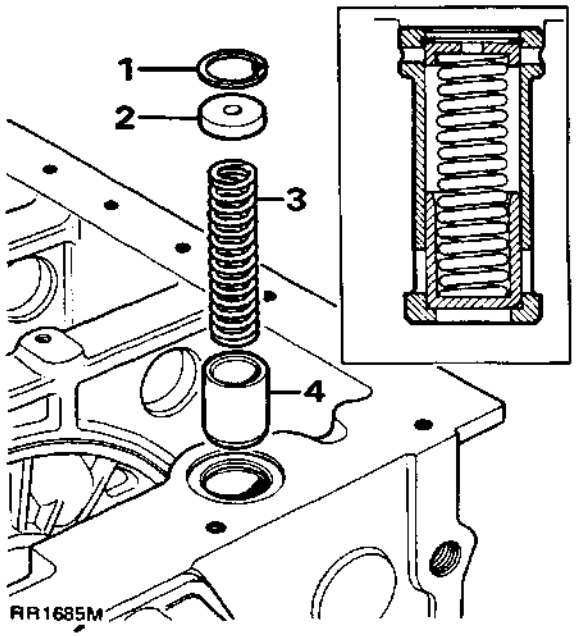
19. Separate the two halves of each carrier, remove from the crankshaft and temporarily re-assemble the carriers. Withdraw the crankshaft through the rear of the crankcase.



20. Remove the cam followers and identify for possible re-assembly to their original locations.
21. If after inspection it is necessary to renew the cylinder liners then they should be removed as follows: position special tool 18G 1371 as illustrated and turn the centre bolt clockwise to withdraw each liner from the cylinder block. Each liner is fitted with three red 'O' rings; the lower one for oil sealing and the others for coolant sealing. The shim under the lip is for achieving the correct protrusion of the liner above the cylinder block face.



22. Remove the pressure relief valve assembly by removing the circlip which will release the cap, spring and relief valve.

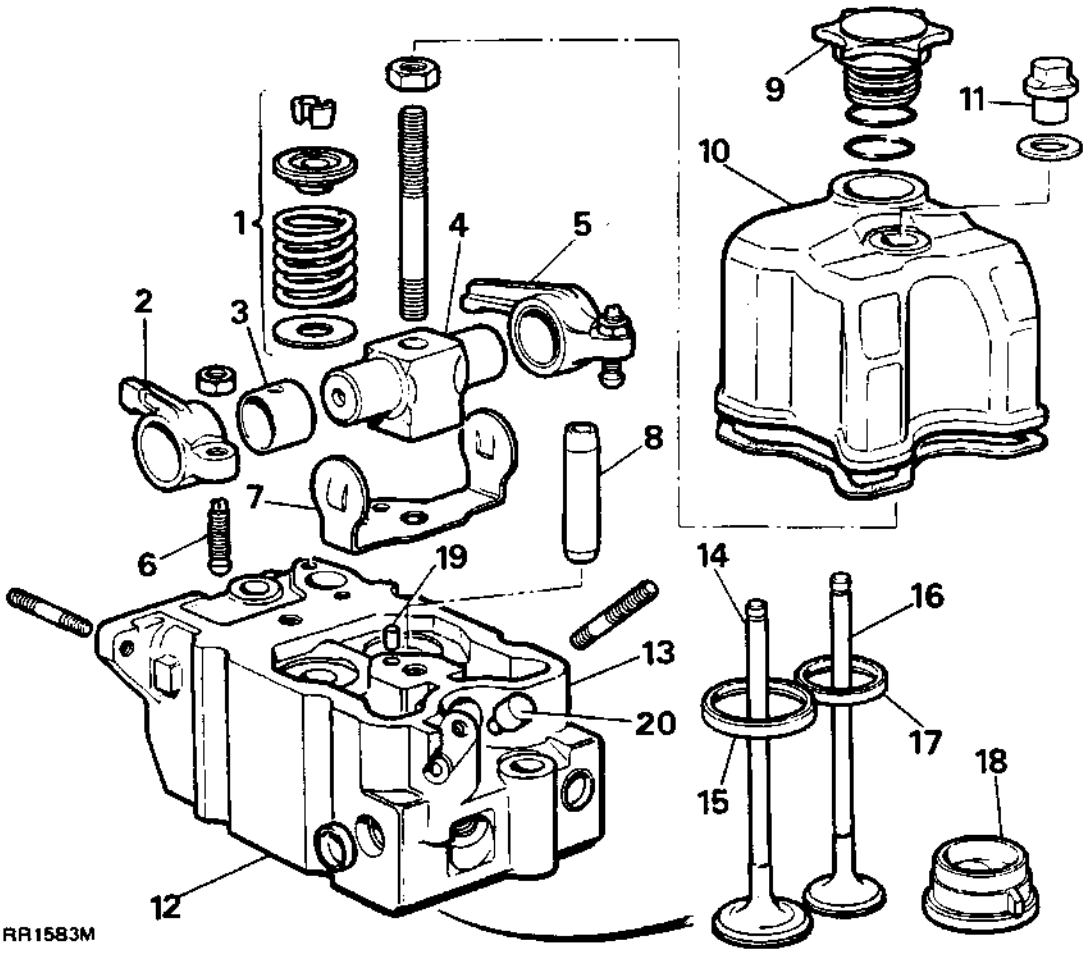


1. Circlip
2. Cap
3. Spring
4. Plunger

INSPECTION AND OVERHAUL OF COMPONENTS

Cylinder head assemblies

Ensure that the marks made when the cylinder heads were removed are maintained and that during the following instructions the various parts of the cylinder heads are similarly identified.



Key to cylinder head and associated components.

1. Valve spring, cap seat and cotters.
2. Inlet valve rocker.
3. Bush.
4. Rocker shaft. (Pedestal)
5. Exhaust valve rocker.
6. Rocker adjusting screw.
7. Spring clip.
8. Valve guide.
9. Oil filler cap.
10. Rocker cover.
11. Rocker cover nut.
12. Cylinder head.
13. Injector locating dowel.
14. Inlet valve.
15. Inlet valve seat.
16. Exhaust valve.
17. Exhaust valve seat.
18. Pre-combustion chamber.(Hot plug.)
19. Pedestal lubrication dowel.
20. Injector clamp dowel

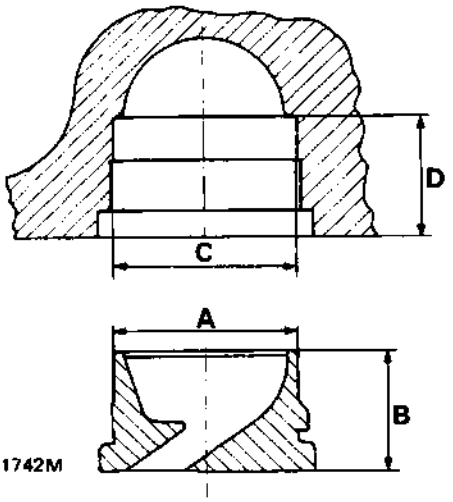
1. Using valve spring compressor 18G 106A or suitable alternative remove the collets, spring cups, springs and valves.
2. Remove the rocker arm pedestal stud and manifold studs.
3. Degrease and remove carbon deposits from the cylinder heads. Examine the cylinder head mating face for cracks pitting and distortion. Renew if necessary.

⚠ **CAUTION: The cylinder heads are plated therefore the face must not be machined.**

4. Cracked or burned hot plugs can be removed by heating the cylinder head uniformly in an oven to 150°C. Tap out the hot plug using a thin drift inserted through the injector hole. Clean-out the hot plug pocket in the cylinder head.
5. Measure the depth of seat (D) and the new hot plug height (B) to establish they meet the fitted tolerance detailed below. If necessary machine the outer face of the hot plug to suit.
6. To fit the new hot-plug cool in liquid nitrogen whilst maintaining the cylinder head at the above temperature fit the hot plug. Ensure that the small pip on the side of the hot plug locates in the groove in the side of the pocket. Allow the cylinder head to cool slowly.

A	Hot plug diameter	30,380 to 30,395 mm
B	Hot plug height	23,350 to 23,440 mm
C	Hot plug seat dia.	30,340 to 30,370 mm
D	Depth of seat	23,570 to 23,730 mm

Maximum protrusion above cylinder head	0,02 mm
Maximum depth below cylinder head	0,03 mm



RR1742M

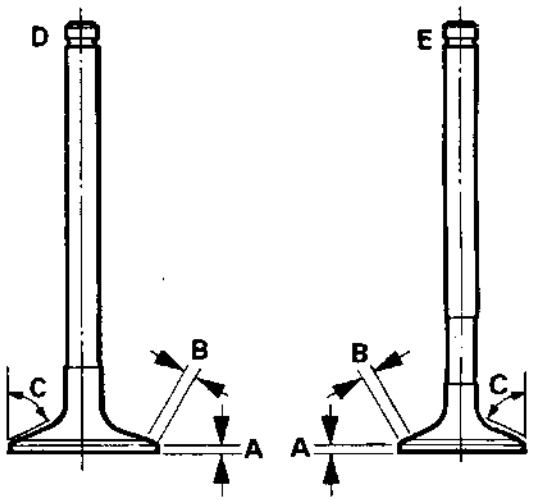
Valves

1. Clean the valves and renew any that are bent, have worn stems, or are burnt and damaged. Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge which must be not less than 1,30 mm (dimension A). Check the valves against the dimensions given in the data section. In addition dimensions B should be as follows:-

D Inlet valve	2,73 to 3,44 mm
E Exhaust valve	2,45 to 3,02 mm

Angle C

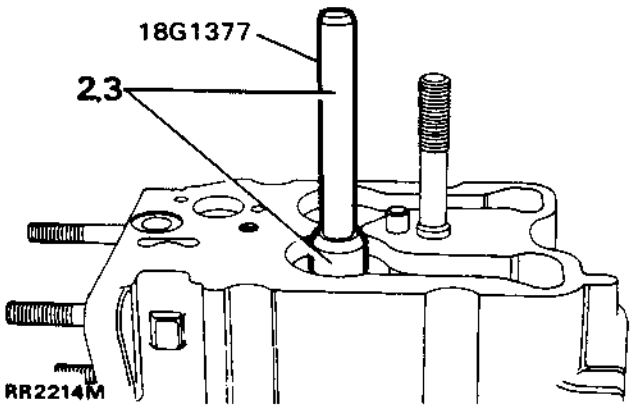
Of inlet valve D.	55° 30'
Of exhaust valve E.	45° 30'



RR1702M

Valve guides

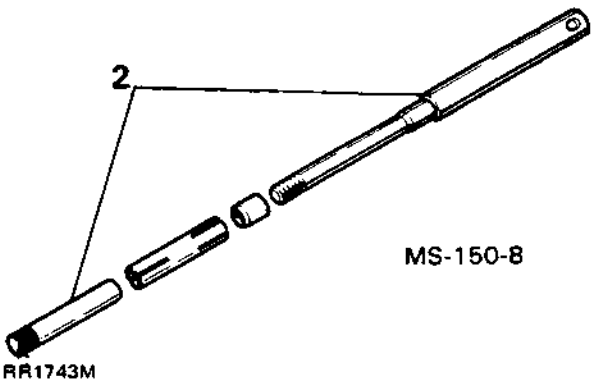
1. Visually examine the guides for damage, cracks, scores and seizure marks. Insert the appropriate servicable or new valve in the guides and check that the stem-to-guide clearance is within the tolerance given in the data.
2. To renew valve guides, heat the cylinder head to a temperature of between 80°C and 90°C and using special tool 18G 1377 without height gauge 18G 1377/2 press the guides out through the top of the cylinder head.

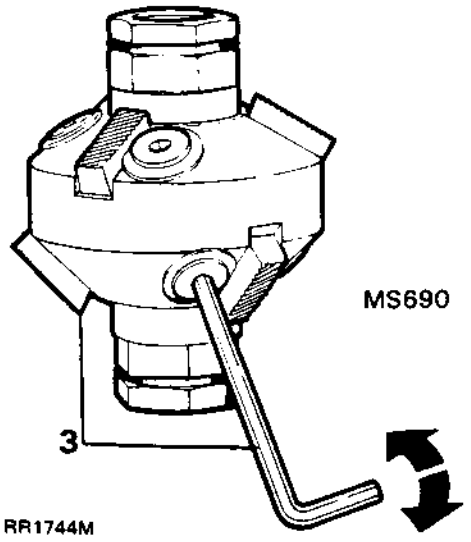


3. Whilst maintaining the above temperature and using the same tool, but with height gauge 18G 1377/2 drive-in new guides from the top of the cylinder head to the distance determined by the gauge or to dimensions in the data.

Valve seat inserts

1. Examine the valve seat inserts for damage, wear and cracks. the seats can be restored provided they are not abnormally wide due to refacing operations. If the seat cutting operation, however, excessively lowers the valve recess or if the seat cannot be narrowed to within the limits given in the data, the insert should be renewed.
2. To recut an inlet valve seat use an expandable pilot M.S. 150-8 loosely assemble the collet, expander and nut. Ensure that the chamfered end of the expander is towards the collet. Insert the assembled pilot into the valve guide from the combustion face side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide. Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.





3. Select cutter MS 690 and ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated. Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS 76.
4. Fit the wrench to the cutter head, apply it to the seat to be refaced and turn clockwise using only very light pressure. Continue cutting until the width of the seat is in accordance with the dimension J in data.
5. To check the effectiveness of the cutting operation use engineer's blue or a feeler gauge made from cellophane.
6. Smear a quantity of engineer's blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a a gap of not more than 12 mm it can be corrected by lapping.
7. Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag the seal is satisfactory at that spot. Repeat this in at least eight places. Lapping in will correct a small open spot.
8. Perform the above instructions to recut an EXHAUST valve seat using cutter MS 621 until the seat width is in accordance with dimension D in data. Check that the valve head recess is within the data limits.
9. To remove either an inlet or exhaust valve seat, hold the cylinder head firmly in a vice, wear protective goggles and grind the old insert away until thin enough to be cracked and prised out. Take care not to damage the insert pocket. Remove any burrs and swarf from the pocket. Failure to do this could cause the new insert to crack when being fitted.
10. Heat the cylinder head, uniformly in an oven, to a temperature of 150°C cool the new seat insert by dipping into liquid Nitrogen. This will enable the seat to be positioned without the use of pressure. Allow the cylinder head to cool naturally to avoid distortion.

Lapping in valves

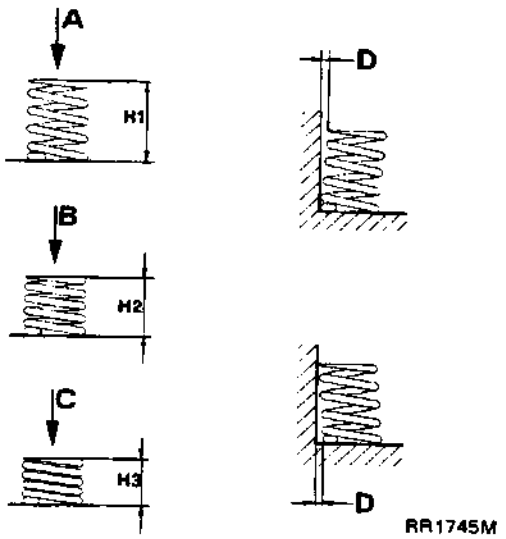
1. To ensure a gas tight seal between the valve face and the valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping in operation has been completed.
2. Unless the faces to be lapped are in poor condition it should only be necessary to use fine valve lapping paste. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil.
3. Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.

4. Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is successful, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face. Insert the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter turn a few times. If all the pencil lines are cut through no further lapping is required.
5. Wash all traces of grinding paste from the valves and cylinder head seats.

Valve springs.

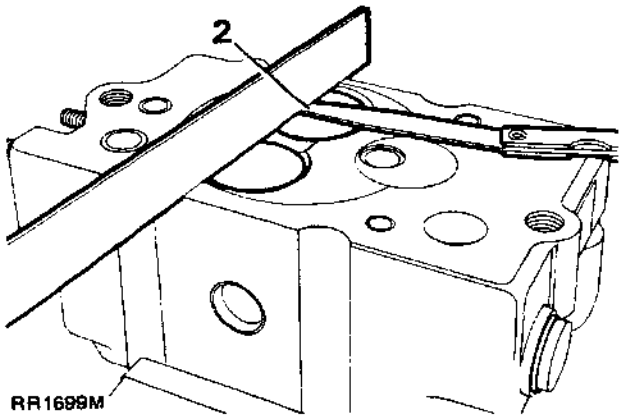
1. Examine the valve springs for damage and overheating and discard any that are visually faulty.
2. New and used valve springs, in the interests of uniformity, should be subjected to load and height tests as shown in the table and diagram below.
   The amount of distortion D must not exceed 2,0 mm (0.078 in).

	Test load (Kg)		Height (mm)	Condition
A	0.00	H1	43.20	Free height
B	33-35	H2	37.00	Closed valve
C	88-94	H3	26.61	Open valve



Assembling the cylinder head

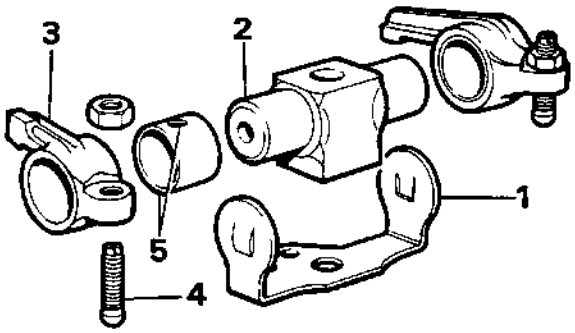
1. Assemble the valves to their respective positions in the cylinder head. Fit the spring plates, springs and cups and secure the assembly with the split collets using valve spring compressor 18G 106A or equivalent.
2. Using feeler gauges check the inlet and exhaust valve head stand down i.e clearance of valve heads below cylinder head combustion face, see data.



3. When renewing the cylinder head water jacket plugs secure them in position with Loctite 601
4. Renew the manifold retaining studs and when fitting a new pedestal stud secure it with Loctite 270.
5. Fit the rocker pedestal location and lubrication dowel into each cylinder head and ensure that the oil hole is clear. Place the heads to one side ready for assembly to the cylinder block at a later stage.

Rocker assembly and push rods.

1. Remove the spring clip and slide the rockers from the shaft.
2. Clean and examine the rocker shafts and check for ovality, overall wear taper, and surface condition. Compare the dimensions with those given in data.
3. Examine the rockers and renew any that have worn rocker pads. It is not permissible to grind a pad in an attempt to restore a rocker.
4. Examine the rocker adjusting screws and renew any that are worn.
5. Check the internal dimensions of the bushes against the figures in data. If necessary renew the bushes ensuring that the oil hole in the bush aligns with the hole in the rocker arm. Check that the rocker arm to shaft clearance is within the figures in data.
6. Assemble the rocker-arms to the shaft noting that they are handed and that when assembled the pad ends point inwards. Retain the assembly with the spring clip and place to one side for fitting to the cylinder head at a later stage.

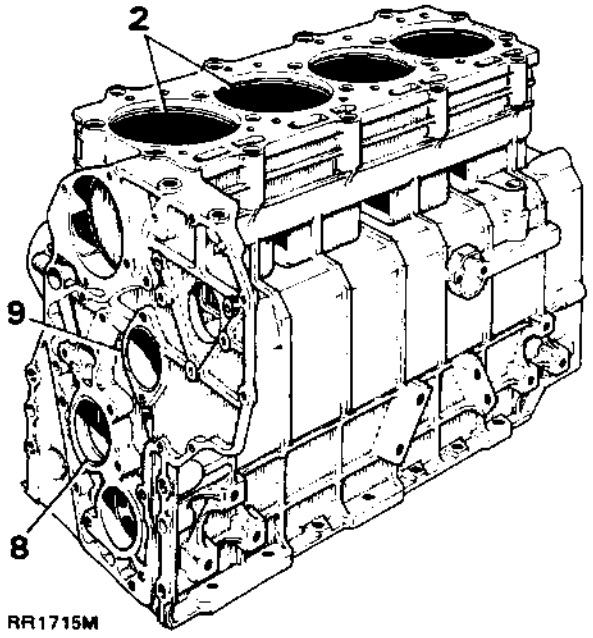


RR1688M

7. Examine the push rods and discard any that are bent or have worn or pitted ends.

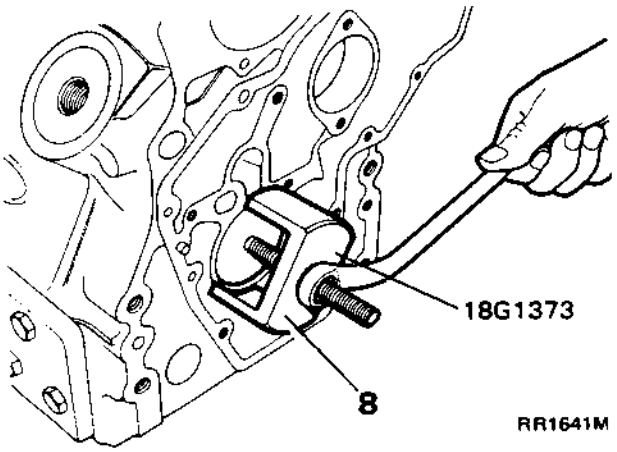
Cylinder block

1. Clean the cylinder block with kerosene or suitable solvent and blow dry with compressed air all oil passages and water ways. Carry out a careful visual examination checking for cracks and damage.
2. Measure the cylinder liner bores for ovality, taper and general wear using any suitable equipment. An inside micrometer is best for checking ovality and a cylinder gauge for taper.
3. Check the ovality of each bore by taking measurements at the top of the cylinder just below the ridge at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50 mm (2.0 in) up from the bottom of the bore so that the overall ovality may be determined.
4. The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line. The difference between the two measurements is the taper.
5. To establish maximum overall bore wear, take measurements at as many points possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder liner.
   (See **Section 04** General specification data).
6. If the cylinder bores are excessively worn outside the limits the cylinder liners must be renewed. ***See ASSEMBLING ENGINE***
7. Alternatively, if the overall wear, taper and ovality are well within the acceptable limits and the original pistons are serviceable new piston rings may be fitted. It is important however, that the bores are deglazed, with a hone, to give a cross-hatched finish to provide a seating for the new rings. It is vital to thoroughly wash the bores afterwards to remove all traces of abrasive material.



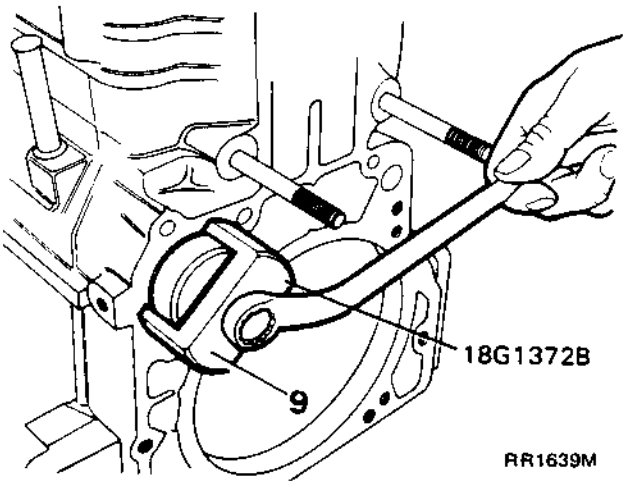
RR1715M

8. Using an inside micrometer check the front main bearings for general condition, overall wear, taper and ovality. If outside the limits given in data remove the bearing. Use special tool 18G 1373 to renew the bearing, ***See ASSEMBLING ENGINE***



RR1641M

9. Measure the internal diameter of each camshaft bearing at several points using an internal micrometer. A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance is excessive or if they are scored or pitted. Use special tool 18G 1372B as illustrated, to remove the bearings.



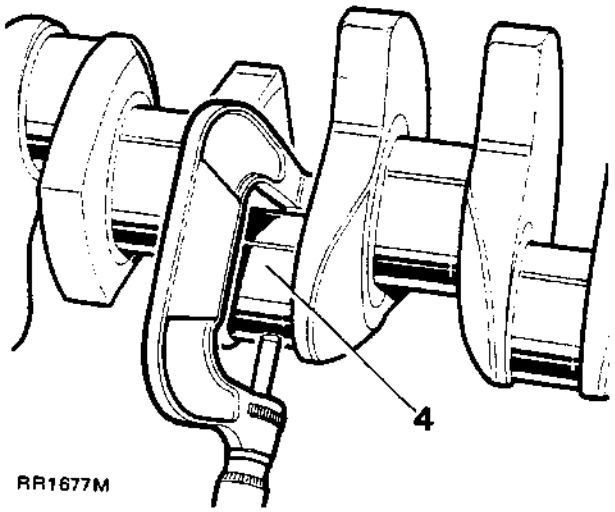
RR1639M

Crankshaft

1. Identify for reassembly and remove the main bearing carriers from the crankshaft.
2. Degrease the crankshaft and clear out the oil ways, which can become clogged after long service.
3. Mount the crankshaft on "V" blocks and examine visually, the crankpins and main bearing journals, for obvious wear, scores, grooves and overheating.
4. With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows:

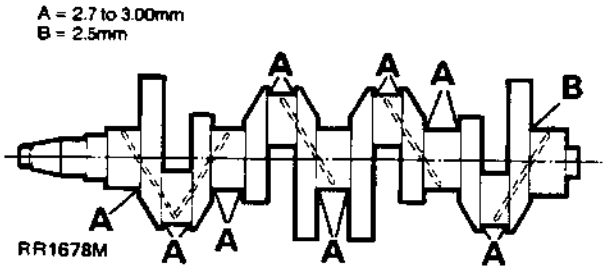
5. Ovality - Take two readings at right-angles to each other at various intervals.

6. Taper - Take two readings parallel to each other at both ends of the main bearing journal and crankpin.



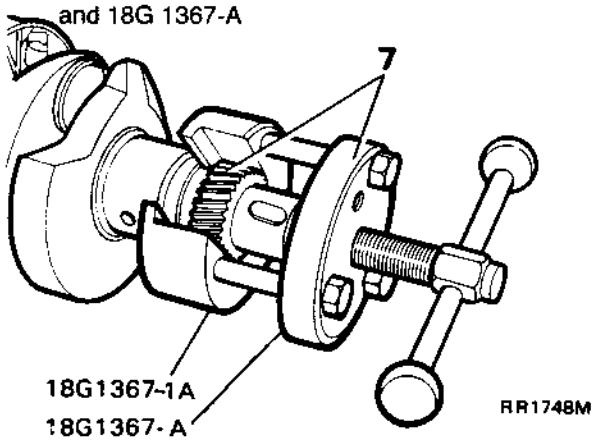
RR1677M

7. If the overall wear exceeds 0,01 mm (0.004 ins) for both main bearing journals and crankpins regrind and fit undersize bearings. When regrinding do not remove any material from thrust faces.
8. After grinding it is important to restore the journal fillet radii as illustrated.



RR1678M

9. Examine the timing gear teeth and if worn remove the gear with special tool 18G 1367-1A and 18G 1367-A

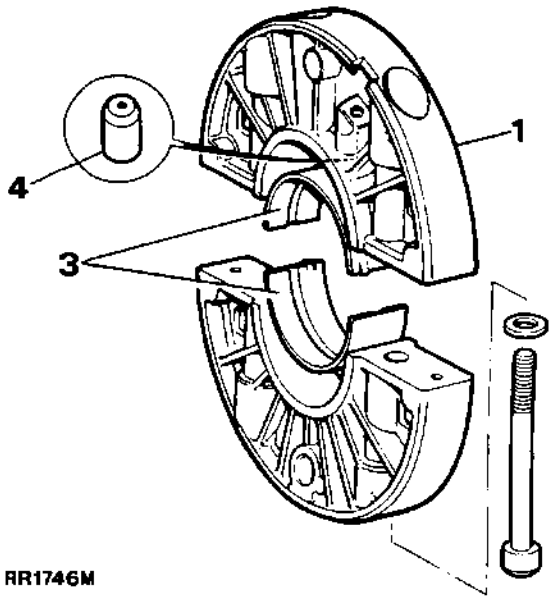


RR1748M

10. To fit a new gear, heat in an oven to 180°C to 200°C, and press-on to the shaft up to the shoulder. Fit a new key for the crankshaft pulley.

Crankshaft carriers

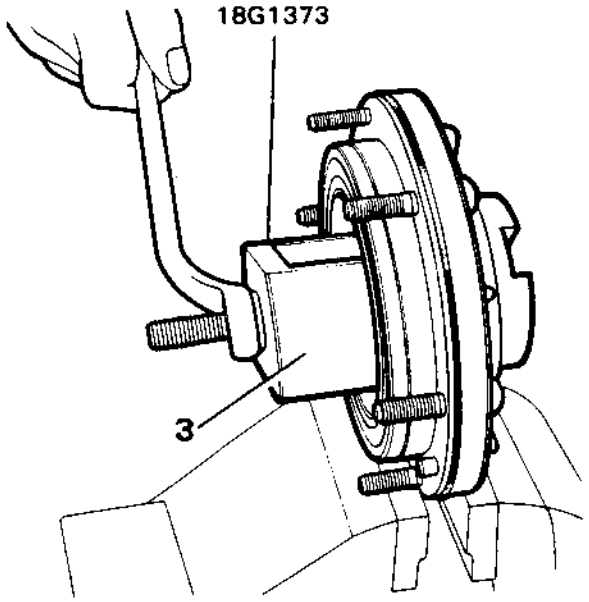
1. Assemble the three main bearing carriers with the bearings fitted and tighten to the correct torque.
2. Using an internal micrometer check the internal diameters of the bearings against the figures in data and renew if necessary or in any event if the crankshaft is being reground.
3. Remove the bearings from the carriers, reassemble and tighten bolts to correct torque. With an internal micrometer check the carrier bore against the figures in data, and for excessive ovality.
4. Check that the piston oil jets in the carriers open at the correct pressure and renew if necessary. Drift the old jet out through the carrier bore, apply a thin coat of Loctite AVX Special around the new jet before fitting.



RR1746M

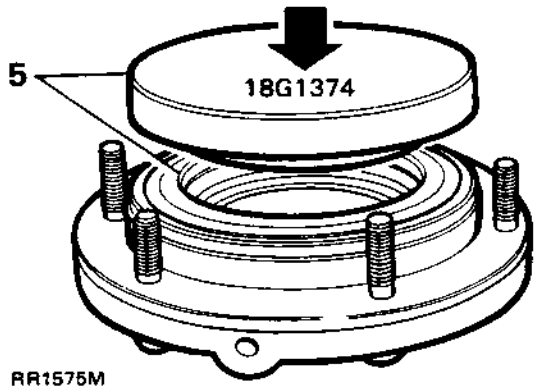
Rear main bearing carrier

1. Extract the oil seal taking care not to damage the carrier bore.
2. Using an internal micrometer check the bearing dimensions against the figures in data.
3. If required remove the bearing using special tool 18G 1373, as illustrated.



RR1642M

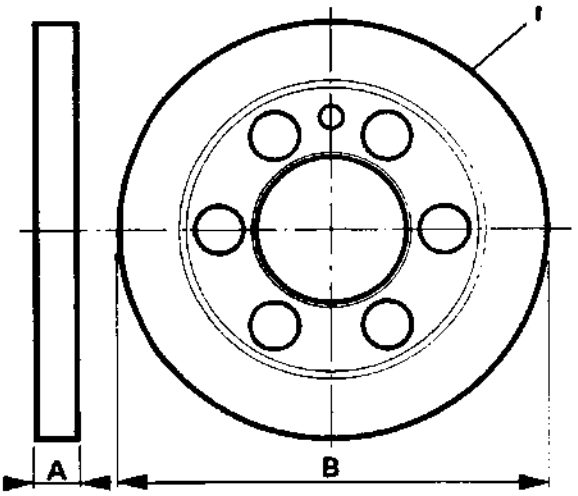
4. Check the carrier bearing bore for wear against the figures in data.
5. With special tool 18G 1374 fit a new oil seal to the rear carrier, lip side leading.



RR1575M

Thrust spacer

1. Examine the spacer thrust face for damage, scratches, cracks and seizure marks. Ensure that outer diameter on which the seal runs is free from imperfections.
2. With micrometers check the thickness A and the diameter B at four diametrically opposite points and compare with the figures in data.



RR1703M

Flywheel

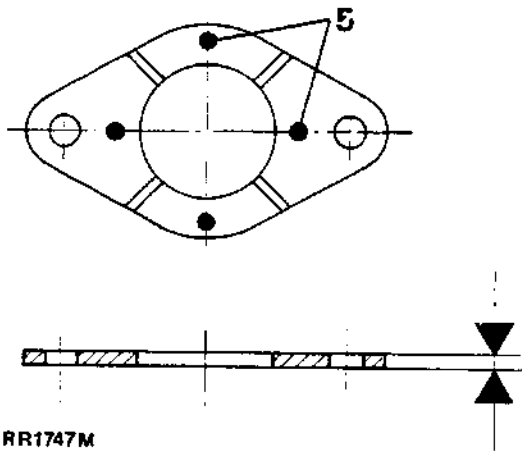
1. Examine the flywheel clutch face for cracks, grooves and signs of over-heating. If excessive damage is evident renew or reface the fly-wheel.

Flywheel face run-out

2. The above check should be carried out during engine assembly. See fitting flywheeel.

Camshaft

1. Carry-out a visual examination of the cam lobes and bearing surfaces. If these are worn, scored or cracked the shaft should be renewed.
2. If visually satisfactory, carry out the dimensional checks detailed in the data section to the cams and bearing journals.
3. Check the camshaft for straightness, by mounting between centres and checking with a dial test gauge on the centre bearing journal. The shaft may be straightened under a press if the bend exceeds 0,05 mm (0.002 in). This work, however, should be entrusted to a specialist.
4. Examine the gear teeth and if worn or damaged press the shaft from the gear, together with the thrust plate.
5. Before fitting a new gear, check the thrust plate thickness at the four points illustrated. Renew the plate if the dimensions do not conform to the limits in data.

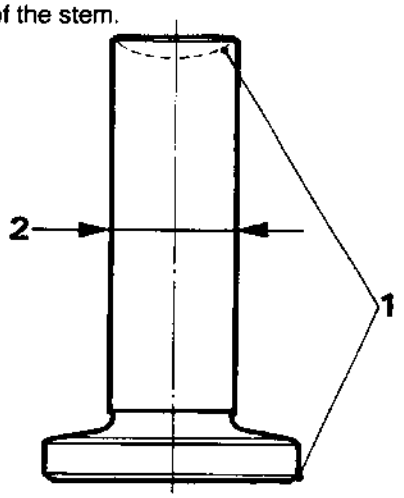


RR1747M

6. Heat the new gear in an oven to 180°C to 200°C, fit the thrust plate and press the gear onto the shaft until the gear is hard against the shoulder. If, when the gear has cooled the thrust plate turns freely on the shaft the camshaft end-float will be correct when fitted.

Cam followers (Tappets)

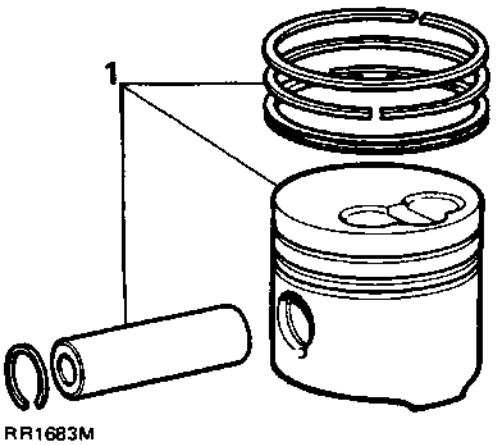
1. Examine the cam followers and discard any that are worn, pitted or scored on the cam contact face. Check also the cups in which the push rods seat.
2. Check the stem diameter for general wear, ovality and taper. Take measurements at several points round the circumference and along the length of the stem.



RR1710M

Connecting rods and pistons

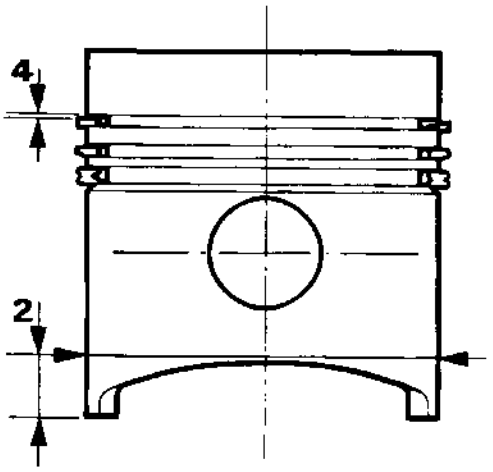
1. Whilst keeping each piston and connecting rod identified for possible refitting, separate the pistons from the rods and remove the piston rings. Degrease and decarbonise the pistons and rings ready for examination. Likewise prepare the connecting rods for inspection.



RR1683M

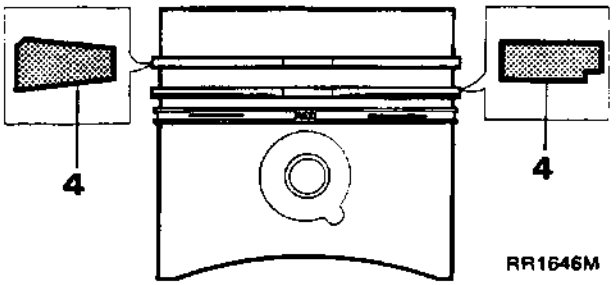
Pistons and rings

1. Examine the pistons for scores, cracks signs of overheating and general wear.
2. If visually satisfactory measure the piston skirt at right angles to the gudgeon pin 15 mm above the bottom of the piston skirt. If the wear is in excess of the maximum permitted in data and the piston to liner clearance is in excess of 0,15 mm (0.006 in) new pistons and liners must be fitted.



RR1714M

3. Check the gudgeon pins for wear, scores, pitting and signs of overheating. Check the gudgeon pin bore for ovality.
4. Examine the piston rings for damage, wear and cracks. Fit the rings to the pistons as illustrated and using a feeler gauge check the side clearance in the grooves.



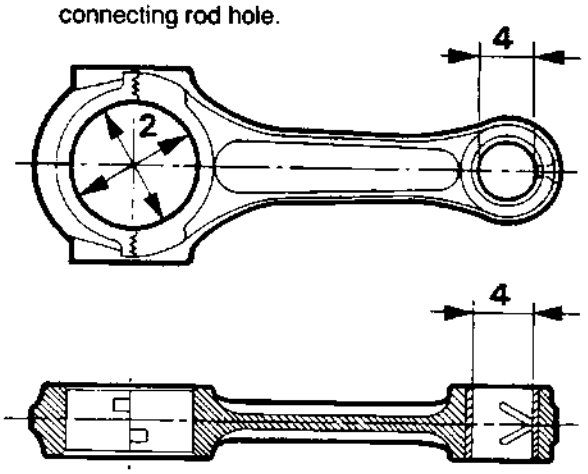
RR1646M

5. To check the piston ring fitted gap insert the ring squarely into the bottom of the bore at the lowest point of piston travel. To ensure squareness push the ring down the bore with a piston. Using an appropriate feeler gauge check the gaps of all the rings in turn. The correct gaps are given in data. If any gap is less than that specified, remove the ring and file the ends square whilst holding the ring in a filing jig or vice.
6. The previous instruction should also be carried out when new pistons and rings are fitted to new liners but the rings may be inserted squarely in any position in the bore.

△ **NOTE: The difference in weight between the four pistons must not exceed 5 grams. When renewing pistons and liners they should all belong to the same classification A or B.**

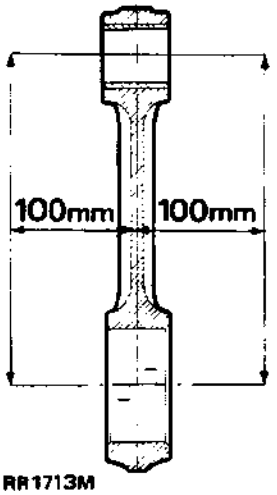
Connecting rods

1. Examine the connecting rods and caps for cracks using a recognised crack testing process.
2. Assemble the cap and rod and tighten to the correct torque. Check the crank pin bore using an inside micrometer and three different points. The bore must be 57,563 to 57,582 mm. Renew rods if the tolerance exceeds 0,02 mm.
3. Examine the connecting rod shells and discard if worn, scored or show signs of overheating. Assemble the rods, caps and shells and tighten to the correct torque. Check the internal diameter against the figures in data.
4. Inspect the small end bush for wear against the figures in data. Check that the wear limit between bush and gudgeon pin does not exceed 0,100 mm (0.004 in). When renewing the bush ensure that the oil hole aligns with the connecting rod hole.



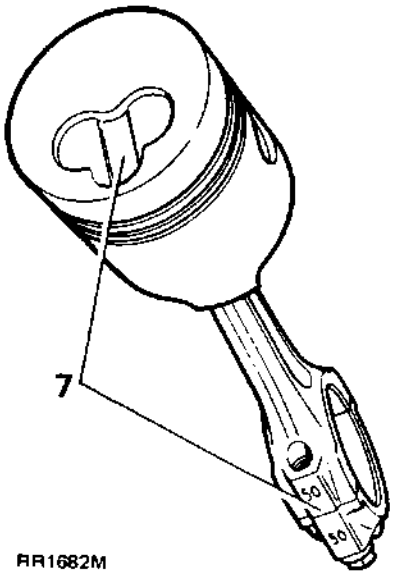
RR1712M

5. Check the rod for bend and twist, taking measurements at approximately 100 mm from the centre of the rod using a recognised alignment gauge. Twist or bend must not exceed 0,5 mm (0.019 in).



RR1713M

6. If it is necessary to renew connecting rods check that the weight difference between them does not exceed 10 grams, see letter code in data (2.4 Litre engines only).
7. Slightly warm the pistons and assemble to the connecting rods ensuring that the recess in the piston crown is on the same side as the number on the connecting rod big end. Insert the gudgeon pins and secure with the circlips.



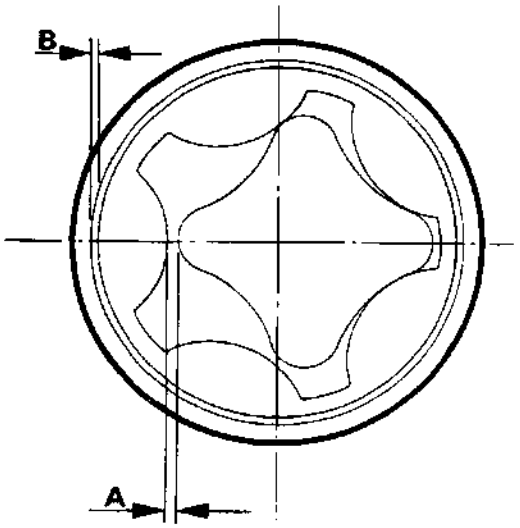
RR1682M

8. Fit the connecting rod bearing shells ensuring that the tags locate in the cutouts.

Oil pump

NOTE: The oil pump is only supplied as an assembly complete with drive gear.

1. Dismantle the oil pump and clean with kerosene or solvent. Examine the rotors and body for wear and pitting.
2. Assemble the oil pump noting that the chamfered side of the outer rotor is fitted downwards towards the drive gear.
3. Check, with a feeler gauge, the clearance between the inner and outer rotor A.
4. Check the clearance between the pump body and outer rotor B and compare the figures in data.

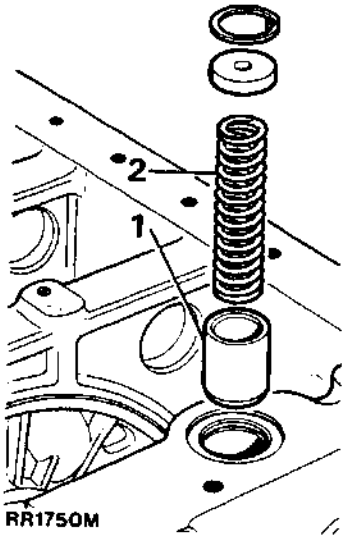


RR1711M

5. Examine the gear teeth for wear, chips and pitting.

Oil pressure relief valve

1. Examine the plunger for scores and pitting. If necessary the valve plunger may be lapped to its seat, to restore efficiency, using fine valve grinding compound. Make sure that all trace of the compound is removed before assembling valve to the crankcase.
2. Check the free length of the spring against the figure in data.



RR1750M

Vacuum pump and gear assembly

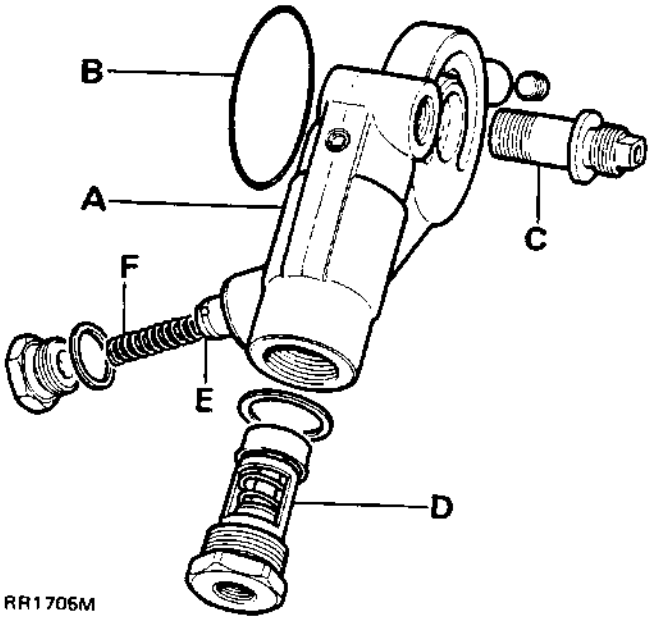
1. Inspect the gear for wear and damage. Check the vanes for wear. Examine the vacuum pump housing for scouring or damage.
   If the unit is worn or damaged the complete assembly should be renewed.

Injection pump drive gear

1. Check the injection pump gear for damage, wear and pitting. Examine the bore and keyways for wear. Renew if any gear is unsatisfactory.

Oil filter adaptor housing

1. This housing contains a by-pass valve which opens to maintain oil circulation when a difference in pressure exists between the filter base outlet to the oil cooler and the main oil gallery due to a restriction in the oil cooling system. A thermostat which opens at 80°C, to allow oil to pass to the oil cooler is also incorporated in the housing.



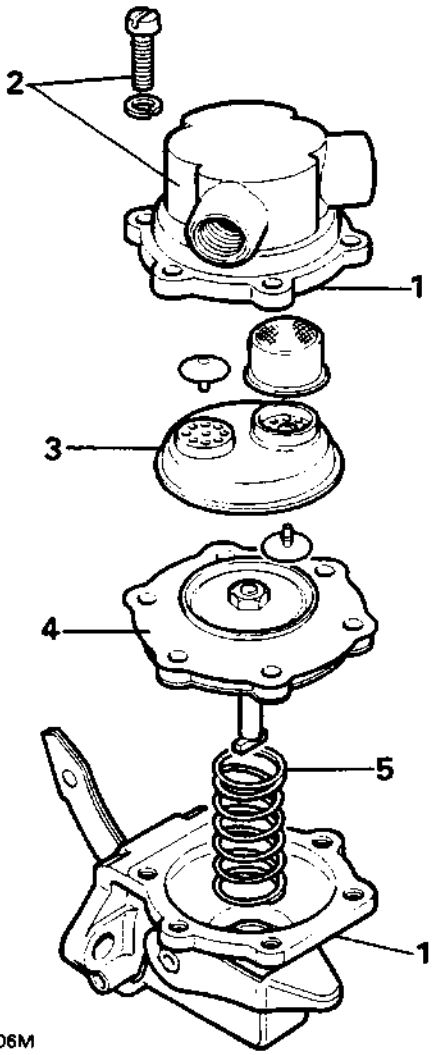
RR1706M

A Adaptor housing.
B 'O' ring
C Oil filter and adaptor housing union screws
D Thermostat
E By-pass plunger
F By-pass plunger spring

2. Remove the thermostat and check the opening temperature. Place the thermostat in vessel containing water and a thermometer. Appply heat and observe the temperature at which the thermostat opens. Refit or renew as necessary, using a new sealing washer.
3. Remove the by-pass valve plug and remove the spring and plunger. Check the plunger for scores and pitting. Refit or renew as necessary using a new sealing washer.

Fuel lift pump

1. Mark the relationship of the pump cover to the body to facilitate reassembly.
2. Remove the six retaining screws and lift-off the cover.
3. Remove the valve plate.
4. Press down on the diaphragm and twist to release the diaphragm from the body.
5. Remove the diaphragm spring.
6. Clean and examine all parts. The diaphragm can be renewed if faulty.



RR1706M

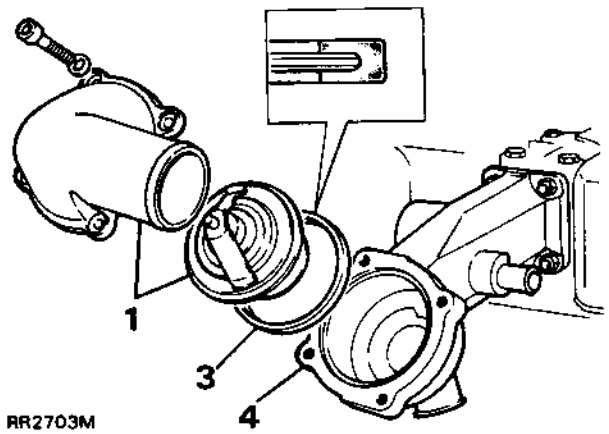
7. Reassemble the pump reversing the above procedure.

Water pump

1. Since the water pump is not serviceable the complete assembly should be renewed if the impeller is worn and corroded or if there is excessive end float or side movement in the impeller shaft.

Thermostat and housing

1. Remove the four socket headed screws and lift the outlet elbow clear to remove the thermostat with its fitted seal from the thermostat housing.

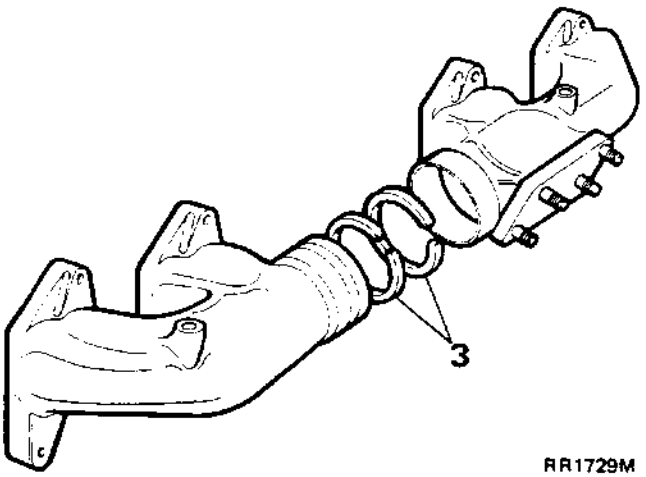


RR2703M

2. To test the thermostat, remove the seal (3) note the opening temperature stamped on the end of the thermostat and place it in a vessel containing water and a thermometer. Apply heat and observe the temperature at which the thermostat opens. Renew if necessary.
3. Fit a new joint seal onto the edge of the thermostat ensuring it is fitted evenly.
4. Refit the thermostat ensuring location of the seal into the recess of the thermostat housing.
5. Refit the outlet elbow and tighten the screws, evenly.

Inlet and exhaust manifold

1. Examine the manifold for damage and cracks.
2. Check the mating faces with the cylinder head for distortion by mounting on a surface plate and checking with feeler gauges. If necessary, the flange faces may be machined to restore maximum surface contact with the cylinder head.
3. The exhaust manifold is manufactured in two sections and piston ring type seals are used to provide a flexible gas tight seal. Renew the rings if cracked and assemble the two sections using Vaseline on the rings to facilitate assembly.

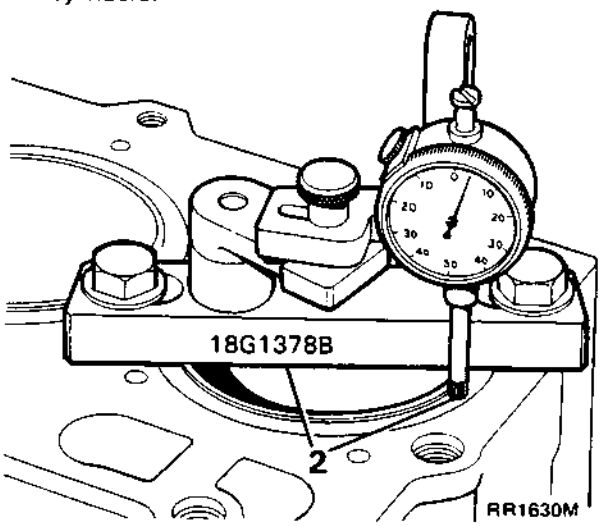


RR1729M

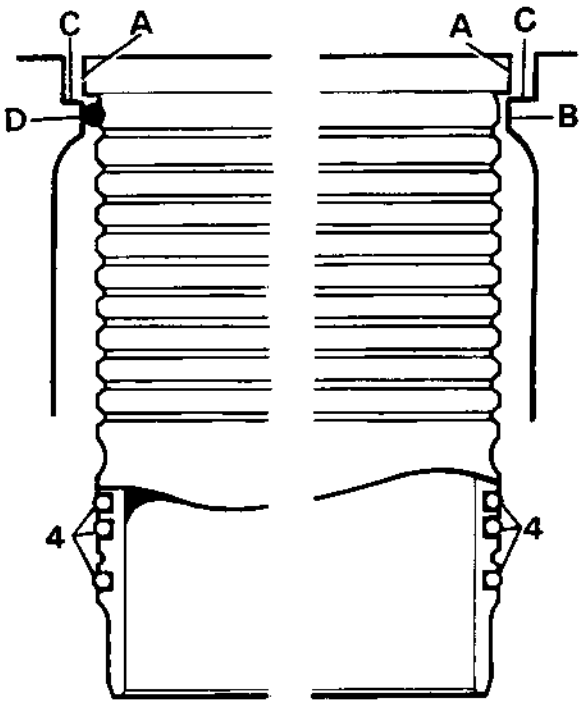
ASSEMBLING ENGINE

Fitting cylinder liners

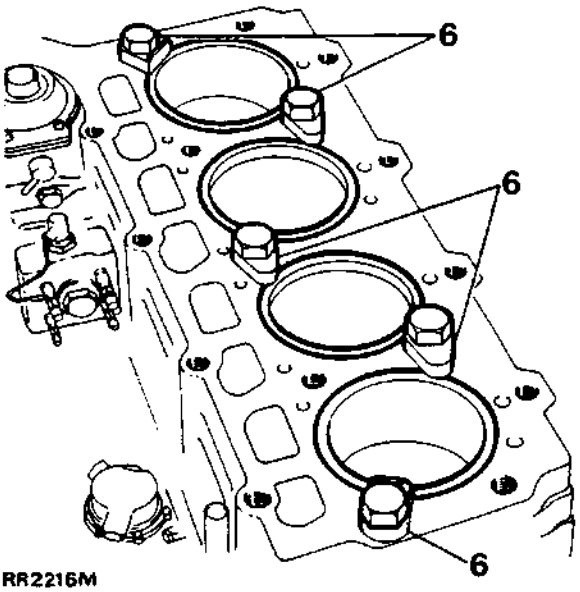
1. Clean the liners and the cylinder block areas of contact. Fit the liners without 'O' rings. The liners should drop into position under their own weight, if not, further cleaning is necessary.
2. To obtain the correct liner protrusion, attach special tool 18G 1378,B as illustrated, to the cylinder block and tighten the bolts to ***30 Nm (22 lbf/ft)*** . Fit a dial test indicator so that the stylus rests in a loaded condition on the external rim of the liner and set the dial to zero. Slide the stylus across to the cylinder block and note the reading.
   Repeat the above procedure to the remaining cylinders.



3. Remove the liners and add shims as required to achieve the protrusion given in the data **Section 04.**
4. Remove the liners and fit three new 'O' rings. Apply molybdenum disulphide grease, such as 'Marston's Molycote' to the 'O' ring contact area in the cylinder block.
5. Apply 'Loctite 275' to areas A and B. Avoid any sealant contacting the shim and face C.
   An 'O' ring is fitted to top of liner, on later 2.5 engines or when fitting new liners to 2.4 and early 2.5 engines. Fit 'O' ring seal to position D and apply Loctite to area A only. Avoid sealant contacting the shim, face C and 'O' ring.

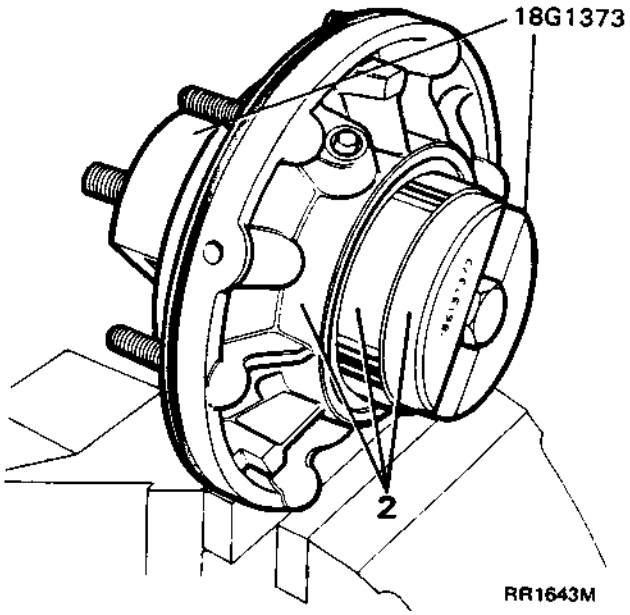


6. Fit the liners to the cylinder block and hold them in using the cylinder head spacers and slave bolts, tighten the bolts to ***30 Nm (22 lb/ft)***, leave the spacers and slave bolts in position for approximately two hours until the Loctite is set.



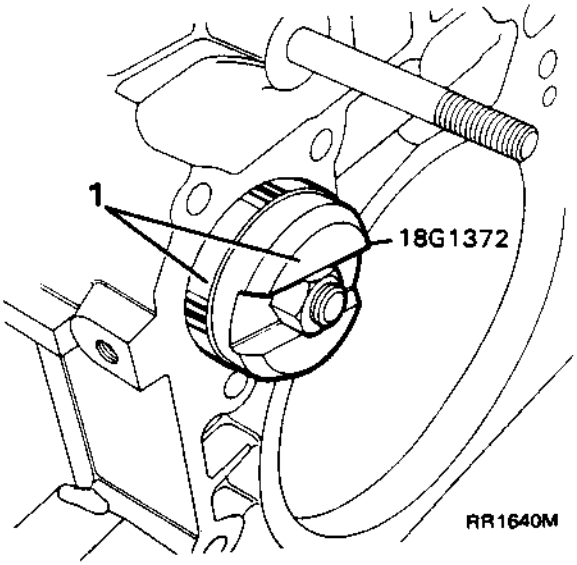
Fitting front and rear main bearings.

1. Use special tool 18G 1373 to refit the front main bearings to the cylinder block, ensuring that the oil hole in bearing aligns with oil hole in the bearing bore.
2. Use the same tool 18G 1373 to refit the rear main bearings to the carrier assembly, ensuring that the oil holes in bearing and carrier align.



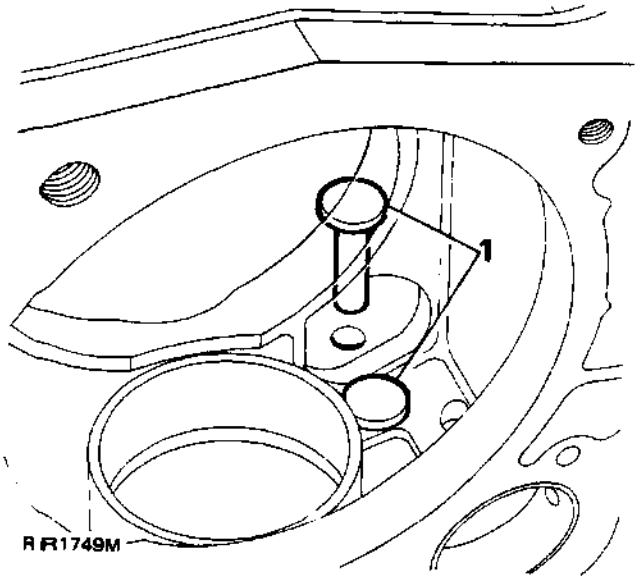
Camshaft bearings

1. Renew the camshaft bearings in the cylinder block using special tool 18G 1372.
2. Each bearing shell has two oil holes and it is essential that these align exactly with the corresponding oil drillings in the cylinder block. The illustration shows the camshaft rear bearing being fitted.



Fitting camshaft and followers

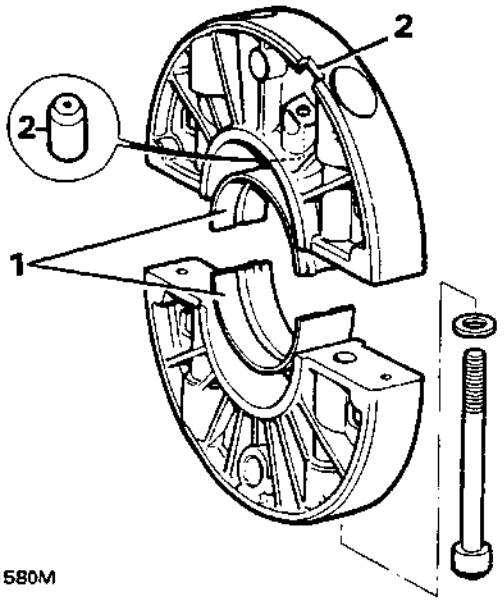
1. Invert the cylinder block and smear the cam followers with clean engine oil and fit them to their original locations in the cylinder block.



2. Smear the camshaft journals with clean engine oil and and carefully insert the camshaft complete with thrust plate and gear. Temporarily secure the camshaft to the cylinder block with the two screws.

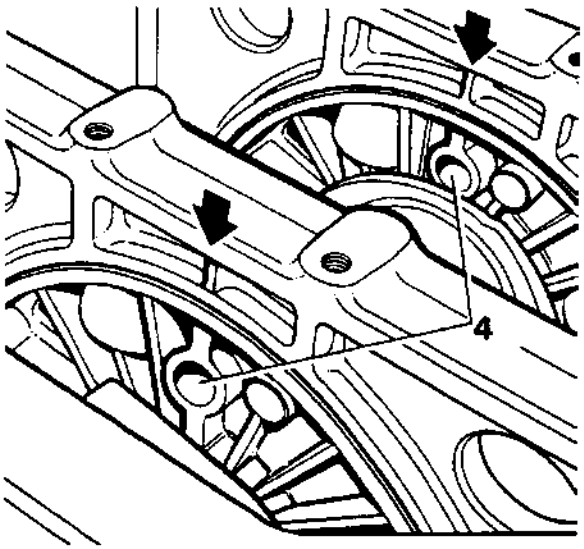
Fitting crankshaft and carrier assembly.

1. Fit new main bearing shells to each of the carrier halves.
2. Assemble the carriers to the crankshaft journals, ensuring that the same carriers are fitted to their original locations and that the piston jet cut-a-way is towards the front of the crankshaft. Secure each carrier with the two bolts tightening evenly to the correct torque. Check that the oil jet is in position.



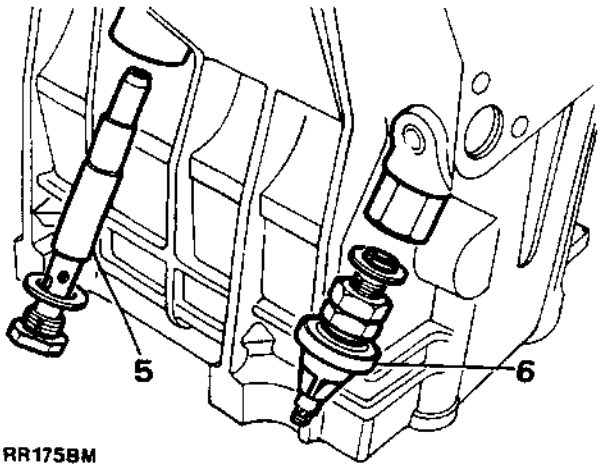
RR1580M

3. Slide special tool 18G 1370 over the crankshaft gear and, if necessary, with assistance insert the crankshaft and carrier assembly into the crankcase in the same manner as for removal.
4. Align the holes in the lower carriers, as illustrated, with the centre of the crankcase webs.



RR1722M

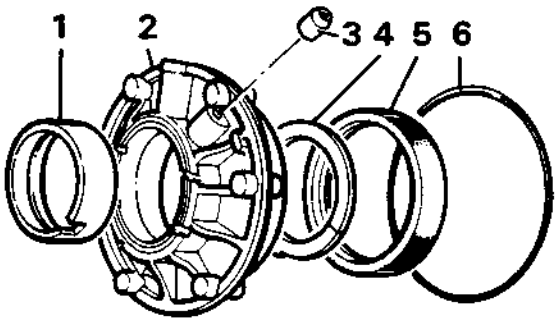
5. Secure each carrier assembly to the crankcase with the appropriate oil feed and carrier location shaft. Ensure that the shafts are fitted to their original locations with new washers.
   The correct locations are as follows:-
   Front carrier shaft - Oil feed to vacuum pump.
   Centre carrier shaft -Oil feed to turbo-charger.
   Rear carrier shaft -Blank
   Tighten the shafts to the correct torque.
6. Fit the oil pressure switch.



RR1758M

Fitting rear main carrier assembly.

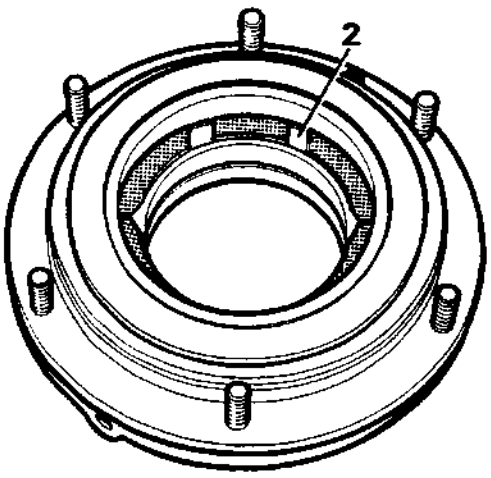
1. Fit a new 'O' ring seal to the rear main carrier.



RR2776M

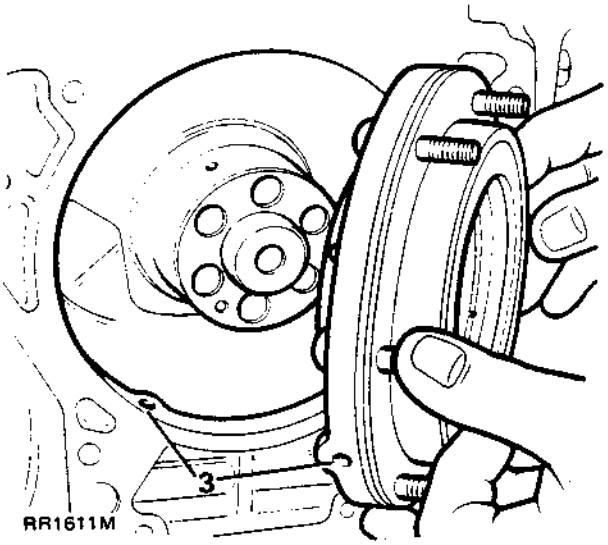
1. Bearing
2. Carrier
3. Oil jet
4. Outer thrust washers
5. Oil seal
6. 'O' ring seal

2. Fit new outer thrust halves to the oil seal side with the oil grooves outwards. Ensure that both halves are of the same thickness value and that the thrust with the tag locates in the keyway in the carrier. Hold the thrusts in position with Vaseline.



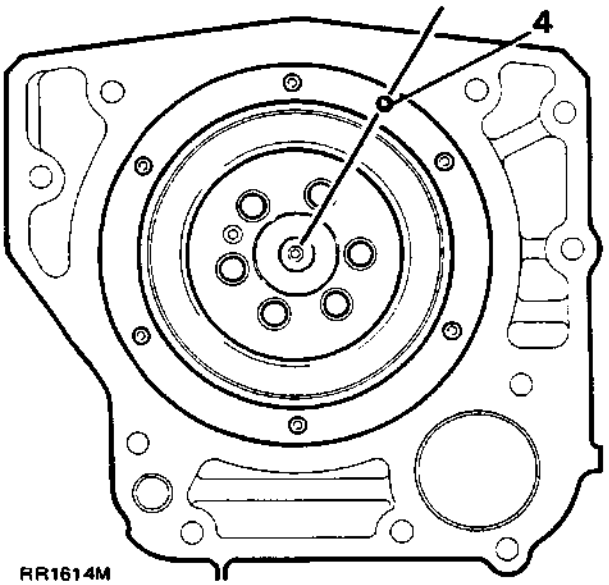
tR1572M

3. With the cylinder block still in the inverted position, lubricate the oil seal with clean engine oil and fit the carrier assembly to the crankcase. Ensure that the oil hole in the crankcase is aligned with the oil hole in the carrier as illustrated.



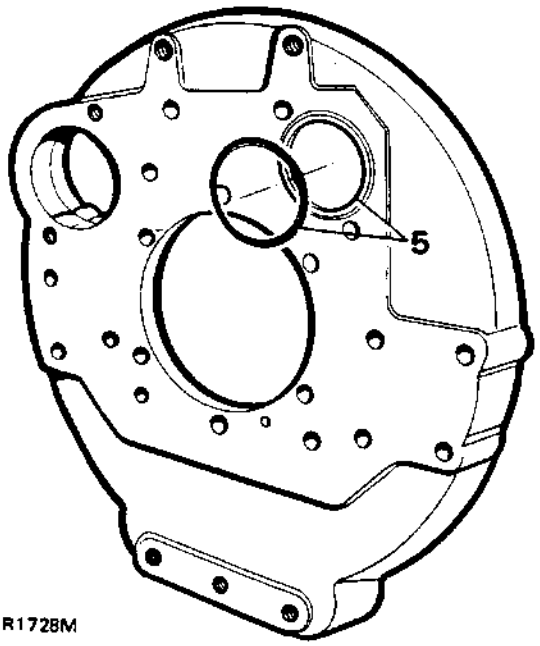
RR1611M

4. When correctly aligned the dowel in the carrier must be at the 1 o'clock position. Final alignment will be achieved when the flywheel housing is fitted.



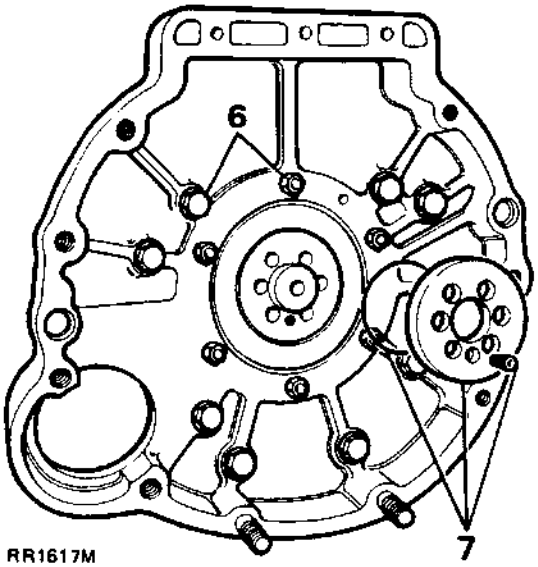
RR1614M

5. Fit a new 'O' ring seal to the rear of the flywheel housing.



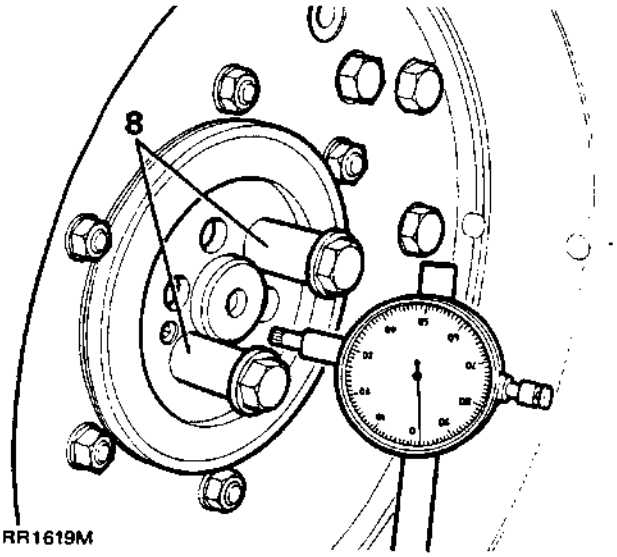
RR1728M

6. Fit the flywheel housing and secure with the nine bolts, tightening evenly to the correct torque. Fit and evenly tighten, to the correct torque, the six carrier retaining nuts.
7. Fit the thrust spacer and a new 'O' ring seal and secure with the socket headed screw.



RR1617M

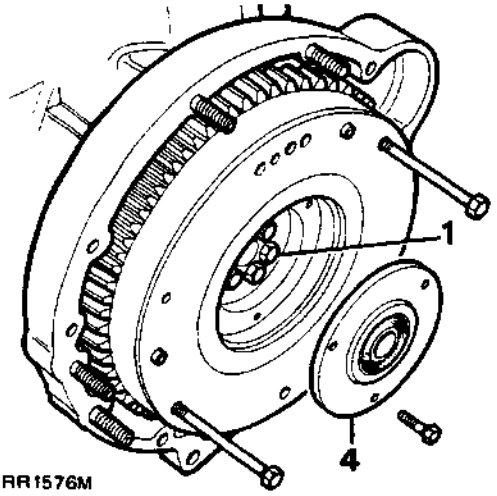
8. To check the crankshaft end-float, insert two flywheel bolts in the crankshaft using spacers equivalent to thickness of the flywheel and tighten to the correct torque. Mount a dial test indicator with the stylus resting, in a loaded condition, on the thrust spacer. Lever the crankshaft back and forth and note the reading. Adjust the end-float, if necessary, by substituting with washers of an appropriate thickness, see data section for available washers.



RR1619M

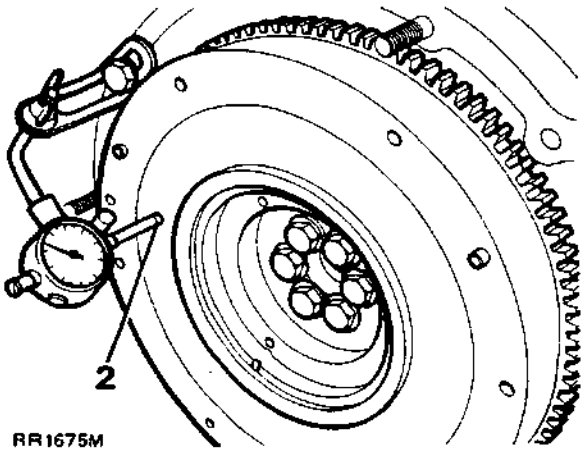
Fitting flywheel

1. Fit the flywheel using the same method as for removal. Fit and evenly tighten the six retaining bolts to the correct torque.



Checking flywheel face run-out

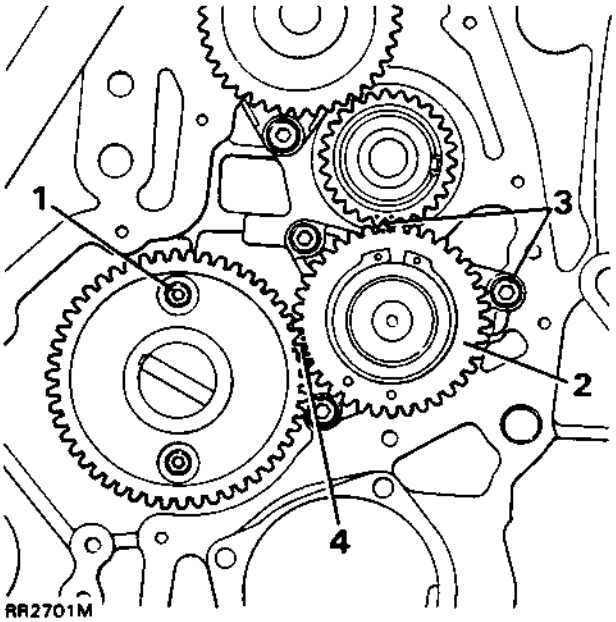
2. Mount a dial test indicator on the flywheel housing with the stylus positioned in a loaded condition on the flywheel face and zero the gauge.
3. Turn the flywheel and take readings every 90°. The difference between the highest and lowest readings taken at all four points should not exceed 0,10 mm (0.004 in) which is the maximum permissible run-out.
4. Fit the spigot bearing and plate and secure with the three bolts.



Fitting vacuum and oil pumps

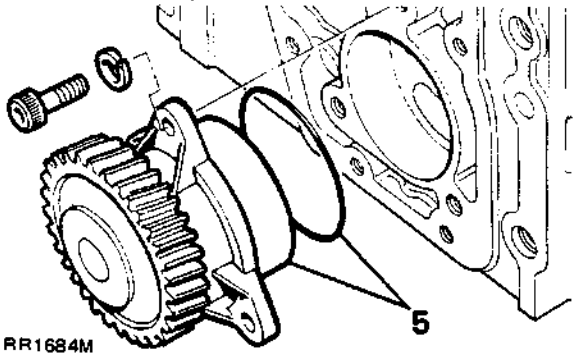
1. Whilst maintaining the cylinder block in the inverted position, remove the two socket headed screws and partially withdraw the camshaft.
2. Using a new 'O' ring seal offer the vacuum pump and gear assembly into its location.
3. Turn the crankshaft and vacuum pump gear until the dots align, as illustrated, with the single dot on the vacuum pump gear between the two dots on the crankshaft gear. Fully house the vacuum pump, tightening the three socket headed screws to the correct torque ***28Nm***

△ **NOTE: The screw with the smaller diameter head should be fitted closest to the camshaft gear.**



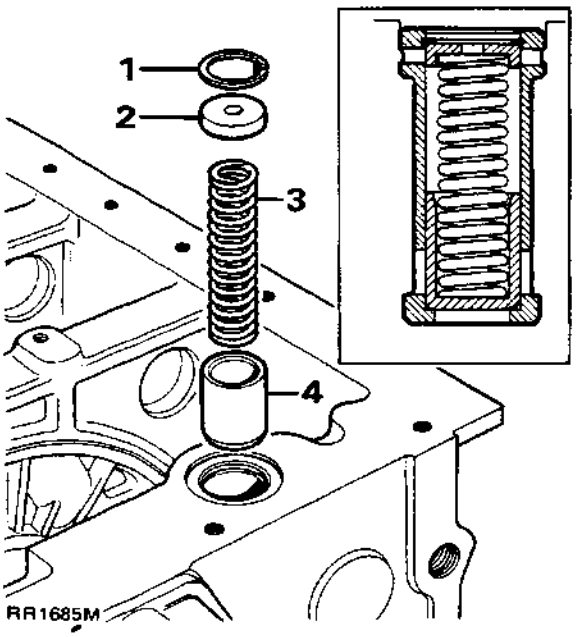
4. Refit the camshaft and align the gears so that the single dot on the camshaft gear is between the two dots on the vacuum pump gear, as illustrated. Fit and tighten the two camshaft retaining screws.

5. Fit the oil pump assembly and secure with the three socket headed screws tightening evenly to the correct torque ***27Nm***



Fitting oil pressure relief valve

1. Clean the valve seating in the crankcase and fit the relief valve, spring and cap and secure with the circlip using 18G 257 or suitable alternative pliers.



1. Circlip
2. Cap
3. Spring
4. Plunger

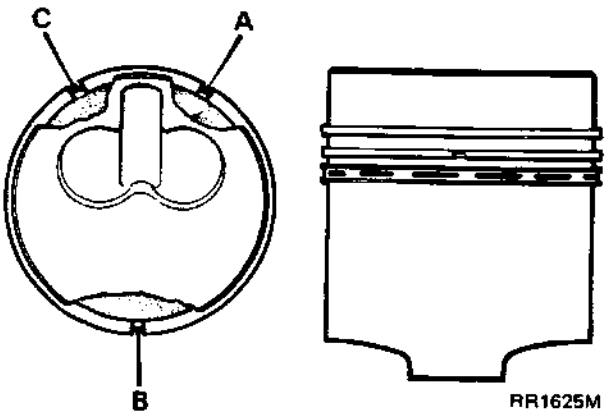
Fitting connecting rods and pistons

1. If the original pistons and connecting rods are being refitted ensure that they are returned to their original locations.
2. Turn the cylinder block over to an upright position.
3. Turn the crankshaft to bring numbers one and four crankpins to the B.D.C position.
4. Stagger the piston ring gaps as follows :-

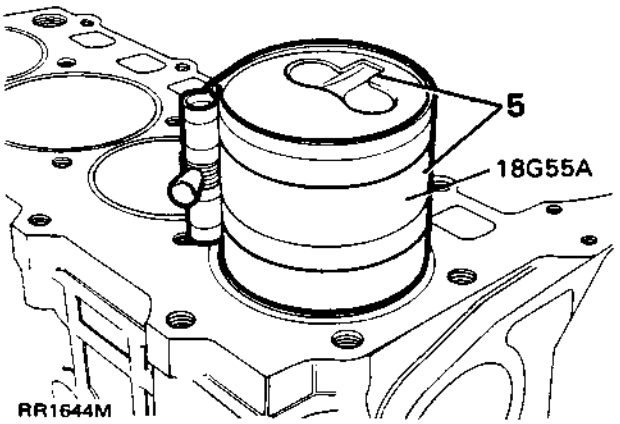
   A Compression ring gap 30° to the right of the combustion chamber recess.

   B Scraper ring gap on the opposite side of the combustion chamber recess.

   C Oil control rings gap 30° to the left of the combustion chamber recess.



5. Check that the recess area in the piston crown is on the same side as the figures on the connecting rod. Fit the connecting rod bearing shells. Using piston ring compressor 18G 55A or a suitable alternative, insert number one and number four pistons into the cylinder bores ensuring that the recess area in the piston crown is toward the camshaft side of the engine. Tap the pistons into position in the bores.



6. Turn the cylinder block over and fit the connecting rod caps so that the figures are on the same side. Apply 'Molyguard' to the threads of the NEW bolts and tighten to the correct torque.
7. Repeat the above instructions to fit number two and three pistons.

Fitting oil strainer and sump.

1. Fit a new 'O' ring seal to the oil pick-up pipe and insert into the crankcase. Secure the strainer end of the pipe to the crankcase with two bolts. See items 42 and 43 on illustration of engine internal components.
2. Clean the sump and crankcase mating faces and apply 'Loctite 518' to both surfaces. Secure the sump with the twenty-one bolts tightening evenly to the correct torque.

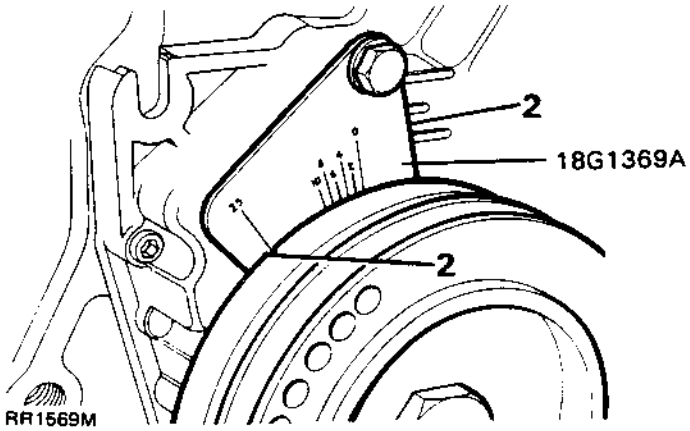
Fitting cylinder heads.

1. The fitting of the cylinder heads requires a precise sequence of instructions to be carried out. It includes - checking cylinder liner protrusion - selecting head gasket thickness and tightening the head bolts in the correct order.

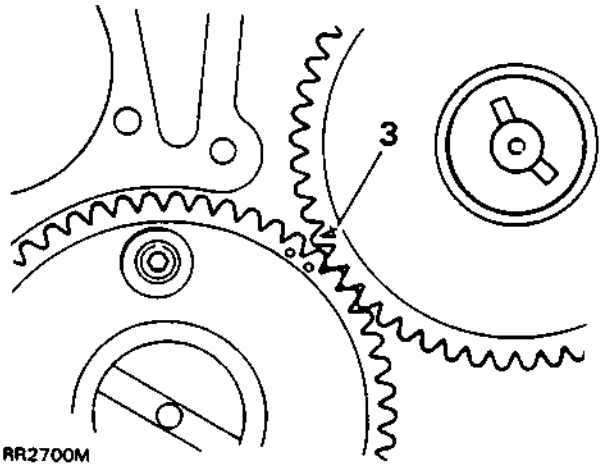
   For these details. ***See Repair, Cylinder heads***

Fitting and timing fuel injector pump.

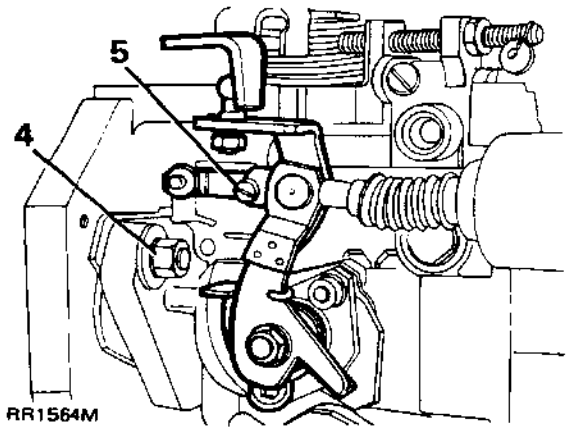
1. Temporarily fit the timing cover and crankshaft pulley and turn the crankshaft until the T.D.C. mark on the cover aligns with the groove in the crankshaft pulley so that number one piston is at T.D.C. on the compression stroke, with number four valves 'rocking'.
2. Attach the special timing gauge 18G 1369A to the timing cover and turn the crankshaft anti-clockwise until the pulley groove aligns with the 25° B.T.D.C. mark on the scale.

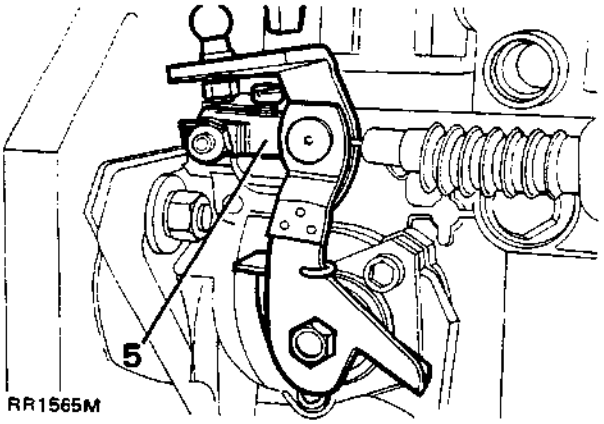


3. Remove the pulley and timing cover and mesh the injection pump and camshaft gears so the tooth marked '4' is offset from the two camshaft teeth marked with dots, also the two keyways positioned exactly as illustrated.

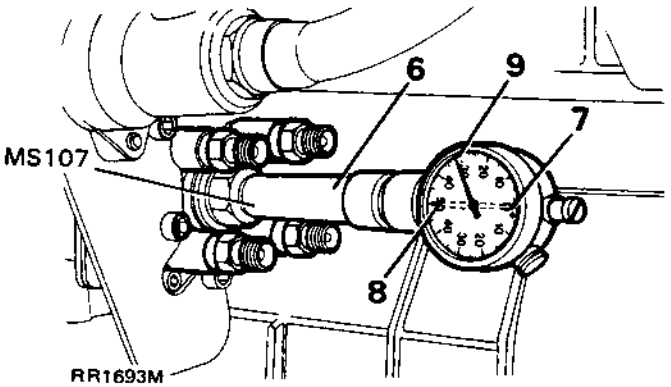


4. Whilst holding the gear in this position fit the injection pump with a new joint washer ensure the key on the shaft is at the 11 o'clock position viewed from front of engine. Secure the three nuts, finger tight only. Fully tighten the injection pump gear retaining nut to the correct torque.
5. Release the screw on the cold start cable and turn the trunnion 90° until the lever is fully released.





6. Fit the special tool MS107 and dial test indicator to the rear of the pump.

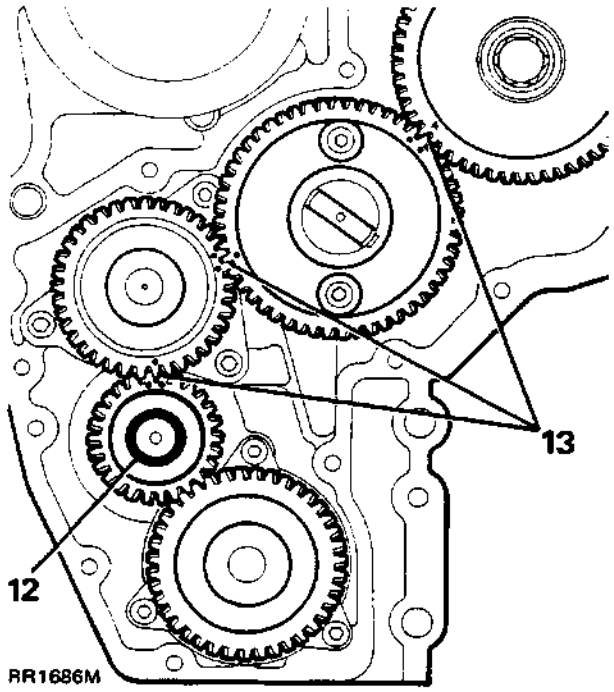


7. Fit the timing cover and scale and crankshaft pulley and turn the crankshaft to T.D.C. Then turn crankshaft anti-clockwise until the indicator needle stops and zero the indicator. The groove on the pulley should now be approximately aligned with the 25° B.T.D.C. mark.
8. Turn the crankshaft clockwise so that the pulley groove is aligned with the 3° B.T.D.C. mark. Turn the injector pump body, clockwise or anti-clockwise as necessary until the indicator reads 50 (0,5 mm).
9. Tighten the pump body retaining nuts and turn crankshaft to T.D.C. and check that the dial reads 68 (0,68 mm)

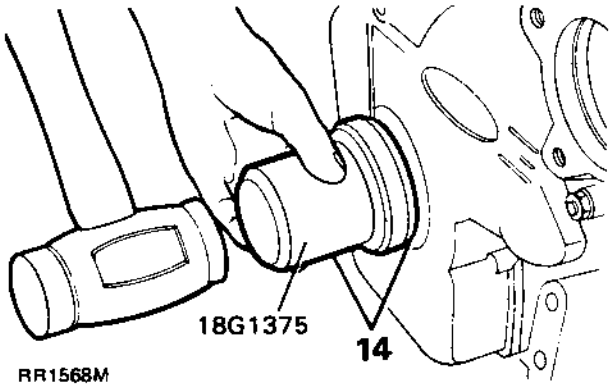
10. Move the cold start lever rearward to the normal running position prior to instruction 5, and tighten the screw. **See Maintenance Section 10** for cold start adjustment.
11. Turn the crankshaft until the T.D.C. mark on the cover or timing gauge aligns with the pulley groove.
12. Remove the pulley and timing cover and fit a new joint washer and 'O' ring seal to the crankshaft.

△ **NOTE: Hylosil RTV is used in place of a joint washer on 2.5 Litre engines.**

13. At the same time check that the timing marks on the gear train all align, as illustration.



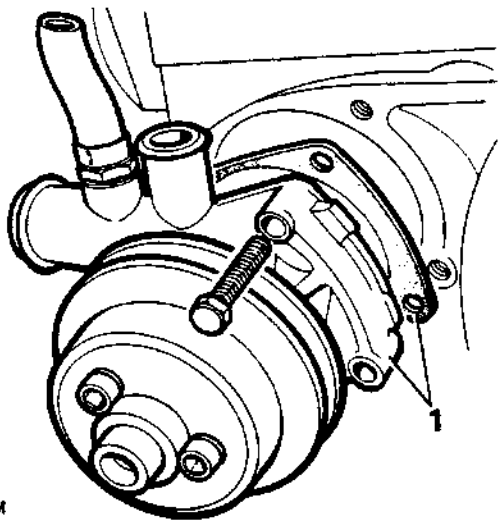
14. Fit the timing cover and secure with the twelve socket-headed screws and one bolt and tighten evenly to the correct torque. Using special tool 18G 1375 drive in a new timing cover seal, cavity side leading.



15. Fit the pump drive gear cover plate using a new 'O' ring seal. Secure with the four bolts and tighten evenly.
16. Fit the crankshaft pulley and tighten the nut to the correct torque.

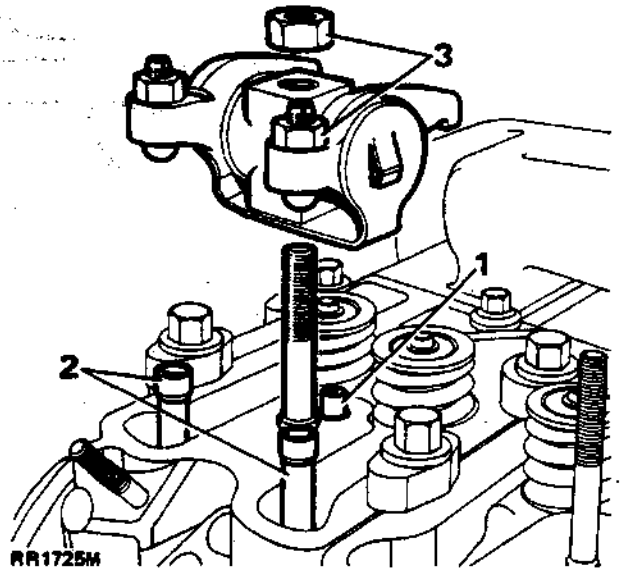
Fitting water pump

1. Using a new joint washer fit the water pump and pulley assembly and secure with the four bolts, tightening evenly to the correct torque.

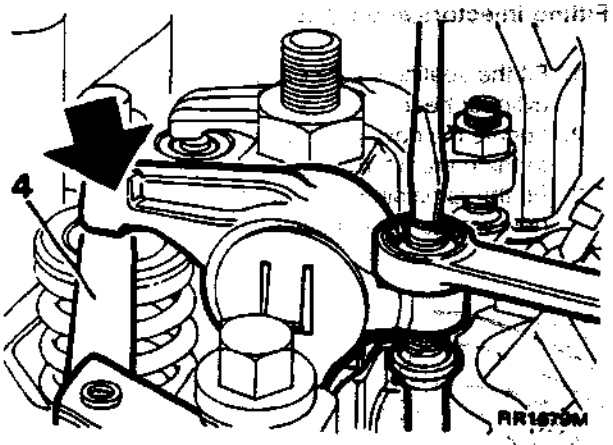


Fitting valve rocker assemblies

1. Check that the oil feed dowels are in position in each cylinder head.
2. Fit the push rods ensuring that the ball-end locates correctly in the cam follower cup.
3. Slacken-off the tappet adjusting screws. Fit the valve rocker assemblies to the cylinder head over the oil feed dowels and locate the tappet adjusting screws in the push rod cups. Secure with the single nut and tighten to the correct torque.



4. Adjust the inlet and exhaust valve tappet clearances to 0,30 mm (0.012 in) in the following manner and sequence. The feeler gauge should be a sliding fit between the rocker and valve tip. Slacken the rocker adjusting screw locknut and turn the screw clockwise to decrease or anti-clockwise to increase the clearance. When correct hold the screw against rotation and tighten the locknut. Two sequences to adjust the clearances may be used.



Sequence A

With No.1 valve fully open adjust No.7 valve.
With No.8 valve fully open adjust No.2 valve.
With No.5 valve fully open adjust No.3 valve.
With No.4 valve fully open adjust No.6 valve.
With No.7 valve fully open adjust No.1 valve.
With No.2 valve fully open adjust No.8 valve.
With No.3 valve fully open adjust No.5 valve.
With No.6 valve fully open adjust No.4 valve.

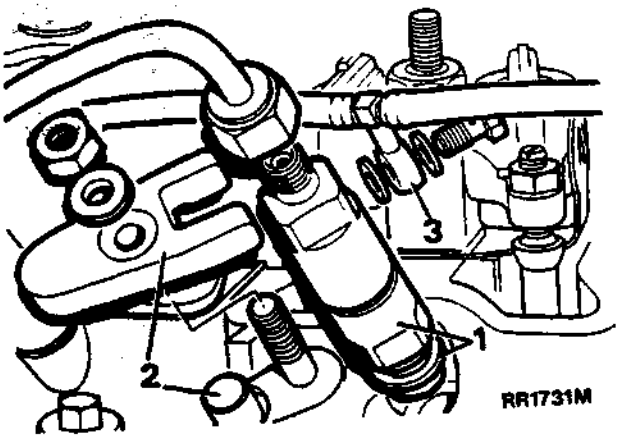
Sequence B

Rotate the crankshaft until the valves of number four cylinder are rocking then adjust the clearance of number one valve. Adjust the remaining valve clearances in the following order:-

Adjust:-
Valves of No. 3 cyl with No. 2 valves rocking
Valves of No. 4 cyl with No. 1 valves rocking
Valves of No. 2 cyl with No. 3 valves rocking

Fitting injectors and pipes

1. Fit the sealing washer and the injector to the cylinder head.
2. Locate the dowel and clamp and tighten the nut to the correct torque.
3. Fit the remaining injectors and spill rail using a new washer both sides of the banjo unions.



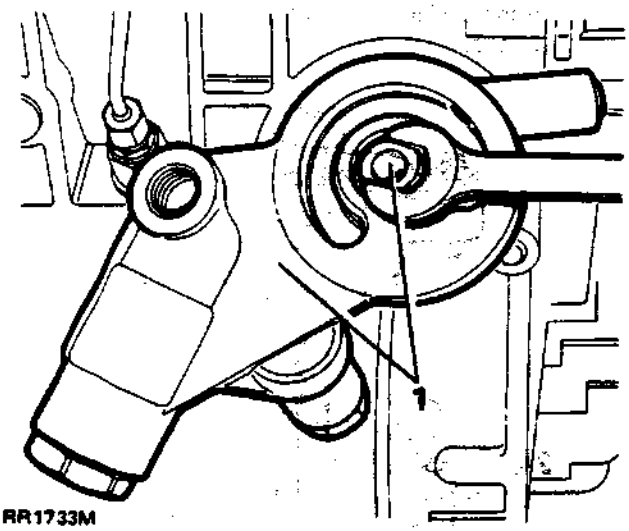
4. Fit the heater plugs and three connecting terminal bars.
5. Fit the supply pipes to the injectors and injector pump. Do not overtighten the union nuts.

Fit rocker covers and coolant rail

1. Using new gaskets fit the rocker covers noting that the tallest covers are fitted to numbers two and three cylinders and the oil filler cap to number one cylinder. Tighten the special nuts to the correct torque.
2. Fit the engine coolant rail complete with thermostat housing to the cylinder heads using new gaskets. Tighten the eight bolts evenly to the correct torque.
3. Fit the water hose from the injector pump cold start device to number three cylinder head rocker cover and the hose from the thermostat housing to cold start device.
4. Fit the by-pass hose between thermostat housing and and water pump.

Fit oil filter adaptor

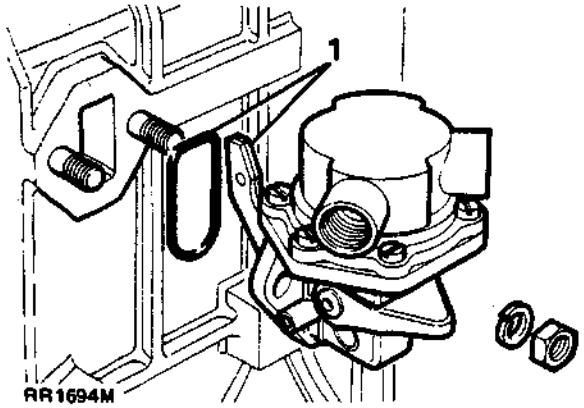
1. Fit the oil filter adaptor, using a new 'O' ring seal, to the cylinder block. Ensure that the adaptor is fitted, as illustrated, with the elongated cavity on the side facing the cylinder block at the bottom. Secure with the union screw to the correct torque.



2. Smear the oil filter canister seal with clean engine oil and screw the canister on to the adaptor until contact then turn a further half turn by hand only. **See maintenance Section 10.**
3. Connect the oil feed pipe to the front main bearing carrier adaptor union and the banjo hose end to the vacuum pump.

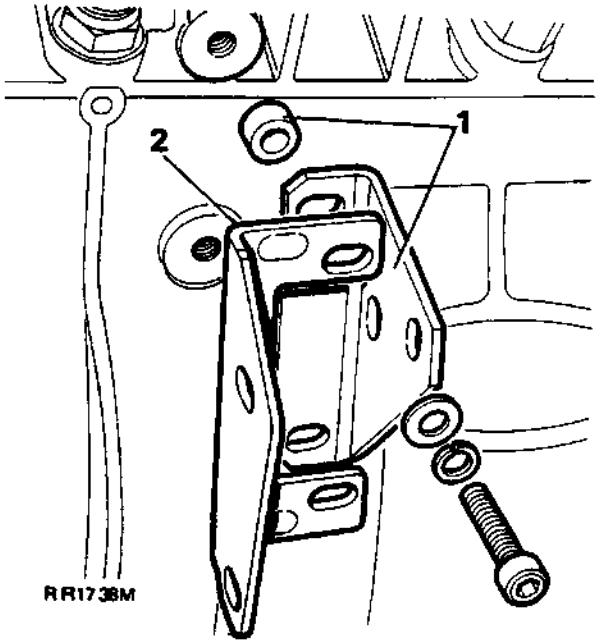
Fit fuel lift pump

1. Using a new gasket fit the fuel lift pump to the cylinder block. Ensure that the actuating lever rides on top of the cam.

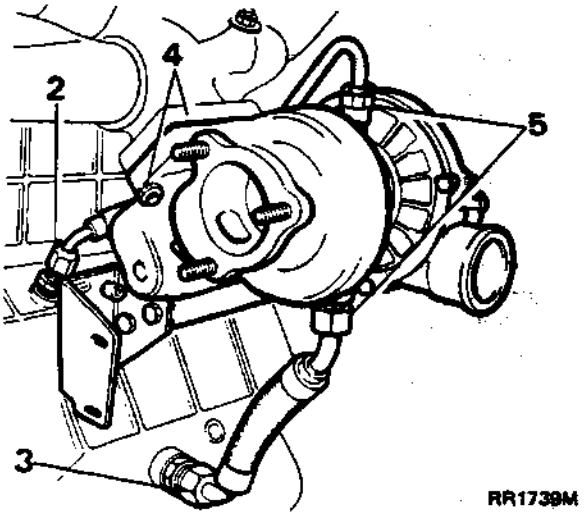


Fit the turbocharger

1. Fit the turbocharger support bracket to the cylinder block attachment bracket.
2. Also fit the starter motor heat shield rear support bracket which shares a common fixing point on the cylinder block.



3. Fit the oil feed hose to the centre union on the cylinder block.
4. Fit the oil return hose to the crankcase union.
5. Fit a new gasket to the exhaust manifold and fit the turbo-charger and tighten the four nuts evenly to the correct torque.
6. Connect the oil feed and oil return pipes to the turbocharger.



7. Fit the heat shield to the exhaust manifold.

Fit power steering pump

1. Fit the power steering pump and support bracket to the engine and fit the drive belt. Adjust the drive belt tension.

Fit the alternator

1. Right hand steer vehicles have the alternator mounted on the left side of the engine. On left hand steer vehicles the alternator is mounted on the right hand side.
2. Fit the alternator and drive belt. Adjust the belt tension.

Fit the air conditioning compressor

1. Fit the mounting bracket to the cylinder block and attach the compressor, noting that on R.H.S. vehicles the compressor and alternator share a common pivot bolt. Fit and tension the drive belt.

Fitting starter motor

1. Fit the starter motor to the flywheel housing and secure with either two bolts or two nuts. Also attach the heat shield to the lower fixing, together with the earth strap.
2. Secure the rear-end of the starter motor to the rear support bracket, fitted earlier, with two bolts and attach the rear of the heat shield to the top bolt.

Fitting clutch

1. Clean the flywheel and clutch assembly faces.
2. Place the clutch centre friction plate in position on the flywheel with the flat side towards the flywheel.
3. Fit the clutch assembly and loosely secure with the six bolts.
4. Centralise the centre plate using special tool 18G 79 or a spare primary shaft and tighten the six bolts evenly to the correct torque.
5. Smear the splines of the centre plate with a Molybdenum disulphide grease.

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

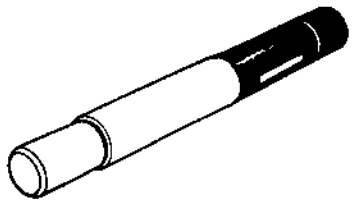
	Nm
ENGINE	
Camshaft screws	24
Connecting rod bolts	81 *
Crankshaft pulley nut	152
Cylinder head bolts, SEE SPECIAL PROCEDURE	
Cylinder head oil pipe unions	8
Engine coolant rail bolts	8
Engine mountings	49
Engine sump bolts	11
Engine sump pan bolts	11
Exhaust manifold nuts	32
Exhaust pipe flange bolts	27
Flywheel bolts	108
Flywheel housing bolts	49
Fuel line unions	19
Heater plugs	23
Injection pump mounting nut	31
Injection pump gear nut	88
Injector nut	27
Inlet manifold nuts	32
Main bearing carrier bolts	42
Oil drain plugs	79
Oil filter base	38
Oil pump screws	27
Oil thermostat	74
Rear main bearing carrier nuts	27
Rocker cover nuts	9
Rocker shaft pedestal nuts	108 *
Timing cover screws	12
Turbo charger to manifold nuts	26
Vacuum pump nuts	21
Vacuum pump screws 2.5 Litre Engine	28
Valve gear oil pipe unions	8
Water pump screws	24
ELECTRICAL	
Alternator tie rod	49
Alternator bracket to crankcase	54
Alternator pulley nut	54
Alternator bottom fixing	54
Starter motor to flywheel housing	68

* Apply Molyguard to threads before fitting.

Notes

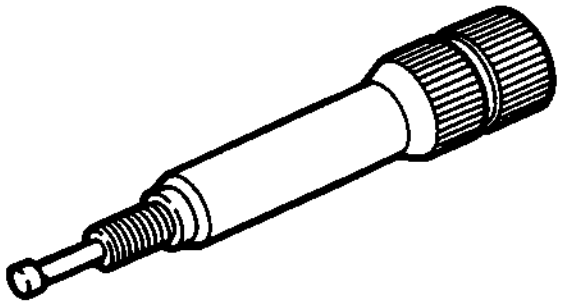
VM SERVICE TOOLS

LRT-12-001 Clutch centralising tool
18G 79



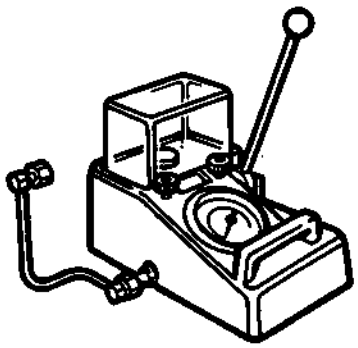
18G79

LRT-12-004 Adaptor timing injector fuel pump
MS 107



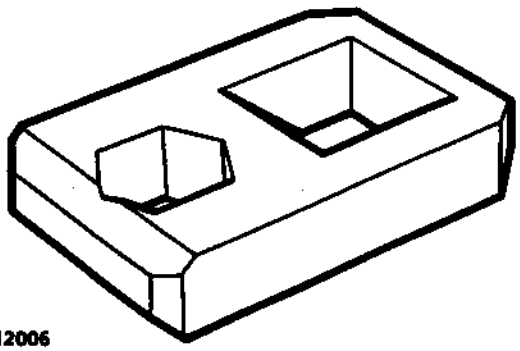
MS107

LRT-12-005 Injector tester
LST 111



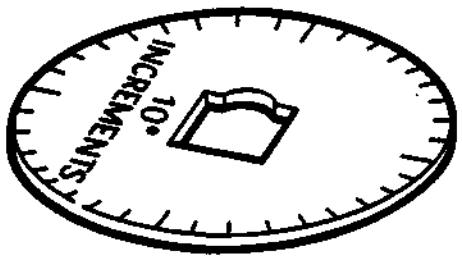
LRT12005

LRT-12-006 Adaptor cylinder head bolts
LST 121



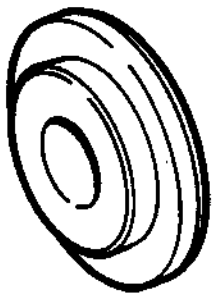
LRT12006

LRT-12-007 Angle gauge
LST 122



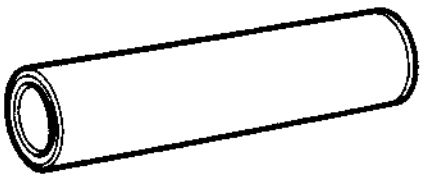
LST122

LRT-12-008 Replacer - crankshaft rear oil seal
18G 134 -11



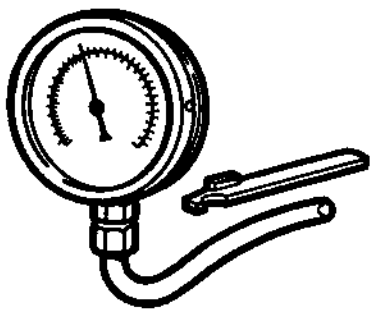
18G1374

LRT-12-009 Adaptor turbocharger spindle
LST 191-1

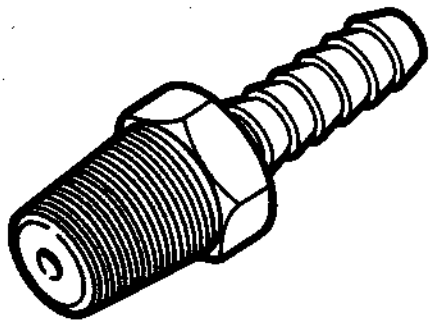


LST104

LRT-12-011 Gauge - turbo boost pressure check
18G 1116

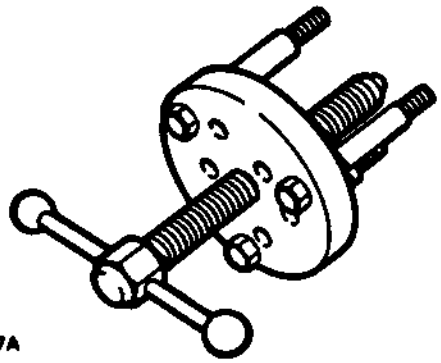


18G1116



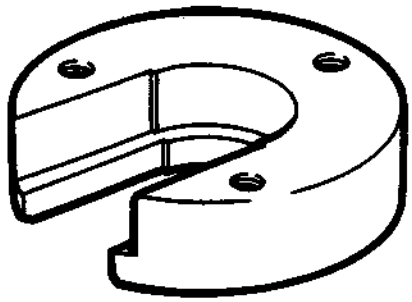
18G11161

LRT-12-012 Adaptor pressure test waste gate valve
18G 1116-1



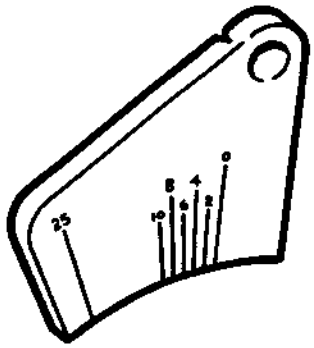
18G1367A

LRT-12-016 Remover crankshaft pulley
18G 1367



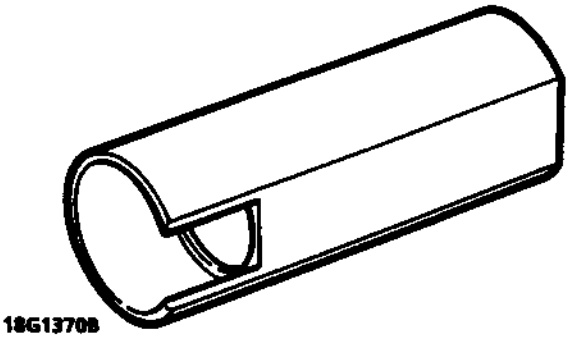
18G13671A

LRT-12-017 Adaptor crankshaft gear remover
18G 1367-1



18G1369A

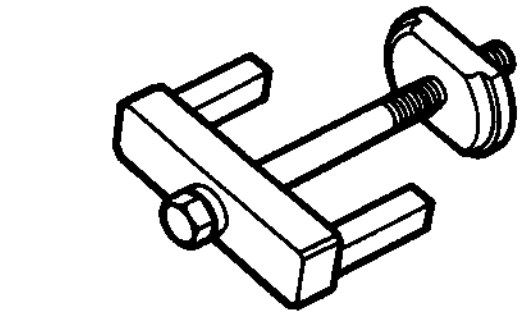
LRT-12-019 Timing gauge
18G 1369A



18G1370B

LRT-12-020
18G 1370B

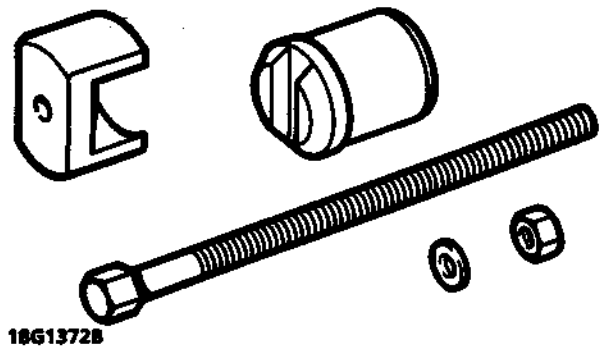
Remover replacer sleeve crankshaft



18G1371

LRT-12-021
18G 1371

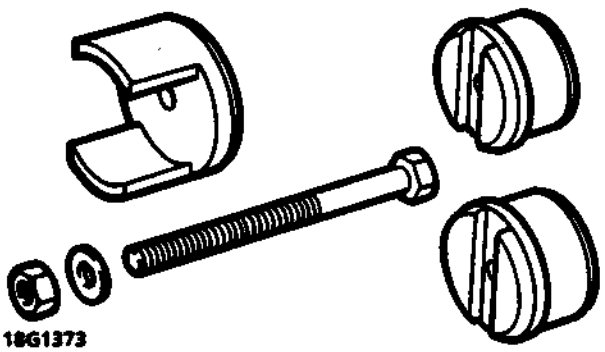
Remover cylinder liner



18G1372B

LRT-12-022
18G 1372B

Remover replacer camshaft bearings

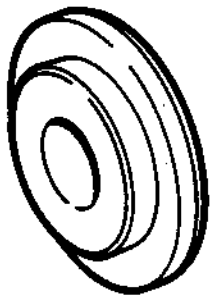


18G1373

LRT-12-023
18G 1373

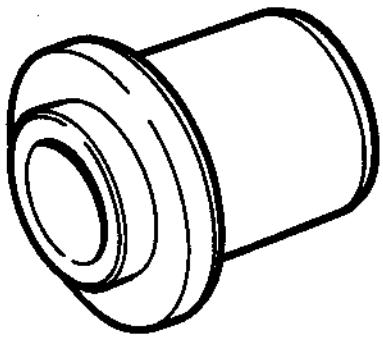
Remover replacer front and rear crankshaft bearings

LRT-12-024 Replacer crankshaft rear oil seal
18G 1374



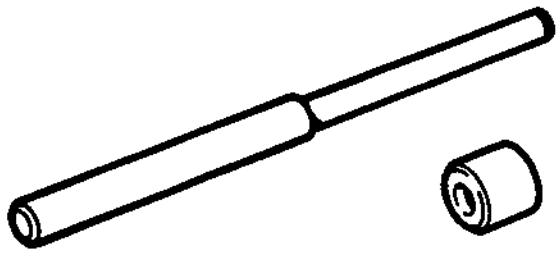
18G1374

LRT-12-025 Replacer timing cover oil seal
18G 1375



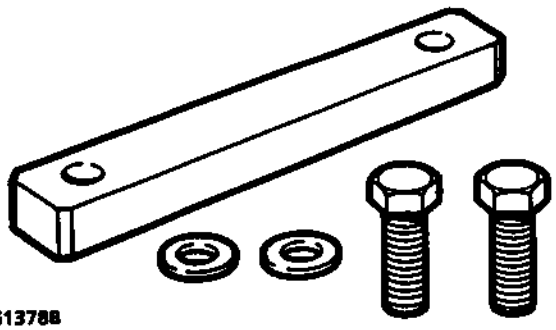
18G1375

LRT-12-026 Remover replacer valve guide
18G 1377

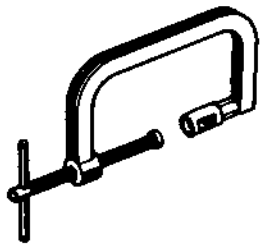


18G1377

LRT-12-027 Retainer cylinder liner
18G 1378B

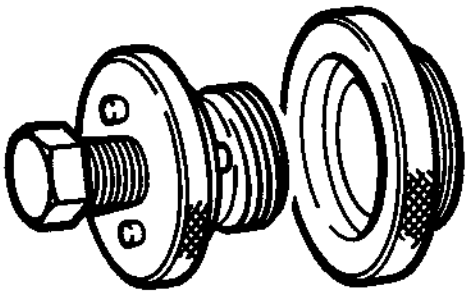


18G1378B



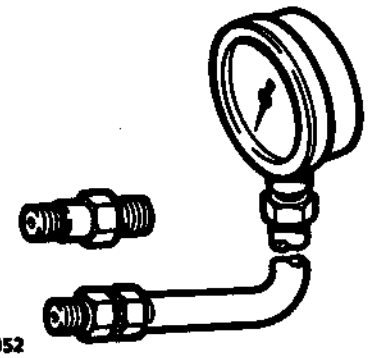
MS1519A

LRT-12-034 Valve spring compressor
MS 1519A



LST139

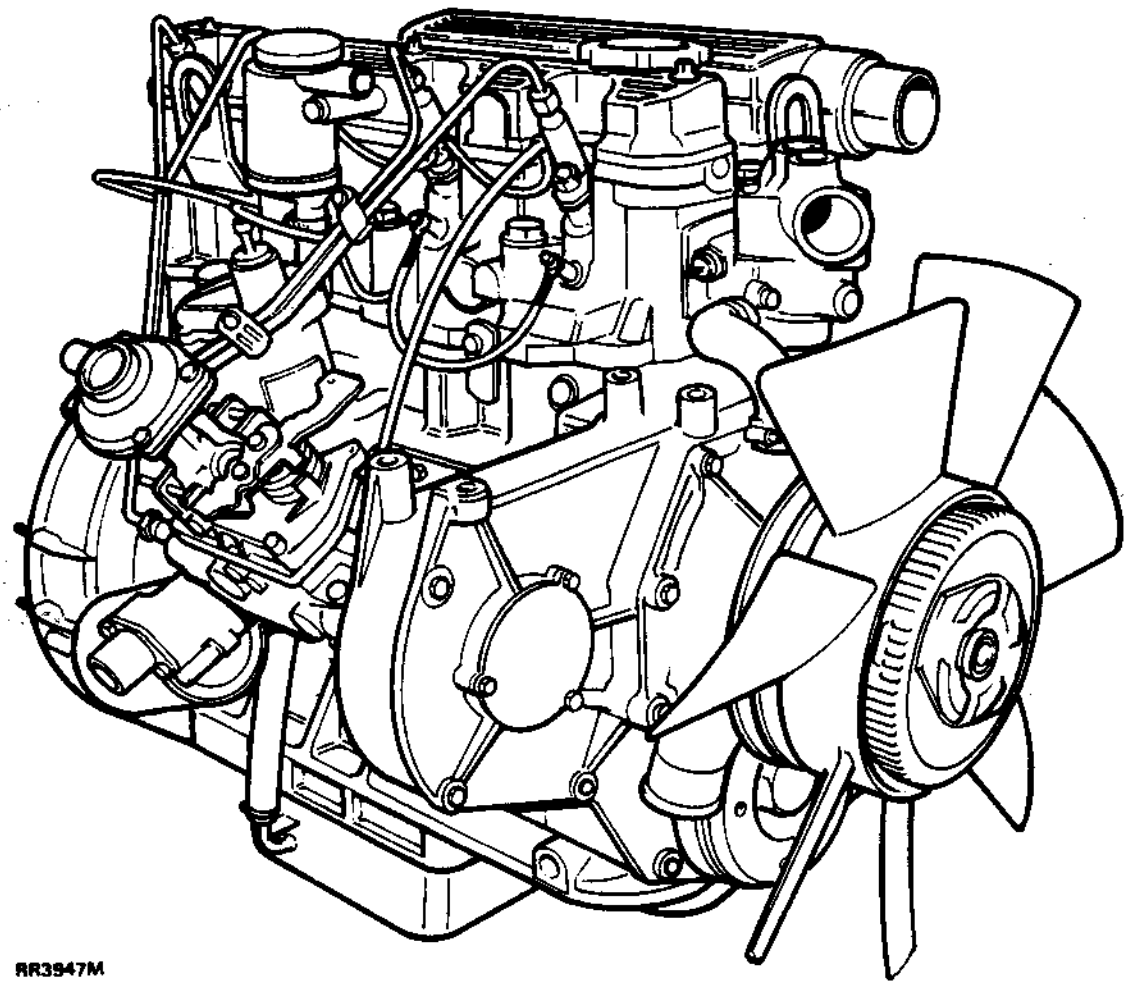
LRT-12-050 Remover and holder injection pumpdrive gear
LST 139



LRT12052

LRT-12-052 Engine oil pressure test equipment

DESCRIPTION



RR3947M

200 Tdi engine

The four cylinder turbocharged direct injection engine is an optional power unit for both Range Rover and Discovery.

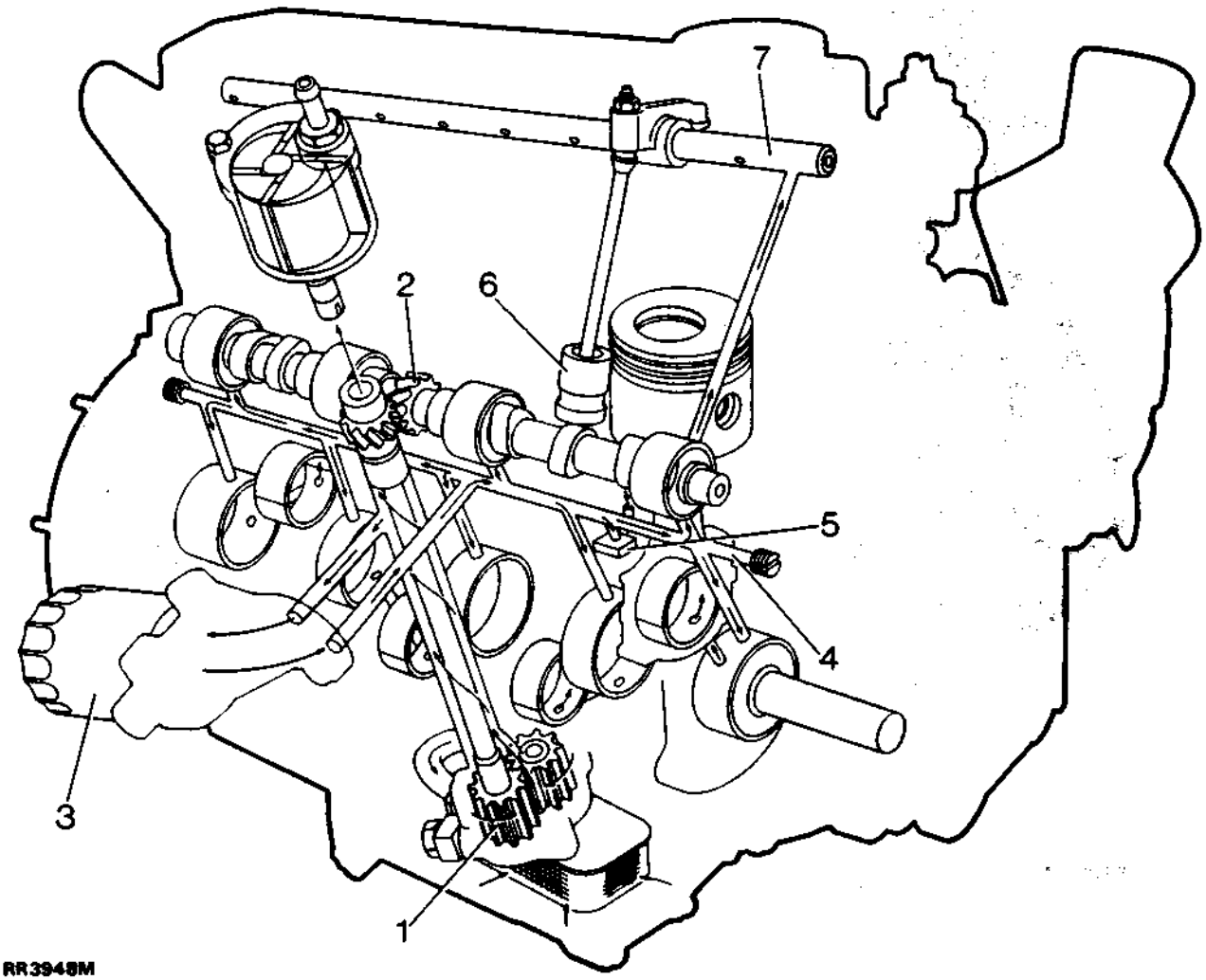
The engine consists of three main castings, cylinder block, ladder frame and cylinder head. The cast iron cylinder block includes the integral cylinders, line bored main bearing locations and caps and bearing locations for support of the camshaft. The cast aluminium ladder frame is bolted to the bottom face of the cylinder block, providing additional rigidity and noise suppresion.

The cast aluminium cylinder head is secured to the cylinder block with eighteen bolts. The head gasket is selected from three different thicknesses to ensure optimum combustion efficiency and performance.

Crankshaft end float is controlled by two selective half thrust washers, one each side of the centre main bearing.

The roller tappet camshaft and fuel injection pump are driven off the front of the crankshaft by a totally enclosed toothed rubber timing belt.

Lubrication system - RR3948M



RR3948M

The lubrication system employs a submerged gear type oil pump (1) driven by the camshaft and skew gear (2). Oil drawn into the gears through the steel gauze filter is pumped up the cavity between the pump body and the vertical drive shaft to the external oil filter (3).

After passing through the filter, the oil flows through the distribution oil gallery (4) and drillings in the cylinder block to lubricate the crankshaft main and big end bearings and the camshaft bearings. The thrust side of each cylinder is lubricated direct from the distribution gallery by separate oil jet tubes (5).

Lubrication to the front camshaft bearing continues through more drillings in the cylinder block to lubricate the roller tappets (6). The rocker shaft (7) is lubricated via a vertical drilling in the cylinder head. The clearance around the pushrods and large ports in the camshaft chamber allows oil drainage to lubricate the skew gear and return to the sump.

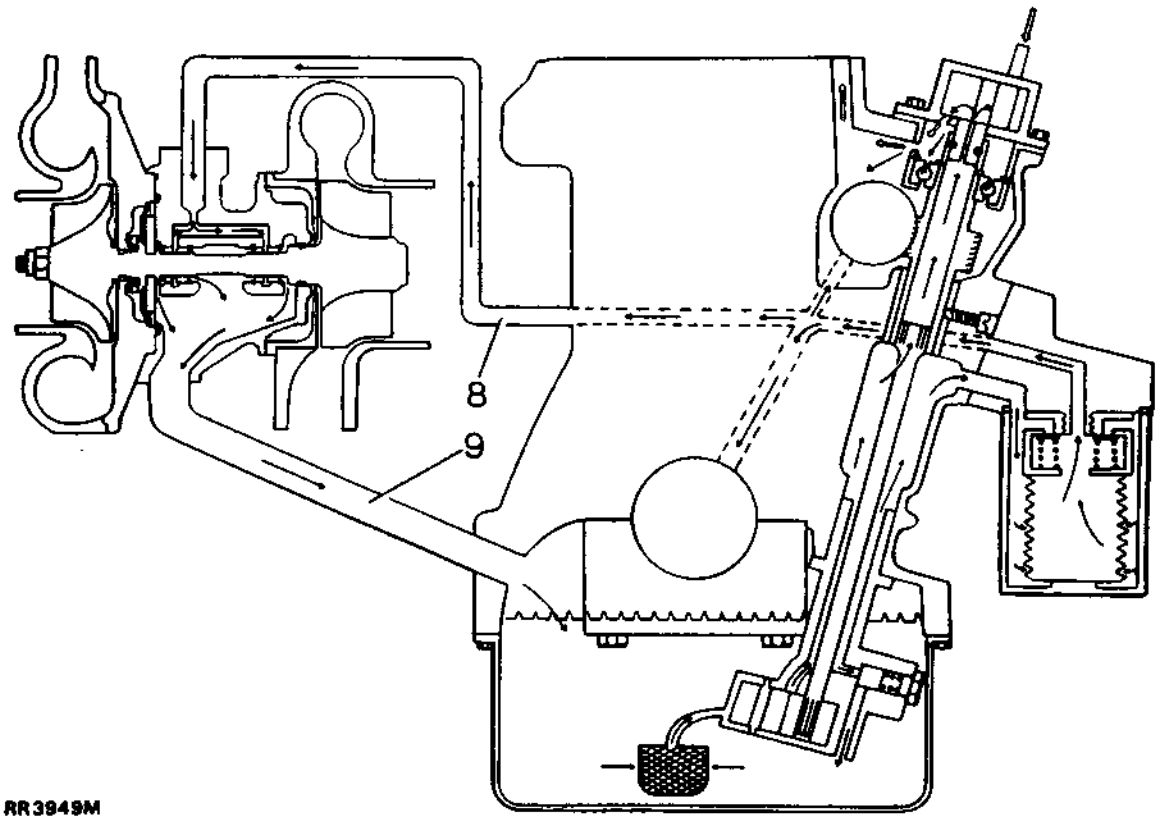
Three of the four camshaft bearing lubrication drillings in the cylinder block are drilled externally. These drillings which are visible on the right hand side of the block are blanked off by each bearing and sealed using an aluminium plug and silicon sealant.

The oil which is pumped up between the vertical drive shaft and pump body is unfilterd. This oil lubricates the skew gear bush and passes through the centre of the skew gear to lubricate the brake servo vacuum pump.

System pressure is controlled by a non adjustable pressure relief valve located in the pump body.

Turbocharger lubrication - RR3949M

The turbocharger bearings are lubricated with filtered oil from the gallery in the cylinder block (8) at pump pressure. After lubricating the bearings the oil returns to the sump via a large diameter drain hose (9). As the turbocharger bearings are subject to extremely high speeds and temperatures, it is essential that they are well sealed, cooled and lubricated.



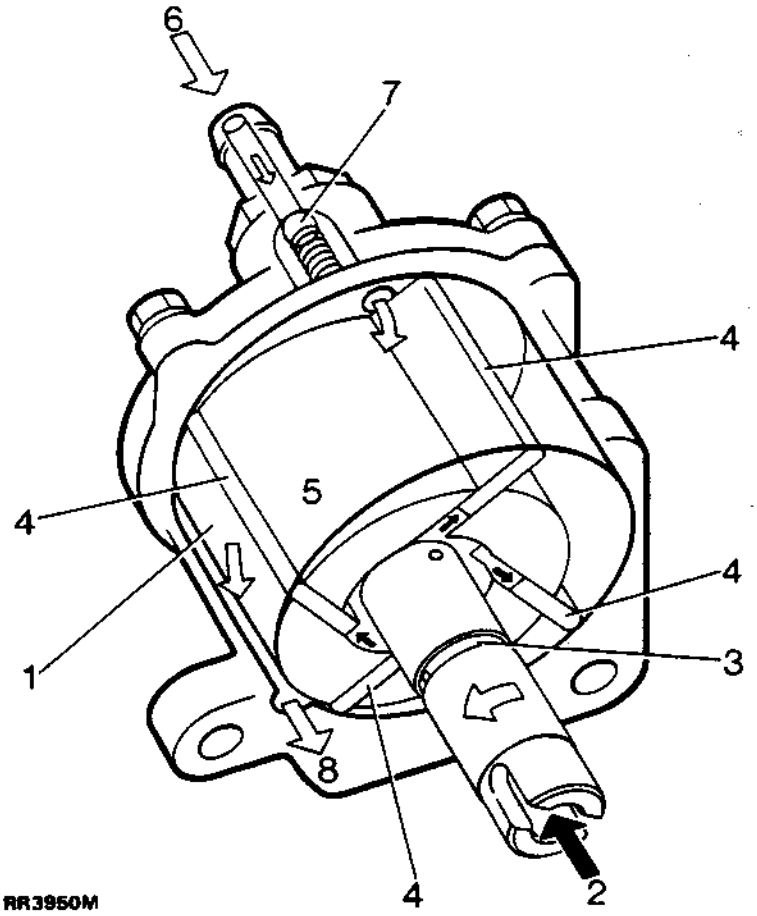
RR3949M

Brake servo vacuum pump - RR3950M

Lubrication

The brake servo vacuum pump rotor (1) is lubricated with unfiltered oil direct from the engine oil pump. Oil is supplied via the centre of the skew gear (2), where it lubricates the vacuum pump shaft (3) and is fed into slots behind each of the four carbon vanes (4).

Oil pressure behind the vanes exerts a force which ensures that they follow the contours of the pump chamber (5) to form a good seal. An 'O' ring is fitted inside the hollow skew gear to form a seal with the pump shaft to prevent pressure leakage. The condition of this 'O' ring should be checked if low oil pressure occurs, before continuing with any further diagnosis.



RR3950M

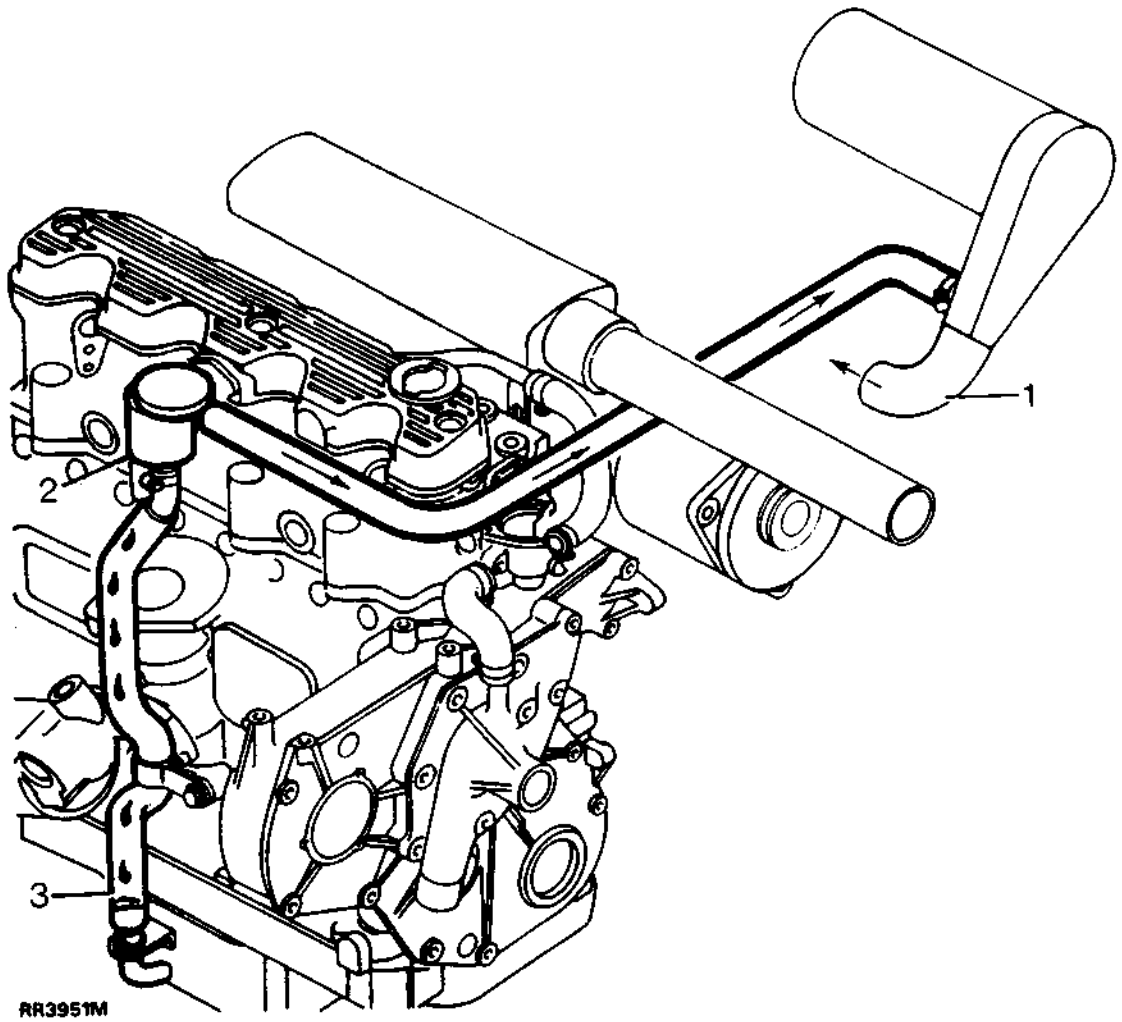
Operation

With the brake servo hose connected and the vacum pump operating, the pump will be producing a depression ready to operate the brakes. Each time the brakes are applied and released the pump will draw a small volume of air (6) from the servo chamber past valve (7) and discharge it through the pump outlet (8) into the cylinder block. Provided the vacuum pump is not pumping an excessive volume of air, the crankcase ventilation system will not be affected. However, if the engine is operated with a faulty brake servo, damaged or disconnected vacuum hose, the pump can force an uncontrolled volume of air into the crankcase ventilation system causing pressure build up.

Crankcase ventilation system - RR3951M

The crankcase ventilation system is associated with drainage of lubricant to the sump and is designed to separate the oil from the gaseous atmosphere before the residue is fed into the inlet system and burned in the combustion chamber.

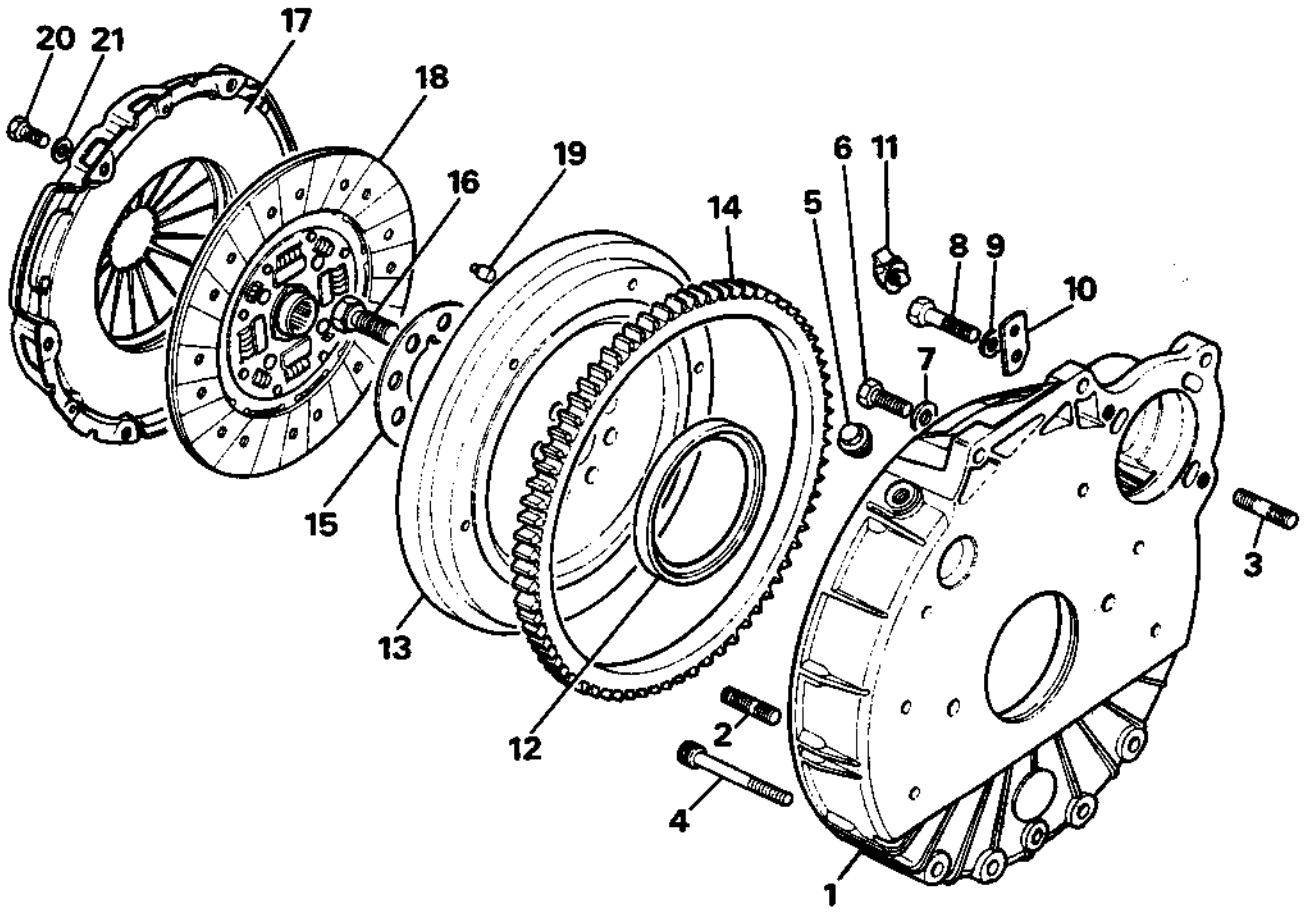
Oil laden air in the engine is drawn from the rocker cover by depression created in the air intake (1). The breather cyclone (2), fitted to the rocker cover, acts as an oil separator. It controls the rate at which air is purged from the sump and extracts the oil. The oil extracted drains back down hose (3) to the sump. The remaining air is controlled by a diaphragm valve in (2), before passing, via the turbocharger, into the engine where it is burned.



RR3951M

CLUTCH AND FLYWHEEL HOUSING COMPONENTS

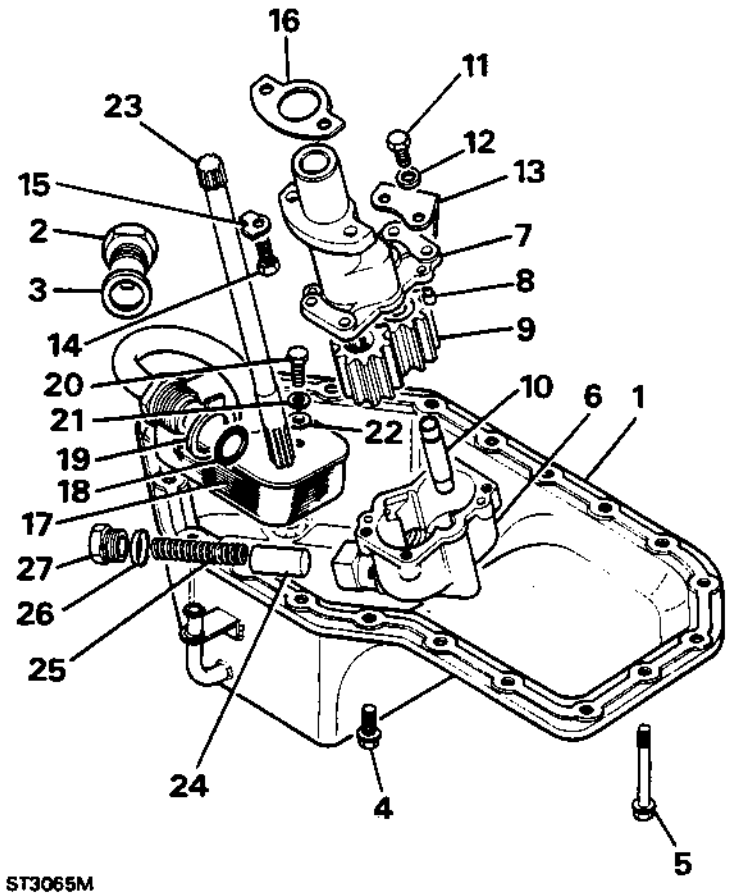
1. Clutch housing
2. Clutch housing stud (9)
3. Starter motor stud (1)
4. Allen bolts (4)
5. Plug (2)
6. Screw housing to block (6)
7. Washer (6)
8. Bolt housing to block (2)
9. Spring washer (2)
10. Bracket (2)
11. Harness clip (2)
12. Oil seal
13. Flywheel
14. Starter ring
15. Reinforcing plate
16. Bolt flywheel to crankshaft
17. Clutch cover
18. Clutch plate
19. Dowel
20. Screw
21. Spring washer



ST3086M

SUMP AND OIL PUMP COMPONENTS

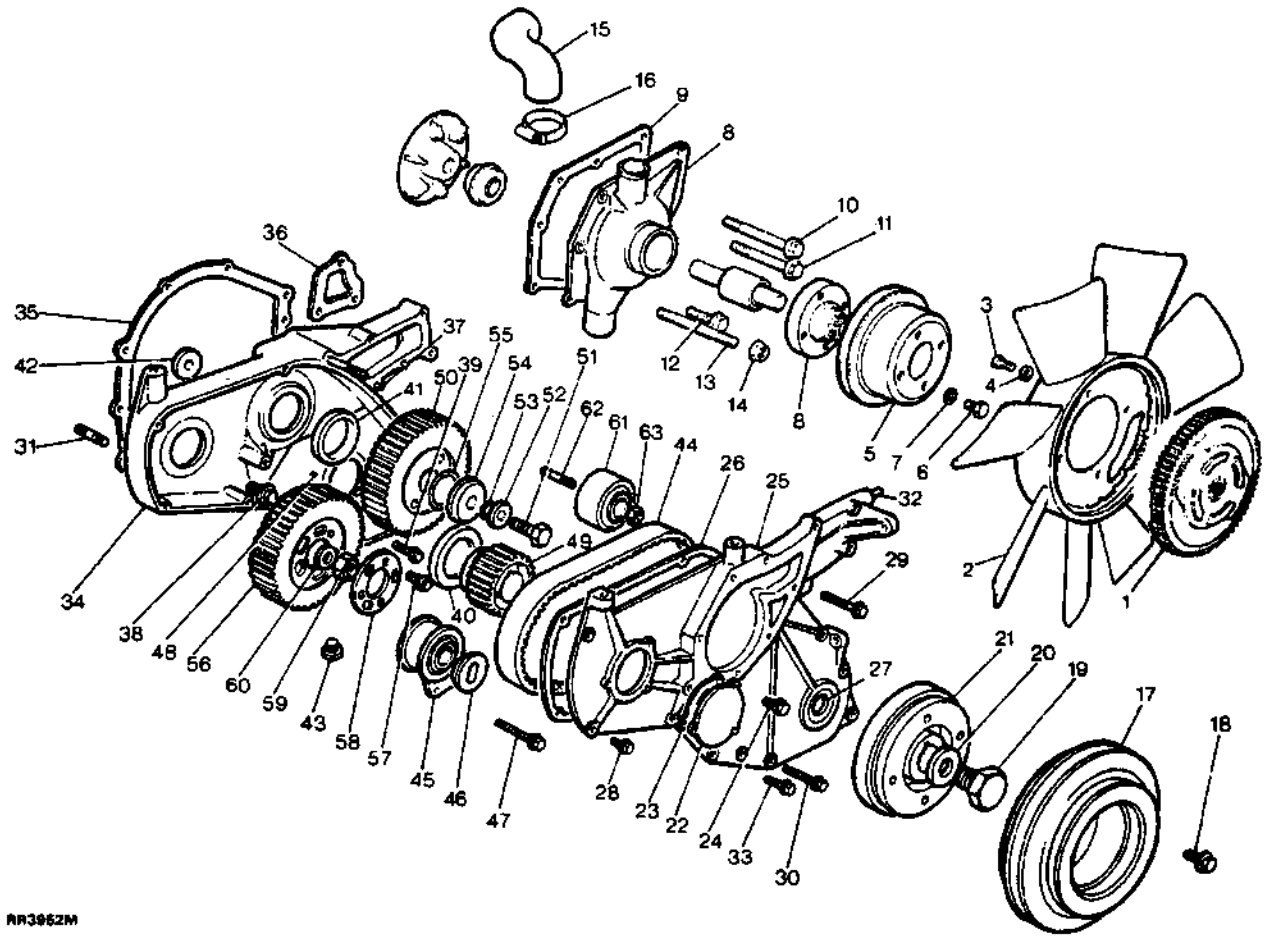
1. Sump
2. Drain plug
3. Joint washer
4. Flange bolt M8x20 (8)
5. Flange bolt M8x60 (12)
6. Oil pump housing lower
7. Oil pump housing upper
8. Dowel
9. Oil pump gears
10. Spindle
11. Screw
12. Spring washer
13. Support bracket
14. Screw
15. Lock washer
16. Gasket
17. Filter
18. 'O' ring
19. Lock washer
20. Screw
21. Spring washer
22. Plain washer
23. Drive shaft
24. Oil relief plunger
25. Spring
26. Joint washer
27. Oil relief plug



ST3065M

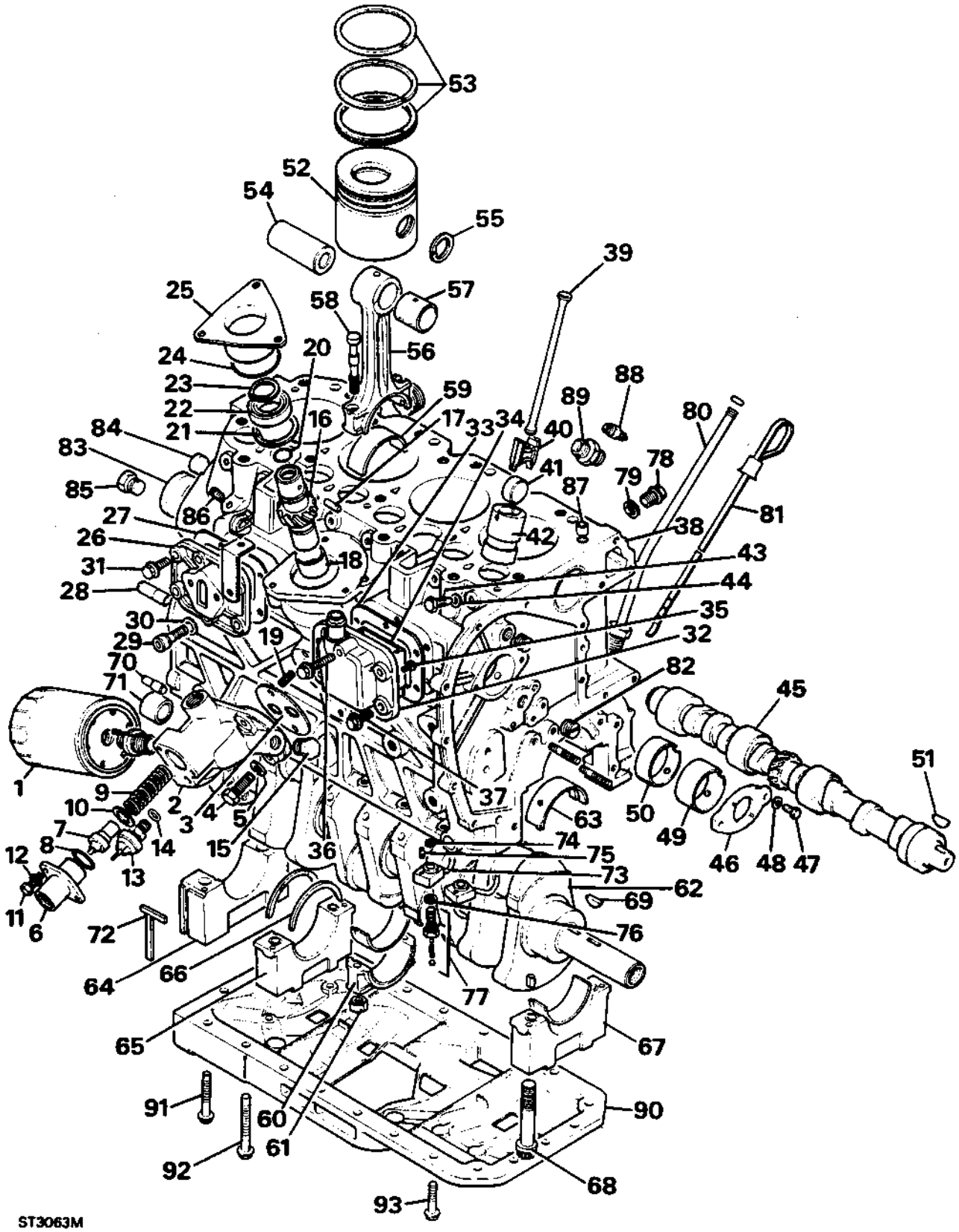
FRONT COVER COMPONENTS

1. Viscous unit
2. Fan assembly
3. Bolt (4)
4. Plain washer (4)
5. Pulley
6. Screw (3)
7. Spring washer (3)
8. Water pump assembly
9. Gasket
10. Flange bolt M8x55 (2)
11. Flange bolt M8x110 (1)
12. Flange screw M8x25 (3)
13. Stud M8x110
14. Flange nut M8
15. By-pass hose
16. Hose clip
17. Crankshaft pulley
18. Flange bolts M8x20 (4)
19. Crankshaft pulley bolt
20. Washer
21. Torsional vibration damper
22. Inspection plate
23. Gasket
24. Flange screw M6x20 (3)
25. Front cover plate
26. Gasket
27. Cover plate seal
28. Flange screw M8x25 (3)
29. Flange bolt M8x90 (2)
30. Flange bolt M8x80 (4)
31. Stud injection pump to front cover M8x92 (3)
32. Stud M8x35 (1)
33. Flange bolt M8x35
34. Front cover
35. Front cover gasket
36. Front cover/water inlet gasket
37. Front cover dowel
38. Flange screw M8x25 (1)
39. Flange bolt M8x70 (1)
40. Crankshaft oil seal
41. Camshaft oil seal
42. Gasket block front face
43. Wading plug
44. Timing belt
45. Timing belt tensioner assembly
46. Slotted washer
47. Flange bolt M10x70
48. Tensioner pivot pin
49. Crankshaft gear wheel
50. Camshaft gear wheel
51. Bolt
52. Washer
53. 'O' ring
54. Retaining plate
55. 'O' ring
56. Injection pump timing gear
57. Flange screw (3)
58. Retaining plate
59. Nut
60. Spring washer (3)
61. Idler pulley
62. Stud
63. Nut


RR395ZM

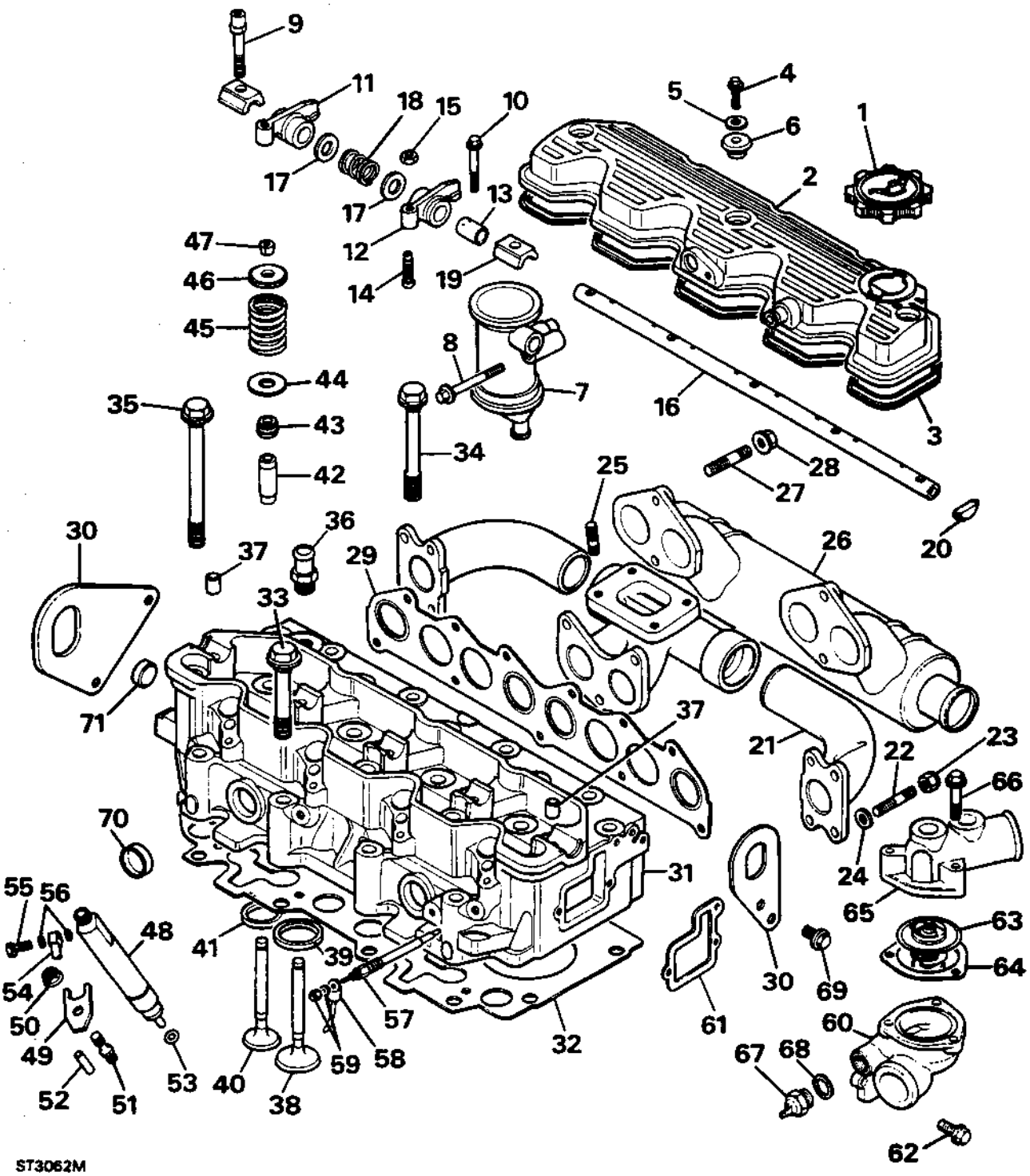
CYLINDER BLOCK COMPONENTS

1. Oil filter element
2. Oil filter adaptor
3. Gasket
4. Screw (2)
5. Spring washer (2)
6. Oil cooler adaptor
7. Thermostat bulb
8. 'O' ring
9. Spring
10. Washer
11. Screw (2)
12. Washer (2)
13. Oil pressure switch
14. Copper washer
15. Blanking plug
16. Skew gear
17. Dowel pin
18. Bush
19. Locking screw
20. 'O' ring
21. Snap ring external
22. Deep groove bearing
23. Snap ring internal
24. 'O' ring bearing housing
25. Bearing housing
26. Rear side cover
27. Gasket
28. Dowel flywheel housing (2)
29. Socket screw (2)
30. Washer (2)
31. Flange bolts (6)
32. Front side cover breather
33. Gasket
34. Baffle plate
35. Screw No.6 (2)
36. Flange bolt M8x40(1)
37. Flange screw M8x25 (5)
38. Cylinder block
39. Pushrod
40. Tappet slide
41. Roller follower
42. Tappet guide
43. Set bolt
44. Washer
45. Camshaft
46. Locking plate
47. Screw (2)
48. Spring washer (2)
49. Camshaft bearing - front
50. Camshaft bearing - inter/rear (3)
51. Camshaft key
52. Piston
53. Piston rings
54. Gudgeon pin
55. Circlip (8)
56. Connecting rod
57. Gudgeon pin bush
58. Connecting rod bolt
59. Big end bearing
60. Big end bearing cap
61. Connecting rod nut
62. Crankshaft
63. Crankshaft main bearing
64. Main bearing cap - rear
65. Main bearing cap - centre
66. Thrust washers
67. Main bearing cap (3)
68. Main bearing cap bolt
69. Crankshaft key
70. Crankshaft dowel
71. Crankshaft bush
72. Packing strip
73. Jet adaptor
74. Joint washer
75. Dowel
76. Joint washer
77. Relief valve assembly
78. Drain plug
79. Joint washer
80. Dipstick tube
81. Dipstick
82. Oil gallery plug
83. Cup plug (5)
84. Cup plug
85. Oil gallery plug
86. Camshaft oil feed plug (3)
87. Ring dowel (2)
88. Oil feed adaptor
89. Oil drain adaptor
90. Ladder frame
91. Flange bolt M8x125 (3)
92. Flange bolt M8x60 (4)
93. Flange screw M8x30 (3)


ST3063M

CYLINDER HEAD COMPONENTS

1. Oil filler cap
2. Rocker cover
3. Rocker cover gasket
4. Flange headed bolt
5. Washer
6. Sealing washer
7. Breather cyclone
8. Flange headed screw
9. Rocker shaft bolt (3)
10. Rocker shaft bolt (2)
11. Rocker arm RH
12. Rocker arm LH
13. Rocker arm bush
14. Tappet adjuster screw
15. Locknut
16. Rocker shaft
17. Rocker shaft spacer
18. Rocker shaft spring
19. Rocker shaft clamp
20. Rocker shaft seal
21. Exhaust manifold
22. Manifold stud exhaust
23. Self locking nut
24. Plain washer
25. Stud turbocharger mounting
26. Inlet manifold
27. Manifold stud inlet
28. Flange nut
29. Manifold gasket
30. Engine lifting brackets
31. Cylinder head
32. Cylinder head gasket
33. Head bolts M12 short (4)
34. Head bolts M12 long (10)
35. Head bolts M10 (4)
36. Adaptor cooling system
37. Ring dowel
38. Valve inlet
39. Valve seat insert
40. Valve exhaust
41. Valve seat insert
42. Valve guide
43. Valve steam seal
44. Valve spring seat
45. Valve spring
46. Valve spring cup
47. Split cotters
48. Injector
49. Injector clamp
50. Injector clamp nut
51. Injector clamp stud
52. Injector clamp dowel
53. Injector sealing washer
54. Spill return pipe
55. Banjo bolt 6mm
56. Copper washer
57. Glow plug
58. Glow plug cable
59. Nut and washer
60. Thermostat housing
61. Gasket
62. Flange screw (3)
63. Thermostat
64. Gasket
65. Thermostat housing cover
66. Flange bolt M6x40 (3)
67. Thermal transmitter
68. Joint washer
69. Flange bolt
70. Cup plug (1)
71. Cup plug (2)


ST3062M

Notes

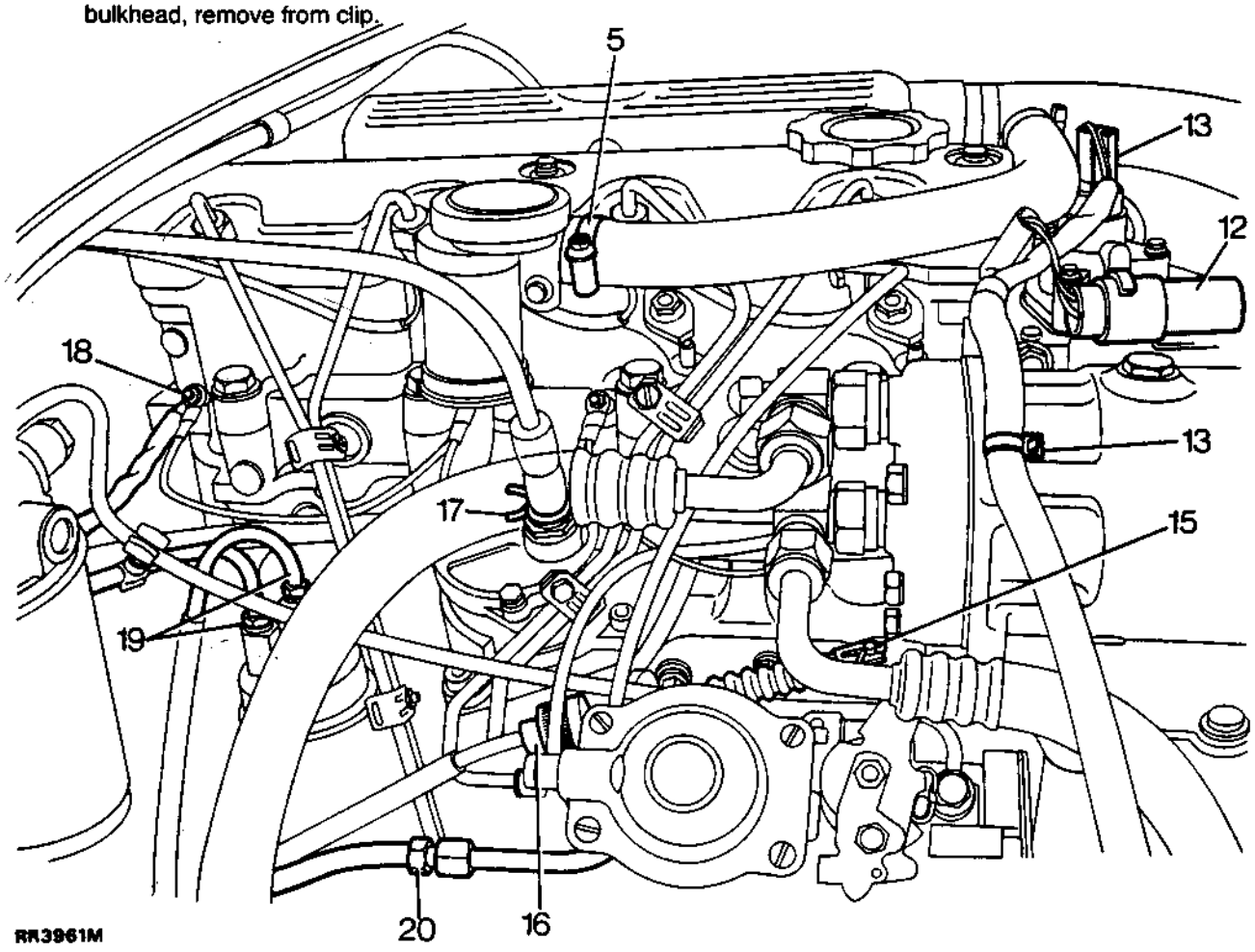
ENGINE

Service repair no - 12.41.01

Remove

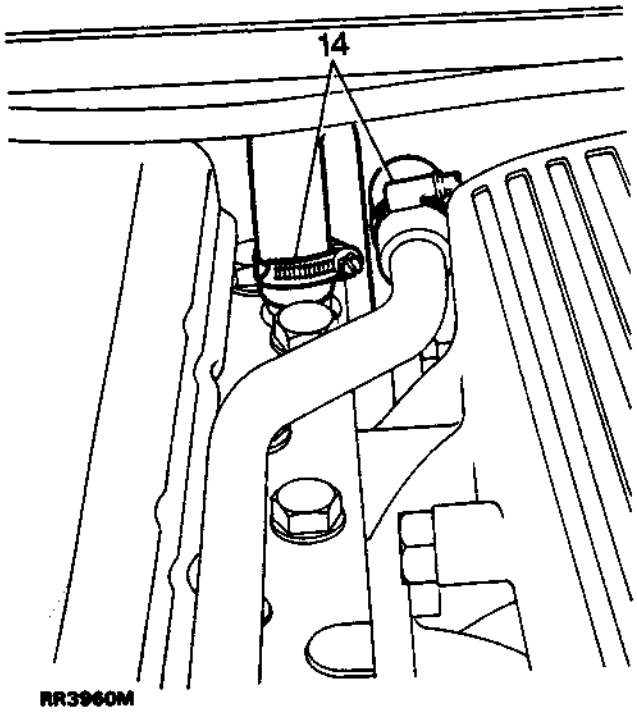
CAUTION: Seal all exposed pipe ends against ingress of dirt after disconnection.

1. Park vehicle on level ground, apply park brake.
2. Remove bonnet ***See CHASSIS AND BODY, Repair, Bonnet***
3. Remove radiator assembly, ***See COOLING SYSTEM, Repair, radiator/oil coolers***
4. Remove air cleaner hose from turbocharger.
5. Remove air cleaner hose from breather cyclone.
6. Remove power steering pump inlet and outlet hoses.
7. Disconnect engine electrical harness at bulkhead, remove from clip.
8. Disconnect positive battery lead, remove from chassis clips.
9. Discharge air conditioning system, ***See AIR CONDITIONING, Repair, Discharging system***
10. Remove high and low pressure hoses from compressor.
11. Remove hose from receiver drier unit.
12. Disconnect compressor clutch multi-plug.
13. Disconnect temperature sensor connection. Remove wiring clip from compressor.

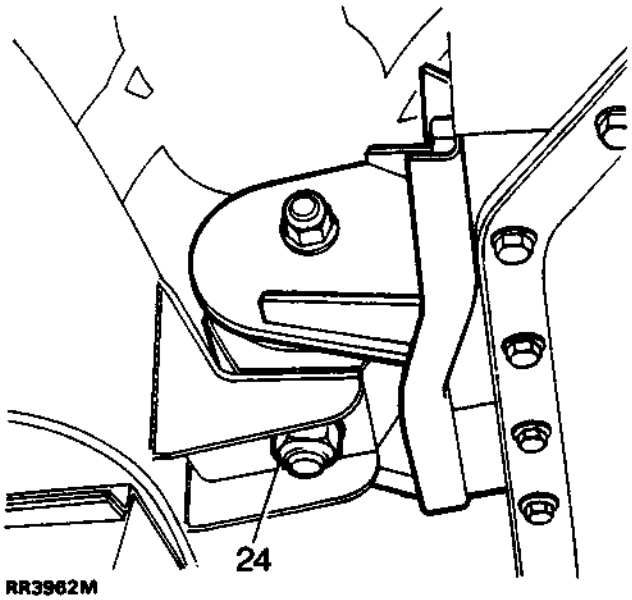


RR3961M

14. Disconnect both heater hoses at rear of engine.



15. Remove split pin securing inner throttle cable to injection pump.
16. Depress tags on outer cable adjusting nut, remove cable from bracket.
17. Disconnect pipe from vacuum pump.
18. Disconnect heater plug feed wire.
19. Remove both pipes from fuel lift pump.
20. Remove spill return pipe from injection pump.
21. Loosen clip, disconnect exhaust down pipe.
22. Remove clip securing transmission breather pipes to rear of cylinder head.
23. Remove starter motor heat shield, disconnect starter earth lead.



24. Remove nuts and plain washers securing front engine mountings to chassis.
25. Support gearbox.
26. Remove bell housing insulation.
27. Remove engine to bell housing fixings, leaving starter motor attached to engine.
28. Fit lifting chains to engine. Carefully raise engine to pull it away from transmission.
29. Ensure all connections to engine have been removed.
30. Remove engine.

Refit

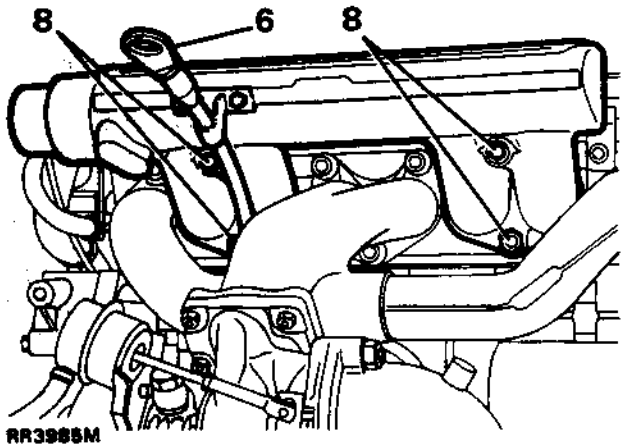
31. Clean bell housing.
32. Apply hylomar to bell housing mating face.
33. Lubricate splines of gearbox primary pinion using Rocol MV 3.
34. Raise vehicle.
35. Lower engine into position. Locate primary pinion into clutch, engage bell housing dowels.
36. Fit engine to bell housing fixings, tighten to ***40 Nm.***
37. Raise engine, refit front engine mountings to chassis.
38. Remove gearbox support, lower engine.
39. Tighten front engine mounting nuts.
40. Reverse removal procedure 1 to 24.

CYLINDER HEAD GASKET

Service repair no - 12.29.02

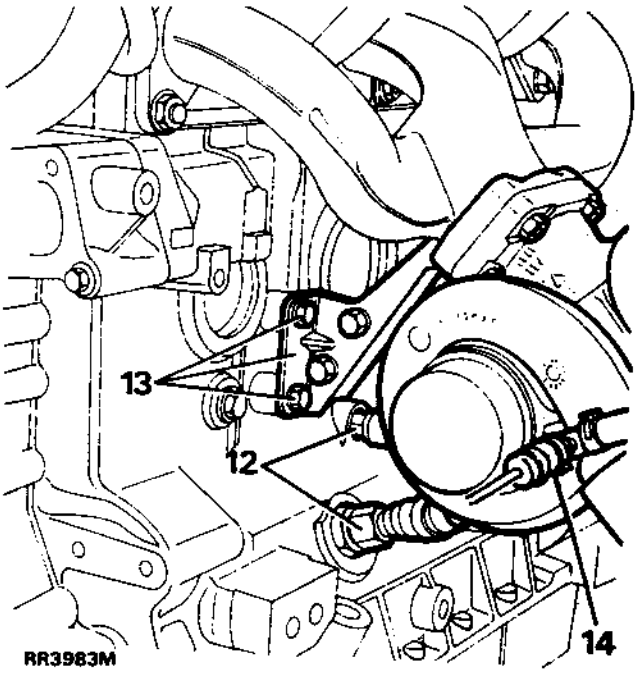
Remove

1. Disconnect the battery negative lead.
2. Drain cooling system.
3. Remove radiator top hose. ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi engine***
4. Remove intercooler hose from inlet manifold.
5. Remove turbocharger intake hose.
6. Remove dipstick.



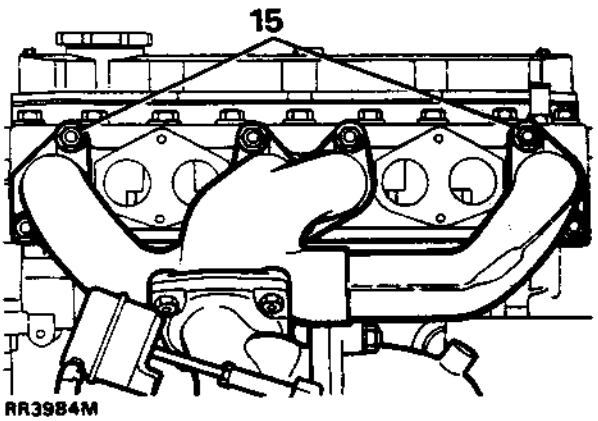
RR3988M

7. Release dipstick tube securing nut from cylinder block.
8. Remove two bolts and two nuts and remove inlet manifold with dipstick tube.
9. Disconnect heater hose and by-pass hose from thermostat housing.
10. Disconnect heater hoses from rear of cylinder head.
11. Remove two nuts securing heater rail to exhaust manifold studs.
12. Disconnect turbocharger lubrication hoses from block.



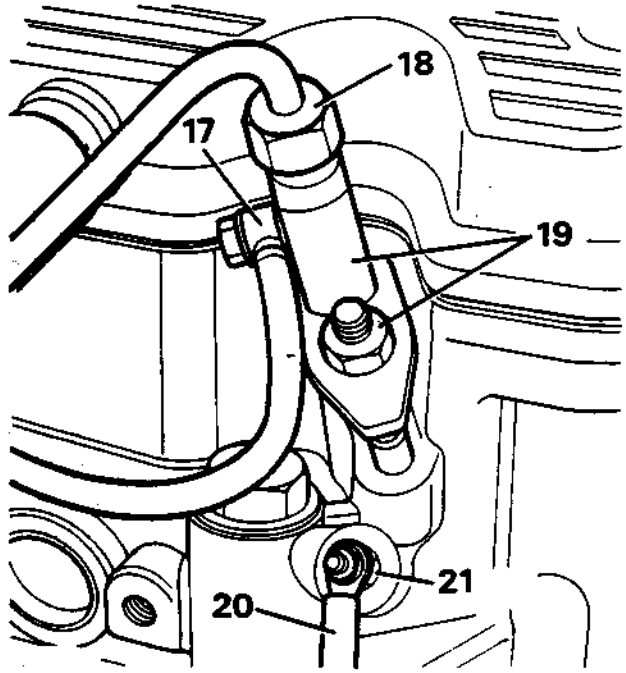
RR3983M

13. Remove two bolts securing support bracket to block.
14. Disconnect pipe to injection pump.



RR3984M

15. Disconnect exhaust front pipe from manifold.
16. Evenly loosen and remove seven nuts and washers. Remove exhaust manifold complete with turbocharger.
17. Disconnect spill return pipe.



RR3986M

18. Remove injector pipes.
19. Mark each injector to ensure they are reassembled in original position. Remove injectors. Retain injectors in separate plastic bags to avoid damage.
20. Disconnect glow plug wiring.
21. Remove glow plugs and sealing washers.
22. Remove rocker cover ***See rocker cover***
23. Evenly release five rocker shaft retaining bolts. Remove rocker shaft keeping bolts in place. Remove valve stem caps.
24. Remove pushrods, retain in original order.
25. Remove clip securing engine breather hose to lifting eye.
26. Disconnect water temperature sensor.
27. Remove clip securing transmission breather pipes to back of cylinder head
28. Evenly loosen eighteen cylinder head bolts. Remove bolts leaving two at rear in position.
29. With assistance remove cylinder head.

△ **NOTE: If cylinder head overhaul is required *See Overhaul, Overhaul and fit cylinder head***

Refit

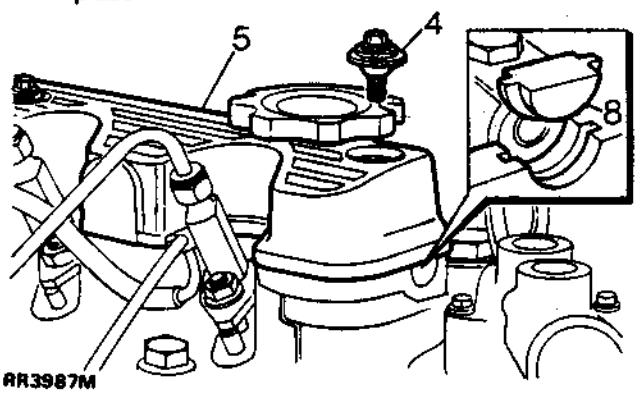
30. Clean mating faces of cylinder head and block.
31. Fit cylinder head ***See Overhaul, Overhaul and fit cylinder head***
32. Fit rocker shaft ***See rocker shaft***
33. Fit rocker cover ***See rocker cover***
34. Fit injectors, pipes and heater plugs ***See Overhaul, injectors, pipes and heater plugs***
35. Fit manifolds. Tighten fixings to ***23 Nm.***
36. Reverse removal procedure.

ROCKER COVER

Service repair no - 12.29.40

Remove

1. Disconnect the battery negative lead.
2. Disconnect air cleaner hose from breather canister.
3. Disconnect oil drain hose from bottom of canister.
4. Remove three rocker cover bolts, washers and sealing washers.
5. Remove rocker cover.
6. Inspect rocker cover gasket. Unless there is evidence of damage or leaks this may be refitted.
7. Clean mating faces of rocker cover and cylinder head.
8. Examine half moon seals. If fitting new ones, clean grooves in cylinder head. Glue seals in place.



RR3987M

Refit

9. Fit gasket to rocker cover.
10. Fit rocker cover. Secure with bolts, washers and sealing washers. Tighten bolts to ***4 Nm.***
11. Connect hoses and tighten clips.

ROCKER SHAFT

Service repair no - 12.29.54

Remove

1. Remove rocker cover ***See rocker cover***
2. Loosen five rocker shaft retaining bolts.
3. Remove rocker shaft. Do not remove retaining bolts at this stage, especially two end bolts, to keep assembly together when it is removed.

Refit

4. Overhaul rocker shaft and refit ***See Overhaul, overhaul and fit rocker shaft***
5. Refit rocker cover.

FLYWHEEL

Service repair no - 12.53.07

Remove

1. Remove clutch assembly ***See CLUTCH, Repair, clutch assembly***
2. Remove flywheel ***See Overhaul, remove flywheel and housing***

Refit

3. Examine flywheel, overhaul as necessary and refit ***See Overhaul, Overhaul and fit flywheel***
4. Refit clutch assembly. ***See CLUTCH, Repair, clutch assembly***

REAR MAIN OIL SEAL

Service repair no - 12.21.90

Remove

1. Remove clutch assembly. ***See CLUTCH, Repair, clutch assembly***
2. Remove flywheel and housing ***See flywheel***
3. Remove rear main oil seal.

Refit

4. Fit new oil seal ***See Overhaul, Fitting rear main oil seal to Flywheel Housing***
5. Fit flywheel housing ***See Overhaul, Overhaul and fit Flywheel***
6. Refit flywheel ***See Overhaul, Overhaul and fit flywheel***
7. Refit clutch assembly. ***See CLUTCH, Repair, clutch assembly***

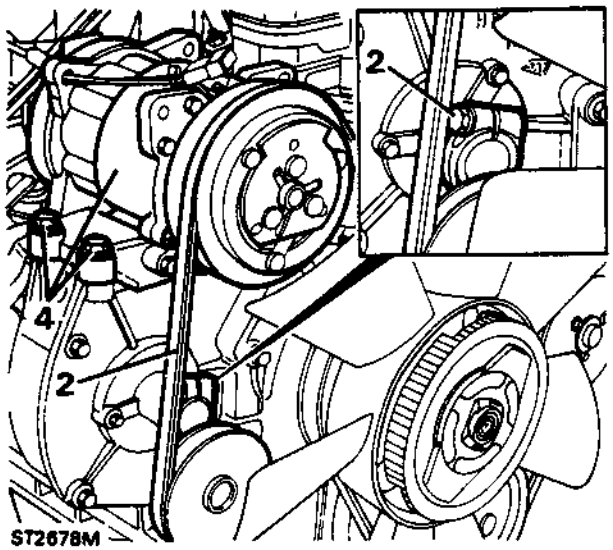
FRONT COVER OIL SEALS

Service repair no - 12.65.05 - Cover plate oil seal
Service repair no - 12.65.10 - Front cover gasket

Remove

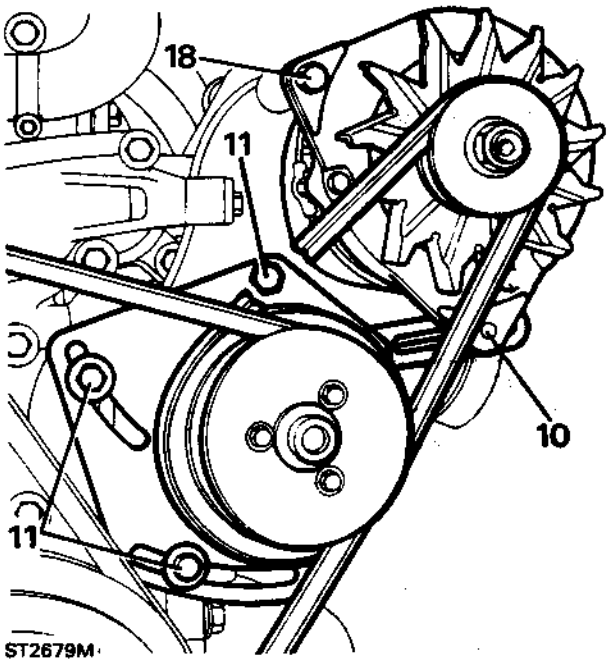
Air conditioning models - to gain access.

1. Disconnect the battery negative lead.
2. Release compressor drive belt tensioning pulley. Remove belt from compressor pulley.
3. Disconnect the two electrical leads from thermostat housing sensor.
4. Remove the four bolts securing compressor to engine and move compressor aside taking care not to strain hoses.

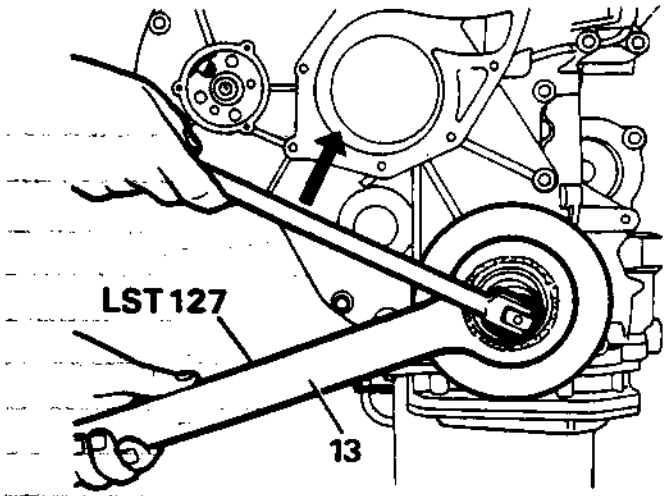


All models - to gain access

5. Disconnect battery and drain cooling system by removing bottom hose from radiator and allowing coolant to drain into a suitable container.
6. Remove viscous coupling and fan assembly, noting that coupling is secured to water pump shaft with a left hand thread.
7. Disconnect intercooler to manifold hose at the manifold.
8. Remove top hose.
9. Remove two nuts securing fan cowl to top of radiator and lift-out cowl.
10. Loosen alternator belt adjustment bolt.
11. Loosen PAS pump belt adjustment bolts and remove both belts.

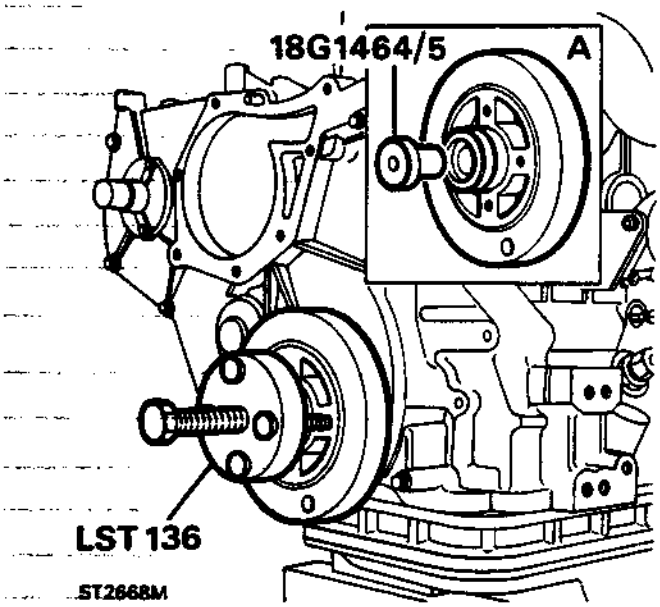


12. Remove four screws. Remove the crankshaft pulley from damper.
13. Restrain damper with special tool LST 127. Using a 30 mm socket, remove damper retaining bolt and spacer. Since this bolt is retained with Loctite and tightened to a very high torque considerable effort will be required to release it.



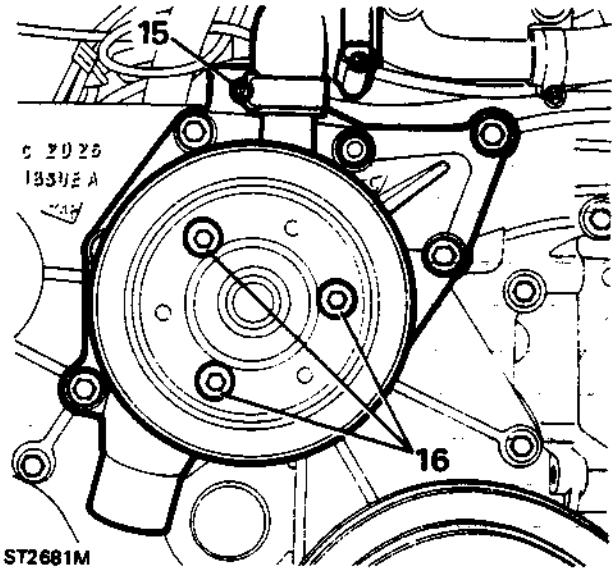
ST2680M

14. Since damper is also retained with Loctite, use special tool LST 136 and pressure button A from 18G 1464/5 to withdraw it from the crankshaft.



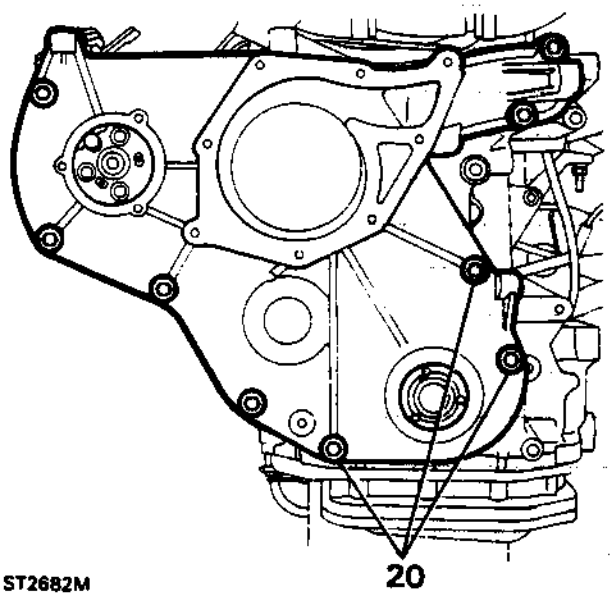
ST2668M

15. Disconnect bottom and by-pass hoses from water pump.
16. Remove three screws to remove water pump pulley. Remove seven bolts to remove water pump.
17. Remove air cleaner to turbo charger hose.
18. Withdraw pivot bolt, and remove the alternator. Similarly, remove PAS pump.



ST2681M

19. Remove five bolts to release common bracket.
20. Remove nine bolts and carefully remove cover plate from front cover.



ST2682M

21. Remove front cover ***See Overhaul, Remove timing gear and injection pump***

Refit

22. Fit front cover ***See Overhaul, fit the front cover***
23. Fit camshaft drive belt ***See Overhaul, valve and injection pump timing***
24. Fit front cover plate and damper ***See Overhaul, Fitting front cover plate and damper***
25. Reverse removal procedure.

Notes

ENGINE OVERHAUL

Engine data
For engine general specification data ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi Engine***

Remove engine from vehicle and clean. ***See Repair, Engine***

To overhaul the engine requires the use of service tools. ***See Service tools, Tdi engine***

The use of a purpose designed engine stand is recommended. Secure engine to stand. Drain the sump oil.

△ **NOTE: The position of brackets, clips, harness, pipes, and hoses, and any non standard items, for assembly.**

Remove the following components where applicable:-

Air conditioning compressor.

Power steering pump and alternator.

Starter motor.

Engine electrical harness.

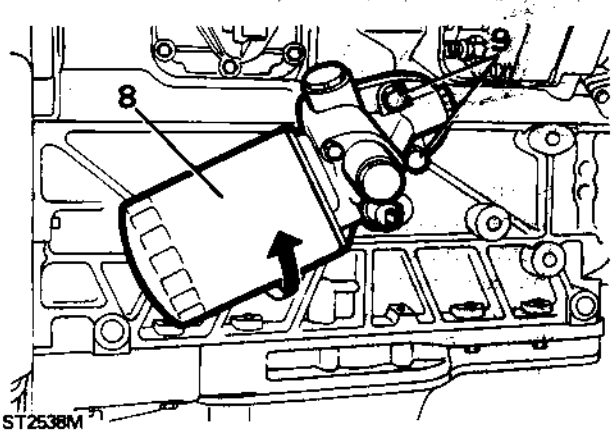
Air inlet manifold

Exhaust manifold and turbocharger

Water pump

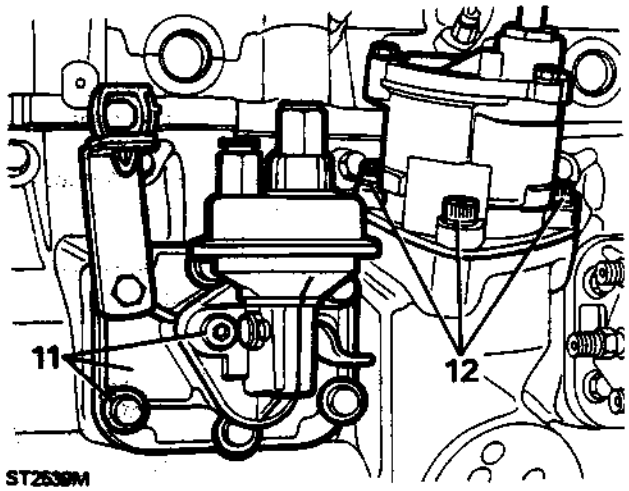
Clutch

1. Loosen all the union nuts at the injectors and injection pump and then remove the pipes from the engine.
2. Remove the spill return pipes from the injectors and injection pump and retrieve the washers.
3. Disconnect the electrical lead from the fuel cut-off switch at the rear of the injector pump.
4. Disconnect the lead from the oil pressure switch.
5. Disconnect the electrical leads from the heater plugs.
6. Remove the lead from the engine coolant temperature switch.
7. Check that all the electrical leads have been disconnected. Release the harness from the retaining clips and remove from the engine.
8. Unscrew the oil filter cartridge, anti-clockwise, using a strap wrench if necessary. Dispose of the oil safely.
9. Release the two bolts and remove the oil filter adaptor and gasket from the engine.



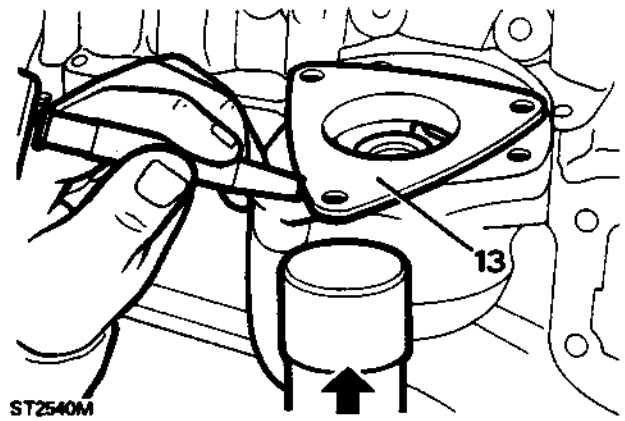
10. Remove the single bolt and pull the engine breather canister fom the rocker cover. Also release the breather hose from the sump connection and remove from the engine.

11. If the fuel lift pump is suspected of being faulty it can be removed from the rear cover by releasing the two retaining screws using a 6 mm Allen key. Alternatively, it can be removed still attached to the rear cover, by removing the six bolts.
12. Mark the position of the brake servo vacuum pump with relation to the cylinder block. Using a 6 mm Allen key remove the three screws and lift out the pump.

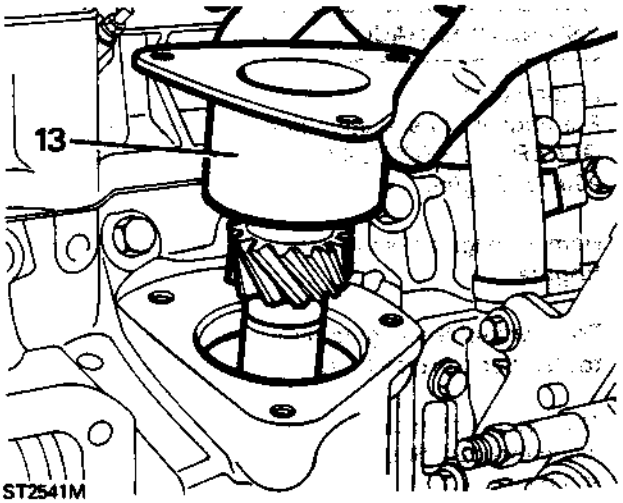


ST2539M

13. Similarly, mark the relationship of the skew gear flange with the cylinder block and the skew gear teeth with the camshaft gear teeth. To remove the skew gear assembly, tap the flange round so that the edges overlap the cylinder block. Tap the flange upwards sufficiently to enable the skew gear assembly to be lifted out.



ST2540M

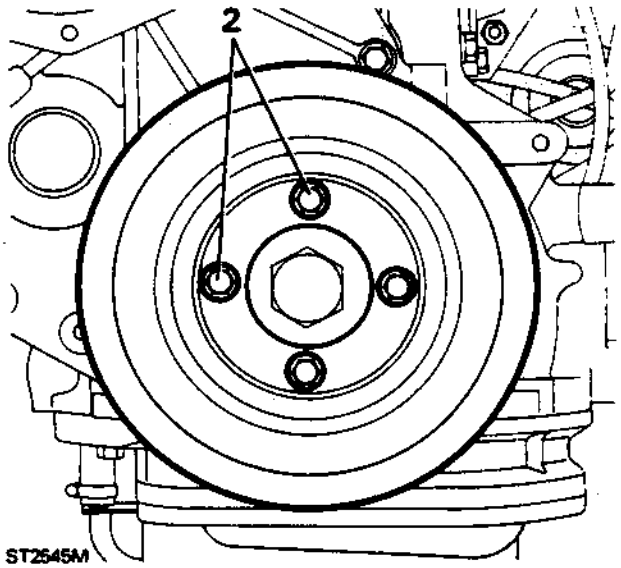


ST2541M

14. Using a length of wire or long nosed pliers withdraw the oil pump drive shaft.

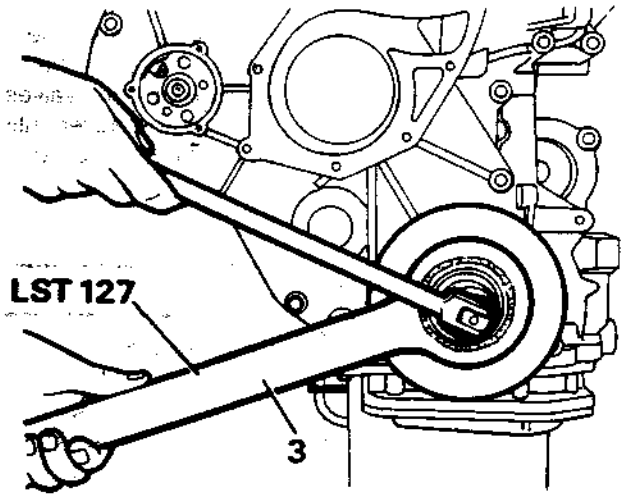
CHECK INJECTION PUMP TIMING

1. Evenly loosen and remove the three rocker shaft cover retaining bolts and remove the cover so that the position of the valves in relation to the crankshaft and pistons may be seen.
2. Release the four bolts and remove the crankshaft pulley from the damper.



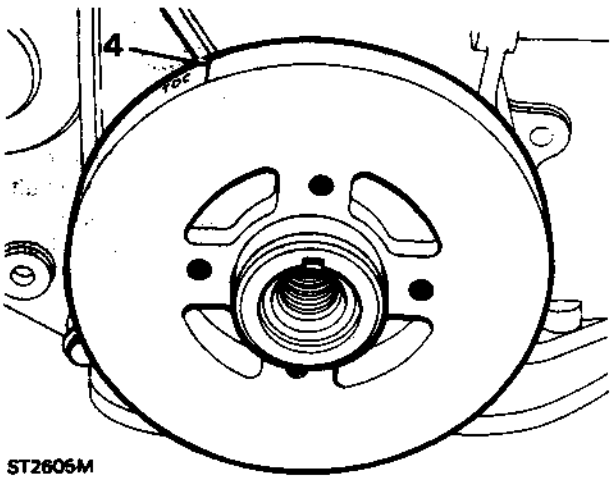
ST2545M

3. To remove the crankshaft damper retaining bolt use special service tool LST127 to restrain the damper and a 30 mm socket to remove the special bolt. Leave the damper in position on the crankshaft.



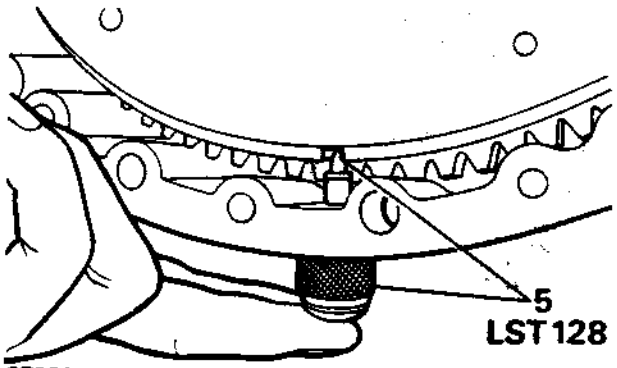
ST2546M

4. Use the restraining tool to turn the crankshaft in a clockwise direction to T.D.C. so that the mark on the damper is in line with the cover plate web as illustrated. The valves of number one cylinder should be closed with number four cylinder valves on the "rock". If the crankshaft is turned beyond T.D.C. continue on round until the above conditions are achieved.



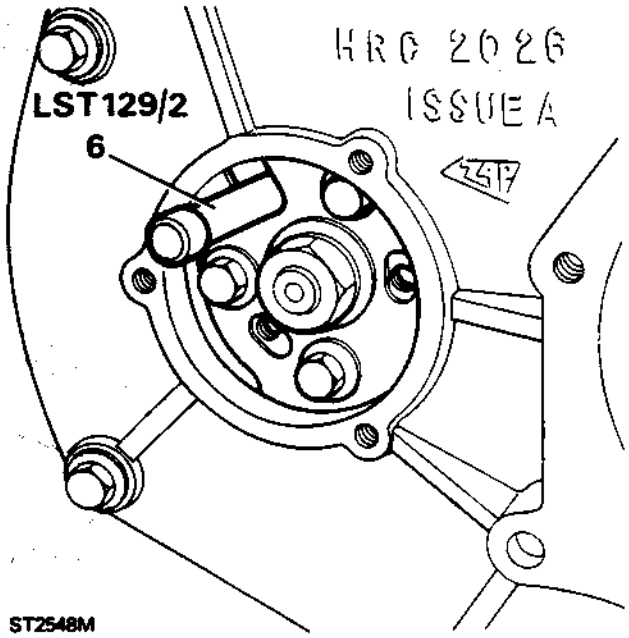
ST2605M

5. Screw the body of the timing pin tool LST128 into the flywheel housing and check the pin can be inserted into the slot in the flywheel. Note that there are two slots in the flywheel. The narrowest slot determines T.D.C. for this direct injection engine and it is therefore important that the correct slot is used.

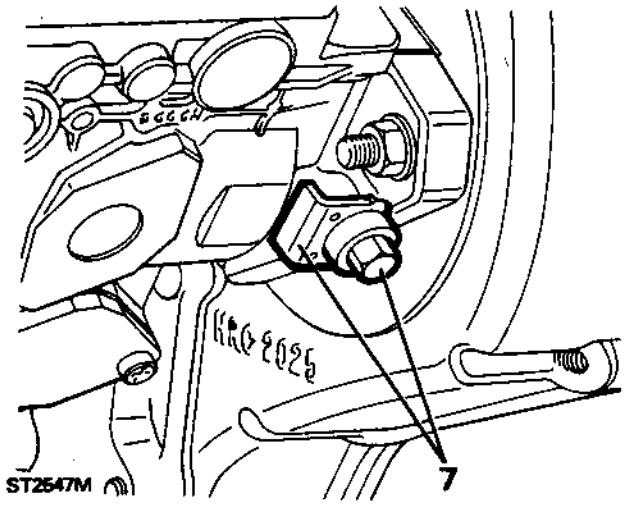


ST2591M

6. Remove the injection pump access cover and check the service tool timing pin can be inserted through the "U" shaped cut-out in the pump hub and into the hole in the pump body. Also the dot on the camshaft gear should align with the web on the front cover. This will confirm that the injection pump is correctly timed in relation to the valves and crankshaft and can be locked ready for removing. Leave the bolt in position in the pump.



7. To lock the pump, loosen the locking screw and remove the inhibiting plate. Tighten the screw to lock the pump shaft. Remove the timing pin from the flywheel housing.

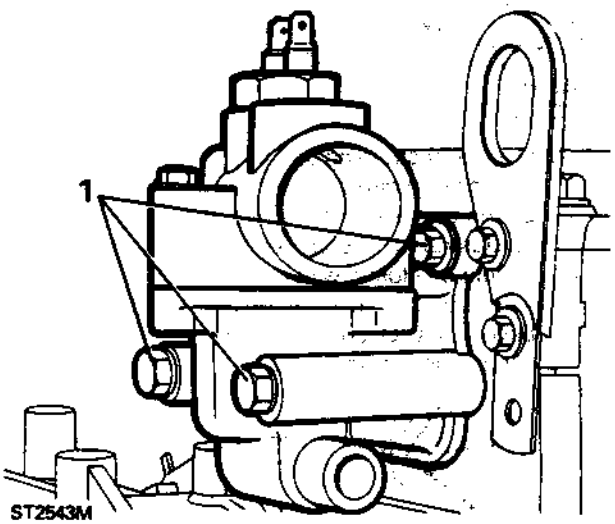


⚠ **CAUTION: It is important to ensure that once the injection pump has been locked no attempt must be made to rotate it. Therefore do not allow the crankshaft to be turned until the pump has been removed.**

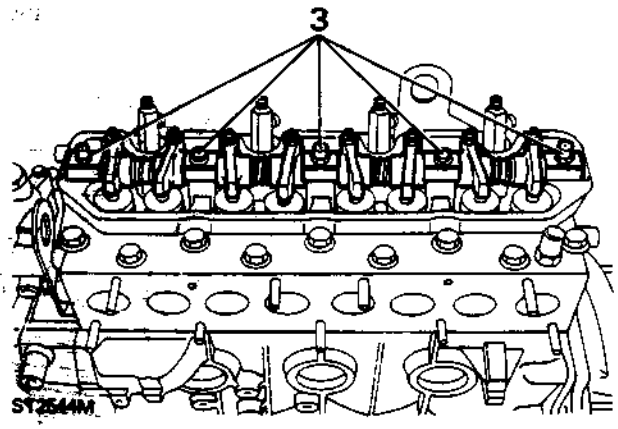
8. Before dismantling the timing components, the cylinder head should be removed to avoid the possibility of damage being caused to the valves and pistons should the camshaft be inadvertently turned once the timing belt has been removed.

REMOVE CYLINDER HEAD

1. Remove the three bolts and remove the thermostat housing.



2. Evenly release the five rocker shaft retaining bolts but do not remove the bolts from the shaft, especially the two end ones, to prevent the assembly from falling apart when removed from the cylinder head.



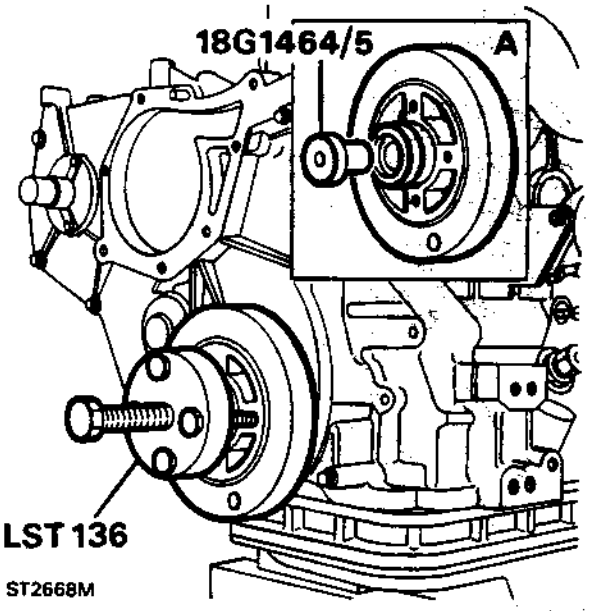
3. Having removed the rocker shaft, lift-out the push rods and insert them through holes in a piece of card marked from 1 to 8 to ensure assembly to their original locations.

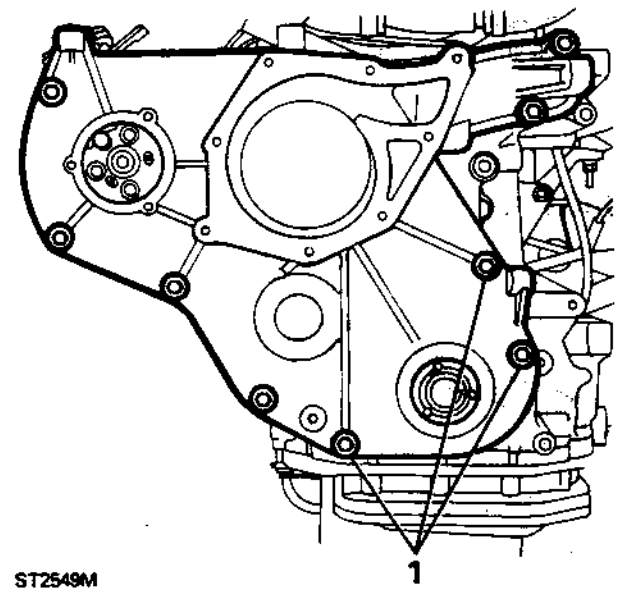
CAUTION: Since the injectors and heater plugs protrude below the combustion face of the cylinder head, it is important that they are removed before removing the cylinder head to avoid the possibility of damage to the injectors, heater plugs and pistons.

4. Remove the valve stem caps.
5. Mark each injector with the number of the cylinder to which it is fitted. Remove the injector clamp nut and carefully remove the injectors. Store in a bag to prevent contamination and damage.
6. Remove the glow plugs and sealing washers and store in a safe place.
7. Evenly loosen and remove the eighteen bolts retaining the cylinder head and lift the cylinder head from the cylinder block and remove the gasket. Discard the cylinder head bolts.

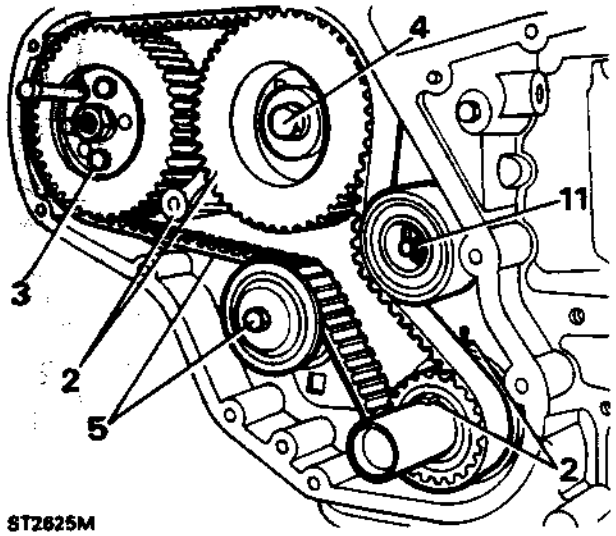
REMOVE TIMING GEAR AND INJECTION PUMP

1. Remove the crankshaft damper using service tool LST136. The damper is secured to the crankshaft with Loctite. Fit the pressure button A from tool 18G1464/5 and assemble the tool LST136 to the damper as illustrated. Remove the nine bolts securing the cover plate to the front cover.



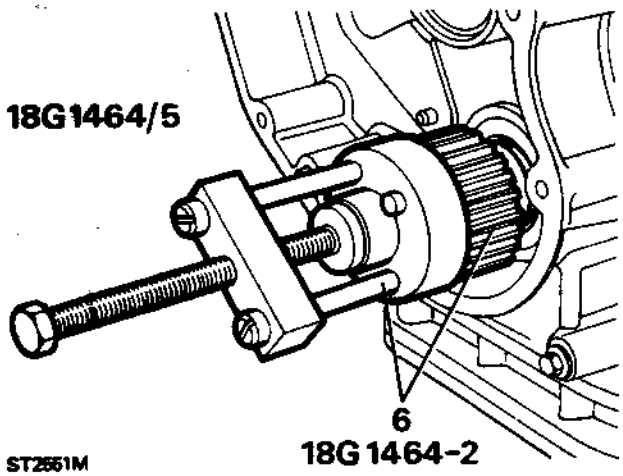


2. Check that the timing marks inside the front cover line-up with the gear wheels, ie. the arrow on the front cover aligns with the crankshaft key and the dot on the camshaft gear aligns with the front cover web.
3. Loosen the three screws securing the pump timing gear to the pump hub.
4. Temporarily fit the damper and restrain the crankshaft with service tool FR101 while the camshaft gear wheel retaining bolt is being loosened.
5. Remove the single bolt and special washer and remove the tensioner and drive belt.



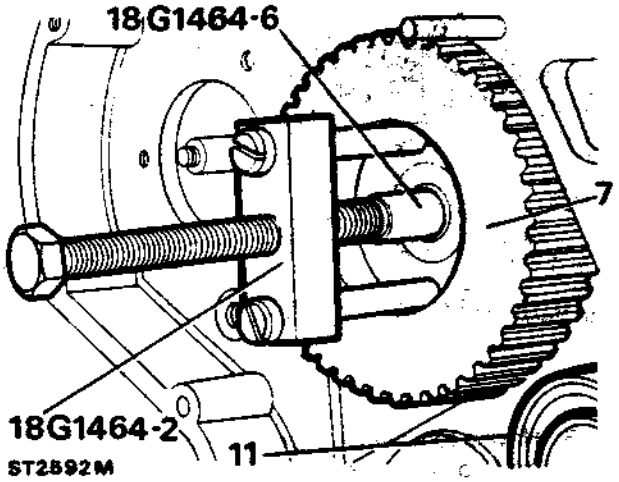
ST2625M

6. If the crankshaft gear wheel cannot be removed by hand, use special service tool 18G1462-2 and pressure button 18G1464/5. Assemble the tool as illustrated and withdraw the gear wheel.



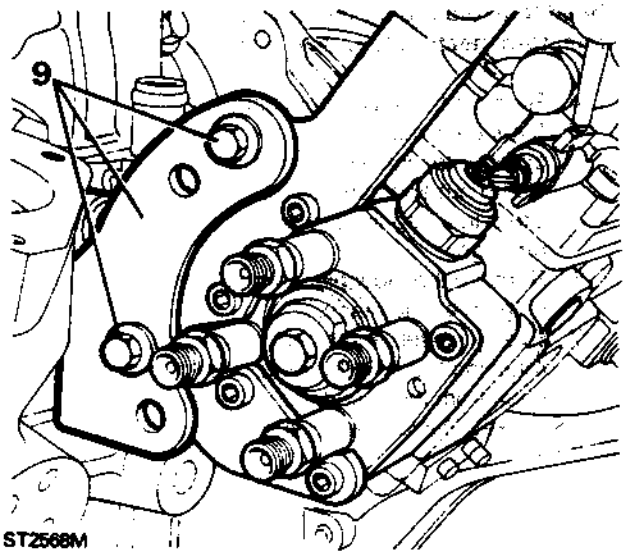
ST2561M

7. Remove the camshaft gear wheel retaining bolt. Remove gear using service tool 18G1462-2 and button 18G1464-6.



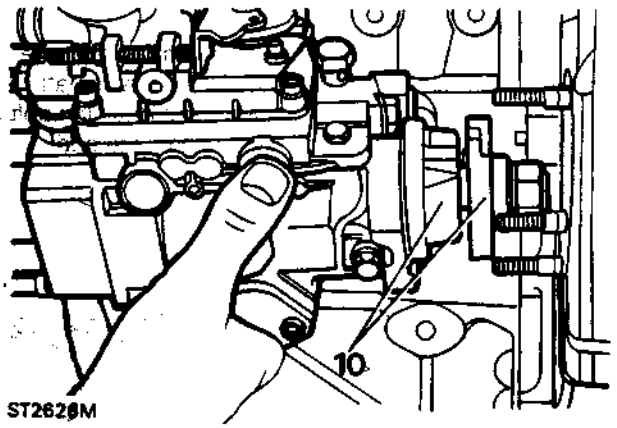
ST2592M

8. The timing bolt can now be withdrawn from the pump together with the three previously loosened screws and the gear removed.
9. Release the pump from the rear support bracket.



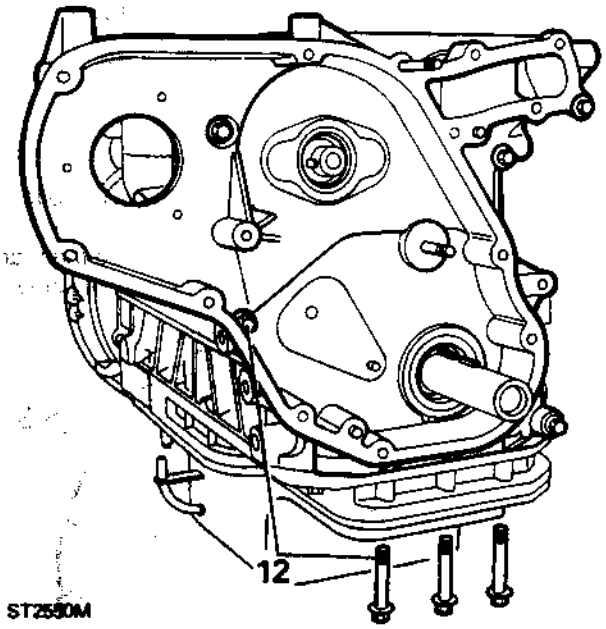
ST2568M

10. Remove the three nuts securing the pump flange to the front cover and withdraw the pump and gasket complete with hub.



ST2628M

11. Remove the single nut to release the static jockey pulley.
12. To remove the front cover, release the five bolts securing it to the cylinder block front face and the three bolts that pass up through the sump and ladder frame into lower face of the cover.

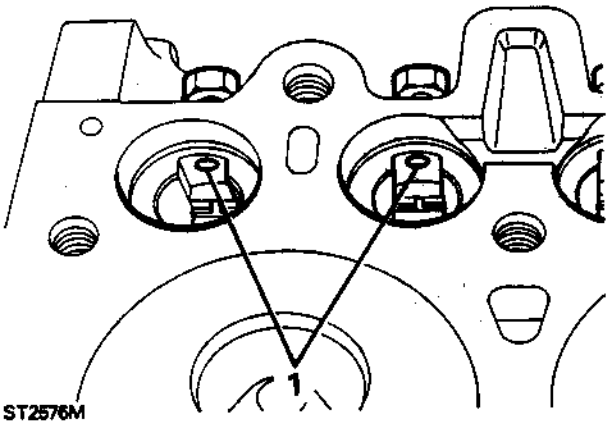


ST2580M

REMOVING CAM FOLLOWER ASSEMBLIES

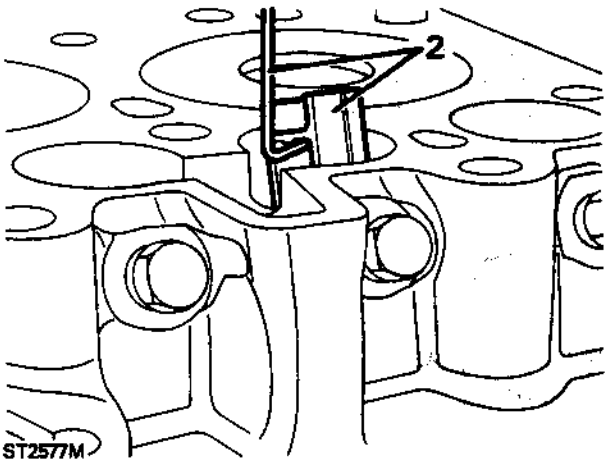
CAUTION: The cam followers are solid rollers held in position against the cam by a slide inside a fixed guide. If the guide is removed before the roller, the roller can fall and jam behind the camshaft. Also the roller could slip past the cam into the crankcase. It is important to follow this procedure for removal:-

1. Loosen back the guide locating screw so that the end is below the bore of the guide.



ST2576M

2. Using a length of thin wire with a hooked end lift-out the slide.



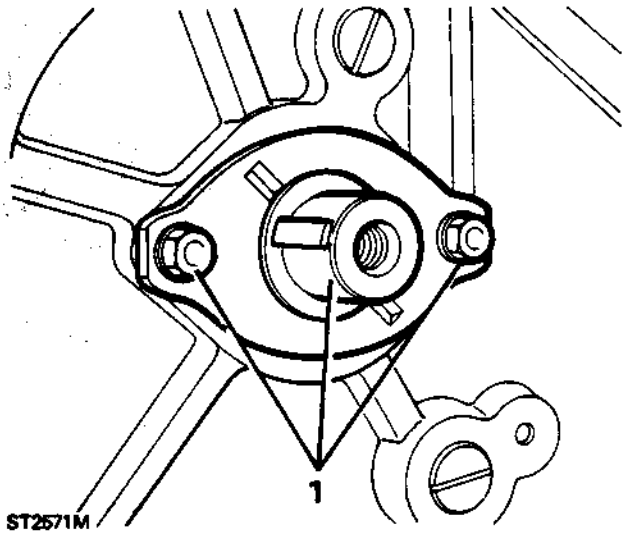
ST2577M

3. With the same piece of wire remove the roller.

4. Remove the guide locating screw and lift-out the guide.
5. As each assembly is removed, number it from one to eight, for refitting to its original location.

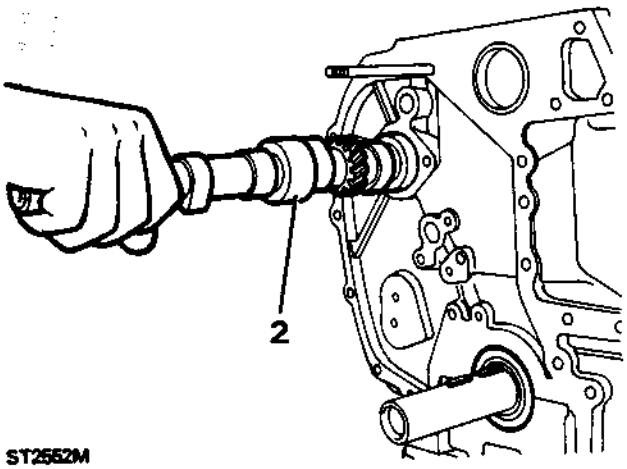
REMOVING THE CAMSHAFT

1. Release the two screws and remove the camshaft thrust plate.



ST2571M

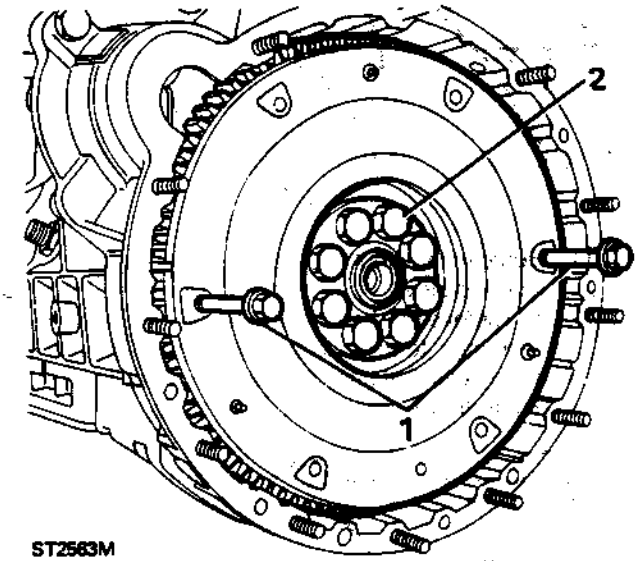
2. Carefully withdraw the camshaft taking care not to allow the end of the shaft to drop on to the bearings as it is removed.



ST2552M

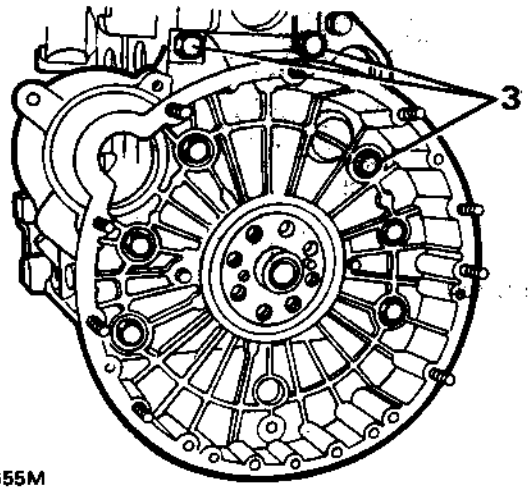
REMOVE FLYWHEEL AND HOUSING

1. In the interests of safety, fit two long 8 mm bolts into the clutch bolt holes, diametrically opposite, to use as handles for lifting the flywheel off the crankshaft.
2. Temporarily fit the crankshaft damper and use service tool FR101 to restrain the crankshaft while loosening the flywheel eight retaining bolts. Remove the bolts and reinforcing plate and lift-off the flywheel.



ST2563M

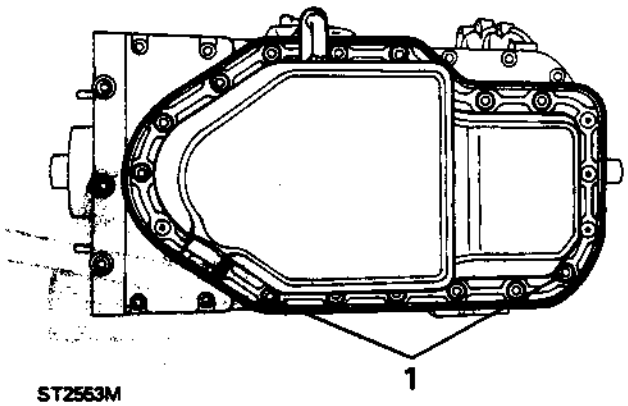
3. Remove the six internal and two external bolts and ease the flywheel housing from the two locating dowels and crankshaft. Discard the rear main oil seal, avoid damaging the seal housing.



ST2655M

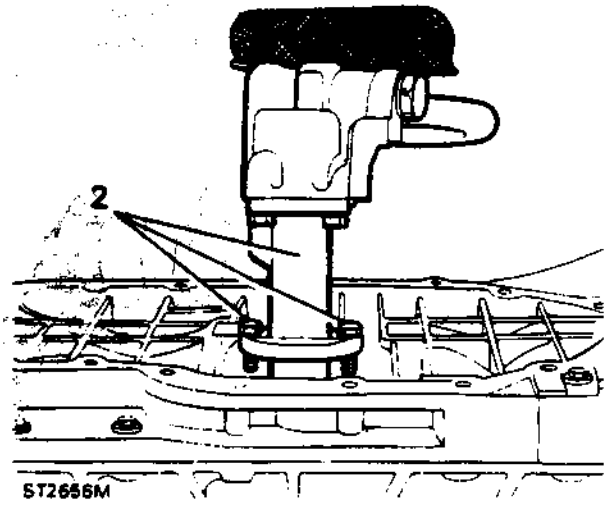
REMOVE SUMP, OIL PUMP AND LADDER FRAME

1. Invert the cylinder block so that the sump is uppermost. Remove the remaining seventeen screws and ease the sump from the ladder frame to reveal the oil pump.



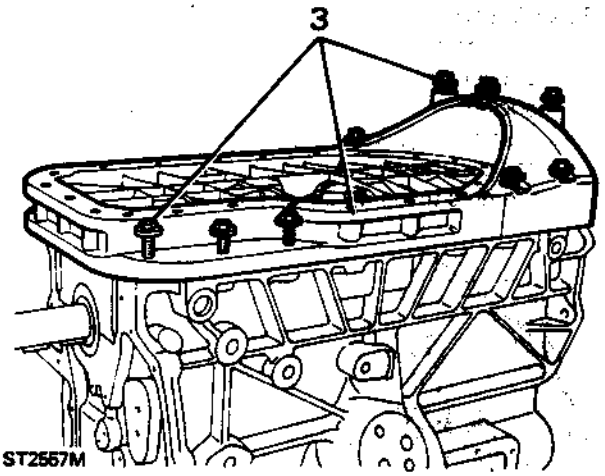
ST2563M

2. Two bolts secure the oil pump to the crankcase. Access to the right hand bolt may require the use of a socket with a universal joint. Removal of the bolts will enable the pump to be withdrawn.



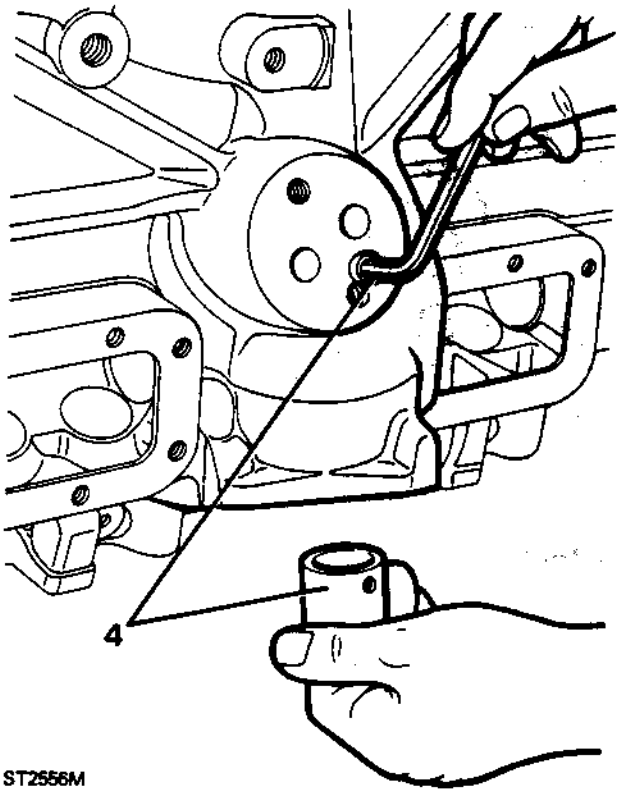
ST2555M

3. Remove the ten bolts and separate the ladder frame from the crankcase by gently tapping to break the seal.



ST2557M

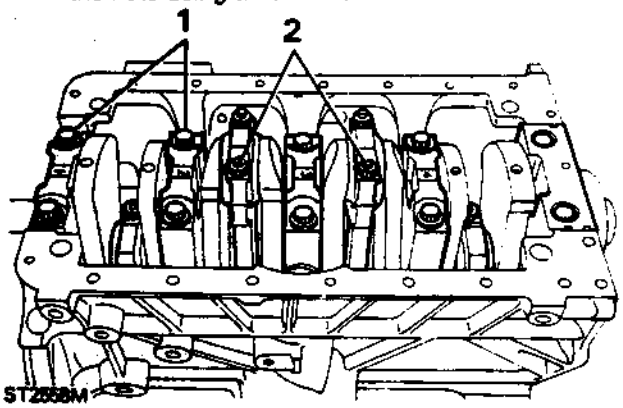
4. Using a 6 mm Allen key remove the socket headed screw retaining the skew gear bush and withdraw the bush.



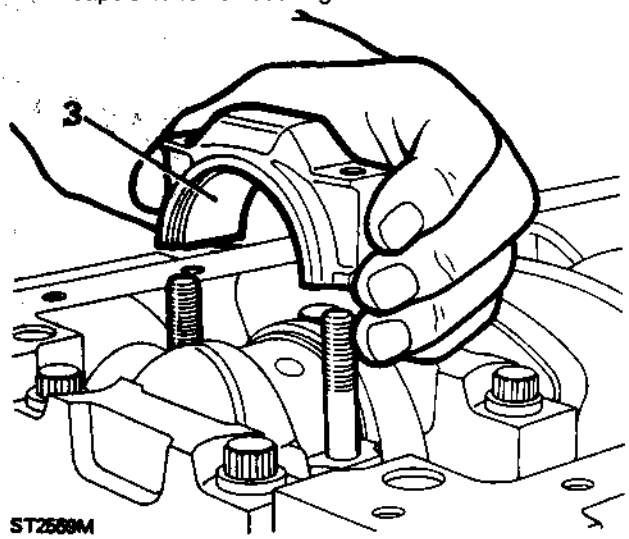
ST2556M

REMOVE CRANKSHAFT

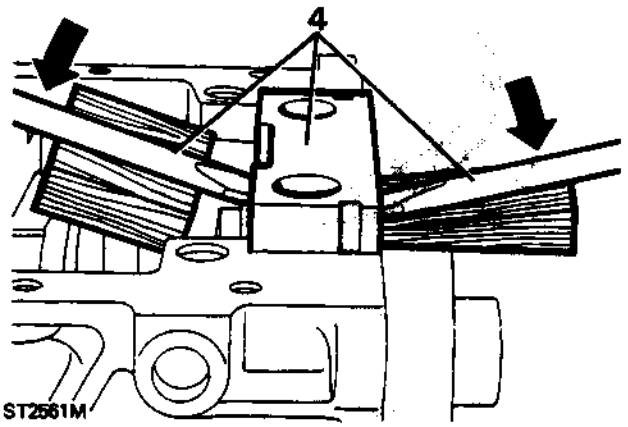
1. Loosen the ten main bearing bolts with a 14 mm socket.
2. Turn the crankshaft to bring all the connecting rod caps to an accessible position and loosen the nuts using a 15 mm socket.



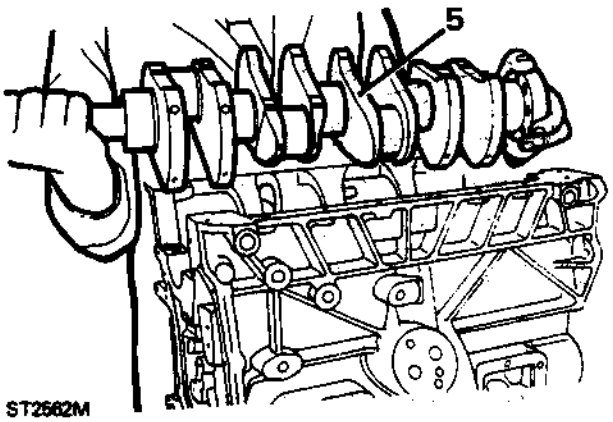
3. Remove the connecting rod nuts and remove the caps and lower bearing shells.



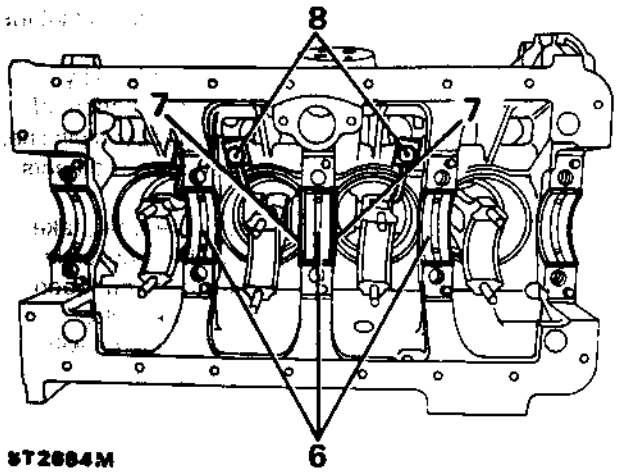
4. The rear main bearing cap has a "T" shaped neoprene seal each side of the main bearing cap. Difficulty may be experienced removing the cap. If so lever the cap from both sides, as illustrated. Insert a suitable bar in the hole in the inside face of the cap and lever against the crankshaft journal on the outside face. **Ensure that timber blocks are used under the levers to protect the crankshaft.**



5. Lift-out the crankshaft either by hand or hoist. If a hoist is used be sure to insert adequate protection between the sling and journals to avoid damage.



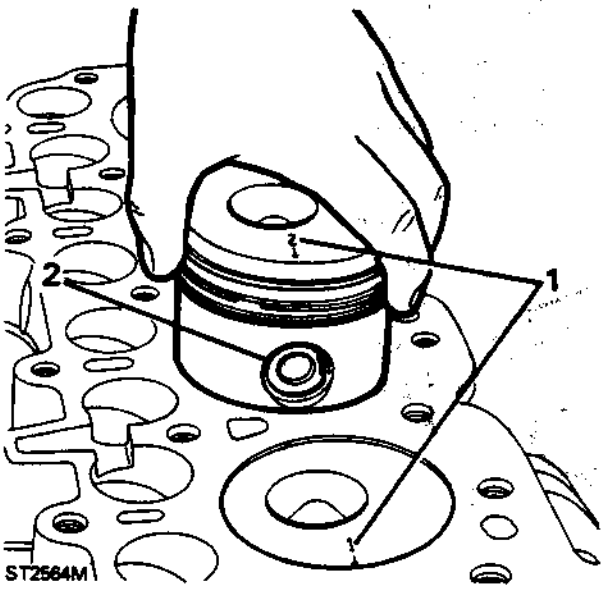
6. Remove the main bearing upper shells from the bearing saddles.
7. Remove the two thrust washers from each side of the centre saddle.
8. Remove the four jet tubes.



ST2564M

REMOVE PISTONS AND CONNECTING RODS

1. Before removing the piston assemblies, number each piston from one to four so that it can be identified with the bore from which it was removed.
2. Push each connecting rod and piston up the bore until it can be withdrawn from the cylinder block. As each piston assembly is removed fit the corresponding cap and bearing shell to the connecting rod noting that the shell locating tags are together on the same side as the connecting rod number.

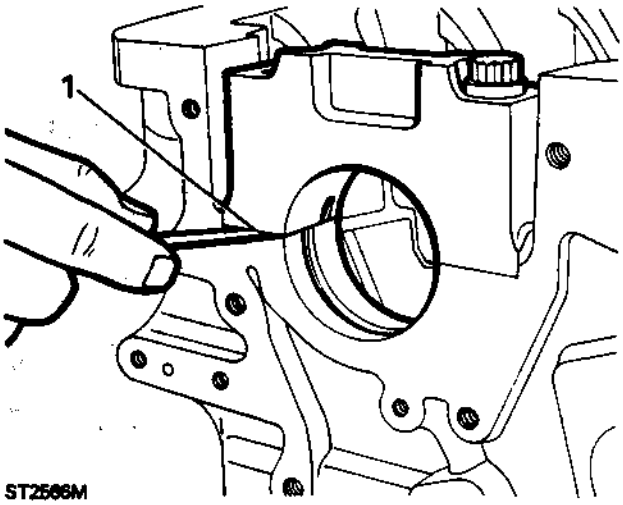


ST2564M

OVERHAUL CYLINDER BLOCK

1. Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage. To check the main bearing caps and saddles for distortion, fit the main bearing caps without bearing shells and tighten to *133 Nm*.

   Loosen and remove the bolt on one side of each bearing cap and check no clearance exists at the joint face between the cap and saddle. A clearance indicates either a bent bolt, distortion of the caps, or block or that the cap has been filed or machined in an attempt to reduce the clearance due to wear in the bearings. Main bearing caps are not available separately from the cylinder block and if clearance exists the block must be renewed.



ST2566M

Inspect cylinder bores

2. Measure the cylinder bores for ovality, taper and general wear, using any suitable equipment. However, an inside micrometer is best for checking ovality and a cylinder gauge for taper.
3. Check the ovality of each bore by taking measurements at the top of the cylinder just below the ridge at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50 mm up from the bottom of the bore so that the overall ovality may be determined.
4. The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line. The difference between the two measurements is the taper.
5. To establish maximum overall bore wear, take measurements at as many points as possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder bore.

   Maximum permissible ovality - 0,127 mm.

   Maximum permissible taper - 0,254 mm.

   Maximum permissible overall wear - 0,177 mm.

   If these figures are exceeded the cylinders may be rebored, depending upon the condition of the bores and the amount of wear. If the overall wear, taper and ovality are well within the acceptable limits and the original pistons are serviceable new piston rings may be fitted. Deglaze the bores to give a cross-hatched finish to provide a seating for new rings. Wash the bores afterwards to remove all traces of abrasive material.

Inspect camshaft bearings

6. Measure the internal diameter of each camshaft bearing at several points using an internal micrometer. A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance exceeds 0,0508 mm or, if scored or pitted.

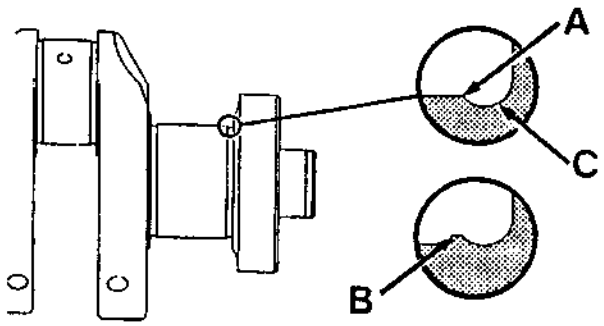
Check crankcase main bearings

7. Discard scored, pitted, cracked and worn bearing shells.
8. To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to ***133 Nm***
9. Using an inside micrometer, measure each bearing at several points and note the greatest figure. The maximum wear is the difference between this figure and the smallest diameter of the corresponding crankshaft journal. The main bearing running clearance is in the data section ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi Engine***
10. The bearing clearances may also be determined by using 'Plastigauge'. Since this method requires the crankshaft to be fitted to the crankcase, the procedure is described under engine assembly.

CRANKSHAFT

1. Degrease the crankshaft and clear out the oil ways which can become clogged after long service. Examine visually, the crankpins and main bearing journals for obvious wear, scores, grooves and overheating.
2. With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows.
3. **Ovality** - Take two readings at right angles to each other at various intervals.
   The maximum ovality must not exceed 0,040 mm
4. **Taper** - Take two readings parallel to each other at both ends of the main bearing journal and crankpin.
   The maximum permissible taper must not exceed 0,025 mm
5. To check for straightness, support the front and rear main bearing journals in 'V' blocks and postion a dial indicator to check the run-out at the centre main bearing journal. Run-out must not exceed 0,076 mm taking into account any ovality in the centre journal.
   The overall wear limit should not exceed 0,114 mm for main bearing journals and 0,088 mm for crankpins.
6. A crankshaft worn beyond the limits of maximum taper, ovality and overall wear can be ground to 0,25 mm under size.

⚠ **CAUTION: When grinding the crankshaft main bearing and crankpin journals, rotation of the grinding wheel and crankshaft must be in the same direction, anti-clockwise, viewed from the flywheel end of the crankshaft. Final finishing of the journals should be achieved by using a static lapping stone with the crankshaft rotating in a clockwise direction viewed from the flywheel end of the crankshaft. It is important to ensure that, when grinding, the stone travels beyond the edge of the journal 'A' to avoid formation of a step 'B' as illustrated. Also care must be taken not to machine or damage the fillet radii 'C'.**

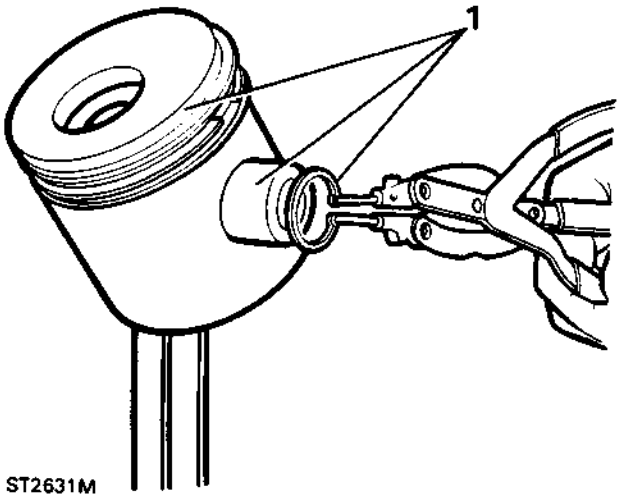


ST1808M

PISTONS AND CONNECTING RODS

The following checks relating to pistons and rings must also be carried out prior to fitting new pistons to rebored and sleeved cylinder blocks. Until it is decided if new components are required all parts must be kept in their related sets and the position of each piston to its connecting rod should be noted.

1. Remove the piston rings and gudgeon pin from each piston and detach the connecting rod.

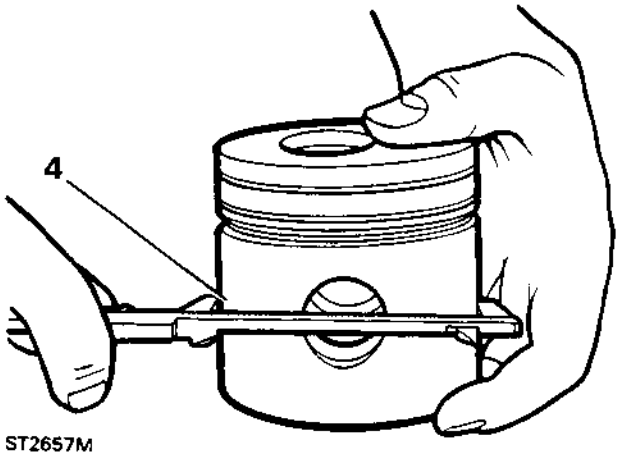


ST2631M

2. **Original pistons** - Decarbonise and degrease all components and carry out a visual examination of the piston and rings and discard any which are unserviceable. Pistons which appear serviceable should be subjected to a more detailed examination described under 'New pistons'.
3. **New pistons** - Original pistons fitted to new engines at the factory are specially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons. Genuine Land Rover service standard size pistons are supplied 0,025 mm oversize to allow for production tolerance on new engines. When fitting new pistons to a standard size cylinder block the bores must be honed to accomodate the pistons with the correct clearances. In addition Land Rover pistons are available 0,50 and 1,01 mm oversize for fitting to rebored cylinder blocks.

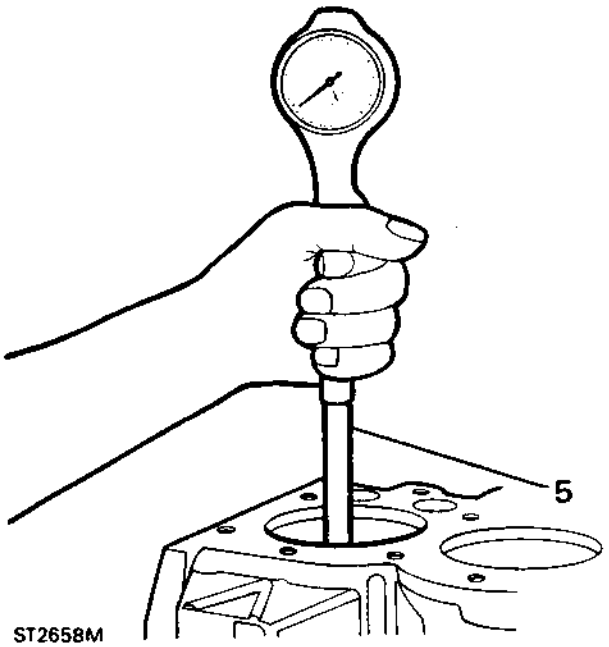
   Clearance limits for new standard size pistons in a standard cylinder bore measured at right angles to the gudgeon pin are in the data section. ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi engine***

4. Using a suitable micrometer or vernier measure the pistons at the bottom of the skirt at right angles to the gudgeon pin.



ST2657M

5. With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half-way down and note the reading.
6. The clearance is determined by subtracting the piston diameter from the bore diameter.



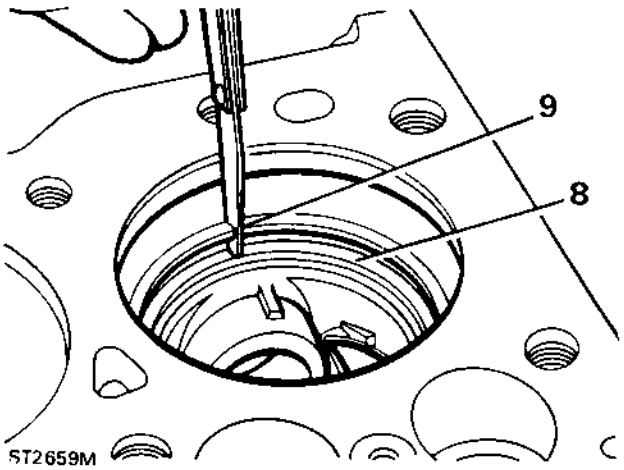
ST2658M

7. If gauge equipment is not available the clearance can be assessed by placing a long, suitably sized, feeler gauge down the thrust side of the bore and inserting the appropriate piston, 'upside down', in the bore and position it with the gudgeon pin parallel to the crankshaft axis. Push the piston down the bore and stop at the tightest point and whilst holding the piston still, slowly withdraw the feeler gauge. If a steady resistance of approximately 2,5 kg is felt, the clearance is satisfactory.

Inspect piston rings

Normally when an engine is being overhauled the piston rings are discarded unless the pistons have been removed for a different purpose and the engine has only completed a small mileage. Before refitting the piston the rings should be examined for wear and damage. In addition the rings must be checked for side clearance in the pistons and gap in the bores. The latter two checks must be made when fitting new rings to new and used pistons.

8. **Check gap** - When checking the ring gap in worn bores, which are within the acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the bore at the lowest point of the piston travel. To ensure squareness of the ring push the ring down into the bore to the correct position with a piston. With newly machined bores, the ring may be inserted squarely into any position in the bore.



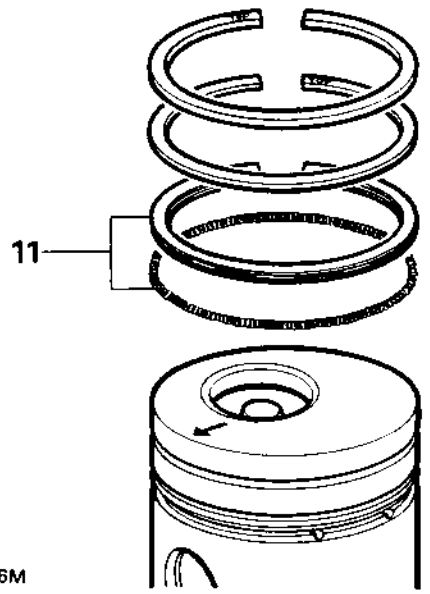
9. Measure the gaps of all the rings, in turn, including the oil control ring assembly.

   The correct gaps are listed in the data section ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi Engine***

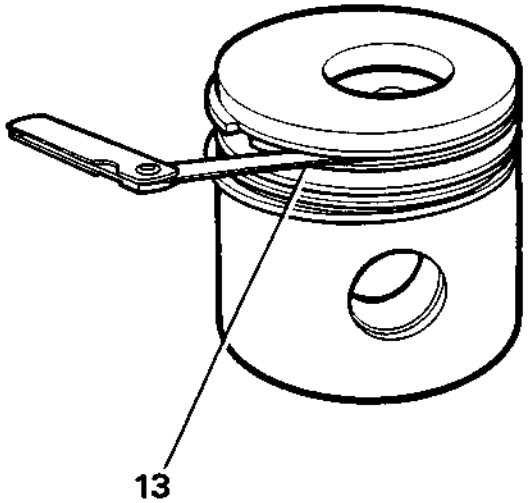
   If any gap is less than that specified, remove the ring, and file the ends square, whilst holding the ring in a filing jig or vice. Should any gap be excessively wide and not likely to close up to within the specified limits when hot, an oversize ring should be fitted.

Check piston side ring clearance

10. It is important that clearances are correct. Rings that are too tight will bind when hot, impairing the radial pressure causing possible loss of compression. Excessive clearance will allow the rings to rock in the grooves and the resulting pumping action could cause excessive oil consumption and eventually broken rings.
11. Fit the oil control ring expander to the bottom groove, then fit the oil control ring ensuring that it fits over the expander. Fit the second, narrow, compression ring with the word "TOP" uppermost. Likewise fit the first compression ring to the top groove, word "TOP" uppermost.
12. After fitting each ring, roll it around the piston groove to ensure that it is free and does not bind.



13. Measure the clearance between the rings and piston grooves. Clearances in excess of the figures given in data section are unnaceptable and the rings or the pistons should be renewed.



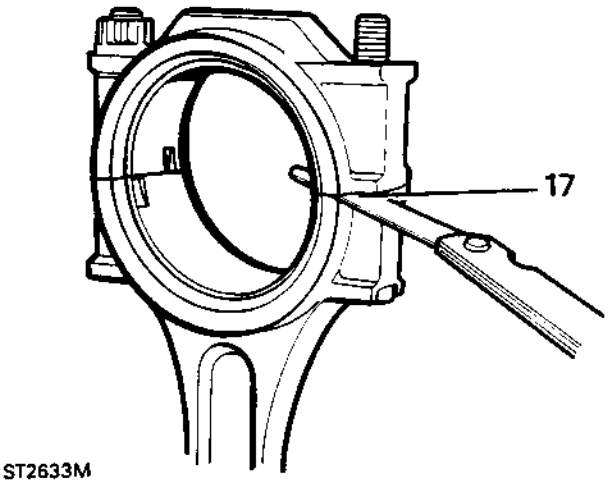
ST2632M

Inspect gudgeon pins

14. Check the gudgeon pins for wear, cracks, scores and overheating.
15. The gudgeon pin fit into the piston must be tight push fit at a temperature of 20°C. Check the gudgeon pin for ovality and taper using a micrometer.

Connecting rod inspection

16. Check the connecting rods and caps for distortion as follows; fit the correct cap, less the bearing shells, to each connecting rod as denoted by the number stamped near the joint faces. This number also indicates the crankshaft journal to which it must be fitted.
17. Tighten the nuts to ***59 Nm*** and release the nut on one side only. Check that no clearance exists between the joint faces. If there is a gap the connecting rod is distorted and should be renewed.



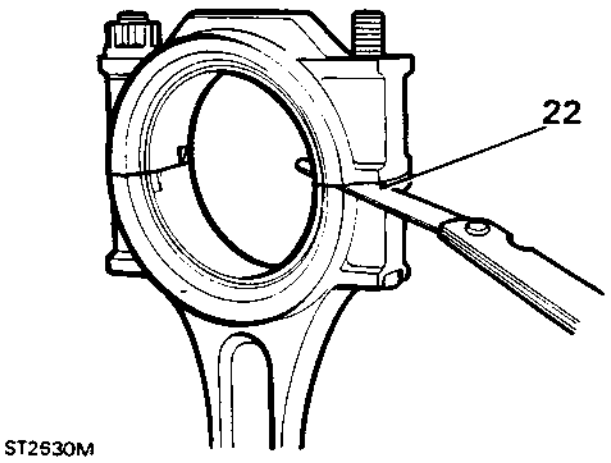
ST2633M

18. Use a connecting rod alignment gauge to check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0,127 mm
19. Examine and check the small-end bush for wear. If necessary renew the bush. The correct clearance of the gudgeon pin in the small-end bush is given in the data section. ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi engine***
20. When renewing a bush, ensure that the oil hole in the bush lines up with the hole in the connecting rod. Finish the bush to the correct size and clearance.
21. Connecting rod bearings that are worn, pitted, scored and show signs of overheating must be discarded. If more than one of the bearings show these signs they must all be renewed. When fitting new or used bearings to serviceable crankpins the clearances must be checked.

Connecting rod bearing nip and clearance

New bearing halves are supplied with a protective coating and must be degreased before fitting.

22. Fit the bearing halves to the connecting rod and cap and secure the assembly to ***59 Nm***
Loosen the nut on one side only and check the clearance between the joint faces with a feeler gauge.

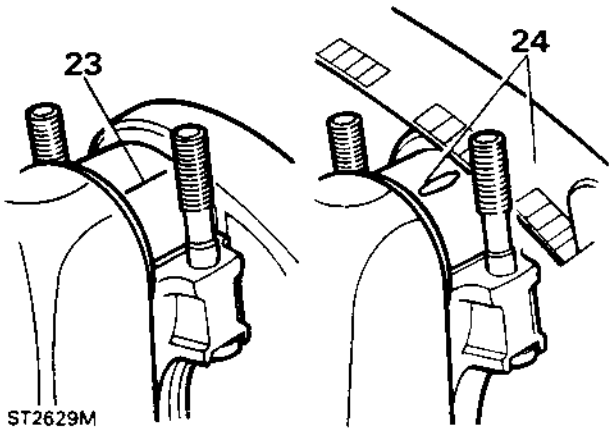


The clearance should be 0,10 to 0,20 mm The bearing nip can be adjusted by the selective assembly of the bearing shells which are available in slightly varying thicknesses. Do not file or machine the rods to vary the bearing nip.

Make a final check to prove the clearance by inserting a 0,063 mm shim paper between the crankpin and one half of the bearing and tighten. The connecting rod should resist rotation and move freely with the shim paper removed. Alternatively, the bearing clearances can be determined by using 'Plastigauge'. This consists of a thin piece of plastic material. When this material is squeezed between the bearing and crankpin the width of the plastic is measured by a scale gauge which indicates clearance.

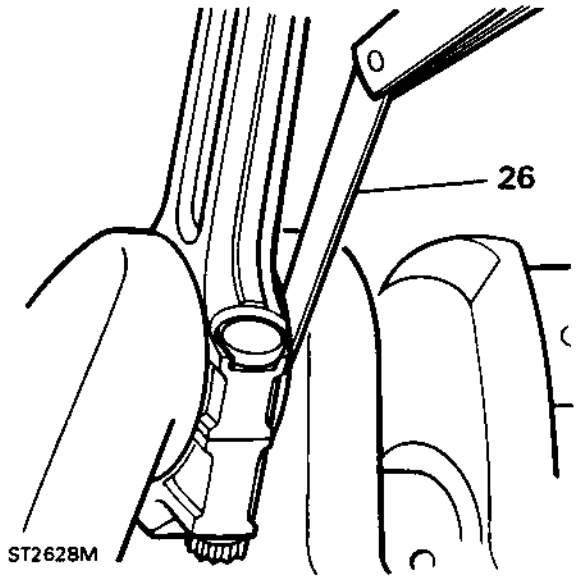
23. Wipe any oil from the crankpins and place a piece of 'Plastigauge' across the centre of the bearing in the connecting rod cap. Assemble the rod to the appropriate crankpin and tighten to the correct torque. Do not rotate the connecting rod or the crankshaft during this operation.

24. Remove the connecting rod cap and bearing shell and using the scale supplied measure the flattened 'Plastigauge' at its widest point. The graduation that most closely corresponds to the width of the 'Plastigauge' indicates the bearing clearance. The correct clearance with new or overhauled components is given in the data section. ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi Engine***
25. Wipe off the 'Plastigauge' with an oily rag. Do not scrape it off otherwise it may damage the crankpins.



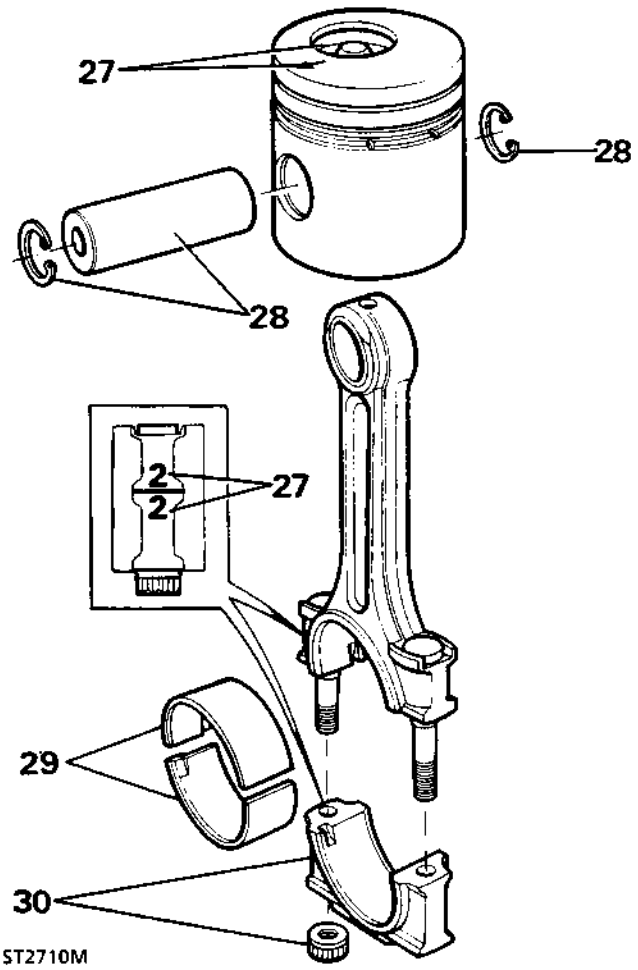
Connecting rod end-float

26. Fit the connecting rods complete with bearings to their respective crankpins. Move the connecting rod to one side and check the clearance, with a feeler gauge, on the opposite side. The correct clearance is given in the data section ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi Engine***



Assembling pistons to connecting rods

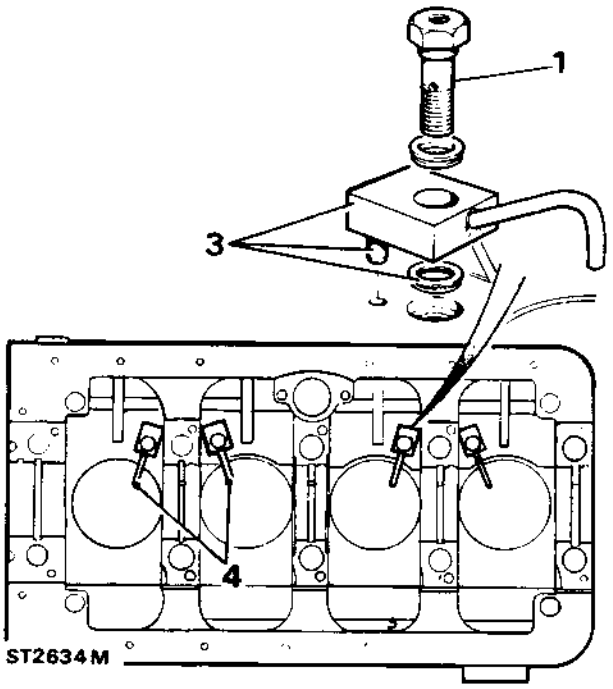
27. The piston must be assembled to the connecting rod so that the arrow on the piston crown points to the front of the engine and the off-set combustion chamber bearing shell tags and connecting rod number are all on the same, right hand side of the cylinder block viewed from the rear of the engine (camshaft side).
28. Insert a circlip in one side of the gudgeon pin boss and assemble the piston to the connecting rod with the gudgeon pin. Secure the assembly with a circlip on the opposite side of the piston.
29. Fit the bearing shells to the connecting rod and cap. Ensure that the tags locate correctly in the cut-outs.
30. Assemble the cap to the rod and secure temporarily with the two nuts until ready for fitting to the cylinder block.



FIT JET TUBES TO CYLINDER BLOCK

Oil jet tubes are fitted to lubricate the pistons and bores directly from the main oil gallery.

1. The jet tubes are 'handed' and can only be fitted one way. It is important to note that the jet retaining bolt contains a non-return valve and therefore on no account must an ordinary bolt be used.
2. Clean the recess in the cylinder block using an air line, if available, to remove any swarf.
3. Assemble and fit the jet tube assemblies ensuring that the pegs locate in the holes in the cylinder block, and that the larger diameter washer fits under the bolt head. Tap the jet blocks down to ensure that the locating dowel is fully home. Fit and tighten the retaining bolts to ***17 Nm***
   When the crankshaft and pistons have been fitted, slowly turn the crankshaft and check that no fouling occurs.



ST2634M

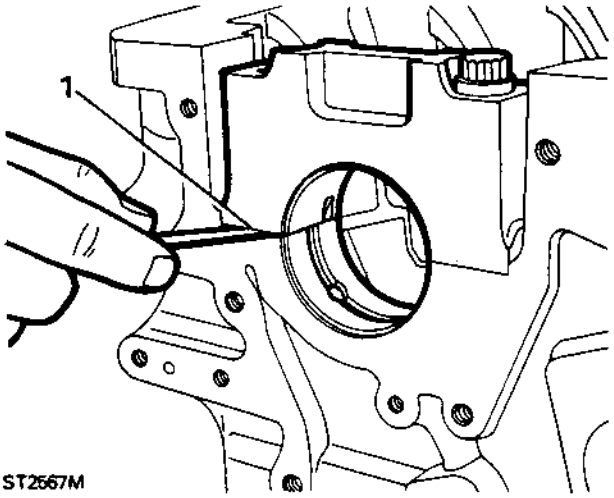
FIT CRANKSHAFT

Main bearing nip and clearance

New main bearing halves are supplied with a protective coating and must be degreased before fitting.

1. Fit the bearing halves in the crankcase saddles and caps and secure the caps to the crankcase and tighten to ***133 Nm***

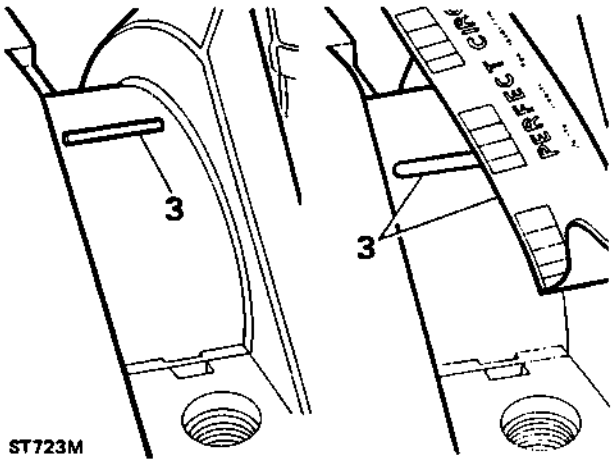
   Loosen the bolts on one side of the caps only and, with a feeler gauge, check the gap between the joint faces. The clearance or nip must be within 0,10 to 0,15 mm The bearing nip can be adjusted by selective assembly of the bearing halves available in varying thicknesses. Do not file or machine the caps or saddles to achieve the correct clearance. Note that the rear main bearings are wider than the remaining four.



ST2567M

2. To make a final check that the clearance is correct, leave the bearing halves in the crankcase saddles and carefully lower the crankshaft into position. Check each bearing in turn by inserting a 0,063 mm shim paper between the bearing cap and crankshaft journal and tighten the bolts to ***133 Nm*** If the clearance is correct, there should be a slight increase in the resistance to the rotation of the crankshaft.
   As an alternative 'Plastigauge' may be used to check the clearance in the same manner as with the connecting rod bearings. This material may also be used to determine the amount of wear in used bearings and journals.

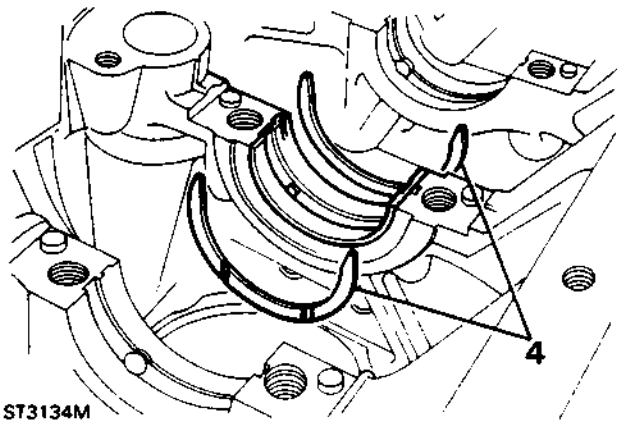
3. Locate the crankshaft in position on the upper bearing halves in the crankcase and wipe any oil from the journals since 'Plastigauge' is soluble in oil. Place a piece of 'Plastigauge' across the lower half of each crankshaft journal or lower bearing cap shell. Fit the cap and tighten to the correct torque. Remove the cap and bearing and using the scale supplied with the 'Plastigauge' measure the flattened 'Plastigauge' at its widest point. The graduation that most closely corresponds with the width of the 'Plastigauge' indicates the bearing clearance.
The correct clearance with new or overhauled components is included in the data section ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi Engine***
If fitting new bearings use selective assembly to obtain the correct clearance. Wipe off, not scrape the 'Plastigauge' with an oily rag from the journals or bearings.



ST723M

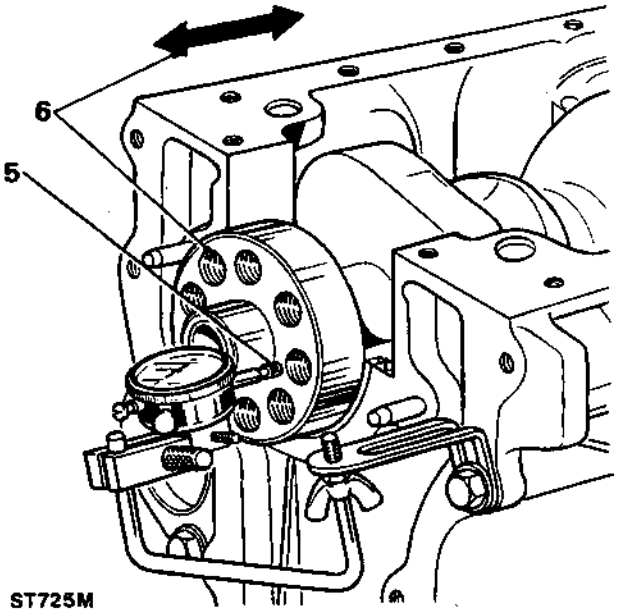
Adjust crankshaft end-float

4. Lift out the crankshaft and insert a standard size thrust washer both sides of the centre main bearing saddle with the grooves towards the crankshaft.



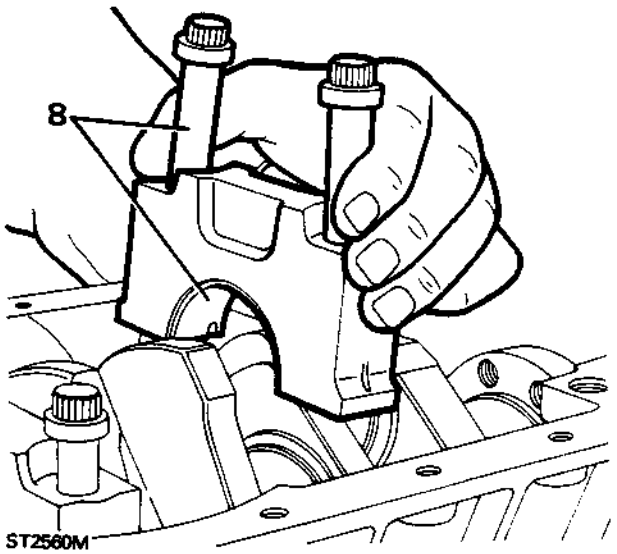
ST3134M

5. Place the crankshaft in position in the crankcase and mount a dial test indicator to read-off the end of the crankshaft. A feeler gauge may be used instead of an indicator.
6. Determine the end-float by moving the crankshaft away from the indicator and zero the dial. Move the crankshaft in the opposite direction and note the indicator reading. Alternatively measure the clearance with a feeler gauge. The end-float should be 0,05 to 0,15 mm



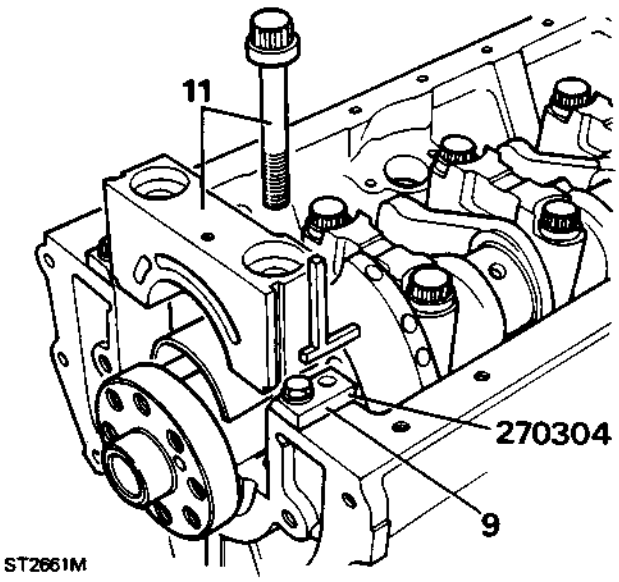
ST725M

7. If adjustment is required substitute with oversize thrust washers. Variation of thrust washer thicknesses at each side of the crankshaft journal must not exceed 0,08 mm to ensure that the crankshaft remains centralised.
8. Lubricate the crankshaft main jounals with clean engine oil and fit the appropriate bearing caps and lower shells to the crankcase with the exception of number five bearing. Ensure that the caps locate properly over the dowels. Using new bolts evenly tighten to ***133 Nm.***

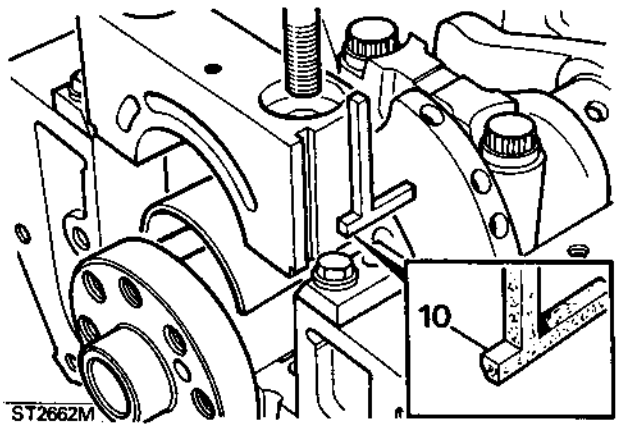


Fit rear main bearing cap

9. Ensure that number five main bearing cap is clean and free from old seal material. Attach the seal guides number 270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.

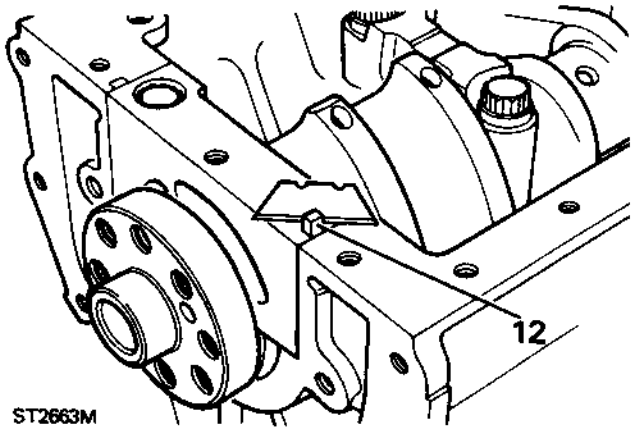


10. To prevent any seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the seal 0,40 to 0,80 mm wide as illustrated. Smear the seals with engine oil and fit them to the bearing cap.



11. Fit the bearing cap and lower shell to the crankcase and secure with new bolts and tighten to ***133 Nm*** . Remove seal guides.

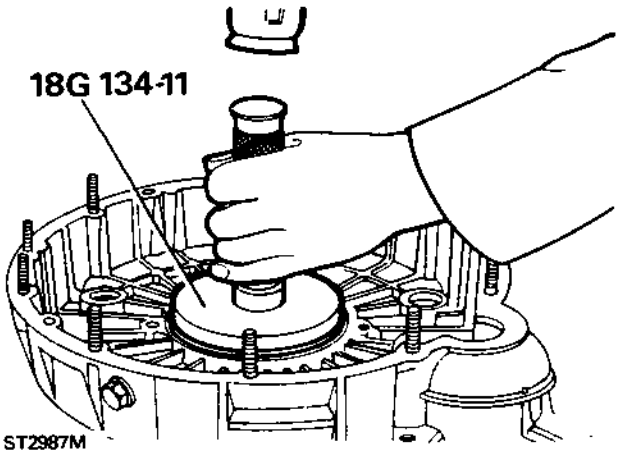
12. To allow for shrinkage after fitting leave the seals standing proud of the crankcase face then using a sharp blade, trim the seals off to approximately 0,80 mm above the crankcase face.



FITTING REAR MAIN OIL SEAL TO FLYWHEEL HOUSING

△ **NOTE: The oil seal is manufactured from PTFE and is supplied with a former to maintain the correct shape which must not be removed until the seal is to be fitted.**

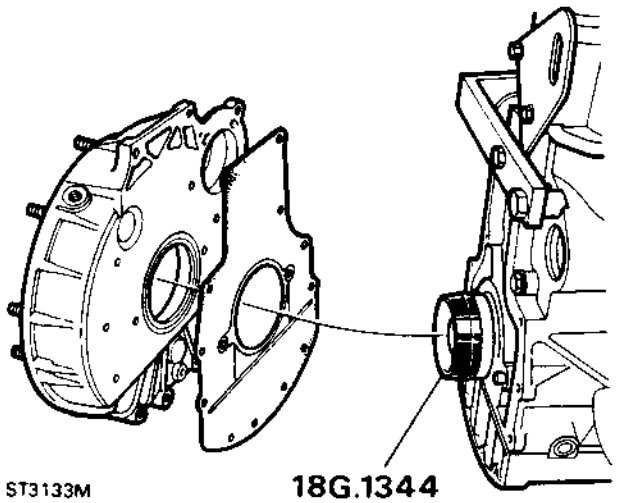
1. Make sure the seal housing is clean and dry and free from burrs. Do not touch the seal lip and ensure that the outside diameter is clean and dry.
2. Using seal replacer 18G134-11 and with the lip side leading fit the seal. Fit the seal to the bottom of the housing.



Fitting flywheel housing

3. Examine the seal guide, number 18G1344 ensuring that it is perfectly smooth and not damaged or scratched. Also check that the crankshaft oil seal journal is smooth and clean.

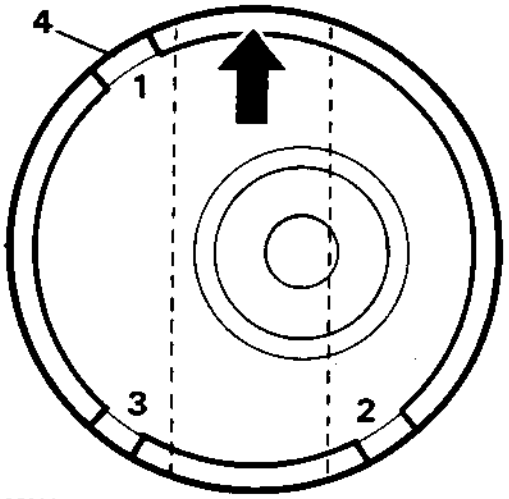
4. Locate the seal guide on to the crankshaft and lubricate the seal, guide and journal.
5. Position the gasket on the cylinder block over the two dowels. The gasket will only fit one way round.
6. Fill the annular groove with RTV sealant.
7. Place the seal guide over the crankshaft flange and using the two dowels as a guide to ensure initial squareness, fit the flywheel housing and remove the seal guide.
8. Secure the housing with the retaining bolts and tighten evenly to ***45 Nm***



ST3133M

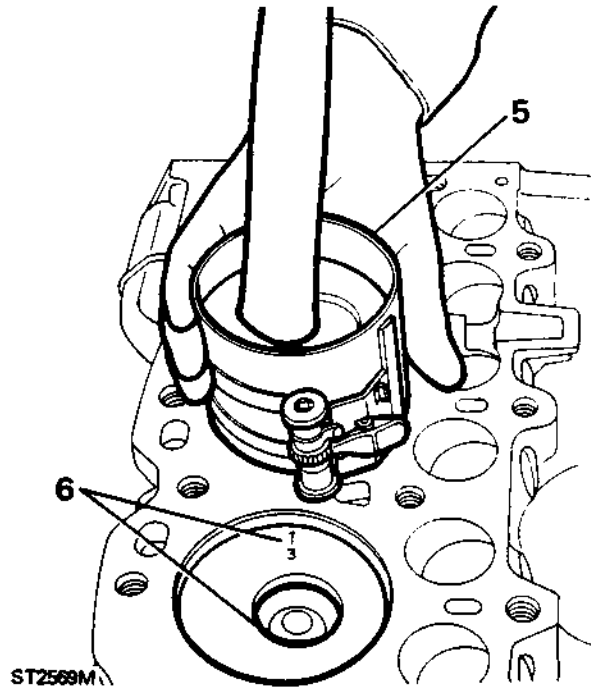
FIT THE CONNECTING RODS AND PISTONS

1. Invert the cylinder block so that the combustion face is uppermost. Turn the crankshaft to position numbers one and four crankpins at bottom dead centre to facilitate fitting the connecting rods.
2. When fitting the connecting rods and pistons ensure that bolts do not foul and damage the crankpins. It is recommended that rubber or soft plastic sleeves are placed over the threads.
3. The connecting rod bolts have eccentric heads which locate in a recess in the connecting rod. It is essential that the head of each new bolt is properly located before tightening.
4. Stagger the compression rings so that the gaps are equidistantly spaced around the piston but, arranged so, that no gap is positioned on the thrust side of the piston i.e. opposite the camshaft. Turn the oil control ring so that the gap is to the left of the gudgeon pin.

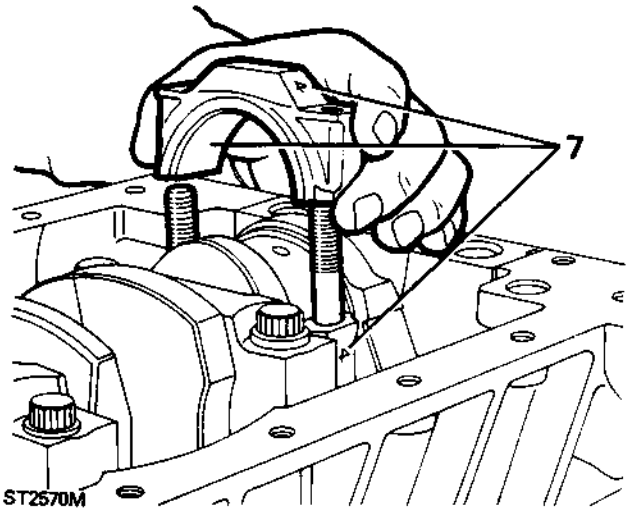


ST2669M

5. Lubricate the cylinder walls, piston rings and crankpins. Compress the piston rings with a suitable compressor tool and carefully lower the connecting rod into the bore ensuring that the piston is assembled in accordance with instruction 27 under "Assemble pistons to connecting rods".
6. The arrow must point to the front of the engine and the offset combustion chamber in the piston crown must be towards the camshaft side of the cylinder block, with the bearing tag also on the camshaft side. Sharply tap the piston into the bore so that the whole of the piston is just below the surface of the cylinder block.

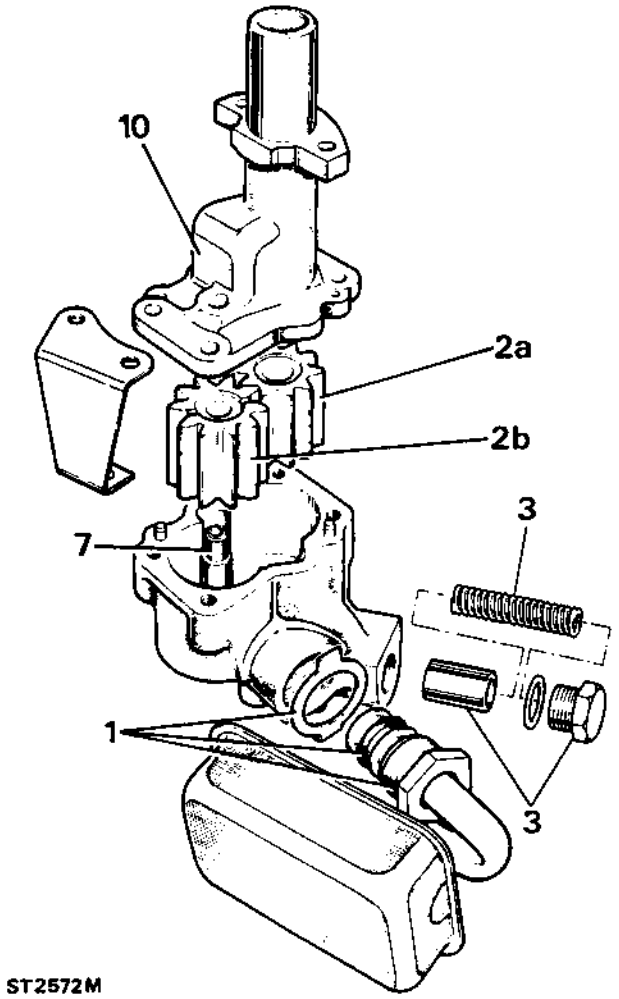


7. Check that the bearing shell is properly located in the connecting rod and pull the rod onto the crankpin. Locate the bearing shell correctly and fit the cap so that the identification numbers are together on the camshaft side of the engine. Fit and tighten new nuts to the correct torque ***59 Nm*** Repeat the foregoing instructions for fitting the remaining piston and connecting rod assemblies.



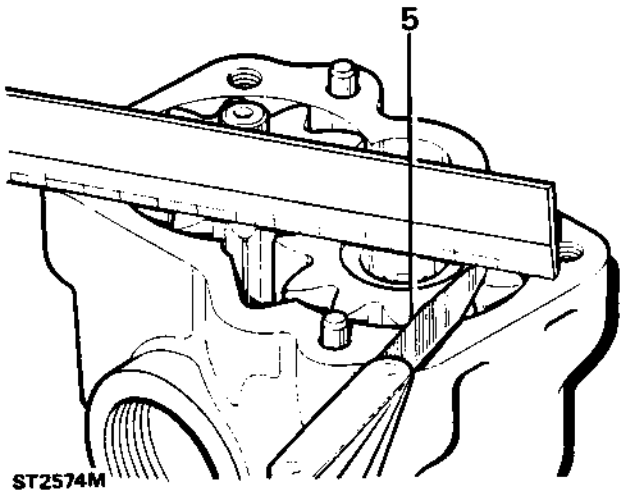
OVERHAUL THE OIL PUMP

1. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
2. Remove four bolts and washers and lift off the oil pump cover and lift out the driven and idler gears.
   (a) driven gear
   (b) idler gear
3. Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring and plunger and examine for wear and scores.
4. Examine the gears for wear, scores and pits. If the gears appear serviceable check for end-float as follows:
5. Clean the pump body and assemble the gears. Place a straight edge across the pump body face, as illustrated, and using a feeler gauge, measure the clearance between the body and gears. Check also the backlash between the gears. The correct clearances are given in the data section ***See GENERAL SPECIFICATION DATA, Information, 200 Tdi Engine***



ST2572M

6. A worn, but serviceable gear, must not be matched with a new one, always renew gears in pairs.

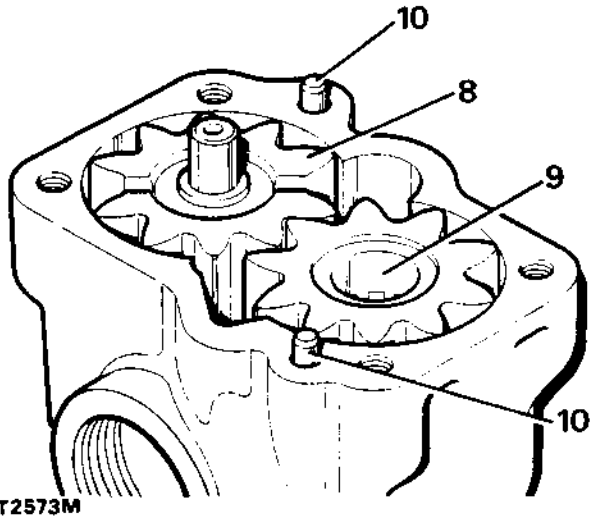


ST2574M

7. If necessary renew idler gear spindle by driving-out the spindle from the pump body and driving or pressing-in a new spindle up to the shoulder of the spindle.

Assemble the oil pump

8. Fit the idler gear to the spindle.
9. Fit the driven gear with the plain part of the bore uppermost.
10. Check the pump cover for wear and scores, and if necessary fit a replacement, locating it over the two pegs. Loosely secure with the four bolts until the strainer is fitted.



ST2573M

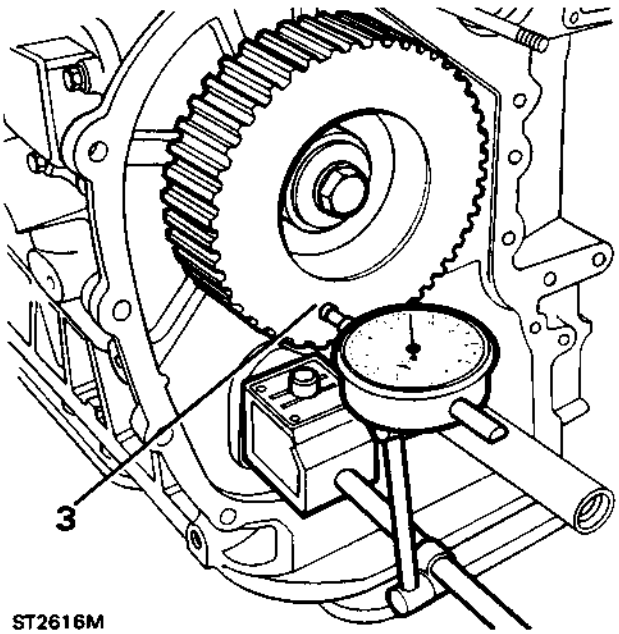
11. Hold relief valve bore vertically and insert the plunger with the solid end first. Fit the spring, sealing washer and plug.
12. Fit a new 'O' ring to the oil strainer pipe and insert into the pump body and loosely secure with the lock washer and nut.
13. Secure the strainer bracket to the pump body and tighten the four screws.
14. Tighten the strainer pipe nut and secure with the lock tab.

EXAMINE AND FIT THE CAMSHAFT

1. Mount the camshaft on "V" blocks on a surface plate and examine the cams for wear, scores, pitting and chipped edges. Examine the journals for obvious wear and scores and signs of overheating, in particular, check the thrust face of the front journal and the thrust plate. If the journals are visibly serviceable, check with a dial indicator or micrometer for overall wear, ovality, taper and run-out.

⚠ **CAUTION: If the skew gear is worn and requires renewal, the camshaft must also be renewed even though the camshaft gear may appear satisfactory. Once the two gears have run together they become a matched pair.**

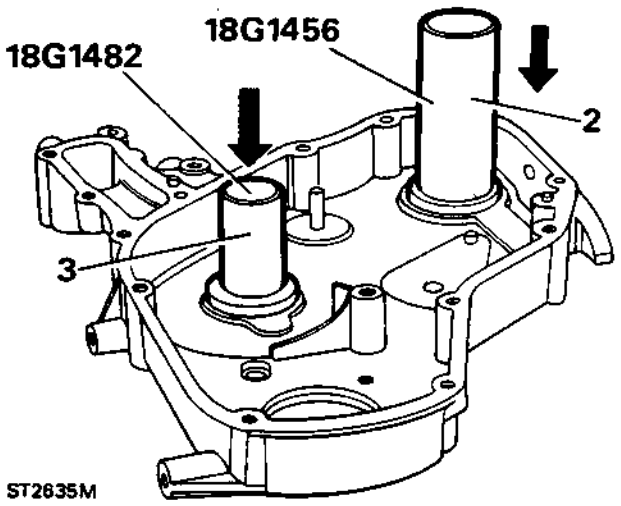
2. Lubricate the camshaft bearings and journals with clean engine oil and carefully insert the camshaft into the cylinder block. Fit the thrust plate and secure with the two bolts and tighten to ***9 Nm.***
3. To check the camshaft end-float, temporarily fit the camshaft gear and mount a dial test indicator so that the stylus rests in a loaded condition upon the machined face of the gear. Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0,06 to 0,13 mm If the end-float is outside these limits, fit different thrust plates until the correct tolerance is achieved.



ST2616M

FIT THE FRONT COVER

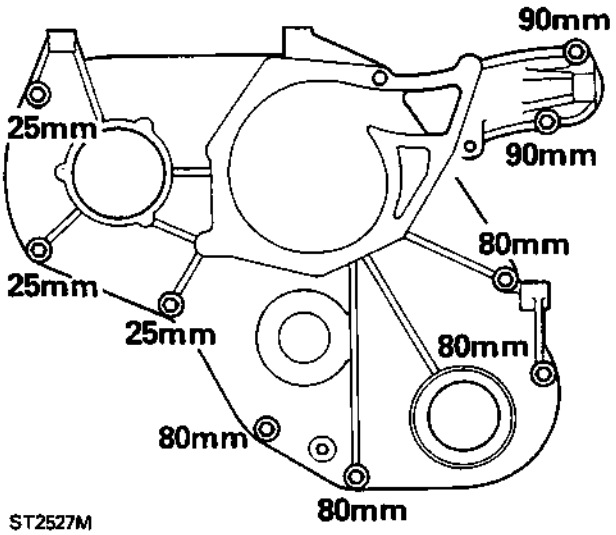
1. Clean the front cover and remove the crankshaft and camshaft oil seals taking care not to damage the seal housings. Examine the cover for damage, cracks and distortion. Check the mating face of the cylinder block and the cover plate for burrs.
2. Place the front cover, cylinder block face downwards on a flat surface and lubricate a new crankshaft oil seal. With the lip side leading, drive-in the seal, squarely, using service tool 18G1456. The back of the seal should be approximately 0,5 mm below the innner face of the cover.
3. Similarly, lubricate and drive-in a new camshaft oil seal, lip side leading using special service tool 18G1482. The seal should be approximately 1,0 mm below the inner face of the cover.



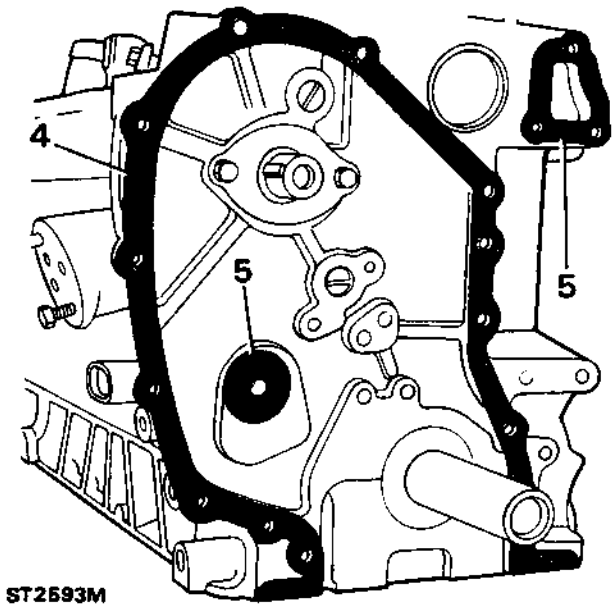
ST2635M

4. Clean the front face of the cylinder block and use a little grease to hold in position a new joint washer.
5. Also fit a new joint washer to the coolant aperture and to the tapped hole for the jockey pulley clamp bolt.

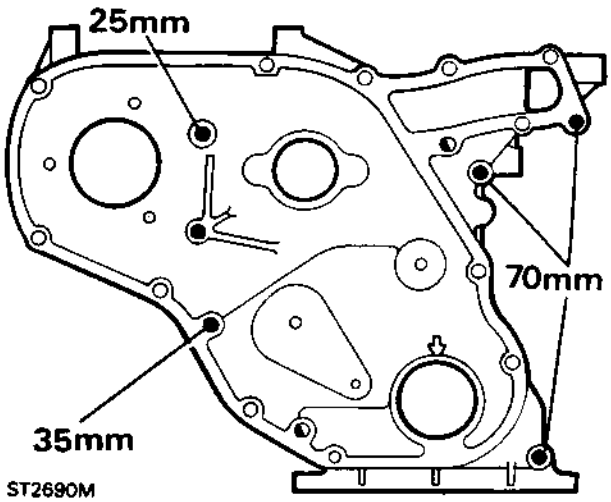
6. Taking care not to damage the oil seals fit the front cover locating it over the single stud. Secure with the five retaining bolts tightening evenly to the correct torque. The correct bolt length for each hole is given in the following chart.



ST2527M



ST2693M

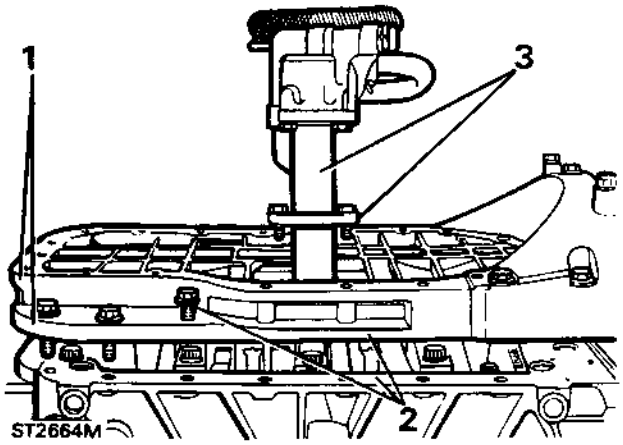


ST2690M

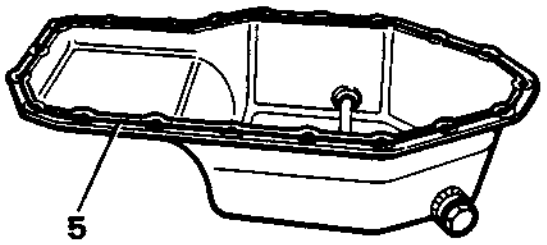
FIT LADDER FRAME, OIL PUMP AND SUMP

The sealant used cures within 15 minutes and as some of the retaining bolts are common to the sump it is important that the ladder frame, oil pump and sump are fitted together without delay. Before applying sealant coat both faces with Hylogrip Primer to clean and hasten curing.

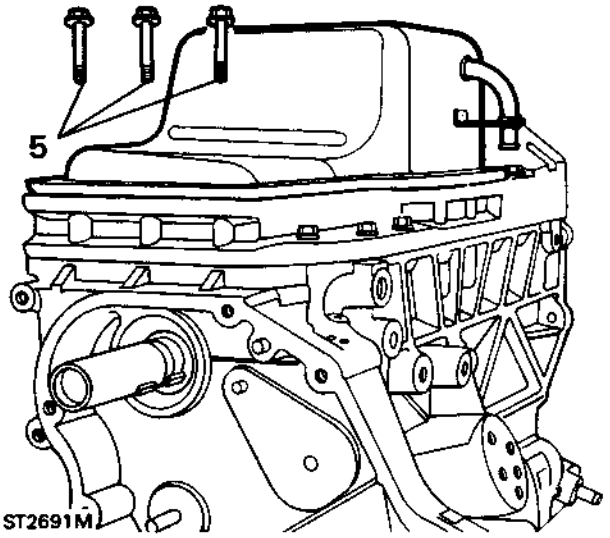
1. Clean both sides of the ladder frame and remove all traces of old sealant. Check the frame is not distorted and is free from burrs and damage on the mating faces that could cause oil or bypass gas to leak.
2. Apply 'Hylogrip 2000' to the mating face with crankcase. Apply 'Hylosil RTV' to joint line of crankcase to flywheel housing. Loosely fit the ladder frame. Fit 4 bolts securing flywheel housing to ladder frame tighten to ***45 Nm.*** Tighten 10 ladder frame to crankcase bolts to ***25 Nm.***
3. Fit the oil pump and strainer assembly to the crankcase location and tighten the two bolts to ***25 Nm***



4. Clean the sump and remove all traces of old sealant. Examine the sump for damage, such as dents, and distortion. Check that the drain plug threads in the sump are not stripped or damaged so that an oil leak could occur.
5. Apply 'Hylosil RTV' to the sump mating face with the ladder frame. Fit the 20 bolts and tighten to ***25 Nm.*** Note that the three long bolts pass through the sump and ladder frame into the front cover.



ST2665M



OVERHAUL AND FIT FLYWHEEL

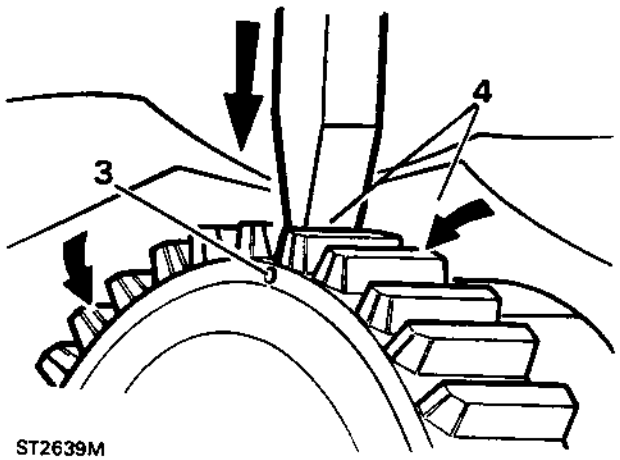
1. Normal wear and scores on the flywheel clutch face can be repaired by machining provided that the overall width of the flywheel is not reduced below 36,96 mm. Examine the ring gear and if the teeth are chipped and worn the gear can be renewed.

Reface the flywheel

2. Remove the clutch cover locating dowels. Machine the flywheel over the entire clutch face removing only the minimum of material necessary to achieve a smooth surface parallel with the crankshaft mating face and within the above dimensions.
3. To renew the ring gear, drill a 8 mm hole between the root of any two teeth and the inner diameter of the ring gear deep enough to weaken the gear. Take care not to allow the drill to enter the flywheel.

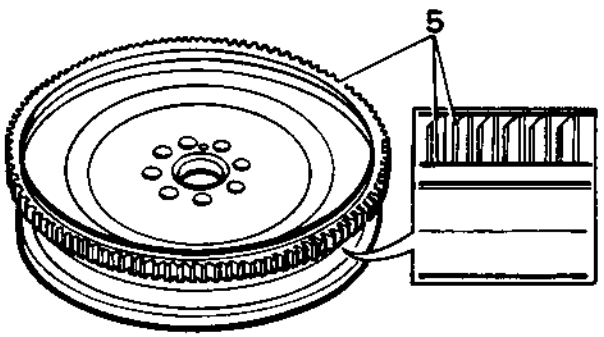
WARNING: Wear industrial goggles to protect the eyes from flying fragments.

4. Secure the flywheel in a soft jawed vice and cover it with a cloth to avoid personal injury. Place a cold chisel above the drilled hole and strike it sharply to split the ring gear.



ST2639M

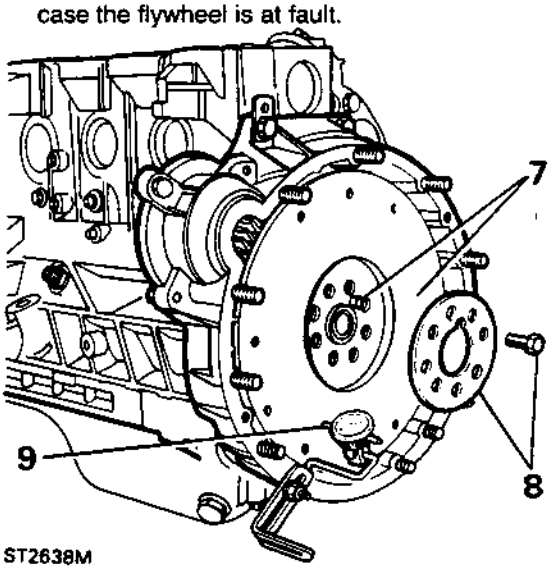
5. Heat the new ring uniformally to between 225°C and 250°C but do not exceed the higher figure. Place the flywheel, clutch face down, on a flat surface and locate the heated ring gear with the square edge of teeth downwards towards the flywheel clutch face and chamfered edge of the teeth uppermost.
6. Press the starter ring firmly against the flange until the ring contracts sufficiently to grip the flywheel. Allow the ring to cool naturally. Do not hasten cooling in anyway otherwise distortion may occur.



ST2640M

Fitting flywheel

7. Make sure the crankshaft and flywheel mating faces are clean and free from burrs and imperfections that could prevent the flywheel running true. Check that the dowel is in position in the crankshaft and that it is undamaged.
8. Offer up the flywheel to the crankshaft and secure with the reinforcing plate and retaining bolts. Temporarily fit the damper to front of crankshaft and use special service tool FR101 or LST127 to restrain the crankshaft whilst the eight retaining bolts are being tightened to ***146 Nm.***
9. To check the flywheel for possible run-out, mount a dial test indicator so that the stylus rests, in a loaded condition, on the clutch pressure face at a radius of 114 mm from the centre of the flywheel. Turn the flywheel, and check that run-out does not exceed 0,05 to 0,07 mm Should any run-out be excessive, remove the flywheel, and check again for irregularities on flywheel and crankshaft mating faces and dowel. Should excessive run-out persist the flywheel should be checked on independant equipment in case the flywheel is at fault.

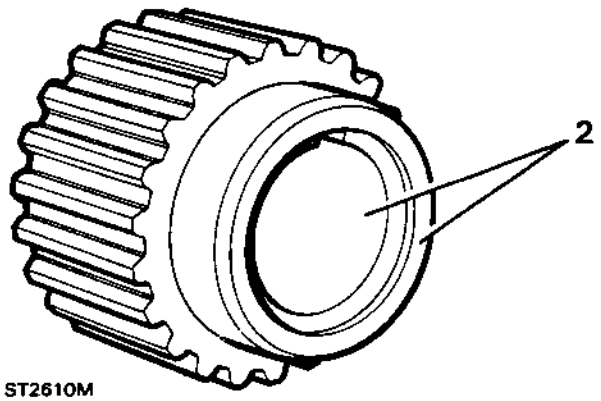


ST2638M

VALVE AND INJECTION PUMP TIMING

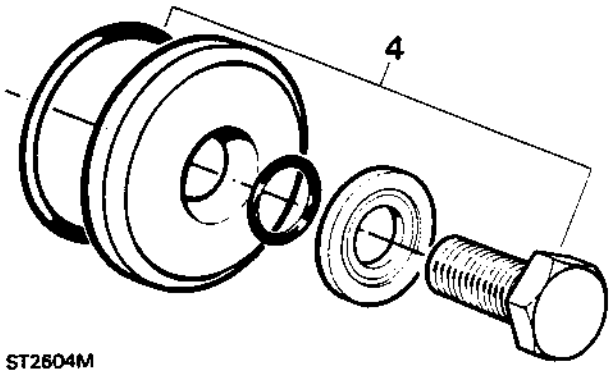
1. Examine the gear wheels for wear and damage. Cleanliness and accuracy are vital when carrying out the following instructions. The gear wheels must be free from oil and grease. Drive belts which have not been stored and treated in the following manner should not be used.
   Drive belts must be stored on edge on a clean flat surface and in such a manner that bends are not less than 50 mm radius.
   When a belt is handled, it must not be bent at an acute angle or an arc of less than 25 mm in diameter, as damage may be caused to the glass fibre reinforcement and premature failure could result.
   During use, a belt develops a wear pattern, therefore, if it has to be re-used, before removal, mark the direction of rotation, using soft chalk or a similar marker, and refit the belt so that it runs in the original direction.
   Belts must be dry and FREE FROM ANY OIL OR OTHER CONTAMINATION.
   Do not turn the crankshaft by applying leverage to the camshaft pulley or its retaining bolt.
   To remove a belt always use clean hands, or a recommended tool - NEVER use a lever.

2. Fit the gearwheel to the crankshaft.



ST2610M

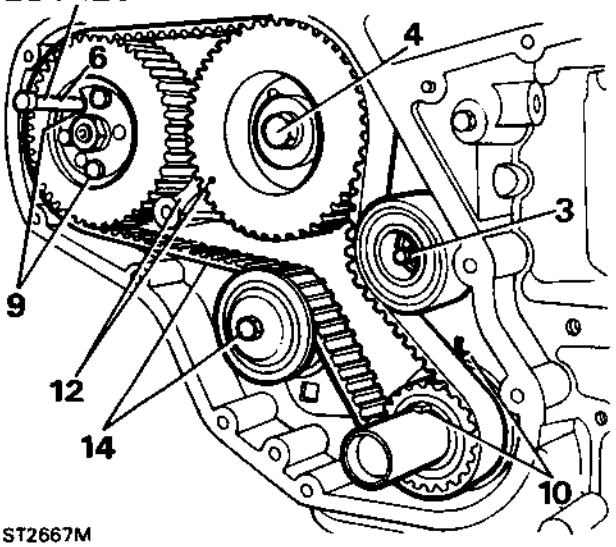
3. Fit the static tensioner and secure with the single nut and tighten to ***45 Nm.***
4. Fit the camshaft gear and secure with the special bolt, washer and 'O' rings.



ST2604M

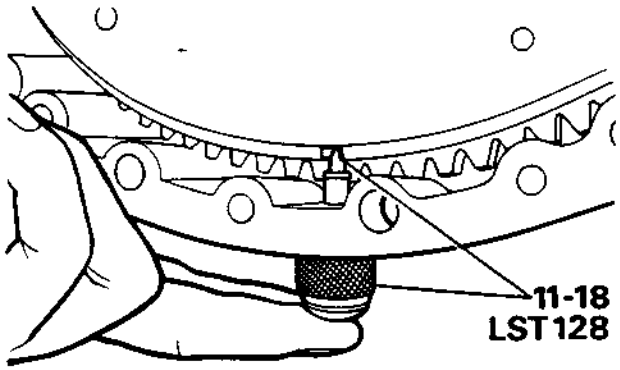
5. Fit the front side cover.
6. Insert timing pin in the pump hub and body.
7. Fit the injection pump and secure with the three nuts and tighten evenly to ***25 Nm.***
8. Fit the pump rear support bracket to the front side cover and secure to the pump with two bolts and nuts.
9. Fit the gear to the injection pump hub with the reinforcing plate and three bolts so that the 'U' shaped slot lines up with the timing pin. Do not fully tighten the three bolts at this stage.
10. Turn the crankshaft so that numbers one and four pistons are at T.D.C. and the woodruff key is aligned with the cast on arrow inside the front cover.

LST129



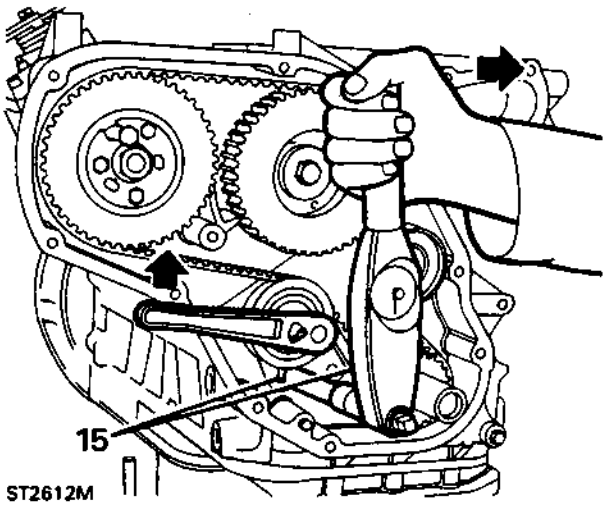
ST2667M

11. Screw the body of timing pin LST128 into the bottom of the flywheel housing and check that the pin will locate into the flywheel slot. It is important to note that there are two slots in the flywheel and that the narrowest is the one that must be used for this direct injection engine.



ST2641M

12. Rotate the camshaft so that the cams are positioned with number one cylinder valves closed and number four cylinder valves on the "rock". The centre dot on the camshaft gear should now be aligned with the front cover web as shown.
13. Feed the drive belt over the gears keeping it tight on the drive side without moving the gears.
14. Fit the belt tensioner with the special washer and single bolt.
15. Insert a 13 mm square drive extension into the hole in the tensioner support plate and with a dial type torque wrench held vertically, tension the belt to 18 to 20 Nm whilst tightening the tensioner clamp bolt to ***25 Nm***. Do not use a "break" type torque wrench.



ST2612M

16. Tighten the three bolts that secure the pump gear and reinforcing plate to the pump hub to ***25 Nm*** and remove the timing pin.

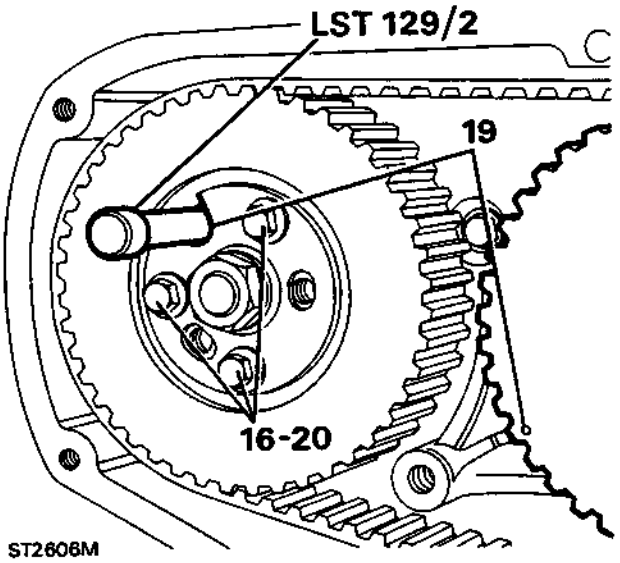
⚠ **CAUTION: Unlock the injection pump and fit the keeper plate before attempting to turn the crankshaft. Also ensure that the flywheel timing pin LST128 is clear of the flywheel slot.**

17. Rotate the crankshaft two complete revolutions and loosen the tensioner clamp bolt and tension the belt again, as previously described.

⚠ **CAUTION: The double tensioning procedure is vital otherwise the belt could fail resulting in serious damage to the engine. If a new belt is not available and it is necessary to fit the old one, it should only be torqued to 16 to 18 Nm**

18. Turn the crankshaft again in a clockwise direction until the flywheel timing pin locates in the T.D.C. slot.

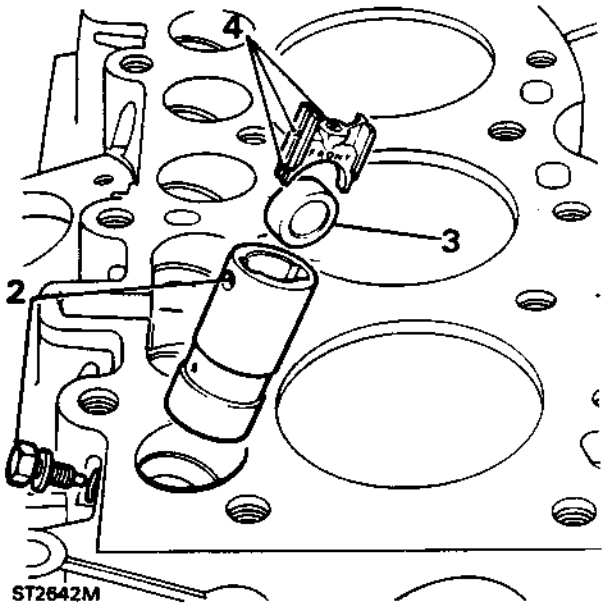
19. Insert the timing pin in the pump hub and check that the crankshaft key aligns with the arrow on the front cover. Also check that the dot on the camshaft gear aligns with the front cover web.
20. If the timing pin cannot be inserted fully into the pump hub slot, it is necessary to loosen the three pump gear retaining bolts and slightly turn the hub, in the appropriate direction, to allow the pin to locate. Retighten the bolts.



ST2606M

FIT CAM FOLLOWER ASSEMBLIES

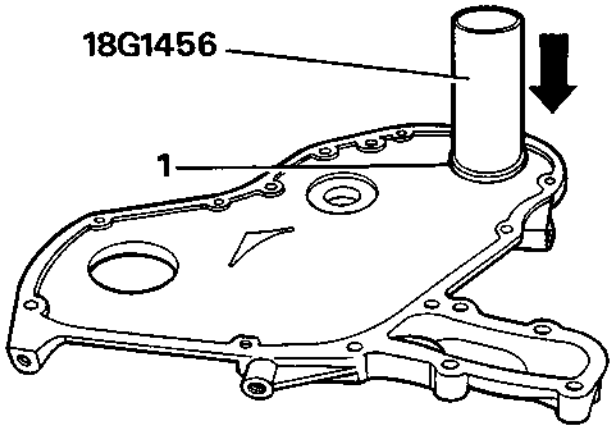
1. Examine all the components for wear and damage, particularly the rollers. Renew any component that is worn. Ensure that the tappet slides move freely in the guides. If the same parts are being refitted, ensure that they are returned to their original positions.
2. Insert the tappet guides into the cylinder block and align the locating screw holes and fit new micro encapsulated screws but do not allow the ends of the screws to protrude into the bore of the guide until the slides and rollers are fitted.
3. Fit the tappet rollers ensuring that they are fitted in accordance with the marks made during removal. New rollers, however, may be fitted either way around.
4. Before fitting the tappet slides make sure the oilways are clear to the tappet bearing surface, the cross drilling and the oil feed to the push rod. Insert the tappet slides with the word 'FRONT' or 'F' towards the front of the engine.
5. Finally tighten the screws securing the guides to ***14 Nm.***



ST2642M

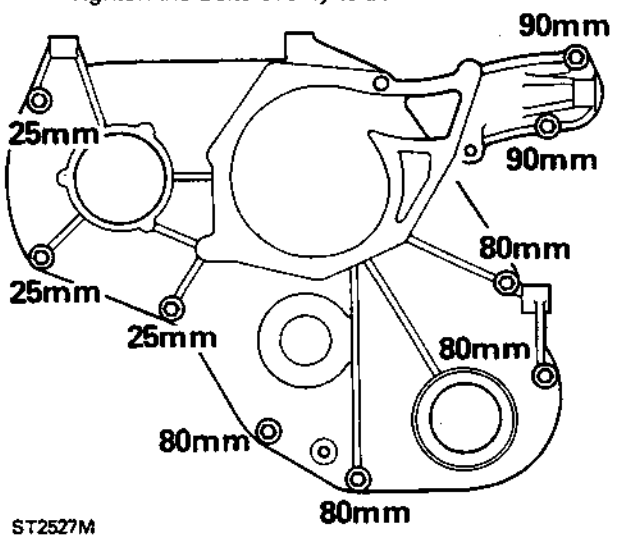
FITTING FRONT COVER PLATE AND DAMPER

1. Remove the old ingress seal from the front cover plate and clean the seal housing. With the inside of the cover uppermost use special service tool 18G1456 to drive-in a new seal, lip side leading, so that when fitted the lip faces away from the crankshaft.



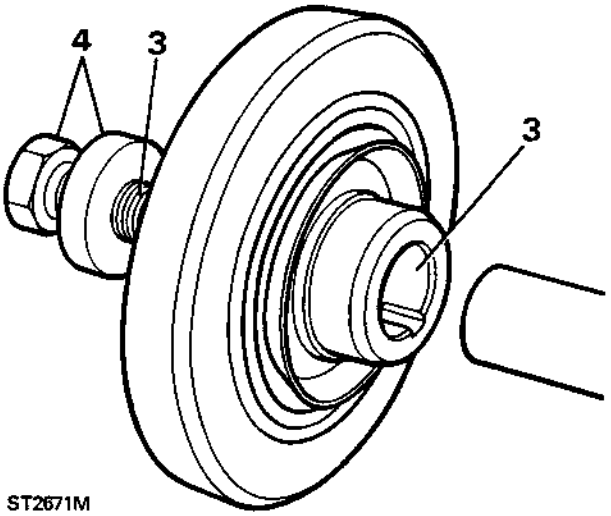
ST2601M

2. Clean the front cover and cover plate mating faces and apply Hylogrip Primer to both faces. The primer acts as a cleaner and a curing agent for the sealant. Apply a bead of Hylogrip 2000 to the cover plate and fit the plate to the front cover. Secure the cover with the nine retaining bolts. Since the bolts are of varying lengths, the following chart shows the correct positions. Tighten the bolts evenly to ***25 Nm.***



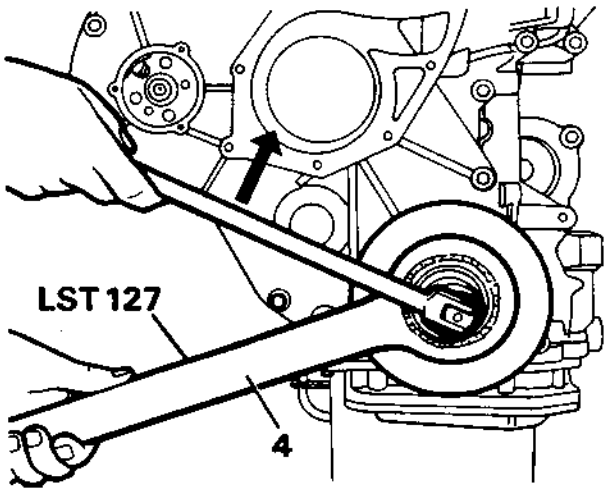
ST2527M

3. Clean off the old Loctite and smear the in-board half of the inside diameter of the damper with Loctite 242.



ST2671M

4. Fit the damper to the crankshaft with the distance piece and special bolt. Using service tool LST127 restrain the damper whilst pulling the damper into position with the bolt. Remove the bolt, apply Loctite 242 to threads and fit and tighten to ***341 Nm.***



ST2643M

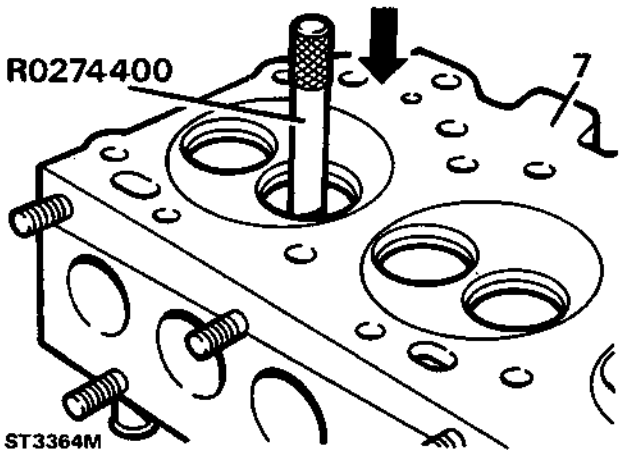
OVERHAUL AND FIT CYLINDER HEAD

CAUTION: 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 resting it on a hard or abrasive surface while carrying out the overhaul operations.

1. Using valve spring compressor MS1519A or a suitable alternative, remove the valve and spring assemblies keeping them identified with their original locations for possible refitting.
2. Discard the valve springs and valve guide oil seals. Remove carbon deposits from the valves and combustion chambers and degrease all parts ready for examination.
3. Examine the cylinder head for damage and distortion. Inspect the valve seat inserts for damage. Seat inserts that are beyond repair and require renewal should only be attempted by skilled specialists in this work. However, refacing of the seats can be carried out using valve seat cutting equipment as described later.
4. Examine the valve guides for wear and damage. Check for stem wear by inserting a new valve, in each guide in turn, approximately 8 mm above the seat and if movement across the head exceeds 0,15 mm, the guide should be renewed.
5. Inspect the valves for wear and damage. Valve heads that are burnt and cracked should be renewed. Valves which are bent and distorted should also be renewed. Check the stems for wear by inserting in a new guide and checking the movement across the valve head when held approximately 8 mm above the seat. If movement exceeds 0,15 mm the valve should be discarded.

Renew valve guides

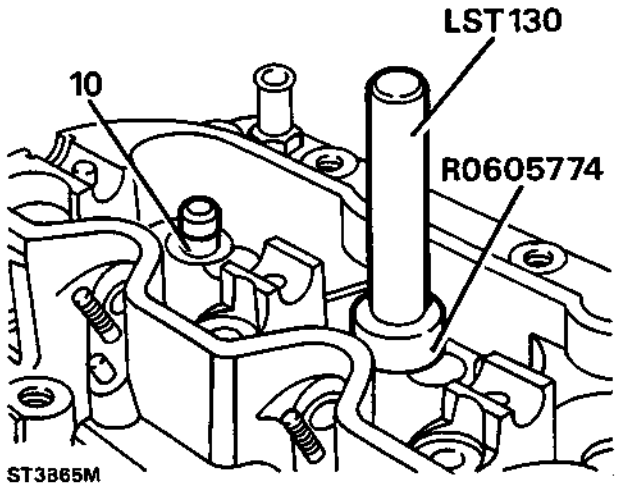
6. Support the cylinder head, to enable valve guides to be driven out.
7. Using service tool RO274400, drive out the inlet and exhaust valve guides.



8. Clean the bores from which the guides were removed.
9. Heat the cylinder head to a temperature of 120°C.

NOTE: Only service valve guides must be used for this operation, standard valve guides are not suitable.

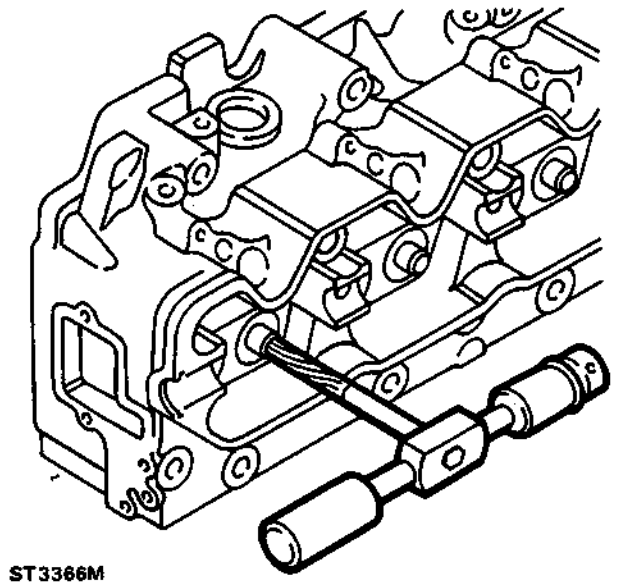
10. Lubricate then fit valve guides using service tools LST130, height gauge RO605774 and a press.



ST3865M

11. To ensure a uniform internal diameter for the total length of the guide, hand ream the guides with 18G 1636.

⚠ **CAUTION: After the cutting edges of the reamer have passed through the guide detach the wrench and withdraw reamer from combustion side of head. Under no circumstances should the reamer be withdrawn back through the guide.**


ST3366M

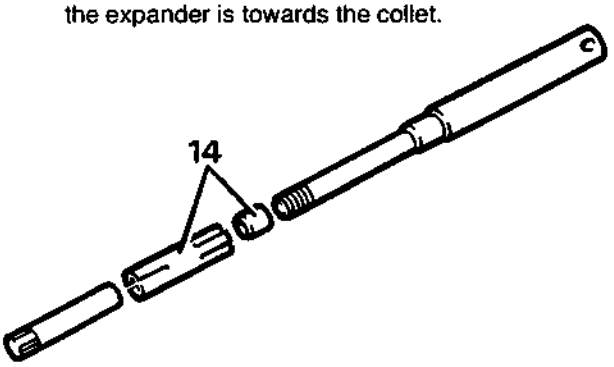
Reface valve seat inserts

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

12. The special set of hand tools recommended for refacing valve seat inserts comprise expandable pilots, MS150-8, that fit tightly into new or worn guides to ensure that the valve seat is concentric with the valve guide.
13. The refacing tool, MS621 has 45° cutters for use on exhaust valve seats, and MS627 has 60° cutters for use on the inlet valve seats. The handle set MS76B is common to both cutting heads.

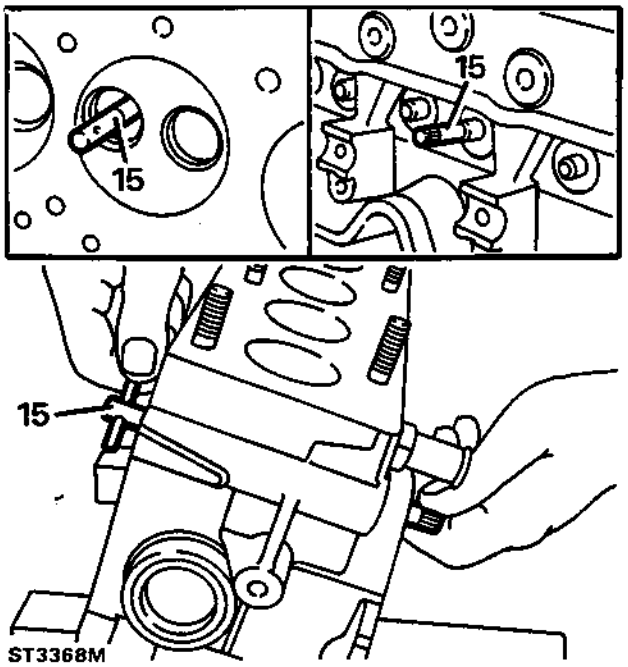
△ **NOTE: Cutter MS621 is a double ended tool having cutters of 30° and 45°. Ensure that the 45° cutter is used in this application.**

14. Loosely assemble the pilot in the sequence illustrated, ensuring that the chamfered end of the expander is towards the collet.

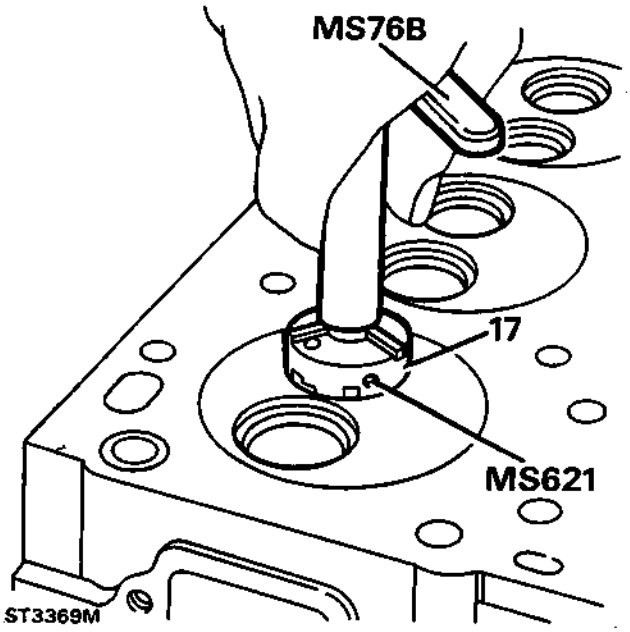


ST3367M

15. Insert the assembled pilot into the valve guide, from the combustion face side of the cylinder head, until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide. Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled knob.



16. Using the appropriate cutter for the valve seat being refaced, ensure that the cutter blades are correctly fitted to the head with the angled end of the blade downwards facing the work. Check that the blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided to make any adjustments.
17. Fit the wrench to the cutter head and turn clockwise using only very light pressure. Continue cutting to approximately the centre of the existing seat.
18. To check the effectiveness of the cutting operation use engineers blue. Smear a small quantity of blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a gap of not more than 12 mm it can be corrected by lapping.



Reface valve head faces

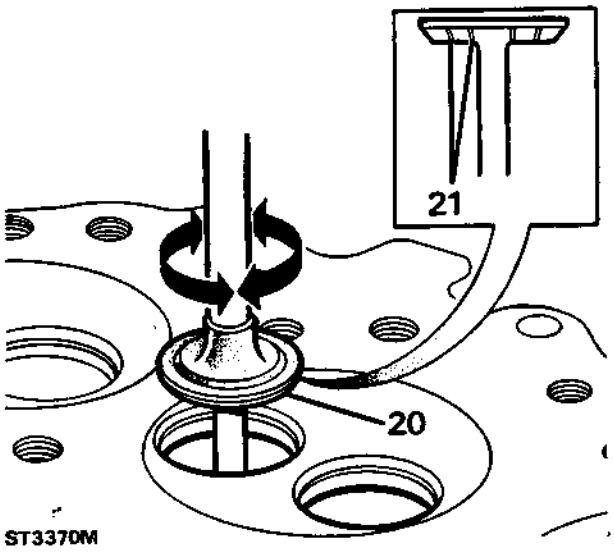
Exhaust valve head faces should be reground to an angle of 45° 00' - 44° 30' to give an included angle of 90°.

Inlet valve head faces should be reground to an angle of 60° 30' - 60° 00' to give an included angle of 120°.

19. Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly when all pits are removed and the face concentric with the stem.

Lap-in valves

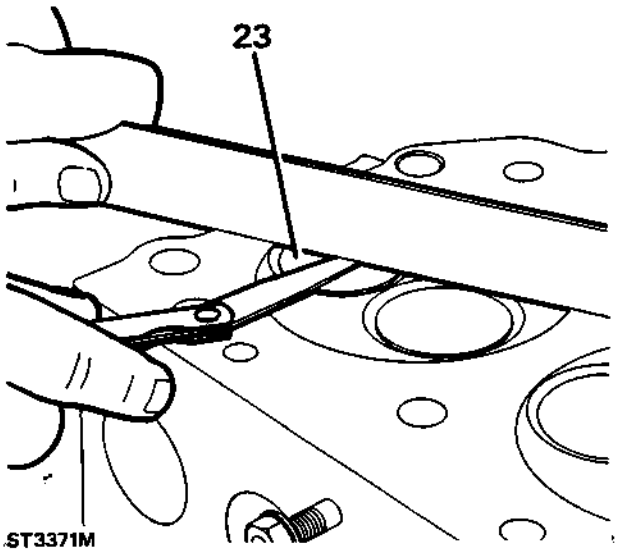
20. To ensure a gas tight seal between the valve face and valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed. Unless the faces to be lapped are in poor condition it should only be necessary to use fine valve lapping paste. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil. Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.



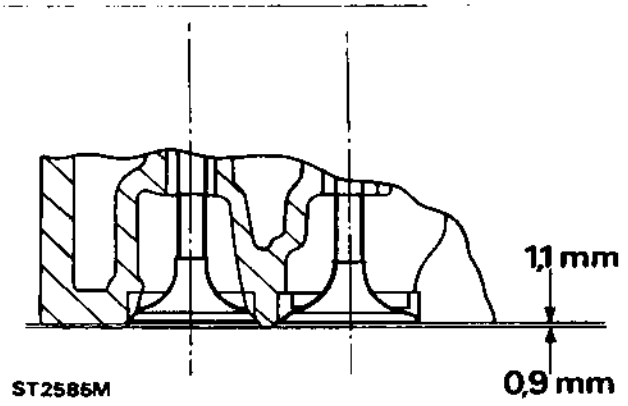
ST3370M

21. Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is sucessful, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face.
22. Insert the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter of a turn a few times. If all the pencil lines are cut through no further lapping is required. Wash all traces of grinding paste from the valves and cylinder head.

23. Position the cylinder head with the combustion face uppermost and insert the valves into their respective guides. To check the valve head stand-down or the correct dimension of the valve head below the combustion face, use either a dial test indicator or a straight edge and feeler gauge. Hold the straight edge across the centre of each valve in turn and measure the gap between the valve head and straight edge. The correct dimension should be 1,1 to 0,9 mm Using a dial gauge zero the gauge on the combustion face then move the stylus across to the valve head and note the reading.



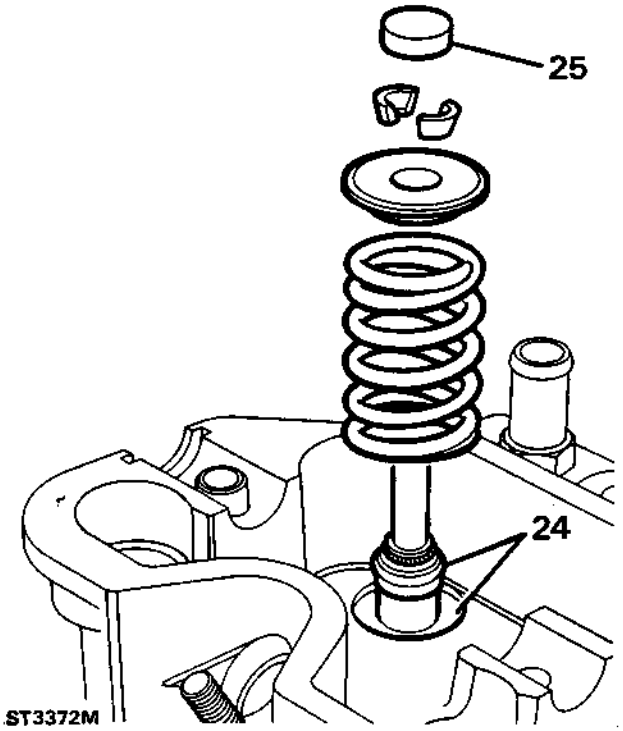
ST3371M

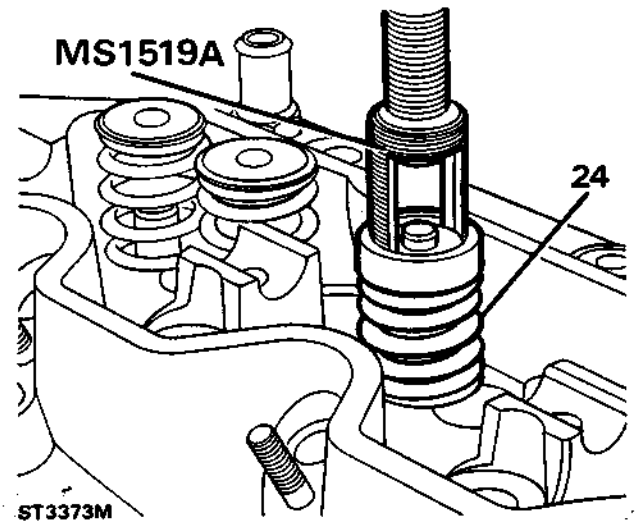


ST2586M

Assemble valves to cylinder head

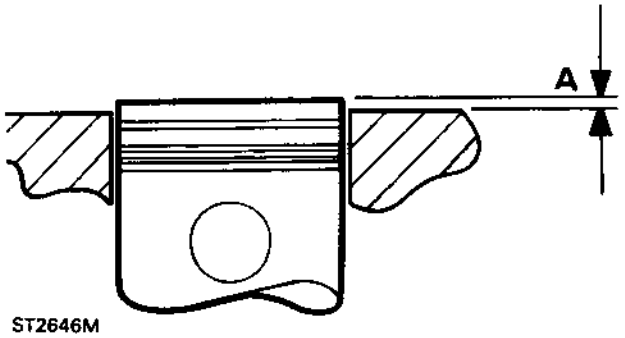
24. Insert the valves into their respective guides. Place the steel spring plate over the valve guide, followed by the oil seal with the garter spring uppermost. Ensure that the seal fits over the valve guide. Fit the spring and cup and secure with the multi-groove butting cotters whilst compressing the assembly with the special service tool MS1519A or a suitable alternative.
25. Fit new caps to the valve tips.





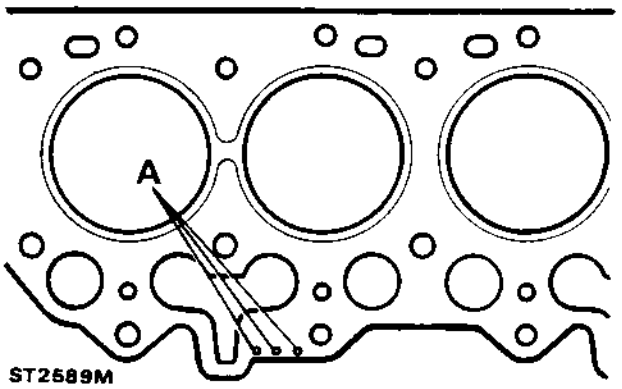
Fitting cylinder head

When the pistons are at T.D.C. they protrude above the top of the cylinder block. The amount of protrusion determines the thickness of cylinder head gasket that must be fitted. The height of all the pistons above the cylinder block must be measured and the thickness of the gasket selected is based upon the largest value of dimension 'A'. This dimension, however, must not exceed 0,8 mm

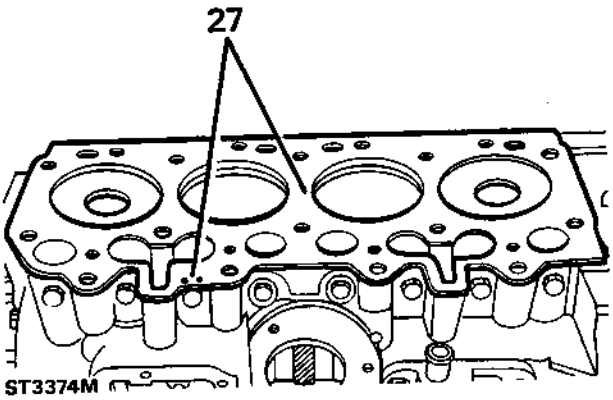


Three thicknesses of gasket are available and each size can be recognised by the number of identification holes punched in the side of the gasket as illustrated. The table below gives the details of the gaskets available. The thickness of gasket fitted can be seen when the cylinder head is fitted since the identification holes can be seen protruding from the right hand side of the engine towards the rear.

No. of holes	Metric	Imperial	Gasket
1	0,60 / 0,50	0.0196 / 0.0236	ERR 0382
2	0,70 / 0,61	0.024 / 0.0275	ERR 0383
3	0,80 / 0,71	0.0279 / 0.0314	ERR 0384

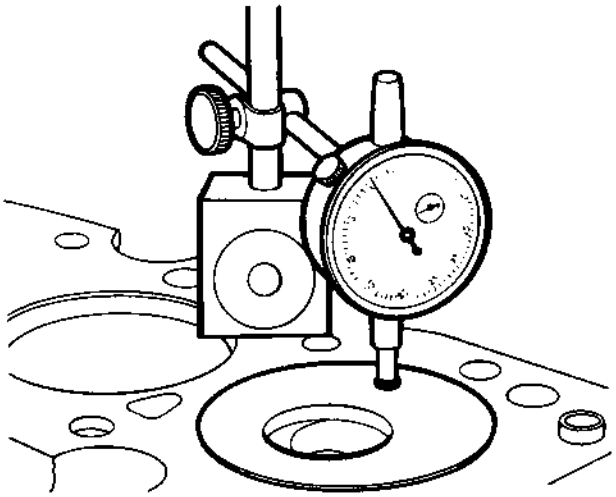


ST2589M



ST3374M

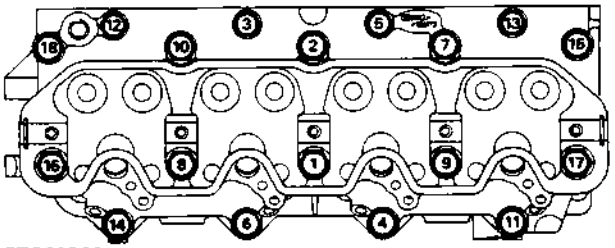
26. Clean the cylinder block combustion face and turn the crankshaft so that number one and number four pistons are at T.D.C. Use a dial test indicator to determine the highest travel of the piston then zero the gauge and move the stylus over to the cylinder block and note the reading. Repeat the procedure on the remaining pistons. The highest figure obtained will determine the gasket to fit.


ST2581M

27. Place the cylinder head gasket in position on the cylinder block so that the identification holes are towards the rear on the right-hand side.
28. Clean the cylinder head face and if preferred, guide studs may be fitted to the cylinder block to facilitate the lowering of the head into position. Locate the head over the two dowels.
29. Lubricate the new bolt threads and fit loosely into their location.

△ **NOTE: Always fit new cylinder head bolts.**

30. Tighten all the bolts down in the sequence shown to Tighten to ***40 Nm.***



ST2619M

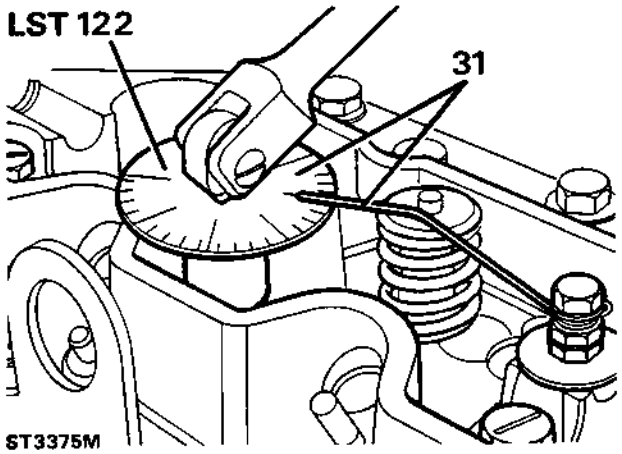
Bolt sizes:

M10 locations - 3, 5, 12 and 13

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

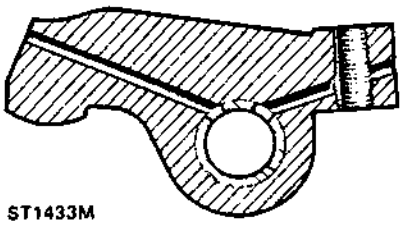
31. Attach the service tool degree disc LST122 to a power bar. Make a suitable pointer from welding rod and attach it to a bolt screwed into a rocker shaft securing bolt hole. Tighten all the bolts down through an angle of 60° strictly in the sequence illustrated. As each bolt is tightened scribe a line across the head with a piece of chalk or crayon to identify which bolts have been tightened. Again, in the correct sequence, tighten the bolts a further 60° and scribe another line across each bolt head as it is tightened. Re-positioning of the pointer will, be necessary to reach all bolts.

⚠ **CAUTION: 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.**

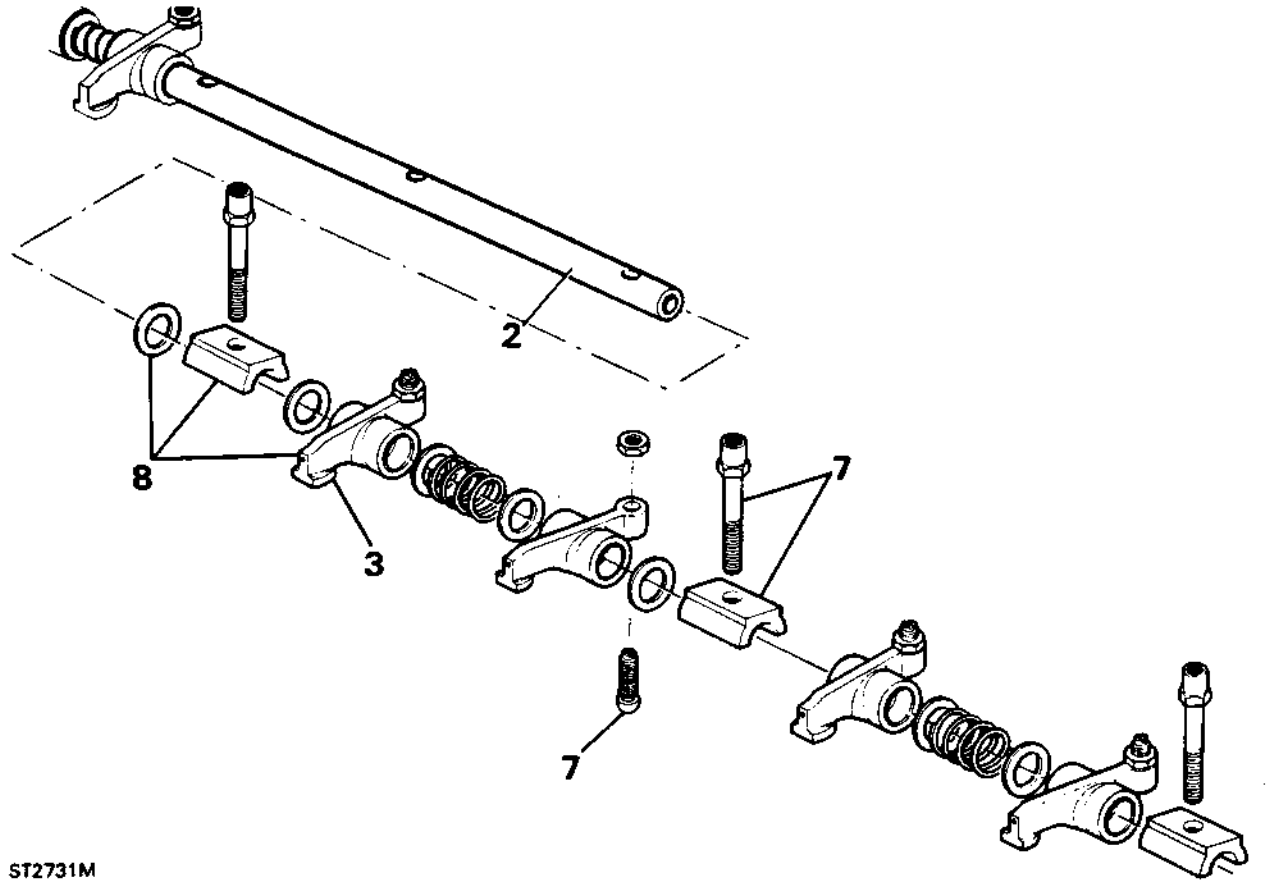


OVERHAUL AND FIT ROCKER SHAFT

1. Remove the five rocker shaft retaining bolts and withdraw the bearing caps, rockers, washers and springs from the shaft.
2. Examine the rocker shaft for wear and discard it if the bearing surface is worn, scored or pitted. Check also that the oilways are clear.
3. Inspect the rockers and discard if the pads are worn. It is not permissible to grind pads in an attempt to reclaim rockers.
4. Renew bushes if the clearance between shaft and bush is in excess of 0,101 to 0,127 mm Press in replacements ensuring that the pre-drilled oil holes coincide with the holes in the rockers.
5. The following cross section of a rocker shows the oil drillings.



6. Finish the bushes to 18,018 to 18,00 mm after fitting.
7. Examine the tappet adjustment screws and check that the ball end is not worn or pitted and that the lubrication hole is clear.



ST2731M

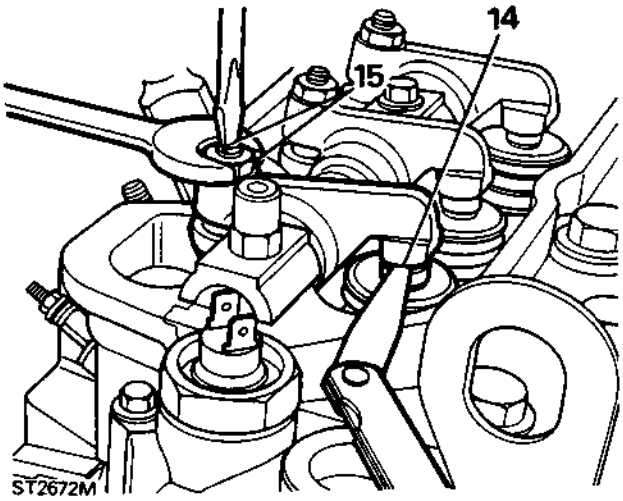
8. Assemble the rockers, bearing caps, new springs and washers to the shaft noting where the washers are fitted. Hold the assembly together with the five rocker shaft retaining bolts.

Fitting rocker shaft assembly

9. Examine the push rods and renew any that are bent or where the ball or cup ends are worn or pitted.
10. Fit the push rods to the engine ensuring that the ball-end locates properly in each camfollower slide.
11. Fit the rocker shaft assembly to the cylinder head and secure in position with the five retaining bolts. Ensure that the tappet adjusting screws locate in the cup ends of the push rods. Evenly tighten the securing bolts to ***30 Nm***

Adjust tappet clearances

12. If the crankshaft is rotated with excessive valve clearances, it is possible that the push rods may become dislodged from the tappet seating and fracture the tappet slide. To prevent damage, eliminate all clearance from any loose rockers before turning the crankshaft to adjust clearances.
13. Turn the engine over until number eight valve (counting from front of engine) is fully open.
14. Using a 0,20 mm feeler gauge check the clearance between the valve tip and rocker pad of number one valve.

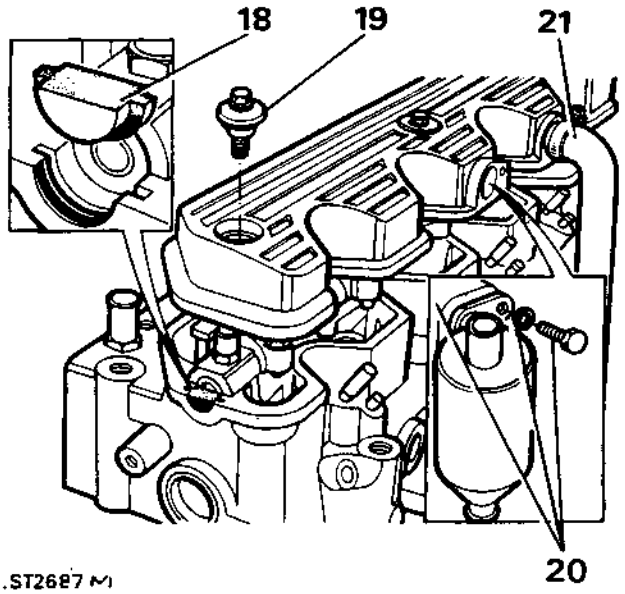


15. Adjust the clearance by loosening the lock nut and turning the tappet adjusting screw clockwise to reduce clearance and anti-clockwise to increase clearance. Recheck the clearance after tightening the lock nut.
16. Continue to check and adjust the remaining tappets in the following sequence:

    Set No. 3 tappet with No. 6 valve fully open.
    Set No. 5 tappet with No. 4 valve fully open.
    Set No. 2 tappet with No. 7 valve fully open.
    Set No. 8 tappet with No. 1 valve fully open.
    Set No. 6 tappet with No. 3 valve fully open.
    Set No. 4 tappet with No. 5 valve fully open.
    Set No. 7 tappet with No. 2 valve fully open.

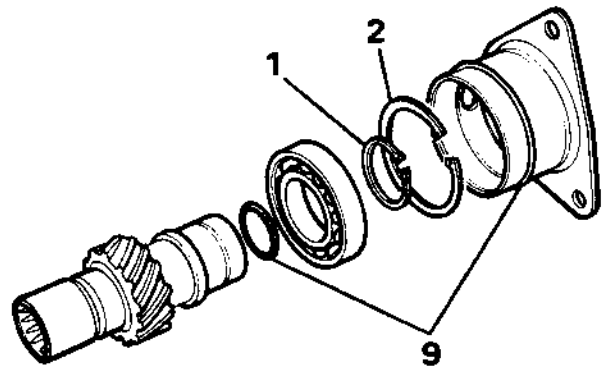
Fitting rocker cover

17. Fit exsisting seal to the rocker cover, renew if damaged or leaks were evident.
18. Apply superglue to the half-moon groove both ends of the cylinder head and then fit the rubber seal.
19. Fit the rocker cover and secure with the three bolts and special conical washers and tighten evenly to ***4 Nm.***
20. If removed, fit the cyclone engine breather to the rocker cover with a new seal and secure with the single bolt.
21. Fit the breather hose that runs between the rocker cover and front side cover.



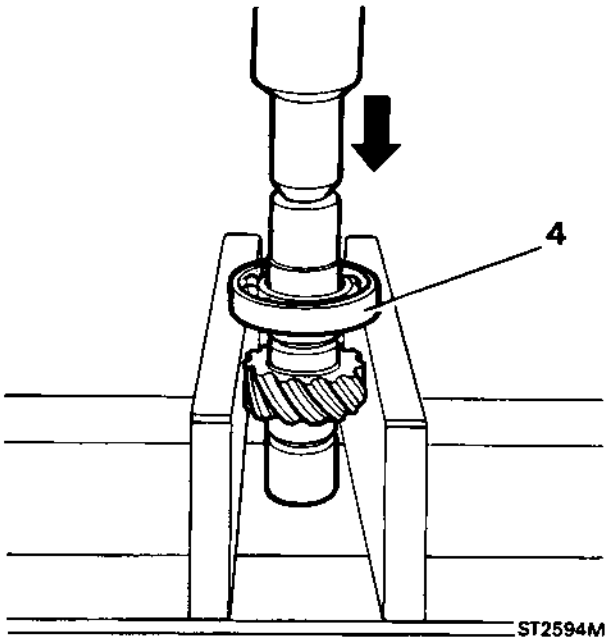
OVERHAUL AND FIT SKEW GEAR ASSEMBLY

1. Remove the circlip from the skew gear shaft.
2. Remove the circlip retaining the bearing in the housing. Remove bearing only if necessary.



ST2584M

3. Press the bearing and shaft assembly from the housing.
4. Press the bearing from the shaft.



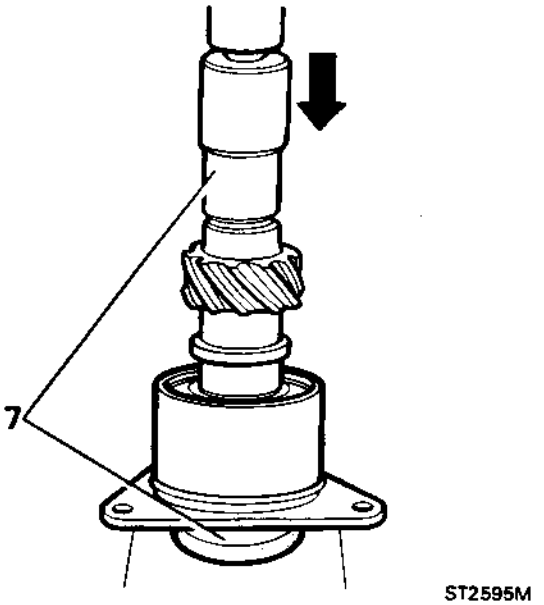
ST2594M

5. Examine all components especially the bearing and skew gear for wear and damage and renew if necessary.

⚠ **CAUTION: If the skew gear is to be refitted, the teeth must mesh with the same teeth on the camshaft. If either the skew gear or the camshaft are renewed, the mating component must also be renewed.**

Assemble

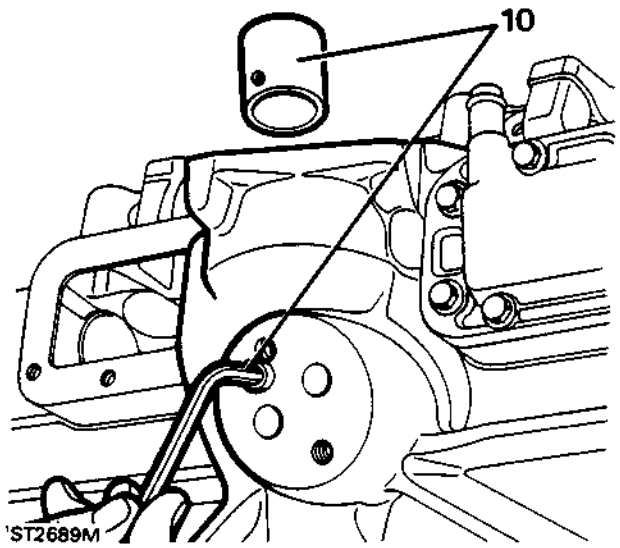
6. Press the bearing into the housing up to the shoulder.
7. Support the outside diameter of the bearing with a suitable tube and press the skew gear shaft on to the bearing.



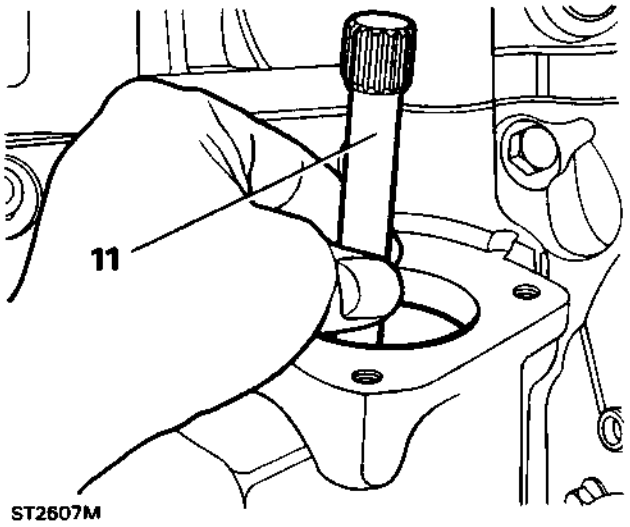
ST2595M

8. Secure the assembly with the two circlips.
9. Fit new 'O' rings to the inside diameter of the skew gear shaft and the outside diameter of the housing.

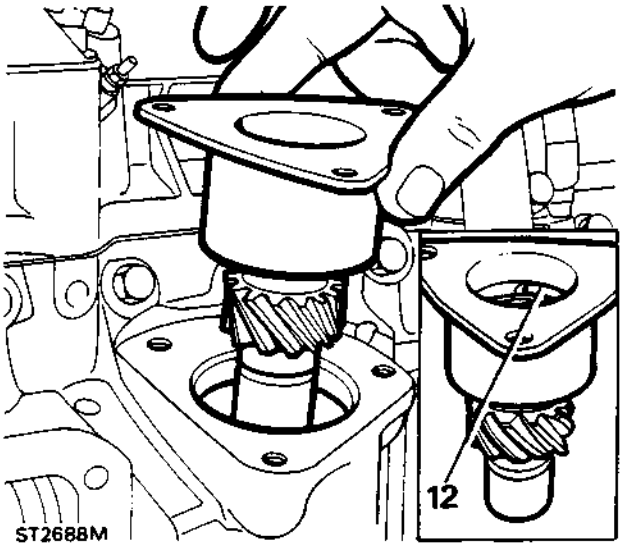
10. Fit a new skew gear bush to the cylinder block and secure with the socket headed screw. Ensure that the screw locates correctly into the hole in the bush.



11. Fit the oil pump drive shaft, long-spline end into the pump.



12. Fit the skew gear assembly so that the slot is towards the front of the engine.

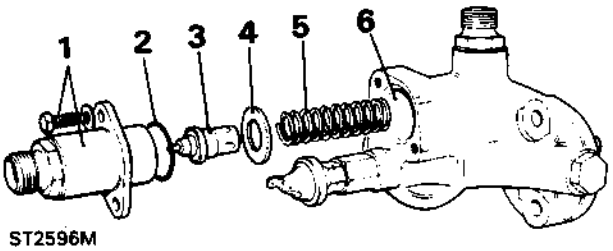


13. Using a new gasket fit the vacuum pump so that the outlet is towards the front of the engine. Ensure that the cross-pin in the skew gear shaft locates in the end of the groove in the end of the pump shaft. Secure with the three screws and tighten evenly.

OVERHAUL AND FIT OIL FILTER ADAPTOR

Renew oil temperature thermostat

1. Remove the two bolts and carefully withdraw the thermostat extension housing.
2. Remove the 'O' ring.
3. Withdraw the thermostat.
4. Remove the washer.
5. Remove the spring.
6. Clean the adaptor housing with lint-free cloth.

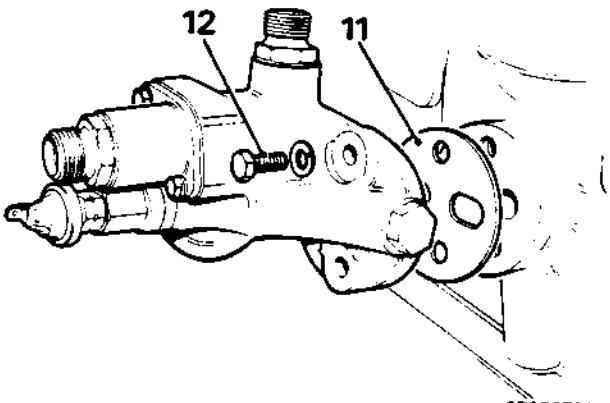


ST2596M

7. Fit the spring and washer.
8. Fit a new thermostat with the pin uppermost.
9. Fit the extension housing using a new 'O' ring. Ensure that the pin protruding from the thermostat locates in the hole in the extension housing.
10. Secure the housing with the two bolts and washers.

Fit oil adaptor

11. Using a new joint washer fit the oil filter adaptor. Ensure that the retaining bolts pass through the two small holes in the joint washer.
12. Tighten the two retaining bolts evenly to ***45 Nm.***



ST2597M

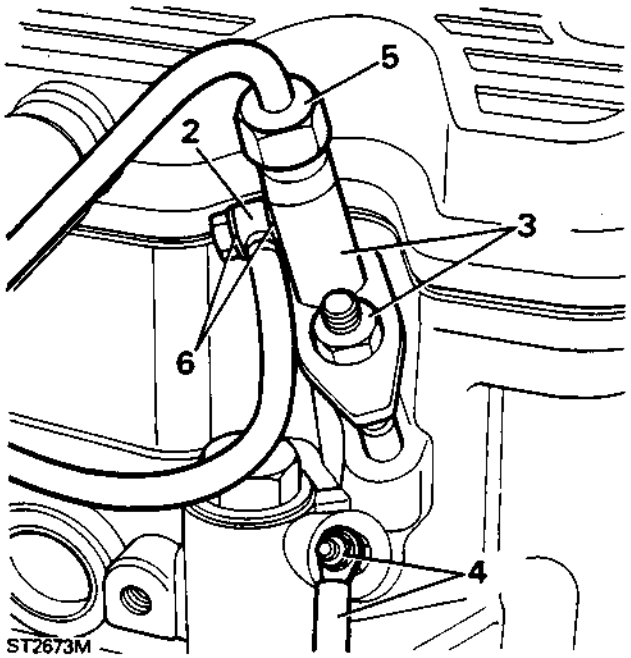
13. Smear a little clean engine oil on the rubber washer of the new filter, then screw the filter on clockwise until the rubber sealing ring touches the machined face, then tighten a further half turn by hand only.
14. Do not overtighten.

FIT FUEL LIFT PUMP AND REARSIDE COVER

1. If the fuel lift pump was separated from the side cover, fit the pump to the cover first using a new joint washer between the pump flange and rear cover, evenly tighten the nuts.
2. Place a new cover plate joint washer in position and fit the cover and pump assembly to the cylinder block.
3. Ensure that the pump actuating lever rides on top of the camshaft.
4. Secure the cover, evenly tighten the retaining bolts.

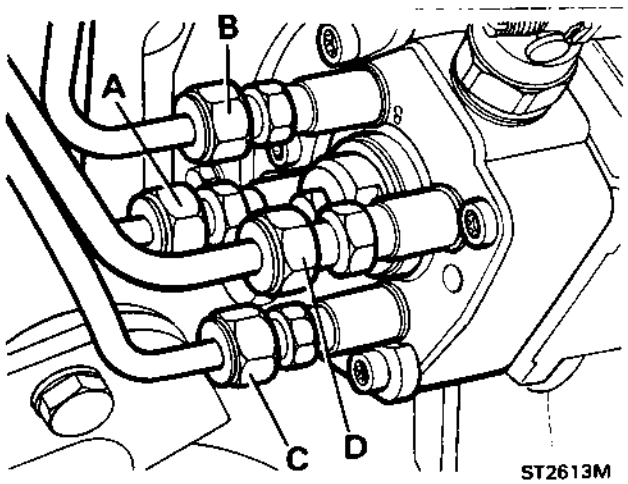
FIT INJECTORS, PIPES AND HEATER PLUGS

1. Ensure injector locations are clean. Grease a new copper washer to hold it in position on the injector.
2. Fit injectors with spill return outlet facing to rear of engine.
3. Secure injector with a clamp and nut. Fit clamps with convex side fitted uppermost. Tighten the nuts to ***20 Nm***
4. Fit the four glow plugs and tighten to ***23 Nm.*** Fit electrical connections to glow plugs and secure with single nut and washer. Tighten to ***2 Nm.*** Ensure the terminal and the insulation clears the cylinder head and breather cyclone.

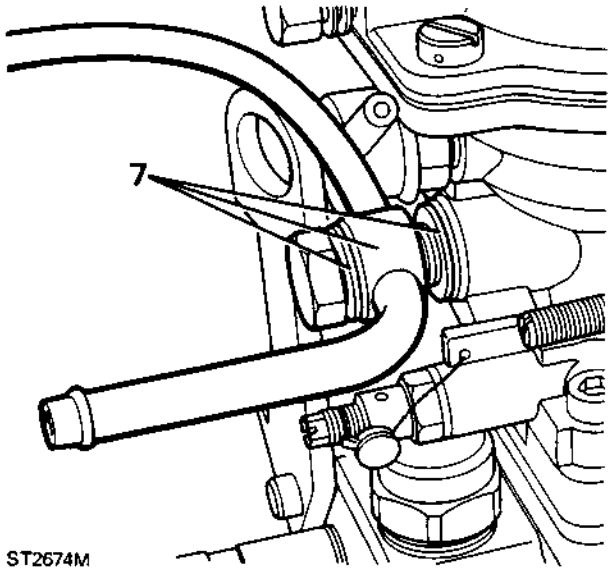


5. Fit loosely all injector fuel supply pipes, then tighten evenly to ***24 Nm.*** From the front of the engine connect the pipes as follows:

   A. To number 1 injector.
   B. To number 2 injector.
   C. To number 3 injector.
   D. To number 4 injector.



6. Fit the spill return rail to the injectors, with copper washers fitted each side of the retaining union screw. The inner washer locates in a recess in the injector.
7. Fit the spill return rail to the rear of the injector pump and secure with a copper washer each side of the banjo and the union bolt.



Fit clutch ***See CLUTCH, Repair, Clutch assembly***

Fit the starter motor

Fit air inlet manifold

Fit exhaust manifold and turbocharger

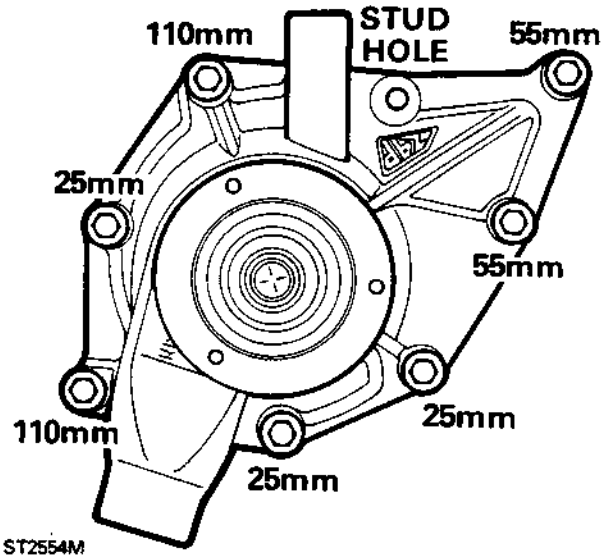
Fit thermostat and housing

Fit alternator

Fit power steering pump

FIT WATER PUMP

1. The water pump is not serviceable. Check condition of the bearings.
2. Check the pump body for signs of coolant or oil leaks. If there is any evidence of leakage, the pump should be renewed.
3. Grease and position a new joint washer on the timing cover.
4. Apply Loctite 572 thread lubricant sealant to the long bolts which penetrate into cylinder block.
5. Fit the pump and secure with the 7 bolts as shown. Tighten the bolts to ***27 Nm.***



6. Connect hose to water pump and thermostat housing and secure with clips.
7. Fit the fan blades to the viscous coupling with the four screws.
8. Fit viscous coupling assembly to water pump spindle. Note it is a left-hand thread.

Fit air conditioning compressor - ***See ELECTRICAL, Repair, See Air Conditioning.***

Fit and tension drive belts ***See SECTION 10, Maintenance, Under Bonnet maintenance***

Fit engine to vehicle ***See Repair, Engine***

Before starting engine

1. Check sump and cylinder block drain plugs are fitted.
2. Add correct lubricant to high mark on the dipstick. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
3. Check that all pipes and hoses are secure and that all electrical connections are made.
4. Fill the cooling system with correct mixture of coolant ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Anti-Freeze***
5. Start and run the engine for up to ten minutes. Check for oil, fuel and coolant leaks. Stop engine and allow to cool. Recheck the oil and coolant levels.
6. Recheck the tension of the drive belts.



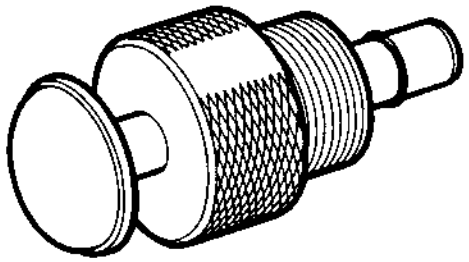
TORQUE VALUES

△ **NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.**

	Nm
ENGINE	
Bearing cap to cylinder block	133
Camshaft thrust plate to cylinder block	9
Clutch cover plate to flywheel	34
Connecting rod to cap	59
Dipstick tube assembly to cylinder block	25
Dipstick mounting bracket to inlet manifold	9
Engine mounting foot to cylinder block M10	45
Engine mounting foot to cylinder block M12	85
Housing flywheel to cylinder block	45
Flywheel to crankshaft	146
Ladder frame to cylinder block	25
Oil filter adaptor to cylinder block	45
Oil pressure switch	17
Oil pump cover to pump body	24
Oil pump relief valve plug	30
Oil pump to cylinder block	25
Oil pump strainer to oil pump	45
Oil jet assembly to cylinder block	17
Oil strainer to mounting bracket	25
Plug - blanking oil gallery	37
Plug - drain oil sump	45
Plug - drain cylinder block	25
Plug - drain flywheel housing	12
Plug - inlet manifold (boost take-off)	25
Side cover to cylinder block	27
Starter motor to flywheel housing	45
Sump to ladder frame	25
Sump to ladder frame/cylinder block	25
Sump to cylinder block/front cover	22
Brackets - exhaust manifold to cylinder block	25
Vacuum pump to cylinder block	25
Vertical drive shaft gear to cylinder block	25
Alternator and heat shield to mounting bracket	25
Adjusting link to alternator	25
Adjusting link to PAS pump plate	25
Breather cyclone to rocker cover	9
Engine lifting bracket to cylinder head	25
Electrical harness clip to cylinder head	25
Exhaust manifold to cylinder head	23
Glow plug terminal nut	2
Glow plug to cylinder head	23
Heater stud (water) to cylinder head	23
Injector clamp stud to cylinder head	8
Injector clamp to injector nut	20
Inlet manifold to cylinder head	23
Rocker cover to cylinder head	4
Rocker shaft to cylinder head	30

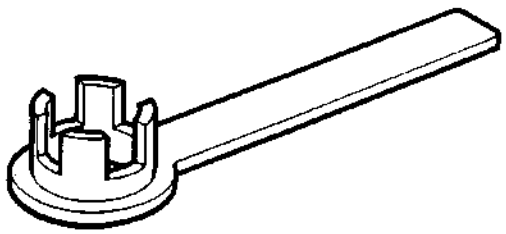
Tappet adjusting nut	24
Thermostat housing to cylinder head	25
Water outlet to thermostat housing	9
Water temperature switch to thermostat housing	17
Cowl mounting bracket to front cover	25
Fan assembly to water pump hub	25
Front cover plate to cylinder block	25
Front cover plate to front cover	25
Front cover to cylinder block	25
Injector pump to front cover	25
Injector pump stud to front cover	8
Injector pump to support bracket	25
Tensioner (timing belt) to cylinder block	45
Timing pulley to camshaft	45
Timing pulley to injector pump hub	25
TV damper pulley to crankshaft	347
Water pump to cylinder block	27
Water pump to cylinder block - stud	27
Water pump to front cover	25
Oil drain adaptor to cylinder block - Turbocharger	25
Oil drain pipe to turbo	40
Oil feed pipe adaptor to cylinder block - Turbocharger	25
Oil feed pipe to turbo	19
Outlet elbow to turbocharger - nut	24
Outlet elbow to turbocharger - stud	25
Turbocharger to exhaust manifold	24
Belt tensioner assembly to front cover plate compressor	15
Compressor to mounting bracket	45
Compressor mounting bracket to front cover and plate	45
Banjo bolt - fuel pump	12
Banjo bolt - boost pipe	12
Banjo bolt - spill rail	25
Banjo bolt - fuel filter	17
Banjo bolt - injector spill rail	2
Fuel lift pump to fuel filler unions	12
Fuel lift pump to cylinder block	25
Injector pipes to injectors and injector pump	24
P.A.S. pump to mounting plate	15
P.A.S. pump mounting plate to front cover	
P.A.S. pump pulley to hub	15
Tappet guide retaining screw	14

Tdi ENGINE



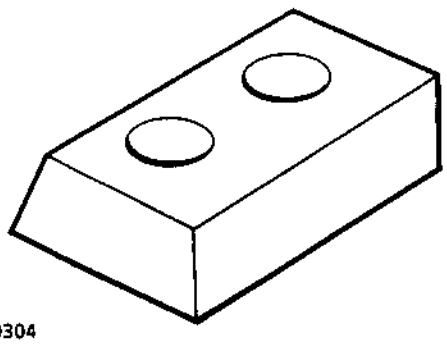
LST128

LRT-12-044 Flywheel timing pin
LST 128



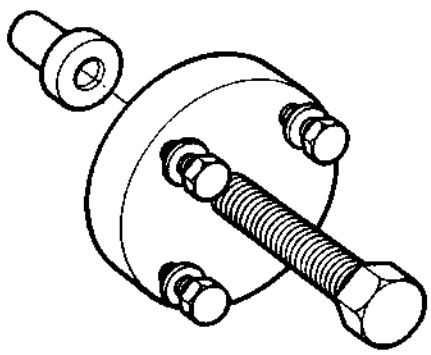
LST127

LRT-12-043 Crankshaft damper restraining tool
LST 127



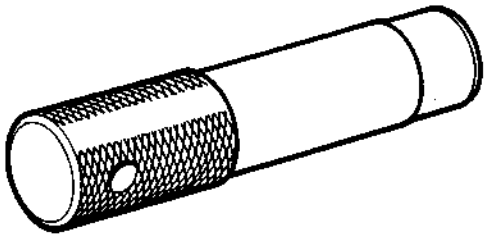
RO270304

LRT-12-035 Rear main cap seal guide
RO 270304A



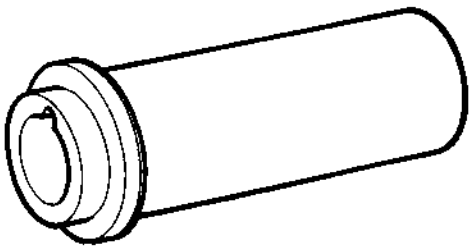
LST136

LRT-12-049 Crankshaft damper tool
LST 136



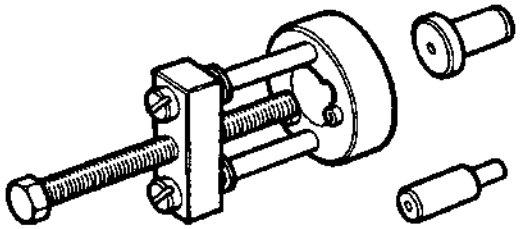
RO605022

LRT-12-040 Mandrel, clutch plate
RO 605022



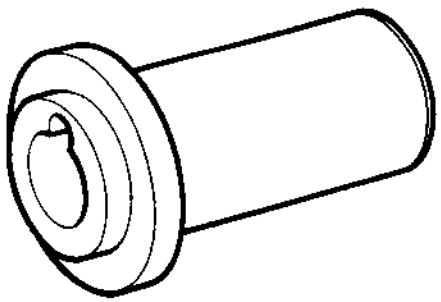
18G1456

LRT-12-028 Replacer, crankshaft front seal
18G 1456



18G1464

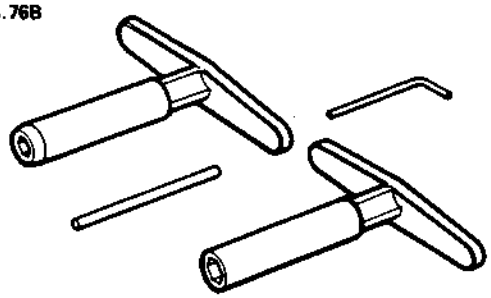
LRT-12-031 Remover, crankshaft/camshaft gear
18G 1464



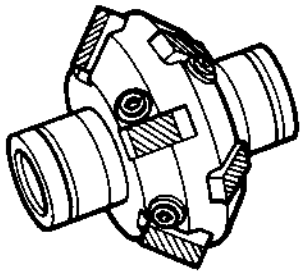
18G1482

LRT-12-032 Replacer, camshaft oil seal
18G 1482

MS.76B

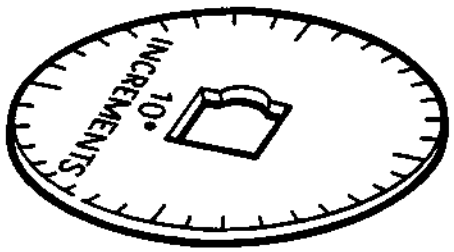


LRT-12-501 Handle set, seat cutter
MS 76B



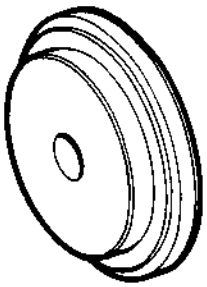
MS621

LRT-12-504 Valve seat cutter
MS 621



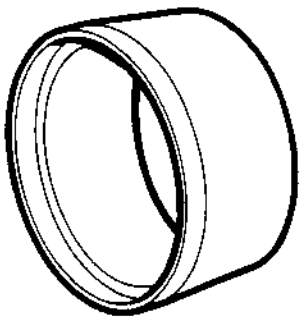
LST122

LRT-12-007 Degree plate
LST 122



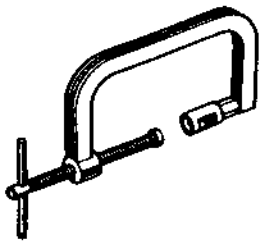
18G13411

LRT-12-008 Adaptor, crankshaft rear seal
18G134-11



RO1014

LRT-12-015 Crankshaft rear seal saver
18G 1344



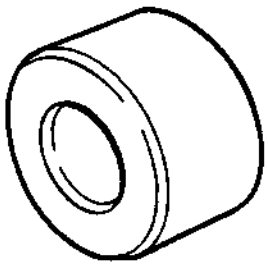
MS1519A

LRT-12-034 Valve spring compressor
MS 1519A



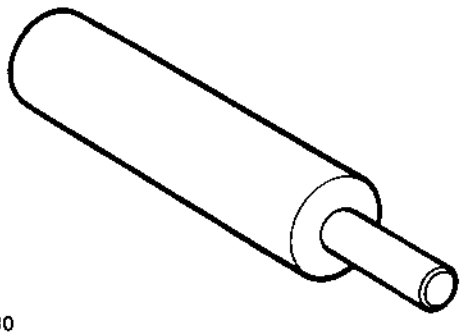
RO274400

LRT-12-036 Drift, valve guide removal
RO 274400



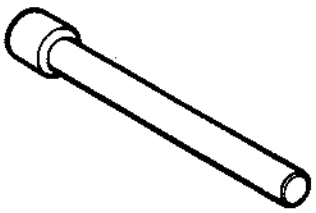
605774A

LRT-12-515 Distance piece, valve guide fitting
RO 605774A
LST 130



LST130

LRT-12-046 Valve guide drift



LST129

LRT-12-045 Retainer injection pump & timing pin LST 129

Notes

17 - EMISSION CONTROL

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DESCRIPTION AND OPERATION

EMISSION CONTROL 1
EVAPORATIVE EMISSION CONTROL 2

FAULT DIAGNOSIS

EVAPORATIVE LOSS CONTROL PRESSURE TEST - 1991 MODEL ONWARDS 1

REPAIR

POSITIVE CRANKCASE VENTILATION AIR INTAKE FILTER 1
POSITIVE CRANKCASE VENTILATION BREATHER FILTER - NOT Tdi 1
FUEL EXPANSION TANK - PRE 1991 MODEL YEAR 2
LAMBDA (OXYGEN) SENSOR 3
CHARCOAL CANISTER 4
CHARCOAL CANISTER - PURGE VALVE 4
VAPOUR SEPARATOR 5
CHARCOAL CANISTER - 1993 MODEL YEAR 6

SPECIFICATIONS, TORQUE

EMISSION LABEL - U.S.A. VEHICLES 1
TORQUE VALUES 2

Notes

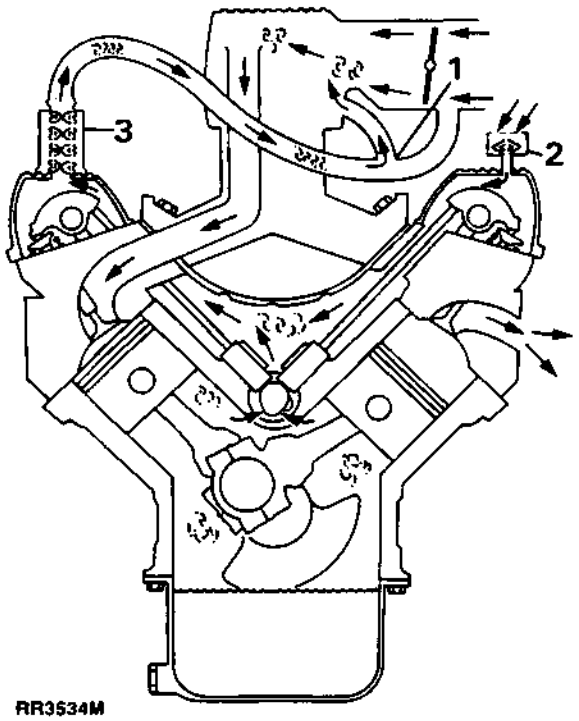
EMISSION CONTROL

Three systems are used to control the vehicle atmospheric emissions these are:

Engine crankcase fume emissions.
Fuel tank evaporative emissions
Engine exhaust gas emissions.

Crankcase ventilation system

The crankcase ventilation system which is an integral part of the air supply to the engine combustion chambers, is often overlooked when diagnosing problems associated with engine performance. A blocked ventilation pipe or filter or excessive air leak into the inlet system through a damaged pipe or leaking gasket can effect the mixture, performance and economy of the engine.



RR3534M

1. Three way connector
2. Air filter
3. Oil separator

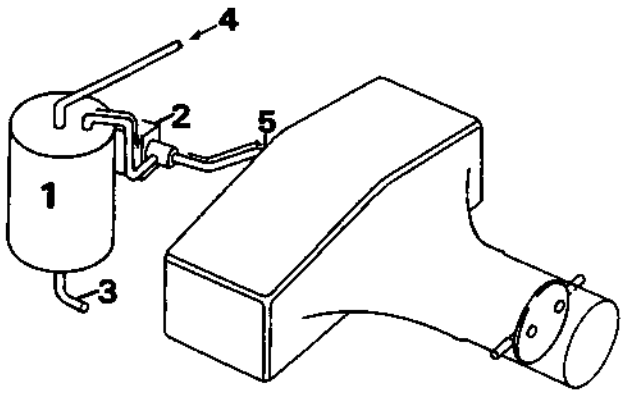
The purpose of the crankcase ventilation system is to ensure that any noxious gas generated in the engine crankcase is rendered harmless by burning in the combustion chambers as follows:
Oil laden noxious gas in the engine crankcase is drawn through an oil separator 3 located on the right hand cylinder head rocker cover, where the oil is separated and returned to the sump. The gas flows through a restrictor in the three way connection 1 and into the inlet plenum chamber where it drawn into the combustion chambers and burned. The volume of fresh air which is drawn from the atmospheric side of the throttle butterfly to mix with the gas, depends on the position of the throttle and the engine speed.

The air filter 2 fitted to the left hand cylinder head rocker cover, must be maintained in clean condition to ensure sufficient air enters the crankcase under varying throttle openings and manifold depression, to prevent excessive crankcase pressure or depression developing.

EVAPORATIVE EMISSION CONTROL

Fuel tank evaporative control

The specification for certain countries requires the recycling of petrol evaporation from the fuel tank. For these countries only, a charcoal canister and purge valve are installed in the engine compartment.



RR3546M

Evaporative purge system

1. Charcoal canister
2. Purge valve
3. Charcoal canister air vent
4. Fuel purge connection from separator/expansion tank
5. Plenum chamber connection

Operation

When the engine is not running, the purge valve 2 seals the plenum chamber connection 5 . Any vapour entering the canister at 4 from fuel tank, is condensed by the air entering at 3 which is then absorbed by the charcoal.

The opening of the purge valve 2 , which is controlled by the EFI ECU occurs when the following conditions prevail:

When the engine is running at speeds above 1700 rev/min and temperatures above 54°C the ECU will hold open the purge valve as necessary.

At speeds below 1700 rev/min the ECU will only pulse the purge valve open for short periods.

While the purge valve 2 is open, engine depression draws air through vent 3 and fuel tank fumes via 4 into the engine combustion chambers, where they are burned. Air entering at 3, passes through the charcoal, where any accumulation of condensed fuel is also extracted and burned in the engine.

A permanent leakage of air into the plenum chamber through the purge system will affect engine performance. ***See FUEL SYSTEM, Description and operation, Hot wire electronic fuel injection***

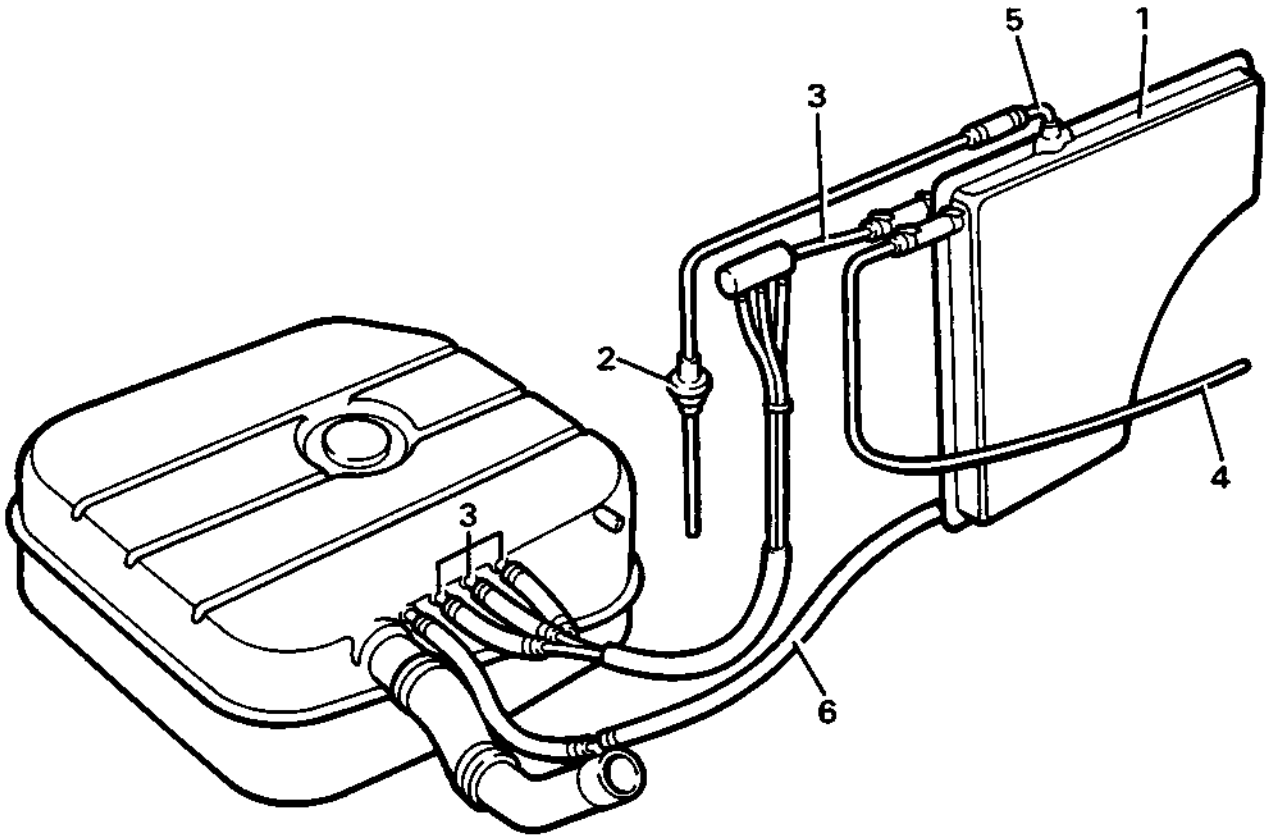
Fuel tank evaporative control system

The system consists of a fuel separator/expansion tank located at a higher level than the fuel tank, between the inner body side and the right rear fender. The tank is vented to atmosphere through a relief valve and is connected to the fuel tank and the charcoal canister purge system in the engine compartment.

The 1990 and 1991 systems are slightly different to one another as follows:

Operation - 1990 system

As the temperature rises, fuel vapour in the fuel tank is allowed to vent into the separator/expansion tank 1 via three pipes and a manifold connector 3. Any vapour which condenses into liquid fuel drains through pipe 6 back into the main fuel tank and residual vapour is dealt with by the purge system connection 4 in the engine compartment, previously explained. The atmosphere relief valve 2 will only open if a blockage occurs in the charcoal canister or purge system.



RR3615M

Fuel tank evaporative control system 1990

1. Fuel separator/expansion tank
2. Relief valve to atmosphere
3. Fuel tank vent
4. Purge connection to Purge System in engine compartment
5. Shut off valve
6. Condensed fuel return to fuel tank

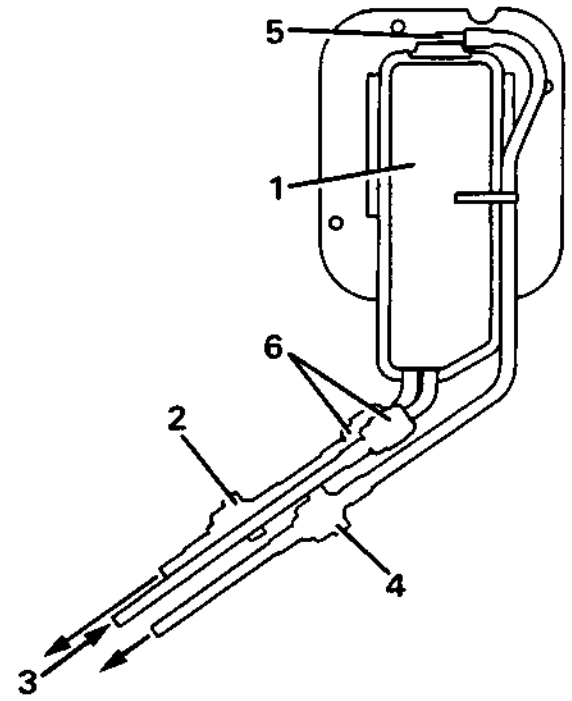
Fuel tank evaporative control system 1991

The 1991 system consists of small vapour separator located between the inner body side and the right rear fender.

Operation

As the temperature rises fuel vapour is allowed to enter the separator tank 1 through pipe 3 . Any condensed liquid fuel returns to the fuel tank by the same pipe. When the pressure inside the separator tank reaches between 0.75 and 1.0 psi the relief valve 4 allows the fumes to pass to the purge system in the engine compartment. Should a blockage or fault develop in pipe 4, excessive pressure is then released to atmosphere by the safety valve 2. In the event of the vehicle rolling over a shut off valve 5 located at the top of the atmospheric vent pipe 4, prevents fuel flowing to the engine compartment.

In the event of the vehicle rolling over a shut off valve 5 located at the top of the atmospheric vent pipe 4, prevents fuel flowing to the engine compartment.



RR3616M

Fuel tank evaporative control system 1991

1. Fuel separator/expansion tank
2. Relief valve to atmosphere
3. Fuel tank vent
4. Purge connection to Purge System in engine compartment
5. Shut off valve
6. 'Speed Fit' pipe connections

EVAPORATIVE LOSS CONTROL PRESSURE TEST - 1991 MODEL ONWARDS

This procedure provides a method for checking system if a leak is suspected. Excessive leakage will affect evaporative loss control.

Equipment required.

Nitrogen cylinder

Water manometer (0 - 30" H2O or more).

Pipework and a "T" piece.

Method.

1. Ensure at least two gallons of fuel in tank.
2. Disconnect, at adsorption canister, pipe to vapor separator.
3. Connect this pipe to nitrogen cylinder and water manometer using "T" piece.
4. Pressurize system to 26.5 and 27.5 inches of water, allow reading to stabilize, turn off nitrogen supply.
5. Measure pressure drop, if drop exceeds 2.5 inches of water after 2 min 30 secs, a leak is indicated. Note that a fully sealed system will show a slight pressure increase.
6. If system leaks, maintain pressure, and apply soap solution round all connections until bubbles reveal source of leak.
7. Repair leak.
8. Repeat test. Remove test equipment, if successful.
9. Reconnect pipe to adsorption canister.

Notes

POSITIVE CRANKCASE VENTILATION AIR INTAKE FILTER

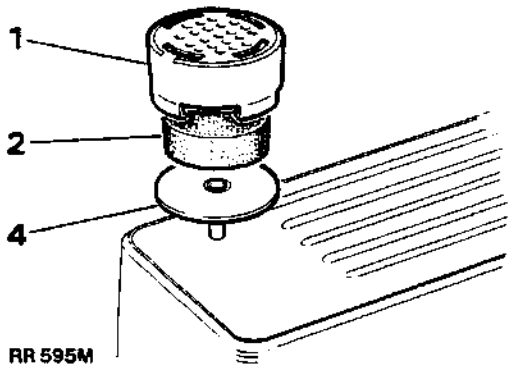
Service repair no - 17.10.02

Remove and refit

The PCV air intake filter is located at rear of left hand rocker cover, beneath throttle linkage bracket.

Remove

1. Pry filter cover upwards to release it.
2. Remove filter from cover and discard.



Refit

3. Insert new filter into filter cover.
4. Press filter onto mounting until it clips firmly into position.

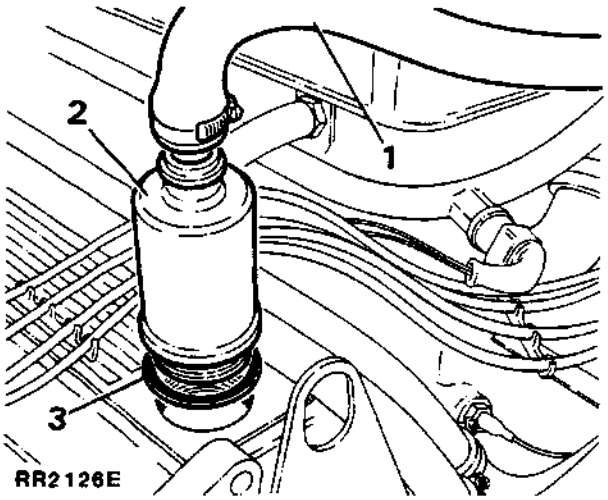
POSITIVE CRANKCASE VENTILATION BREATHER FILTER - NOT Tdi

Service repair no - 17.10.03

Remove and refit

Remove

1. Release hose clamp, pull hose off canister.
2. Unscrew canister and remove.
3. Remove large rubber 'O' ring, inspect for deterioration.



4. Inspect condition of wire screen within canister, if necessary, replace assembly. If filter unit is in acceptable condition, clean as follows.
5. Immerse canister in small amount of solvent (mineral spirits), allow solvent to dissolve or loosen debris.
6. Remove canister from solvent, allow to dry in still air.

WARNING: Do not use compressed air to dry, clean or remove particles of debris within the canister. This could cause fire or personal injury.

Refit

7. Fit a new 'O' ring to original canister.
8. Screw canister into rocker cover securely - hand tight only.
9. Refit hose, tighten hose clamp securely.

FUEL EXPANSION TANK - PRE 1991 MODEL YEAR

Service repair no - 17.15.19

Remove and refit

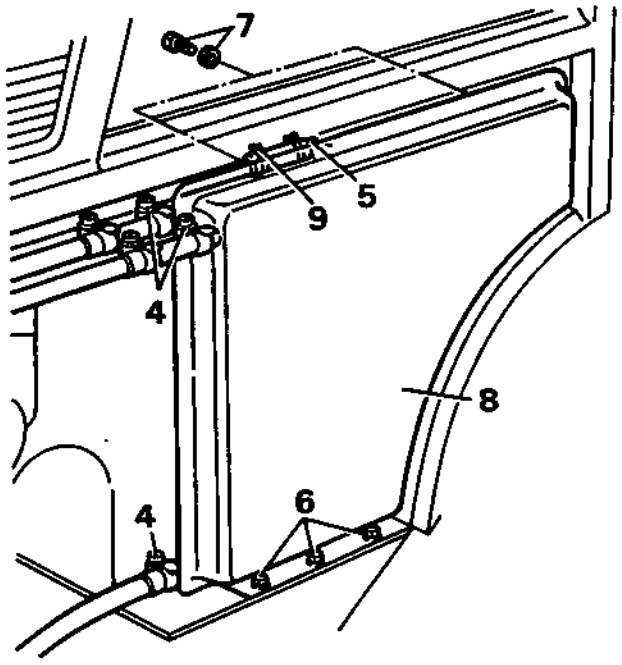
The fuel expansion tank is located between right hand rear wing and inner body side assembly. Access to tank is gained by removing rear wing and body corner panel.

WARNING: Ensure all necessary precautions are taken against spillage of fuel when disconnecting expansion tank hoses.

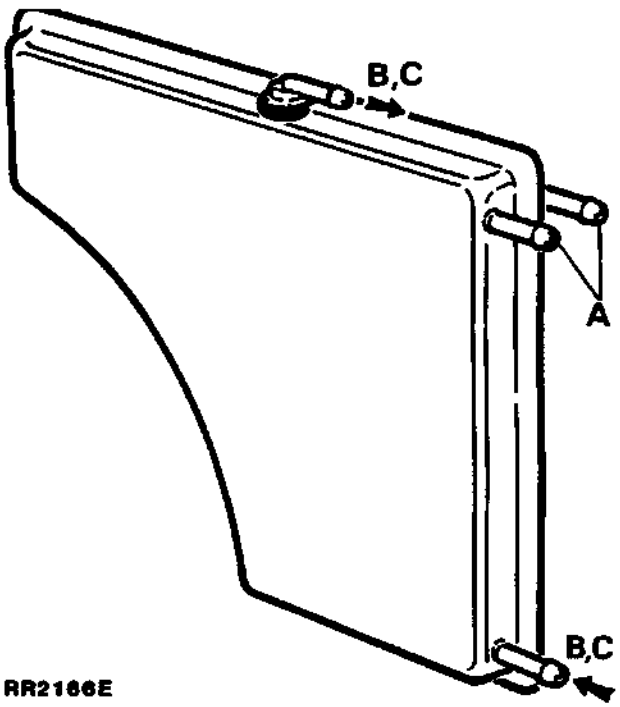
Remove

1. Depressurise fuel system. ***See FUEL SYSTEM, Repair, Depressurising fuel system***
2. Disconnect the battery negative lead.
3. Remove rear wing and corner panel assembly. ***See CHASSIS AND BODY, Repair, Rear corner panel and wing***
4. Release three hose clamps and remove three hoses from expansion tank.
5. Release hose clamp and remove hose from float valve located on top of expansion tank.
6. Remove three bolts retaining bottom of expansion tank.
7. Lift trim covering vehicle tool kit, remove two expansion tank securing bolts.
8. Remove tank from vehicle.
9. Remove short hose from top vapour hose. Check restrictor in hose is free from blockages.
10. Check operation of the float/rollover valve with tank removed from vehicle as follows:
    - A. Seal top two outlet pipes.
    - B. Apply air pressure at 2 p.s.i to bottom pipe. With tank in its upright position air flow will pass through valve. Rotate tank 90° onto its side, air flow should not pass through the valve.
    - C. Disconnect air supply to tank. With bottom pipe sealed fill tank with mineral spirit. Hold tank upright, float valve should shut off and prevent fluid passing through the valve.
    - D. If valve does not operate as above, replace float valve.

NOTE: DO NOT remove float valve unless faulty. If new valve is fitted, always fit new grommet.



RR3587M



RR2166E

11. Before refitting tank remove breather hose attached to top of filler neck, identify filler neck to breather hose end to aid reassembly. Vigourously shake hose, listen for valve ball movement, no sound from valve, replace hose assembly.

Refit

12. Refit expansion tank ensuring all connections are secure, all hose clamps securely tightened.

LAMBDA (OXYGEN) SENSOR

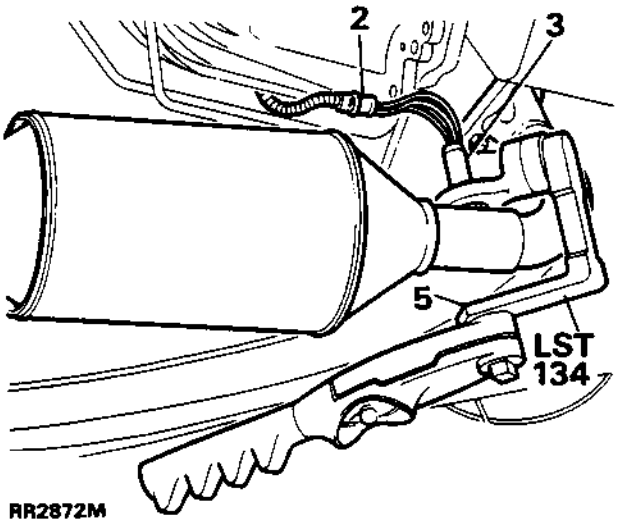
Service repair no - 18.30.39

Remove and refit

Remove sensors from exhaust system only when engine is cold.

Remove

1. Disconnect the battery negative lead.
2. Disconnect electrical plugs from sensors.
3. Remove sensors from exhaust downpipes.



RR2872M

Refit

4. Coat threads of sensor with anti-seize compound.

⚠ **CAUTION: To ensure efficiency of sensor is not impaired, DO NOT allow anti-seize compound to come into contact with sensor nose.**

5. Fit sensor and tighten to ***20 Nm***, using service tool LRT-12-047.
6. Connect electrical plugs and battery lead.

CHARCOAL CANISTER

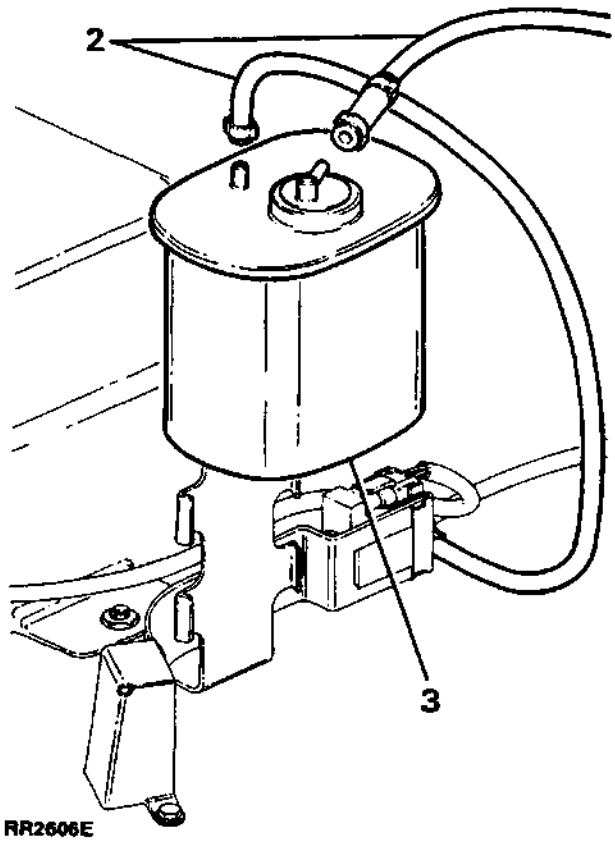
Service repair no - 17.15.39

Remove and refit

NOTE: If crimped hoses are removed it is essential that they are recrimped on reassembly to ensure a leak free joint.

Remove

1. Disconnect the battery negative lead.
2. Disconnect both purge lines.
3. Release canister from mounting.



RR2606E

Refit

4. Reverse removal procedure. Ensure that canister is securely located and both purge lines are fitted correctly to canister.

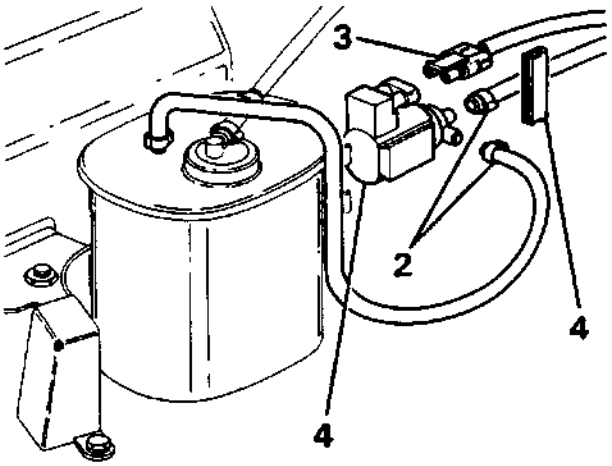
CHARCOAL CANISTER - PURGE VALVE

Purge valve fault diagnosis. ***See ETM, A1***

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect two purge valve pipes.
3. Disconnect electrical connection.
4. Remove edge clip retaining purge valve and withdraw purge valve.



RR2607E

Refit

5. Reverse removal procedure. Ensuring pipes are securely crimped.

VAPOUR SEPARATOR

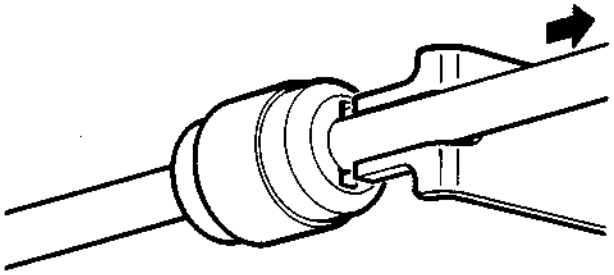
Service tools:
LRS-19-002 Speedfit disconnector

Remove and refit

Remove

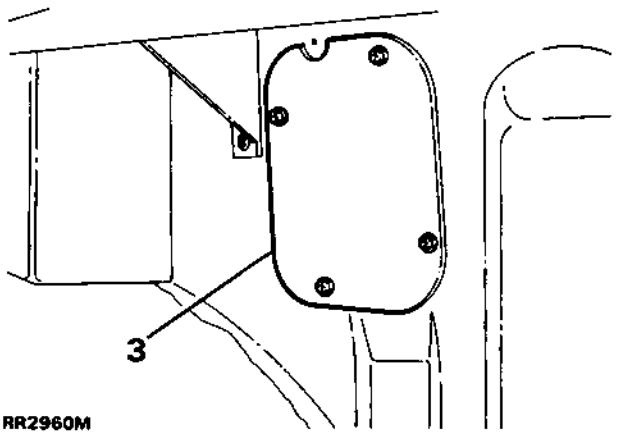
WARNING: Ensure that all necessary precautions are taken against fuel spillage and fuel vapor to prevent fire or explosion.

1. Disconnect the battery negative lead.
2. Working underneath vehicle, disconnect evaporative control pipes from green end of "speedfit" connectors. Use LRS-19-002, press down on collet and pull pipe from connector.



ST2877M

3. Remove four screws securing vapor separator support plate to body panel situated in right hand side of load space.



RR2960M

4. Remove separator and pressure relief valves.

NOTE: Pressure relief valves are renewable, but shut-off valve in top of separator is only available as a complete new separator assembly.

Fitting vapor separator.

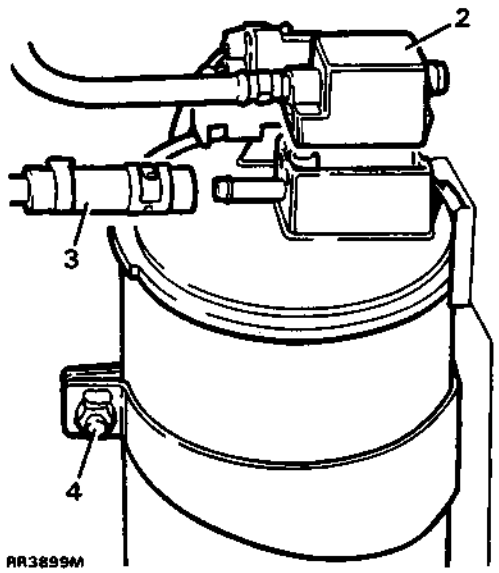
1. Fit separator and pipes into vehicle side panel. If necessary use a new seal, with self adhesive side to separator. Secure with four screws.
2. From beneath vehicle, fit pipes from separator to connectors. Push each pipe into its corresponding connector as far as it will go, ensure it is locked by collet. Check pipes are free, not trapped or kinked. Secure pipes to under body clips.

CHARCOAL CANISTER - 1993 MODEL YEAR

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pry out purge valve.
3. Disconnect pipe.
4. Loosen bolt.
5. Remove charcoal canister.



Refit

6. Reverse removal procedure.

EMISSION LABEL - U.S.A. VEHICLES

A vehicle Emission Control Information label is attached to the bonnet locking platform located above the right hand headlamp assembly. The label gives Engine Tune Details to ensure that correct Emissions Levels are achieved. The label is fitted to comply with U.S Federal and State of California Regulations and should not be removed from its location within the vehicle.

Example of Label - 1990 Model Year

LAND ROVER LTD.

IMPORTANT VEHICLE INFORMATION

ENGINE FAMILY	:LLR3.9T5FSS5
DISPLACEMENT	:241 CU INS
EVAP. FAMILY	:RAF 1
EX.EM.CONTROL SYSTEM	:MP1:2-TWC/2 HO2S

IGNITION TIMING	6° + 1° B.T.D.C. AT BELOW 800 r.p.m. WITH DISTRIBUTOR VACUUM UNIT DISCONNECTED
IDLE SPEED	665-735 r.p.m.
SPARK PLUG GAP	0.033-0.038in

IDLE SPEED ADJUSTMENT

ENGINE HAS IDLE SPEED CONTROL - NO ADJUSTMENT NORMALLY REQUIRED.

REFER TO WORKSHOP MANUAL.

NO OTHER ADJUSTMENTS NEEDED.

3T39T5FSSA

THIS VEHICLE CONFORMS TO U.S. EPA AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1990 MODEL YEAR NEW LIGHT DUTY TRUCKS.

RR2698E

Example of Label - 1991 Model Year

ROVER GROUP LIMITED

IMPORTANT VEHICLE INFORMATION - RANGE ROVER

ENGINE FAMILY	:MLR3.9T5FSS6
DISPLACEMENT	:241 CU INS / 3.9 LITERS
EVAP.FAMILY	:RBFI
EXHAUST EMISSION CONTROL SYSTEM	:MPI:2-TWC/2-H02S

39T5FSSA

TUNE UP SPECIFICATIONS **CATALYST**

TUNE UP CONDITIONS :-
ENGINE AT NORMAL OPERATING TEMPERATURE
TRANSMISSION IN PARK
IDLE SPEED - 665-735 rpm
ENGINE HAS IDLE SPEED CONTROL
NO ADJUSTMENT NORMALLY REQUIRED
SPARK PLUG GAP - 0.033-0.038 inch
IGNITION TIMING - 6° : 1° BTDC AT BELOW 600 rpm
WITH DISTRIBUTOR VACUUM UNIT DISCONNECTED
NO OTHER ADJUSTMENTS NEEDED

THIS VEHICLE CONFORMS TO U.S. EPA AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1991 MODEL YEAR NEW LIGHT DUTY TRUCKS.

RR2935E

Example of Label - 1992 Model Year

ROVER GROUP LIMITED

IMPORTANT VEHICLE INFORMATION - RANGE ROVER

ENGINE FAMILY	:NLR3.9T5FSS7
DISPLACEMENT	:241 CU INS / 3.9 LITERS
EVAP.FAMILY	:RBFI
EXHAUST EMISSION CONTROL SYSTEM	:MPI/2-TWC/2-H02S

39T5FSSA

TUNE UP SPECIFICATIONS **CATALYST**

TUNE UP CONDITIONS :-
ENGINE AT NORMAL OPERATING TEMPERATURE
TRANSMISSION IN PARK
IDLE SPEED - 665-735 rpm
ENGINE HAS IDLE SPEED CONTROL
NO ADJUSTMENT NORMALLY REQUIRED
SPARK PLUG GAP - 0.033-0.038 inch
IGNITION TIMING - 6° ± 1° BTDC AT BELOW 800 rpm
WITH DISTRIBUTOR VACUUM UNIT DISCONNECTED
NO OTHER ADJUSTMENTS NEEDED

THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1992 MODEL YEAR NEW LIGHT DUTY TRUCKS AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1992 MODEL YEAR NEW MEDIUM DUTY VEHICLES

RR3585M

Example of Label - 1993 Model Year

ROVER GROUP LIMITED.

IMPORTANT VEHICLE INFORMATION - RANGE ROVER 4.2

ENGINE FAMILY	:PLR 4.2T5FSS8
DISPLACEMENT	:261 CU INS / 4.2 LITERS
EVAP.FAMILY	:RCFI
EXHAUST EMISSION CONTROL SYSTEM	:MP1/2-TWC/2-H02S
OBD I CERTIFIED	

42T5FSSA

BTR5424

TUNE UP SPECIFICATIONS **CATALYST**

TUNE UP CONDITIONS :-
ENGINE AT NORMAL OPERATING TEMPERATURE
TRANSMISSION IN PARK
IDLE SPEED - 665-735 rpm
ENGINE HAS IDLE SPEED CONTROL
NO ADJUSTMENT NORMALLY REQUIRED
SPARK PLUG GAP - 0.033-0.038 inch
IGNITION TIMING - 8° ± 1° BTDC AT BELOW 800 rpm
WITH DISTRIBUTOR VACUUM UNIT DISCONNECTED
NO OTHER ADJUSTMENTS NEEDED

THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1993 MODEL YEAR NEW LIGHT DUTY TRUCKS AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 1993 MODEL YEAR NEW MEDIUM DUTY VEHICLES

RR3913M

TORQUE VALUES

△ **NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.**

	Nm
Lamda sensor	20

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REPAIR

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HOT WIRE ELECTRONIC FUEL INJECTION

Description

The 'Hot Wire' Electronic Fuel Injection system derives its name from the air flow meter which uses one cold wire and one electrically heated wire to measure the volume of air entering the engine.

The function of the system is to supply the exact amount of fuel directly into the inlet manifold according to the prevailing engine operating conditions.

To monitor these conditions, various sensors are fitted to the engine to measure engine parameters. Data from the sensors is received by the Electronic Control Unit (E.C.U.), the E.C.U. will then determine the exact amount of fuel required at any condition.

The E.C.U. having received data from the sensors produces pulses, the length of which will determine the simultaneous open time of each bank of injectors in turn, which will govern the amount of fuel injected.

Electronic control unit-ECU

The Electronic Fuel Injection system is controlled by the E.C.U. which is located under the front right hand seat. The control unit is a microprocessor with integrated circuits and components mounted on printed circuit boards. The E.C.U. is connected to the main harness by a 40 pin plug.

Injectors

The eight fuel injectors are fitted between the pressurized fuel rail and inlet manifold. Each injector comprises a solenoid operated needle valve with a movable plunger rigidly attached to the nozzle valve. When the solenoid is energized the plunger is attracted off its seat and allows pressurized fuel into the intake manifold.

Engine coolant temperature thermistor (sensor)

The coolant thermistor (sensor) is located by the front left hand branch of the intake manifold. The thermistor provides engine coolant information to the E.C.U. The E.C.U. on receiving the signal from the thermistor will lengthen slightly the time that the injectors are open, and reducing this time as the engine reaches normal operating temperature.

Fuel temperature thermistor (sensor)

The fuel temperature thermistor (sensor) is located in the fuel rail forward of the ram housing. The thermistor sends fuel temperature data to the E.C.U, the E.C.U on receiving the data will adjust the injector open time accordingly to produce good hot starting in high ambient temperatures.

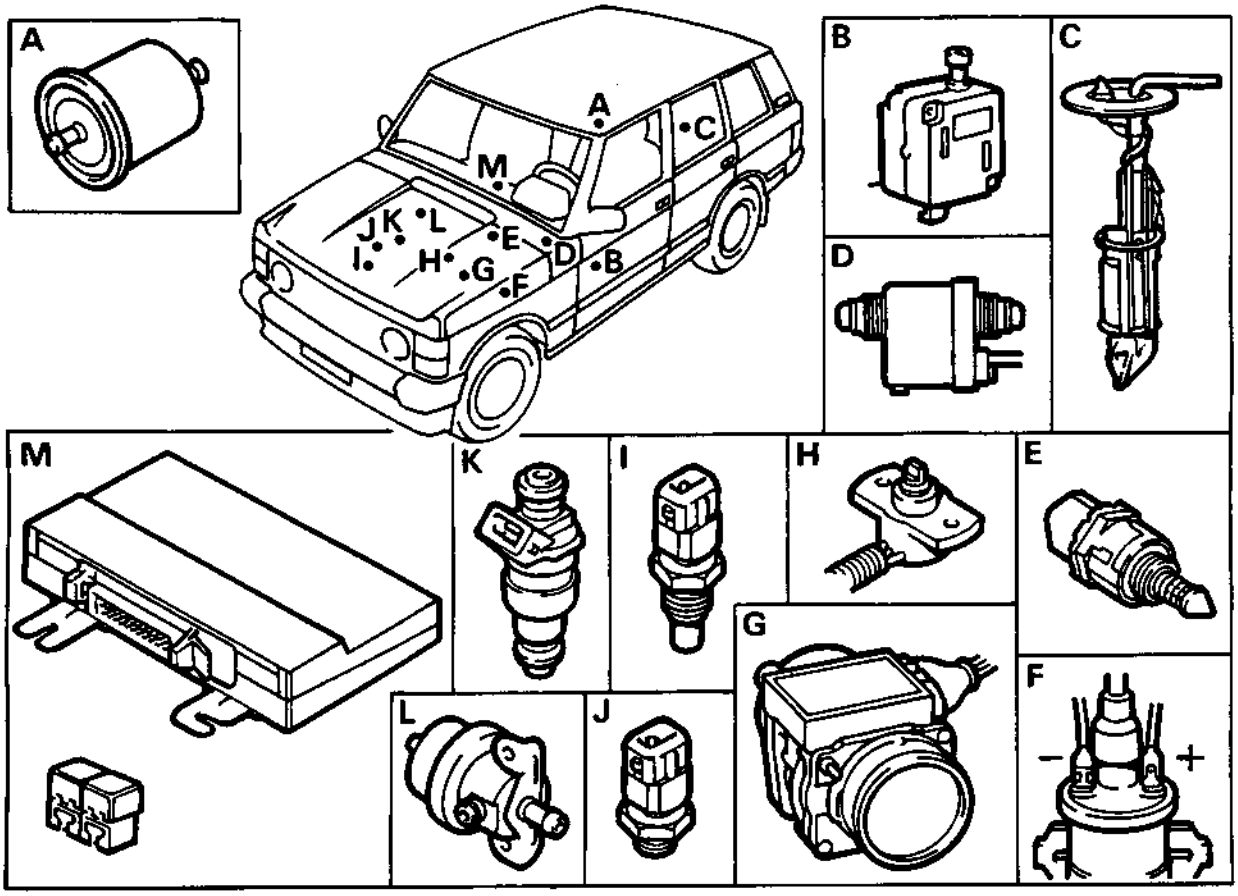
Bypass air valve (stepper motor)

The bypass valve is screwed into a housing attached to the rear of the plenum chamber, between the plenum chamber and bulkhead. The bypass valve has two windings which enable the motor to be energised in both directions thus opening or closing the air valve as required by the E.C.U.
The bypass valve will open and allow extra air into the plenum chamber to maintain engine idle speed when the engine is under increased (Electrical and Mechanical) loads.
The bypass valve will control engine idle speed when the vehicle is stationary.

Lambda sensors (0_2 sensors) - Catalyst vehicles

The two Lambda sensors are located forward of the catalysts mounted in the exhaust downpipes.
The sensors monitor the oxygen content of the exhaust gases and provide feedback information of the air/fuel ratio to the E.C.U. Each sensor is heated by an electrical element to improve its response time when the ignition is switched on.

EFI COMPONENTS



A - Filter - right side rear on chassis.
B - Inertia switch - under left front seat.
C - Fuel pump - in fuel tank.
D - Road speed transducer - left side on chassis.
E - Bypass air valve - rear of plenum chamber.
F - Ignition coil - left front inner wing panel.
G - Air flow sensor - left side of engine.
H - Throttle potentiometer - secured to throttle housing.
I - Coolant temperature sensor - front of thermostat housing.
J - Fuel temperature sensor - injector fuel rail.
K - Fuel injectors - four to each cylinder head.
L - Fuel regulator - rear right side of plenum chamber
M - ECU - under right front seat

Fuel pressure regulator

The fuel pressure regulator is mounted in the fuel rail at the rear of the plenum chamber. The regulator is a mechanical device controlled by plenum chamber vacuum, it ensures that fuel rail pressure is maintained at a constant pressure difference of 2.5 bar above that of the manifold.
When pressure exceeds the regulator setting excess fuel is returned to the fuel tank.

Fuel pump

The electric fuel pump is located in the fuel tank, and is a self priming 'wet' pump, the motor is immersed in the fuel within the tank.

Air flow sensor

The hot-wire air flow sensor is mounted on a bracket attached to the left hand valance, rigidly connected to the air cleaner and by hose to the plenum chamber inlet neck.
The air flow sensor consists of a cast alloy body through which air flows. A proportion of this air flows through a bypass in which two wire elements are situated: one is a sensing wire and the other is a compensating wire. Under the control of an electronic module which is mounted on the air flow sensor body, a small current is passed through the sensing wire to produce a heating effect. The compensating wire is also connected to the module but is not heated, but reacts to the temperature of the air taken in, as engine intake air passes over the wires a cooling effect takes place.

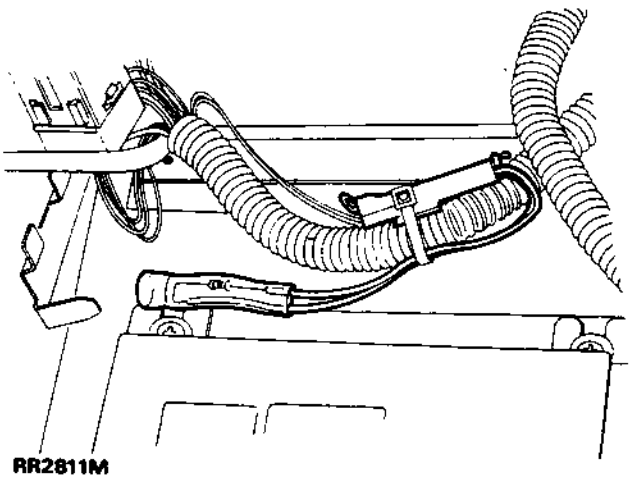
The electronic module monitors the reaction of the wires in proportion to the air stream and provides output signals in proportion to the air mass flow rate which are compatible with the requirements of the E.C.U.

Throttle potentiometer

The throttle potentiometer is mounted on the side of the plenum chamber inlet neck and is directly coupled to the throttle butterfly shaft.
The potentiometer is a resistive device supplied with a voltage from the E.C.U. Movement of the throttle pedal causes the throttle butterfly to open, thus rotating the wiper arm within the potentiometer which in turn varies the resistance in proportion to the valve position. The E.C.U. lengthens the injector open time when it detects a change in output voltage (rising) from the potentiometer.
In addition the E.C.U. will weaken the mixture when it detects the potentiometer output voltage is decreasing under deceleration and will shorten the length of time the injectors are open.
When the throttle is fully open, the E.C.U. will detect the corresponding throttle potentiometer voltage and will apply full load enrichment. This is a fixed percentage and is independent of temperature. Full load enrichment is also achieved by adjusting the length of the injector open time.
When the throttle is closed, overrun fuel cut off or idle speed control may be facilitated dependant on other inputs to the E.C.U.
The potentiometer is 'self adaptive', which means that adjustment is not possible. It also means the potentiometer setting is not lost, for example, when throttle stop wear occurs.

⚠ **CAUTION: Do not attempt to adjust throttle potentiometer.**

Tune select resistor - RR2811M



RR2811M

To suit individual market requirements a tune select resistor is connected across pins 5 and 27 of the ECU. It is located adjacent to the ECU, and strapped to the EFI cable assembly. The value of the resistor is dependent on the market application:
Red wire, 180 ohms, Australia, Rest of world.
Green wire, 470 Ohms, UK and Europe - non catalyst.
Yellow wire 910 Ohms, Saudi non catalyst.
White wire, 3K9 Ohms, European catalyst

Condenser fans

It should be noted that under high coolant temperatures, when the engine is switched off, the condenser fans will be activated and will run for approximately ten minutes.

Road speed transducer

The road speed transducer mounted on a bracket located on the left hand chassis side member adjacent to the rear engine mounting. The transducer provides road speed data to the ECU. The ECU in turn detects vehicle movement from the road speed input and ensures that idle speed control mode is disengaged. Should the speed transducer fail in service the ECU idle speed control would become erratic.

The transducer also provides road speed data to the electric speedometer and, when fitted, air suspension ECU.

Inertia switch

The inertia switch is a mechanically operated switch located under the left hand front seat attached to the seat base rear cross-member.
The switch is normally closed and is in the fuse to fuel pump circuit. In the event of a sudden impact the switch opens, and disconnects the electrical feed to the fuel pump. The switch is reset by pressing down the button.

Relays

The two electronic fuel injection relays are located under the front right hand seat mounted forward of the E.C.U. The main relay is energized via the E.C.U when the ignition is switched on and supplies current to the fuel injection system. The fuel pump relay is energized by the E.C.U. which in turn operates the fuel pump to pressurize the fuel system.

ENGINE TUNING

ECU - EFI circuit diagnosis

Circuit fault diagnosis may be carried out on all EFI vehicles, using a good quality Multi Meter or the hand held tester RTC6834. The tester displays the fault code and guides the operator by visual prompts, through a series of diagnostic checks. Full operational and diagnosis instructions are provided with the unit memory card. ***See Service tools, Diagnostic equipment***

Which ever instrument is used to diagnose the problem, the following Preliminary Checks must be carried out first.

Preliminary checks

⚠ **CAUTION: Catalyst exhaust: If engine is misfiring or fails to start within 12 seconds the cause must be rectified. Failure to do so will result in irreparable damage to the catalysts. After rectification the engine must be run at 1500 rev/min (no load) for 3 minutes to purge any accumulation of fuel in the system.**

1. Check that the inertia switch is not tripped.
2. Check fuse C4 in main fuse panel and the fuel pump fuse 10A under the drivers seat.
3. Check for ample fuel in tank.
4. Check air inlet system for possible leaks into the inlet manifold.
5. Check HT cables for correct firing order and routing.
6. Check ignition timing.

Only when the above checks have been carried out, should circuit diagnosis begin.

For diagnosis procedure using a Multi Meter. ***See ETM, A1***

The diagnosis procedure using Hand Held Tester is contained in the hand held tester manual. ***See Service tools, Diagnostic equipment***

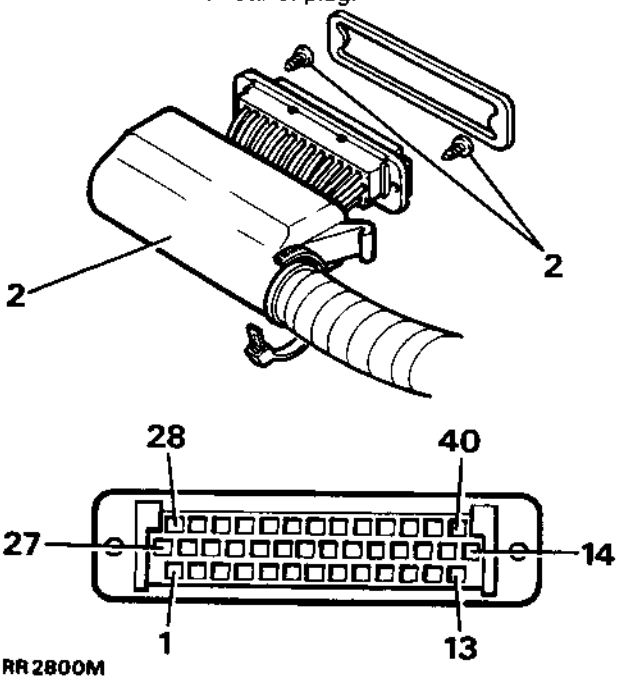
MULTI METER CHECKS

To carry out tests when 40 way multi-plug is connected to the E.C.U., it is necessary to remove the two screws securing the shroud to the plug to enable the multi-meter probes to be inserted into the back of the appropriate pin.

⚠ **CAUTION: Tests requiring plug to be removed from E.C.U., must have meter probes inserted into back of plug. If probes are inserted into plug sockets, damage will occur to sockets resulting in poor connections when plug is reconnected.**

Test

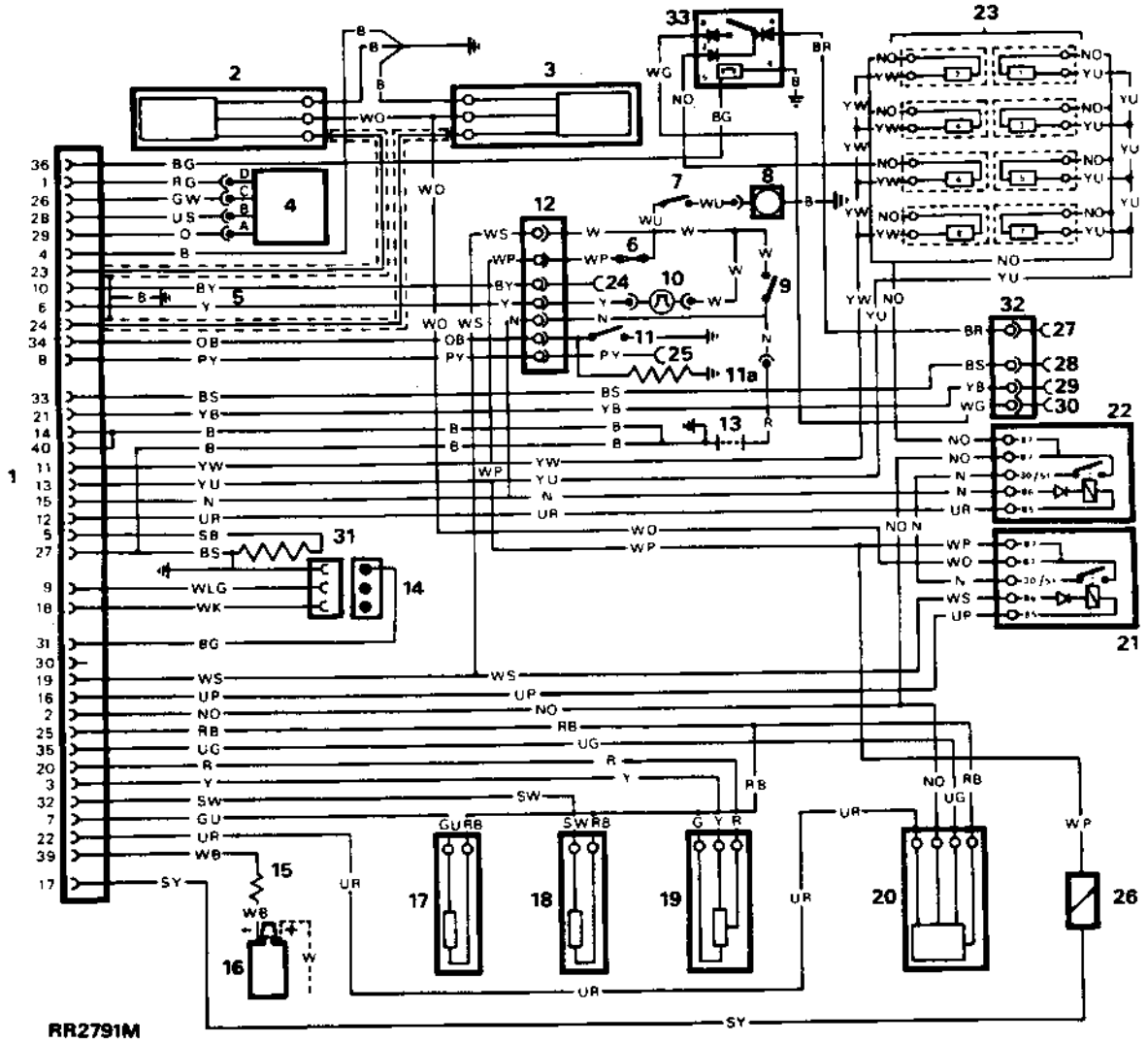
1. Release harness plug from E.C.U. Access is gained by removing front seat base trim of front right hand seat.
2. Remove plug shroud and manoeuvre it along harness to enable meter probes to be inserted into back of plug.
3. Only pin numbers 1, 13, 14, 27, 28 and 40 are moulded onto rear of plug.



RR2800M

View of plug - cover removed.
Pins 1 to 13 bottom row.
Pins 14 to 27 centre row.
Pins 28 to 40 top row. For clarity electrical leads omitted.
For diagnostics using a multi meter. ***See ETM, A1***

FUEL INJECTION - CIRCUIT DIAGRAM - 1990 - 1991



1. (ECU). 40 Way connector.
2. Lambda sensor (left bank A).
3. Lambda sensor (right bank B).
4. By-pass air valve (stepper motor)(fast idle).
5. Lambda sensor screened ground.
6. Fuse C4 - main fuse panel.
7. Interia switch.
8. Fuel pump.
9. Ignition switch.
10. Speed transducer (road speed input).
11. Neutral switch (automatic gearbox)(load input).
12. Main cable connector.
13. Battery.
14. Diagnostic plug.
15. In-line resistor.
16. Coil/-ve (engine RPM input).
17. Coolant temperature thermistor (sensor)(input).
18. Fuel temperature thermistor (sensor)(input).
19. Throttle potentiometer.
20. Air flow sensor.
21. Fuel pump relay.
22. Main relay.
23. Injectors-1 to 8.
24. Pick-up point E.F.I. warning symbol instrument binnacle.
25. Heated front screen sense.
26. Purge control valve-if fitted.
27. 12V from fan relay.
28. Air conditioning output control.
29. Air conditioning load input.
30. Fan relay feed.
31. Tune resistor.
32. Heater/air con. cable connector.
33. Condenser fan timer control.
34. Resistor (manual gearbox)

= = = Denotes screened ground.

NOTE: Lambda sensors fitted to catalyst vehicles only.

BASE IDLE SPEED SETTING

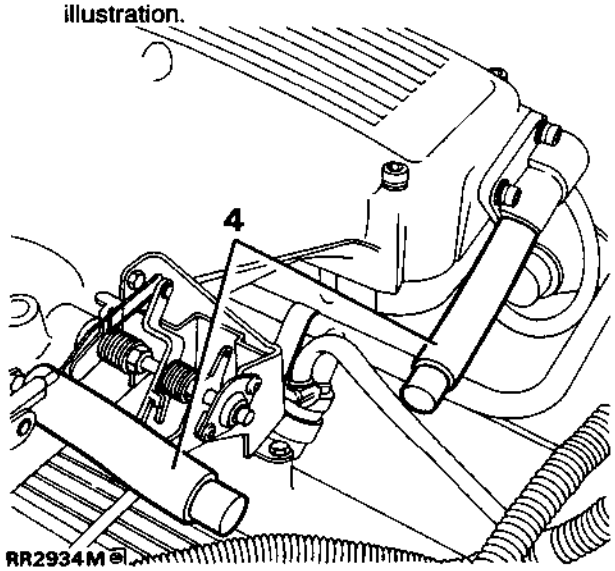
△ **NOTE: Base idle speed is set at factory. It should not require further adjustment unless plenum chamber is changed. The adjustment screw is sealed with a plug to prevent unauthorised alteration. Check ignition timing before attempting following procedure, since this will affect idle speed.**

Equipment required

Two blanking hoses. these are manufactured using a new air by-pass valve hose - Part No.ETC7874. Cut two equal pieces 90mm long from hose and seal one end of each, using 13mm diameter bar. Use a suitable clamp to ensure an air tight seal.

Checking procedure

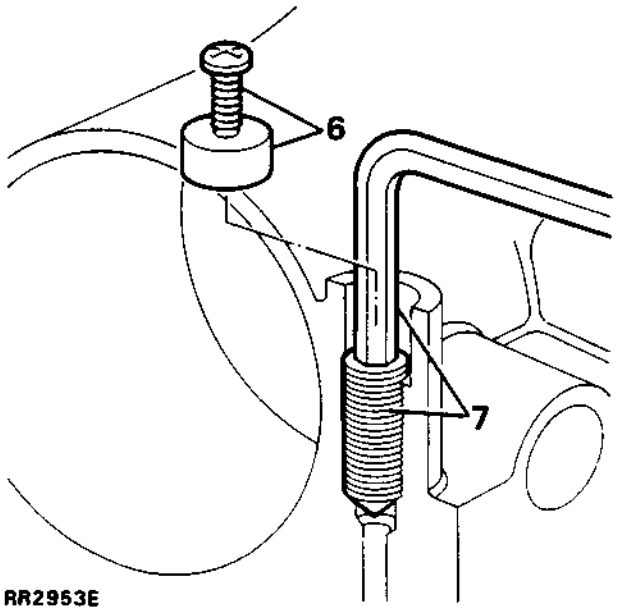
1. Drive vehicle at least two miles until engine and transmission are hot. Switch off engine.
2. Check all electrical loads are OFF, including air conditioning.
3. Remove air by-pass valve hose.
4. Fit blanking hoses to both plenum chamber and air by-pass valve. Ensure hoses are securely fitted to prevent air leaks. Note throttle cable and cruise control actuator have been omitted from illustration.



5. Start engine and check idle speed is within limits. ***See ENGINE TUNING DATA, Information, Engine Tuning Data***

Adjusting base idle speed

6. Drill tamper proof plug and insert a self tapping screw to enable plug to be extracted.



7. Start engine, adjust idle screw clockwise to decrease or anti-clockwise to increase idle speed.
8. Stop engine, remove blanking hoses. Reconnect hose to plenum.
9. Fit new tamper proof plug.

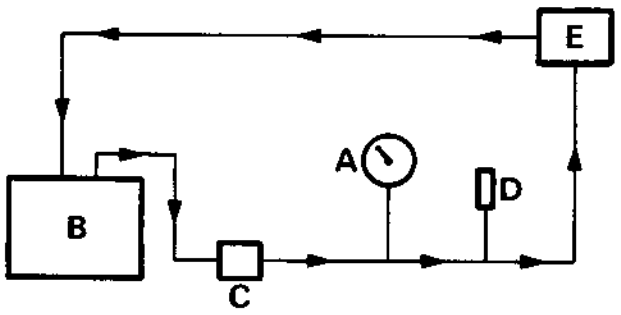
FUEL PRESSURE CHECK

In order to check the fuel pressure it is necessary to first depressurise the fuel system as follows:

WARNING: Under normal operating conditions the fuel injection system is pressurised by a high pressure fuel pump, operating at up to 2.3 to 2.5 bar. When engine is stationary pressure is maintained within system. To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise fuel injection system before any service operations are carried out.

If vehicle has not been run there will be a small amount of residual pressure in fuel line. The depressurising procedure must still be carried out before disconnecting any component within the fuel system.

The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



RR3834M

A Pressure gauge 18G1500
B Fuel tank and pump
C Fuel filter
D Fuel injectors x 8
E Regulator

1. Remove fuel pump relay. ***See Repair, Electronic fuel injection-relays***
2. Start and run engine.
3. When sufficient fuel has been used to cause fuel line pressure to drop, injectors will become inoperative, resulting in engine stall. Switch off ignition.
4. Disconnect the battery negative lead.

NOTE: Fuel at low pressure will remain in system. To remove low pressure fuel, place absorbent cloth around fuel pipe at the filter during disconnection.

5. Connect the pressure gauge on the outlet from the filter, located on the chassis under the right rear wheel arch.
6. Reconnect the battery and turn the ignition to position II while observing the pressure gauge.
   Results
   Expected reading 2,39-2,672 kgf/cm^2
   Pressure drop-max 0.7 kgf/cm^2 in one minute.
   If pressure is low check that filter is not blocked and pump is operating satisfactorily. Then recheck pressure. If pressure is still low renew regulator. ***See Repair, Fuel pressure regulator***

INJECTOR TESTS

NOTE: Before removing any of the injectors, remove and examine the spark plugs, check for consistent colouration of plugs. A leaking injector will result in the appropriate spark plug being 'sooted up'.

The following test may only be carried out using suitable injector test equipment.

Leak Test

Leak test with the injectors closed but pressurise to 2.54 Kgf/cm^2. No injector should leak more than 2 drops of fuel per minute.

Fuel Delivery Test

Fuel delivery test with the injector open and pressurised as above, fuel delivery from each injector should be 160-175 cc per minute using white spirit, or 180-195 cc per minute using petrol at 20°C ± 2°C.

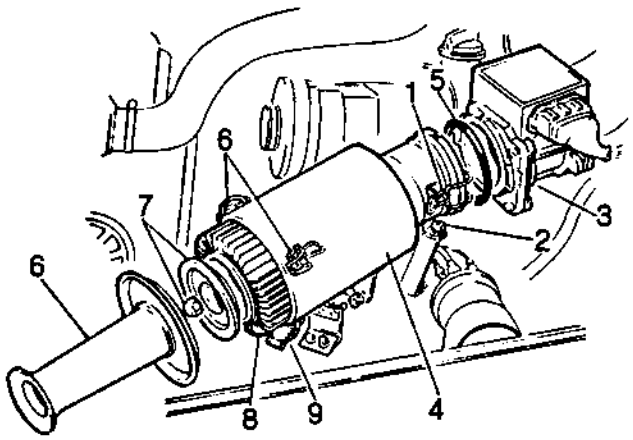
AIR CLEANER

Service repair no - 19.10.30

Remove and refit

Remove

1. Release two clips securing air cleaner to air flow sensor.
2. Release two nuts and bolts securing air cleaner to left hand valance mounting bracket.
3. Detach air flow sensor from air cleaner, and lay carefully to one side.
4. Detach air cleaner from centre mounting bracket and withdraw from engine compartment.
5. Remove large 'O' ring from outlet tube of air cleaner. Fit a new 'O' ring if in poor condition.
6. Unclip three catches and remove inlet tube.
7. Remove nut and end plate securing air cleaner element in position.
8. Withdraw air cleaner element and discard.
9. Inspect dump valve for condition and check it is free of obstructions.



RR1854E

Refit

10. Fit new element and secure in position.
11. Refit inlet tube.
12. Refit air cleaner to mounting bracket and secure.
13. Clip air cleaner to air flow sensor.

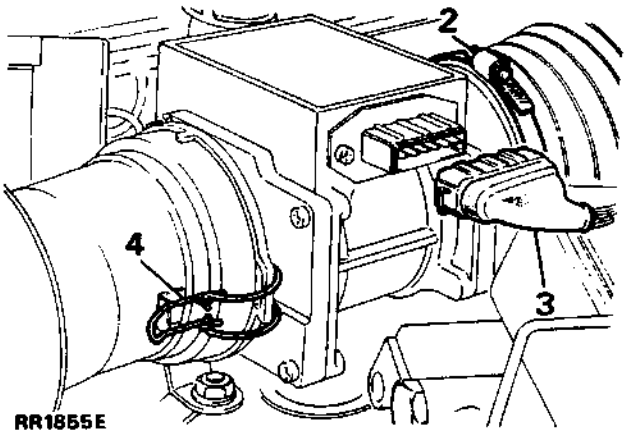
AIR FLOW SENSOR

Remove and refit

Remove

△ **NOTE: The air flow sensor is not a serviceable item. In event of failure or damage complete unit must be replaced.**

1. Disconnect the battery negative lead.
2. Release intake hose clamp, disconnect from sensor.
3. Disconnect multi-plug.
4. Release two clips securing air cleaner case to air flow sensor. Remove sensor from engine compartment.



RR1855E

Refit

5. Reverse removal procedure. Ensure multi-plug is firmly reconnected, and hose clamp at the rear of sensor is securely tightened, to prevent unmetered air entering engine.

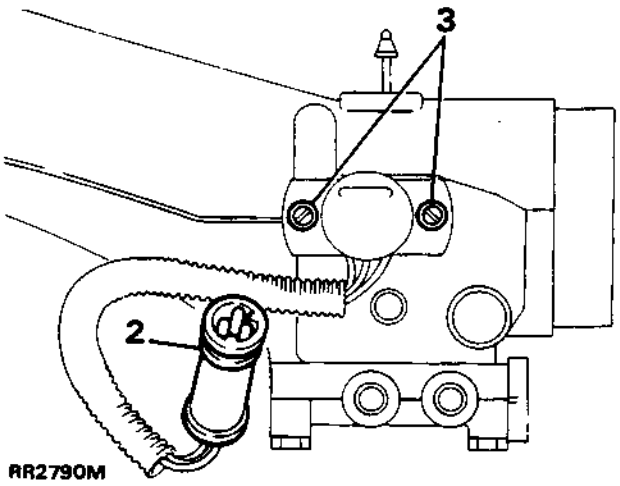
THROTTLE POTENTIOMETER

Service repair no - 19.22.49

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect electrical plug.
3. Remove two screws securing switch to plenum chamber and carefully pull switch off throttle shaft.



4. Remove old gasket.

Refit

5. Fit new gasket.
6. Align switch and shaft flats, slide switch on to throttle shaft. Secure switch to plenum chamber.

⚠ **CAUTION: DO NOT operate throttle mechanism while potentiometer is loosely fitted, damage may be caused to potentiometer wiper track.**

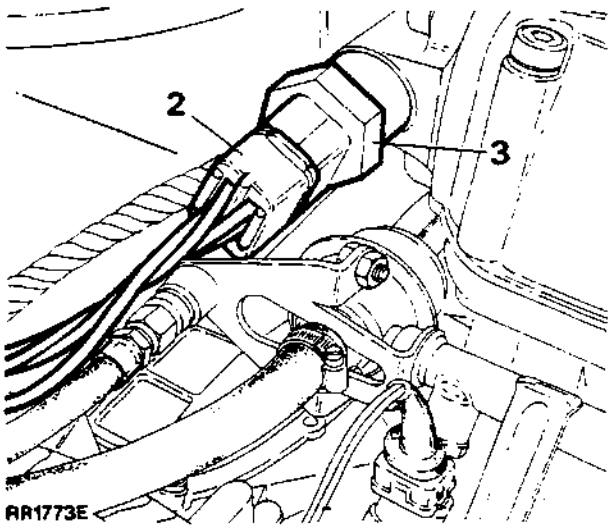
BY-PASS AIR VALVE (STEPPER MOTOR)

Service repair no - 19.22.54

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove multi-plug.
3. Unscrew valve from rear plenum chamber.
4. Remove washer.



Refit

5. Fit **NEW** sealing washer.

△ **NOTE: If same by-pass valve is being refitted clean sealing compounds from threads. Apply Loctite 241 to threads of valve before reassembly.**

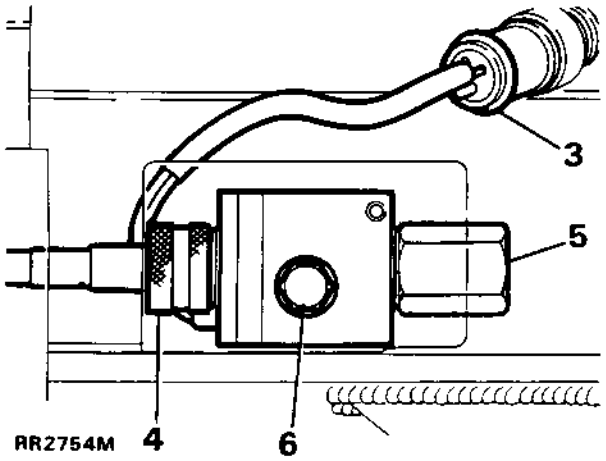
6. Tighten valve to ***20 Nm.***
7. Reverse removal procedure.

SPEED TRANSDUCER

Remove and refit

Remove

1. Place vehicle on ramp, apply parking brake.
2. Disconnect the battery negative lead.
3. Raise ramp, disconnect electrical plug.
4. Disconnect speedometer cable.
5. Do not remove blanking cap.
6. Remove single bolt. Remove transducer from mounting bracket.



Refit

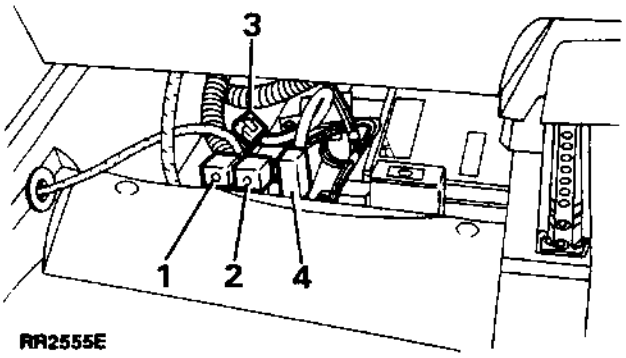
7. Reverse removal procedure.

ELECTRONIC FUEL INJECTION-RELAYS

Service repair no - 19.22.08

Incorporated in fuel injection electrical system are two relays which are located beneath front right hand seat adjacent to cruise control relay and emission maintenance reminder. Access to the relays is gained through the opening at the bottom of the seat when the seat is fully forward.

1. **Fuel pump relay - blue base.**
2. **Main relay - black base.**
3. **Diagnostic plug.**



Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pull relay(s) from base.

Refit

3. Reverse removal procedure.

ELECTRONIC CONTROL UNIT (ECU)-14 CUX

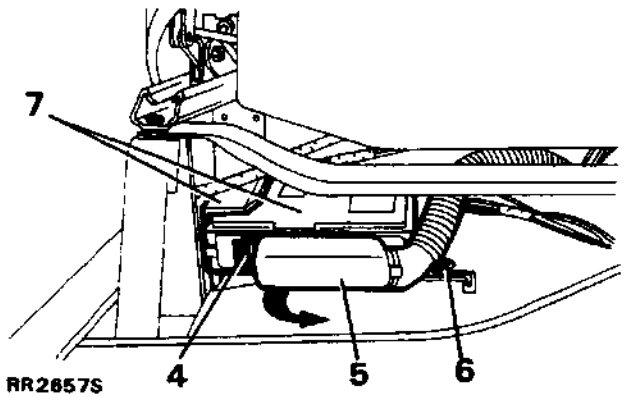
Service repair no - 19.22.34

NOTE: The ECU is not serviceable, in event of unit failure it must be replaced.

Remove and refit

Remove

1. Remove front and side seat base trim of front right hand seat.
2. Adjust seat to its rearward position, to allow access to ECU.
3. Disconnect the battery negative lead.
4. Release ECU plug retaining clip.
5. Manoeuvre front of plug in the direction of arrow. Detach other end of plug from retaining peg.
6. Release two screws securing ECU.
7. Withdraw ECU from spring clip.



Refit

8. Refit ECU securely in spring clip. Fit and tighten 2 securing screws.
9. Reconnect ECU harness plug. Ensure plug is pushed firmly into location and retaining clip secures plug in position.
10. Reverse removal procedure.

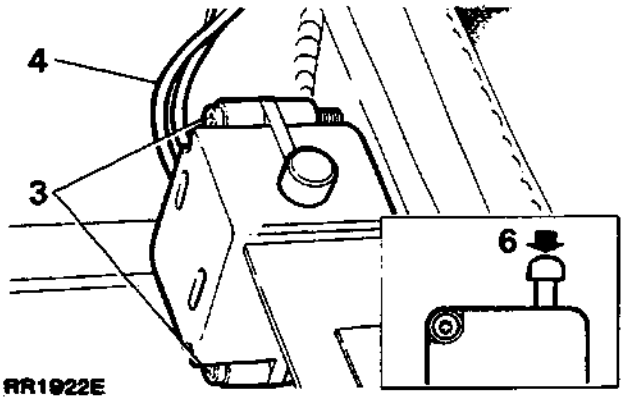
INERTIA SWITCH

The inertia switch is located under left hand front seat. Access to switch is gained through opening at rear of seat base.

Remove and refit

Remove

1. Ensure seat is fully forward.
2. Disconnect the battery negative lead.
3. Remove two screws securing switch to cross member.
4. Withdraw switch and disconnect multi-plug.
5. Remove switch.



Refit

6. Reverse removal procedure. Ensure that switch is reset (plunger in lowest position).

FUEL TEMPERATURE THERMISTOR (SENSOR)

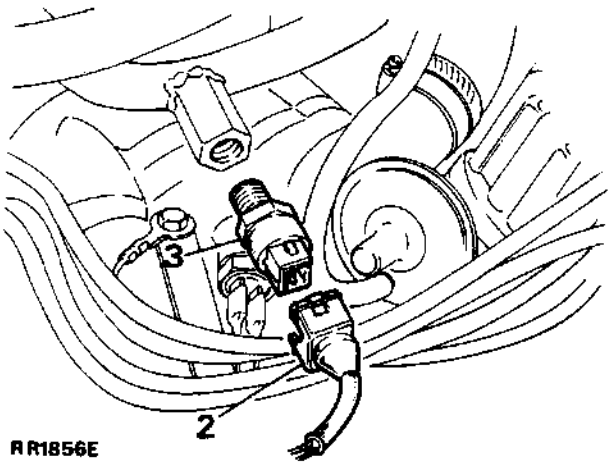
Service repair no - 19.22.08

Remove and refit

Remove

NOTE: Fuel leakage will not occur when thermistor is removed from fuel rail, therefore it is not necessary to depressurise the fuel system.

1. Disconnect the battery negative lead.
2. Remove multi - plug from thermistor.
3. Release thermistor from fuel feed rail.



RR1856E

Refit

4. Reverse removal procedure. Ensure thermistor is tightened securely in fuel rail.

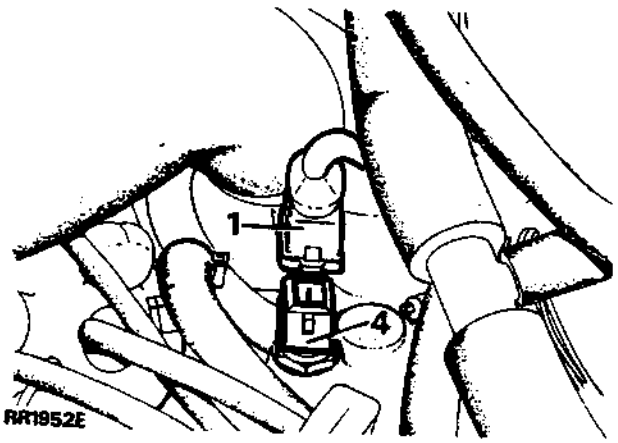
COOLANT TEMPERATURE THERMISTOR (SENSOR)

Service repair no - 19.22.18

Remove and refit

Remove

1. Remove thermistor multi-plug.
2. Release radiator bottom hose, partially drain cooling system.
3. Refit hose and tighten clamp.
4. Remove thermistor from left hand front branch of intake manifold.
5. Remove copper washer.



RR1952E

Refit

6. Fit a NEW copper washer.
7. Fit thermistor and tighten securely.
8. Refill cooling system.
9. Run engine, check for water leaks around thermistor.

DEPRESSURISING FUEL SYSTEM

WARNING: Under normal operating conditions the fuel injection system is pressurised by a high pressure fuel pump, operating at up to 2.3 to 2.5 bar When engine is stationary pressure is maintained within system. To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise fuel injection system before any service operations are carried out.

If vehicle has not been run there will be a small amount of residual pressure in fuel line. The depressurising procedure must still be carried out before disconnecting any component within the fuel system.

The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Remove fuel pump relay. ***See Electronic Fuel Injection-Relays***
2. Start and run engine.
3. When sufficient fuel has been used to cause fuel line pressure to drop, injectors will become inoperative, resulting in engine stall. Switch off ignition.
4. Disconnect the battery negative lead.

NOTE: Fuel at low pressure will remain in system. To remove low pressure fuel, place absorbent cloth around fuel feed hose at fuel rail.

5. Disconnect either:
   a) Nut and olive at fuel rail
   OR
   b) Hose at inlet end of fuel filter.

Refit

6. Refit fuel feed hose.
7. Refit fuel pump relay, reconnect battery.
8. Crank engine (engine will fire in approximately 6 to 8 seconds).

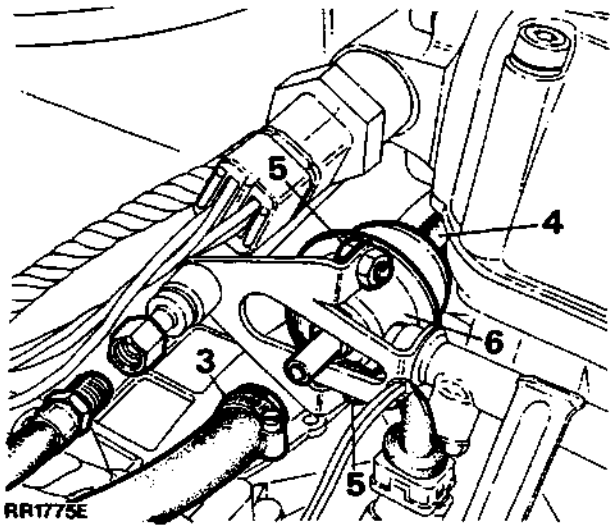
FUEL PRESSURE REGULATOR

Service repair no - 19.45.06

Remove and refit

Remove

1. Depressurise fuel system. ***See Depressurising fuel system***
2. Disconnect the battery negative lead.
3. Release hose clamp securing fuel return hose to regulator. Remove the hose.
4. Pull vacuum hose from rear of regulator.
5. Remove two nuts and bolts securing regulator to fuel rail, ease regulator fuel inlet pipe out of fuel rail.
6. Withdraw regulator from engine compartment.



NOTE: Fit a NEW 'O' ring to fuel inlet pipe if original regulator is refitted.

Refit

7. Lightly coat 'O' ring with silicon grease 300 before fitting regulator.
8. Reverse removal procedure.
9. Reconnect battery and pressurise fuel system. Check there are no fuel leaks around regulator connections.

FUEL RAIL-INJECTORS R/H AND L/H

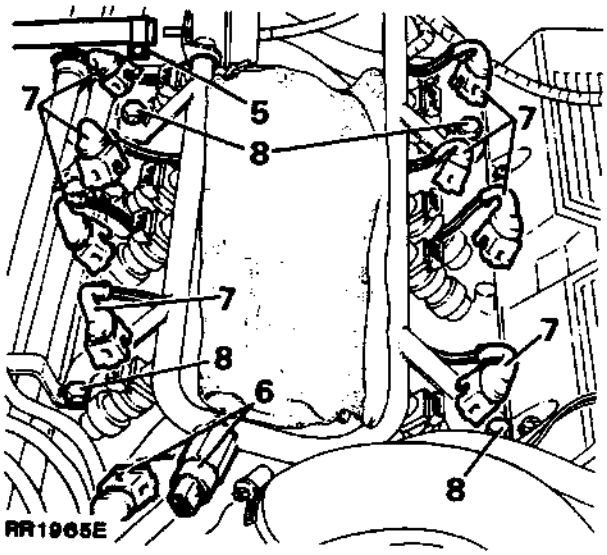
Remove and refit

Remove

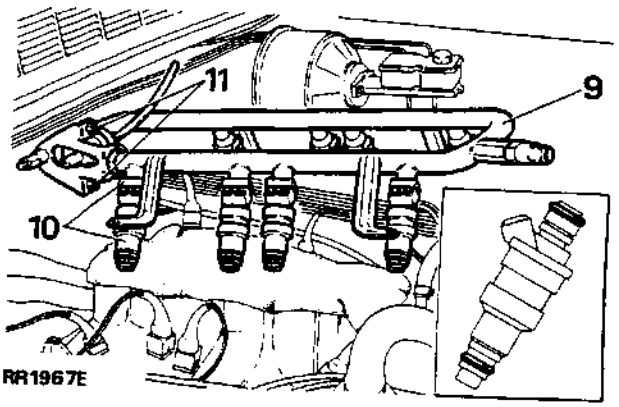
1. Depressurise fuel system. ***See Depressurising fuel system***
2. Disconnect the battery negative lead.
3. Remove plenum chamber. ***See Plenum Chamber***
4. Remove ram housing. ***See Ram Housing***

NOTE: Place cloth over ram tube openings to prevent ingress of dirt.

5. Release hose clamp and remove fuel return hose from regulator.
6. Disconnect multi-plug from fuel temperature thermistor (sensor).
7. Disconnect multi-plugs from injectors.
8. Remove five bolts securing fuel rail support brackets to intake manifold. Lay heater pipes to one side.



9. Remove fuel rail and injectors.
10. Remove injector retaining clips, ease injectors from rail.
11. Remove fuel regulator if required.



Refit

12. Fit **NEW** 'O' rings, to injectors. Lightly coat 'O' rings with silicon grease 300. Insert injectors into fuel rail, multi-plug connections facing outwards.
13. Refit retaining clips.

CAUTION: Care must be taken when refitting the fuel rail and injectors to intake manifold to prevent damage to 'O' rings.

14. Fit a **NEW** 'O' ring to pressure regulator lightly coat 'O' ring with silicon grease 300 and secure regulator to the fuel rail.
15. Fit fuel rail and heater pipe assemblies to intake manifold. Secure rail and pipes in position with five bolts.
16. Reverse removal procedure. 2 to 7.
17. Pressurise fuel system and check for fuel leaks around injectors and pressure regulator.

PLENUM CHAMBER

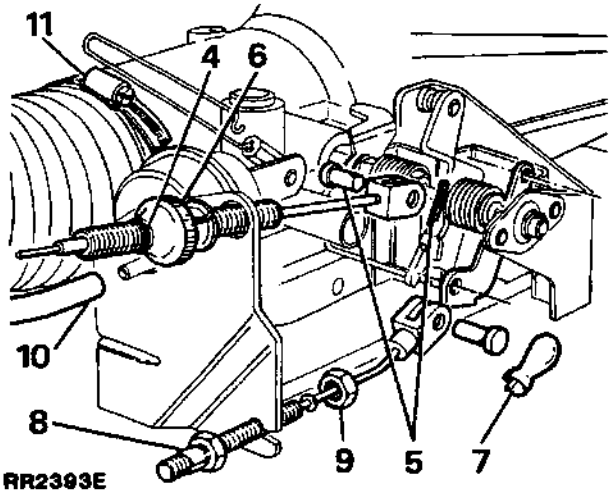
Service repair no - 19.22.46

Includes throttle levers and throttle disc

Remove and refit

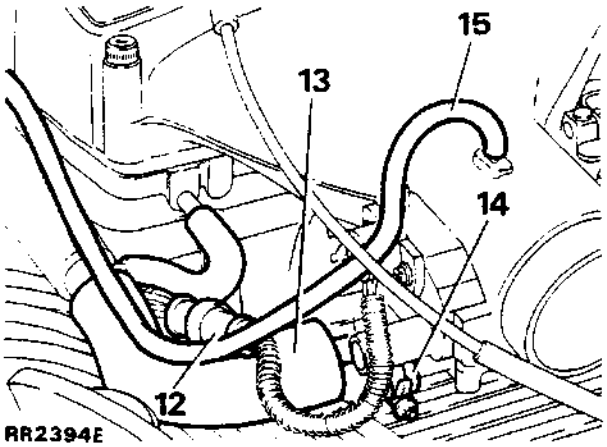
Remove

1. Disconnect the battery negative lead.
2. Disconnect electrical multi-plug from bypass air valve.
3. Disconnect vacuum hose adjacent to bypass air valve.
4. Mark an identification line on throttle cable outer to assist re-assembly.
5. Remove clevis pin from throttle cable.
6. Pry adjustment thumb wheel from throttle bracket. Lay cable aside.
7. Remove retaining clip and clevis pin from kick down cable (automatic vehicles).
8. Apply adhesive tape behind rear adjustment nut on kick down cable to prevent nut moving.
9. Remove front lock nut. Remove cable and lay aside.
10. Remove cruise control vacuum hose.



RR2393E

11. Remove intake hose from neck of plenum chamber.
12. Disconnect throttle potentiometer multi-plug.
13. Remove PCV breather hose.
14. Disconnect two coolant hoses and plug each hose to prevent excessive loss of coolant. Identify each hose for re-assembly.

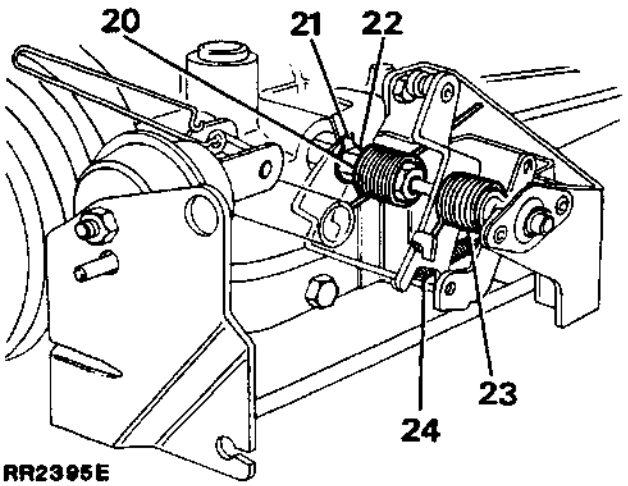


RR2394E

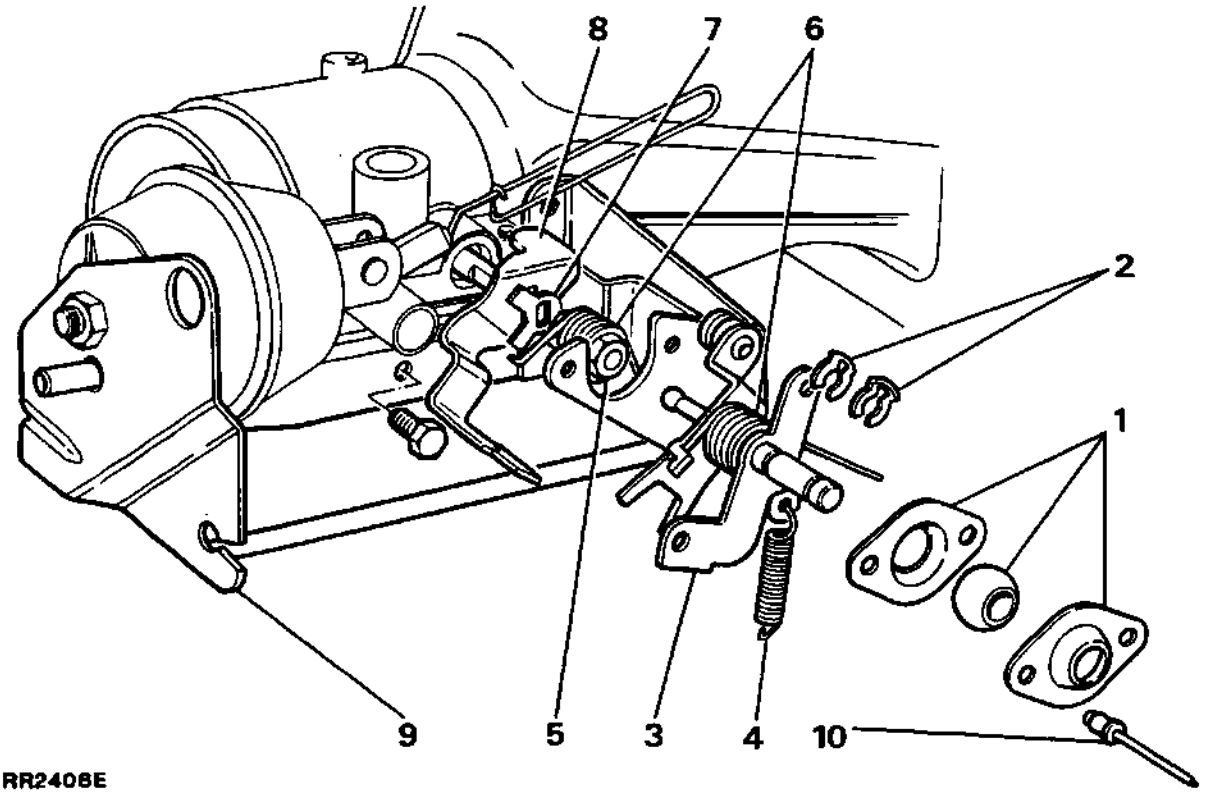
15. Remove distributor vacuum hose.
16. Release two screws and remove potentiometer.
17. Remove six screws securing plenum chamber. Remove plenum chamber.
18. Remove air bypass valve hose.

Throttle lever assembly - remove

19. If fitted - unclip cruise control actuator link. Hold throttle fully open, release link from countershaft assembly. Carefully return lever assembly to close throttle.
20. Release tension on inboard throttle spring.
21. Bend back lock washer tabs.
22. Hold throttle stop lever in closed position, release nut from throttle shaft.
23. Release tension on outboard throttle spring.
24. Remove overtravel spring.



RR2395E

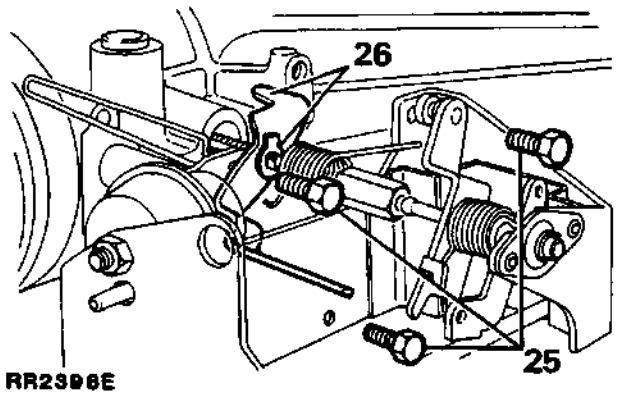


RR2408E

KEY

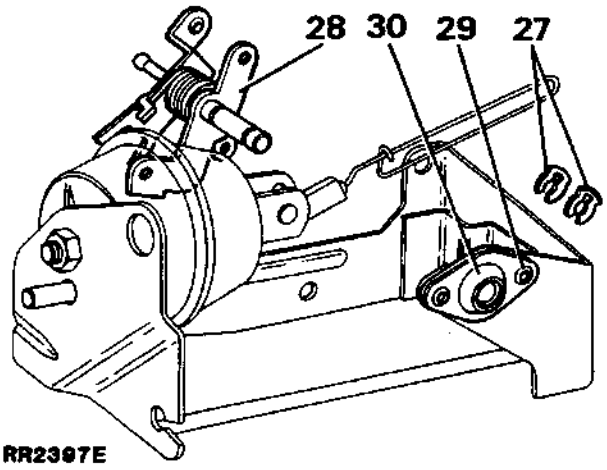
1. Spherical bush/housing
2. Retaining clips (2)
3. Countershaft assembly
4. Overtravel spring
5. Throttle spindle nut
6. Throttle return spring (2)
7. Tab washer
8. Throttle stop lever
9. Throttle bracket assembly
10. Pop rivets (2)

25. Remove three bolts securing throttle bracket to plenum chamber, withdraw bracket assembly.
26. Remove tab washer and throttle stop lever from throttle shaft.

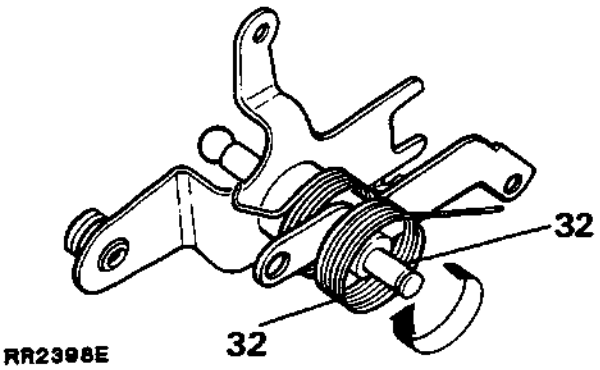


Throttle lever assembly - inspect and overhaul

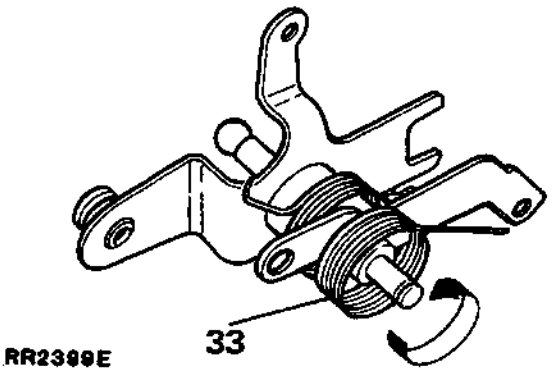
27. Remove two retaining clips from spherical bush.
28. Remove the countershaft assembly.
29. If spherical bush worn, drill out two securing rivets (4,7 mm, (3/16 in) diameter drill).
30. Split assembly, discard worn bush.



31. Grease new bush with Admax L3 or Energrease LS3. Assemble bush into housing. Assemble to throttle bracket using two 4.7 mm (3/16 in) diameter domed head rivets.
32. Examine bearing surface of countershaft assembly. If worn fit new assembly, otherwise wind throttle return spring off levers.



33. Wind new spring onto countershaft assembly, small hooked end of spring is wound on first.

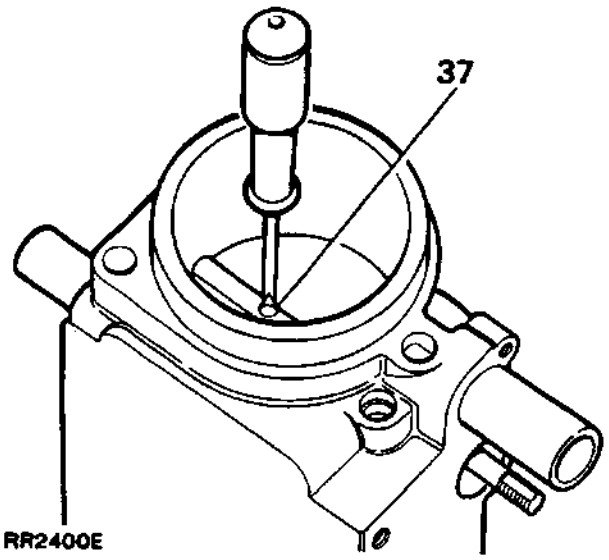


34. Grease shaft with Admax L3 or Energrease LS3, fit countershaft assembly to spherical bearing, secure with two clips.
35. Examine throttle stop lever for wear, fit a new lever if necessary.

Throttle disc - inspect and overhaul

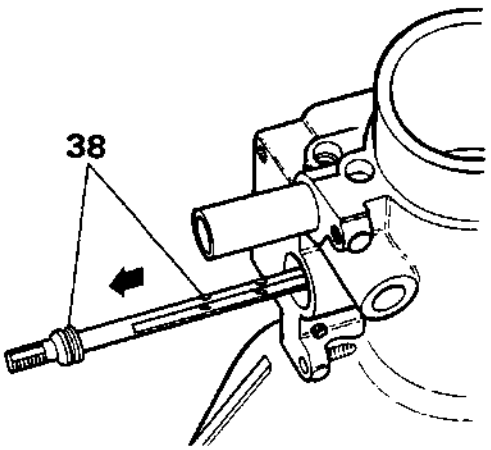
36. Examine throttle shaft for excessive wear between bushes in plenum chamber and shaft. A small amount of clearance is permissible. If excessive wear is evident fit new shaft and bushes as follows.
37. Remove two split screws securing throttle disc and withdraw disc.

⚠ **CAUTION: Take care not to damage shaft.**



RR2400E

38. Remove shaft and air seal from plenum chamber.



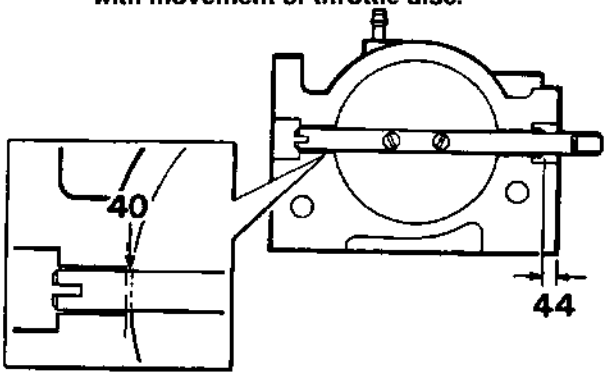
RR2401E

39. Using suitable drift, drive out bushes.

⚠ **CAUTION: Take care not to damage plenum chamber bores**

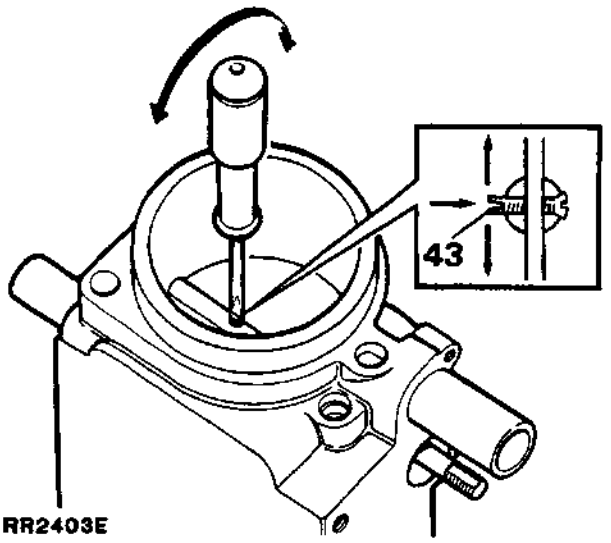
40. Press in new bushes until flush with throttle disc bore.

⚠ **CAUTION: Ensure that bushes do not protrude into bore, as they will interfere with movement of throttle disc.**



RR2402E

41. Fit throttle shaft and disc, secure with two split screws. Do not fully tighten screws.
42. Rotate throttle shaft 360° once or twice to centralise disc in bore. Tighten split screws.
43. Rotate shaft. Use screw driver to spread split.

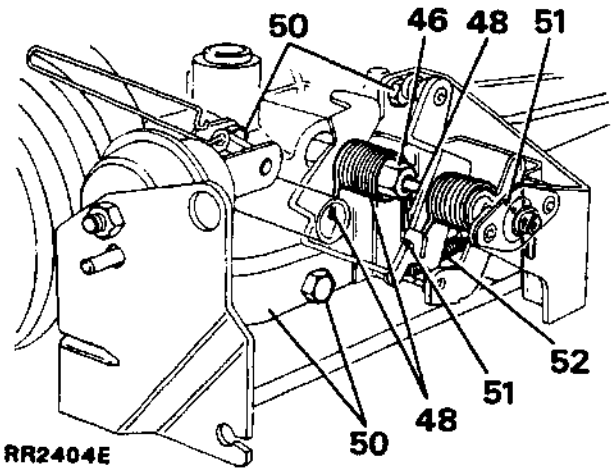


RR2403E

44. Grease new air seal with Admax L3 or Energrease LS3. Push seal down shaft, into counterbore until seal is 6.0 mm (0.236 in) below face of plenum.

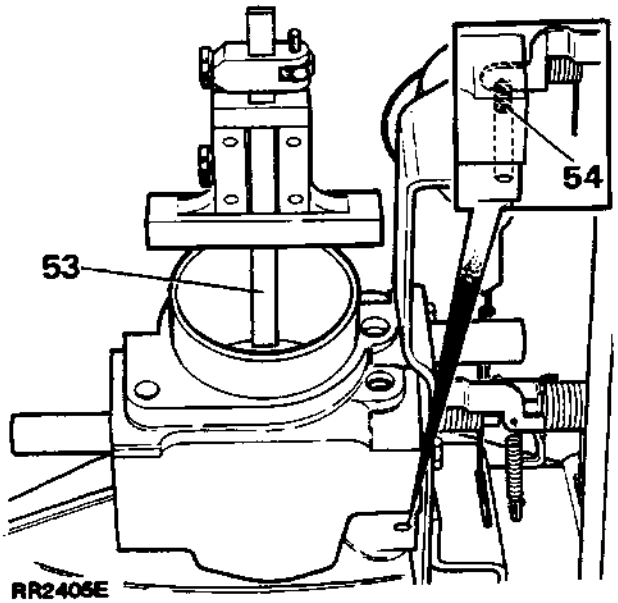
Throttle levers and bracket - assemble

45. Fit stop lever to throttle shaft, fit a new tab washer and secure with throttle spindle nut.
46. Holding stop lever on stop, tighten throttle spindle nut securely, bend over tabs to lock nut in position.
47. Fit inboard throttle return spring noting that small hooked end of spring is nearest plenum.
48. Locate hooked end of inboard spring on stop lever. Wind up straight end one full turn and locate in appropriate slot.
49. Fit countershaft to interconnecting nut of throttle valve shaft.
50. Secure throttle bracket assembly to plenum. Secure with three retaining bolts.
51. Ensure hooked end of outboard spring is retained by lever, wind spring up one full turn and locate free end in appropriate slot.
52. Fit overtravel spring.
Lightly grease throttle return and overtravel springs with Admax L3 or Energrease LS3.



△ **NOTE: If new throttle levers have been fitted, minimum throttle setting of disc must be checked to ensure it is 90° to bore.**

53. Using a depth vernier or depth micrometer, check dimension from mouth of bore to top and bottom of valve disc. Dimension must be within 0.5 mm (0.019 in) total indicator reading across diameter of disc.
54. If dimension is out of limits, adjust small set screw below stop lever.



Refit

55. Reconnect and adjust cruise control actuator link. ***See actuator link-setting***
56. Clean joint faces of plenum and ram housing. Apply 'Hylomar' sealant, refit plenum chamber. Tighten to ***26 Nm.***
57. Reverse removal procedure.

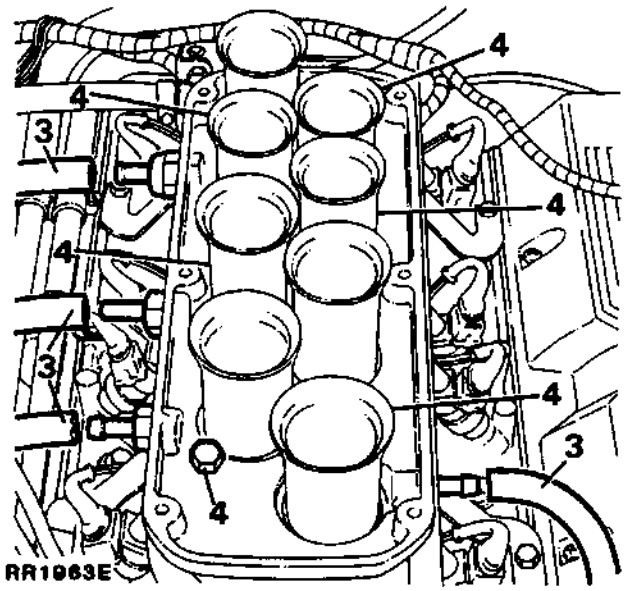
RAM HOUSING

Service repair no - 19.70.04

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove plenum chamber. ***See Plenum Chamber***
3. Release hoses from ram housing.
4. Remove six through bolts (with plain washers) securing ram housing to intake manifold.



5. Remove ram housing from intake manifold.
6. Place a protective cover over inlet bores to prevent ingress of dirt.

Refit

7. Clean all mating faces.
8. Apply 'Hylomar' sealant to intake manifold face.
9. Fit ram housing. Tighten bolts, working from two centre bolts, diagonally towards outer four bolts.
10. Tighten to ***26 Nm.***

INTAKE MANIFOLD

Remove and refit

Remove

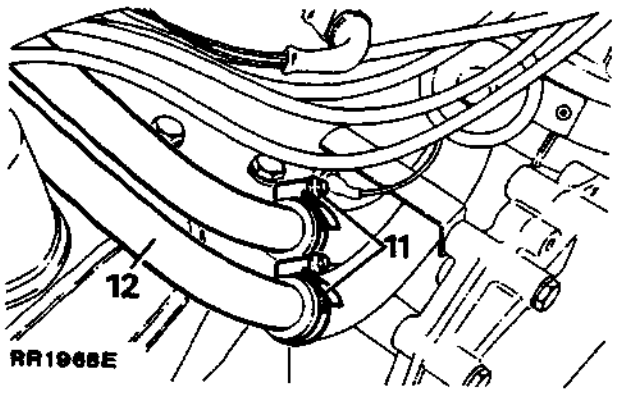
1. Depressurise fuel system. ***See Depressurising fuel system***
2. Disconnect the battery negative lead.
3. Remove radiator bottom hose, drain coolant until level is below thermostat housing. Refit hose, tighten clamp.
4. Remove plenum chamber. ***See Plenum Chamber***
5. Remove ram housing. ***See Ram Housing***

CAUTION: Place a protective cover over intake manifold openings to prevent ingress of dirt.

6. Disconnect electrical multi-plugs to fuel temperature thermistor and injectors.
7. Remove two nuts and bolts securing pressure regulator to fuel rail, ease regulator out of rail. Seal end of fuel rail with plastic plugs to prevent ingress of dirt.

NOTE: Intake manifold can be removed from cylinder block without removing fuel rail and injectors.

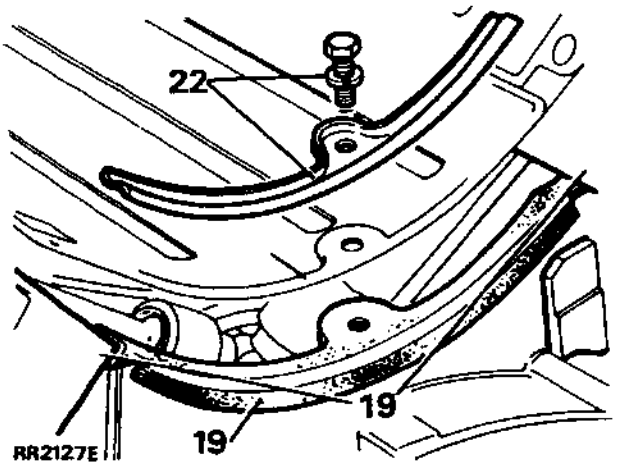
8. Disconnect electrical leads from air-conditioning engine coolant sensor.
9. Disconnect electrical leads to coolant temperature transmitter located at front of intake manifold.
10. Remove injector harnesses from behind fuel rail, lay to one side.
11. Release hose clamps securing two heater hoses behind water pump.
12. Remove two bolts securing rigid heater pipes to intake manifold and ease pipes out of hoses.



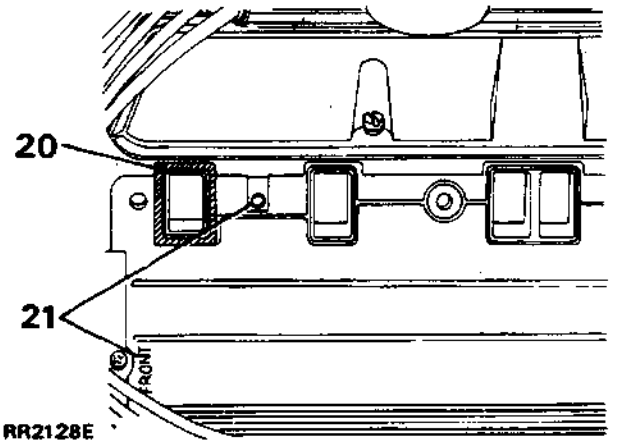
13. Lay heater pipe assembly to one side.
14. Release twelve bolts securing intake manifold.
15. Remove intake manifold.
16. Remove two gasket clamps from cylinder block.
17. Lift off gasket, remove gasket seals.
18. Remove sealing compound from around water passage openings of cylinder heads.

Refit

19. Locate NEW seals in position with ends engaged in notches formed between cylinder heads and block.



20. Lightly apply 'Hylomar' sealant around outside of water passage openings on cylinder heads, manifold gasket and intake manifold.



21. Fit manifold gasket with word **'FRONT'** to front and open bolt hole to front right hand side.
22. Fit gasket clamps, **DO NOT** fully tighten bolts.
23. Locate intake manifold onto cylinder heads, clean threads of manifold securing bolts.
24. Fit manifold bolts. Evenly tighten a little at a time, alternating sides, working from centre outwards.
25. Tighten to ***38 Nm.***
26. Tighten gasket clamps to ***18 Nm.***
27. Reverse removal procedure.
28. Replenish cooling system.
29. Start engine, check for water and fuel leaks.

FUEL FILTER

Service repair no - 19.25.02

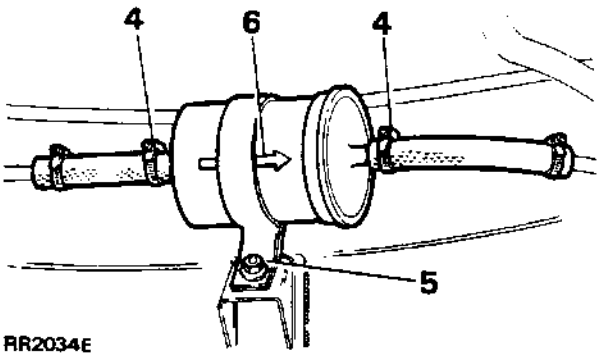
Remove and refit

Remove

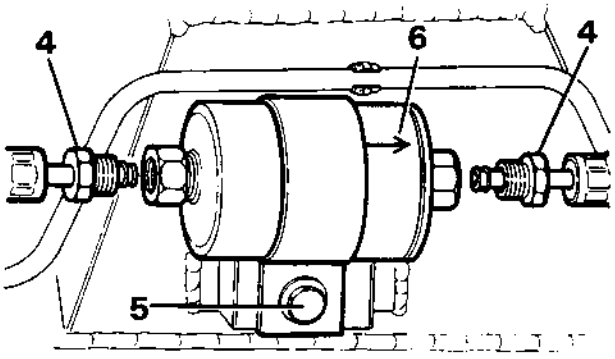
WARNING: Spilling of fuel is unavoidable during this operation. Ensure all necessary precautions are taken to prevent fire and explosion.

WARNING: Ensure fuel handling precautions given in Section 01 - Introduction are strictly adhered to when carrying out following instructions.

1. Depressurise fuel system. ***See Depressurising fuel system***
2. Access to filter is gained through right hand rear wheel arch.
3. Clean area around hose connections to prevent ingress of foreign matter into fuel system. 1991 model year onwards: Clamp inlet and outlet hoses to prevent fuel spillage when disconnecting hoses see RR2966E.
4. Loosen two hose clamps nearest filter to enable hoses to be removed from filter canister. 1991 model: Loosen two fuel line unions and remove hoses. Plug ends of hoses to prevent ingress of dirt.
5. Release securing bolt and bracket and remove filter from chassis side member.



RR2034E



RR2966E

Refit

6. Fit a new filter observing direction of flow arrows stamped on canister.
7. Tighten securing nut and bolt.
8. Fit inlet and outlet hoses. Tighten hose clamps. 1991 models: Tighten to ***30 Nm.***
9. Refit fuel pump relay, reconnect battery.
10. Start engine and inspect for fuel leaks around hose connections.

FUEL TANK - PRE 1991

Service repair no - 19.55.08

Remove and refit

Remove

WARNING: Ensure fuel handling precautions given in Section 01 - introduction are strictly adhered to when carrying out following instructions.

CAUTION: Before disconnecting any part of fuel system it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.

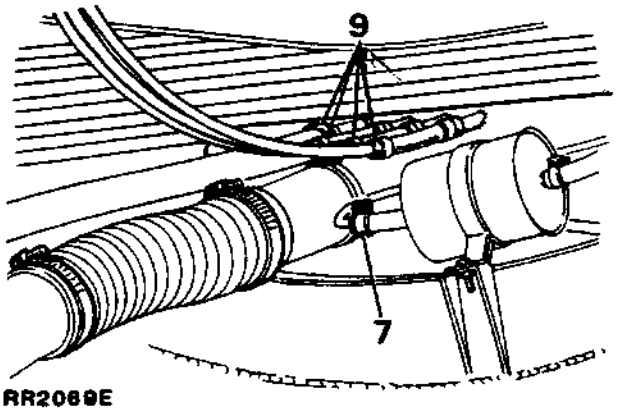
1. Drive vehicle onto suitable ramp.
2. Depressurise fuel system. ***See Depressurising fuel system***
3. Disconnect the battery negative lead.
4. Disconnect electrical leads to fuel tank sender unit. Disconnect fuel pump electrical multiplug.

NOTE: Multi-plug is located between underside of body and chassis side member, accessed through left hand rear wheel arch.

5. Raise ramp.
6. Remove drain plug from bottom of fuel tank, drain fuel into a suitable container that can be sealed afterwards.
   ENSURE TANK IS DRAINED COMPLETELY.
   Refit drain plug - refer to WARNING concerning fuel handling at start of procedure.

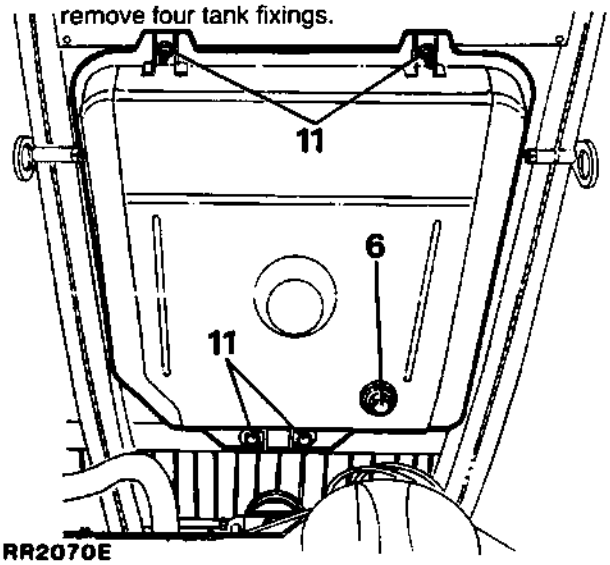
Underneath vehicle

7. Disconnect fuel hose from fuel filter.
8. Disconnect fuel return pipe to fuel tank.
9. Remove breather hose and three evaporative loss hoses from fuel tank. Seal all exposed openings to prevent ingress of foreign matter.



RR2069E

10. Release two hose clamps, securing hose to tank ad filler tube. Manoueuvre hose up filler tube until it is removed from tank filler neck.
11. With a second person supporting fuel tank, remove four tank fixings.



RR2070E

12. Tilt left hand side of tank downwards, manoeuvre tank out of chassis frame. Ensure that fuel feed pipe to filter is not damaged when lowering tank.
13. Place tank in a safe area.
    A fuel vapour warning label must be attached to vehicle.
14. If necessary remove fuel pump from tank. ***See Fuel Pump - pre 1991***

Refit

15. Refit fuel tank to chassis. Position fuel feed pipe grommets between fuel tank and chassis.
16. Ensure all sealing ring, fuel line and hose connections are secure.
17. Run engine and re-check all connections for fuel leaks. Reverse removal procedure.

FUEL PUMP - PRE 1991

Service repair no - 19.45.03

Remove and refit

Remove

WARNING: Ensure fuel handling precautions given in Section 01 - Introduction are strictly adhered to when carrying out following instructions.

1. Drive vehicle onto a suitable ramp.
2. Depressurise fuel system. ***See Depressurise fuel system***
3. Disconnect the battery negative lead.
4. Remove fuel tank. ***See Fuel Tank - pre 1991***
5. Disconnect fuel supply hose from pump.
6. Remove sealant from top of pump flange.
7. Remove five screws, remove tank.

Refit

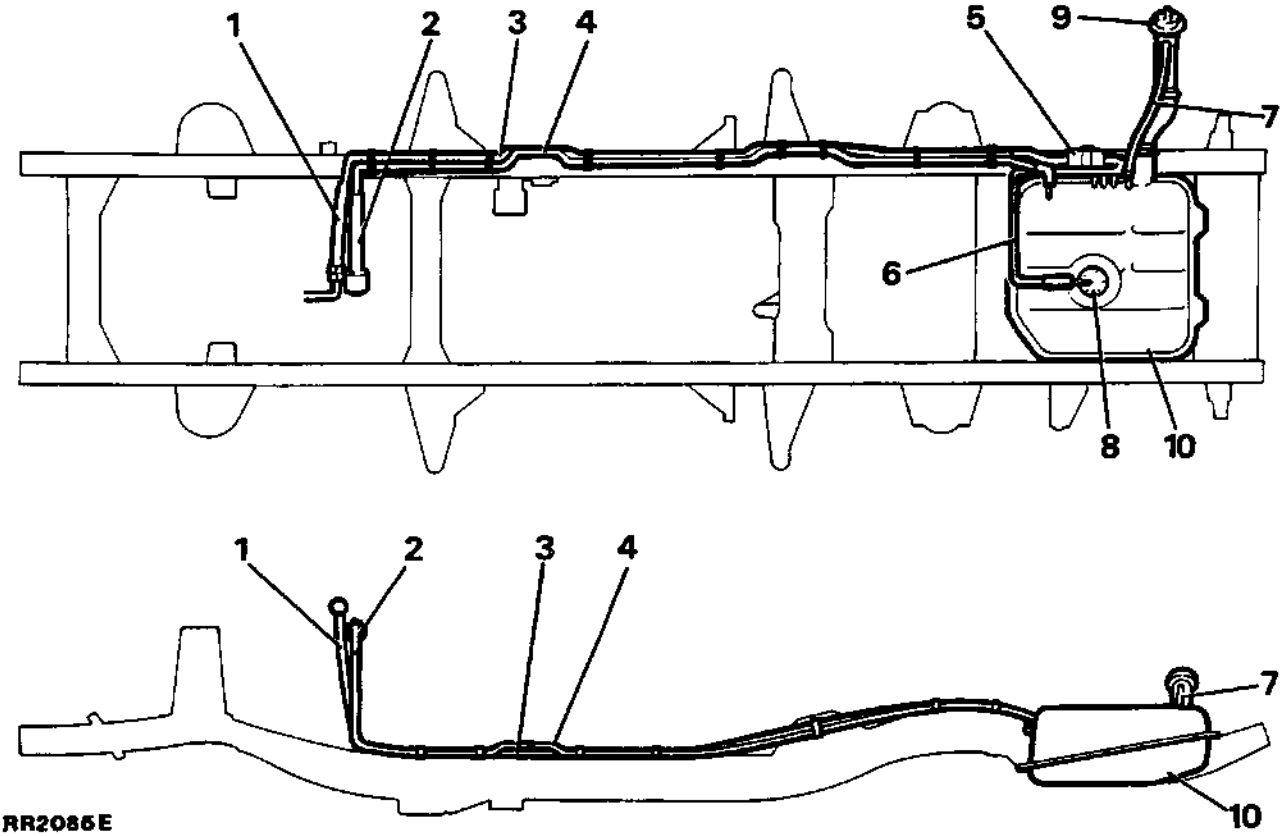
8. Clean area around pump opening in fuel tank.
9. Fit **NEW** pump seal.
10. Secure pump to tank, tighten screws securely.
11. Liberally coat heads of screws and flange of fuel pump with Sikaflex 221 flexible adhesive sealant.
12. Reverse removal procedure. Ensuring that sealing ring, fuel line and hose connections are secure.
13. Run engine and re-check all connections for fuel leaks.

FUEL PIPES

Service repair no - 19.40.92

WARNING: Depressurise fuel system. ***See Depressurise fuel system before disconnecting any fuel pipes ensure that all necessary precautions are taken against fuel spillage***

WARNING: Ensure fuel handling precautions given in Section 01 - introduction are strictly adhered to when carrying out following instructions.



RR2086E

KEY

1. Fuel feed hose to fuel rail.
2. Fuel return hose to fuel tank.
3. Rigid fuel feed pipe.
4. Rigid fuel return pipe.
5. Fuel filter.
6. Rigid fuel feed pipe to filter.
7. Breather hose.
8. In-tank fuel pump.
9. Fuel filler neck.
10. Fuel tank.

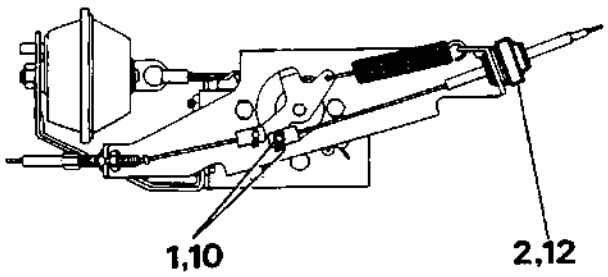
THROTTLE CABLE

Service repair no - 19.20.06

Remove and refit

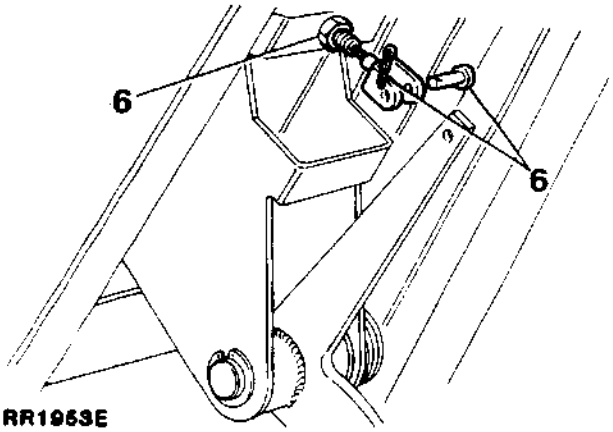
Remove

1. Remove clevis pin securing cable to lever.
2. Carefully pry throttle cable adjustment nut out of mounting bracket.
3. Remove cable from mounting bracket.



RR1954E

4. Release outer cable from retaining clips in engine compartment.
5. Remove lower fascia panel. ***See CHASSIS AND BODY, Repair, lower dash panel***
6. Disconnect cable from throttle pedal and release cable locknut.
7. Feed cable through bulkhead grommet into engine compartment.



RR1953E

Refit

8. Feed new cable from engine compartment through bulkhead grommet.
9. Connect cable to throttle pedal.
10. Connect cable to throttle linkage, using a new split pin.
11. Clip outer cable adjustment nut into mounting bracket.
12. Adjust outer cable to give 1.57 mm (0.062 in) free play in inner cable. Check throttle operation.

THROTTLE PEDAL

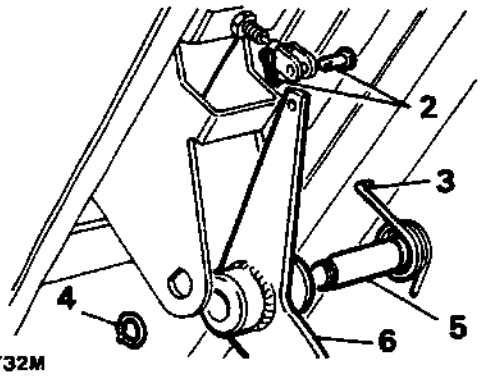
Remove and refit

Remove

1. Remove lower fascia panel. ***See CHASSIS AND BODY, Repair, Lower dash panel***
2. Remove clevis pin securing throttle cable to throttle pedal.
3. Release tension from pedal return spring.
4. Remove circlip from pedal pivot pin.
5. Withdraw pivot pin.

NOTE: It may be necessary to lower steering column to gain access to pivot pin circlip.

6. Remove throttle pedal.



RR 732M

Refit

7. Lightly grease pivot and clevis pins.
8. Fit clevis pin using a **NEW** split pin.
9. Reverse removal procedure.

FUEL SYSTEM - 1991 MODEL YEAR

Remove and refit

A revised fuel sytem was fitted to 1991 model year vehicles. The major change was fitting of a plastic fuel tank with improved breather system. The remote expansion tank is deleted.
A further improvement is use of a combined fuel pump and sender unit. A panel in freight floor of vehicle permits access to fuel pump/sender unit

Fuel pump/sender unit - 1991 Onwards

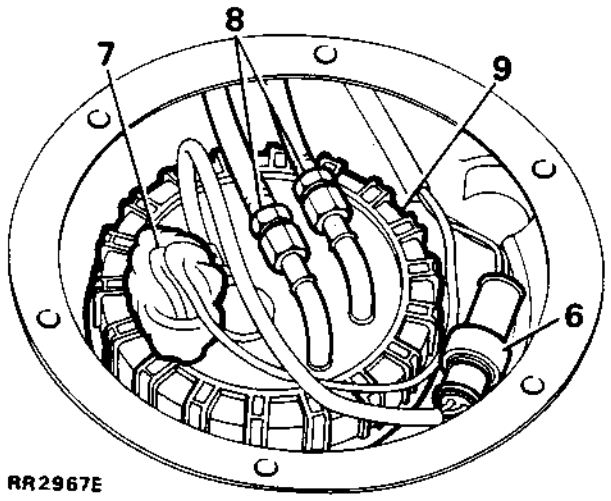
WARNING: Ensure that fuel handling precautions given in Section 01 - Introduction are strictly adhered to when carrying out following instructions.

CAUTION: Before disconnecting any part of fuel system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.

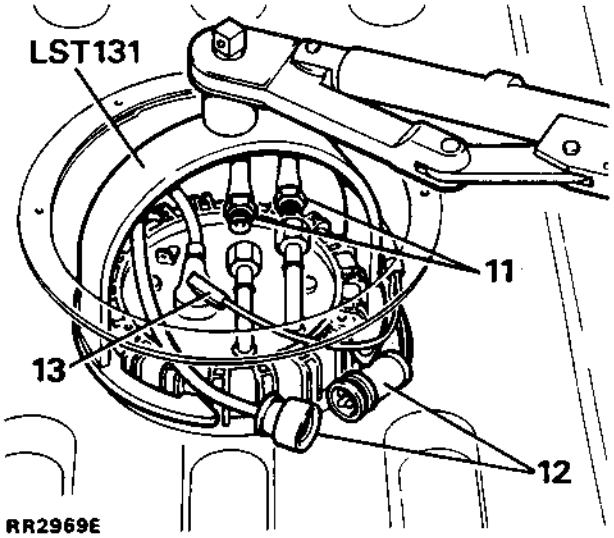
Service Tools:
LRS-19-001 spanner - pump retaining ring
LRS-19-002 'Speedfit' disconnector

Remove

1. Depressurise fuel system. ***See Depressurise fuel system***
2. Disconnect the battery negative lead.
3. Syphon at least 9 litres (2 gallons) of fuel from fuel tank into a suitable container that can be sealed.
4. Remove carpet from loadspace floor and tailgate.
5. Fold back loadspace sound insulation to reveal access panel.



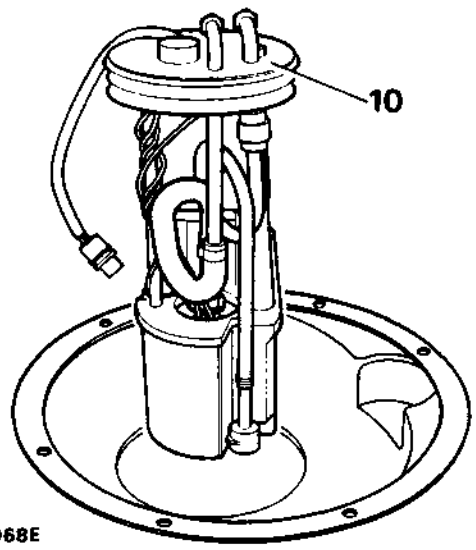
RR2967E



RR2969E

6. Remove access panel from floor.
7. Disconnect electrical connections at multi-plug.
8. Remove insulation sealant from around ground lead, disconnect ground lead.
9. Disconnect two fuel line unions from fuel pump.
10. Using service tool no. LRS-19-001, remove pump unit retaining ring. Withdraw unit from fuel tank.

WARNING: A quantity of fuel will be retained in body of unit, care must be taken to prevent fuel spillage when unit is removed.



RR2968E

Refit

11. Insert fuel pump into tank. Fit retaining ring. Tighten to ***48 Nm.***
12. Connect fuel lines to pump.
13. Connect electrical leads at multi-plug.
14. Connect ground lead to pump and insulate with suitable sealant.
15. After assembly, check all fuel pipes, sealing rings and hose connections are secure.
16. Run engine to check for fuel leaks.
17. Inspect access panel seal, fit a new seal if necessary.
18. Fit access panel and tighten screws.
19. Reverse removal procedure. 4 - 5. Fit insulation and carpet.

FUEL TANK - 1991 ONWARDS

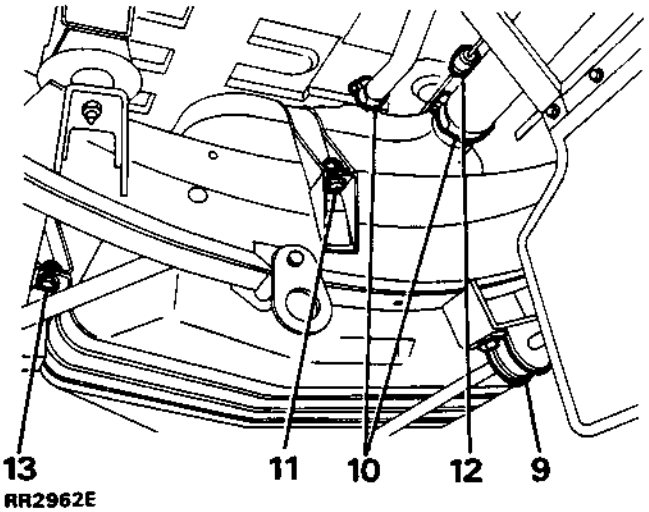
Remove and refit

WARNING: Ensure that fuel handling precautions given in Section 01 - introduction are strictly adhered to when carrying out following instructions.

CAUTION: Before disconnecting any part of fuel system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.

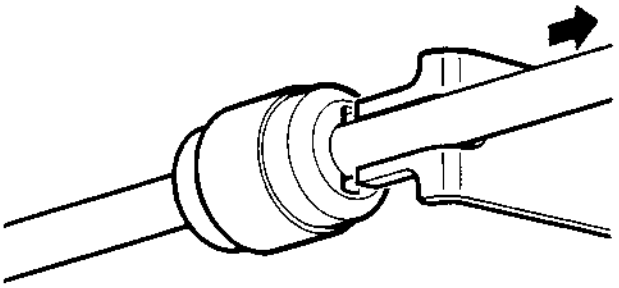
Remove

1. Depressurise fuel system. Disconnect the battery negative lead.
2. Syphon fuel tank into a suitable container that can be sealed afterwards.
   ENSURE TANK IS DRAINED COMPLETELY.
   (refer to Warning concerning fuel vapor and spillage at start of procedure).
3. Remove carpet loadspace floor and tailgate.
4. Fold back sound insulation to reveal access panel.
5. Remove access panel.
6. Disconnect electrical multi-plug.
7. Remove insulation sealant from around ground lead, and disconnect.
8. Disconnect two fuel line unions from fuel pump.
9. Working underneath vehicle, remove rear anti-roll bar straps, and allow bar to swing down clear of tank.

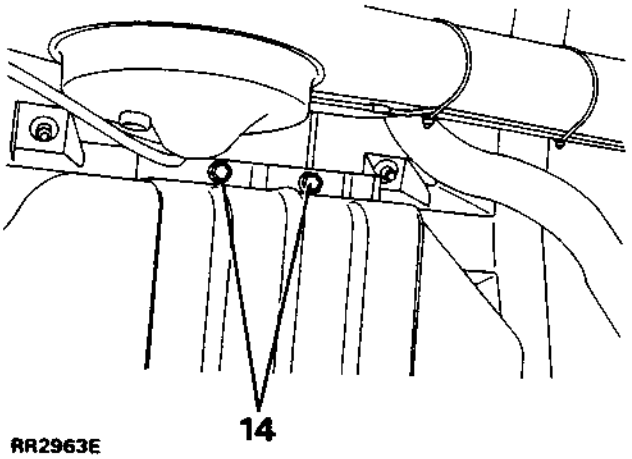


RR2962E

10. Remove tank filler and vent hoses at fuel tank.
11. Remove nut and bolt securing right hand side fuel tank strap.
12. Disconnect evaporative control pipe at green end of 'speedfit' connector.


ST2877M

NOTE: To disconnect 'speedfit' connector, insert forked end of LRS-19-002 into slots of connector see illustration. Press down on collet and simultaneously pull pipe from connector.



RR2963E

13. Remove back two bolts and nut plates securing fuel tank cradle.
14. Remove front nuts, bolts and washers. Remove fuel tank cradle.
15. With assistance, tilt right hand side of tank upwards and manoeuvre tank through chassis to remove.

Refit

16. Reverse removal procedure. Ensuring sealing ring, fuel pipe and hose connections are secure.
17. Run engine, check all connections for fuel leaks. Reverse removal procedure.

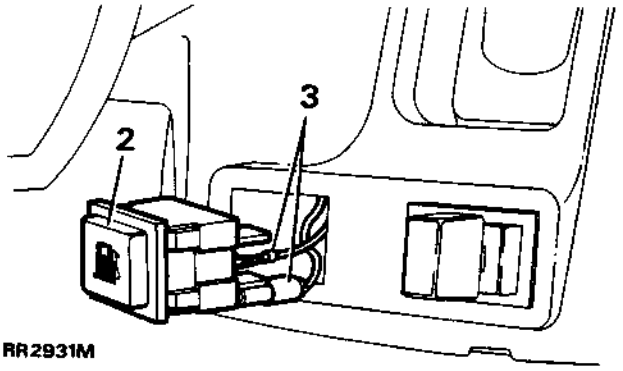
FUEL FILLER FLAP RELEASE BUTTON

Remove and refit

The fuel filler flap is no longer part of central locking system on 1991 model year vehicles. The filler flap is permanently locked. To release flap press button on steering column shroud. On closing, filler flap will be locked automatically. Note that release button will only work with ignition switched to OFF or AUX.

Remove

1. Disconnect the battery negative lead.
2. Carefully pry release button from steering column shroud.



RR2931M

3. Remove release button from shroud and disconnect two wiring connectors. Ensure wires protrude through shroud for reassembly.

Refit

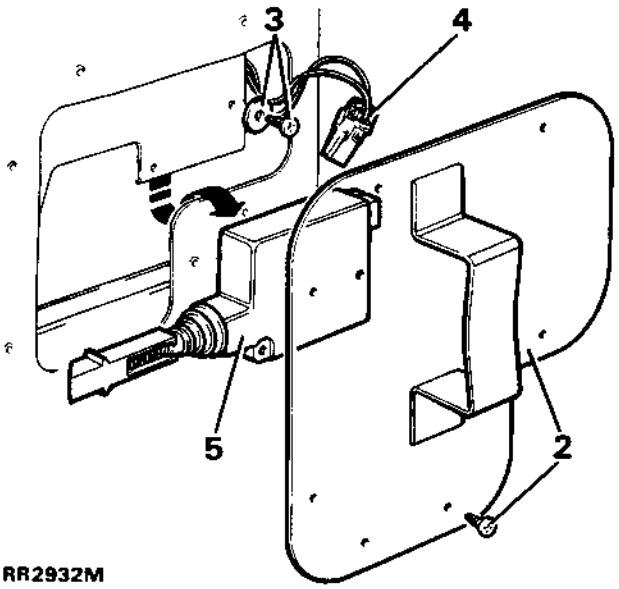
4. Reverse removal procedure.

FUEL FILLER FLAP RELEASE ACTUATOR

Remove and refit

Remove

1. Release fuel filler flap. Disconnect the battery negative lead.
2. Remove eight screws, withdraw closure panel, in right hand side of load space.
3. Release two screws and manoeuvre actuator clear of its mounting.
4. Disconnect wiring plug.
5. Withdraw actuator.



RR2932M

Refit

6. Reverse removal procedure.

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Air-Bypass valve (stepper motor)	20
All flexible hose securing clamps	1,3
Fuel feed pipe - hose to fuel rail	22
1991 Model Year	
Fuel filter	31
EVAPORATIVE LOSS CONTROL SYSTEM	
All flexible hose securing clamps	1,7

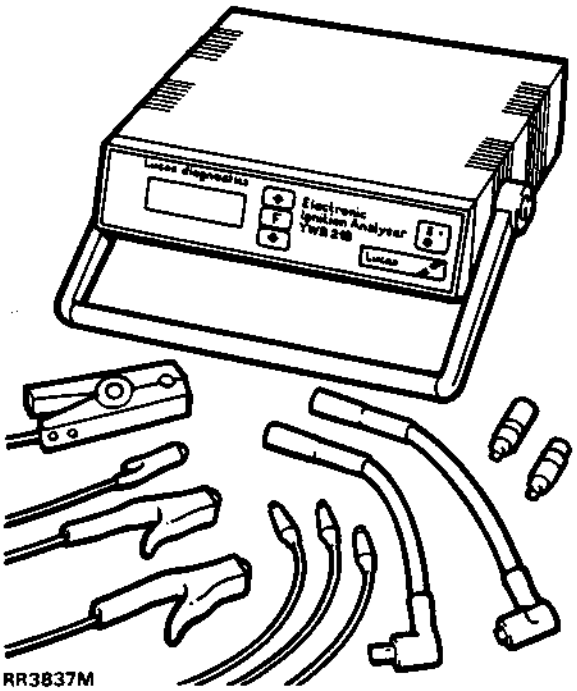
	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

NOTE: Torque values above are for all screws and bolts used except for those specified.

Notes

DIAGNOSTIC EQUIPMENT

Electronic Ignition Analsyer
Lucas Part No. - YWB 119
Supplied by Lucas with instruction manual.

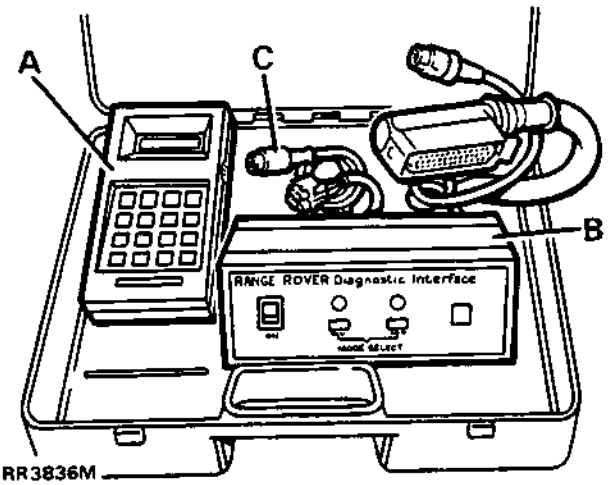

RR3837M

LUCAS EFI DIAGNOSTIC EQUIPMENT

Land Rover Part No. RTC 6834

Comprising:-

A Hand held tester
B Interface unit
C Serial link cable
Foam lined carrying case



RR3836M

MEMORY CARDS

Land Rover Part Numbers include two memory cards and instruction manual.

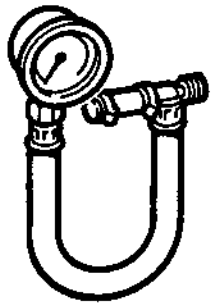
Suitable for 14CUX FUEL SYSTEM

ENGLISH	RTC 6835
USA	RTC 6836
FRENCH	RTC 6837
GERMANY	RTC 6838
ITALIAN	RTC 6839
SPANISH	RTC 6840
DUTCH	RTC 6842
JAPANESE	STC 127



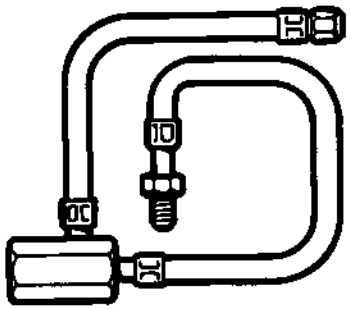
RR3838M

FUEL SYSTEM



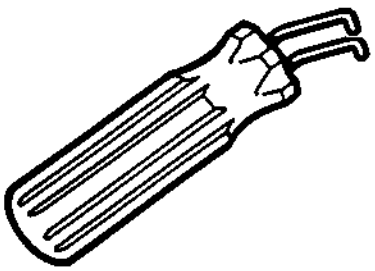
18G1500

LRT-19-004 Test equipment fuel pressure
18G 500



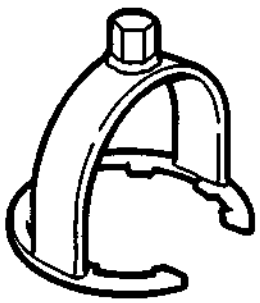
LST 143

LRT-19-003 EFI pressure test adaptor
LST 143



LST 144

LRT-19-002 Connector splitter
LST 144



LST 131

LRT-19-001 Fuel pump remover
LST 131

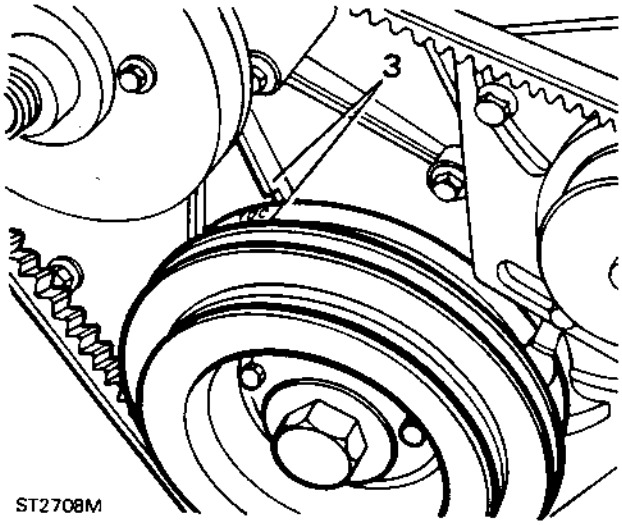
FUEL INJECTION PUMP

Special tools:

Flywheel timing pin	LST 128
Pump gear retaining tool	LST 129

Remove

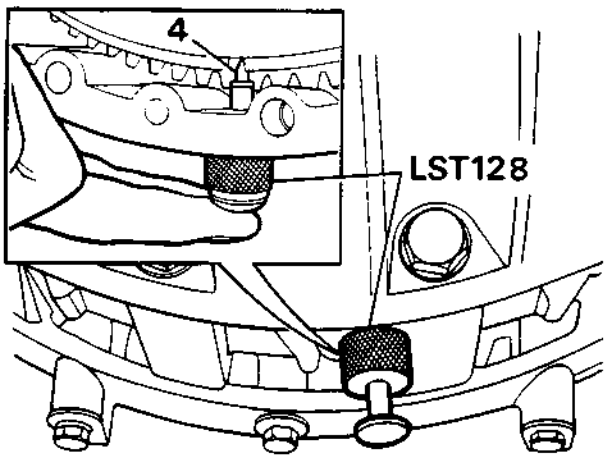
1. Disconnect the battery negative lead.
2. Remove oil filler cap so that the position of the rockers can be seen to assist in obtaining T.D.C.
3. Turn the crankshaft to align the T.D.C. mark on the crankshaft pulley with the web on the front cover plate. At the same time check that both valves of number one cylinder are closed. Refit filler cap.



ST2708M

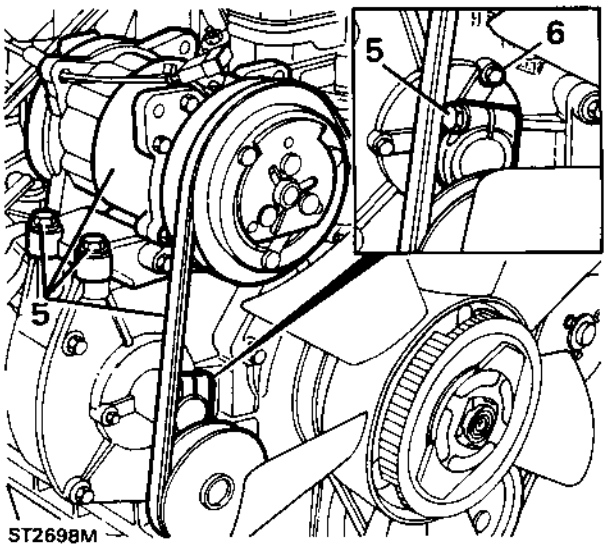
4. Remove blanking plug from bottom of flywheel housing. Fit flywheel timing pin body LST 128. Check that timing pin can be inserted into appropriate slot in the flywheel. Note that there are two slots in the flywheel the narrowest one being that which determines T.D.C. for this direct injection engine.

△ **NOTE: If automatic gearbox - The same timing pin fits into a slot in the ring gear. Access is through a hole in engine backplate below the starter motor.**



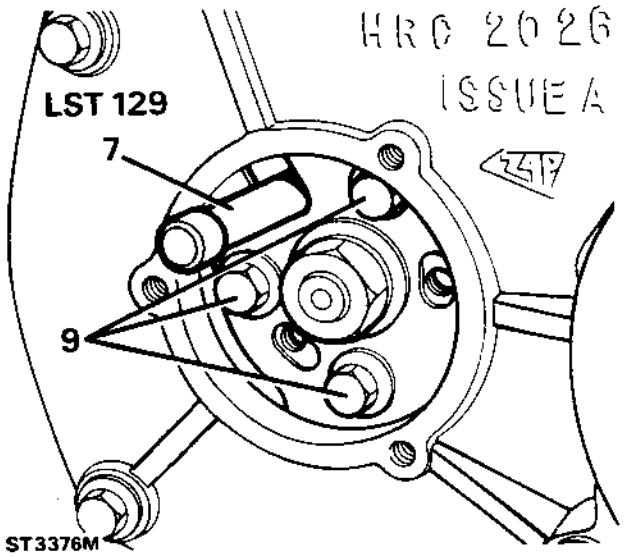
ST2709M

5. Vehicles with air conditioning, slacken and remove compressor drive belt from pulley, remove the four securing bolts and move the compressor aside.
6. Remove three screws to release injection pump hub blanking plate. On air conditioning vehicles this plate also provides a pivot pivot for the compressor drive belt tensioning pulley.



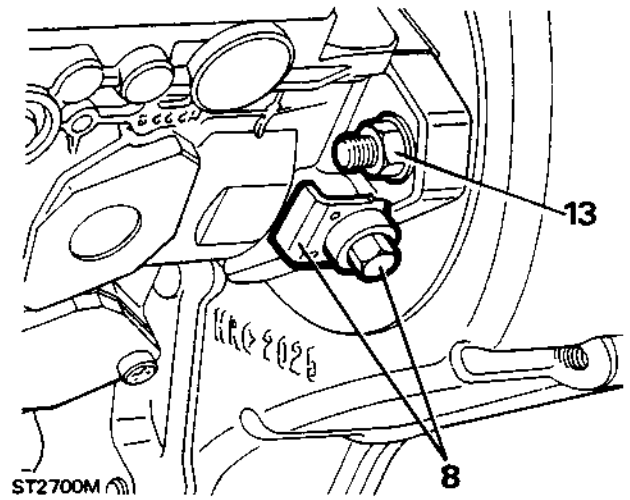
ST2698M

7. Insert the injection pump timing pin LST 129 through the "U" shaped slot in the pump hub into the pump body. Ensure that the pin fits easily and is fully inserted.

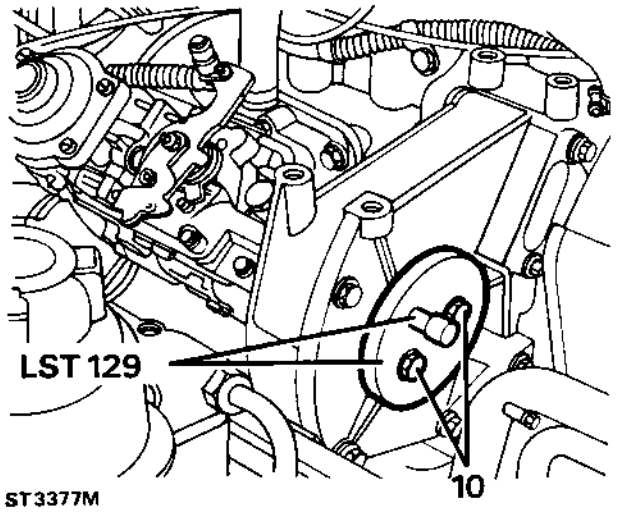


8. Loosen pump locking screw, remove keeper plate. Tighten screw to lock pump.

⚠ **CAUTION: Once timimg pin LST 129 has been inserted and the pump shaft locked, DO NOT TURN the crankshaft.**



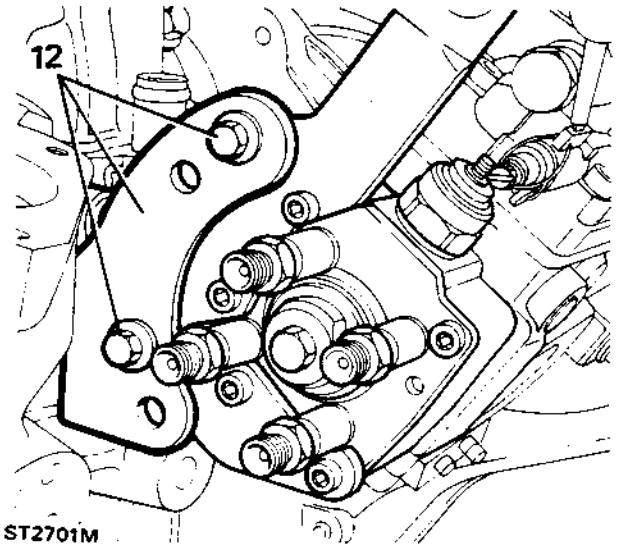
9. Remove three bolts retaining the pump drive gear. Remove the locking plate and timing pin.
10. Fit pump gear retaining tool LST129. Align and tighten the two bolts. Reinsert the timing pin through the hole provided in the retaining tool.

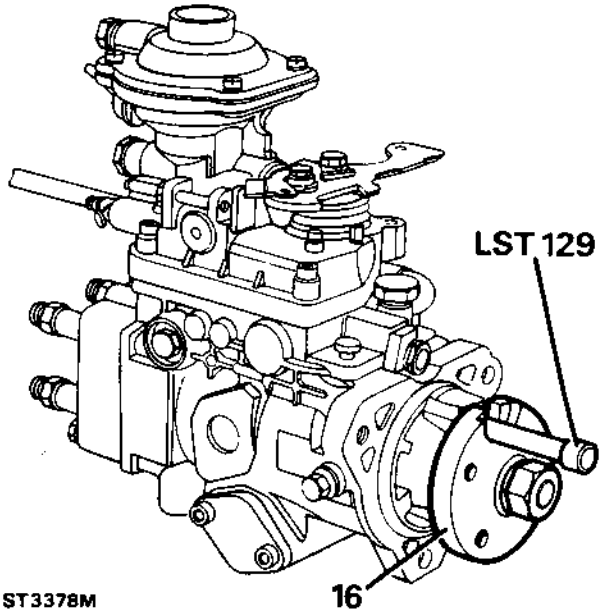


11. Remove injector pipes, disconnect following items from injection pump:

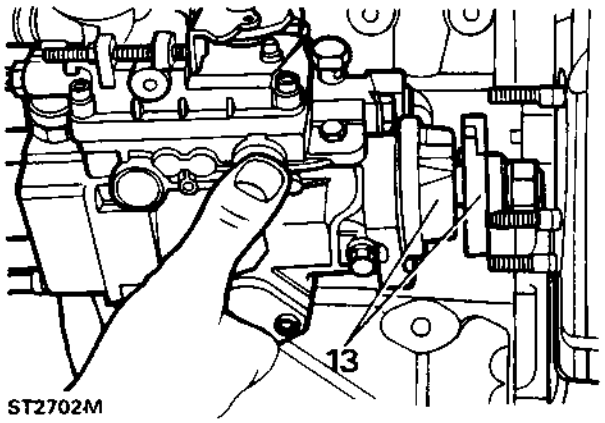
    Throttle cable.
    Stop control solenoid lucar.
    Spill return pip.
    Turbo charger boost hose.
    Main fuel supply pipe.

12. Remove two bolts securing pump to rear support bracket and the bolts securing the bracket to cylinder block. Remove the bracket.





13. Remove flange pump nuts. Remove pump and gasket from the front cover.
14. Fit blanks to fuel pump inlet and outlets to prevent entry of dirt. Loosen the locking screw, fit the keeper plate and tighten the screw.



Refit

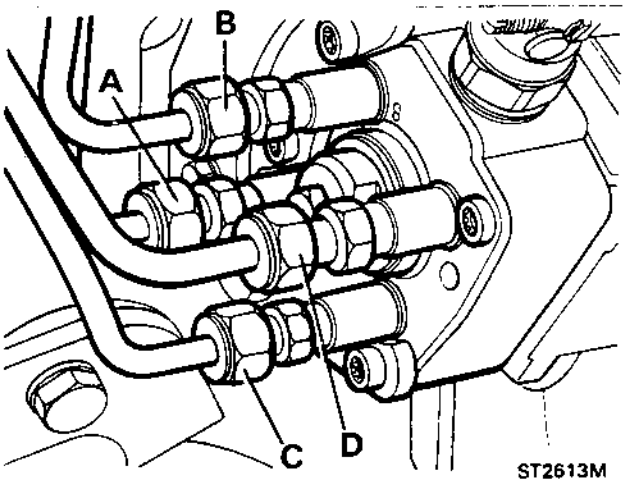
15. Clean pump flange and front cover mating face. Place a new gasket in position over the studs.
16. Fit the timing pin LST 129 to the pump. If necessary, rotate pump to enable the pin to locate easily and fully.
17. Loosen pump locking screw, remove keeper plate, Tighten screw to lock the pump.
18. Fit the pump to the front cover and drive gear. Fit the three nuts, tighten evenly to ***24 Nm.***
19. Fit the rear support bracket to the cylinder block and secure the pump to the bracket. Tighten all bolts to ***24 Nm.***
20. Connect the following:

    Throttle cable.
    Stop control solenoid lucar.
    Spill return pipe.
    Turbo boost hose.
    Main fuel supply pipe.

21. Fit injector fuel supply pipes loosely. Commencing at the front of the engine connect the pipes as follows

    A to number one injector.
    B to number two injector.
    C to number three injector.
    D to number four injector.

Finally tighten evenly, do not over tighten. Tighten to ***25 Nm.***



22. Remove pump timing pin and pump gear retaining tool LST 129/1.
23. Reinsert pump timing pin. Fit the gear lock plate, secure with the three bolts, tighten to ***25 Nm.***
24. Remove the timing pin. Unlock the pump, fit the keeper plate and tighten the bolt.

Injection pump timing check

25. To check that pump timing is correct, turn crankshaft two complete revolutions, check that the timing pin LST 129/2 can be inserted easily and fully into the pump. At the same time check that the flywheel timing pin can also be inserted in the flywheel slot.
26. If, with flywheel timing pin located, the timing pin cannot be inserted cleanly into the pump, carry out the following instructions:

    (1) Turn crankshaft the small amount necessary to enable the timing pin to be inserted into the pump.

    (2) Remove keeper plate, lock pump.

    (3) Slacken the three pump gear retaining bolts.

    (4) Turn

    (5) Check that timing pin is an easy fit in the pump and that the flywheel timing pin locates.

    (6) Tighten pump gear retaining bolts to ***25 Nm.***

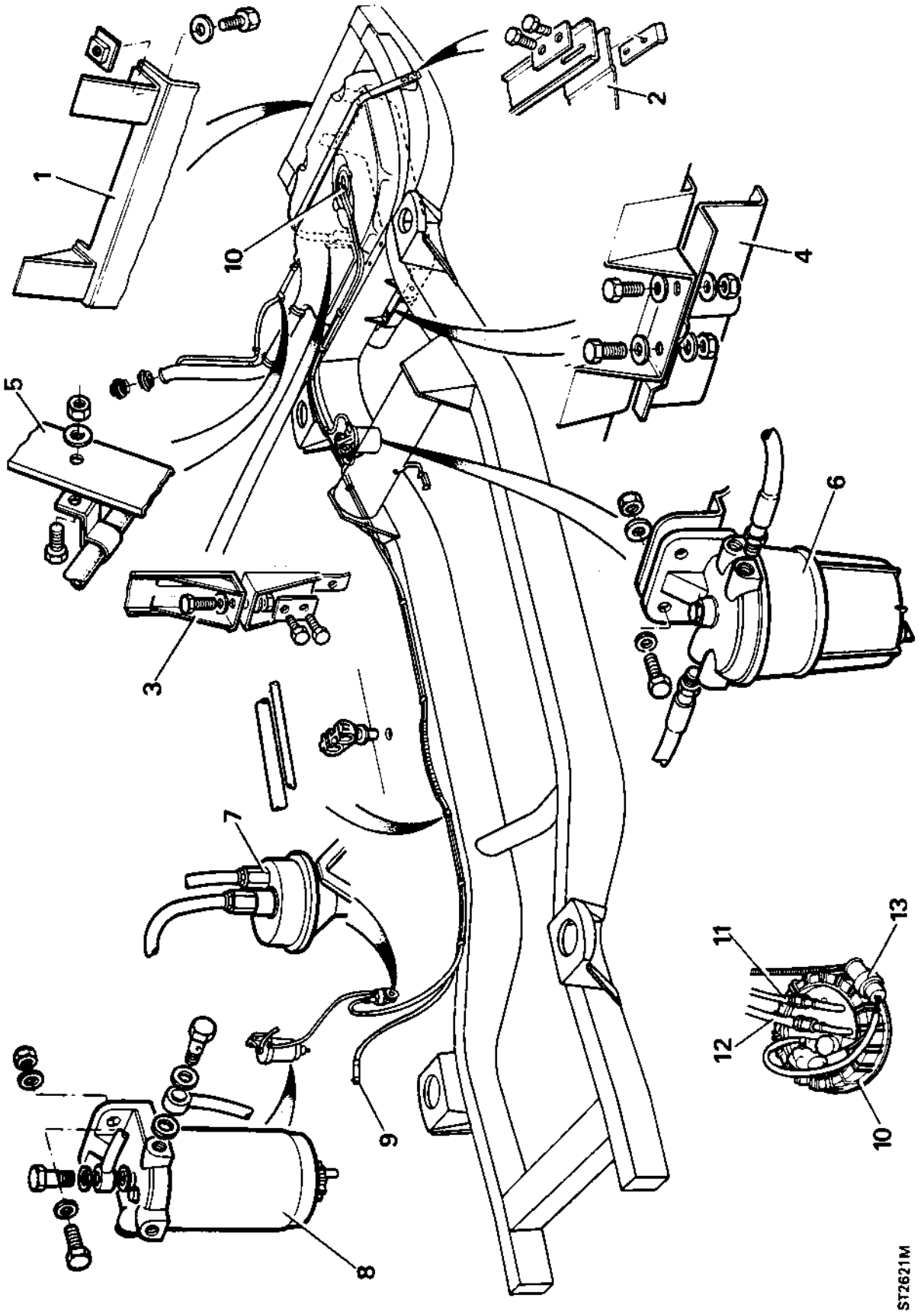
    (7) Unlock pump, fit keeper plate, tighten the bolt. Remove timing pin from pump and timing pin tool from flywheel.

27. Fit the pump aperture cover plate with a new gasket and secure with the three screws.
28. Where appropriate, fit the air conditioning compressor and tension the drive belt.

△ **NOTE: Pump timing may also be checked by following the procedure in the technical information bulletin number 099/92/EN**

KEY TO DIESEL FUEL SYSTEM LAYOUT

1. Fuel tank rear support bracket.
2. Fuel tank retaining strap fixings left hand side.
3. Retaining strap fixing, right hand side.
4. Fuel tank front support bracket.
5. Fuel filler pipe vent hose support.
6. Fuel sedimenter.
7. Engine operated fuel lift pump.
8. Fuel filter located on engine compartment bulk head.
9. Spill return pipe from injectors via fuel injection pump.
10. Fuel tank unit.
11. Spill return pipe to fuel tank.
12. Fuel supply pipe to lift pump via the sedimenter.
13. Multiplug connector for fuel indicator sender unit.


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ST2621M

Notes

CRUISE CONTROL SYSTEM-HELLA GR66

Description

The cruise control system consists of electro-mechanical devices, and comprises of the following components. A 1993 model year introduction is the inclusion of cruise control on manual vehicles.

Electronic control unit (ECU)

The electronic control unit is located behind the lower dash panel. The microprocessor based ECU evaluates the signals provided by the driver controls, brake pedal switch, clutch pedal switch on 1993 manual models, and the road speed transducer. The ECU activates the vacuum pump as required. The ECU also has a memory function for set speed storage.

Driver operated switches

The main cruise control switch is located in the auxiliary switch panel and activates the cruise control system. The steering wheel switches provide 'set/accelerate' and 'resume/decelerate' features. These switches provide the interface between driver and cruise control system.

Brake pedal switch

The brake pedal switch is located under the lower dash attached to the brake pedal mounting bracket. The switch provides for fast disengagement of the cruise control system and rapid return of the throttle levers to the idle position when the brake pedal is applied.

Clutch pedal switch - 1993 introduction

The clutch pedal switch is located under the lower dash attached to the clutch pedal mounting bracket. The switch provides for fast disengagement of the cruise control system and rapid return of the throttle levers to the idle position when the clutch pedal is applied.

Road speed transducer

The road speed transducer is mounted on a bracket located on the left hand chassis side member adjacent to the rear engine mounting. The transducer provides road speed data to the ECU. The cruise control system cannot be engaged until the road speed exceeds 45 km/h, (28 mph) the system will automatically disengage at a road speed of 42 km/h (26 mph).

Vacuum pump

The vacuum pump is located in the engine compartment, attached to the left hand valance. The vacuum pump is energised when the main cruise control switch is operated, and is actuated by the steering wheel and brake pedal switches. The pump provides a vacuum source to the cruise control actuator at the throttle levers. A control valve in the pump provides for steady increase of road speed or purge of the system when the brake pedal is applied.

Actuator

The actuator is located in the engine compartment and is bolted to the throttle lever bracketry. The actuator provides the servo mechanism link between the cruise control system and throttle linkage and is operated by vacuum from the vacuum pump.

Neutral lockout relay-cruise control - Automatic vehicles

The relay is located under the rear of the front right hand seat. Access is gained through the opening at the bottom of the seat when the seat is in its fully forward position.

1993 models - the relay is located in the right hand side footwell, accessible by removing the trim panel.

The function of the relay is to disengage the cruise control system if neutral, or park, is selected in the main gearbox, when the system is engaged.

Engine speed trip ECU - Manual vehicles

This unit is located in the right hand side footwell, accessible by removing the trim panel.

The function of the unit is to disengage cruise control if engine speed exceeds 5000 rev/min.

CRUISE CONTROL - CIRCUIT DIAGRAM - 1990/92

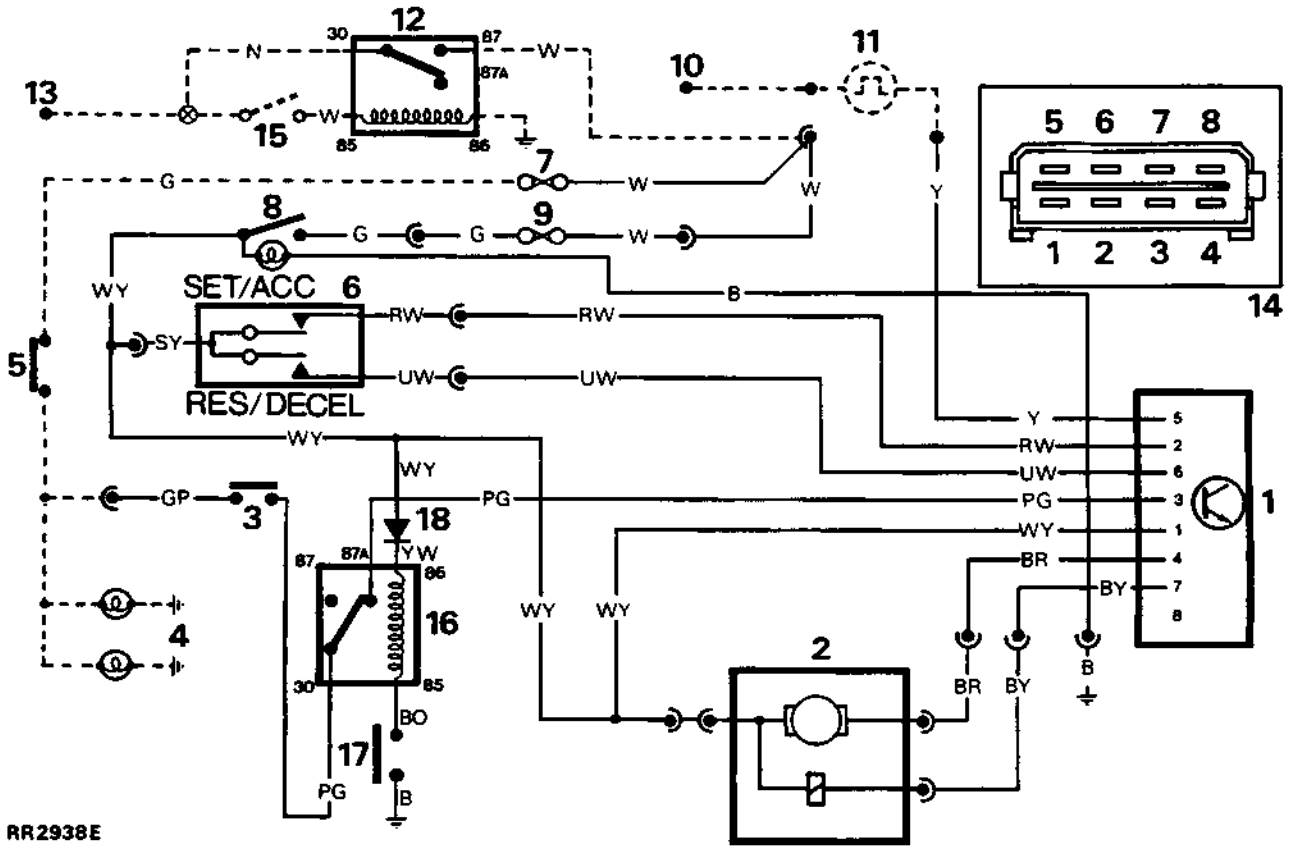
1. Cruise control ECU
2. Vacuum pump
3. Brake switch/vent valve
4. Stop lamps
5. Brake switch
6. Steering wheel set and reset switches
7. Fuse A5
8. Main cruise control switch-auxiliary panel
9. Fuse C5 (10A)
10. 12V + supply to transducer
11. Speed transducer
12. Ignition load relay-item 1 main circuit diagram
13. Battery feed
14. Cruise control harness multi-plug identification
15. Ignition switch-item 8 main circuit diagram
16. Relay - neutral lockout
17. Start inhibit switch
18. Diode

--- Denotes existing main cable

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.



CRUISE CONTROL - CIRCUIT DIAGRAM - AUTOMATIC VEHICLES - 1993 MODEL YEAR

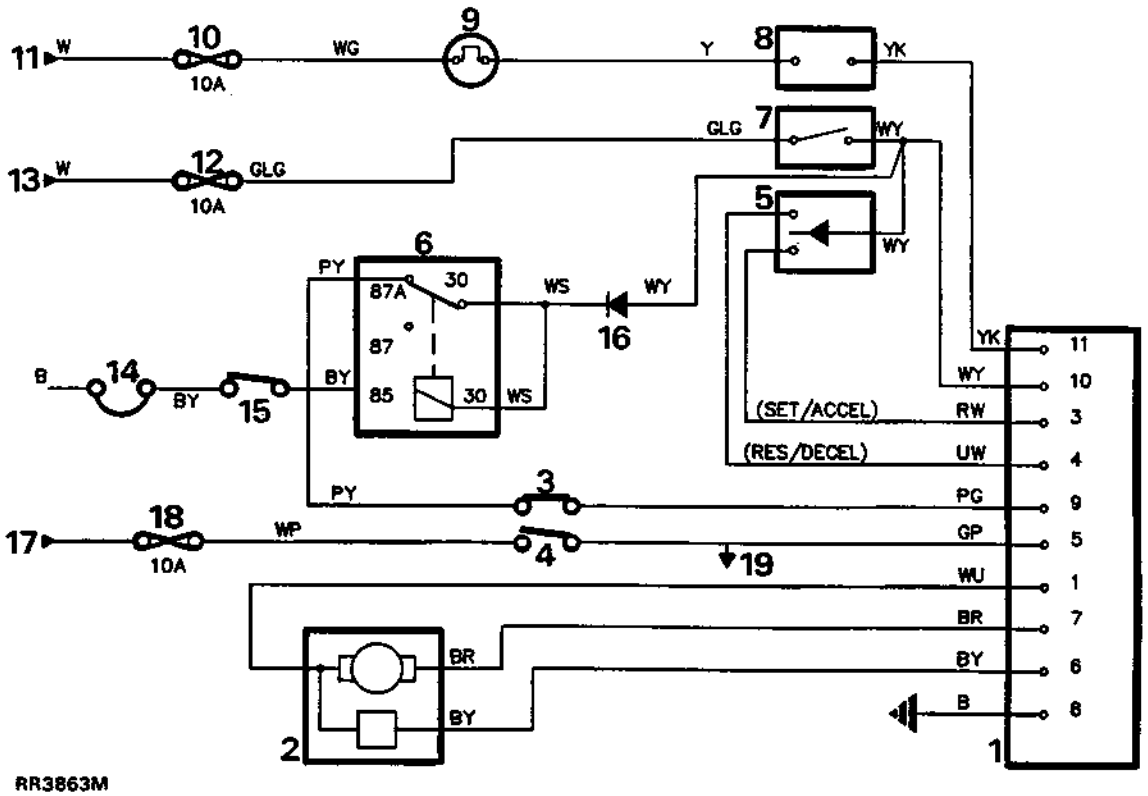
1. Cruise control ECU
2. Vacuum pump
3. Brake switch/vent valve
4. Brake light switch
5. Steering wheel set and reset switches
6. Neutral lock out relay
7. Main cruise control switch-auxiliary panel
8. Speed buffer
9. Speed transducer
10. Fuse B4 10A
11. Ignition feed
12. Fuse E2 10A
13. Ignition feed from load relay
14. Vehicle alarm
15. Park/neutral switch
16. Diode
17. Ignition feed
18. Fuse B1 10A
19. Stop lamps

--- Denotes existing main cable

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.



CRUISE CONTROL - CIRCUIT DIAGRAM - MANUAL VEHICLES - 1993 MODEL YEAR

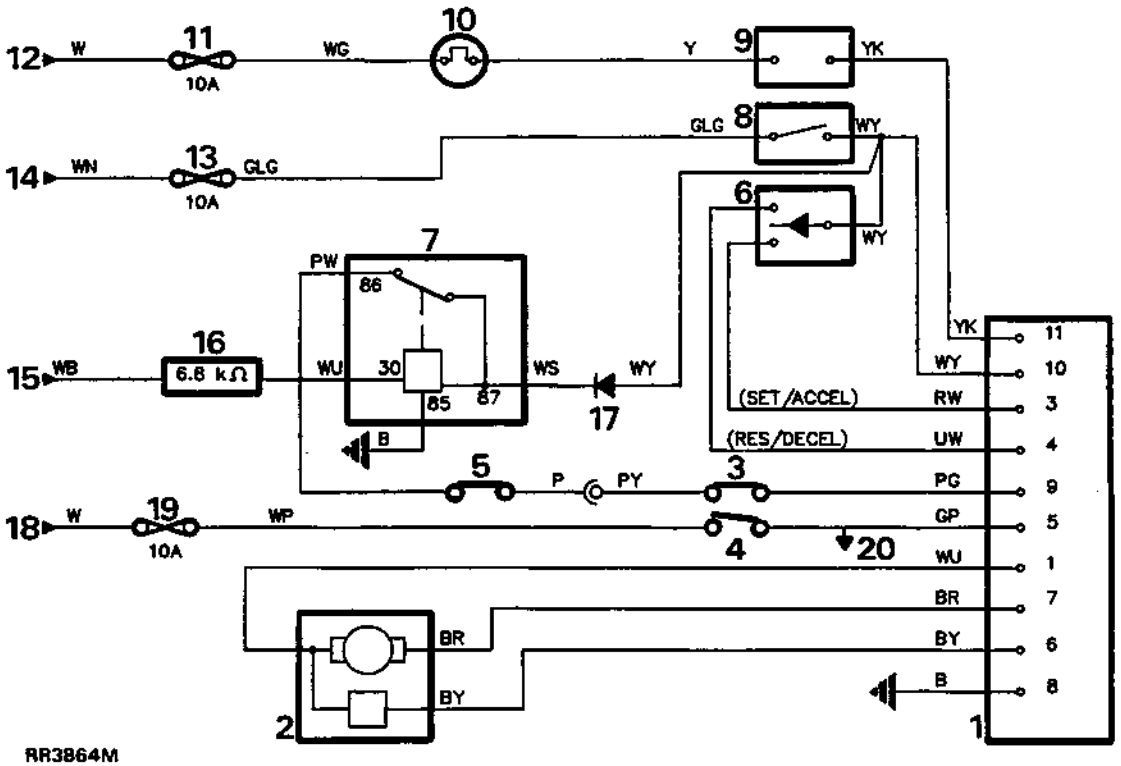
1. Cruise control ECU
2. Vacuum pump
3. Brake switch/vent valve
4. Brake light switch
5. Clutch switch
6. Steering wheel set and reset switches
7. Engine trip ECU
8. Main cruise control switch-auxiliary panel
9. Speed buffer
10. Speed transducer
11. Fuse B4 10A
12. Ignition feed
13. Fuse E2 10A
14. Ignition feed from load relay
15. Speed signal from ignition module
16. 6.8 Kohm resistor
17. Diode
18. Ignition feed
19. Fuse B1 10A
20. Stop lamps

--- Denotes existing main cable

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.





ROAD TEST - PRE 1993 MODELS

CAUTION: Do not engage cruise control when vehicle is being used in low transfer gear or reverse.

WARNING: The use of cruise control is not recommended on winding, snow covered or slippery roads or in heavy traffic conditions where a constant speed cannot be maintained.

1. Start engine, depress main control switch to actuate cruise control system. Accelerate to approximately 50 km/h, (30 mph), operate '**set/acc**' switch, immediately release switch, remove foot from accelerator pedal. Vehicle should maintain speed at which '**set/acc**' switch was operated.
2. Operate '**set/acc**' switch and hold at that position, vehicle should accelerate smoothly until switch is released. Vehicle should now maintain new speed at which '**set/acc**' switch was released.
3. Apply '**res/decel**' switch while vehicle is in cruise control mode, cruise control should disengage. Slow to approximately 55 km/h, (35 mph) operate '**res/decel**' switch, immediately release switch and remove foot from accelerator, vehicle should smoothly accelerate to previously set speed. Increase speed using accelerator pedal, release pedal, vehicle should return to previously set speed.
4. Operate brake pedal, cruise control system should immediately disengage returning vehicle to driver control at accelerator pedal. Operate '**res/decel**' switch, vehicle should accelerate to previously set speed without driver operation of accelerator pedal.
5. Operate '**res/decel**' switch and allow vehicle to decelerate to below 42 km/h, (26 mph). Operate '**res/decel**' switch, cruise control system should remain disengaged.
6. Operate '**set/acc**' switch below 45 km/h, (28 mph), cruise control system should remain disengaged. Accelerate, using accelerator pedal to above 45 km/h, (28 mph), operate '**res/decel**' switch, and remove foot from accelerator pedal, vehicle should smoothly adjust to previously memorised speed.
7. Depress main control switch in control system should immediately disengage and erase previously set speed from E.C.U. memory ***See ETM, B5***

ROAD TEST - 1993 MODELS

⚠ **CAUTION: Do not engage cruise control when vehicle is being used in low transfer gear or reverse.**

⚠ **WARNING: The use of cruise control is not recommended on winding, snow covered or slippery roads or in heavy traffic conditions where a constant speed cannot be maintained.**

1. Start engine, depress main control switch to actuate cruise control system. Accelerate to approximately 50 km/h, (30 mph), operate **'set/acc'** switch, immediately release switch, remove foot from accelerator pedal. Vehicle should maintain speed at which **'set/acc'** switch was operated.
2. Operate **'set/acc'** switch and hold at that position, vehicle should accelerate smoothly until switch is released. Vehicle should now maintain new speed at which **'set/acc'** switch was released.
3. Momentarily touch and release **'set/acc'** switch, vehicle speed should increase 1.6 km/h (1 mph) for each touch. Note that five touches will increase speed 8 km/h (5 mph).
4. Apply **'res/decel'** switch while vehicle is in cruise control mode, cruise control should disengage. Slow to approximately 55 km/h, (35 mph) operate **'res/decel'** switch, immediately release switch and remove foot from accelerator, vehicle should smoothly accelerate to previously set speed. Increase speed using accelerator pedal, release pedal, vehicle should return to previously set speed.
5. Operate brake pedal, cruise control system should immediately disengage returning vehicle to driver control at accelerator pedal. Operate **'res/decel'** switch, vehicle should accelerate to previously set speed without driver operation of accelerator pedal.
6. Operate **'res/decel'** switch and allow vehicle to decelerate to below 42 km/h, (26 mph). Operate **'res/decel'** switch, cruise control system should remain disengaged.
7. Operate **'set/acc'** switch below 40 km/h, (28 mph), cruise control system should remain disengaged. Accelerate, using accelerator pedal to above 45 km/h, (28 mph), operate **'res/decel'** switch, and remove foot from accelerator pedal, vehicle should smoothly adjust to previously memorised speed.
8. **Automatic vehicles** - select neutral, system should disengage. **Manual vehicles** - depress clutch, system should disengage.
9. Cruise at 80 km/h (50 mph), declutch, select neutral, remove foot from clutch. Operate **'res/decel'** switch. Engine should rev to 5000 rev/min, cruise control disengages, engine returns to idle.
10. Engage forward gear. Operate **'res/decel'** switch. Remove foot from accelerator. Speed should accelerate to previous set speed.
11. Depress main control switch in control system should immediately disengage and erase previously set speed from E.C.U. memory ***See ETM, B5***

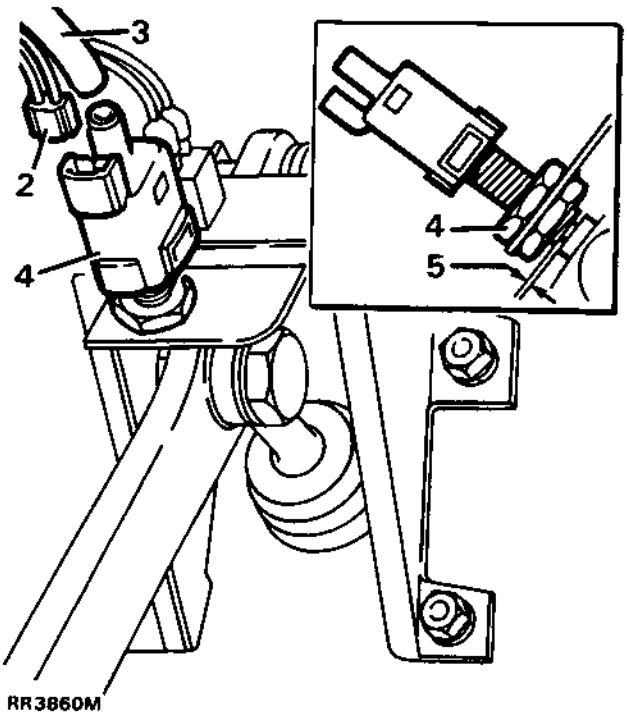
BRAKE PEDAL SWITCH/VENT VALVE

Service repair no - 19.75.35

Remove and refit

Remove

1. Remove lower dash panel, ***See CHASSIS AND BODY, Repair, Lower dash panel***
2. Disconnect electrical multi-plug from brake pedal switch.
3. Pull vent hose from switch.
4. Loosen locknut, unscrew switch from bracket.



RR3860M

Refit

5. Fit switch. Adjust switch to provide a clearance of 1.0 mm between switch body and contact button.
6. Tighten locknut.
7. Fit hose and multi-plug securely.
8. Reverse removal procedure.

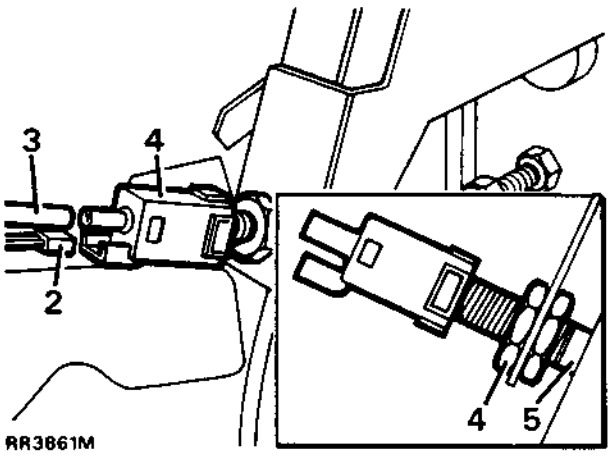
CLUTCH PEDAL SWITCH/VENT VALVE - 1993 MODEL YEAR ADDITION

Service repair no - 19.75.34

Remove and refit

Remove

1. Remove lower dash panel, ***See CHASSIS AND BODY, Repair, Lower dash panel***
2. Disconnect electrical multi-plug from clutch pedal switch.
3. Pull vent hose from switch.
4. Unscrew adjusting nut, remove switch.



RR3861M

Refit

5. Refit switch, fit adjusting nut. Adjust valve to provide zero clearance between valve body and inside shoulder of contact button.
6. Tighten adjusting nut
7. Fit hose and multi-plug securely.
8. Reverse removal procedure.

MAIN CONTROL SWITCH

Service repair no - 19.75.30

Remove and refit of main control switch and bulb replacement is included in Electrical Section 86, ***See ELECTRICAL, Repair, auxiliary switch panel***

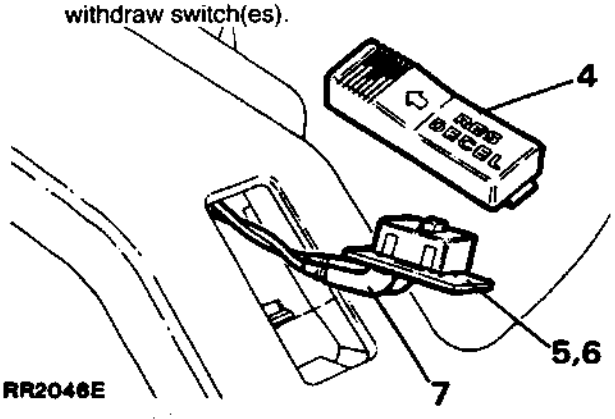
DRIVER OPERATED CRUISE CONTROL SWITCHES-STEERING WHEEL

Service repair no - Set - 19.75.36
Service repair no - Resume - 19.75.37

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pry centre trim pad off steering wheel.
3. Disconnect electrical multi-plug located in small opening below steering wheel retaining nut.
4. Carefully pry switch(es) out of steering wheel spoke(s).
5. Release small switch button from opening within spoke(s).
6. Carefully pull switch and electrical leads through spoke until access is gained to electrical connections beneath switch.
7. Disconnect electrical leads from switch and withdraw switch(es).



Refit

8. Reverse removal procedure. Ensuring electrical leads are fitted securely.

SPIRAL CASSETTE

Service repair no - 19.75.54

Remove and refit

The spiral cassette is located behind steering wheel. Access to unit is gained by removing steering wheel and steering column shroud.

△ **NOTE: To enable steering wheel to be refitted in correct radial position, ensure front road wheels are in straight ahead position.**

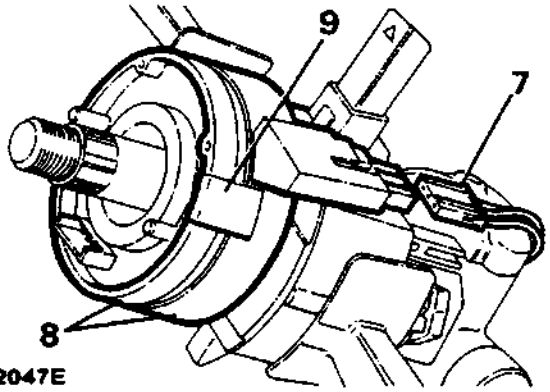
Remove

Service Tools:
LRT-57-014 Steering wheel remover
LRT-57-015 Adaptor pins

1. Disconnect the battery negative lead.
2. Remove steering wheel centre trim panel.
3. Disconnect electrical multi-plug located in small opening in centre of steering wheel.
4. Remove steering wheel securing nut and serrated washer, using service tool LRT-57-014 and adaptor pins, withdraw steering wheel.

⚠ **CAUTION: Apply adhesive tape to upper and lower halves of spiral cassette to prevent upper half rotating after steering wheel is removed. Failure to do this will result in damage to flexible tape inside cassette.**

5. Remove six lower fixings securing steering column shroud.
6. Release either left hand or right hand fixing securing top of shroud.
7. Ease halves of shroud apart until access is gained to electrical multi-plug on cassette. Disconnect multi-plug.
8. Remove cassette from steering column.



RR2047E

Refit

9. Remove adhesive tape retaining halves of spiral assette.

△ **NOTE: Ensure that two pegs on spiral cassette locate in two holes on underside of steering wheel before securing steering wheel.**

10. Reverse removal procedure. Ensuring that electrical leads within steering column shroud are not trapped between shroud mating faces.

ACTUATOR

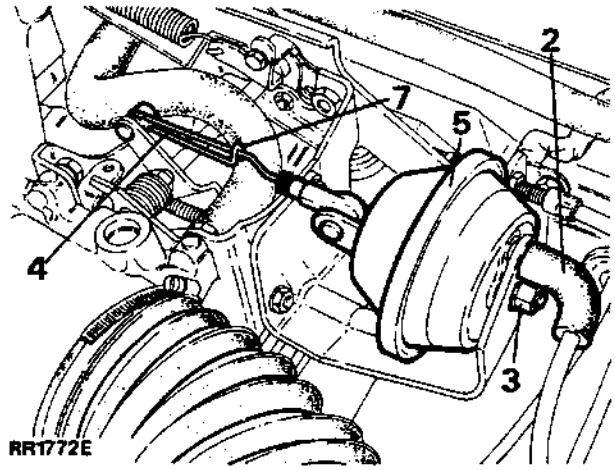
Service repair no - 19.75.12

Remove and refit

NOTE: The actuator is non serviceable, fit a new unit if failure or damage occurs.

Remove

1. Disconnect the battery negative lead.
2. Pull rubber elbow from actuator.
3. Remove nut securing actuator to throttle bracket.
4. Remove actuator, and manoeuvre actuator operating link off throttle lever.
5. Withdraw actuator.



RR1772E

Refit

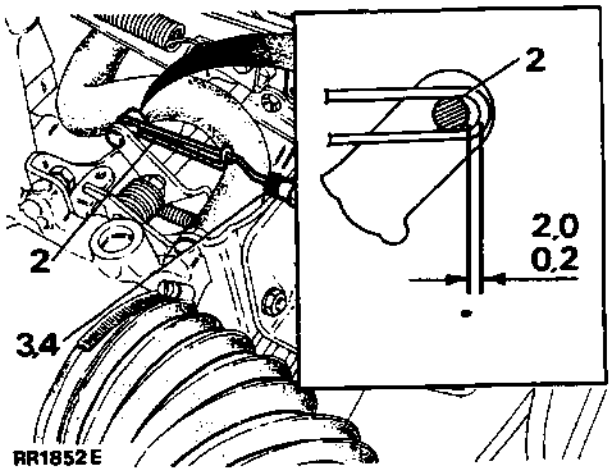
6. Inspect rubber diaphragm. Fit a new actuator assembly if diaphragm is damaged.
7. Reverse removal procedure. Fitting hook uppermost

ACTUATOR LINK-SETTING

Service repair no - 19.75.21

NOTE: Setting procedure is carried out at minimum throttle condition only.

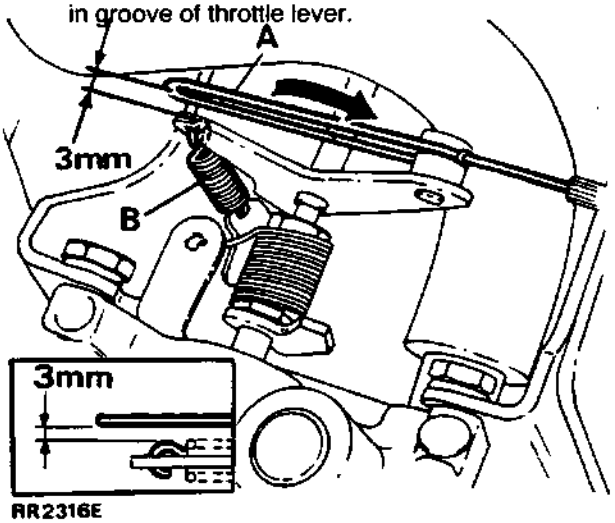
1. Ensure ignition is switched 'OFF'.
2. Check clearance between inside edge of actuator link and recessed diameter of throttle lever. Clearance should be 0.2 to 2.0 mm.



RR1852E

Link - adjust

3. Remove link from actuator.
4. Rotate socket joint adjuster as necessary.
5. Refit link to actuator and recheck clearance between link and lever.
6. With throttle fully open, check a gap of at least 3mm exists between side of link ("A" in illustration) and side of small spring ("B" in illustration). Realign link by bending to achieve correct gap. Recheck clearance at closed throttle/open throttle. Check link slides smoothly in groove of throttle lever.



RR2316E

VACUUM PUMP

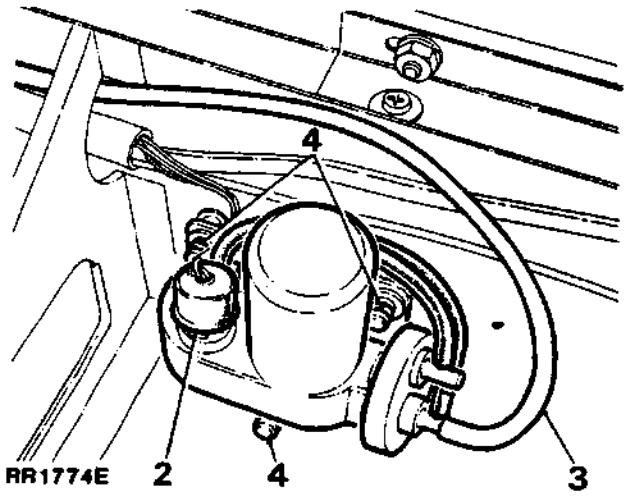
Service repair no - 19.75.06

Remove and refit

NOTE: The vacuum pump is non serviceable, fit a new unit if failure or damage occurs.

Remove

1. Disconnect the battery negative lead.
2. Disconnect multi-plug from top of vacuum pump.
3. Disconnect vacuum feed hose from vacuum pump.
4. Withdraw three vacuum pump rubber mountings.



5. Remove vacuum pump.

Refit

6. Reverse removal procedure. Ensuring all hose and electrical connections are secure.

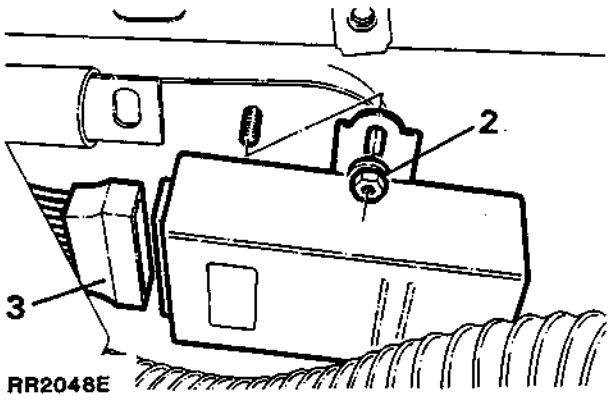
ELECTRONIC CONTROL UNIT (ECU) - CRUISE CONTROL- Pre 1993

Service repair no - 19.75.49

Remove and refit

Remove

1. Remove lower dash panel, ***See CHASSIS AND BODY, Repair, Lower dash panel***
2. Remove two fixings, lower ECU to access multi-plug.
3. Disconnect ECU multi-plug, remove unit from vehicle.



Refit

4. Reverse removal procedure. Ensuring that electrical multi-plug is securely reconnected.

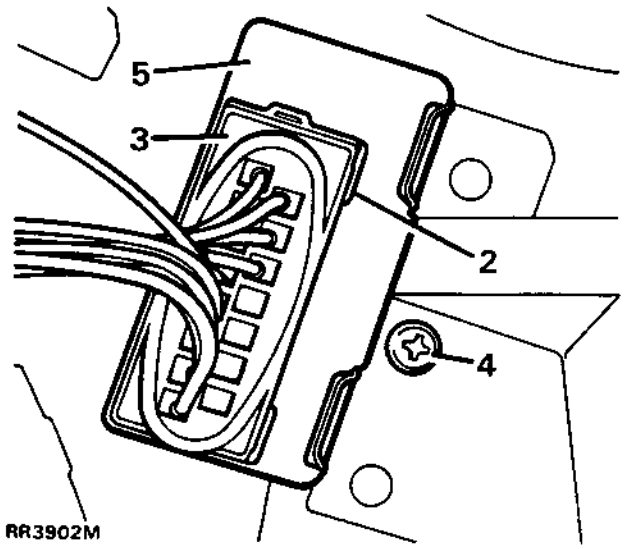
ELECTRONIC CONTROL UNIT (ECU) - CRUISE CONTROL - 1993

Service repair no - 19.75.49

Remove and refit

Remove

1. Remove lower dash panel, ***See CHASSIS AND BODY, Repair, Lower dash panel***
2. Release wire clip.
3. Disconnect ECU multi-plug.
4. Remove ECU fixing.
5. Remove ECU.



Refit

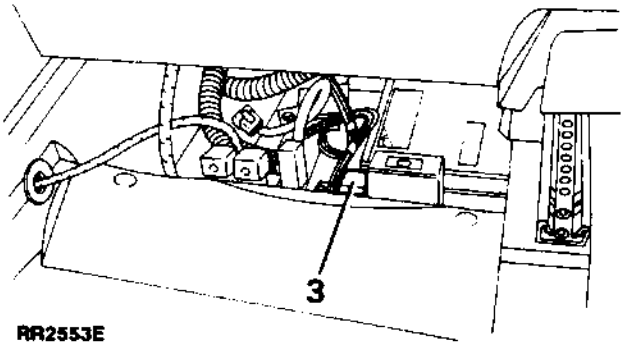
6. Reverse removal procedure. Ensuring that electrical multi-plug is securely reconnected.

NEUTRAL LOCKOUT RELAY - Pre 1993

Remove and refit

Remove

1. Adjust seat fully forward.
2. Disconnect the battery negative lead.
3. Pull relay from terminal block.



Refit

4. Reverse removal procedure.

NEUTRAL LOCKOUT RELAY - AUTOMATIC - SPEED TRIP ECU - MANUAL - 1993

NOTE: The neutral lock out relay/speed trip ECU is mounted in the right hand side footwell. To identify components, see 1993 Range Rover Electrical Troubleshooting Manual.

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ADJUSTMENT

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REPAIR

RADIATOR ASSEMBLY 1



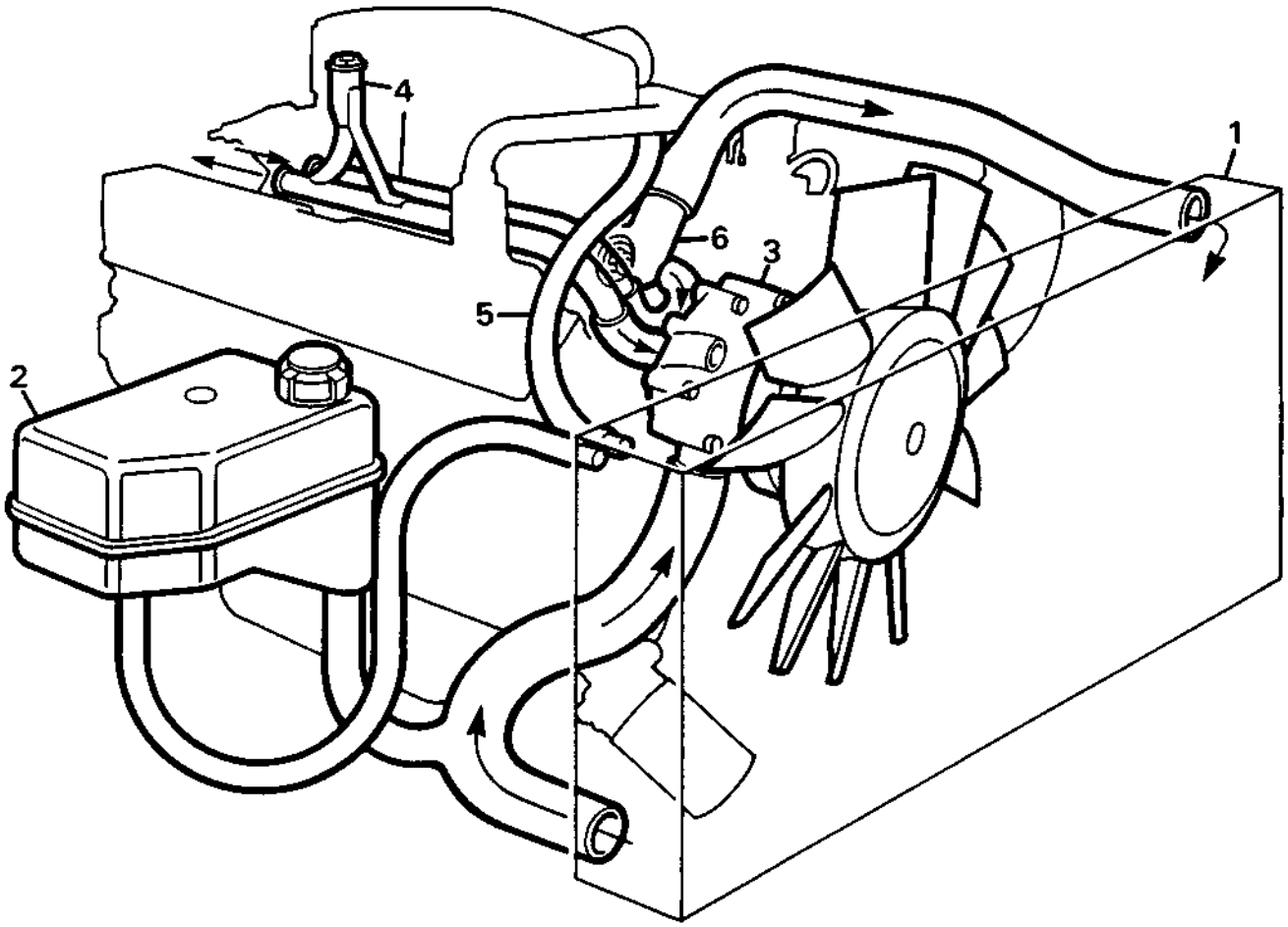
Notes

V8 PETROL ENGINE COOLING

Description

The V8 engine uses a pressurized cooling system and cross flow radiator which is supplied from a separate header tank. The coolant radiator also incorporates a section at the left hand end for cooling the transmission oil and a section at the other end for cooling the engine oil.

The belt driven viscous fan and centrifugal water pump is located in the engine front cover with ports for circulation of coolant to both banks of cylinders and cylinder heads. Coolant returns to the top of the radiator via ports in the inlet manifold where the thermostat is mounted horizontally.
Coolant also circulates through the vehicle heating system and is used to heat air entering the inlet manifold plenum chamber.



RR3532M

Coolant circulation (engine hot)

1. Cross flow radiator
2. Header tank
3. Viscous fan and water pump
4. Heater pipes and filling tower
5. Plenum chamber connection
6. Thermostat

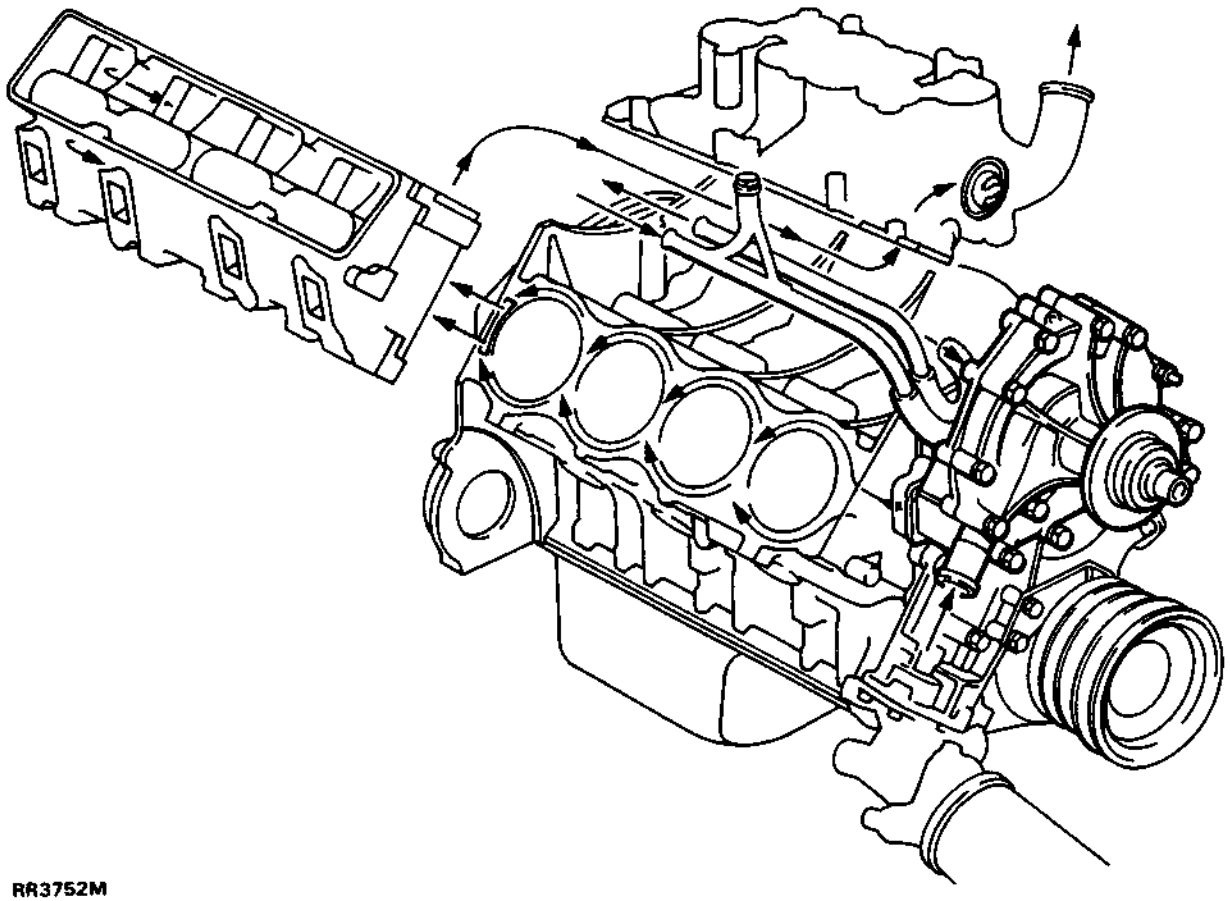
COOLANT CIRCULATION

Operation

When the engine is started from cold the thermostat prevents any coolant circulation through the radiator by closing off the top hose. During the engine warm up period, the water pump, pumps coolant around the cylinders to the rear of the cylinder block along the main galleries in both cylinder banks. At the rear of the cylinder block the coolant rises through a large port in each cylinder head/block joint face, and then flows forward to connect with ports at the front of the inlet manifold. From the manifold the coolant is carried by an external pipe to the heater unit and from the heater through another external pipe to the pump inlet.

The coolant circulation through the cylinder block and heads, does not change when normal running temperature is reached and the thermostat opens. But with the thermostat open, coolant flows through the top hose to the radiator where it is cooled and drawn back into the pump via the bottom hose.

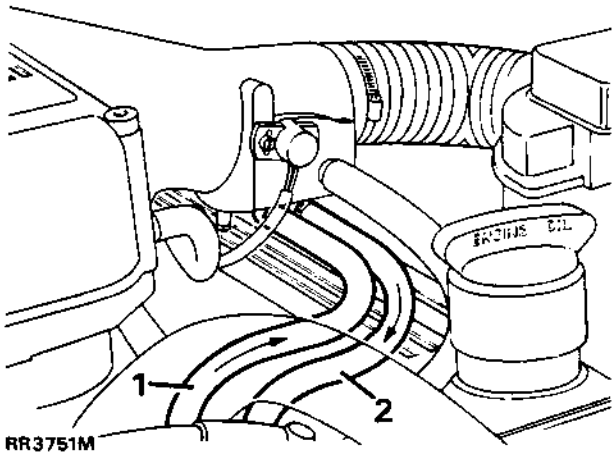
The purpose of the 'filling tower' on the heater return pipe, is allow any air locks in the system to be purged.



RR3752M

Plenum chamber heating

Air entering the plenum chamber is heated by a flow of coolant from the inlet manifold which returns through a long hose, to the top right corner of the radiator.



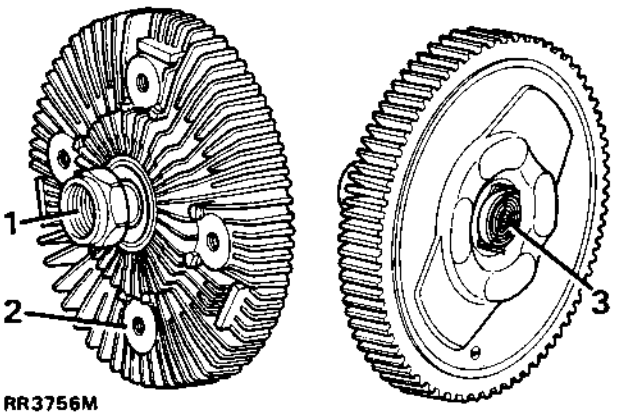
RR3751M

1. Hot water supply
2. Cold return to radiator

VISCOUS FAN

Description

The viscous drive unit for the engine cooling fan, provides a means of controlling the speed of the fan relative to the running temperature of the engine. The viscous unit is a type of fluid coupling, which drives the fan blades through the medium of a special 'silicone fluid' injected into the unit during manufacture.



RR3756M

1. Drive in from water pump spindle
2. Drive out to fan blades
3. Bi-metal

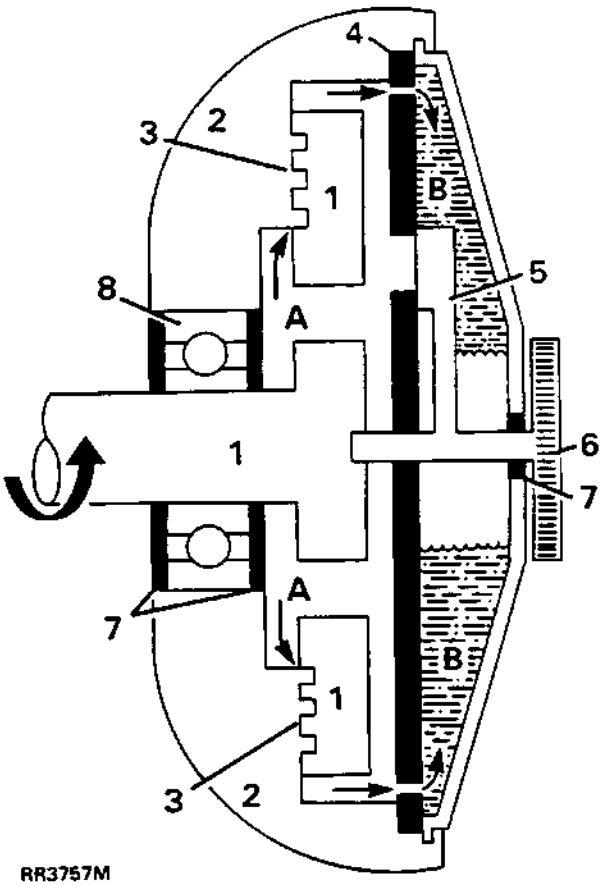
Operation

The viscous unit consists of two principal components:
An inner member 1 which is secured to water pump spindle and is driven by the fan belt.
An outer member 2 which has the fan blades attached, houses the working parts and is driven through the medium of the viscous fluid.

The inner and outer members have interlocking annular grooves machined in each, with a small running clearance 3 to allow the silicone fluid to circulate through the valve plate 4.
The unit also contains a valve 5 which is controlled by an external bi-metal thermostat 6.

Starting engine from cold

During the time the engine is at rest the silicone fluid drains down, half filling chambers A and B. Thus when the engine is first started sufficient fluid is present in chamber A to provide a positive drive between the members, as is evident by the initial noise of the fan. However within a very short period of time, after starting the engine, the fan speed and noise will decline indicating that the fluid is being centrifuged into chamber B (as seen in RR3757M causing the drive to slip.



RR3757M

Viscous unit slipping (Engine at normal running temperature)

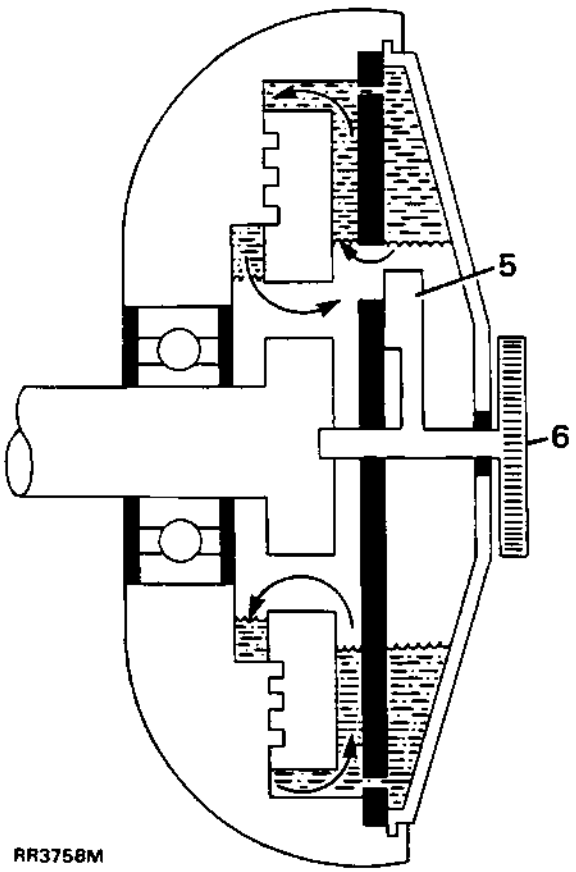
1. Inner member (drive in fast)
2. Outer member (drive out slow)
3. Running clearance
4. Valve plate
5. Valve (closed)
6. Bi-metal
7. Fluid seals
8. Ball race

A. Fluid chamber
B. Fluid chamber

If the engine speed is increased the degree of slip will also increase to limit the maximum fan speed.

Hot conditions

When operating in high ambient temperatures or when stationary in traffic, the bi-metal thermostat will operate and open the valve port between chambers A and B.
Opening the valve (as shown in RR3758M) allows the fluid to circulate between the two members, causing the unit to couple, thus increasing the fan speed and cooling effect.



Viscous unit coupled (Hot running conditions)

Bi- metal expanded, valve (open)

Notes



ENGINE OVERHEATING

Before conducting any cooling system diagnosis: ***See Description and operation, V8 Petrol Engine Cooling***

1. Is coolant level correct?
   NO - Allow engine to cool, top up level to expansion tank seam.
   YES - Continue.

2. Is drive belt tension correct?
   NO - ***See SECTION 10, Maintenance, Service schedule***
   YES - Continue.

3. Is ignition timing correct?
   NO - ***See ELECTRICAL, Adjustment, Ignition timing***
   YES - Continue.

4. Is coolant in radiator frozen?
   YES - Slowly thaw and drain system. ***See Adjustment, Coolant requirements***
   NO - Continue.

5. Is air flow through radiator restricted or blocked?
   YES - Apply air pressure from engine side of radiator to clear obstruction.
   NO - Continue.

6. Are there any external leaks, from water pump, engine gaskets or the heater unit?
   YES - Investigate and rectify. ***See Adjustment, Coolant requirements***
   NO - Continue.

7. Are fan blades fitted correct way round, concave side towards engine?
   NO - Rectify.
   YES - Continue

8. Is viscous unit operating correctly? ***See Description and operation, Viscous fan***
   NO - Renew. ***See Repair, Viscous coupling, fan blades, pulley and fan cowl***
   YES - Carry out a pressure test on radiator cap and system. Check thermostat type, operation and correct fitting. ***See ENGINE, Overhaul, Test and fit thermostat***
   If pressure test leads you to suspect coolant leakage across gaskets, go to check 11, otherwise: Continue.

9. Are the air conditioning fans operating correctly? ***See ETM, K5***
   NO - Rectify.
   YES - Continue.

10. Is temperature sender and gauge giving accurate readings?
    NO - Substitute parts and compare readings.
    YES - Continue.

11. Carry out cylinder pressure test to determine if pressure is leaking into cooling system causing over pressurising and loss of coolant.

If problem is not diagnosed, check the coolant system for engine oil contamination and engine lubrication system for coolant contamination.

If the coolant only, or both systems are contaminated, suspect cylinder head gaskets or radiator.

If only the lubrication stystem is contaminated with coolant, suspect inlet manifold or front cover gaskets.

ENGINE RUNS COLD

Before conducting any cooling system diagnosis: ***See Description and operation, V8 Petrol Engine Cooling***

1. Check operation of viscous unit. ***See Description and operation, Viscous fan***

2. Is viscous unit operating correctly?
   NO - ***See Repair, Viscous coupling, fan blades, pulley and fan cowl***
   YES - Continue.

3. Is thermostat correct type and operating? ***See ENGINE, Overhaul, Test and fit thermostat***

4. If problem is not diagnosed: Continue.

5. Are the airconditioning fans operating continuously?
   YES - ***See ETM, K5***
   NO - Continue.

6. Is temperature sender and gauge giving accurate readings? Substitute parts and compare readings. If problem is not diagnosed repeat tests, starting at 1.

COOLANT REQUIREMENTS

Frost precautions and engine protection.

Cooling system **MUST ALWAYS** be filled and topped-up with solution of water and anti-freeze, winter and summer. **NEVER** use water alone, this may corrode aluminium alloy.

CAUTION: Do not use salt water otherwise corrosion will occur. In certain territories where only available natural water supply has some salt content use only rain or distilled water.

Recommended solutions

Anti-freeze: Universal anti-freeze or permanent type ethylene base, without methanol, containing a suitable inhibitor for aluminium engines and engine parts.

Use one part of anti-freeze to one part of water.

Anti-freeze can remain in the cooling system and will provide adequate protection for two years provided that specific gravity of coolant is checked before onset of second winter and topped-up with new anti-freeze as required.

Vehicles leaving factory have cooling system filled with 50% solution of anti-freeze and water. This gives protection against frost down to minus 36°C (minus 33°F). Vehicles so filled are identified by a label affixed to radiator.

NOTE: Should ambient temperatures be below that stated above refer to Anti-Freeze Data in Recommended Lubricants, Fluids and Capacities in Section 09. Instructions in chart must be strictly adhered to before driving vehicle.

After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and replace defective hoses to make sure that the system is leakproof.

See the 'Recommended Lubricants Fluids and Capacities' for protection quantities. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Lubricants Fluids and Capacities***

COOLANT

Service repair no - 26.10.02

Drain and refill

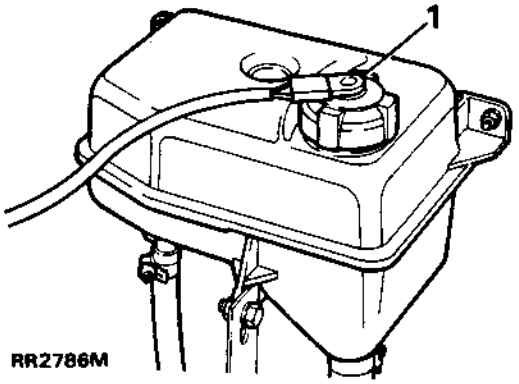
Draining

WARNING: Do not remove expansion tank filler cap when engine is hot. The cooling system is pressurised and personal scalding could result.

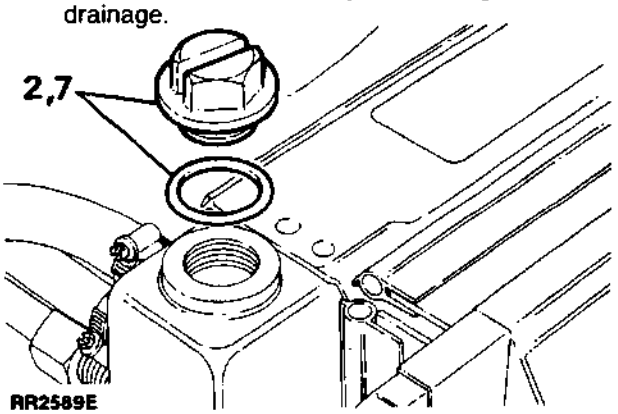
See coolant requirements before refilling system.

1. Remove expansion tank filler cap by slowly turning it anti-clockwise, pause to allow pressure to escape. Continue turning it in same direction and remove.

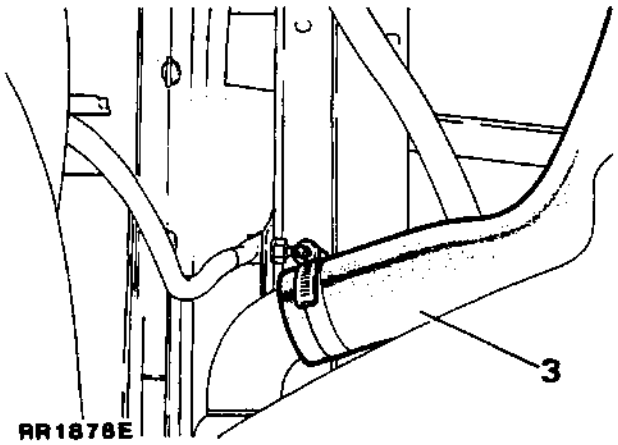
NOTE: The filler cap incorporates a low coolant sensing unit.



2. Remove radiator filler plug and 'O' ring to assist drainage.

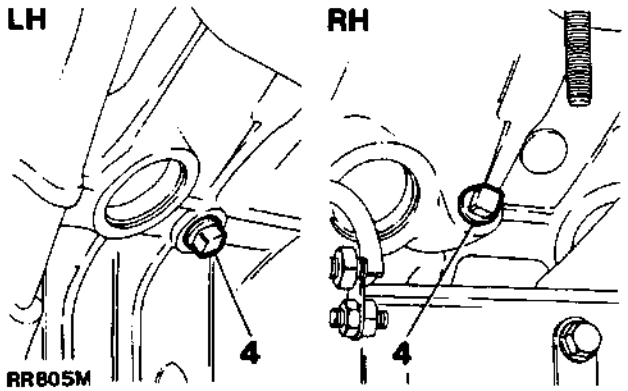


3. Disconnect bottom hose from radiator. Drain coolant into a clean container. Reconnect bottom hose, re-tighten hose clamp.



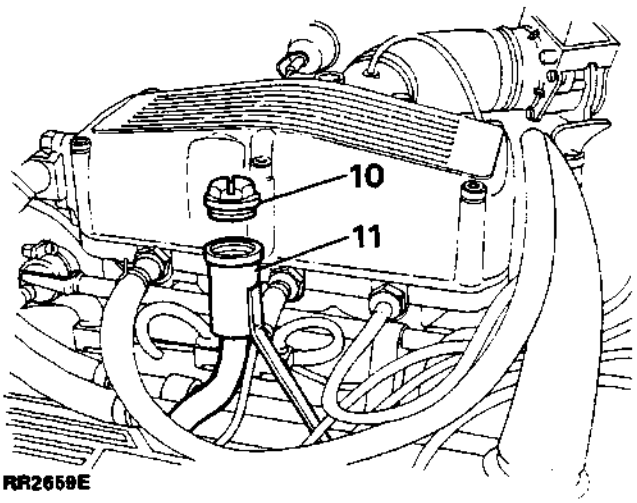
NOTE: It is not possible to drain all coolant retained in heater system. Flush through system, after draining, by pouring clean water into the fill tower. (see RR2659E), with bottom hose disconnected and engine drain plugs removed.

4. Remove engine drain plugs, one each side of cylinder block, beneath exhaust manifolds. Drain coolant, refit and tighten plugs.



5. Pour correct solution of water and anti-freeze into expansion tank until radiator is full.
6. Start engine, run it until normal operating temperature is attained, topping up as necessary.
7. Refit tradiator filler plug and 'O' ring, with new 'O' ring if required. Tighten to ***6 Nm.***
8. Fit expansion tank filler cap.
9. Allow engine to cool, check coolant level. Finally top up expansion tank until level reaches seam of expansion tank.

CAUTION: The following fill procedure must be followed whenever heater pipes mounted on top of rocker cover have been removed.



10. Remove fill tower plug.
11. Briskly pour correct solution of water and anti-freeze into fill tower until radiator is full.
12. Start engine, run it until normal operating temperature is attained, topping up as necessary.
13. Refit radiator filler plug and fill tower plug, with new 'O' rings if required. Tighten to ***6 Nm.***
14. Fit expansion tank filler cap.
15. Allow engine to cool, check coolant level in expansion tank. Finally top up until level reaches seam of expansion tank.

EXPANSION TANK

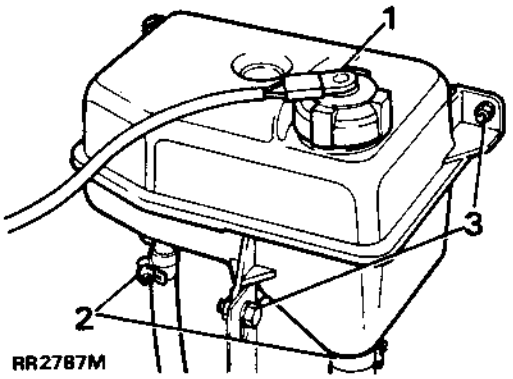
Service repair no - 26.15.01

Remove and refit

Remove

WARNING: Do not remove expansion tank filler cap when engine is hot. The cooling system is pressurised and personal scalding could result.

1. Remove expansion tank filler cap by first turning it slowly anti-clockwise, pause to allow pressure to escape. Continue turning in same direction and lift off.
2. Disconnect two hoses from bottom of expansion tank, allowing coolant to drain into a suitable container.
3. Remove three fixing bolts, remove expansion tank.



Refit

4. Reverse removal procedure.
5. Replenish cooling system.
6. Check for leaks around all hose connections.

FAN BELT

Service repair no - 65.07.76

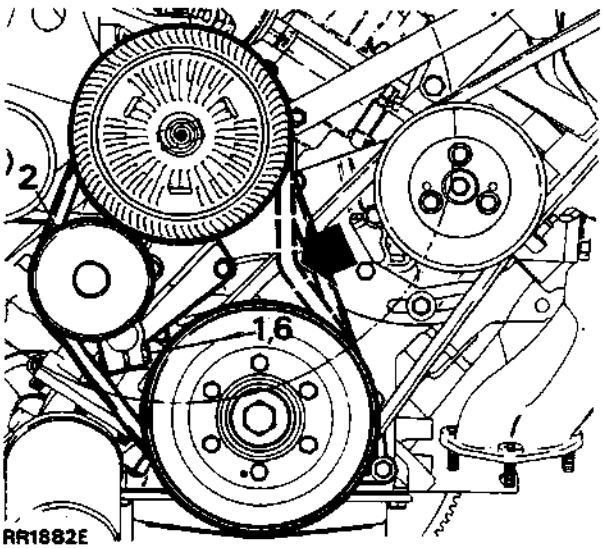
Check and adjust tension, 1 and 5 to 6

Remove and refit

Remove

WARNING: Disconnect battery negative terminal to prevent engine being started before removing or adjusting drive belts.

1. Loosen idler pulley pivot bolt.
2. Pivot idler pulley inwards.
3. Remove fan belt.



Refit

4. Locate fan belt on pulleys.
5. Adjust fan belt using idler pulley to give 4 to 6 mm free movement midway between fan and crankshaft pulleys by hand.
6. Tighten idler pulley pivot bolt, recheck adjustment.

NOTE: Recheck belt adjustment after running engine at fast idle for 3 to 5 minutes when new belt has been fitted.

VISCOUS COUPLING, FAN BLADES, PULLEY AND FAN COWL

Viscous coupling-remove and refit 1 to 5

Fan blades-remove and refit 1 to 5 and 8

Fan cowl-remove and refit 1 to 4

Fan pulley-remove and refit 1 to 7

Remove and refit

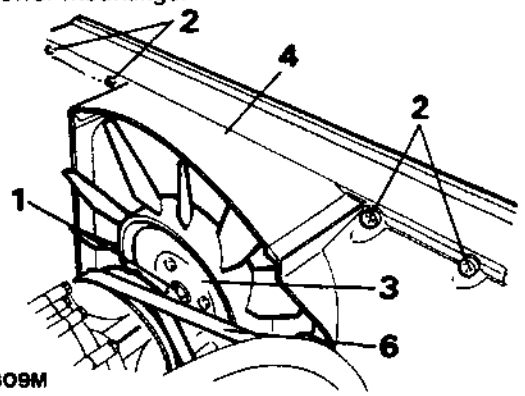
Remove

WARNING: Disconnect battery negative terminal to prevent engine being started before removing or adjusting drive belts.

1. Loosen nut securing viscous coupling/fan blade assembly to water pump.

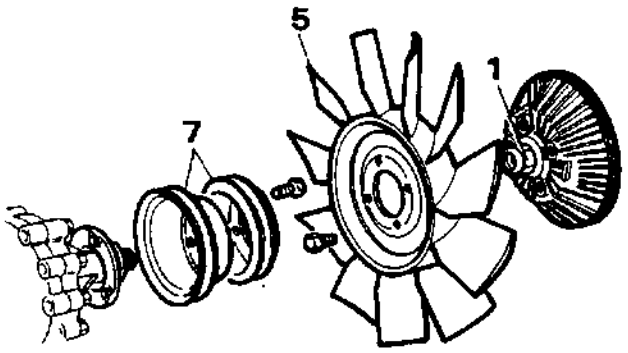
NOTE: Nut securing viscous unit to water pump has a left hand thread. Release by turning clockwise when viewed from front of viscous unit.

2. Remove four fan cowl fixings, lift cowl out of lower mountings.



RR809M

3. Remove viscous coupling securing nut, withdraw assembly.
4. Remove fan cowl, if necessary.
5. Remove fan blades from viscous coupling, if necessary.
6. Remove fan belt and, if fitted, air conditioning compressor belt.
7. Remove pulley fixings, remove pulley.



RR810M

Refit

8. Reverse removal procedure. Ensuring fan blades are fitted correctly. Fan is marked **FRONT** and should be fitted with word **FRONT** closest to radiator. Tighten to ***30 Nm.***
9. Adjust fan belt and compressor belt. ***See SECTION 10, Maintenance, Under Bonnet maintenance***

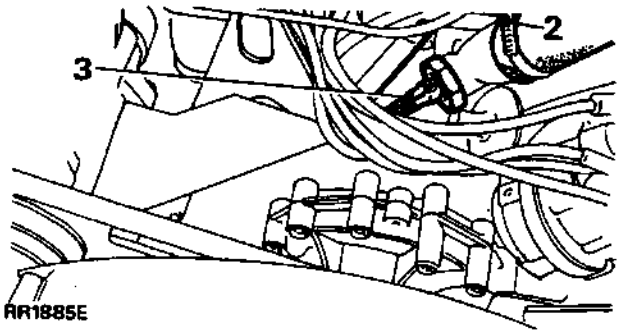
THERMOSTAT

Service repair no - 26.45.01

Remove,test and refit

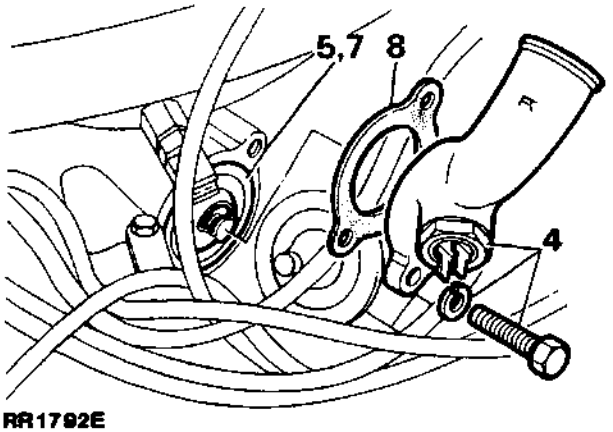
Remove

1. Partially drain cooling system, until coolant level is below thermostat housing.
2. Disconnect hose from thermostat housing.
3. Disconnect electrical connections to water temperature switch.



RR1885E

4. Remove outlet elbow.
5. Withdraw thermostat.



RR1792E

Test

6. Note rating of thermostat is 88°C (190°F). Place thermostat in a container half full of water. Heat water, observe temperature at which thermostat opens. Thermostat is satisfactory if it opens between 85°C and 89°C.

Refit

7. Insert thermostat with jiggle pin/vent hole uppermost (12 o'clock position).
8. Fit the outlet elbow and new joint washer. Tighten to ***28 Nm.***
9. Reverse removal procedure. 1 to 3.
10. Check for coolant leaks around all connections and joint faces.

WATER PUMP

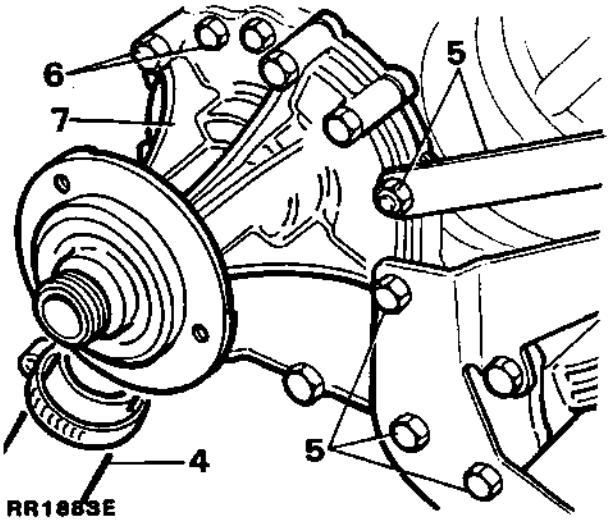
Service repair no - 26.50.01

Remove and refit

Remove

WARNING: Disconnect battery negative terminal to prevent engine being started before removing or adjusting drive belts.

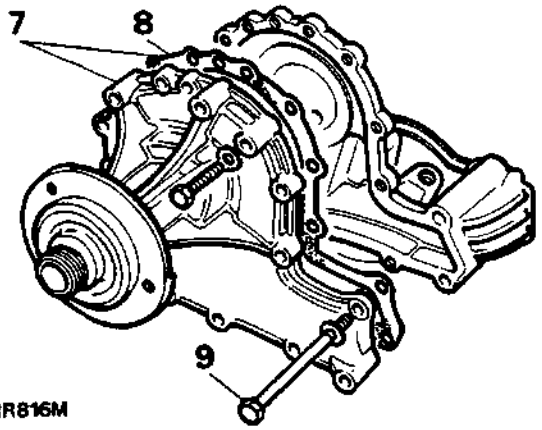
1. Drain engine cooling system. ***See Adjustment, Coolant***
2. Remove water pump, power steering pump and compressor belts ***See SECTION 10, Maintenance, Under Bonnet Maintenance***
3. Remove fan blades and pulley. ***See Viscous coupling, fan blades pulley and fan cowl***
4. Disconnect inlet hose from water pump.
5. Release alternator adjusting link and power steering pump fixings.
6. Remove remaining water pump bolts.
7. Remove water pump and joint washer.



RR1883E

Refit

8. Lightly grease new joint washer, position it on timing cover.



RR816M

9. Clean threads of four long bolts and coat with Loctite 572 thread lubricant-sealant.
10. Locate water pump in position.
11. Locate alternator adjusting link and power-steering pump bracket.
12. Leave alternator adjusting link loose, tighten remaining water pump housing bolts evenly to ***28 Nm.***
13. Reverse removal procedure. 1. to 5.
14. Check for coolant leaks around all hose connections and joint faces.

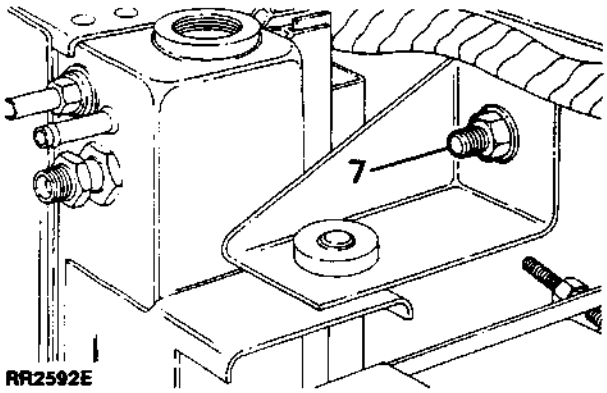
RADIATOR/OIL COOLERS

Service repair no - 26.40.01

Remove and refit

Remove

1. Drain cooling system.
2. Remove fan blade assembly - See RR 2591E.
3. Remove fan cowl.
4. Disconnect radiator top hoses.
5. Disconnect four transmission and engine oil cooler connections to radiator end tanks. Note oil spillage will occur when connections are loosened. Blank off exposed oil connections.
6. Disconnect transmission oil temperature sensor plug.
7. Remove radiator securing brackets from each side.

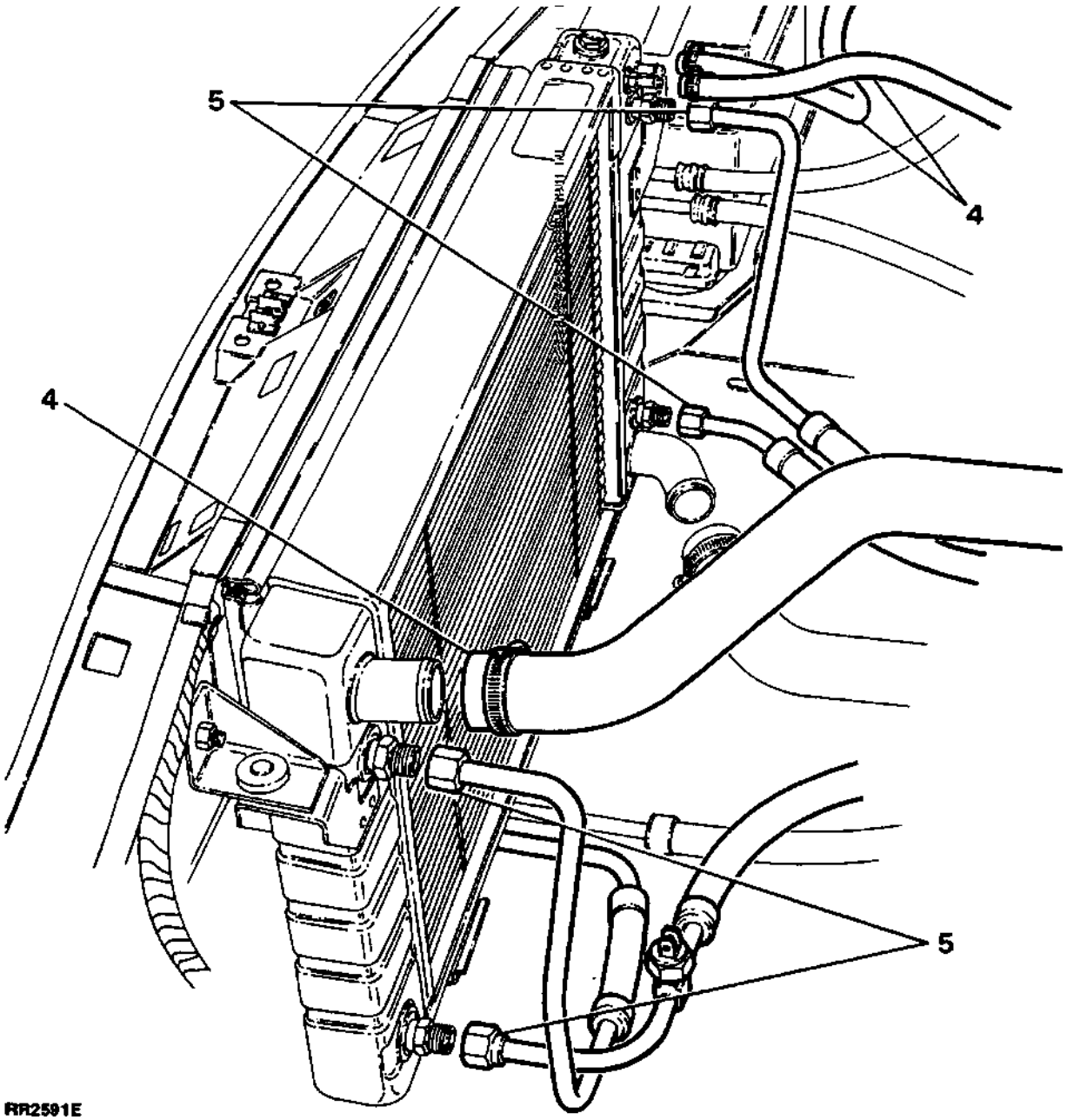


8. Remove radiator unit by lifting from its location. Check condition of rubber mounting pads.

Refit

9. Check radiator sealing strips are securely located.
10. Transfer oil cooler adaptors if fitting new radiator.
11. Reverse removal procedure. Ensure that oil cooler connections are tightened to ***30 Nm.*** before fitting fan blades and cowl.
12. Clean coolant/oil spillage from vehicle.
13. Check all connections for coolant/oil leaks.

RADIATOR/OIL COOLERS





TORQUE VALUES

△ **NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.**

	Nm
Oil cooler pipes	30
Radiator filler plug (plastic)	6
Water pump housing bolts	28
Outlet elbow bolts	28
Fan bolts	30

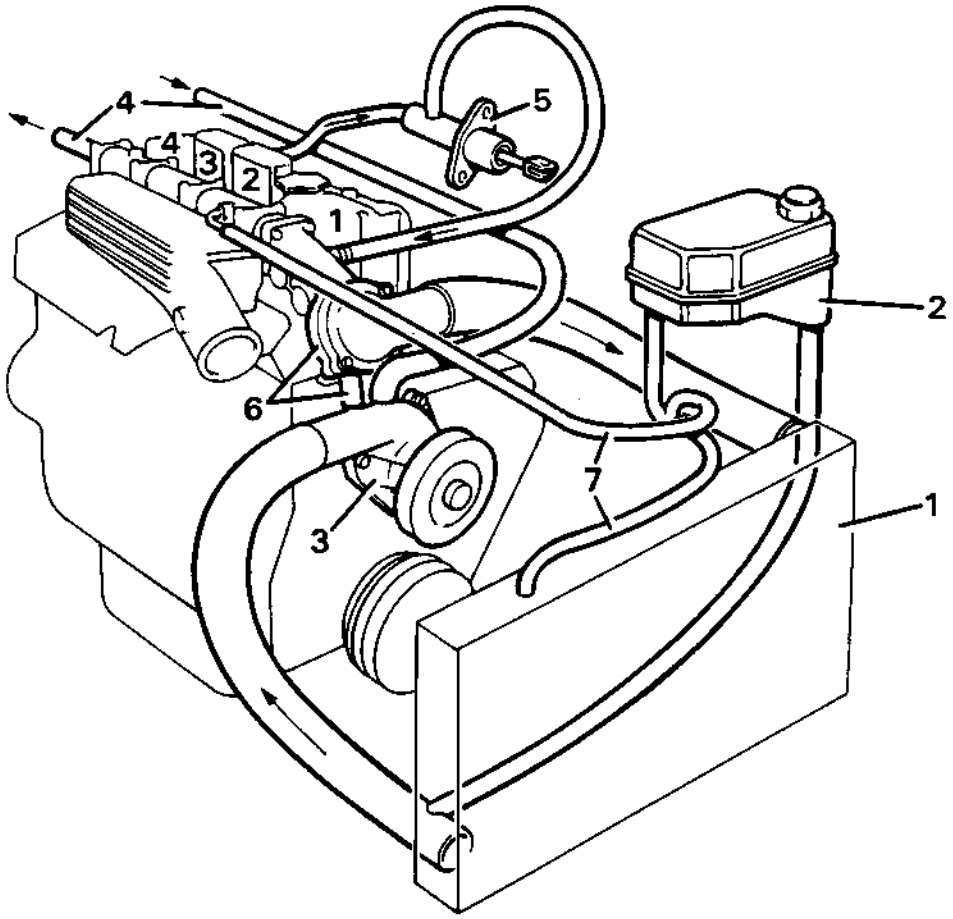
Notes

VM DIESEL ENGINE COOLING

Description

The VM engine uses a pressurized cooling system and cross flow radiator which is supplied from a separate header tank. The radiator assembly is in three sections. The largest section is for engine coolant and the other two sections which are cast in aluminium, are the engine oil cooler and the turbo charger intercooler.

A belt driven viscous fan and centrifugal water pump is located in the front of the cylinder block. Hot coolant is supplied to the heater and the fast idle thermostat through rubber hoses. Two small diameter air purge hoses connect the top of the radiator and cylinder head water gallery, to the header tank.



RR3753M

Coolant circulation (engine cold)

1. Cross flow radiator
2. Header tank
3. Viscous fan and water pump
4. Heater pipes
5. Fast idle thermostat and connections
6. By pass hose and engine thermostat
7. Air purge hoses

COOLANT CIRCULATION

Operation

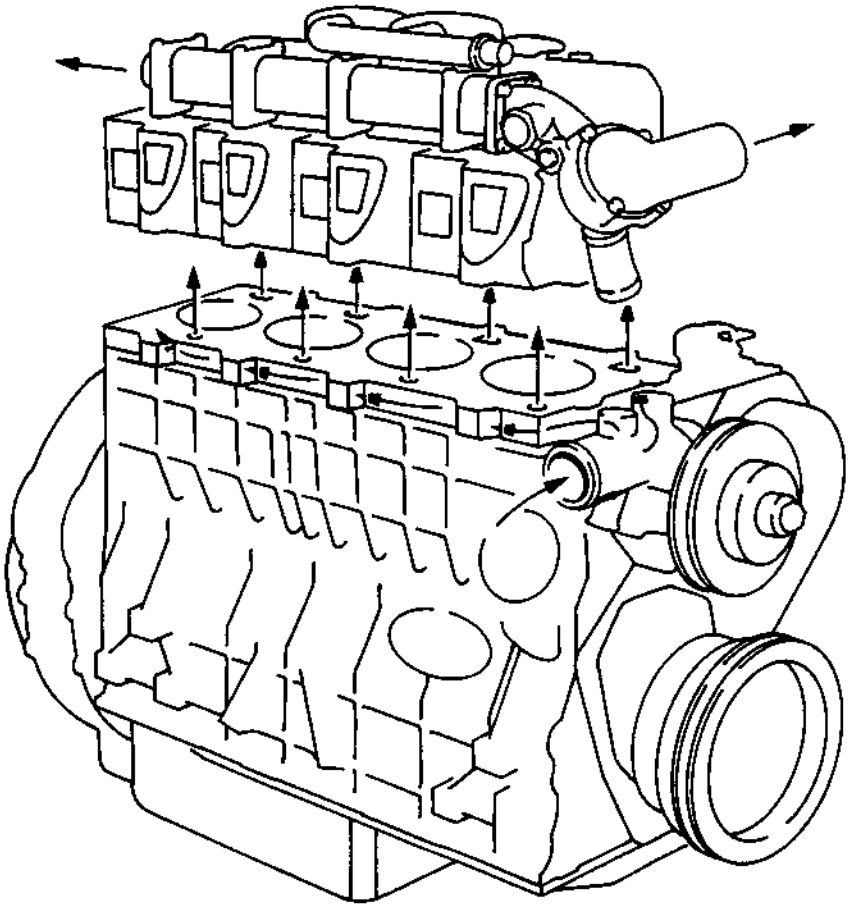
When the engine is started from cold the thermostat prevents any coolant circulation through the radiator by closing off the top hose. During the engine warm up period, the water pump, pumps coolant towards the rear of the cylinder block around each of the cylinders. Coolant as it is heated rises through ports in the cylinder block and head gasket, into each of the four separate cylinder heads. A cast aluminium water gallary which is bolted to the top of the cylinder heads, carries the coolant forwards to the thermostat, by-pass port and radiator top hose connection.

Starting from cold (thermostat closed)

While the thermostat is closed, coolant circulates around the cylinder block and cylinder heads via the by-pass. Coolant also flows from number three cylinder head through the cold start thermostat, which reduces the engine idle speed when running temperature is attained.

Engine warm (thermostat open)

When the engine reaches normal running temperature the thermostat closes off the by-pass and opens the flow to the top of the radiator.

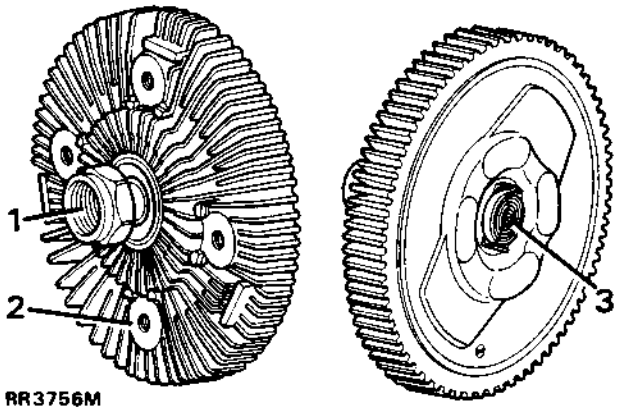


RR3759M

VISCOUS FAN

Description

The viscous drive unit for the engine cooling fan, provides a means of controlling the speed of the fan relative to the running temperature of the engine. The viscous unit is a type of fluid coupling, which drives the fan blades through the medium of a special 'silicone fluid' injected into the unit during manufacture.



RR3756M

1. Drive in from water pump spindle
2. Drive out to fan blades
3. Bi-metal

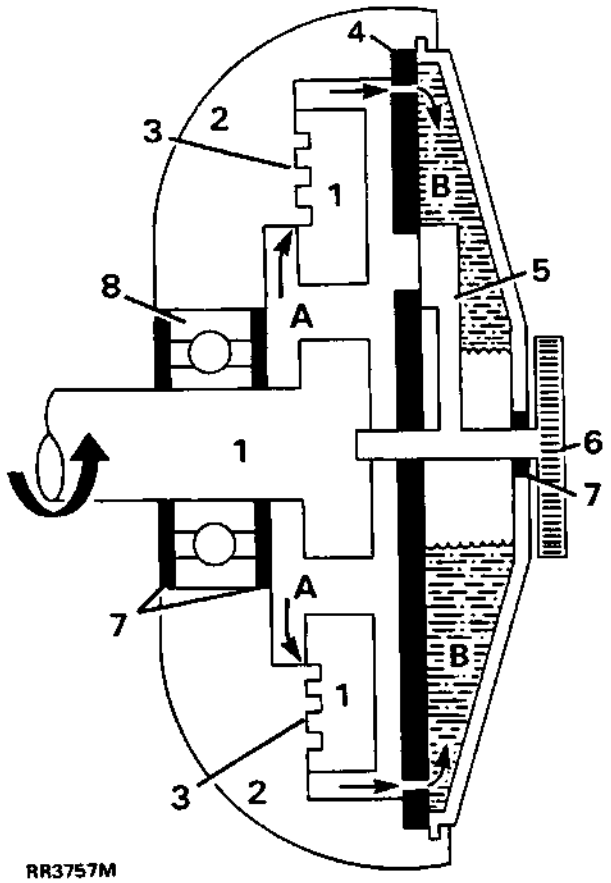
Operation

The viscous unit consists of two principal components:
An inner member 1 which is secured to water pump spindle and is driven by the fan belt.
An outer member 2 which has the fan blades attached, houses the working parts and is driven through the medium of the viscous fluid.

The inner and outer members have interlocking annular grooves machined in each, with a small running clearance 3 to allow the silicone fluid to circulate through the valve plate 4.
The unit also contains a valve 5 which is controlled by an external bi-metal thermostat 6.

Starting engine from cold

During the time the engine is at rest the silicone fluid drains down, half filling chambers A and B. Thus when the engine is first started sufficient fluid is present in chamber A to provide a positive drive between the members, as is evident by the initial noise of the fan. However within a very short period of time, after starting the engine, the fan speed and noise will decline indicating that the fluid is being centrifuged into chamber B (as seen in RR3757M causing the drive to slip.



RR3757M

Viscous unit slipping (Engine at normal running temperature)

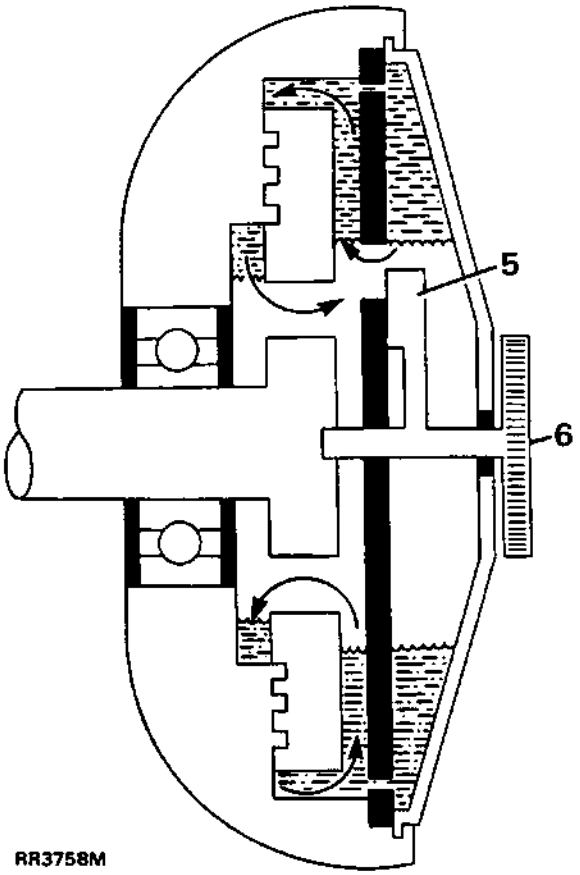
1. Inner member (drive in fast)
2. Outer member (drive out slow)
3. Running clearance
4. Valve plate
5. Valve (closed)
6. Bi-metal
7. Fluid seals
8. Ball race

A. Fluid chamber
B. Fluid chamber

If the engine speed is increased the degree of slip will also increase to limit the maximum fan speed.

Hot conditions

When operating in high ambient temperatures or when stationary in traffic, the bi-metal thermostat will operate and open the valve port between chambers A and B.
Opening the valve (as shown in RR3758M) allows the fluid to circulate between the two members, causing the unit to couple, thus increasing the fan speed and cooling effect.



RR3758M

Viscous unit coupled (Hot running conditions)

Bi-metal expanded, valve (open)



ENGINE OVERHEATING

Before conducting any cooling system diagnosis: ***See Description and operation, VM Diesel Engine cooling***

1. Is coolant level correct?
   NO - Allow engine to cool, top up level to expansion tank seam.
   YES - Continue.

2. Is drive belt tension correct?
   NO - ***See SECTION 10, Maintenance, Under Bonnet Maintenance***
   YES - Continue.

3. Is coolant in radiator frozen?
   YES - Slowly thaw and drain system. ***See Adjustment, Coolant requirements***
   NO - Continue.

4. Is air flow through radiator restricted or blocked?
   YES - Apply air pressure from engine side of radiator to clear obstruction.
   NO - Continue.

5. Are there any external leaks, from water pump, engine gaskets, fast idle thermostat or the heater unit?
   YES - Investigate and rectify. ***See Adjustment, Coolant requirements***
   NO - Continue.

6. Are fan blades fitted correct way round, concave side towards engine?
   NO - Rectify.
   YES - Continue

7. Is viscous unit operating correctly? ***See Description and operation, Viscous fan***
   NO - Renew. ***See Repair, Viscous coupling, fan blades, pulley and fan cowl***
   YES - Carry out a pressure test on radiator cap and system. Check thermostat type, operation and correct fitting. ***See ENGINE, Overhaul, Dismantling, Overhaul and Reassembly***

   If pressure test leads you to suspect coolant leakage across gaskets, go to check 10, otherwise: Continue.

8. Are the airconditioning fans operating correctly? ***See ETM, K5***
   NO - Rectify.
   YES - Continue.

9. Is temperature sender and gauge giving accurate readings?
   NO - Sustitute parts and compare readings.
   YES - Continue.

10. Carry out cylinder pressure test to determine if pressure is leaking into cooling system causing over pressurising and loss of coolant.

If problem is not diagnosed, check the coolant system for engine oil contamination and engine lubrication system for coolant contamination.

If only the coolant system is contaminated suspect a cylinder head gasket.

If both systems are contaminated, suspect the radiator.

If only the lubrication system is contaminated with coolant, suspect leakage past cylinder liner seals or cylinder head gasket.

ENGINE RUNS COLD

Before conducting any cooling system diagnosis: ***See Description and operation, VM Diesel Engine cooling***

1. Check operation of viscous unit. ***See Description and operation, Viscous fan***
   Is viscous unit operating correctly?
   NO - ***See Repair, Viscous coupling, fan blades, pulley and fan cowl***
   YES - Continue.

2. Is thermostat correct type and operating? ***See ENGINE, Overhaul, Dismantling, Overhaul and Reassembly***
   If problem is not diagnosed: Continue.

3. Are the airconditioning fans operating continuously?
   YES - ***See ETM, K5***
   NO - Continue.

4. Is temperature sender and gauge giving accurate readings? Substitute parts and compare readings. If problem is not diagnosed repeat tests, starting at 1.

COOLANT - VM DIESEL

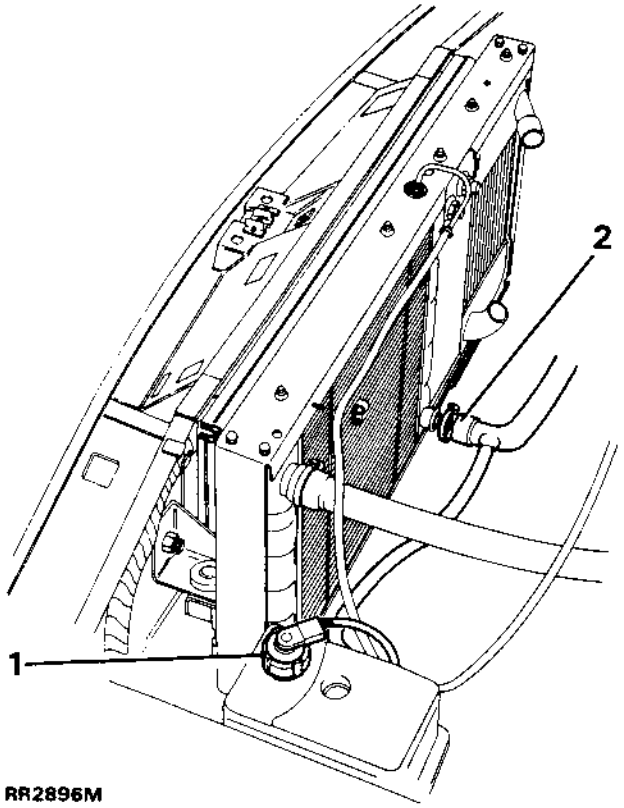
Drain and refill

Drain

WARNING: Do not remove the expansion tank filler cap when the engine is hot. The cooling system is pressurised and personal scalding could result.

NOTE: The screwed filler cap incorporates a low coolant sensing unit.

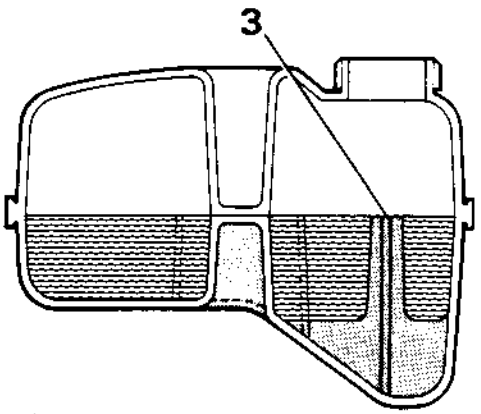
1. Remove expansion tank filler cap.
2. Disconnect bottom hose from radiator and allow coolant to drain into a container. Ensure container is clean if reusing coolant. Reconnect hose after draining and tighten hose clamp.



RR2896M

Refill

3. Add correct mix of coolant into expansion tank, to level of indicator post visible in tank. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Anti-freeze***



RR2897M

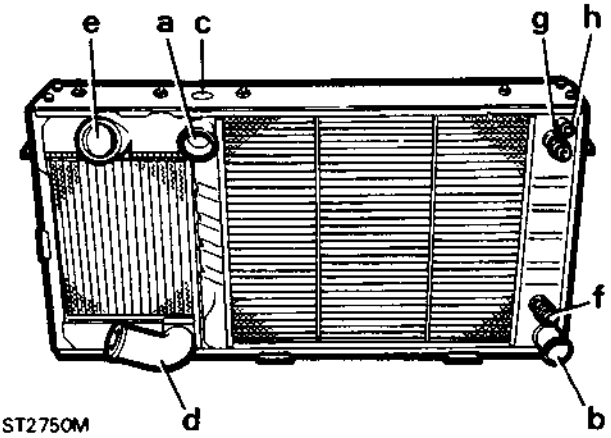
4. Start engine and run until normal operating temperature is attained, topping up as necessary.
5. Fit expansion tank filler cap.
6. Allow engine to cool, check coolant level and top up to level indicator post.

Notes

RADIATOR ASSEMBLY

NOTE: The radiator assembly comprises the engine coolant radiator, turbo-charger intercooler and the engine oil cooler.

a. Engine coolant inlet to radiator.
b. Engine coolant outlet to waterpump.
c. Engine coolant filler plug.
d. High temperature air inlet from turbo-charger.
e. Cooled air outlet to inlet manifold.
f. High temperature engine oil inlet to radiator.
g. Cooled engine oil from radiator to engine.
h. Bleed outlet to expansion tank.



ST2750M

Remove

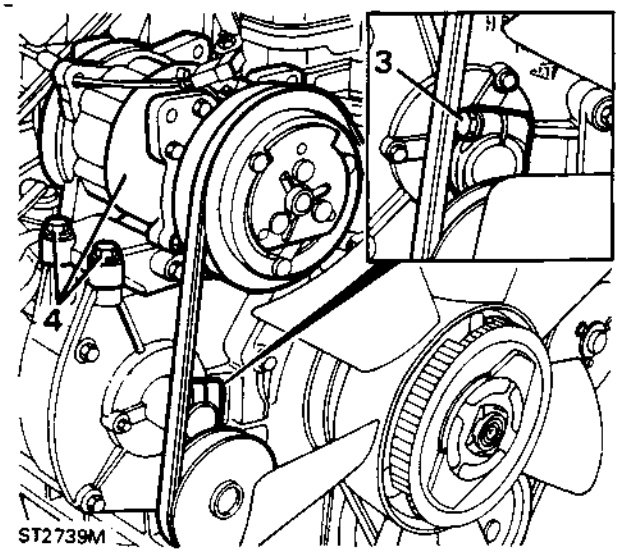
1. Disconnect the battery negative lead.

WARNING: Do not carry out the next instruction until the system is cool to avoid personal injury from scalding water.

2. Remove the expansion tank cap and radiator filler plug. Remove bottom hose from the radiator, allow coolant to drain into a suitable container.

Air conditioning vehicles.

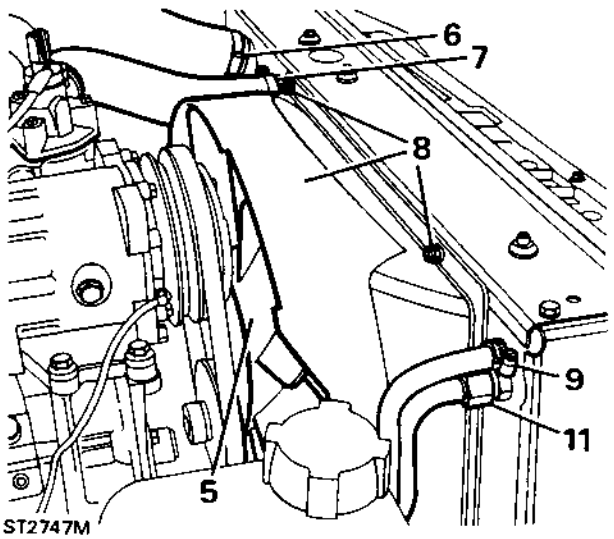
3. Release compressor drive belt tension, remove belt from the pulleys.
4. Remove the four bolts securing the compressor mounting bracket to the engine, move the compressor aside.



ST2739M

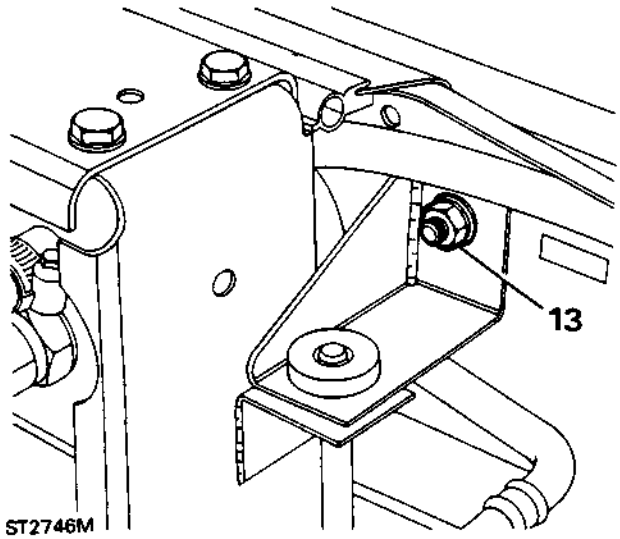
All vehicles.

5. Remove the viscous coupling and fan assembly from the water pump, note that coupling has a left hand thread.
6. Remove the hose, intercooler to manifold.
7. Remove radiator top hose.
8. Release two nuts securing fan cowl to radiator, remove the cowl.
9. Disconnect expansion tank bleed hose from radiator.
10. Disconnect turbo-charger hose at the intercooler.
11. Place a container beneath the oil cooler to catch escaping oil. Disconnect oil pipe connections. Cover, do not plug, ends of pipes to prevent entry of dirt.



ST2747M

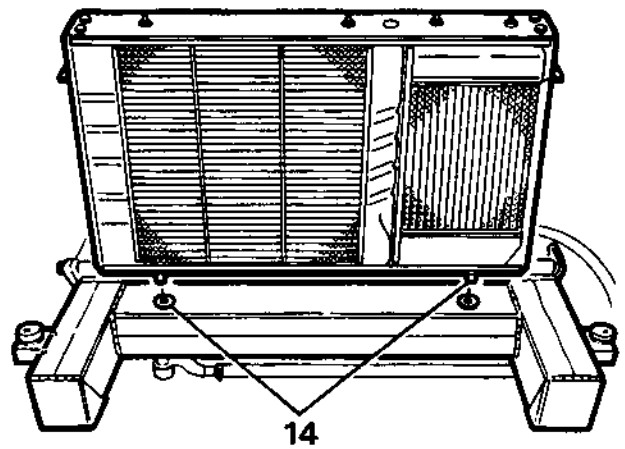
12. The radiator assembly is secured with two bolts and nuts. Viewing the radiator from the front, remove right hand nut and bolt, move the bracket, with the PAS reservoir attached, aside.
13. Remove left hand nut and bolt. Remove radiator assembly from vehicle.



ST2746M

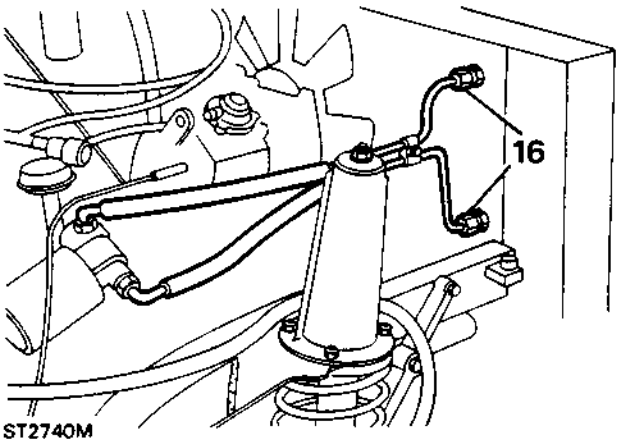
Refit

14. Lower radiator assembly into position. Ensure that the two pegs at the base of radiator locate through the two corresponding grommets in the chassis cross member.



ST2755M

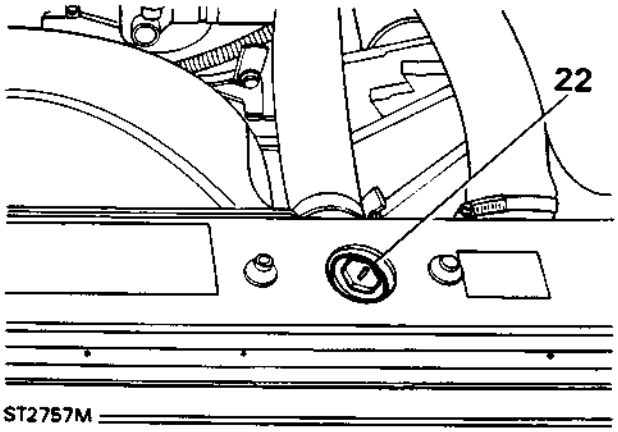
15. Secure radiator brackets to body brackets. Fit PAS reservoir to right hand bracket.
16. Fit oil cooler pipes to radiator connections.



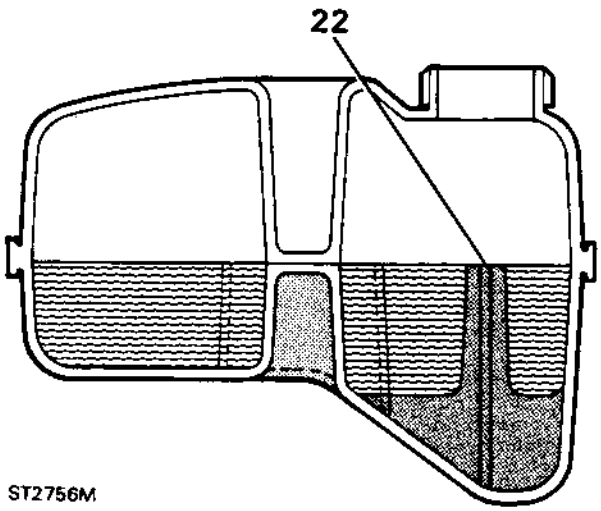
ST2740M

17. Connect expansion tank hose to radiator.
18. Connect turbo-charger to intercooler bottom hose. Connect engine coolant bottom hose.
19. Fit fan cowl. Secure with the two screws to the top of the radiator. Connect intercooler to inlet manifold hose. Connect engine coolant top hose.
20. Fit fan and viscous coupling, note that it has a left-hand thread.
21. Secure the compressor and bracket to the engine, tighten the four bolts to Tighten to ***45 Nm.***Fit and tension the drive belt ***See SECTION 10, Maintenance, 200Tdi Engines***

Filling Cooling System



ST2757M



ST2756M

22. Remove radiator filler plug. Fill system with a 50% solution of water and anti-freeze. Fit and tighten the plug. Check that expansion tank level is up to the level indicator. Connect the battery, start the engine and run for about five to ten minutes until the thermostat has opened. Also check for oil and coolant leaks while the engine is running. Stop the engine and allow to cool and the oil to drain back into the sump.
23. When cold, check oil level, top up as necessary.
24. Remove radiator filler plug, top up as necessary. Check coolant level in expansion tank. Fit radiator plug. Tighten to ***5 Nm***
25. Check air conditioning drive belt tension.
26. Reconnect the battery negative lead.

Notes

30 - MANIFOLD AND EXHAUST SYSTEM

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DESCRIPTION AND OPERATION

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30 - MANIFOLD AND EXHAUST SYSTEM

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Tdi

REPAIR

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CATALYTIC CONVERTERS

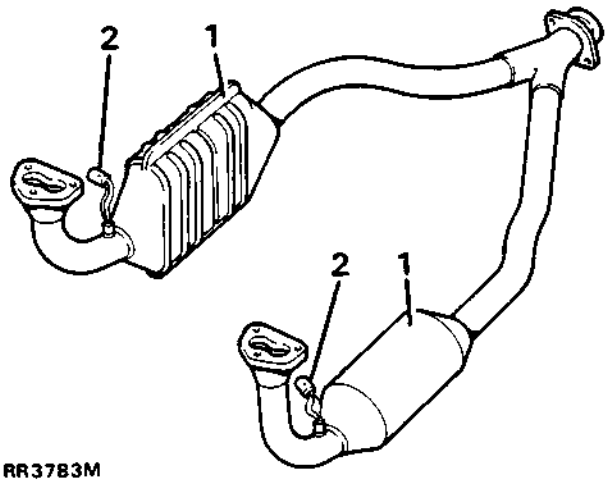
Description

Catalytic converters which form part of the engine emission control system, are designed to 'clean' the exhaust gases, by closely controlling the fuel air ratio delivered to the engine and converting the residual exhaust compounds into products more acceptable to the environment.

The front section of the exhaust system to each cylinder bank contain the ceramic elements of the catalytic converters. The oxygen sensors which transmit information to the fuel ECU for control of the mixture, are located in the exhaust down pipes.

The Hydrocarbons (HC), Nitogen oxides (NO_x) and Carbon monoxide (CO) emitted by the engine react with the catalytic element and exhaust temperature to convert the toxic gas, into Nitrogen (N), Carbon dioxide (CO_2) and water vapour.

Should the engine be supplied with a rich mixture causing high CO in the exhaust gas, the ceramic element will become coated and the useful life of the catalyst reduced. If the mixture is too weak, excess oxygen in the exhaust gas will cause the catalysts to burn out.



RR3783M

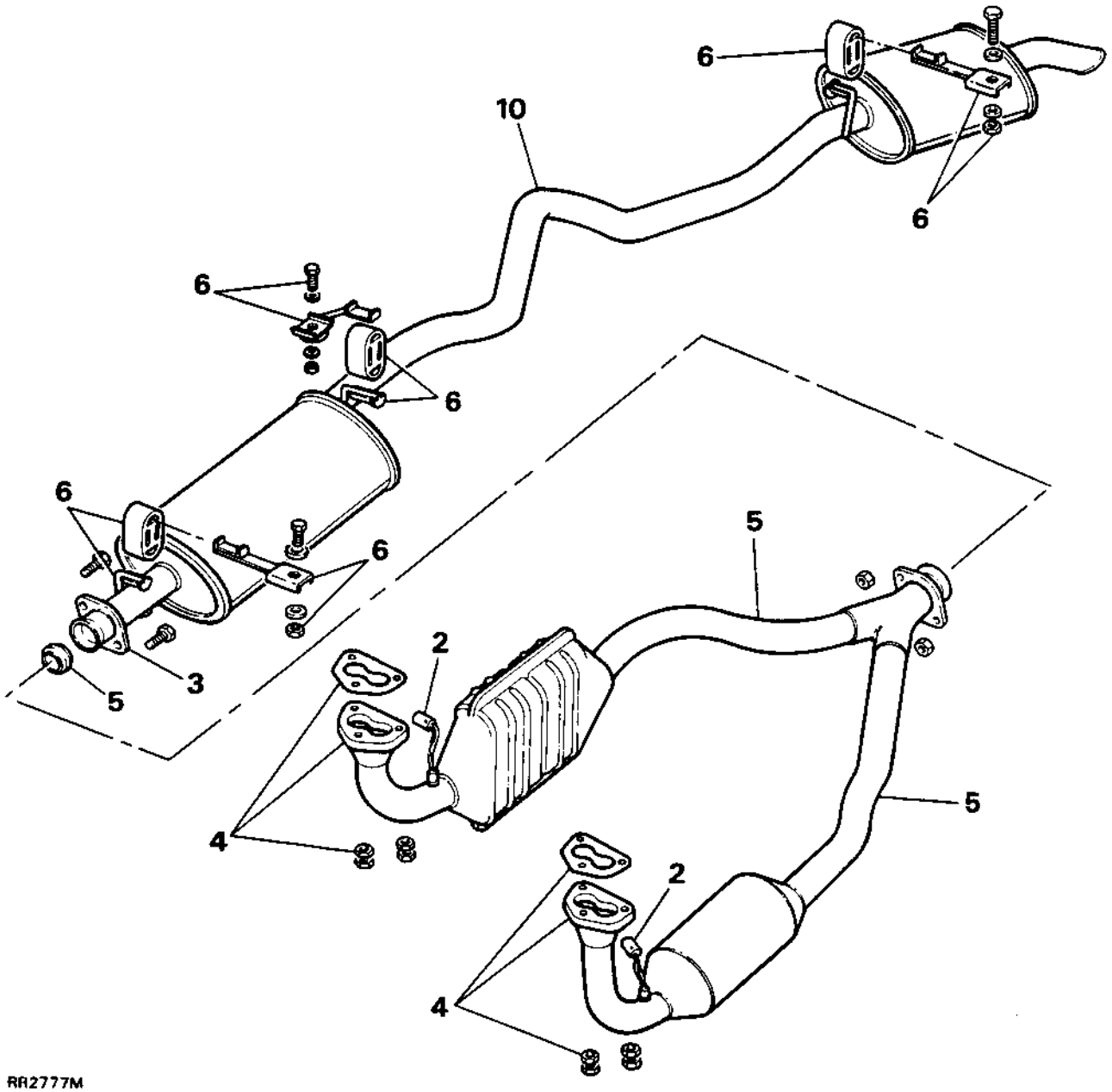
1. Catalysts
2. Lambda oxygen sensors

Notes

EXHAUST SYSTEM COMPLETE

Service repair no - 30.11.01

Remove and refit



RR2777M

To improve sealing and accuracy of assembly, a two piece exhaust system is fitted.

△ **NOTE: Ensure no exhaust leaks are evident in either a new or old exhaust system, as this will affect vehicle performance.**

⚠ **WARNING: To prevent personal injury occurring from a hot exhaust system, DO NOT attempt to disconnect any components until exhaust system has cooled down.**

Remove

Catalysts - remove and refit 1 to 5

1. Raise vehicle on suitable ramp, apply parking brake.
2. **Catalyst vehicles only:** Disconnect two lambda sensor wiring connectors.
3. Remove two bolts securing rear exhaust assembly to front exhaust assembly.
4. Remove nuts and release front downpipes from manifolds. Discard gaskets.
5. Lower front exhaust assembly with catalysts (if fitted), retain olive.

△ **NOTE: Assistance is required for removing and refitting rear exhaust assembly.**

6. Remove bolts securing three hanger brackets to chassis. Lower exhaust assembly onto rear axle. Detach rubbers from hanging brackets.
7. Place extended axle stands underneath chassis, in front of chassis mounted rear towing brackets.
8. Lower ramp until vehicle weight is supported securely on stands.
9. Lower ramp until rear shock absorbers are ALMOST fully extended.
10. Move rear exhaust to a diagonal position, centre silencer to right of vehicle.
11. Facing rear of vehicle, twist assembly anti-clockwise clear of rear axle.
12. Remove rear exhaust assembly from vehicle.

Refit

13. Position rear exhaust assembly over rear axle in a diagonal position, as for removing.
14. Twist assembly clockwise until it is in mounting position.
15. Reverse removal procedure. 1 to 9 using new manifold gaskets and applying exhaust sealer to system joint.
16. Examine system for leaks, ensuring that system does not foul underbody components. Rectify if necessary.

EXHAUST MANIFOLD

Service repair no - Left hand - 30.15.10
Service repair no - Right hand - 30.15.11

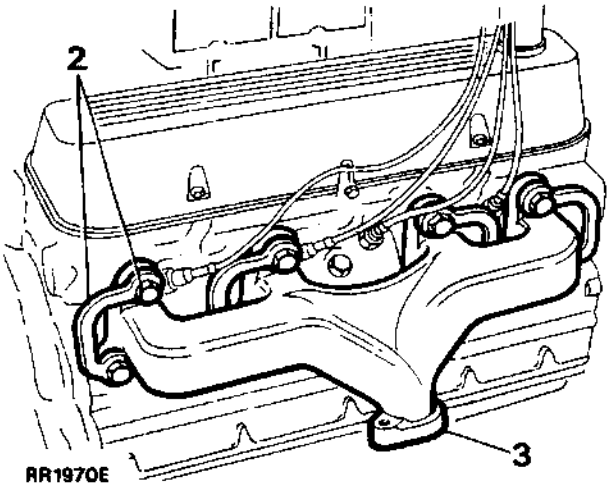
Remove and refit

Left hand

Right hand

Remove

1. Disconnect front exhaust pipe(s) from manifold(s).
2. Tap back bolt locking tabs and remove eight bolts, lock tabs and washers.
3. Remove manifold(s) and old gaskets.



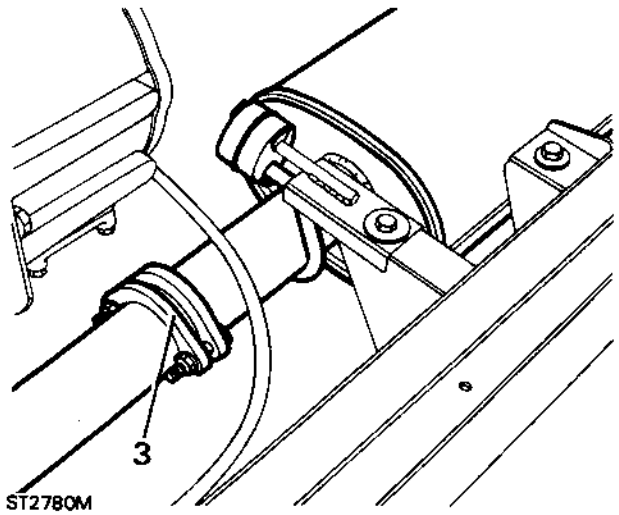
Refit

4. Ensure that mating surfaces of cylinder head and exhaust manifold are clean and smooth.
5. Coat threads of each bolt with anti-seize compound.
6. Place manifold and new gaskets in position on cylinder head and fit securing bolts, new lockplates and plain washers. Plain washers are fitted between manifold and lockplates.
7. Evenly tighten manifold bolts to ***20 Nm*** bend over lockplate tabs.
8. Reconnect front exhaust pipe, using new exhaust flange gaskets.

EXHAUST MANIFOLD

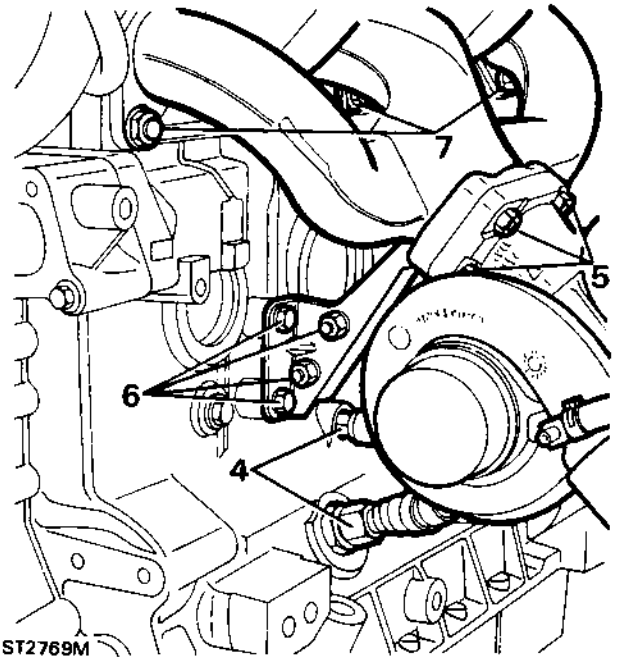
Remove

1. Disconnect the battery negative lead.
2. Remove the air intake manifold ***See Air Intake Manifold***



ST2780M

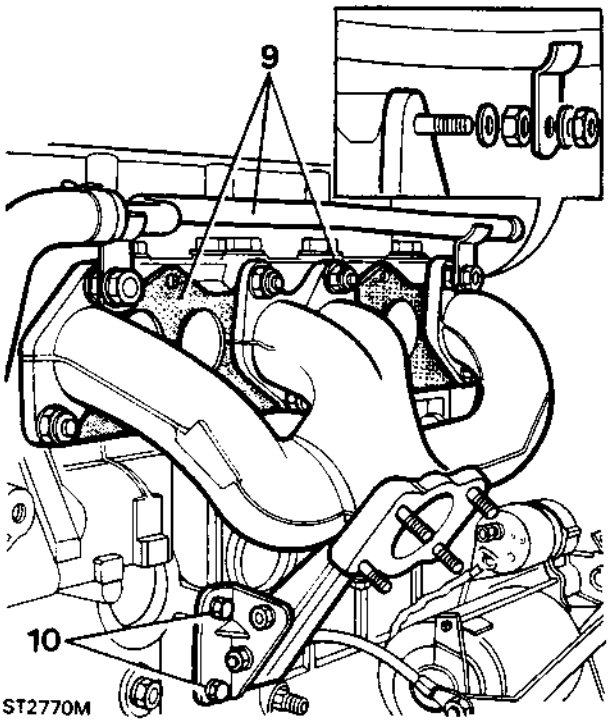
3. Loosen front exhaust pipe fixings at the silencer end.
4. Release turbocharger oil pipes from cylinder block.
5. Remove the four nuts securing turbocharger to exhaust manifold, move turbo away from manifold.
6. Remove nut securing support bracket to manifold. Loosen the two support bracket nuts and bolts. Remove bolts retaining bracket to cylinder block, remove support bracket.
7. Remove seven bolts securing manifold. Release heater rail, remove manifold and gasket.



ST2769M

Refit

8. Fit support bracket to manifold with single nut.
9. Fit gasket and manifold and heater rail to cylinder head. Secure with the seven bolts tightening evenly to ***25 Nm.***
10. Fit support bracket to cylinder block and tighten support bracket to ***25 Nm.***



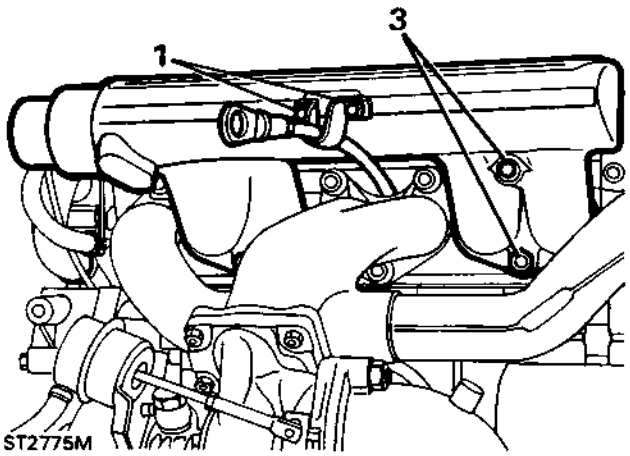
ST2770M

11. Secure turbocharger to manifold with steel gasket and four nuts. Tighten to ***25 Nm.***
12. Connect the turbo oil pipes to the cylinder block.
13. Prime turbocharger ***See ENGINE, Overhaul, Fitting Manifolds And Turbocharger***
14. Fit air inlet manifold. Connect hose. Secure dipstick tube at top and bottom.
15. Tighten exhaust front pipe connection.
16. Reconnect the battery negative lead.
17. Start engine and check for leaks.

AIR INTAKE MANIFOLD

Remove

1. Release dipstick tube attachment to air intake manifold.
2. Disconnect intake hose from manifold.
3. Remove two bolts and two nuts securing intake manifold to cylinder head. Remove manifold.



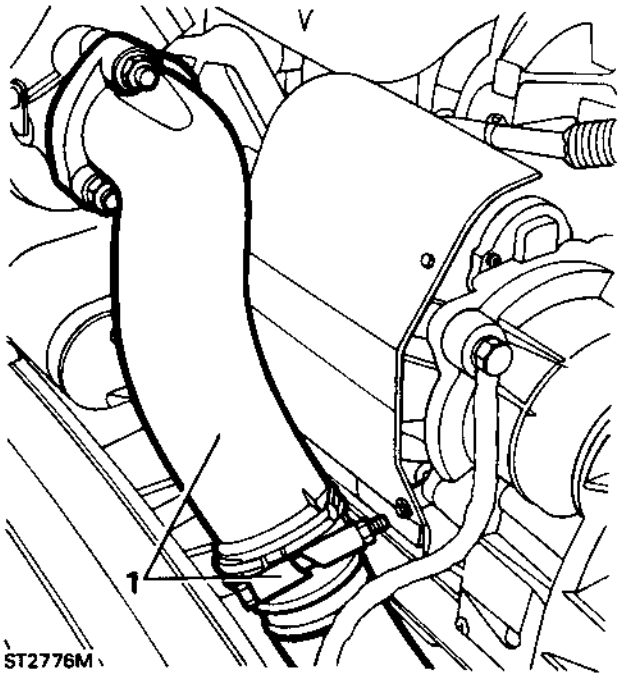
Refit

4. Check that the manifold gasket is in good condition. Secure air intake to cylinder head. Tighten the two nuts and two bolts evenly to ***25Nm.***
5. Connect inlet hose to manifold.
6. Secure dipstick tube to manifold.

EXHAUST SYSTEM FRONT PIPE

Remove

1. Release the clamp securing front pipe to turbocharger elbow.



2. Remove the two flange bolts and nuts connecting front pipe to silencer.
3. Release front silencer from the support bracket.
4. Release silencer from rear support bracket to prevent straining the system.
5. Separate front pipe from the silencer. Remove front pipe from the elbow.

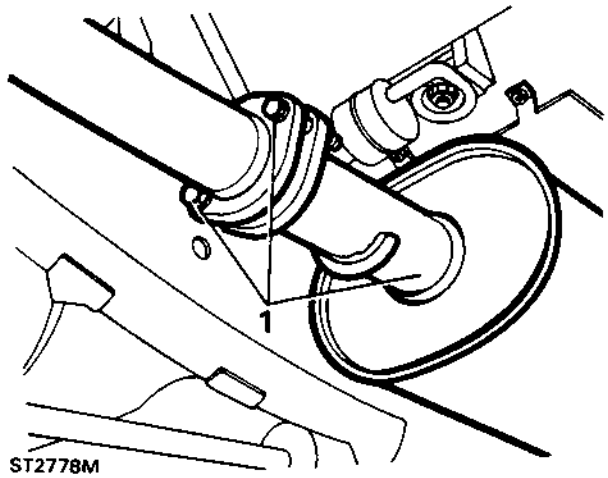
Refit

6. Apply Holts "Firegum" to the outside of the elbow and to the inside of the front pipe.
7. Slide clamp over the front pipe, fit pipe to elbow. Loosely secure the joint with the clamp.
8. Connect front pipe to silencer with the olive, loosely secure joint with the bolts and nuts.
9. Connect silencer to front and rear support brackets with new rubbers, if necessary.
10. Tighten all fixings evenly.

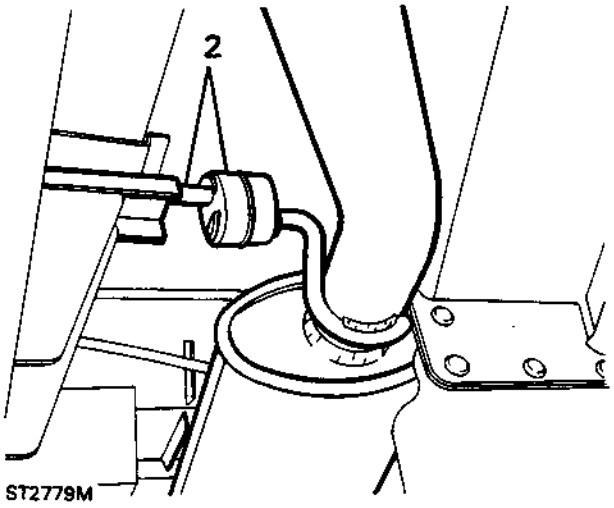
REAR PIPE AND SILENCER

Remove

1. Remove the two flange bolts and nuts connecting rear pipe section to front silencer.



2. Release rear pipe from rear support bracket, remove the section from the vehicle.



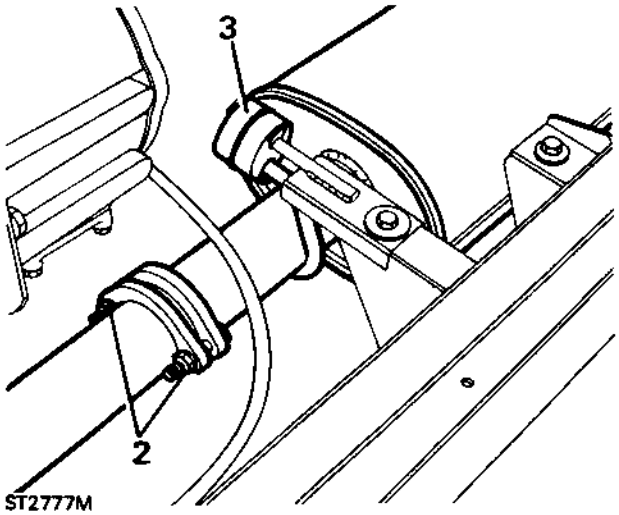
Refit

3. Fit rear pipe section to rear support bracket, with new rubbers if necessary.
4. Connect rear pipe to front silencer with olive and two flange bolts and nuts, tighten evenly.

FRONT SILENCER

Remove

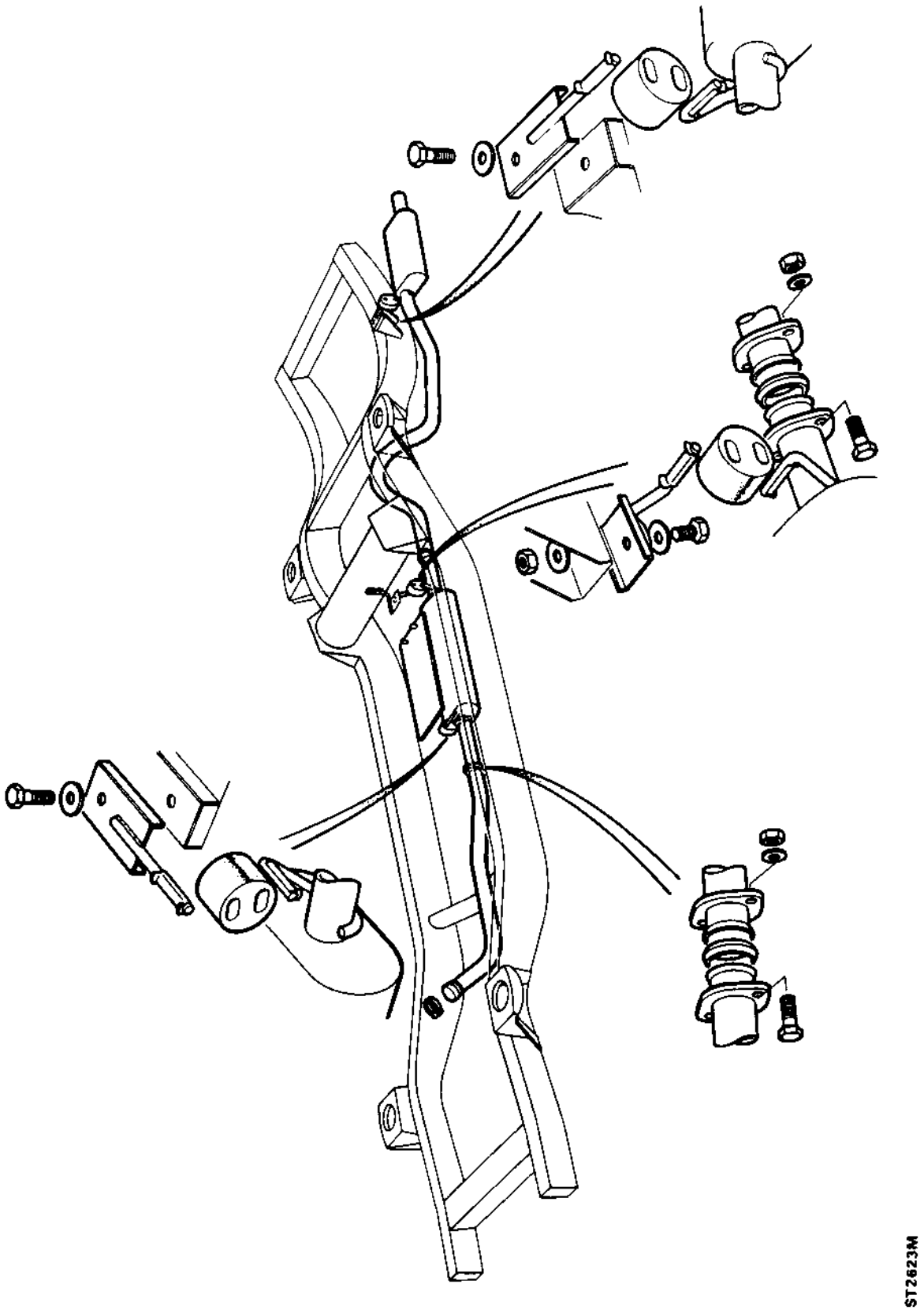
1. Remove rear pipe and silencer ***See Rear Pipe And Silencer***
2. Remove two flange nuts and bolts retaining front pipe to silencer.
3. Release silencer from front support bracket, remove it from the front pipe.



ST2777M

Refit

4. Loosely secure olive and two bolts and nuts.
5. Attach silencer to front support bracket. Evenly tighten the two flange bolts.
6. Fit rear pipe and silencer into position, attach to rear support bracket.
7. Connect rear pipe to silencer with the olive and two bolts, evenly tighten the two nuts.



Diesel Engine Exhaust System

Notes

33 - CLUTCH

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OVERHAUL

MASTER CYLINDER 1
SLAVE CYLINDER 2

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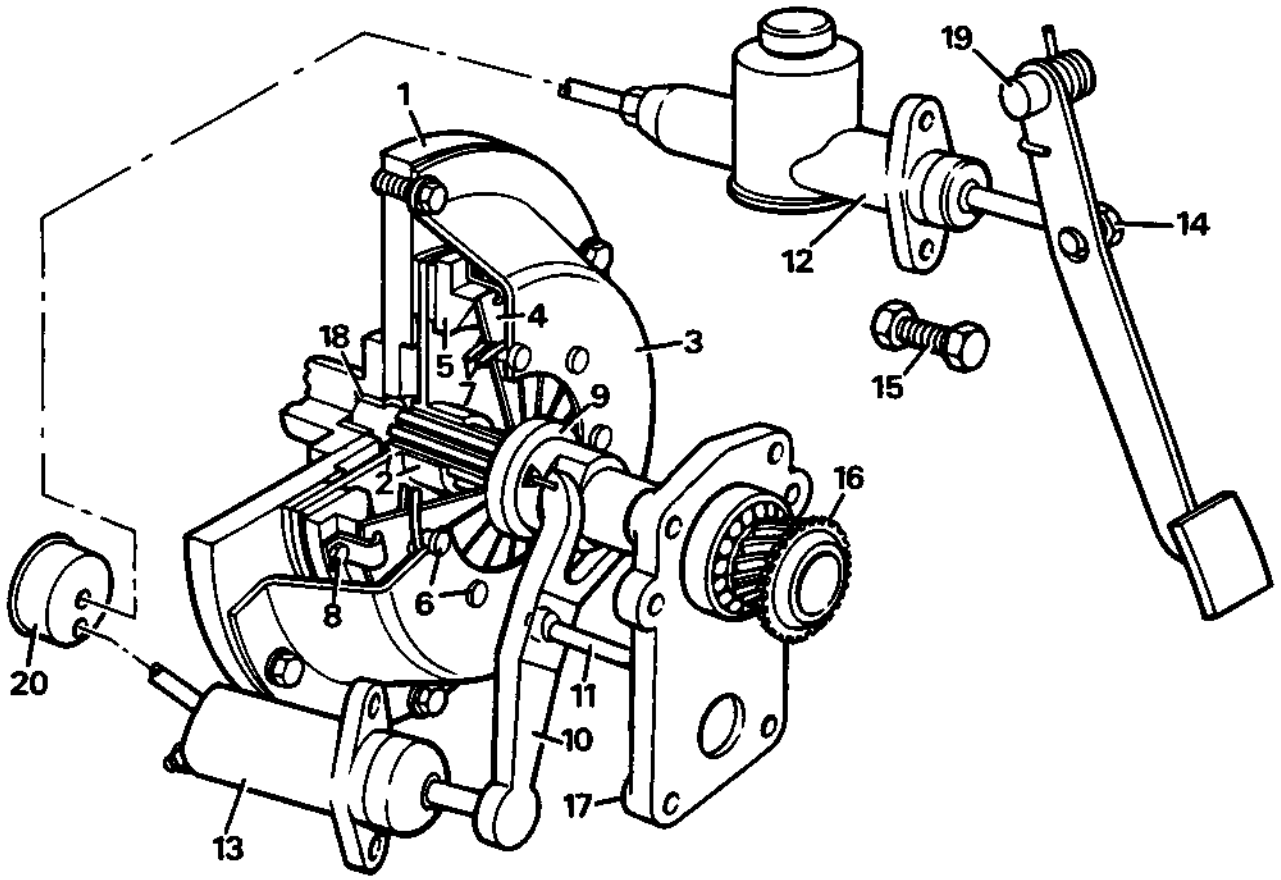
DESCRIPTION

The clutch unit fitted with the manual transmission, comprises a single dry plate friction disc and diaphragm spring clutch unit, secured to the engine flywheel.

OPERATION

The unit is operated hydraulically by the clutch master cylinder 12 and a slave cylinder 13 attached to the transmission bell housing.

With the clutch pedal released and the clutch fully engaged, a small clearance should exist between the pedal pushrod 14 and the master cylinder piston 12 also between the withdraw bearing 9 and the diaphragm spring 4.



RR3556M

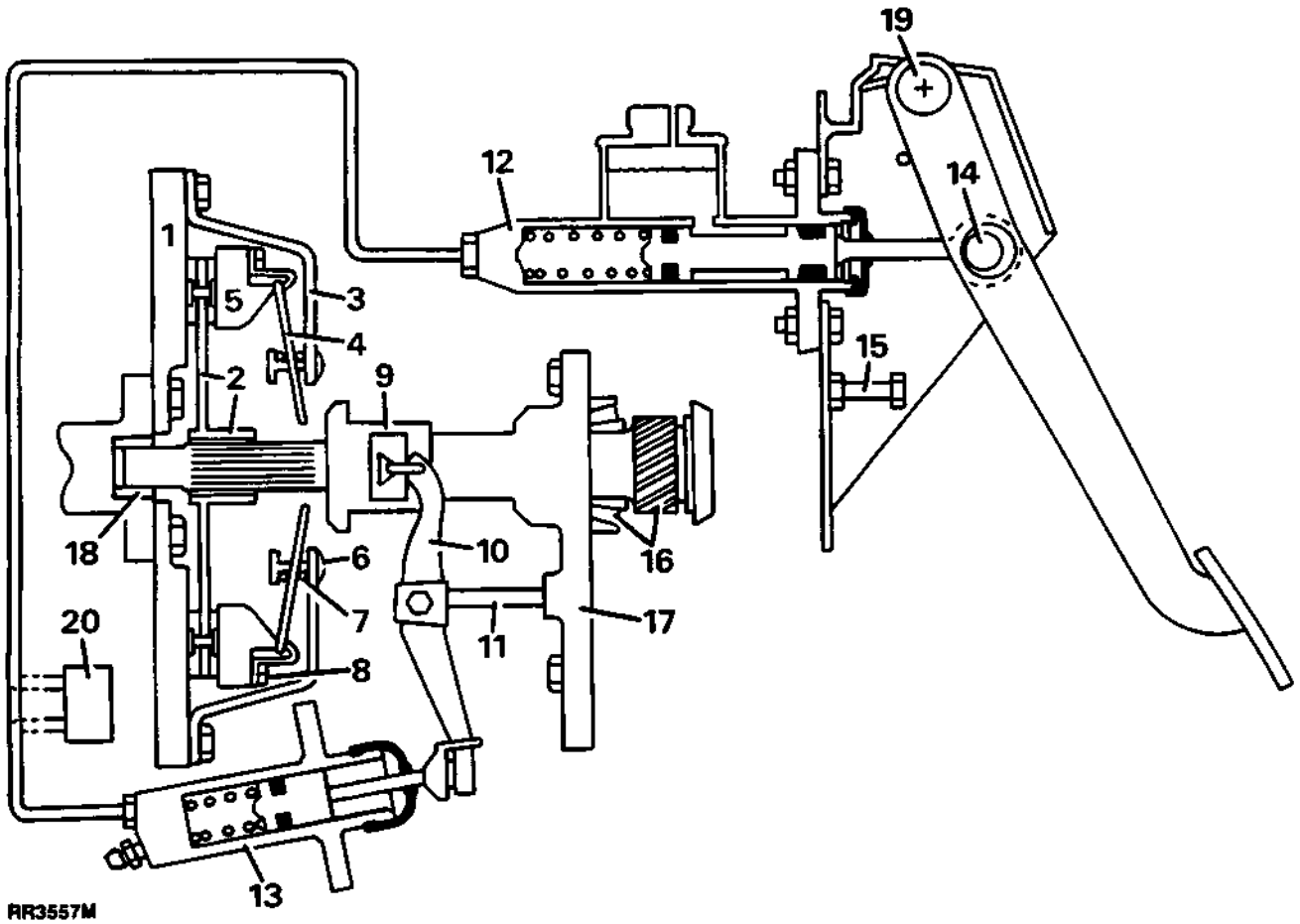
1. Crankshaft and flywheel
2. Friction plate
3. Clutch cover
4. Diaphragm spring
5. Pressure plate
6. Fulcrum posts (9) for diaphragm spring
7. Bearing rings (2) for diaphragm spring
8. Retraction links and bolts (3) for pressure plate
9. Release bearing
10. Release lever
11. Release lever pivot post
12. Master cylinder
13. Slave cylinder
14. Pivot bolt
15. Pedal limit adjustment bolt
16. Primary shaft and taper bearing (in gearbox)
17. Gearbox front cover
18. Primary shaft flywheel bush
19. Pedal pivot and return spring
20. Hydraulic damper (Diesel only)

When the clutch pedal is depressed, hydraulic fluid transmits the movement via the slave cylinder, lever 10, bearing 9, to the inner fingers of the diaphragm spring 4.

The diaphragm spring 4 pivots on the bearing rings 7 and fulcrum posts 6 causing the pressure plate 5 to release the clamping force on the friction plate and linings 2.

As the the clamping force is removed from the friction plate 2, the plate slides on the splines of the primary shaft 16 and takes up a neutral position between the flywheel 1 and the pressure plate 5 , thus breaking the drive between the engine and the gearbox.

△ **NOTE: Diesel engined vehicles have an hydraulic damper 20 fitted into the system. The damper contains a steel diaphragm which absorbs slight hydraulic pulses caused by cyclic variations of the diesel engine crankshaft at low rpm.**



RR3557M

CLUTCH ASSEMBLY CONDITIONS

For the clutch to operate correctly as described and illustrated in the "Description and Operation", it is important the following conditions are satisfied:-

A. The primary shaft 16 must be free in the crankshaft spigot bush 18.

B. The friction plate 2 must be able to slide easily on the splines on the primary shaft 16, to a position where it does not contact either the flywheel or the pressure plate.

C. The friction plate must not be distorted or the linings contaminated with oil, which may cause it to stick or continue to run in contact with the flywheel or pressure plate.

D. Master cylinder to pedal free play and the pedal stop adjustment must be correct.

A number of faults can develop in the operation of the clutch for a variety of reasons and although most faults are due to normal wear at high mileage, problems can also occur if the unit has been renewed by an unskilled operator.

Recognising and diagnosing a particular clutch fault is therefore of paramount importance in ensuring, that the problem is rectified at the first attempt.

Problems which develop in the clutch are as follows:-

A. Clutch spin/drag

B. Clutch slip

C. Clutch judder/fierce

CLUTCH SPIN - DRAG

Symptoms

Clutch spin is that, with engine running and clutch pedal depressed, the gears cannot be immediately engaged without making a grinding noise. This indicates the clutch is not making a clean break.

However, if the clutch pedal is held depressed for several seconds the friction plate will eventually break free from the engine and the gear will engage silently.

Clutch spin as it becomes more severe develops into clutch drag, making the silent engagement of a gear impossible, regardless of how long the pedal is held depressed.

CLUTCH SLIP

Symptoms

Clutch slip is most evident climbing a hill or when the vehicle is moving off from stationary with a heavy load. As the clutch is released slip occurs between the engine and the transmission, allowing the engine speed to increase without a corresponding increase in vehicle speed.

Clutch slip can develop to the stage where no power is transmitted through the clutch as the pedal is released.

CLUTCH JUDDER - FIERCE

Symptoms

Clutch judder or fierce engagement, like slip, is most likely to occur when the vehicle is moving off from stationary. As the clutch pedal is released the vehicle will move rapidly or in a series of jerks, which can not be controlled even by careful operation of the clutch by the driver.

It should be noted that a vehicle may display all the symptoms or any combination of the symptoms described, depending on the driving conditions vehicle load and operating temperatures.

FAULT/SYMPTOM CHART

Symptoms				
Slip	Spin/Drag	Judder/Fierce	Fault	Item
*	*	*	Worn or oil on clutch linings	2
*	*	*	Mechanical damage	4 5 6 7 8
	*	*	Distorted clutch plate	2
	*		Failed or air in hydraulic system	12 13
	*	*	Primary shaft tight fit in crankshaft bush	16 18
	*		Clutch splines sticking	2 16
	*		Limited pedal travel	14 15
		*	Weak clutch plate springs or insecure/worn engine/gearbox mountings	6
		*	Insecure/worn propeller shafts	
		*	Insecure/worn suspension components/rubber bushes	

For items refered to in this chart. ***See Description and operation, Description***

CLUTCH NOISE - MECHANICAL FAULTS

Noise from clutch or gearbox in neutral, which disappears when clutch is depressed.

Suspect gearbox input/primary shaft bearings. ***See MANUAL GEARBOX, Fault diagnosis, LT77 manual gearbox*** Noise from gearbox in neutral, which disappears when clutch is depressed

Noise from clutch or gearbox in neutral, which changes tone or becomes worse when the clutch is depressed.

Suspect worn release bearing.

Knocking/rattling from clutch or gearbox in neutral, which is reduced or disappears when the clutch is depressed.

Suspect worn/weak release lever retainer or clutch unit.

Noise from clutch or gearbox in neutral, which disappears when clutch is depressed.

Suspect gearbox fault.
See MANUAL GEARBOX, Fault diagnosis, LT77 manual gearbox
- Noise from gearbox in neutral, which disappears when clutch is depressed.

HYDRAULIC FAULTS

Unable to dis-engage clutch, little or no pedal resistance.

1. Check condition, specification and level of fluid.
2. Check pipes and cylinders for leaks.
3. Check that air vent in reservoir lid is clear. Suspect faulty master cylinder if no fluid leaks present. ***See Repair, Master cylinder***

Spongy pedal operation

1. Check condition, specification and level of fluid.
2. Check that air vent in reservoir lid is clear. Suspect air in fluid. ***See Repair, Bleed hydraulic system***

Clutch is difficult to dis-engage and/or does not immediately re-engage when pedal is released.

1. Check condition, specification and level of fluid.
2. Check that air vent in reservoir lid is clear. Suspect pedal pivot, master cylinder or slave cylinder seizure. ***See Repair, Master cylinder***

CLUTCH ASSEMBLY

Service repair no - 33.10.01

Remove and refit

Clutch pressure plate

Renew pressure plate if diaphragm spring fingers are worn or if pressure plate shows signs of wear, cracks or burning.

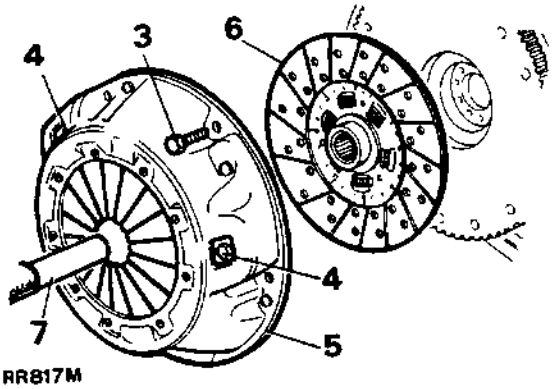
Clutch driven plate

Renew driven plate if centre hub splines are worn or if lining is contaminated, burned or unevenly worn.

Service tools:
LRT-12-001 clutch centralising tool

Remove

1. Remove engine. ***See ENGINE, Overhaul, Engine removal***
2. Mark position of clutch cover to flywheel for reassembly.
3. Remove clutch cover securing bolts, working evenly and diagonally.
4. Do not disturb three bolts in clutch cover.
5. Remove clutch assembly.
6. Withdraw clutch driven plate.



RR817M

Refit

NOTE: To prevent clutch plate sticking, lubricate splines using Rocol MV 3 or Rocol MTS 1000 grease.

7. Reverse removal procedure. 5 and 6, aligning assembly marks. Centralising tool LRT-12-001.
8. Secure cover fixings evenly, working in a diagonal sequence. Tighten to ***28 Nm.***
9. Fit engine.

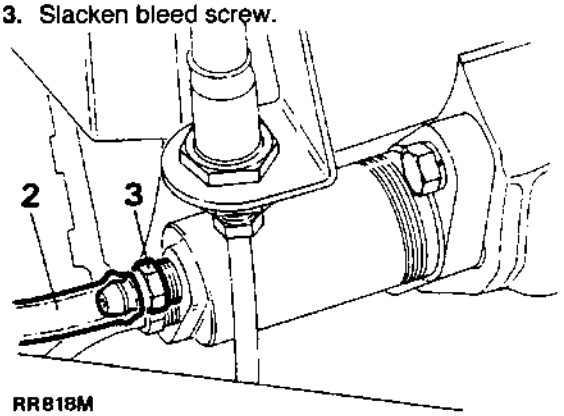
BLEED HYDRAULIC SYSTEM

Service repair no - 33.15.01

Procedure

NOTE: During bleed procedure, keep fluid reservoir topped up to avoid introducing air to system. For hydraulic fluid recommendations. *See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants, fluids and capacities*

1. Attach suitable tubing to slave cylinder bleed screw.
2. Place free end of tube in a glass jar containing clutch fluid.
3. Slacken bleed screw.



RR818M

4. Pump clutch pedal, pausing at end of each stroke, until fluid from tubing is free of air. Keeping free end of tube below surface of fluid.
5. Hold clutch pedal down, tighten bleed screw.
6. Top up fluid reservoir.

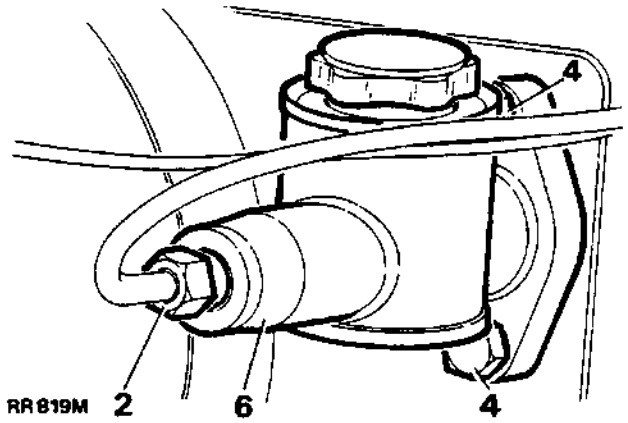
MASTER CYLINDER

Service repair no - 33.20.01/03

Remove and refit

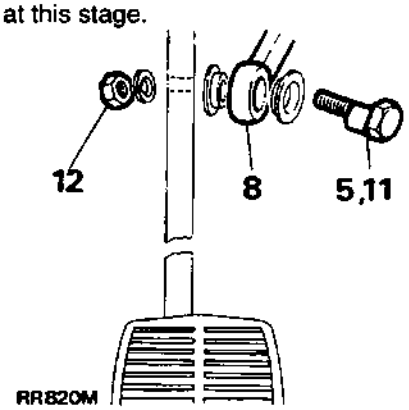
Remove

1. Evacuate hydraulic fluid from system.
2. Disconnect fluid pipe at master cylinder. Plug master cylinder fluid port and seal end of hydraulic pipe to prevent ingress of foreign matter.
3. Remove lower fascia panel. ***See CHASSIS AND BODY, Repair, lower dash panel***
4. Remove master cylinder fixings.
5. Remove pivot bolt and sleeves from push rod and clutch pedal.
6. Remove master cylinder.

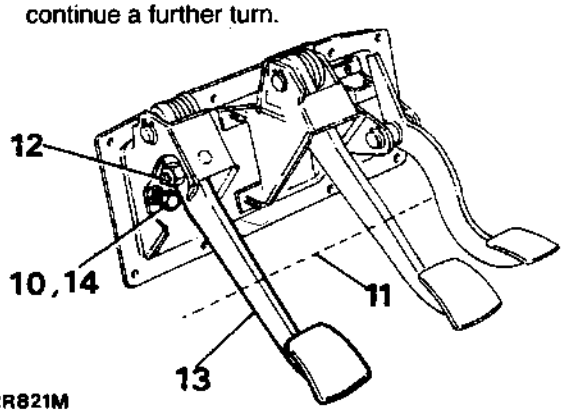


Refit

7. Fit the master cylinder and fixings.
8. Fit push-rod to pedal. Do not tighten pivot bolt nut at this stage.



9. Check brake pedal setting.
10. Back off lower stop bolt.
11. Align clutch pedal to align with brake pedal by turning pivot bolt.
12. Tighten pivot bolt securing nut.
13. Fully depress pedal.
14. Adjust lower stop bolt to touch pedal then continue a further turn.



15. Fit fluid pipe to master cylinder.
16. Bleed system. ***See bleed hydraulic system***
17. Fit lower fascia panel

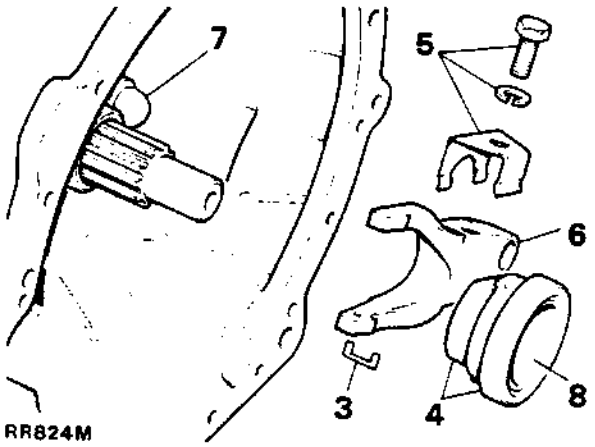
RELEASE BEARING ASSEMBLY

Service repair no - 33.10.07

Remove and refit

Remove

1. Remove engine.
2. Remove clutch slave cylinder.
3. Withdraw retainer staple.



RR824M

4. Withdraw bearing and sleeve. If required, press bearing off sleeve. Fit replacement bearing with domed face outwards from sleeve.
5. Remove spring clip and fixings.
6. Withdraw release lever assembly.

Refit

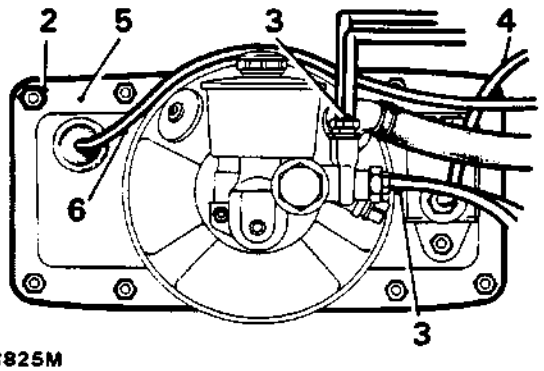
7. Smear pivot with grease and fit release lever and retain with spring clip and bolt.
8. Smear release bearing sleeve inner diameter with molybdenum disulphide base grease.
9. Reverse removal procedure. 1 to 4.

CLUTCH PEDAL

Remove and refit

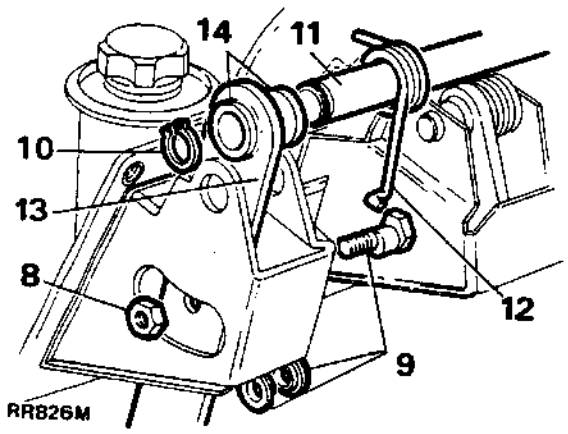
Remove

1. Remove lower fascia panel. ***See CHASSIS AND BODY, Repair, Lower dash panel***
2. Remove pedal bracket fixings at dash panel.
3. Disconnect brake fluid pipes and electrical connection at brake master cylinder.
4. Disconnect fluid pipe at clutch master cylinder.
5. Withdraw pedal bracket assembly into engine compartment.



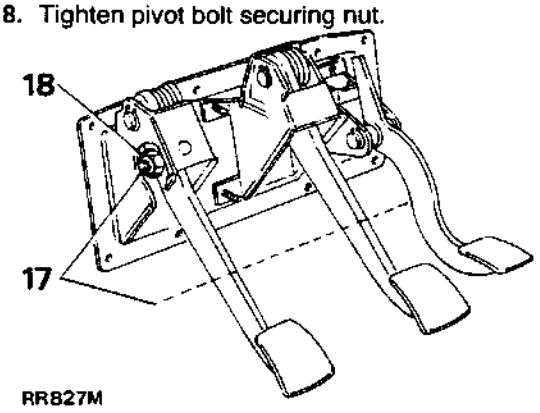
RR825M

6. Disconnect accelerator control cable at pedal.
7. Withdraw pedal bracket assembly from vehicle.
8. Remove pivot bolt nut.
9. Withdraw pivot bolt and bearing sleeves which retain master cylinder push-rod.
10. Remove pedal spindle circlip.
11. Withdraw spindle.
12. Lift out return spring.
13. Withdraw pedal.
14. If required, press out spindle bushes. Press in replacements and lubricate.



Refit

15. Reverse removal procedure. 9 to 13.
16. Loosely fit pivot bolt nut.
17. Align clutch pedal to same angle as brake pedal by turning pivot bolt and integral cam.
18. Tighten pivot bolt securing nut.



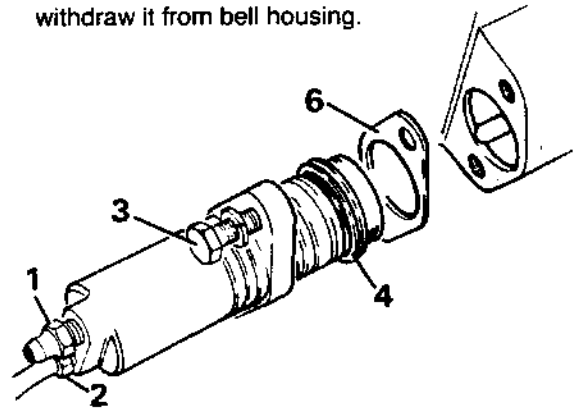
19. Fit accelerator cable.
20. Offer pedal bracket assembly and joint washer to dash panel. Avoid damaging brake light switch.
21. Reverse removal procedure. 1 to 4.
22. Bleed brake and clutch systems.

SLAVE CYLINDER

Service repair no - 33.35.01

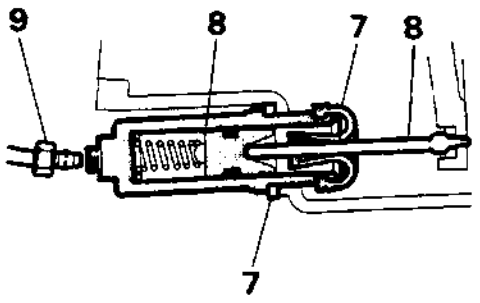
Remove

1. Evacuate clutch system fluid at slave cylinder bleed valve.
2. Disconnect fluid pipe.
3. Remove two securing bolts and withdraw slave cylinder and backing plate.
4. If dust cover is not withdrawn with slave cylinder, withdraw it from bell housing.



Refit

5. Withdraw dust cover and backing plate from slave cylinder.
6. Coat both sides of backing plate with Hylomar P232M waterproof jointing compound.
7. Locate backing plate and dust cover in position on slave cylinder.
8. Fit slave cylinder, engaging push-rod through centre of dust cover and with bleed screw uppermost.



9. Reconnect fluid pipe.
10. Replenish and bleed clutch hydraulic system.
11. Check for fluid leaks with pedal depressed and also with system at rest.

MASTER CYLINDER

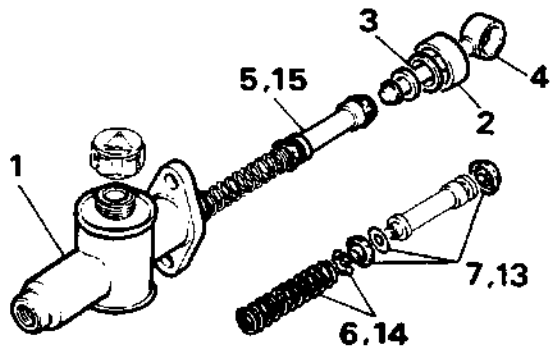
Service repair no - 30.20.07

Overhaul

1. Remove master cylinder. ***See Repair, Master cylinder***

Dismantle

1. Pull back and remove rubber sealing boot from pushrod.
2. Depress push-rod and extract circlip.
3. Withdraw push-rod assembly.
4. Withdraw piston assembly.
5. Withdraw retainer and spring.

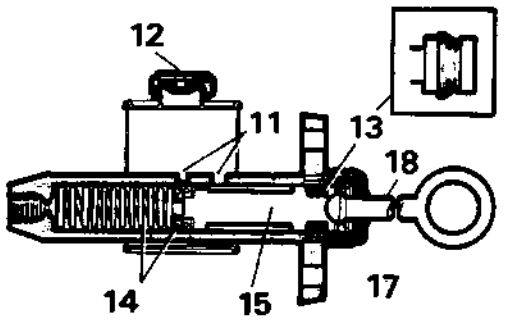


RR822M

6. Remove two piston seals and piston washer.

Inspecting

7. Clean all components thoroughly using new hydraulic fluid. Dry, using a lint-free cloth.
8. Examine cylinder bore and piston, ensure they are smooth to touch with no corrosion, score marks or ridges. If in doubt, fit new components.
9. Fit new seals and rubber boot. These items are all included in master cylinder overhaul kit.
10. Ensure that feed and by-pass ports are not obstructed.



RR823M

11. Ensure reservoir cap vent is clear.

Reassemble

△ **NOTE: Cleanliness is essential, ensure hands are free of grease or dirt. Lubricate cylinder bore and rubber seals with new hydraulic fluid before assembly.**

1. Fit a new piston washer and thinner of two piston seals, lip last, over piston nose, up against drilled piston head. Fit thicker seal into piston groove with lip facing towards seal at opposite end.
2. Insert spring and retainer into master cylinder bore.
3. Insert piston and seal assembly, ensuring that seal lips do not bend back.
4. Reverse removal procedure. 3 and 4, correctly locating circlip.
5. Stretch new rubber boot over push-rod, pack with rubber grease. Fit securely into locating groove.
6. Operate push-rod several times to ensure free movement of internal components.
7. Fit master cylinder.

SLAVE CYLINDER

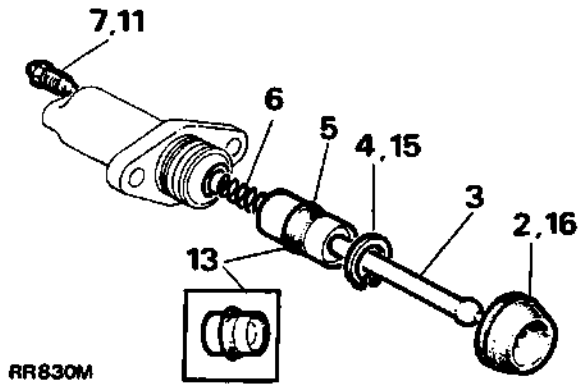
Service repair no - 33.35.07

Overhaul

1. Remove slave cylinder.

Dismantle

1. Withdraw rubber boot.
2. Withdraw push-rod.
3. Remove circlip.
4. Extract piston and seal assembly, applying low pressure air to fluid inlet if necessary.
5. Withdraw spring.
6. Remove bleed valve.



Inspecting

7. Clean all components thoroughly using new hydraulic fluid, and dry using lint-free cloth.
8. Examine cylinder bore and piston which must be free from corrosion, scores and ridges.
9. Replace seal and rubber boot using appropriate repair kit.

Reassemble

NOTE: Cleanliness is essential, ensure hands are free of grease or dirt.

1. Fit bleed valve. Do not overtighten.
2. Lubricate seals, piston and bore using new hydraulic fluid.
3. Fit seal into piston groove, lip of seal towards fluid inlet end of cylinder.
4. Enter piston assembly, spring first, into cylinder bore. Ensure that seal lip does not fold back.
5. Secure with circlip.
6. Fill rubber boot with rubber grease.
7. Reverse removal procedure. 1 to 3.

37 - MANUAL GEARBOX

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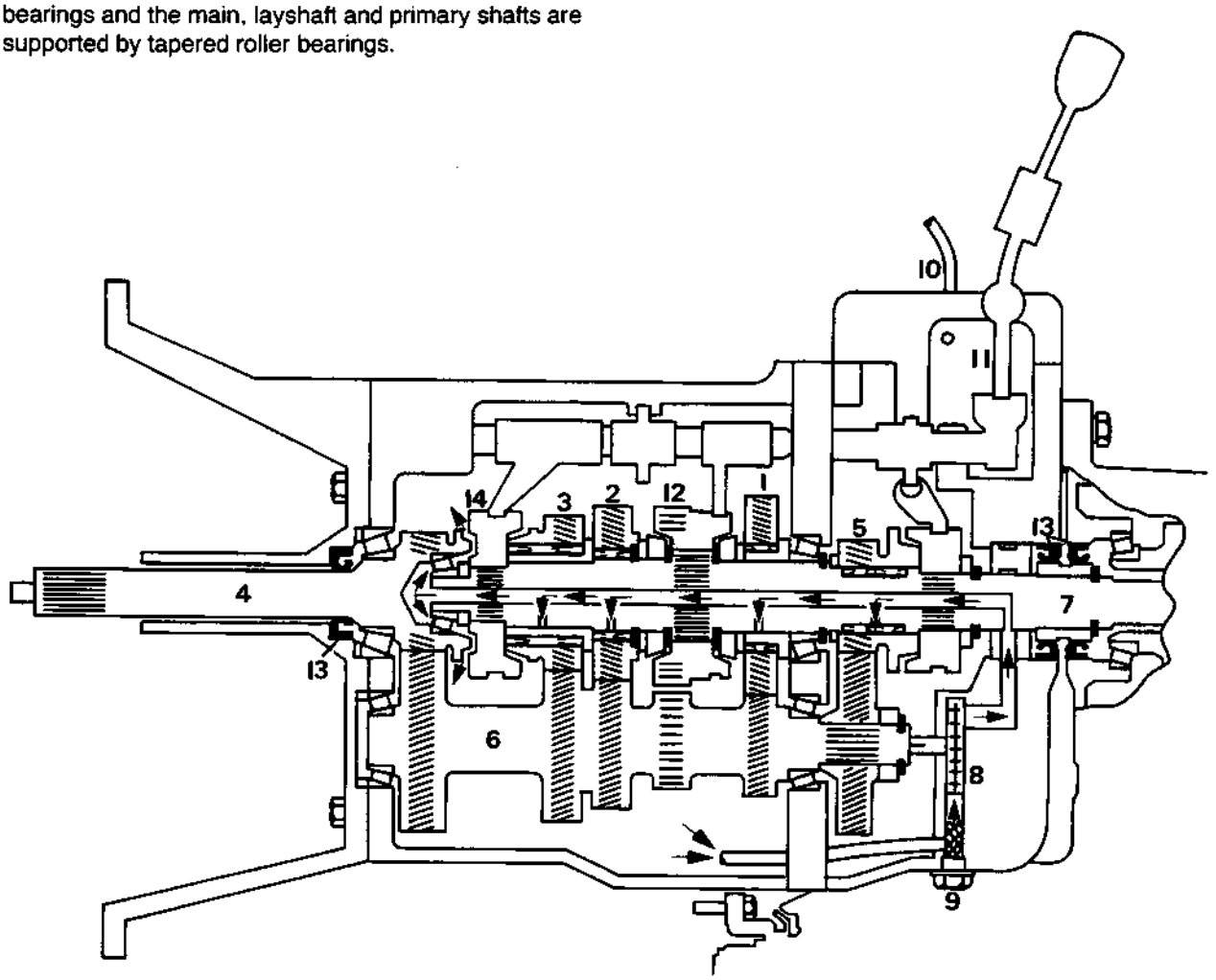
MANUAL TRANSMISSION

Description

The 77mm all synchromesh five speed manual gearbox unit, is married to a Borg Warner two speed chain drive transfer gearbox.

All the gears including reverse run on needle roller bearings and the main, layshaft and primary shafts are supported by tapered roller bearings.

The whole of the geartrain is lubricated through drillings in the shafts, supplied by a low pressure pump driven from the rear of the layshaft. The gear change has a single rail selector and spool type interlock. The main and transfer gearboxes ventilate through nylon pipes, which terminate high up in the engine compartment to prevent water entry when the vehicle is operating in adverse conditions.



RR3586M

1. Mainshaft 1st gear
2. Mainshaft 2nd gear
3. Mainshaft 1st gear
4. Primary input shaft
5. Mainshaft 5th gear
6. Layshaft
7. Mainshaft
8. Lubrication pump
9. Drain plug and oil filter
10. Ventilation pipe
11. Single rail gear shift
12. 1st/2nd synchromesh
13. Oil seals
14. 3rd/4th synchromesh
15. 5th gear synchromesh

Notes

LT77 MANUAL GEARBOX

Symptom - Gear jumps out of engagement (any forward gear)

1. Check condition and security of transmission and engine mountings.
2. Check in situ, gear lever and selector adjustments.
3. In situ, remove gearshift and check selector rail yoke security.
   Also check selector detent spring tension and both spool retainers.
   Suspect internal fault
   See remove and overhaul procedure.
4. Check action/operation of main selector rail and forks.
5. Check condition of synchromesh and gear dog teeth.
6. Check main and layshaft end floats bearings and adjustments.
7. Check condition of all gearbox components, ensure clearances and adjustments are correct on reassembly.

Symptom - Reverse gear only jumps out of engagment

1. Check condition and security of transmission and engine mountings.
2. Check in situ, gear lever and selector adjustments.
3. In situ, remove gearshift and check selector rail yoke security.
   Also check selector detent spring tension and both spool retainers.
   Suspect internal fault
   See remove and overhaul procedure.
4. Check action/operation of main selector rail and reverse lever.
5. Check condition of reverse gear, angled bearings and shaft.
6. Check condition of all gearbox components, ensure clearances and adjustments are correct on reassembly.

Symptom - Excessive force required to engage or change gear, vehicle stationary or moving.

1. Check lubricant specification and level, if low do not top up at this stage.
2. In situ, lubricate gear mechanism, and check selector adjustments.
3. In situ, remove gearshift and check selector rail is free and that the yoke is secure. Also check selector detent spring tension and both spool retainers.
4. Drain lubricant and check for contamination or metal particles.
   Suspect worn synchromesh unit or baulk rings on effected gears. ***See remove and overhaul procedure.***

Symptom - Noisy gear engagement, vehicle stationary, ***See CLUTCH, Fault diagnosis, Clutch Noise - Mechanical Faults***

Symptom - Noisy gear selection, vehicle moving.

1. Confirm that clutch operation is satisfactory.
2. Establish which gear/gears is causing noise.
3. Check lubricant specification and level, if low do not top up at this stage.
4. Drain lubricant and check for contamination or metal particles.
   Suspect worn synchromesh. ***See remove and overhaul procedure.***
5. Check condition of synchromesh unit, springs and cones for distortion and wear. Also check dog teeth for damage and cone mating surface on gear for signs of overheating.
6. Check condition of all gearbox components, ensure clearances and adjustments are correct on reassembly.

Symptom - Noise from gearbox in neutral, which changes tone or becomes worse when clutch is depressed ***See CLUTCH, Fault diagnosis, Clutch Noise - Mechanical Faults***

Symptom - Noise from gearbox in neutral, which disappears when clutch is depressed.

1. Check lubricant specification and level, if low do not top up at this stage.
2. Drain lubricant and check for contamination or metal particles.
   Suspect worn bearings on layshaft, primary shaft or front of main shaft. ***See remove and overhaul procedure.***

Symptom - Noise from gearbox in one or more gears when being driven.

1. Check lubricant specification and level, if low do not top up at this stage.
2. Drain lubricant and check for contamination or metal particles.
   Suspect worn roller bearings on particular mainshaft gears. ***See remove and overhaul procedure.***

LT77 GEARBOX

Service repair no - 37. 20. 02.

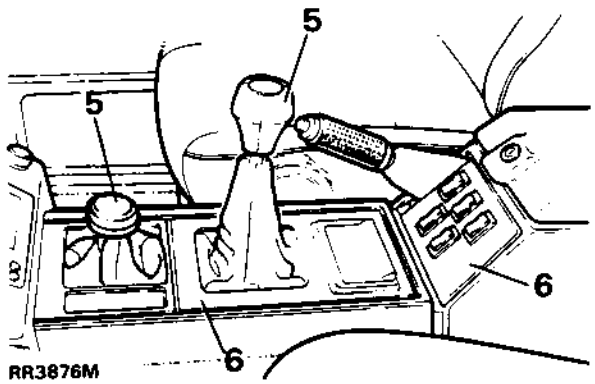
Remove and refit

Remove

1. Site vehicle on ramp and chock wheels.
2. Disconnect the battery negative lead.
3. Remove fan blade assembly.

△ **NOTE: The nut securing viscous unit has left hand thread.**

4. Disconnect airflow meter to plenum chamber hose.
5. Remove two gear lever knobs.

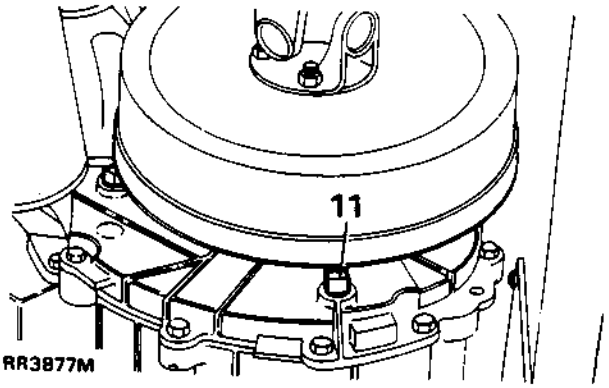


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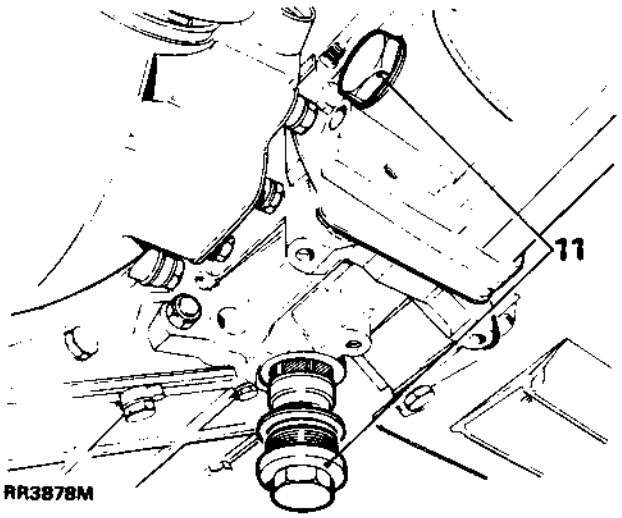
6. Remove floor mounted console assembly. ***See CHASSIS AND BODY, Repair, Glovebox and floor mounted console assembly***
7. Remove padding from top of transmission tunnel.
8. Loosen pinch bolt and remove upper gear lever.
9. Remove screws and detach high low lever and main gearlever retaining plates.

Underneath vehicle

10. Drain oil from transfer gearbox, main gearbox and extension housing.
11. Refit plugs, cleaning filter on extension housing plug.



RR3877M



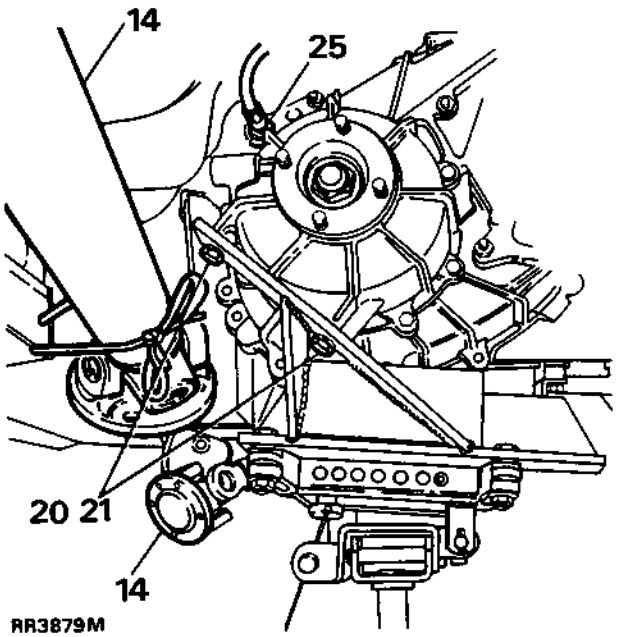
RR3878M

12. Disconnect Llambda sensor and remove front section of exhausts.
13. Remove chassis cross member secured by eight nuts and bolts.

14. Mark each drive flange for reassembly and disconnect front and rear propeller shafts from transfer box. Tie the shafts to one side.
15. Release clamp and disconnect speedometer cable from rear output housing.
16. Release cable from left hand side of transfer gearbox. Tie cable to one side.
17. Remove two bolts and withdraw clutch slave cylinder from bell housing.

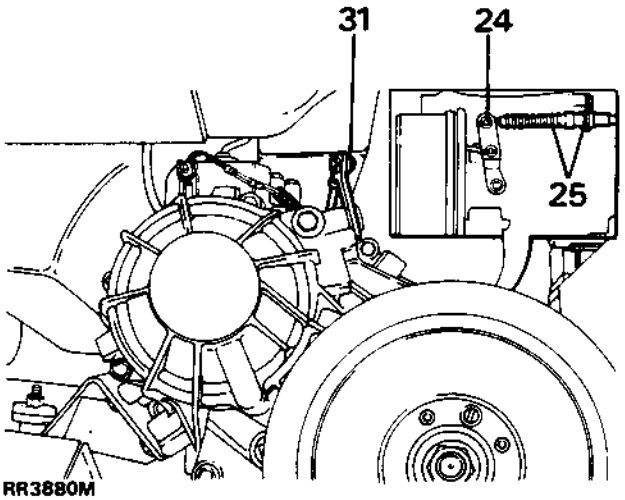
Remove transmission assembly

18. Position a suitable transmission hoist on rear output housing to support weight of assembly.
19. Remove fixings and withdraw transfer gearbox mountings.



RR3879M

20. Fit adaptor plate to transmission hoist. Raise hoist and position under transfer box. ***See TRANSFER BOX, Service tools, Adapter plate transfer box***
21. Secure fixture to transfer box mounting points.
22. Remove hoist from rear of transfer box.
23. Lower transmission until top of transfer gearbox clears rear floor.
24. Disconnect handbrake cable.
25. Remove clip securing handbrake outer cable to support bracket,feed cable through bracket, and tie to one side.
26. Position hoist under engine to support weight.
27. Remove bolts from bell housing.
28. Ensuring all fixings are released, withdraw transmission.



RR3880M

Separating transfer box from gearbox

29. Remove transmission assembly from hoist and cradle.
30. Place sling round transfer box and attach to hoist.
31. Detach high low link from transfer gearbox selector lever and remove breather pipe.
32. Remove bolts and two nuts retaining transfer box to extension housing and separate.

Assembling transfer box to main gearbox

1. Stand gearbox bell housing face on two pieces of wood.
2. Lower transfer gearbox onto main gearbox. Secure with bolts and two nuts. Tighten to ***40 Nm***
3. Refit breather pipe and selector link.

Transfer gearbox high/low link adjustment

4. Ensure transfer gearbox is in neutral position.
5. Set transfer gearbox lever in a vertical position. Rotate fork end of rod until holes align with hole in selector lever.
6. Fit clevis pin and retaining clip. Select high and low transfer to ensure full engagement is obtained. Repeat adjustment procedure if full engagement is not evident.

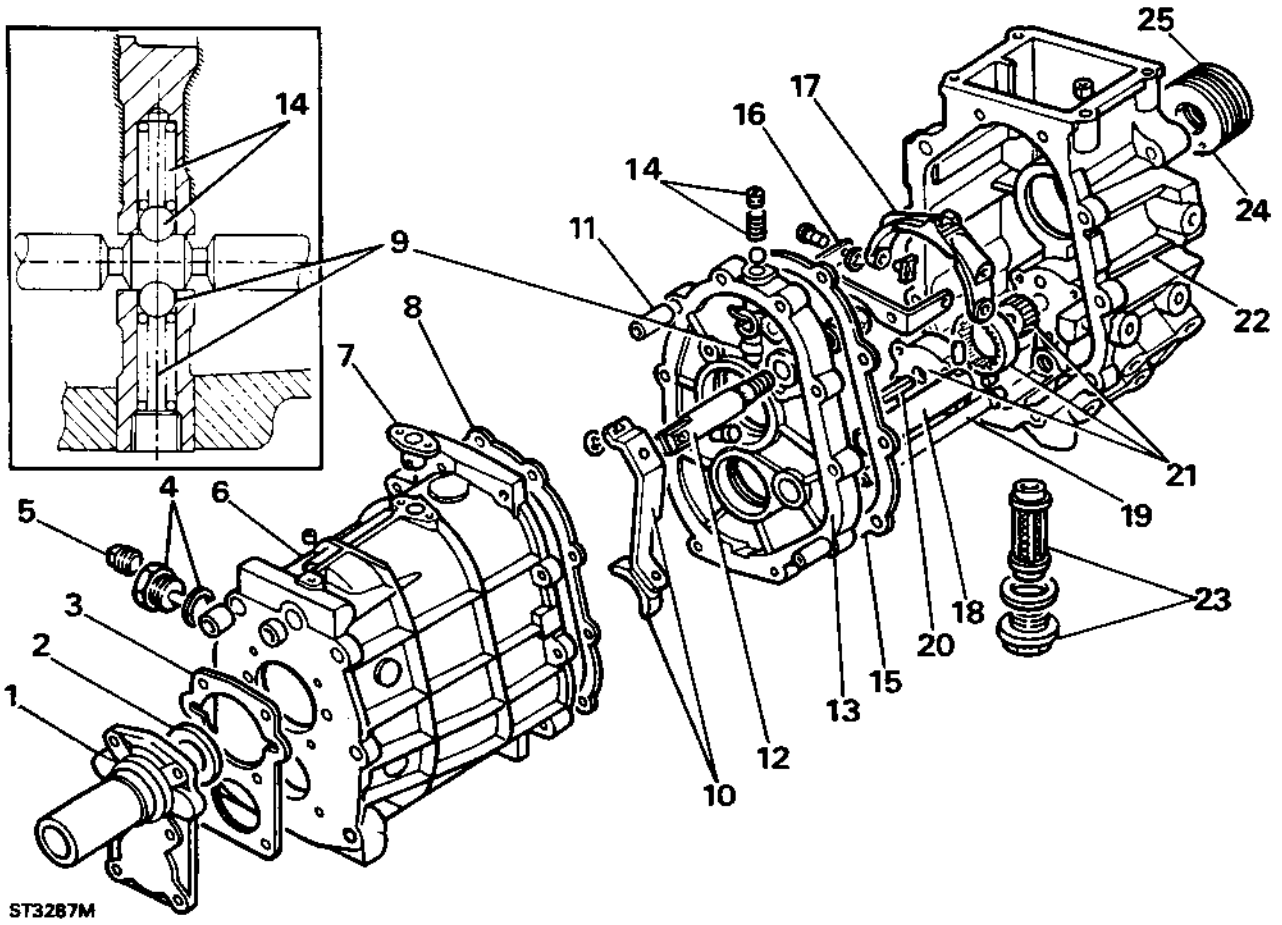
Refit

7. Fit cradle to transmission hoist and transmission to cradle. Apply Hylomar on bell housing mating face with engine.
8. Select any gear in main and transfer gearbox to facilitate entry of the input shaft. Ensure that the clutch centre plate is in alignment.
9. Position and raise hoist to line up with engine, feed handbrake cable through aperture in tunnel, ensure that any pipes or electrical leads do not become trapped.
10. Fit transmission assembly to engine. Tighten to ***40 Nm***
11. Reverse removal procedure noting following points.
12. Tighten all fixings to the correct torque. ***See Specifications, torque, LT77 Gearbox Data***
13. Fill both main and transfer gearboxes with recommended oil up to level of filler hole. Apply Hylomar sealant to threads and fit level plugs. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***

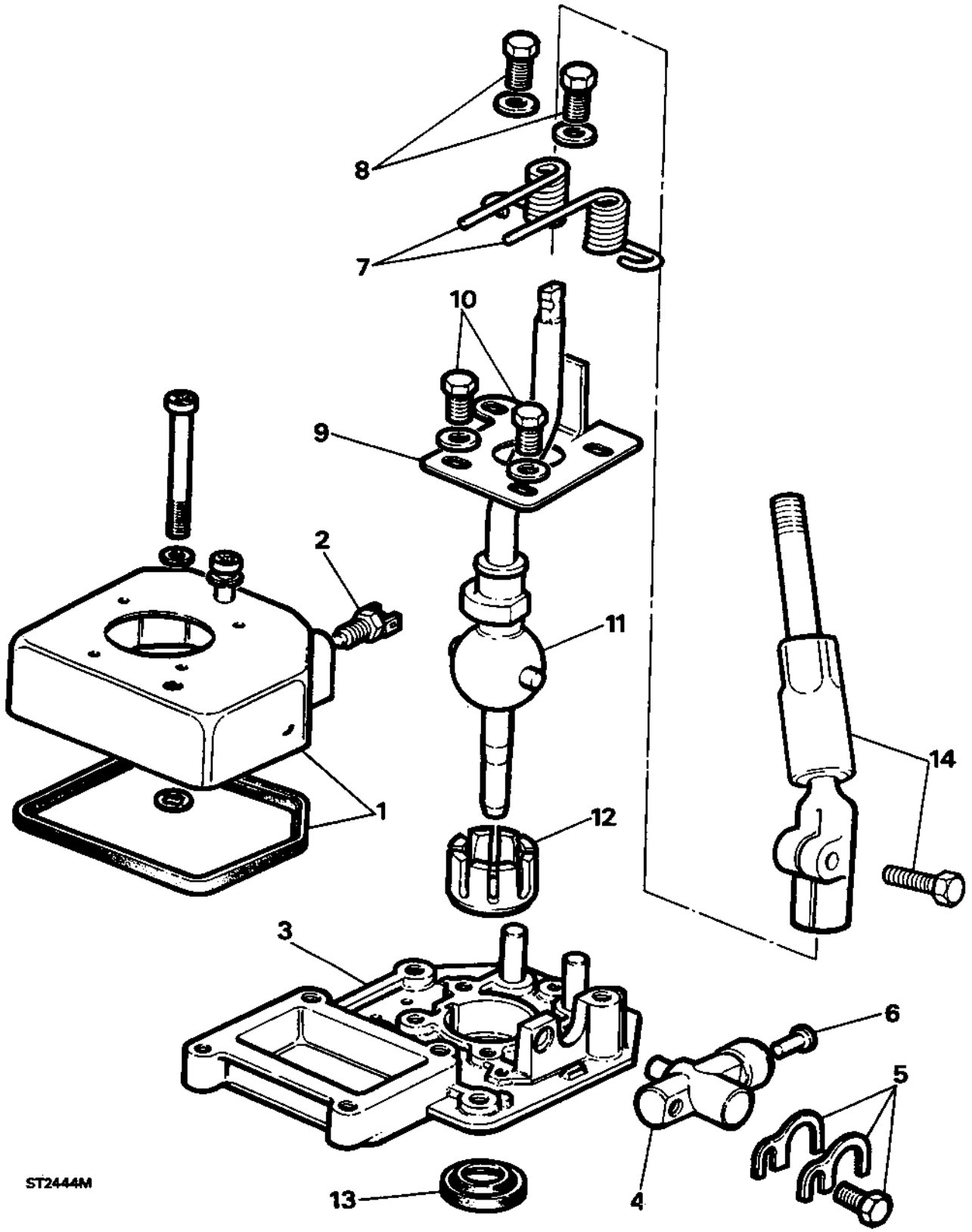
Notes

GEARBOX CASING COMPONENTS

1. Front cover.
2. Front cover oil seal.
3. Front cover gasket.
4. Oil drain plug and washer.
5. Oil level plug.
6. Gearbox main casing.
7. Spool retainer.
8. Gasket.
9. Inboard detent ball and spring.
10. Reverse lever and slipper.
11. Locating dowels - centre plate to maincase.
12. Reverse lever pivot post.
13. Centre plate.
14. Selector plug, detent ball and spring.
15. Gasket.
16. Fifth gear selector bracket.
17. Fifth gear selector fork.
18. Reverse gear shaft.
19. Oil pick-up pipe.
20. Oil pump drive shaft.
21. Oil pump gears and cover.
22. Fifth gear extension housing.
23. Fifth gear extension housing drain plug and filter.
24. Ferrobestos bush.
25. Oil seal.



GEAR CHANGE HOUSING COMPONENTS

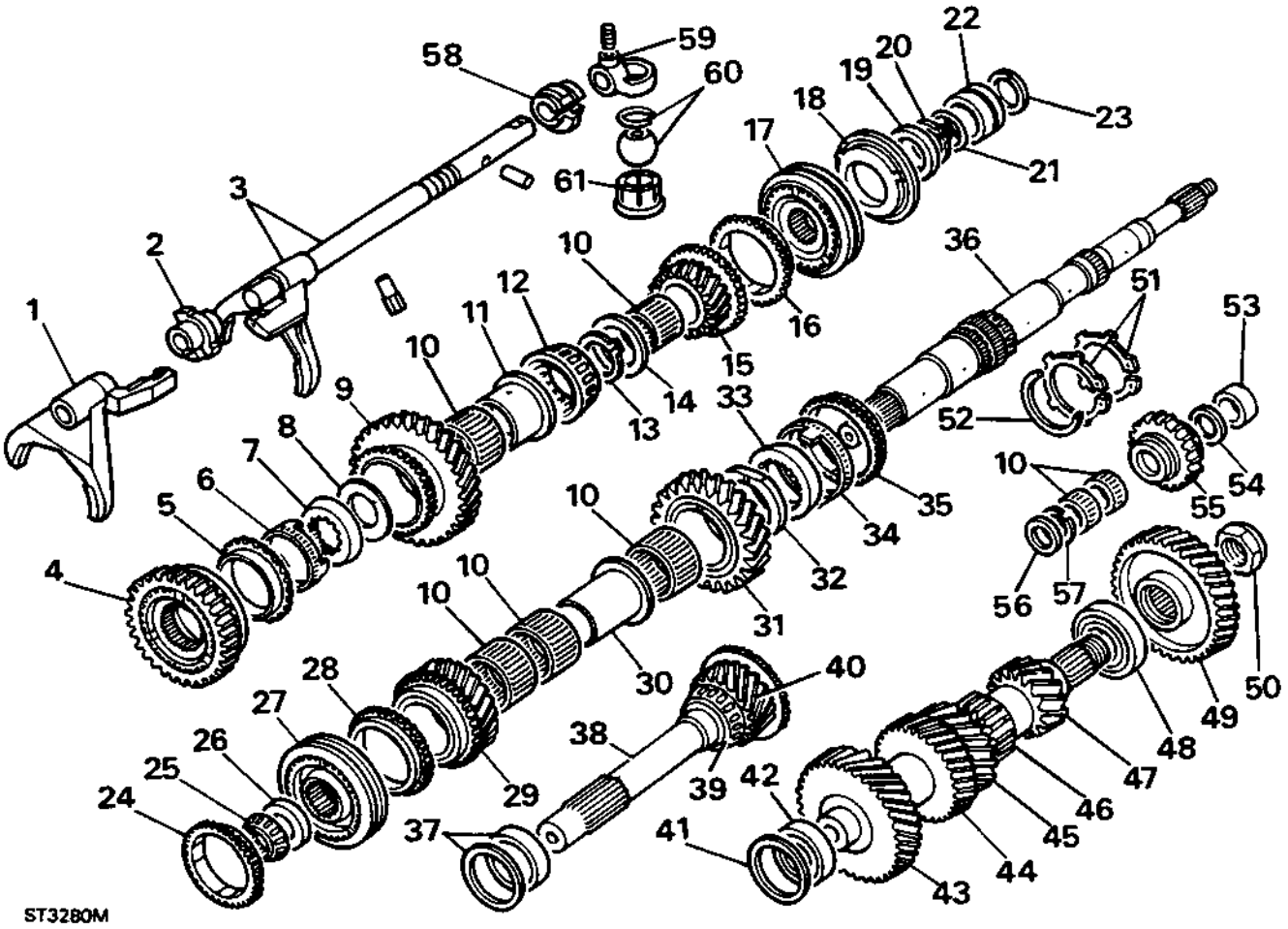




GEAR CHANGE HOUSING COMPONENTS

1. Gear change housing cover and gasket
2. Reverse lamp switch
3. Gear change housing
4. Reverse gear plunger
5. Reverse gear plunger shims and bolt
6. Reverse lamp plunger
7. Bias springs
8. Bias spring retaining bolts
9. Bias adjustment plate
10. Bias adjustment plate bolts
11. Lower gear lever
12. Railko bush
13. Lower gear lever housing oil seal
14. Upper gear lever pinch bolt

GEARS AND SHAFTS COMPONENTS



GEARS AND SHAFTS

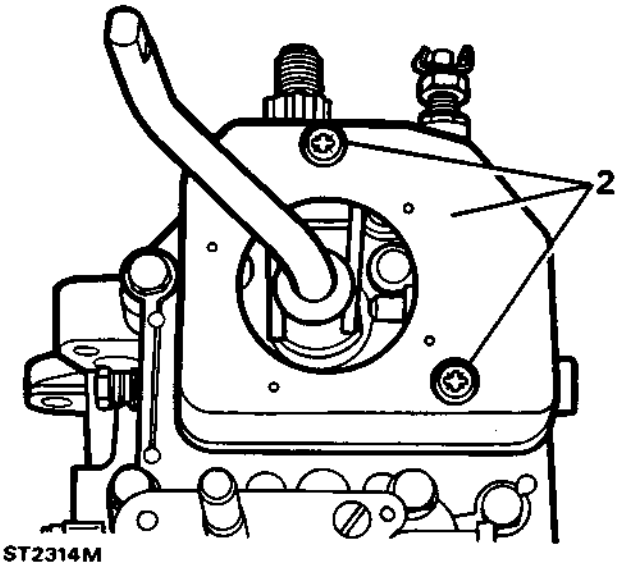
1. Third - fourth selector fork.
2. Interlock spool.
3. First - second fork and selector rail assembly.
4. First - second synchromesh.
5. First gear synchromesh outer baulk ring.
6. First gear synchromesh inner baulk ring.
7. Cone.
8. Thrust washer.
9. First gear.
10. Needle roller bearings.
11. First gear selective bush.
12. Centre taper roller bearing.
13. Circlip.
14. Thrust washer.
15. Fifth gear.
16. Fifth gear baulk ring.
17. Fifth gear synchromesh.
18. Fifth gear synchromesh back plate.
19. Fifth gear synchromesh selective washer.
20. Circlip.
21. "O" ring.
22. Oil seal collar.
23. Snap ring.
24. Fourth gear baulk ring.
25. Pilot taper bearing.
26. Spacer.
27. Third - fourth synchromesh.
28. Third gear baulk ring.
29. Third gear.
30. Third gear bush.
31. Second gear.
32. Thrust washer.
33. Cone.
34. Second gear synchromesh inner baulk ring.
35. Second gear synchromesh outer baulk ring.
36. Mainshaft.
37. Input shaft bearing track and selective washer.
38. Input shaft.
39. Input shaft taper bearing.
40. Fourth gear.
41. Selective shim.
42. Taper bearing.
43. Layshaft fourth gear.
44. Layshaft third gear.
45. Layshaft second gear.
46. Layshaft reverse gear.
47. Layshaft first gear.
48. Taper bearing.
49. Layshaft fifth gear.
50. Layshaft fifth gear retaining stake nut.
51. Circlips retaining first gear and first-second gear synchromesh.
52. Snap ring retaining second gear cone and spacer.
53. Spacer.
54. Snap ring.
55. Reverse idler gear.
56. Thrust washer.
57. Snap ring.
58. Fifth gear spool.
59. Gear change lever yoke.
60. Gear change ball and retaining ring.
61. Gear change nylon seating.

LT77S GEARBOX

1. Remove gearbox from vehicle. ***See Repair, LT77 Gearbox***

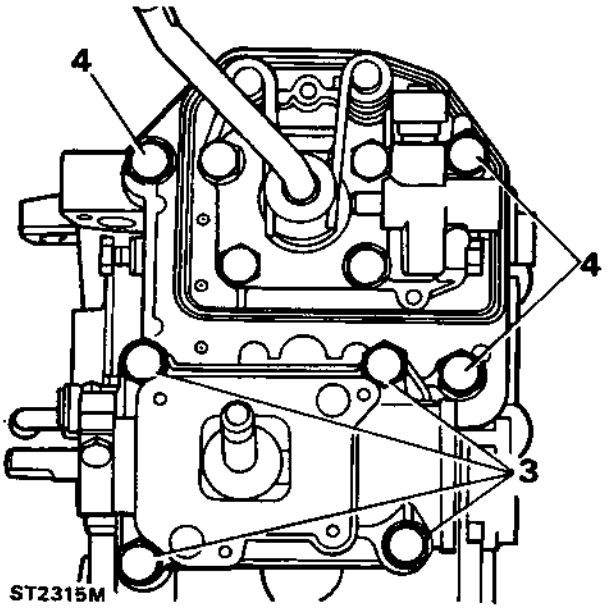
Gear change housing

1. Separate main gearbox from transfer box, remove bell housing, drain oil, and clean exterior.
2. Remove gear change housing cover.



ST2314M

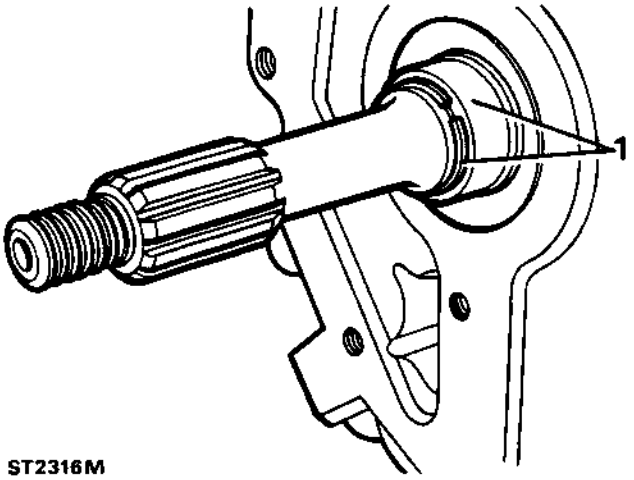
3. Remove transfer gear change housing.
4. Remove main gear change housing.



ST2315M

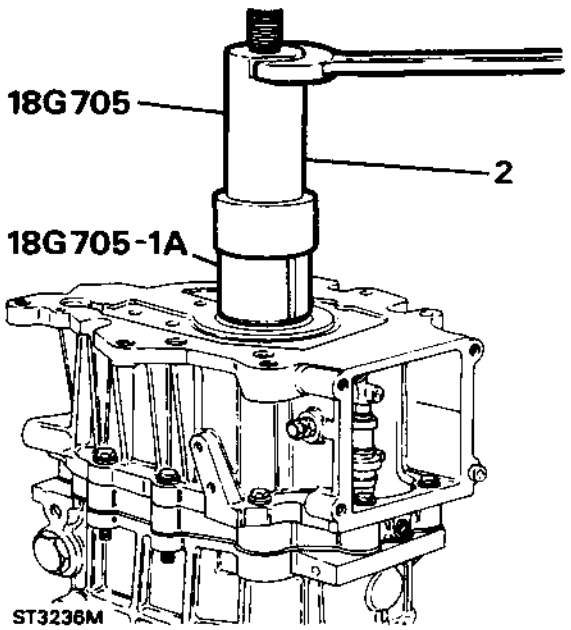
Extension housing

1. Remove snap ring retaining oil seal collar.



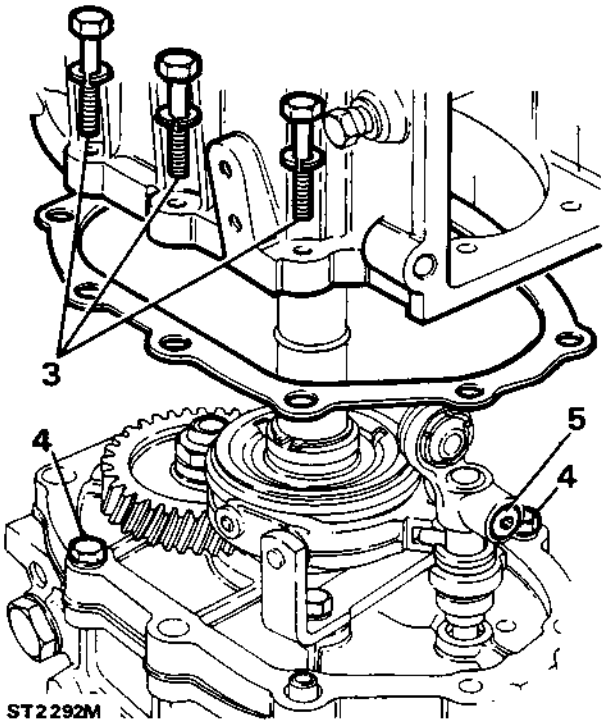
ST2316M

2. Using service tools LRT-37-009 (18G 705) and LRT-37-010 (18G 705-1A) withdraw oil seal collar.



ST3236M

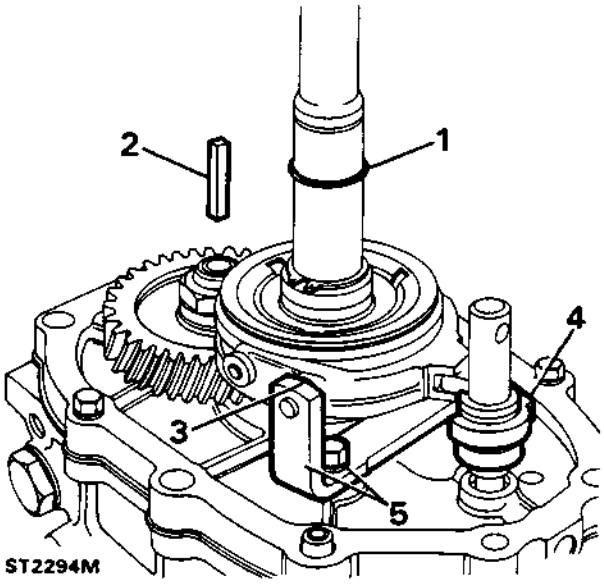
3. Remove fifth gear extention housing.
4. Secure centre plate to gearcase with two 8 x 35mm bolts.
5. Remove selector yoke from selector shaft.



ST2292M

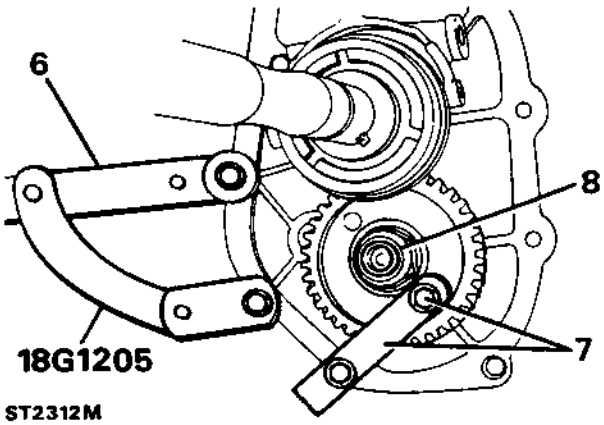
Mainshaft and layshaft fifth gears.

1. Remove mainshaft "O" ring.
2. Remove oil pump drive shaft.
3. Remove "E" clips from selector fork.
4. Remove fifth gear selector spool.
5. Remove selector fork bracket.



ST2294M

6. Locate flange holder tool LRT-51-003 (18G 1205).
7. Fit manufactured tool "A" and spacer to restrain layshaft fifth gear.
8. De-stake and remove fifth gear nut.

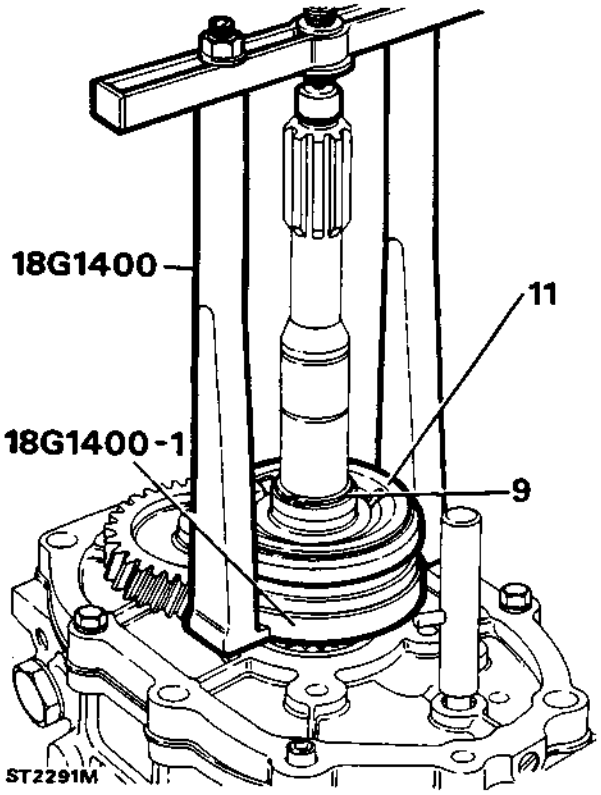


ST2312M

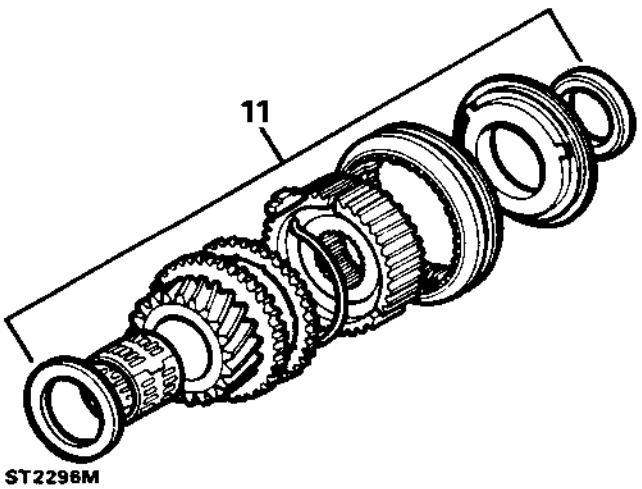
9. Remove circlip retaining mainshaft fifth gear synchromesh.

10. Fit special tool LRT-37-013 (18G 1400-1) and LRT-37-012 (18G 1400) as illustrated.

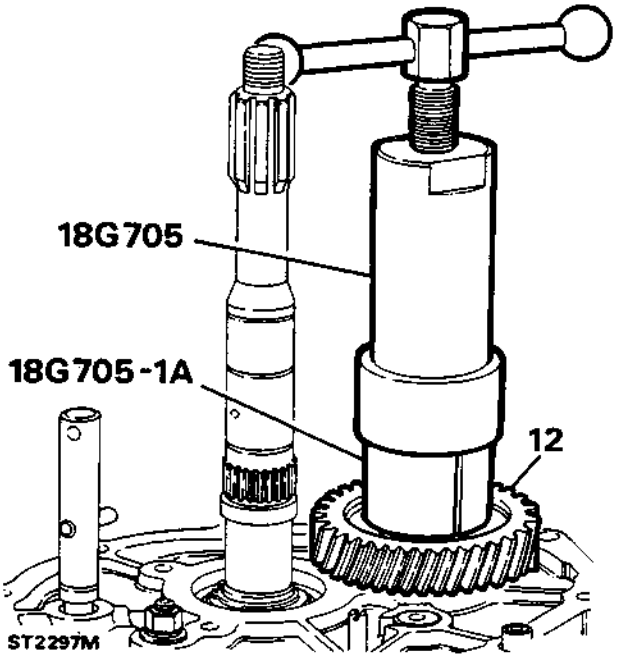
⚠ **CAUTION: Ensure the puller feet locate in the two cut-outs in LRT-37-013 and between the pins.**



11. Remove fifth gear synchromesh.

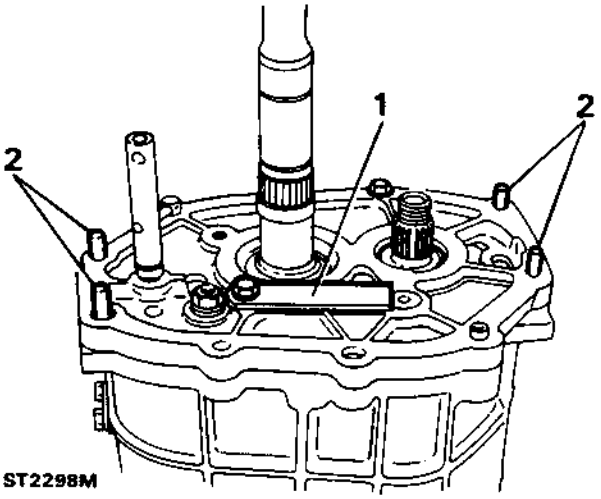


12. Remove layshaft fifth gear using special tools LRT-37-009 (18G 705) and LRT-37-010 (18G 705-1A).

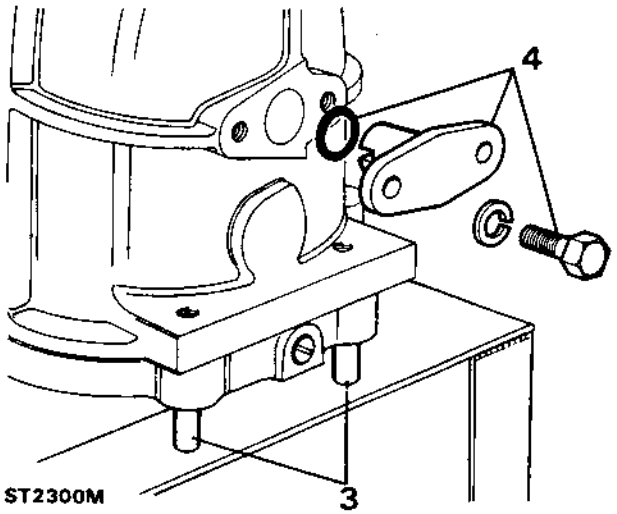


Main gear case.

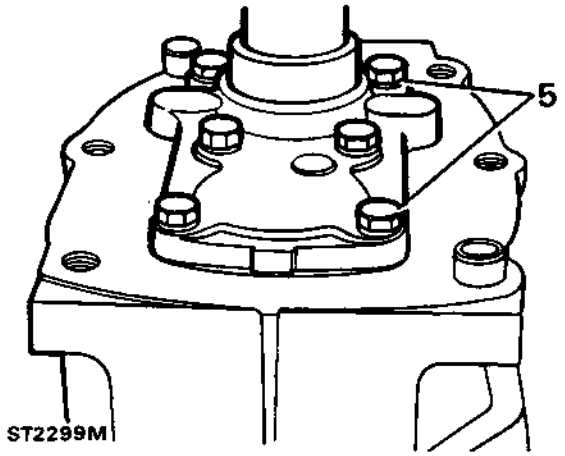
1. Secure reverse shaft retainer, manufactured tool "A", to centre plate.
2. Fit studs, manufactured tool"B" to gear case.



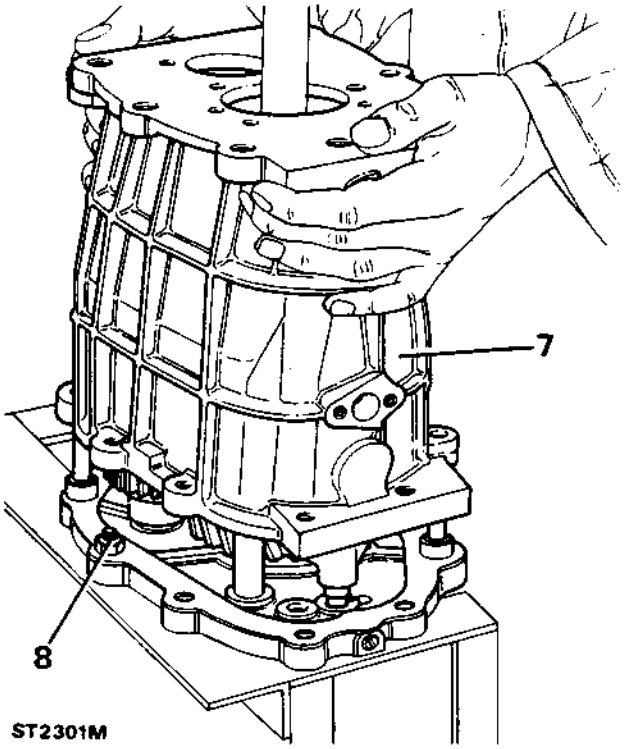
3. Invert gear case and locate studs in workstand holes.
4. Remove selector shaft spool retainer.



5. Remove front cover and gasket.
6. Retrieve selective washers.

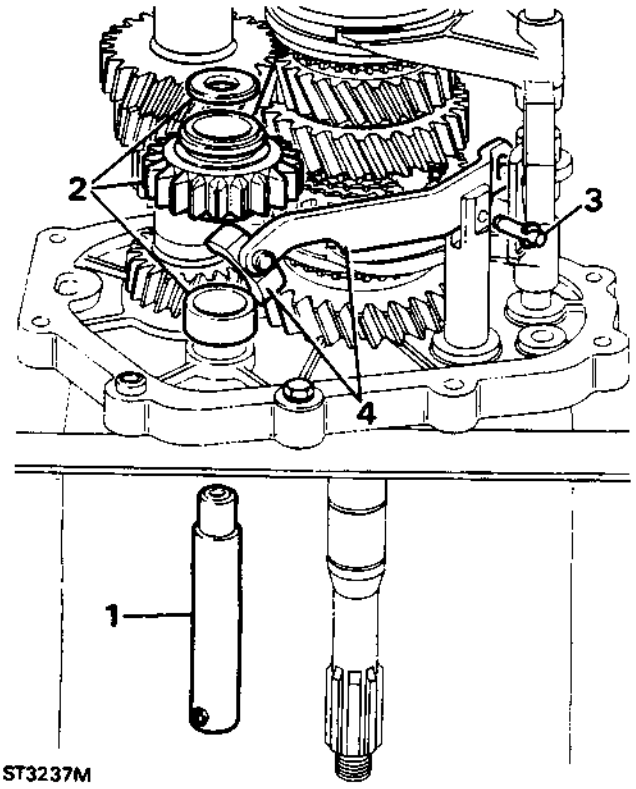


7. Remove bolts and lift-off gear case.
8. Secure centre plate with nut and bolt.



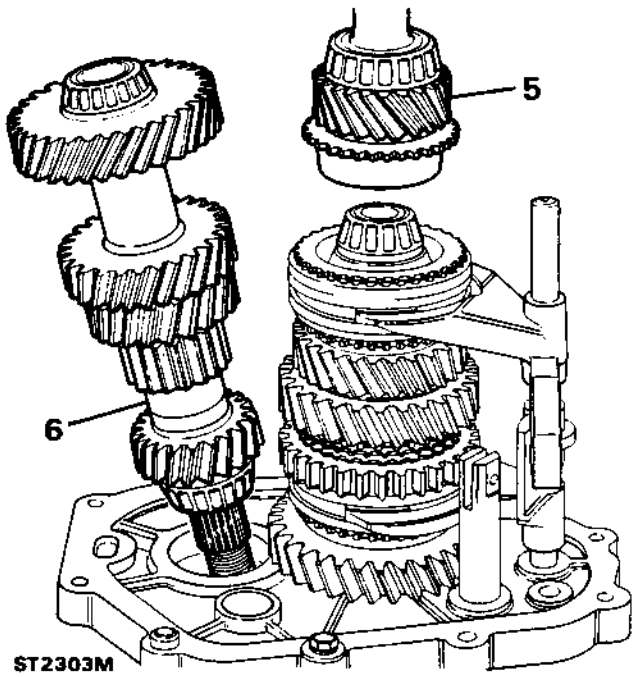
Reverse shaft, layshaft and mainshaft

1. Remove retainer (tool "A") and reverse shaft.
2. Remove thrust washer, reverse gear and spacer.
3. Remove reverse lever pin with "E" clip attached.
4. Remove lever and slipper pad.



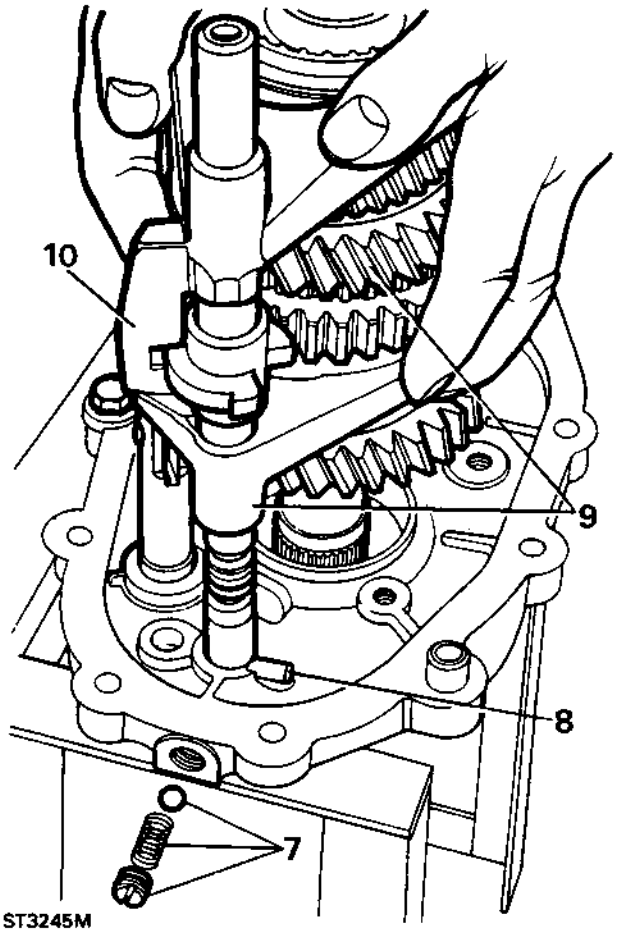
ST3237M

5. Remove input shaft and fourth gear baulk ring.
6. Remove layshaft by tilting, as illustrated and lifting mainshaft.



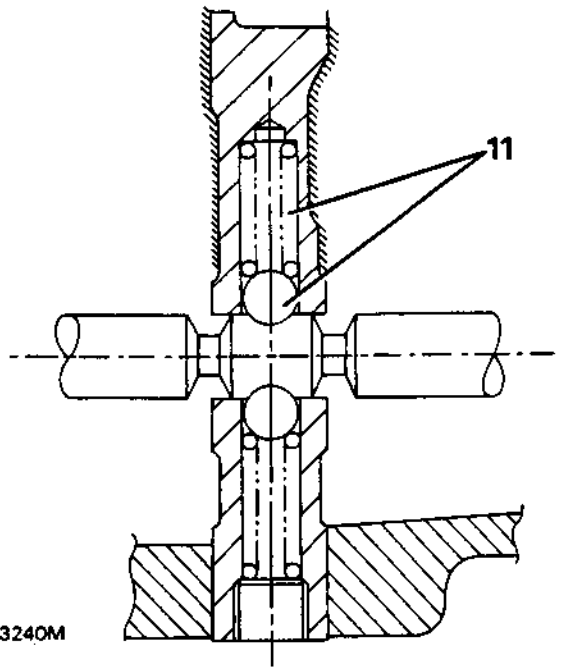
ST2303M

7. Unscrew plug and remove spring and outboard detent ball.
8. Align fifth gear selector pin with centre plate slot.
9. Remove mainshaft, gears, selectors and forks.
10. Remove selector fork assembly from gears.

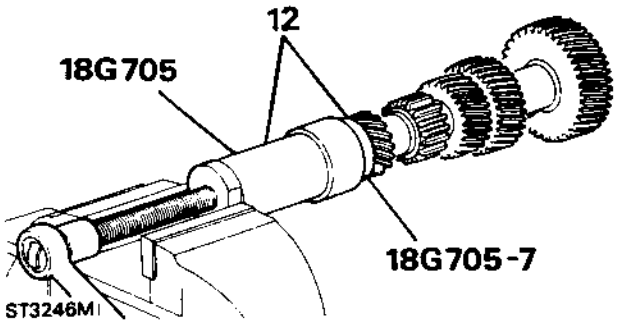


ST3245M

11. Collect inboard detent ball and spring from centre plate.

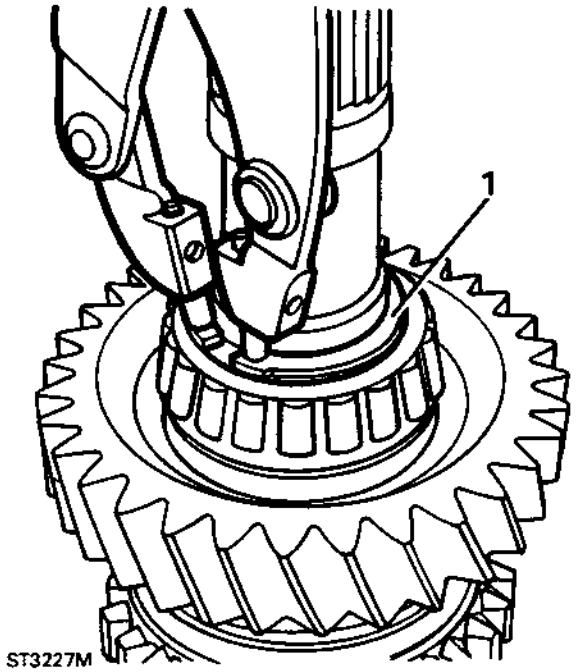


12. Using extractor tool LRT-37-009 (18G 705) and collets LRT-37-017 (18G 705-7), withdraw layshaft bearings.

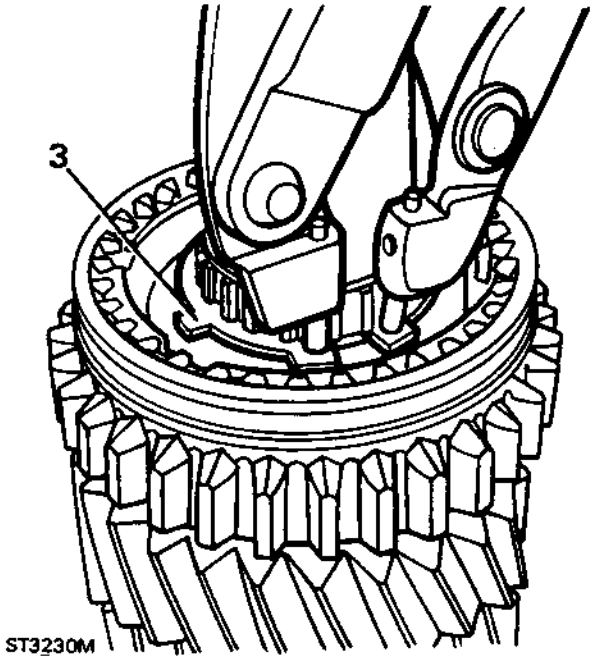


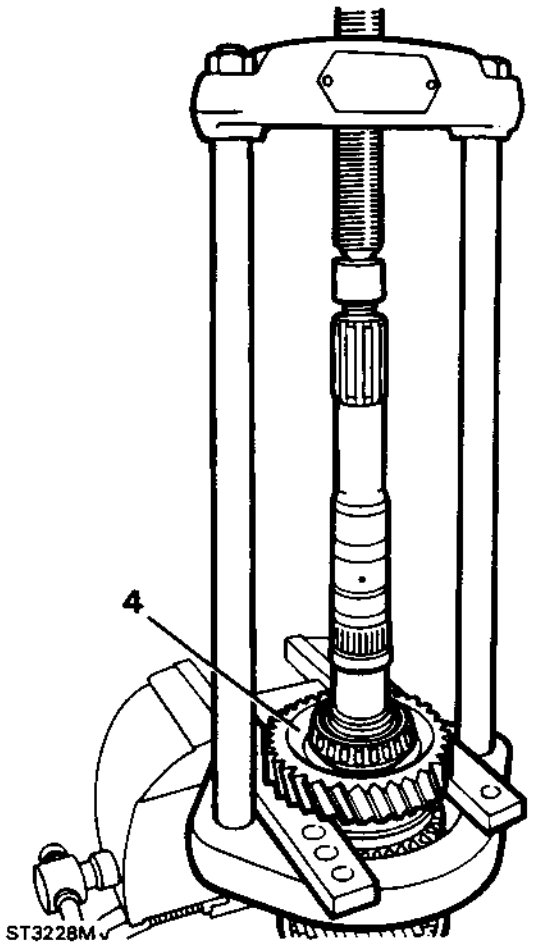
DISMANTLE MAINSHAFT

1. Remove circlip retaining first gear assembly.

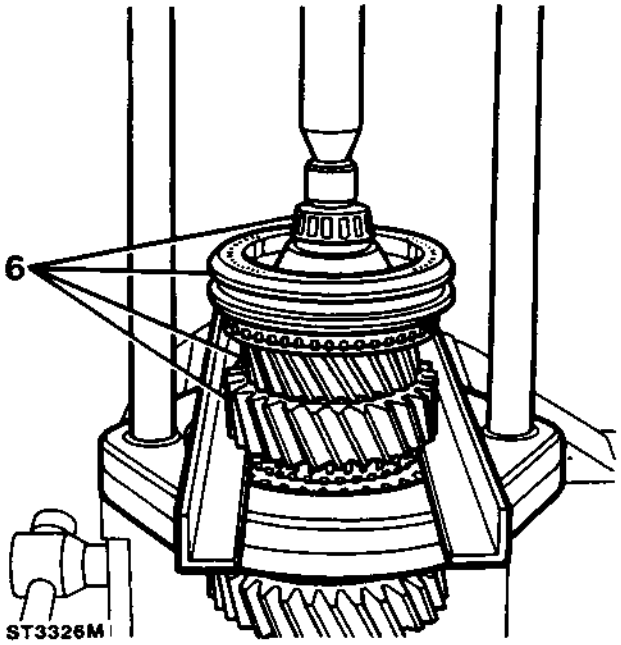


2. Remove taper bearing, bush, needle bearing, first gear spacer, cone, inner and outer baulk rings.
3. Remove circlip to release first and second gear synchromesh assembly.

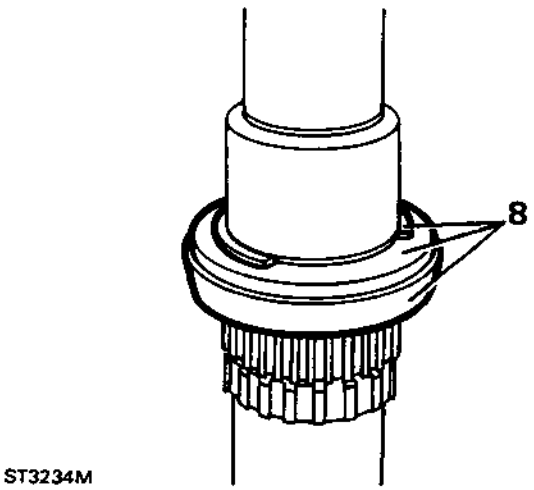




4. With LRT-99-002 (MS 47) press first gear assembly from mainshaft.
5. Remove first and second synchromesh baulk rings.
6. Using LRT-99-002 and support bars under 2nd gear, press off pilot bearing, third, fourth synchromesh second and third gear assembly.



7. Remove washer, third, fourth synchromesh, third gear baulk ring, split needle rollers, bush, needle bearing and second gear.
8. Remove snap ring, spacer, second gear cone and circlip.

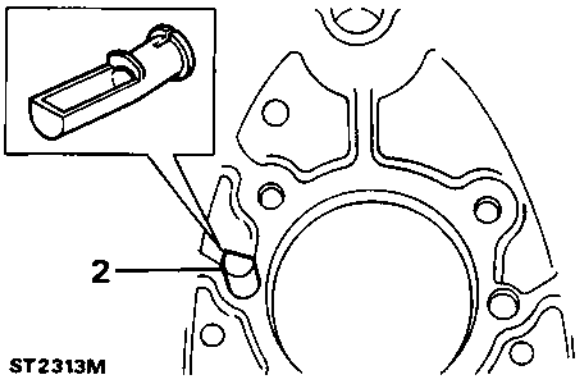


Gearbox casings and oil pump

Degrease and clean all components and discard gaskets and seals.

Gearbox casing

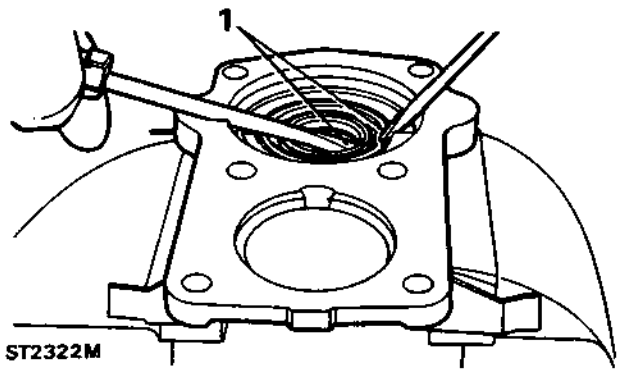
1. Remove mainshaft and layshaft bearing tracks.
2. Remove plastic scoop from inside the casing.



3. Inspect case for damage, cracks and stripped threads.
4. Fit a new scoop with scoop side towards top of casing.

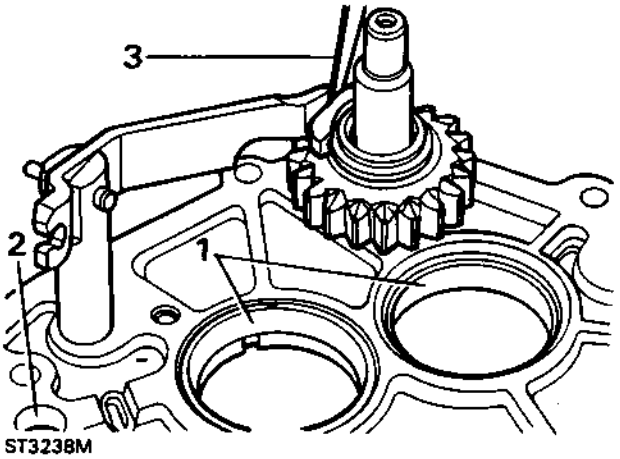
Front cover

1. Remove oil seal from cover. Do not fit a new seal at this stage



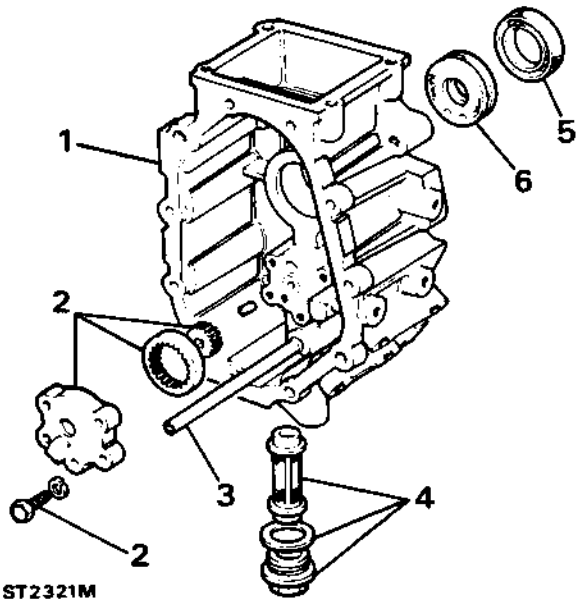
Centre plate

1. Remove bearing tracks.
2. Inspect for damage and selector rail bore for wear.
3. Temporally fit reverse shaft gear and lever and check clearance between slipper and lever does not exceed 0,20 mm (0.008 in).



Extension case

1. Examine for damage to threads and machined faces.
2. Remove oil pump cover, inspect gears and housing and renew if required.

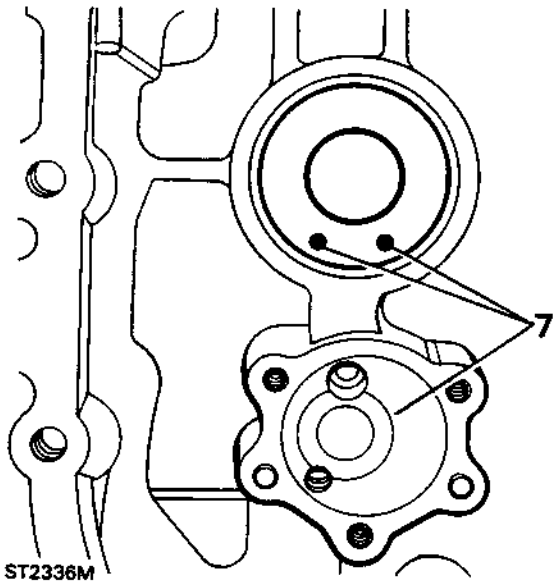


3. Check oil pick up pipe for obstruction but do not remove.
4. Remove drain plug assembly. Clean and renew filter and washers if necessary.
5. Renew oil seal.
6. Renew Ferrobestos bush.

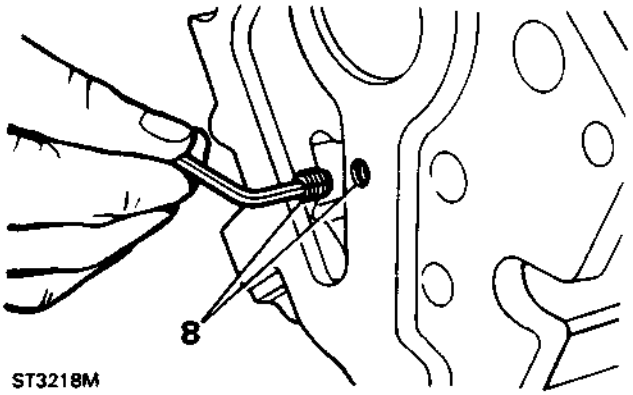
WARNING: This bush contains abestos. Do not attempt to clean it. ***See INTRODUCTION, Information, Poisonous substances***

7. Fit new bush with drain holes towards bottom of casing.

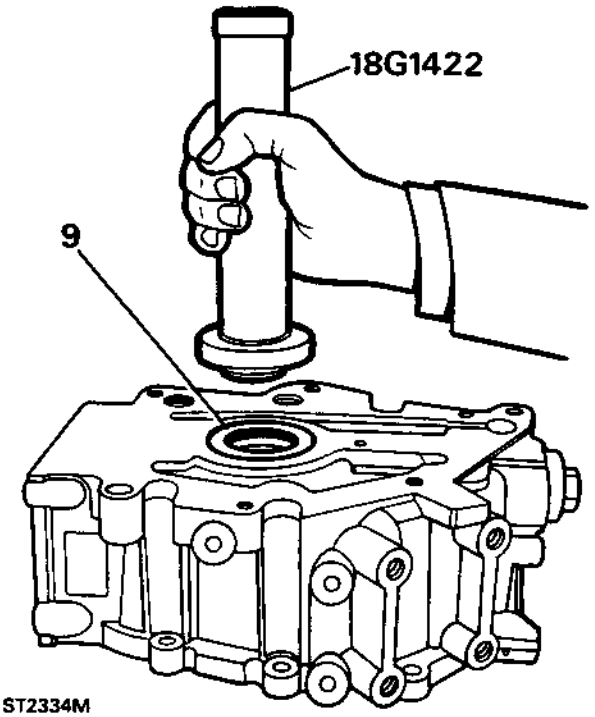
CAUTION: If drain holes are not positioned correctly oil may build up behind oil seal and cause a leak.



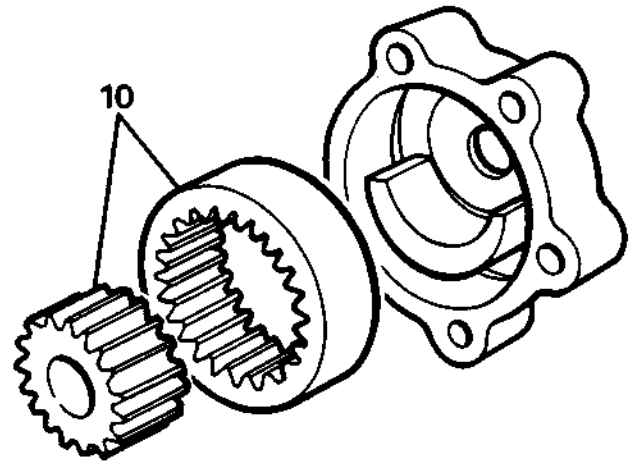
8. If extension housing is being renewed transfer grub screw to new housing. Apply Loctite to threads.



9. Fit oil seal to housing, lip side leading, using LRT-37-014 (18G 1422). Apply SAE 40 oil to lip.

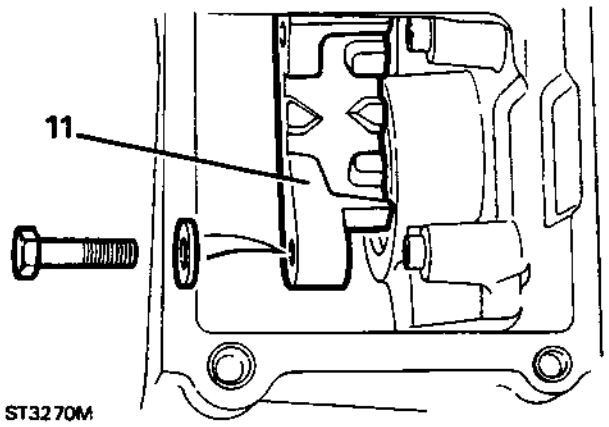


10. Assemble gears to oil pump and fit cover.



ST3254M

11. Examine gate plate and renew if worn or damaged.



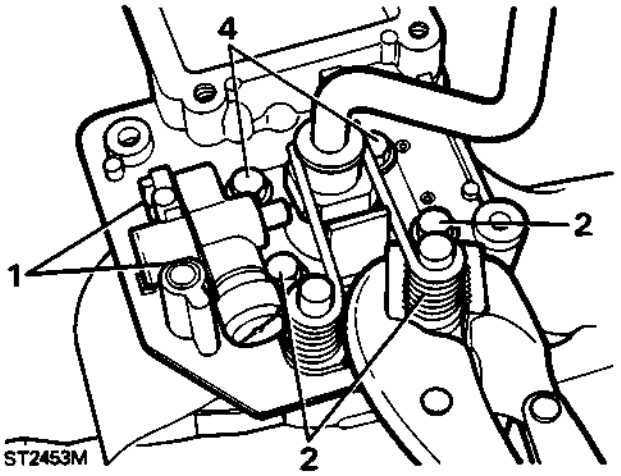
ST3270M

Gear change housing

1. Remove reverse plunger and retain shims.
2. Remove bolts retaining bias springs.

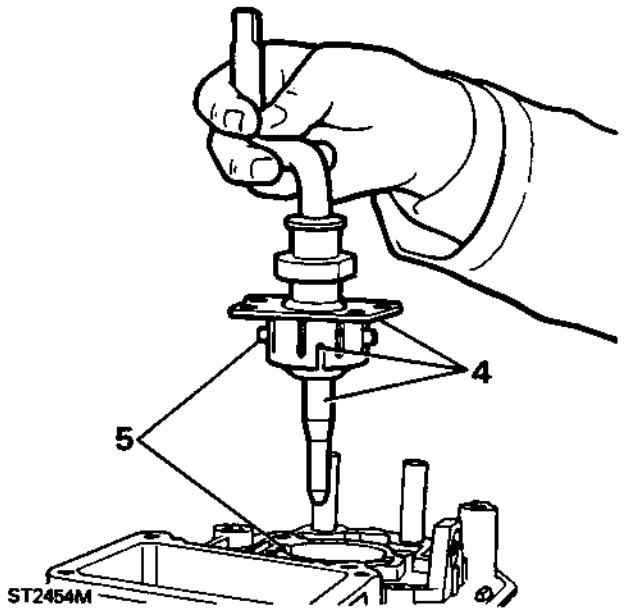
WARNING: To avoid personal injury, restrain each spring in turn with a pair of grips while the bolts are being removed.

3. Remove the two springs.
4. Remove remaining bolts to release lower gear lever assembly.



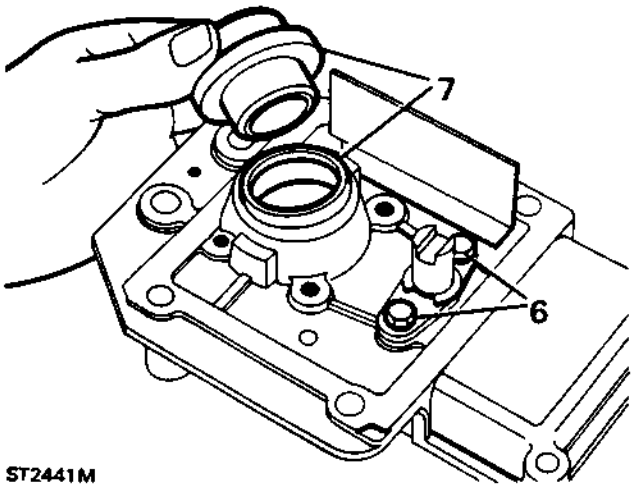
ST2453M

5. Check for wear in cross pin slots in housing and wear in lower gear lever.

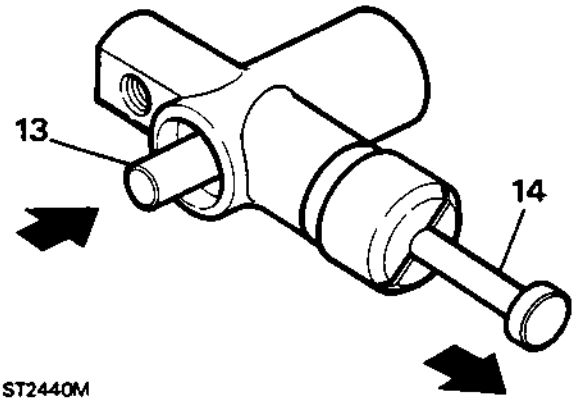


ST2454M

6. Turn housing over and check security of spool guide bolts.
7. Remove oil seal and fit a replacement, lip side leading.



ST2441M



ST2440M

8. Examine bias springs and renew if weak or distorted.
9. Grease lower gear lever ball with Shell Alvina R3 and fit new Railko bush.
10. Fit gear lever to housing.
11. Fit adjustment plate.

△ **NOTE: Apply Hylomar PL 32 or Loctite 290 to threads of two short bolts and fit them forward of the gear lever. Tighten bolts to prevent plate moving while springs are being fitted.**

12. Fit bias springs locating long end against gear lever.

△ **NOTE: Apply above sealant to threads of spring retaining bolts. Use grips to compress springs to enable bolts to be fitted.**

13. Examine and test reverse gear plunger.

△ **NOTE: Apply a load of 45 to 55 kg to plunger nose. If it functions within these limits it is satisfactory. The plunger is only available as a complete assembly.**

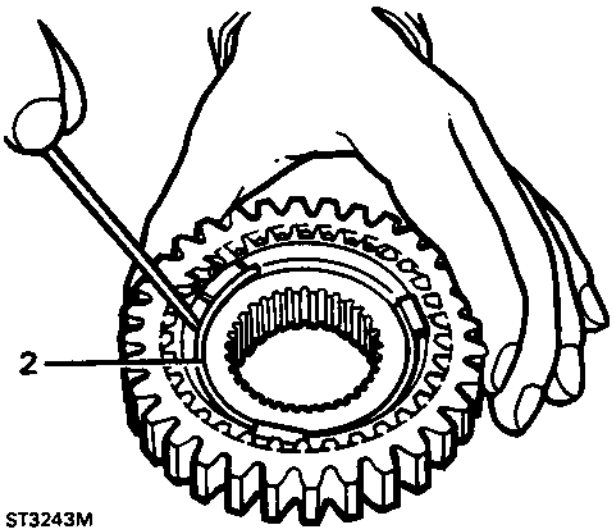
14. Check that the reverse switch plunger operates when reverse plunger is depressed.

SYNCHROMESH ASSEMBLIES

Third-fourth and fifth gear synchromesh.

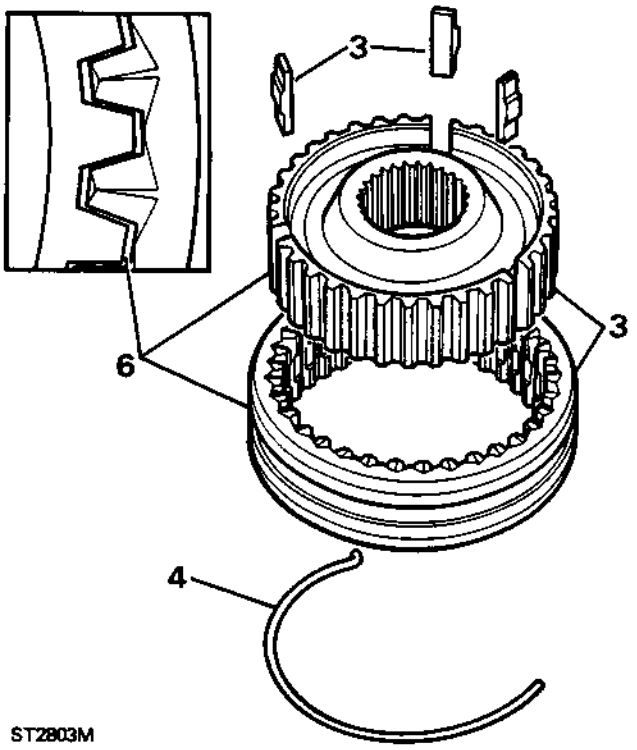
△ **NOTE: The above assemblies are the same except that fifth gear synchromesh has a retainer plate.**

1. Mark relationship of inner and outer members.
2. Remove wire clip from both sides of assembly.



ST3243M

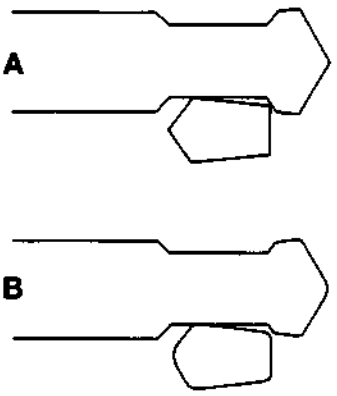
3. Remove slippers and separate the two members.
4. Examine all parts for damage and wear including wire clips for tension.
5. Check no radial movement exists between inner members and mainshaft splines. (except fifth gear synchromesh).
6. Examine inner and outer splines for wear.



ST2803M

7. Examine the dog teeth on all gears for wear and damage.

△ **NOTE: Example "A" shows a tooth in good condition. Example "B" shows the rounded corners of a worn tooth.**

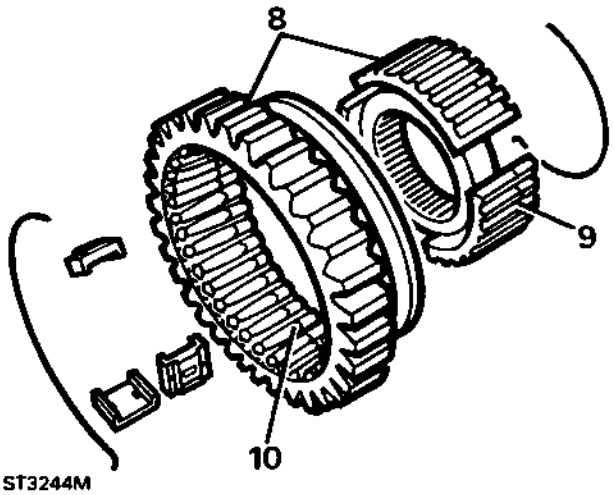


ST2449M

First-second synchromesh

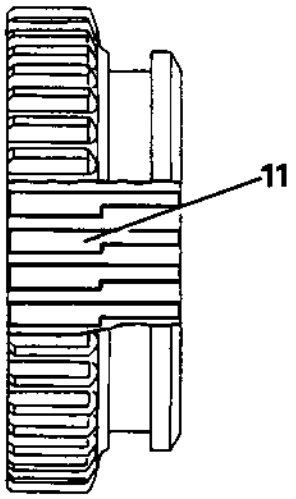
8. Repeat instructions 1 to 6 for third-fourth synchromesh.
9. Examine step in each of outer splines.
10. Check that the step on both sides of the internal splines are sharp not rounded.

△ **NOTE: This applies only to splines on selector groove side of member.**



ST3244M

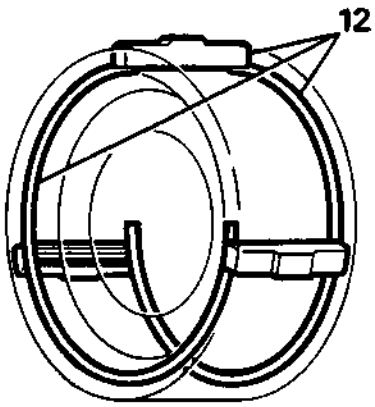
11. Fit inner member to outer so that the wide splines of inner member are under the spur gear teeth.



ST3247M

12. Fit the slippers and secure with a spring each side of the synchromesh.

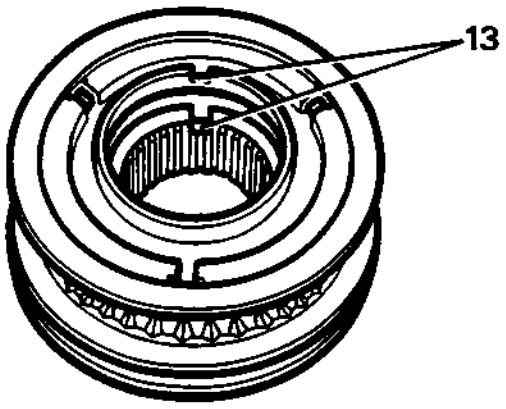
△ **NOTE: The hooked end of each spring must locate in the same slipper with the free ends running in opposite directions and resting against the remaining slippers.**



ST2467M

13. Assemble third-fourth and fifth gear synchromesh components as in instruction 12.

△ **NOTE: The back plate for fifth gear is fitted to the rear of the assembly with the single tag locating in a slot in the inner member.**

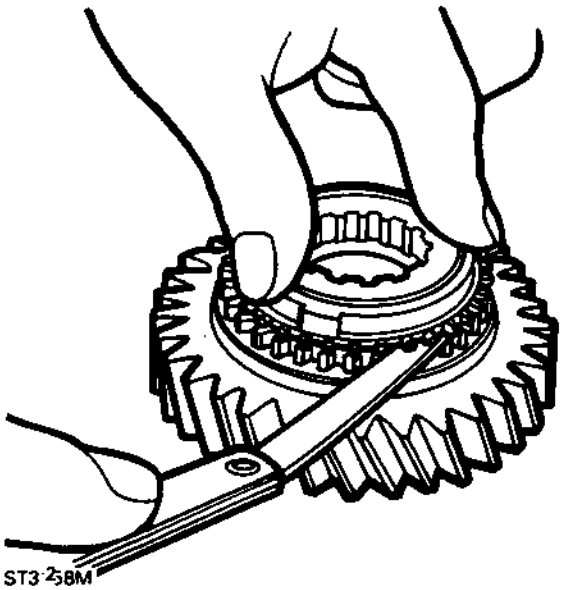


ST3276M

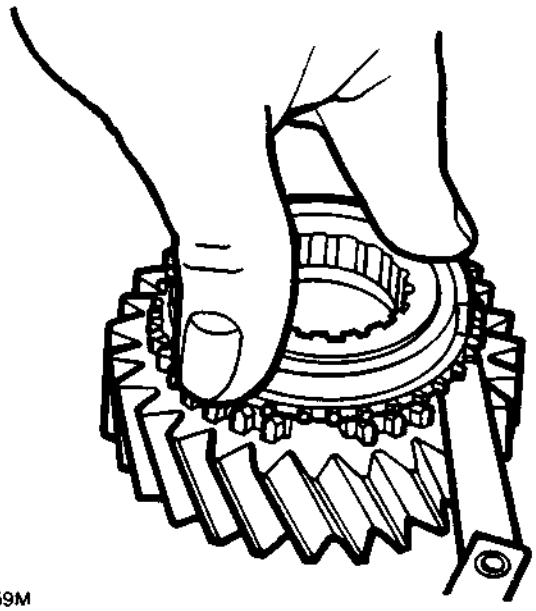
CHECKING BAULK RING CLEARANCES

Check clearance of all baulk rings and gears by pressing the baulk ring against the gear and measuring the gap. The minimum clearance should be 0,38mm.

First gear

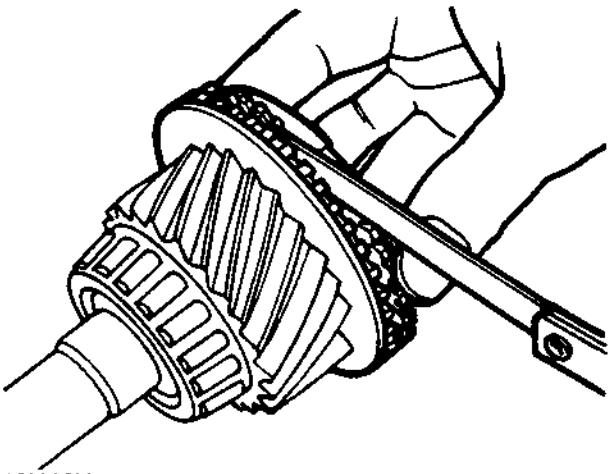

ST3258M

Second gear



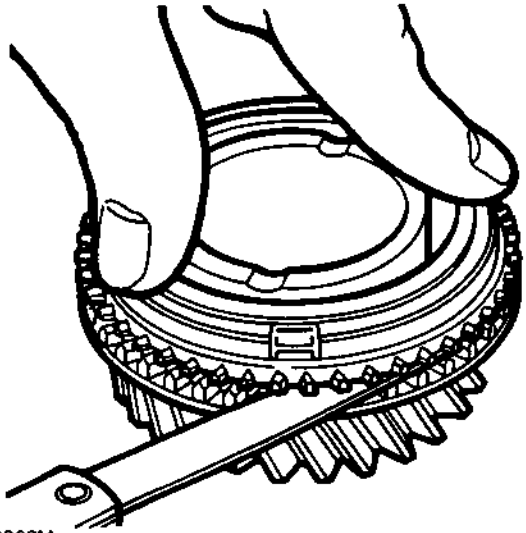
ST3259M

Fourth gear



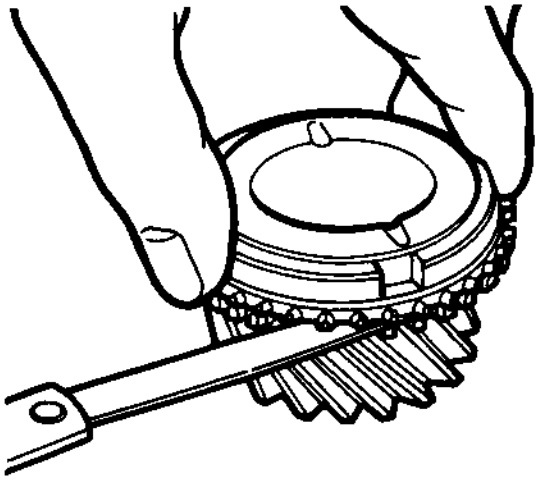
ST3226M

Third gear



ST3260M

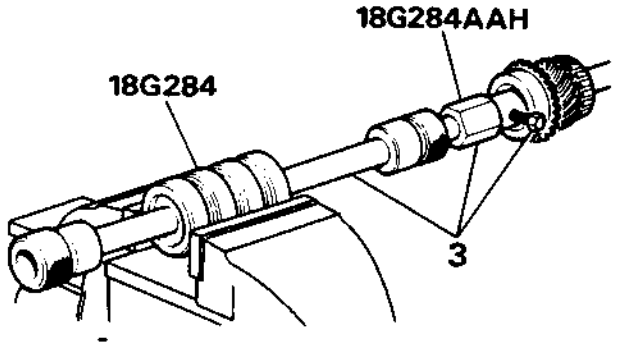
Fifth gear



ST3261M

Input shaft

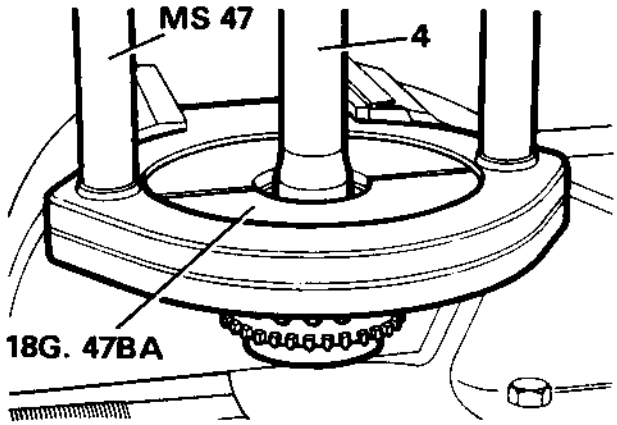
1. Examine the gear and dog teeth for wear and damage.
2. Polish oil seal track if necessary.
3. Using LRT-37-004 (18G 284 AAH) and LRT-99-004 (18G 284) remove pilot bearing track.



ST3278M

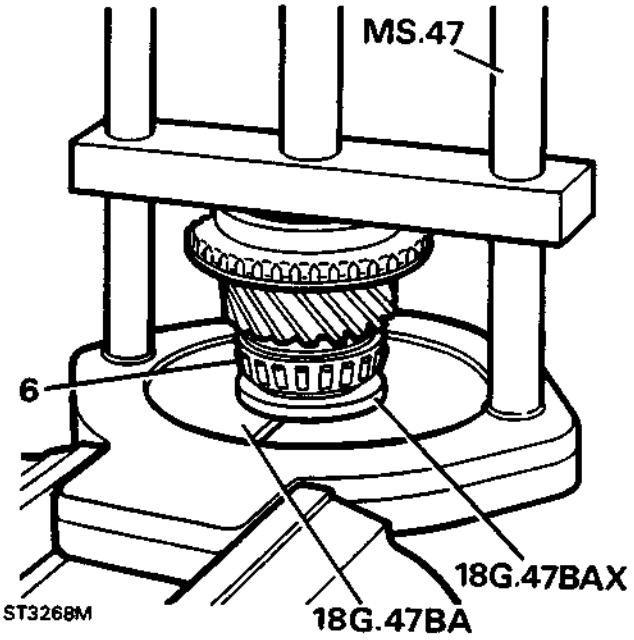
4. Using LRT-37-001 (18G 47BA) and LRT-99-002 (MS 47) remove taper bearing.

NOTE: Ensure that the bearing is supported by the lip inside LRT-37-001.



ST3279M

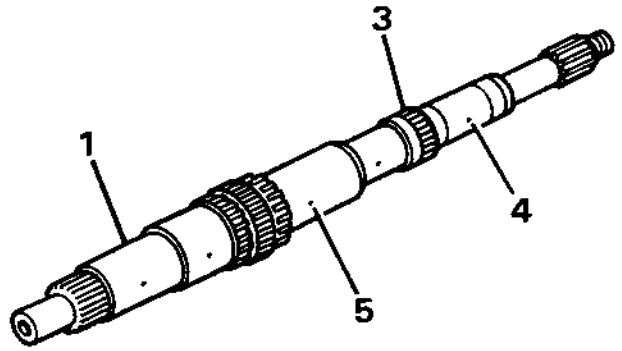
5. Support the shaft under press in a new track.
6. Using collets LRT-37-001 (18G 47BA) and adaptor LRT-37-002 (18G 47 BAX) fit a new taper bearing.



ST3268M

Mainshaft

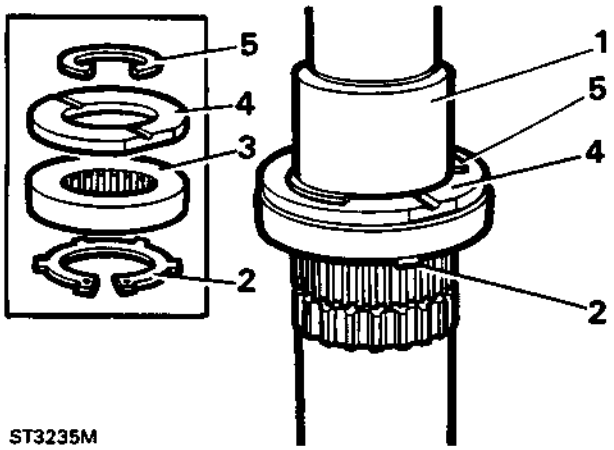
1. Examine bearing journals for wear and scores.
2. Check condition of circlip grooves.
3. Examine splines for wear and damage.
4. Use an air line to check that the main oil feed from the pump is clear and feed to spigot bearing.
5. Check oil feed holes to roller bearings are clear.



ST3241M

MAINSHAFT GEAR END FLOAT CHECKS

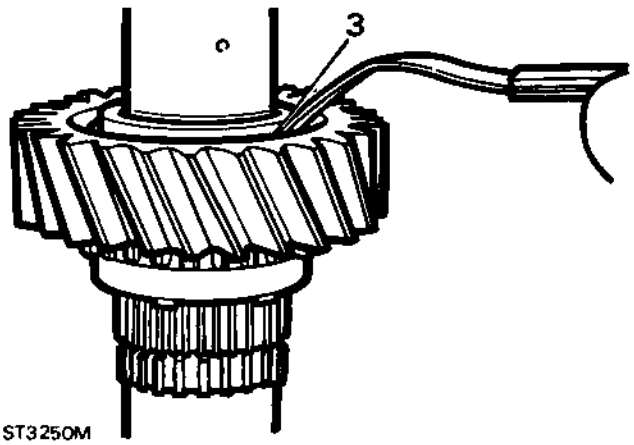
1. Hold mainshaft in vice front end downwards.
2. Fit front circlip for first-second synchromesh.
3. Fit second gear cone.
4. Fit spacer.
5. Fit snap ring.



ST3235M

Second gear end-float.

1. Fit needle roller and second gear.
2. Fit third gear bush.

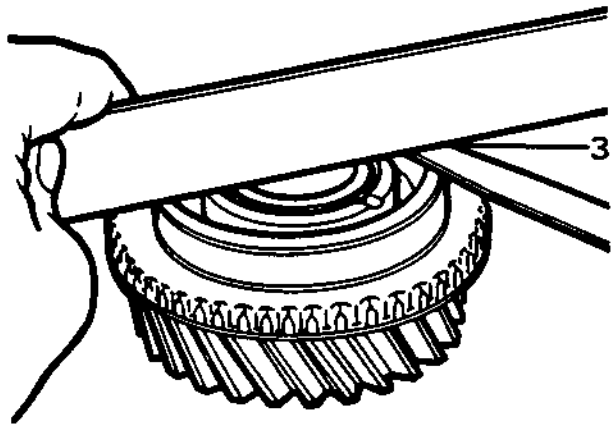


ST3250M

3. Check clearance between second gear and bush flange. Not to exceed 0,20 (0.008in).
4. Remove above components.

Third gear end-float.

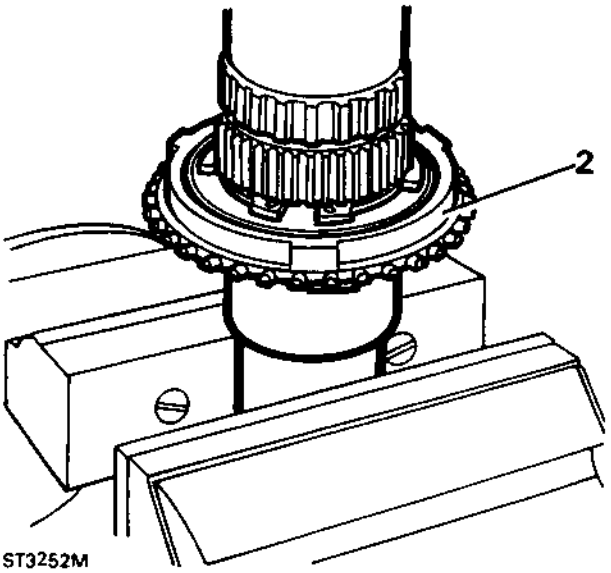
1. Fit needle roller to third gear.
2. fit third gear bush to third gear.
3. Place gear on flat surface, bush flange downwards, and with a straight edge across gear check clearance between straight edge and gear. Not to exceed 0,20mm.



ST3251M

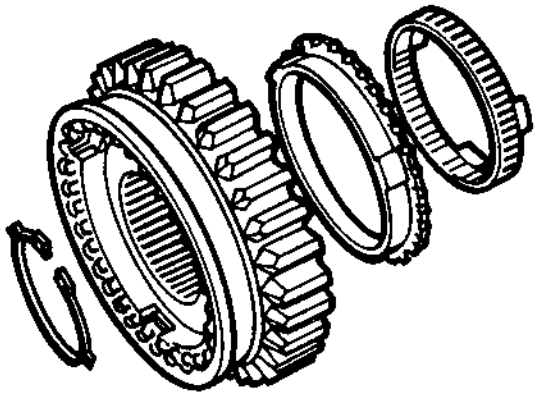
First gear bush end-float.

1. Invert mainshaft rear end uppermost.
2. Fit inner and outer second gear baulk rings.



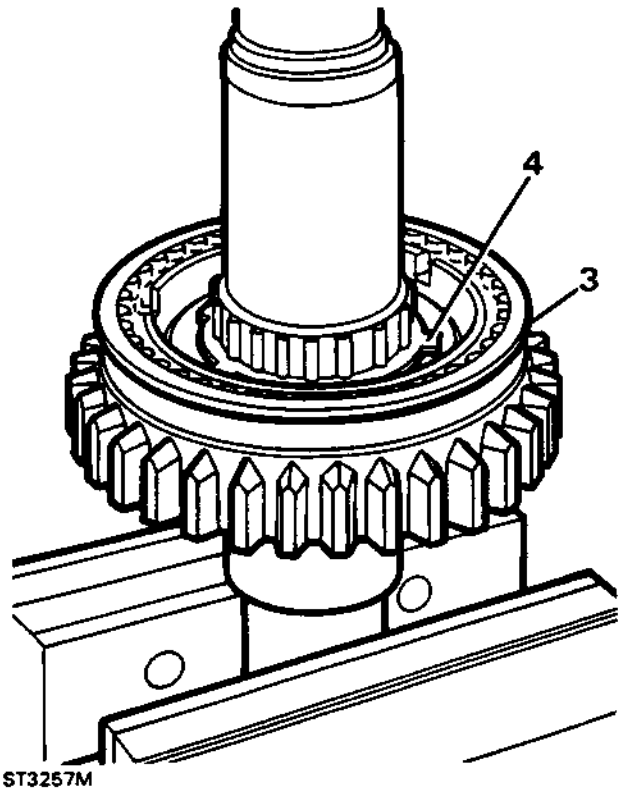
ST3252M

3. Fit first-second synchromesh hub, fork groove uppermost.
4. Fit circlip.



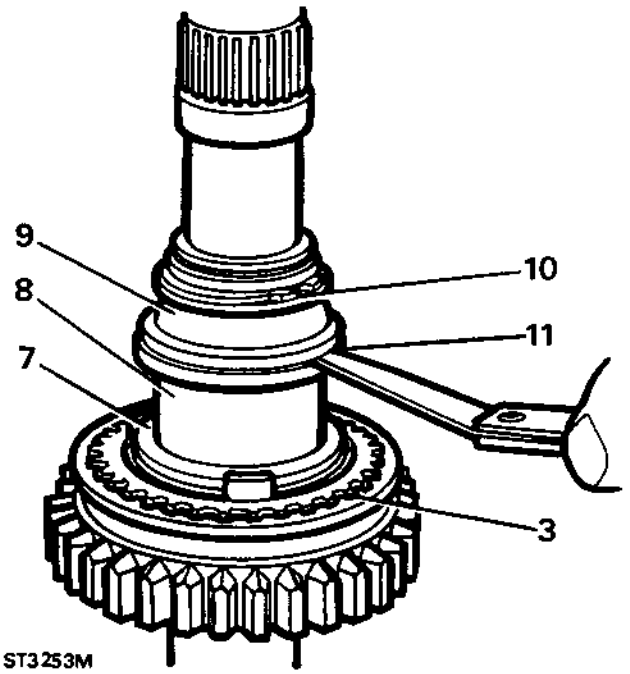
ST3231M

First-second synchromesh assembly



ST3257M

5. Fit first gear inner and outer baulk ring.
6. Fit cone.
7. Fit spacer.
8. Fit first gear bush.
9. Fit dummy bearing.
10. Fit circlip.
11. Check clearance between dummy bearing and bush. Not to exceed 0,75mm.
12. Remove circlip, dummy bearing and bush.



ST3253M

Selective first gear bush

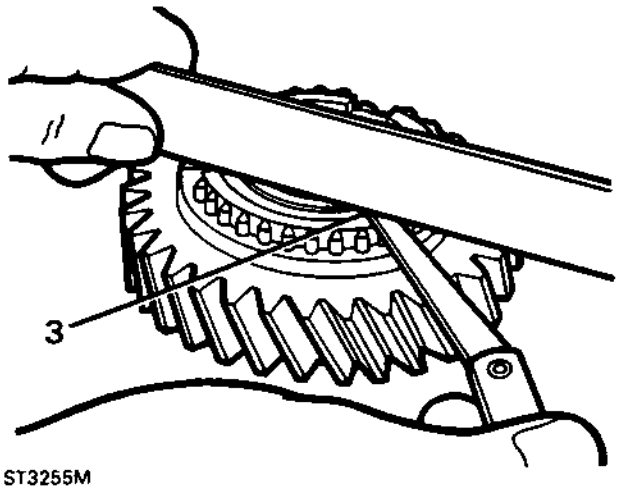
Part Number	Thickness (mm)
FTC2005	30,905/30,955
FTC2006	30,955/31,005
FTC2007	31,005/31,055
FTC2008	31,055/31,105
FTC2009	31,105/31,155

Check first gear to bush end-float.

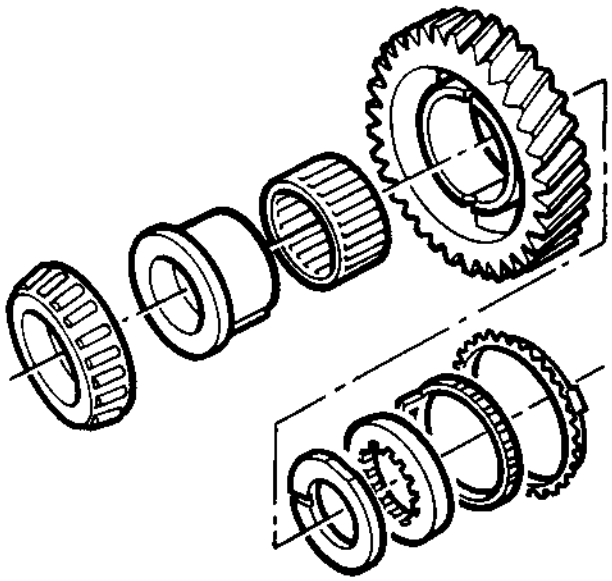
1. Fit roller bearing and bush to first gear.
2. Place bush flange side downwards on a raised block on a flat surface.

△ **NOTE: The block should be approximately the same diameter as the bush flange so that the gear is suspended and does not rest on the flat surface.**

3. Place straight edge across gear and check clearance between gear and straight edge.Not to exceed 0,20mm



ST3255M

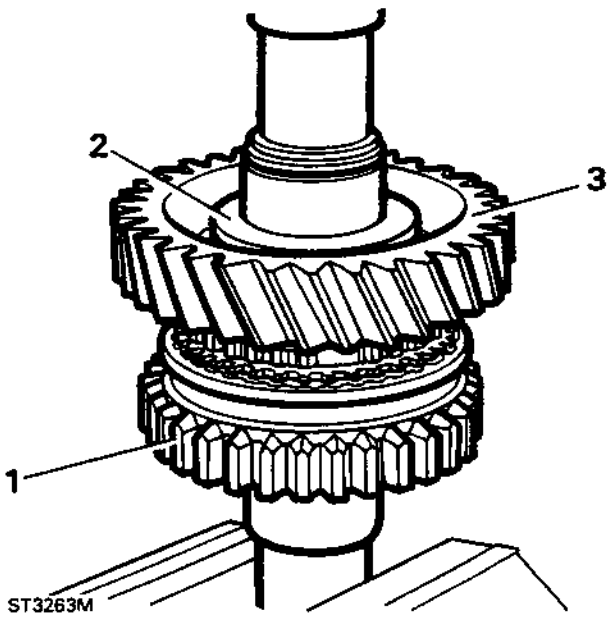


ST3229M

First gear assembly

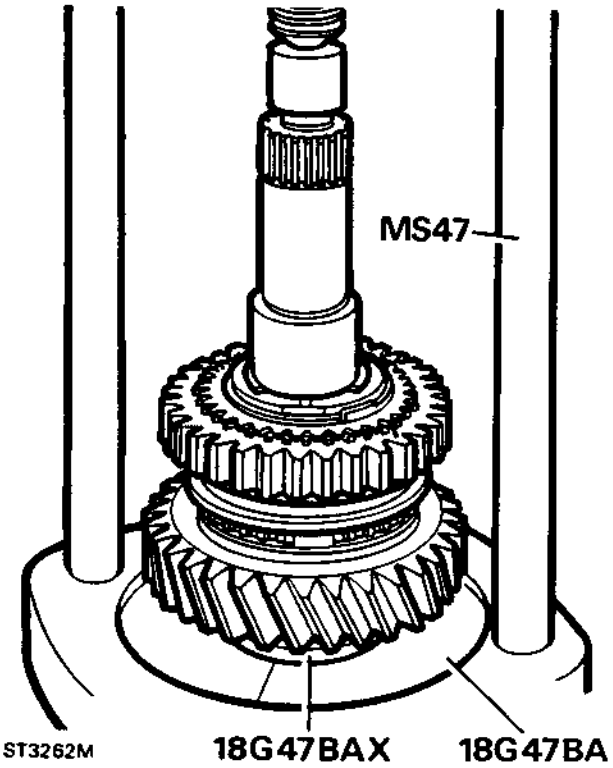
ASSEMBLING MAINSHAFT

1. With the first-second synchromesh hub and spacer in position, assemble the rear end of the shaft.
2. Fit the roller bearing and bush to first gear.
3. Fit first gear to mainshaft.



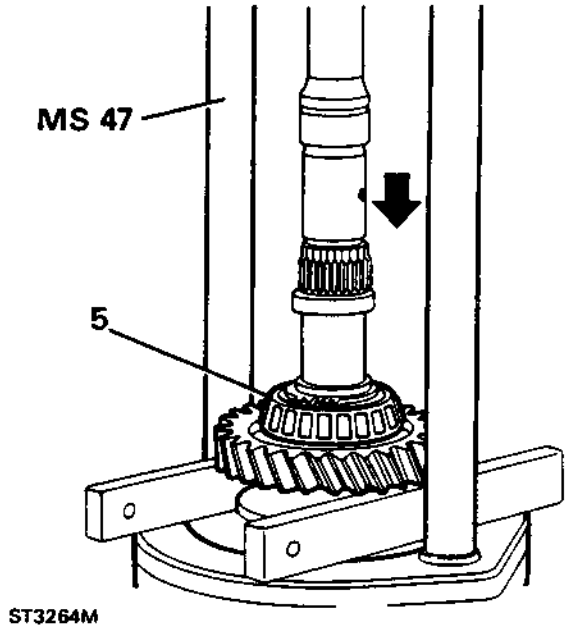
ST3263M

4. Fit the taper bearing to mainshaft using LRT-99-002 (MS 47), collets LRT-37-001 (18G 47 BA) and adaptor LRT-37-002 (18G 47 BAX).



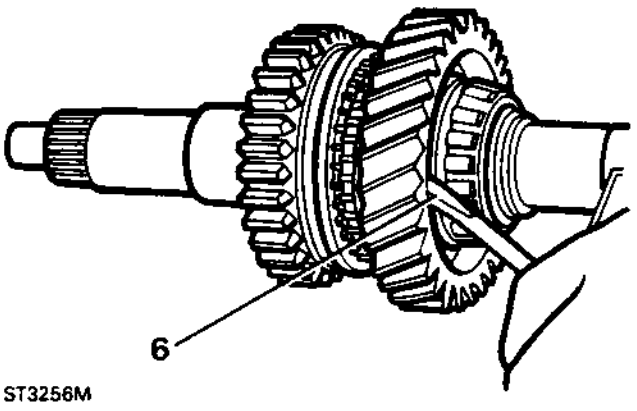
CAUTION: Ensure that the slots in the baulk ring align with the synchromesh slippers while pressing on the bearing.

5. Invert mainshaft and press assembly back against circlip.

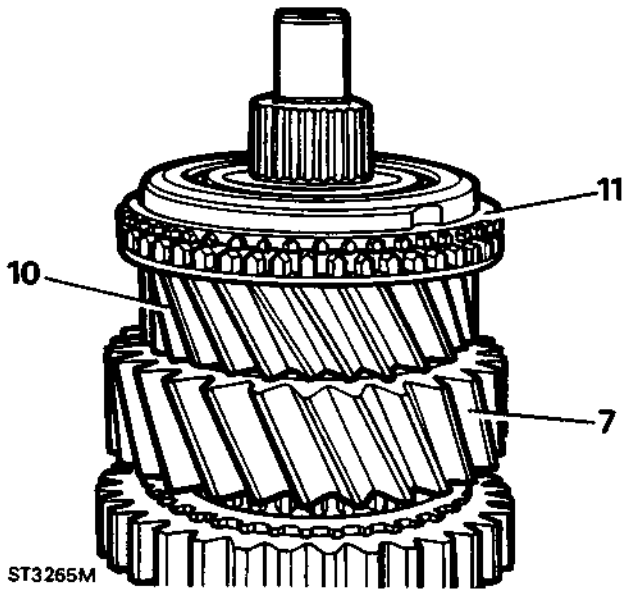


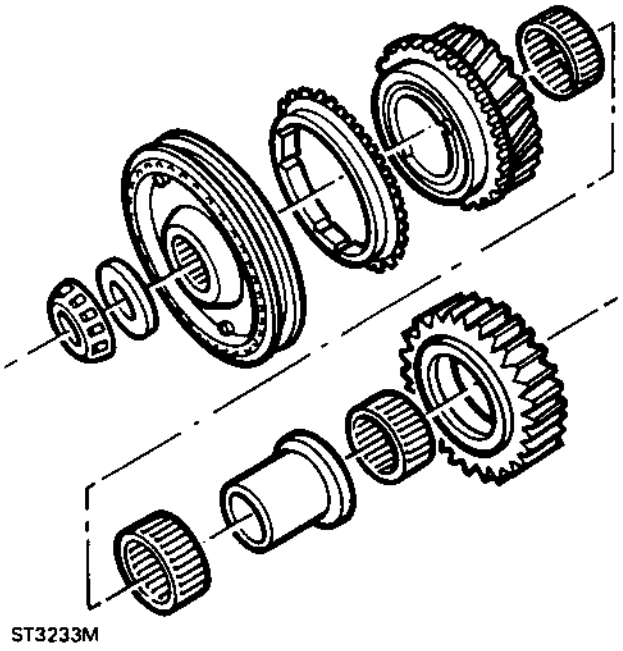
NOTE: Instruction 5 is necessary since it is probable that when pressing on the bearing it will have clamped the first gear bush preventing it from turning.

6. Reposition mainshaft in vice and using a screw driver blade check that the first gear bush is free to turn.



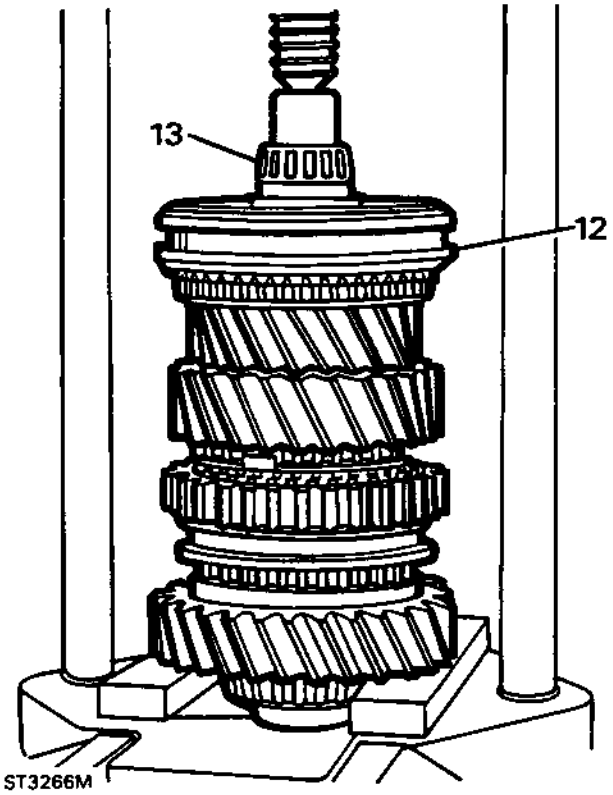
7. Position mainshaft in vice, rear end downwards and fit second gear needle roller, and second gear.
8. Fit third gear bush.
9. Fit third gear needle rollers.
10. Fit third gear.
11. Fit third gear baulk ring.




ST3233M

Third-fourth synchomesh assembly

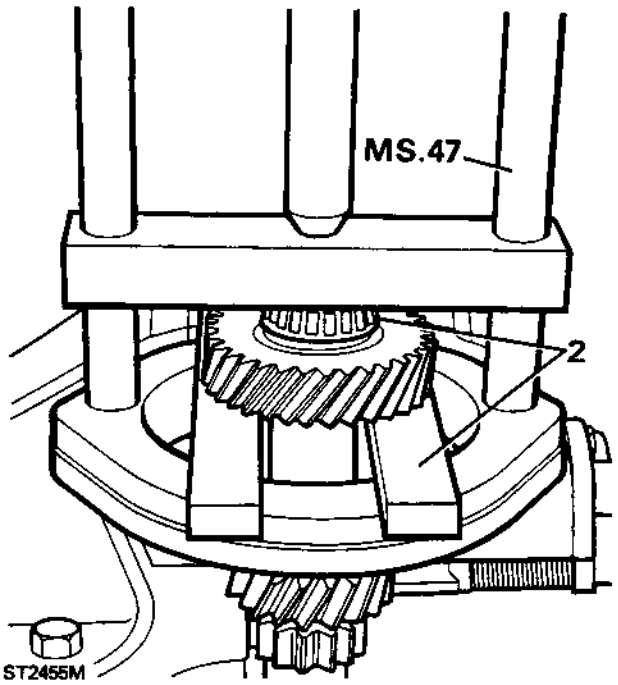
12. Fit third-fourth gear synchromesh hub.
13. Using press with supports under first gear, press the spigot bearing on to shaft.



ST3266M

LAYSHAFT

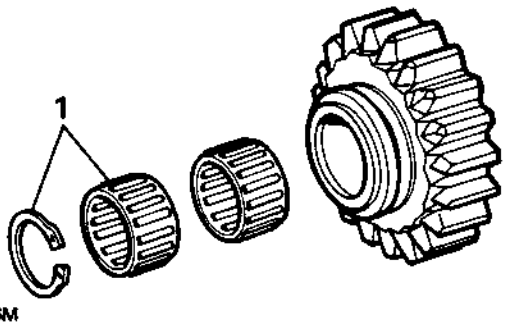
1. Examine the layshaft for wear and damage.
2. Press bearings on to layshaft using press and supporting bars.



ST2455M

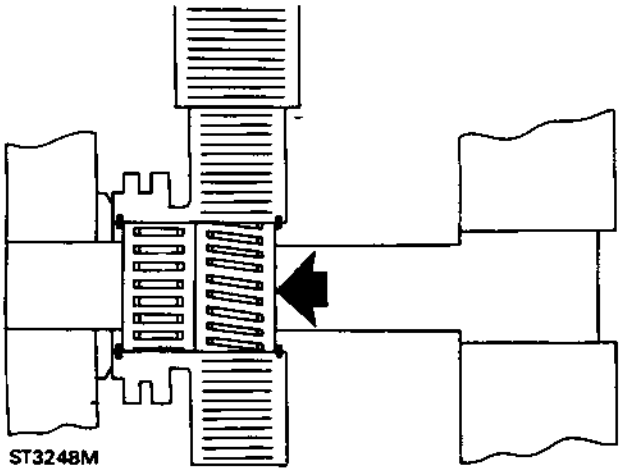
REVERSE GEAR AND SHAFT

1. Remove one circlip from the idler gear and remove bearings.

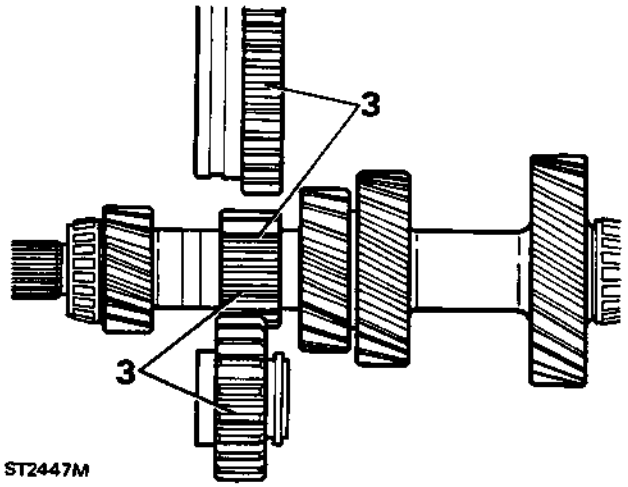


ST2466M

△ **NOTE: One bearing cage is twisted in manufacture. The twist causes the gear to tilt on the shaft forcing the gear into engagement. Renew bearings if worn or if the gear jumps out of engagement.**


ST3248M

2. Fit the bearings either way round and secure with the circlip.
3. Check condition of idler gear and mating teeth on layshaft and synchromesh outer member.



ST2447M

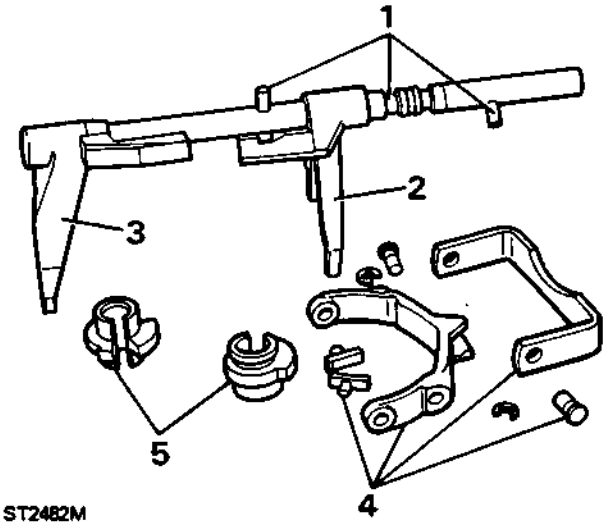
4. Examine idler shaft for wear, scores and pitting.

SELECTORS

1. Examine selector rail and pins for wear and damage.
2. Examine first-second selector fork for wear cracks and damage.

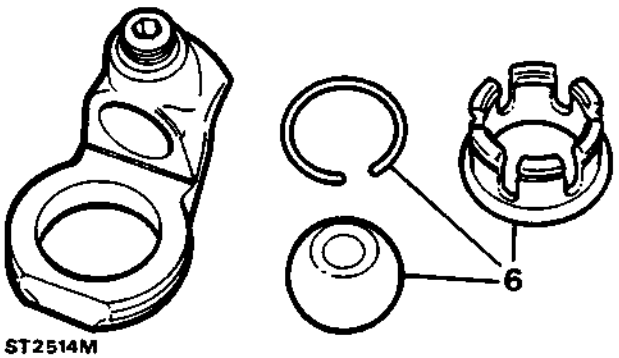
△ **NOTE: The selector rail and fork is only supplied as a complete assembly.**

3. Examine third-fourth selector fork for wear, cracks and damage.
4. Examine fifth gear selector fork, pads and pivot pins.
5. Examine interlock spools for wear and damage.



ST2482M

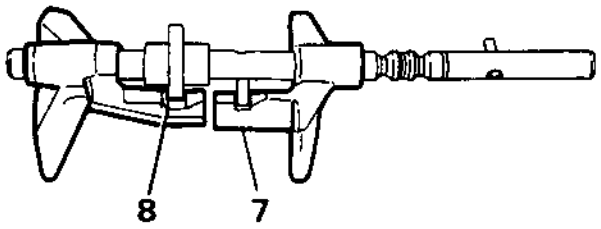
6. Remove snap ring and examine selector yoke assembly.



ST2514M

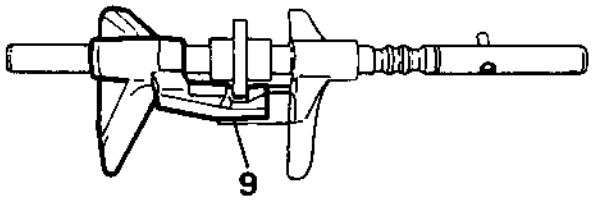
Assembling selectors.

7. Rest first-second fork and shaft assembly on bench and locate pin in jaw of fork.
8. Fit interlock spool and third-fourth fork and engage spool in jaw of fork.



ST2488M

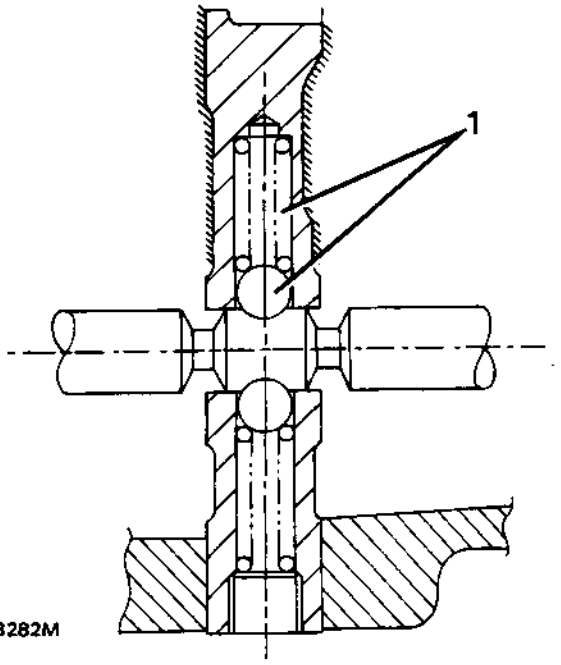
9. Slide spool and fork towards first- second selector until slot in spool locates over pin keeping the spool engaged in third-fourth fork jaw.



ST2487M

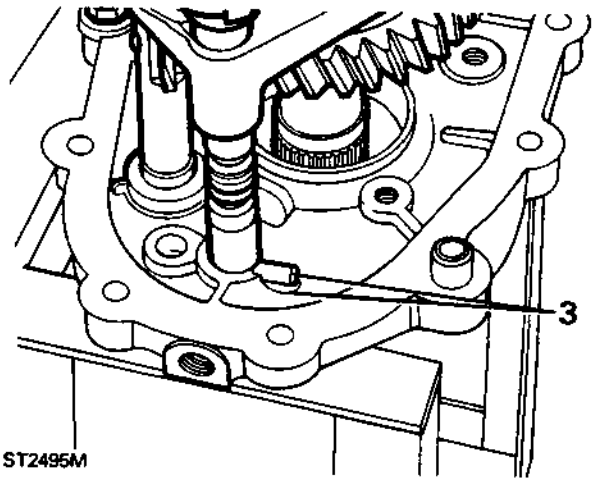
FITTING GEARS TO CENTRE PLATE

1. Secure centre plate to workstand, fit bearing tracks and inboard detent ball and spring.



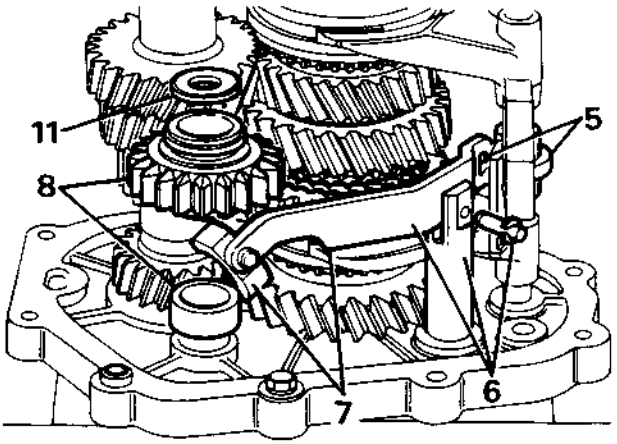
ST3282M

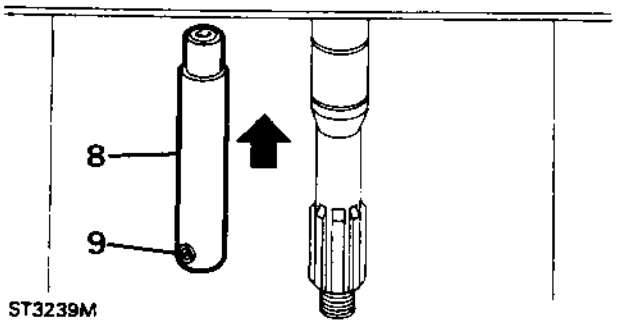
2. Check both synchromesh units are in neutral and fit selector shaft assembly.
3. Fit mainshaft and selectors to centre plate and align pin with slot in plate.



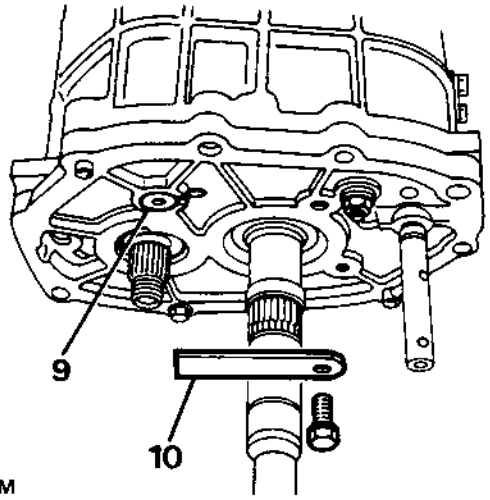
ST2495M

4. Fit layshaft while lifting mainshaft to clear layshaft rear bearing.
5. Turn selector shaft and interlock spool to allow reverse lever to engage spool flange.



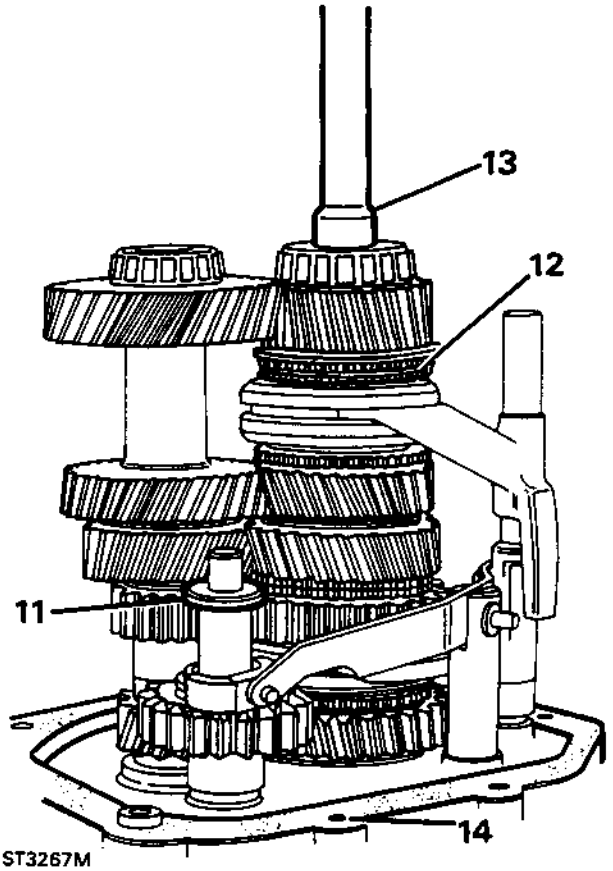


ST3239M



ST2492M

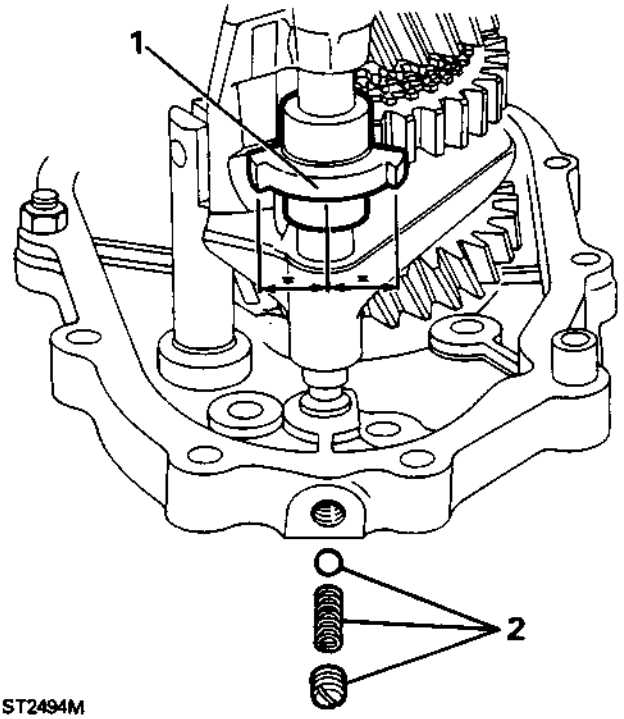
6. Fit reverse lever to pivot post and secure with pin and circlip.
7. Fit slipper pad to lever.
8. Fit reverse gear shaft, spacer and gear.
9. Fit slipper to reverse gear and ensure roll pin in shaft engages in slot in centre plate.
10. Secure reverse shaft with manufactured tool "A".
11. Fit reverse gear thrust washer to shaft.
12. Fit fourth gear baulk ring.
13. Lubricate spigot bearing and fit input shaft.
14. Remove centre plate workstand bolt and fit gasket.



ST3267M

Fitting gearbox casing

1. Turn selector shaft and spool to neutral position.
2. Fit out-board detent ball and spring and secure with plug.



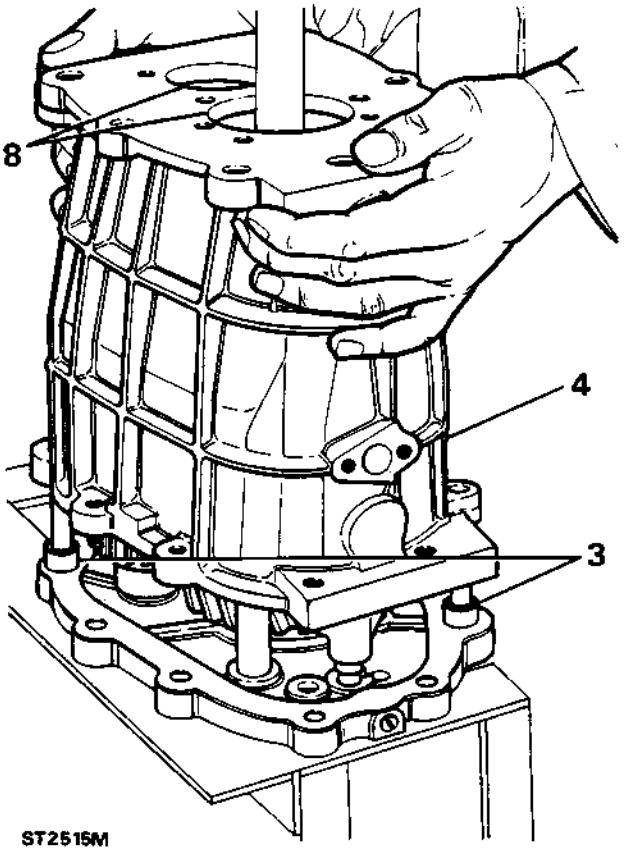
ST2494M

3. Fit guide studs to casing and check oil scoop is correctly fitted.
4. Without using force, fit gearcase.

NOTE: Ensure that the centre plate dowels and selector shaft are properly located.

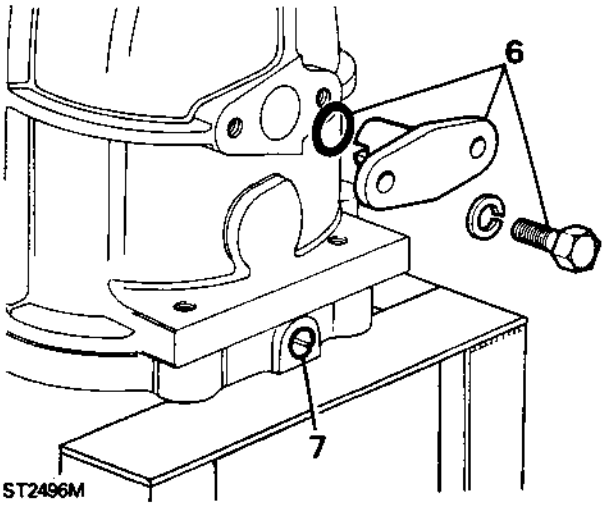
5. Secure centre plate and gearcase to workstand with two 8 x 35mm bolts.
6. Apply PL 32 to joint face and bolt threads and fit spool retainer.

CAUTION: Do not use force to fit retainer. Provided the spool has not been disturbed the retainer will slide into position. If not, remove the gear case and reposition spool or shaft.



ST2515M

7. Remove detent plug, apply Loctite 290 or Hylomar PL 32 to thread, refit and stake.
8. Fit layshaft and input shaft bearing tracks.

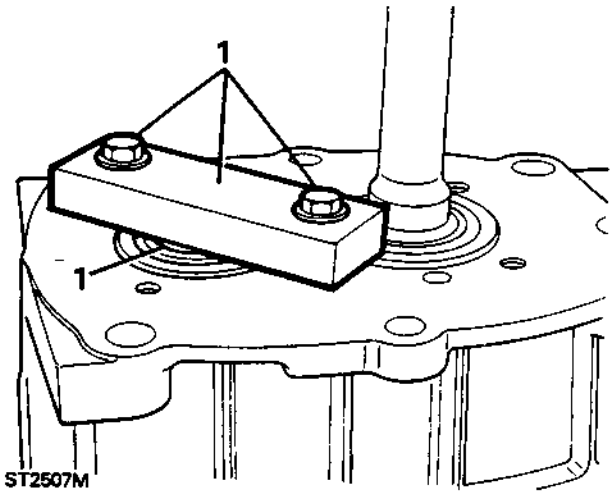


ST2496M

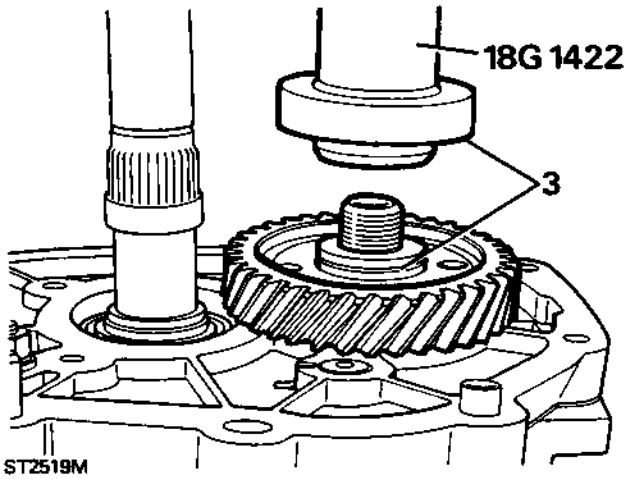
Fitting fifth gear

⚠ **CAUTION: Since the fifth gear is a tight fit on the layshaft, the force, when pressing the gear, must not be transfered to the layshaft front bearing. Tool "D" and packing disc should be made to the dimensions given to absorb the force. The plate also retains the input shaft bearing outer track.**

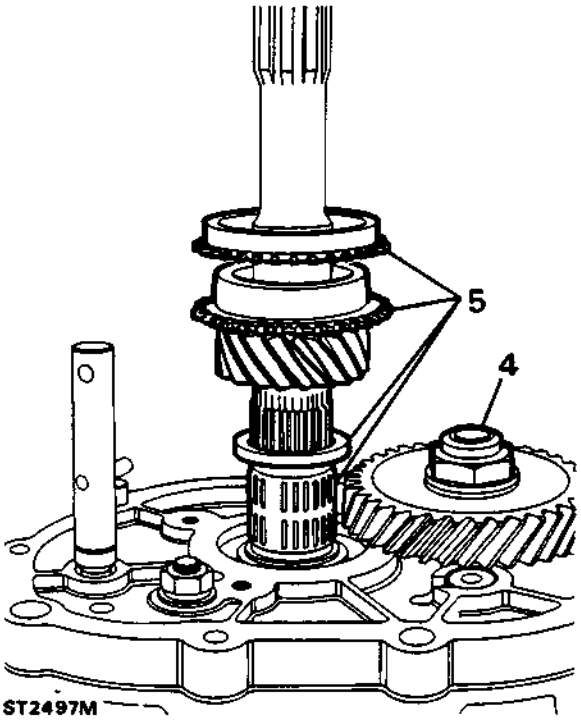
1. Secure the plate with two 8x25mm bolts. Insert disc between plate and layshaft.



2. Release and invert gearbox and remove reverse shaft retainer plate.
3. With the extraction groove uppermost, drive fifth gear on to layshaft using LRT-37-014 (18G 1422).

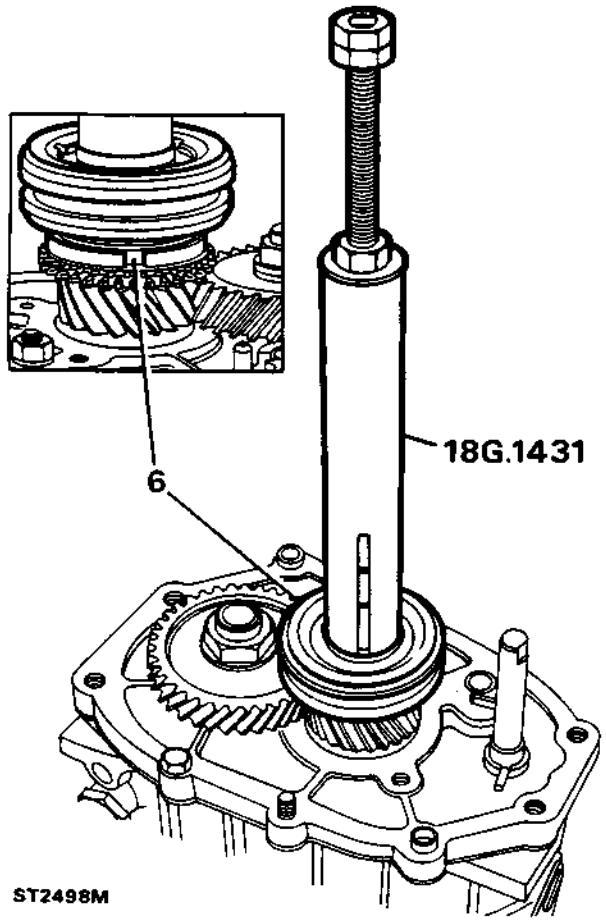


4. Fit a new stake nut but do not tighten.
5. Fit fifth gear assembly to mainshaft.



6. Press fifth gear synchromesh assembly to mainshaft using LRT-37-015 (18G 1431).

⚠ **CAUTION: Before pressing the assembly fully home, ensure that the slipper pads locate in the baulk ring slots.**

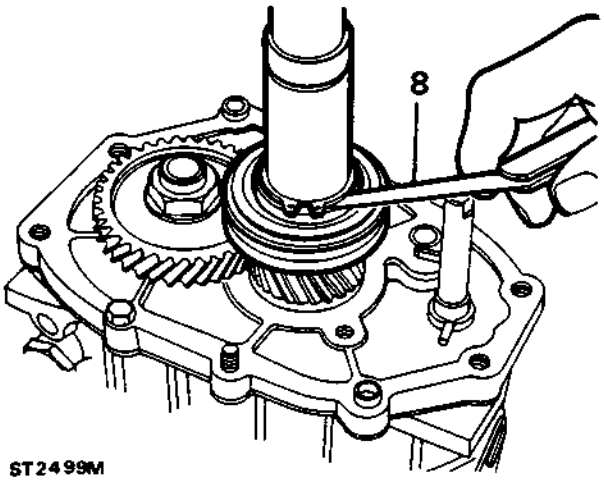


ST2498M

△ **NOTE: Only limited movement of the synchromesh inner member on the main-shaft is permissable. The maximum clearance is 0,005mm to 0,055mm to achieve this the following selective washers are available.**

Part Number	Thickness (mm)
FRC 5284	5,10
FRC 5286	5,16
FRC 5288	5,22
FRC 5290	5,58
FRC 5292	5,34
FRC 5294	5,40
FRC 5296	5,46
FRC 5298	5,52
FRC 5300	5,58
FRC 5302	5,64

7. Fit the thinnest washer and secure with circlip.
8. Measure clearance between circlip and washer.

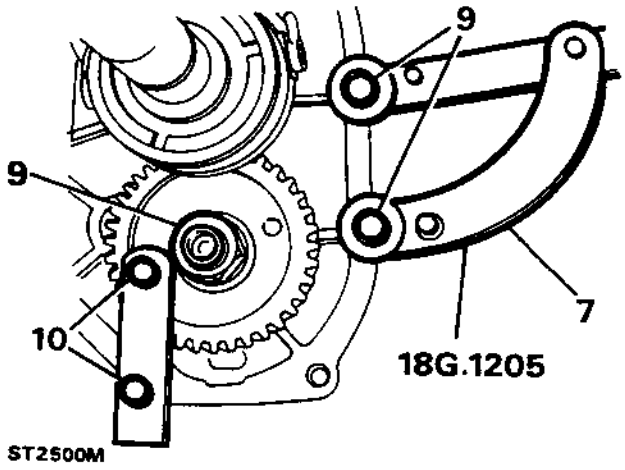


ST2499M

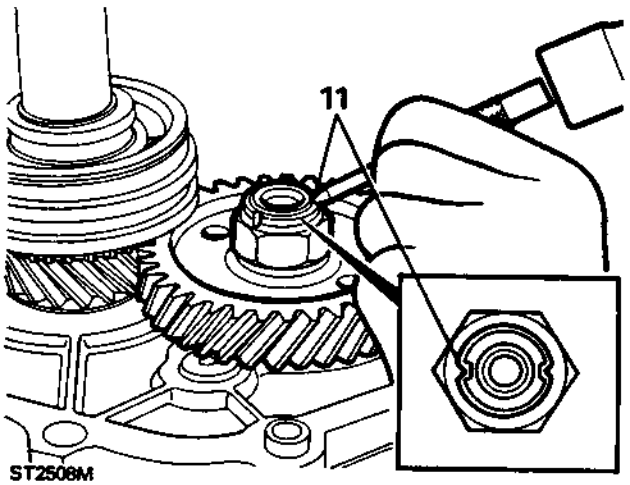
9. Tighten layshaft stake nut using LRT-51-003 (18G 1205).

CAUTION: The practice of locking gears to provide a restraint to tighten the nut is not acceptable due to high torque figure required.

10. Secure tool "A" to gear and gear case and using a suitable torque wrench tighten the nut to the correct torque.

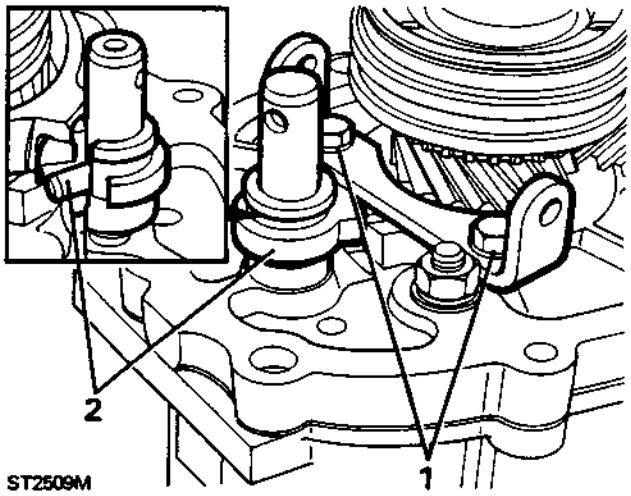


11. Using a round nose punch, form the collar into the layshaft slots.



FIFTH GEAR SELECTOR FORK ASSEMBLY

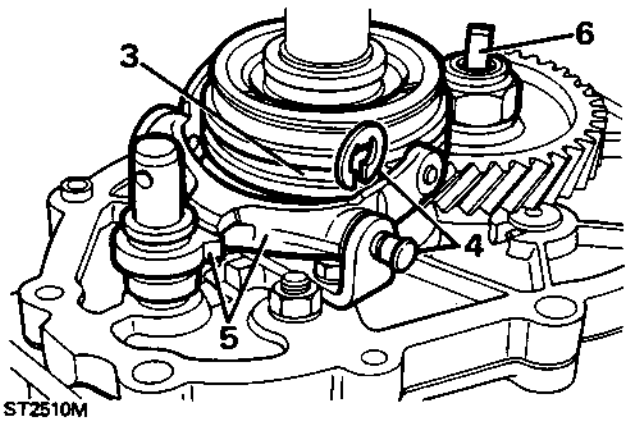
1. Fit fifth gear selector fork bracket.
2. Fit the fifth gear spool long end towards centre plate.



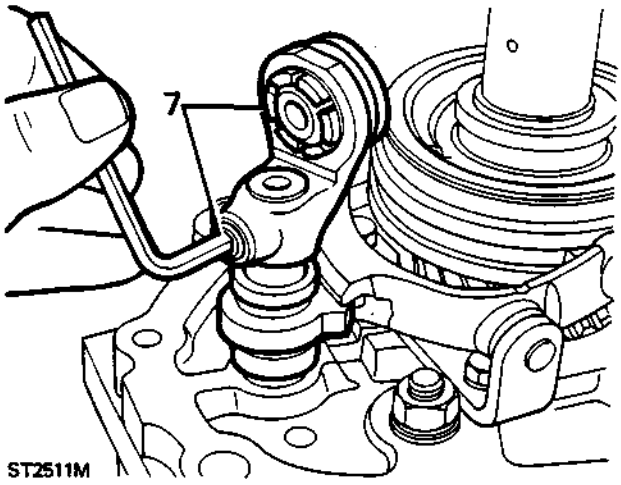
3. Fit slippers to selector fork.
4. Fit fork to synchromesh and secure with pins and "E" clips.

NOTE: Before fitting pins and clips cover holes in centre plate to prevent them falling into casing.

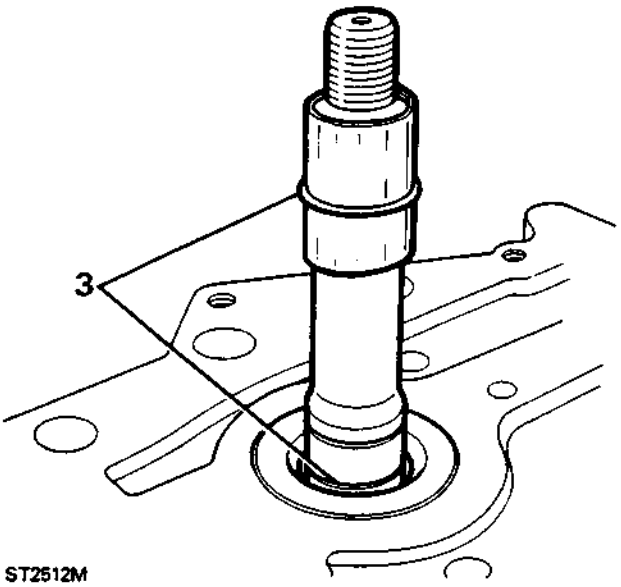
5. Engage tongue of spool in selector fork.
6. Fit oil pump drive to layshaft.



7. Fit yoke to selector shaft and secure with a new Loctite encapsulated grub screw.



ST2511M



ST2512M

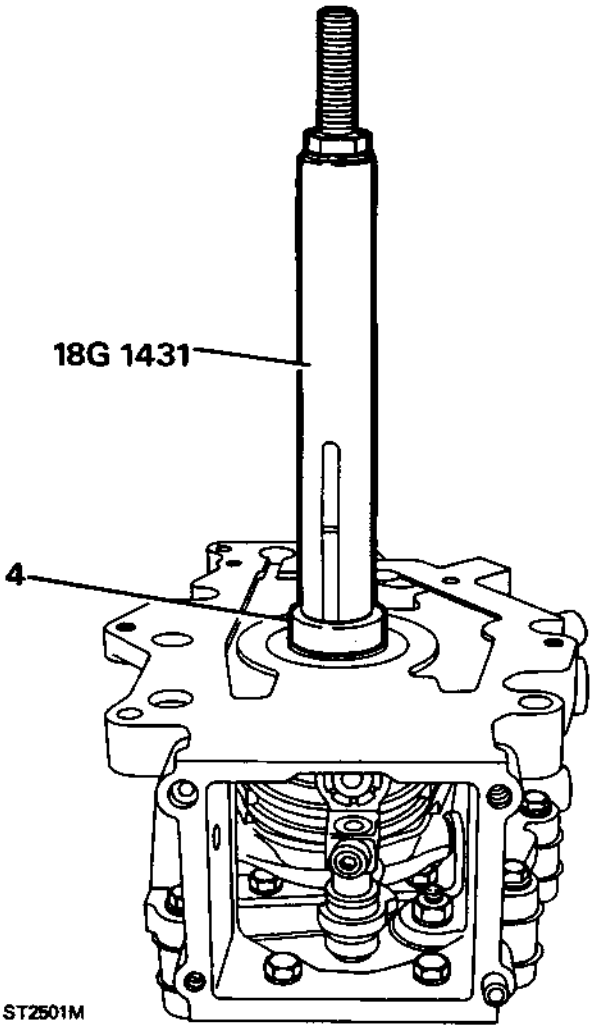
EXTENSION CASE

1. Release centre plate from workstand and fit gasket on joint face.
2. Fit extension case while aligning oil pick-up pipe. Remove guide studs and secure to main case.

△ **NOTE: Do not use force, if necessary remove case and re-align oil pump drive if case does not fit first time.**

⚠ **CAUTION: To protect "O" ring while fitting, cover mainshaft splines with smooth tape.**

3. Fit "O" ring to mainshaft groove.
4. Fit "O" ring collar to mainshaft using LRT-37-015 (18G 1431).



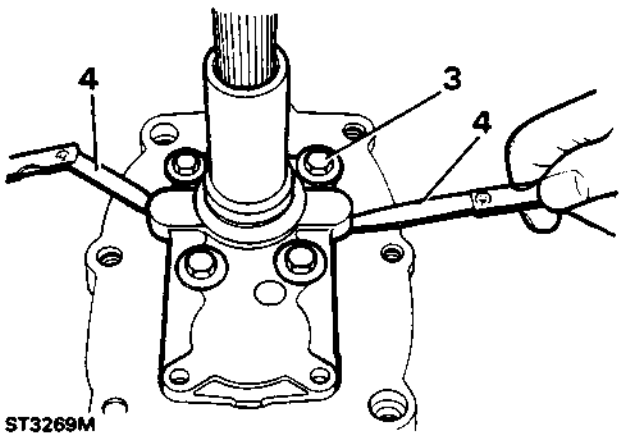
ST2501M

Input-Mainshaft bearing adjustment.

1. Turn gearbox over with input shaft uppermost. Remove layshaft support plate.

△ **NOTE: Correct shimming of the input shaft bearing is vital to ensure that the mainshaft assembly has the design intended end float, and the bearings are not pre-loaded.**

2. Measure the thickness of a new front cover gasket.
3. Place the original shim on mainshaft bearing and finger tighten the bolts.
4. Measure the clearance between front cover and gearcase with two feeler gauges.



5. If required, change the selective washer to provide a clearance of 0,35mm to 0,085mm less than the gasket thickness.

△ **NOTE: This will ensure that when the gasket and cover is fitted to the correct torque, the input and mainshaft bearings will have no pre-load and not more than 0,06mm end float.**

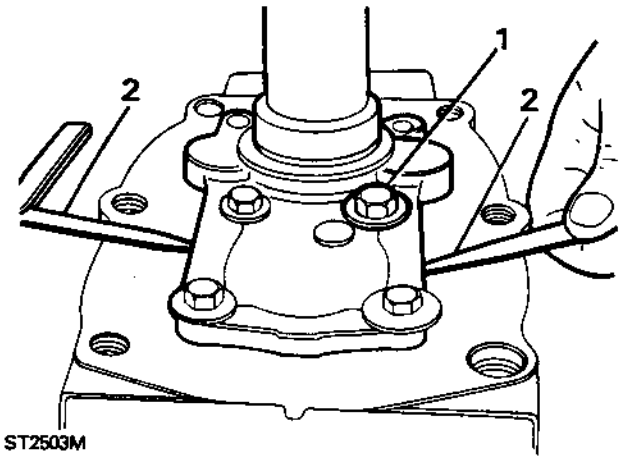
6. Remove front cover and keep gasket and selective washer together.

Mainshaft selective washers

Part Number	Thickness (mm)
FRC 4327	1,51
FRC 4329	1,57
FRC 4331	1,63
FRC 4333	1,69
FRC 4335	1,75
FRC 4337	1,81
FRC 4339	1,87
FRC 4341	1,93
FRC 4343	1,99
FRC 4345	2,05
FRC 4347	2,11
FRC 4349	2,17
FRC 4351	2,23
FRC 4353	2,29
FRC 4355	2,35
FRC 4357	2,41
FRC 4359	2,47
FRC 4361	2,53
FRC 4363	2,59
FRC 4365	2,65
FRC 4367	2,67
FRC 4369	2,77

LAYSHAFT BEARING ADJUSTMENT

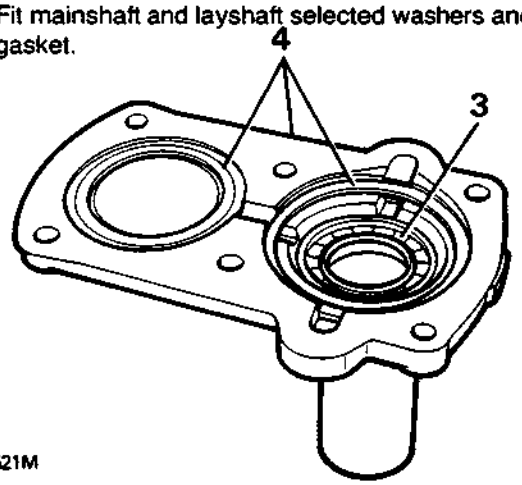
1. Place original selective washer on layshaft bearing, fit front cover without gasket, and finger tighten bolts.
2. Measure clearance, with two feeler gauges, between cover and gearcase. Select a shim that will provide a clearance equal to the thickness of the gasket that was selected and measured when calculating the adjustment of the input and mainshaft bearing.



ST2503M

△ **NOTE: This will ensure zero layshaft bearing end float and not more than 0,025mm pre-load once the cover and gasket are fitted and bolts correctly torqued.**

3. Remove cover and selected washer and fit new oil seal, lip towards gearcase.
4. Fit mainshaft and layshaft selected washers and gasket.



ST2521M

5. Wrap protective tape round input shaft splines.
6. Apply Hylomar PL 32 to bolt threads and secure cover.

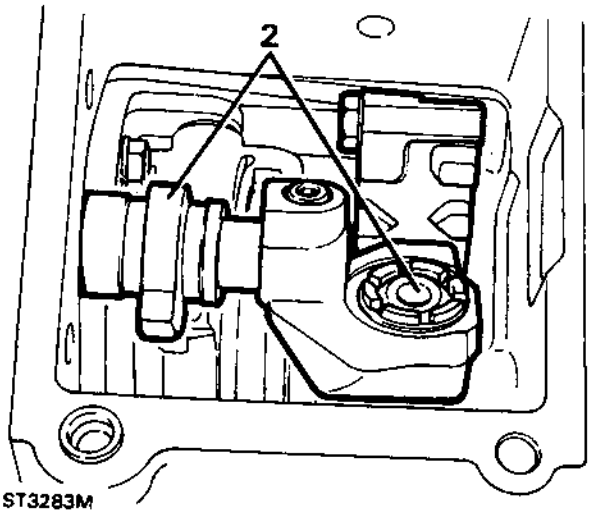
Layshaft selective washers.

Part Number	Thickness (mm)
FTC 0262	1,36
FTC 0264	1,42
FTC 0266	1,48
FTC 0268	1,54
FTC 0270	1,60
FTC 0272	1,66
FTC 0274	1,72
FTC 0276	1,78
FTC 0278	1,84
FTC 0280	1,90
FTC 0282	1,96
FTC 0284	2,02
FTC 0286	2,08
FTC 0288	2,14
FTC 0290	2,20
FTC 0292	2,26
FTC 0294	2,32
FTC 0296	2,38

GEAR CHANGE HOUSING

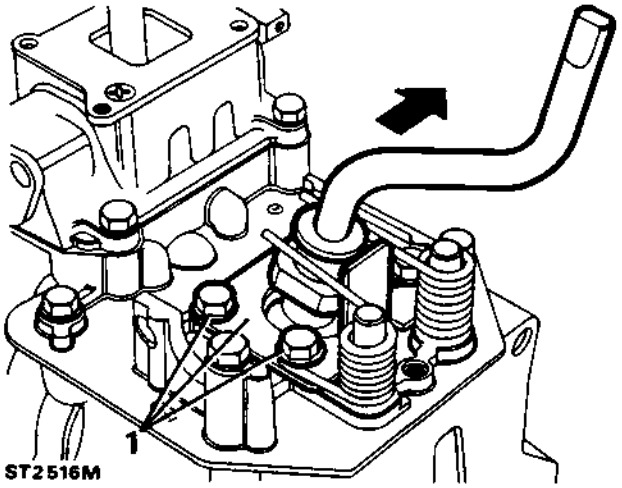
1. Remove gearbox from workstand and place on bench.
2. Fit gasket and gear change assembly to extension housing.

△ **NOTE: Ensure that the gear lever pin passes through the centre of the yoke and engages in the gate plate. Also, the spool retainer must locate over the fifth gear spool.**



Bias adjustment plate setting.

1. Slacken bias adjustment plate bolts. Select fourth gear and move lever fully to right.



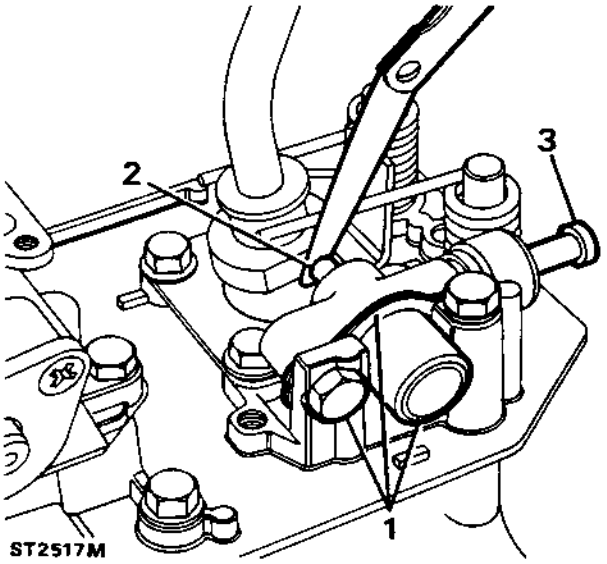
2. Tighten adjustment plate bolts.
3. Check adjustment is correct by selecting third gear then fourth.

Setting reverse gear plunger.

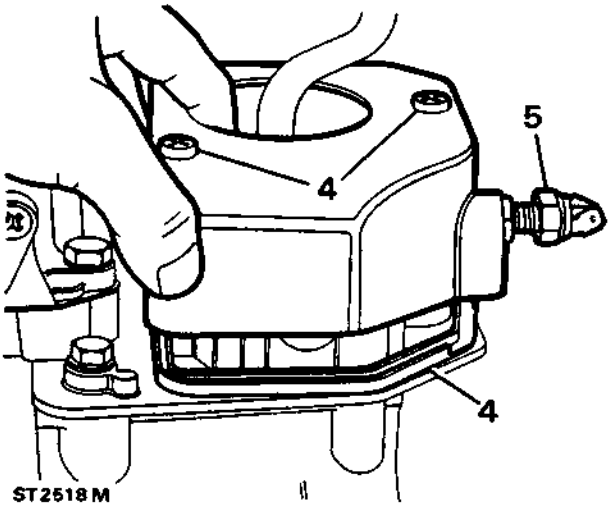
1. Fit plunger and original shims to gear change housing.
2. Select first gear and measure clearance between reverse plunger and flat on side of gear lever.

△ **NOTE: The clearance should be 0,6mm to 0,85mm. Adjust by adding or removing shims.**

3. Fit reverse lamp switch plunger.



4. Fit sealing rubber to gear change housing and fit cover.
5. Fit and adjust reverse lamp switch. ***See ELECTRICAL, Repair, Reverse light switch***
6. Fit bell housing.



LT77S GEARBOX DATA

Reverse lever and slipper pad clearance	0,725 mm
Reverse gear plunger operating load	45 to 55 kg
Synchromesh assemblies push through load	8,2 to 10 kgf
Clearance between baulk rings and gears	0,38 mm
Fifth gear end float	0,020 mm
Third gear end float	0,020 mm
Second gear end float	0,020 mm
First gear bush end float	0,7 mm
First gear end float	0,20 mm
Fifth gear synchromesh end float	0,005 to 0,055 mm
Reverse gear plunger clearance	0,6 to 0.85 mm

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Bottom cover to clutch housing	8
Oil pump to extension case	8
Clip, clutch release lever	8
Spool retainer to gearcase	8
Extension case to gearcase	25
Pivot, clutch lever to bell housing	25
Guide, clutch release sleeve	25
Slave cylinder to bell housing	25
Front cover to gearcase	25
Fifth gear support bracket	25
Bell housing to gearbox	70
Oil drain plug	50
Oil filter plug	70
Breather	15
Oil level plug	30
Gear lever extension to lower lever	25
Fifth gear layshaft stake nut	218
Gear change housing to extension case	25
Reverse plunger to gear change housing	25
Adjustment plate to gear change housing	25
Cover to gear change housing	10
Bell housing to cylinder block	40
Yoke to selector shaft	25
Reverse lever pivot post nut	25
Plug detent ball and spring	25

△ **NOTE: Torque values below are for all screws and bolts used except for those that are specified otherwise.**

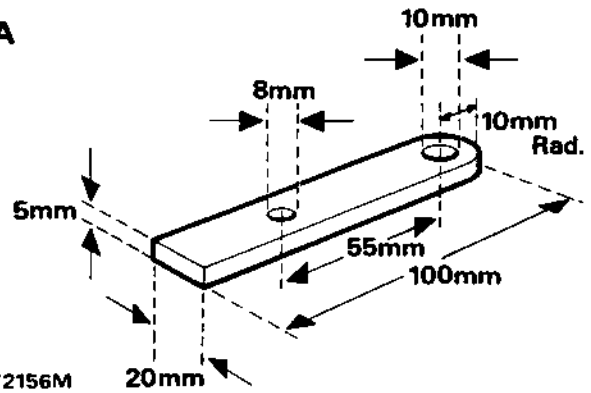
	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

SELF MANUFACTURED TOOLS

The following tools can be self made to aid the dismantling and assembly of the gearbox.

Tool 'A'. Dual purpose tool. Reverse shaft retainer to prevent the shaft falling out when the gearbox in inverted. Also, a layshaft fifth gear retainer to hold the fifth gear whilst releasing stake nut. Use 5mm mild steel to manufacture the tool. When using the tool for the layshaft nut, a suitable spacer is required 20mm diameter 23mm long, with an 8mm diameter clearance hole.

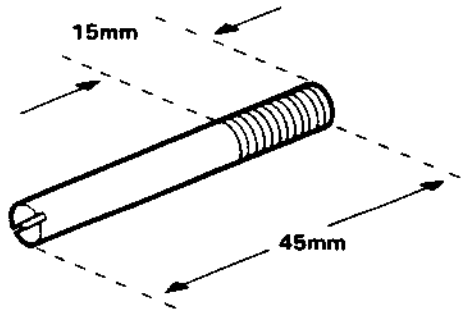
A



ST2156M

Tool 'B'. Four pilot studs with an 8mm thread for locating in the four counter sunk blind holes in the workstand.

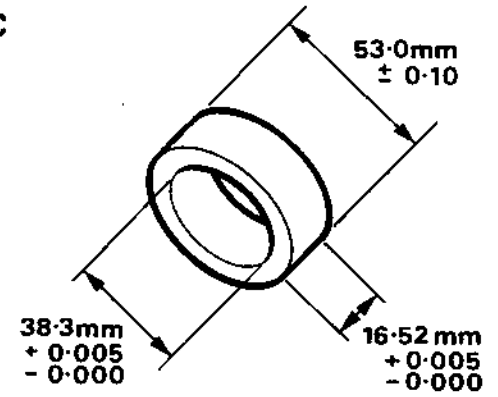
B



ST 2155M

Tool 'C'. Mild steel dummy centre bearing for the selection of first gear bush.

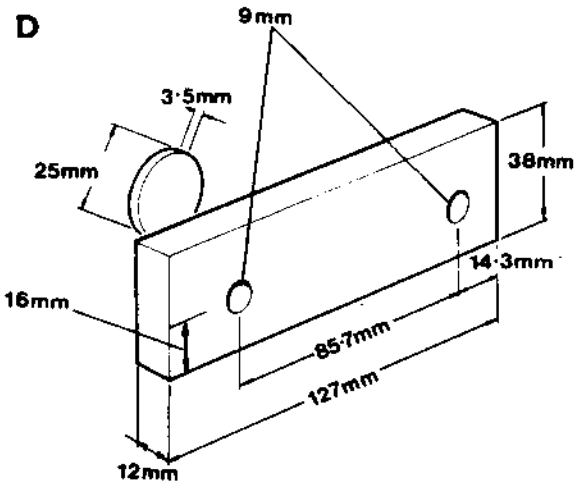
C



ST2154M

Tool 'D'. Layshaft support plate is fitted with two 8 x 25mm bolts and washers to the front of the gearbox case. It also supports the input shaft bearing outer track.

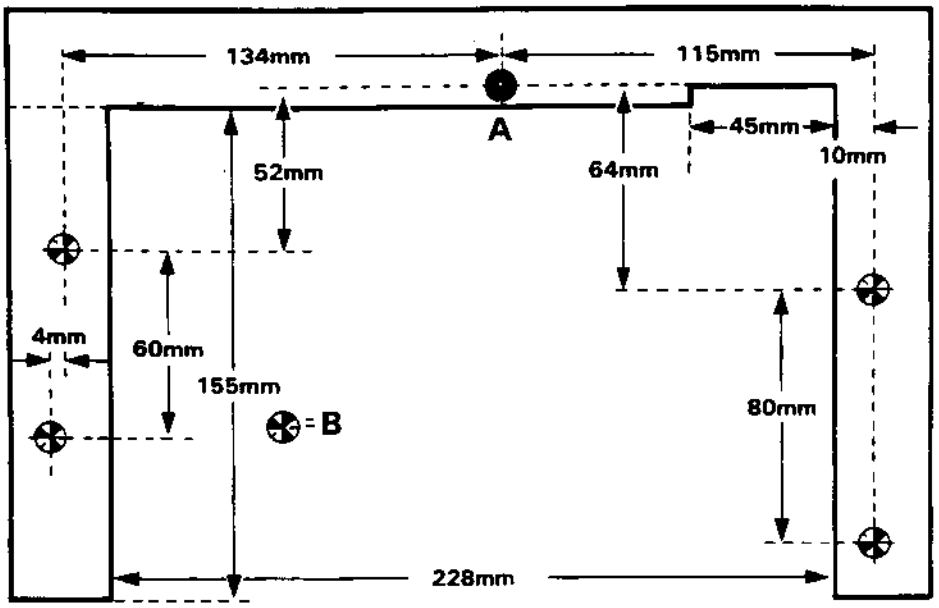
D

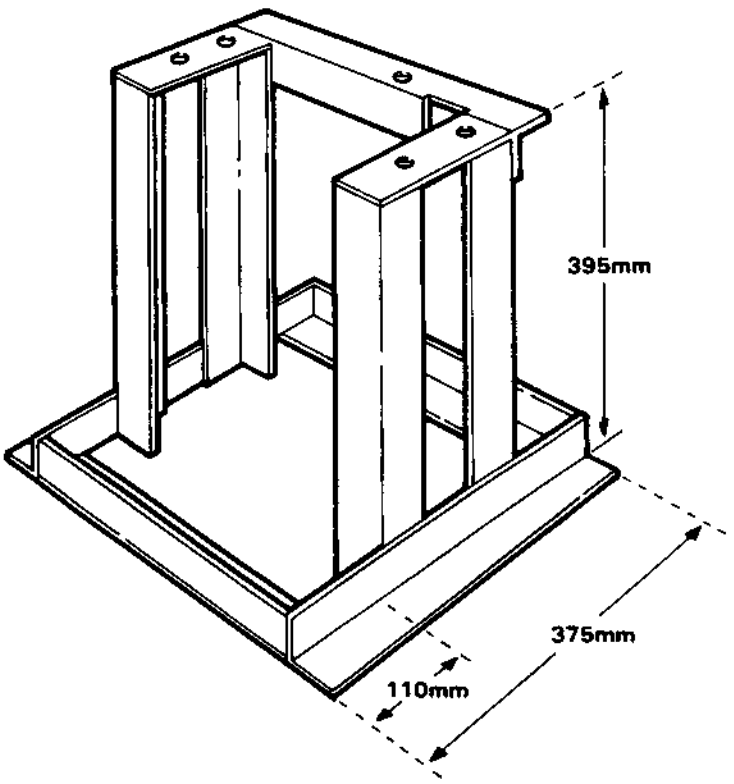


ST1118M

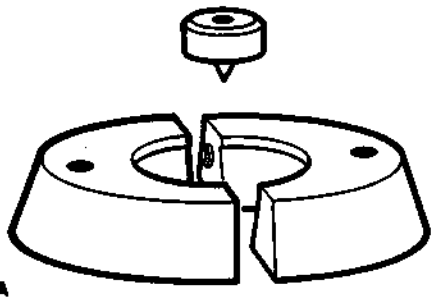
Tool 'E'. Workstand for securely locating the gearbox during overhaul. Manufacture from 30mm x 30mm angle iron. The single hole marked 'A' should be drilled through the material with a 10mm drill.

The four counter sunk blind holes marked 'B' should also be made with a 10mm drill, but must not be drilled through the material.



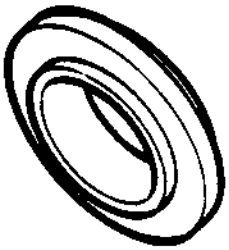


ST2153M



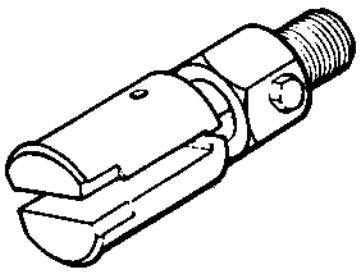
18G47BA

LRT-37-001 Layshaft bearing remover adaptor.
18G.47BA



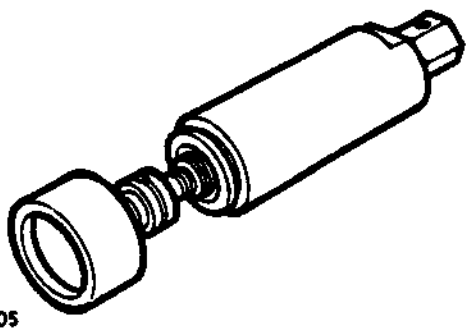
18G47BAX

LRT-37-002 Conversion kit to primary shaft
18G.47BAX bearing remover.



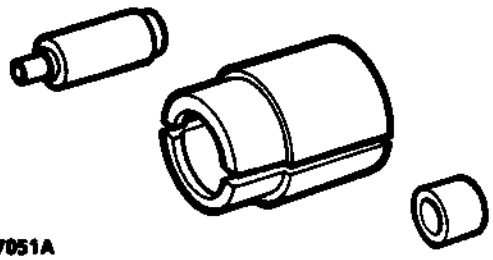
8G284AAH

LRT-37-004 Adaptor remover input shaft pilot
18G.284AAH bearing track.



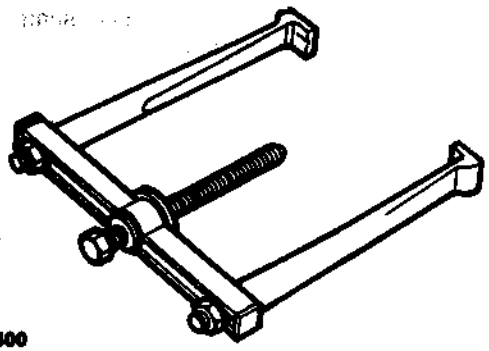
18G705

LRT-37-009 Remover bearing race centre - main
18G.705 tool.



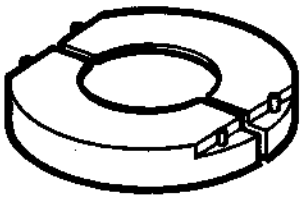
18G7051A

LRT-37-010 Adaptor - remover mainshaft oil seal
18G.705-1A track layshaft 5th gear.



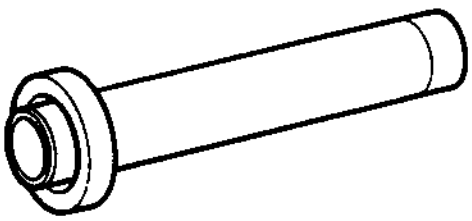
18G1400

LRT-37-012 Remover 1st speed synchromesh hub
18G.1400 and gear cluster.



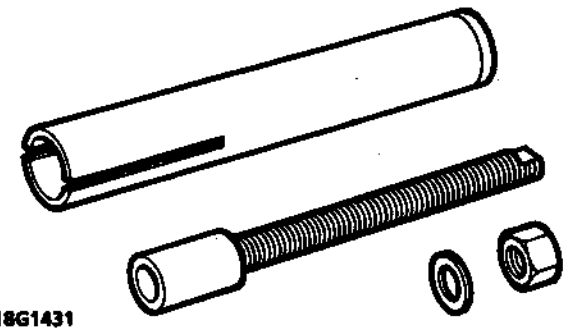
18G14001

LRT-37-013 Adaptor mainshaft 5th gear remover.
18G.1400-1



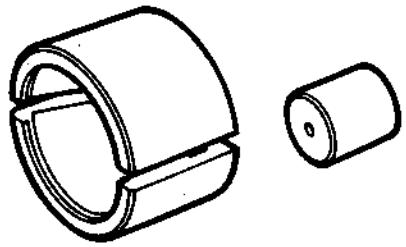
18G1422

LRT-37-014 Mainshaft rear oil seal replacer
18G.1422



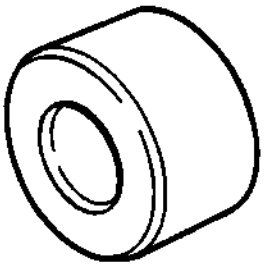
18G1431

LRT-37-015 Mainshaft 5th gear and oil seal collar
18G.1431 replacer.



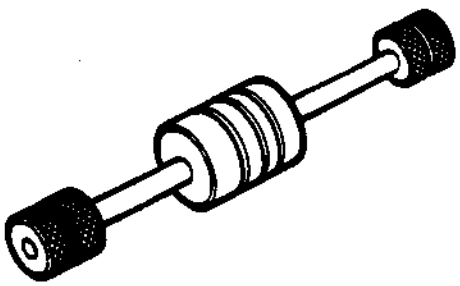
18G7057

LRT-37-017 Layshaft bearing remover.
18G.705-7



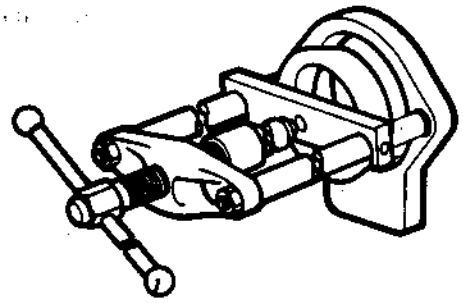
605774A

LRT-37-018 Dummy bearing.



18G284

LRT-99-004 Impulse extractor.
18G.284



MS47

LRT-99-002 Hand press.
MS.47

41 - TRANSFER BOX

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BORG WARNER

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Notes

DESCRIPTION

The Borg Warner transfer gearbox incorporates a single epicyclic gear set which is driven by the main gearbox output shaft to provide high, neutral or low gear ratios.

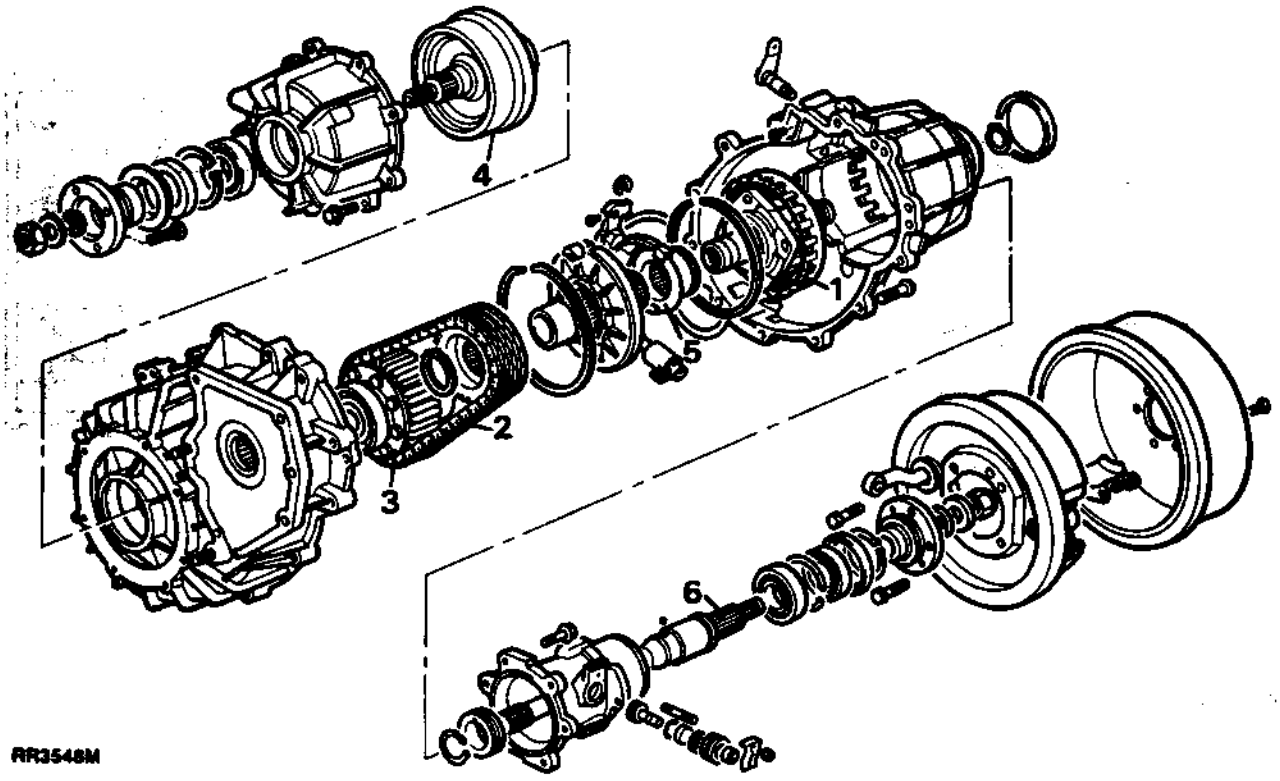
With high or low gear selected, power is transmitted by a Morse Chain to the front and rear output shafts via a differential and a limited slip viscous unit.

The gear lever allows neutral, high or low to be selected. A differential lock is not necessary as this function is automatically performed by the viscous coupling unit.

Lubrication is by a low pressure plunger type oil pump, driven by the epicyclic gear set. Oil is delivered to the gears and bearings via oilways in the components.

The viscous coupling though partly immersed in lubricating oil, is a self contained and sealed unit.

Illustration RR3548M showing the component parts of the transfer box, is a useful cross reference when studying the following power flow diagrams.



RR3548M

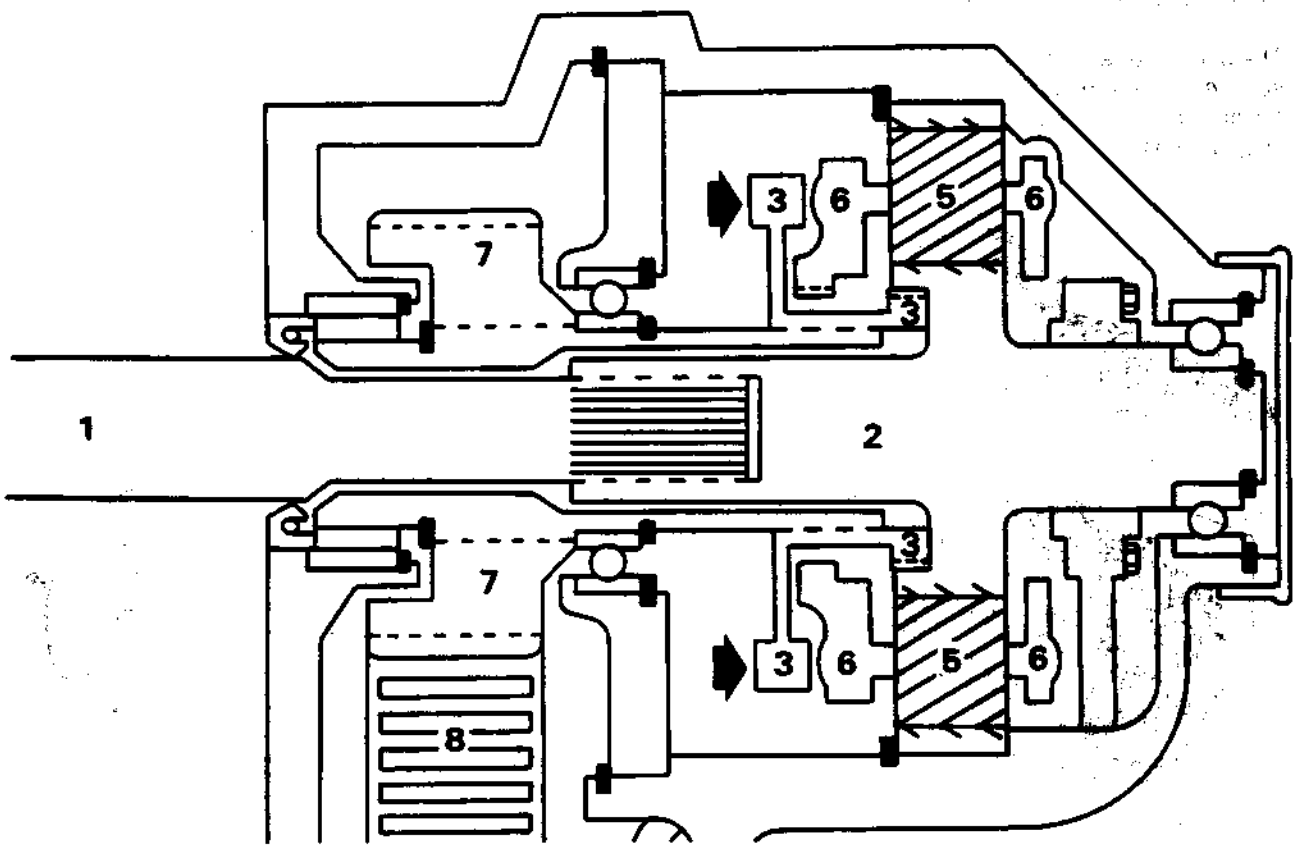
1. Epicyclic gear set
2. Morse chain
3. Differential
4. Viscous unit/front output shaft
5. High,neutral,low selection sleeve
6. Rear output shaft

Power flow - operation

Broken lines in the following illustration indicate gear or sliding splined connections.

High ratio

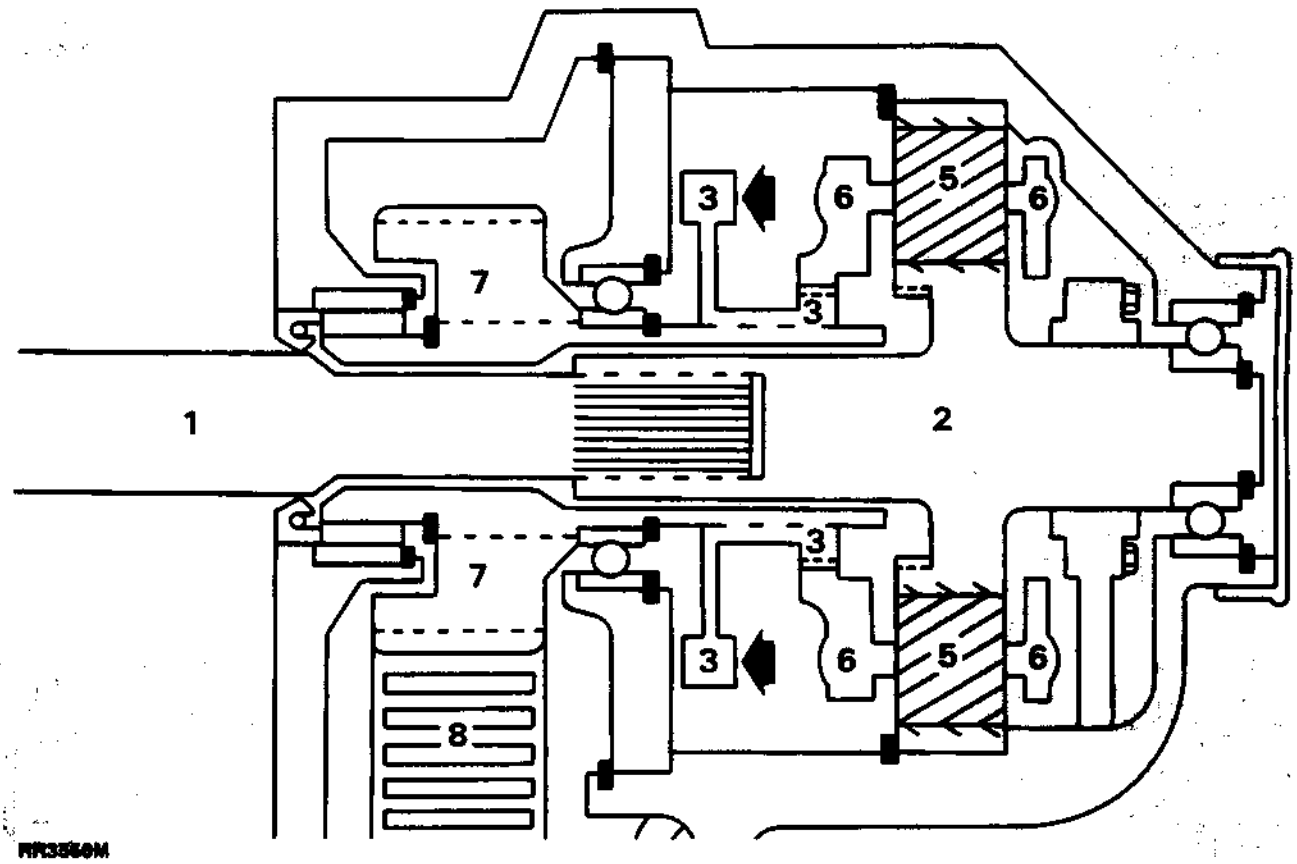
Moving the gear lever to the high position seen in RR3551M causes the sleeve 3 to engage directly with the sungear 2, allowing the power to by-pass the planetary gear set 5 and provide a direct drive to the drive sprocket 7, and Morse chain 8 to the differential and output shafts.



RR3551M

Low ratio

In low gear the selector sleeve 3 connects with the planet carrier 6 and planet gears 5 to provide low ratio.



RR3350M

Differential and viscous coupling

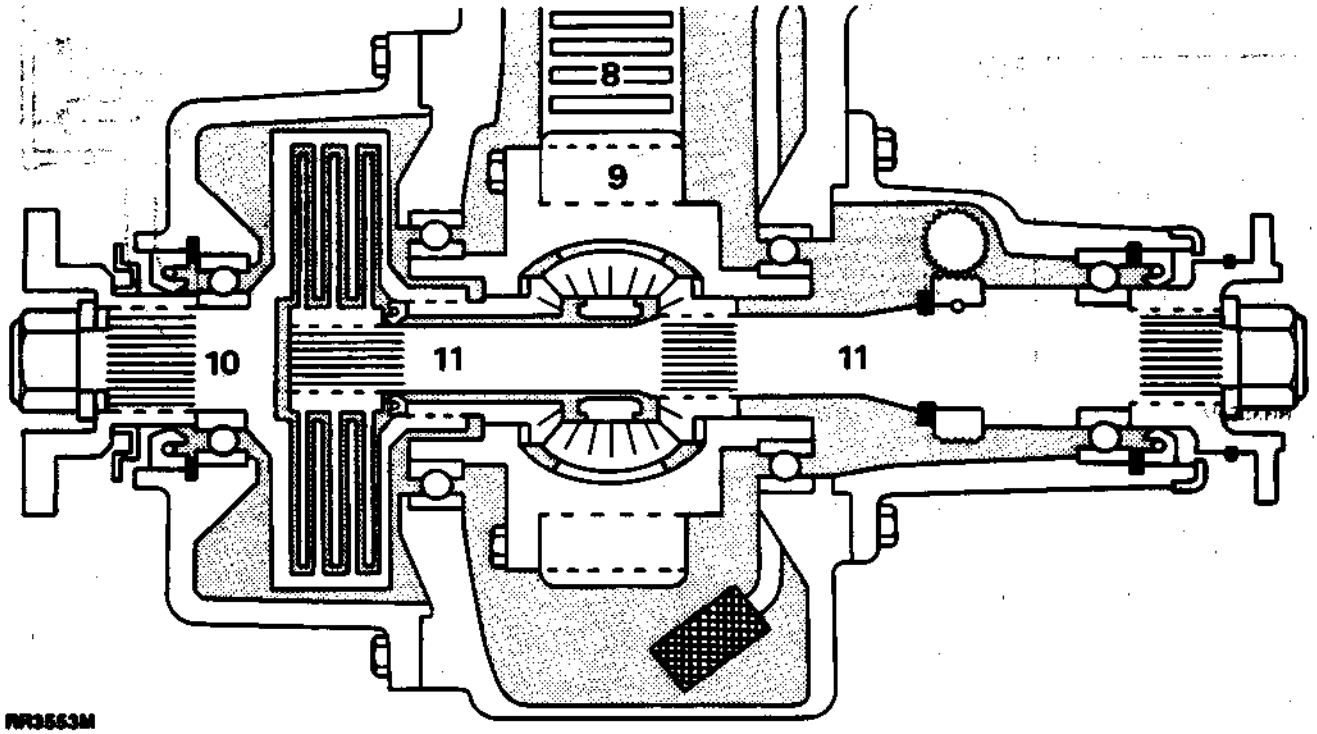
The Morse chain 8 drives a conventional type differential 9. The front and rear output shafts 10 and 11 are splined to the differential output pinions. The front output shaft 10 forms the outer member of the viscous coupling, while the inner member plates are splined to the rear output shaft 11.

Its only function is to limit the maximum difference in speed between the two shafts, with the effect of automatically locking the differential.

The maximum difference in speed permitted by the viscous coupling must however be sufficient to allow the vehicle to be driven on a dry road surface, in a circle on full lock, without inducing 'wind up' or causing damage to the transmission caused by wind up.

The viscous coupling has alternate plates splined to the inner and outer members.

One set of plates is splined to 10, the outer member/front shaft and the other plates are splined to the rear output shaft 11. The coupling is filled with a special silicone jelly which allows sufficient slip to occur in normal driving conditions but, which increase the drag between the plates as the speed difference and temperature rises, thus eliminating the need for a manual differential lock.



RR3553M

BORG WARNER - SYMPTOMS

Oil leaks

1. Check that nylon ventilation pipes are not blocked or damaged.
2. Check lubrication level and specification in both boxes and recheck leaks.
3. Location area of leak.

A - Transfer box front output flange oil seal.

B - Transfer box rear output flange oil seal.

C - Oil leaking from vent hole between main and transfer boxes.
The oil may be leaking from the main or transfer box oil seals. Renew the faulty seal.

D - Oil leaking from engine flywheel housing.
The oil may be leaking from the gearbox front seal, torque converter seal or the engine crankshaft rear seal. Renew the faulty seal.

Loss of drive - no abnormal noise from box.

1. Check that the main transmission unit is satisfactory and confirm that loss of drive is in the transfer box.
2. Check by 'feel' the operation of the High/Low transfer gear selection. Suspect failed viscous unit.

Knocking or rattling noise in high and low ratio.

1. Check lubricant specification and level, if low do not top up at this stage.
2. Drain lubricant and check for contamination or metal particles.
Suspect drive chain has stretched.

Abnormal noise in operation.

1. Check lubricant specification and level, if low do not top up at this stage.
2. Drain lubricant and check for contamination or metal particles.
Suspect oil pump failure, mechanical wear or damage.

Transmission wind up

'Transmission wind up' is a build up of tension in the transmission which will only occur if either the differential or viscous unit is partially or completely seized.

Vibration - harshness

1. Check operation of differential and viscous units. Ensure that neither is partially seized.

△ **NOTE: If both are satisfactory, but the vibration - harshness is still present, the alignment of the propeller shafts and balance of the road wheels should be checked.**

For balancing of road wheels. ***See WHEELS AND TYRES, Repair, Wheel balancing***

For propeller shaft alignment. ***See PROPELLER SHAFTS, Description and operation, Propeller shaft alignment***

Notes

REAR OUTPUT SHAFT OIL SEAL

Service tool: 18G1422

1. Disconnect rear propeller shaft from output drive flange and tie shaft to one side.
2. Apply parkbrake and release drive flange nut.
3. Release parkbrake and remove brake drum secured with two screws.
4. Remove oil catcher secured to backplate with two bolts.
5. Remove output shaft nut, steel washer, rubber seal and withdraw flange.
6. Tap dust cover from housing and remove oil seal.
7. Lubricate and fit new seal using service tool 18G1422. Fit so spring side of seal abuts circlip.
8. Fit dust cover.
9. If necessary release circlip from drive flange to allow new bolts to be installed.
10. Examine flange, if surface is corroded or a groove worn by previous seal discard flange.
11. Lubricate running surface and fit flange. Do not tighten nut.
12. Seal oil catcher to back plate using silicone rubber sealant and secure with two bolts.
13. Fit brake drum and secure with two screws. Apply parkbrake and tighten drive flange nut to ***224 Nm***
14. Fit propeller shaft. Tighten nuts to ***46 Nm***

FRONT OUTPUT SHAFT OIL SEAL

Service tool: 18G1422

1. Disconnect front propeller shaft from flange.
2. Apply parkbrake and release drive flange nut.
3. Remove output shaft nut, steel washer, rubber seal and withdraw flange.
4. Prise out oil seal.
5. Lubricate and fit new seal using service tool 18G1422. Fit spring side of seal abuting circlip.
6. Examine flange if surface is corroded or worn by previous seal discard flange.
7. Lubricate seal running surface of flange.
8. Fit flange. Tighten to ***224 Nm***
9. Refit propeller shaft. Tighten nuts to ***46 Nm***

BORG WARNER TRANSFER GEARBOX

Service repair no - 41.20.25.

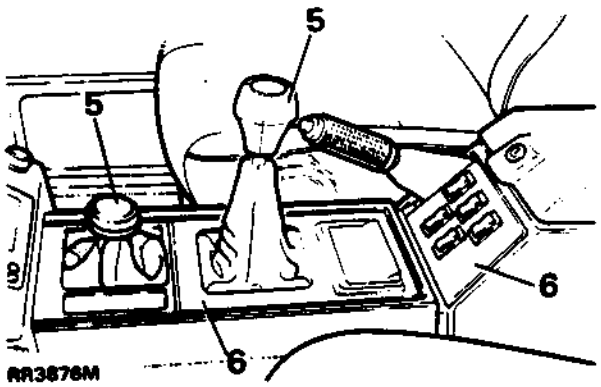
Remove and refit

Remove

1. Site vehicle on ramp and chock wheels.
2. Disconnect the battery negative lead.
3. Remove fan blade assembly.

△ **NOTE: The nut securing viscous unit has left hand thread.**

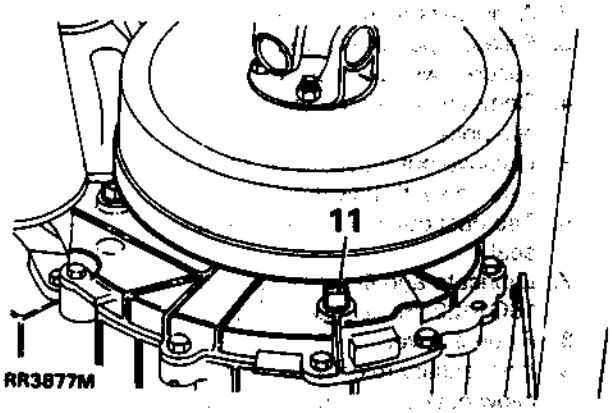
4. Disconnect airflow meter to plenum chamber hose.
5. Remove two gear lever knobs. If Automatic type remove gear selector. ***See ELECTRICAL, Repair, Automatic gear selector - panel illumination***



6. Remove floor mounted console assembly. ***See CHASSIS AND BODY, Repair, Glovebox and floor mounted console assembly***
7. Remove padding from top of transmission tunnel.
8. Loosen pinch bolt and remove upper gear lever.
9. Remove screws and detach high low lever and main gearlever retaining plates.

Underneath vehicle

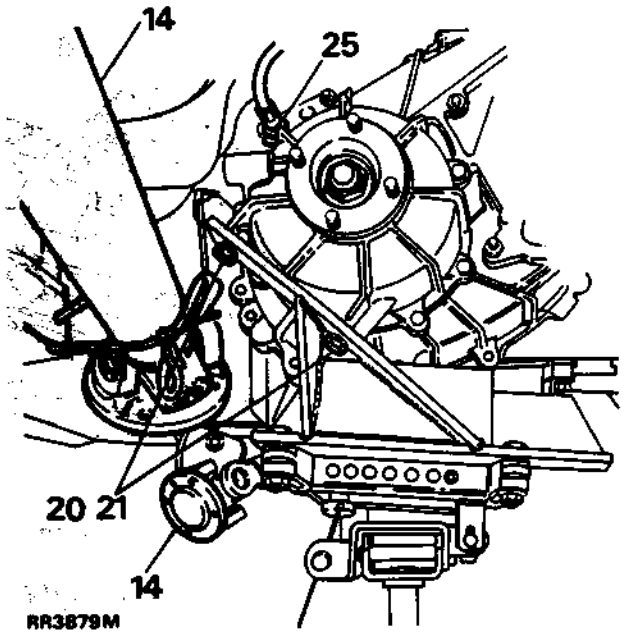
10. Drain oil from transfer gearbox.
11. Refit plug.



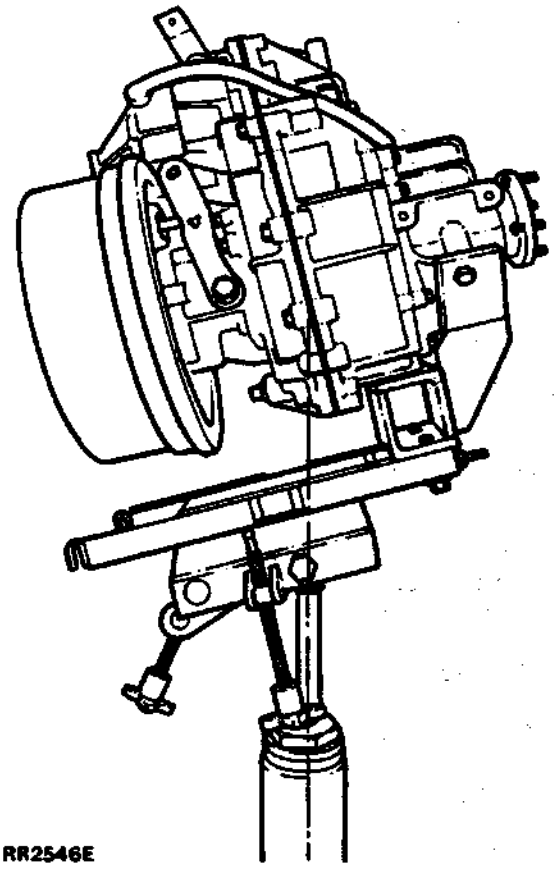
12. Disconnect Llambda sensor and remove front section of exhausts.
13. Remove chassis cross member secured by eight nuts and bolts.
14. Mark each drive flange for reassembly and disconnect front and rear propeller shafts from transfer box. Tie the shafts to one side.
15. Release clamp and disconnect speedometer cable from rear output housing.
16. Release cable from left hand side of transfer gearbox. Tie cable to one side.
17. Remove two bolts and withdraw clutch slave cylinder from bell housing. If automatic remove fixings securing tie bar to transmission.

Remove transmission assembly

18. Position a suitable transmission hoist on rear output housing to support weight of assembly.
19. Remove fixings and withdraw transfer gearbox mountings.



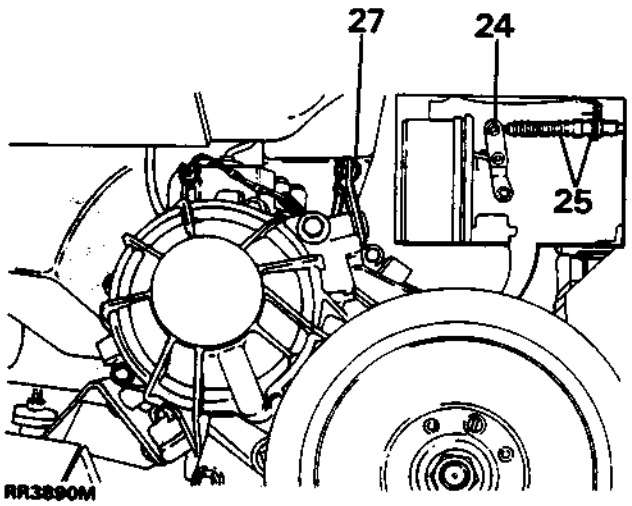
RR3879M


RR2546E

20. Fit adaptor plate to transmission hoist. Raise hoist and position under transfer box. ***See Service tools, Adapter plate transfer box***

△ **NOTE: Centralise adaptor plate on hoist platform so split line of gearbox is aligned with centre of ram.**

21. Secure fixture to transfer box mounting points.
22. Remove hoist from rear of transfer box.
23. Lower transmission until top of transfer gearbox clears rear floor.
24. Disconnect handbrake cable.
25. Remove clip securing handbrake outer cable to support bracket,feed cable through bracket, and tie to one side.
26. Remove breather pipe from top of gearbox.
27. Remove high/low rod from gearbox selector lever.



28. Support main gearbox with hoist and detach transfer gearbox.
29. Remove upper and lower bolts and two nuts securing transfer box to main gearbox.
30. Move transfer gearbox rearwards to detach it.

Refit Transfer Gearbox

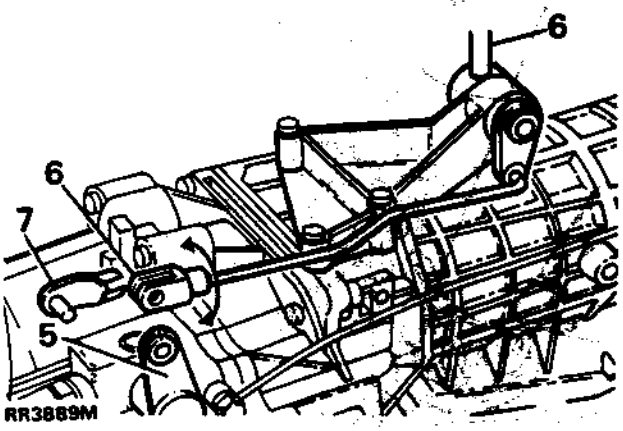
1. Clean joint faces of transfer gearbox and main gearbox.
2. Lubricate oil seal in joint face of transfer gearbox.
3. Fit gearbox to adaptor plate on hoist. Raise hoist until input shaft enters transfer gearbox.

CAUTION: Ensure input shaft splines do not damage oil seal in transfer gearbox.

4. Fit transfer gearbox to main gearbox with nuts onto two studs. Fit remaining bolts.

Transfer gearbox high/low link adjustment

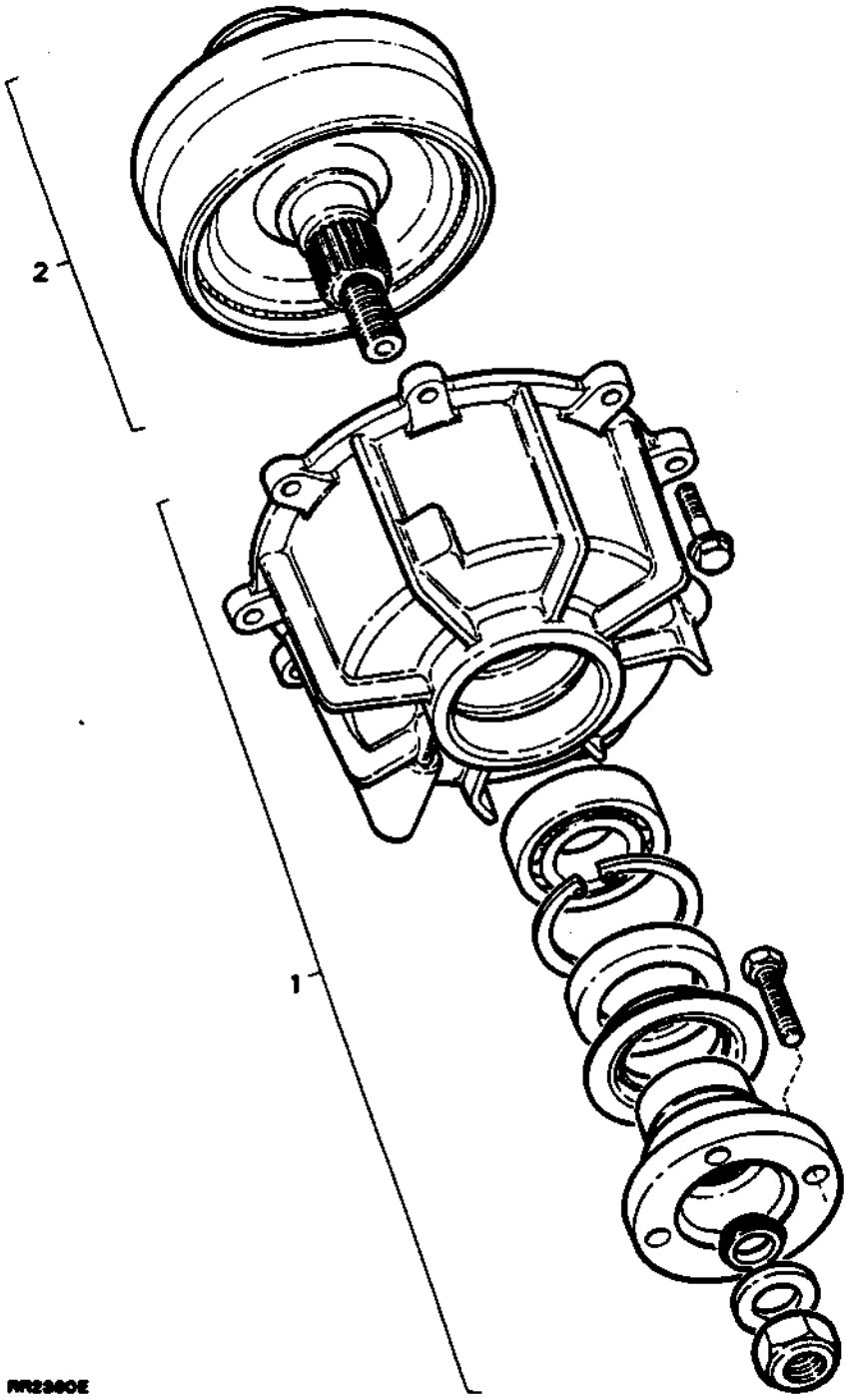
5. Select neutral gear position.
6. Set transfer gearbox lever in a vertical position. Rotate clevis on end of rod until hole aligns with hole in selector lever.
7. Fit clevis pin and retaining clip. Select high and low transfer to prove operation



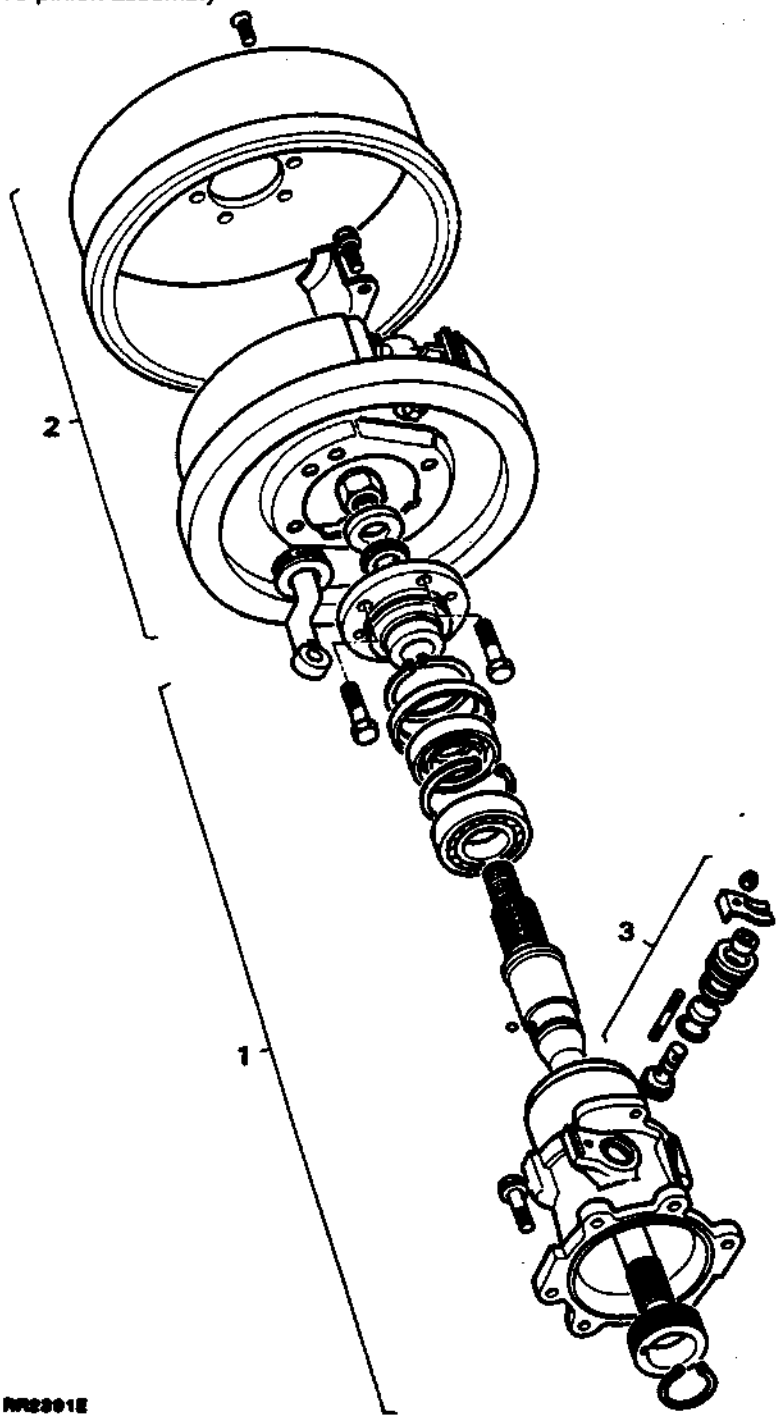
8. Reverse removal instructions, noting following points.
9. Fit mounting bracket to gearbox. Tighten to ***102 Nm***
10. Fit three fixings which secure right hand mounting bracket to chassis. Tighten to ***45 Nm***
11. Fit propeller shafts. Tighten nuts to ***46Nm***
12. Refill transfer gearbox with oil. See maintenance schedule - check / top up transfer gearbox oil. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
13. Check operation of parkbrake and adjust if necessary. ***See BRAKES, Repair, Parking brake cable***

BORG WARNER GEARBOX ILLUSTRATED ASSEMBLIES

1. Front output housing assembly
2. Viscous unit

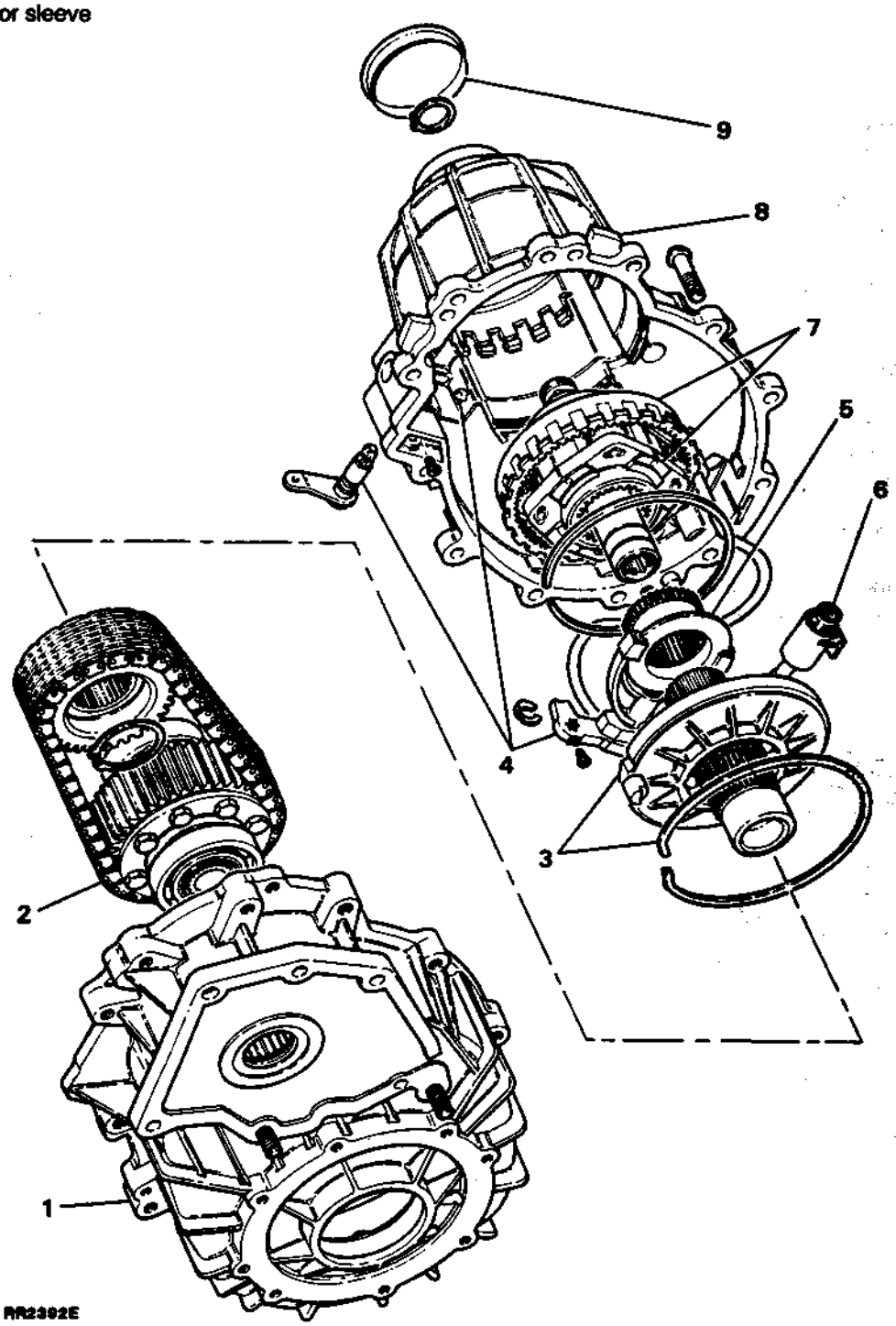


1. Rear output housing and output shaft assembly
2. Transmission brake drum assembly
3. Speedometer drive pinion assembly



RR2301E

1. Front cover - main casing
2. Transfer sprocket, centre differential assembly, driven sprocket and chain
3. Bearing carrier and transfer shaft
4. Selector fork and lever assembly
5. Selector sleeve
6. Oil pickup pipe and filter
7. Planetary set (epicyclic unit)
8. Rear cover - main case
9. End cap



RR2392E

BORG WARNER TRANSFER GEARBOX

DISMANTLING, OVERHAUL AND REASSEMBLY

Service Tools *See Service tools, Adapter plate transfer box*

18G1422 - Oil seal replacer
18G1205 - Adjustable flange holding wrench
18G134 - Bearing and oil seal replacer
LST550 - 6 - Input shaft oil seal replacer

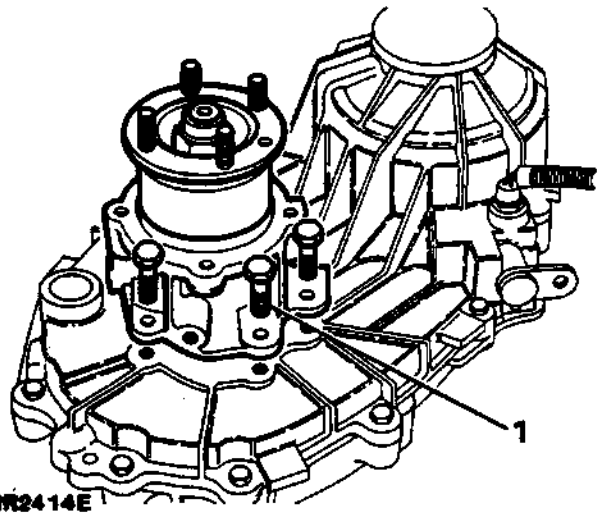
△ **NOTE: Before commencing the overhaul procedure thorougly clean the exterior of the transfer gearbox. If the gearbox oil has not previously been drained, drain the oil into a suitable container.**

DISMANTLING

△ **NOTE: Before commencing the dismantling procedure remove the brake drum assembly.**

Rear output housing

1. Remove the six bolts and withdraw the rear output housing complete with output shaft.

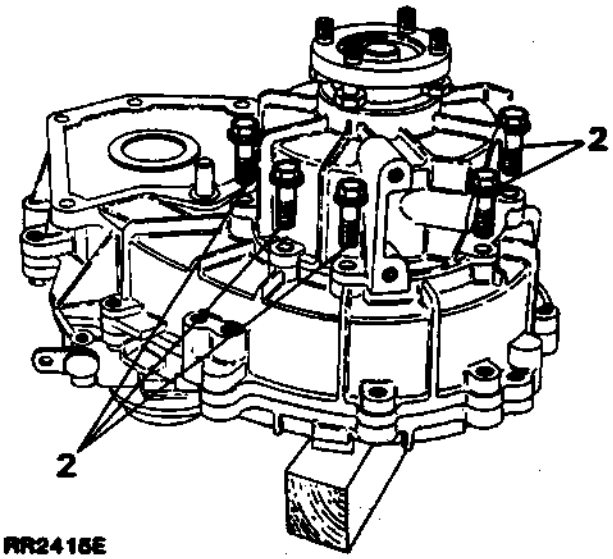


RR2414E

Front output housing

△ **NOTE: Invert the gearbox. Level up the assembly by placing wooden blocks under the transfer gearbox to main gearbox joint face.**

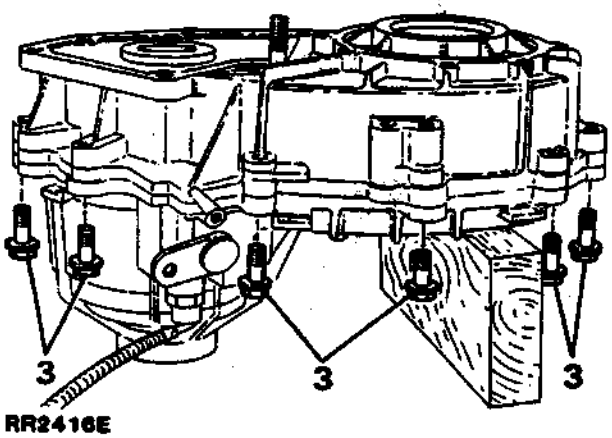
2. Remove the eight bolts and withdraw the front output housing complete with viscous unit.



RR2415E

Front cover - main casing

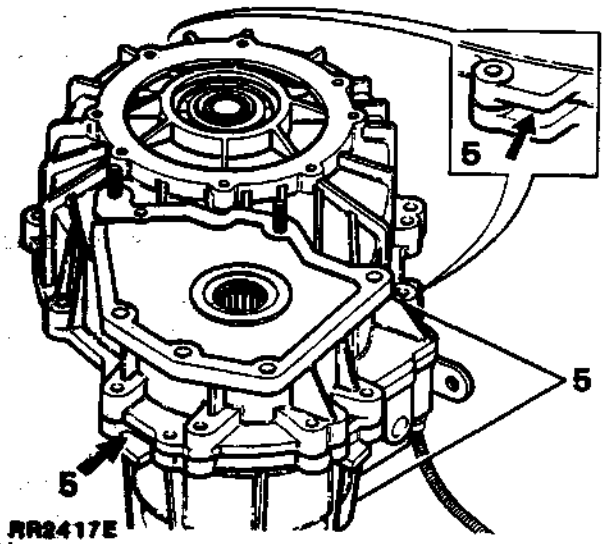
3. Remove the eleven bolts securing the front and rear cover (main case) together.



RR2416E

4. Clean any previous sealant from the threads of the bolts.
5. Using two levers between the cast lugs on the outer edges of the casing, to assist in separating the gearbox, carefully prise the front cover from the rear cover.

CAUTION: Do not lever between the mating faces.

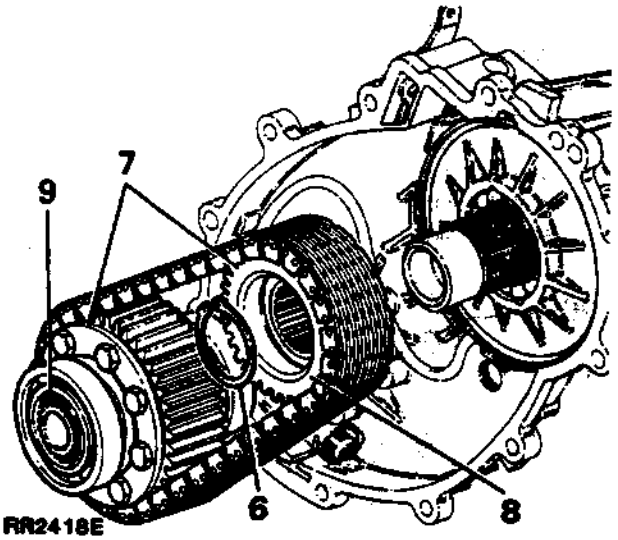


RR2417E

Transfer sprocket, centre differential, assembly and chain

NOTE: Before dismantling, mark one chain link and corresponding tooth on the transfer sprocket with an identification line. This is to ensure that the balance of the unit is maintained when reassembled with original components and that the chain is fitted the correct way up.

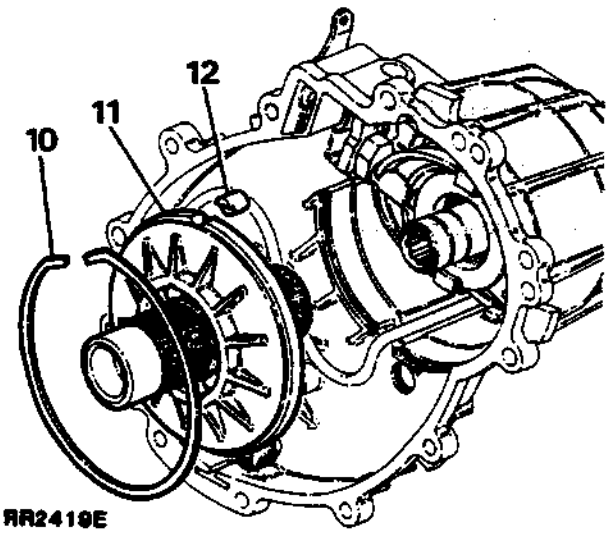
6. Remove the circlip retaining the transfer sprocket to the transfer shaft.
7. Place two thin pieces of wood on the joint face to prevent damage and using two levers behind the differential assembly carefully lever the differential bearing from its bore while simultaneously easing the transfer sprocket off the transfer shaft to maintain alignment during removal.
8. Remove the transfer sprocket from the chain.
9. Remove the differential assembly from the chain.



RR2418E

Bearing carrier and transfer shaft

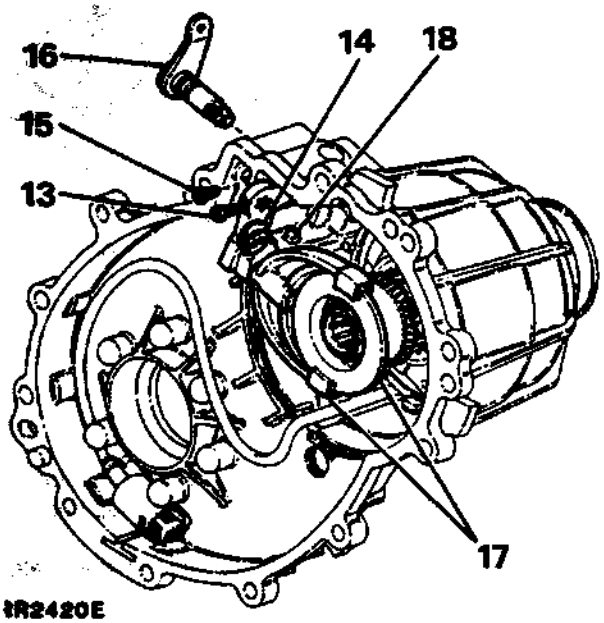
10. Insert a screw driver between the anti - rotation dowel and snap ring gently prise the snap ring out of the groove.
11. Withdraw the carrier complete with transfer shaft.
12. Withdraw the anti - rotation dowel.



RR2419E

Selector fork assembly

13. Using Torx bit 25 remove the screw securing the selector arm to the selector lever shaft.
14. Remove the retaining clip securing the selector fork arm to the selector lever shaft.
15. Using Torx bit 25 remove the screw retaining the selector lever.
16. Remove the selector lever shaft from the case and fork assembly.
17. Withdraw the selector fork assembly and selector sleeve.

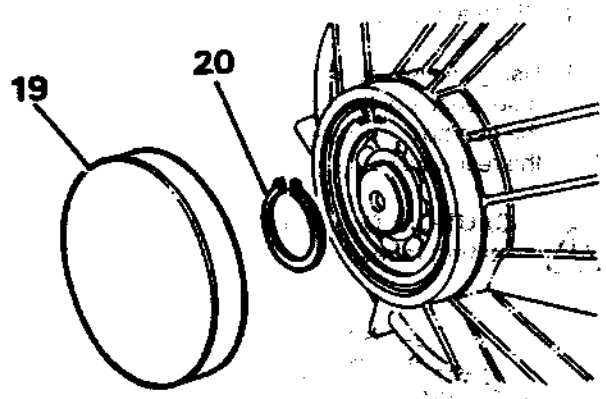


RR2420E

18. Retrieve the selector plunger and spring from the rear cover.

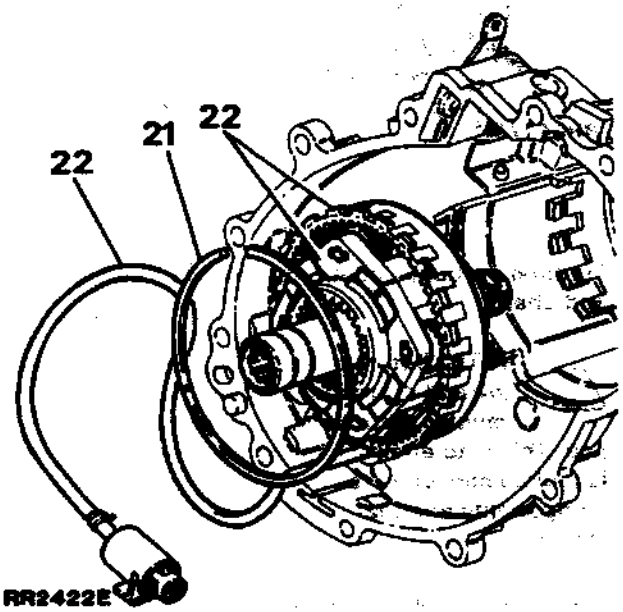
Planetary set (Epicyclic unit)

19. Turn the case over and prise the end cap off the planetary set housing.
20. Remove the circlip retaining the sun gear shaft.



RR2421E

21. Turn the casing over and remove the large snap ring retaining the planetary set.
22. Withdraw the annulus and planetary assembly from the planetary set housing, complete with oil pump, feed pipe and filter.

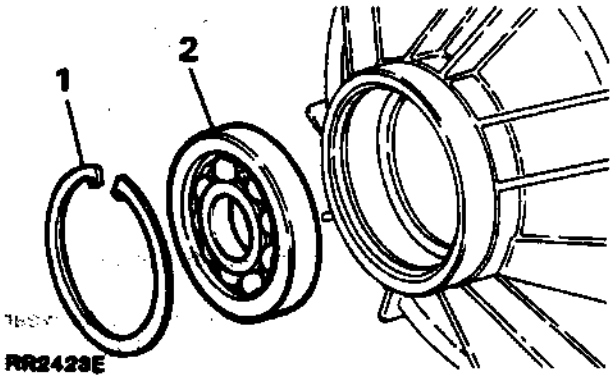


RR2422E

DISMANTLE, INSPECTION AND OVERHAUL

Rear cover main case - Dismantle and inspection

1. Remove the circlip retaining the bearing in the rear cover.
2. Drive or press the bearing from the cover and discard the bearing.



RR2423E

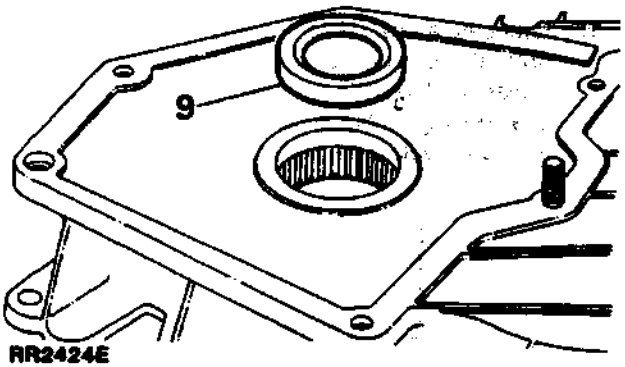
3. Remove any previous sealant evident on the rear cover joint faces.
4. Using a suitable solvent thoroughly clean the cover.
5. Examine the cover for damage, cracks and porosity, renew if necessary.
6. Check the selector lever shaft bore, for ovality and wear. If worn renew the cover.

Rear cover main case - Assemble

7. Drive or press a new bearing into the cover and secure in position with the circlip.
8. Place the cover aside until the gearbox is ready to be assembled.

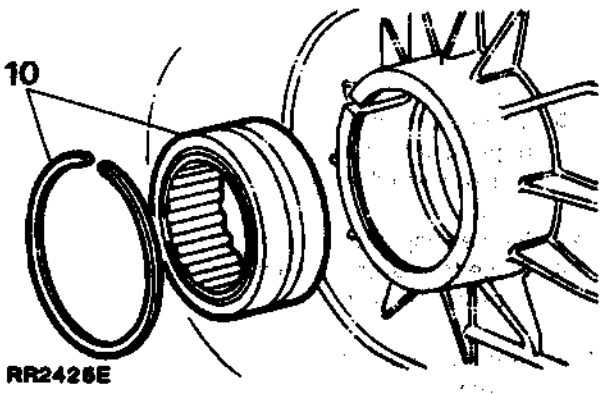
Front cover main case - Dismantle and inspection

9. Prise the input shaft oil seal from the front cover and discard the oil seal.



RR2424E

10. Remove the snap ring retaining the needle roller bearing, withdraw the bearing and discard.

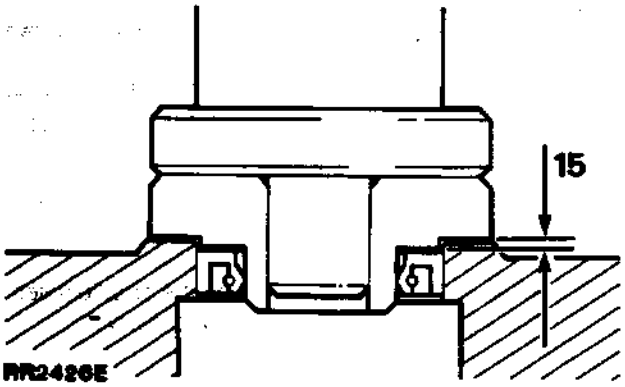


RR2426E

11. Remove any previous sealant from the joint faces of the front cover.
12. Thoroughly clean the cover using a suitable solvent.
13. Examine the cover for damage, cracks and porosity, renew if necessary.
14. Check the inside edges of the case for witness marks which may indicate a chain that has stretched.

Front cover main case - Assemble

15. Lubricate a new oil seal. Using service tool LST 550 - 6 in conjunction with bearing and oil seal replacer 18G134 fit the seal, open side of the seal leading, until the face of the seal is 1 mm (0.039 in) below the surface of the boss.



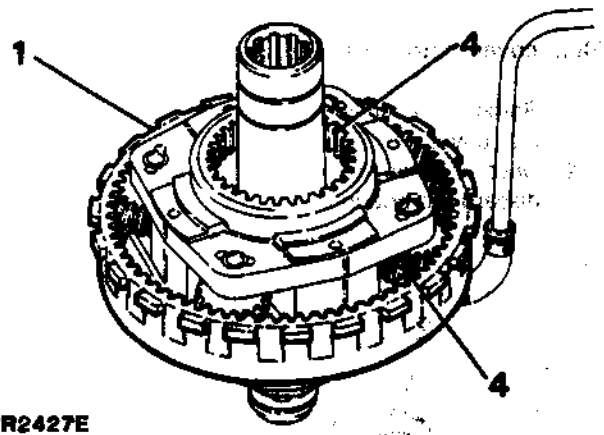
RR2426E

16. Lubricate a new needle roller bearing and drive or press the bearing into its recess until contact is made with the shoulder at the bottom of the bore.
17. Fit the snap ring to retain the bearing.
18. Place the cover aside until the gearbox is ready to be assembled.

Planetary set (Epicyclic unit) and oil pump - Dismantle and inspection

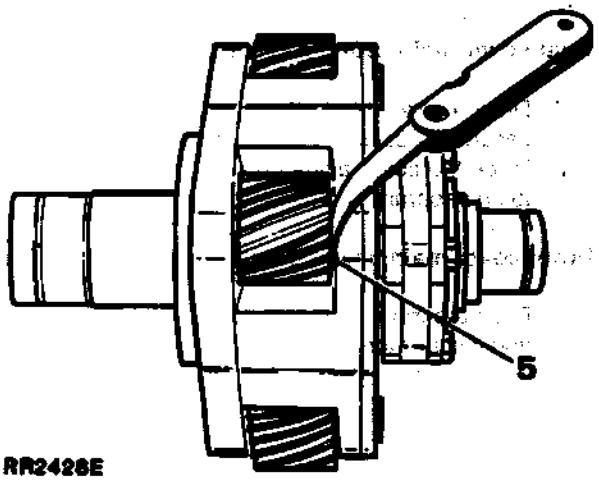
△ **NOTE: The Epicyclic unit and oil pump are serviced as a complete assembly, if after inspection either of the units is found to be worn a complete new assembly must be fitted.**

1. Remove the annulus from the planetary set.



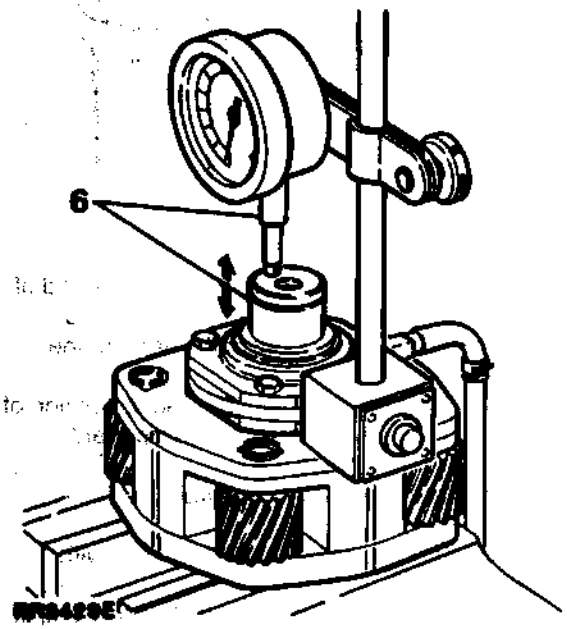
RR2427E

2. Thoroughly clean all components using a suitable solvent.
3. Examine the helical teeth of the annulus for wear or damage. If damage is evident it will be necessary to renew both the annulus and planetary set.
4. Examine the planetary gears and high/low gear teeth for wear or damage. If damaged renew both the annulus and planetary set.
5. Check the end float of the four planet gears, between the end of the gear and planetary set carrier. End float of each planet gear should not exceed 0.83 mm (0.033 in) if any one of the planet gears is out of limits renew the planetary set assembly.



RR2428E

6. Check the end float of the sun gear to the planetary set carrier by supporting the body of the assembly on the top of a vice. Using a dial test indicator attached to a magnetic base, position the base on top of the assembly and zero the indicator on the end of the sun gear shaft, lift the shaft and check the end float. End float should not exceed 0.83 mm (0.033 in). Fit a new planetary set assembly if out of limits.



RR2429E

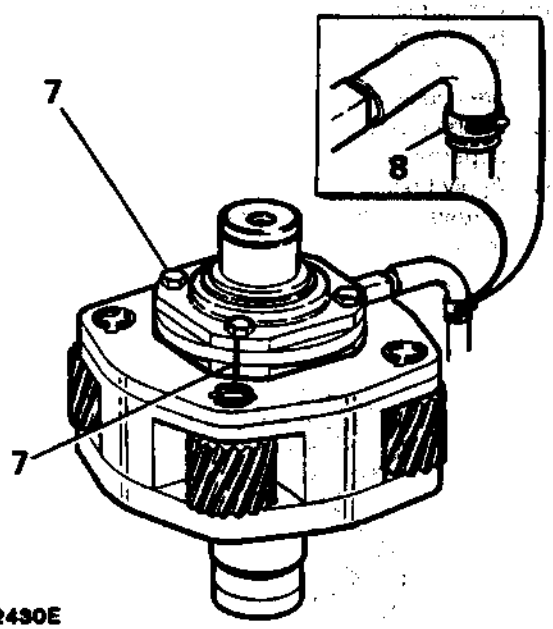
△ **NOTE: If the previous inspection instructions prove the assembly to be in an acceptable condition carry out the following examination of the oil pump.**

Oil pump and filter
- Dismantle and inspection

7. To aid re - assembly mark an identification line on the edges of the oil pump plates. Remove the four bolts securing the pump front and rear plates, separate the pump by removing the plungers, spring and bearing plate.

△ **NOTE: The front plate of the oil pump is stamped 'TOP', the centre bearing plate is stamped 'REAR' and the rear plate is stamped 'TOP REAR'. The fixing holes of the plates and body are also offset to ensure correct re - assembly of the pump.**

8. Depress the retaining clips, remove the oil pick - up pipe and rubber connection tubes. Examine the tubes and pipe for damage or fractures, renew as necessary.

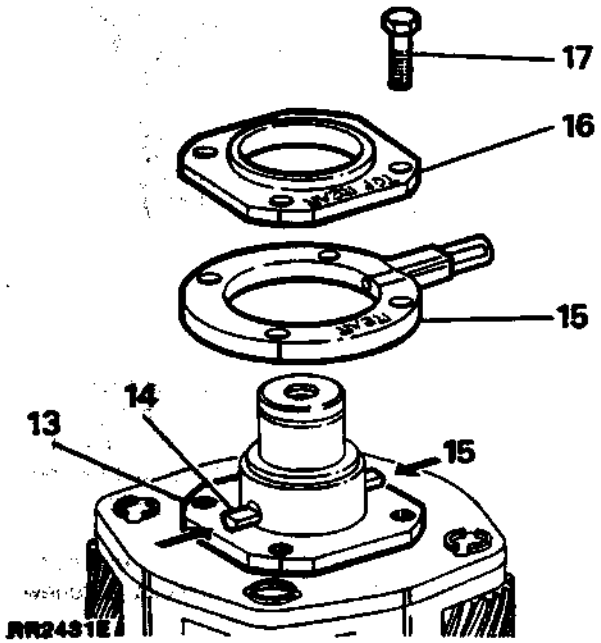


RR2430E

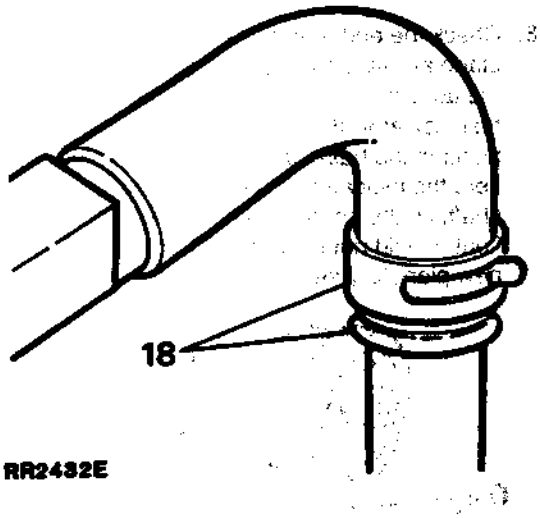
9. Clean the pump components and check for damage and wear, i.e. blueing of the pump plungers, scoring of the centre bearing plate, if any wear is evident a new planetary set must be fitted, as the pump is part of the complete assembly.
10. Thoroughly clean the oil pick - up filter, examine the filter screen for damage and blockage, renew or clean the filter as necessary.

Oil pump and filter - Assemble

11. Clean the sealant from the oil pump securing screws.
12. Prior to assembly lubricate the pump components with clean oil.
13. Fit the plate stamped **'TOP'** to the sun gear shaft with the word **'TOP'** facing the planetary assembly.
14. Fit the plungers and spring noting that the flats on the plungers must be uppermost to enable the **'TOP REAR'** plate to be fitted.
15. Compress the plungers and fit the middle bearing plate with the word **'REAR'** uppermost. Align the offset fixing holes and also noting the previously marked identification line.
16. Fit the top rear plate with the words **'TOP REAR'** uppermost.
17. Apply Loctite 242 to the threads of the four screws and fit the screws, tighten to the specified torque.



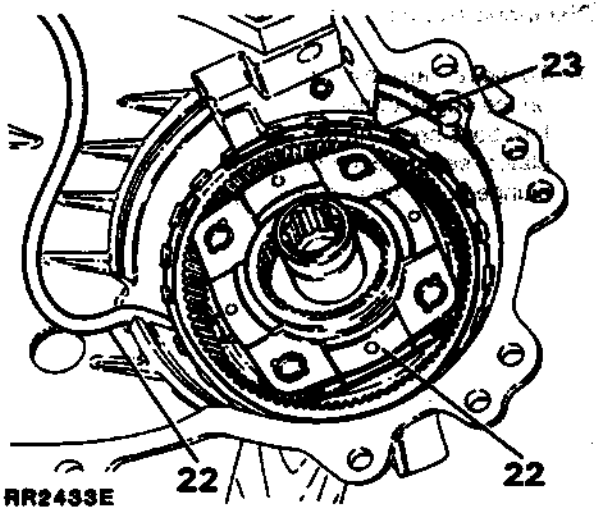
18. Fit the rubber connection tube and oil pick - up pipe to the oil pump, fit the retaining clip. Note that the clip securing the tube to the pick - up pipe is positioned in front of the flare on the pipe.



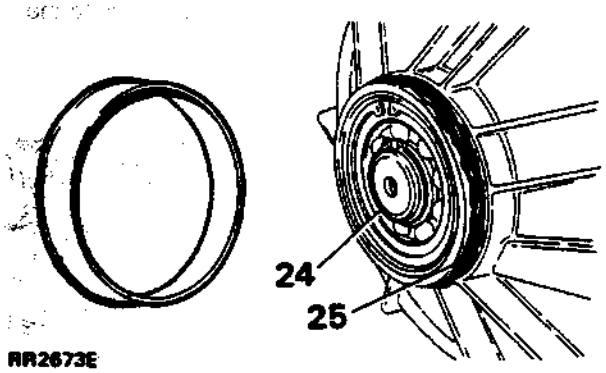
19. Fit the rubber connection tube to the filter end of the pipe, fit the clip ensuring that the tube is clamped by the clip in front of the flare on the pipe.
20. Push the filter into the tube. The radial position of the filter to pipe at this stage is unimportant.

Planetary set and annulus - assemble

21. Lubricate the planetary set and annulus with clean oil.
22. Position the annulus around the planetary set, fit the assembly to the rear cover locating the oil pump inlet port in the groove at the bottom of the planetary set housing, the sun gear shaft in the bearing and the lugs on the outer edge of the annulus in the anti - rotation lugs. It may be necessary to tap the sun gear shaft into the bearing to enable the large ring gear snap ring to be fitted.

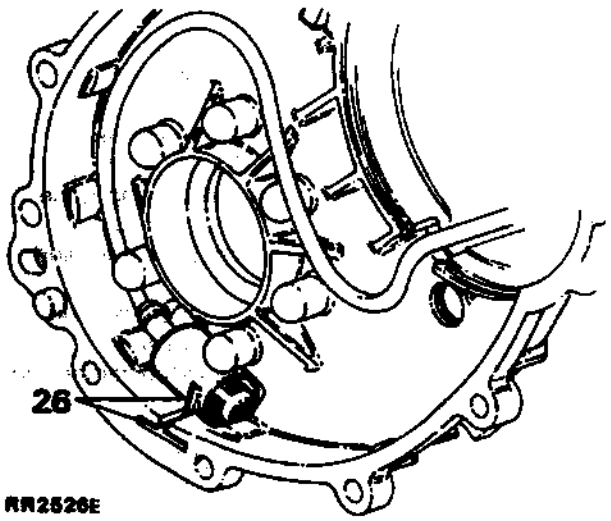


23. Fit the snap ring with the stepped ends adjacent to the selector shaft bore.
24. Turn the rear cover over and fit the circlip to retain the sun gear shaft.
25. Remove any previous sealant from the end cap. Apply Dow Corning 732 silicon sealant or a suitable equivalent to the outside diameter of the rear cover, evenly tap the cap into position.



RR2673E

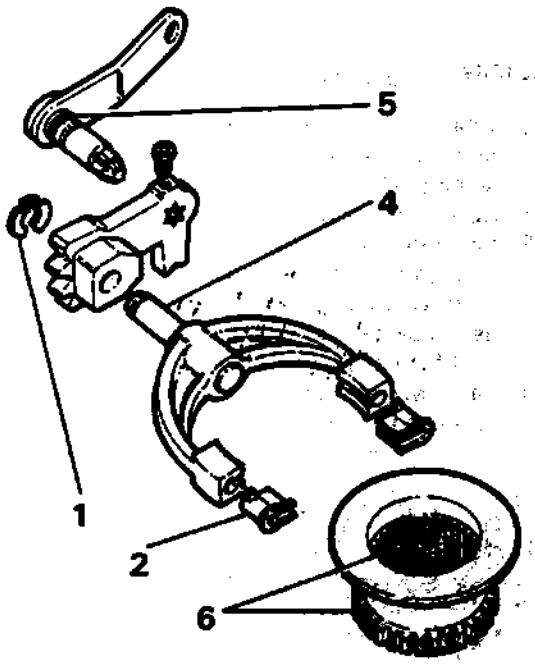
26. If necessary re - position the filter on the oil pick - up pipe until the lug on the filter can be pushed into the slot in the rear cover.



RR2526E

Selector fork
- Dismantle and inspection

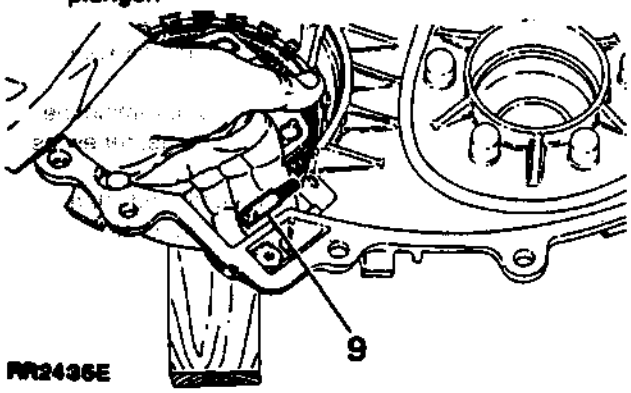
1. Remove the retaining clip and separate the fork from the arm.
2. Detach the two nylon slippers from the selector fork feet and discard.
3. Thoroughly clean all components.
4. Examine the fork, arm and pivot pin for wear. Renew as necessary.
5. Remove the 'O' ring and discard. Examine the shaft and lever for wear and damage, renew as necessary.
6. Examine the selector sleeve teeth and internal splines for damage and wear. Renew as necessary.



RR2434E

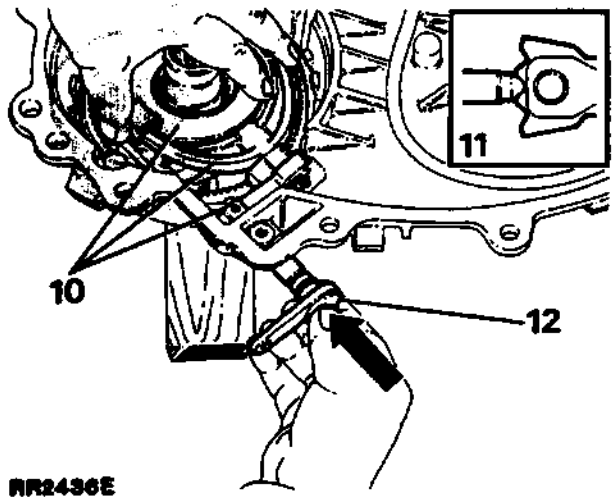
Selector fork - Assemble

7. Fit new nylon slippers to the fork.
8. Assemble the fork to the selector arm and secure in position using a new retaining clip.
9. Lightly lubricate and fit the spring and selector plunger.



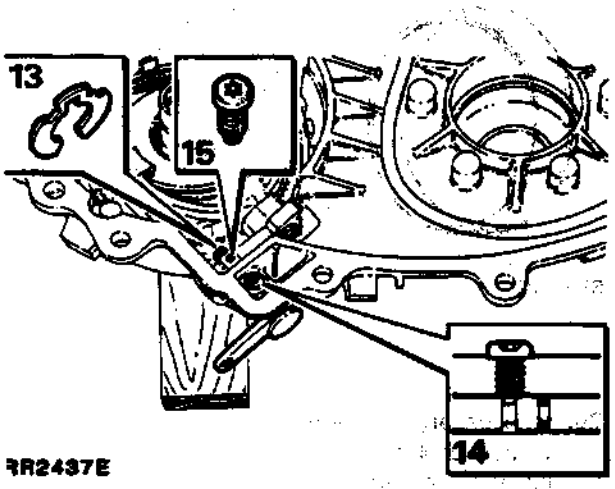
RR2435E

10. While compressing the plunger and spring, fit the selector fork, operating arm assembly and selector sleeve simultaneously.
11. Select neutral gear position at the operating arm.
12. Fit a new 'O' ring to the selector lever shaft. Lubricate the 'O' ring and fit the lever assembly to the rear cover, noting that when fully assembled the lever should lie parallel with the joint face of the rear cover.
13. Fit a new retaining clip to secure the selector fork operating arm to the selector lever shaft.



RR2436E

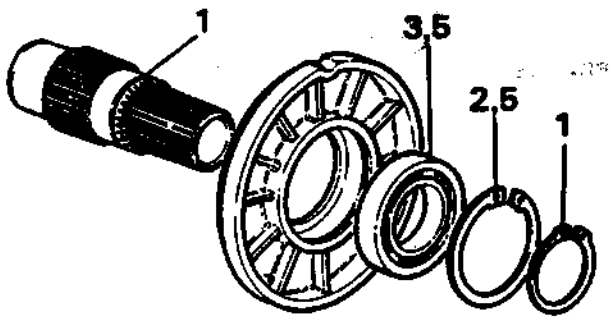
14. Remove any previous sealant from the Torx screw. Align the selector lever shaft groove to the retaining screw hole, apply a small amount of Loctite 242 to the screw threads and using Torx bit 25 fit and tighten the screw to the specified torque. Ensure that the screw locates in the groove of the shaft.
15. Clean any previous sealant from the Torx screw. Apply a small amount of Loctite 242 to the threads of the screw and fit to the selector fork operating arm, tighten using Torx bit 25 to the specified torque.



RR2437E

Bearing carrier
- Dismantle, inspection and assemble

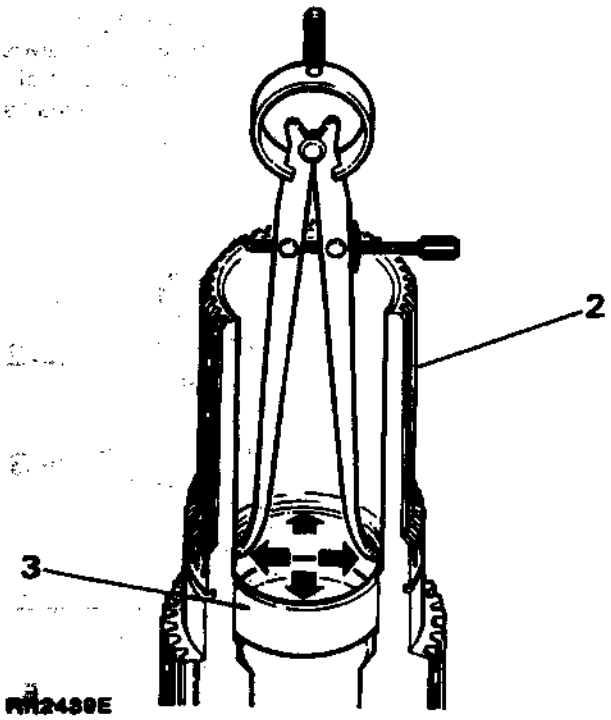
1. Remove the circlip and drive or press the transfer shaft from the bearing.
2. Remove the circlip retaining the bearing in the carrier.
3. Drive or press the bearing from the carrier and discard the bearing.
4. Clean and examine the carrier for cracks and general condition. Renew as necessary.
5. Press or drive a new bearing into the carrier and secure with the circlip.



RR2438E

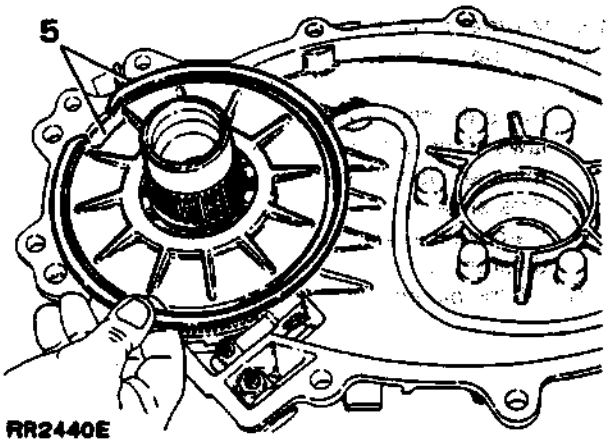
Transfer shaft
- Inspection and assemble

1. Clean the transfer shaft.
2. Visually examine the external splines for damage and wear, if worn fit a new the component.
3. Check the phospher bronze bush for wear by measuring the internal diameter of the bush with internal calipers and a micrometer or with an internal micrometer. The bush diameter must not exceed 38.515 mm (1.516 in) fit a new transfer shaft if the bush has worn above the figure given.



RR2439E

4. Drive or press the transfer shaft into the bearing in the carrier. Secure the shaft with the circlip.
5. Fit the carrier to the rear cover, fit the anti - rotation dowel and secure the assembly with the snap ring, noting that the open ends of the snap ring must be positioned by the cast relief in the bearing carrier upper face.



RR2440E

Transfer sprocket - Inspection

1. Examine the sprocket teeth and splines for wear and damage, if either are evident discard the sprocket, otherwise clean and place to one side.

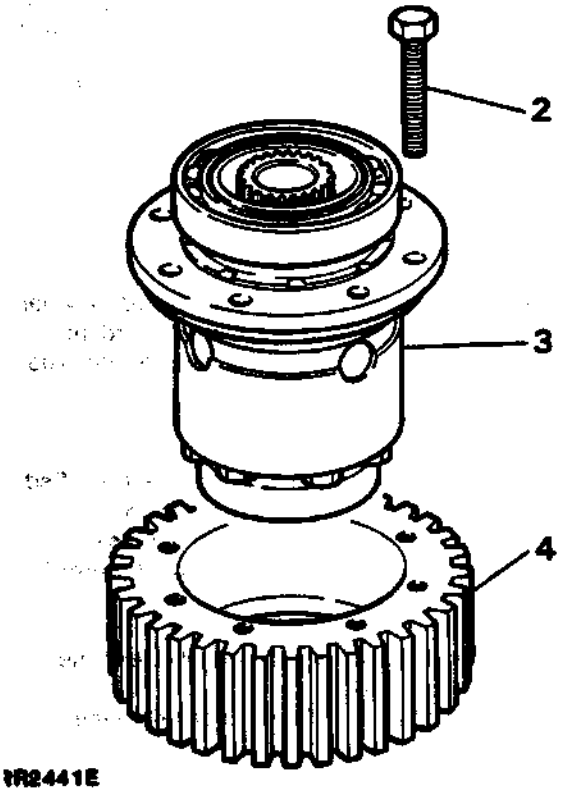
Chain - Inspection

△ **NOTE: A stretched chain can be identified by either excessive noise when the gearbox is operational or by witness marks on the inside edges of the case. If either is evident, renew the chain.**

1. Using a suitable solvent thoroughly clean the chain.
2. Check the chain links for wear and damage, if necessary renew the chain.
3. Place the chain to one side.

Centre differential and sprocket
- Dismantle and inspection

1. Place the differential unit in a vice fitted with soft jaws. If the original components are to be refitted mark an identification line on the sprocket and differential unit.
2. Remove the bolts securing the sprocket to the differential.
3. Lift the differential assembly from the sprocket.

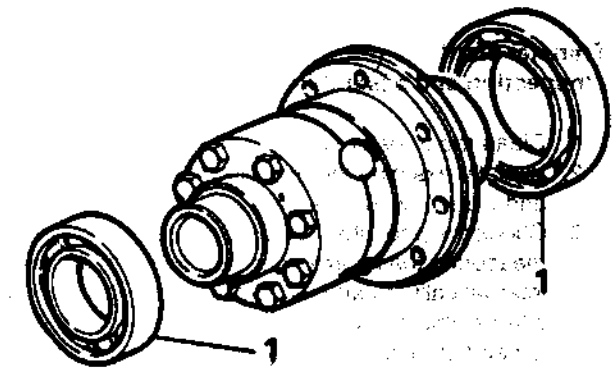


RR2441E

4. Examine the sprocket teeth for wear and damage, if either are evident renew the sprocket. Place the sprocket aside until the differential is ready to be assembled.

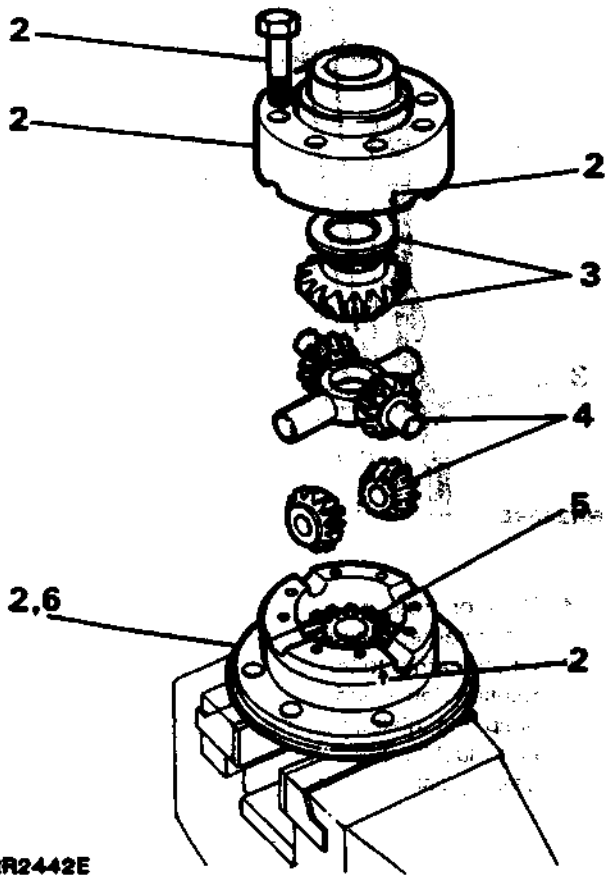
Centre differential
- Dismantle and inspection

1. Using a two legged puller, ease the bearings from the differential assembly and discard the bearings.



RR2460E

2. Secure the front half of the differential unit in a vice fitted with soft jaws, remove the eight retaining bolts securing the front and rear halves of the assembly together, lift off the rear part of the differential unit. Note the identification marks on the exterior of the differential unit.

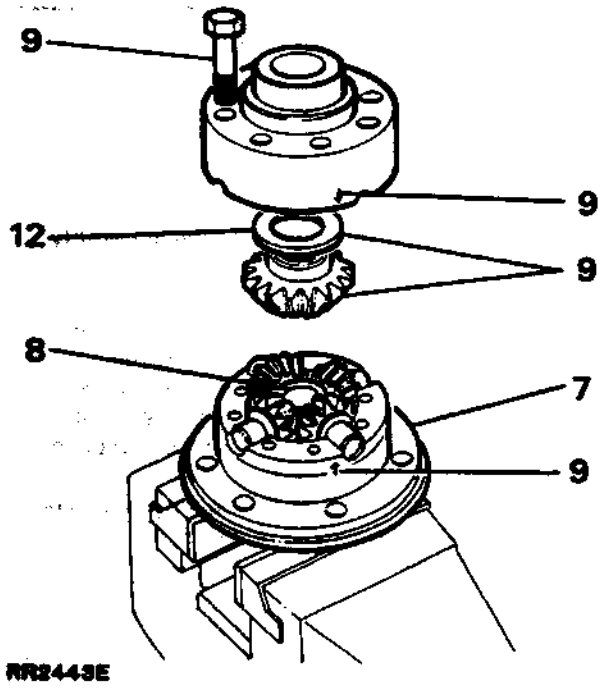


RR2442E

3. Remove the rear upper bevel gear and thrust washer.
4. Remove the pinion gears and dished washers along with the cross shaft.
5. Remove the front lower bevel gear and thrust washer from the front half of the differential unit.
6. Remove the front half of the differential unit from the vice and clean all components. Examine for wear or damage, renew if necessary.

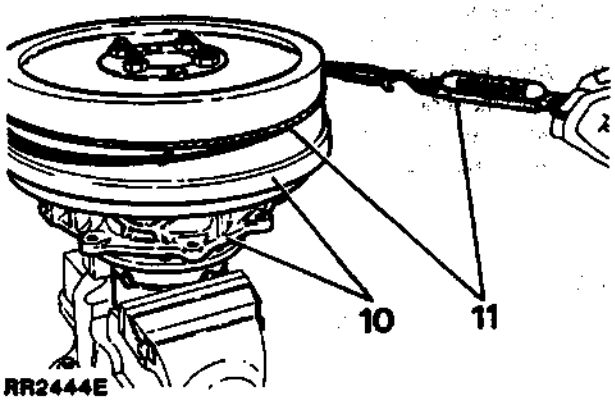
Differential pinions - rolling resistance

7. Using soft jaws secure the front half of the differential unit in the vice.
8. Fit the front bevel gear without the thrust washer. Lightly lubricate and fit the cross shaft, pinion gears and new dished washers.
9. Fit the rear bevel gear together with the thinnest thrust washer to the rear half of the differential. Assemble both halves of the differential noting the identification marks. Fit the bolts and tighten to the specified torque.



RR2443E

10. Invert the differential unit in the vice, fit the front output housing to the differential, locating the viscous unit splines on the front bevel gear. Fit the drive flange to the viscous unit and place the brake drum on top of the drive flange, secure with the nut. Check that the gears are free to rotate.
11. Tie a length of string around the brake drum, attach a spring balance to the free end and carefully tension the string until a load to turn is achieved. Alternatively use a torque wrench applied to the drive flange nut. Rotate the brake drum slowly by hand to overcome the initial load when using either method.



RR2444E

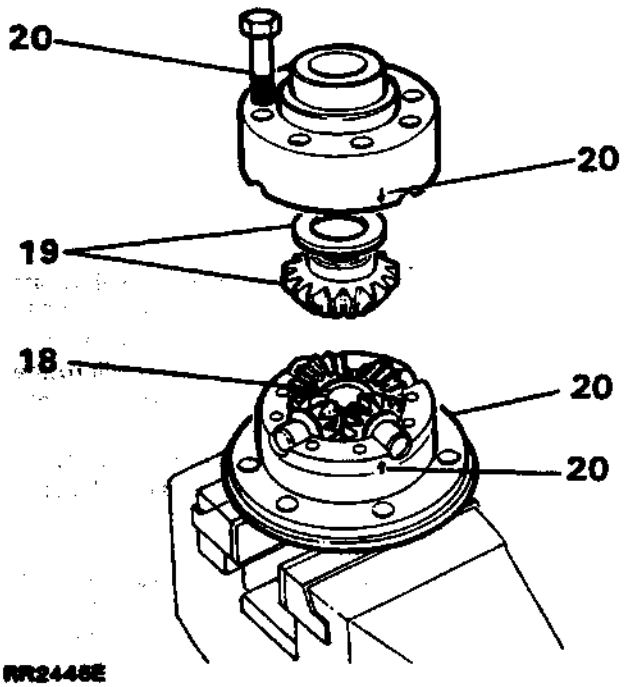
NOTE: Gears that have been run will rotate smoothly and will require a torque of 0.56 Nm (5 in lb), equivalent force using a spring balance 0.45 kg (1 lb). New gears will rotate with a notchy feel and will require a torque of not more than 2.26 Nm (20 in lb), equivalent force using a spring balance 7.72 Kg (3.8 lb). Keep all components lubricated when carrying out these adjustments.

12. Change the thrust washer for a thicker one if the torque reading is too low and re - check the torque. Five thrust washers are available in 0.10mm steps ranging from 1.05 to 1.45mm.
13. Dismantle the unit when the rear bevel gear thrust washer has been selected.
14. Remove and retain the rear bevel gear and thrust washer combination.

15. Repeat the procedure to obtain the correct thrust washer for the front bevel gear, it is not necessary to fit the rear bevel gear when checking the front bevel gear rolling resistance.
16. When the thrust washer has been selected for the front bevel gear, again dismantle the differential unit and retain the thrust washer and front bevel gear combination.

Centre differential - Assemble

17. Fit the thrust washer and front bevel gear into the front half of the differential unit.
18. Fit the pinion gears with dished washers to the cross shaft and fit the assembly to the differential unit.
19. Fit the thrust washer and rear bevel gear to the rear half of the differential unit.
20. Align both halves of the differential noting the identification marks. Secure both halves together with the eight bolts. Tighten the bolts to the specified torque.

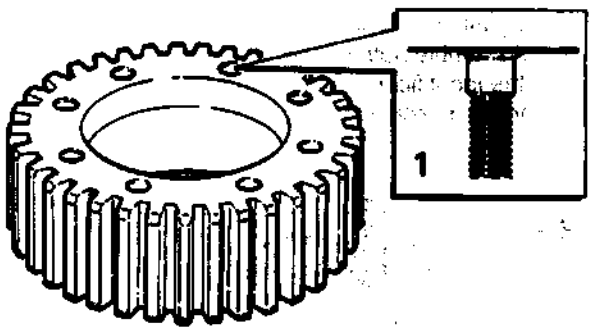


RR2446E

21. Check the overall torque required to turn the differential, this should be approximately equal to both bevel gears added together.
22. Drive or press new bearings onto the differential, noting that the smaller of the two bearings is fitted to the rear half of the differential.

Centre differential sprocket - Assemble

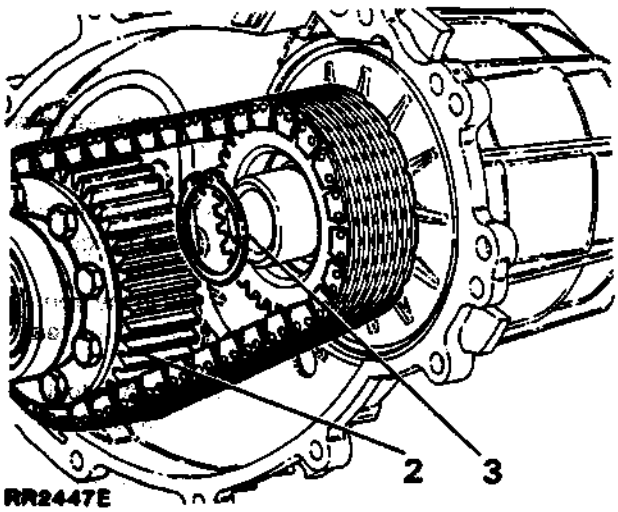
1. Fit the sprocket to the differential noting that the face of the sprocket with the relieved threads must contact the flange of the differential housing. Observe the previously marked identification lines if the original components are being refitted.
2. Fit new bolts and tighten evenly to the specified torque.



RR2446E

Transfer sprocket, centre differential assembly and chain - Assemble

1. Place the differential assembly and transfer sprocket inside the chain. If the original components are being refitted observe the identification marks previously applied to the chain and transfer sprocket. Fit the complete assembly simultaneously.
2. Carefully tap the differential bearing into its bore while easing the transfer sprocket onto the transfer shaft.

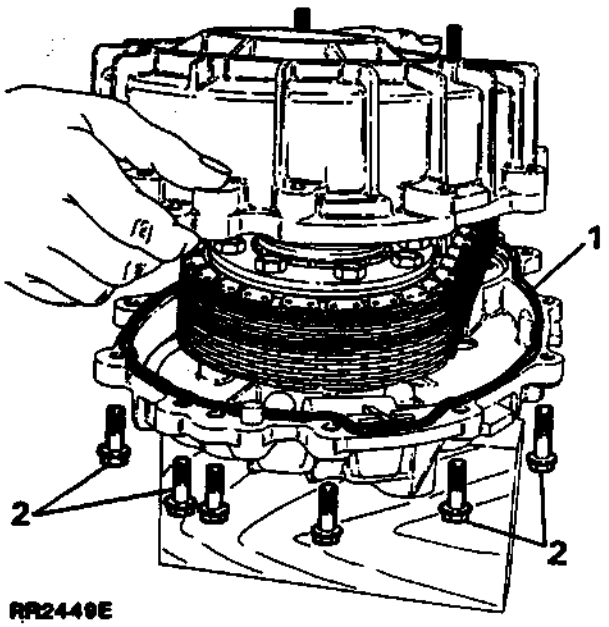


RR2447E

3. Ensuring that the transfer sprocket is fully down, secure the sprocket to the transfer shaft with the circlip.

Front and rear cover - main casing - Assemble

1. Ensuring that the joint faces of the front and rear covers are clean, apply a bead of Dow Corning 732 or a suitable equivalent silicone sealant to the joint face of the rear cover and evenly spread the sealant over the face. Do not over apply the sealant.



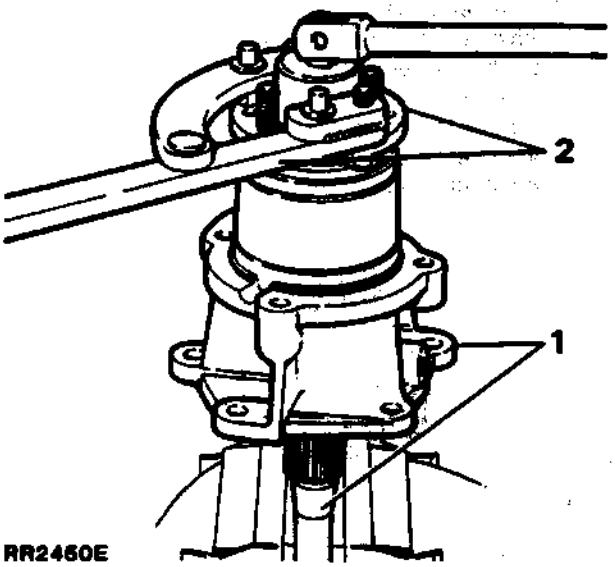
RR2449E

2. Fit the front cover, secure with the eleven bolts, tightening evenly to the specified torque. Do not wipe away the surplus sealant which is forced out of the joint.

Rear output housing
- Dismantle and inspection

Service tools:
18G1422 - Oil seal replacer
18G1205 - Adjustable flange holding wrench

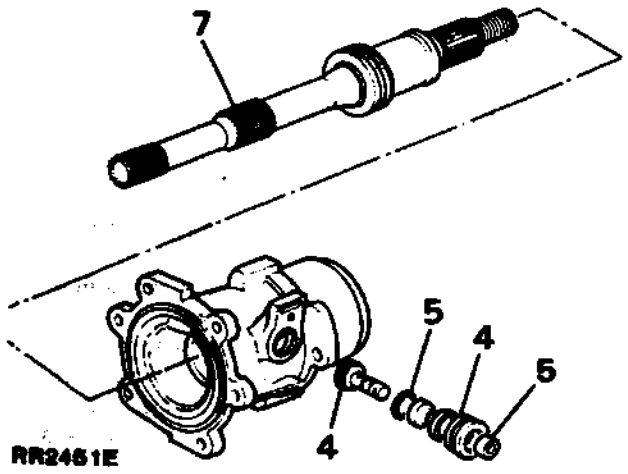
1. Support the rear output housing by the output shaft in a vice fitted with soft jaws.
2. Using service tool 18G1205 to restrain the drive flange, release and remove the nyloc nut and plain washer securing the drive flange to the output shaft, withdraw the rubber seal. Discard the nut and seal.



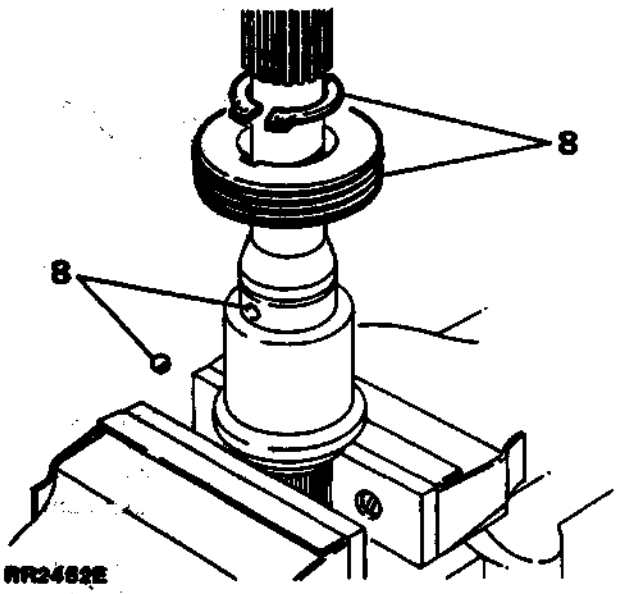
RR2460E

3. Remove the drive flange from the output shaft. Examine the flange for damage or wear particularly the seal running surface, if the surface is corroded or a groove has been worn by the previous seal discard the flange.
4. Prise the speedometer sleeve and driven gear from the housing. Examine the gear teeth for wear, if worn discard the gear.
5. Prise the oil seal from the sleeve and remove the 'O' ring, discard both the seal and 'O' ring.

6. Clean the sleeve and place to one side.
7. Drive or press the output shaft from the housing.



8. Clean and examine the splines and speedometer drive gear for wear or damage. The output shaft can be further dismantled if either the speedometer drive gear or output shaft is worn: remove the circlip and slide the gear from the shaft, retrieve the ball bearing from the indent in the shaft. Discard the worn component.

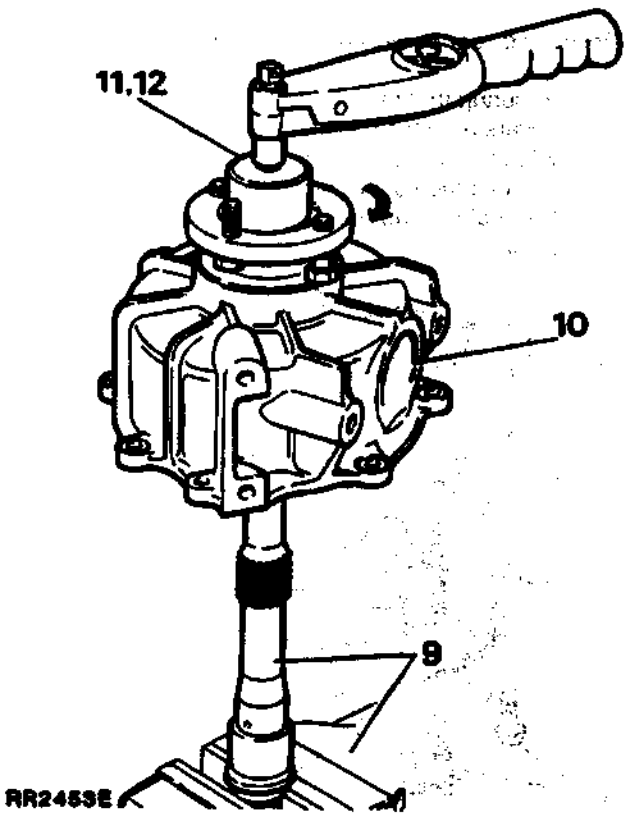


△ **NOTE: While the output shaft is removed from the rear output housing, the shaft can be utilised for checking the rolling resistance of the viscous unit as follows.**

Viscous unit - rolling resistance
Bench check

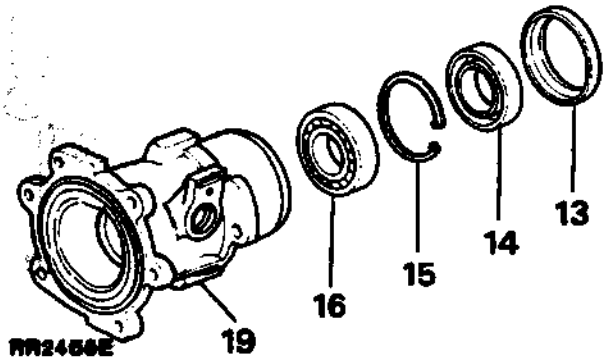
△ **NOTE: Testing should be carried out in an ambient of 20 °C.**

9. Secure the output shaft in a vice fitted with soft jaws, gripping the shaft on the drive flange splines.
10. With the viscous unit still installed in the front output housing place the assembly on the rear output shaft spline.
11. Apply a clockwise torque of *27 Nm* to output flange nut. If no resistance to turn is felt, unit requires replacing.
12. If resistance to turn is felt, apply a clockwise torque of *20 Nm* , to output flange nut for 1 minute, this should result in a rotation of approximately 25° - 30°. If no rotation or a greater force is required, unit requires replacing.



Rear output housing (continued)

13. Lever off the dust shield.
14. Prise the oil seal from the housing and discard the seal.
15. Remove the circlip retaining the bearing.
16. Drive or press the bearing from the housing. Discard the bearing.
17. Remove any previous sealant from the housing joint face.



18. Thoroughly clean all components with a suitable solvent.
19. Examine the housing for damage and wear. Renew as necessary.

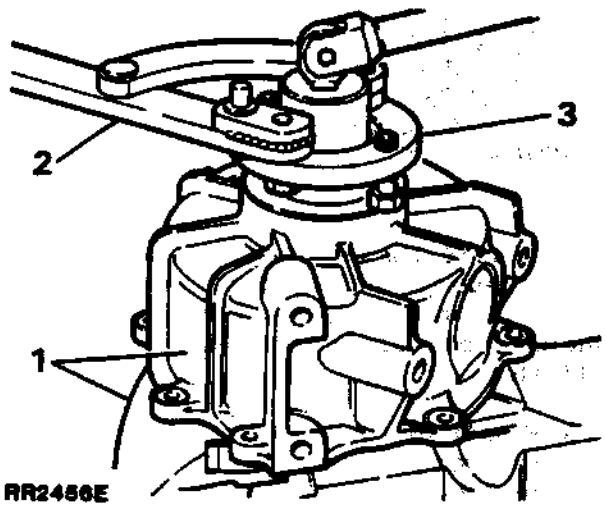
Rear output housing - Assemble

20. Drive or press a new bearing into the housing until the bearing contacts the shoulder.
21. Fit the circlip.
22. Lubricate a new oil seal. Using oil seal replacer 18G1422 fit the seal, lip side leading until it contacts the circlip.
23. Fit the dust shield.
24. Place the ball bearing in the indent on the output shaft, fit the speedometer drive gear to the shaft, secure together with the circlip.
25. Press or drive the output shaft into the housing until the shoulder of the shaft contacts the bearing.
26. Lubricate the oil seal bearing surface of the drive flange and fit the flange followed by a new rubber seal. Fit the steel washer and secure the flange to the shaft using a new nut. Tighten to the specified torque.
27. Lubricate a new speedometer sleeve oil seal, press the seal into the top of the sleeve.
28. Fit a new 'O' ring to the outside of the sleeve, push the driven gear spindle into the sleeve.
29. Lubricate the 'O' ring and push the sleeve and gear assembly into the housing. It may be necessary to rotate the output shaft to ensure that the driven gear engages with the drive gear on the shaft.
30. Apply Dow Corning 732 or a suitable equivalent silicone sealant to the rear output housing joint face on the main casing. Evenly spread the sealant on the face to ensure a good seal.
31. Fit the housing to the main casing and secure with the six bolts tightened to the specified torque.

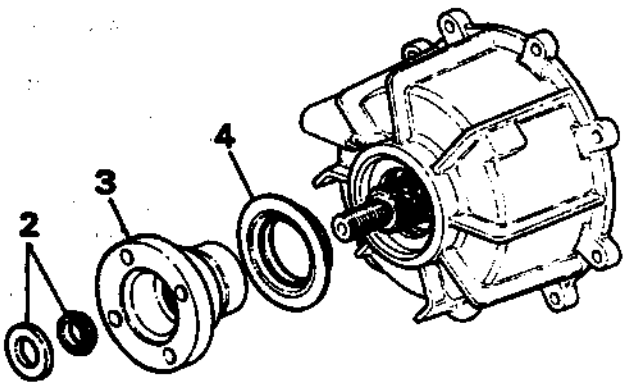
Front output housing
- Dismantle and Inspection

Service tools:
18G1422 - Oil seal replacer.
18G1205 - Adjustable flange holding wrench

1. Support the viscous unit and front output housing in a vice fitted with soft jaws gripping on the two flats of the viscous unit.
2. Using service tool 18G1205 to restrain the drive flange, release and remove the nyloc nut and plain washer securing the drive flange to the output shaft, withdraw the rubber seal. Discard the nut and seal.
3. Remove the drive flange from the viscous unit. Examine the flange for damage or wear particularly the seal running surface, if the surface is corroded or a groove has been worn by the previous seal discard the flange.

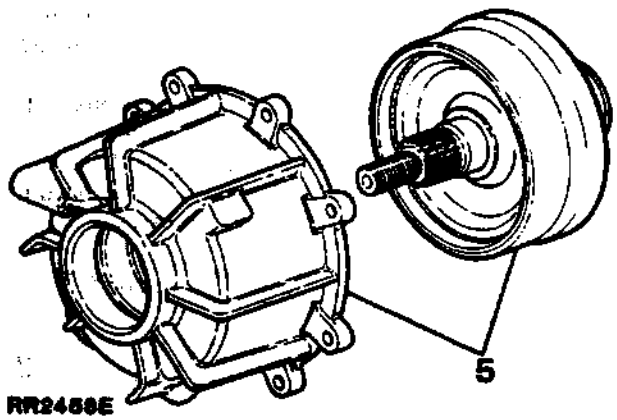


4. If necessary the oil catcher can be carefully pressed from the drive flange, if either a new oil catcher or bolts are being fitted.



RR2457E

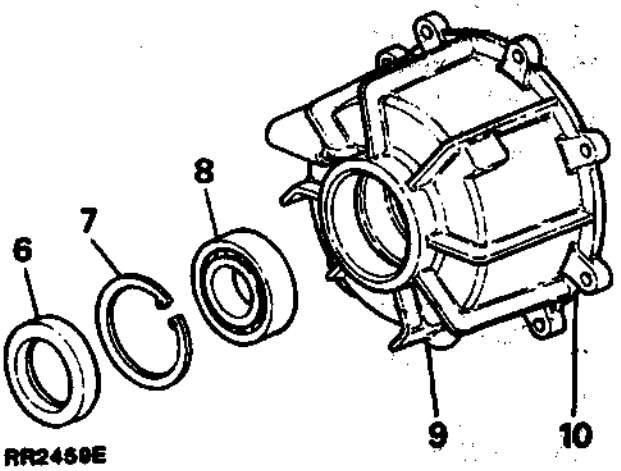
5. Carefully tap the viscous unit out of the housing. If the original unit is being refitted wipe clean with a clean cloth.



RR2458E

△ **NOTE: The viscous unit is a sealed assembly and cannot be further dismantled, a new unit should be fitted if the unit is damaged or if the torque to turn is out of limits.**

6. Prise the oil seal out from the front output housing and discard.
7. Remove the circlip retaining the bearing.
8. Drive or press the bearing from the housing and discard.
9. Clean the housing with a suitable solvent.
10. Remove any previous sealant from the joint face of the housing.



RR2459E

11. Examine the housing for damage and wear, renew the housing if necessary.

Front output housing - Assemble

12. Drive or press a new bearing into the housing
13. Fit the circlip to retain the bearing.
14. Lubricate a new oil seal. Using oil seal replacing tool 18G1422 fit the seal, lip side of the seal leading until it contacts the circlip.
15. Carefully tap the original or new viscous unit into the housing until contact is made with the face of the bearing.
16. Lubricate the lips of the seal and fit the flange followed by a new rubber seal; fit the steel washer and secure the flange with a new nut. Tighten to the specified torque.
17. Apply Dow Corning 732 or a suitable equivalent silicone sealant to the output housing joint face of the main casing. Evenly spread the sealant on the face to ensure a good seal.
18. Fit the housing to the main casing and secure in position with the eight bolts tightened evenly to the specified torque.
19. Refit the gearbox to the vehicle. (Refer to transfer gearbox remove and refit).

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Brake drum back plate to rear output housing	73
Brake drum to drive flange	25
Centre differential (front to rear)	60
Drive flanges to transfer gearbox	224
Driven gear to centre differential	50
Front cover to rear cover - main case	40
Front output housing to main case	33
Gearbox mounting brackets to chassis	45
Mounting bracket to gearbox	102
Neutral warning switch	47
Oil drain plug	25
Oil filler/level plug	25
Oil pump fixings	7
Propeller shafts to drive flanges	46
Rear output housing to main case	40
Selector lever shaft	8
Selector fork operating arm	8

Torque values below are for all screws and bolts used except for those that are specified otherwise.

METRIC

M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180

UNC / UNF

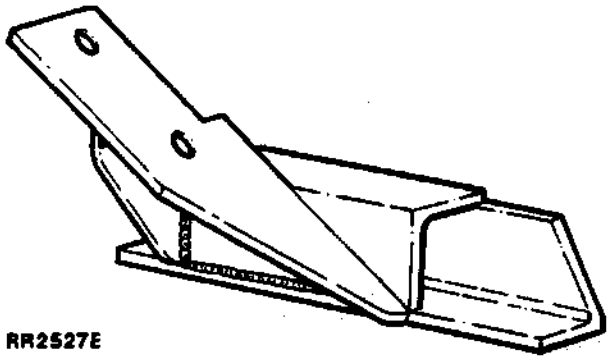
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

Notes

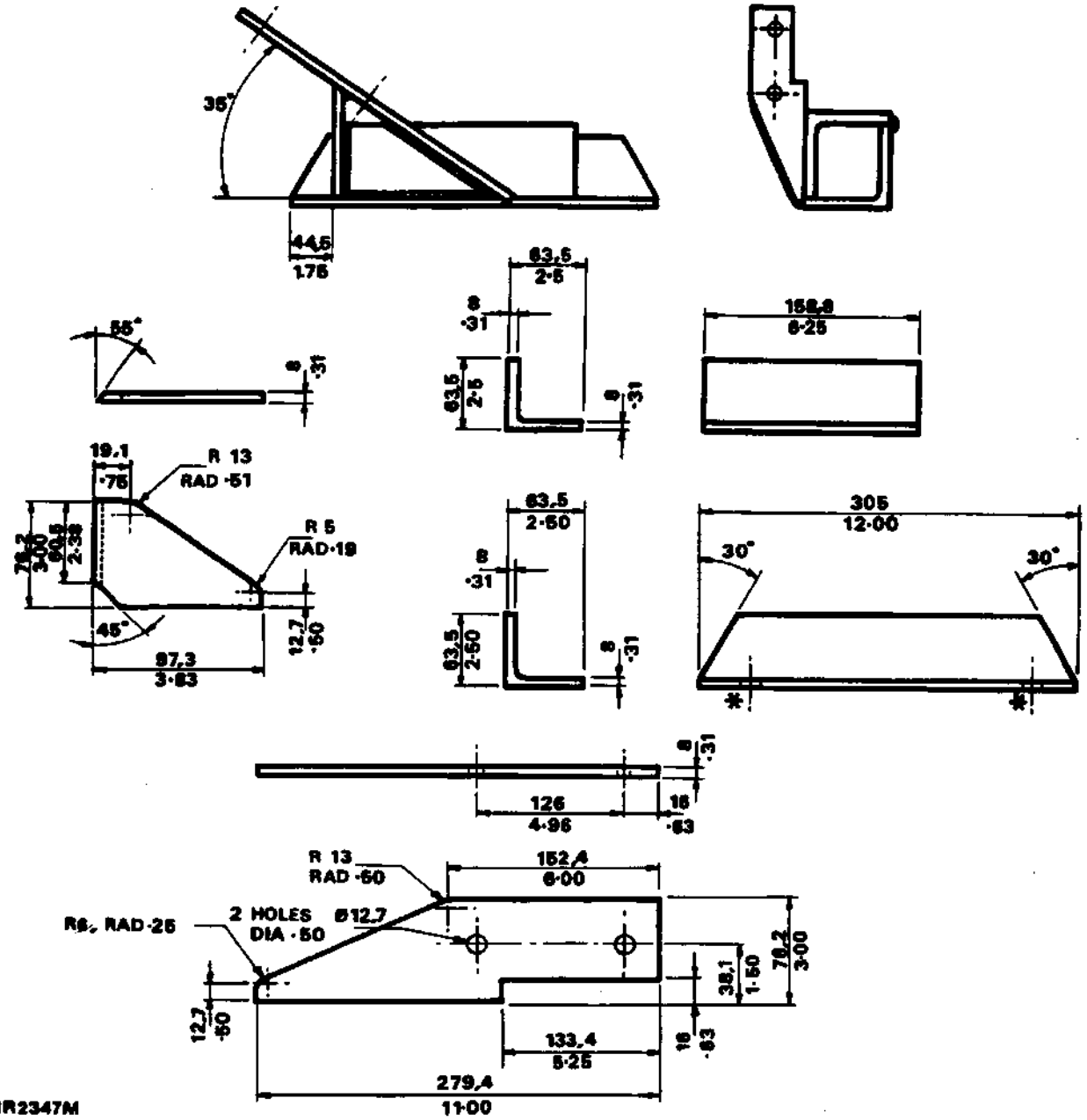
ADAPTER PLATE TRANSFER BOX

Adaptor plate for removing Borg Warner transfer gearbox. This can be manufactured locally to drawing shown.

Material: Steel BS 1449 Grade 4 or 14.
Drill holes marked * to fit hoist used.

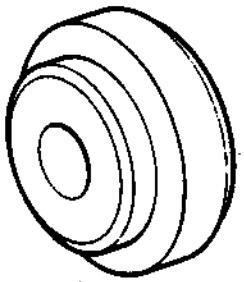


RR2527E



RR2347M

LRT-41-010 Oil seal replacer.
LST.550-6



LST5506

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ZF4HP22

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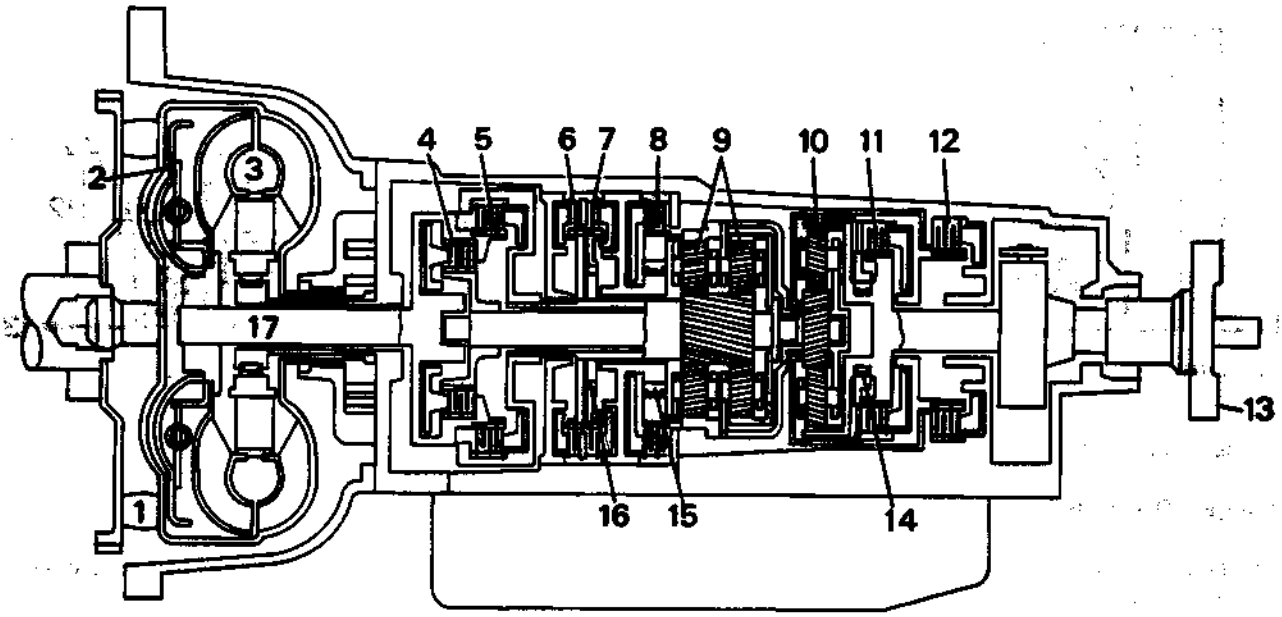
SERVICE TOOLS

AUTOMATIC GEARBOX HOLDING FIXTURE 1
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DESCRIPTION

The automatic transmission is specially tailored version of the ZF4 HP22, used by many manufactures of high performance vehicles.

A three element torque converter delivers the power to a four speed epicyclic transmission. First, second and third gears are reduction ratios but fourth is an overdrive gear for high speed cruising. A direct drive clutch, integral with the torque converter operates to engage fourth gear.



RR3560M

The gear selector has seven positions as follows:

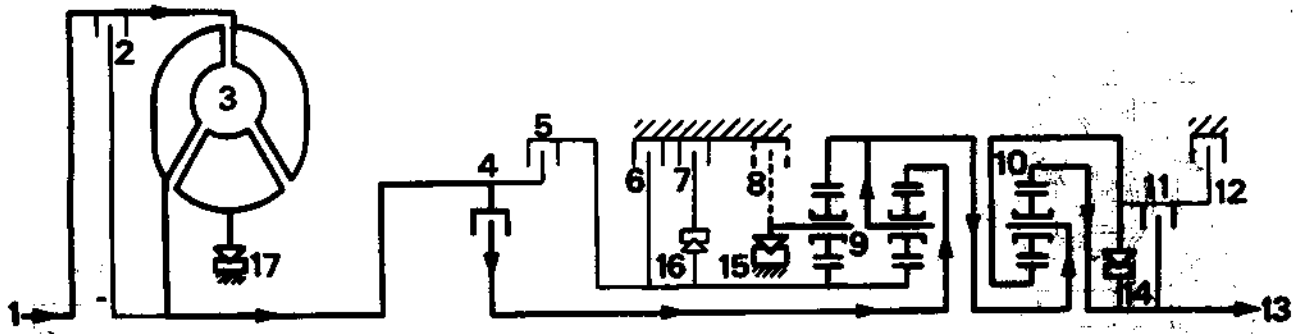
P = Park provides a mechanical lock on the output shaft.
R = Reverse gear.
N = Neutral.
D = Provides a 1st gear start and automatic shifts 1-2-3-4-3-2-1.
3 = Provides a 1st gear start and automatic shifts 1-2-3-2-1.
2 = Provides a 1st gear start and automatic shifts 1-2-1 or 3-2-1.
1 = Provides a 1st gear start with no up shifts, or 3-2-1.

All automatic shifts are automatically controlled by the valve block and an hydraulic governor driven by the output shaft.

Power flow

1st gear D selected

With D selected 1st gear engaged, clutches 4 and 11 are operative. The front planet gear carrier of gear set 9 is locked against the housing through freewheel 15 when the engine is pulling but freewheels when the vehicle is coasting. Epicyclic gear set 10 rotates as a solid unit with the front planet gear carrier. In selector position 1 with 1st gear engaged, clutch 8 operates to prevent the loss of drive on the overrun through freewheel 15, to provide engine braking.

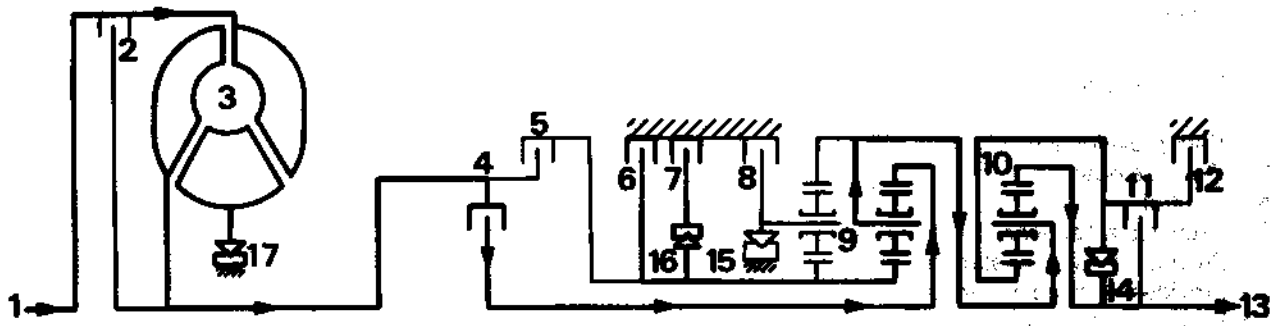


RR3561M

1st gear D selected

2nd gear D selected

Clutches 4, 6, 7 and 11 are engaged. Freewheel 15 overruns. the hollow shaft with the sun wheel of epicyclic gear set 9 is locked. Epicyclic gear set 10 also rotates as a solid unit.

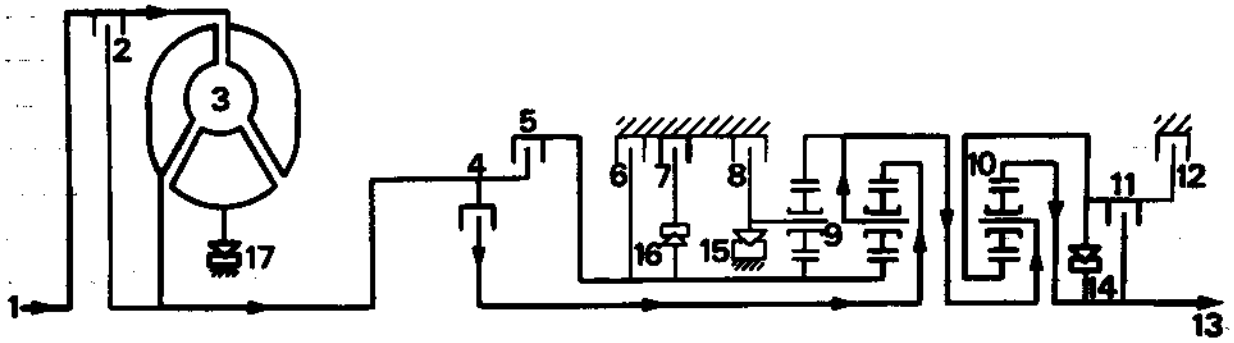


RR3562M

2nd gear D selected

3rd gear D selected

Clutches 4, 6, 7 and 11 are engaged. Freewheel 15 and 16 are overrun. Epicyclic gear set 9 and 10 rotate as a solid unit at a ratio of 1:1.



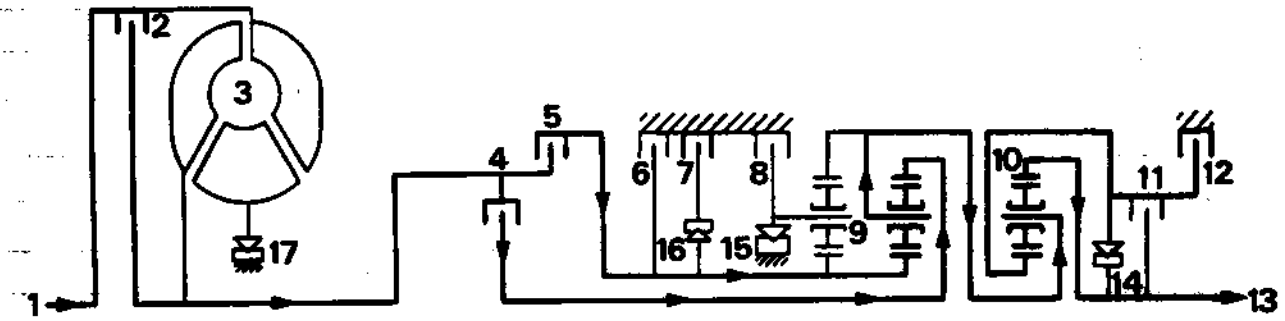
RR3563M

3rd gear D selected

4th gear D selected

Clutches 4, 6, 7 and 12 are engaged. Freewheel 14, 15 and 16 are overrun. Epicyclic gear set 9 rotates as a solid unit. The hollow shaft with the sun wheel of epicyclic gear set 10 is locked.

Above a predetermined road speed, clutch 2 locks the gearbox power input direct to the engine, by-passing the torque converter.



RR3564M

4th gear D selected

Reverse gear

Clutches 5, 8 and 11 are engaged. Since the front planet gear carrier of epicyclic gear set 9 is locked, the direction of output-shaft rotation is reversed. Epicyclic gear set 10 also rotates as a solid block.

Notes

ZF AUTOMATIC GEARBOX

Before referring to fault symptoms, carry out initial static checks first:

INITIAL STATIC CHECKS

Check start positions	'P' & 'N' only
Reverse lights	'R' only
Gear engagements	N-D,N-3,N-2,N-1,N-R
Full throttle	Engine switched off, check full travel at engine and at pedal.
Oil level	'N' selected, engine running at normal running temperature.

Pressure test

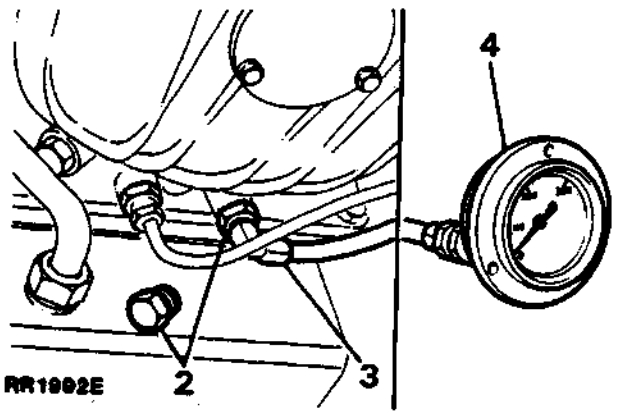
2000 rev/min	150 ± 5 p.s.i.
Idle pressure	100 ± 5 p.s.i. at 665 to 735 rev/min.

To fit pressure gauge

Service tools: ***See Service tools, Automatic gearbox***

0 to 300 p.s.i. Pressure gauge.
Flexible hose adaptor.

1. Site vehicle on a ramp.
2. From under gearbox, remove socket head plug (located 10 cm from oil pipe) Fit hose adaptor LST502-1.
3. Fit hose to adaptor.
4. Fit gauge 18G502A to hose and route into vehicle, ensuring hose is clear of rotating parts and exhaust pipes.



5. Carry out road test. ***See Road test procedure.***

Remove pressure gauge

6. Reverse removal procedure.

ROAD TEST PROCEDURE

Follow the procedure given commencing each test, from a standing start, on a level road, in good weather conditions.

ROADTEST 1 = CHECKS 1-2-3-4-5-6-7-8

D SELECTED KICKDOWN START FROM REST

CHECK 1

Check for clutch squeal and slip. Check pressure is 150 lbf/in2

CHECK 2

Check 1st to 2nd upshift speed and quality. Pressure should fall to 120 lbf/in2.

CHECK 3

Check 2nd-3rd upshift speed and quality. Pressure should fall to 100 lbf/in2

CHECK 4

Release throttle to allow simultaneous engagement 4th + DDC. Check shift quality and engine rpm drop of approximately 500 rev/min.

CHECK 5

To proceed to Check 5 release throttle and check drop out speed of direct drive clutch to 4th.

CHECK 6

Check down shift speed and quality 4th to 3rd.

△ **NOTE: This shift is usually very smooth and difficult to detect.**

CHECK 7

Check downshift speed and quality 3rd to 2nd.

CHECK 8

Check downshift speed and quality 2nd to 1st. Also difficult to detect.

END OF ROADTEST 1

ROADTEST 2 CHECKS = 9-10-11

D SELECTED FROM REST

FULL THROTTLE START

CHECK 9

Check 1st-2nd upshift speed and quality.

CHECK 10

Check 2nd-3rd upshift speed and quality.

CHECK 11

Check 3rd-4th and direct drive clutch upshift speed and quality.

△ **NOTE: 4th and the direct drive clutch engage simultaneously.**

END OF ROADTEST 2

ROADTEST 3 = CHECKS
12-13-14-15-16-17-18-19-20-21-22-23

D SELECTED FROM REST

LIGHT THROTTLE START

CHECK 12

Check 1st-2nd upshift speed and quality.

CHECK 13

Check 2nd-3rd upshift speed and quality.

CHECK 14

Check 3rd-4th upshift speed and quality.

△ **NOTE: This shift is usually very difficult to detect but can be confirmed by a 200 rev/min drop in engine speed.**

CHECK 15

Check speed and quality of shift into direct drive clutch, confirmed by 300 rev/min drop in engine speed.

△ **NOTE: An intermediate throttle position engagement of 4th and the direct drive clutch, which is indicated by a fall of 500 rev/min in engine speed.**

CHECK 16

At approximately 88 kph (55 mph) depress throttle to kickdown - gearbox should change down to 2nd - release throttle to re-engage 4th direct drive clutch continue to accelerate gently.

CHECK 17

At approximately 128 kph (80 mph) depress throttle to kickdown - gearbox should change down to 3rd - release throttle to re-engage 4th direct drive clutch and continue to accelerate gently.

CHECK 18

At approximately 138 kph (85 mph) select 3rd, gearbox should change immediately down to 3rd. Release throttle.

CHECK 19

Decelerate to approximately 47 kph (30 mph) depress throttle to kickdown - geabox should downshift to 1st gear, continue accelerating at full throttle until 3rd gear is attained. To do this you will have repeated check 2 of Test 1.

CHECK 20

At 128 kph (80 mph) select 2nd no downshift should occur. Release throttle.

CHECK 21

At 104 kph (65 mph) an automatic downshift into 2nd gear should occur. Continue to decelerate.

CHECK 22

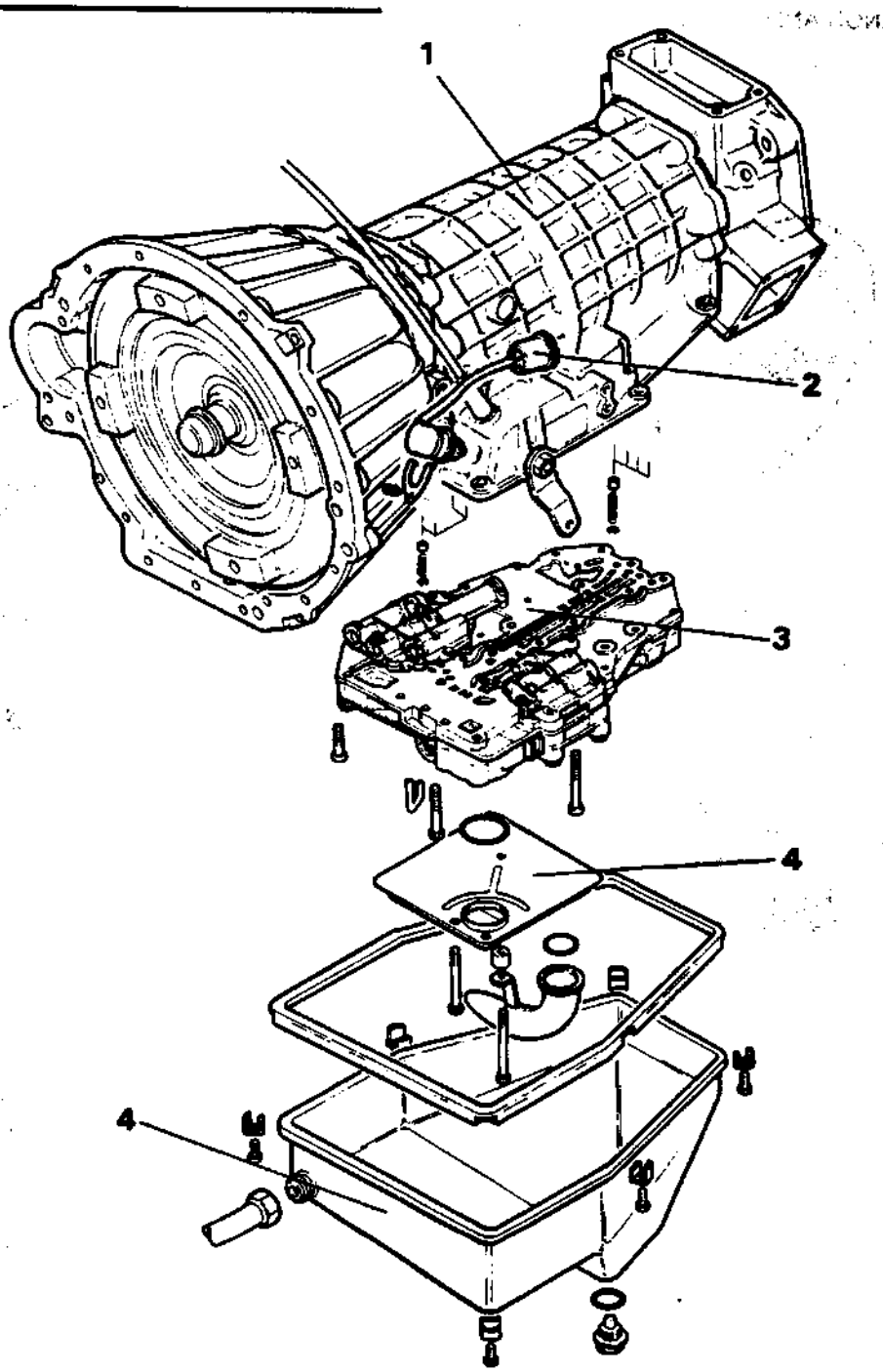
At 88 kph (55 mph) select 1st. No downshift should occur. Continue to decelerate.

CHECK 23

With 1 selected 2nd gear engaged continue to decelerate and at 45 kph (28 mph) the box should automatically downshift to 1st gear after which no upshifts will occur in this selector position.

END OF ROADTEST

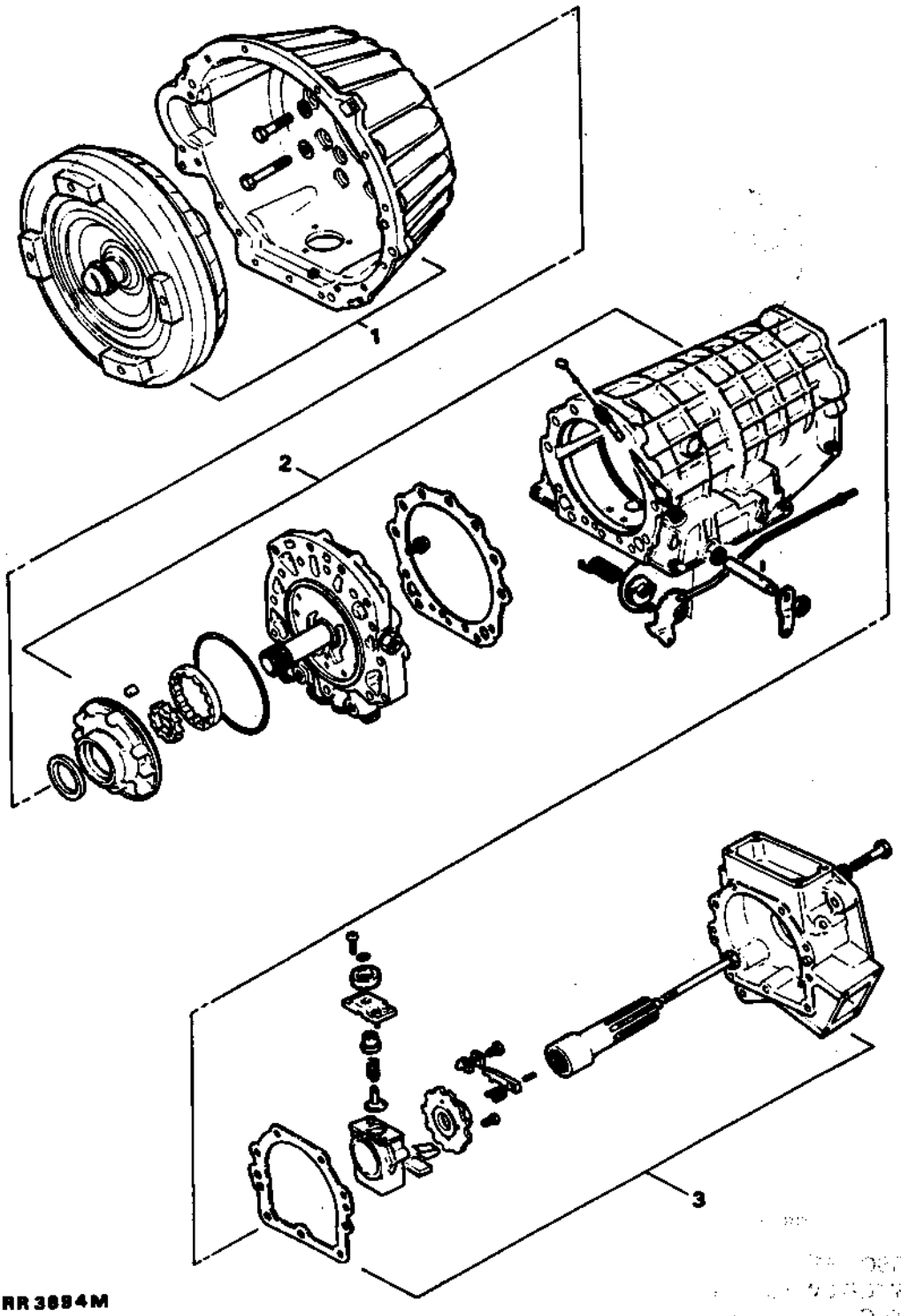
AUTOMATIC GEARBOX ASSEMBLY ILLUSTRATED



RR524M

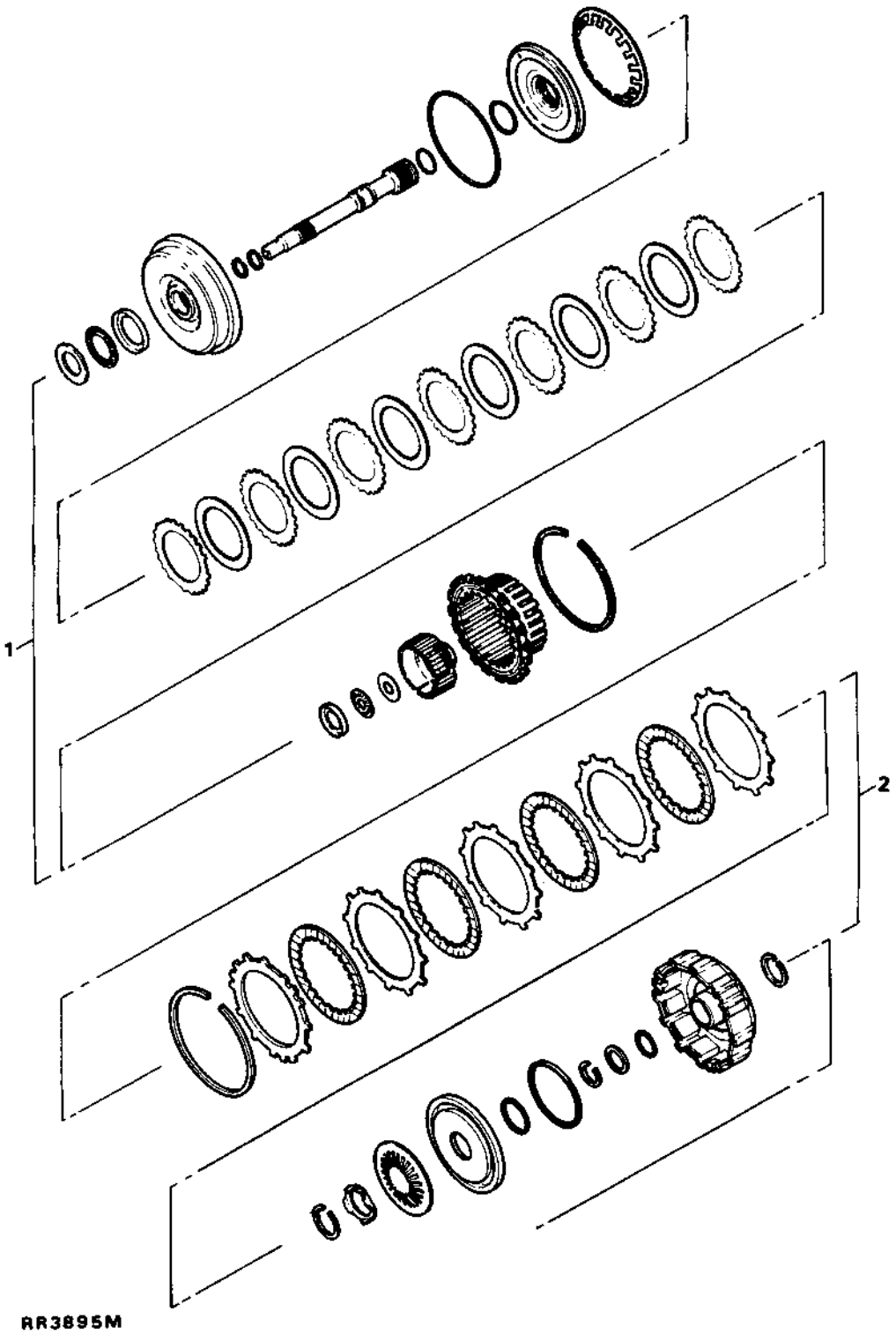
1. GEARBOX ASSEMBLY
2. INHIBITOR SWITCH ASSEMBLY
3. CONTROL UNIT ASSEMBLY
4. FILTER AND SUMP ASSEMBLY

1. TORQUE CONVERTER HOUSING ASSEMBLY
2. GEARBOX PUMP AND CASING ASSEMBLY
3. GOVERNOR AND ADAPTOR HOUSING ASSEMBLY

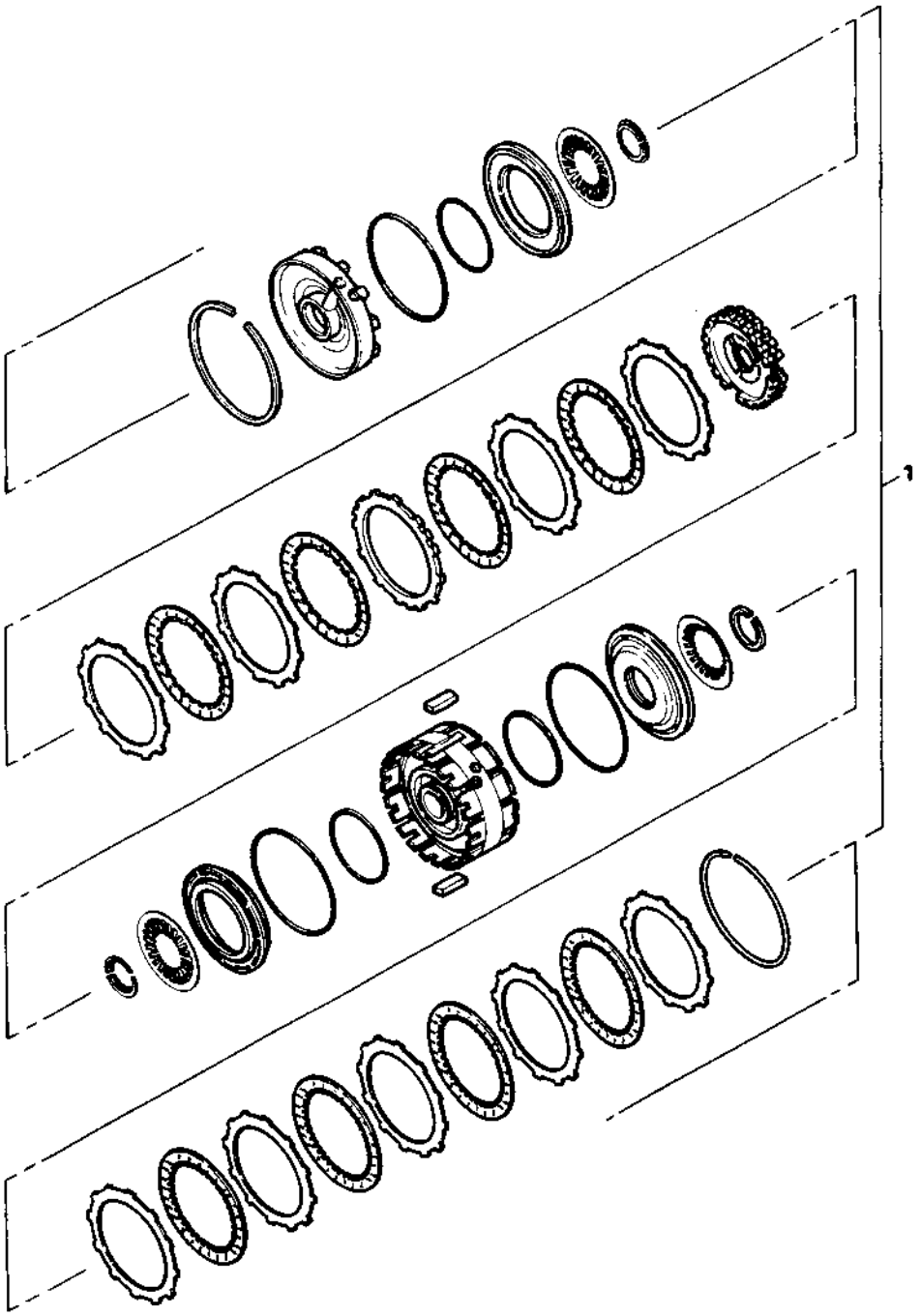


RR3884M

1. A CLUTCH ASSEMBLY
2. B CLUTCH ASSEMBLY

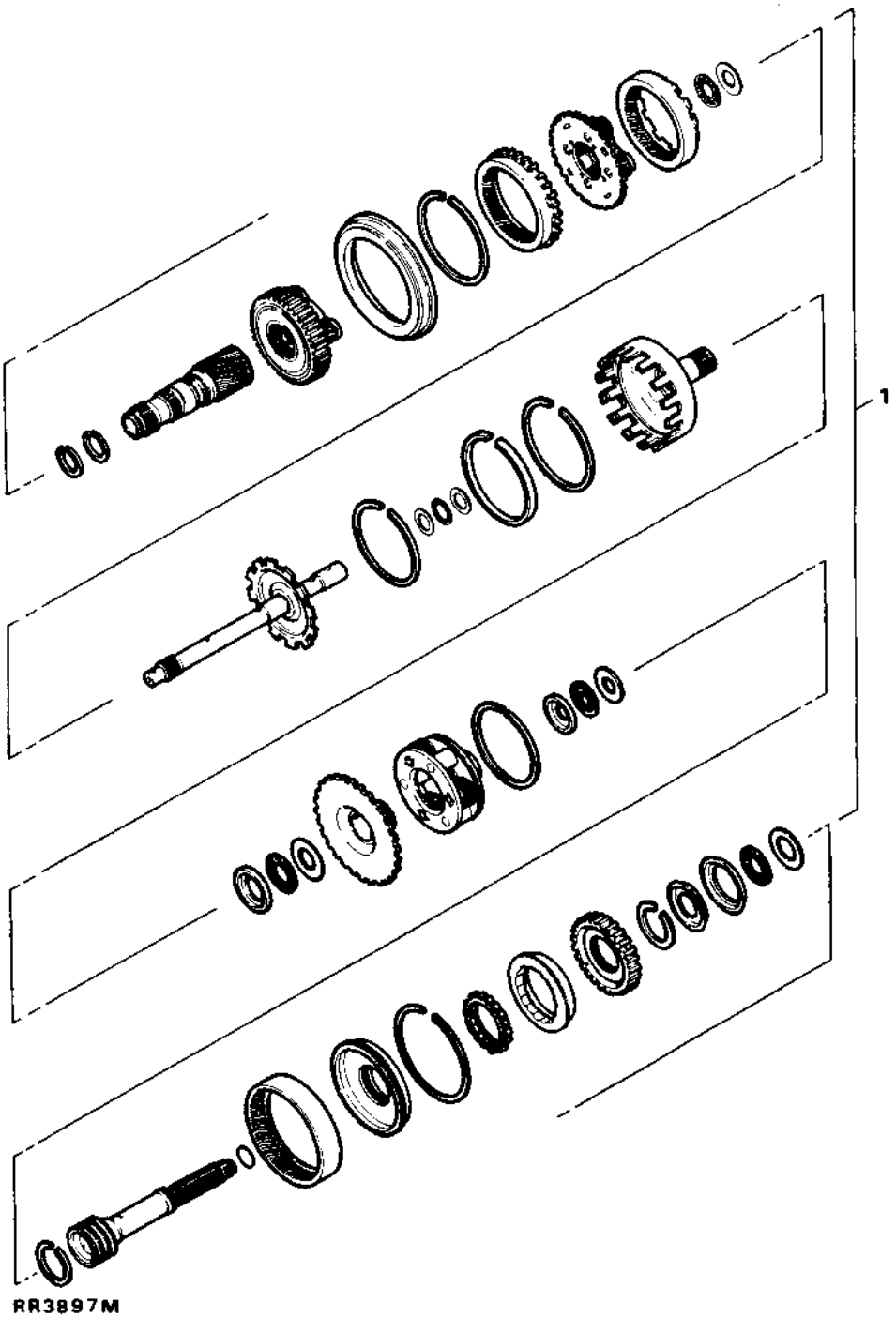


1. C,C AND D CLUTCH ASSEMBLY

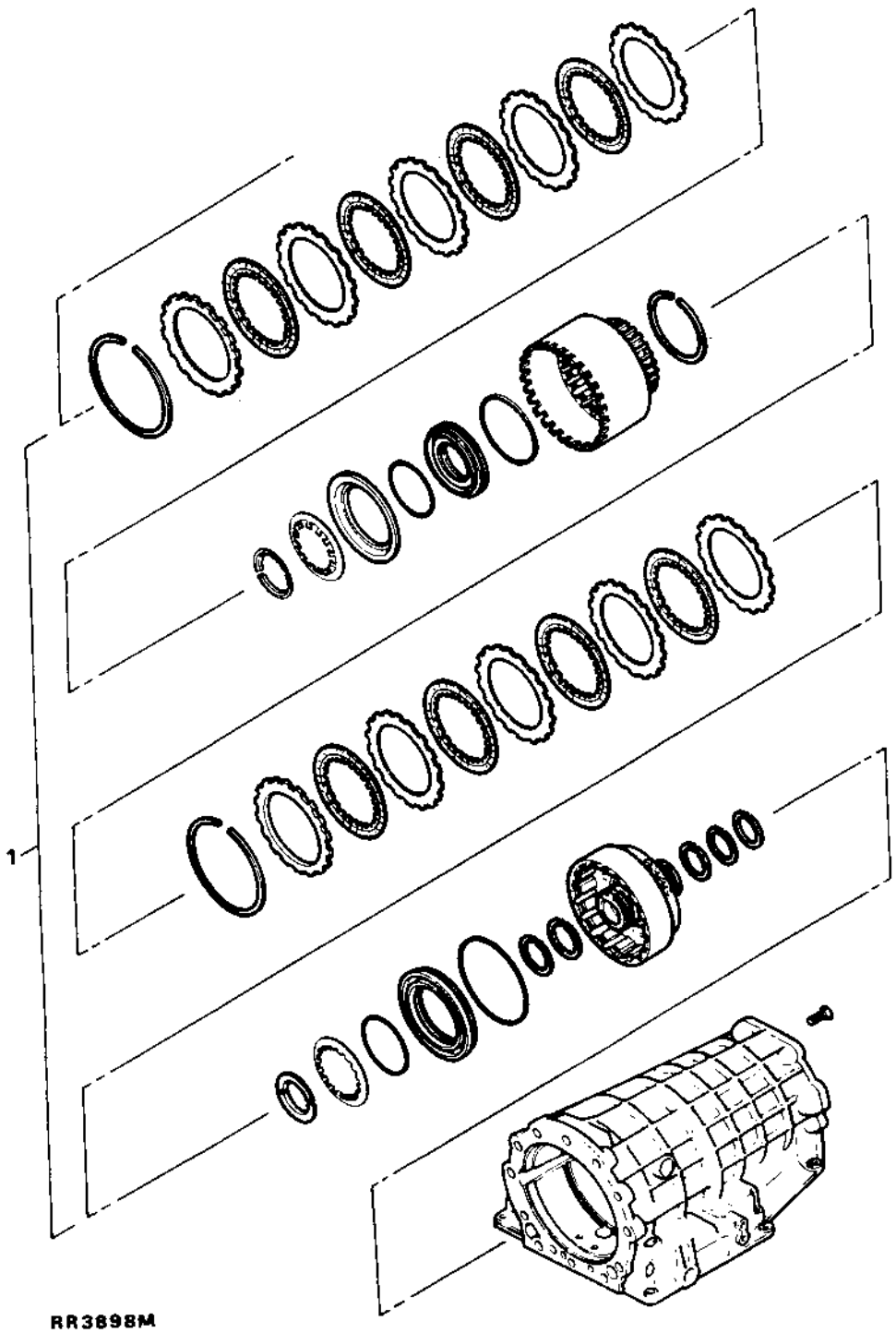


RR3896M

1. FREEWHEEL AND FOURTH GEAR ASSEMBLY



1. E AND F CLUTCH ASSEMBLY



FAULT SYMPTOMS

SYMPTOM 1 - Intermittent drive and high pitched noise

FAULT - Low fluid level or restricted filter

SYMPTOM 2 - No drive in reverse

Select 'D'
- No drive
  FAULT - Continue with Symptom 3
- Drives forward
  FAULT - Reverse gear interlock valve seized

Select '1'
- No engine braking
  FAULT - Clutch brake 3

SYMPTOM 3 - No drive from rest with 'D' selected

Select '1'
- Vehicle drives
  FAULT - No 2 freewheel
- No drive

Carry out main line pressure check

- Normal pressure
  FAULT - Clutch A
- No pressure
  FAULT - Blocked filter or pump failure
- Low pressure
  FAULT - Restricted filter or sticking primary regulator

SYMPTOM 4 - Slip in all forward gears

Carry out main line pressure check
- No pressure
  FAULT - Blocked filter or pump failure
- Low pressure
  FAULT - Restricted filter or sticking primary regulator
- Normal pressure
  FAULT - Clutch 'A'

SYMPTOM 5 - Harsh engagement 'N' to 'D'

Check engine idle speed

Carry out main line pressure check
- High pressure
  FAULT - Primary regulator sTUCK
- Normal pressure
  FAULT - Clutch 'A' or damper for clutch'A'

SYMPTOM 6 - Fierce shift or flare 1st to 2nd shift

Check engine idle speed

Carry out mainline pressure check
- High pressure
  FAULT - Continue with symptom 5
- Normal pressure
  FAULT - Modulator valve or dampers for clutch brake CB1 and/or clutch brake CB2
  FAULT - Clutch brake CB1 and/or clutch brake CB2

SYMPTOM 7 - Fierce shift or flare 2nd to 3rd

Carry out mainline pressure check
- High pressure
  FAULT - Continue with symptom 5
- Normal pressure
  FAULT - Modulator valve or clutch 'B' damper
  FAULT - Clutch 'B'

SYMPTOM 8 - No 3rd gear

FAULT - 2-3 shift valve
FAULT - Clutch 'B'

SYMPTOM 9 - No 4th gear 'D' selected

FAULT - 4th to 3rd downshift valve stuck or 3rd to 4th upshift valve stuck
FAULT - Clutch brake 4

SYMPTOM 10 - None or harsh engagement of direct drive clutch

△ **NOTE: The direct drive clutch will only engage if 4th gear is engaged at 40 to 45 mph.**

Carry out road test pressure check with gauge connected to torque converter.

- Normal pressure
  FAULT - Failed direct drive clutch
- Pressures correct but remains high
  FAULTS POSSIBLE -
  Direct drive clutch and torque converter control valve stuck
  Hysteresis valve stuck
  Direct drive clutch control valve stuck

SYMPTOM 11 - Direct drive clutch shift point incorrect or at low speed

△ **NOTE: Direct drive clutch engagement at low speed will cause vibration in the torque converter**

Carry out mainline and torque converter pressure check

- Normal pressure
  FAULT - Governor valve sticking
- Low or incorrect pressure
  FAULTS POSSIBLE -
  Direct drive clutch and torque converter control valve sticking.
  Hysteresis valve stuck.
  Direct drive clutch control valve stuck.

SYMPTOM 12 - Drives in 'D' but immediately upshifts to 3rd

FAULT - 2nd to 3rd shift valve stuck.

SYMPTOM 13 - With 'D' selected vehicle starts in 2nd

FAULTS POSSIBLE -
1st and 2nd shift valve stuck.
Governor sleeve sticking.

SYMPTOM 14 - With 'D' selected vehicle starts in 3rd

FAULTS POSSIBLE -
1st to 2nd and 2nd to 3rd shift valves stuck.
Governor sleeve sticking.

SYMPTOM 15 - No kickdown 4th to 3rd

FAULT - 4th to 3rd kickdown valve stuck.

SYMPTOM 16 - Upshifts/downshifts and kickdown shifts at incorrect road speeds

Check throttle kickdown cable adjustment
Carry out main line pressure check

- Normal pressure
  FAULT - Governor valve sticking
- Incorrect pressure
  FAULTS POSSIBLE -
  Incorrect throttle valve adjustment
  Primary regulator sticking

SYMPTOM 17 - No upshifts at light throttle

FAULTS POSSIBLE
Governor valve sticking
Shift valves sticking

SYMPTOM 18 - No engine braking '3' selected 3rd gear

FAULT - Clutch 'C'

SYMPTOM 19 - Delayed or no downshift occurs when making a manual selection from '3' to '2'

FAULTS POSSIBLE -
2nd and 3rd upshift valve sticking.
Governor valve sticking.
'2' Position interlock valve sticking.

SYMPTOM 20 - At speeds below 28 mph when making a manual selection from '2' to '1', downshift is delayed or does not occur

FAULTS POSSIBLE -
Governor sticking.
1st to 2nd shift valve sticking.
'1' Position interlock valve sticking.

SYMPTOM 21 - '1' Selected 1st gear no engine braking

FAULT - Clutch brake 3

SYMPTOM 22 - '2' Selected 2nd gear no engine braking

FAULT - Clutch brake 1

SYMPTOM 23 - Vehicle drives forward in 'N'

FAULT - Clutch 'A' stuck

ZF AUTO WITH BORG WARNER TRANSFER GEARBOX

Service repair no - 44.20.04.

Remove and refit

Remove

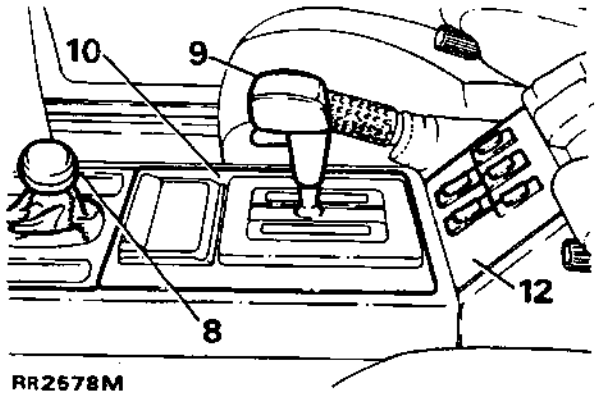
Under bonnet

WARNING: When using transmission jack follow equipment manufacturers instructions to ensure safe and effective use of equipment.

1. Place vehicle on ramp, chock road wheels.
2. Disconnect the battery negative lead.
3. Remove fan blade assembly. Note assembly has a left hand thread.
4. Remove air intake hose from plenum chamber.
5. Disconnect kickdown cable from throttle linkage.
6. Release two gearbox breather pipes from lifting eye at rear of right hand cylinder head.
7. Remove gearbox dipstick.

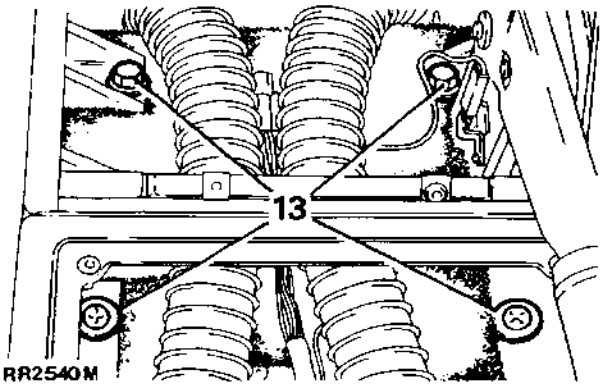
Inside vehicle

8. Select low range, unscrew and remove transfer gearbox knob.



RR2578M

9. Remove gear selector, ***See ELECTRICAL, Repair, Automatic gear selector-panel illumination***
10. Pry inset panel out of floor mounted console. Disconnect multiplug to graphics panel and remove inset panel.
11. Remove glove box liner.
12. Remove window lift switch panel from glove box. Place panel aside on gearbox tunnel.
13. Release two bolts and two screws securing glove console assembly to gearbox tunnel.

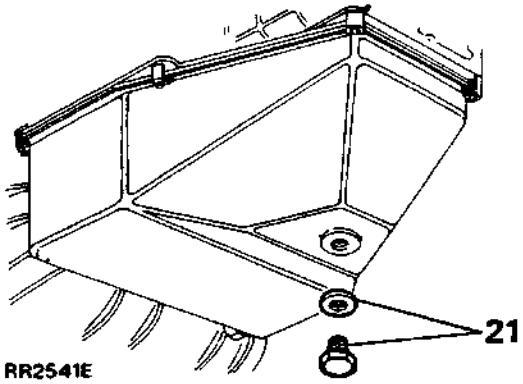


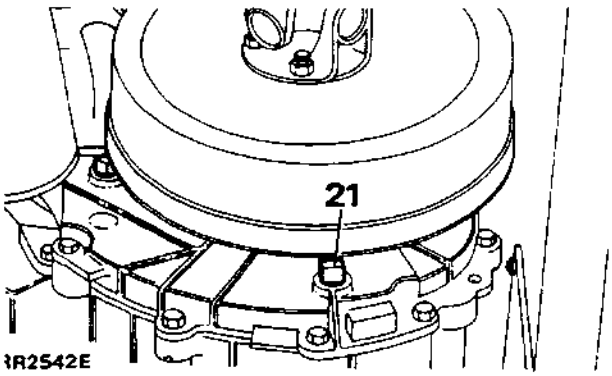
RR2540M

14. Detach relays from inner side of glove box.
15. Disconnect electrical leads to rear cigar lighter.
16. Disconnect parkbrake cable from parkbrake lever. Raise lever and remove console assembly from vehicle.
17. Remove retaining clip and pull parkbrake adjustment thumb wheel from outer sleeve. Push inner sleeve to underside of vehicle.
18. Remove sound deadening trim from top of gearbox tunnel.
19. Remove retaining plate from transfer gearbox lever.

Under vehicle

20. Raise ramp.
21. Drain oil from main and transfer gearbox.

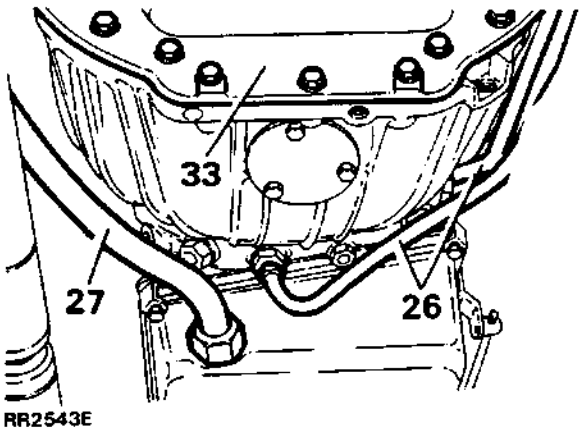




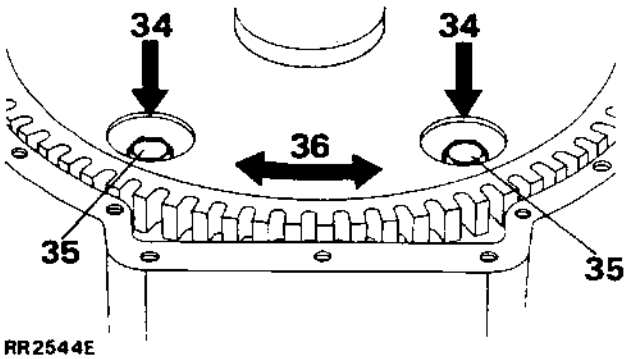
22. Disconnect multiplugs to Lambda sensors.
23. Remove front exhaust assembly.
24. Remove chassis crossmember.
25. Release two clamps securing gearbox oil cooler pipes.
26. Place a suitable container below gearbox, disconnect oil cooler return pipes from gearbox. Plug open ends of pipes.
27. Remove dipstick tube from gearbox sump.
28. Mark propeller shaft and transfer gearbox flanges for re-assembly. Disconnect propeller shafts at output flanges. Tie shafts to one side.
29. Disconnect speedometer cable from rear output housing, tie cable to one side.
30. Disconnect main gearbox selector cable and rod from left side of gearbox. Lay cable aside.
31. Disconnect inhibitor switch.
32. Disconnect speed transducer multiplug.

Remove transmission assembly

33. Remove nine bolts from bottom of gearbox bellhousing, remove cover plate.



34. Rotate engine using crankshaft pulley until two access holes in drive plate are visible.
35. Remove two bolts securing drive plate to torque converter. Mark one access hole and one bolt hole with an identification line for accurate reassembly.
36. Rotate crankshaft 180°. Remove remaining two bolts.



37. Position transmission jack on brake drum to support weight of transmission assembly.
38. Remove bolts and withdraw transfer gearbox mountings.
39. Fit service tool adaptor plate to transmission hoist, raise and position hoist under transfer gearbox mounting points.
40. Secure adaptor plate to gearbox using gearbox mounting bolts.
41. Remove transmission jack from transmission assembly.
42. Carefully lower transmission until top of transfer gearbox clears rear passenger footwell.
43. Position transmission jack under engine to support weight while bellhousing bolts are removed.
44. Remove bellhousing bolts noting that one bolt secures gearbox dipstick tube.
45. Withdraw transmission assembly from engine, ensuring that torque convertor is removed with gearbox.

Refit

46. Refitting gearbox is a reversal of removal procedure noting following points.
47. Coat drive plate to torque converter bolts with Loctite 270.
48. Tighten all bolts to specified torque. ***See Specifications, torque, Torque values***
49. Fit new gaskets to exhaust flanges.
50. Refill gearboxes with correct grade and quantity of oil ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***

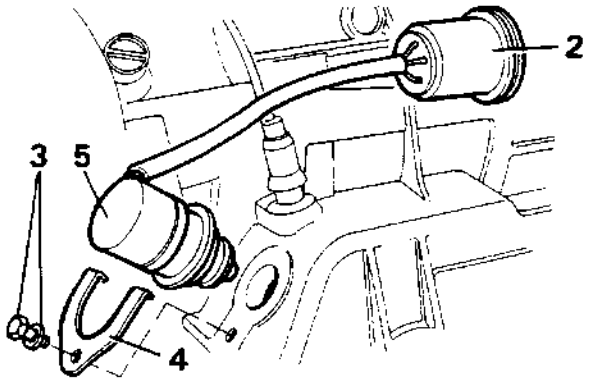
INHIBITOR SWITCH

Service repair no - 44.15.19.

Remove and refit

Remove

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Disconnect inhibitor lead.
3. Remove bolt and spring washer.
4. Remove retaining plate.
5. Remove inhibitor switch.



RR579M

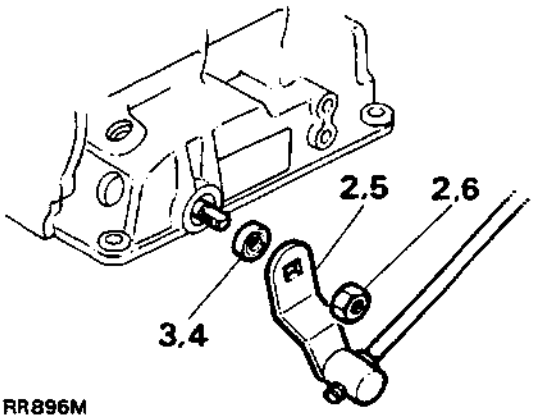
Refit

6. Fit new 'O' ring seal to inhibitor switch.
7. Fit switch and secure with retaining plate, spring washer and bolt.
8. Connect inhibitor lead.
9. Reconnect the battery negative lead.

SELECTOR SHAFT OIL SEAL

Service repair no - 44.15.34.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Remove gear change lever.
3. Remove oil seal.
4. Coat new oil seal with light grease. Fit seal using selector shaft oil seal replacer LST114.
5. Refit gearchange lever.
6. Fit nut. Tighten to ***25 Nm.***

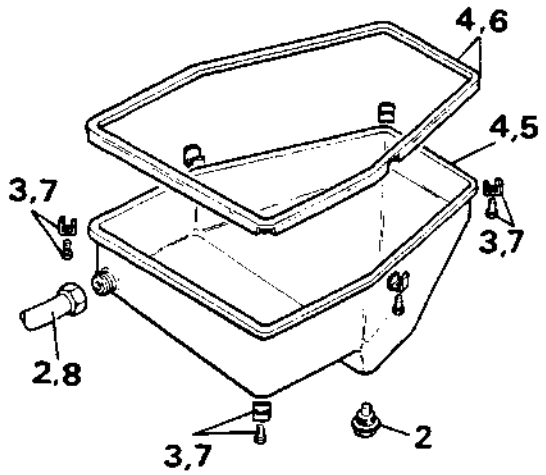


RR896M

OIL SUMP GASKET

Service repair no - 44.24.05.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil. Remove oil level tube.
3. Remove six retaining plates and bolts.
4. Remove sump, discard gasket.
5. Inspect sump for damage. Replace if necessary.



RR903M

6. Fit new gasket to sump.
7. Refit sump. Fit six retaining plates tighten screws to ***10Nm.***
8. Reconnect oil filler level tube. Tighten to ***70Nm.*** Fit sump plug with new seal. Tighten to ***10Nm.***
9. Reconnect the battery negative lead.
10. Add correct oil through filler/level tube, ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
11. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected after selecting each gear.

△ **NOTE: If leak persists after ftting existing oil pan - fit new oil pan.**

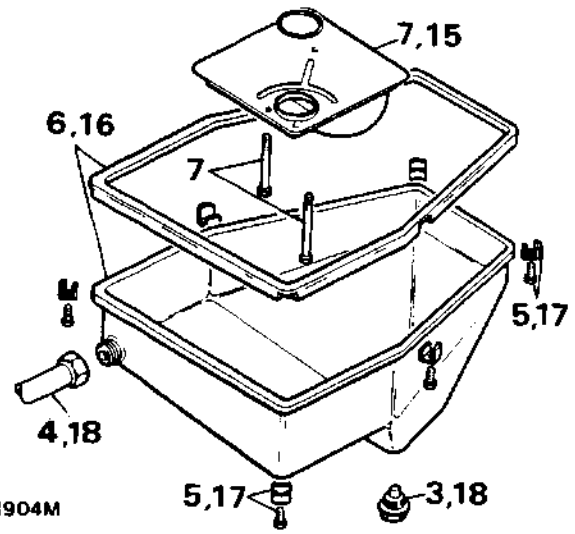
KICKDOWN CABLE LEAK

Service repair no - 44.15.01.

Remove and refit

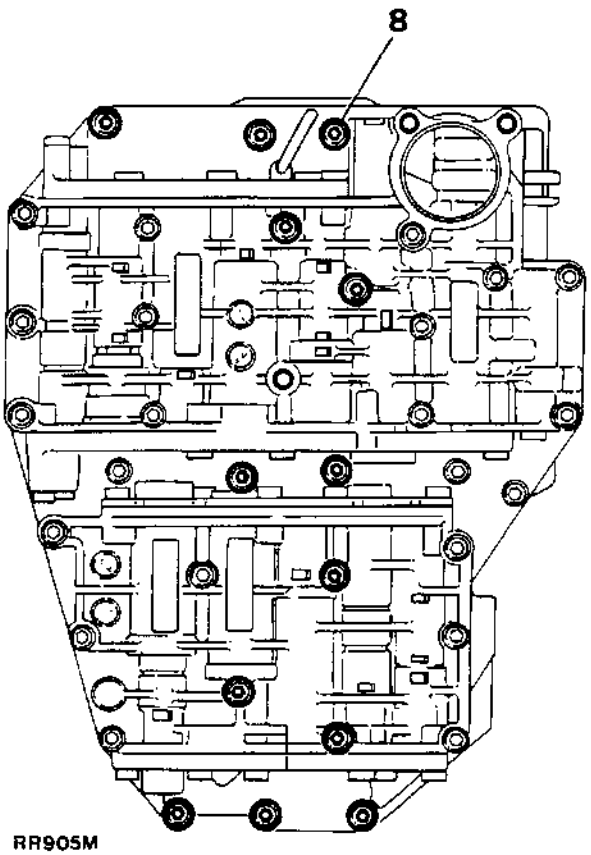
Remove

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Disconnect kickdown cable from engine.
3. Drain gearbox oil. Remove front exhaust assembly and chassis crossmember.
4. Remove oil level tube.
5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.



RR904M

7. Loosen three bolts, remove oil screen.
8. Loosen thirteen remaining bolts, remove control unit.
9. Locate selector cam, remove nipple, holding kickdown cable from seat.

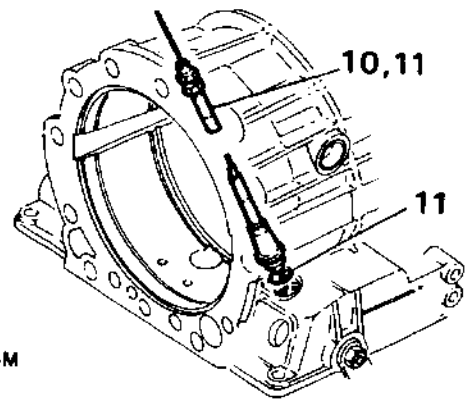


RR905M

10. Using kickdown cable remover LST112, remove cable and its housing from casing and discard.

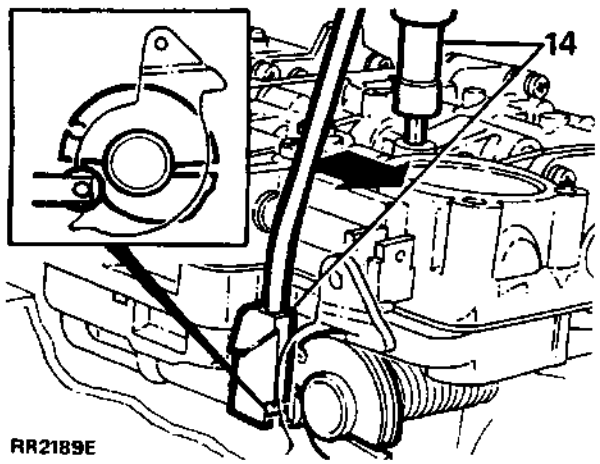
Refit

11. Fit new cable and new 'O' ring into casing.



RR906M

12. Spring load cam by turning once before fitting. Fit nipple into cam seat.
13. Fit control unit after cleaning face with a lint free rag. Ensure selector shaft locates into gear shift fork. Fit thirteen bolts loosely.
14. Place selector linkage setting gauge LST109 in position, gently press control unit in direction shown. Tighten all thirteen bolts to ***8Nm.***



15. Remove setting gauge. Fit oil screen, tighten fixings to ***8Nm.***
16. Refit sump with new gasket.
17. Refit six retaining plates tighten screws to ***8Nm.***
18. Reconnect oil filler tube. Tighten to ***70Nm.*** Fit sump plug with new seal. Tighten to ***10Nm.***
19. Fit chassis crossmember
20. Fit front exhaust assembly
21. Reconnect the battery negative lead.
22. Add correct quantity and grade oil to gearbox. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
23. Connect kickdown cable to engine.

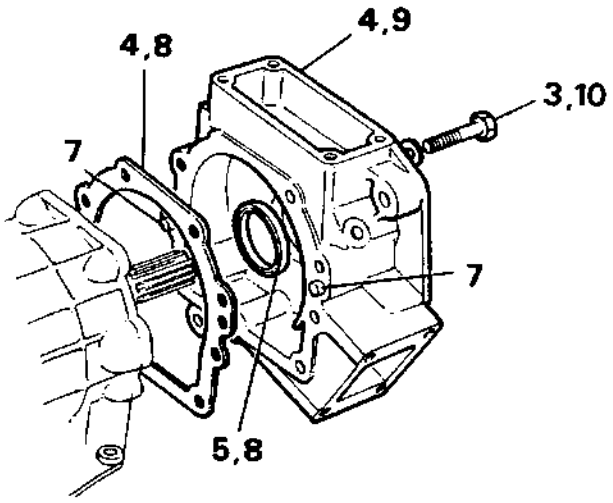
Adjust

24. Adjust cable sheath to achieve a crimp gap of 0.25 to 1.25 mm.
25. Hold cable sheath while tightening locknuts.
26. Ensuring vehicle is on level ground with park brake applied. Check oil level with engine at idle with neutral selected, after selecting each gear.

EXTENSION CASE

Service repair no - 44.20.18.

1. Remove transfer box, ***See TRANSFER BOX, Repair, Borg Warner transfer gearbox***
2. Remove transfer gear selector.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing, discard gasket.
5. Place extension housing on bench, remove oil seal.
6. Ensure that all surfaces are clean and case is free from damage.
7. If fitting new case, fit two dowels to case.
8. Fit a new gasket and oil seal using rear oil seal replacer LST108.

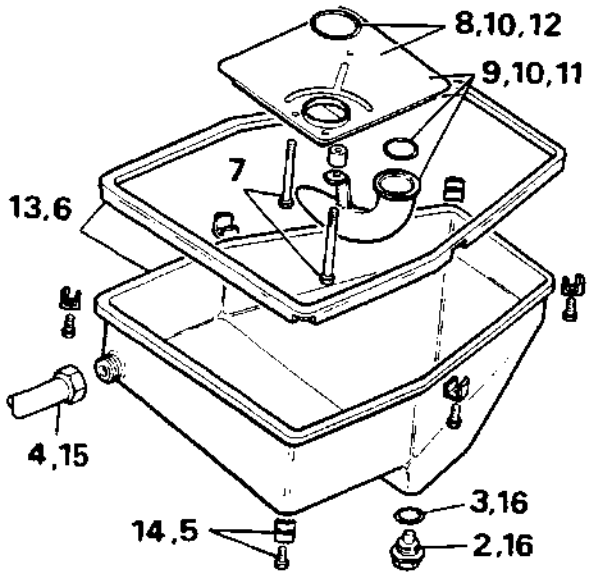


9. Fit extension case to gearbox, ensure oil seal is not damaged by extension shaft.
10. Fit and tighten nine bolts to ***23 Nm.***
11. Refit transfer gear selector.
12. Tighten three bolts to ***25 Nm.***
13. Refit transfer box.

OIL SCREEN

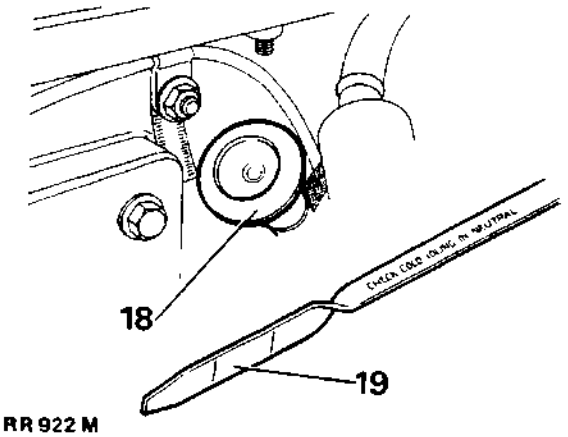
Service repair no - 44.24.07

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil.
3. Discard sump plug seal.
4. Remove level tube from sump.
5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.
7. Loosen three screws from oil screen.
8. Remove oil screen, discard 'O' rings.
9. Separate oil screen from suction tube, discard 'O' ring and oil screen.
10. Fit two new 'O' rings to oil screen.
11. Fit suction tube to oil screen.
12. Fit oil screen to control unit, tighten three bolts to ***8 Nm.***



RR691M

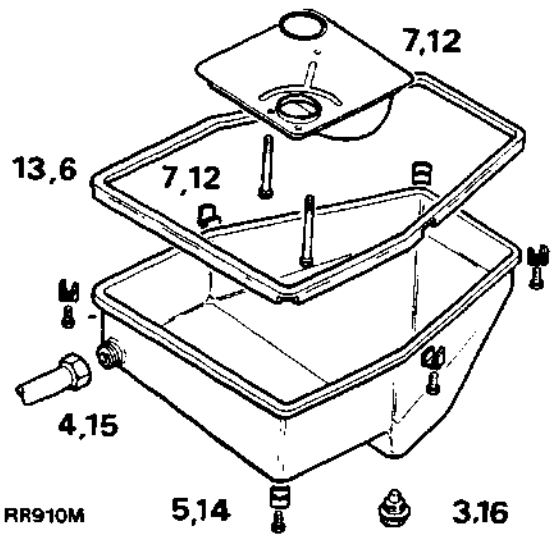
13. Refit sump using a new gasket.
14. Secure using six retaining plates and bolts. Tighten to ***8Nm.***
15. Reconnect oil level/filler tube. Tighten to ***70 Nm.***
16. Fit sump plug using a new seal. Tighten to ***10 Nm.***
17. Connect battery lead.
18. Add correct oil to gearbox ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
19. Ensuring vehicle is on level ground with park brake applied, check oil level with engine at idle, neutral selected, after selecting each gear.



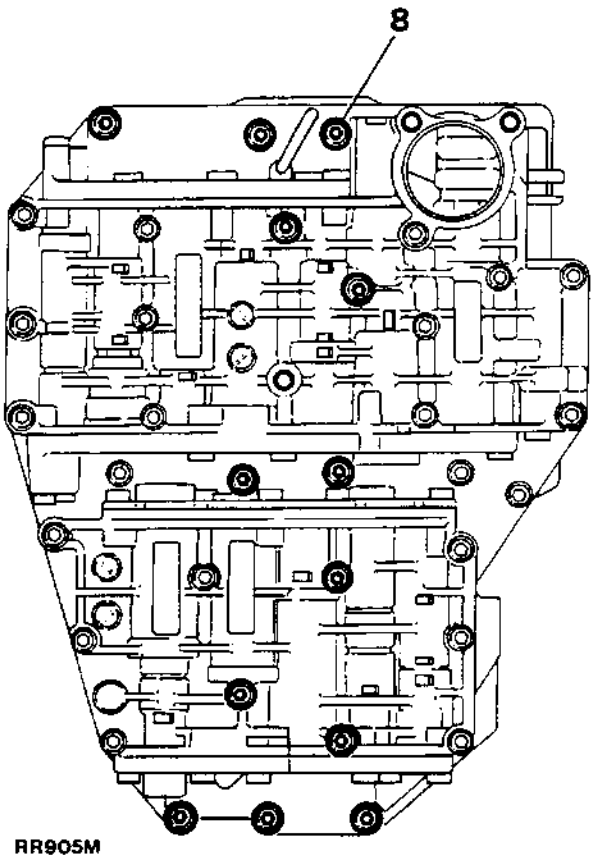
RR 922 M

CONTROL UNIT

1. Site vehicle on ramp, Disconnect the battery negative lead.
2. Drain gearbox oil into a container.
3. Discard sump plug seal.
4. Remove oil level tube from sump.

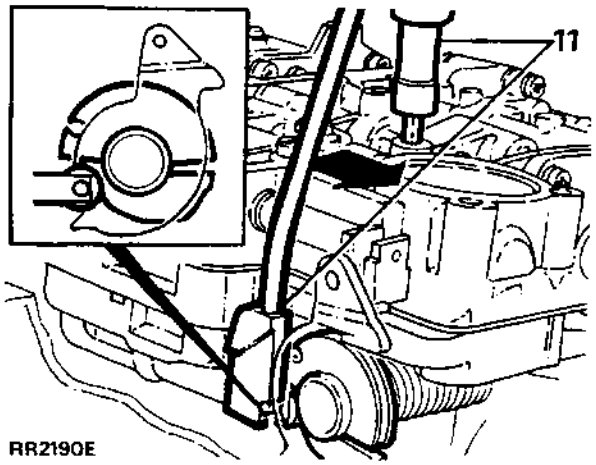


5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.
7. Loosen three bolts and remove oil screen.
8. Loosen remaining thirteen bolts retaining control unit.



9. Clean surfaces using a lint-free rag. Ensure no damage has occurred to mounting face of case.
10. Fit control unit ensuring selector shaft locates into gear shift fork. Loosely fit thirteen bolts.

11. Place selector linkage setting gauge LST109 in position, gently press control unit against tool. Tighten to ***8Nm.***



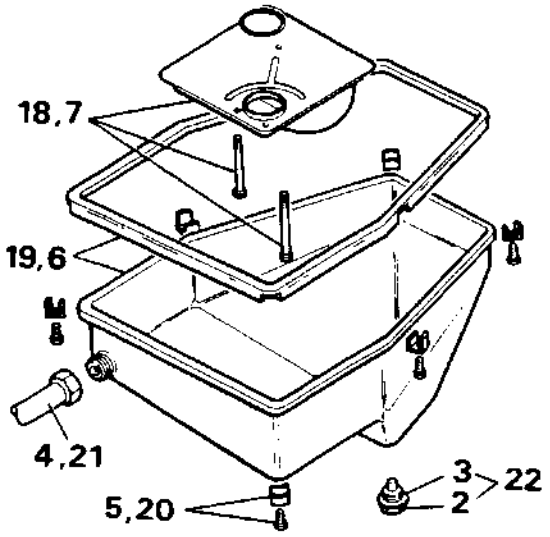
RR2190E

12. Remove setting gauge. Fit oil screen. Tighten to ***8Nm.***
13. Refit sump using a new gasket.
14. Secure with six retaining plates and bolts. Tighten to ***8 Nm.***
15. Reconnect oil level tube. Tighten to ***70 Nm.***
16. Fit sump plug with new seal. Tighten to ***10 Nm.***
17. Reconnect the battery negative lead.
18. Add correct quantity and grade of oil to gearbox, ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
19. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected, after selecting each gear.

OIL INLET SEALING RINGS

Service repair no - 44.20.13.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil into a container.

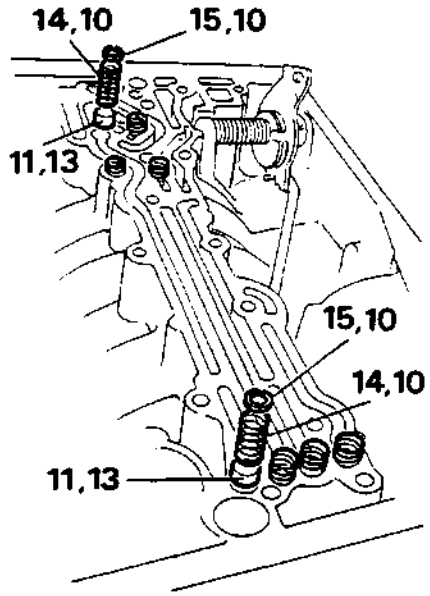


RR913M

3. Discard sump plug seal.
4. Remove oil level tube from sump.
5. Remove six retaining plates and bolts.
6. Remove sump, discard gasket.
7. Loosen three bolts and remove oil screen.
8. Loosen remaining thirteen bolts retaining control unit.
9. Clean surfaces using a lint-free rag. Ensure no damage has occurred to mounting face of case.
10. Remove eight circlips and springs from gearbox.
11. Using LST 113 remove eight oil seals.
12. Clean orifices, check for damage.

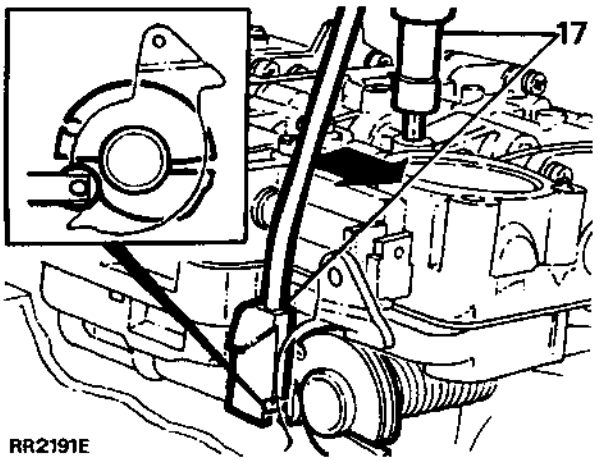
△ **NOTE: If damage has occurred replace box, *See ZF Auto with Borg Warner Transfer Gearbox***

13. Using LST 113 fit new seals.
14. Fit eight compression springs, four short ones at front and four long ones at rear.



RR580M

15. Fit eight circlips to retain compression springs.
16. Fit control unit locating selector shaft into gear shift fork. Fit thirteen bolts loosely.
17. Place setting gauge LST 109 in position. Press control unit against tool, tighten thirteen bolts to ***8Nm.***



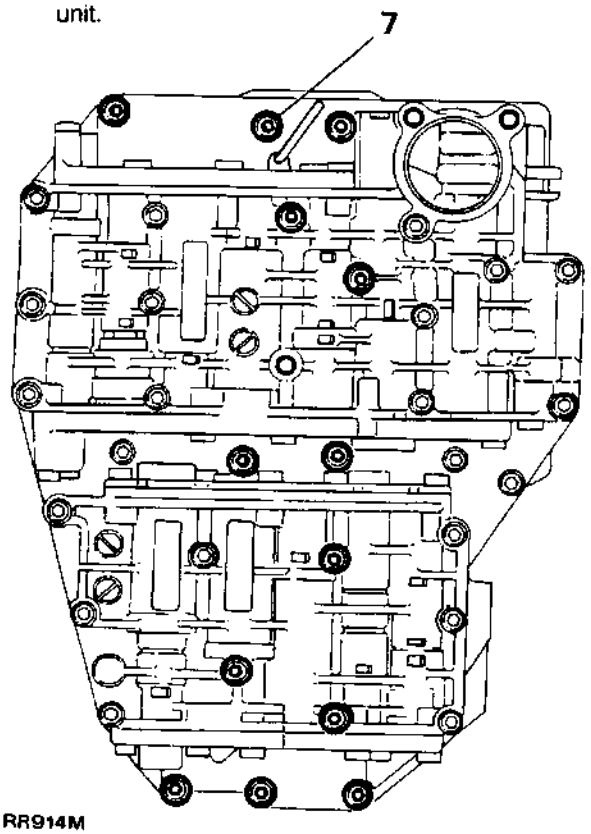
RR2191E

18. Remove setting gauge. Fit oil screen, tighten fixings to ***8 Nm.***
19. Refit oil pan with new gasket.
20. Secure with six retaining plates and bolt. Tighten to ***8 Nm.***
21. Reconnect oil level tube. Tighten to ***70 Nm.***
22. Fit sump plug with new seal. Tighten to ***10 Nm.***
23. Reconnect the battery negative lead.
24. Add correct quantity and grade of oil to gearbox, ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
25. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected, after selecting each gear.

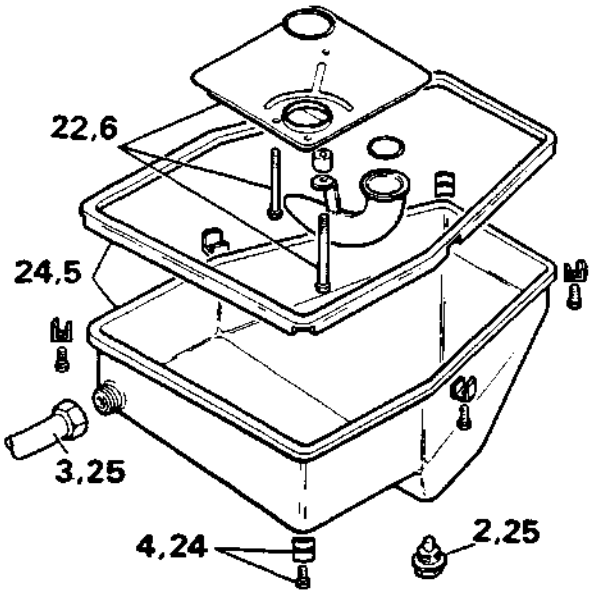
MANUAL VALVE OPERATING MECHANISM

Service repair no - 44.40.01.

1. Site vehicle on ramp. Disconnect the battery negative lead.
2. Drain gearbox oil into a container. Discard sump plug seal.
3. Remove oil level tube from sump.
4. Remove six retaining plates and bolts.
5. Remove sump, discard gasket.
6. Loosen three bolts and remove oil screen.
7. Loosen remaining thirteen bolts retaining control unit.

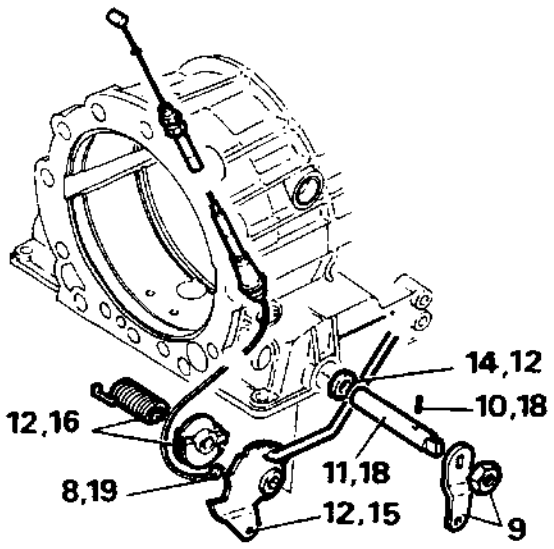


RR914M



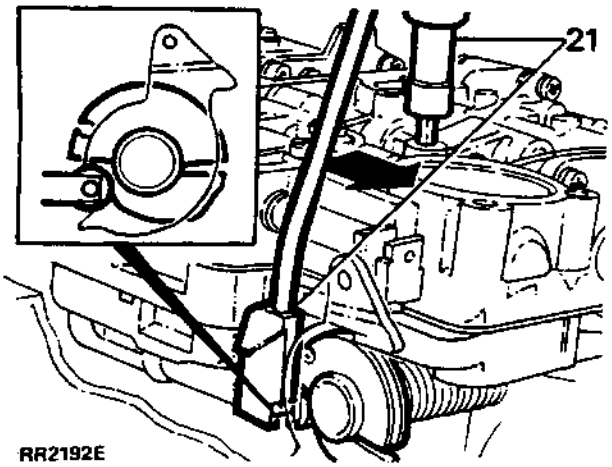
RR582M

8. Locate selector cam, remove kickdown cable nipple from its seat.
9. Remove gear change lever.
10. Drift out roll pin from selector shaft, discard pin.
11. Remove selector shaft from box, note position of detent plate for reassembly.
12. Remove connecting rod with detent plate, accelerator cam, and spring. Remove and discard oil seal.
13. Check all parts for wear or damage, replace as necessary.



RR581M

14. Using LST114, fit oil seal use petroleum jelly to aid assembly.
15. Fit connecting rod to detent plate, locate in box by pushing selector shaft through from outside of casing.
16. Fit accelerator cam with spring.
17. Fit assembly into box and secure by pushing selector shaft through.
18. Align hole in selector shaft with hole in detent plate. Secure with a new roll pin.
19. Spring load cam by turning once. Fit kickdown cable nipple into cam seat.
20. Fit control unit ensuring selector shaft locates into gear shift fork. Fit thirteen bolts loosely.
21. Position setting gauge LST 109. Press control unit against tool. Tighten thirteen bolts to ***8 Nm.***



RR2192E

22. Remove setting gauge, fit oil screen, tighten fixings to ***8 Nm.***
23. Refit oil pan with new gasket.
24. Secure with six retaining plates and bolt. Tighten to ***8 Nm.***
25. Reconnect oil level tube. Tighten to ***70 Nm.***
26. Fit sump plug with new seal. Tighten to ***10 Nm.***
27. Reconnect the battery negative lead.
28. Add correct quantity and grade of oil to gearbox, ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
29. Ensure vehicle is on level ground with park brake applied. Check oil level with engine at idle, neutral selected, after selecting each gear.

GOVERNOR HOUSING

Service repair no - 44.22.01.

Remove and refit

Remove

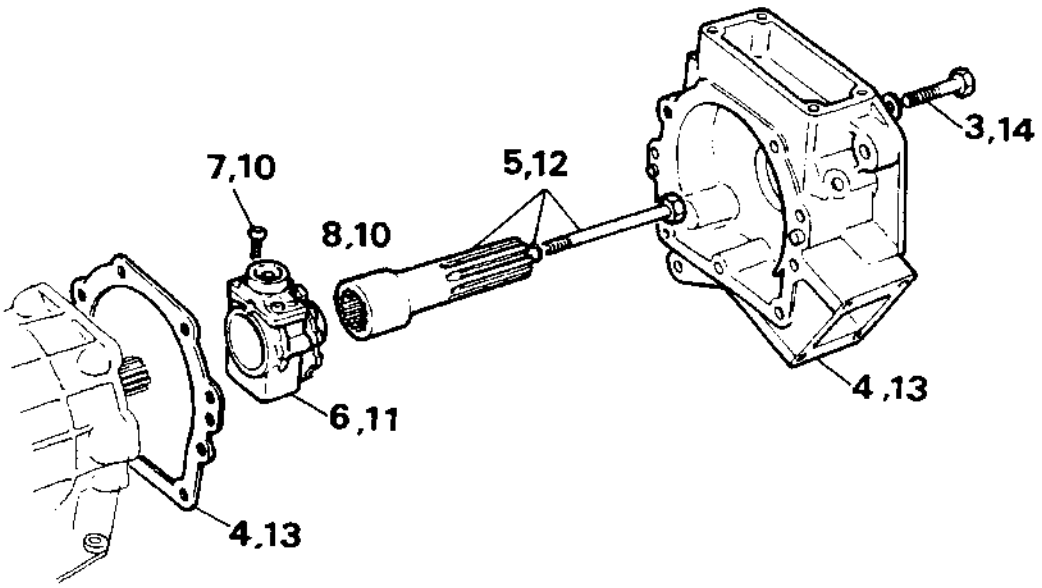
1. Remove transfer box, ***See TRANSFER BOX, Repair, Borg Warner transfer gearbox***
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring.
6. Remove governor assembly with parking wheel.
7. Remove two screws holding governor housing.
8. Remove governor housing complete and discard.
9. Inspect governor hub and parking wheel for damage.

Refit

10. Fit new governor housing complete to governor hub and parking wheel. Tighten to ***10 Nm.***
11. Push governor assembly with parking wheel onto output shaft until fully seated.

△ **NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.**

12. Fit extension shaft, apply Loctite 270 to retaining bolt. Using a new 'O' ring. Tighten to ***42 Nm.***
13. Fit new gasket to rear of gearbox. Fit extension housing, avoid damage to seal.
14. Tighten nine extension housing nine bolts to ***23 Nm.***
15. Fit transfer gear selector housing.
16. Tighten three bolts to ***25Nm.***
17. Refit transfer box.



RR586M

GOVERNOR HUB

Remove and refit

Remove

1. Remove transfer box, ***See TRANSFER BOX, Repair, Borg Warner transfer gearbox***
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring.
6. Remove governor assembly with parking wheel.
7. Remove two screws holding governor housing.
8. Remove two bolts, remove parking wheel. Discard governor hub.
9. Remove security clip and counter-weight.
10. Remove 'O' ring from output shaft and discard.
11. Remove three seal rings from 'F' clutch housing shaft.
12. Inspect all parts for damage or wear, replace if necessary.

Refit

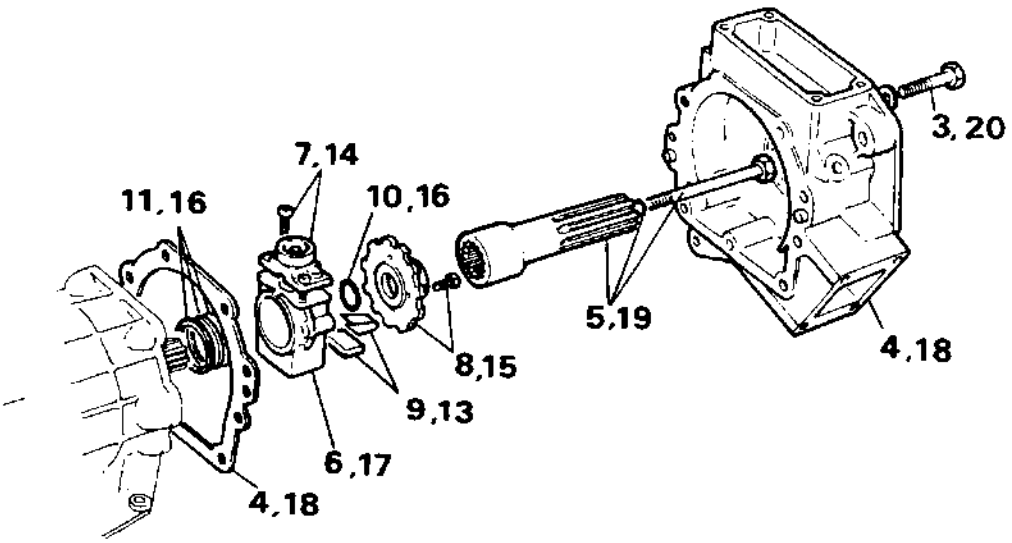
13. Fit counterweight and security clip into new governor hub.
14. Secure governor housing to governor hub. Tighten to ***10Nm.***
15. Fit parking wheel to governor hub. Tighten to ***10 Nm.***
16. Fit three new seal rings onto F clutch housing shaft, fit 'O' ring onto output shaft.

△ **NOTE: To aid fitment of 'O' ring apply petroleum jelly.**

17. Push governor assembly and parking wheel onto output shaft until seated.

△ **NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.**

18. Fit new gasket to rear of gearbox. Fit extension housing, avoid damaging seal.
19. Fit extension shaft, apply Loctite 270 to retaining bolt. Using a new 'O' ring. Tighten to ***42 Nm.***
20. Tighten nine extension housing nine bolts to ***23 Nm.***
21. Fit transfer gear selector housing, tighten three bolts to ***25 Nm.***
22. Refit transfer box.



RR919M

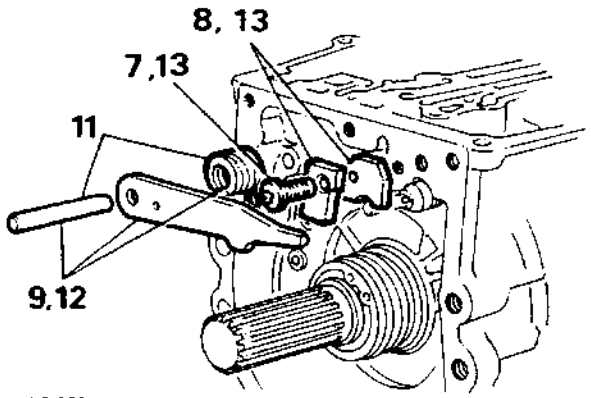
PARKING PAWL MECHANISM

Service repair no - 44.28.07.

Remove and refit

Remove

1. Remove transfer box, ***See TRANSFER BOX, Repair, Borg Warner transfer box***
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring.
6. Remove governor assembly with parking wheel.



RR584M

7. Remove guide plate bolt.
8. Remove plate and guide plate from gearbox case.
9. Remove pin, pawl and spring.

CAUTION: When removing assembly. Avoid damaging parts which could weaken spring tension.

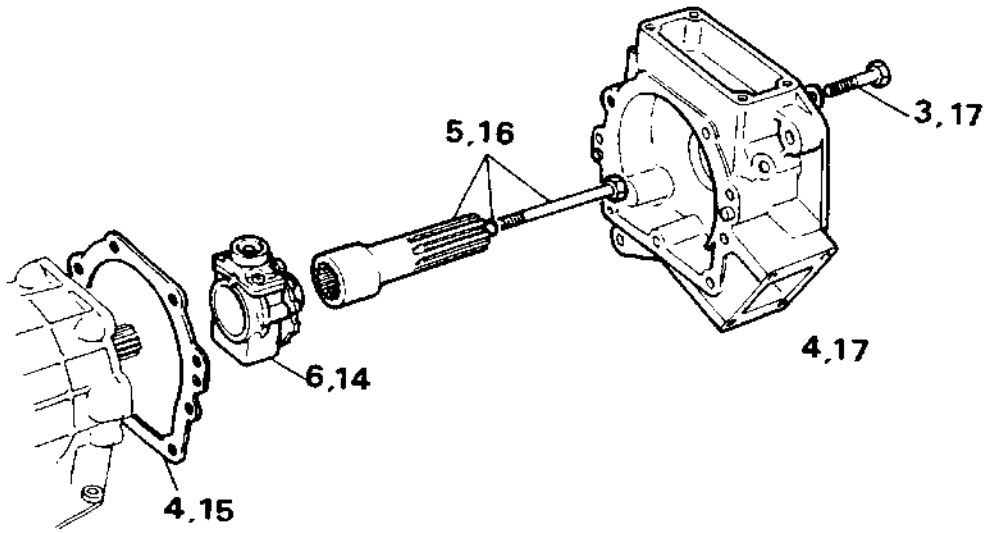
10. Inspect all parts for wear or damage. Replace if necessary.

Refit

11. Fit pin and leg spring, locate spring correctly.
12. Fit pawl to pin. Locate spring leg into hole in pawl to create tension in spring.
13. Fit plate and guide plate. Tighten to ***10 Nm.***
14. Push governor assembly with parking wheel onto output shaft until seated.

NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.

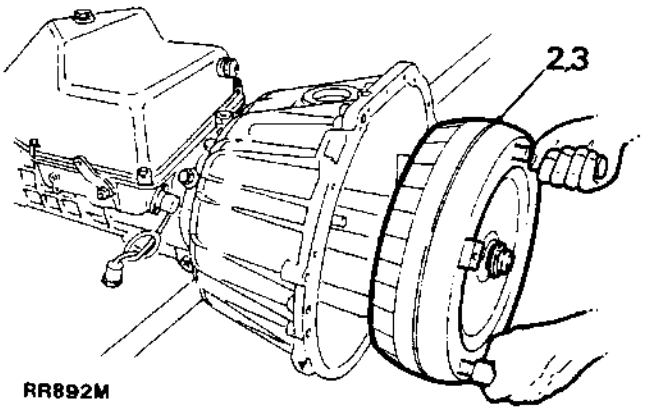
15. Fit new gasket to rear of gearbox. Fit extension housing, taking care not to damage seal or assembly.
16. Fit extension shaft and retaining bolt with new 'O' ring.
17. Fit extension housing, tighten nine bolts to ***23Nm.***
18. Fit transfer gear selector housing, tighten three bolts to ***25 Nm.***
19. Refit transfer box.



RR920M

REPLACING TORQUE CONVERTER

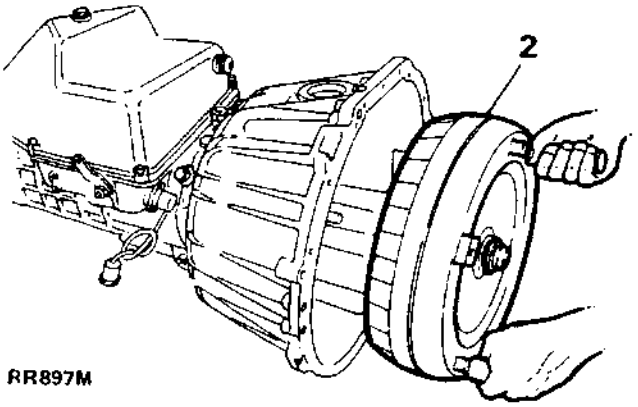
1. Remove gearbox and transfer box assembly, ***See ZF Auto with Borg Warner transfer gearbox***
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.
3. Fit new torque converter using torque converter handles 18G1501. Check dimension from converter fixing boss to converter housing face is 50 mm. This shows converter is correctly seated in housing.
4. Refit gearbox and transfer box assembly. ***See ZF Auto with Borg Warner transfer gearbox***



RR892M

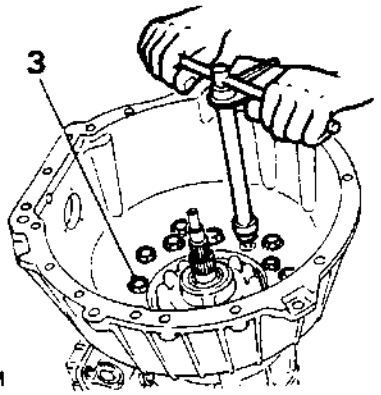
ELIMINATING LEAKS ON PUMP HOUSING

1. Remove gearbox and transfer box assembly, ***See ZF Auto with Borg Warner transfer gearbox***
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



RR897M

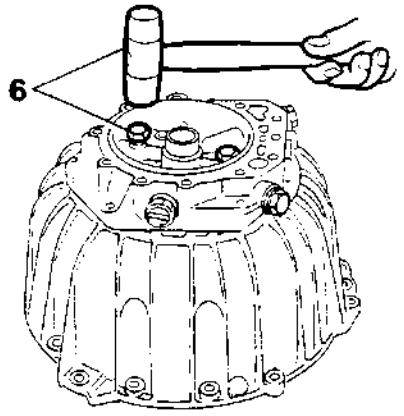
3. Remove twelve hexagonal bolts (inner ring pattern).



RR577M

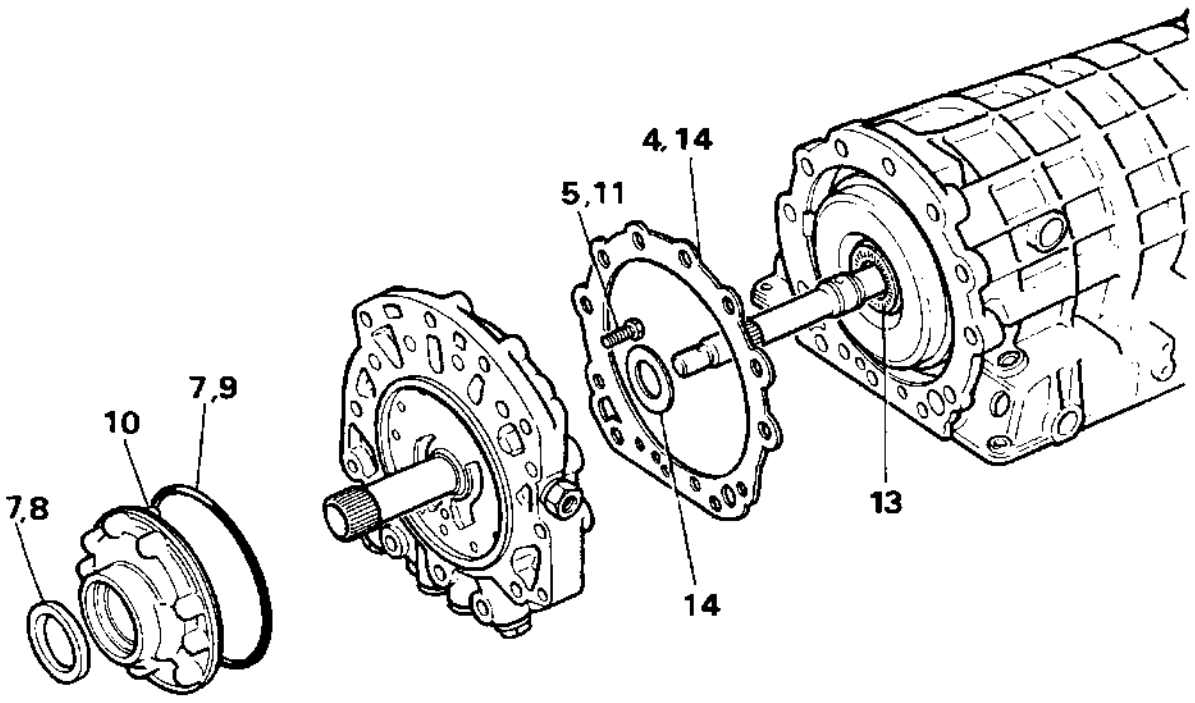
4. Remove bellhousing and pump assembly, discard gasket.
5. Remove eight hexagonal bolts on rear of pump.

6. Screw in two bolts, diagonally opposite each other. Tap lightly using a soft headed mallet to remove pump assembly from intermediate plate.



RR578M

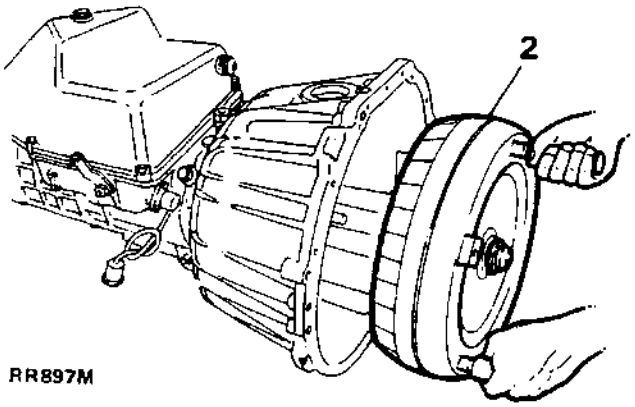
7. Remove shaft sealing ring and 'O' ring from pump housing and discard.
8. Using oil seal replacer LST108 fit shaft seal ring into pump housing.
9. Fit 'O' ring onto circumference of pump housing.
10. Align dowel with hole in intermediate plate and press pump housing home.
11. Fit pump housing to intermediate plate, tighten eight bolts to ***10 Nm.***
12. Place bellhousing and intermediate plate assembly on bench, front face up. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
13. Before fitting intermediate plate and bellhousing assembly,check that thrust washer and axial cage are seated on A clutch housing.
14. Place gasket and disc washer onto bellhousing and intermediate plate assembly using Petroleum Jelly.
15. Fit bellhousing and intermediate plate assembly to gearcase. Tighten twelve bolts to ***46 Nm.***
16. Place end float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with a suitable washer to give required end float.
17. Refit torque converter into housing using torque converter handles 18G1501, checking that dimension from converter fixing bolt boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
18. Refit gearbox/transfer box assembly. ***See ZF Auto with Borg Warner transfer gearbox***



RR878M

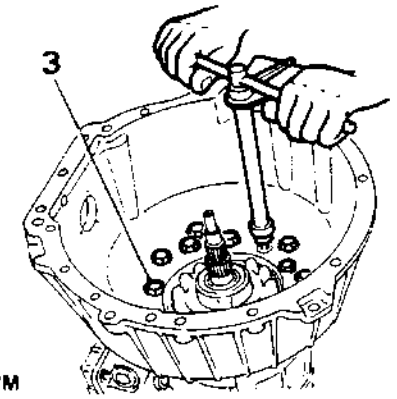
ELIMINATING LEAKS BETWEEN GEARBOX HOUSING AND INTERMEDIATE PLATE

1. Remove gearbox and transfer box assembly, ***See ZF Auto with Borg Warner transfer gearbox***
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



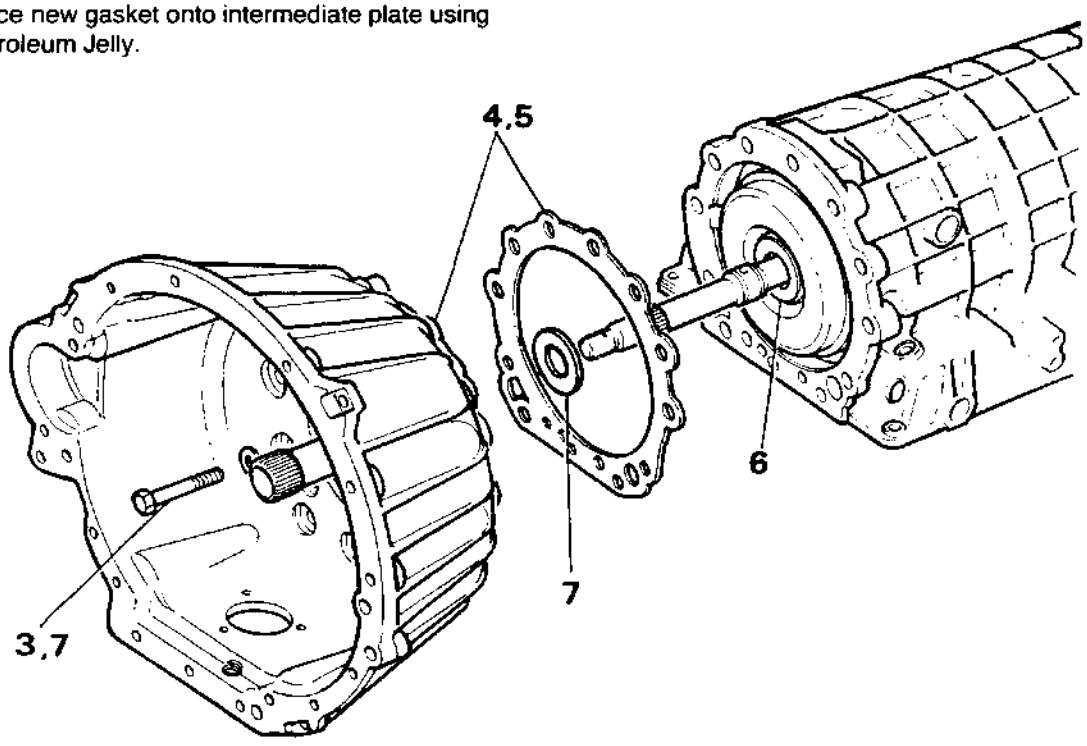
RR897M

3. Remove twelve hexagonal bolts (inner ring pattern).
4. Remove bellhousing/intermediate plate assembly from gearbox case and discard gasket.
5. Place new gasket onto intermediate plate using Petroleum Jelly.



RR577M

6. Before fitting bellhousing assembly check that thrust washer and axial cage are seated on A clutch housing.
7. Fit bellhousing assembly with disc washer to gearcase. Tighten twelve bolts to ***46Nm.***
8. Place end-float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with a suitable washer to give required end-float.
9. Refit torque converter using torque converter handles 18G1501. Checking that dimension from converter fixing boss to converter housing case is 50mm. This dimension shows converter is properly seated.
10. Refit gearbox/transfer box assembly. ***See ZF Auto with Borg Warner transfer gearbox***

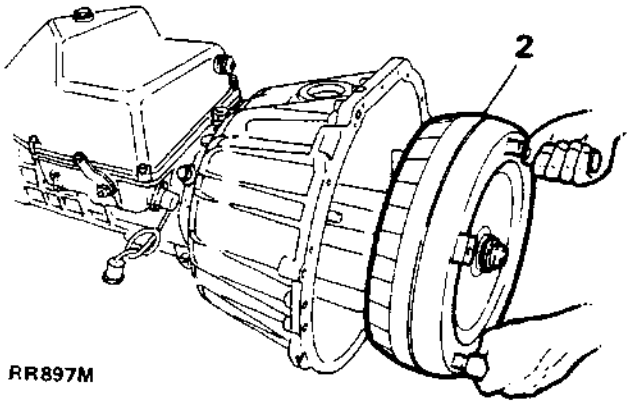


RR576M

REPLACING BELLHOUSING

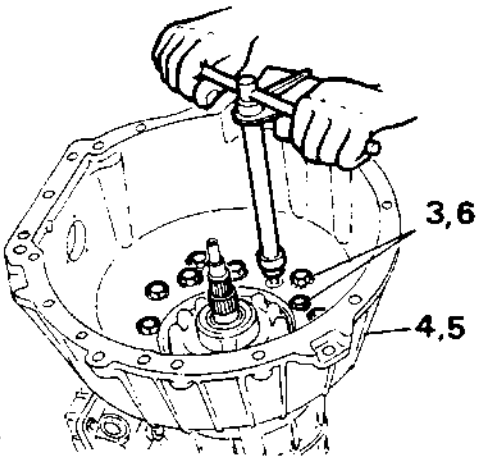
Service repair no - 44.17.01

1. Remove gearbox and transfer box assembly, ***See ZF Auto with Borg Warner transfer gearbox***
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



RR897M

3. Remove eighteen hexagonal bolts.
4. Remove bellhousing.
5. Fit new bellhousing.
6. Secure bellhousing, tighten eighteen bolts to ***46 Nm.***



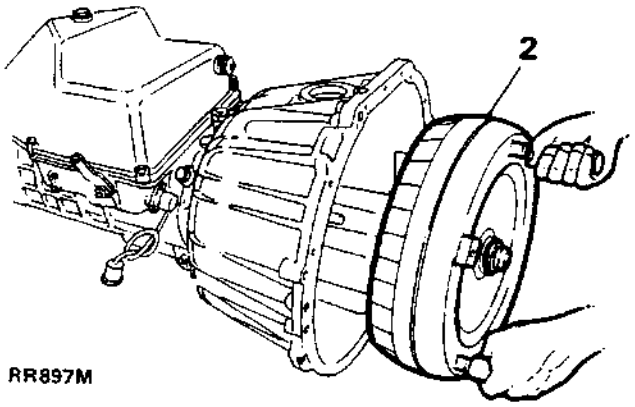
RR899M

7. Refit torque converter using torque converter handles 18G1501. Check that dimension from converter fixing boss to converter housing face is 50 mm. This dimension shows converter is properly seated in housing.
8. Refit gearbox/transfer assembly. ***See ZF Auto with Borg Warner transfer gearbox***

REPLACING PUMP

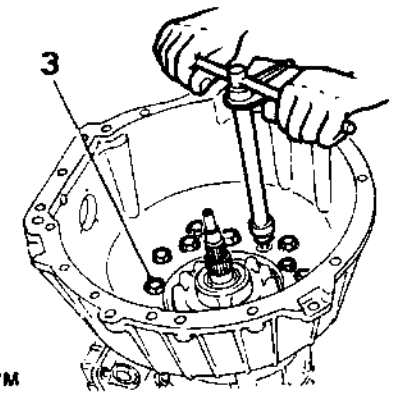
Service repair no - 44.32.01.

1. Remove gearbox and transfer box assembly, ***See ZF Auto with Borg Warner transfer gearbox***
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



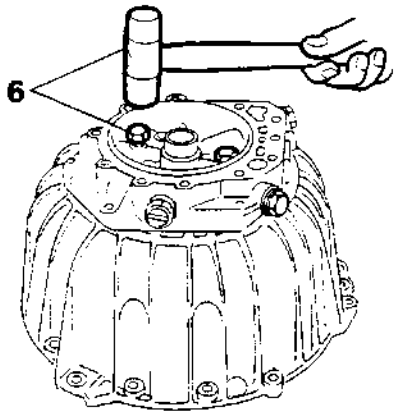
RR897M

3. Remove twelve bolts (inner ring pattern).



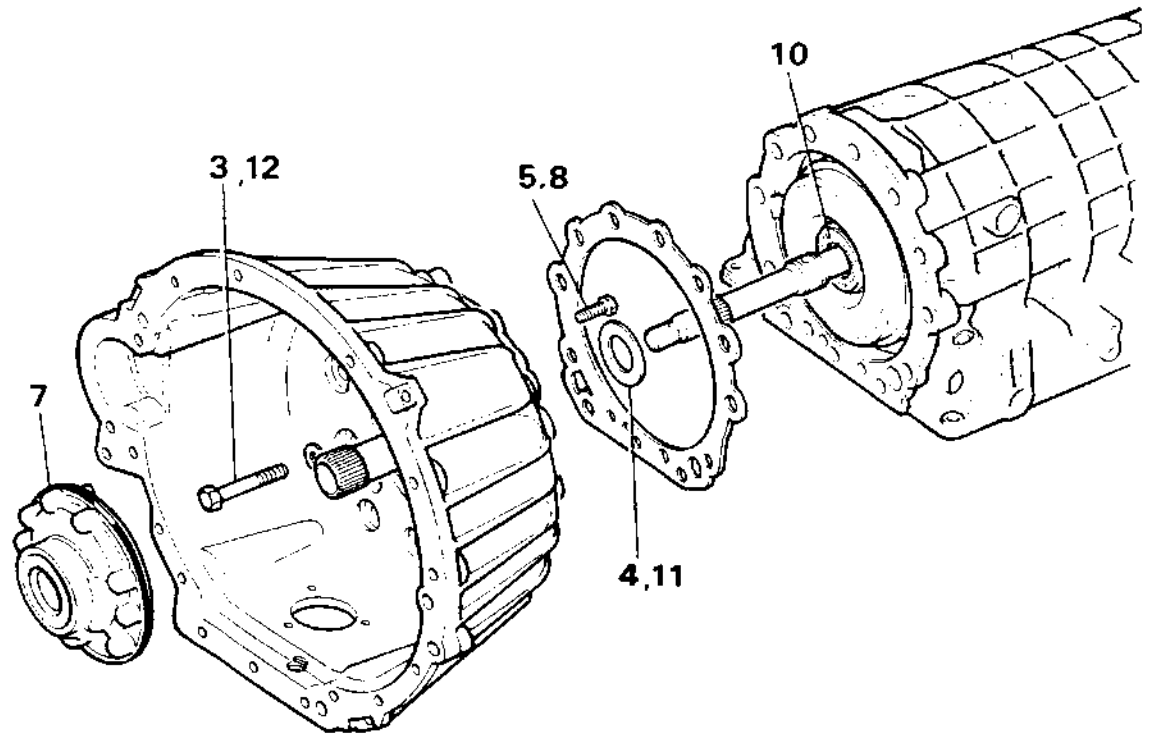
RR577M

4. Remove bellhousing and pump assembly from gearbox case, discard gasket.
5. Remove eight bolts on rear of pump.
6. Screw in two bolts,diagonally opposite each other, tap lightly using a soft headed mallet to free pump assembly from intermediate plate.



RR578M

7. Fit new pump assembly, aligning dowel with hole in intermediate plate,press pump housing home.
8. Secure pump housing to intermediate plate using eight hexagonal bolts and. Tighten to ***10 Nm.***
9. Place bellhousing and intermediate plate assembly on bench, front face up. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
10. Before replacing intermediate plate/bellhousing assembly check that thrust washer and axial cage are seated on A clutch housing.
11. Place new gasket and disc washer onto bellhousing and intermediate plate assembly using a Petroleum Jelly.
12. Fit bellhousing and intermediate plate assembly, tighten twelve bolts to ***46 Nm.***



RR891M

13. Place end-float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with suitable washer to give required end-float.

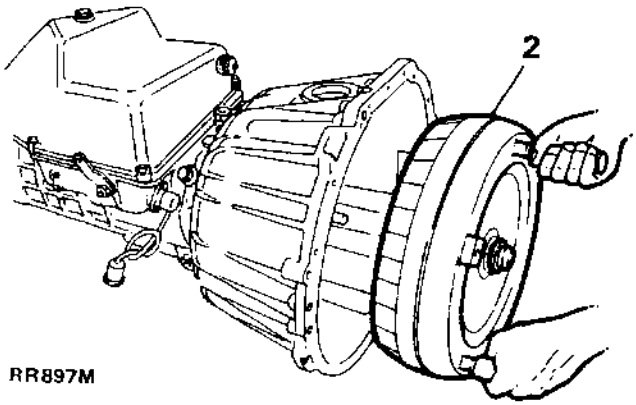
△ **NOTE: If damage is apparent to bolts they should be replaced.**

14. Refit torque converter into housing using torque converter handles 18G1501. Check dimension converter fixing boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
15. Refit gearbox/transfer box assembly. ***See ZF Auto with Borg Warner transfer gearbox***

REPLACING INTERMEDIATE PLATE

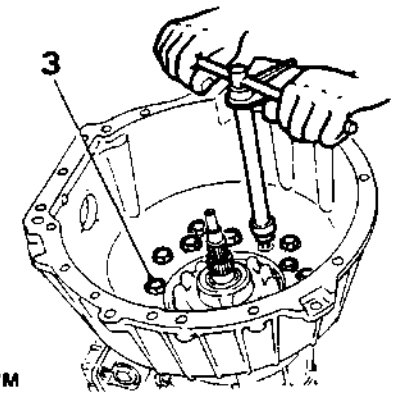
Service repair no - 44.20.11.

1. Remove gearbox and transfer box assembly, ***See ZF Auto with Borg Warner transfer gearbox***
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501.



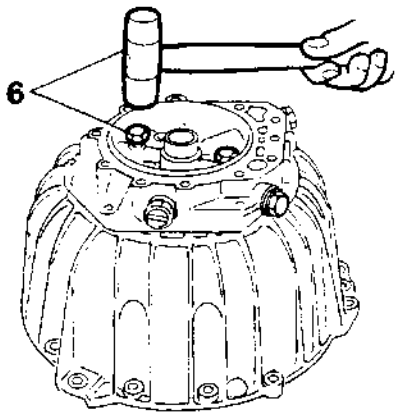
RR897M

3. Remove twelve bolts (inner ring pattern).



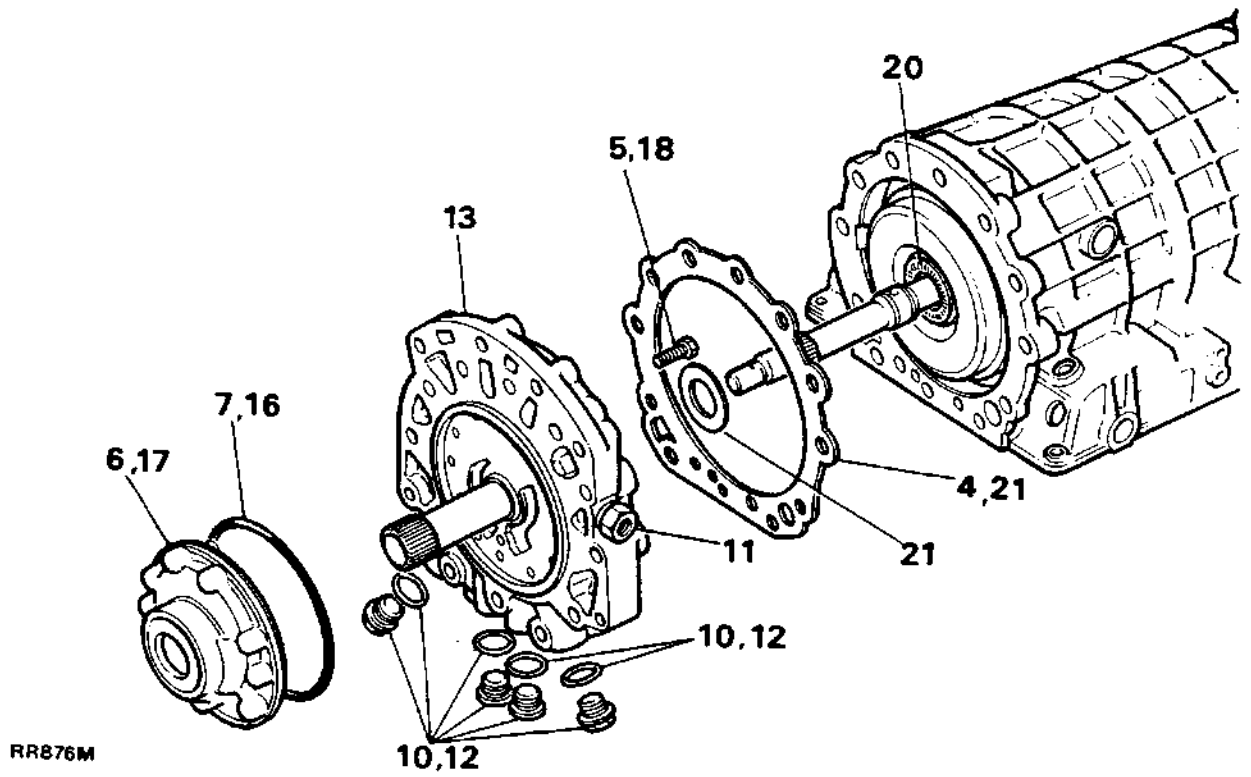
RR577M

4. Remove bellhousing and pump assembly from gearbox case, discard gasket.
5. Remove eight bolts from rear of pump.
6. Screw in two bolts, diagonally opposite each other, tap pump to free pump assembly from intermediate plate.



RR578M

7. Remove 'O' ring from pump housing and discard.
8. Place bellhousing and intermediate plate assembly on bench.



9. Remove six bolts and remove bellhousing from intermediate plate assembly.
10. Remove four screw plugs and seal rings from intermediate plate, discard seal rings.
11. Remove oil cooler pipe adaptors, fit them into new intermediate plate.
12. Fit plugs and new seal rings into new intermediate plate.
13. Fit intermediate plate assembly onto bellhousing.
14. Secure with six hexagonal bolts (outer ring pattern). Tighten to ***46 Nm.***
15. Place intermediate plate and bellhousing assembly on bench, front face up.
16. Fit 'O' ring onto circumference of pump housing.
17. Align dowel with hole in intermediate plate, press pump housing home.
18. Secure pump housing to intermediate plate, tighten eight bolts to ***10Nm.***
19. Place bellhousing and intermediate plate assembly on bench. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
20. Before replacing intermediate plate and bellhousing assembly check that thrust washer and axial cage are seated on 'A' clutch housing.
21. Place gasket and disc washer onto bellhousing and intermediate plate assembly using Petroleum Jelly.
22. Fit bellhousing and intermediate plate assembly onto gearcase, tighten twelve bolts to ***46 Nm.***
23. Place end-float gauge LST111 on pump housing and check that axial play is between 0,2-0,4 mm. Renew existing washer, at rear of intermediate plate, to give required end-float.
24. Refit torque converter into housing using torque converter handles 18G1501. Check dimension from converter fixing boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
25. Refit gearbox/transfer box assembly. ***See ZF Auto with Borg Warner transfer gearbox***

Notes

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Coupling shaft to mainshaft	42*
Filler tube to sump	70
Gear change lever to gearbox	25
Cooler pipe adaptor to gearbox	42
Securing screws - clutch F	10
Securing screw - parking pawl	10
Securing screws - pump	10
Intermediate plate plugs (M20)	50
Intermediate plate plugs (M14)	40
Bell housing mounting bolts	46
Governor mounting screws	10
Extension housing bolts	23
Control unit mounting bolts	8
Sump plug	10
Mounting screws for sump	8
Drive plate to converter	39*
Gearbox to engine	42
Strut (threaded end)	42
Bottom cover to converter housing	9
Cover - converter housing	9
Drive plates to crankshaft adaptor	40*
Adaptor to crankshaft	84

NOTE: * These bolts must have threads coated with Loctite 270 prior to assembly.

Torque values below are for all screws and bolts used except for those that are specified otherwise.

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

ZF GEARBOX DATA

Axial end float 0.2 to 0.4 mm.

From torque converter boss to torque converter housing face 50 mm

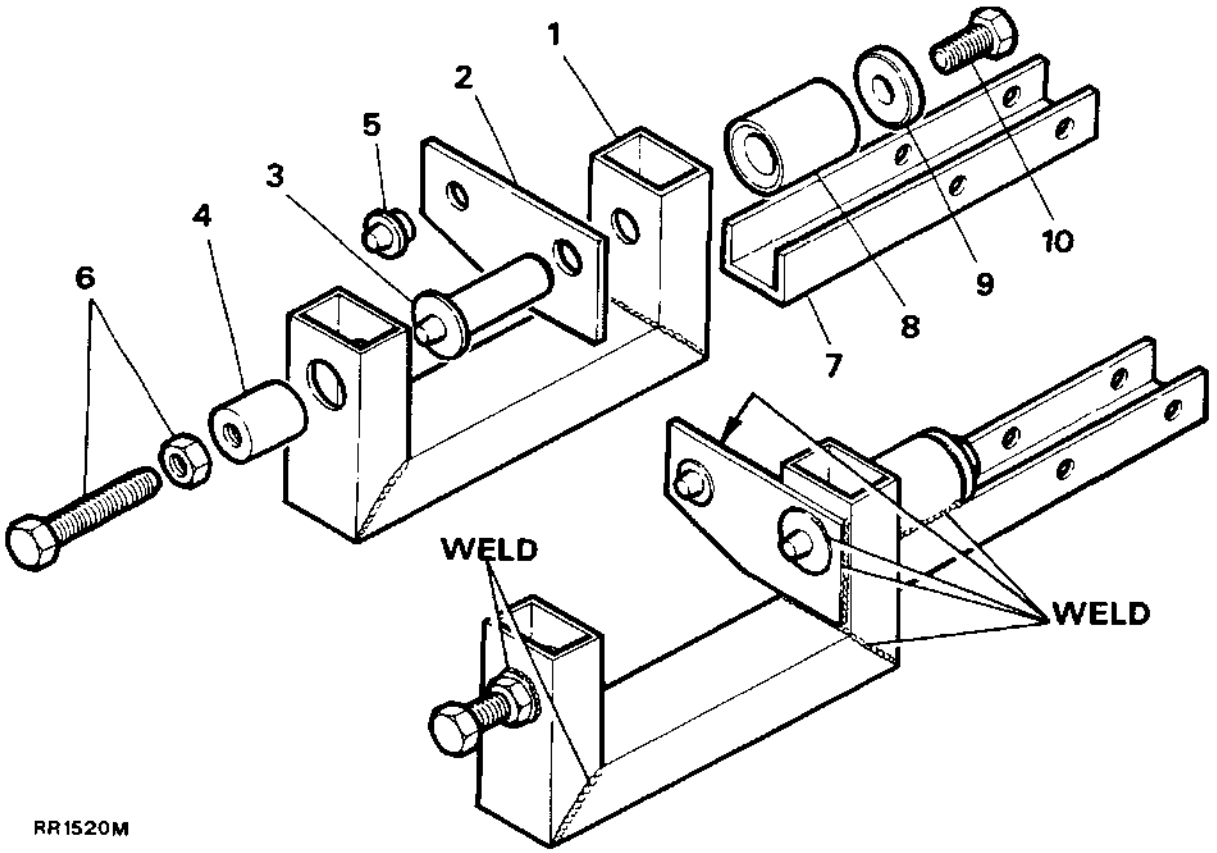
Freewheel cage assembly to ring gear; minimum clearance 0.1 mm

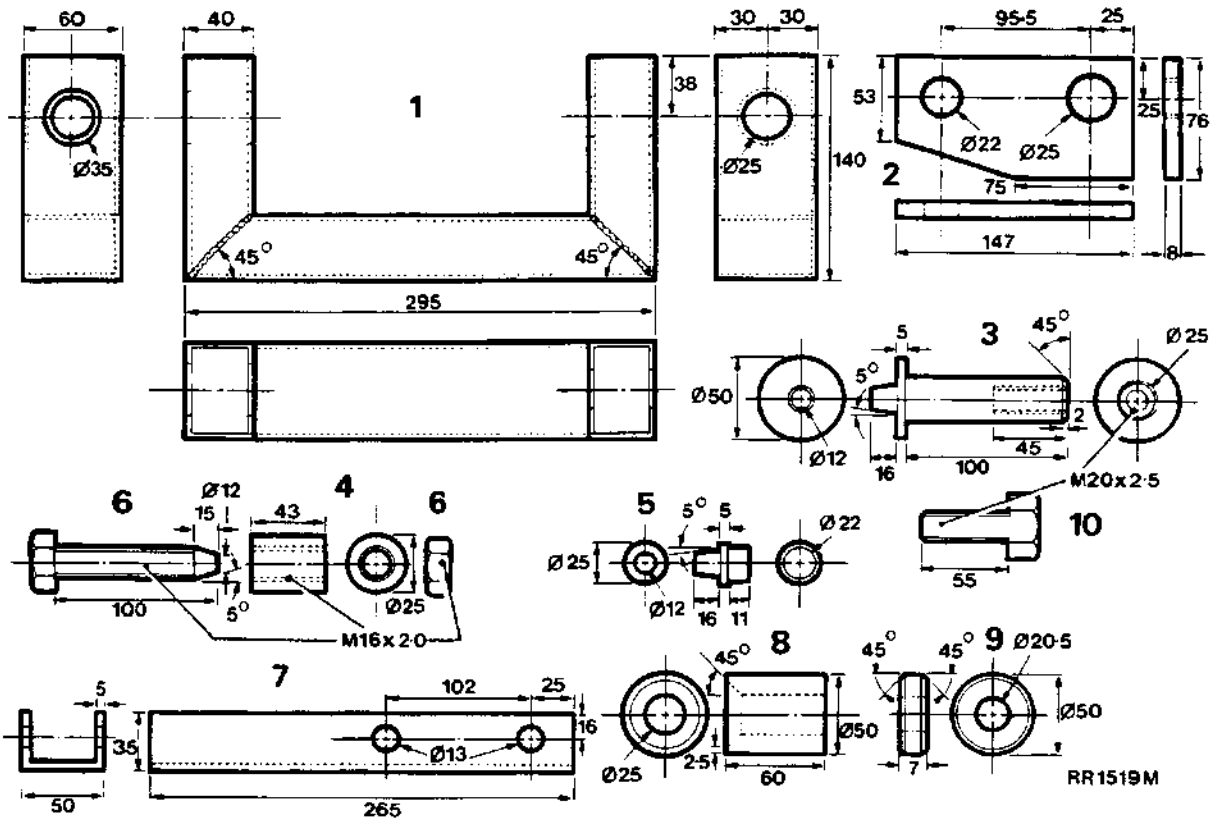
Output shaft above cylinder F assembly; dimension 10.00 mm

A cylinder protrusion above gearbox front face not more than 8.5 mm

AUTOMATIC GEARBOX HOLDING FIXTURE

△ **NOTE: This fixture enables ZF gearbox to be held securely during bench sited repairs. It can be manufactured to details given, or purchased under service tool number LST 118.**



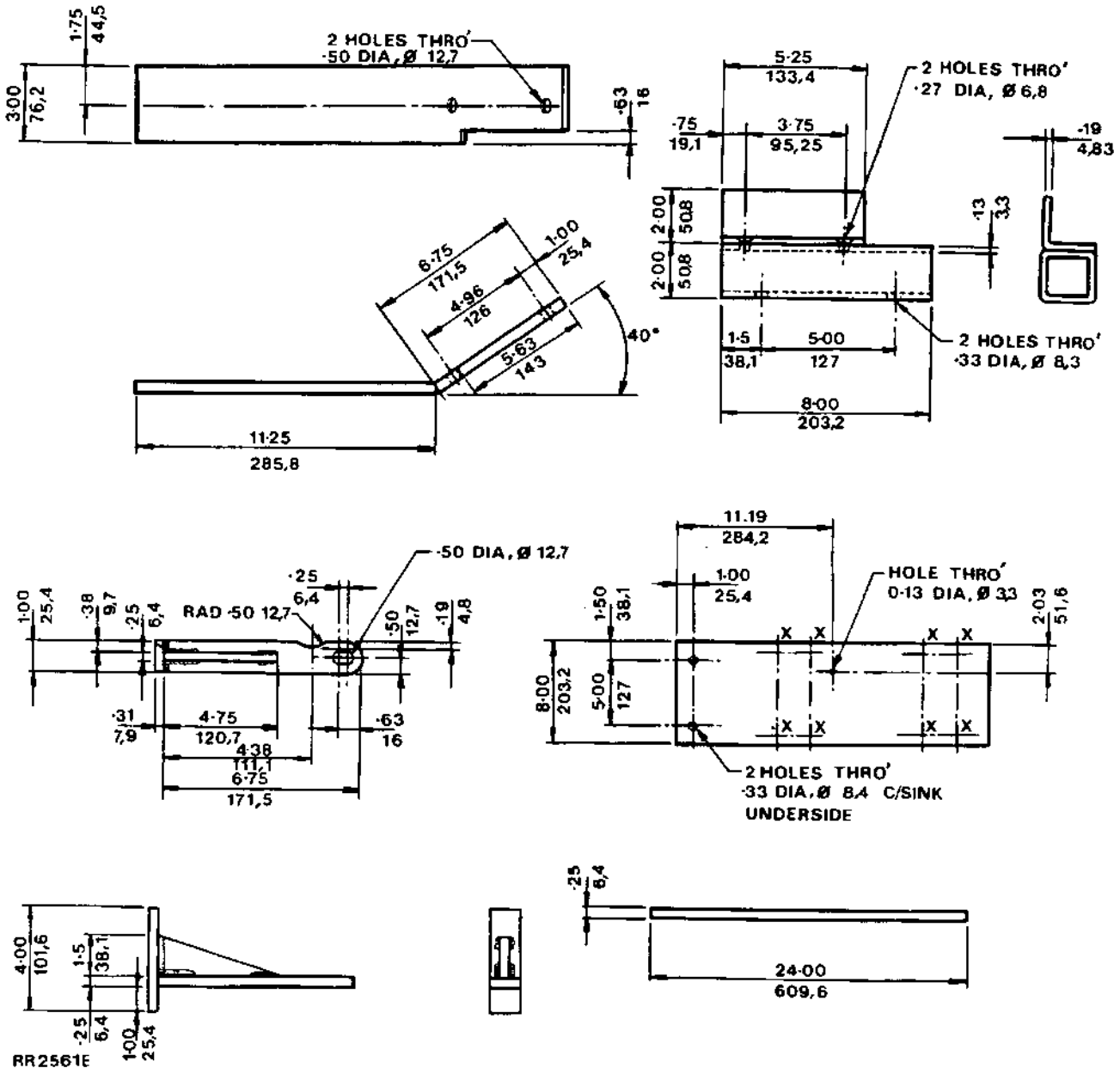

1
60
40
30
30
38
Ø35
Ø25
140
45°
45°
295
2
95·5
25
53
25
76
Ø22
Ø25
75
147
8
3
45°
5
5°
Ø25
Ø50
Ø12
16
100
45
2
M20x2·5
4
6
6
Ø12
15
43
100
5°
Ø25
M16x2·0
5
5°
5
Ø22
Ø25
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5
102
25
35
16
Ø13
50
265
8
45°
Ø50
Ø25
2·5
60
9
45°
45°
Ø20·5
Ø50
7
RR1519M

AUTOMATIC GEARBOX AND BORG WARNER TRANSFER GEARBOX

Adaptor plate

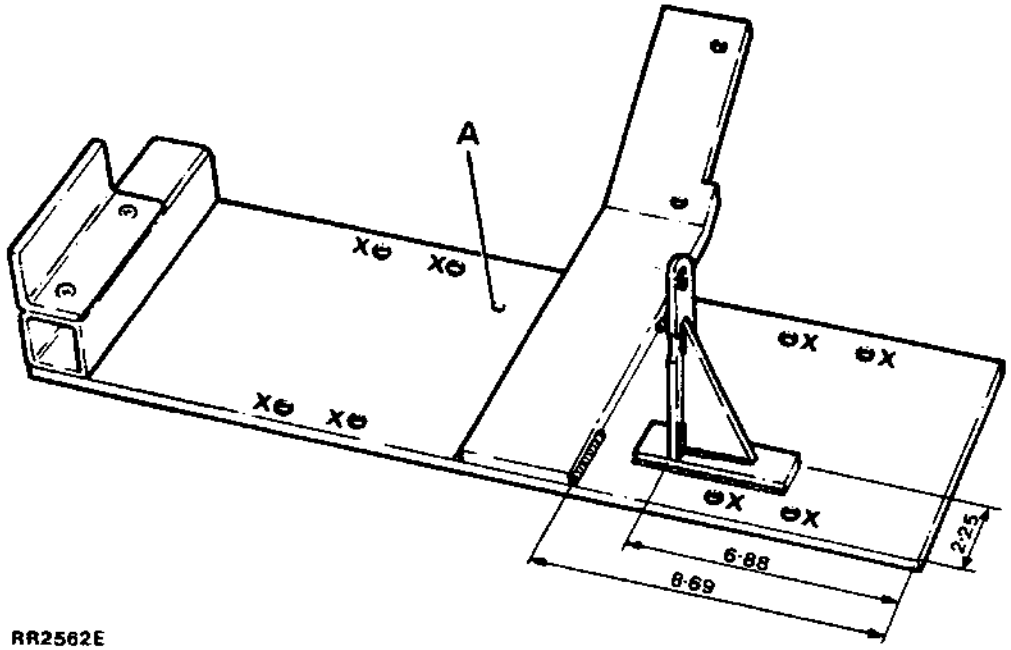
To remove transmission assembly from vehicle it is necessary to manufacture an adaptor plate to use with transmission hoist.

△ **NOTE: Four holes (A) to be countersunk on underside to suit hoist.**



A: Centre of the lifting hoist
X: Drill fixing holes to suit hoist table

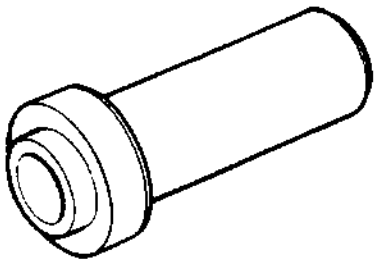
Material:Mild Steel plate BS 1449, 14SWG



RR2562E

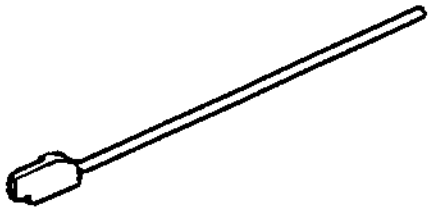
AUTOMATIC GEARBOX

LRT-44-001 Front and rear oil seal replacer.
LST 108



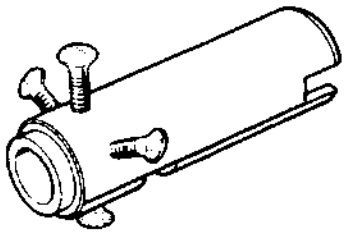
LST108

LRT-44-002 Selector linkage setting gauge.
LST 109



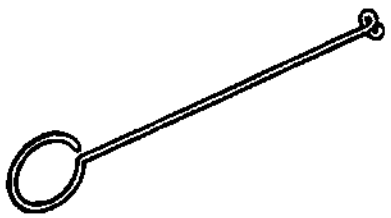
LST109

LRT-44-003 Oil pump rotation sleeve and end float gauge.
LST 111

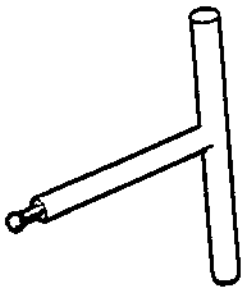


LST111

LRT-44-004 Kickdown cable remover.
LST 112

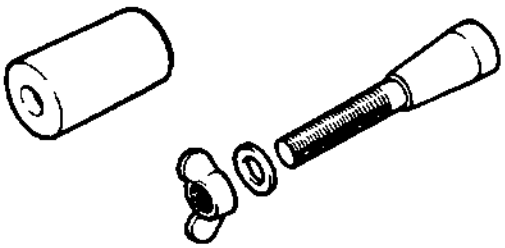


LST112



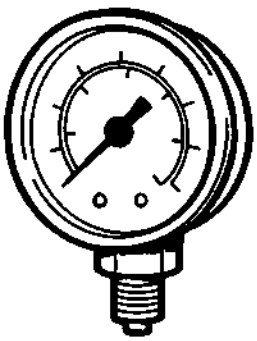
LST113

LRT-44-005 Control unit oil seal remover/replacer.
LST 113



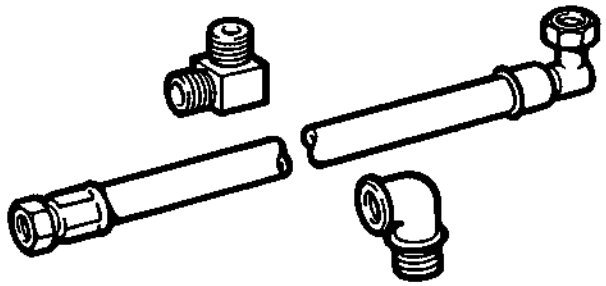
LST114

LRT-44-006 Selector shaft oil seal replacer.
LST 114



18G502A

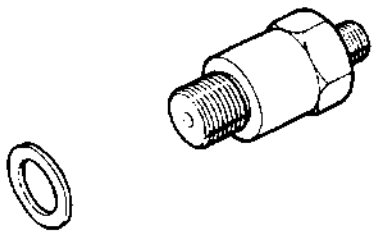
LRT-44-007 Line pressure test gauge.
18G.502A



18G502K

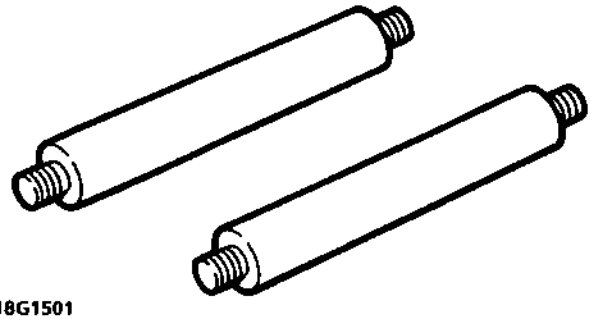
LRT-44-008 Hose and adaptor.
18G.502K

LRT-44-009 Adaptor pressure take off.
LST 502-1



LST502-1

LRT-44-010 Convertor lifting handles.
18G.1501



18G1501

Notes

47 - PROPELLER SHAFTS

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VIBRATION HARSHNESS 1

OVERHAUL

PROPELLER SHAFTS FRONT AND REAR 1



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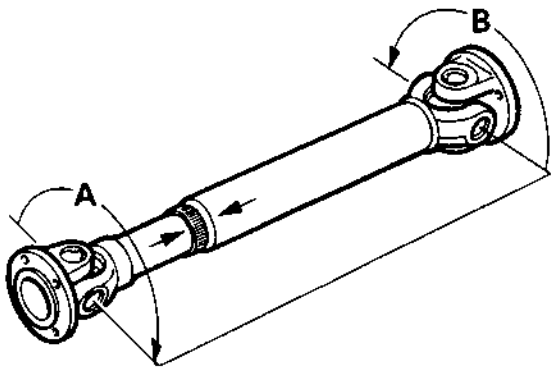
PROPELLER SHAFT ALIGNMENT

Description

The front and rear propeller shafts have non-constant velocity 'Hooks' type universal joints, with needle roller bearings. The bearing cups are pre-packed with lubricant on assembly and a grease nipple is fitted for servicing as specified, in maintenance section.

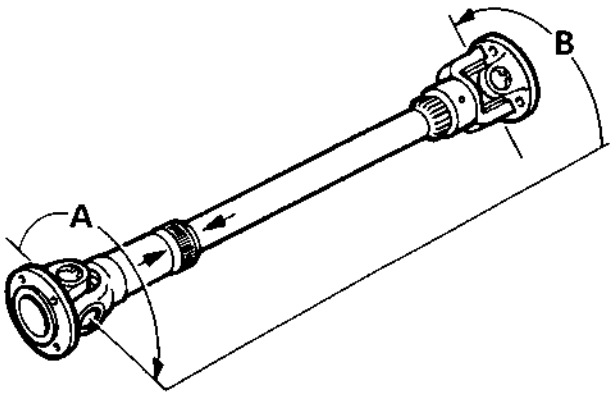
Both shafts have plain sliding splines to accommodate the variation in distance between the axles and transmission. The splines are pre-packed with lubricant and sealed.

The bearing yokes on the rear shaft are conventionally aligned, with the yokes A and B on each end of the shaft are aligned to one another as seen in RR3642M.



RR3642M

The front shaft which is shorter than the rear is 'Phased', with the joints at each end, A and B miss-aligned as shown in RR3643M.



RR3643M

The phasing is necessary on the front shaft only to allow for greater variation in angular changes.

Both halves of each shaft are marked with an arrow, which must be aligned to ensure any phasing and correct original balance is retained.

Notes

VIBRATION HARSHNESS

1. Check that the propeller shaft universal joints and sliding splines are not siezed or worn and that the shafts are correctly aligned.

△ **NOTE: In the event that both shafts are satisfactory, but the vibration/harshness is still present, the transfer box operation and balance of the road wheels should be checked.**

For transfer box operation. ***See TRANSFER BOX, Fault diagnosis, Borg Warner - Symptoms***

For balance of road wheels. ***See WHEELS AND TYRES, Repair, Wheel balancing***

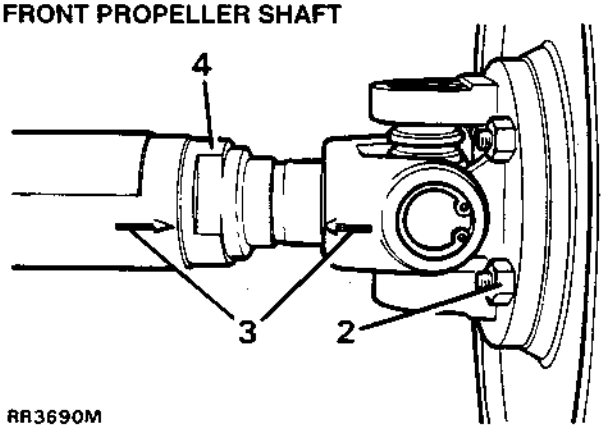
Notes

PROPELLER SHAFTS FRONT AND REAR

Overhaul

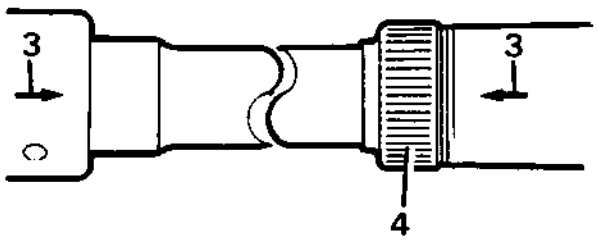
1. Place vehicle over pit or on a ramp.
2. Remove nuts from each end of propeller shaft. Remove shaft.
3. Note alignment markings on propeller shaft front and rear.

FRONT PROPELLER SHAFT



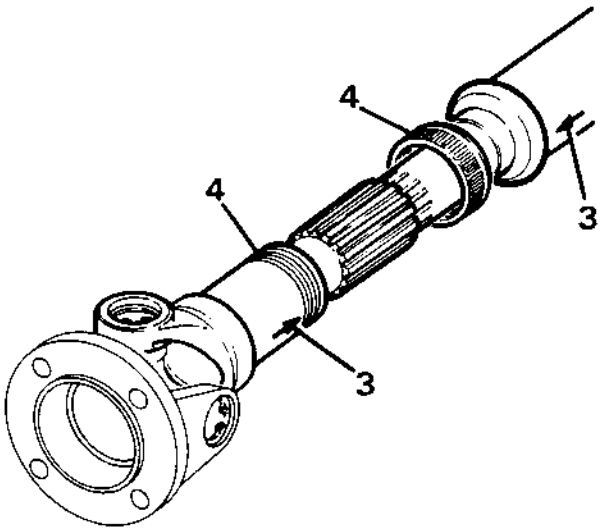
RR3690M

REAR PROPELLER SHAFT



RR3691M

4. Unscrew dust cap and withdraw sliding member.

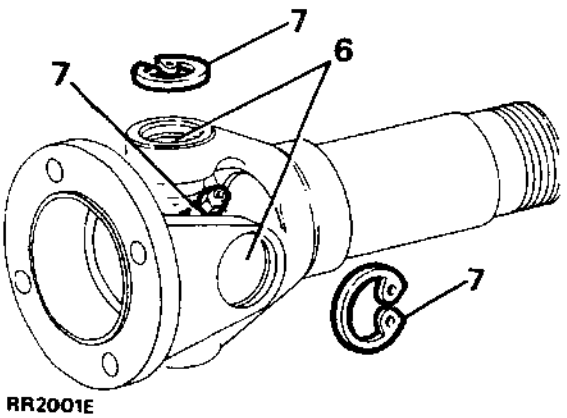


RR1999E

5. Examine splines for wear. Worn splines will require drive shaft replacement.
6. Clean universal joint bearing cups and circlips.

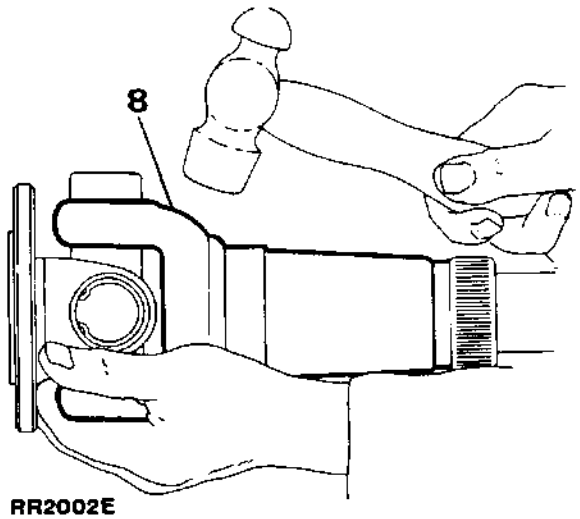
⚠ **CAUTION: To ensure correct assembly and reduce possibility of imbalance. Before removing propeller shaft joint. Mark position of spider pin lubricator relative to journal yoke ears.**

7. Remove circlips, and grease nipple.



RR2001E

8. Tap yokes to eject bearing cups.

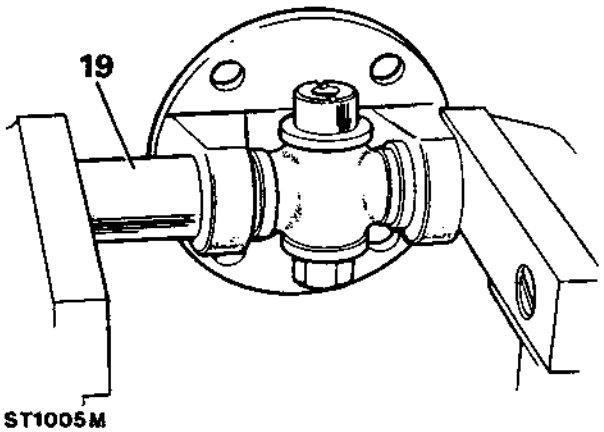


RR2002E

9. Remove bearing cups and spider.
10. Repeat instructions 5 to 8 for opposite end of propeller shaft.
11. Clean yokes and bearing cup locations.

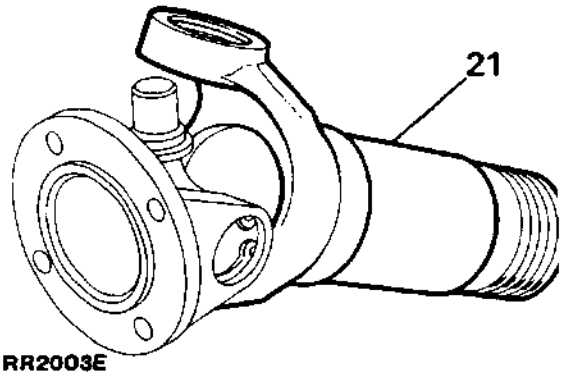
Assemble

12. Remove bearing cups from new spider.
13. Check all needle rollers are present and positioned in bearing cups.
14. Ensure bearing cups are one-third full of lubricant. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
15. Enter new spider with seals into yokes of sliding member flange.
16. Partially insert one bearing cup into flange yoke and enter spider trunnion into bearing cup.
17. Insert opposite bearing cup into flange yoke.
18. Press both cups into place.



ST1005M

19. Press each cup into its respective yoke up to lower land of circlip grooves. Damage may be caused to cups and seals if cups pass this point.
20. Fit circlips.
21. Engage spider in yokes of sliding member. Fit bearing cups and circlips as described in instructions 15 to 20.



RR2003E

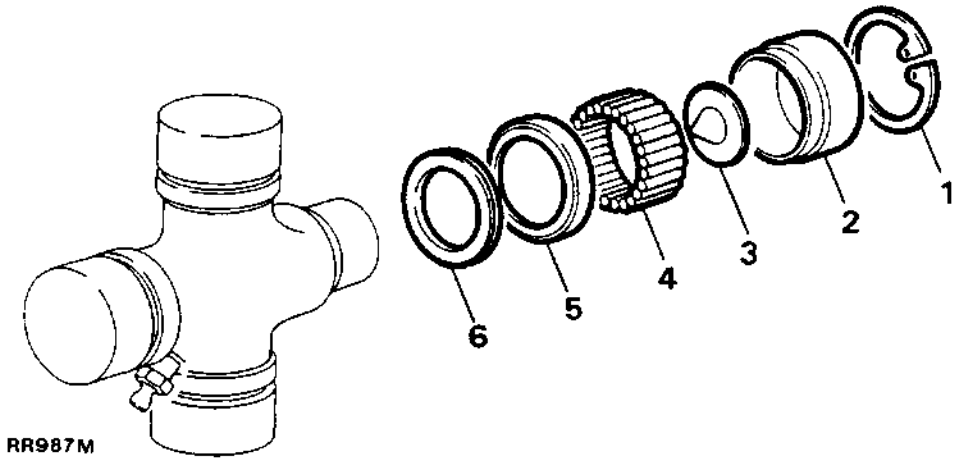
22. Lubricate sliding member splines and fit sliding member to propeller shaft. Ensure markings on both sliding member and propeller shaft align.
23. Fit and tighten dust cap.
24. Fit grease nipples to spider and sliding member.
25. Apply instructions 15 to 20 to opposite end of propeller shaft.
26. Fit grease nipple and lubricate.

Refit

27. Fit propeller shafts to vehicle. Tighten nuts to ***47Nm***
    Refit FRONT propeller shaft so sliding joint end of shaft is fitted to transfer gearbox.
    Refit REAR propeller shaft so sliding joint end of shaft is fitted to handbrake drum.

SPIDER ASSEMBLY COMPONENTS

1. Circlip
2. Bearing cup
3. Nylatron washer
4. Needle rollers (27 per cup)
5. Seal retainer
6. Seal



Notes

51 - REAR AXLE AND FINAL DRIVE

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FAULT DIAGNOSIS 1

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REAR HUB ASSEMBLY NON ABS 3
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REAR HUB 1
TORQUE VALUES 1

SERVICE TOOLS

AXLE DIFFERENTIAL 1
REAR HUB 3



Notes

DESCRIPTION

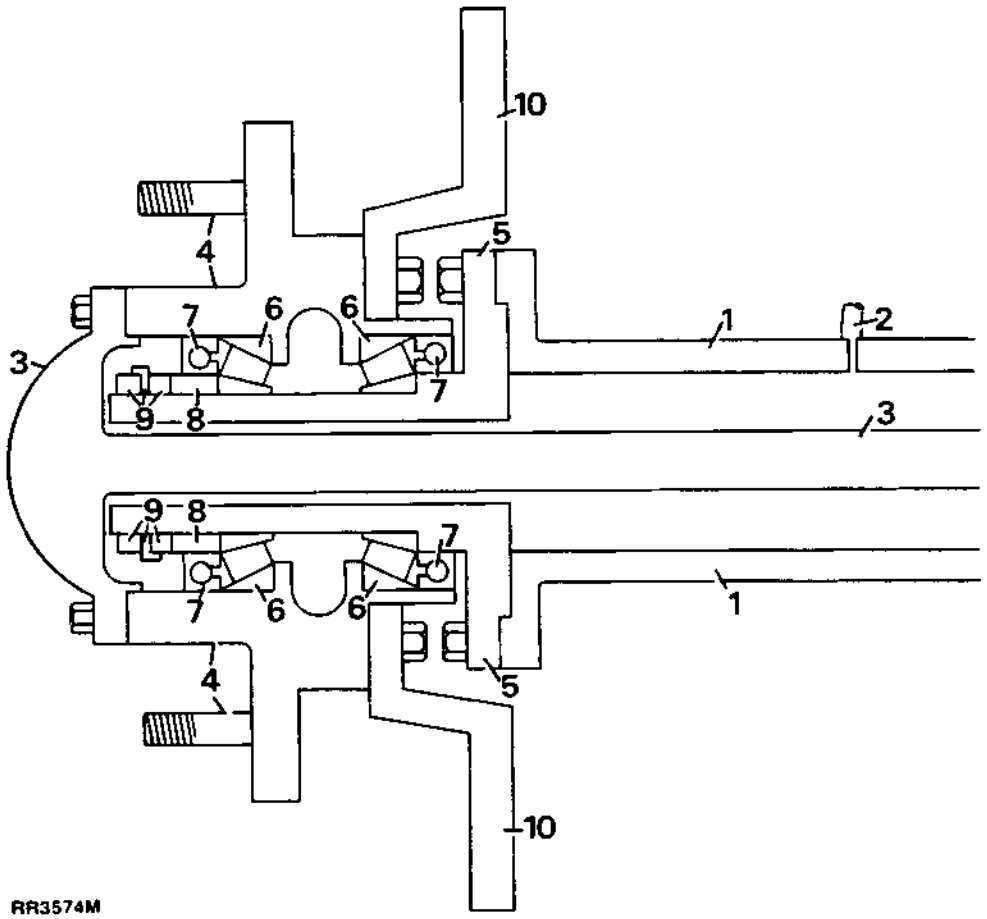
The welded steel rear axle casing houses a separate spiral bevel type differential unit, which is off set to the right of the vehicle centre line. The differential unit drives the rear wheels via the axle shafts and fully floating hubs which are mounted on tapered roller bearings.

Lubrication

The differential is lubricated with oil and the hub bearings with grease. The hub bearings are fitted with inner and outer seals. The outer seals prevent the differential oil mixing with the hub grease and the inner seals prevent dirt ingress into the hub.

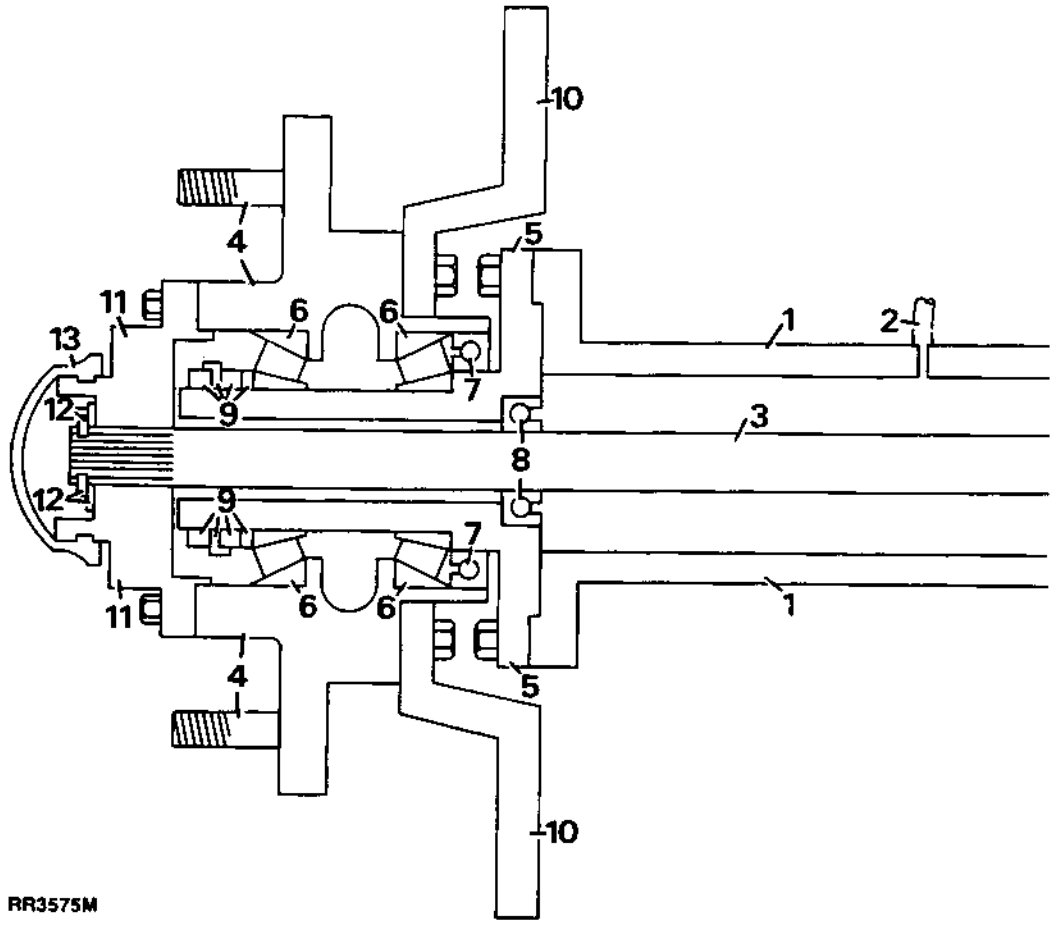
Ventilation

Ventilation of the hub bearings is through the outer oil seals and the differential ventilation pipe, which terminates at a high level.
The wheel hubs on axles fitted with ABS brakes are of slightly different construction to non ABS axles. Both types are illustrated



Rear axle hub - non ABS brakes

1. Axle casing
2. Ventilation pipe
3. Axle shaft/drive flange
4. Wheel studs and hub
5. Wheel bearing stub axle
6. Wheel bearings (2)
7. Inner and outer hub seals
8. Outer seal, inner track/spacer
9. Hub lock plate and nuts (2)
10. Brake disc



Rear axle hub - with ABS brakes

1. Axle casing
2. Ventilation pipe
3. Axle shaft
4. Wheel studs and hub
5. Wheel bearing stub axle
6. Wheel bearings (2)
7. Inner hub seal
8. Outer hub/axle shaft seal
9. Hub lock plate, thrust washer and nuts (2)
10. Brake disc
11. Drive flange - hub/axle shaft
12. Shim washer and circlip
13. Dust cap

FAULT DIAGNOSIS

Complaint - Oil leaks

Rear axles with ABS brakes and those with non ABS brakes have different internal oil seals which separate the lubrication of the differential from the wheel hubs. The external seals on both axles are the same.

An external leak of lubrication from the hub seals can be caused by a faulty internal seal. For example, if the internal seals which separate the differential from the hubs are faulty and the vehicle is operating or parked on an embankment. Oil from the differential may flood one hub causing a leak and leave the differential lacking lubrication.

When a seal is found to be leaking check the axle ventilation system, as a blockage can cause internal pressure to force oil past the seals.

See 'Description and Operation' for illustrations of oil seal locations.

When investigating hub seal leaks check the grease for dilution with oil. Check also the differential level and oil for metal particles and the condition of internal seals.

If the vehicle is driven in deep water with defective oil seals, water may contaminate the lubricants and raise the differential level giving a false impression that the housing has been overfilled with oil.

Do not assume that a high oil level in the differential is due to over filling or, that a low level is because of an external leak.

Notes

REAR AXLE

Service repair no - 51.25.01
Service repair no - 51.26.01(ABS)

Remove and refit

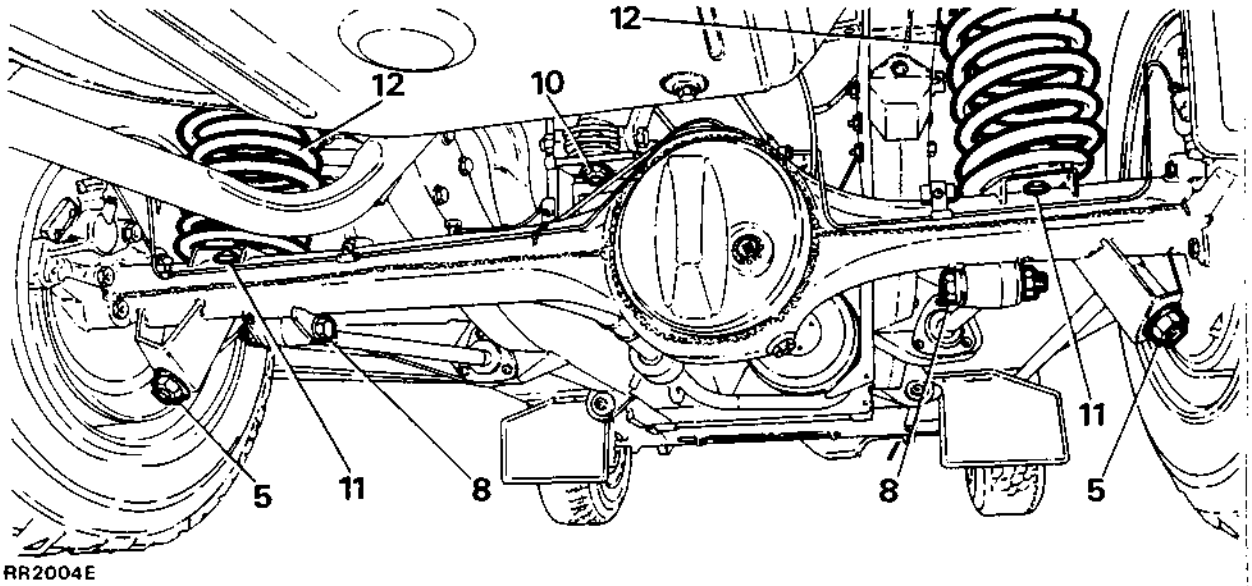
Remove

WARNING: Remove and refit of axle requires a further two persons to steady the axle when lowering or repositioning axle.

1. Drain brake system.
2. Support chassis rear.
3. Remove road wheels.
4. Support axle weight with hydraulic jack.
5. Disconnect shock absorbers.
6. Disconnect flexible brake hose at connection under floor.
7. Disconnect pad wear multiplug.
8. Disconnect lower links at axle.
9. Mark differential and propeller shaft flanges with identification marks for assembly. Remove four nuts and bolts. Lower propeller shaft and tie to one side.
10. Disconnect pivot bracket ball joint at axle bracket.
11. Release bolts and remove coil spring retaining plates.
12. Lower axle and remove road springs.
13. Disconnect anti-roll bar links to axle. ***See REAR SUSPENSION, Repair, Anti-roll bar ball joint links***
14. Remove axle assembly.

Refit

15. Position axle and fit lower links. Tighten to ***176 Nm***
16. Reverse removal procedure.
17. Tighten pivot bracket ball joint to axle to ***176 Nm.***
18. Tighten propeller shaft to differential drive flange nuts to ***47 Nm***
19. Bleed brake system. ***See BRAKES, Repair, Brake System Bleed***



RR2004E

REAR BRAKE DISC NON ABS

Service repair no - 70.10.11.

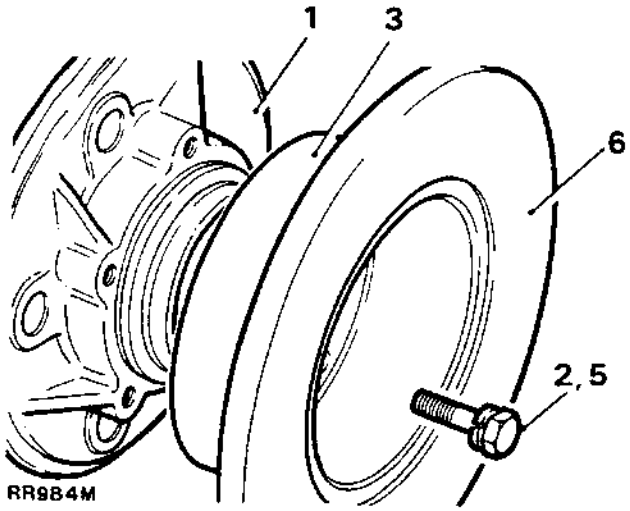
Remove, refit and reclaim.

Remove

1. Remove rear hub assembly. ***See Rear hub assembly non ABS***
2. Remove disc bolts.
3. Remove disc from rear hub.

Refit

4. Fit disc to rear hub.
5. Fit disc bolts. Tighten to ***73 Nm.***
6. Check total disc run out, this must not exceed 0,15 mm. If necessary reposition disc.



7. Fit rear hub assembly. ***See Rear hub assembly non ABS***

Disc reclamation

8. Check disc thickness. This dimension may be reduced to minimum thickness of 12 mm. Machine equal amounts off each face.

REAR BRAKE DISCS ABS

Service repair no - 70.11.11.

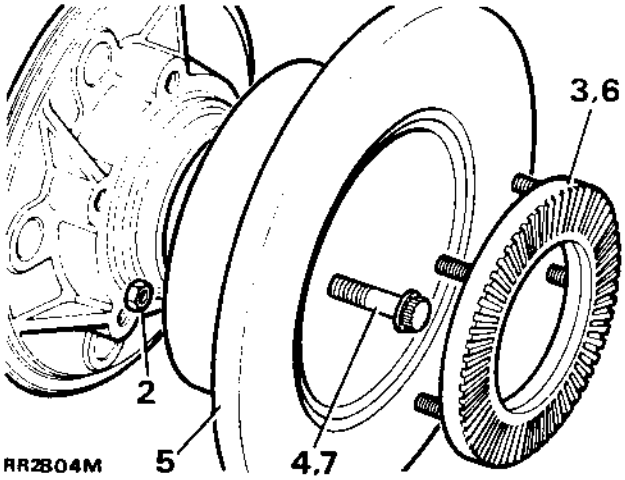
Remove, refit and reclaim

Remove

1. Remove rear hub assembly. ***See Rear hub assembly ABS***
2. Remove five nyloc nuts.
3. Remove sensor ring.
4. Remove five hub to disc retaining bolts.
5. Remove disc from hub.

Refit

6. Fit disc onto hub.
7. Apply loctite 270 and fit hub to disc retaining bolts. Tighten to ***73 Nm.***
8. Using new nyloc nuts fit sensor ring.



9. Check total disc run out, this must not exceed 0,15 mm. If necessary reposition disc.
10. Fit hub assembly. ***See Rear hub assembly ABS***

Disc reclamation

11. Check disc thickness. This dimension may be reduced to a minimum thickness of 12 mm. Machine equal amounts off each face.

REAR HUB ASSEMBLY NON ABS

Service repair no - 64.15.01

Remove and refit

Remove

1. Place rear axle onto axle stands and remove road wheel.
2. Release brake hose clips and remove brake caliper bolts. Secure to one side.

WARNING: Take care not to kink brake hose.

3. Remove bolts, axle shaft to hub and withdraw shaft.
4. Straighten locking washer tab. Use service tool LRT-54-002 to remove locknut. Remove lock washer and adjusting nut.
5. Remove seal track spacer.
6. Remove hub assembly.

Refit

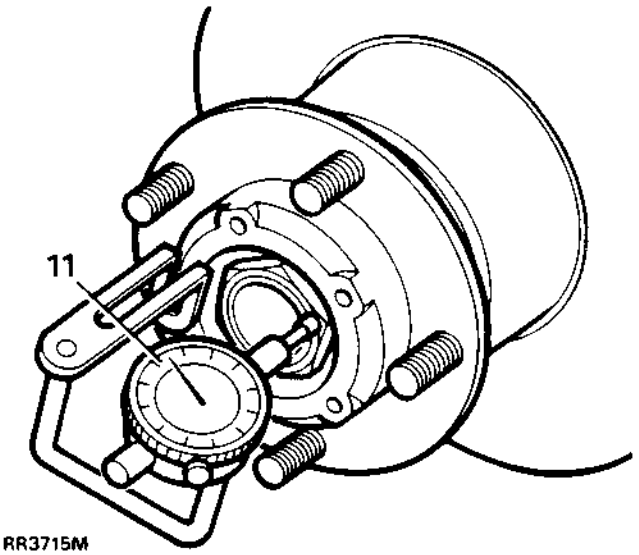
7. Select a new seal track spacer. Check outer diameter is smooth and no burrs are on chamfered leading edge.
8. Fit hub assembly to stub axle.

CAUTION: Outer seal damage could occur if hub is rested on stub axle before seal track spacer is fitted.

9. Fit seal track spacer, seal lip leading.

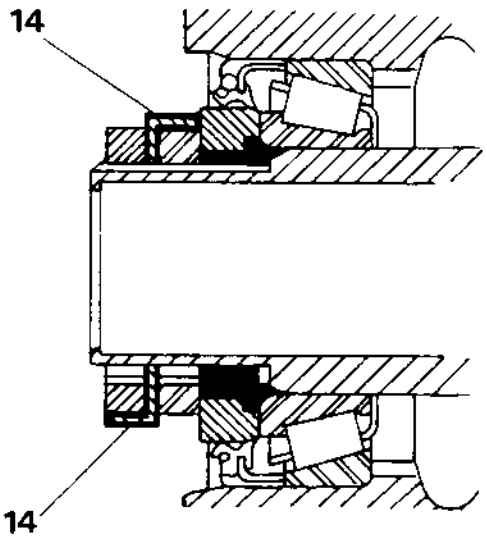
NOTE: Instruction 10 applies to hubs fitted with new components. Instruction 11 applies if fitting original components.

10. Fit adjusting nut and using spanner 606435 tighten nut while revolving hub, until end float is removed. Back-off nut, half a turn and retighten to ***1.5 Nm*** giving required hub end-float of**0,013 to 0,10 mm.**
11. If seal track spacer has previously been compresssed hub end-float is checked by mounting a dial indicator on hub so trace pin rests preloaded on nut. Rotate hub and check end-float of 0,013 to 0,10 mm by pushing and pulling the hub.
12. Fit a new lock washer and locknut. Restrain adjustment nut and tighten lock nut to ***102 Nm.***



RR3715M

13. If fitting original components rotate hub then recheck end-float.
14. Bend lock washer over adjusting nut and over locknut. Avoid damaging outer seal.
15. Using a new joint washer, fit hub driving shaft. Tighten to ***47 Nm.***
16. Fit brake caliper bolts. Tighten to ***82 Nm.*** Secure brake pipes to axle casing.

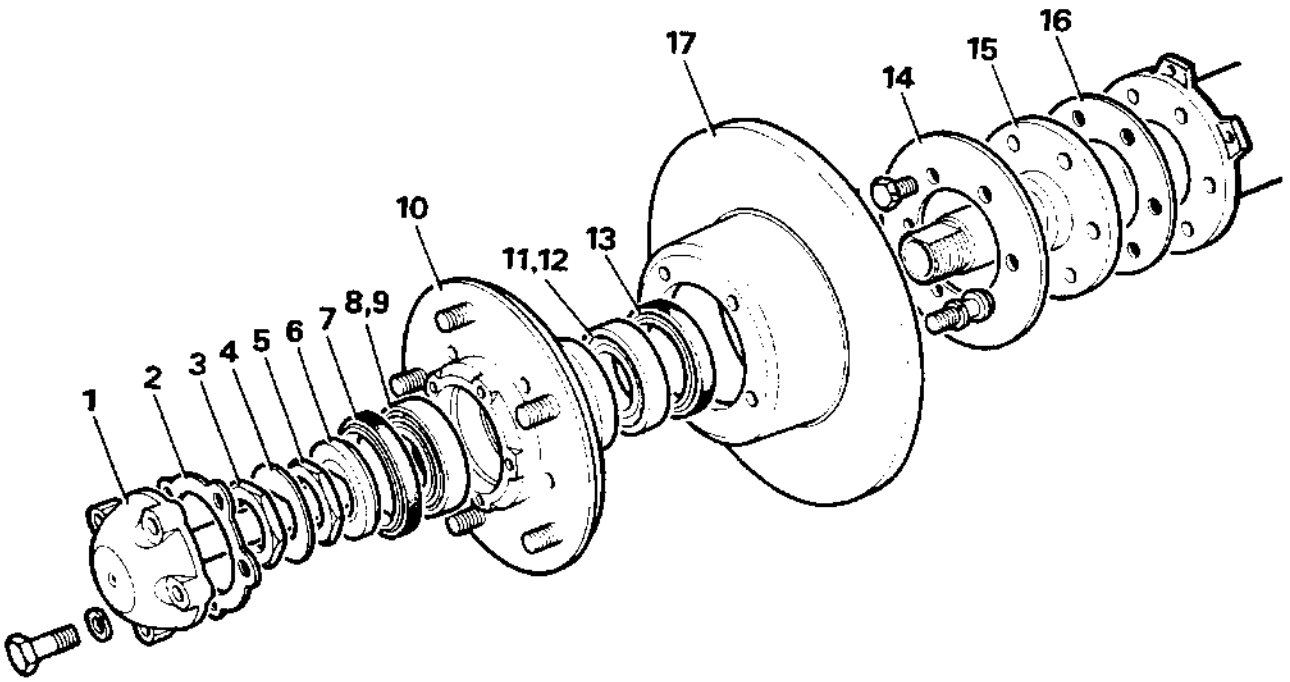


RR3714M

17. Fit road wheel. Place vehicle onto ground and tighten road wheel nuts to ***126 Nm.***

REAR HUB ASSEMBLY NON ABS

1. Rear axle shaft
2. Joint washer
3. Locknut
4. Lock washer
5. Adjusting nut
6. Seal track spacer
7. Outer oil seal
8. Outer bearing cone
9. Outer bearing cup
10. Hub
11. Inner bearing cup
12. Inner bearing cone
13. Inner oil seal
14. Mudshield
15. Stub axle
16. Stub axle joint washer
17. Brake disc



RR706M

REAR HUB ASSEMBLY ABS

Service repair no - 64.16.01

Remove and refit

Remove

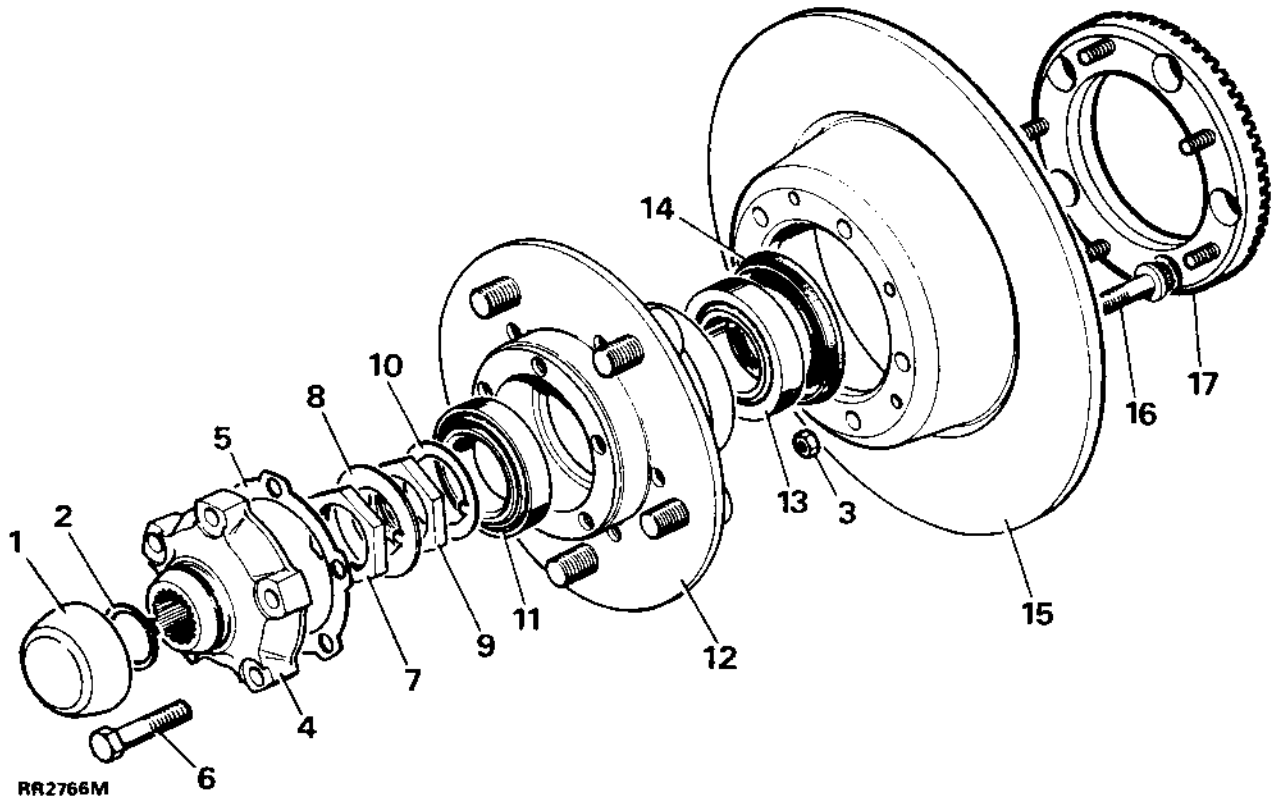
1. Place rear axle onto axle stands and remove road wheel.
2. Release brake hose clips and remove brake caliper bolts. Secure to one side.

WARNING: Take care not to kink brake hose.

3. Remove dust cap.
4. Remove circlip from rear axle shaft.
5. Remove five bolts and withdraw driving member and joint washer.
6. Straighten lock washer tab.
7. Remove locknut and tab washer.
8. Remove hub adjusting nut.
9. Remove keyed washer.
10. Remove hub and brake disc assembly complete with bearings.

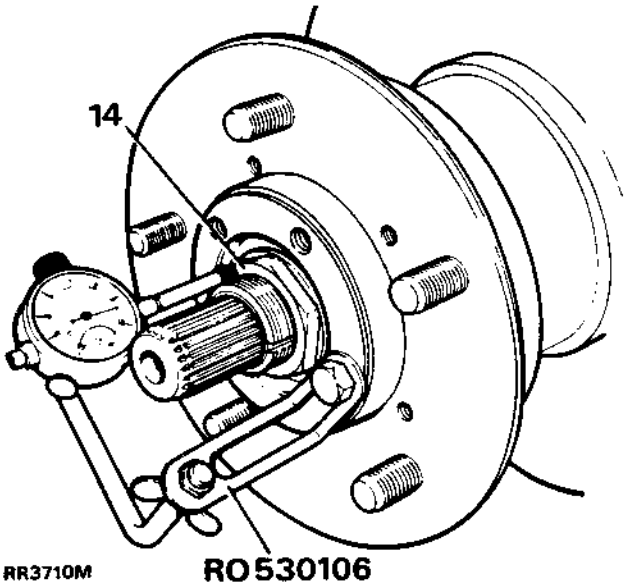
REAR HUB COMPONENTS

1. Dust cap.
2. Circlip.
3. Sensor ring retaining nut.
4. Drive member.
5. Drive member joint washer.
6. Drive member retaining bolt (five off).
7. Lock nut.
8. Lock washer.
9. Hub adjusting nut.
10. Keyed washer.
11. Outer bearing.
12. Hub.
13. Inner bearing.
14. Grease seal.
15. Brake disc.
16. Disc retaining bolt (five off).
17. Sensor ring.



Refit

11. Clean stub axle and rear axle shaft. Retract ABS sensor slightly from sensor sleeve.
12. Fit hub assembly to stub axle.
13. Fit keyed washer.
14. Fit hub adjusting nut while rotating hub, until end-play is taken up.
15. Mount dial gauge using bracket LRT-99-503. Rest stylus, in a loaded condition, on adjusting nut.



16. Loosen adjusting nut until **end-play of 0,013 to 0,05 mm** is obtained.
17. Fit a new keyed lock tab washer.
18. Fit and tighten lock nut. Recheck end-play, bend lock tab over.
19. Using a new joint washer fit drive member to hub. Tighten to ***65 Nm.***
20. Fit circlip to groove on rear axle shaft.
21. Fit dust cap.
22. Fit brake caliper. Tighten two bolts to ***82 Nm.*** Secure brake pipes to axle casing.
23. Set ABS brake sensor. Push sensor in until it touches sensor ring. Then rotate hub to set sensor.
24. Fit road wheel, remove axle stands and final tighten road wheel nuts to ***126 Nm***
25. Operate footbrake to locate brake pads before driving vehicle.

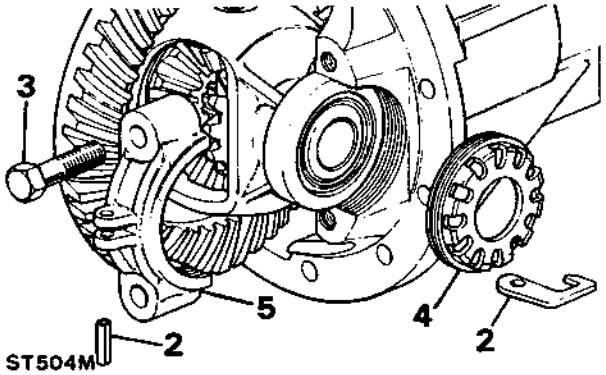
AXLE DIFFERENTIAL ASSEMBLY

Service repair no - 51.15.07.

DISMANTLE

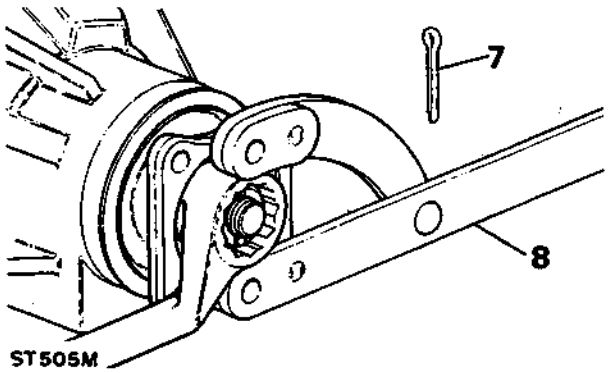
NOTE: Mark differential components so their original positions relative to other components is maintained. Bearing caps must not be interchanged.

1. Remove axle shafts then differential assembly from axle.
2. Remove roll pin securing bearing nut locking fingers to bearing caps. Remove locking fingers.
3. Loosen bearing cap bolts and mark caps for assembly.
4. Using service tool LRT-54-508, remove bearing adjusting nuts.
5. Remove bearing cap bolts and bearing caps.
6. Remove crown wheel differential unit and bearings.



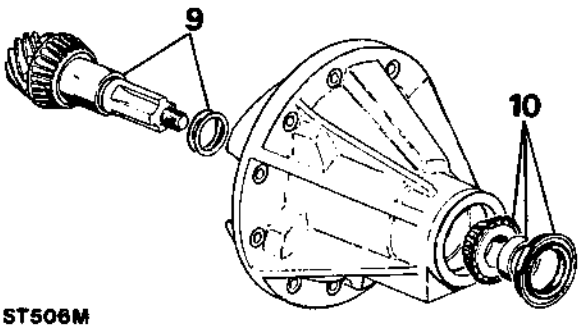
ST504M

7. Remove split pin securing pinion flange nut.
8. Remove pinion flange nut using service tool LRT-51-003 to restrain flange.



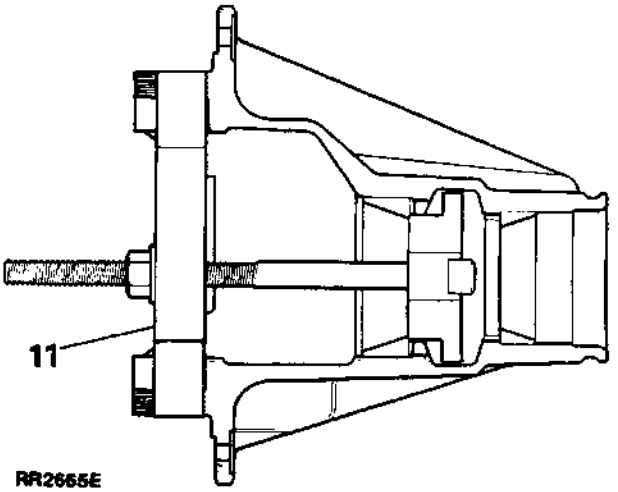
ST505M

9. Remove pinion complete with bearing and outer bearing shims.
10. Remove pinion flange oil seal, spacer and bearing.



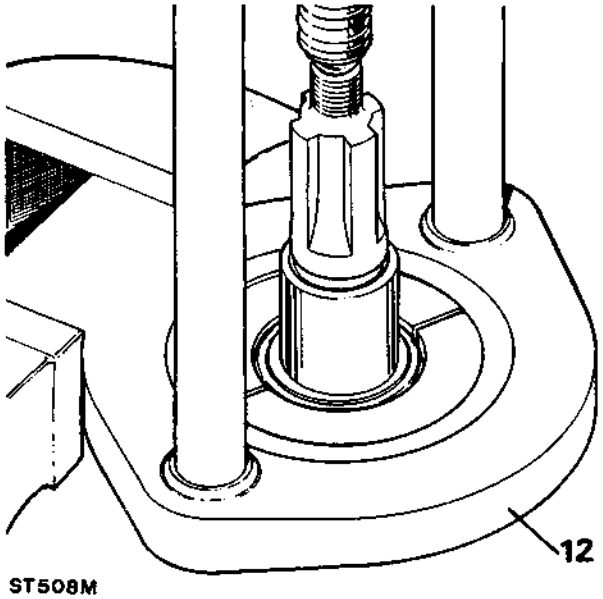
ST506M

11. Using service tool LRT-54-505, remove pinion head bearing track and shim and drive out outer bearing of differential housing.



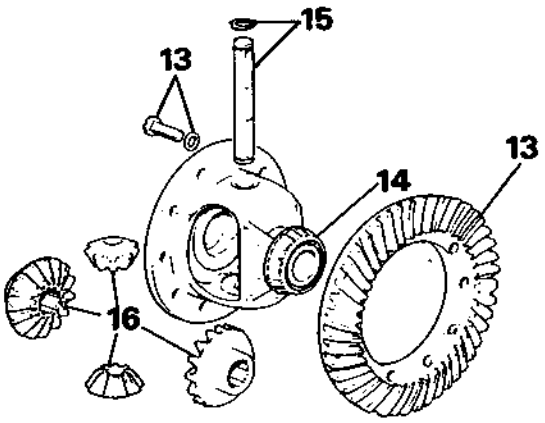
RR2665E

12. Remove pinion head bearing with service tool LRT-99-002.



ST508M

13. Remove bolts and washers securing crown wheel to differential flange. Remove crown wheel.
14. Remove differential carrier bearings.
15. Remove circlips and extract differential cross shaft.
16. Withdraw differential gears and pinions.
17. Clean all components.



ST509M

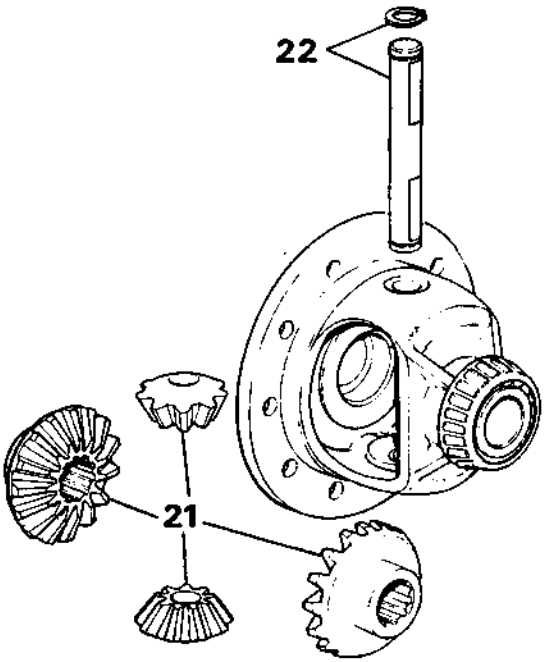
INSPECTION

18. Check all bearings for wear and pitting.
19. Check all gears for wear, scuffing, pitting and damaged teeth.
20. Supplied as matched sets are: crown wheel and pinion, pinion housing and bearing caps.

ASSEMBLE

Differential gears

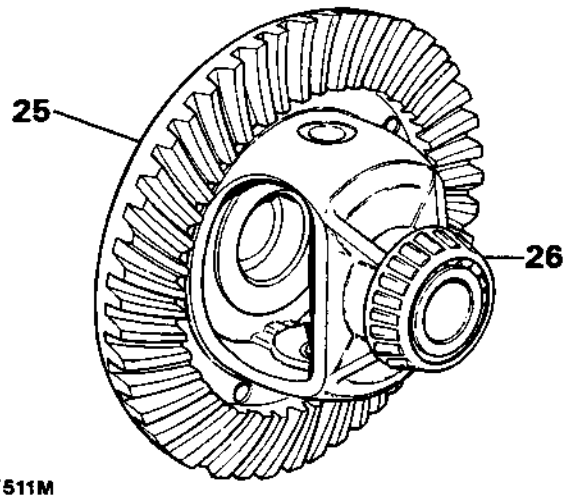
21. Fit differential gears to differential housing.
22. Fit differential cross shaft and circlips.



ST510M

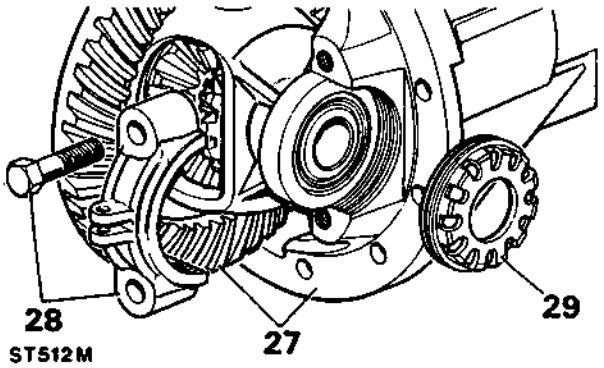
23. Check gear for freedom of rotation and backlash. Nominal backlash should be present. Excess backlash necessitates replacement of gears or differential housing.
24. Check serial number marked on pinion end face matches that on crown wheel.

25. Clean and fit crown wheel.
26. Fit carrier bearings and assemble tracks to bearings.



ST511M

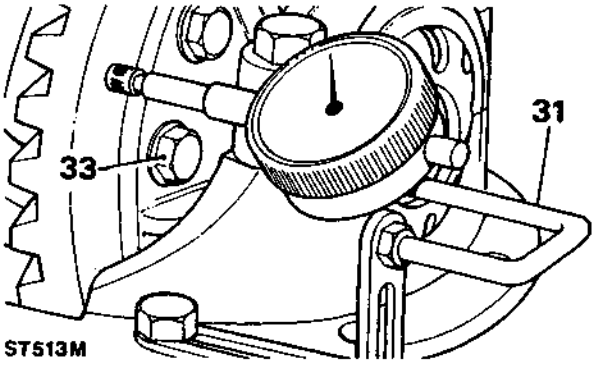
27. Place differential housing with crown wheel and bearings in pinion housing.
28. Fit bearing caps and bolts. Do not tighten bolts.
29. Fit bearing adjusting nuts and adjust to obtain zero end float.



ST512M

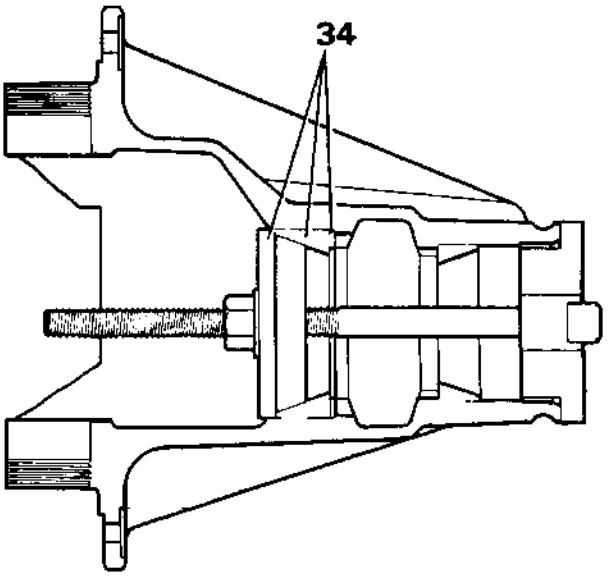
30. Tighten bearing cap bolts to ***90Nm***
31. Check crown wheel for run-out. This should not exceed 0,10 mm. If exceeded examine crown wheel and mounting flange for burrs, grit, etc. Refit and recheck. A buckled or damaged differential housing flange is corrected by replacing differential gear housing.
32. After checking run out remove differential housing from pinion housing.

33. Remove crown wheel bolts and refit using Loctite 'Studlock'. Tighten to ***58Nm.***



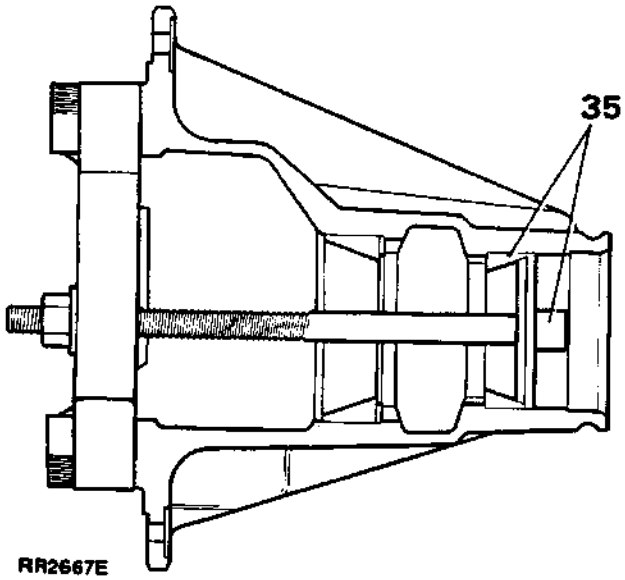
ST513M

34. Fit pinion head bearing track and original shim to pinion housing. Use service tools LRT-54-505 and LRT-54-505. If fitting a new shim use minimum 1.27 mm thickness.



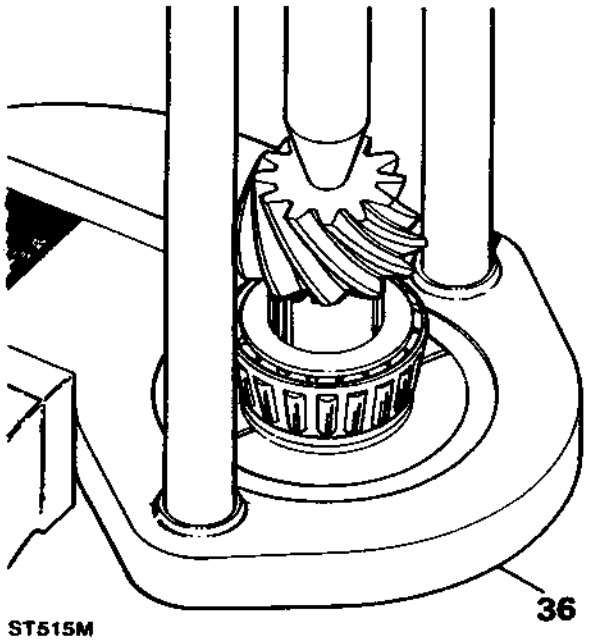
RR2666E

35. Fit pinion outer bearing track to pinion housing. Use service tools LRT-54-505 and LRT-54-507.



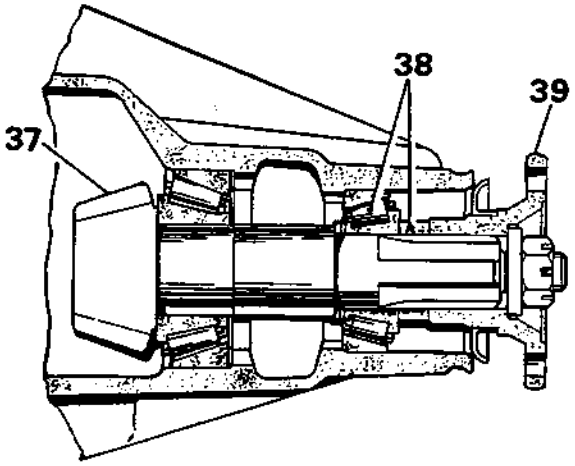
RR2667E

36. Fit pinion head bearing to pinion. Use service tool LRT-54-502.



ST515M

37. Fit pinion into its location without shims for bearing pre-load.
38. Fit outer bearing and spacer.
39. Fit driving flange, washer and nut.



ST516M

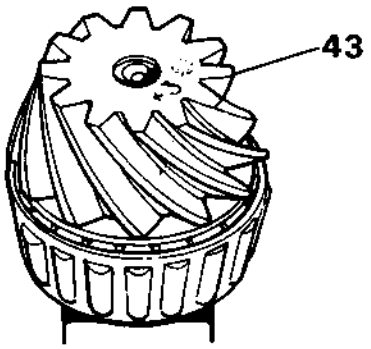
40. Do not fit oil seal at this stage.
41. Tighten pinion flange nut until force required to rotate pinion is ***3Nm*** if new bearings are fitted. This will pre-load bearings to check pinion height dimension.

△ **NOTE: If using original bearings, pre-load figure is *1.5Nm*.**

Drive pinion markings

△ **NOTE: Markings on end face adjacent to serial number are of no relevance to servicing.**

42. Figures marked on end face opposite to serial number show in thousandths of an inch, deviation from nominal, required to set pinion. Pinions marked plus (+) must be set below nominal. Pinions marked minus (-) must be set above nominal. Unmarked pinions must be set at nominal.



ST517

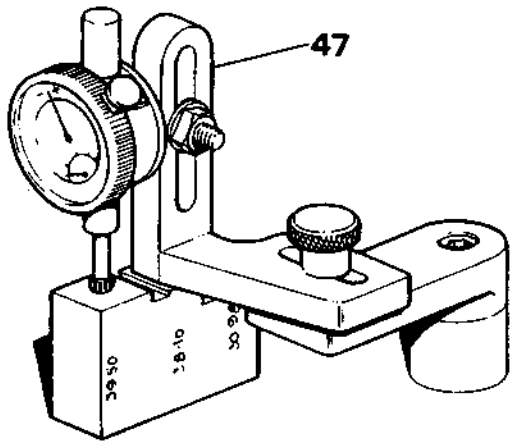
43. Nominal setting dimension is represented by setting gauge block LRT-54-503. Referenced from pinion end face to bottom radius of differential bearing bore.

Drive pinion adjustment

44. Ensure pinion end face is free of burrs around etched markings.
45. Remove keep disc from magnetized base of dial gauge tool.
46. Place dial gauge and setting block on surface plate. Zero dial gauge trace pin on setting block.

△ **NOTE: Setting block has three height settings heights.**

47. Use 39.50 mm setting mark for this differential.

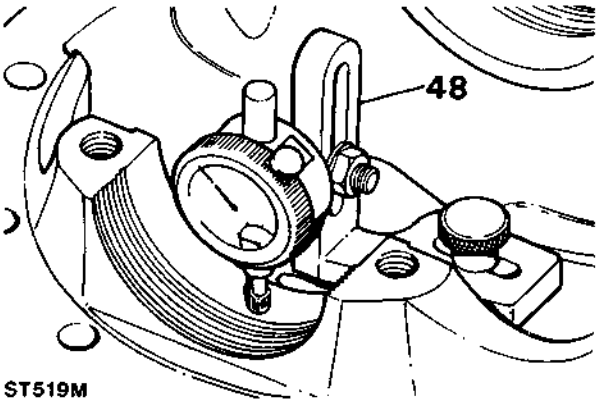


ST518M

Pinion height shims

PART No.	INCH	MM
549230	.038	0.97
549232	.040	1.02
549234	.042	1.07
549236	.044	1.12
549238	.046	1.17
549240	.048	1.22
549242	.050	1.27
549244	.052	1.32
549246	.054	1.37
549248	.056	1.42
549250	.058	1.47
549252	.060	1.52
576236	.062	1.57
576237	.063	1.60
576238	.064	1.63
576239	.065	1.65

48. Position dial gauge centrally on pinion end face, register on lowest point on one differential bearing bore. Note dial gauge measurement from zeroed setting.



ST519M

49. Repeat on other bearing bore. Add readings then halve sum to obtain mean reading. Note whether trace pin has moved up or down from zero.
    A. Where trace pin moves down, reading is equal to thickness of shims to remove, to bring pinion to nominal.
    B. Where trace pin moves up. Reading is equal to thickness of shims to add,to bring pinion to nominal.

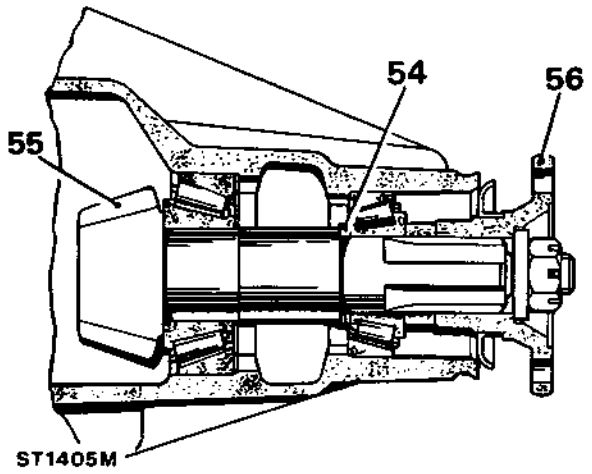
INCH		MM
.001	=	.025
.002	=	.05
.003	=	.075
.004	=	.10
.005	=	.125
.006	=	.15
.007	=	.175
.008	=	.20
.009	=	.225
.010	=	.25

△ **NOTE: Where dial indicator is metric conversion must be made to inches when measuring and selecting shims.**

50. Before adjusting shim thickness: check pinion face marking. If a plus (+) figure, subtract in thousandths of an inch from shim thickness figure.
51. If pinion has a minus (-) figure, add amount to shim thickness figure.
    Adjust shim thickness under pinion head bearing track as necessary.
52. Recheck pinion height setting. If setting is correct, mean reading of dial gauge will agree with figure marked on pinion end face.
    For example, with end face marking of +3, dial gauge reading should indicate pinion is +0.003 in.

Bearing pre-load adjustment

53. Remove the pinion flange, pinion, outer bearing and spacer.
54. Slide new shims, of same thickness as originals (bearing pre-load) into position on pinion shaft. If fitting a new shim use minimum 4.06 mm thickness.
55. Fit pinion to pinion housing and fit outer bearing and spacer.
56. Fit driving flange, washer and nut.
57. Do not fit oil seal at this stage.



58. Tighten pinion flange nut to ***130Nm.*** Force to rotate pinion shaft is 3Nm using new bearings. Change shim as necessary to obtain reading. Thicker shim will reduce pre-load. Thinner shim will increase pre-load.

△ **NOTE: If using original bedded in bearings, pre-load figure is *1.5Nm.***

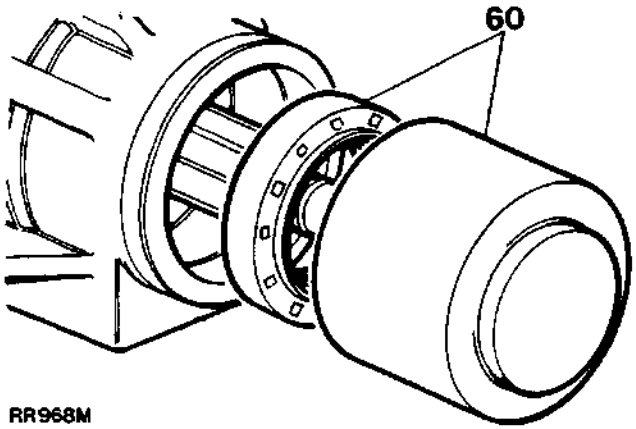
59. Remove pinion flange.

PINION PRELOAD SHIMS

PART No.	INCH	MM
FRC1193	.060	1.52
FRC1195	.062	1.57
FRC1197	.064	1.63
FRC1199	.066	1.68
FRC1201	.068	1.73
FRC1203	.070	1.78
539718	.072	1.83
539720	.074	1.88
539722	.076	1.93
539724	.080	2.03

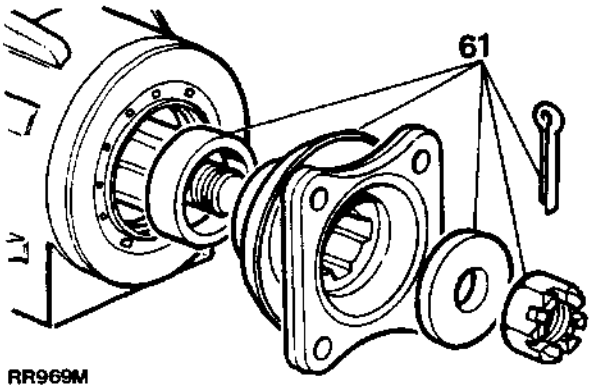
Fitting Pinion Oil Seal

60. Coat outer diameter of seal with grease. Fit seal lip side leading flush with end face of housing using tool LRT-51-001.



RR968M

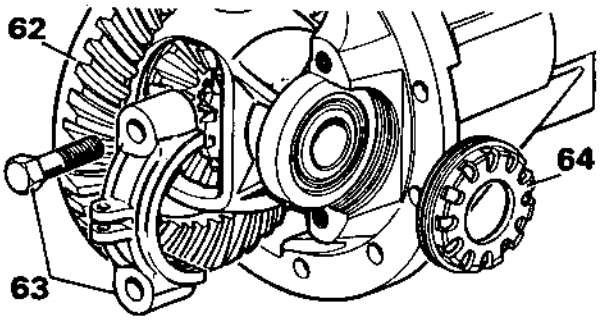
61. Lubricate seal lips with axle oil. Fit distance piece and flange, secure with washer and nut. Tighten to ***130Nm*** fit a new split pin.



RR969M

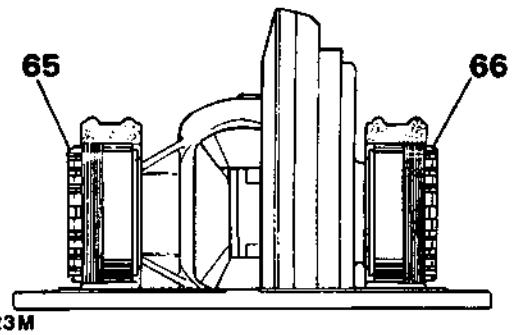
CROWN WHEEL/PINION BACKLASH ADJUSTMENT

62. Place differential housing in pinion housing.
63. Fit bearing caps and partly tighten bolts.



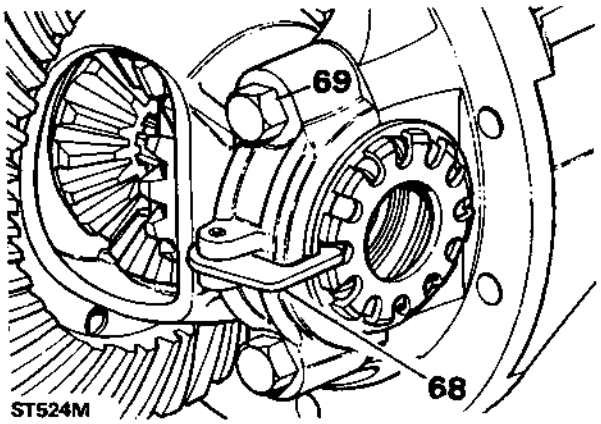
ST522M

64. Fit bearing adjusting nuts.
65. Mesh crown wheel to pinion. Using service tool LRT-54-508 loosen left bearing adjuster nut.
66. Tighten right nut until crown wheel/pinion backlash is just removed.



ST523M

67. Tighten left nut until it contacts bearing. Continue turning until a backlash of 0,10 to 0,17 mm is met. **DO NOT** slacken right nut otherwise bearing preload will be affected.
68. Fit locking fingers and roll pins. Align locking finger with a slot.
69. Evenly tighten bearing cap bolts to ***90Nm***



ST524M

70. Recheck crown wheel/pinion backlash.
71. Lubricate bearings and gears.

REAR HUB ASSEMBLY ABS

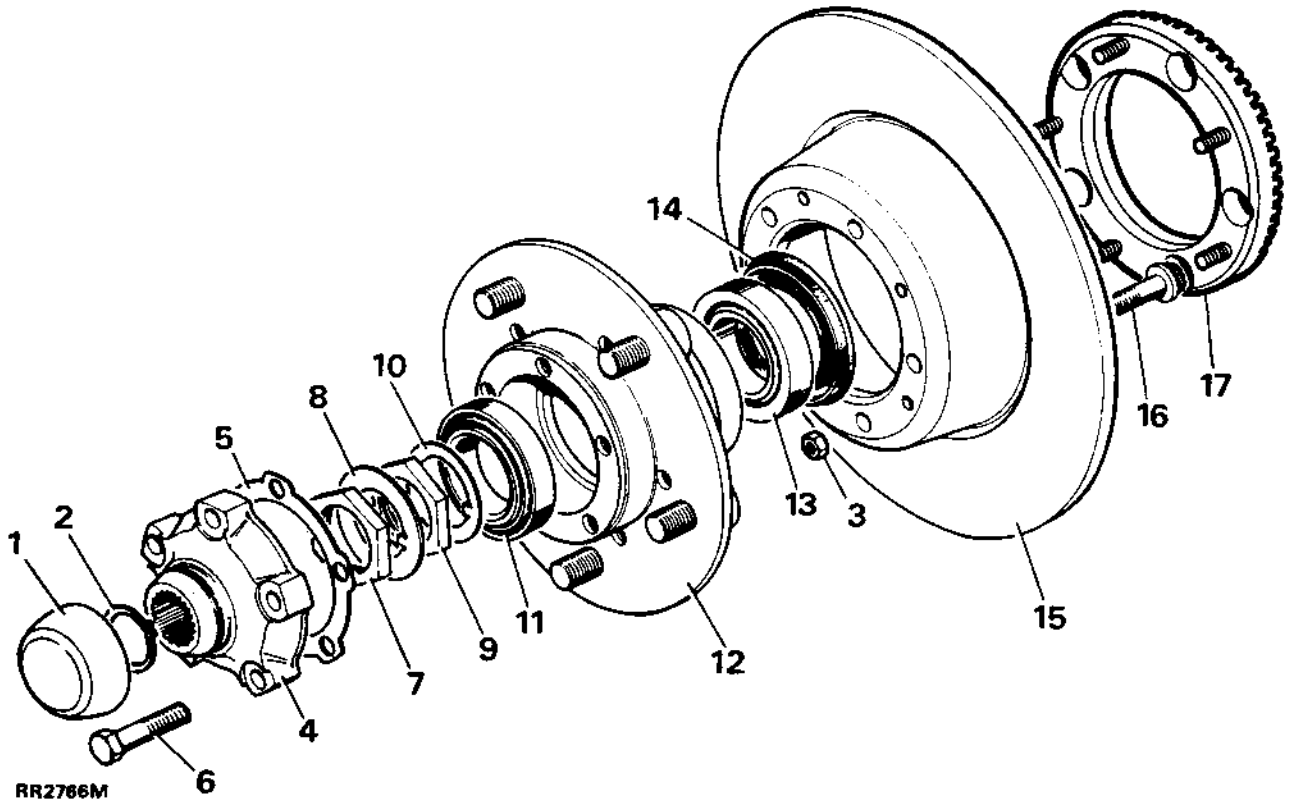
Service repair no - 64.16.13.

Overhaul

1. Remove rear hub assembly. ***See Repair, Rear hub assembly ABS***
2. Remove outer bearing.
3. Remove five nyloc nuts and withdraw sensor ring.
4. Mark, for reassembly, position of hub to brake disc.
5. Remove five bolts and separate hub from brake disc.

WARNING: A maximum of two road wheel retaining studs can be renewed. Should more studs be unserviceable fit new hub with studs.

6. Remove grease seal and inner bearing from hub.
7. Remove inner and outer bearing tracks.

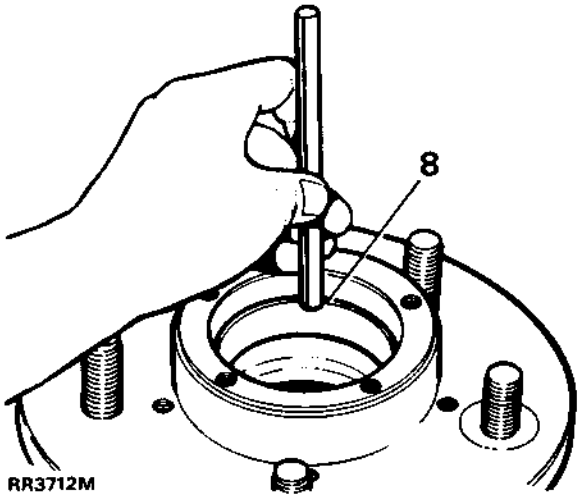


REAR HUB COMPONENTS WITH ANTI-LOCK BRAKES

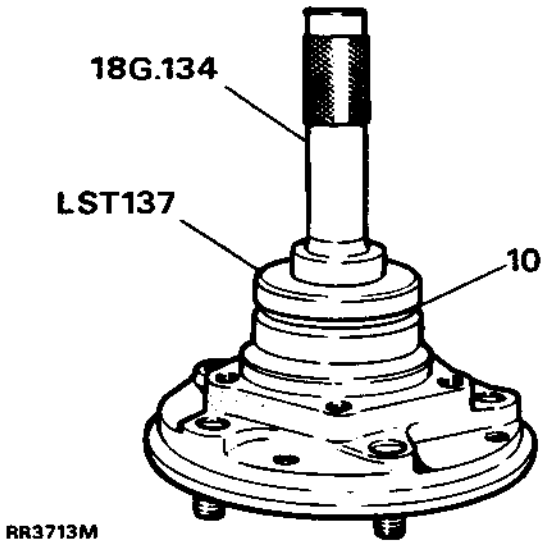
1. Dust cap.
2. Circlip.
3. Sensor ring retaining nut.
4. Drive member.
5. Drive member joint washer.
6. Drive member retaining bolt (five off).
7. Lock nut.
8. Lock washer.
9. Hub adjusting nut.
10. Keyed washer.
11. Outer bearing.
12. Hub.
13. Inner bearing.
14. Grease seal.
15. Brake disc.
16. Disc retaining bolt (five off).
17. Sensor ring.

Refit

8. Clean hub and fit inner and outer bearing tracks.



9. Pack hub inner bearing with grease and fit to hub.
10. With lip side leading fit a new seal flush with rear face of hub. Using service tool LRT-54-003 seal replacer and drift. Apply grease between seal lips.



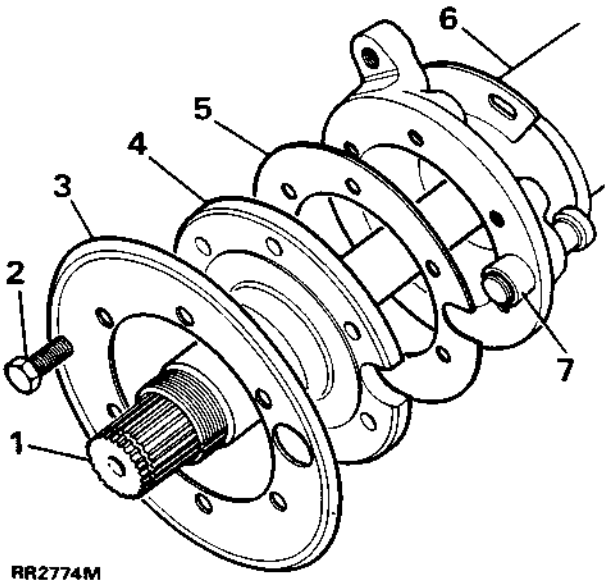
11. Assemble brake disc to the hub, line up reassembly marks. Applying Loctite 270, fit and tighten retaining bolts to ***73Nm.***
12. If necessary renew sensor ring studs applying Loctite 270 to threads. Fit sensor ring using new nyloc nuts tighten to ***9Nm.*** Ensuring it is correctly fitted to avoid tooth run out.
13. Pack hub outer bearing with grease and fit to hub.
14. Fit rear hub assembly. ***See Repair, Rear hub assembly abs.***

REAR STUB AXLE ABS

Service repair no - 64.16.22.

STUB AXLE COMPONENTS

1. Rear axle shaft.
2. Stub axle to axle casing bolt.
3. Mudshield.
4. Stub axle.
5. Stub axle joint washer.
6. Axle case.
7. Sensor bush sleeve.

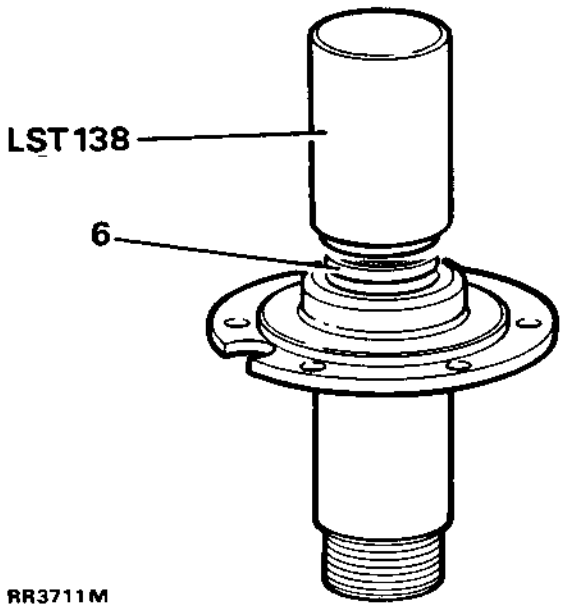


Overhaul

1. Remove hub assembly. ***See Repair, Rear hub assembly abs***
2. Remove six bolts from stub axle to axle casing.
3. Remove mudshield.
4. Remove stub axle and joint washer.
5. Remove rear axle shaft from axle casing.

Renew rear stub axle oil seal

6. Remove and discard oil seal. Lubricate seal and lip with EP90 oil. Using special tool LST 138 fit new oil seal lipside trailing so that seal is flush with rear face of stub axle.



RR3711M

Refit

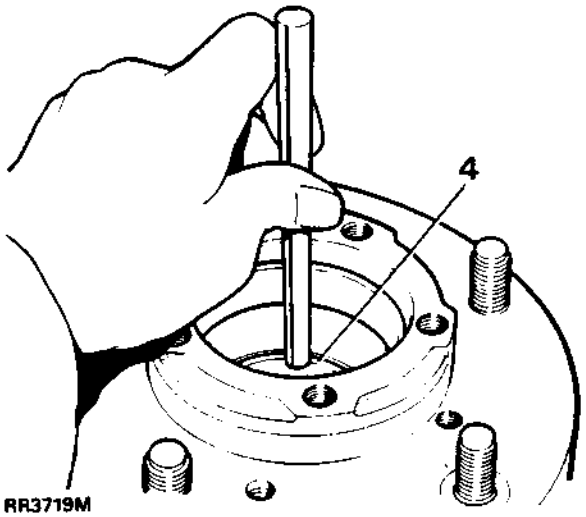
7. Fit new joint washer, stub axle and mudshield with bolts. Tighten to ***65Nm.***
8. Fit rear axle shaft avoid damaging stub axle seal.
9. Refit rear hub assembly. ***See Repair, Rear hub assembly abs***

REAR HUB NON ABS

Service repair no - 64.15.13.

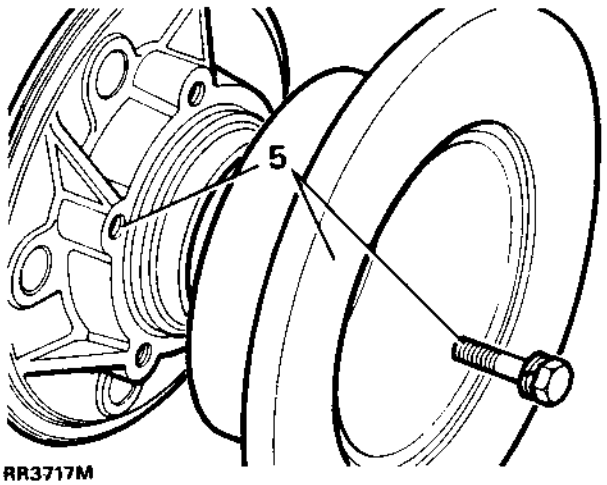
Overhaul

1. Remove hub assembly. ***See Repair, Rear hub assembly non ABS***
2. Remove inner and outer oil seals.
3. Remove inner and outer bearing cones (races).
4. Drive out inner and outer bearing cups.



RR3719M

5. Examine hub and brake disc and replace if unserviceable. Mark position of hub to disc if original parts are to be re-assembled.

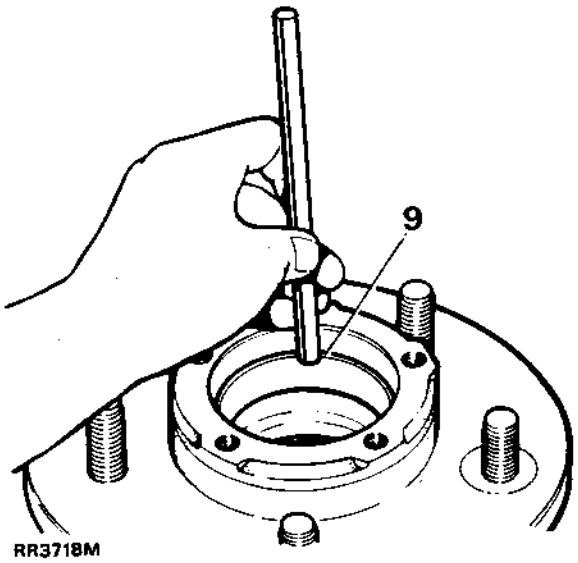


RR3717M

6. Examine stub axle. Check inner seal track is smooth and free from blemishes.
7. If necessary remove six bolts and remove stub axle complete with mudshield and joint washer.

Assemble

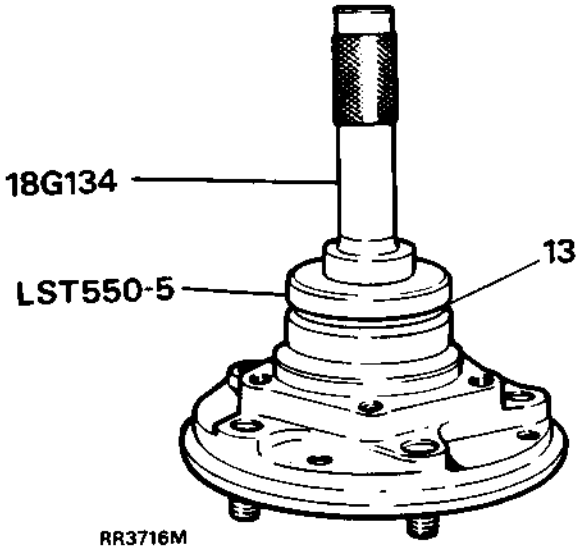
8. Using a new joint washer fit stub axle and mud shield. Coat threads of bolts with Loctite 270. Tighten to ***65Nm***
9. Fit new inner and outer bearing cups to hub.



10. Fit new inner bearing cone and pack with recommended hub grease.

Fit inner oil seal

11. Clean oil seal housing and check seal locating surface is smooth and free from burrs.
12. Apply recommended hub bearing grease to outside diameter of seal before fitting.
13. Fit seal, lip side leading, using the 76 mm end of service tool LRT-54-001 and drift LRT-99-003, flush with end face of hub.

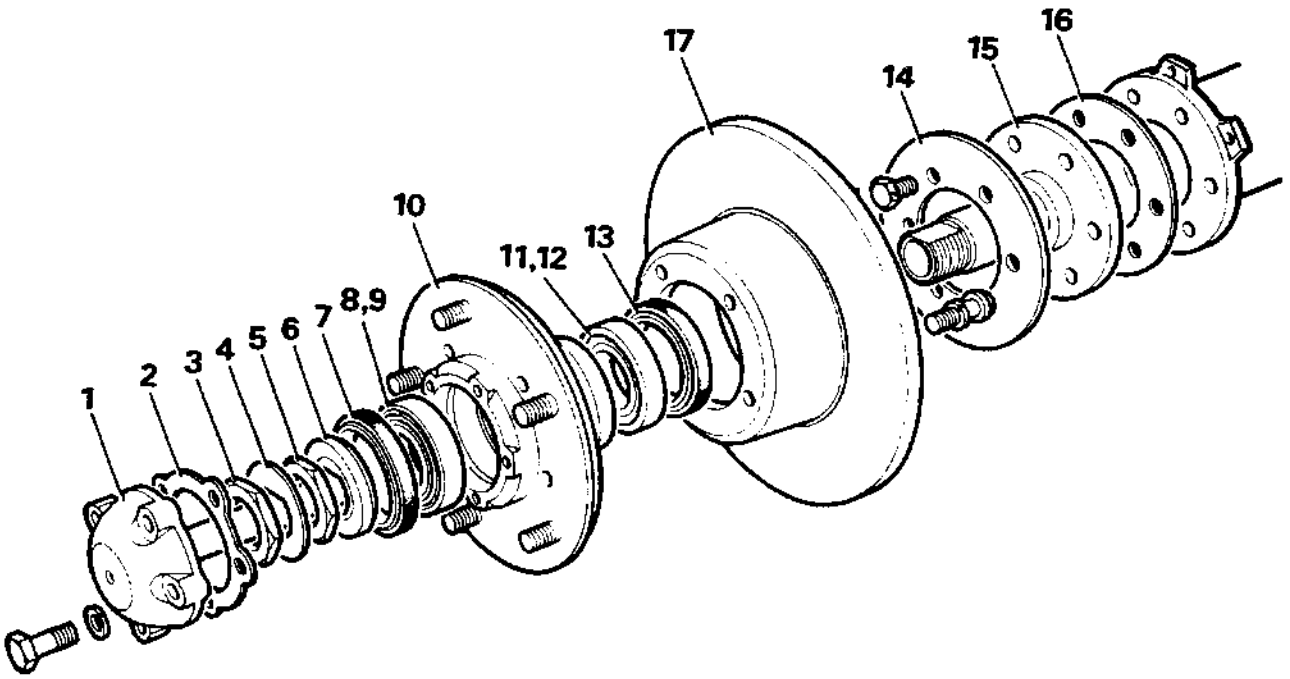


Fit outer oil seal

14. Fit new outer bearing cone and pack with a recommended grease. Repeat instructions 11 and 12.
15. Fit seal, lip side leading, using 72 mm end of service tool LRT-54-001 and drift LRT-99-003, to depth determined by tool.
16. Coat lips of seals with recommended grease.
17. Fit hub to axle. ***See Repair, Rear hub assembly non ABS***

REAR HUB COMPONENTS NON ABS VEHICLES

1. Rear axle shaft
2. Joint washer
3. Locknut
4. Lock washer
5. Adjusting nut
6. Seal track spacer
7. Outer oil seal
8. Outer bearing cone
9. Outer bearing cup
10. Hub
11. Inner bearing cup
12. Inner bearing cone
13. Inner oil seal
14. Mudshield
15. Stub axle
16. Stub axle joint washer
17. Brake disc



RR706M

AXLE DIFFERENTIAL DATA

Pinion bearing pre-load:
(new bearings) 3Nm
(bearings bedded in) 1,5Nm
Crown wheel run-out ..... 0,10 mm
Crown wheel/pinion backlash ..... 0,10 to 0,17 mm

REAR HUB

Rear hub non ABS vehicle end float ..... 0,013 to 0,10mm
Rear hub ABS vehicle end float ..... 0,013 to 0,05mm

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

Nm

REAR AXLE

Pinion housing to axle case 41
Crown wheel to differential case 58
Differential bearing cap to pinion housing 90
Differential drive flange to drive shaft 47
Bevel pinion nut 129
Lower link to axle 176
Pivot bracket ball joint to axle 176

REAR HUB NON ABS VEHICLES

Axle shaft to hub 47*
Brake disc to hub 73*
Stub axle rear to axle case 65
Brake caliper to axle case 82
Mudshield to axle case 11

REAR HUB ABS VEHICLES

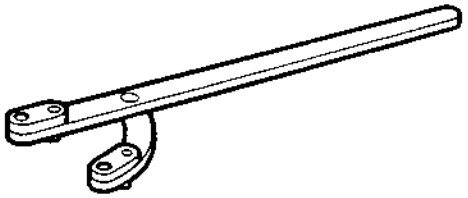
Hub driving member to hub 65*
Brake disc to hub 73*
Stub axle rear to axle case 65
Brake caliper to axle case 82
Disc shield to axle case 11
Sensor ring to brake disc 9

*** Apply loctite 270 prior to assembly.**

Torque values below cover all screws and bolts used, unless specified otherwise.

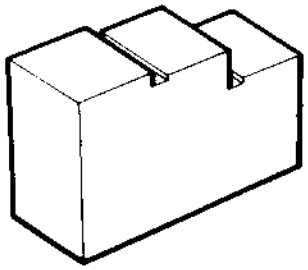
	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

AXLE DIFFERENTIAL



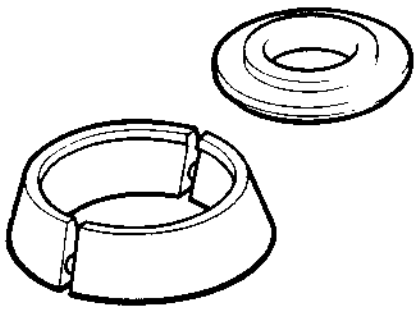
18G1205

LRT-51-003 Flange holder tool
18G1205



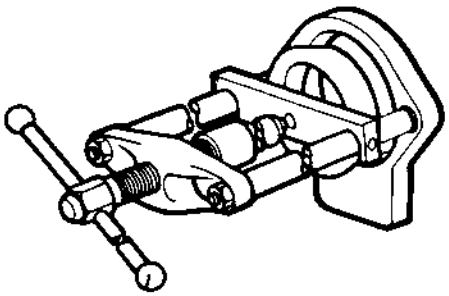
18G1914

LRT-54-504 Universal setting block
18G1914



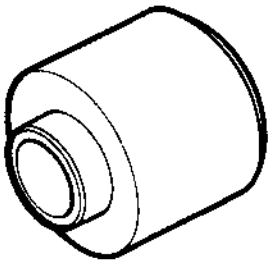
18G476

LRT-54-502 Pinion head bearing remover/replacer
18G476



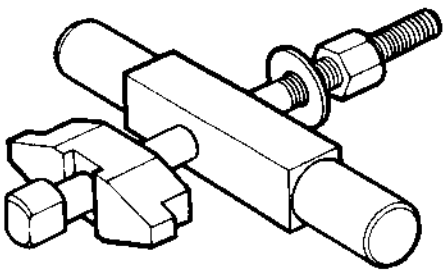
MS47

LRT-99-002 Press
MS47



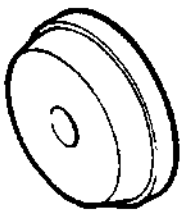
LST106

LRT-51-001 Oil seal replacer
LST106



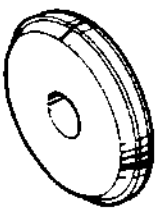
262757A

LRT-54-505 Extractor for pinion bearing races
RO262757A



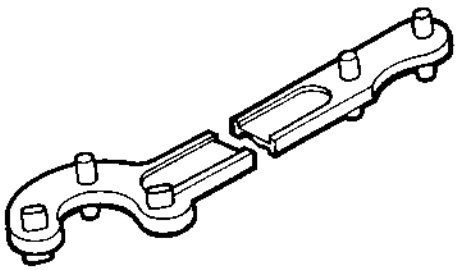
2627571

LRT-54-506 Replacer adapter pinion head bearing cup
RO2627571



2627572

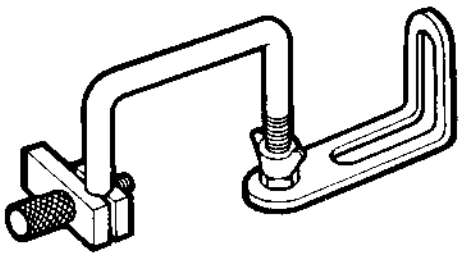
LRT-54-507 Adaptor pinion tail bearing cup replacer
RO2627572



RO530105

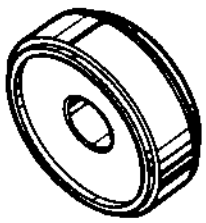
LRT-54-508 Spanner flange and carrier bearing
RO530105 nuts

REAR HUB



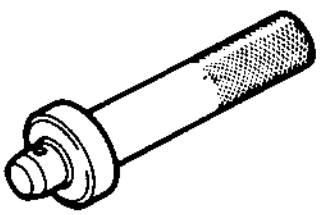
RO530106

LRT-99-503 Bracket for dial gauge and indicator
RO530106



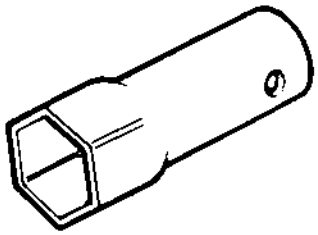
LST 5505

LRT-54-001 Oil seal replacer non ABS
LST550-5



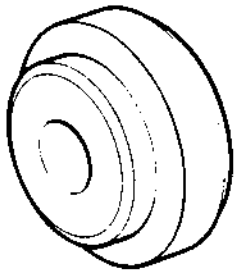
18G134

LRT-99-003 Drift
18G134



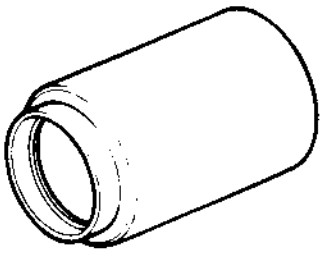
606435A

LRT-54-002 Hub nut spanner
RO606435A



LST137

LRT-54-003 Hub oil seal replacer ABS
LST137



LST138

LRT-54-004 Oil seal replacer ABS
LST138

54 - FRONT AXLE AND FINAL DRIVE

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FAULT DIAGNOSIS 1

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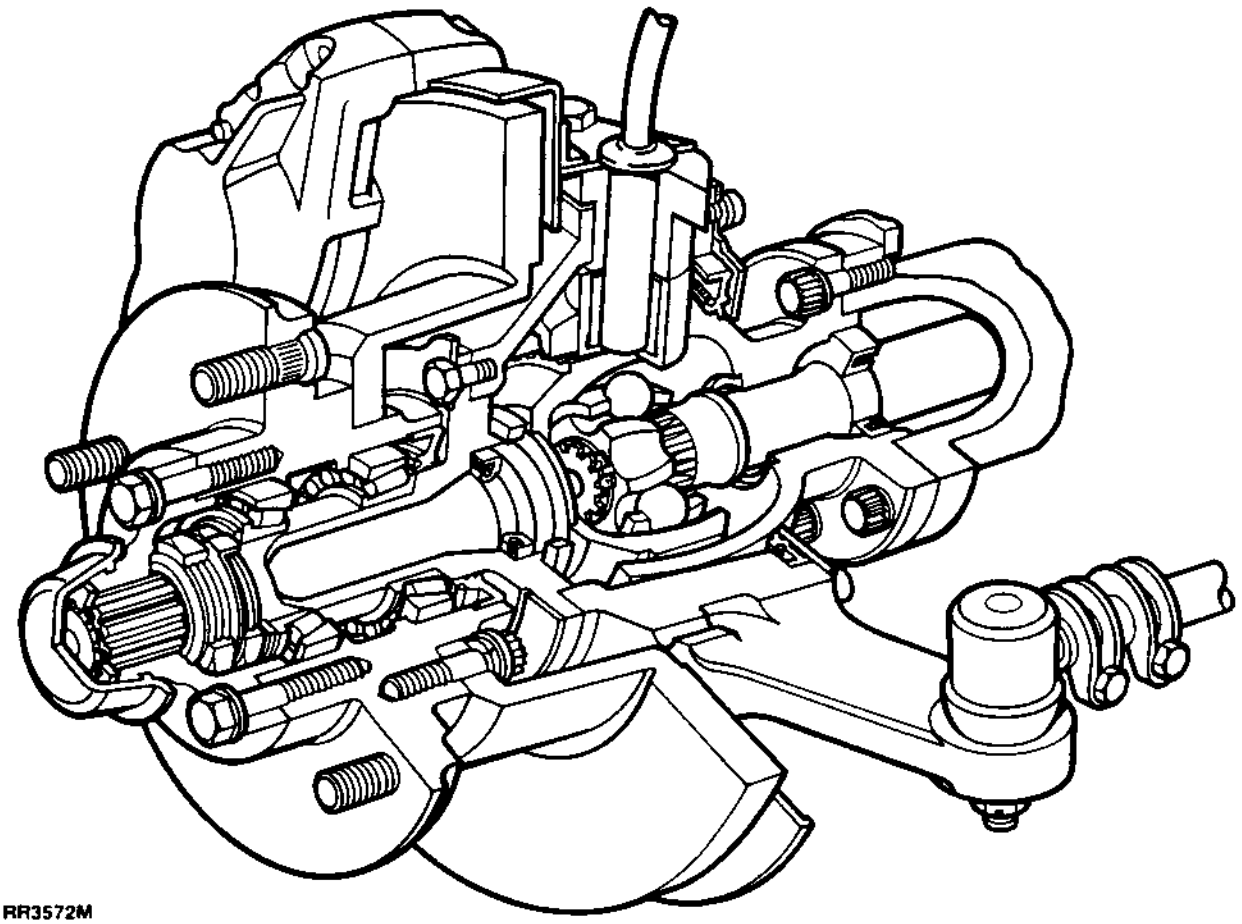
FRONT HUB 1



Notes

DESCRIPTION

The welded steel front axle casing houses a separate spiral bevel type differential unit, which is off set to the right of the vehicle centre line. The differential unit drives the front wheels via the axle shafts and constant velocity joints which are totally enclosed in the spherical and swivel housings.
Front axles fitted with ABS brakes are of slightly different construction to axles with non ABS brakes.

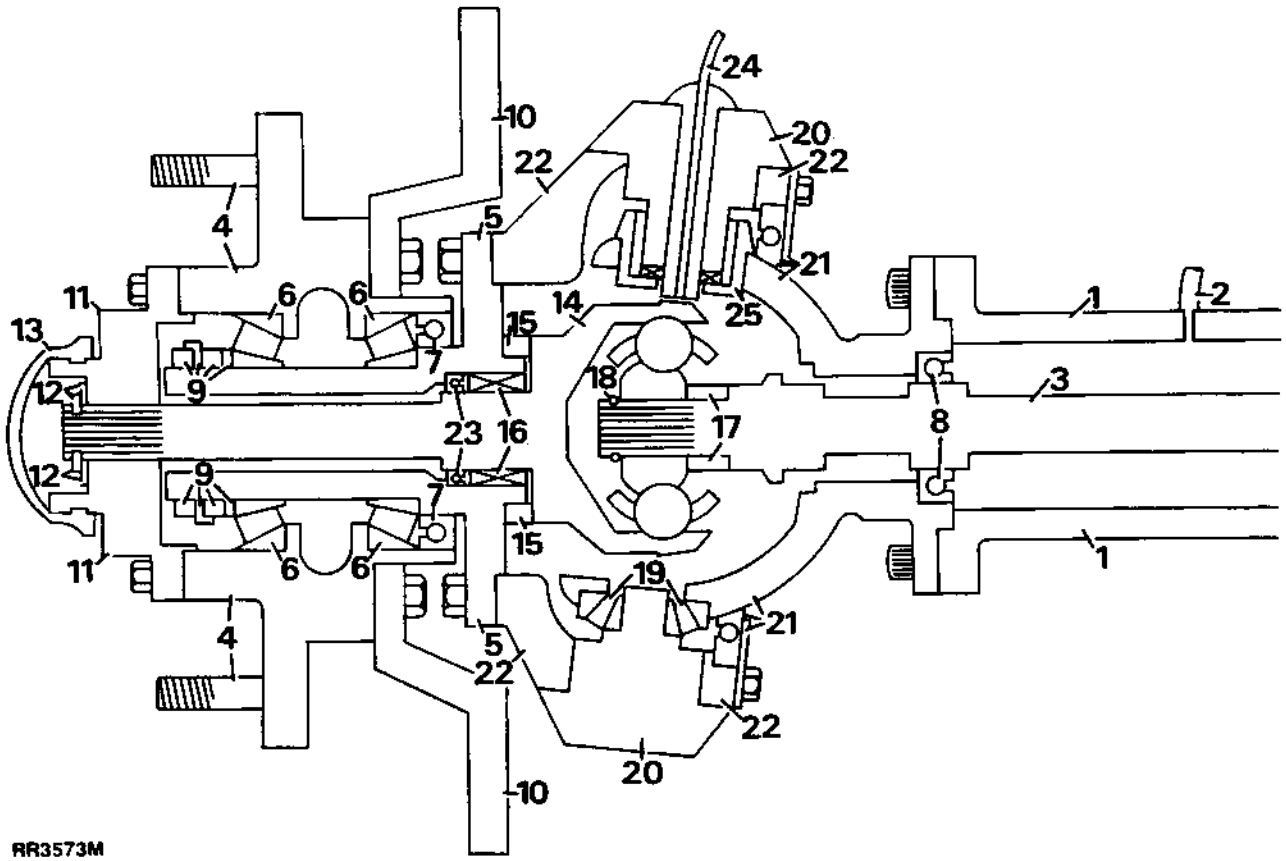


RR3572M

Front axle - ABS brakes

Front axle - ABS brakes

The front wheels are pivoted on taper roller bearings at the bottom of the swivel housing and a 'Railko bush' at the top. The wheel hubs are supported by two taper bearings and driven by drive flanges which are splined to the one piece, stub shaft/constant velocity joint.



RR3573M

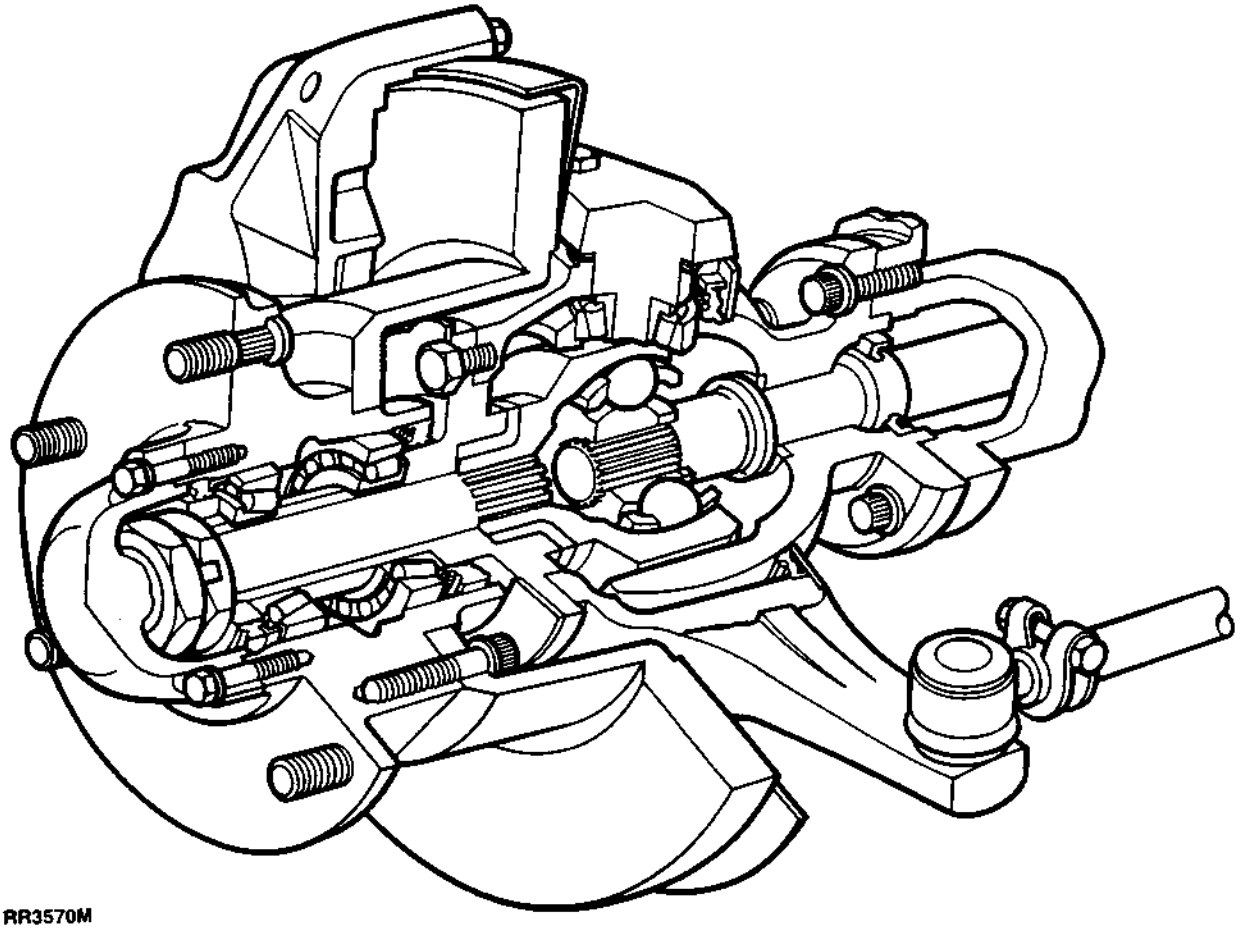
Front axle - ABS brakes

1. Axle casing
2. Ventilation pipe
3. Axle shaft
4. Wheel studs and hub
5. Stub axle
6. Wheel bearings (2)
7. Inner and outer hub seals
8. Axle shaft seal
9. Hub lock plate, thrust washer and nuts (2)
10. Brake disc
11. Drive flange
12. Shim washer and circlip
13. Dust cap
14. Constant velocity joint/shaft
15. Thrust collar for CV joint
16. Roller bearing
17. Spacer
18. Circlip
19. Bottom swivel taper bearing
20. Top and bottom swivel pins
21. Spherical housing, seal and retainer
22. Swivel housing
23. Constant velocity shaft seal
24. ABS pickup (electrical connection)
25. 'Railko' bush see note below

Ref item 25. Early ABS axles are fitted with a 'Railko' bush and thrust washer. Later axles have a 'Railko' bush and roller thrust bearings as illustrated.

Front axle - non ABS brakes

The front wheels are pivoted on taper roller bearings at the top and bottom of the swivel housing. The wheel hubs are supported by two taper bearings and driven by a one piece shaft/constant velocity joint which are splined to the axle shafts.



RR3570M

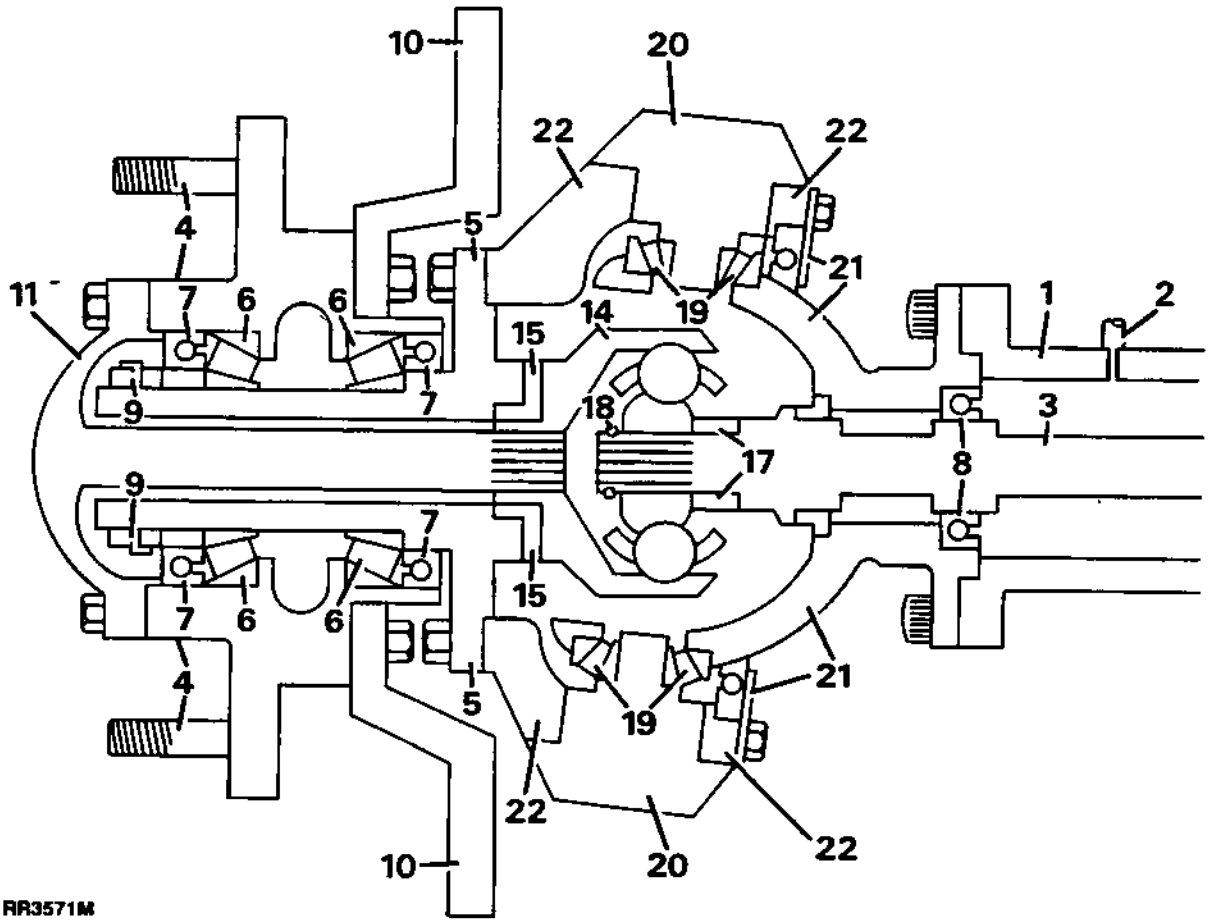
Lubrication

The differential, swivel housing and wheel hubs are individually lubricated and separated by oil seals 7 and 8, to prevent oil transfer across the axle when the vehicle is traversing steep inclines.

The wheel bearings are lubricated with grease and the swivel housing and differential with oil.

Ventilation

Ventilation of the differential is through a plastic pipe which terminates at a high level on the vehicle on both ABS and non ABS axles. The swivel housings ventilate through axle shaft oil seals 8 into the differential and the hub bearings vent via the oil seals into swivel housing.



Front axle - non ABS brakes

Key

1. Axle casing
2. Ventilation pipe
3. Axle shaft
4. Wheel studs and hub
5. Stub axle
6. Wheel bearings (2)
7. Inner and outer hub seals
8. Axle shaft seal
9. Hub lock plate, thrust washer and nuts (2)
10. Brake disc
11. Drive flange and shaft
12. Constant velocity joint/shaft
13. Thrust collar/support bush for CV joint
14. Spacer
15. Circlip
16. Top and bottom swivel taper bearing
17. Top and bottom swivel pins
18. Spherical housing, seal and retainer
19. Swivel housing

FAULT DIAGNOSIS

Complaint - Oil leaks

Front axles with ABS brakes and those with non ABS brakes have different internal oil seals which separate the lubrication of the differential, swivel housings and wheel hubs. The external seals on both axles are the same. An external leak of lubrication can be caused by a faulty internal seal. For example, if the seals which separate the differential from the swivel housings are faulty and the vehicle is operating or parked on an embankment, oil may leak across the axle leaving one swivel with a high level and the other swivel and differential lacking lubrication.

See 'Description and Operation' for illustrations of oil seal locations.

When investigating leaks or checking oil levels, it is essential that all the lubrication is drained from any housing with a high level and that the other levels are checked.

Swivel oil should be checked for signs of grease leaking from the hub bearings and the hub grease should not contain oil.

Check that the axle ventilation system is clear, as a blockage can cause internal pressure to force oil past the seals.

If the vehicle is driven in deep water with defective oil seals, water may contaminate the lubricants and when checked, give a false impression that the housing has been overfilled with oil.

Do not assume that a high oil level is due to over filling or, that a low level is because of an external leak.

Notes

FRONT AXLE ASSEMBLY

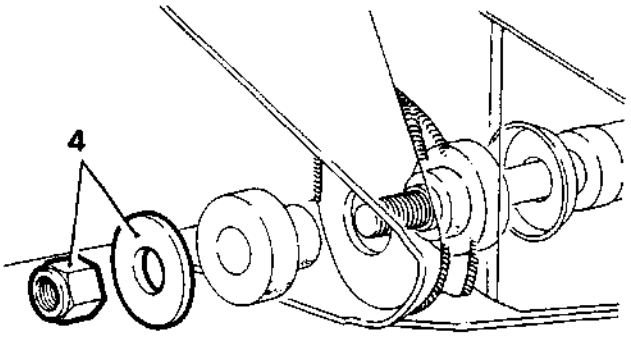
Service repair no - 54.15.01 or -54.16.01(ABS)

Remove and refit

Remove

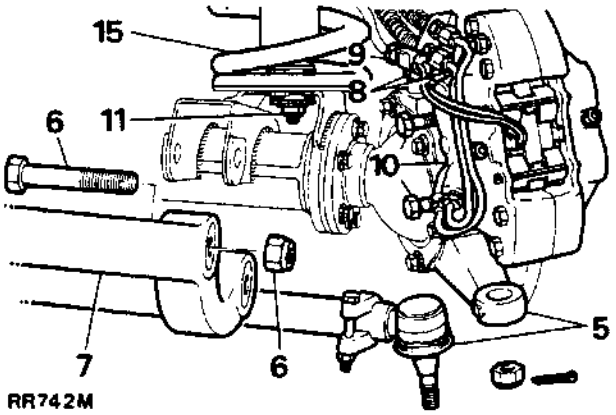
WARNING: Remove and refit of axle requires a further two persons to steady axle when lowering or repositioning axle.

1. Support chassis front.
2. Remove road wheels.
3. Support axle weight with hydraulic jack.
4. Remove radius arms to chassis frame nuts.



RR983M

5. Disconnect steering damper from track rod. Using an extractor remove track rod links from swivel pin arms.
6. Remove four nuts and bolts securing radius arms to axle bracket.
7. Remove radius arms.
8. Remove bolts securing brake hose brackets. Refit bolts to prevent oil leakage.
9. Disconnect brake pad wear multiplug, and where applicable remove ABS sensor.
10. Remove bolts from brake calipers and tie to one side.
11. Remove nuts and washers securing shock absorbers to axle.
12. Disconnect drag link from swivel pin housing arm.



RR742M

13. Remove two nuts and bolts securing Panhard rod to axle bracket. Lift rod clear of axle.
14. Mark for reassembly drive shaft flanges. Remove four nuts and bolts, tie propeller shaft to one side.
15. Lower axle assembly and remove road springs.
16. Disconnect anti roll bar link. ***See FRONT SUSPENSION, Repair, Anti-roll bar ball joint links***
17. Remove axle assembly.

Refit

18. Position axle under vehicle, supporting left side of axle.
19. Reverse removal procedure.
20. Tighten propeller shaft bolts to ***47 Nm.***
21. Tighten Panhard rod to axle bracket to ***88 Nm.***
22. Tighten drag link to hub arm to ***40 Nm.***
23. Tighten upper swivel pin bolts. ***See Specifications, torque, Torque Values***
24. Tighten radius arms to axle bolts to ***197 Nm.***
25. Tighten radius arms to chassis side member nuts to ***197 Nm.***
26. Tighten track rod end to ***40 Nm***
    Fit new split pin.

FRONT BRAKE DISCS ABS

Service repair no - 70.11.10.

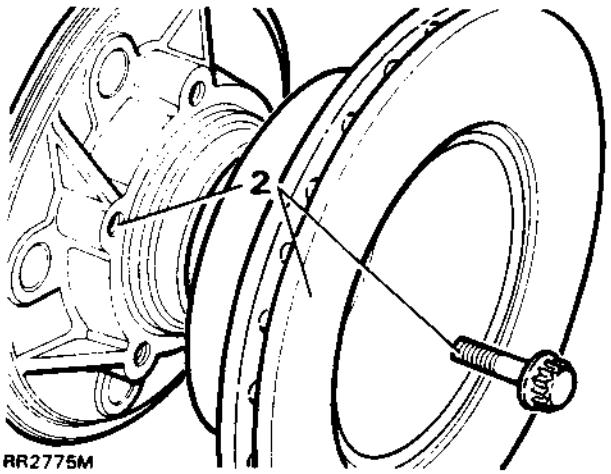
Remove and refit

Remove

1. Remove front hub assembly. ***See Front hub assembly ABS***
2. Remove five hub to disc bolts.
3. Tap disc to separate from hub.

Refit

4. Locate disc to hub.
5. Apply Loctite 270 to disc bolts. Tighten to ***73Nm.***



6. Check total disc runout with a dial indicator, this must not exceed 0,15 mm. If necessary reposition disc.
7. Fit hub assembly. ***See Front hub assembly ABS***

Front brake vented disc reclamation

Vented discs may be reduced to a total minimum thickness of 22 mm.
Metal may be machined off each disc face, but equal thicknesses of disc must remain each side of vent.

FRONT BRAKE DISCS NON ABS

Service repair no - 70.10.10.

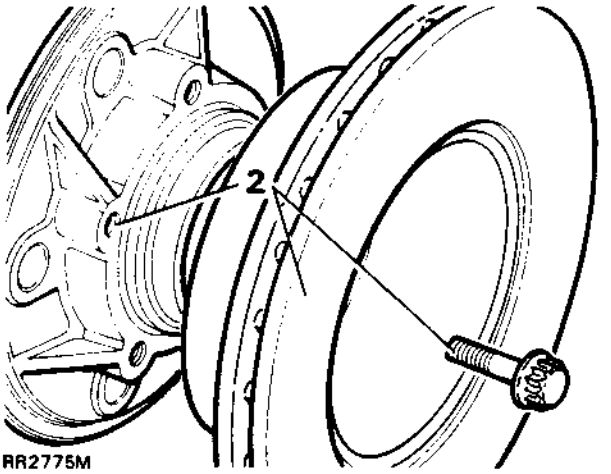
Remove and refit

Remove

1. Remove front hub assembly. ***See Front hub assembly non ABS***
2. Remove five hub to disc bolts.
3. Tap disc to separate from hub.

Refit

4. Locate disc to hub.
5. Apply Loctite 270 to disc bolts. Tighten to ***73Nm.***



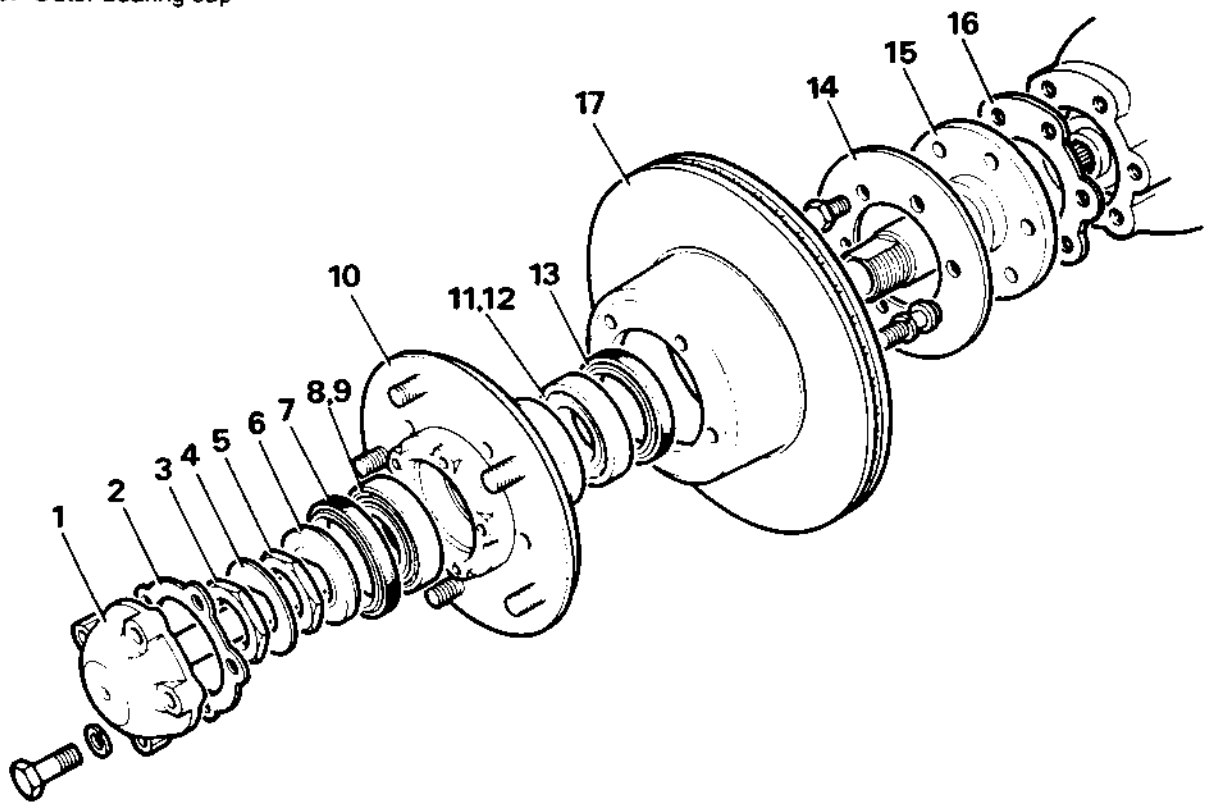
6. Check total disc runout with a dial indicator, this must not exceed 0,15 mm. If necessary reposition disc.
7. Fit hub assembly. ***See Front hub assembly non ABS***

FRONT HUB ASSEMBLY NON ABS

Service repair no - 60.25.01.

Front hub components

1. Hub driving shaft
2. Gasket
3. Locknut
4. Lock washer
5. Adjusting nut
6. Seal track spacer
7. Outer oil seal
8. Outer bearing cone
9. Outer bearing cup
10. Hub
11. Inner bearing cup
12. Inner bearing cone
13. Inner oil seal
14. Mudshield
15. Stub axle
16. Stub axle joint washer
17. Brake disc



RR3775M

Remove and refit

Remove

1. Place front axle onto axle stands and remove road wheel.
2. Release brake hose clips and remove brake caliper bolts. Secure to one side.

WARNING: Take care not to kink brake hose.

3. Remove bolts, hub driving shaft to hub and withdraw shaft.
4. Straighten locking washer tab. Use service tool 606435 box spanner to remove locknut. Remove lock washer and adjusting nut.
5. Remove seal track spacer.
6. Remove hub assembly.

Refit

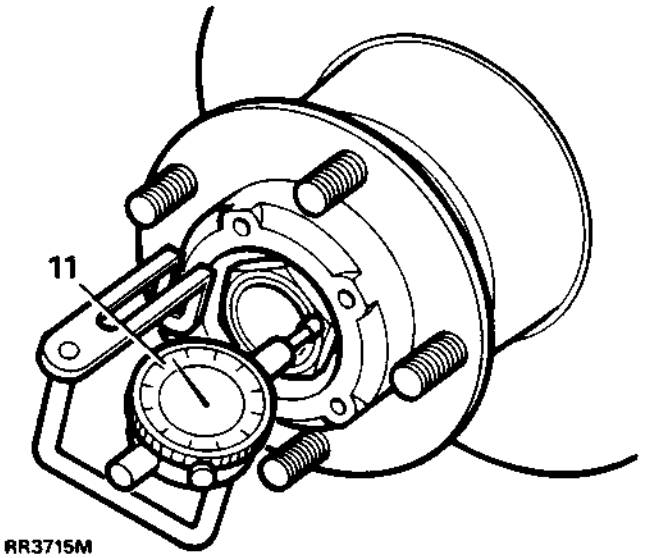
7. Select a new seal track spacer. Check outer diameter is smooth and no burrs are on chamfered leading edge.
8. Fit hub assembly to stub axle.

CAUTION: Outer seal damage could occur if hub is rested on stub axle before seal track spacer is fitted.

9. Fit seal track spacer,seal lip leading.

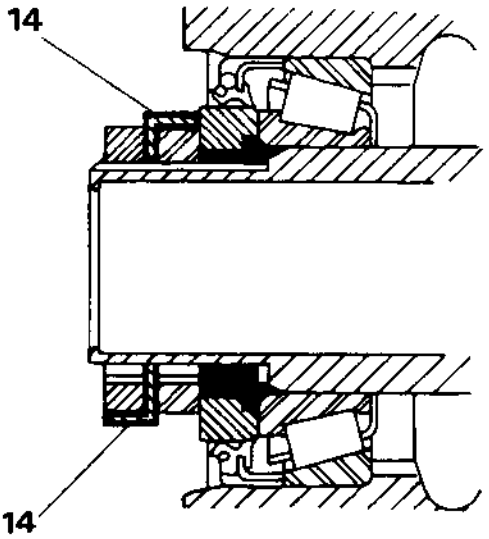
NOTE: Instruction 10 applies to hubs fitted with new components. Instruction 11 applies if fitting original components.

10. Fit adjusting nut and using box spanner 606435 tighten nut while revolving hub until end float is removed. Back-off nut half a turn and retighten to ***1.5Nm giving required hub end-float of 0,013 to 0,10 mm.***
11. If seal track spacer has previously been compresssed hub end-float is checked by mounting a dial indicator on hub so trace pin rests preloaded on nut. Rotate hub and check end-float of **0,013 to 0,10 mm** by pushing and pulling the hub.
12. Fit a new lock washer and locknut. Restrain adjustment nut and tighten lock nut to ***102 Nm.***
13. If fitting original components rotate hub then recheck end-float.



RR3715M

14. Bend lock washer over adjusting nut and over locknut. Avoid damaging outer seal.
15. Using a new joint washer, fit hub driving shaft. Tighten to ***47Nm.***
16. Fit brake caliper retaining bolts. Tighten to ***82Nm.***
    Fit brake pipe bracket to top of swivel housing.



RR3714M

17. Fit road wheel. Place vehicle onto ground and tighten road wheel nuts to ***126Nm.***

FRONT HUB ASSEMBLY ABS

Service repair no - 60.26.01.

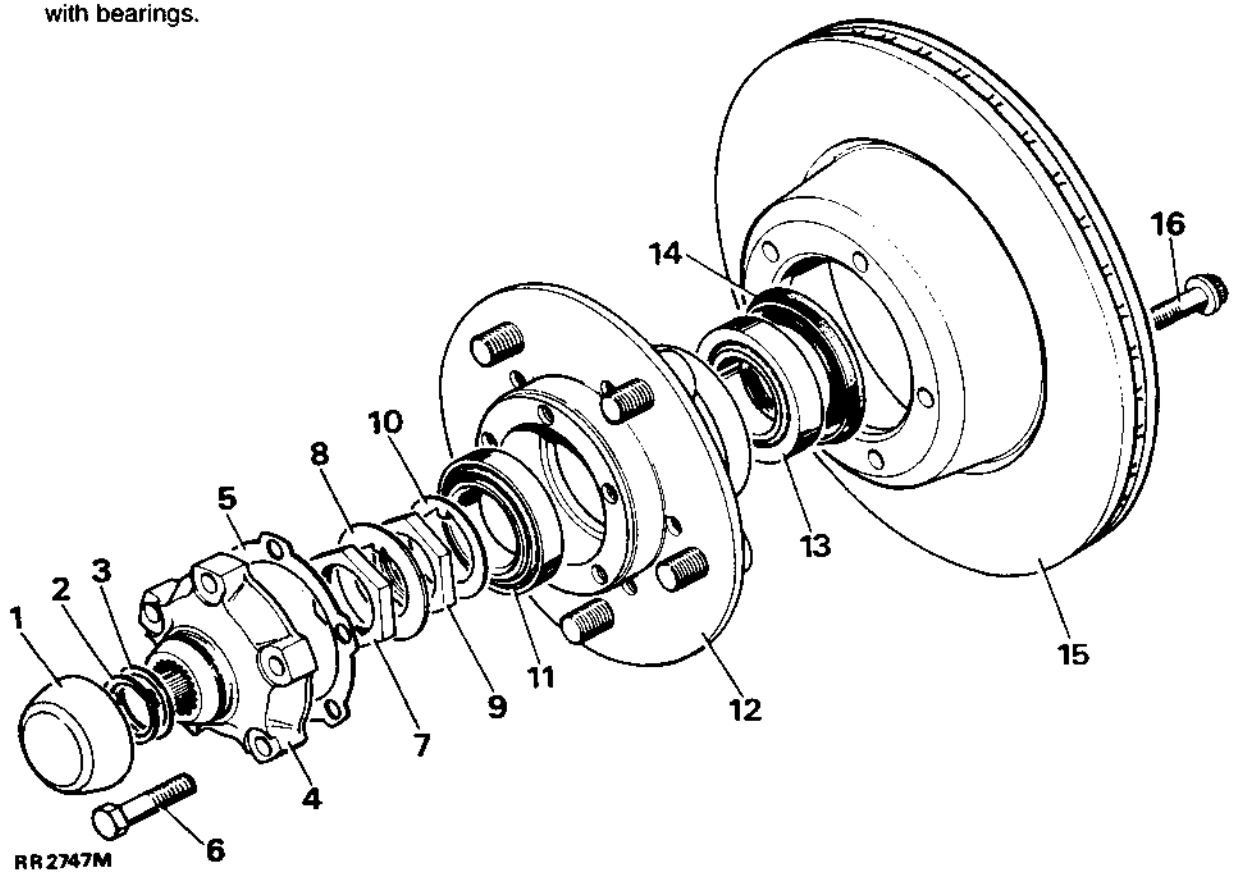
Remove and refit

Remove

1. Slacken front wheel nuts, jack up vehicle and lower onto axle stands and remove road wheel.
2. Release brake hose clips and remove brake caliper. Secure to one side.
3. Lever off dust cap.
4. Remove circlip and propeller shaft shim from propeller shaft.
5. Remove five bolts and withdraw driving member and joint washer.
6. Bend back lock washer tab.
7. Remove locknut and tab washer.
8. Remove hub adjusting nut.
9. Remove keyed washer.
10. Remove hub and brake disc assembly complete with bearings.

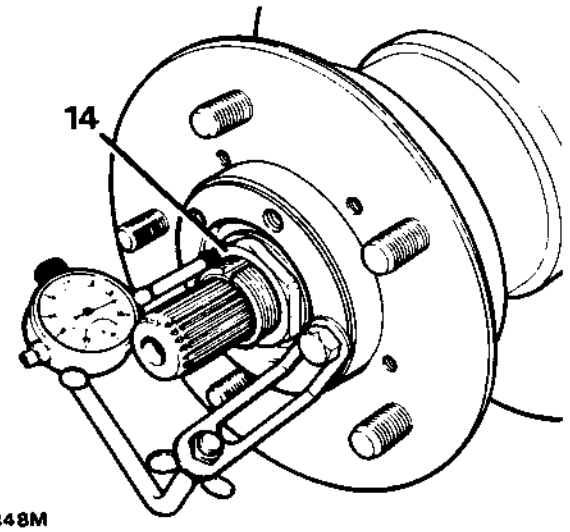
HUB COMPONENTS

1. Dust cap.
2. Propeller shaft circlip.
3. Propeller shaft shim.
4. Drive member.
5. Drive member joint washer.
6. Drive member retaining bolt.
7. Lock nut.
8. Lock washer.
9. Hub adjusting nut.
10. Keyed washer.
11. Outer bearing.
12. Hub.
13. Inner bearing.
14. Grease seal.
15. Brake disc (vented).
16. Disc retaining bolt.



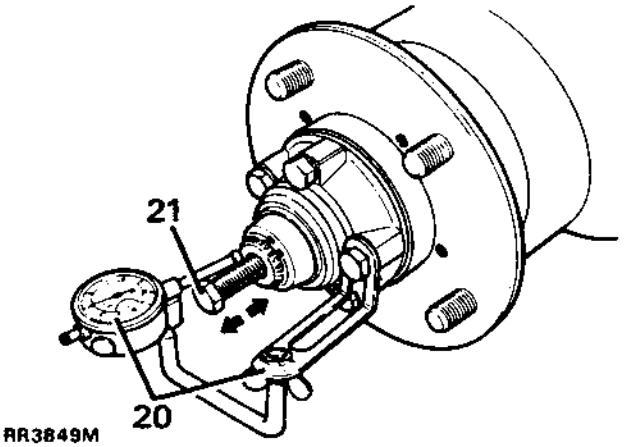
Refit

11. Clean stub axle and propeller shaft and fit hub assembly to axle.
12. Fit keyed washer.
13. Fit hub adjusting nut and tighten by hand whilst rotating hub until all end-play is taken up.
14. Mount a dial gauge using bracket LRT-99-503 and rest pin in a loaded condition on adjusting nut.



RR3848M

15. Slacken off adjusting nut until a hub end play of **0,013 to 0,05 mm** is obtained.
16. Fit a new keyed lock tab washer.
17. Fit and tighten hub adjusting nut and recheck end play before bending lock tab over.
18. Fit a new joint washer to driving member and fit member to hub and secure with five bolts. Tighten to ***65Nm.***
19. Fit original propeller shaft shim and secure with a circlip.
20. To check drive shaft end play mount a dial gauge using bracket LRT-99-503 and rest pin in a loaded condition on end of propeller shaft.
21. Fit a suitable bolt to threaded end of propeller shaft. Move propeller shaft in and out noting dial gauge reading. End play should be between **0,08 to 0,25 mm.**



RR3849M

22. If end play requires adjustment, remove circlip, measure shim thickness and fit an appropriate shim to give required end-play.
23. Remove bolt from propeller shaft, fit circlip and dust cap.
24. Fit brake caliper. Tighten to ***82Nm.***
25. Bleed brake system. ***See BRAKES, Repair, Brake System Bleed (ABS)***
26. Fit road wheel, remove axle stands and tighten road wheel nuts to ***126Nm.***
27. Operate footbrake to locate brake pads before taking vehicle on road.

FRONT DIFFERENTIAL

Service repair no - 54.10.07. or - 54.11.07.

Overhaul

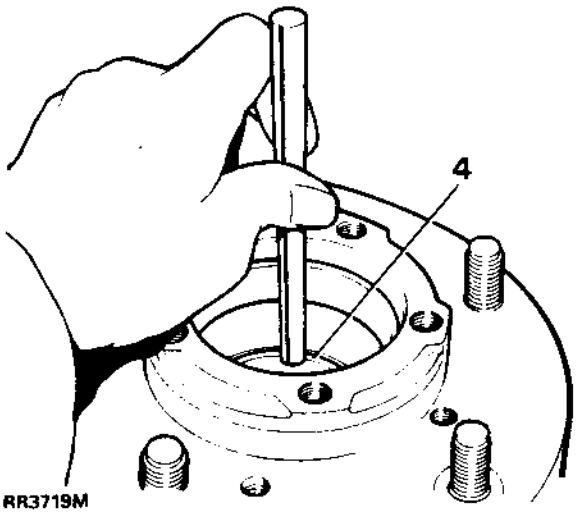
The front and rear differentials fitted to Range Rover are the same. When overhauling front differential. ***See REAR AXLE AND FINAL DRIVE, Overhaul, Axle differential assembly***

FRONT HUB NON ABS

Service repair no - 60.25.14.

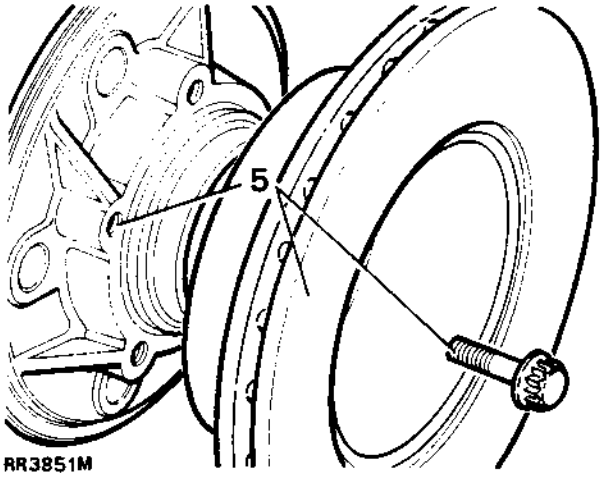
Overhaul

1. Remove hub assembly. ***See Repair, Front hub assembly non ABS***
2. Remove inner and outer oil seals.
3. Remove inner and outer bearing cones.
4. Remove inner and outer bearing cups.



RR3719M

5. Examine hub and brake disc and replace if unserviceable. Mark position of hub to disc if original parts are to be assembled.
6. Examine stub axle. Check inner seal track is smooth and free from blemishes.

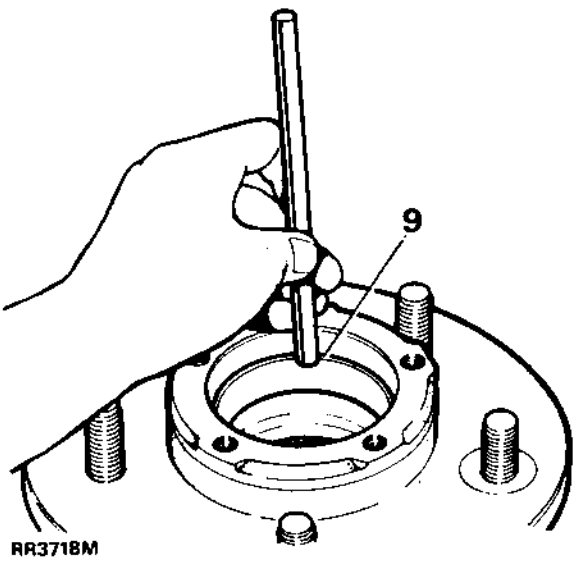


RR3851M

7. If necessary remove six bolts and remove stub axle complete with mudshield and joint washer.

Assemble

8. Using a new joint washer fit stub axle and mud shield. Coat threads of bolts with Loctite 270. Tighten to ***65Nm***
9. Fit new inner and outer bearing cups to hub.

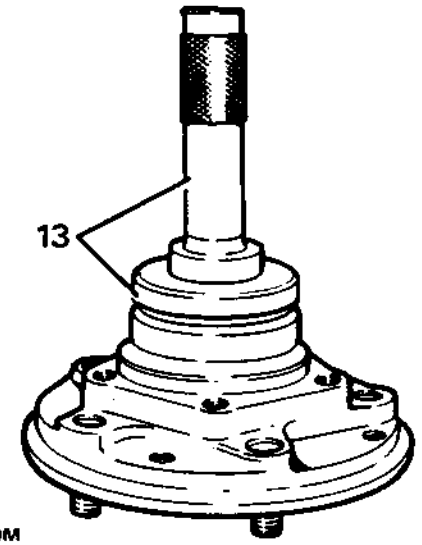


RR3718M

10. Fit new inner bearing cone and pack with recommended grease.

Fitting inner oil seal

11. Clean oil seal housing and check seal locating surface is smooth and free from burrs.
12. Apply recommended grease to outside diameter of seal before fitting.
13. Fit seal, lip side leading, using the 76 mm end of service tool LRT-54-001 and drift LRT-99-003 flush with end face of hub.



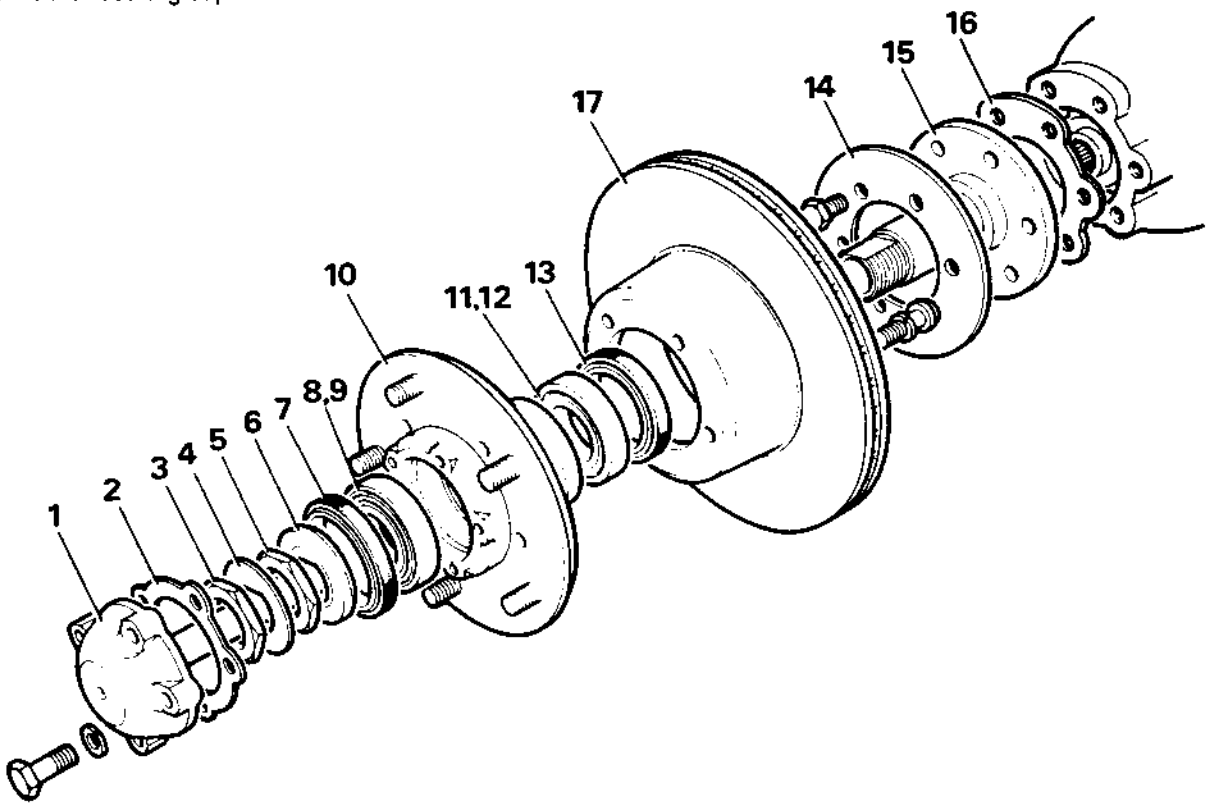
RR3850M

Fitting outer oil seal

14. Fit new outer bearing cone and pack with a recommended grease. Repeat instructions 11 and 12.
15. Fit outer seal, lip side leading, using 72 mm end of service tool LRT-54-001 and drift LRT-99-003, to depth determined by tool.
16. Coat lips of seals with recommended grease.
17. Fit hub assembly to axle. ***See Repair, Front hub assembly non ABS***

FRONT HUB ASSEMBLY COMPONENTS NON ABS

1. Hub driving shaft
2. Gasket
3. Locknut
4. Lock washer
5. Adjusting nut
6. Seal track spacer
7. Outer oil seal
8. Outer bearing cone
9. Outer bearing cup
10. Hub
11. Inner bearing cup
12. Inner bearing cone
13. Inner oil seal
14. Mudshield
15. Stub axle
16. Stub axle joint washer
17. Brake disc



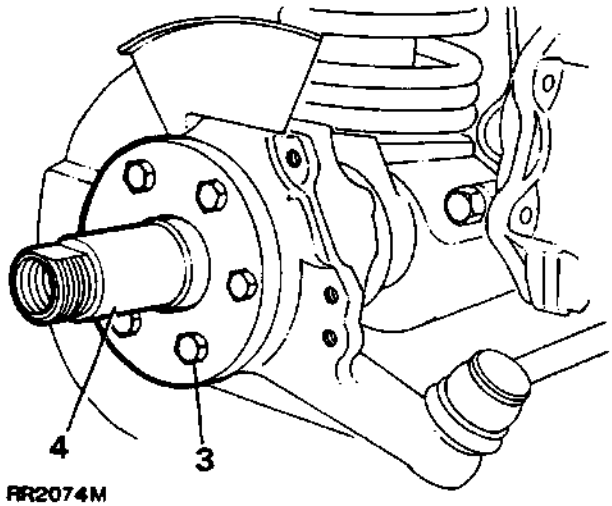
RR3775M

STUB AXLE, AXLE SHAFT, CONSTANT VELOCITY JOINT AND SWIVEL PIN, NON ABS

Service repair no - 60.15.45.

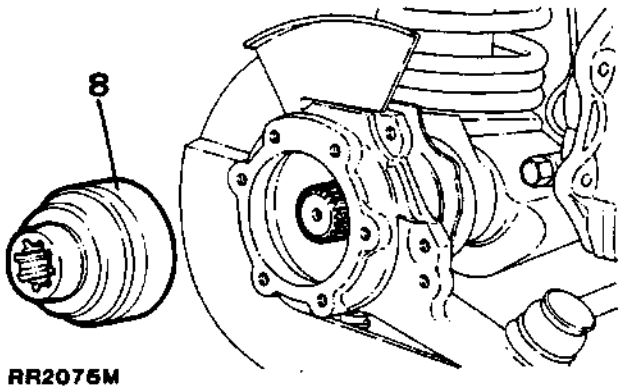
Overhaul

1. Remove hub assembly. ***See Repair, Front hub assembly non ABS***
2. Drain oil from swivel pin housing.
3. Remove six bolts retaining stub axle to swivel pin housing.
4. Remove mud shield, stub axle and joint washer.
5. Remove brake disc shield.



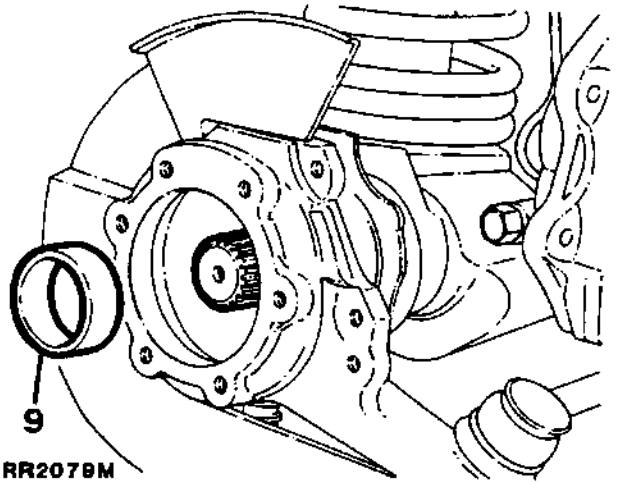
RR2074M

6. Disconnect tie-rod end ball joint from swivel pin housing.
7. Disconnect drag link ball joint.
8. Remove constant velocity joint from axle shaft.



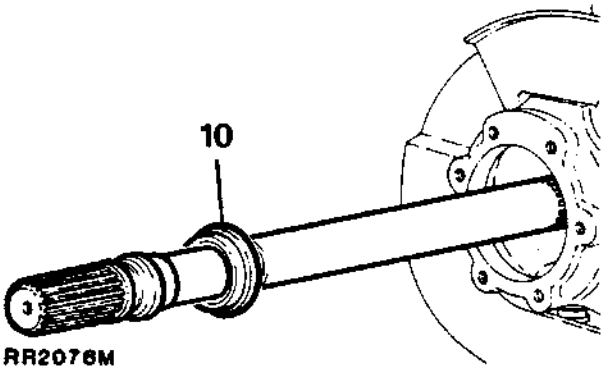
RR2075M

9. Remove spacer from axle shaft and then axle shaft from axle tube.



RR2078M

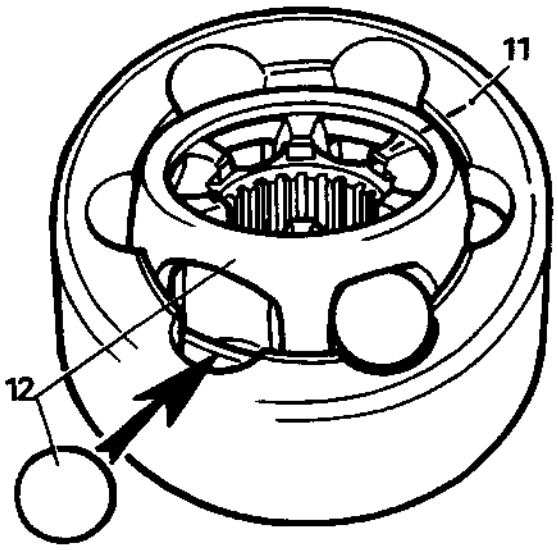
10. Remove bush from axle shaft.



RR2076M

Constant velocity joint

11. Mark positions of constant velocity joint, inner and outer race and cage for reassembly.
12. Swivel cage and inner race to remove balls.



RR2077M

13. Examine all components in particular inner and outer track, cage balls and bearing surfaces for damage and excessive wear.
14. Maximum acceptable end-float on assembled joint 0,64mm. Renew if worn or damaged. Lubricate with a recommended oil during assembly.

Stub axle

15. Remove phospher bronze bush.
16. Examine stub axle, in particular check inner seal track diameter is smooth.
17. Press on a new bush up to shoulder of stub axle.

Swivel pin housing assembly

18. Remove bolts securing oil seal, retaining plate and joint washer. Release assembly from swivel pin housing.

△ **NOTE: Removal of oil seal and retaining plate is achieved when swivel bearing housing is removed.**

19. Remove two bolts, retaining lower swivel pin to housing.
20. Remove brake disc shield bracket.
21. Tap lug to remove lower swivel pin and joint washer.
22. Remove two bolts retaining brake hose bracket and top swivel pin.
23. Remove bracket, top swivel pin and shims.
24. Remove swivel pin housing while retrieving lower and upper bearings.

Swivel bearing housing

25. Remove lower bearing track from swivel bearing housing.

△ **NOTE: Use upper bearing opening to gain access to lower bearing track.**

26. Remove seven bolts retaining swivel bearing housing to axle case.
27. Remove inner oil seal from back of housing.
28. Remove top bearing track from swivel bearing housing.

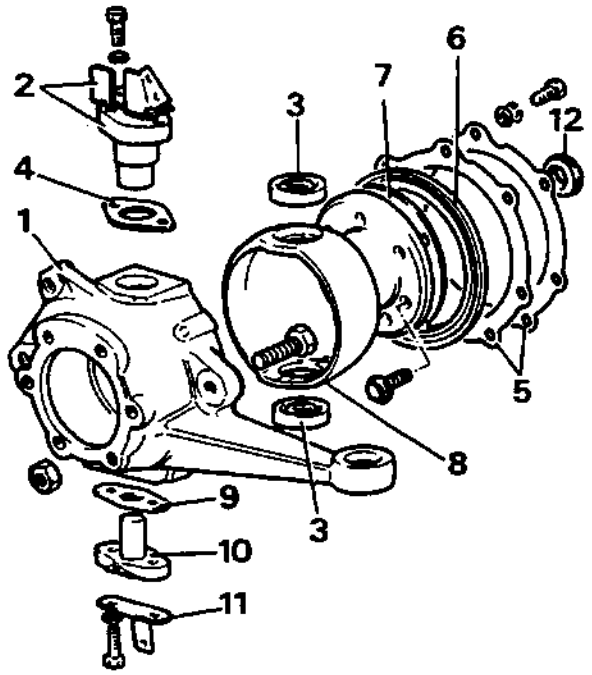
△ **NOTE: Use lower bearing opening to gain access to upper bearing track.**

29. If worn, pitted or damaged, renew housing.
30. Fit upper and lower bearing tracks into swivel bearing housing.

⚠ **CAUTION: Ensure bearing tracks are fitted square or damage could occur.**

31. With seal lips trailing, fit swivel housing inner oil seal into rear of housing. Grease seal lips.

Swivel assembly components



RR980M

1. Swivel pin housing
2. Top swivel pin and brake hose bracket
3. Upper and lower swivel pin bearings
4. Shim
5. Retaining plate and washer
6. Oil seal
7. Joint washer
8. Swivel bearing housing
9. Joint washer
10. Lower swivel pin
11. Mudshield bracket
12. Swivel housing inner oil seal

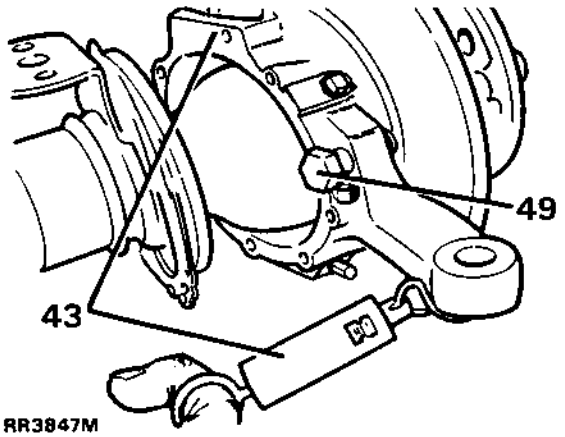
Assemble swivel pin housing.

32. Coat swivel bearing housing to axle casing bolts with Loctite 270 or equivalent.
33. Coat both sides of joint washer with a sealing compound. Position swivel bearing housing to axle mating face.
34. Place retaining plate, joint washer and oil seal over axle flange ready for assembly.
35. Fit swivel bearing housing to axle flange with seven bolts. Tighten to ***73 Nm.***
36. Grease and fit upper and lower swivel pin taper roller bearings.
37. Position swivel pin housing over swivel bearing housing.
38. Coat joint washer both sides with sealing compound and position on lower swivel pin.
39. Loosely fit brake shield bracket plus lower swivel pin with lug outboard to swivel pin housing.
40. Loosely fit top swivel pin plus existing shims and brake hose bracket to swivel pin housing.
41. Apply Loctite 270 or equivalent to lower swivel pin bolts. Tighten to ***78Nm*** bend over lock tabs.
42. Tighten top swivel pin bolts to ***78Nm.***

Check and adjust preload on bearings non ABS

△ **NOTE: Swivel housing oil seal and axle should not be fitted.**

43. Attach a spring balance to ball joint bore and pull balance to determine effort required to turn swivel pin housing.
Resistance, once initial inertia has been overcome, should be **1.16 to 1.46 kg.** Adjust by removing or adding shims to top swivel pin.



RR3847M

44. When setting is correct remove top swivel bolts, apply Loctite 270 or equivalent. Refit to ***78Nm***, and bend over lock tabs.
45. Apply recommended grease between lips of swivel oil seal.
46. Fit oil seal, joint washer and retaining plate with seven bolts and spring washers to ***11Nm.***
47. Fit tie rod and drag link and secure with new split pins. Tighten to ***40Nm.***
48. Fit brake disc shield.
49. Loosely fit lock stop bolt and nut.

Assemble constant velocity joint, stub axle and axle shaft.

50. Fit a new phosphor bronze bush onto axle shaft.
51. Place axle shaft into axle tube, ensuring splines are engaged push shaft home.

⚠ **CAUTION: When fitting axle shaft avoid damage to oil seal.**

52. Fit constant velocity bearing journal into bush on stub axle.
53. Fit spacer onto axle shaft.
54. Position joint washer on swivel pin housing to stub axle mating surface.
55. Fit stub axle with flat at 12 o'clock position. Ensure constant velocity bearing journal engages fully into bush.

⚠ **CAUTION: Damage to bush may occur if assembly is not engaged fully.**

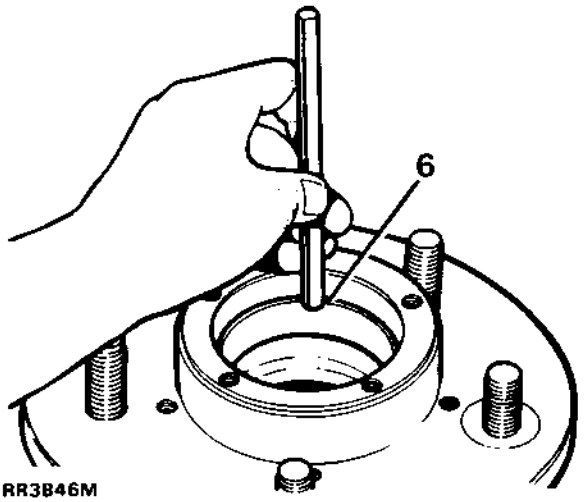
56. Fit mudshield and stub axle to swivel pin housing with six bolts. Apply Loctite 270 or equivalent. Tighten to ***65Nm.***
57. Fit front hub assembly. ***See Repair, Front hub assembly non ABS***
58. Fill swivel assembly to correctlevel, with new oil. ***See SECTION 10, Maintenance, Under Vehicle Maintenance***
59. Set steering lock stop bolts. ***See STEERING, Adjustment, Steering lock stops***

FRONT HUB ABS

Service repair no - 60.26.14.

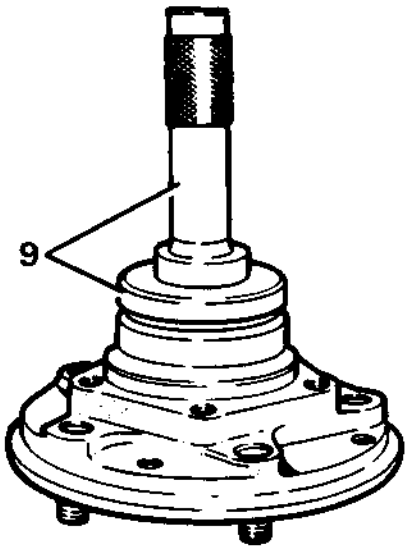
Overhaul

1. Remove front hub assembly ABS. ***See Repair, Front hub assembly ABS***
2. Remove outer bearing.
3. Mark, for reassembly, relationship between hub and brake disc, if original hub is to be refitted.
4. Remove five bolts and separate hub from brake disc.
5. Drift out grease seal and inner bearing from hub and discard seal.
6. Drift out inner and outer bearing tracks.
7. Clean hub and drift in inner and outer bearing tracks.



8. Pack hub inner bearing with recommended grease and fit to hub.

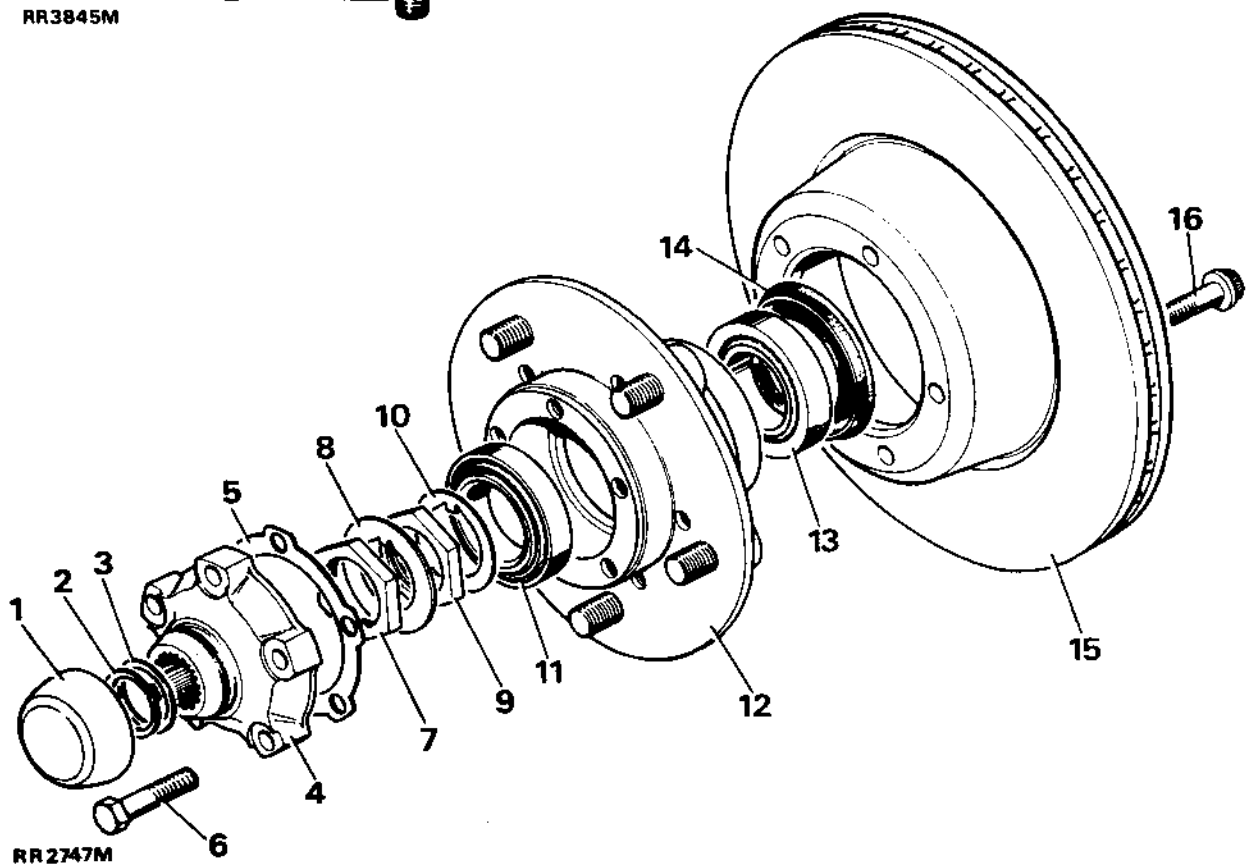
9. With lip side leading fit new seal to hub using special tool LST 137 seal replacer and drift 18G 134. Drive in seal flush with rear face of hub. Apply grease between seal lips.
10. Fit brake disc to hub, lining up to marks made during dismantling. Applying Loctite 270, fit and tighten five retaining bolts to ***73Nm.***
11. Grease and fit outer bearing to hub.
12. Fit front hub assembly. ***See Repair, Front hub assembly ABS***



RR3845M

HUB COMPONENTS

1. Dust cap.
2. Propeller shaft circlip.
3. Propeller shaft shim.
4. Drive member.
5. Drive member joint washer.
6. Drive member retaining bolt.
7. Lock nut.
8. Lock washer.
9. Hub adjusting nut.
10. Keyed washer.
11. Outer bearing.
12. Hub.
13. Inner bearing.
14. Grease seal.
15. Brake disc (vented).
16. Disc retaining bolt.



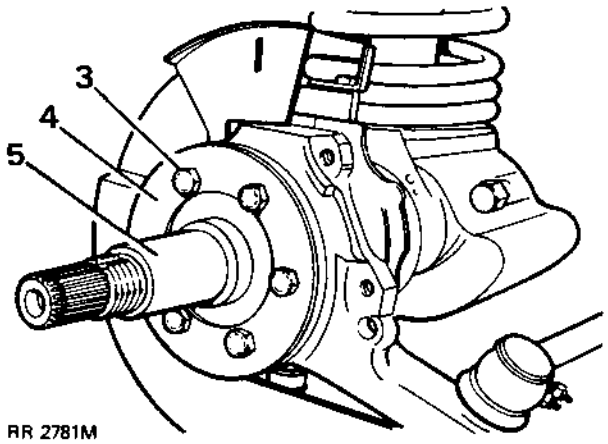
RR2747M

FRONT STUB AXLE, CONSTANT VELOCITY JOINT AND SWIVEL WITH ABS

Service repair no - 60.16.43.

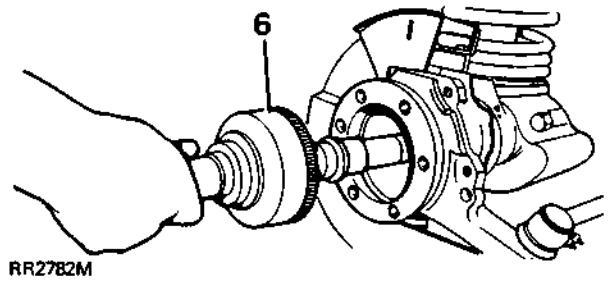
Remove stub axle, axle shaft and constant velocity joint.

1. Remove front hub assembly with abs. ***See Repair, Front hub assembly abs***
2. Drain swivel pin housing and refit plug.
3. Remove six bolts retaining stub axle to swivel housing.
4. Remove mud shield.
5. Remove stub axle and joint washer.



RR 2781M

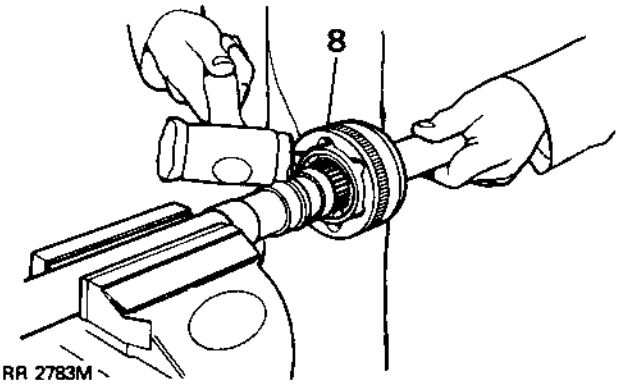
6. Pull out axle shaft and constant velocity joint from axle casing.



RR2782M

Remove constant velocity joint from axle shaft

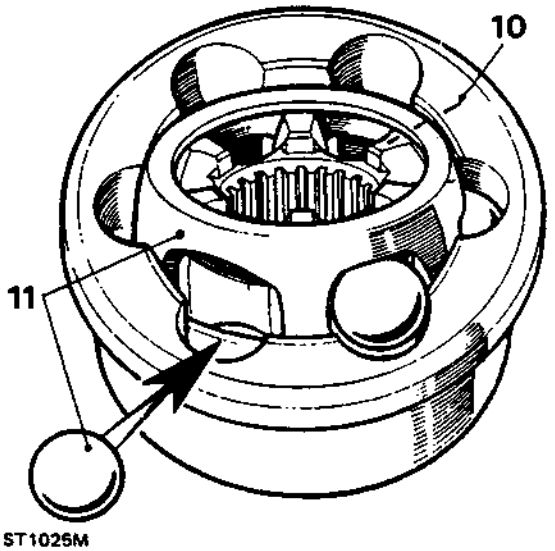
7. Hold axle shaft firmly in a soft jawed vice.
8. Using a soft mallet drive constant velocity joint from shaft.
9. Remove circlip and collar from axle shaft.



RR 2783M

Constant velocity joint

10. Mark positions of constant velocity joint, inner and outer race and cage for reassembly.
11. Swivel cage and inner race to remove balls.

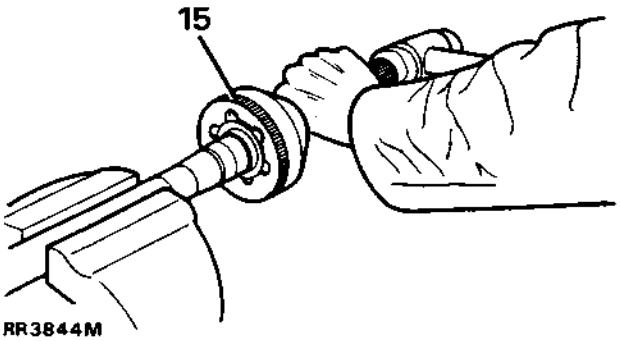


ST1025M

12. Examine all components in particular inner and outer track, cage balls and bearing surfaces for damage and excessive wear.
13. Maximum acceptable end-float on assembled joint 0,64mm. Renew if worn or damaged. Lubricate with a recommended oil during assembly.

Fit constant velocity joint to axle

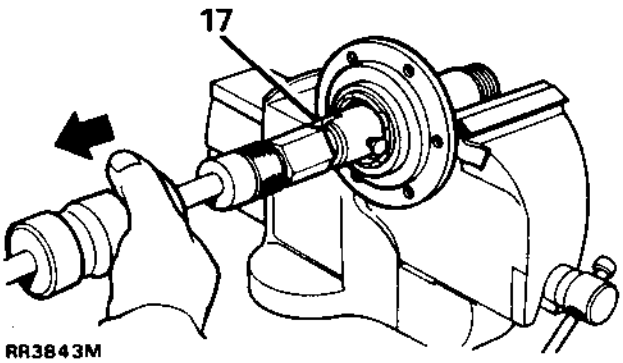
14. Fit collar and a new circlip.
15. Engage constant velocity joint on axle shaft splines and using a soft mallet, drive joint in fully.



RR3844M

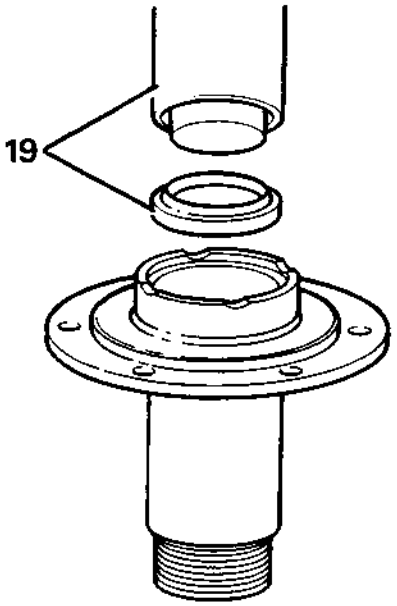
Renew stub axle,thrust ring, oil seal and bearing

16. Drill and chisel off thrust ring taking care to avoid damaging stub axle.
17. Remove bearing and oil seal using special tool TRT-37-004 and slide hammer LRT-99-004. Ensure lip of tool locates behind bearing to to drive it out.
18. Repeat instruction for removal of oil seal.



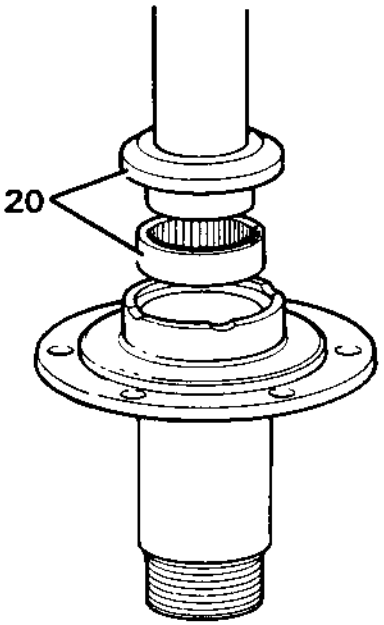
RR3843M

19. Lubricate seal and lip with EP90 oil and with cavity side leading press in a new oil seal using special tool LRT-54-004.



RR3840M

20. Using special tool LRT-54-005, fit bearing with its part number visible when fitted, and flush with end face of stub axle.



RR3839M

21. Press fit a new thrust ring onto stub axle.

Swivel pin housing.

22. Remove brake shield secured at bottom by one nut and bolt, and midway by lock stop nut.
23. Disconect track-rod end ball joint from housing.
24. Disconnect drag-link ball joint.
25. Disconnect jump hoses from brake jump hose bracket.
26. Remove ABS brake sensor.
27. Remove six bolts securing oil seal and retaining plate to swivel pin housing. Prise seal from swivel pin housing.

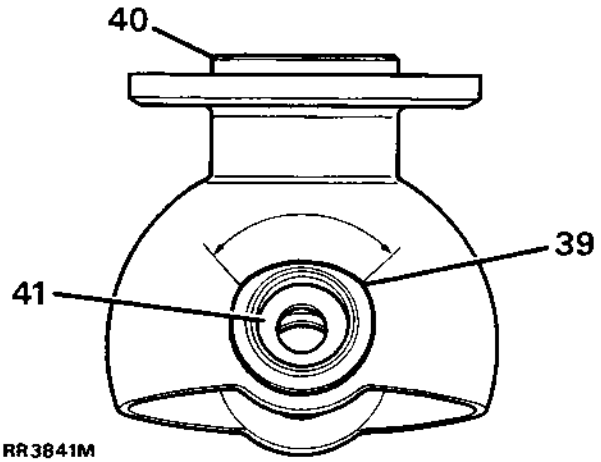
△ **NOTE: Oil seal and retaining plate cannot be removed until swivel pin bearing housing is removed.**

28. Remove two screws securing brake damper/shield bracket, and lower swivel pin to housing.
29. Withdraw lower swivel pin and joint washer by tapping protruding lug.
30. Remove top swivel pin retaining bolts complete with brake jump hose bracket.
31. Remove top swivel pin and shims.
32. Remove swivel pin housing while retrieving lower taper bearing.

Swivel pin bearing housing

33. Remove seven bolts securing swivel pin bearing housing to axle case.
34. Remove and discard oil seal and joint washer.
35. Remove lower swivel pin bearing track.
36. Remove top swivel pin bush housing assembly. Discard thrust washer.
    From 1991 model year on, discard two thrust washers and bearing.

37. If worn, pitted or damaged, renew swivel pin bearing housing.
38. Fit a new lower swivel pin bearing track.
39. Fit a new bush and bush housing. Ensure relieved lip of bush housing faces towards rear, as shown.



RR3841M

40. With seal lips trailing press axle shaft oil seal flush into rear of housing. Grease lips.
41. Fit a new thrust washer into top swivel pin bush with black P.T.F.E. coating uppermost. Check it is in position when fitting top swivel pin.
    From 1991 model year fit new thrust washers and thrust bearing.

42. Hang swivel pin bearing housing oil seal and retainer plate over back of housing. Ensure they are in correct assembly order.
43. Fit a new joint washer and secure swivel pin bearing housing to axle. Starting with top fixing dowel bolt. Tighten to ***72Nm.***

Fit swivel pin housing

44. Grease and fit lower swivel pin bearing to bearing housing.
45. Place swivel pin housing in position over swivel pin bearing housing.
46. Using a new joint washer, fit lower swivel pin with lip outboard. Do not secure with screws at this stage.
47. Fit a new sensor bush and new oil seal, lip side leading to top swivel pin.
48. Lubricate with a recommended oil and fit top swivel pin with existing shims.
49. Coat threads of top swivel pin bolts with Loctite 542. Fit bolts and jump hose bracket (do not tighten).

50. Coat threads of lower swivel pin screws with Loctite 270 and fit, together with damper and shield bracket. Tighten to ***25Nm.***
51. Tighten top swivel pin and brake jump hose bracket securing bolts to ***65Nm.***

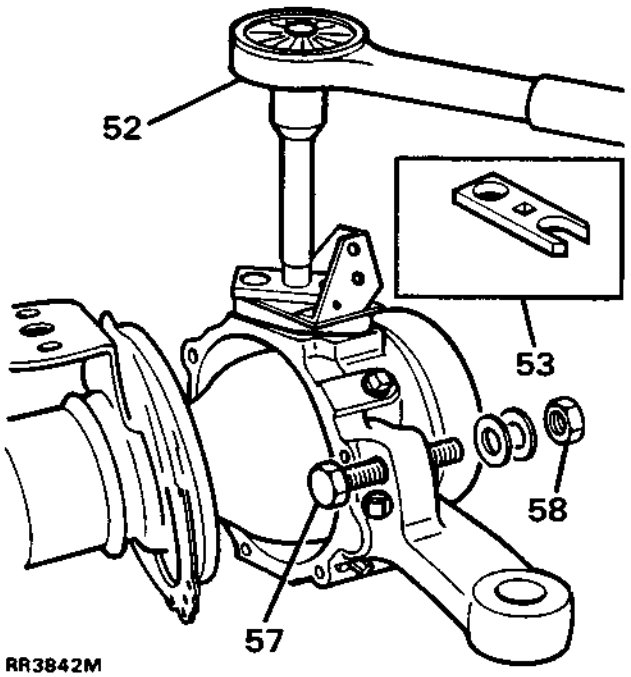
Check and adjust preload on bearings 1990 model year with ABS.

52. The preload on bearings to be **0,18 to 0,23 mm, without** swivel housing oil seal and axle fitted, and reading from centre of swivel pin. The torque required to turn swivel assembly from lock to lock to be **5.1 to 7.3 Nm.** Adjust by removing or adding shims as necessary.

Check and adjust preload on bearings 1991 model year on with ABS.

The preload on bearings to be **0,25 to 0,30 mm, without** swivel housing oil seal and axle fitted, and reading from centre of swivel pin. The torque required to turn swivel assembly from lock to lock to be 2.0 to 2.8 Nm. Adjust by removing or adding shims as necessary.

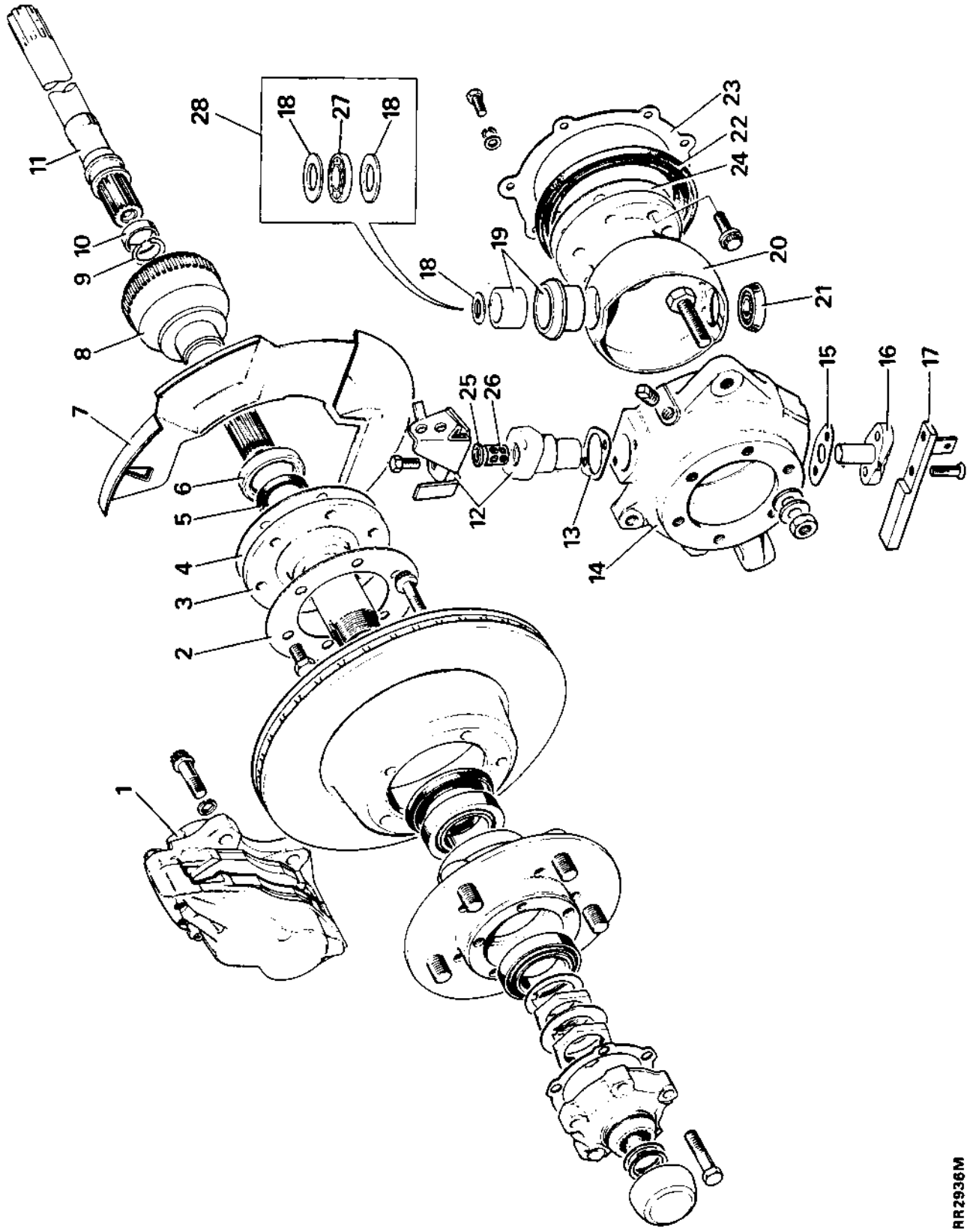
53. To take a reading use special tool LRT-57-024 torque test adaptor, with a torque spanner and extension as shown.



RR3842M

FRONT HUB AND SWIVEL COMPONENTS

1. Brake caliper.
2. Mud shield.
3. Stub axle.
4. Joint washer.
5. Oil seal.
6. Bearing.
7. Brake disc shield.
8. Constant velocity joint.
9. Circlip.
10. Bush.
11. Inner propeller shaft.
12. Top swivel pin and jump hose bracket.
13. Shim.
14. Swivel pin housing.
15. Joint washer.
16. Lower swivel pin.
17. Damper and shield bracket.
18. Thrust washer.
19. Bush and housing.
20. Swivel pin bearing housing.
21. Lower swivel pin bearing.
22. Oil seal.
23. Oil seal retaining plate.
24. Joint washer.
25. Oil seal.
26. Sensor bush.
27. Thrust bearing.
28. 1991 model year on.


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RR2936M

Fit remaining components

54. Apply a recommended grease between lips of swivel housing oil seal.
55. Secure oil seal with retaining plate and securing bolts. Tighten to ***11Nm.***
56. Fit track-rod and drag link and secure with new split pins.
57. Loosely fit lock stop bolt for later adjustment.
58. Fit brake disc shield. Leaving middle fixing nut loose until lock stop has been set.

Fit propeller shaft and stub axle

59. Insert axle shaft, and when differential splines are engaged, push assembly in fully.



CAUTION: Take care not to damage axle shaft oil seals.

60. Place a new joint washer in position on swivel pin housing to stub axle mating face. Coat threads of stub axle bolts with Loctite 270.
61. Fit stub axle with keyway at 12 o'clock position.



CAUTION: Ensure that constant velocity joint bearing journal is butted against thrust ring on stub axle. Before stub axle is secured.

62. Place mud shield in position and secure stub axle to swivel pin housing with six bolts and tighten evenly to ***65Nm.***
63. Fit brake jump hoses to brake jump hose bracket.
64. Fit front hub complete assembly. ***See Repair, Front hub assembly ABS***
65. Check swivel pin housing oil drain plug is fitted.
66. Fill swivel assembly to correct level, with new oil. ***See SECTION 10, Maintenance, Under Vehicle Maintenance***
67. Set steering lock stop bolts to provide a clearance of 20mm. ***See STEERING, Adjustment, Steering lock stops***
68. Fit ABS brake sensor. ***See BRAKES, Repair, Sensors-front***

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

Nm

FRONT AXLE

Hub driving shaft to hub	4
Brake disc to hub	73
Stub axle to swivel pin housing	65
Brake caliper to swivel pin housing	82
Upper swivel pin to swivel pin housing	78*
Lower swivel pin to swivel pin housing	78*
Oil seal retainer to swivel pin housing	11
Swivel bearing housing to axle case	73*
Pinion housing to axle case	41
Crown wheel to differential housing	58
Differential bearing cap to pinion housing	90
Differential drive flange to drive shaft	47
Mudshield to bracket lower swivel pin	11
Bevel pinion nut	130
Draglink to hub arm	40
Panhard rod to axle bracket	88
Radius arm to axle	190
Radius arm to chassis side member	190

FRONT AXLE ABS

Hub driving member to hub	65*
Brake disc to hub	73*
Stub axle to swivel pin housing	65*
Brake caliper to swivel pin housing	82
Upper swivel pin to swivel pin housing	65
Lower swivel pin to swivel pin housing	25*
Oil seal retainer to swivel pin housing	11
Swivel pin bearing housing to axle case	73*
Disc shield to bracket lower	9

NOTE: * These bolts to be coated with Loctite 270 prior to assembly.

Torque values below cover all screws and bolts used, unless specified otherwise.

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

FRONT HUB AND SWIVEL DATA

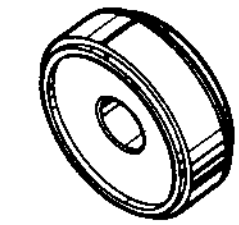
Front hub

Front hub end float non ABS	0,013 to 0,10 mm
Front hub end float with ABS	0,013 to 0,05 mm
Drive shaft end play with ABS	0,08 to 0,25 mm

Swivel pin bearing preload

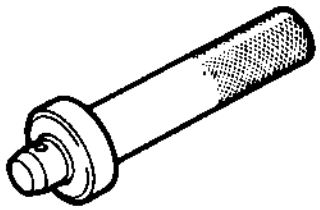
1990 model year vehicles with ABS	
- Torque to turn	5. to 7.Nm
1991 model year on with ABS - Torque to turn	2. to 3.Nm
Non ABS vehicles - Resistance to turn	1,16 to 1,46Kg

FRONT HUB



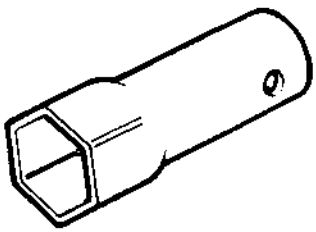
LST 5505

LRT-54-001 Oil seal replacer non ABS
LST550-5



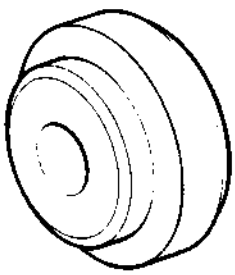
18G134

LRT-99-003 Drift
18G134



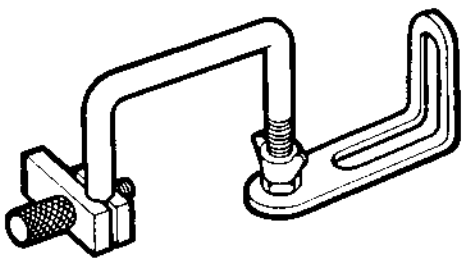
606435A

LRT-54-002 Hub nut wrench
RO606435A



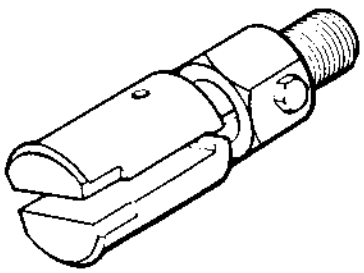
LST137

LRT-54-003 Hub oil seal replacer ABS
LST137



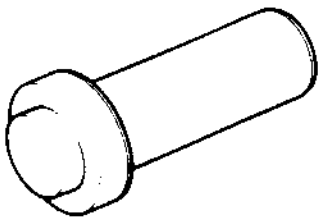
RO530106

LRT-99-503 Dial gauge bracket
RO530106



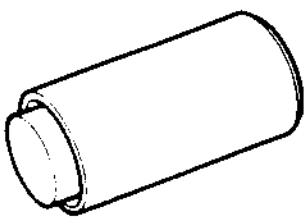
8G284AAH

LRT-37-004 Extractor ABS
18G284AAH



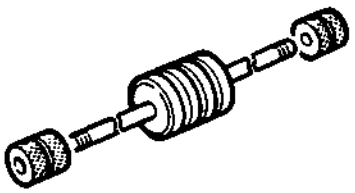
LST132

LRT-54-005 Bearing installer ABS
LST132



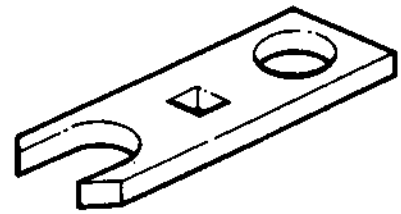
LST133

LRT-54-004 Seal installer ABS
LST133



MS284

LRT-99-004 Impulse extractor
MS284



LST141

LRT-570-024 Torque test adaptor ABS
LST141

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SERVICE TOOLS

POWER STEERING BOX 1
STEERING WHEEL 4

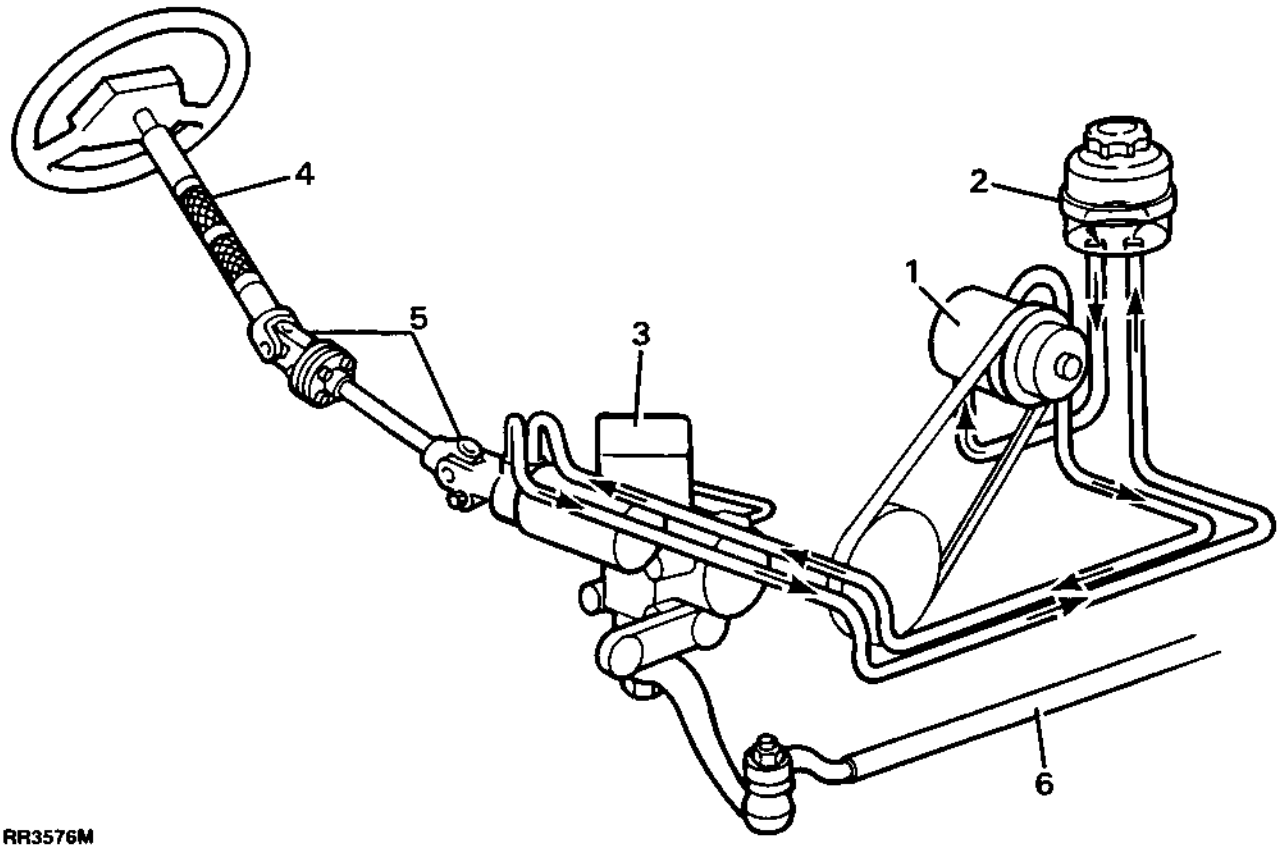
DESCRIPTION

The power assisted steering system incorporates a safety steering column, designed to collapse on impact.
The mis-alignment of the steering column with the steering box and the inclusion of two universal joints in the linkage, is also designed to prevent frontal impact moving the column toward the driver.
The steering box is located behind the second cross member of the chassis and is connected to the road wheels by the drag link and track rod. A hydraulic damper connected between the differential housing and the track rod absorbs shocks in the steering, caused by road wheel deflections when operating on rough terrain.

Power steering system

The power steering system comprises an hydraulic pump which is belt driven from the engine and supplied with fluid from a reservoir that also acts as a cooler.
The steering box houses a self neutralizing rotary valve which is part of the worm/valve assy and an hydraulic piston/rack to assist the mechanical operation.

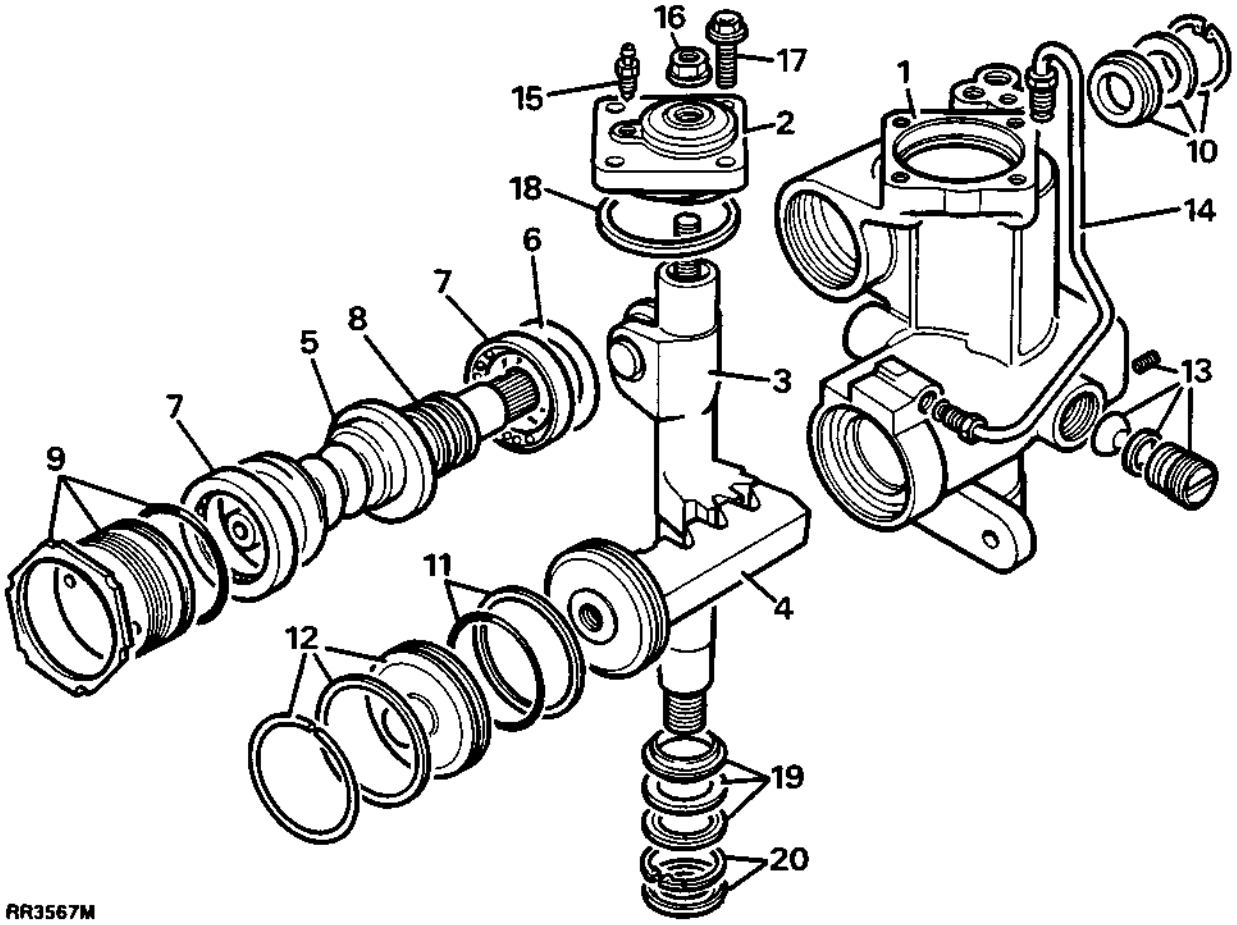
The rotary valve which is operated by movement of the steering wheel, directs fluid pressure to the appropriate side of the hydraulic piston/rack to provide assistance.



RR3576M

Power steering system

1. Hydraulic pump
2. Fluid reservoir
3. Steering box
4. Collapsable column
5. Universal joints
6. Drag link



RR3567M

Power steering box components

1. Housing complete with sector shaft bearings
2. Cover plate complete with bearing
3. Sector shaft
4. Hydraulic piston/rack
5. Worm/valve and torsion bar assembly
6. Shims for centralizing worm/valve
7. Ball race (2)
8. 'Teflon' seals for valve sleeve (3)
9. Bearing adjuster, locknut and seal
10. Worm shaft pressure seal, circlip and dirt excluder
11. 'Teflon' and rubber seal for piston
12. End cover seal and snap ring
13. Adjustment components for piston/rack
14. Hydraulic pipe
15. Bleed screw
16. Sector shaft adjustment lock nut with seal
17. Cover plate bolts (4)
18. Cover plate seal
19. Seal, washer and backup seal
20. Circlip and dust cover

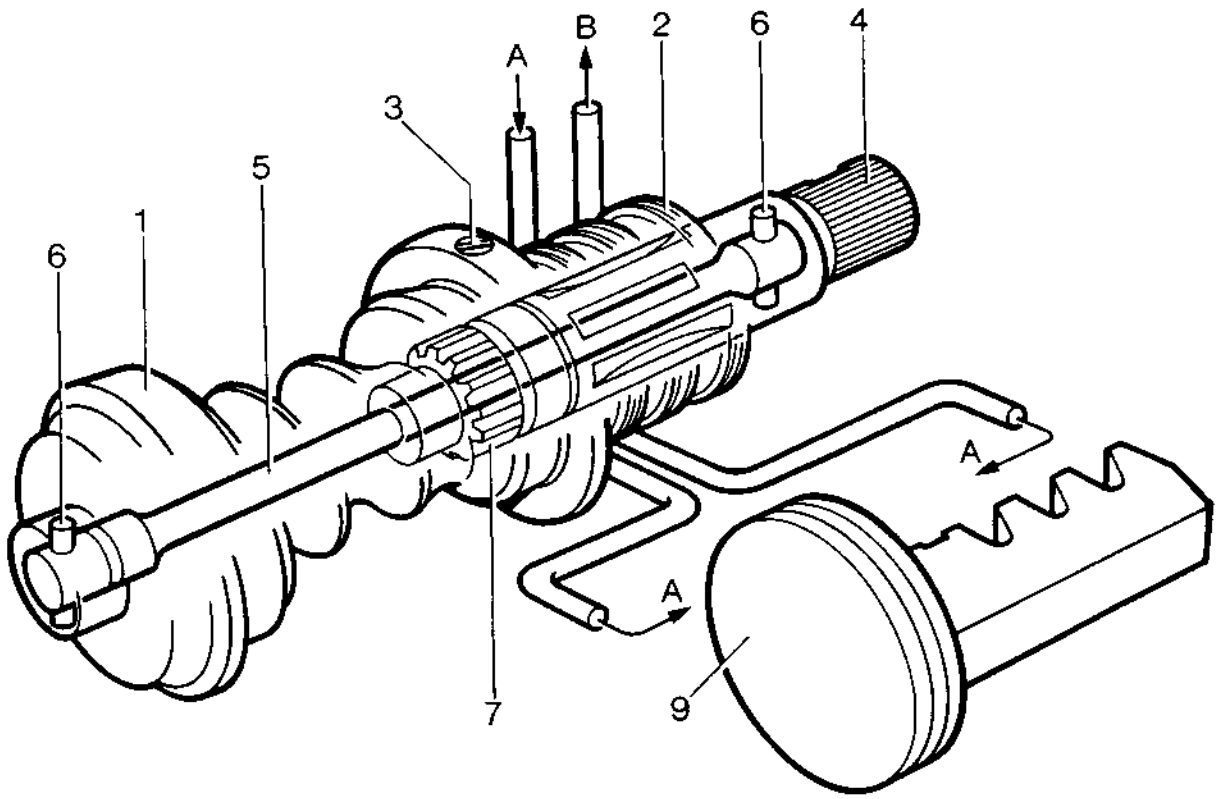
△ **NOTE: Changes to seal arrangements are described in steering box overhaul procedure,** ***See Overhaul, Power steering box***

Rotary valve operation

The rotary valve assembly seen in RR3620M comprises 1 the worm. 2 the valve sleeve which has valve ports in its inner bore is a snug fit into the worm and is retained with the trim screw 3. The input shaft 4 which is attached to the steering wheel via the steering shaft and steering column, also has valve ports on its outer diameter to align with those in the sleeve. The input shaft and sleeve valve ports are held in neutral alignment by the torsion bar 5 which is secured with pins 6 at each end to the worm and input shaft. Note that only one pin, at input shaft is used on later models

No demand for assistance (Valve at neutral)

When there is no demand for assistance as seen in RR3620M, the torsion bar holds the input shaft and sleeve valve ports in neutral relationship to one another, allowing equal pump pressure A to both sides of the piston/rack 9. Any excess fluid flow from the the pump returns to the reservoir via B.



RR3620M

Rotary valve at neutral

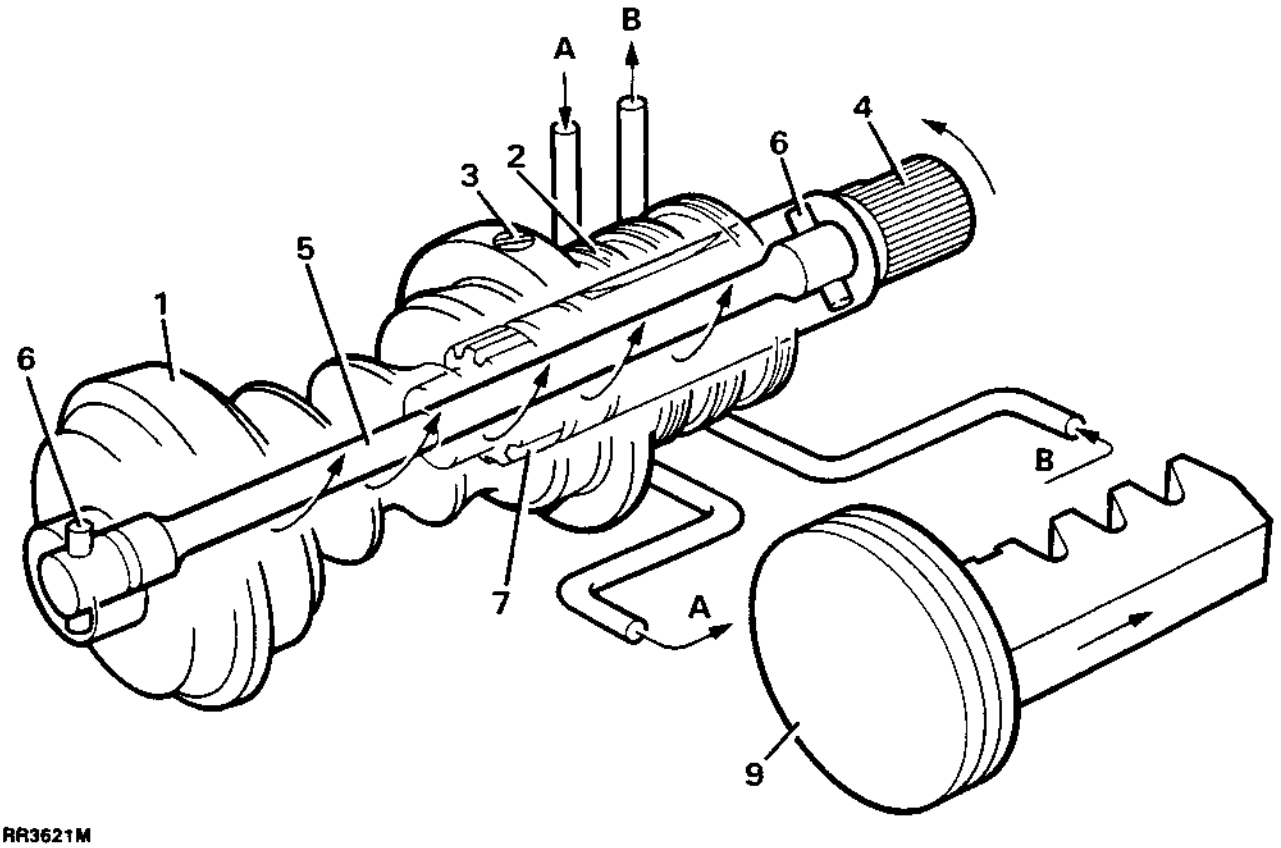
Demand for assistance (Valve misaligned)

When the steering wheel and input shaft is turned, steering resistance transmitted to the worm causes the torsion bar to be twisted and the valve ports to be misaligned for a right or left turn. The misalignment of the valve ports directs all fluid pressure A to one side of the piston only and allows displaced fluid B on the other side.

When demanding maximum assistance, any excessive fluid output from the pump due to high pump speed, will circulate through the regulator valve located in the pump unit, causing the temperature of the fluid and the pump to rise rapidly.
To avoid excessive fluid temperatures which could damage the oil seals, the steering must not be held on full lock for more that 30 seconds in one minute.

Only when the steering wheel and the demand for assistance is released, will the torsion bar return the valve to neutral, allowing the fluid to circulate through the reservoir where it is cooled.

In the unlikely event of mechanical failure of the torsion bar, a coarse splined connection 7 between the input shaft and worm, ensures steering control is maintained sufficient to allow the vehicle to be recovered.



RR3621M

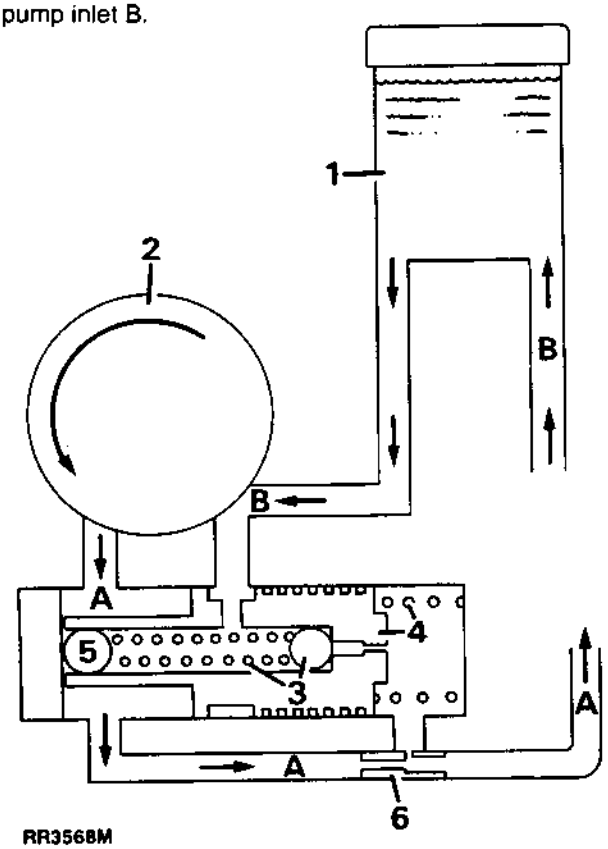
Rotary valve misaligned

Pump and regulator valve operation

The pump which is belt driven from the engine is an eccentric roller type and also houses the pressure regulator and flow control valve. The pressure is controlled by a spring loaded ball valve 3 which is housed inside the flow control valve piston 4.

No demand for assistance High flow through box - Low pressure

With no demand for assistance as illustrated in RR3568M the rotary valve in the steering box acts as a pressure relief valve, allowing fluid A to flow freely through the steering box and back to the reservoir and pump inlet B.



RR3568M

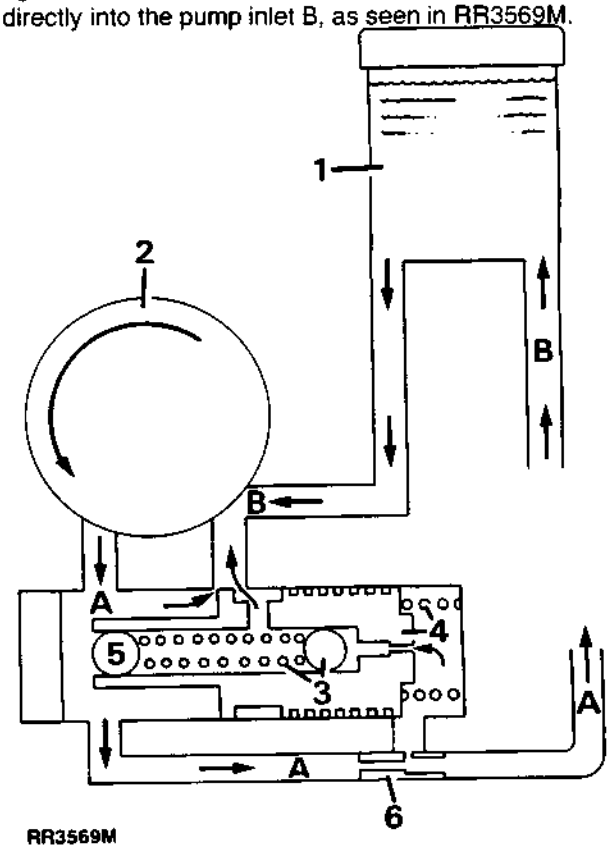
No demand for assistance

1. Reservoir
2. Pump
3. Pressure control ball valve and spring
4. Flow control valveand spring
5. Press fit plug (ball bearing)
6. Restrictor

The ball plug item 5 is pressed into the valve 4 during manufacture and determines the opening pressure of pressure relief valve 3.

No flow, through box - High pressure

When the steering is turned, the rotary valve effectively stops all fluid flow through the steering box, thus causing an increase in pressure A. This increase in pressure is felt in the flow control valve spring chamber where, at a pre-determined pressure the relief valve 3 will open and allow the pressure to escape. The fall in pressure in the flow control spring chamber, allows the flow control valve to move to the right, which in turn allows pump output A to escape directly into the pump inlet B, as seen in RR3569M.



RR3569M

Assistance demanded

As soon as the steering wheel is released after making a turn, the system reverts to the condition seen in RR3568M and the road wheels are returned to the straight ahead position by the mechanical steering geometry.

In the event of any hydraulic failure steering control though heavy, will be maintained through the mechanical components in the steering box.

Notes

FAULT DIAGNOSIS

INSUFFICIENT POWER ASSISTANCE

1. Is fluid level correct?
   YES - go to 3.
   NO - Fill/bleed sytem

2. Is problem a leak?
   YES - Diagnose ***See power steering fluid leaks***
   NO - continue

3. Is drive belt tension correct?
   YES - go to 5.
   NO - retension ***See Adjustment, power steering pump drive belt***

4. Is problem resolved?
   YES - end
   NO - continue

5. Carry out pressure test at idle and 1000 rev/min, ***See power steering system - test***

6. Is correct pressure achieved?
   YES - steering box defective
   Not at any speed go to 9.
   Not at idle go to 7.

7. Is idle speed correct?
   YES - Go to 8.
   NO - Correct idle speed, ***See ENGINE TUNING DATA, Information, ENGINE 3.9 V8***

8. Is problem resolved?
   YES - end
   NO - go to 9.

9. Bypass steering box using adaptor tap LRT-57-001

10. Is correct pressure obtained?
    YES - defective steering box
    NO - defective steering pump

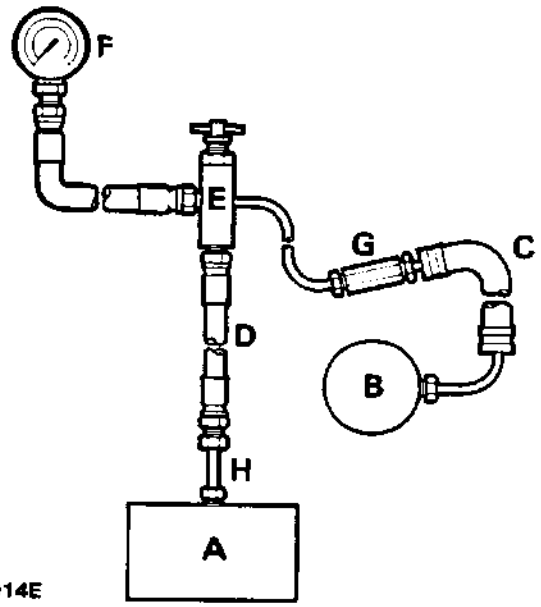
CAUTION: Do not hold steering wheel on full lock for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

NOTE: 1. Excessive pressure in the system is almost always caused by a faulty relief valve in the PAS pump.

NOTE: 2. Insufficient pressure in the system is usually caused by low fluid level or PAS pump drive belt slip, or one of the following: PAS system leaks, faulty PAS pump relief valve, fault in steering box valve and worm assembly, leak at piston in steering box, worn components in PAS pump or box.

POWER STEERING SYSTEM - TEST

NOTE: If steering lacks power assistance. Check pressure of hydraulic pump before fitting new components. Use fault diagnosis chart to assist in tracing faults.



RR1914E

A. Steering box.
B. Steering pump.
C. Existing hose, steering box to pump.
D. Hose LRT-57-002.
E. Test adaptor LRT-57-001.
F. Pressure gauge LRT-57-005.
G. Thread adaptor LRT-57-004.
H. Thread adaptor LRT-57-004.

Procedure

1. A hydraulic pressure gauge and test adaptor is used to test power steering system. This gauge is able to measure 140 kgf/cm^2. The maximum power steering system pressure is 77 kgf/cm^2.
2. Some fault conditions of hydraulic pump may obtain pressures up to 105 kgf/cm^2. Pressure on gauge is same pressure being exerted upon steering wheel. When testing, turn steering wheel gradually while reading pressure gauge.
3. Check and maintain maximum fluid level of reservoir.
4. Examine power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.
5. Check steering pump drive belt tension. ***See Adjustment, Power steering pump drive belt***
6. Assemble test equipment and fit to vehicle, as shown in RR1914E.
7. Open tap of adaptor.
8. Bleed system, take care not to overload pressure gauge.
9. With system in good condition, pressures should be:

   (A) Steering wheel held on full lock and engine running at 1,000 rev/min, 70 to 77 kgf/cm^2.
   (B) Steering wheel held on full lock and engine idling, 28 kgf/cm^2.

Checks should be carried out on both full lock positions.

CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

10. Release steering wheel and with engine idling. Pressure should read below 7 kgf/cm^2.
11. If pressures differ to those given a fault exists.
12. To determine if fault is steering box or pump. Close adaptor tap for a maximum five seconds.
13. If gauge does not register specified pressure, pump is faulty.
14. Fit a new pump, bleed system and repeat test. If low pressure or a substantial imbalance exists, fault is in steering box valve and worm assembly.

STEERING DAMPER

The power steering system, as well as reducing the effort required to manoeuvre the vehicle when parking, also helps to dampen any deflections of the road wheels, being transmitted back to the steering wheel.

When operating the vehicle off road, the road wheels are often deflected by ruts and boulders causing the steering wheel to turn left and right. This phenomenon is known as 'steering kickback'. To subdue the effects of 'steering kickback', a hydraulic damper is fitted in the steering linkage between the track rod and the differential casing. The damper, which offers the same resistance in extension and compression, is sealed for life.

Steering damper check

Check the condition operation of the hydraulic steering damper as follows:

Check procedure

1. Inspect damper for casing damage or leaks.
2. Clamp one end of the damper horizontally in a vice using soft jaws. Compress and extend the unit by hand. Resistance should be equal in both directions.
3. If it is felt that the unit is outside acceptable limits, fit a new steering damper

STEERING FAULTS

Symptom:-

Excessive kickback through steering wheel - when driven on rough terrain.

1. Is the steering damper in good working order? ***See Steering damper***
   NO - Renew unit. ***See Repair, Steering damper***
   YES - Continue.

2. Is there any looseness or free play in the steering ball joints and linkage.
   YES - ***See Steering Linkage Inspect***
   NO - Continue.

3. Is there any looseness or worn bushes in front suspension?
   YES - ***See FRONT SUSPENSION, Repair, Radius Arm***

   △ **NOTE: When replacing suspension bushes ALL bushes and fixings must be replaced.**
   NO - Continue.

4. Is the steering exceptionally light/sensitive when driven on good road surface?
   YES - See fault symptom - **Steering excessively light/sensitive and freeplay at steering wheel.**
   NO - Suspect axle swivel resistance.

5. Check the resistance of the axle swivels. ***See FRONT AXLE AND FINAL DRIVE, Overhaul, Stub Axle, Axle Shaft, Constant Velocity Joint and Swivel Pin, non ABS See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel with ABS***

Symptom:-

Fluid leaks from steering box seals.

⚠ **CAUTION: The steering wheel must not be held on full lock for more than 30 seconds in one minute, as this may overheat the fluid and cause damage to the oil seals.**

1. Check fluid level. ***See Repair, Power steering fluid reservoir***

2. *Check fluid pressure.* ***See Power Steering System - Test***

3. *Is pressure high?.*
   YES - Renew pump. ***See Repair, Steering pump***

   If oil seal leaks persist after renewing the pump. ***See Overhaul, Power steering box***
   NO - ***See Overhaul, Power steering box***

Symptom:-

Insufficient power assistance - castor return action normal.

1. Are tyres correct type and pressure?.
   NO - ***See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres***
   YES - Continue.

2. Is fluid level correct?
   NO - Check fluid level ***See Repair, Power steering fluid reservoir***
   YES - Check system for air locks. ***See Repair, Power steering system - bleed***

3. *Is pressure correct?*
   NO - Check fluid pressure. ***See Power Steering System - Test***

   If pressure is not correct after bleeding the system, renew pump. ***See Repair, Steering pump***
   YES - ***See Overhaul, Power steering box***

Symptom:-

Steering heavy - stiff, poor castor return action.

1. Are tyres correct type and pressure?
   NO - ***See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres***
   YES - Check column universal joints for seizure and correct alignment. ***See Repair, Lower steering shaft and universal joints pre 1991 See Repair, Lower steering shaft and universal joints 1991 onward***

   Check power steering box adjustments. ***See Overhaul, Power steering box***

2. *Is the power assistance satisfactory?*
   NO - See fault symptom **Insufficient assistance, (castor return action normal).**
   YES - Disconnect drag link from drop arm and check steering column and box for stiffness. ***See Repair, Drag link and drag link ends***

3. *Is the steering stiff with the drag link disconnected?*
   NO - Check steering ball joints for seizure and axle swivels lubrication and resistance. ***See Repair, Drag link and drag link ends See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel with ABS See FRONT AXLE AND FINAL DRIVE, Overhaul, Stub Axle, Axle Shaft, constant Velocity Joint and Swivel Pin, Non ABS***
   YES - Disconnect the lower steering shaft and check the column and box for stiffness. ***See Repair, Lower steering shaft and universal joints pre 1991 See Repair, Lower steering shaft and universal joints 1991 onward***

4. *Is the steering column stiff to turn when disconnected from the box?*
   NO - Remove and overhaul box. ***See Overhaul, Power steering box***
   YES - Adjust steering column. ***See Stiff steering checklist***

Symptom :-

Steering excessively light/sensitive. Excessive freeplay at steering wheel.

1. Are steering box adjustments correct?
   NO - ***See Adjustment, Power steering box***

WARNING: Adjustments of steering box should not be required while in warranty period. If box is within warranty, it must be returned to manufacturers. No attempt must be made to introduce backlash.

   YES - Suspect worn panhard rod or radius arm bushes Check condition of ball joints and the lower steering column shaft universal joints for wear. ***See Repair, Lower steering shaft and universal joints pre 1991 See Repair, Lower steering shaft and universal joints 1991 onward***

Symptom :-

Steering vibration, road wheel shimmy - wobble.

Vibration through the steering linkage powerful enough to induce high frequency oscillation of the steering wheel, is generally caused by out of balance road wheels. However there are a number of other possible causes of this symptom which if severe, may be described as shimmy or wobble. Regardless of the terminology used by the owner/driver to describe the symptoms, the following diagnostic checks should be carried out in the order presented.

1. Check the tyres and balance of the road wheels. ***See GENERAL SPECIFICATION DATA, Information, Wheels and tyres See WHEELS AND TYRES, Fault diagnosis, Fault - Symptoms See WHEELS AND TYRES, Repair, Wheel balancing***

2. Check the steering hydraulic damper function. ***See Steering damper***

3. Check steering column universal joints for wear and correct alignment. ***See Repair, Lower steering shaft and universal joints pre 1991 See Repair, Lower steering shaft and universal joints 1991 onward***

4. Check steering linkage ball joints for wear, correct alignment and security, including steering box and tie rod. ***See Steering Linkage Inspect***

5. Check all front suspension rubbers for wear. Check all fixing torques, including radius arm bushes, panhard rod and anti-roll bar. ***See FRONT SUSPENSION, Repair, panhard rod See FRONT SUSPENSION, Repair, radius arm See FRONT SUSPENSION, Repair, anti-roll bar front See FRONT SUSPENSION, Repair, Front shock absorber***

6. Fit new radius arm bushes using NTC 6860. Fit harmonic damper if vehicle has air suspension. Fit new nuts, bolts and washers.

7. **Coil spring vehicles only** - If problem persists fit damper kit STC 241 (2 off front and STC 242 (2 off rear)). Road test vehicle.

8. Check the power steering box adjustments and operation. ***See Overhaul, Power Steering Box***

9. Check the hub bearing end floats and determine the condition of the hub bearings. As applicable. ***See FRONT AXLE AND FINAL DRIVE, Repair, Front hub assembly abs See FRONT AXLE AND FINAL DRIVE, Repair, Front hub assembly non abs***

10. Check the resistance and condition of the swivels. ***See FRONT AXLE AND FINAL DRIVE, Description and operation, Description***
    If problem is not diagnosed: Repeat checks starting at 1.

11. Carry out a full steering geometry check. ***See GENERAL SPECIFICATION DATA, Information, Steering***

STEERING STABILITY AND VEER UNDER BRAKING

Possible cause:

Incorrectly set, swivel pin bearing preload. There are three different settings for these bearings dependant on model year and if fitted with ABS brakes.

Remedy.

1. Establish model year of vehicle.
2. If fitted with or without antilock brakes.
3. Follow instructions to overhaul front stub axle, constant velocity joint and swivel pin non ABS, or with ABS as appropriate.
   See FRONT AXLE AND FINAL DRIVE, Overhaul, Stub axle, axle shaft, constant velocity joint and swivel pin non ABS
   or ***See FRONT AXLE AND FINAL DRIVE, Overhaul, Front stub axle, constant velocity joint and swivel with ABS***

DIAGNOSTIC CHARTS

1. GENERAL STEERING

1. Carry out visual and safety checks ***See Visual and safety checks***
2. Road test vehicle ***See Road test procedure***
3. Is problem resolved?
   YES - end
   NO - continue
4. Is problem stiff steering
   YES - ***See stiff steering check list***
   NO - Go to 6.
5. Is problem resolved?
   YES - end
   NO - go to 8.
6. Is problem steering niggle
   YES - Replace radius arm bushes, arm and axle
   See FRONT SUSPENSION, Repair, radius arm
   Fit NTC 6860 to coil spring Range Rovers. Fit RTC 6860 plus harmonic damper kit 6825 to air suspension Range Rovers.
   NO - go to 8.
7. Is problem resolved?
   YES - end
   NO - continue.
8. Carry out visual check and basic adjustments.
   See visual check and basic adjustments
9. Is problem resolved?
   YES - end
   NO - continue.
10. Centralise steering box ***See Adjustment, Centralise steering box***
11. Is problem resolved?
    YES - end
    NO - continue.
12. Check, adjust if necessary, steering geometry.
13. Is problem resolved?
    YES - end
    NO - continue.
14. Categorise the remaining problems into one or more of the following descriptions:
    See 2. STEERING VEER
    See 3. VEER UNDER BRAKING
    See 4. DIRECTIONAL STABILITY

2. STEERING VEER

From 1. GENERAL STEERING:

1. Vehicle veers, not under braking, swap front tyres side to side.
2. Is problem resolved?
   YES - end
   NO - continue.
3. Does vehicle now veer in other direction?
   YES - fit new tyres
   NO - continue.
4. Recentralise steering box ***See Adjustment, Power Steering Box***
5. Is problem resolved?
   YES - end
   NO - contact local technical office.

3. VEER UNDER BRAKING

From 1. GENERAL STEERING:

1. Vehicle veers under braking, bleed brake system.

NOTE: Power bleed is recommended.

2. Is problem resolved?
   YES - end
   NO - continue.

3. Check brake pads for glazing, and discs, axles etc for contamination.

4. Is problem resolved?
   YES - end
   NO - continue.

5. Check brake lines and hoses for deterioration. Replace as necessary.

6. Is problem resolved?
   YES - end
   NO - continue.

7. Contact local technical office.

4. DIRECTIONAL STABILITY

From 1. GENERAL STEERING:

1. Is directional stability concern when vehicle is towing?
   YES - Check towing/vehicle loading parameters in Owner's Handbook.
   NO - go to 3.

2. Is problem resolved?
   YES - end
   NO - continue.

3. Check condition of rear trailing link/chassis bushes. Fit STC 618 axle set if replacing.

4. Is problem resolved?
   YES - end
   NO - continue.

5. Check condition of front and rear shock absorbers. If in doubt change units in pairs, side to side.

6. Is problem resolved?
   YES - end
   NO - continue.

7. Check steering damper ***See Steering damper***

8. Is problem resolved?
   YES - end
   NO - continue.

9. Check wheel balance

10. Is problem resolved?
    YES - end
    NO - contact local technical office.

POWER STEERING FLUID LEAKS

1. Is fluid level correct?
   YES - go to 3.
   NO - Refill or drain to correct level. Bleed system, check for leaks.

2. Is problem resolved?
   YES - end
   NO - continue.

3. Are hoses or joints leaking? Check on full lock with engine at 2000 rev/min.
   YES - slacken and retorque joints.
   NO - go to 6.

4. Does leak remain?
   YES - change PAS pipe.
   NO - end.

5. Does leak remain?
   YES - suspect seal in in component. Check and replace as necessary.
   NO - end.

6. Is oil escaping from filler cap?
   YES - bleed system ***See Repair, power steering system - bleed***
   NO - go to 8.

7. Is oil still escaping from filler cap?
   YES - go back to 1.
   NO - end.

8. Is oil leaking from PAS pump?
   YES - go to 10.
   NO - continue.

9. Is oil leaking from PAS box?
   YES - go to 10.
   NO - end.

10. Clean unit, add tracer dye to system. Retest

11. Is oil still leaking?
    YES - establish leak point. Repair or replace unit as necessary.
    NO - end.

POWER STEERING SYSTEM - EXCESSIVE NOISE

1. Is fluid level correct?
   YES - go to 3.
   NO - Refill or drain to correct level. Bleed system, check for leaks.

2. Is problem resolved?
   YES - end
   NO - continue.

3. Is pressure hose from pump to box touching body in a hard foul condition?
   YES - reroute hose away from body.
   NO - go to 5.

4. Does noise remain?
   YES - continue.
   NO - end.

5. Is noise a whistle or hiss on full lock?
   YES - noise is not a fault unless excessive. Compare with other vehicles
   NO - go to 8.

6. Is noise excessive?
   YES - continue.
   NO - end.

7. Change steering box and/or pump.

8. Is noise a squeal on full lock?
   YES - check/reset drive belt tension, using tension gauge.
   NO - go to 10.

9. Does squeal remain?
   YES - drive belts contaminated, change belts.
   NO - end.

10. Is noise a continuous moan?
    YES - bleed PAS system.
    NO - go to 13.

11. Does moan remain?
    YES - do figure 8 manouevres e.g. on car park.
    NO - end.

12. Does moan remain?
    YES - continue
    NO - end.

13. Is noise an intermittent "grunt"?
    YES - ***See power steering system "grunt"***
    NO - continue.

14. Is it a clunking noise?
    YES - reset drive belt tension, using tension gauge.
    NO - contact local technical office.

15. Does noise remain?
    YES - Suspect suspension or drive train.
    NO - end.

POWER STEERING SYSTEM "GRUNT"

Steering box grunts intermittently when turning from lock to lock:

1. Is fluid level correct?
   YES - go to 3.
   NO - refill or drain to correct level. Bleed system, check for leaks.

2. Does grunt remain?
   YES - continue
   NO - end.

3. Is correct high pressure hose, pump to box fitted? Diesel NTC 1881, V8 ANR 1887 (Right hand drive only).
   YES - go to 5.
   NO - Fit correct hose.

4. Does grunt remain?
   YES - continue
   NO - end.

5. Purge box by doing figure 8 manouevres e.g. on car park, followed by 10 minutes normal road use.
6. Does grunt remain?
   YES - Contact local technical office
   NO - end.

VISUAL AND SAFETY CHECKS

WARNING: Before taking vehicle out on the public highway for road test, it is important that the following basic visual checks are carried out to ensure that the vehicle complies with legal requirements.

Tyres and wheel rims

1. Check and adjust tyre pressures ***See GENERAL SPECIFICATION DATA, Information, tyre pressures***
   Note that this information refers to standard tyres fitted as original equipment.

2. Check condition of tyres. Inspect for signs of uneven wear, damage and feathering. Check tread depth.

3. Ensure that the tyre make, type and general condition are common across each axle.

4. Check wheel rims for signs of damage and excessive run out.

5. Carry out road test ***See road test procedure***

ROAD TEST PROCEDURE

General steering/handling problems can usually be classified into one of the categories listed and ARE GENERALLY RELATED TO THE AGE, CONDITION AND USE OF THE VEHICLE.

WARNING: Ensure that all road tests are conducted by suitably qualified drivers in a safe and legal manner, and where local traffic conditions allow.

1. Carry out visual and safety checks. ***See visual and safety checks***

Confirm general nature of complaint with customer, simulating where possible the conditions under which the problem occurs. Carry out following road test procedure to establish the problem.

2. Steering load assessment - drive at 16 km/h (10 mph). Put 90° turn input into steering wheel, check self centering. The self centering should be equal on each lock BUT not necessarily return to exactly straight ahead without assistance from the driver.

3. Steering assessment - drive at 64 km/h (40 mph) on a staight FLAT road (no camber), check for steering veer. The vehicle should follow a straight path with NO tendency to follow a curved path. If vehicle veers towards the kerb, vehicle may be 'camber sensitive'. A small amount of veer in direction of camber is acceptable.

4. Directional stability assessment - drive at 112 km/h (70 mph) or maximum legal speed on a straight flat road. Carry out a normal lane change. Vehicle should quickly settle into a new straight path.

5. Braking assessment (medium effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply steady medium braking effort, noting any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.

6. Braking assessment (full effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply full braking effort, noting any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.

If the symptom described by the customer is stiff steering or steering niggle, carry out stiff steering procedure ***See Stiff steering checklist***

If not proceed with basic checks and adjustments ***See Visual check and basic adjustments***

STIFF STEERING CHECKLIST

NOTE: Having completed visual checks and steering assessment and confirmed that vehicle steering load is incorrect carry out the following procedure in order shown.

Steering wheel 'torque to turn' loads

1. Raise vehicle with both front wheels free.
2. With engine off, centralise steering wheel. Remove steering wheel cover. Using torque wrench on column nut, check torque required to turn the steering wheel one turn in each direction.
3. Record readings obtained in each direction. Compare figures obtained with the specified figures:

Range Rover with ABS ***5.65 Nm.***

Range Rover non-ABS and Discovery ***4.40 Nm.***

NOTE: If figures are in excess of those specified carry out steering box tie bar reset below. If figures are as specified, *See Visual check and basic adjustments*

Steering box tie bar reset

1. Loosen the three tie bar fixings one complete turn.
2. Drive vehicle carefully a short distance (within the dealership) applying full lock in both directions in order to settle steering components. Drive vehicle over speed bumps and include harsh braking if possible.

WARNING: DO NOT DRIVE ON PUBLIC HIGHWAY.

3. Near end of 2. ensure vehicle is driven in a straight line on level ground and halted.
4. Tighten panhard rod mounting arm nut, ***110 Nm.***
5. Tighten the two fixings tie bar to steering box, ***81 Nm.***
6. Recheck steering wheel torque to turn. If torque reading is still greater than specified carry out steering shaft u/j lubrication

Lower steering shaft universal joint lubrication

1. Check lower steering shaft is correctly phased, ***See Repair, Lower steering shaft and universal joints pre 1991 See Repair, Lower steering shaft and universal joints 1991 onward***
2. Lubricate universal joints with an anti-seizure type penetrating spray. Work the joints to ensure full penetration of the spray by driving vehicle and steering from lock to lock.
3. If steering stiffness still persists carry out swivel pin preload setting.

Swivel pin preload setting

The swivel pin preload seting must be checked and set following the workshop manual procedure.

1. NON ABS vehicles ***See FRONT AXLE AND FINAL DRIVE, Overhaul, STUB AXLE, AXLE SHAFT, CONSTANT VELOCITY JOINT AND SWIVEL PIN, NON ABS***
   Note that a pull load of 1.16 - 1.46 kg is required after the axle shaft and swivel housing seal have been removed.
2. 1990 model year ABS vehicles ***See FRONT AXLE AND FINAL DRIVE, Overhaul, FRONT STUB AXLE, CONSTANT VELOCITY JOINT AND SWIVEL WITH ABS***
   Note that a torque to turn of 5.1 - 7.3 Nm is required after the axle shaft and swivel housing seal have been removed.
3. 1991 model year ABS vehicles ***See FRONT AXLE AND FINAL DRIVE, Overhaul, FRONT STUB AXLE, CONSTANT VELOCITY JOINT AND SWIVEL WITH ABS***
   Note that a torque to turn of 2.0 - 2.8 Nm is required after the axle shaft and swivel housing seal have been removed.
4. If steering stiffness still persists carry out steering column alignment.

Steering column alignment

1. Place vehicle on level ground. Measure the angle of lower steering shaft using a Pernumeter placed on the shaft between the universal joints. The angle should measure a minimum of 12°.

2. If necessary, realign the shaft. Release the five fixings securing the steering column. Position column as required. Tighten the fixings evenly, ***27 Nm.***

3. Loosen the two screws nearest steering wheel securing lower steering column shroud to upper shroud. Reposition shroud, tighten fixings.

4. Recheck steering column angle.

Steering box adjustment

1. Check steering box adjustment ***See Adjustment, Power steering box***

Steering damper check

1. Check condition of steering damper ***See steering damper***

VISUAL CHECK AND BASIC ADJUSTMENTS

△ **NOTE: It is important that the following instructions are carried out in the sequence shown and the results recorded.**

1. Road springs - check that road springs are correctly seated and are to correct specification for vehicle. For spring specification ***See GENERAL SPECIFICATION DATA, Information, road spring data***

2. Ride height - measure trim height from wheel centre to wheelarch eyebrow. Record results on data sheet.

3. Check/top up power steering fluid ***See Repair, Power steering fluid reservoir***

4. Check tension and condition of drive belt, ***See Adjustment, power steering pump drive belt*** If using a belt tension gauge the following figures should be obtained:

Run-in belt: 355 - 400 N (80 - 90 lbf)

New belt: 400 - 425 N (90 - 100 lbf)

5. Steering shaft universal joints - check the phasing of the universal joints on vehicles prior to VIN Nos. 601607 (Range Rover) and LJ 002272 (Discovery). Rephase if required, ***See Repair, Lower steering shaft and universal joints pre 1991 See Repair, Lower steering shaft and universal joints 1991 onward***

6. Track rod/draglink - check condition of track rod, drag link and ball joints, ***See Repair, Drag Link and Drag Link Ends*** If either component is damaged, check operation of steering damper and steering box for smoothness. Replace all damaged or worn components that impair the operation of the steering system.

7. Suspension bushes - examine all steering and suspension bushes for signs of wear and deterioration. Also check all fixings for torque relaxation. Tighten to correct torque value, ***See FRONT SUSPENSION, Specifications, torque, torque values***

8. Oil leaks - check front and rear axle hubs for leaks. repair as necessary.

9. Brake system - check brake system for leaks, pipe condition, pad wear/contamination, disc wear/condition and ABS sensors for correct fitting.

10. Hub end float - check movement in the hubs by rocking the wheels.

11. Check front wheel alignment, ensuring toe out is between 0 - 2.0 mm. Note that for vehicles displaying a tendency to veer more than considered allowable, it is permissible to set the front track to parallel.

12. Having completed all the above checks and adjustments, road test vehicle ***See road test procedure***
Attempting to reproduce the symptoms established earlier. If symptoms still exist refer to relevant Diagnostic Chart.

STEERING LINKAGE INSPECT

△ **NOTE: When inspecting steering linkages and ball joints for wear the following items must be checked.**

Steering ball joints

1. Check ball joint rubber boots for security, signs of cracking or deterioration.

2. Check ball joint assemblies for seizure i.e. no movement on ball joint and associated assemblies.

3. Check for excessive wear. This will be evident as extreme movement on track rod and steering linkages. Renew parts as necessary, ***See Repair, track rod and linkage, See Repair, drag link and drag link ends***

Steering linkages

4. Check all linkages for wear, deterioration and damage. Renew parts as necessary, ***See Repair, track rod and linkage See Repair, drag link and drag link ends***

POWER STEERING BOX

Service repair no - 57.10.13.

WARNING: Adjustments of steering box should not be required while in warranty period. If box is stiff or tight and within warranty, it must be returned to manufacturers. No attempt must be made to introduce backlash.

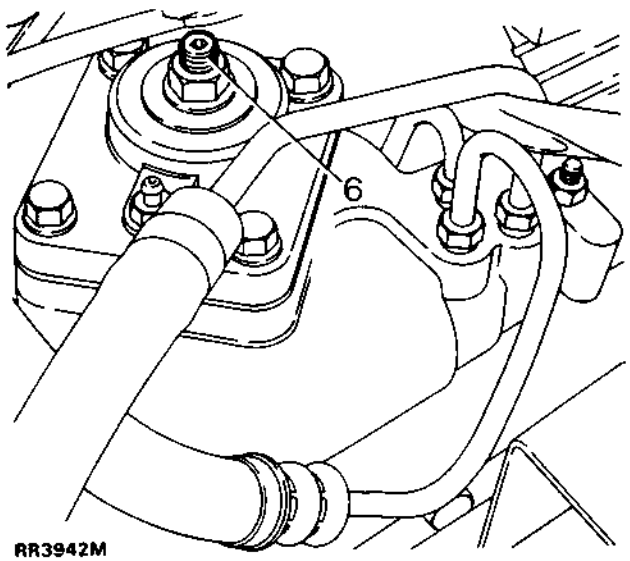
1. Apply park brake, select 'P' in automatic transmission and chock wheels. Support chassis front on axle stands.
2. Remove engine undertray, ***See CHASSIS AND BODY, Repair, Engine undertray***
3. Disconnect drag link from steering drop arm.
4. Check torque to turn, ***See Fault diagnosis, Stiff steering check list***
5. Centralise steering box ***See Centralise steering box.***

NOTE: Only check for no backlash when steering box is in central position.

NOTE: If steering wheel is not straight, it should be repositioned. *See Repair, Steering wheel*

The adjustment of the steering box ensures any preload or end float present on centre is removed.

6. The adjustment is obtained by rocking the drop arm about centre whilst an assistant slowly tightens the steering box adjuster screw.



7. Tighten the locknut when all backlash has been removed.
8. Repeat the check for backlash. If backlash exist slacken locknut and repeat adjustment procedure.
9. Turn steering wheel lock to lock and check no tightness exists.
10. Ensure front wheels are aligned and in straigh ahead position ***See front wheel alignment***
11. Adjust draglink 919 mm between centres if vehicle is prior to November 1991 (drop arm ball joint).Adjust draglink 924 mm between centres if vehicle is post November 1991.
12. Connect drag link and tighten nut to ***40Nm fit new split pin.***
13. Lower vehicle to ground level and remove chocks.
14. Road test vehicle ***See Fault diagnosis, road test procedure***

NOTE: If steering wheel is not in straight ahead position when vehicle is travelling in a straight line, draglink length is incorrect and is pushing drop arm away from central position.

Draglink adjust

15. Right hand drive vehicles - if steering wheel is to right, draglink is too long. If steering wheel is to left draglink is too short. Left hand drive vehicles - if steering wheel is to right, draglink is too short. If steering wheel is to left draglink is too long.
16. Adjust draglink until steering wheel points straight ahead when vehicle is travelling in a straight line.
17. If vehicle has cruise control centralise the cassette ***See Repair, Cruise control cassette centralise***

CENTRALISE STEERING BOX

1. Rotate steering wheel to full left hand lock (right hand drive) full right hand lock (left hand drive). Turn steering wheel back towards centre two full turns.

△ **NOTE: Steering boxes fitted to Range Rover post VIN 615503 and Discovery post VIN 018110 have a pegging feature to enable the steering box to be positively pegged on centre.**

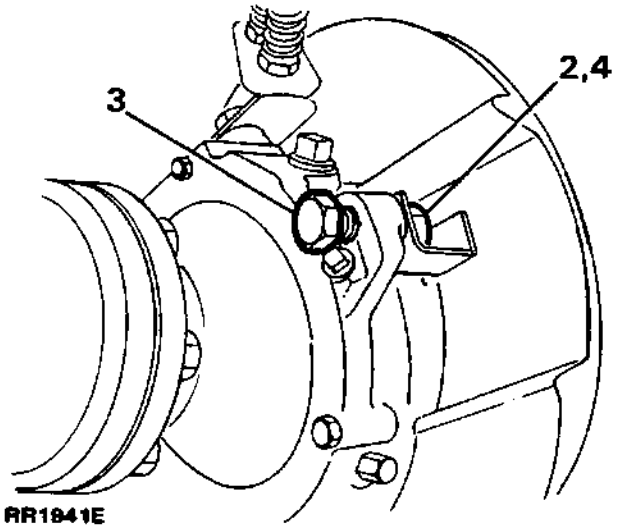
2. To centralise the box insert a suitable peg (hole size 8.06 mm) into the rear of the drop arm and into the steering box casing to enable rapid and accurate setting on centre.

STEERING LOCK STOPS

Service repair no - 57.65.03.

Check

1. Measure clearance between tyre wall and radius arm at full lock. This must be 20 mm.



RR1941E

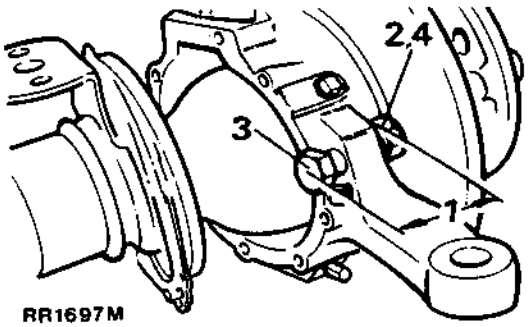
Adjust

2. Loosen stop bolt locknut.
3. Turn stop bolt as required.
4. Tighten locknut.
5. Check clearance between tyre wall and radius arm on each lock.

△ **NOTE: Alternatively lock stop adjustment may be carried out using following procedure.**

Check

1. Measure stop bolt protrusion as shown in RR1697M. This must be 40.5 mm.



RR1697M

Adjust

2. Loosen stop bolt locknut.
3. Turn stop bolt as required.
4. Tighten locknut.
5. Check wheel position at full lock.

FRONT WHEEL ALIGNMENT

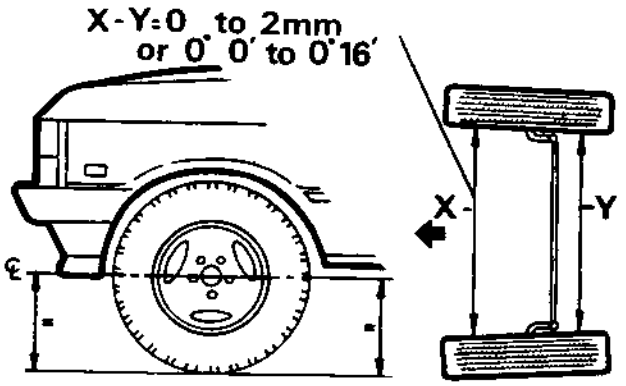
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Check and adjust

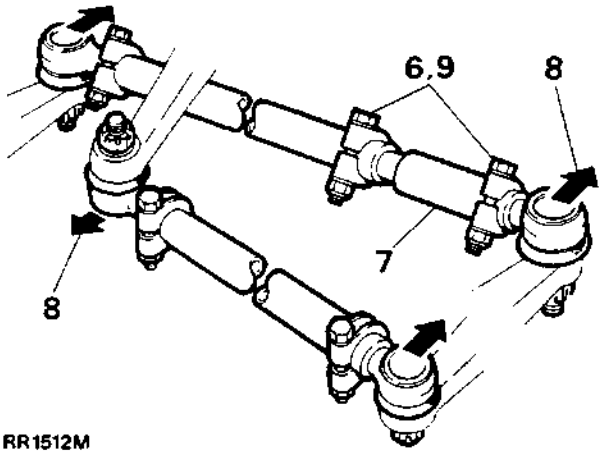
Checking Toe-out dimensions

NOTE: No Adjustment is provided for castor, camber or swivel pin inclinations.

1. Set vehicle on level ground with road wheels positioned straight ahead.
2. Push vehicle back and forwards to settle linkage.
3. Measure toe-out at horizontal centre-line of wheels.
4. Check tightness of clamp bolt fixings.
5. Tighten to ***14Nm.***



RR2172E



RR1512M

Adjust

6. Loosen adjuster sleeve clamp.
7. Rotate adjuster to lengthen or shorten track rod.
8. Check toe-out setting as instructions 1 to 4. When toe-out is correct, tap steering linkage ball joint, in directions of arrows shown, to maximum of their travel. This ensures full unrestricted working travel.
9. Tighten clamp bolts to ***14Nm.***

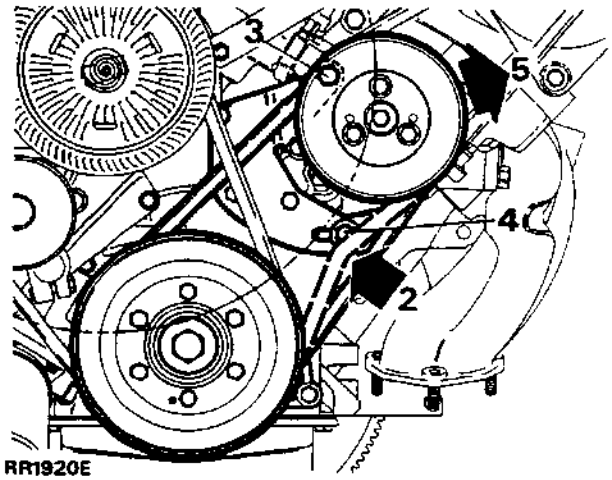
POWER STEERING PUMP DRIVE BELT

Service repair no - 57.20.01.

Adjust

1. Disconnect the battery negative lead.
2. Check belt tension midway between crankshaft and pump pulley. There should be movement of 4 to 6mm.
3. Loosen two nuts at side of pump.
4. Loosen bolt securing lower bracket to slotted adjustment link.
5. Pivot pump until correct belt tension is obtained.

CAUTION: Do not lever against pump casing. Damage to pump casing may cause fluid leaks.



6. Hold tension and tighten pump adjusting bolt and two nuts.

NOTE: Check alternator drive belt tension after adjusting power steering pump belt.

7. Reconnect the battery negative lead.
8. Recheck belt tension after running engine 3 to 5 minutes, if new belt fitted.

POWER STEERING FLUID PIPES

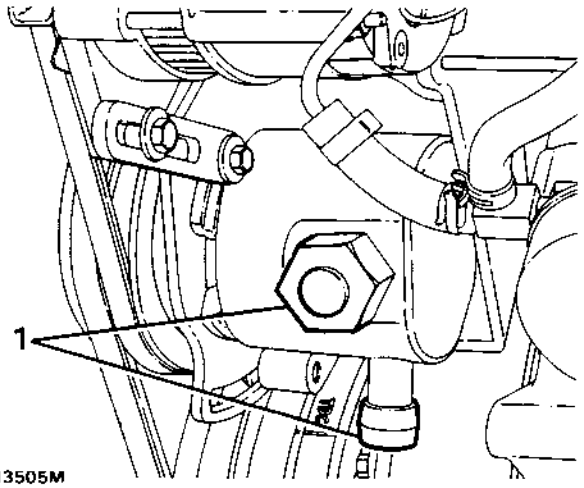
Service repair no - 57.15.21.

CAUTION: If any joints are disconnected, it is essential that open pipe and ports are plugged to prevent ingress of dirt.

The following procedures must be followed when refitting fluid pipes:

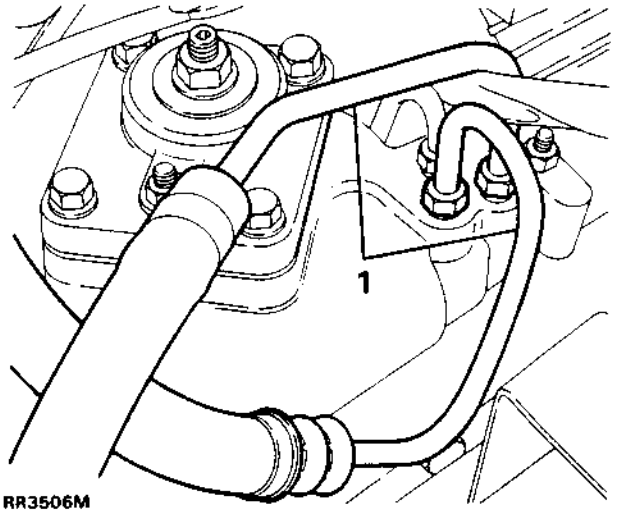
Power steering pump

1. Remove plugs, place clamp on feed hose.



RR3505M

2. Push hose onto pump.
3. Hold clamp in position, torque clamp to ***3 Nm***
4. Fit high pressure union into pump.
5. Hold pipe in correct position, and torque union to ***20Nm***

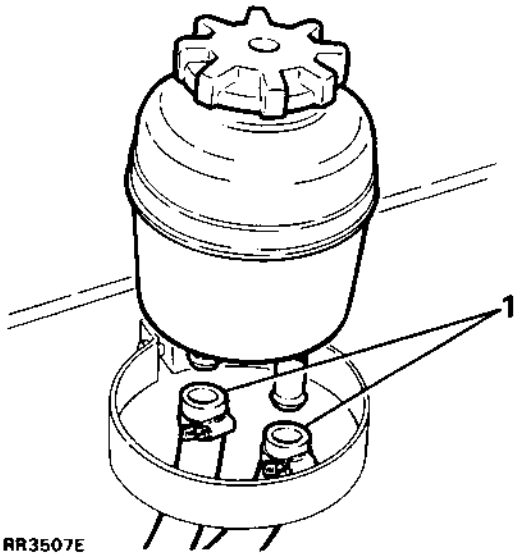


RR3506M

6. Remove plugs and refit pipes fingertight.
7. Tighten to torque: 16mm thread ***20 Nm*** 14mm thread ***15Nm.***

Power steering reservoir

1. Remove plugs and refit pipes and clamps.



RR3507E

2. Hold clamps. Tighten to ***3 Nm***

POWER STEERING BOX

Service repair no - 57.10.01.

General precautions

1. Whenever any part of system, is removed or disconnected, utmost cleanliness must be observed.
2. Disconnected ports and hoses must be plugged to prevent ingress of dirt. If metal sediment is found in system, establish cause rectify and flush system.
3. Do not start engine until reservoir is full as pump will be damaged.
4. Metric pipe fittings are used with 'O' ring pipe ends on fittings to steering box.
5. Follow normal 'O' ring replacement procedure whenever pipes are disconnected.
6. Ensure compatible metric components when fitting replacement pipes.

CAUTION: Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. Then steering wheel removed to prevent cruise control spiral cassette being wound up or damaged.

CAUTION: After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on cruise control cassette are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

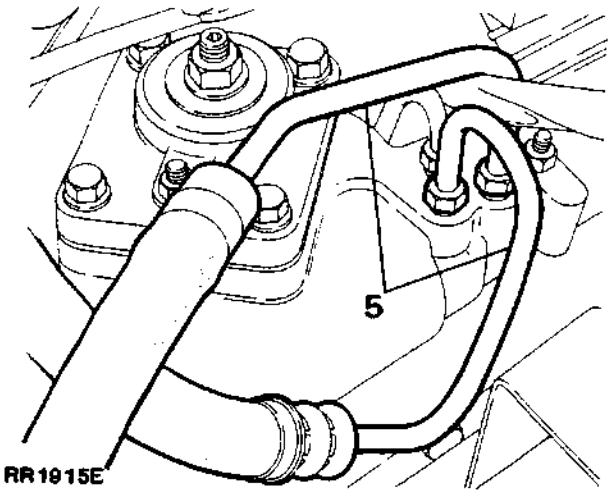
After final alignment connect multiplug to cassette, tighten steering wheel securing nut and fit trim.

NOTE: When drag link is disconnected from steering box, travel available at steering wheel to each full lock is not equal. Steering box is assymetric, to set box on centre follow correct procedure.

Remove and refit

Remove

1. Site vehicle on level surface.
2. Open bonnet.
3. Remove filler cap from power steering fluid reservoir.
4. Disconnect fluid pipes from pump. Drain and discard fluid. Replace filler cap.
5. Disconnect feed and return pipes from steering box.



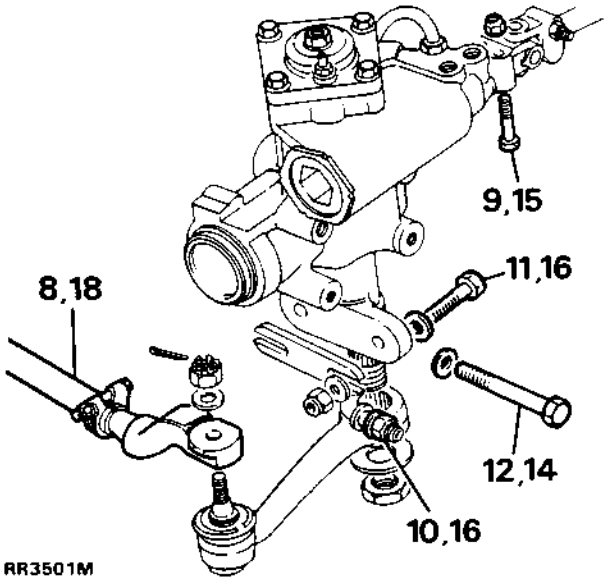
RR1915E

6. Plug open pipes and steering box ports to prevent ingress of dirt.
7. Support chassis front on axle stands. Or raise vehicle on a ramp.

WARNING: Ensure wheels are chocked, parking brake is applied, and low range selected.

8. Disconnect drag link from drop arm using a suitable extractor.
9. Remove pinch bolt attaching universal joint to power steering box.

10. Loosen nut, tie bar to panhard rod mounting bracket.
11. Remove bolts securing tie bar to steering box. Move tie bar aside.
12. Remove fixings securing power steering box to chassis side member.
13. Withdraw power steering box.



Refit

14. Refit steering box to chassis side member, tighten four bolts to ***81Nm.***
15. Connect pinch bolt securing universal joint to power steering box. Tighten to ***35Nm.***
16. Refit tie bar, tighten three fixings. Starting with tie bar to panhard rod, then loosen all three by one complete turn.
17. Check steering box, adjust if necessary. ***See Adjustment, Power steering box***
18. Refit drag link and secure.
19. Lower vehicle to ground.
20. Remove plugs and refit pipes to steering box. Tighten 16mm thread to ***20Nm.***
    14mm thread to ***15Nm.***
21. Remove filler cap. Fill reservoir to oil level mark on dipstick. Use recommended fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
    and bleed power steering system. ***See Power steering system - bleed***
22. Recheck fluid level and replace cap.
23. With engine running, test steering system for leaks by holding steering in both full lock directions.

CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute, to avoid oil overheating and possible seal damage.

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

WARNING: Do not test drive vehicle on public highway.

25. Drive vehicle in a straight line on level ground and stop.
26. Tighten tie bar to panhard rod mounting arm to ***110Nm.***
27. Tighten two fixings securing tie bar to steering box to ***81Nm.***
28. Ensure steering wheel is correctly aligned when wheels are positioned straight ahead.
29. If necessary reposition steering wheel. ***See steering wheel***
30. Road test vehicle.

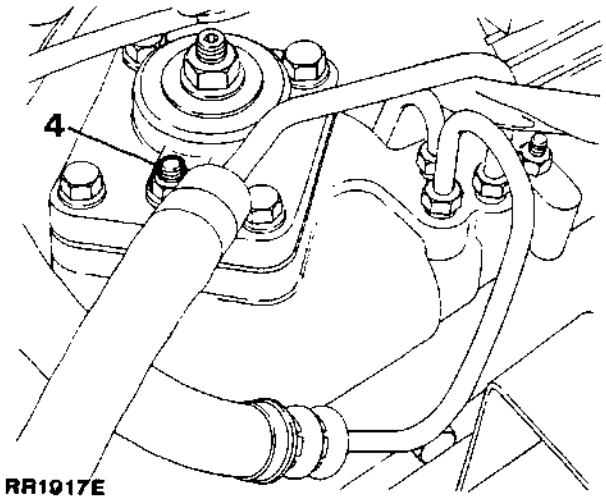
POWER STEERING SYSTEM - BLEED

Service repair no - 57.15.02.

1. Ensure fluid in reservoir reaches dipstick maximum.
2. Run engine to normal operating temperature.
3. Recheck and correct reservoir fluid level.

NOTE: During instructions 4 to 6, maintain maximum fluid level in reservoir. Do not increase engine speed or move steering wheel.

4. With engine at idle speed, loosen bleed screw. When fluid seeps past bleed screw retighten screw.



RR1917E

5. Check fluid level.
6. Clean away fluid around bleed screw.
7. Check hose connections, pump and steering box for fluid leaks by holding steering on full lock in both directions.

CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

8. Carry out road test.

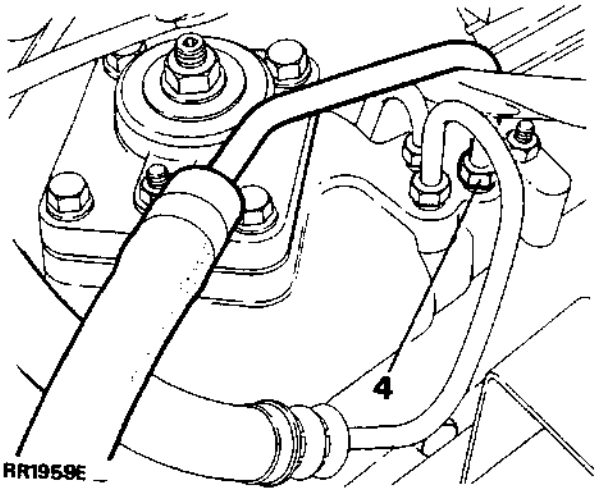
POWER STEERING FLUID RESERVOIR

Service repair no - 57.15.08.

Remove and refit

Remove

1. Place tray under power steering box.
2. Prop open bonnet.
3. Remove reservoir filler cap.
4. Disconnect return hose from steering box. Drain fluid from reservoir.

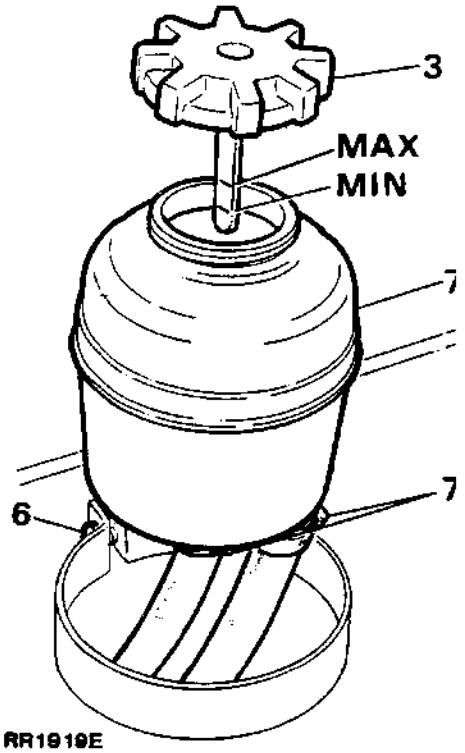


RR1959E

CAUTION: Power steering fluid damages paintwork. Clean immediately any spillage. Use only fresh fluid when filling power steering system.

5. Refit return hose to steering box.
6. Release bolt and remove reservoir.
7. Remove flexible hoses from reservoir. ***See Power steering fluid pipes***

NOTE: The reservoir contains a non serviceable filter. Should power steering fluid prove to be contaminated a new reservoir must be fitted. Vehicles after VIN 629042 have a serviceable filter fitted in the neck of the PAS reservoir.



RR1919E

Refit

8. Reconnect flexible hoses to reservoir. Tighten hose clamps to ***3 Nm.***
9. Refit reservoir and tighten pinch bolt.
10. Fill reservoir to level on dipstick with fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids***
11. Bleed power steering system. ***See Power Steering System - bleed***
12. Fit reservoir filler cap.

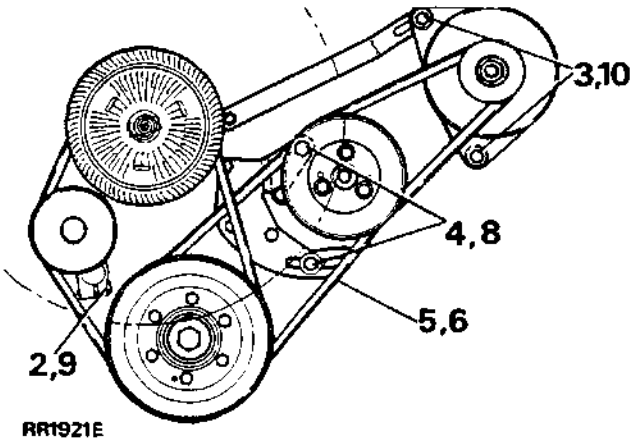
POWER STEERING PUMP DRIVE BELT

Service repair no - 57.20.02.

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Loosen idler pulley bolt and remove fan belt.
3. Loosen alternator mountings and remove drive belt.
4. Loosen power steering pump mountings.
5. Pivot pump and remove drive belt.



RR1921E

Refit

6. Fit drive belt onto crankshaft and pump pulleys.
7. Adjust belt tension. ***See Adjustment, Power steering pump drive belt***

STEERING PUMP

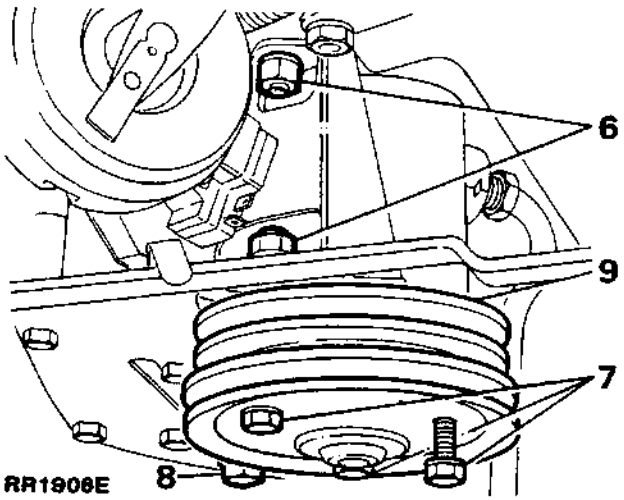
Service repair no - 57.20.14.

Remove and refit

NOTE: The power steering pump is not serviceable. Fit new pump if worn or damaged.

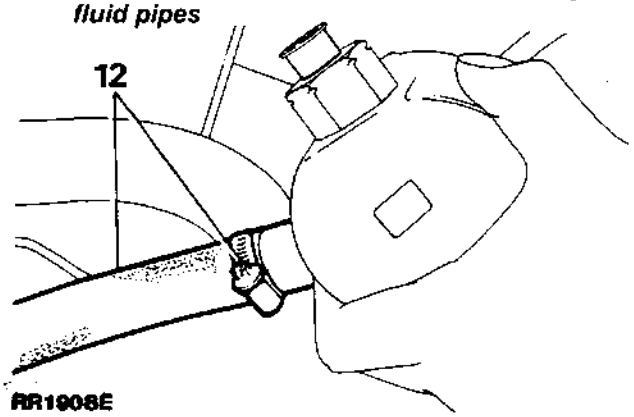
Remove

1. Disconnect the battery negative lead.
2. Remove alternator drive belt. ***See SECTION 10, Maintenance, Under Bonnet Maintenance***
3. Remove water pump drive belt. ***See SECTION 10, Maintenance, Under Bonnet Maintenance***
4. Remove left bank spark plug leads and detach distributor cap.
5. Disconnect electrical plug from distributor amplifier unit.
6. Loosen two nuts securing steering pump pivot bracket.



RR1906E

7. Loosen three bolts securing pulley to steering pump.
8. Loosen adjustment bolt, and remove drive belt.
9. Remove three bolts with plain washers and remove pulley.
10. Disconnect fluid pipe from side of pump. ***See Power steering fluid pipes***
11. Remove three bolts securing pump to pivot bracket. Remove pump as far as connected hose will permit.
12. Remove hose to pump. ***See Power steering fluid pipes***



RR1908E

Refit

13. Fit feed hose to pump. Tighten hose clamp to ***3Nm.***
14. Fit pump into pivot bracket and secure with three bolts. Tighten to ***35Nm.***
15. Fit pressure pipe to steering pump. Hold pipe in position. Tighten to ***20Nm.***

CAUTION: Ensure high pressure fluid pipe is clear of drive belt and top of steering box.

16. Fit pulley to steering pump coat three bolts with Loctite and fit fingertight.
17. Refit and tension steering pump drive belt. ***See Adjustment, Power steering pump drive belt***
18. Tighten three steering pump pulley bolts to ***10Nm.***
19. Reverse remaining removal instructions.
20. Bleed power steering system. ***See Power steering system - Bleed***

LOWER STEERING SHAFT AND UNIVERSAL JOINTS PRE 1991

Service repair no - 57.40.25.

NOTE: Vehicles built before VIN 601607 Range Rover or VIN 002272 Discovery (Jan 1991) require lower steering shaft universal joints checked for alignment and rephased if necessary. The two bolts marked * in RR3943M must be in line. Vehicles after these VINs have a pre assembled rubber coupling and universal joint, with a further change which eliminates the possibility of misaligned universal joints, ***See lower steering shaft and universal joints 1991 onwards***

CAUTION: Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. Then steering wheel removed to prevent cruise control spiral cassette being wound up or damaged.

CAUTION: After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on cruise control cassette are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

After final alignment connect multiplug to cassette, tighten steering wheel securing nut and fit trim.

Remove and refit

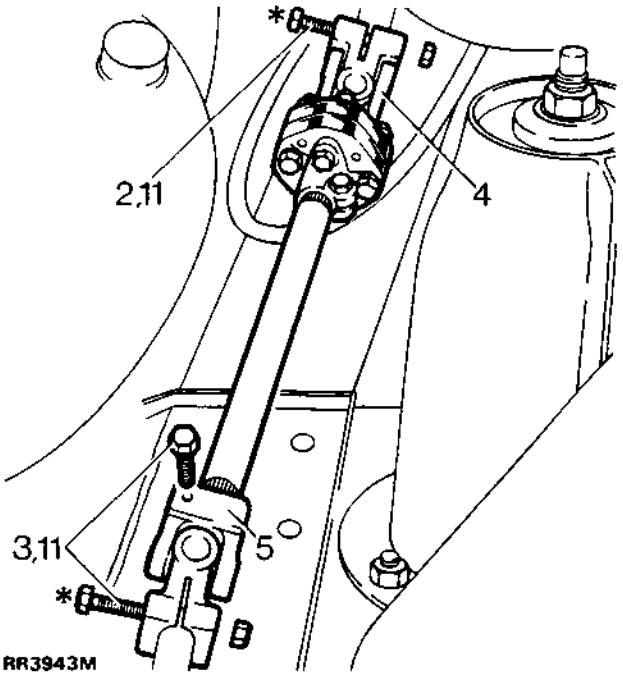
Remove

1. Ensure road wheels are straight ahead.

NOTE: To access coupling shaft, on left hand drive vehicles, remove air flow sensor and air filter canister.

2. Remove pinch bolt from top universal joint to steering column.
3. Remove two pinch bolts from lower universal joint.
4. Move shaft up to release lower joint from steering box splines. Remove shaft from the steering column splines.
5. Remove lower universal joint from shaft.

NOTE: Do not dismantle upper coupling joint. Steering shaft, rubber coupling and top universal joint is only available as an assembly.



6. Inspect universal joints for wear and excessive play, renew if necessary.
7. Inspect rubber coupling renew assembly if necessary.
8. Inspect universal joints for stiffness, lubricate if necessary.

Refit

NOTE: Fit universal joints so pinch bolt holes line up with groove on shaft.

9. Position lower universal joint on shaft.
10. Position shaft assembly onto steering column. Move assembly up spline to enable lower universal joint to fit onto steering box splines.
11. Align bolt holes with grooves in splines. Fit pinch bolts, and tighten nuts to ***35Nm.***

LOWER STEERING SHAFT AND UNIVERSAL JOINTS 1991 ONWARD

NOTE: JAN 1991 introduction at VIN 601607 Range Rover or VIN 002272 Discovery. Where applicable *See Lower steering shaft and universal joints pre 1991*

CAUTION: Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. Then steering wheel removed to prevent cruise control spiral cassette being wound up or damaged.

CAUTION: After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on cruise control cassette are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

After final alignment connect multiplug to cassette, tighten steering wheel securing nut and fit trim.

Remove and refit

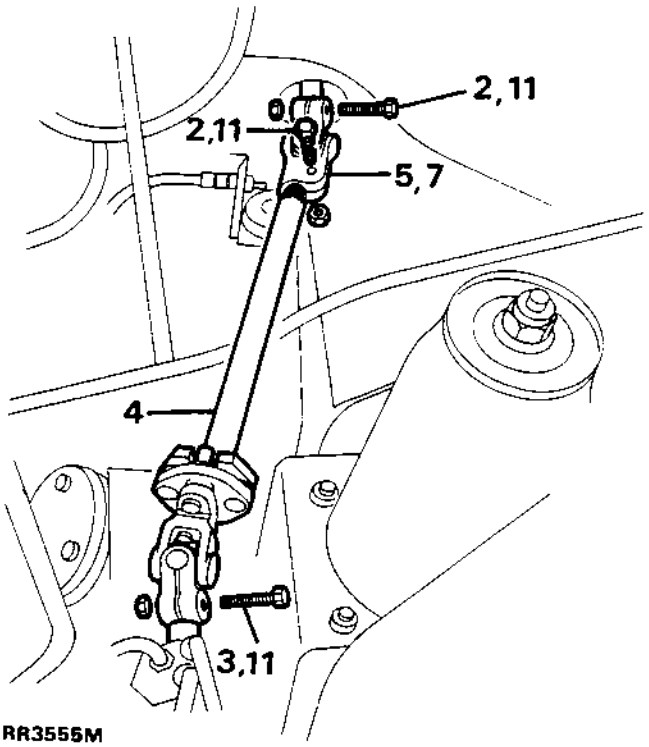
Remove

1. Ensure road wheels are straight ahead.

NOTE: To access coupling shaft, on left hand drive vehicles, remove air flow sensor and air filter canister.

2. Remove two pinch bolts from top universal joint to steering column.
3. Remove pinch bolt from lower universal joint.
4. Move shaft up to release lower joint from steering box splines. Remove shaft from the steering column splines.
5. Remove top universal joint from shaft.

NOTE: Do not dismantle upper coupling joint. Steering shaft, rubber coupling and top universal joint is only available as an assembly.



RR3555M

6. Inspect universal joints for wear and excessive play, renew if necessary.
7. Inspect rubber coupling renew assembly if necessary.
8. Inspect universal joints for stiffness, lubricate if necessary.

Refit

NOTE: Fit universal joints so pinch bolt holes line up with flat on shaft.

9. Position lower universal joint on shaft.
10. Position shaft assembly onto steering column. Move assembly up spline to enable lower universal joint to fit onto steering box splines.
11. Align bolt holes with grooves in splines. Fit pinch bolts, and tighten nuts to ***35Nm***.

STEERING WHEEL

Service repair no - 57.60.01.

CAUTION: Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. Then remove steering wheel to prevent cruise control spiral cassette being wound up or damaged.

CAUTION: After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on cruise control cassette are correctly positioned before steering wheel is replaced. Centralise cruise control cassette ***See Cruise control cassette centralise***

This ensures drive pegs locate in their holes in rear of steering wheel.

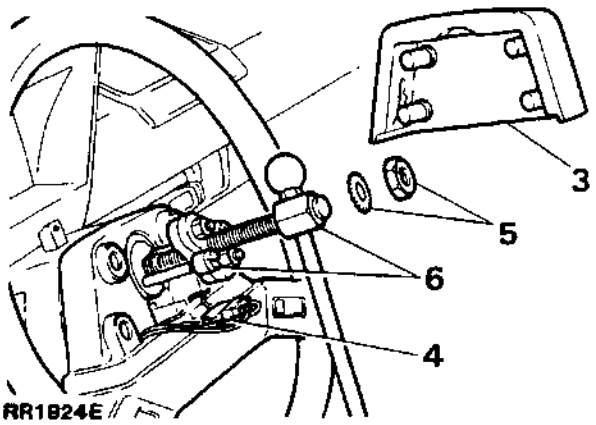
After final alignment connect multiplug to cassette, tighten steering wheel securing nut and fit trim.

Remove and refit

Remove

NOTE: The steering column incorporates shear pins. do not impart shock loads to steering column during remove and refit of steering wheel.

1. Disconnect the battery negative lead.
2. Position road wheels straight ahead so steering wheel can be correctly re-assembled.
3. Remove centre trim pad from steering wheel.
4. Disconnect cruise control multiplug located below centre nut.
5. Remove retaining nut and serrated washer.
6. Remove steering wheel using service tools LRT-57-014 and 015.



CAUTION: Prevent rotation of cruise control cassette once steering wheel is removed. Secure cassette in position with adhesive tape.

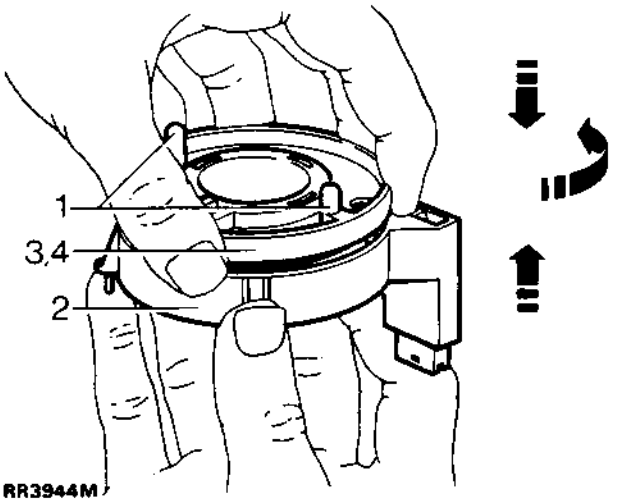
Refit

7. Recheck road wheels are positioned straight ahead.
8. Fit steering wheel on column splines. Remove adhesive tape securing cruise control cassette.
9. Fit drive pegs of cassette into holes in steering wheel.
10. Fit washer and nut tighten to ***38nm.***
11. Fit cruise control multiplug. fit centre trim pad.
12. Reconnect the battery negative lead.

CRUISE CONTROL CASSETTE CENTRALISE

On vehicles with cruise control the cruise control cassette is centralised using the following procedure.

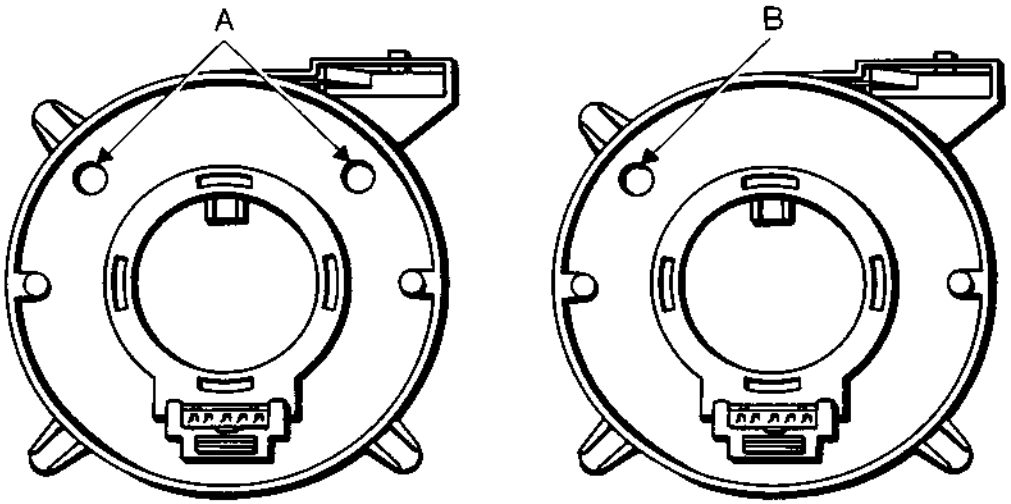
1. Hold spiral cassette with steering wheel location pegs facing forwards, see RR3944M.
2. Hold lower half of cassette.
3. Rotate upper half anti-clockwise as far as tape will allow.



RR3944M

△ **NOTE: To disengage ratchet force the two halves together. Do not apply excessive force when limit is reached, as ths may result in tape breakage.**

4. Rotate the upper half of the cassette approximately 1/4 turn clockwise until holes in cassette upper and lower halves are aligned. Item A in illustration RR3945M, shows two holes aligned with holes in lower half, vehicles before VIN 452004. B shows one hole aligned with hole in lower half, vehicles after VIN 452004.



RR3945M

STEERING COLUMN

Service repair no - 57.40.01.

NOTE: Steering column assembly is not a serviceable component.

Remove

CAUTION: The steering column incorporates shear pins. Do not impart shock loads to steering column during remove and refit of steering wheel.

CAUTION: Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. then steering wheel removed to prevent cruise control spiral cassette being wound up or damaged.

CAUTION: After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. if steering wheel requires repositioning, ensure that drive pegs on cruise control cassette are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

After final alignment connect multiplug to cassette, tighten steering wheel securing nut and fit trim.

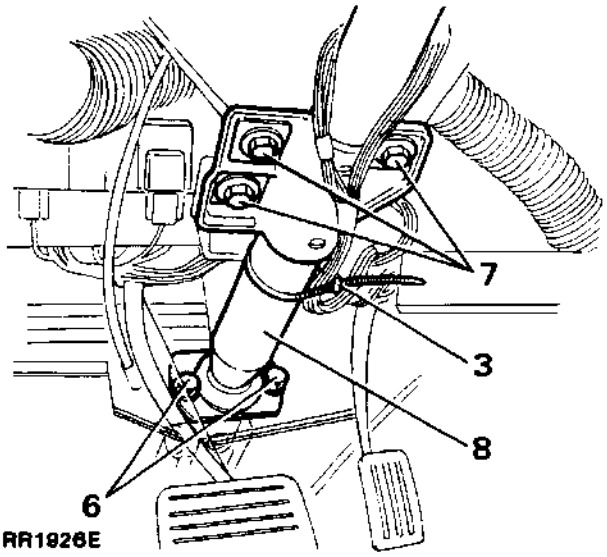
Remove and refit

Remove

1. Remove steering wheel. ***See Steering Wheel***

CAUTION: Prevent rotation of cruise control cassette once steering wheel is removed. secure cassette in position with adhesive tape.

2. Remove lower dash panel and unclip lower trim pad.
3. Disconnect electrical multiplugs from steering column switches. Release wire retaining clip from steering column.
4. Remove steering column shroud. ***See CHASSIS AND BODY, Repair, Steering column shroud***
5. Remove pinch bolt, from upper universal joint to steering column, ***See lower steering shaft and universal joints pre 1991 See lower steering shaft and universal joints 1991 onward***
6. Remove fixings, steering column to floor.
7. Remove fixings, steering column to dash bracket.
8. Remove steering column assembly.



RR1926E

Refit

9. Position sealing gasket to end of column assembly.
10. Fit steering column to universal joint.
11. Fit column upper fixings, do not tighten.
12. Fit column lower fixings, do not tighten.
13. Tighten lower fixings to ***27 Nm.***
14. Fit universal joint pinch bolt. Tighten to ***35 Nm.***
15. Tighten column upper fixings to ***27 Nm.***
16. Reverse removal procedure. 1 to 4.

STEERING COLUMN LOCK ASSEMBLY

Service repair no - 57.40.31.

Remove

For remove and refit of ignition switch. ***See ELECTRICAL, Repair, Ignition starter switch***

⚠ **CAUTION: Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. Then steering wheel removed to prevent cruise control spiral cassette being wound up or damaged.**

⚠ **CAUTION: After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on cruise control cassette are correctly positioned before steering wheel is replaced.**

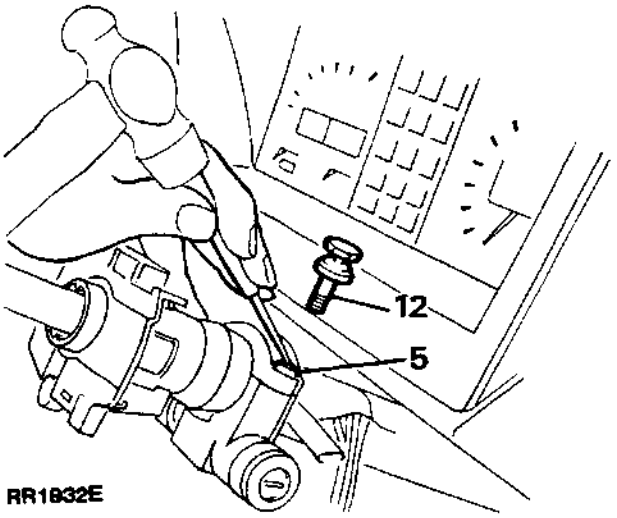
This ensures drive pegs locate in their holes in rear of steering wheel.

After final alignment connect multiplug to cassette, tighten steering wheel securing nut and fit trim.

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove steering wheel, ***See Steering wheel***
3. Remove steering column shroud. ***See CHASSIS AND BODY, Repair, Steering column shroud***
4. Release column switches from switch housing to access column lock fixings.



RR1832E

5. Tap head of shear pins anti-clockwise to release them.
6. Remove sheared bolts.
7. Detach upper cap.
8. Remove steering column lock assembly.

Refit

9. Position steering lock upper cap on outer column, locating spigot in hole provided.
10. Place lower lock assembly into column.
11. Fit shear bolts to retain cap and lock.
12. Tighten bolts sufficient to shear off heads.
13. Reverse removal procedure. 1 to 4.

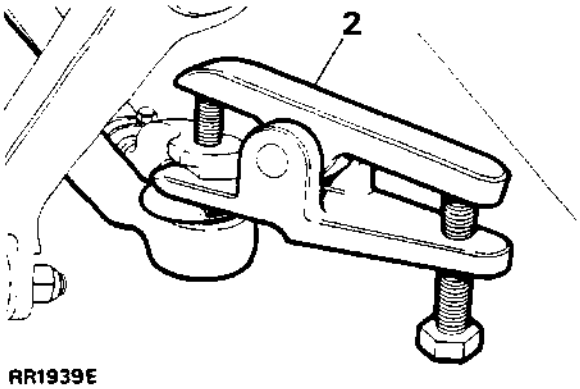
DROP ARM

Service repair no - 57.50.14.

Remove and refit

Remove

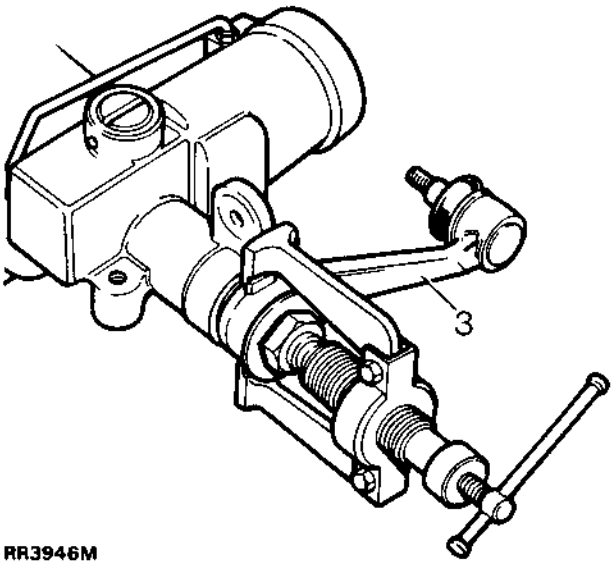
1. Place vehicle on a hoist,or support front axle on axle stands.
2. Disconnect drag link from drop arm ball joint, using extractor LRT-57-018.



RR1939E

3. Remove drop arm using extractor LRT-57-012. Loosen drop arm securing nut, but do not remove before using extractor.

△ **NOTE: The drop arm integral ball joint was deleted in November 1991. Vehicles after this date have the ball joint on the drag link.**



RR3946M

Refit

4. Centralise steering box by rotating steering wheel to full inner lock, (full left lock for right drive vehicle or full right lock for left drive vehicle). Turn steering wheel back exactly two full turns.
5. Fit drop arm, align master splines.
6. Fit a new tab washer and drop arm fixing. Tighten to ***176 Nm,*** bend over tab.
7. Fit drag link. Tighten to ***40 Nm.***

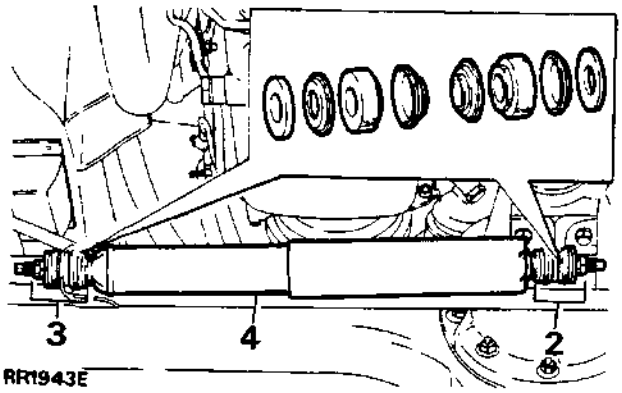
STEERING DAMPER

Service repair no - 57.55.21.

Remove and refit

Remove

1. Place vehicle on a hoist, or support front axle on axle stands.
2. Remove fixings at differential case bracket.
3. Remove fixings at track rod bracket.
4. Remove steering damper.



RR1943E

Refit

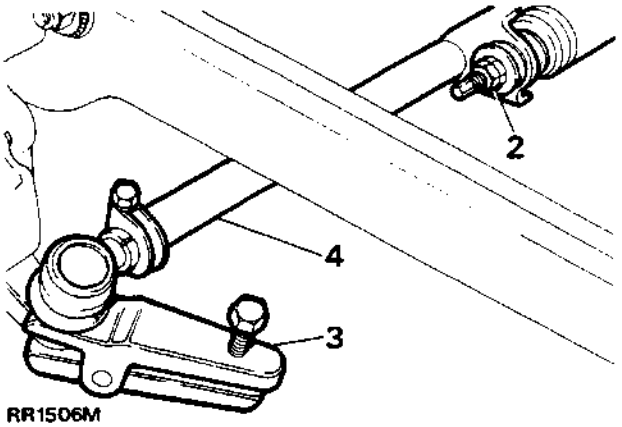
5. Reverse removal procedure. 1 to 4.

TRACK ROD AND LINKAGE

Service repair no - 57.55.09.

Remove track rod

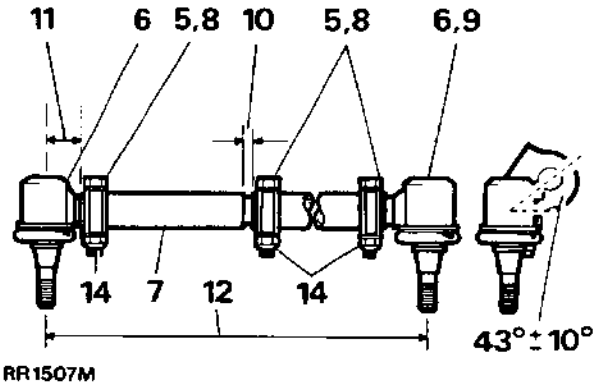
1. Place vehicle on a hoist,or support front axle on axle stands.
2. Disconnect steering damper at track rod.
3. Disconnect track rod at ball joints, using extractor LRT-57-018.
4. Remove track rod.



RR1506M

Remove linkage

5. Loosen clamp bolts.
6. Unscrew ball joints.
7. Unscrew track rod adjuster. (left hand thread).



RR1507M

Refit linkage

8. Fit replacement parts. Loosely fit clamp pinch bolts.
9. Screw in ball joint to full extent of threads.
10. Set adjuster to track rod distance to 9mm as shown.
11. Set adjuster end ball joint distance to 28.5mm as shown.
12. Track rod effective length of 1230.0mm is subject to adjustment during wheel alignment check.

Refit track rod

⚠ **CAUTION: Fit a new track rod if existing is damaged or bent. No attempt should be made to repair it.**

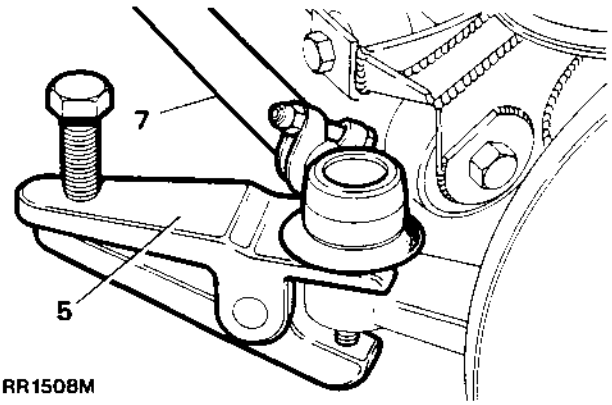
13. Fit track rod and tighten ball joint nuts to ***40 Nm.***
14. Check front wheel alignment. ***See Adjustment, Front wheel alignment***
15. Connect steering damper to track rod.
16. Remove vehicle from hoist, or axle stands.

DRAG LINK AND DRAG LINK ENDS

Service repair no - 57.55.17.

Remove drag link

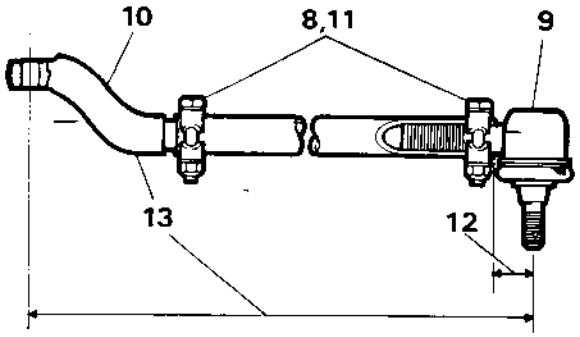
1. Check front wheel alignment. ***See Adjustment, Front wheel alignment***
2. Ensure wheels are positioned straight ahead during following procedure.
3. Place vehicle on a hoist, or support front axle on axle stands.
4. Remove right front road wheel.
5. Disconnect drag link ball joint at swivel housing arm, using extractor LRT-57-018.
6. Disconnect drag link end at drop arm ball joint.
7. Remove drag link.



RR1508M

Remove drag link ends

8. Loosen clamp bolts.
9. Unscrew ball joint.
10. Unscrew offset end.



RR1509M

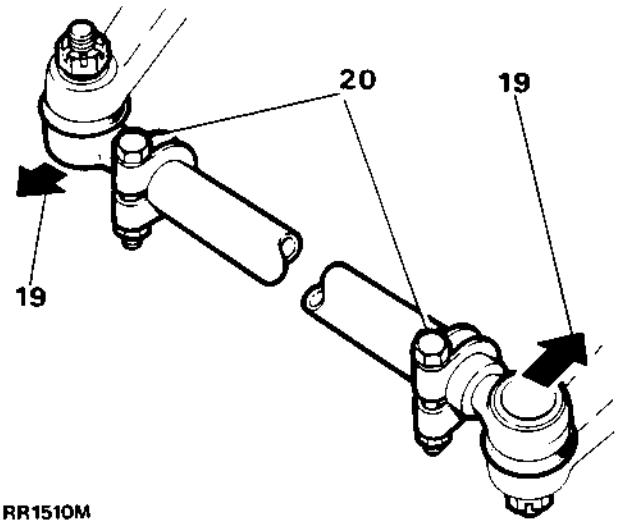
Remove drag link ends

11. Fit replacement ends. Loosely fit clamp bolts.
12. Set ball joint to drag link distance to 28.5mm as shown.
13. Adjust offset end to nominal length of 919.0mm. this length is adjusted during refit. Adjust to nominal length of 924.00 mm if vehicle is post November 1991.
14. Centralise steering box by rotating steering wheel to full inner lock, (full left lock for right drive vehicle or full right lock for left drive vehicle). Turn steering wheel back exactly two full turns. OR, use centralising feature if possible.
15. Align steering wheel, if necessary. ***See steering wheel***

Refit drag link

CAUTION: Fit new drag link if existing drag link is damaged or bent. No attempt should be made to repair it.

16. Fit drag link. Tighten ball-joint nuts to ***40nm.***
17. Check steering lock stops, ***See Adjustment, steering lock stops***
18. Ensure full steering travel is obtained between lock stops. Adjust drag link length to suit.
19. Tap ball joints in direction shown, so both pins are in same angular plane.
20. Tighten clamp bolts to ***14 Nm.***



RR1510M

21. Reverse removal procedure. 3 and 4.
22. Road test vehicle.
23. If driving straight ahead and steering wheel is offset by 0° to ± 5° in either direction. Remedy by adjusting drag link length.

WARNING: To correct steering wheel deviations greater than ±5°. Remove and reposition steering wheel, *See steering wheel*

POWER STEERING BOX

Service repair no - 57.10.07.

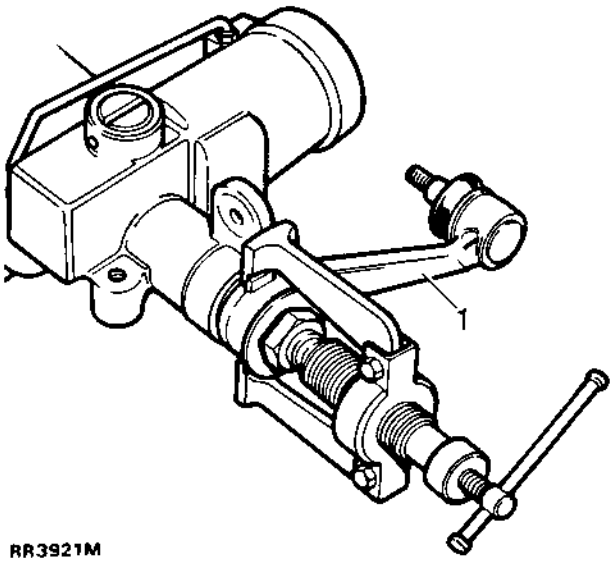
Overhaul

NOTE: Overhaul of steering box should not be carried out during the warranty period.

WARNING: Wear safety glasses while removing and refitting circlips and retaining ring.

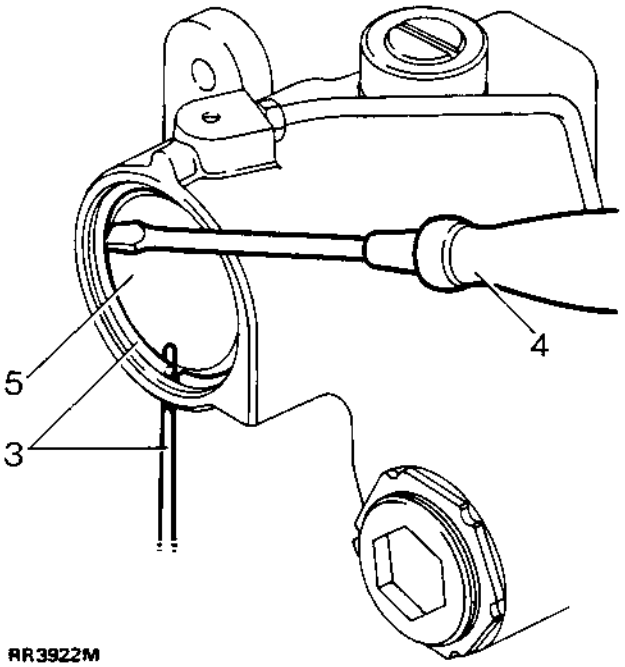
CAUTION: Absolute cleanliness is essential when overhauling power steering box.

1. Remove steering box from vehicle, ***See Repair, Power steering box***
   Remove drop arm using extractor LRT-57-012. Loosen drop arm securing nut, but do not remove before using extractor. Remove dirt excluder from output shaft.



RR3921M

2. Drain oil, remove blanking plugs and bleed screw. Hold steering box over suitable container, turn input shaft from lock to lock, until oil is drained. Refit bleed screw.
3. Rotate retainer ring until one end is 12 mm from extractor hole. Using a drift through hole in cylinder, lift retaining ring from groove in cylinder bore.
4. Remove retainer ring, using a screwdriver.

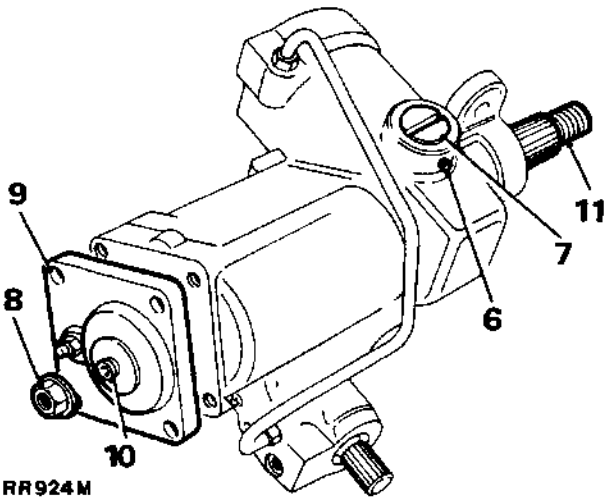


RR3922M

5. Turn input shaft (left lock on left hand drive, right lock on right hand drive) until piston pushes out cover. Turn input shaft fully in oposite direction, applying pressure to piston.
6. Remove set screw retaining rack pad adjuster.
7. Remove rack adjuster and pad.
8. Remove sector shaft adjuster locknut.
9. Remove four bolts from sector shaft cover.
10. Screw in sector shaft adjuster until cover is removed.

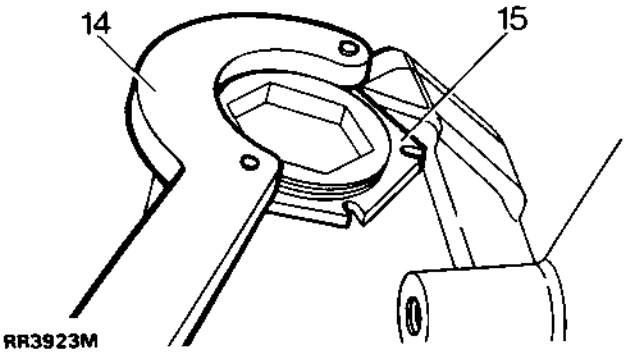
NOTE: Steering boxes after serial number 2 M 2166 have sealant applied to hexagon socket to 'tamperproof' sector shaft adjuster.

11. Slide out sector shaft.



RR924M

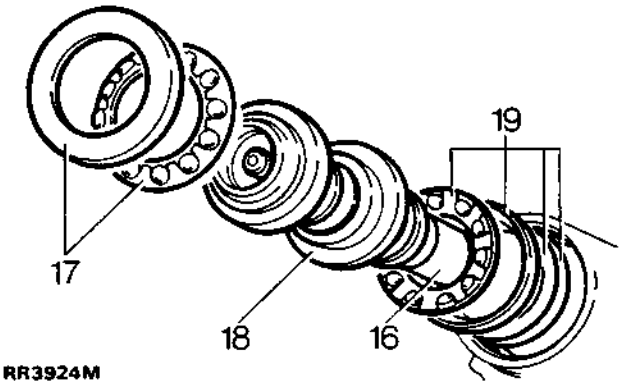
12. Remove piston, a bolt screwed into piston will assist removal.
13. Remove input shaft dirt excluder.
14. Remove worm adjuster locknut using 'C' wrench LRT-57-007.
15. Remove worm adjuster using wrench LRT-57-006.



RR3923M

16. Tap splined end of shaft to free bearing.
17. Remove bearing cup and caged ball bearing assembly.
18. Remove valve and worm assembly.
19. Remove inner bearing cage, cup and shim washers. Retain shims for reassembly.

NOTE: Should difficulty be experienced warm casing and bearing assembly. Cool bearing cup using a mandrel and tap steering box on a bench.



RR3924M

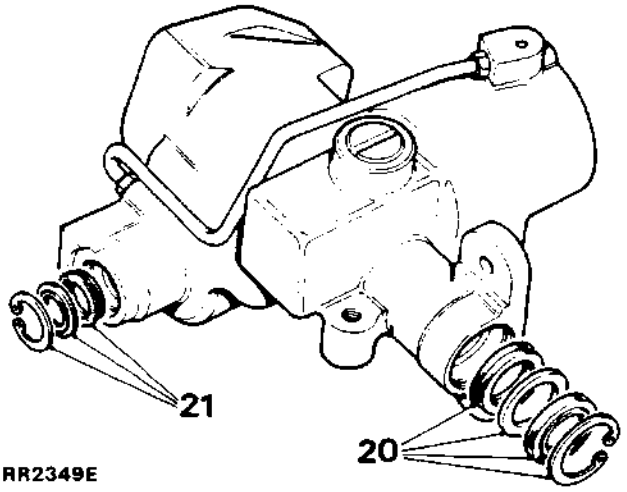
Steering box seals

20. Remove circlip and seal from sector shaft housing bore.

CAUTION: Do not remove sector shaft bearings from casing. Replacement parts are not available. If sector shaft bearings are worn fit a new steering box.

21. Remove circlip and seals from input shaft housing bore.

CAUTION: The use of a seal puller is recommended to prevent damage to casing, and possible oil leaks.



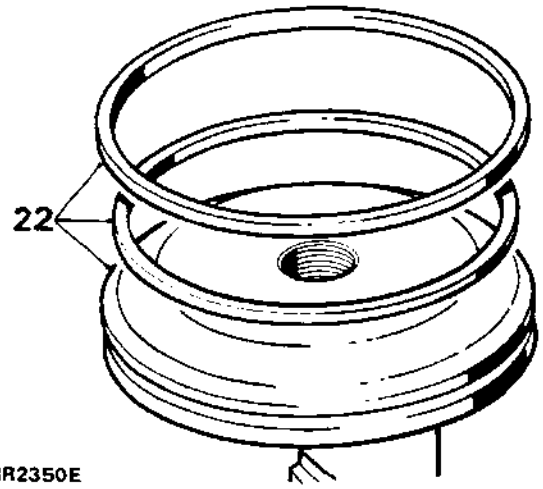
RR2349E

INSPECTING

Piston

22. Discard all rubber seals and provide replacements.

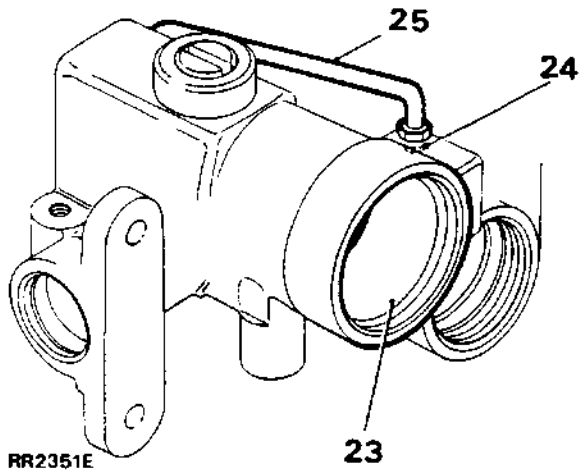
△ **NOTE: A rubber seal is fitted behind plastic ring on rack piston. Discard seal and plastic ring.**



RR2350E

Steering box casing

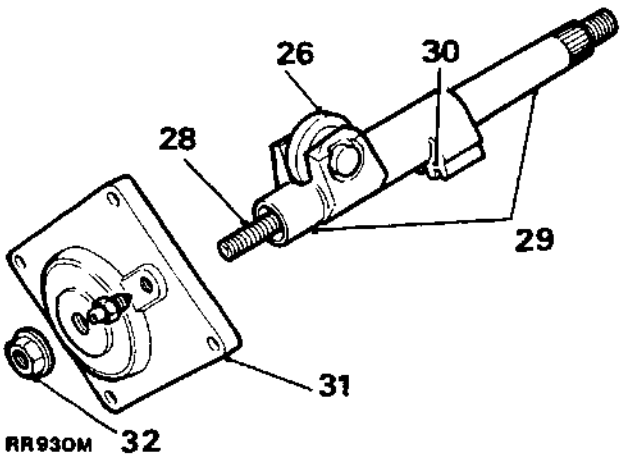
23. Examine piston bore for scoring and wear.
24. Examine feed tube.
25. Fit a new feed tube if damaged. Tighten to 22 *Nm.*



RR2351E

Sector shaft assembly

26. Check there is no side play on roller.
27. If side play on roller exists fit a new sector shaft.
28. Check condition of adjuster screw threads. Check adjuster end float. Fit new adjuster if end float exceeds 0.15 mm.
29. Examine bearing areas on shaft for excessive wear.
30. Examine gear teeth for uneven or excessive wear.



RR930M

Sector shaft cover assembly

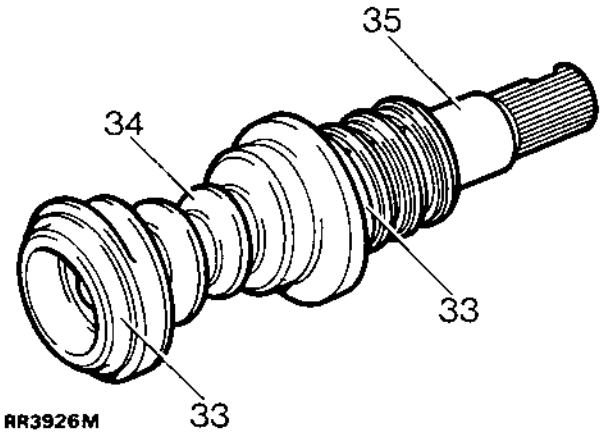
31. Inspect cover and bearing. If worn or damaged, replacement parts are not available, fit a new steering box.

Sector shaft adjuster locknut

32. The locknut is also a fluid seal. Fit new nut at overhaul.

Valve and worm assembly

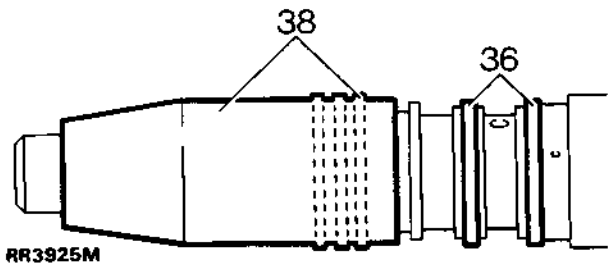
33. Examine bearing areas for wear. The areas must be smooth and not indented.
34. Examine worm track which must be smooth and not indented.



35. Check for wear on torsion bar assembly pin. No free movement should exist between input shaft and torsion bar or between torsion bar and worm.

△ **NOTE: Any sign of wear makes it essential to fit new valve and worm assembly.**

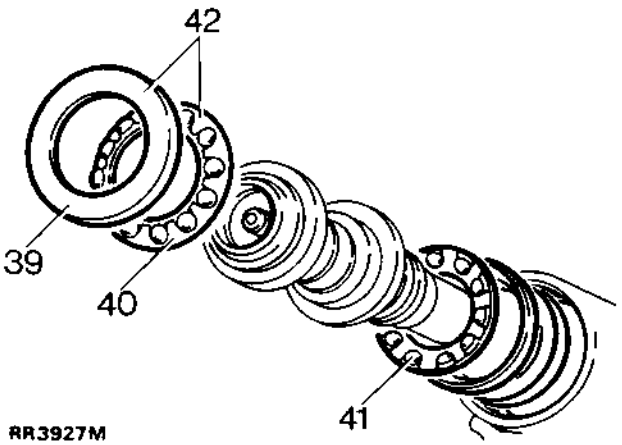
36. Examine valve rings for cuts, scratches and grooves. The valve rings should be free to rotate in grooves.



37. If required, replace all three rings, using ring expander LRT-57-04619. The expander will not pass over rings already fitted. Remove rings to allow access without damaging seal grooves.
38. Warm rings and expander tool to aid assembly. Fit rings to expander, slide expander over valve and worm assembly. In turn fit rings to their grooves. Remove expander, slide valve and worm assembly into ring compressor LRT-57-020 and allow to cool.

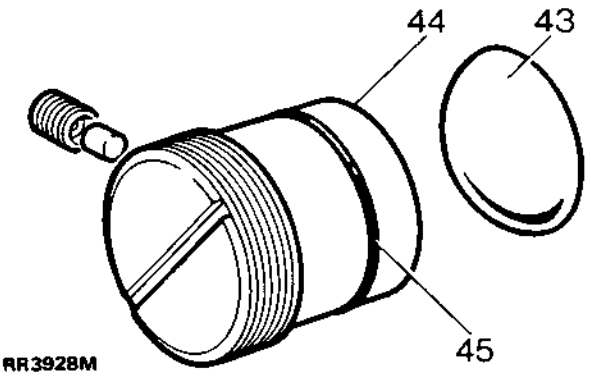
Ball bearing and cage assemblies

39. Examine ball races and cups for wear and general condition.
40. If ball cage has worn against bearing cup, fit replacements.
41. Bearing balls must be retained by cage.
42. Bearing and cage repair is carried out by complete replacement of assembly.



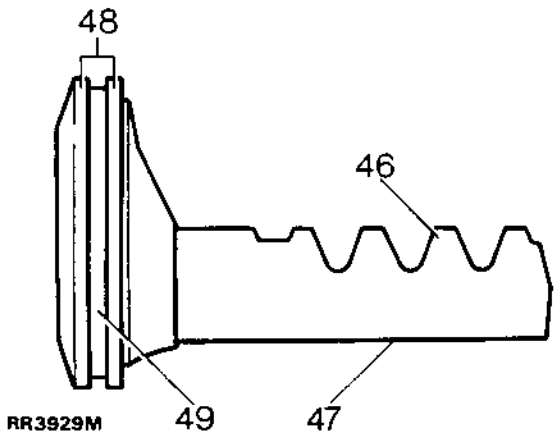
Rack thrust pad and adjuster

43. Examine thrust pad for scores.
44. Examine adjuster for wear in pad seat.
45. Fit new sealing ring to rack adjuster.

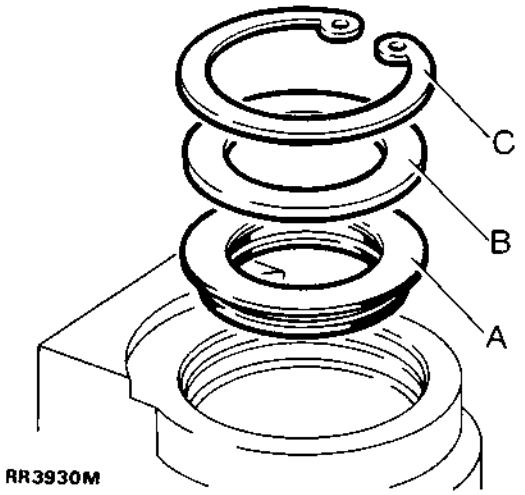


Rack and piston

46. Examine for excessive wear on rack teeth.
47. Ensure thrust pad bearing surface is free from scores and wear.
48. Ensure piston outer diameters are free from burrs and damage.



RR3929M



RR3930M

49. Examine seal and ring groove for scores and damage.
50. Fit new ring to piston. Warm nylon seal and fit to piston.
51. Slide piston assembly into cylinder with rack tube outwards.

Reassemble

△ **NOTE: When fitting replacement oil seals lubricate with recommended fluid and ensure absolute cleanliness.**

Input shaft oil seal

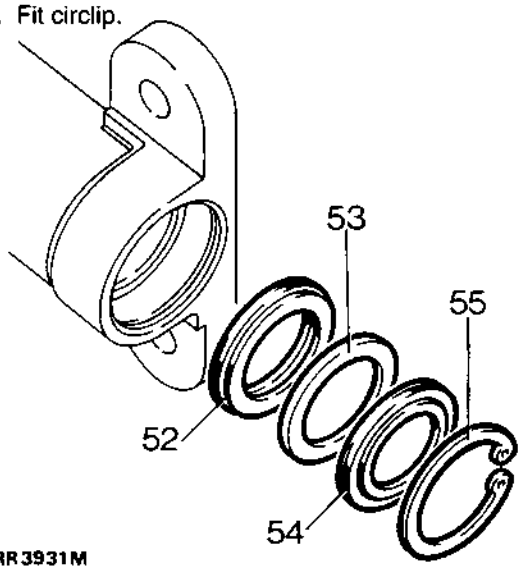
△ **NOTE: Changes to input oil seal. Up to steering box number GBE 51000 00 (see Adwest identity plate) the input shaft oil seal was as shown in RR3930M. This type of seal MUST be fitted at this stage.**

a) **Fit oil seal, lip side first, into housing. Seat backing to lie flat on bore shoulder.**
b) **Fit backing washer.**
c) **Fit circlip.**

A dirt excluder was added at steering box serial number GBE 51000 00. This is fitted at instruction 94. A revised seal without backing washer was introduced at serial number GBE 51400 00. This seal MUST be fitted at instruction 92.

Sector shaft oil seal

52. Fit oil seal, lip side first.
53. Fit extrusion washer.
54. Fit dust seal, lipped side last.
55. Fit circlip.



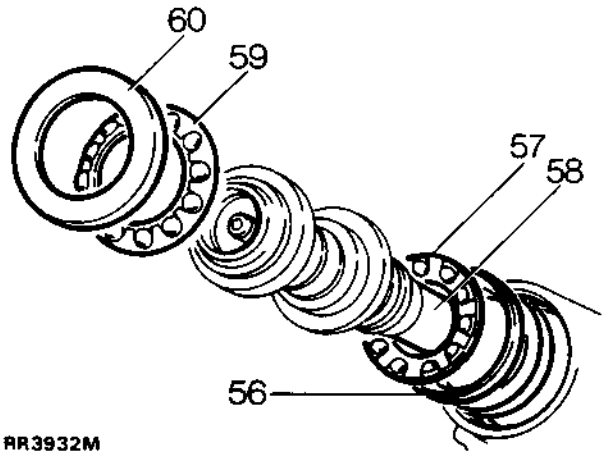
RR3931M

Fitting valve and worm assembly

56. Refit original shims and inner bearing cup. Use Petroleum Jelly to aid assembly.

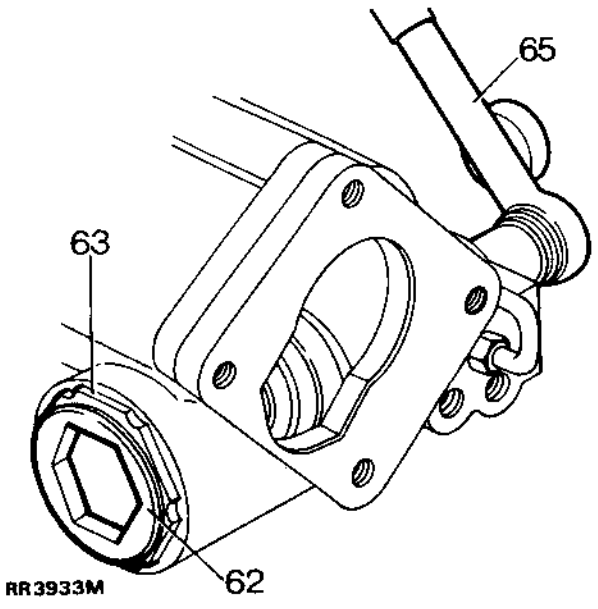
△ **NOTE: If original shims are not used, fit shims of 0.76 mm thickness.**

57. Fit inner cage and bearings assembly.
58. Fit valve and worm assembly.
59. Fit outer cage and bearings assembly.
60. Fit outer bearing cup.



RR3932M

61. Fit new worm adjuster sealing ring.
62. Loosely screw adjuster into casing.
63. Fit locknut, do not tighten.
64. Turn in worm adjuster until end float is almost eliminated. Ensure bearing cages are seated correctly.
65. Measure maximum rolling torque of valve and worm assembly, using a torque spanner and spline socket LRT-57-025.
66. Turn in worm adjuster while rotating shaft to increase figure measured in instruction ***65. to 0.56 Nm.***
67. Back off worm adjuster 1/4 turn. Turn in worm adjuster to increase reading at ***65. by 0.21 - 0.34 Nm*** with locknut tight, ***100Nm. Use worm adjusting wrench LRT-57-006 and locknut wrench LRT-57-028.***



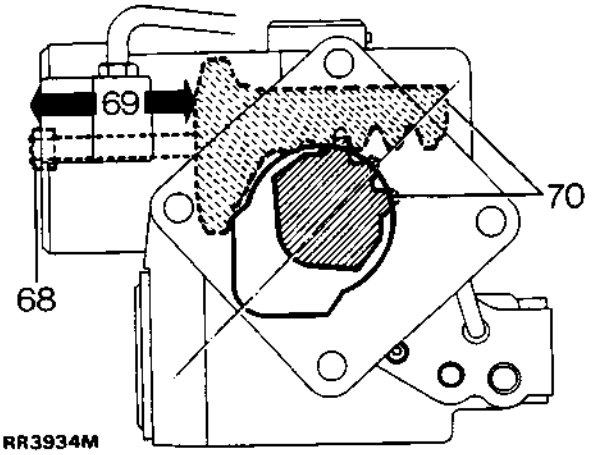
RR3933M

Fitting rack and piston

68. Screw slave bolt into piston to aid assembly.
69. Fit piston and rack so piston is 70 mm from outer end of bore.

Fitting sector shaft

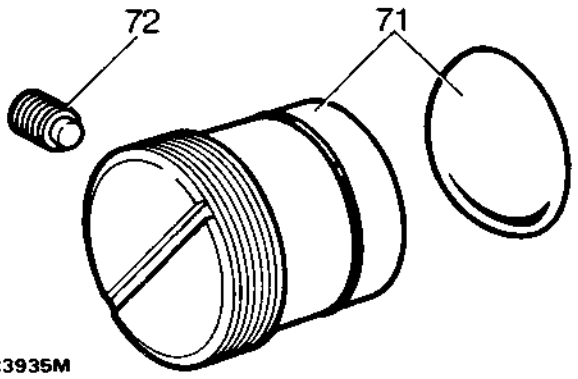
70. Fit sector shaft using seal saver LRT-57-021. Align roller with cut out in casing - see RR3944M. Push in sector shaft while rotating input shaft to allow sector roller to engage worm.



RR3934M

Fitting rack adjuster

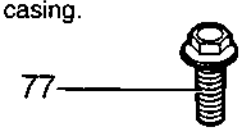
71. Fit rack adjuster and thrust pad to engage rack. Back off half turn on adjuster.
72. Loosely fit new nylon pad and adjuster set screw assembly.

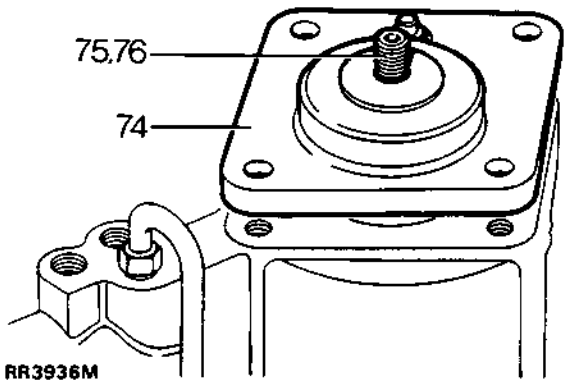


RR3935M

Fitting sector shaft cover

73. Fit new sealing ring to cover.
74. Align cover with casing.
75. Screw cover assembly fully on to sector shaft adjuster screw.
76. If necessary back off sector shaft adjuster screw. Tap cover in place to allow cover to joint fully with casing.



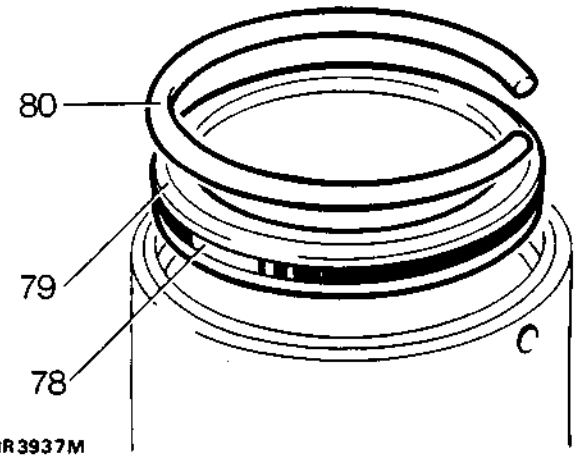


△ **NOTE: Before tightening fixings, rotate input shaft to ensure sector shaft roller is free to move in valve worm. If initial resistance is left, turn adjuster screw approximately two turns in a clockwise direction.**

77. Fit cover bolts. Tighten to ***50Nm.***
From steering box serial number 1J001. Tighten to ***75Nm.***

Fitting cylinder cover

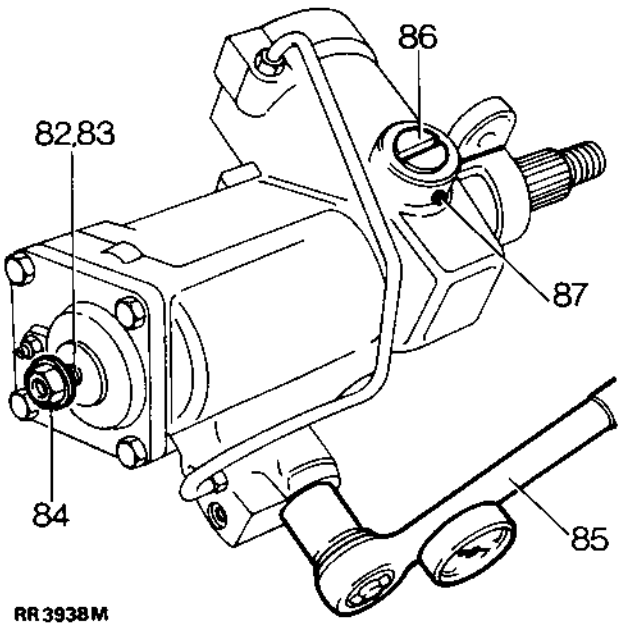
78. Fit new square section seal to cover.
79. Remove slave bolt fitted at instruction 68. Press cover into cylinder just to clear retainer ring groove.
80. Fit retaining ring to groove with one end of ring positioned 12 mm from extractor hole.



Adjusting sector shaft

△ **NOTE: Refit drop arm and tighten nut sufficiently to ensure that no backlash exists between drop arm and sector shaft.**

81. To set worm on centre, rotate input shaft to full inner-lock (full right lock for a left hand drive vehicle, full left lock for a right hand drive vehicle). Rotate input shaft back towards centre two full turns.
82. The box is now on centre and can be adjusted.



83. Hold input shaft and rock drop arm to establish backlash is present. Continue rocking and slowly turn sector shaft adjusting screw clockwise. Continue rotating adjuster screw until backlash has almost been eliminated.
84. Refit locknut and tighten.

△ **NOTE: It is important steering box is centralised before any adjustments are made.**

85. Check maximum rolling torque one and a quarter turns either side of centre position, using a torque wrench and spline socket LRT-57-025. Rotate adjuster screw to obtain across centre torque of 0.34 Nm plus torque figure at one and a quater turns. Tighten adjuster locknut to 60 Nm.

Adjusting rack adjuster.

86. Turn in rack adjuster to increase figure measured in instruction 85. by 0.23 - 0.34 Nm. **The final figure may be less, but must not exceed 1.35 Nm.**
87. Lock rack adjuster in position with grub screw. Tighten to ***5 Nm.***

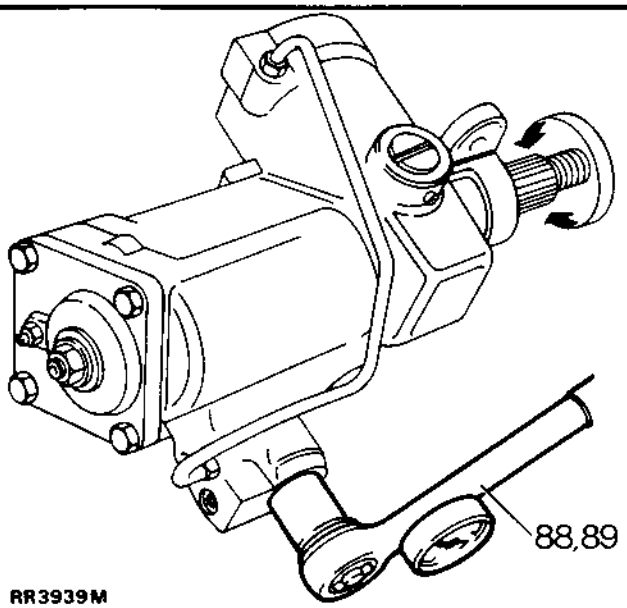
Torque peak check

With input shaft rotated from lock to lock, rolling torque figures should be greatest across centre position and equally disposed about centre position.

The condition depends on value of shimming fitted between valve and worm assembly inner bearing cup and casing. The original shim washer value will give correct torque peak position unless major components have been replaced.

Procedure

88. With input coupling shaft toward the operator, turn shaft fully counter-clockwise.
89. Check torque figures obtained from lock to lock using torque spanner and spline socket LRT-57-025.
90. Check also for equal engagement either side of centre.



RR3939M

Adjustments

91. Note where greatest figures are recorded relative to steering position.If greatest figures are not recorded across centre of travel (steering straight-ahead), adjust as follows:

If torque peak occurs **before** centre position, **add** to shim washer value; if torque peak occurs **after** centre position, **subtract** from shim washer value, see fitting valve and worm assembly.

Shim washers are available as follows: 0.03mm, 0.07mm, 0.12mm and 0.24mm.

△ **NOTE: Adjustment of 0.07mm to shim value will move torque peak area by 1/4 turn on the shaft.**

⚠ **CAUTION: When reshimming valve and worm extreme, caution must be exercised to prevent seal damage during reassembly.**

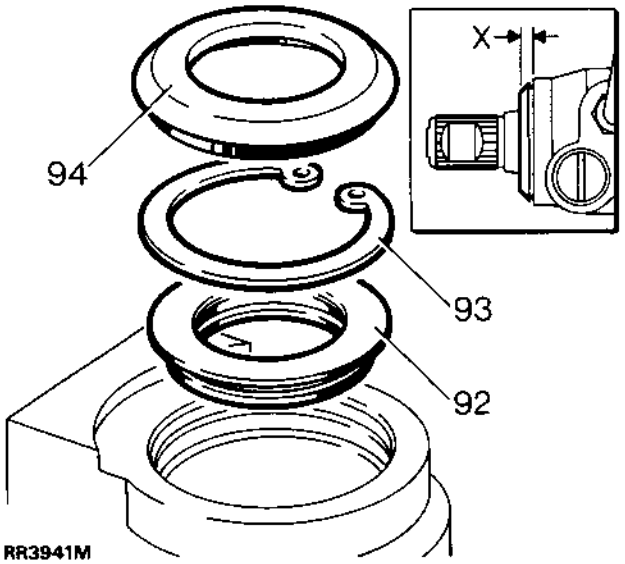
Input shaft oil seal

△ **NOTE: Instructions 92. and 93. refers to boxes after GBE 51400 00.**

92. Fit seal, lip side first, into housing. Use seal saver LRT 57-016 and seal installer LRT-57-026. Note that seal is fitted to a depth of 4.75 - 5.00 mm from face of box.
93. Secure seal with circlip.

NOTE: Instruction 84. refers to boxes after GBE 51000 00.

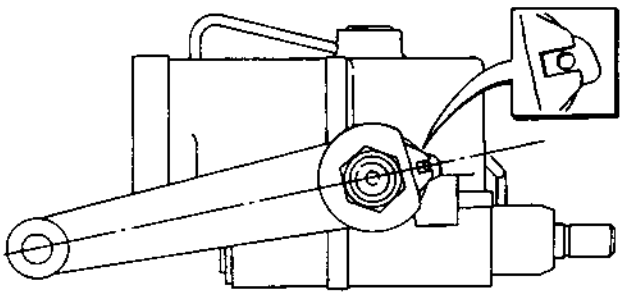
94. Smear inner lip of dirt excluder with PTFE grease. Fit dirt excluder using LRT-57-027. When fitted correctly outer shoulder of excluder is 4.00 - 4.50 mm from face of box, dimension X in RR3941M.



RR3941M

95. Remove drop arm. Smear inner lip of dirt excluder with PTFE grease and refit, ensuring outer lip is flush with casing.
96. With input shaft on centre, line up centalising holes (if fitted) in drop arm and steering box see inset in RR3940M. Fit drop arm to steering box using a new tab washer. Tighten to ***176Nm,*** bend over tab.

NOTE: If steering box is earlier type without centralising holes, fit drop arm in position shown in RR3940M with input shaft on centre.


RR3940M

97. Refit steering box to vehicle. Tighten chassis fixings to ***81Nm***
98. Fill system with power steering fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids***
99. Bleed system. ***See Repair, Power steering system - bleed***
100. Test system for leaks, with engine running hold steering on full lock in both directions.

CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

101. Road test vehicle.

DROP ARM BALL JOINT

NOTE: This procedure relates to steering boxes having the ball joint incorporated in the drop arm. Steering boxes from Adwest serial number GBE 48200 00 have a taper hole in the drop arm. The ball joint is fitted to the drag link . These drop arms also have a cut out which is lined up with the casing for accurately centralising the steering box.

Overhaul

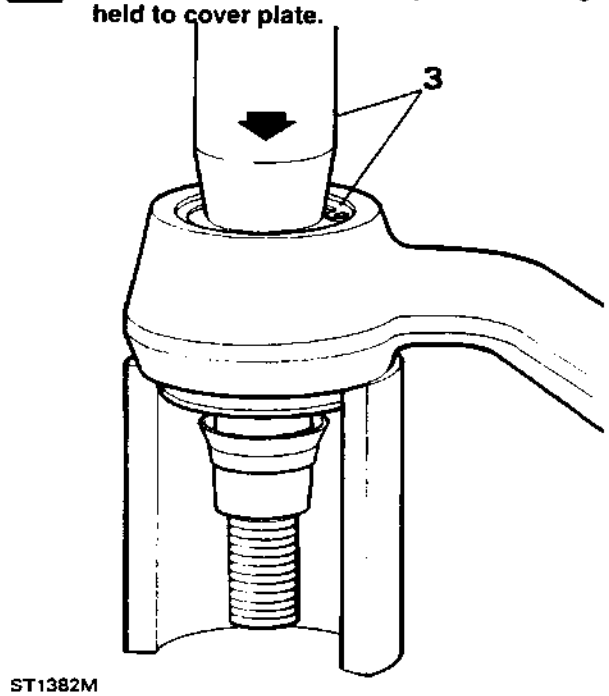
Overhaul drop arm ball joint with repair kit which consists of following items:

Ball pin	**Ball lower socket**
Retainer	Spring
Spring rings	'O' ring
Dust cover	Coverplate
Ball top socket	Circlip

Dismantle

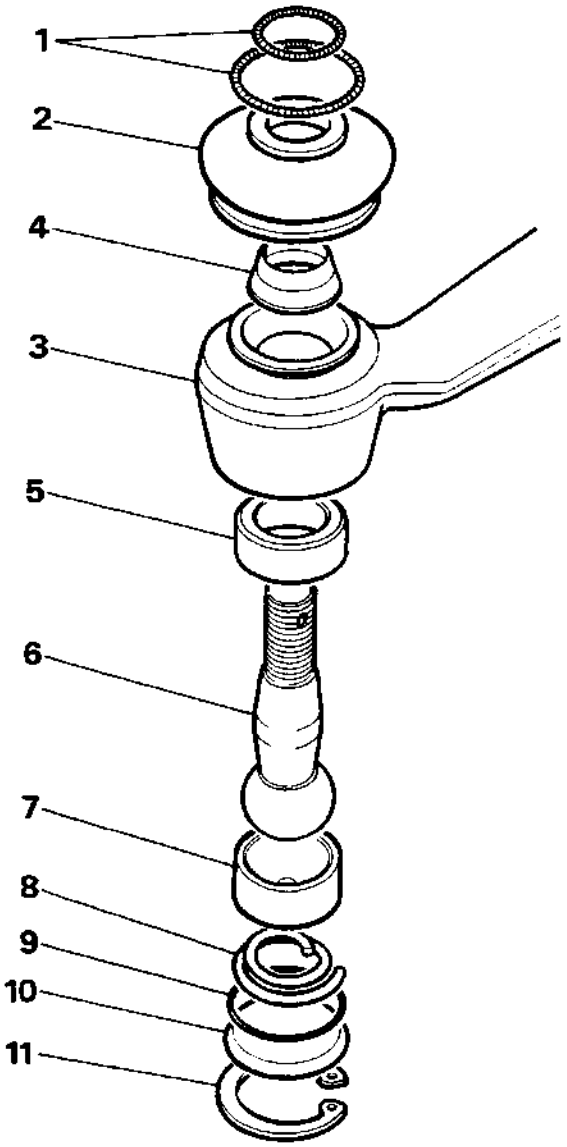
1. Remove drop arm. ***See Repair, Drop arm***
2. Remove spring rings and dust cover.
3. Compress ball joint to relieve spring tension while supporting housing as shown. Remove circlip and release pressure.

WARNING: Personal injury could result if circlip is removed without pressure being held to cover plate.



ST1382M

4. Remove spring, top socket and 'O' ring.

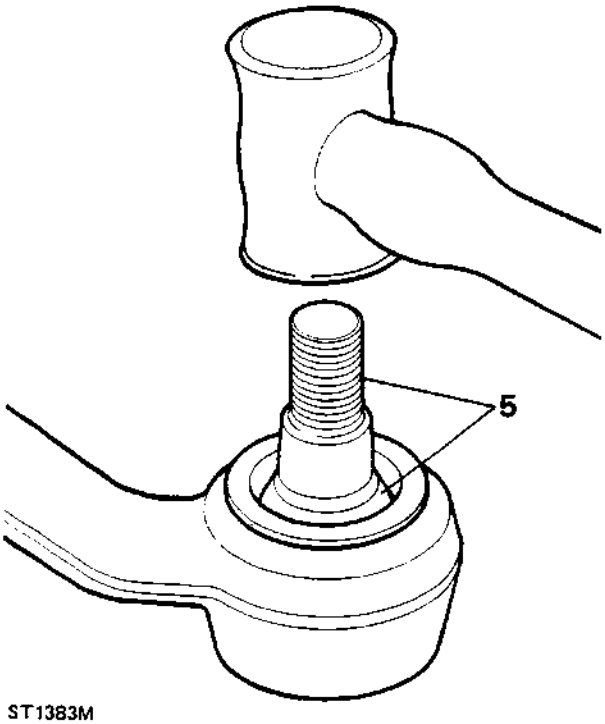


ST1381M

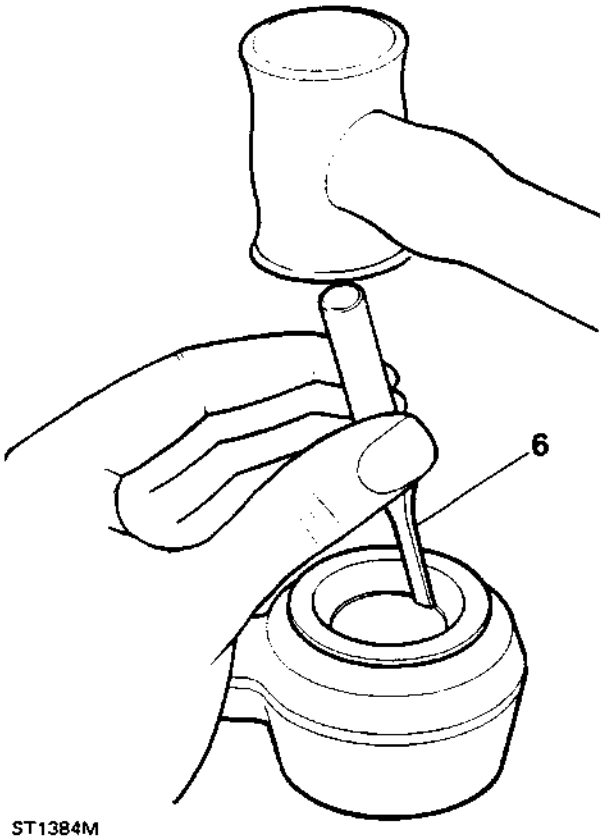
BALL JOINT COMPONENTS

1. Spring rings
2. Dust cover
3. Ball housing
4. Retainer
5. Bottom socket
6. Ball pin
7. Top socket
8. Spring
9. 'O' ring
10. Cover-plate
11. Circlip

5. Tap threaded end of ball pin to release components, remove retainer and ball pin.



ST1383M

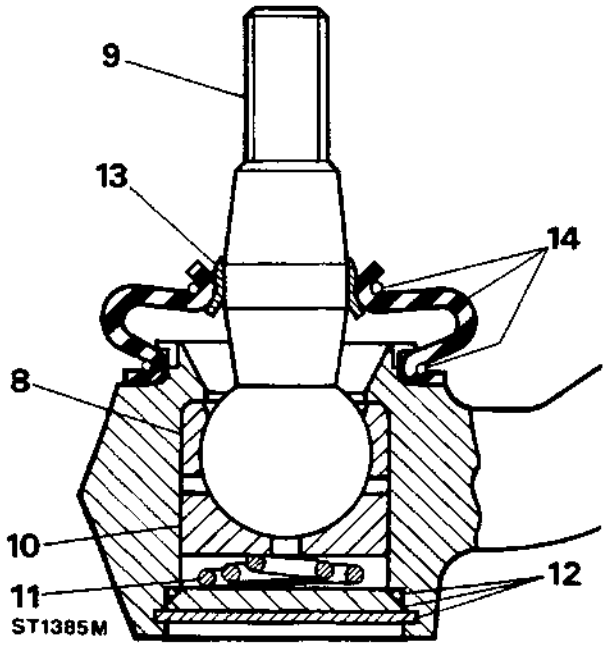


ST1384M

6. Using a punch, drive out ball lower socket.
7. Clean housing and remove any burrs.

Assemble

8. Press in lower socket up to shoulder.
9. Dip ball in grease, fit to housing and pack with grease.
10. Fit top socket.
11. Fit spring, small diameter towards ball.
12. Fit 'O' ring. Compress cover plate and fit circlip, ensure circlip is seated.
13. Press retainer onto ball pin until top edge is level with edge of taper.



14. Fit dust cover and retain with two spring rings.
15. Fit drop arm to steering box using new lock washer. Tighten to ***176Nm. Bend over lock washer.***
16. Fit ball pin to drag link. ***See Repair, Drag link and drag link ends***

STEERING PUMP

Make/type	Hobourn series 200
Operating pressure - straight ahead position - at idle	7 kgf/cm^2 maximum
Full lock (left or right) at idle	28 kgf/cm^2 minimum
Full lock (left or right) 1000 rev/min	70-77 kgf/cm^2

TORQUE VALUES

△ **NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.**

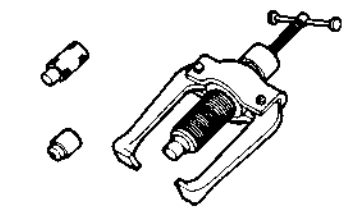
	Nm
Ball joint nuts	40
Clamp bolt nuts	14
Steering column bracket nuts	27
Steering wheel nut	38
Universal joint pinch bolt	35
PAS box	
Adjuster locknut	60
Drop arm nut	176
Sector shaft cover to steering box	25
Steering box to chassis	81
Steering box fluid pipes 14mm thread	15
Steering box fluid pipes 16mm thread	20
Tie bar to steering box	81
PAS pump	
High pressure fluid pipe	20
Power steering pump mounting	35
Pulley bolts, power steering pump	10
Hose clamp	3
PAS reservoir	
Hose clamp	3

*** Torque values below are for all screws and bolts used except for those that are specified otherwise.**

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

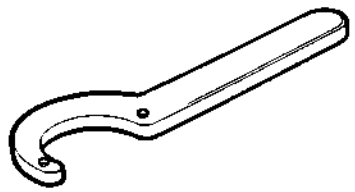
Notes

POWER STEERING BOX



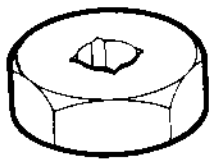
MS252A

LRT-57-012 Drop arm extractor
MS252A



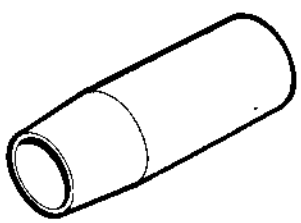
LST120

LRT-57-007 'C' Wrench
LST120



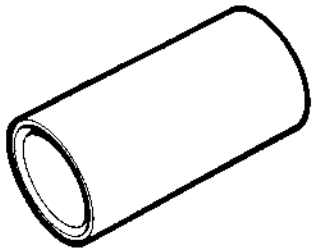
LST119

LRT-57-006 Worm adjusting wrench
LST119



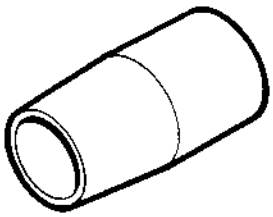
RO606602

LRT-57-019 Ring expander
RO606602



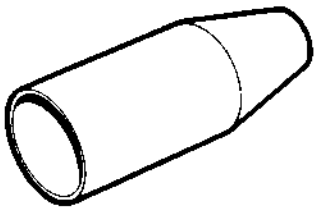
RO606603

LRT-57-020 Ring compressor
RO606603



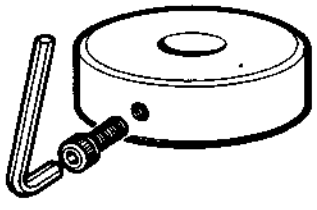
RO606604

LRT-57-021 Seal saver, sector shaft
RO606604



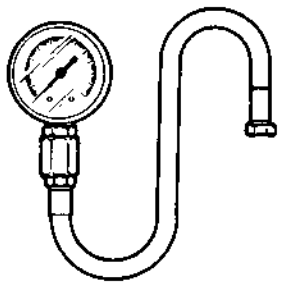
RO1015

LRT-57-016 Seal saver, valve and worm
RO1015



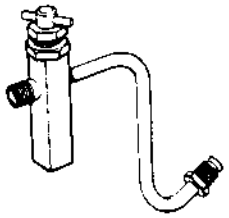
ROI 016

LRT-57-017 Torque setting tool
RO1016



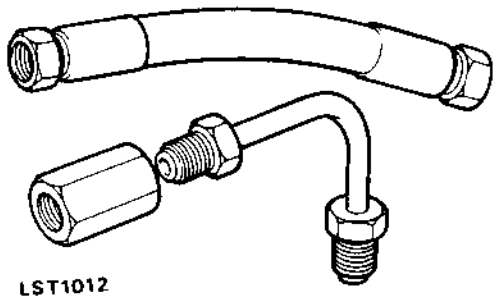
HY23

LRT-57-005 Pressure gauge
HY23



JD102

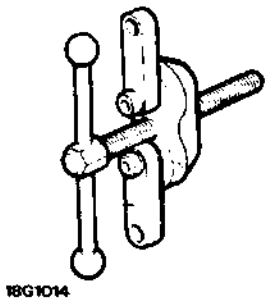
LRT-57-001 Test adaptor
JD10-2



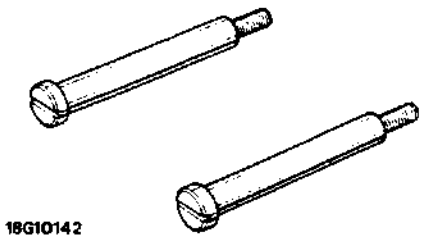
LST1012

LRT-57-022 Pressure test adaptors
LST10-12

STEERING WHEEL



LRT-57-014 Steering wheel remover
18G1014



LRT-57-015 Adaptor pins
18G1014-2

60 - FRONT SUSPENSION

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ANTI-ROLL BAR ASSEMBLY 5
ANTI-ROLL BAR FRONT 6
ANTI-ROLL BAR BALL JOINT LINKS 6

SPECIFICATIONS, TORQUE

TORQUE VALUES 1

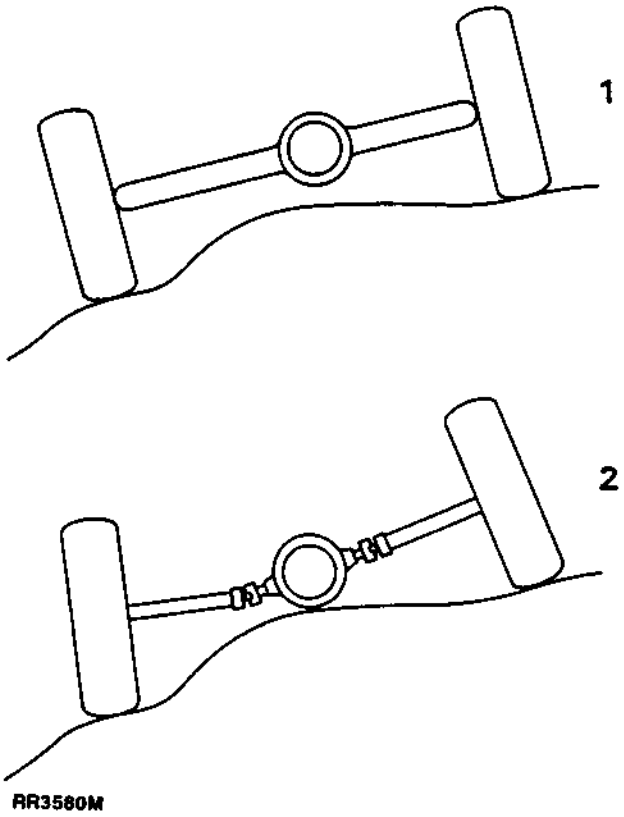


Notes

INTRODUCTION

Suspension design is a major factor in determining the comfort, safety and performance of any vehicle, but is particularly significant to 4 wheel drive cross country vehicles. The ideal suspension must allow maximum wheel travel and axle articulation, and provide good ground clearance without loss of traction or directional stability.

A well designed beam axle layout can embrace all of these qualities and also has the inherent advantage (over independent systems) of no variation in wheel track or camber angle.

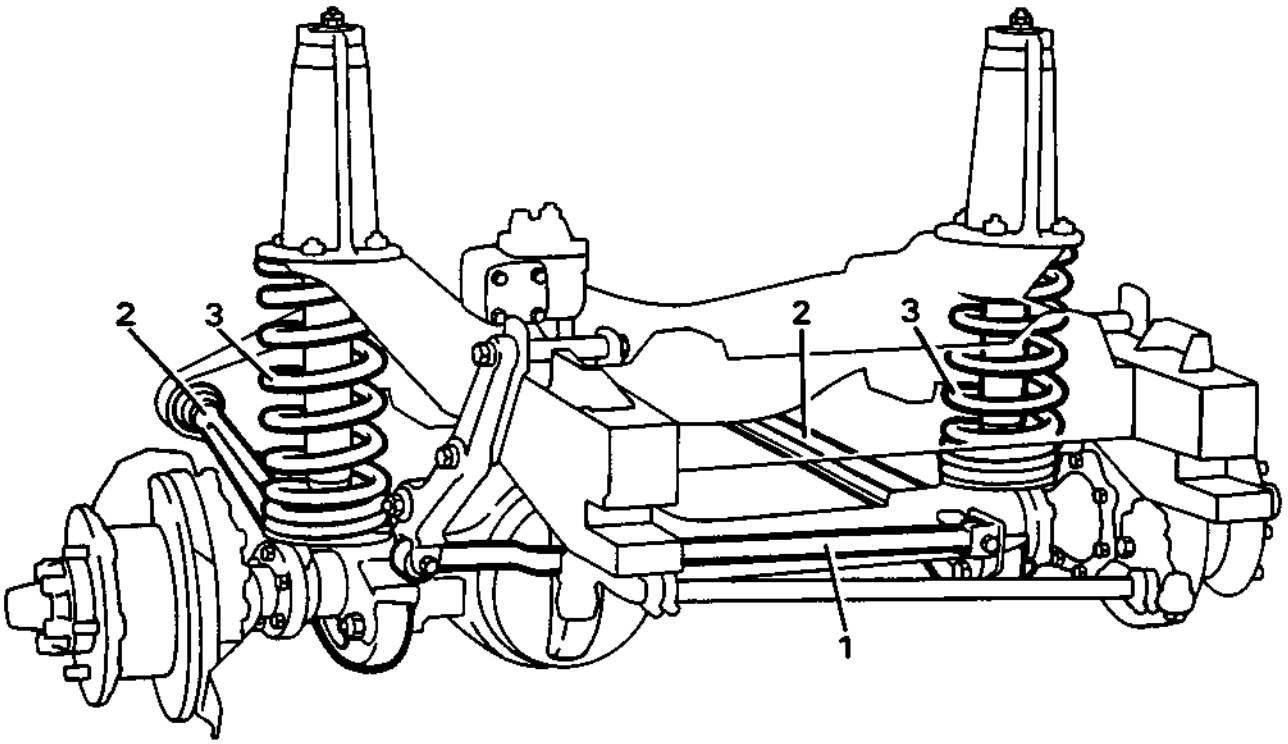


Suspension comparison

1. Beam axle system
2. Independent system

AXLE LOCATION

The front axle is controlled fore and aft, by two forged steel radius arms and transversely by a panhard rod.



RR3561M

Front axle suspension

1. Panhard rod - transverse location
2. Radius arms - fore aft location
3. Coil springs

Long travel coil springs and hydraulic shock absorbers, provide the springing for each wheel.

SELF LOCKING NUTS

WARNING: Where self locking nuts are removed, they must be replaced with new nuts of same specification.

PANHARD ROD

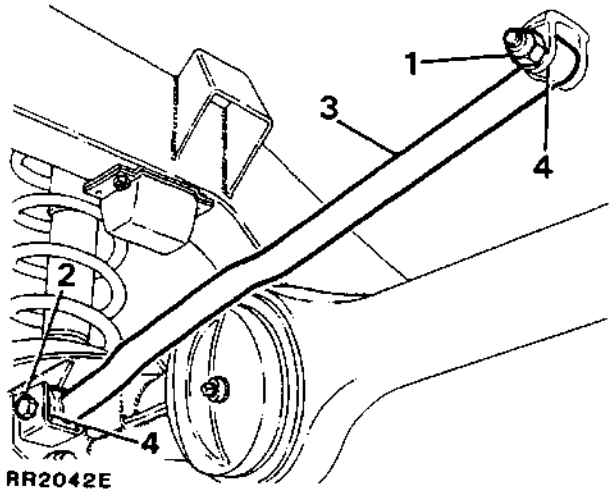
Service repair no - 60. 10. 07.

Remove and refit

Remove

WARNING: Air suspension vehicles: Depressurise system before commencing work, *See AIR SUSPENSION, Repair, Depressurise system*

1. Remove fixings at mounting arm.
2. Remove fixings at axle bracket.
3. Remove Panhard rod.
4. Press out flexible bushes. Ensure the steel tubing locates on the outer edge of the bush and not on the rubber inner.



RR2042E

Refit

5. Fit replacement bushes.

CAUTION: Apply pressure to outer edge of bush, and not rubber inner.

6. Reverse removal procedure. 1 to 4. Tighten fixings to *88Nm*

NOTE: Air suspension vehicles: Repressurise system

RADIUS ARM

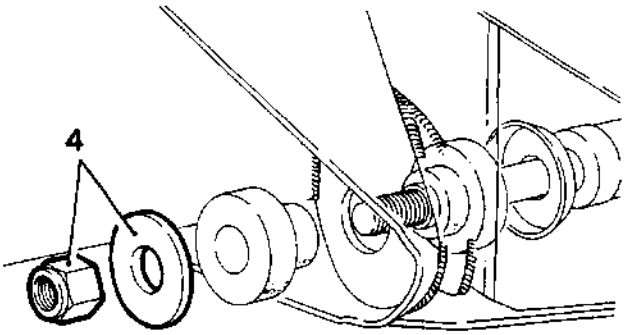
Service repair no - 60.10.16.

Remove and refit

Remove

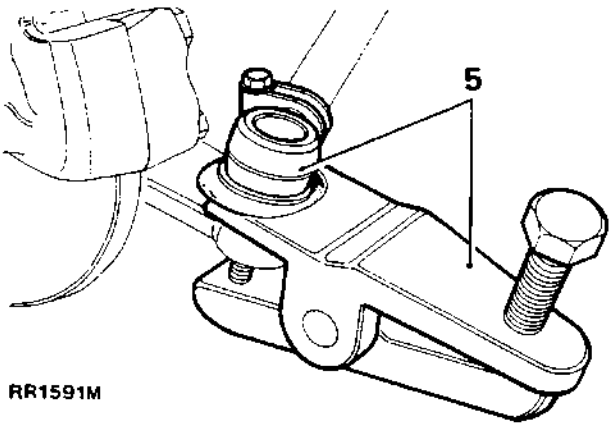
WARNING: Air suspension vehicles: Depressurise system before commencing work, *See AIR SUSPENSION, Repair, Depressurise system*

1. Loosen road wheel retaining nuts.
2. Raise front of vehicle. Support chassis on stands and remove wheel.
3. Support front axle weight with jack.
4. Remove radius arm to chassis side member fixings.

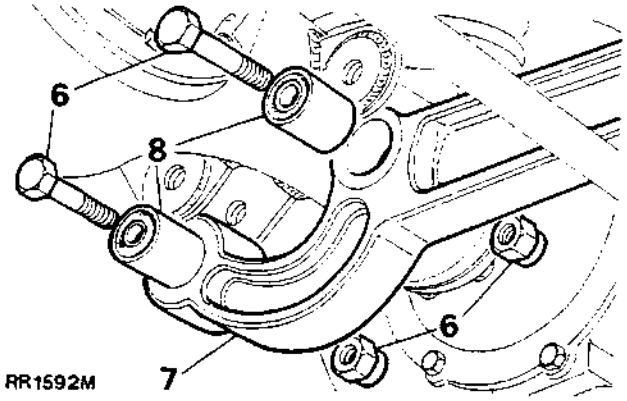


RR983M

5. Disconnect track rod at ball joint.
6. Remove fixings, radius arm to axle.
7. Lower radius arm front end to clear axle and remove from vehicle.



RR1591M



8. Press out flexible bushes.

Refit

9. Press in replacement bushes.

CAUTION: When pressing in new bushes press on outer edge of bush and not rubber inner.

10. Reverse removal procedure. 1 to 7. Tighten fixings to following torques:
Radius arm to chassiss *176 Nm*
Radius arm to axle *197 Nm*

NOTE: Air suspension vehicles: Repressurise system

FRONT SHOCK ABSORBER

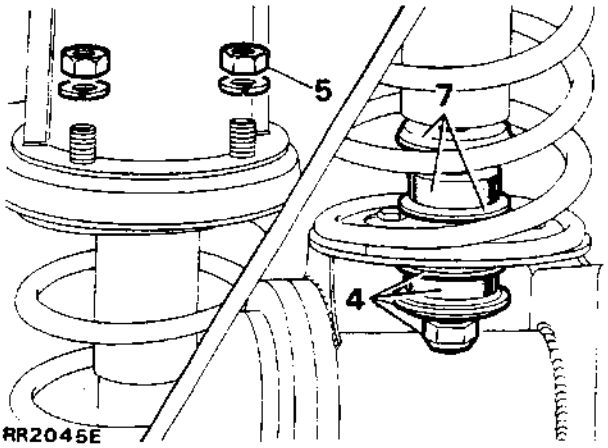
Service repair no - 60.30.02.

NOTE: Air suspension vehicles: ***See AIR SUSPENSION, Repair, Front shock absorber***

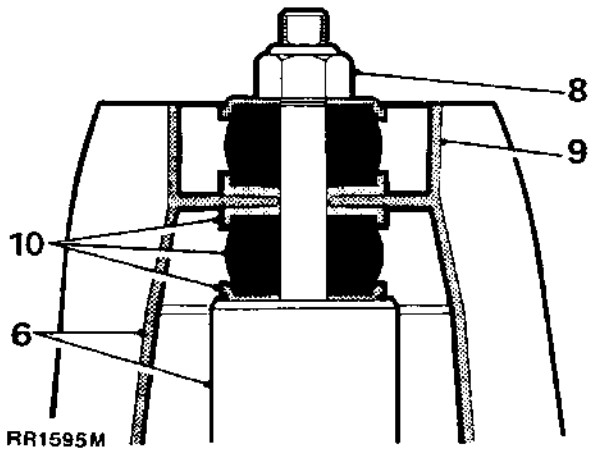
Remove and refit

Remove

1. Loosen road wheel retaining nuts.
2. Support chassis on stands and remove road wheel.
3. Support axle weight with jack.



4. Remove shock absorber lower fixing and withdraw cupwasher, rubber bush and seating washer.
5. Remove four shock absorber bracket fixings.
6. Withdraw shock absorber and bracket complete.



7. Withdraw lower seating washer, rubber bush and cupwasher.
8. Remove fixings, shock absorber to mounting bracket.
9. Withdraw mounting bracket.
10. Lift off top seating washer, rubber bush and cupwasher.

Refit

11. Reverse removal procedure. 1 to 10.

FRONT ROAD SPRING

Service repair no - 60.20.11.

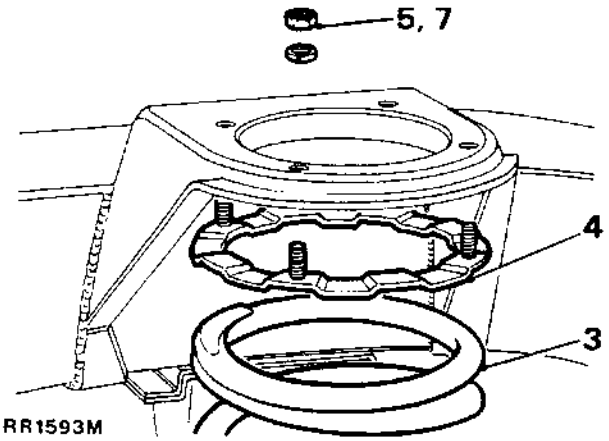
Remove and refit

Remove

1. Remove front shock absorber, ***See Front shock absorber***

CAUTION: Avoid over stretching brake hoses. If necessary loosen hose connector locknuts to allow hoses to follow axle.

2. Lower axle sufficient to free road spring.
3. Withdraw road spring.
4. Withdraw shock absorber bracket securing ring.



Refit

5. Fit shock absorber bracket retaining ring. Retain in position with a nut.
6. Reverse removal procedure. 2 and 3.
7. Remove nut retaining securing ring.
8. Fit front shock absorber.

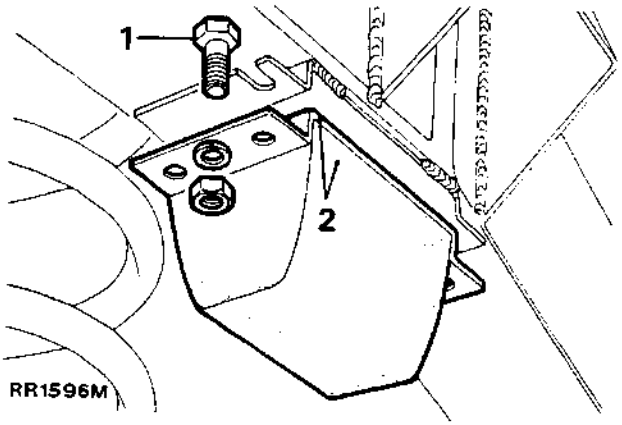
BUMP STOP

Service repair no - 60.30.10.

Remove and refit

Remove

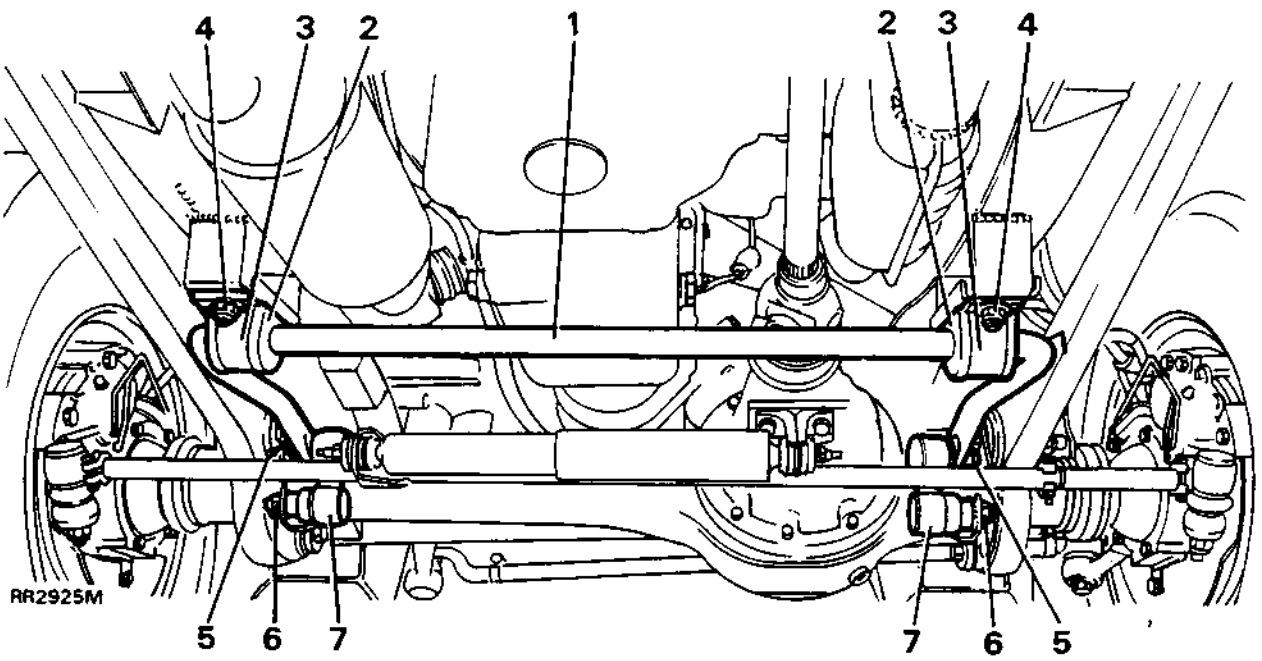
1. Remove fixings.
2. Remove bump stop.



Refit

3. Position bolts in slots in chassis brackets.
4. Fit bump stop, secure with washers and nuts.

ANTI-ROLL BAR ASSEMBLY



KEY

1. Anti-roll bar
2. Rubber bush
3. Strap
4. Nut, bolt, washer
5. Nut and washer
6. Castellated nut and cotter pin
7. Ball joint link arm

ANTI-ROLL BAR FRONT

Service repair no - 60.10.01.

Remove and refit

Remove

1. Mark for reassembly position of rubber bushes on anti-roll bar.
2. Remove four nuts, bolts and washers securing two bush straps.
3. Remove nuts, bolts, washers and rubber bushes from ball joint links and remove anti-roll bar.

Refit

4. Position bushes on anti-roll bar. Ensure split points towards axle.
5. Fit anti-roll bar with two straps. To ensure correct fit angled sides of bar should point down as shown. Loosely fit the bolts, washers and nyloc nuts.
6. Fit bolt, washers and rubber bushes. Using new nuts fit anti-roll bar to ball joint links. Tighten to ***68 Nm.***
7. Tighten nuts securing straps to ***30 Nm***

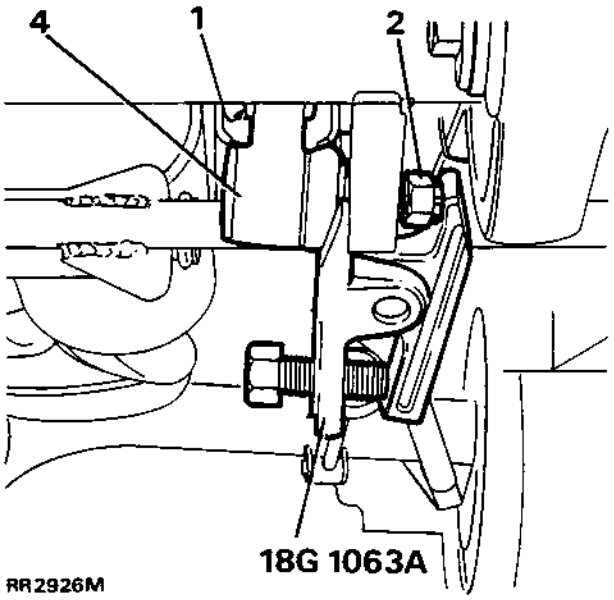
ANTI-ROLL BAR BALL JOINT LINKS

Service repair no - 60.10.04.

Remove and refit

Remove

1. Remove two nuts, bolts, washers and rubber bushes from ball joint links.
2. Remove cotter pin and loosen castellated nut a few turns.
3. Release ball joint using special tool 18G 1063A as shown.
4. Remove castellated nut and ball joint link.



RR2926M

Refit

5. Fit ball joint link and castellated nut. Ensure ball joint link arm points up. Tighten to ***40 Nm*** and fit new cotter pin.
6. Align anti-roll bar to ball joint links.
7. Fit bolts, washers and rubber bushes using new self locking nuts secure anti-roll bar to ball joint links. Tighten to ***68 Nm.***

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Anti-roll bar front	
Strap nyloc nuts	30
Ball link self lock nut	68
Castellated nut	40
Drag link to axle	40
Securing ring for mounting turret	14
Radius arm to chassis	176
Panhard rod mounting arm to chassis	88
Panhard rod to axle	88
Panhard rod to mounting bracket	88
Tie bar to Panhard rod	110
Radius arm to axle (front only)	197

Torque values below are for all screws and bolts used except for those that are specified otherwise.

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

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64 - REAR SUSPENSION

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SPECIFICATIONS, TORQUE

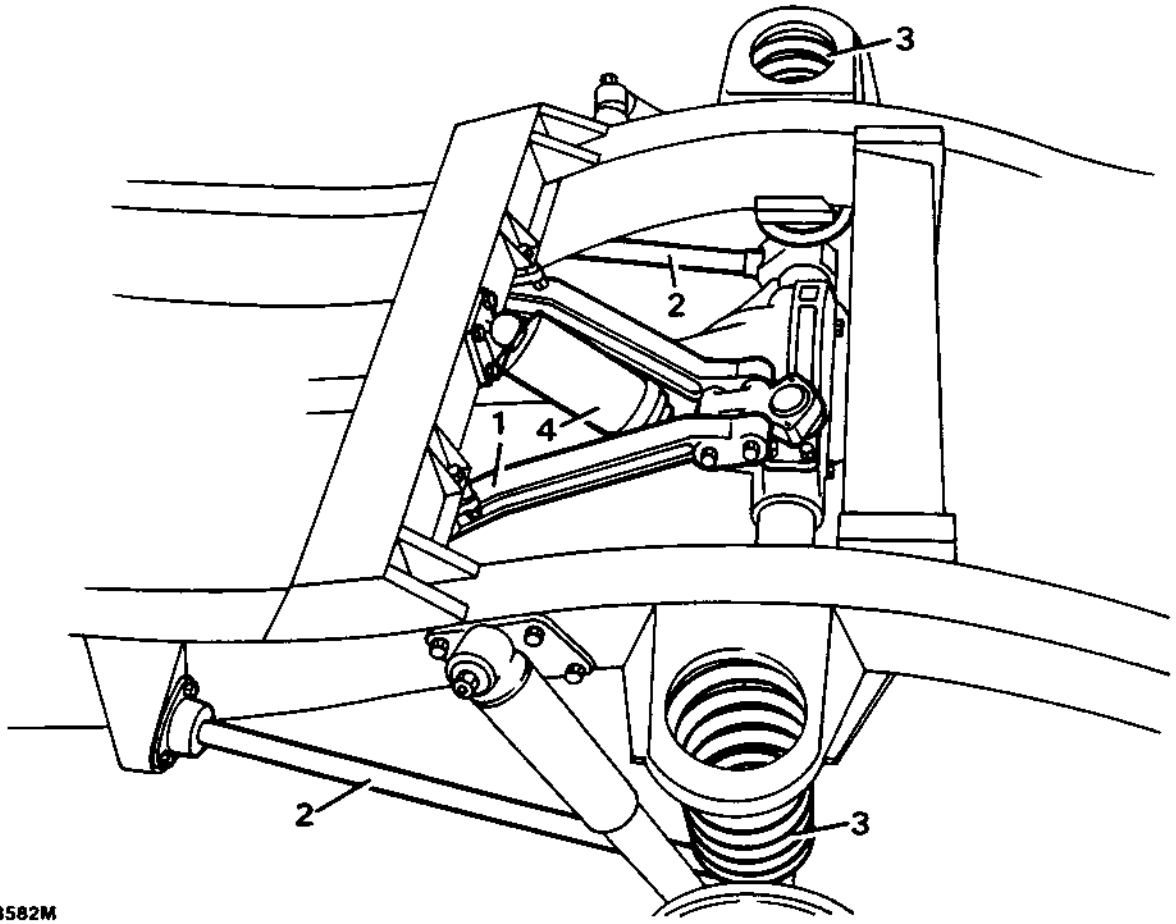
TORQUE VALUES 1



Notes

AXLE LOCATION

Fore and aft location of the rear axle is by solid round section steel radius arms and a forged "A" frame which is secured to a chassis cross member and provides transverse control.



RR3582M

Rear axle suspension

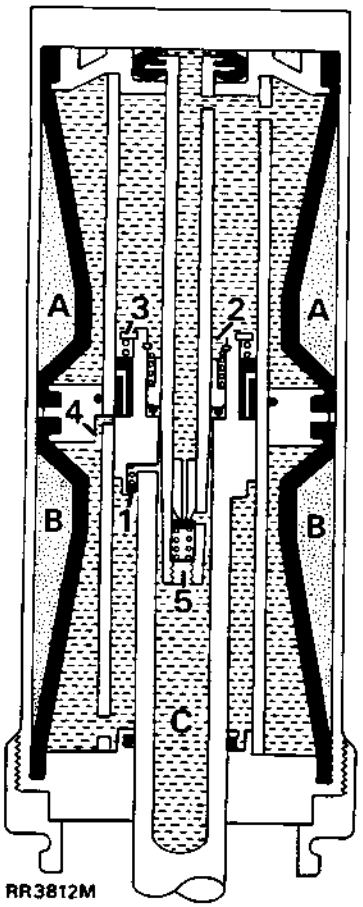
1. "A" frame - transverse location
2. Radius arms - fore aft location
3. Coil springs
4. Self levelling unit

Long travel coil springs and hydraulic shock absorbers, provide the springing for each wheel. On the rear only, a self levelling unit is mounted in conjunction with the "A" frame to provide automatic self levelling of the vehicle, when heavily loaded or towing a trailer.

SELF LEVELING UNIT

DESCRIPTION

The leveling unit fitted to the rear axle is a self contained and sealed for life hydropneumatic device, which resembles a large telescopic damper. The unit utilizes the energy produced by the relative movement of the axle to the vehicle, when the vehicle is in motion, to maintain the vehicle at nominally level height. The unit will compensate for additional loads placed on the vehicle up to the recommended maximum. Excess load beyond the design limits of the unit will prevent it leveling the vehicle but, will not impede its capabilities as a damper.



RR3812M

OPERATION

Leveling the suspension (Pumping up)

The unit, contains hydraulic fluid and an inert gas, pressurized to approximately 65 bar during manufacture. The gas which provides the springing medium, is contained in two chambers **A** and **B** and is separated from the fluid by rubber sleeves. The movement of the axle and pumping action of the piston shaft when the vehicle is in motion, causes fluid to be transferred from the lower chamber to the upper chamber via internal valves **1** and **2** and high pressure chamber **C**. As the fluid is transferred to the upper section of the unit, pressure is applied to the gas in chamber **A** which provides the springing. At the same time the piston shaft is forced outwards increasing the operating length of the leveling unit.

Level position (Fluid circulates)

When the optimum level position is reached, as illustrated in RR3812M, fluid pumped from the lower section to the upper section as previously explained, circulates via valve **3** and port **4** back to the lower section.

Full bump/over load

If the vehicle suspension encounters a large 'bump' in the road or is over loaded the unit provides a damping effect only, as valves **5** and **1** are forced open allowing the pressure to escape from the upper to the lower chamber.

Full rebound

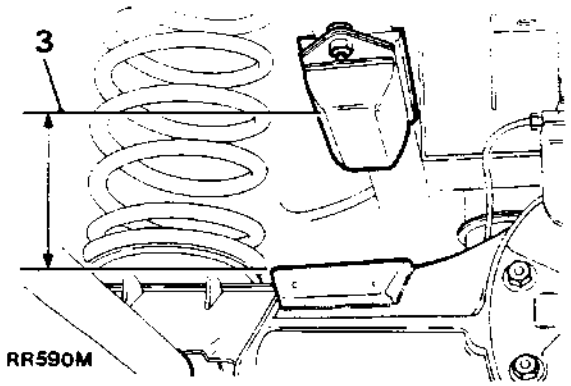
If the vehicle suspension encounters a large 'hole' in the road, the unit extends causing port **4** to allow free flow of fluid between the upper and lower chambers and the pressures to equalise.

SELF LEVELLING UNIT

Functional check

Before carrying out checks, verify vehicle is used within specified maximum loading capability.

1. Check levelling unit for excessive oil leakage, if so, change unit. Slight oil seepage is permissible.
2. Remove excessive mud deposits from underneath vehicle and any heavy items from vehicle that is not original equipment.
3. Measure clearance between rear axle bump pad and bump stop rubber at front outer corner on both sides. Average clearance should be in excess of 67mm. If less, remove rear springs and check their free length against Road Spring Data. ***See GENERAL SPECIFICATION DATA, Information, Road Spring Data***
4. Replace any spring whose free length is more than 20mm shorter than figure given. If after replacing a spring the average bump clearance is still less than 67mm, replace levelling unit.
5. With rear seat upright, load 450 kg into rear of vehicle, distributing the load evenly. Check bump stop clearance, with driving seat occupied.
6. Drive vehicle for 3 miles over undulating roads or graded tracks. Stop vehicle without disturbing loading. With driving seat occupied, check bump stop clearance again.
7. If change in clearance is less than 20mm levelling unit must be replaced. ***See Repair, Levelling unit***



Notes

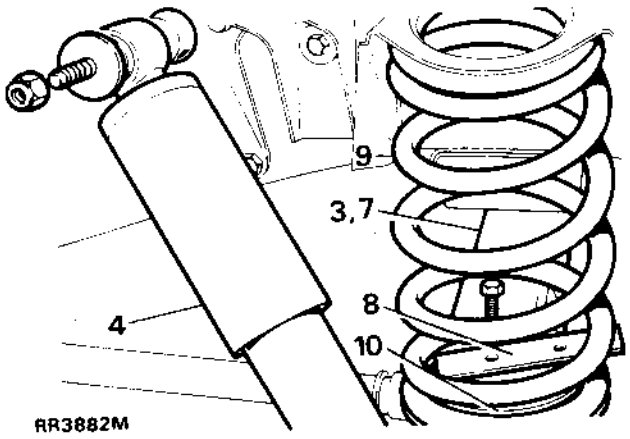
REAR ROAD SPRING

Service repair no - 64.20.01.

Remove and refit

Remove

1. Loosen rear road wheel retaining nuts.
2. Support chassis on stands and remove wheels.
3. Support rear axle weight with jack.
4. Disconnect shock absorbers at one end.



5. Position coil spring compressor correctly on road spring.
6. Compress spring evenly to facilitate removal.
7. Lower axle to free road spring from upper seat.

CAUTION: Avoid lowering axle further than rear brake flexible hose will allow.

8. Remove spring retainer plate.
9. Withdraw road spring.
10. Lift off spring seat.

Refit

11. Reverse removal procedure.

REAR SHOCK ABSORBER

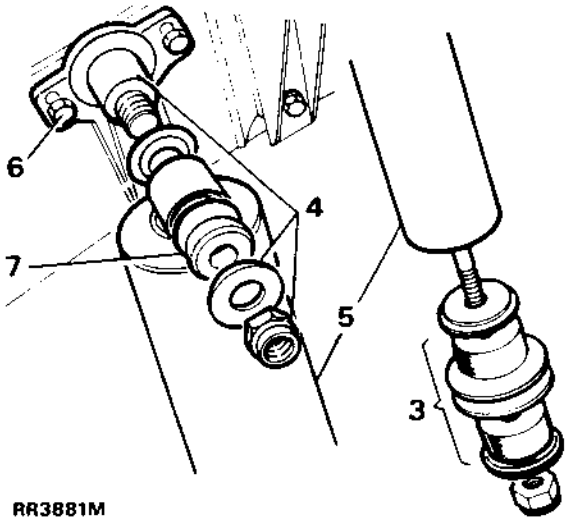
Service repair no - 64.30.02.

Remove and refit

Remove

NOTE: Air suspension vehicles: ***See AIR SUSPENSION, Repair, Rear shock absorber***

1. Loosen road wheel retaining nuts.
2. Support chassis on stands. Remove road wheel and support rear axle weight with jack.
3. Remove fixings and withdraw shock absorber from axle bracket.



4. Remove upper fixings.
5. Withdraw shock absorber.
6. If required remove mounting bracket
7. If required remove mounting rubbers.

Refit

8. Reverse removal procedure.

LEVELLING UNIT

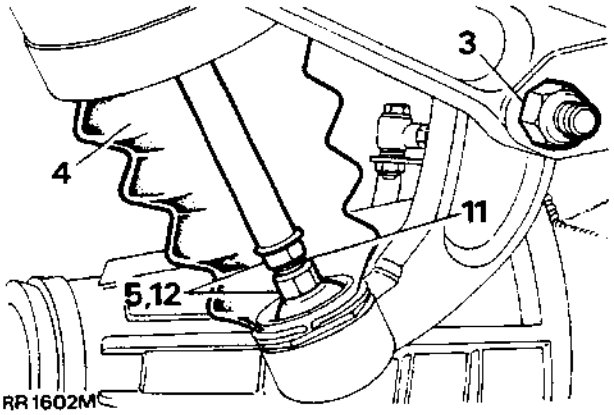
Service repair no - 64.30.09.

Remove and refit

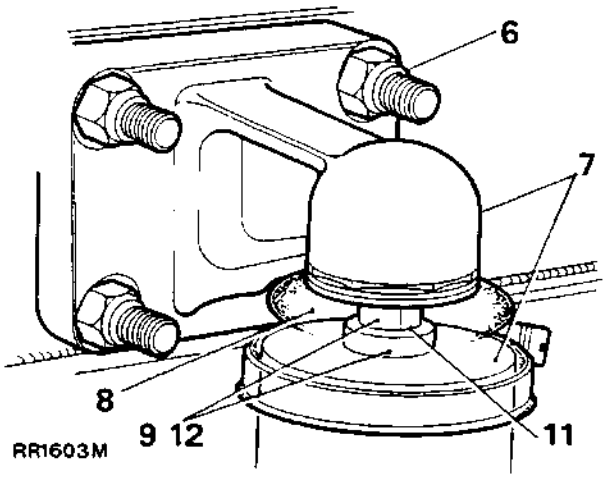
Remove

WARNING: The levelling unit contains pressurised gas and must not be dismantled or casing screws removed. Repair is by replacement of complete unit only.

1. Support chassis rear on stands.
2. Support axle weight with jack.
3. Disconnect suspension upper links at pivot bracket.



4. Lift up lower boot.
5. Unscrew lower ball joint at levelling unit push rod.
6. Remove top bracket fixings at cross member.
7. Withdraw levelling unit and top bracket complete.
8. Lift up upper boot.
9. Unscrew upper ball joint at levelling unit.
10. Withdraw upper and lower boots and retaining spring.



Refit

11. Coat ball pin threads with 'Loctite' grade CVX or equivalent sealant.
12. Reverse removal procedure. 1 to 10. Fit all items in position, then tighten to correct torque. ***See Specifications, torque, Torque Values***

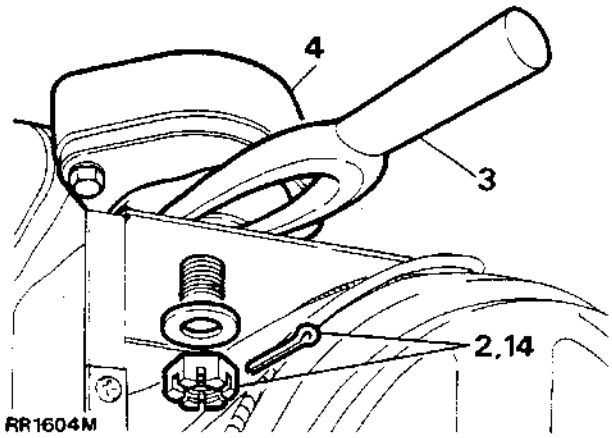
LEVELLING UNIT BALL JOINTS

Service repair no - 64.30.10.

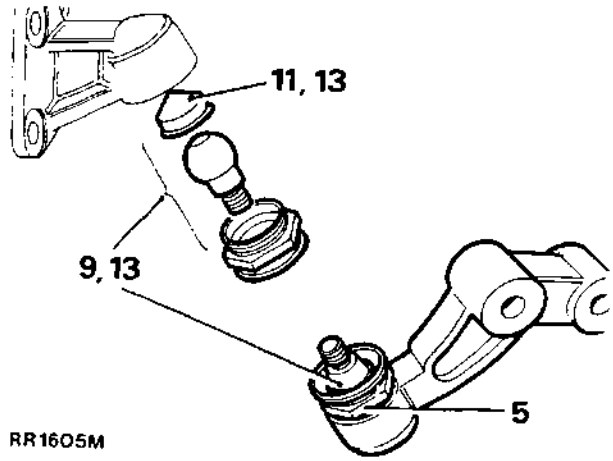
Remove and refit

Remove

1. Remove levelling unit. ***See Levelling unit***
2. Remove cotter pin and nut at rear axle bracket.
3. Extract ball pin from axle bracket using extractor RO1006.
4. Withdraw pivot bracket with ball joints.



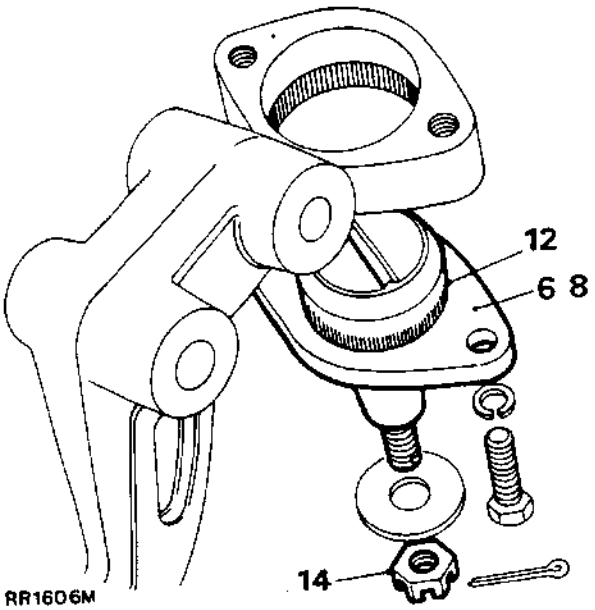
5. Unscrew ball joint assembly.
6. Remove ball joint assembly from axle bracket.



7. Replacement ball joints are supplied complete, less fixings, and greased.
8. Axle bracket ball joint must not be dismantled.
9. Levelling unit ball joint may be dismantled and cleaned.
10. Pack ball joint with Dextagrease GP or equivalent grease.
11. Ensure that ball is square in housing before refitting.

Refit

12. Press knurled ball joint into pivot bracket.
13. Screw levelling unit ball joints into mounting brackets. Ball joints should screw in easily and fully. Tighten to correct torque. ***See Specifications, torque, Torque Values***



14. Fit pivot bracket complete with ball joints to rear axle. Tighten to ***176 Nm.***
15. Fit levelling unit.

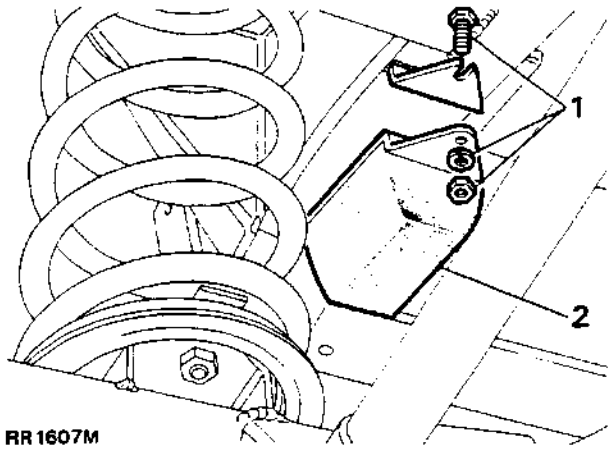
BUMP STOP

Service repair no - 64.30.15.

Remove and refit

Remove

1. Remove fixings.
2. Remove bump stop.



Refit

3. Position bolts in slots in bracket.
4. Fit bump stop secure with washer and nuts.

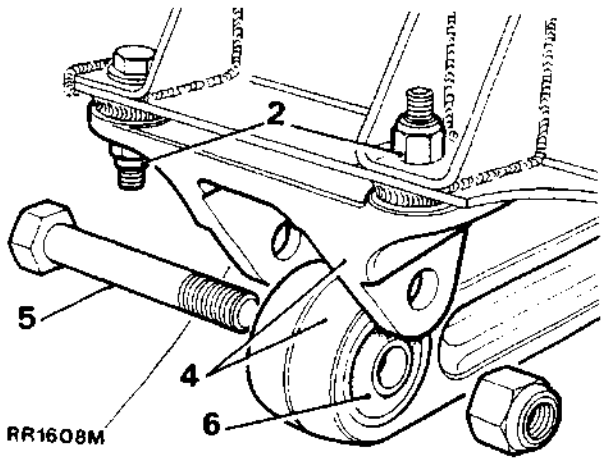
SUSPENSION LINK UPPER

Service repair no - 64.35.44.

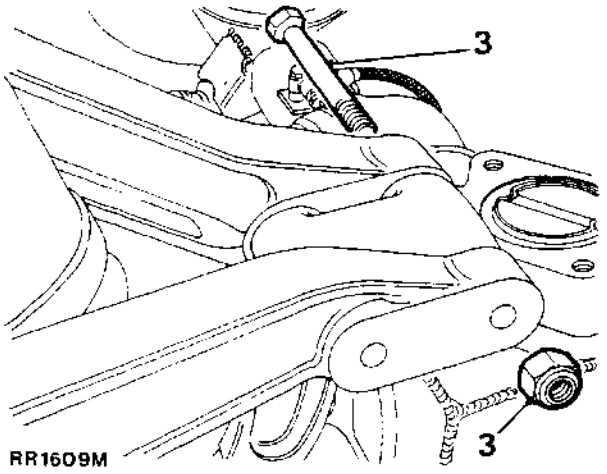
Remove/renew bush and refit

Remove

1. Support rear of chassis on stands, allow axle to hang freely.
2. Remove fixings, upper link bracket to frame.
3. Remove fixings, upper links to pivot bracket.
4. Remove upper link complete with frame bracket.



5. Remove bolt.
6. Separate link from bracket.



Renew bush

7. Press out rubber bushes.
8. Fit bush centrally in housing.

CAUTION: Apply pressure to outer edge of bush, and not rubber inner.

Refit

9. Reverse removal procedure. 1 to 6. Do not fully tighten fixings until all components are in position.
10. Tighten fixings to correct torque. ***See Specifications, torque, Torque Values***

SUSPENSION LINK LOWER

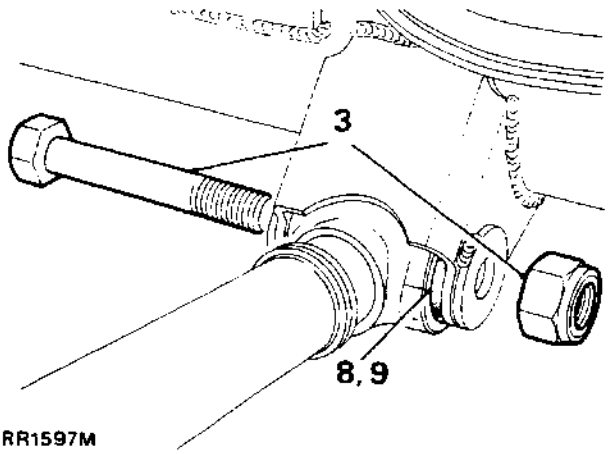
Service repair no - 64.35.02.

WARNING: Air suspension vehicles: Depressurise system before commencing work, *See AIR SUSPENSION, Repair, Depressurise system*

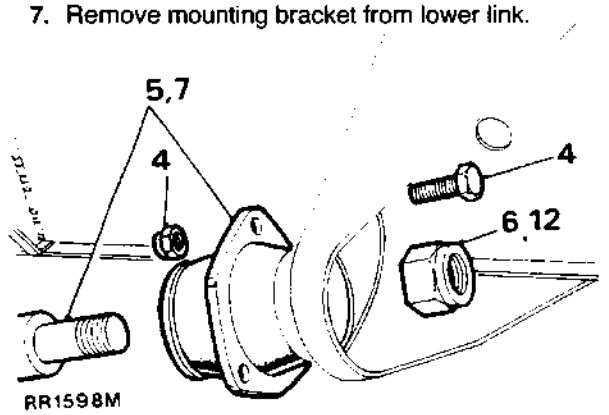
Remove/renew bush and refit

Remove

1. Site vehicle on a ramp
2. Alternatively, support vehicle on stands under rear axle.
3. Remove rear fixings.



4. Remove mounting bracket fixings at side member bracket.
5. Remove lower link complete.
6. Remove locknut.
7. Remove mounting bracket from lower link.



Renew bush

8. Press out rubber bushes.
9. Fit bush centrally in housing.

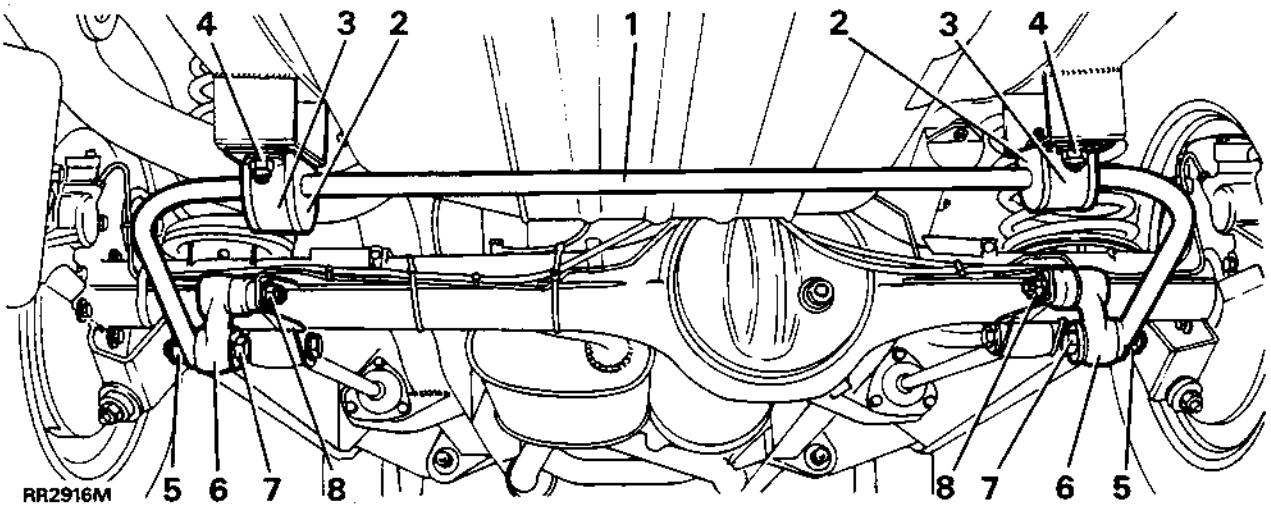
CAUTION: Apply pressure to outer edge of bush, and not rubber inner.

Refit

10. Reverse instructions 6 and 7. Do not tighten locknut.
11. Reverse instructions 3 to 5.
12. Lower vehicle, allow axle to take up static laden position. Tighten locknut to ***176Nm***

NOTE: Air suspension vehicles: Repressurise system

ANTI-ROLL BAR ASSEMBLY REAR



KEY

1. Anti-roll bar
2. Rubber bush
3. Strap
4. Nut, bolt, washer
5. Nut and washer
6. Ball joint link arm
7. Bolt and washer
8. Castellated nut and cotter pin

ANTI-ROLL BAR REAR

Service repair no - 64.35.08.

Remove and refit

Remove

1. Note for reassembly, position of rubber bushes on anti-roll bar.
2. Remove four nuts, bolts and washers securing two bush straps.
3. Remove nuts, bolts, washers and rubber bushes from the ball joint links and remove anti-roll bar.

Refit

4. Position rubber bushes on anti-roll bar. Fit joint towards axle.
5. Fit anti-roll bar with two straps. Ensure ball joint link arms point down as shown. Loosely fit, bolts, washers and new nyloc nuts.
6. Fit bolt, washers and rubber bushes. Fit anti-roll bar to ball joint links. Tighten to ***68Nm***
7. Tighten nuts securing straps to ***30Nm.***

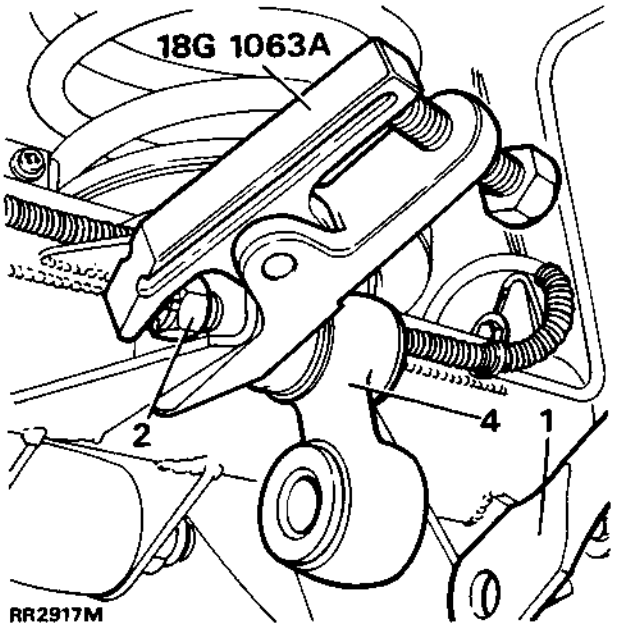
ANTI-ROLL BAR BALL JOINT LINKS

Service repair no - 64.35.24.

Remove and refit

Remove

1. Remove two nuts, bolts, washers and rubber bushes from ball joint links and lower anti-roll bar to clear links.
2. Remove cotter pin and loosen castellated nut a few turns.
3. Release ball joint using special tool 18G 1063A as shown.
4. Remove castellated nut and ball joint link.



Refit

5. Fit ball joint link arm and castellated nut. Point ball joint link arm down as shown. Tighten to ***40Nm*** and fit new cotter pin.
6. Align anti-roll bar to ball joint links.
7. Fit bolts, washers and rubber bushes using new self locking nuts secure anti-roll bar to ball joint links. Tighten to ***68Nm.***

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Anti-roll bar rear	
Strap nyloc nuts	30
Ball link self lock nut	68
Castellated nut	40
Ball joint - levelling unit to rear axle	176
Top link to levelling unit	115
Top link to mounting bracket	176
Upper joint to levelling unit	34
Lower joint to levelling unit	34
Bottom link to axle	176
Bottom link to chassis	176
Top link bracket to rear cross member	47
Levelling unit to cross member	47
Shock absorber to axle	37

Torque values below are for all screws and bolts used except for those that are specified otherwise.

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

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SERVICE TOOLS

RECOMMENDED EQUIPMENT 1



RANGE ROVER ELECTRONIC AIR SUSPENSION - (EAS)

Description

The electronic air suspension is a versatile microprocessor controlled system that exploits the advantages of air suspension. It provides a variable spring rate which achieves near constant ride frequency for all load conditions, giving:

- **Improved ride quality.**
- **Continuity of ride quality, laden or unladen.**
- **Constant ride height.**
- **Improved headlamp levelling.**

The function of the system is to provide five height modes, each of which is automatically maintained at the given height by the system logic with the minimum of driver involvement. Vehicle height is sensed by four rotary potentiometer type height sensors. Vehicle height information from each potentiometer signals the ECU to adjust each air spring by switching the solenoid valves to hold, add or release air. The system provides five height settings and automatic self levelling as follows:

Standard - standard ride height i.e. 790mm ± 7mm, measured from centre of wheelarch eyebrow to floor.

Low profile: 20 mm below standard.

Access: 60 mm below standard.

High profile: 40 mm above standard.

Extended profile: 20 to 30 mm above high profile.

Self levelling

The system provides self levelling under varying vehicle loads. The vehicle will self level to the lowest corner height level for 20 seconds after switching off engine, exiting vehicle and closing doors.

Standard

Vehicle ride height is the same as with conventional suspension, but is maintained under all load conditions. This also provides improved headlamp levelling.

Low profile

This position gives improved handling and fuel consumption at high speed. When the vehicle speed exceeds 80 kph (50 mph) for more than 30 seconds, with INHIBIT switch off, the vehicle will enter the low profile position. The vehicle will return to standard height when vehicle speed drops below 56 kph (35 mph) for more than 30 seconds, unless vehicle stops, in which case it returns to standard when driven away. The LOWER lamp is illuminated in this condition.

Access

This position makes passenger boarding and luggage loading easier. With the vehicle stationary, park brake on (manual), P selected (automatic), footbrake off, doors closed and INHIBIT switch off, pressing the LOWER switch will select the ACCESS position. It is possible to select access for 15 seconds after switching engine off. The LOWER lamp flashes until access position is reached, when it remain constantly illuminated

△ **NOTE: Opening a door will freeze vehicle position.**

From access the vehicle will return to standard ride height if the RAISE switch is pressed, OR inhibit switched on OR park brake released, OR the vehicle driven off.

High profile

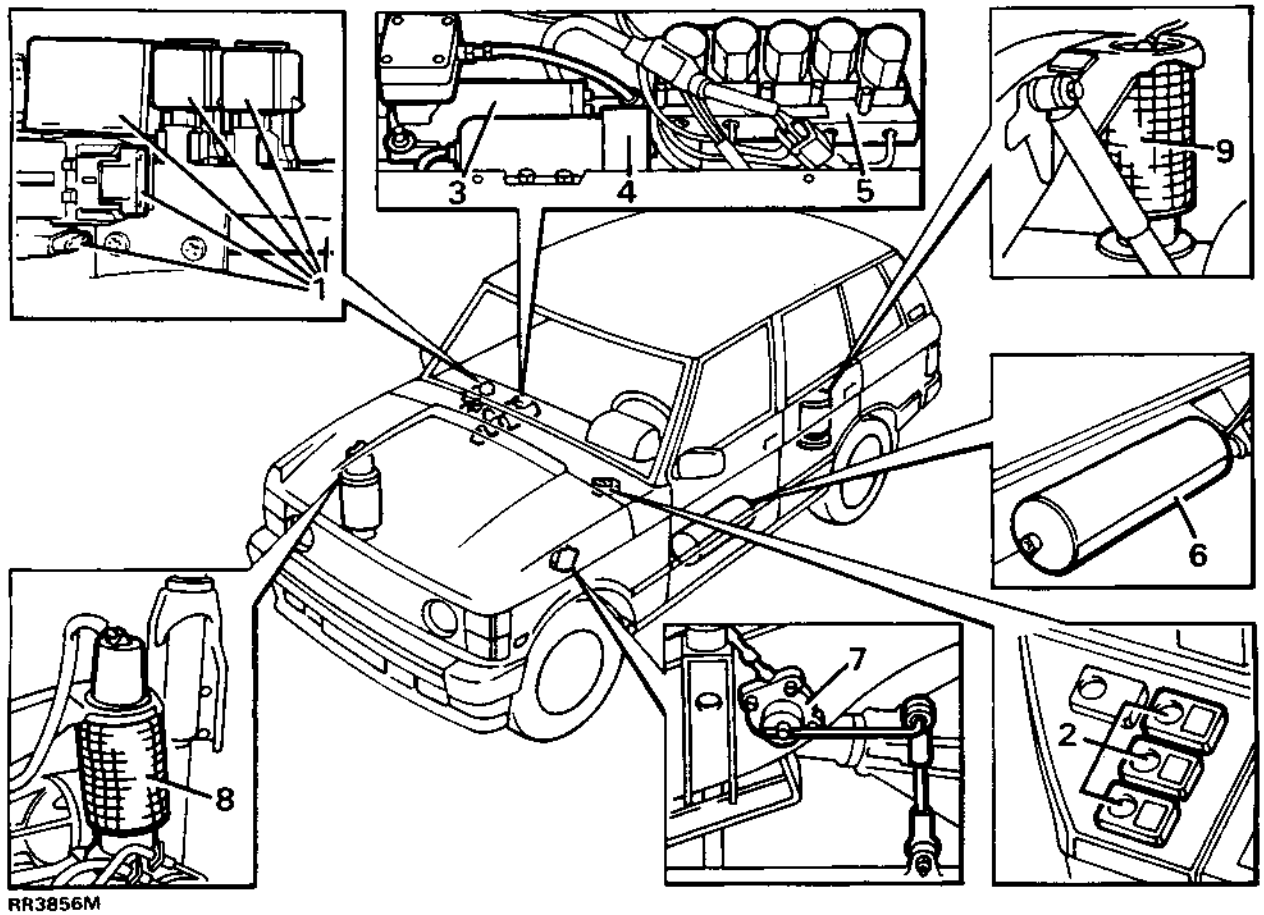
This position is used to improve approach and departure angles and when wading. Pressing the RAISE switch will select this position provided the road speed is below 56 kph (35 mph) with INHIBIT off. The vehicle will return to standard position when road speed exceeds 56 kph (35 mph) or LOWER switch is pressed. The RAISE lamp is illuminated in this condition.

△ **NOTE: When raising ride height, rear of vehicle will raise by 70% of movement first followed by 70% of front. Rear will raise remaining 30% before front. Lowering will be achieved by lowering front of vehicle first. This will ensure that, with headlamps illuminated, there is no inconvenience from headlamp dazzle to other road users. BUT, lowering to access position will be achieved by the fastest possible means, by opening all air valves at the same time.**

Extended profile

This position is achieved when vehicle is off road in standard or high profile and the chassis is grounded leaving wheels unsupported. Initial ECU reaction is to deflate (lower) affected springs. After a timed period ECU detects no height change, therefore it reinflates springs in an attempt to regain traction. The RAISE lamp will flash in this mode. After ten minutes system will return to high profile, unless LOWER switch is pressed.

LOCATION OF COMPONENTS (RR3856M)



RR3856M

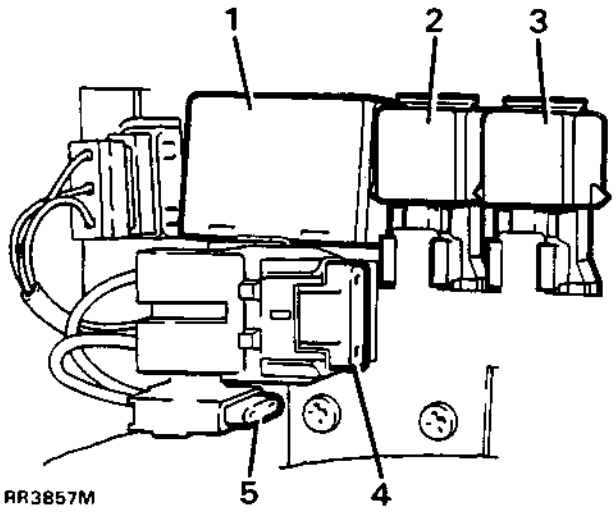
1. Electronic control unit (ECU), relays, fuses and disable switch.
2. Control switches
3. Compressor
4. Air dryer
5. Valve block
6. Reservoir
7. Height sensors (4)
8. Front air spring
9. Back air spring

DESCRIPTION OF COMPONENTS - see RR3868M

Electrical control unit - ECU

The ECU is located underneath the right hand front seat, on top of the fuel ECU. It maintains the requested vehicle ride height by adjusting the volume of air in each air spring. It is connected to the cable assembly by a 35 way connector. To ensure safe operation the ECU has extensive on board diagnostic and safety features. The ECU is non-serviceable, in case of failure it must be replaced.

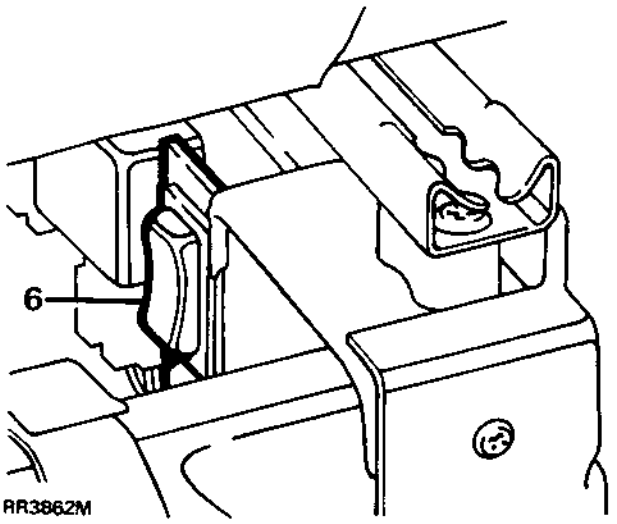
Relays, fuses - RR3857M



Power supply for the system consists of the following components:

1. Delayed power turn off relay. This remains powered up for 20 seconds after exiting vehicle to allow self levelling.
2. Compressor relay, 4 pin.
3. Warning light relay, 5 pin.
4. 30 amp 'maxifuse' for compressor power.
5. 15 amp fuse for ECU pin 1.

Disable switch - RR3862M

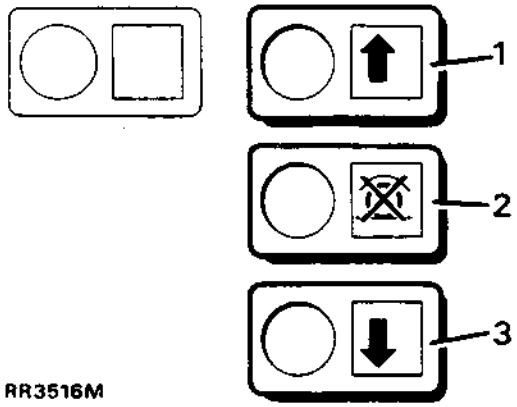


The disable switch 6. is mounted under the right hand front seat. The switch has no markings, in the DISABLE position the bottom of the switch is pushed in. It is used to disable system when vehicle is being delivered, or when working on the system after depressurising. The switch disables the system at speeds below 56 kph (35 mph).

Height sensors

Four potentiometer type height sensors signal vehicle height information to the ECU. The potentiometers are mounted on the chassis and activated by links to the front radius arms and rear trailing links. In case of height sensor failure the assembly must be replaced.

Control switches - see RR3516M



RR3516M

Mounted on the lower fascia, three control switches are arranged thus:

1 - Raise - momentary touch switch.

2 - Inhibit - self latching switch, when switched on the vehicle will remain at standard ride height. This position is used when the automatic height adjustment is not required i.e. when towing. Self levelling will continue to function.

3 - Lower - momentary touch switch.

The switches incorporate a warning lamp. When engine is started all three warning lamps will illuminate for three seconds as part of bulb check. The switches are illuminated when the vehicle lights are on, controlled by the dimmer switch.

The following components, AIR COMPRESSOR, AIR DRYER and VALVE BLOCK are contained in the AIR SUPPLY UNIT mounted on the right hand chassis side.

Air compressor

The air compressor provides system pressure. A thermal switch is incorporated which switches off the compressor relay earth at 130°C. The compressor has an air intake silencer mounted behind rear mud flap. The air intake filter is located adjacent to the fuel filler flap. The filter is renewed every 40,000 kms/24,000 miles/24 months. (30,000 miles USA).

Air dryer

The air dryer is connected into the air line between compressor and reservoir. It removes moisture from pressurised air entering the system. When air is exhausted from the system it passes through the dryer in the opposite direction. The air dryer is regenerative in that air absorbs moisture in the dryer and expells it to atmosphere.

The air dryer unit is non-serviceable, designed to last the life of the vehicle. However if water is found in the system when reservoir drain plug is removed, the air dryer must be changed.

CAUTION: If the air dryer is removed from the vehicle the ports must be plugged to prevent moisture ingress.

Valve block

The valve block controls the direction of air flow. Air flow to and from the air springs is controlled by six solenoid operated valves, one for each air spring, one inlet and one exhaust. A diaphragm valve operated by the solenoid outlet valve ensures that all exhausted air passes through the air dryer. In response to signals by the ECU, the valves allow high pressure air to flow in or out of the air springs according to the need to increase or decrease pressure. The valve block is non-serviceable, in case of failure it must be replaced.

Non-return valves

The valve block contains three non-return valves.
NRV1 retains compressor air pressure by preventing flow back to the compressor.
NRV2 prevents loss of pressure in the system if reservoir pressure drops. It also ensures correct flow through the inlet valve.
NRV3 ensures correct flow through the exhaust valve.

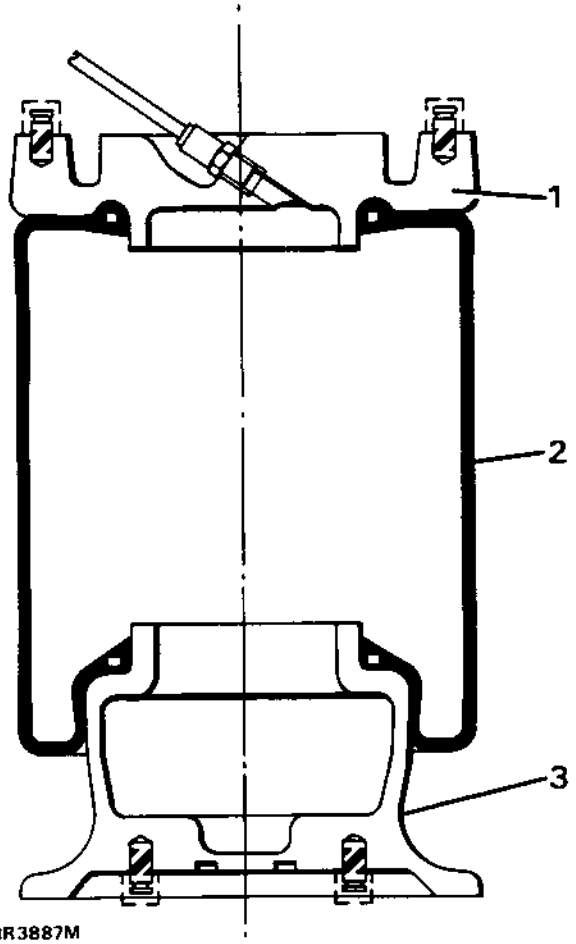
Reservoir

The 10 litre reservoir is mounted on the left hand side of the chassis. One connection acts as inlet and outlet to the rest of the system. It stores compressed air between set pressure levels. The reservoir drain plug requires removing every 40,000 kms/24,000 miles/24 months. (30,000 miles USA) to check for moisture in the system, ***See Repair, Air reservoir - drain.***

Pressure switch

Mounted on the reservoir is a pressure switch which senses air pressure and signals the ECU to operate the compressor when required. The compressor will operate when pressure falls to between 7.2 and 8.0 bar. It will cut out at a rising pressure of between 9.5 and 10.5 bar.

Air springs - see RR3887M



RR3887M

Air springs components

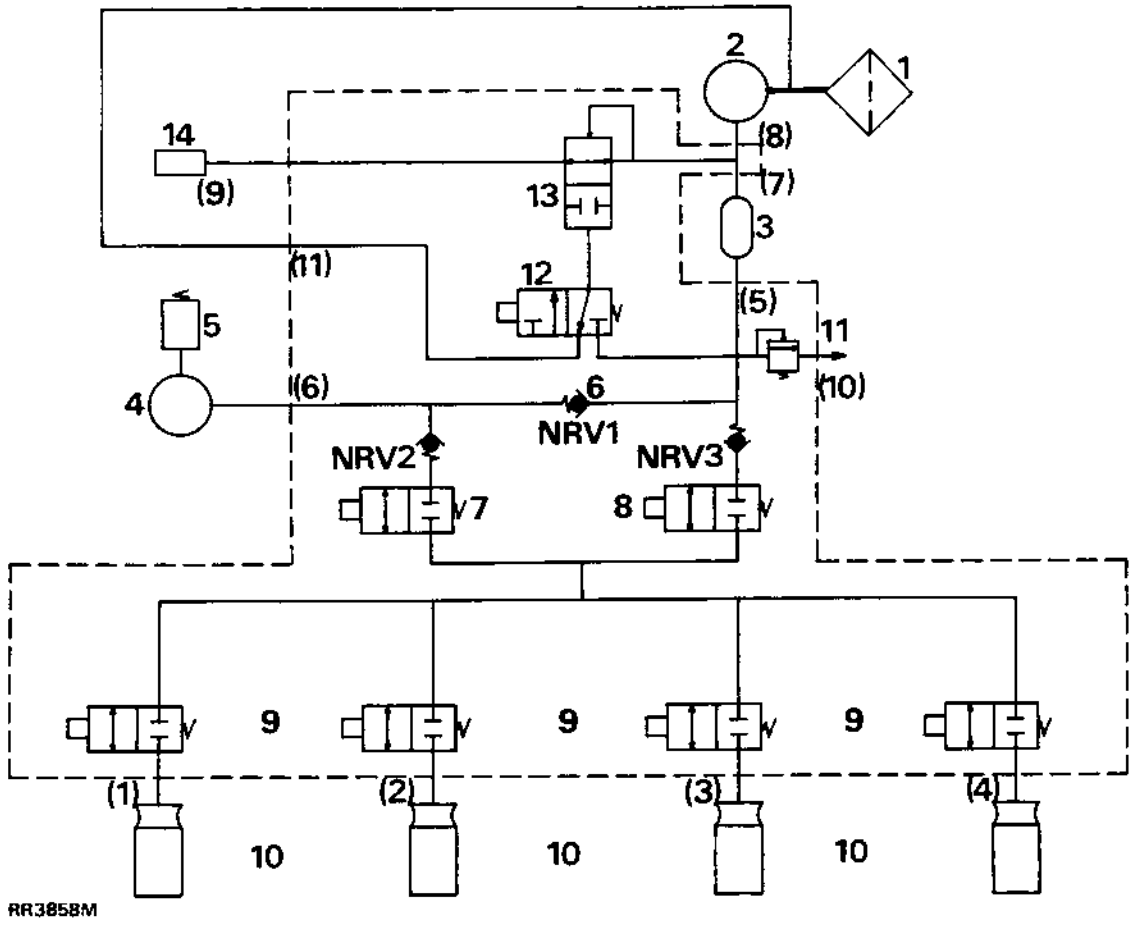
1. Top plate
2. Rolling rubber diaphragm
3. Piston

The air springs are mounted in the same position as conventional coil springs.

Front and back air springs are of similar construction, but are not interchangeable.

The diaphragm is NOT repairable, if failure occurs the complete unit must be replaced.

PNEUMATIC SYSTEM DIAGRAM



Key to RR3858M

1. Inlet filter
2. Compressor
3. Air dryer
4. Reservoir
5. Pressure switch

Valve block comprises items 6. to 12.

1. One way valves NRV1, 2 and 3.
2. Inlet solenoid valve
3. Exhaust solenoid valve
4. Air spring solenoid valves
5. Air springs
6. Pressure relief valve
7. Solenoid diaphragm valve
8. System air operated diaphragm valve
9. Silencer

Valve block port numbers (1) TO (11)

(1) Air spring - back left
(2) Air spring - back right
(3) Air spring - front left
(4) Air spring - front right
(5) Dryer outlet
(6) Reservoir in/out
(7) Dryer inlet
(8) Compressor inlet
(9) Outlet
(10) Pressure relief valve vent
(11) Diaphragm outlet (to compressor inlet)

---------- denotes valve block

AIR PIPE COLOUR CODES

The following pipes have a coloured band to aid assembly:

Component	Colour
Back left spring	Red
Back right spring	Blue
Front left spring	Yellow
Front right spring	Green
Reservoir	Brown
Exhaust	Violet

SYSTEM OPERATION - see RR3858M

Air is drawn through the inlet filter 1. to the compressor 2., where it is compressed to 10.0 ± 0.5 bar.

Compressor operation activates the diaphragm solenoid valve 12. to prevent air going straight to atmosphere.

Compressed air passes to the air dryer 3. Moisture is removed as air flows through the dryer dessicant. The dessicant in the dryer becomes wet.

Dried air passes to the valve block, through NRV1 to the reservoir 4.

The three non-return valves 6. ensure correct air flow. They also prevent loss of spring pressure if total loss of reservoir pressure occurs.

A pressure switch 5. maintains system pressure between set limits by switching the compressor on and off via an ECU controlled relay.

For air to be admited to any spring or springs, inlet valve 7. and the relevant air spring solenoid valve or valves 9. must be energised.

For air to be exhausted from any spring, the exhaust valve 8. and the relevant air spring solenoid valve or valves must be energised.

The diaphragm solenoid valve ensures that air exhausted to atmosphere passes through the dryer. This action purges moisture from the dessicant and regenerates the air dryer.

Air is finally exhausted through the system air operated diaphragm valve 13. and to atmosphere through a silencer 14. at the chassis rear crossmember.

ECU INPUTS

The air suspension system is controlled by the ECU, which operates dependant on driver selected inputs plus those listed below. In each mode the ECU maintains the requested ride height by adjusting the volume of air in one or more of the air springs.

Battery - 12 volt supply from ignition load relay.

Engine - from alternator phase tap, signals engine speed to ECU. Note that engine must be running for all height changes, except access and self-levelling when parked. The compressor will be disabled if engine speed falls below 500 rev/min. This is to prevent the compressor drawing current from the battery when the alternator is not charging.

Height sensors - four potentiometer height sensors provide suspension height signals to the ECU.

Road speed - the road speed transducer provides information enabling height changes to occur at correct road speed. Input speed signal to ECU is from a buffer unit located in the driver's side footwell.

Interior light delay unit - signals ECU if any door, not tailgate, is opened, which immediately suspends all height changes.

Parkbrake switch, manual vehicles - the parkbrake must be ON to enter ACCESS.

Gearbox inhibit switch, automatic vehicles - the transmission must be in park to enter ACCESS, parkbrake on or off.

Footbrake switch (brake light) - when footbrake is applied, and for one second after release, all height levelling is suspended below 1.6 kph (1 mph) and above 8 kph (5 mph). The purpose of this is to prevent the system reacting to suspension movement caused by weight transfer during braking and to prevent suspension wind up during height change. Note that this inhibit function is removed after sixty seconds e.g. if footbrake is held on for this time.

Delayed turn off relay - remains energised after switching engine off and exiting vehicle, enables self levelling to occur for 20 secs. If vehicle is stationary, the ECU will energise the relay every six hours to allow self levelling to occur if necessary.

Reservoir pressure switch - when the ECU detects an output from the pressure switch indicating low pressure, the ECU will operate the compressor relay until the pressure switch indicates normal pressure.

Diagnostic plug ground - note that the two halves of the diagnostic plug are normally connected. When disconnected the system will not operate. It will remain frozen at its current height until reconnected.

Disable switch - In the disable position the switch sends a door open signal to the ECU. This freezes the system in position at speeds below 56 kph (35 mph).



SYSTEM FUNCTION

The following table indicates conditions required for various air suspension modes.

△ **NOTE: That the engine must be running unless indicated, and that ACCESS may be selected for 15 seconds after switching engine off.**

Function	Condition		Warning lamp on
1. Automatic functions - Inhibit switch OFF.			
High profile to standard	Over 56kph (35mph)		No
Standard to low profile	Over 80kph (50 mph) for 30 secs		Lower
Low profile to standard	Below 56kph (35 mph) for 30 secs (but above 1.6 kph (1 mph))		No
Access to standard	Park brake off or drive away		No
2. Driver select functions - Inhibit switch OFF.			
Standard to high profile	Raise switch below 56kph (35 mph)		Raise
High profile to standard	Lower switch below 56kph (35 mph)		No
Standard to access	Lower switch	)Stationary/)park brake on	Lower
Low profile to access (where vehicle has not returned to standard	Lower switch	)- manual/)transmission P)- automatic/	Lower
High to Access	Press lower switch twice	)doors shut	No
Access to standard	Raise switch		Lower
Access to high	Press raise switch twice		Raise
3. Inhibit switch ON			
High profile to standard	Below 56kph (35 mph)		Inhibit
Low profile to standard			Inhibit
Access to standard	Stationary/park brake on		Inhibit
4. Self levelling			
Vehicle levelling for 20 secs, and every 6 hrs	Stationary/engine off/ exit vehicle		No

DIAGNOSTICS AND FAULT RECOVERY

The ECU incorporates Fault Recovery Strategies to minimise the effect of a system failure. A serial data link is provided to allow diagnostic information to be retrieved using the Lucas hand held tester. This is also used to set height sensor datum when required. Note that the serial link connector is coloured black for identification purposes. Any faults stored in the ECU memory, from the previous or current running period will cause the ECU to flash the RAISE and LOWER lamps for 30 secs. followed by continuous illumination. If the ECU registers a system fault, it will store the fault in the memory. The fault recovery programme will operate the system depending on the nature of the fault as follows:

Speed sensor fault - the ECU will place the system in standard height and activate inhibit.

Height sensor fault - the ECU will place the system in standard height and activate inhibit. Note that if more than one height sensor fails, the ECU will deflate the air springs to the bump stops.

WARNING: If any two failures occur the system deflates and lowers vehicle to its bump stops, it is possible to drive the vehicle provided that great caution is exercised. The vehicle ride will be extremely uncomfortable and only low speeds will be possible. It is essential that the vehicle fault is rectified as soon as possible.

Pressure switch fault - the ECU will register pressure switch failure if it detects that the compressor has worked for a programmed time with normal air spring operation possible. The ECU will periodically operate the compressor as air is required. The vehicle will be inhibited to standard.

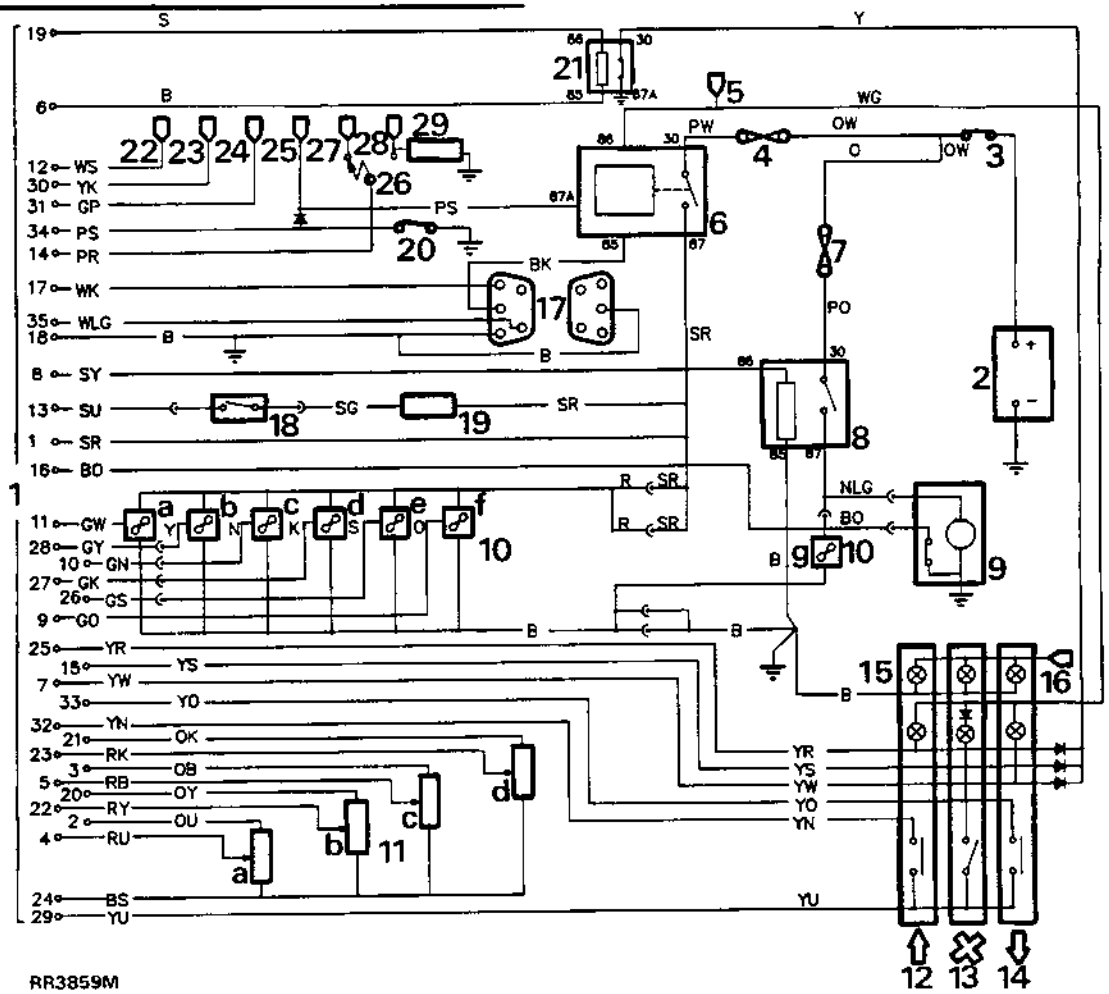
Compressor fault - the ECU will register compressor failure if it detects that the compressor has worked for a programmed time with normal air spring operation not possible. The ECU will attempt to place the system in standard ride height, or a safe lowered position (which could be system deflated). The system will be inhibited from further ride height changes.

Air leaks - during normal operation the ECU correlates the operating time of the compressor with air usage. If compressor use is greater than programmed, the ECU will register an air leak and attempt to place the system in standard ride height, or a safe lowered position (which could be system deflated). The system will be inhibited from further ride height changes.

Valve block fault - the control of each air spring is monitored to determine that every valve is working correctly.

1. If the ECU detects an air valve stuck open it will attempt to adjust the vehicle to standard height or a safe lowered position (which could be system deflated). The system will be inhibited from further ride height changes.
2. If an air valve is stuck closed above standard height the ECU will deflate the other three air springs.
3. If an air valve is stuck closed, at or below standard height, the ECU will attempt to adjust the other springs to the same height and activate inhibit

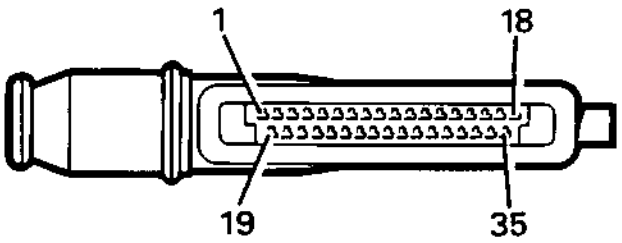
AIR SUSPENSION CIRCUIT DIAGRAM - RR3859M



Key to RR3859M

1. ECU
2. Battery
3. Fusible link
4. 15 amp fuse
5. Ignition feed
6. Delayed turn off relay
7. 30 amp maxi fuse
8. Compressor relay
9. Compressor and thermal switch
10. Solenoid valves
    a. back left
    b. back right
    c. front left
    d. front right
    e. inlet
    f. exhaust
    g. outlet
11. Height sensors
    a. back left
    b. back right
    c. front left
    d. front right
12. RAISE switch
13. INHIBIT switch
14. LOWER switch
15. Warning lamps
16. Switch illumination from panel lamps
17. Diagnostic plug
18. Pressure switch
19. 1 Kohm resistor (in harness)
20. Disable switch
21. Warning light relay
22. Engine speed input from alternator
23. Road speed input from speed buffer
24. Brake switch input
25. Door open input
26. Manual/auto select link
27. Park brake input
28. Park switch (microswitch in shifter)
29. 1 Kohm resistor (in harness)

ECU HARNESS PLUG WIRING DETAILS - see RR3692M



RR3692M

1. Slate/red
2. Orange/slate
3. Orange/blue
4. Orange/pink
5. Orange/green
6. Black/slate
7. Yellow/white
8. Slate/yellow
9. Green/slate
10. Green/black
11. Green/white
12. White/slate
13. Slate/blue
14. Black/blue
15. Yellow/slate
16. Not used
17. White/pink
19. Slate/red
20. Orange/red
21. Orange/purple
22. Orange/brown
23. Orange/Yellow
24. Black/pink
25. Yellow/pink
26. Green/orange
27. Green/pink
28. Green/yellow
29. Yellow/blue
30. Yellow/pink
31. Green/pink
32. Yellow/brown
33. Yellow/orange
34. Purple/slate
35. White/light green

SYSTEM CALIBRATION - HEIGHT SENSOR DATUM

Equipment required:

Lucas hand held test unit and air suspension memory card

△ **NOTE: This procedure must be carried out when a new ECU or height sensor has been fitted.**

Calibration will also be required if any part affecting damper relationship to body is changed i.e. damper mounts, axles, chassis unit and body panels. The vehicle can be calibrated laden or unladen, but Gross Vehicle Weight must not be exceeded. Tyres must all be the same size and at correct pressures.

IMPORTANT: The floor used for calibration must be level and smooth in all directions to enable procedure to be carried out successfully.

SUSPENSION COMPONENTS

This section gives repair procedures for air suspension components. It is essential to note that repairs to other suspension and transmission components are affected by air suspension.

To remove the following components DEPRESSURISE the system: front axle, panhard rod, radius arms, rear top and bottom links and rear axle.

WARNING: The air spring must be restricted by suspension loading, with dampers fitted before inflation. Unrestricted movement of a pressurised air spring will result in failure of the assembly, causing component and possible personal injury.

DEPRESSURISE SYSTEM

Service repair no - 60.50.38

Service tool:
RTC 6834 - Lucas hand held tester

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

1. Depressurising system will lower body on to bump stops.
2. Connect hand held tester and follow manufacturer's instructions to depressurise complete system.
3. Ensure system is completely depressurised. Check that all air springs are deflated, and vehicle has dropped evenly to the bump stops. If a spring, or springs, remains inflated possibly due to a stuck solenoid valve, it will be necessary to disconnect the pressurised pipe at air spring.

WARNING: Wear hand, ear and eye safety standard protection. For extra protection wrap a clean cloth around pipe to be disconnected. Note that vehicle will lower to bump stops when pipe is disconnected.

4. Disconnect air pipe ***See Disconnect/connect air pipe***
5. Disable system using switch under right hand front seat.

Repressurise

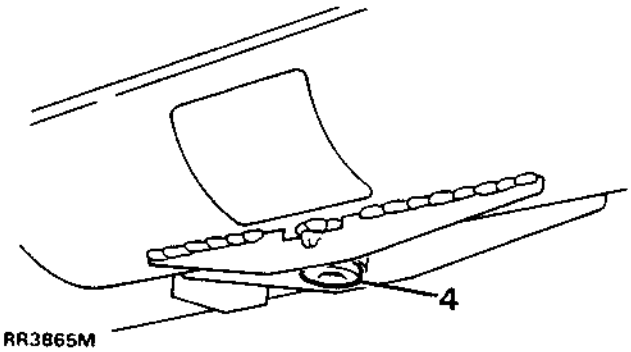
6. Switch disable switch OFF.
7. Run engine to repressurise system.

AIR RESERVOIR - DRAIN

Service repair no - 50.50.24

The reservoir is drained every 40,000 Kms (24,000 miles) - USA 30,000 miles.

1. Depressurise system, ***See Depressurise system***
2. Clean area around reservoir drain plug.
3. Partially open drain plug, allow residual air to escape.



4. Remove drain plug, NO water should be present. If water is present, air dryer unit must be changed ***See Air dryer***
5. Fit drain plug, checking sealing washer. Tighten to ***70 Nm.***
6. Repressurise system.

AIR SPRINGS/HEIGHT SENSORS - INSPECT

Visually check air springs for cuts, abrasions and stone damage to alloy end plates. Check security of retention clips. Check height sensors for damage to housing, operating links and cable assembly.

AIR HARNESS INSPECT

Check air harness (pipes) for damage and security over its full length around vehicle.

LEAK TEST PROCEDURE

Service repair no - 60.50.35

If an air leak is suspected the use of a proprietery leak detection spray is recommended. This procedure should also be used where pneumatic components have been disturbed.

The spray used must have a corrosion inhibitor, and must not cause damage to paintwork, plastics, metals and plastic pipes.

Recommended leak detection spray is GOTEC LDS. This is available under part number STC1090.

1. Ensure system is fully pressurised.
2. Clean around area of suspected leak.
3. Using manufacturer's instructions, spray around all component joints and air springs, working systematically until source of leak is found.
4. If a component eg: air spring, air dryer is leaking, rectify by fitting a new component.
5. If an air pipe connection is leaking cut 5 mm off end of pipe. Fit new collet, ***See Air pipe connection collet and 'O' rings***
6. Reinflate system, carry out leak test.

OPERATING SWITCH WARNING LIGHT AND ILLUMINATION

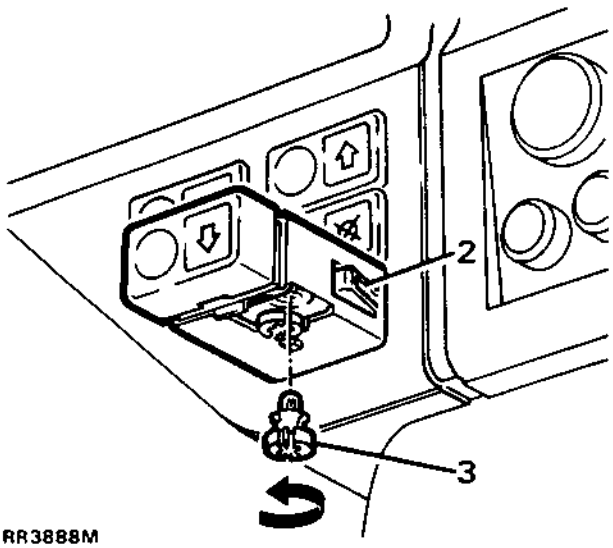
Service repair no - 60.50.17

Remove and refit

NOTE: Each switch contains a warning light bulb, and an illumination bulb.

Remove

1. Remove centre dash panel, ***See CHASSIS AND BODY, Repair, centre dash panel***
2. Depress locating tags of switch to remove switch.



RR3888M

3. Remove bulb by turning anti-clockwise and releasing from switch.

Refit

4. Fit new bulb and turn anti-clockwise until fully located.
5. Reverse removal procedure.

DISCONNECT/CONNECT AIR PIPE

Remove and refit

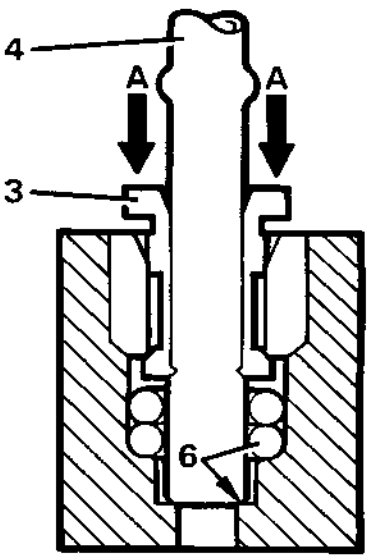
Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

1. Depressurise complete system, ***See Depressurise system***

CAUTION: Air pipes may be damaged if not disconnected correctly, resulting in possible leaks.

2. Clean air pipe connection with stiff brush and soapy water. Peel back rubber boot.
3. To disconnect air pipes apply equal downward pressure on collet at 'A' as shown.



RR3592M

4. Pull air pipe firmly out through centre of collet.
5. Inspect disconnected end of air pipe for damage and scores. Rectify as necessary.

NOTE: Air pipe may be trimmed if sufficient straight pipe remains. Ensure pipe end is cut square, without distortion or frays to obtain air tight seal. Use service tool LRT 60 - 002. Lightly chamfer pipe using a pencil sharpener after cutting. DO NOT CUT PIPES MORE THAN TWICE.

Refit

6. Push pipe firmly through two 'O' rings until it contacts base of housing as shown. Gently pull pipe to ensure connection. The collet will retain some movement while depressurised. Refit rubber boot.
7. Pressurise system, ***See Depressurise system***
8. Leak test connection, ***See Leak test procedure***

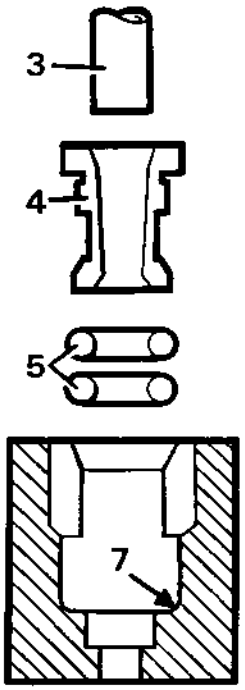
AIR PIPE CONNECTION COLLET AND 'O' RINGS

Remove and refit

Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

1. Clean area with stiff brush and soapy water.
2. Depressurise system, ***See Depressurise system***
3. Disconnect air pipe, ***See Disconnect/Connect air pipe***



RR3593M

4. Remove collet.
5. Carefully pry out two 'O' rings, using a smooth plastic hook, eg: a crochet hook.

CAUTION: Avoid scratching inside wall of housing, creating possible leak path.

Refit

6. Lightly grease new 'O' rings.
7. Fit 'O' rings into recess. Use a crochet hook to avoid damage to 'O' rings and housing.
8. Locate collet legs into housing, push fully home.
9. Inspect end of air pipe for damage and scores rectify by trimming.

NOTE: Air pipe may be trimmed if sufficient straight pipe remains. Ensure pipe end is cut square, without distortion or frays to obtain air tight seal. Use service tool LRT-60 - 002. Lightly chamfer pipe using a pencil sharpener after cutting. DO NOT CUT PIPES MORE THAN TWICE.

10. Connect air pipe, ***See Disconnect/connect air pipe***
11. Pressurise system, ***See Depressurise system***
12. Leak test connection, ***See Leak test procedure***

FRONT SHOCK ABSORBER

Service repair no - 60.30.02

Remove and refit

Remove

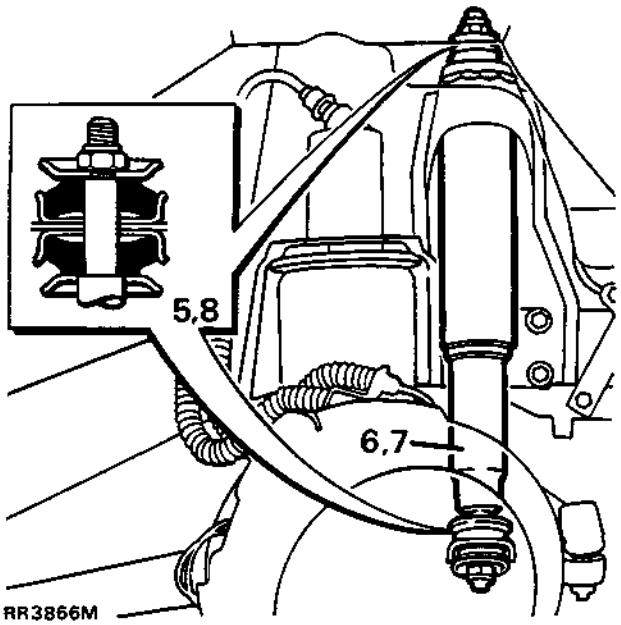
WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

WARNING: Unrestricted movement of a pressurised air spring will result in failure of assembly, causing component damage and possible personal injury. It is possible to remove shock absorber assembly without depressurising air springs, providing distance between axle and chassis is held as if shock absorber assembly were still fitted. This is achieved by supporting vehicle on stands with a jack under the axle.

1. Disconnect the battery negative lead.
2. Remove wheel, ***See WHEELS AND TYRES, Repair, Wheels***
3. Support chassis on axle stands.
4. Support front axle with jack.

CAUTION: Do not lower axle when shock absorber is removed, this may result in damage to air springs.

5. Remove top and bottom shock absorber fixings.



6. Remove shock absorber.

Refit

7. Fit shock absorber.
8. Fit top and bottom fixings, ensuring mounting rubbers are fitted as shown.
9. Tighten fixings to ***38 Nm.***
10. Reverse removal procedure. 1 to 4.

REAR SHOCK ABSORBER

Service repair no - 64.31.02

Remove and refit

Remove

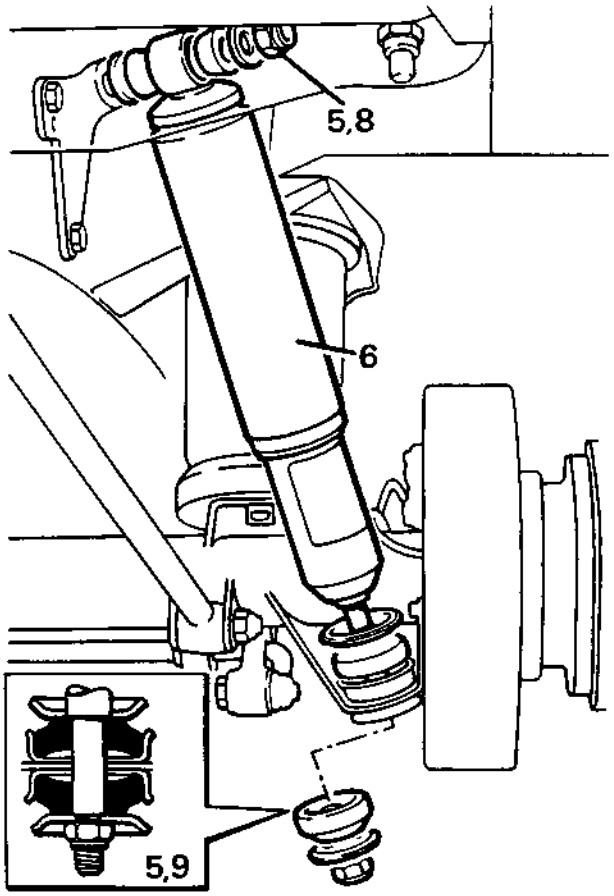
WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

WARNING: Unrestricted movement of pressurised air spring will result in failure of assembly, causing component damage and possible personal injury. It is possible to remove shock absorber assembly without depressurising air springs, providing distance between axle and chassis is held as if shock absorber assembly were still fitted. This is achieved by supporting vehicle on stands with a jack under the axle.

1. Disconnect the battery negative lead.
2. Remove wheel, ***See WHEELS AND TYRES, Repair, Wheels***
3. Support chassis on stands.
4. Support axle with jack.

CAUTION: Do not lower axle when shock absorber is removed, this may result in damage to air springs.

5. Remove shock absorber top and bottom fixings.



RR3867M

6. Remove shock absorber.

Refit

7. Fit shock absorber.
8. Fit top fixings. Tighten to ***82 Nm***
9. Fit bottom fixings, ensure mounting rubbers are fitted as shown. Tighten to ***38 Nm***
10. Reverse removal procedure. 1 to 4.

FRONT AIR SPRING

Service repair no - 60.21.01

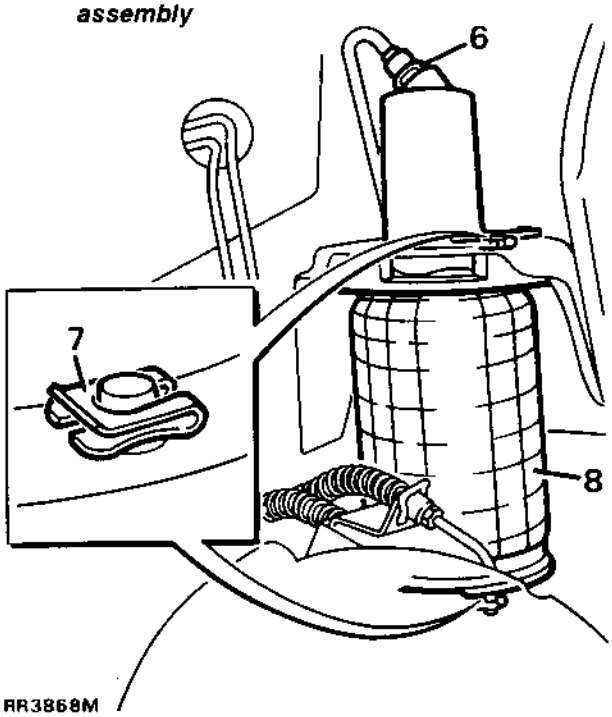
Remove and refit

Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

WARNING: The air spring must be restricted by suspension loading, with shock absorbers fitted before inflation. Failure to observe this warning could cause air spring failure, resulting in component damage or personal injury. DO NOT ATTEMPT TO DISMANTLE AIR SPRING

1. Depressurise system. ***See Depressurise system***
2. Disconnect the battery negative lead.
3. Remove wheel. ***See WHEELS AND TYRES, Repair, Wheels***
4. Support chassis on axle stands.
5. Support front axle with jack.
6. Peel back rubber boot. Disconnect air pipe from air spring. ***See Disconnect/Connect air pipe assembly***



RR3868M

7. Remove four retaining clips from upper and lower fixing.
8. Remove air spring assembly.

Refit

9. Locate air spring assembly onto lower fixing, ensure air pipe connection points rearwards.
10. Connect air pipe to air spring assembly, ***See Disconnect/Connect air pipe assembly.***
11. Raise axle to locate air spring assembly into upper fixing, if required.
12. Fit new retaining clips to fixing points.
13. Reverse removal instructions 1 to 6.
14. Leak test air spring and around conections, ***See Leak test procedure***

REAR AIR SPRING ASSEMBLY

Service repair no - 64.21.01

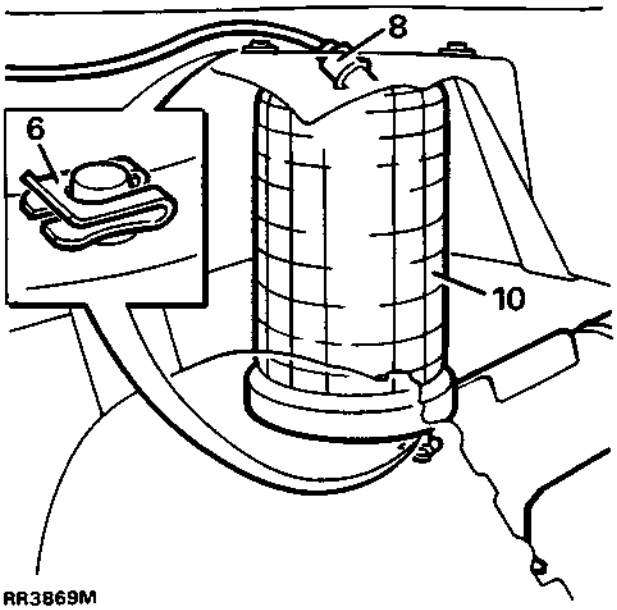
Remove and refit

Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

WARNING: The air spring must be restricted by suspension loading, with shock absorbers fitted before inflation. Failure to observe this warning could cause air spring failure, resulting in component damage or personal injury. DO NOT ATTEMPT TO DISMANTLE AIR SPRING

1. Depressurise system, ***See Depressurise system***
2. Disconnect the battery negative lead.
3. Remove wheel ***See WHEELS AND TYRES, Repair, Wheels***
4. Support chassis on axle stands.
5. Support axle with jack.
6. Remove four retaining clips from upper and lower fixing.



RR3869M

7. Lower axle for access to air pipe connection at top of air spring.
8. Clean connection with a stiff brush and soapy water. Peel back rubber boot.
9. Disconnect air pipe, ***See Disconnect/Connect air pipe***
10. Remove air spring assembly.

Refit

11. Locate air spring assembly onto lower fixing. Ensure air pipe connection points towards rear.
12. Connect air pipe to air spring assembly, fitting rubber boot, ***See Disconnect/Connect air pipe***
13. Raise axle to locate air spring assembly into upper fixing, if required.
14. Fit four new retaining clips to fixing points.
15. Reverse removal procedure. 1 to 5.
16. Leak test air spring and connector, ***See Leak test procedure***

BUMP STOP

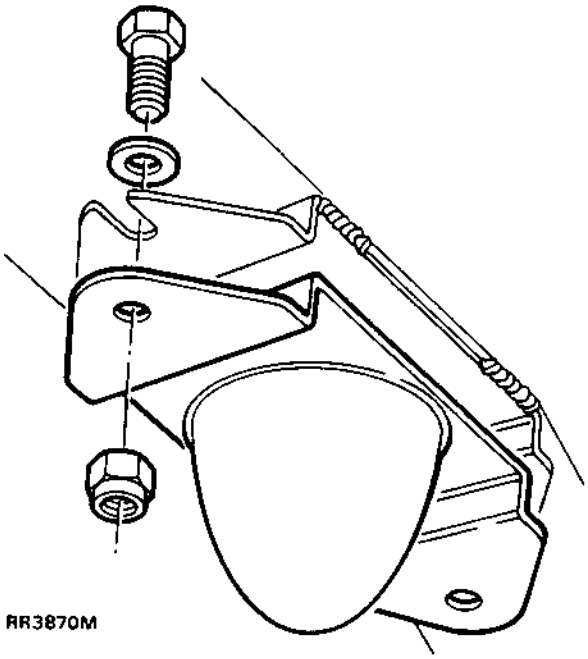
Service repair no - 60.30.10

Remove and refit

CAUTION: Air suspension system uses 'progessive' bump stops, which must not be interchanged with those used on coil spring suspension.

Remove

1. Remove fixings.
2. Remove bump stop assembly.



RR3870M

Refit

3. Position fixing bolts in chassis bracket.
4. Fit bump stop.
5. Tighten fixings.

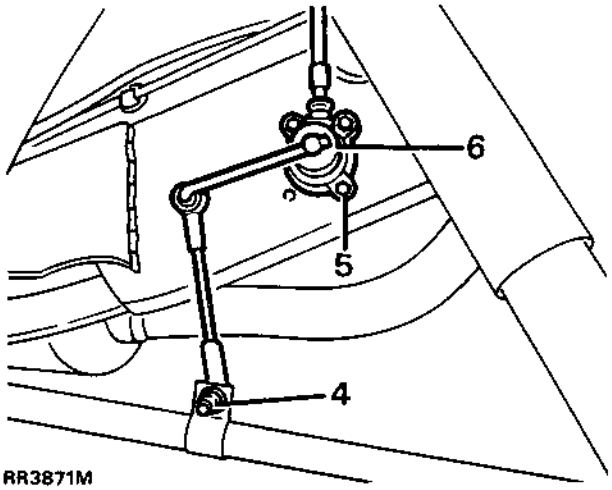
HEIGHT SENSOR

Service repair no - 60.36.01 - Front
Service repair no - 64.36.01 - Back

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove wheel ***See WHEELS AND TYRES, Repair, Wheels***
3. Disconnect height sensor multiplug.
4. Remove height sensor lower link fixing.



RR3871M

CAUTION: Back height sensors have longer lower link than the front sensors.

5. Remove height sensor fixings.
6. Remove height sensor.

Refit

7. Reverse removal instructions.
8. Recalibrate system ***See Description and operation, System calibration - height sensor datum***
9. Attain standard ride height.

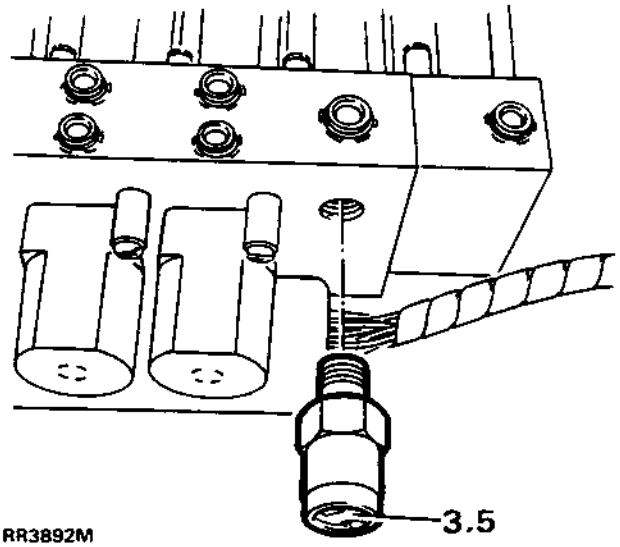
PRESSURE RELIEF VALVE

Remove and refit

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

Remove

1. Remove valve block *See Valve block*
2. Clean around pressure relief valve with a stiff brush and soapy water.
3. Remove pressure relief valve.



RR3892M

Refit

4. Coat threads of pressure relief valve with Loctite 572.
5. Fit valve. Tighten to *12 Nm.*
6. Reverse removal procedure.

COMPRESSOR INLET FILTER

Service repair no - 60.50.12

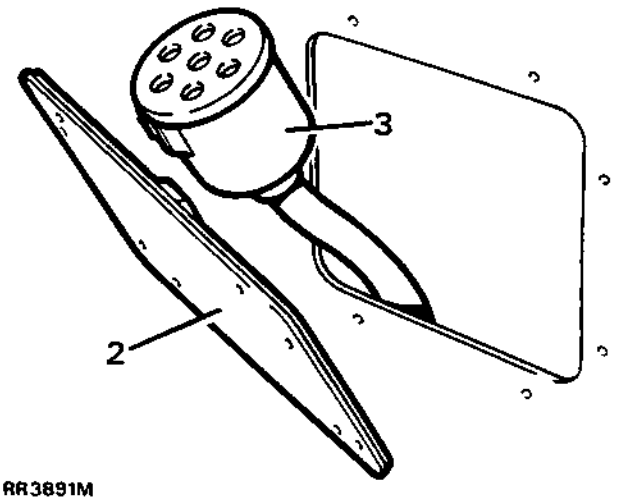
Remove and refit

The inlet filter is changed every 40,000 Kms (24,000 miles) - USA 30,000 miles.

NOTE: Compressor inlet filter is situated adjacent to the fuel filler flap. Access is gained by removing the closure plate situated in the right hand side of load space.

Remove

1. Remove sub woofer, (if fitted) *See ELECTRICAL, Repair, Subwoofer box*
2. Remove eight screws. Remove closure panel.



RR3891M

3. Remove inlet filter from mounting bracket.
4. Remove filter from pipe.

Refit

5. Fit new filter.
6. Reverse removal procedure.

AIR SUPPLY UNIT

Service repair no - 60.50.23

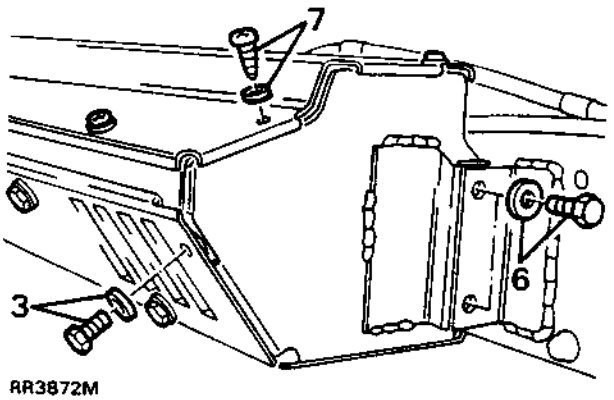
Remove and refit

Mounted on the chasis this unit contains compressor, air dryer and valve block. The unit must be removed before removing these components.

WARNING: System is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand,ear and eye safety standard protection when servicing system.

Remove

1. Depressurise system ***See Depressurise system***
2. Disconnect the battery negative lead.
3. Remove air supply unit side cover plate.

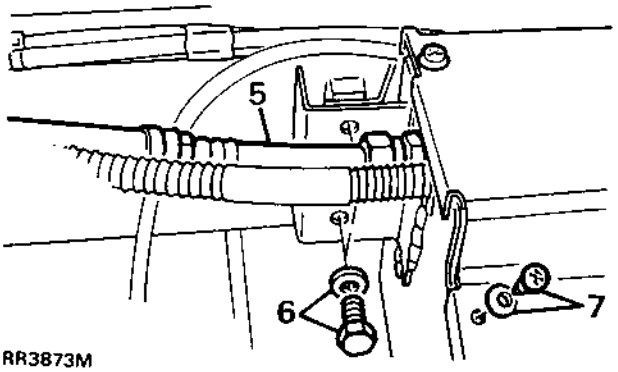


RR3872M

4. Disconnect multiplug.
5. Disconnect compressor inlet pipe, seal all exposed ends.
6. Support air supply unit. Remove four mounting bolts.

CAUTION: DO NOT allow unit to hang on pipes or electrical leads.

7. Remove air supply assembly top cover plate.



RR3873M

8. Clean all components. Identify air pipe connections.
9. Disconnect air pipe connections, ***See Disconnect/Connect air pipe***
   Seal all exposed ends. Disconnect remaining multiplug.
10. Remove air pipes and wiring harness from assembly.
11. Remove air supply unit from vehicle.

Refit

12. Reverse removal procedure. Tighten mounting bolts to ***24 Nm.***
13. Leak test all disturbed connections ***See Leak test procedure***

AIR DRYER

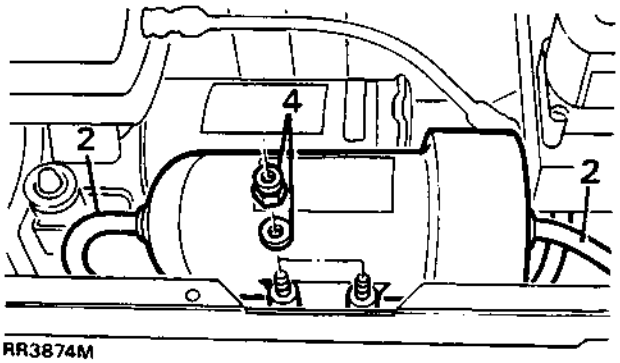
Service repair no - 60.50.09

Remove and refit

Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

1. Remove air supply unit ***See Air supply unit***
2. Disconnect two air pipes from air dryer, ***See Disconnect/Connect air pipe***



RR3874M

3. Seal dryer connections to prevent moisture intake.
4. Remove fixings.
5. Remove dryer.

Refit

6. Inspect air pipes. If damaged fit new pipes. DO NOT ATTEMPT TO TRIM DRYER PIPES.
7. Reverse removal procedure. Tighten nuts to ***12 Nm***
8. Leak test connections, ***See Leak test procedure***

AIR COMPRESSOR

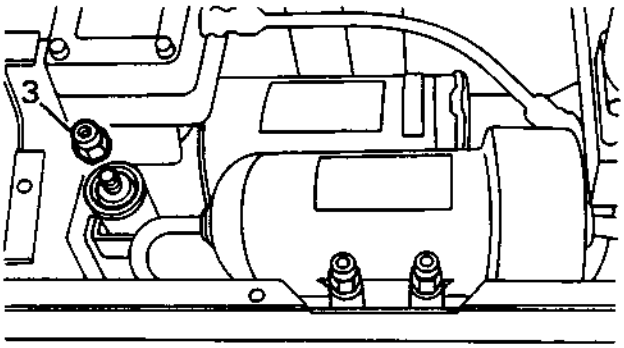
Service repair no - 60.50.10

Remove and refit

Remove

WARNING: The air compressor assembly becomes hot when running. Avoid personal contact or allow to cool.

1. Remove air supply unit, ***See Air supply unit***
2. Remove compressor outlet pipe, seal all exposed ends.



RR3875M

3. Remove four fixing nuts.
4. Remove compressor assembly.

Refit

5. Inspect compressor mountings, replace if necessary.
6. Reverse removal procedure. Tighten nuts to ***7Nm***
7. Check operation of compressor.
8. Leak test connections, ***See Leak test procedure***

VALVE BLOCK

Service repair no - 60.50.11

Remove and refit

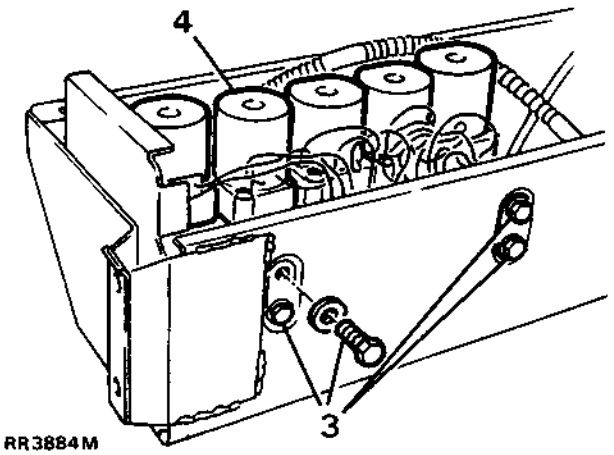
Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

1. Remove air supply assembly *See Air supply unit*
2. Disconnect air pipes from valve block, *See Disconnect/Connect air pipe*

CAUTION: Air pipes must be refitted correctly to avoid component damage.

3. Remove four fixing bolts.



RR3884M

4. Remove valve block assembly.

Refit

5. Reverse removal procedure.
6. Leak test connections, *See Leak test procedure*

RESERVOIR PRESSURE SWITCH

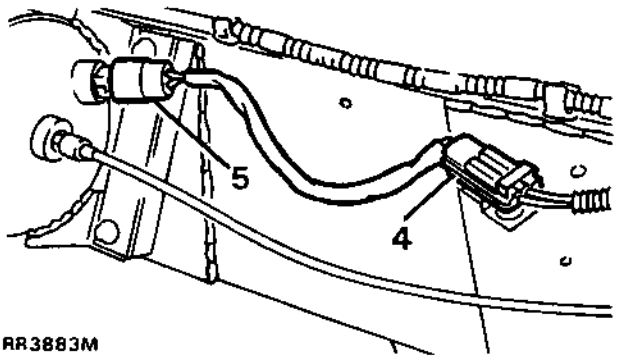
Service repair no - 60.50.07

Remove and refit

Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

1. Depressurise system, *See Depressurise system*
2. Disconnect the battery negative lead.
3. Clean around pressure switch with stiff brush and soapy water.
4. Disconnect pressure switch multiplug.



RR3883M

5. Unscrew and remove pressure switch.

CAUTION: Protect opening from ingress of dirt.

Refit

6. Apply Loctite 572 to thread of pressure switch.
7. Fit pressure switch. Tighten to *23 Nm.*
8. Connect multiplug and battery.
9. Start engine to re-pressurise system.
10. Attain standard ride height.
11. Leak test pressure switch, *See Leak test procedure*

AIR RESERVOIR

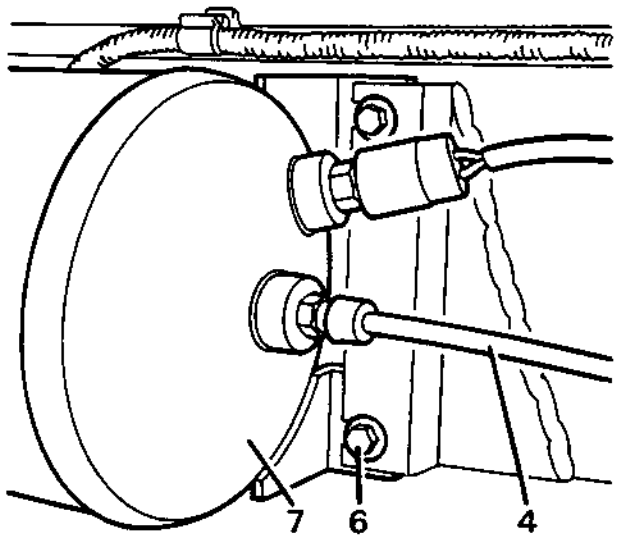
Service repair no - 60.50.03

Remove and refit

Remove

WARNING: Air suspension is pressurised up to 10 bar. Dirt or grease must not enter the system. Wear hand, ear and eye safety standard protection when servicing system.

1. Depressurise reservoir, ***See Depressurise system***
2. Clean around air pipe connection and drain plug with stiff brush and soapy water.
3. Open drain plug to release any residual pressure.
4. Disconnect air pipe, ***See Disconnect/Connect air pipe***



RR3885M

5. Disconnect pressure switch multi-plug.
6. Release four fixing bolts.
7. Remove reservoir.

Refit

8. Fit reservoir. Tighten to ***24 Nm.***
9. Connect air pipe, fitting rubber boot, ***See Disconnect/Connect air pipe***
10. Connect pressure switch multi-plug.
11. Tighten drain plug to ***70 Nm.***
12. Start engine to repressurise system.
13. Leak test reservoir, ***See Leak test procedure***

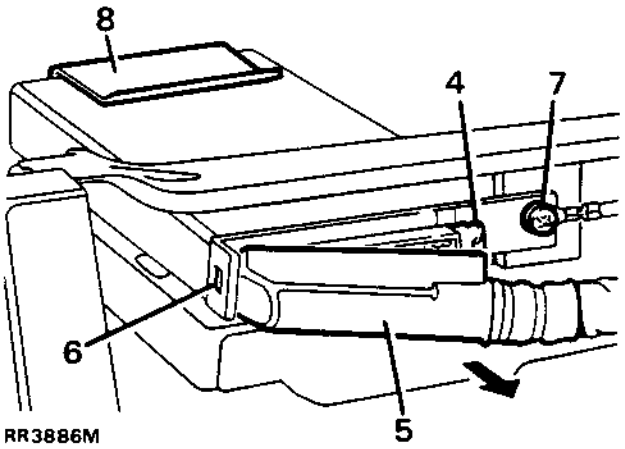
ELECTRONIC CONTROL UNIT

Service repair no - 60.50.04

Remove and refit

Remove

1. Remove front trim from right hand front seat base.
2. Adjust seat rearward and upward.
3. Disconnect the battery negative lead.
4. Release retaining clip from upper ECU plug.



RR3886M

5. Move plug in direction of arrow.
6. Detach hooked end of plug from retaining post.
7. Remove retaining screw.
8. Remove ECU from retaining clip.

Refit

9. Fit ECU into retaining clip.
10. Fit retaining screw.
11. Connect ECU harness plug. Ensure plug retaining clip engages.
12. Reverse removal procedure.
13. If fitting a new ECU, recalibrate height settings, ***See Description and operation, System Calibration - height sensor datum***

AIR HARNESS

Service repair no - 60.50.21

Remove and refit

Remove

CAUTION: Thoroughly clean around all connections before disconnecting air pipes. Seal all exposed components against ingress of dirt and moisture.

1. Place vehicle on a wheel free ramp.
2. Remove wheels, ***See WHEELS AND TYRES, Repair, Wheels***
3. Remove air supply unit, ***See Air supply unit***
4. Disconnect air pipe from front left air spring.
5. Release front left chassis cable ties and clips.
6. Disconnect air pipe from reservoir.
7. Release back left chassis cable ties and clips, leave clips in chassis.
8. Disconnect air pipe from back left air spring.
9. Release three rear chassis cable ties.
10. Disconnect air pipe from back right air spring.
11. Release back right chassis cable ties and clips.
12. Disconnect air pipe from front right air spring.
13. Release front right chassis cable ties and clips.
14. Remove air harness from vehicle.

Refit

15. Layout air harness, identifying routing and connections.
16. Route air harness around chassis.
17. Remove sealing plugs, reconnect left front air spring.
18. Secure left front chassis ties and clips.
19. Working around chassis. Reverse removal procedure.

Notes

RECOMMENDED EQUIPMENT

Lucas hand held tester ..... RTC 6834
Adaptor lead, air suspension ..... STC 1089

Memory card, air suspension
- English ..... STC 590
- French ..... STC 591
- German ..... STC 592
- Italian ..... STC 593
- Spanish ..... STC 594
- Dutch ..... STC 595
- Japanese ..... STC 598

Pressure test equipment ..... LRT 60.001
Pipe cutter ..... LRT 60.002
Leak detection spray ..... STC 1090
35 way 'pin out' box ..... STC 644

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BRAKE SERVO UNIT

Description

The power assistance for the brake system is provided by a twin diaphragm suspended vacuum servo.

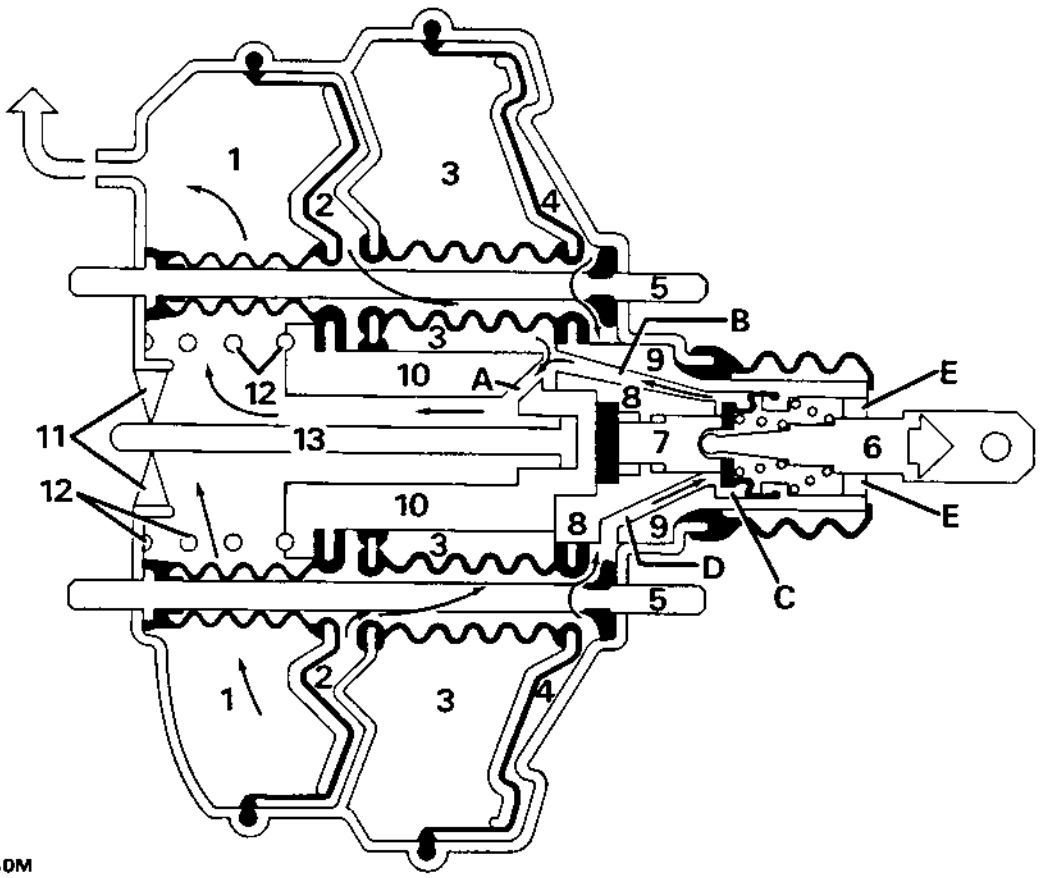
A 'Suspended Vacuum' servo is one where, with the engine running vacuum is present both sides of the diaphragm or diaphragms when the brakes are fully released or partially applied. The principal of having vacuum both sides of the diaphragm has two main advantages. First, it ensures instantaneous servo response to the brake being applied or released and second, it provides very accurate control of the position of the diaphragm and therefore, the degree of partial brake application.

At full pedal depression, vacuum is present in front of the diaphragm with atmospheric pressure on the rear.

Operation

Brakes released

With the brakes released depression is present both sides of the diaphragms, in chambers 1,2,3 and 4. The chambers comunicate by ports A, B, D via the valve C which is shown fully released in RR3640M.



RR3640M

Brakes applied

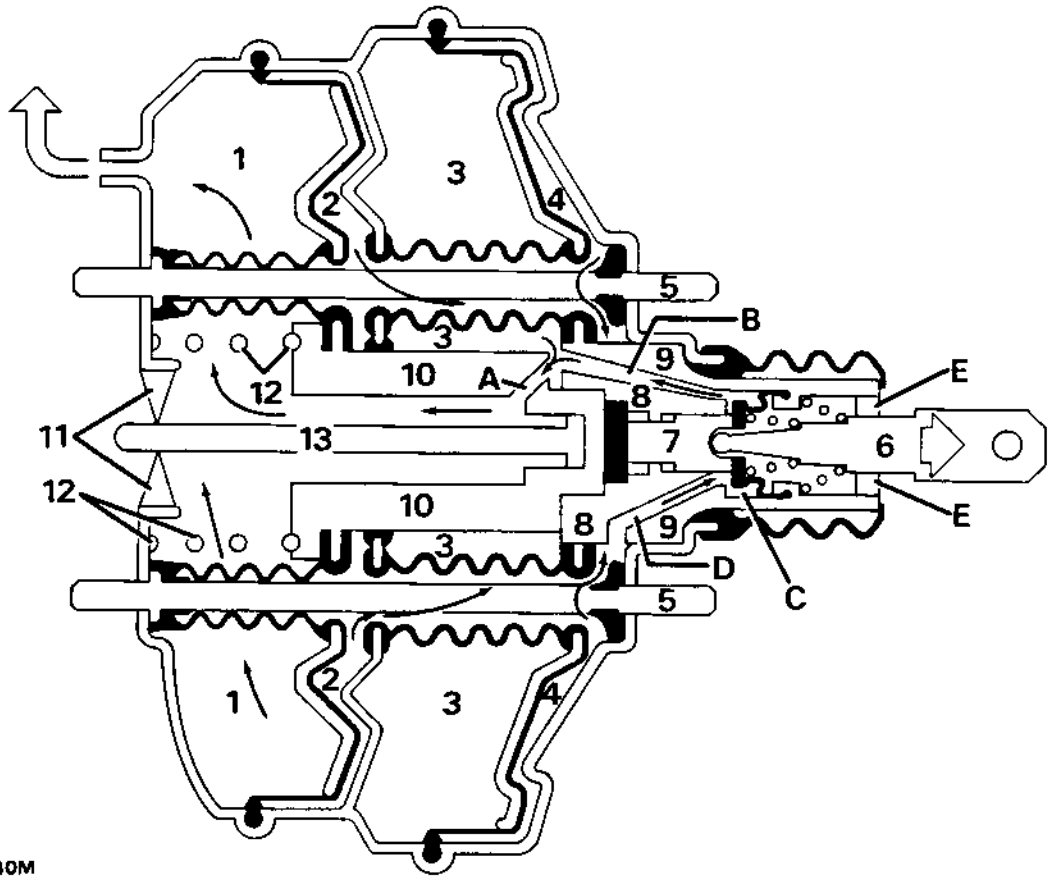
When the brake pedal is depressed the pedal pushrod operates valve C situated in the plastic diaphragm hub 9 and 10. Inital depression of the the brake pedal, push rod 6 and plunger 7 compress a rubber pad 8. This slight movement causes valve C to close port D sealing off the vacuum to chambers 2/4 and allows atospheric pressure to enter the chambers through the air filter E.

With depression in chambers 1/3 and air pressure in chambers 2/4 the servo hub will apply the brakes via the master cylinder push rod 13.

Atmospheric pressure over the large area of the diaphragms multiples the force applied to the master cylinder piston, to provide the power assistance. If the brake pedal is only partially depressed, the servo hub, diaphragms and master cylinder push rod will stop moving, when valve C comes to rest on the plunger 7. At this point the valve will balance the pressure in all the chambers, to the applied effort at the pedal and provide proportional braking.

It is only when the brakes are fully applied that the valve does not balance the pressures in all the chambers, but ensures that maximum available depression is in chambers 1/3 and full atmospheric pressure enters chambers 2/4.

When the brake pedal is released, the pressure in all chambers is equalised and the servo is returned to the rest position by spring 12.



RR3640M

Petrol engine vacuum system

The vacuum necessary to operate the brake servo on petrol engine vehicles is provided by the engine inlet manifold. During normal operation of the brakes only a small volume of air is drawn from the servo and into the inlet manifold or plenum chamber. However any excessive air leaks due to damage in the brake servo system or manifold hose connection, will effect the mixture strength and ECU fuelling calculations on engines equipped with an EFI system. ***See FUEL SYSTEM, Description and operation, Hot wire electronic fuel injection***

Diesel engine vacuum system

As the diesel engine inlet system does not produce depression sufficient to operate the brake servo, it is necessary to install an engine driven vacuum pump.

During normal operation of the brakes only a small volume of air is drawn from the servo by the vacuum pump. However as the pump exhausts air into the engine crankcase atmosphere, an air leak due to damage in the brake servo system or pump hose connection, may cause excessive crankcase pressure. ***See ENGINE, Description and operation, Vacuum pump***

BRAKE SYSTEM

Description

The servo assisted hydraulic braking system is the dual line type, incorporating primary and secondary hydraulic circuits, see illustration RR2225M.

△ **NOTE: References made to primary or secondary do not imply main service brakes or emergency brakes but denote hydraulic line identification.**

The brake pedal is connected to a vacuum assisted mechanical servo which in turn operates a tandem master cylinder. The front disc brake calipers each house four pistons, the upper pistons are fed by the primary hydraulic circuit, the lower pistons by the secondary hydraulic circuit. The rear disc brake calipers each house two pistons, these are fed by the secondary hydraulic circuit via a pressure reducing valve.

A brake fluid level switch is incorporated into the reservoir cap assembly, the switch will immediately illuminate a warning light in the instrument binnacle indicating low fluid or sudden fluid loss.

The brake fluid reservoir is divided, the section closest to the servo feeds the primary circuit and the section furthest from the servo feeds the secondary circuit. Under normal operating conditions both the primary and secondary circuits operate simultaneously on brake pedal application. In the event of a failure in the primary circuit the secondary circuit will still function and operate front and rear calipers. Alternatively, if the secondary circuit fails the primary circuit will still function and operate the lower pistons in the front calipers, allowances should be made and vehicle speed adjusted accordingly to allow for the lack of full braking efficiency.

If the servo should fail, both hydraulic circuits will stillfuntion but would require greater pedal effort due to the lack of vacuum assistance.

The hand operated parking brake acts on a brake drum at the rear of the transfer gearbox and is completely independent of the hydraulic circuits.

Brake pad wear sensors are incorporated in the front and rear right hand side inboard brake pads. The sensors will illuminate a brake pad wear warning light in the instrument binnacle, when pads require renewal.

CAUTION: Thoroughly clean all brake calipers, pipes and fittings before commencing work on any part of the brake system. Failure to do so could cause foreign matter to enter the system and cause damage to seals and pistons which will seriously impair the efficiency of the brake system.

To ensure the brake system efficiency is not impaired the following warnings must be adhered to :-

DO NOT use any petroleum (gasoline) based cleaning fluids or any proprietary fluids containing petroleum (gasoline) Use only the correct brake fluid.

USE ONLY the correct brake fluid if assembly fluid is required.

WARNING: Some components on the vehicle such as gaskets and friction surfaces (brake linings, clutch discs, or automatic transmission brake bands), may contain asbestos. inhaling asbestos dust is dangerous to your health and the following essential precautions must be observed:

- **Work out of doors or in a well ventilated area. Wear a protective mask.**
- **Dust found on vehicle or produced during work on vehicle should be removed by vacuuming or by using a well dampened cloth and not by blowing.**
- **Dust waste should be dampened, placed in a sealed container and marked to ensure safe disposal.**
- **If any cutting, drilling etc, is attempted on materials containing asbestos the item should be dampened and only hand tools or low speed power tools used.**

DO NOT use brake fluid previously bled from the system.

DO NOT use old or stored brake fluid.

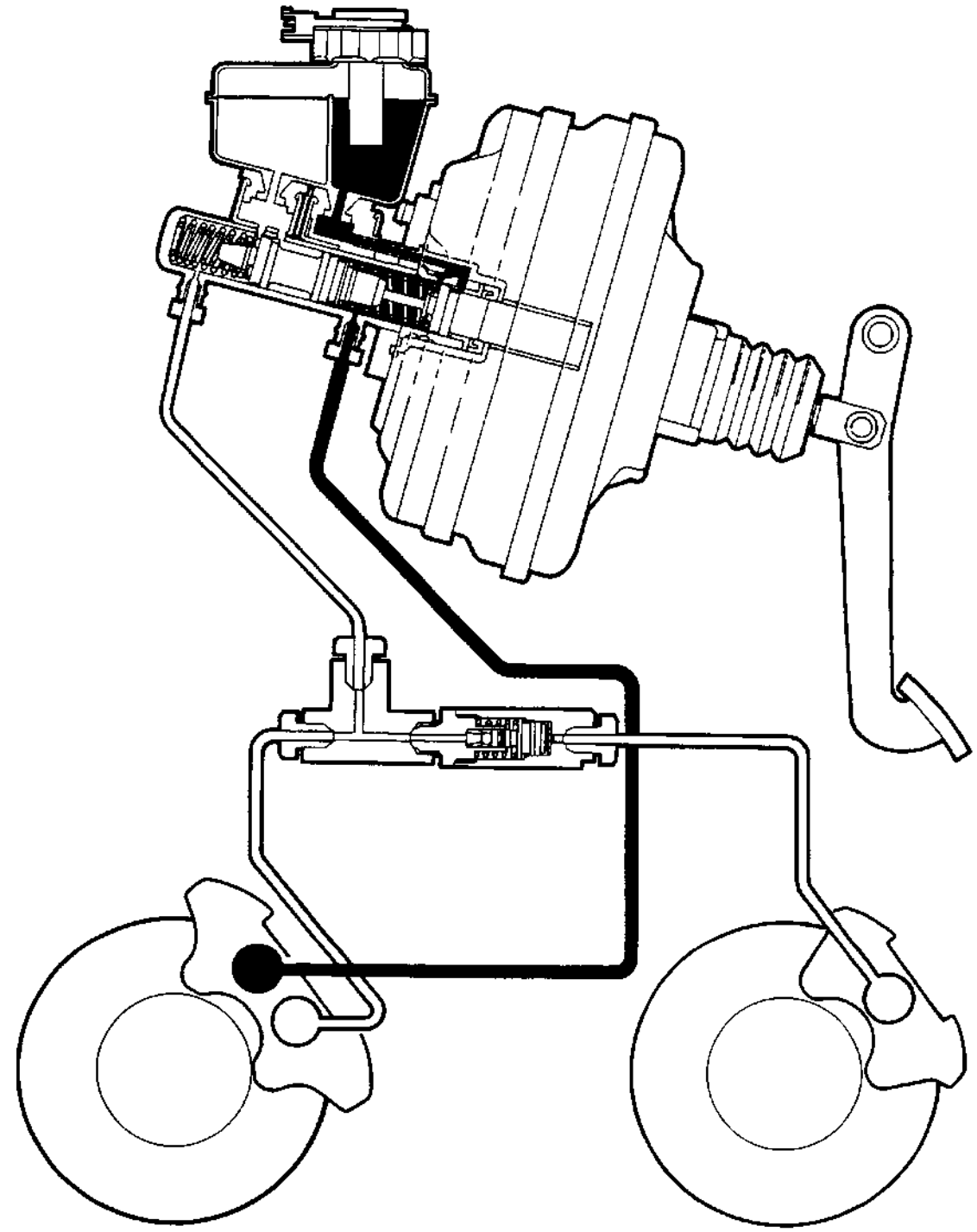
ENSURE that only new fluid is used and that it is taken from a sealed container.

DO NOT flush the brake system with any fluid other than the recommended brake fluid.

The brake system should be drained and flushed at the recommended service intervals.

PRIMARY HYDRAULIC CIRCUIT

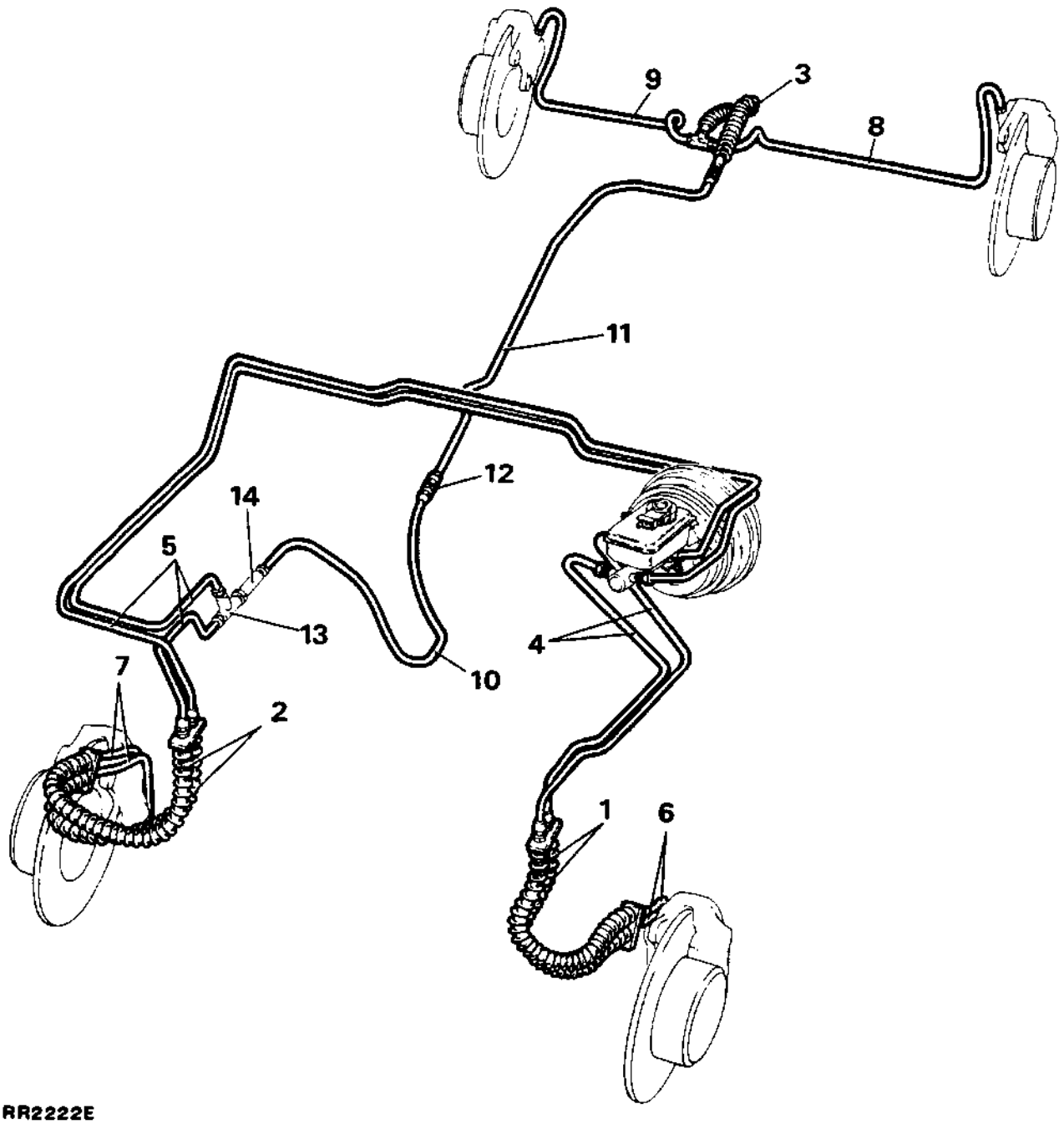
SECONDARY HYDRAULIC CIRCUIT



RR2225M

BRAKE PIPE LAYOUT

Left hand drive



RR2222E

HOSES

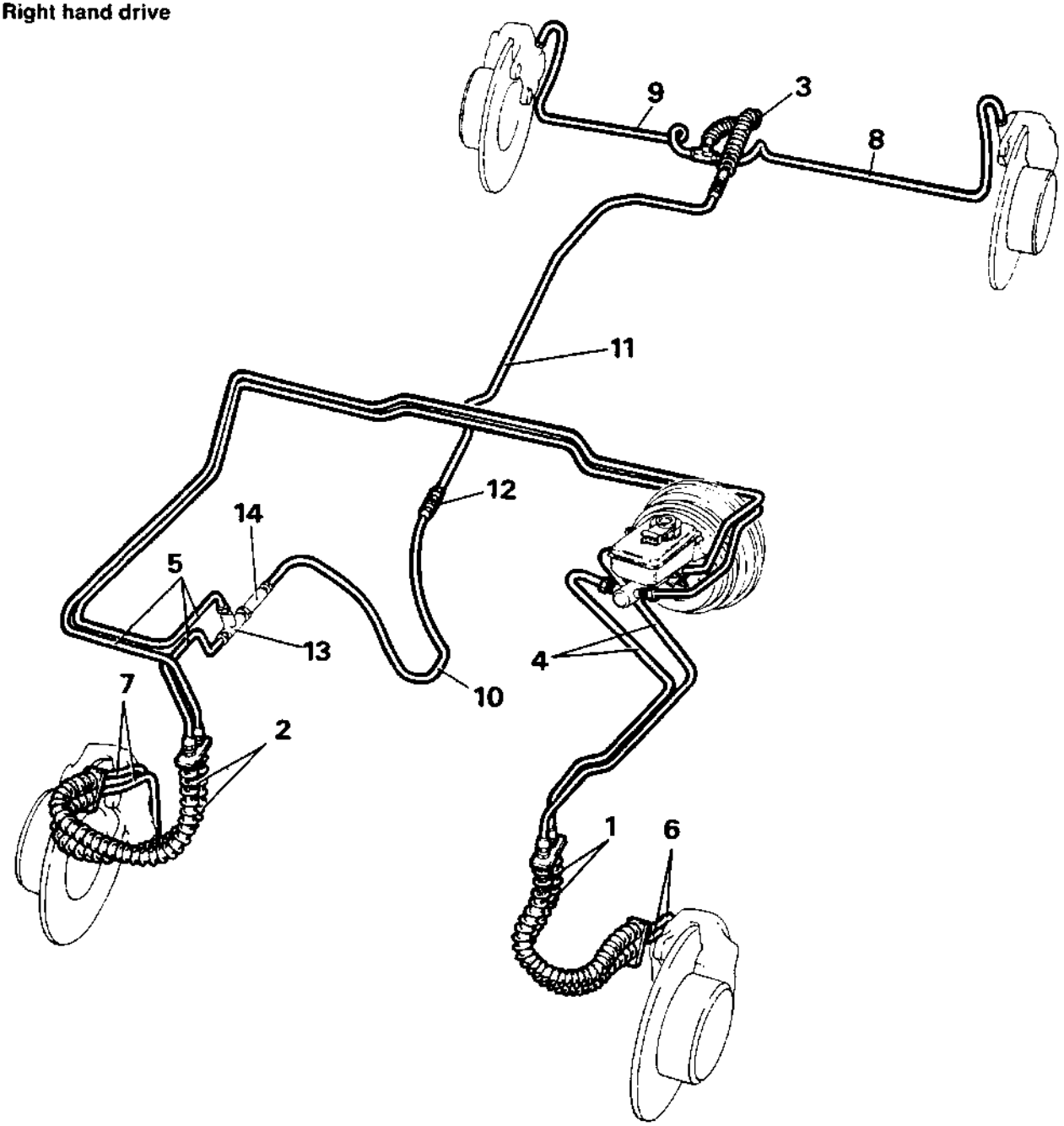
1. Front left hand flexible hoses.
2. Front right hand flexible hoses.
3. Intermediate flexible hose.

PIPES

4. Feed to front left hand hose connector.
5. Feed to front right hand hose connector.
6. Feed to front left hand caliper.
7. Feed to front right hand caliper.
8. Feed to rear left hand caliper.
9. Feed to rear right hand caliper.
10. Feed to two way connector.
11. Feed to intermediate hose.
12. Two way connector.
13. Three way connector.
14. Pressure reducing valve.

BRAKE PIPE LAYOUT

Right hand drive



RR2222E

Notes

BRAKE SYSTEM BLEED

Service repair no - 70.25.02

Also ***See Brake system bleed (ABS)***

The hydraulic system comprises two completely independent circuits. The rear calipers and lower pistons in front calipers form secondary circuit, while upper pistons in front calipers form primary circuit. The following procedure covers bleeding complete system, but it is permissible to bleed one circuit only if disconnections are limited to that circuit.

Bleeding will be assisted if engine is run or a vacuum supply is connected to servo.

WARNING: If engine is running during brake bleeding process ensure that neutral or park is selected in main gearbox and that park brake is applied.

When bleeding any part of secondary circuit, almost full brake pedal travel is available. When bleeding primary circuit only, brake pedal travel will be restricted to approximately half.

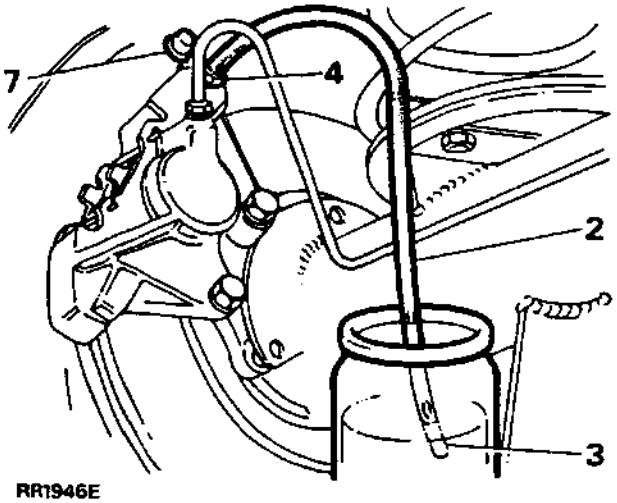
NOTE: When bleeding system commence with caliper furthest from master cylinder. Finally tighten bleed screws to *10 Nm*.

Bleeding

1. Fill fluid reservoir with correct grade of fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***

NOTE: Maintain correct fluid level throughout procedure of bleeding.

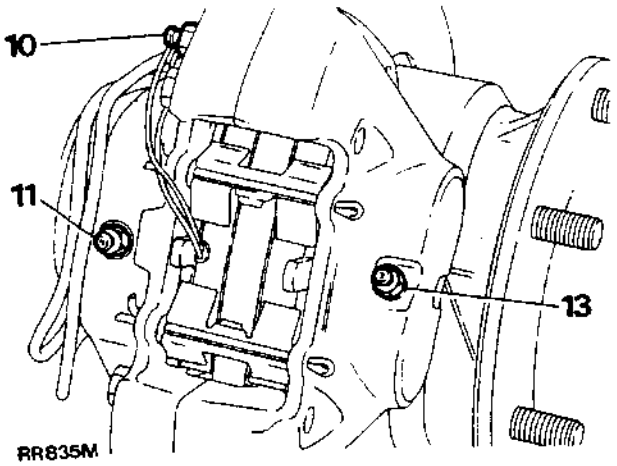
2. Connect bleed hose to bleed screw on rear caliper furthest from master cylinder.
3. Submerge free end of bleed hose in a container of clean brake fluid.
4. Loosen bleed screw 1/2-3/4 of a turn.
5. Operate brake pedal fully and allow to return.



RR1946E

NOTE: Allow at least five seconds to elapse with foot right off pedal to ensure pistons fully return before operating pedal again.

6. Repeat 5 until fluid clear of air bubbles appears in container. Keeping pedal fully depressed, tighten bleed screw.
7. Remove bleed hose, replace dust cap on bleed screw.
8. Repeat 1 to 7 for other rear caliper.
9. Remove front wheel furthest from master cylinder
10. Connect a bleed hose to primary bleed screw on front caliper.
11. Connect a bleed hose to secondary bleed screw on same side of caliper as primary screw.



RR835M

12. Repeat 3 to 7 for front caliper, bleeding two screws simultaneously.
13. Connect a bleed hose to other screw on front caliper furthest from master cylinder.
14. Repeat 3 to 7 for second secondary screw on front caliper.
15. Refit front wheel.
16. Repeat 9 to 15 for front caliper nearest master cylinder.

MASTER CYLINDER

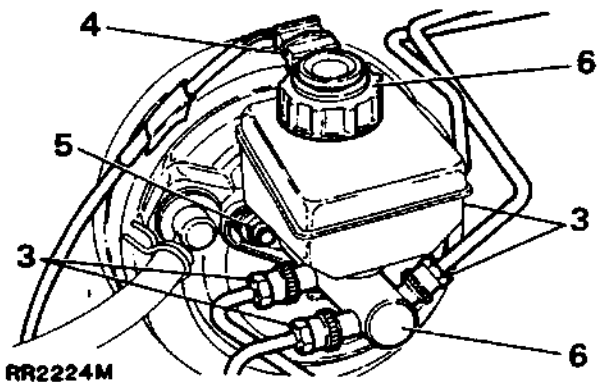
- Lucas Girling - Type 25.4mm AS/AS

Service repair no - 70.30.08 - Remove
Service repair no - 70.30.09 - Repair

Remove, repair and refit

Remove

1. Disconnect the battery negative lead.
2. Place a suitable container under master cylinder to catch brake fluid from cylinder when brake pipes are disconnected.
3. Thoroughly clean immediate area around all outlet ports. Remove each brake pipe, sealing each pipe and outlet port with suitable plugs to prevent ingress of foreign matter.
4. Disconnect electrical plug from low fluid switch on reservoir cap.
5. Remove two nuts securing master cylinder to servo unit remove also spring and plain washers.



RR2224M

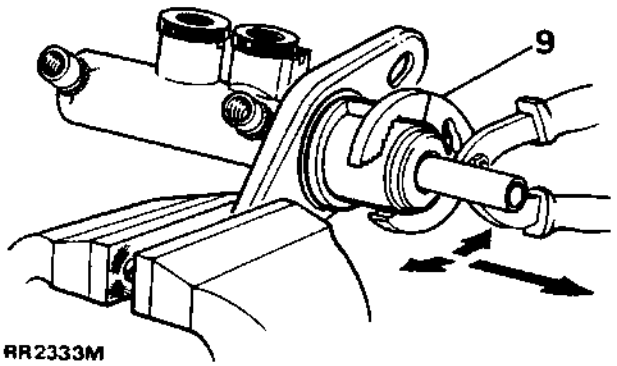
6. Detach master cylinder from servo, remove reservoir cap and drain brake fluid into a suitable container.

WARNING: Do not use brake fluid previously drained or bled from system. Carefully dispose of unwanted fluid, if stored in a sealed container, ensure that container is marked USED BRAKE FLUID.

Repair

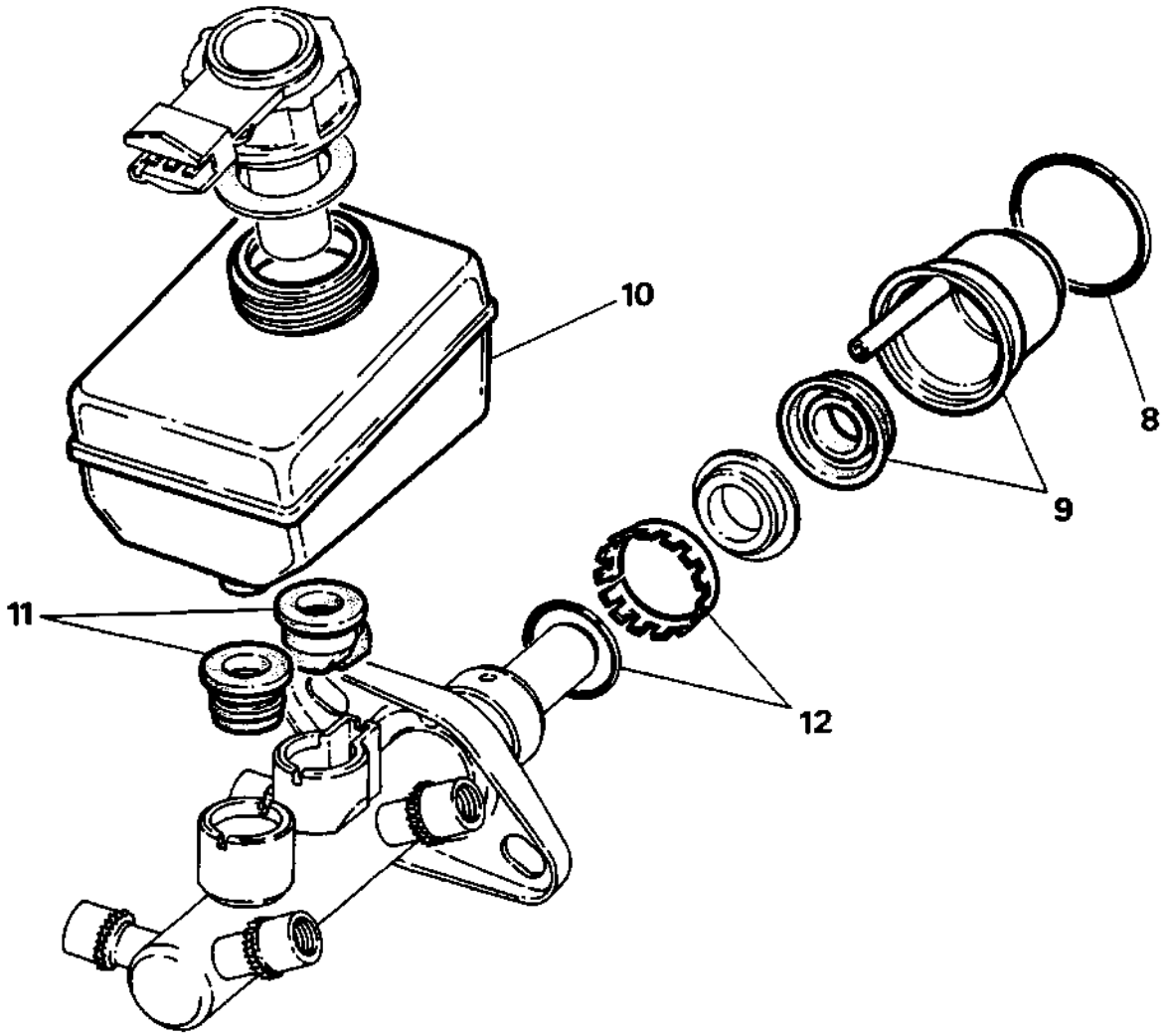
WARNING: Use only unused brake fluid to clean any part of brake system. DO NOT use petrol, kerosene or other mineral based fluids.

7. Thoroughly clean master cylinder and inspect outer surfaces for damage and condition, renew complete assembly if necessary.
8. Using two soft jaws, clamp master cylinder flange in a suitable vice. Remove water ingress 'O' ring seal from master cylinder to servo flange and discard.

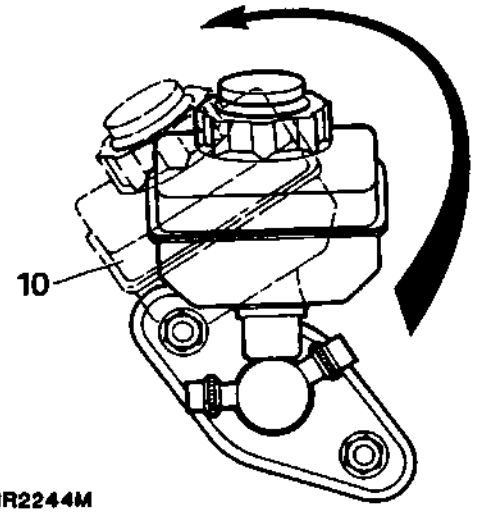


RR2333M

9. Grip outside of transfer housing with a suitable pair of pliers, carefully pull, working pliers in a backwards and forwards rocking motion to ease housing off master cylinder. Discard housing and vacuum seal.



RR2237M

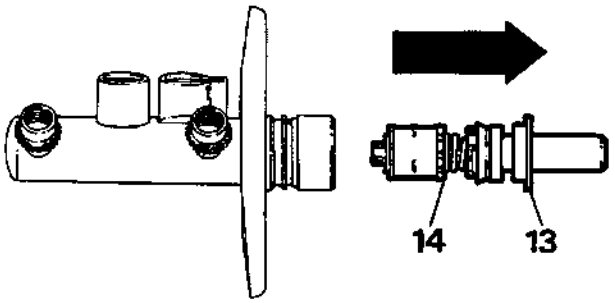


RR2244M

10. Ease reservoir out of master cylinder taking care to ensure that two outlet ports on bottom of reservoir do not become damaged during this process.
11. Withdraw two reservoir seals from master cylinder inlet ports. Note for reassembly these seals are different. Discard seals.
12. Remove retaining ring and 'O' ring seal from machined outer surface of master cylinder. Discard both seal and retaining ring.

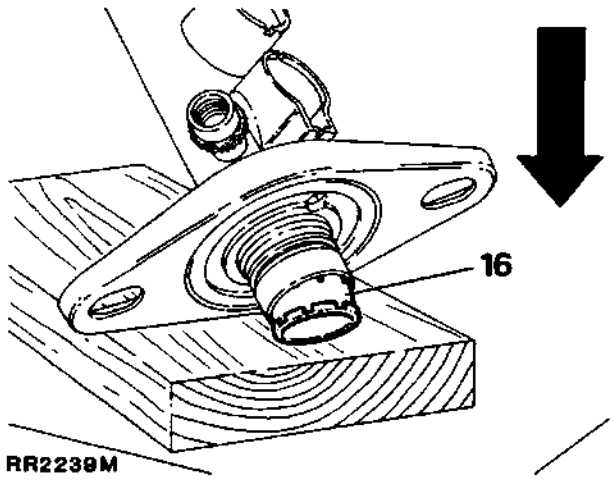
13. Remove guide ring, which supports primary plunger assembly, from mouth of master cylinder. Place to one side for reassembly, note this component is not part of service kit.
14. Pull primary plunger assembly out of master cylinder.

△ **NOTE: The primary plunger assembly cannot be broken down any further and is serviced as a complete unit. Discard assembly.**



RR2238M

15. The secondary plunger assembly will remain at bottom of master cylinder bore. Remove by tapping assembly on a piece of wood until plunger appears at cylinder mouth, carefully pull plunger out of master cylinder.



RR2239M

16. If swirl tube was not expelled at same time as secondary plunger, repeat above operation to remove it from bottom of master cylinder bore and discard.

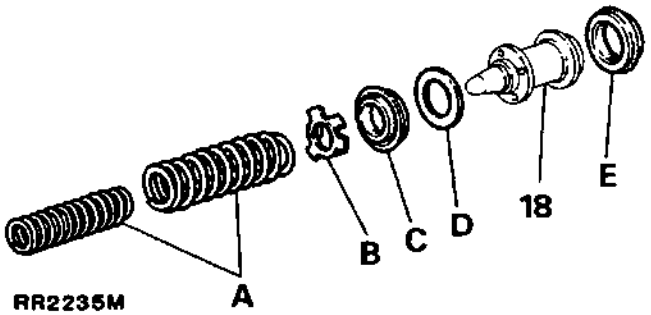
17. Clean all parts with unused brake fluid. Place cleaned parts onto a clean sheet of paper. Inspect cylinder bore and plungers for signs of corrosion, ridges and score marks. Provided working surfaces are in perfect condition, new seals from a Girling Service repair kit may be used.

Renewing secondary plunger seals

18. Remove following components from secondary plunger and discard:

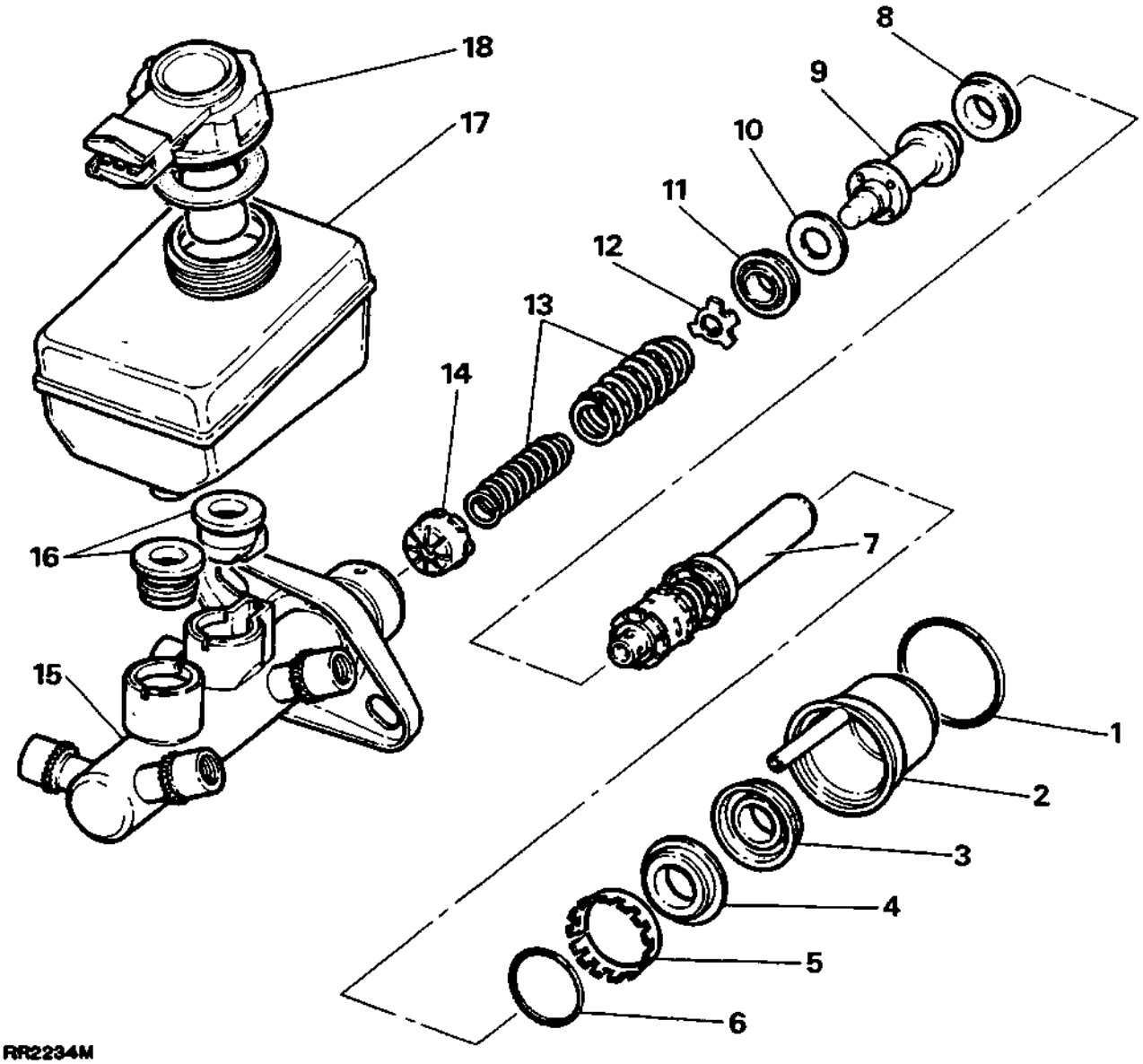
△ **NOTE: A small screwdriver with end rounded off and polished is required to remove 'L' seal. DO NOT damage secondary plunger.**

(A) Springs
(B) Seal retainer
(C) Recuperating seal (primary cup)
(D) Washer
(E) 'L' seal



RR2235M

MASTER CYLINDER ASSEMBLY



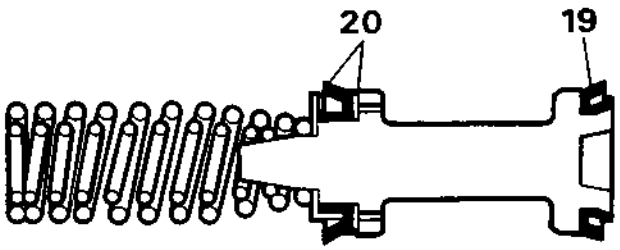
RR2234M

Key to master cylinder

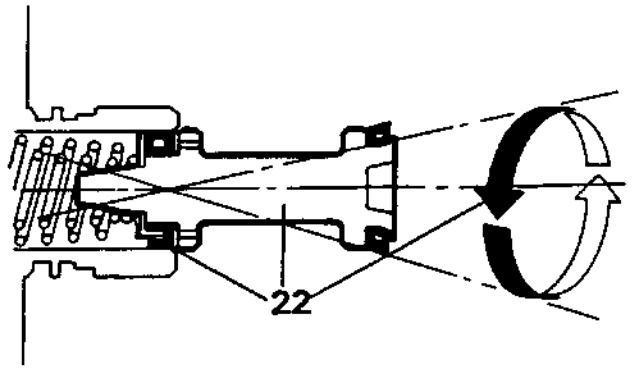
1. Water ingress seal
2. Transfer housing
3. Vacuum seal
4. Guide ring
5. Retaining ring
6. 'O' ring seal
7. Primary plunger assembly
8. 'L' seal
9. Secondary plunger
10. Washer
11. Recuperating seal (primary cup)
12. Seal retainer
13. Springs (2 off)
14. Swirl tube
15. Master cylinder body
16. Reservoir seals
17. Reservoir
18. Low fluid level switch and cap

△ **NOTE: Thoroughly check that no debris is lodged in fluid passageways and drillings. If debris is found, carefully remove, re-clean cylinder and re-check.**

19. Coat new seals in unused brake fluid. Fit 'L' seal to plunger.
20. Fit washer followed by recuperating seal. Fit seal retainer and springs, ensure springs are correctly seated.



RR2236M



RR2240M

ASSEMBLING MASTER CYLINDER

⚠ **CAUTION: It is important that following instructions are carried out precisely, otherwise damage could be caused to new seals when inserting plungers into cylinder bore. Generous amounts of new brake fluid should be used to lubricate parts during assembly. Never use old fluid or any other form of cleaning and lubricating material. Cleanliness throughout is essential.**

21. Fit new swirl tube to bottom of cylinder bore.
22. Lubricate secondary plunger and cylinder bore. Offer plunger assembly to cylinder until recuperation seal is resting centrally in mouth of bore. Gently introduce plunger with a circular rocking motion, as illustrated. Ensuring that seal does not become trapped, ease seal into bore and slowly push plunger down bore in one continuous movement.
23. Fit new primary plunger assembly using same method as for secondary plunger.
24. Fit original guide ring to support primary plunger.
25. Coat a new 'O' ring with brake fluid and fit to its respective groove on outer location surface of master cylinder.

△ **NOTE: DO NOT ROLL 'O' ring down outer location surface of master cylinder. It should be slightly stretched and eased down cylinder and into its groove. DO NOT OVER STRETCH SEAL.**

26. Fit new retaining ring on outer surface of master cylinder ensuring that serrations of ring are facing mounting flange.
27. Fit two new reservoir seals in respective ports.
28. Fit a new vacuum seal to either primary plunger or to bottom of transfer housing bore, open face of seal towards primary plunger.
29. Lubricate vacuum seal with brake fluid. Fit transfer housing to master cylinder, push housing fully up to cylinder mounting flange, DO NOT ADJUST TRANSFER HOUSING AFTER FITTING.
30. Lubricate new water ingress seal with brake fluid, Slightly stretch seal and ease down housing until it is in position between housing and flange.
31. Roll reservoir into top of master cylinder, reversing procedure described in instruction 10.

Refit

32. Fit master cylinder to servo. Secure in position with two nuts, plain and spring washers. Tighten to ***26 Nm.***
33. Fit brake pipes to master cylinder. Tighten to ***10 Nm.***
34. Top-up master cylinder with correct grade of brake ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
35. Bleed system. ***See Brake system bleed***

WARNING: Do not use brake fluid previously drained or bled from system. Carefully dispose of unwanted fluid, if stored in a sealed container, ensure that container is marked USED BRAKE FLUID.

36. Fit cap, reconnect electrical lead to fluid level switch. Reconnect the battery negative lead.

SERVO ASSEMBLY

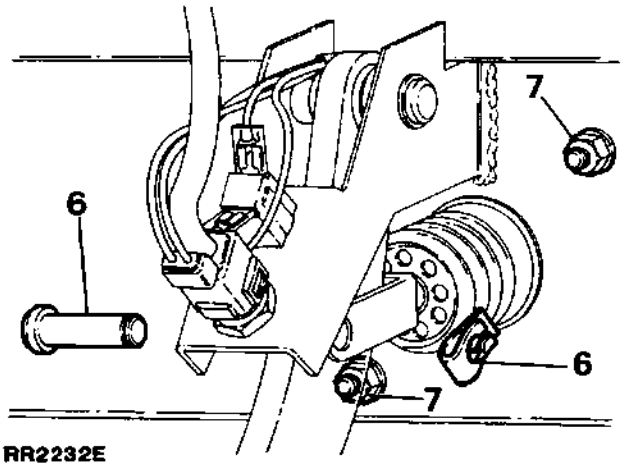
Service repair no - 70.50.01

Remove and refit

Remove

NOTE: Other than replacing filter, non-return valve and grommet, the servo is not a serviceable component, in event of failure or damage fit a new unit.

1. Disconnect the battery negative lead.
2. Disconnect electrical plug to low fluid level switch.
3. Thoroughly clean immediate area around all master cylinder outlet ports. Remove each brake pipe, sealing each pipe and outlet port with suitable plugs to prevent ingress of foreign matter.
4. Disconnect vacuum supply hose to servo.
5. Remove lower dash panel to gain access to servo push rod to brake pedal.
6. Remove clevis pin securing servo push rod to brake pedal.
7. Remove two nuts and plain washers securing servo.



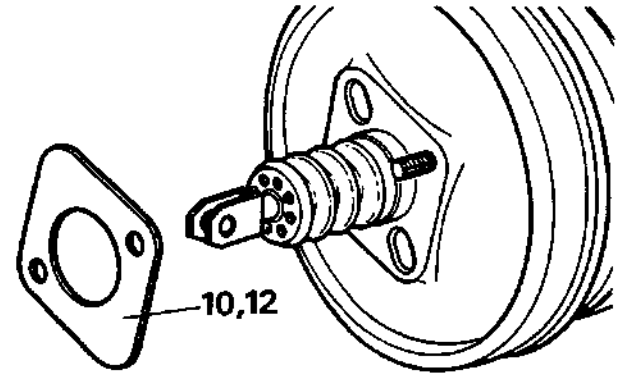
RR2232E

8. Remove servo and master cylinder assembly.
9. Drain brake fluid into a suitable container. (If master cylinder is kept horizontal it is not necessary to drain fluid).

WARNING: Do not use brake fluid previously drained or bled from system. Carefully dispose of unwanted fluid, if stored in a sealed container, ensure that container is marked USED BRAKE FLUID.

10. Detach spacer from pedal box mounting face of servo.

NOTE: Retain spacer reassembly. The spacer ensures stringent pedal to servo operating dimensions are maintained.



RR2233M

11. Remove master cylinder from existing servo and refit to new servo, if fitting new unit.

Refit

12. Fit spacer to servo.
13. Fit servo to pedal box.
14. Lightly grease brake pedal around area servo push rod pivots.
15. Fit push rod to brake pedal. Fit clevis pin and clip.
16. Secure servo with two nuts and plain washers. Tighten to ***24 Nm.***
17. Refit lower dash panel.
18. Fit master cylinder to servo, refit nuts, plain and spring washers. Tighten to ***26 Nm.***
19. Remove all sealing plugs. Refit brake pipes to respective ports. Tighten brake pipes to ***10 Nm.***
20. Refit vacuum supply hose.
21. Fill master cylinder to correct level using correct grade of brake fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
22. Bleed brake system. ***See Brake system bleed***

PEDAL ASSEMBLY

Service repair no - 70.35.01 - remove
Service repair no - 70.35.02

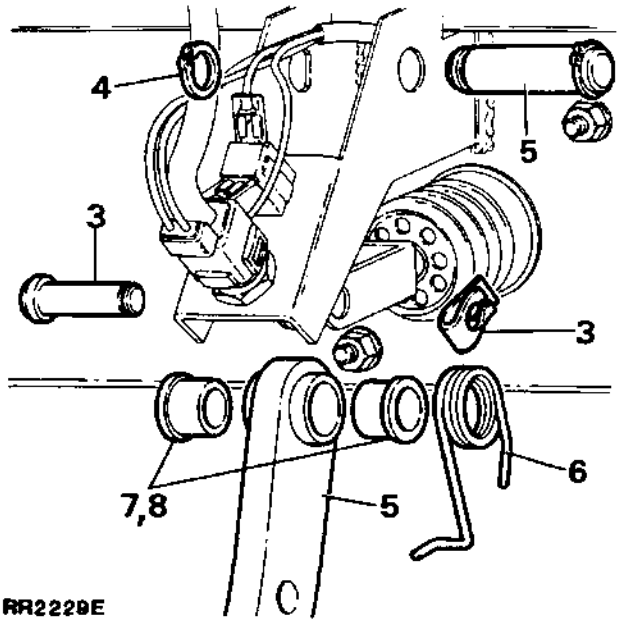
Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel to gain access to pedal assembly.
3. Remove spring clip and clevis pin.
4. Remove circlip from 'D' shaped end of pedal shaft.
5. Remove pedal shaft and withdraw pedal.
6. Remove return spring from pedal.

Renew bushes

7. Remove bushes from pedal pivot tube.
8. Press new bushes into pedal pivot tube. If necessary ream out bushes to 15,87mm plus 0,05mm.
9. Lightly grease bushes.



RR2229E

Refit

10. Fit return spring to pedal.
11. Fit pedal to pedal box. Refit pedal shaft and new circlip.
12. Lightly grease servo push rod and secure in position with clevis pin and clip.
13. Refit lower dash panel. Reconnect the battery negative lead.

FRONT BRAKE PADS

Service repair no - 70.40.02

Service tool:
LRT.70-500 - Piston clamp

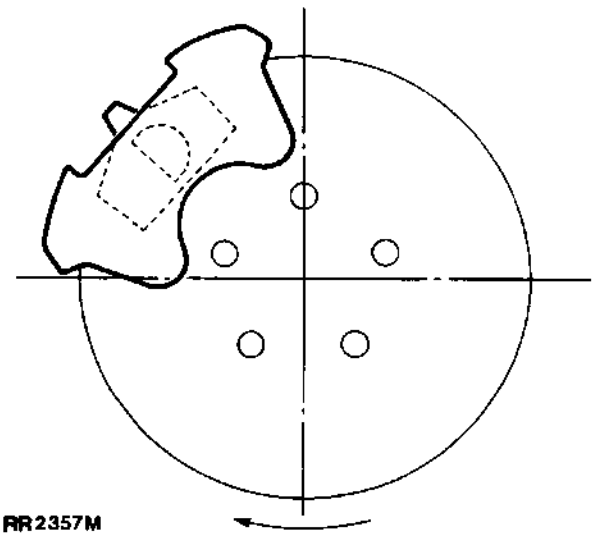
Remove and refit

Remove

Brake pad identification

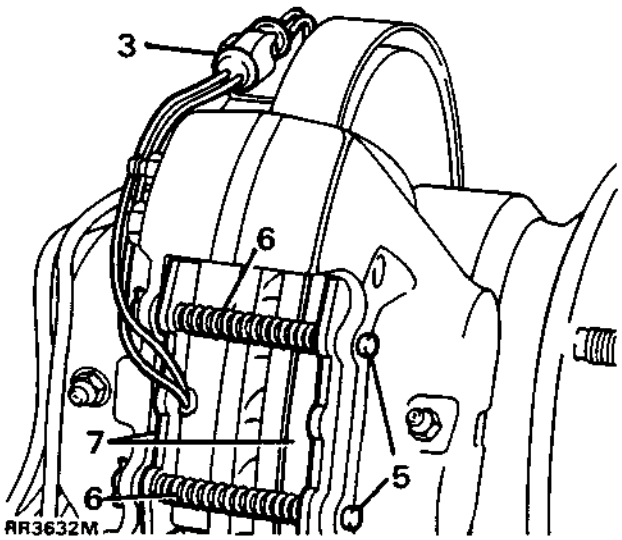
From side of vehicle, looking through disc and caliper at inboard pad, 'D' shaped material on rear of inboard pad should face direction of forward rotation of road wheel with curved part of 'D' always at trailing end of caliper.

Brake pad wear sensed at right hand wheels

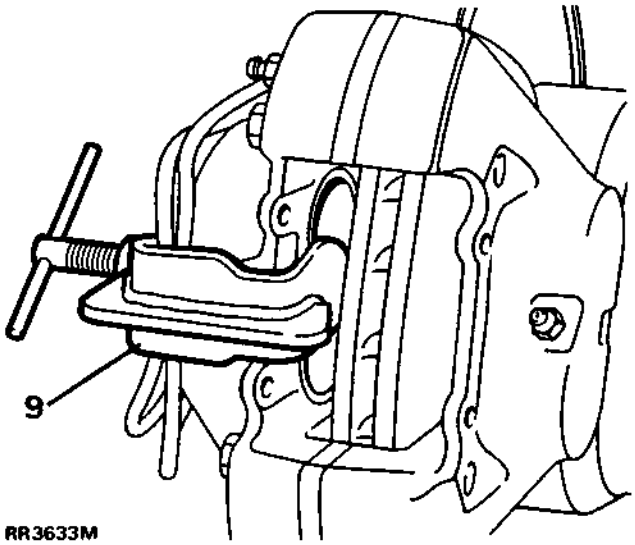

RR2357M

Direction of rotation

1. Remove front road wheels. ***See WHEELS AND TYRES, Repair, Wheels***
2. Disconnect the battery negative lead.
3. Disconnect pad wear sensor plug (front right hand side only).



4. Clean exterior of calipers.
5. Remove split pins from retaining pins.
6. Remove pad retaining pins and anti-rattle springs.
7. Remove brake pads.



8. Clean exposed parts of pistons, using new brake fluid.
9. Using piston clamp LRT-70-500 press each piston back into its bore. Ensure that displaced brake fluid does not overflow from reservoir.
10. Coat faces of pistons with brake fluid, keeping it away from lining material.

Refit

11. Insert brake pads, ensuring pad with wear indicator is fitted to inboard side right hand caliper.
12. Fit pad retaining pins and anti-rattle springs. Secure with new split pins. Reconnect pad sensor wear plug.
13. Apply service brake pedal several times to locate pads.
14. Check fluid reservoir. Top up if necessary, using correct grade of fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***

REAR BRAKE PADS

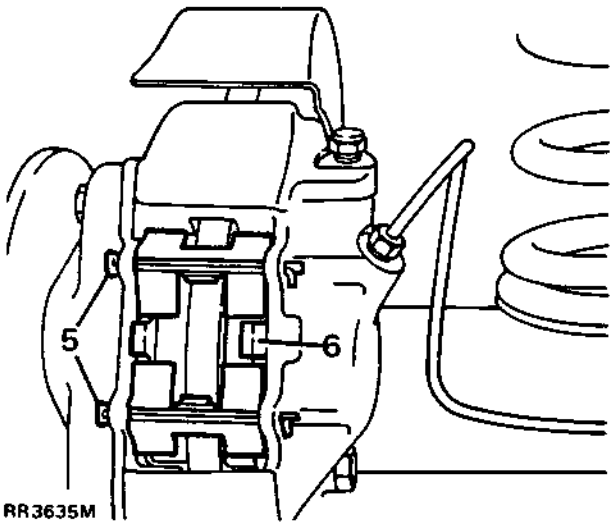
Service repair no - 70.40.03

Service tool:
LRT-70-500 - Piston clamp

Remove and refit

Remove

1. Remove rear road wheels. ***See WHEELS AND TYRES, Repair, Wheels***
2. Disconnect the battery negative lead.
3. Disconnect pad wear sensor plug (rear right hand side only).
4. Clean exterior of calipers.
5. Remove pad retaining pins and springs.
6. Remove brake pads.

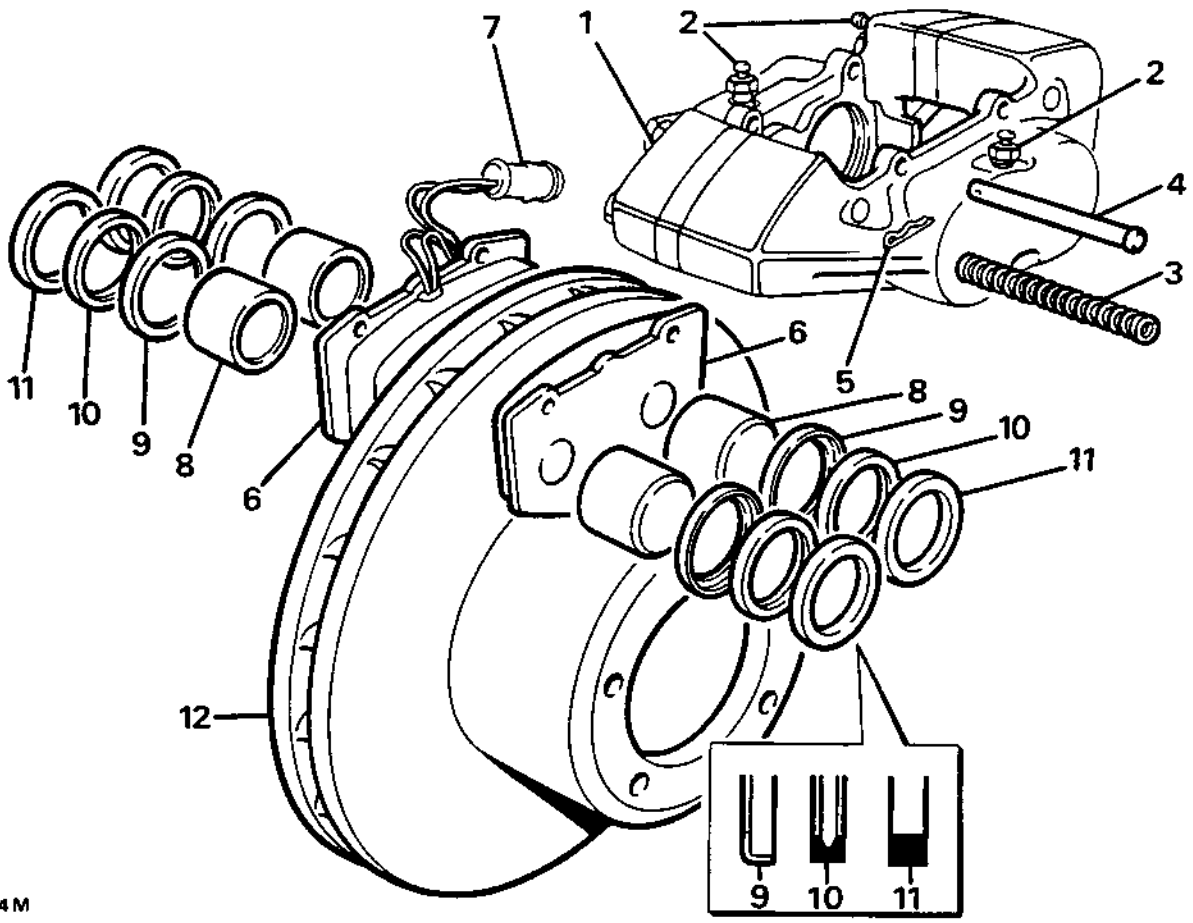


7. Clean exposed parts of pistons, using new brake fluid.
8. Using piston clamp LRT-70-500 press each piston back into its bore. Ensure that displaced brake fluid does not overflow from reservoir.
9. Coat faces of pistons with brake fluid, keeping it away from lining material.

Refit

10. Insert brake pads, ensuring pad with wear indicator is fitted to inboard, right hand side caliper.
11. Position pad retaining springs, fit new pins and spread ends. Reconnect pad sensor wear plug.
12. Apply service brake pedal several times to locate pads.
13. Check fluid reservoir, top up if necessary, using correct grade of fluid. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***

FRONT BRAKE CALIPER ASSEMBLY



Key to caliper

1. Caliper
2. Bleedscrews
3. Anti-rattle springs
4. Pad retaining pins
5. Split pins
6. Friction pads
7. Pad wear indicator plug
8. Piston
9. Wiper seal retainer
10. Wiper seal
11. Fluid seal
12. Brake disc

FRONT BRAKE CALIPERS

Service repair no - 70.55.03
Service repair no - 70.55.16

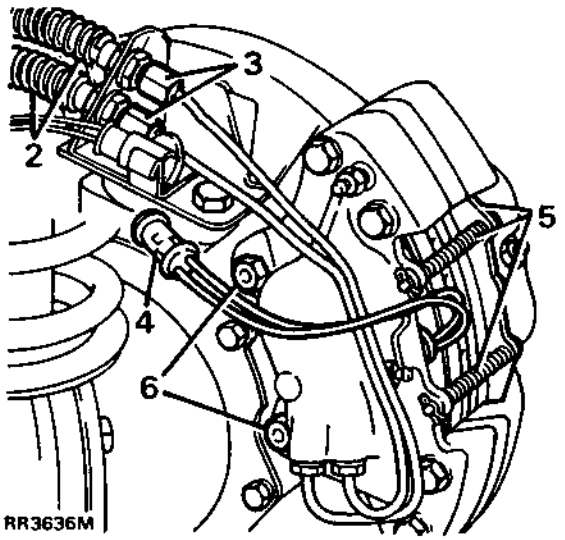
Service tool:
LRT-70-500 - Piston clamp

Remove, repair and refit

△ **NOTE: Pad wear warning indicators are incorporated into front and rear right hand inboard pads.**

Remove caliper

1. Loosen front wheel retaining nuts, raise front of vehicle, lower onto axle stands, remove wheels.
2. Expose flexible brake hoses by moving coiled protective covering. Using a recognised hose clamp, clamp both hoses to prevent loss of brake fluid.
3. Disconnect rigid brake pipes from flexible hoses, seal exposed ends to prevent ingress of dirt. (If necessary rigid brake pipes to caliper can be disconnected when caliper is removed).
4. Disconnect pad wear warning indicator (front right hand side only).
5. Remove split pins, retaining pins and springs, withdraw pads. If refitting pads, identify them for assembly to original locations.
6. Loosen bolts and remove caliper.

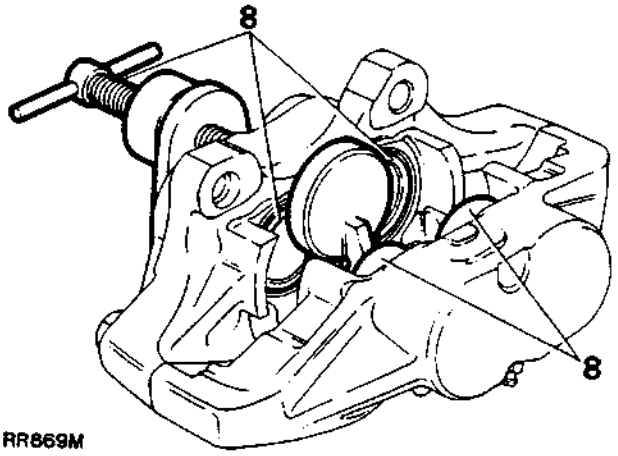


RR3636M

DISMANTLE AND REPAIR

Do not separate caliper halves

7. Clean outer surfaces of caliper using aerosol brake cleaner.
8. Using special tool LRT-70-500, clamp pistons in inboard half of caliper. Gently, keeping fingers clear, and with **CAUTION,** apply air pressure to fluid inlet port to expel pistons. It is unlikely that pistons will expel at same time, regulate rate with a suitable piece of wood between appropriate piston and caliper.



RR869M

9. Finally remove pistons, identifying them with their respective bores.
10. Remove wiper seal retainer by inserting a blunt screwdriver between retainer and seal. Pry retainer carefully from mouth of bore.
11. Taking care not to damage seal grooves, extract wiper seal and fluid seal.
12. Clean bores, pistons and seal grooves using clean brake fluid only. If caliper or pistons are corroded, or their condition is not perfect, new parts must be fitted.

Assemble outboard pistons

13. Coat new fluid seal with brake fluid. Ease seal into groove in bore using only fingers, ensuring it is properly seated. Fluid seal and groove are not same in section, so when seal is seated it feels raised to touch at edge furthest away from mouth of bore.
14. Coat appropriate piston with brake fluid. Insert it squarely into bore by hand only. Do not tilt piston during insertion, leave approximately 8mm projecting from bore.
15. Coat new wiper seal with brake fluid and fit to new seal retainer. Slide assembly, seal first, over protruding piston and into bore recess. Use piston clamp to press home seal retainer and piston.

Mounting inboard pistons

16. Clamp outboard pistons and carry out same procedure for removing and fitting outboard pistons and seals, instructions 8 to 15.

Refit calipers and pads

17. Fit caliper, tighten bolts evenly to, ***82 Nm.***
18. Connect brake flexible hoses to caliper. Tighten to ***10 Nm.***
19. Remove hose clamps.
20. Lightly coat back and edges of pads with brake fluid, avoid friction material.
21. Insert pads. Fit pins and springs, secure using new split pins.

△ **NOTE: Ensure friction pad with wear indicator is fitted to inboard side of front right hand caliper.**

22. Reconnect pad wear indicator plug.
23. Bleed brake system. ***See Brake system bleed***
24. Press brake pedal firmly several times to locate friction pads.
25. Fit road wheels, remove axle stands. Finally tighten road wheel nuts.
26. Road test vehicle. Note that new friction pads require 'bedding-in', this may take several hundred miles before brakes are at maximum efficiency.

REAR BRAKE CALIPERS

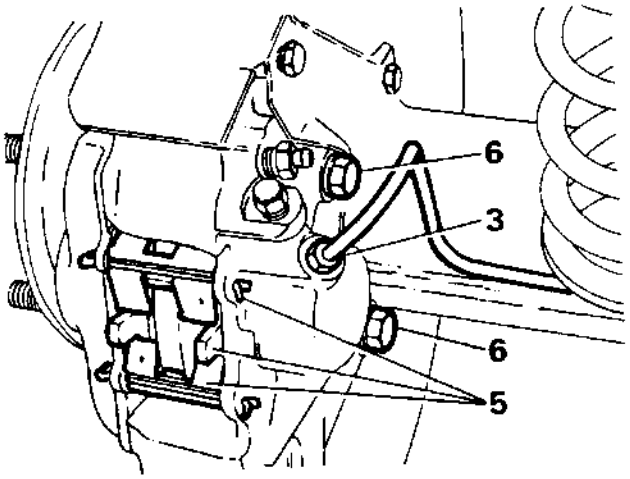
Service repair no - 70.55.06
Service repair no - 70.55.17

Service tool:
LRT-50-700 - Piston clamp

Remove, repair and refit

Remove caliper

1. Loosen rear road wheel nuts. Jack up vehicle, lower onto axle stands, remove wheels.
2. Using a recognised hose clamp, clamp flexible brake hose above rear axle.
3. Remove brake pipe(s) from rear brake caliper(s). Seal pipe ends to prevent ingress of dirt.
4. Rear right hand caliper only, disconnect pad wear indicator.
5. Remove retaining pins and springs and withdraw pads. If same pads are to be refitted, identify them for assembly in original positions.
6. Remove two bolts, withdraw caliper from axle.

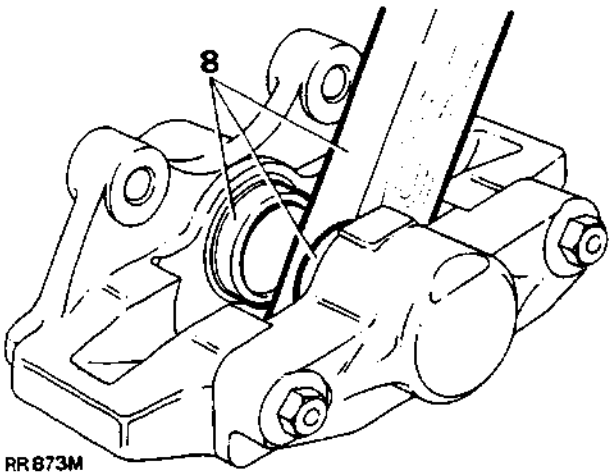


RR2007E

DISMANTLE AND REPAIR

Do not separate caliper halves

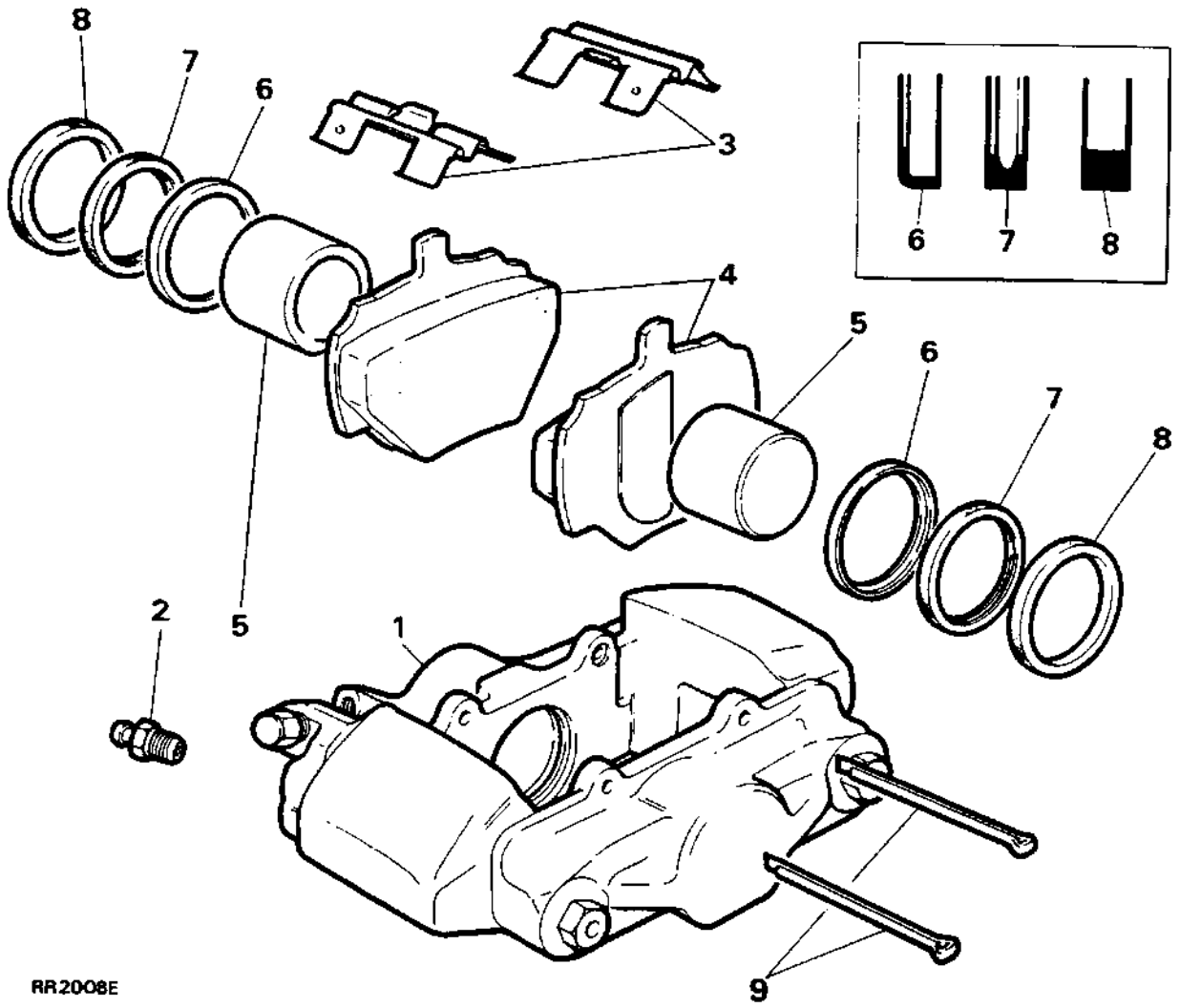
7. Clean outer surfaces of caliper with aerosol brake cleaner.
8. **WITH CAUTION** expel pistons from their bores by applying air pressure to fluid inlet port. It is unlikely both pistons will expel at same time, regulate rate with a suitable piece of wood inserted between two pistons.



RR873M

9. Finally, remove pistons keeping them identified with their respective bores.
10. Remove wiper seal retainer by inserting a blunt screwdriver between retainer and seal and pry retainer carefully from mouth of bore.
11. Taking care not to damage seal grooves, extract wiper seal and fluid seal.
12. Clean bores, pistons and particularly seal grooves using clean brake fluid only. If caliper or pistons are corroded or their condition is not perfect new parts must be fitted.

REAR BRAKE CALIPER ASSEMBLY



LH Rear Caliper illustrated

Key to caliper

1. Caliper
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

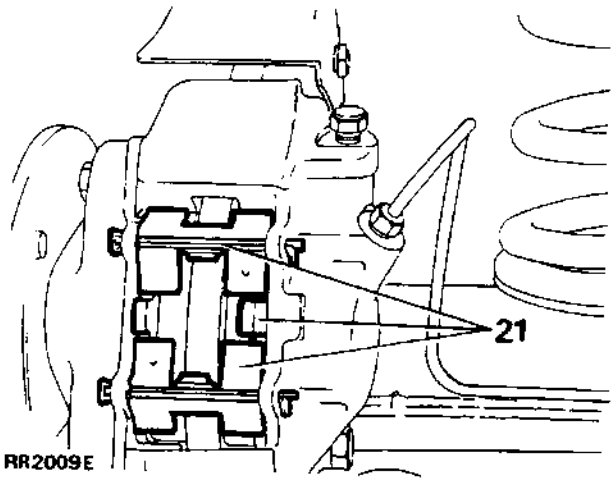
13. Coat a new fluid seal using brake fluid. Ease seal into groove in bore using only fingers and ensure that it is properly seated. The fluid seal and groove are not same in section so that when seal is seated it feels raised to touch at edge furthest away from mouth of bore.
14. Coat appropriate piston with brake fluid. Insert it squarely into bore by hand only. Do not tilt piston during insertion and leave approximately 8mm projecting from bore.
15. Coat a new wiper seal with brake fluid and fit to new seal retainer. Slide assembly, seal first, over protruding piston into bore recess.
16. Using special tool LRT-70-500 - piston clamp, press home seal retainer and piston.

Mounting inboard piston

17. Carry out same procedure as for removing and fitting outboard piston and seals, instructions 8 to 16.

Refit calipers and pads

18. Fit caliper to axle, tighten two bolts evenly to ***82 Nm.***
19. Connect brake pipe to caliper. Tighten to ***12 Nm.*** Remove clamp from flexible brake hose.
20. Lightly coat back and edges of pads using brake fluid, avoid friction material.
21. Insert pads and retaining springs, secure in position with new retaining pins and spread ends. Note correct position of retaining springs.



△ **NOTE: Ensure pad with wear indicator is fitted to inboard side of rear right hand, brake caliper.**

22. Reconnect pad wear indicator electrical plug.
23. Bleed secondary brake system at rear calipers, starting at caliper furthest away from master cylinder.
24. Press brake pedal firmly several times to locate pads.
25. Fit road wheels, remove axle stands and finally tighten road wheel nuts,
26. Road test vehicle. Note new brake pads require 'bedding-in', for several hundred miles before brakes are at maximum efficiency.

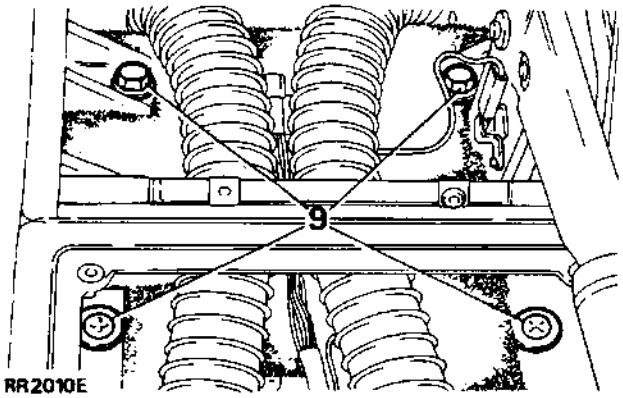
PARKING BRAKE LEVER

Service repair no - 70.45.01

Remove and refit

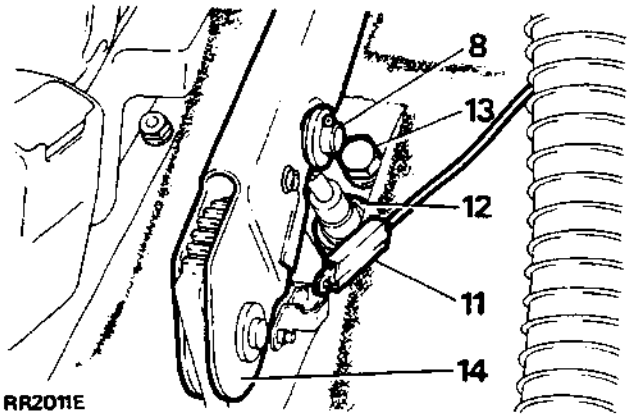
Remove

1. Disconnect the battery negative lead.
2. Chock road wheels and release parking brake.
3. Open glove box lid, remove four screws securing glove box liner and remove liner.
4. Remove two electrical leads from glove box cigar lighter. Release two heater hoses from clamps.
5. Carefully pry window lift switch panel away from front of glove box. Manoeuvre panel through opening into inside of glove box.
6. Remove gear selector and transfer gearbox knobs.
7. Carefully pry centre panel out of console. Disconnect electrical multi-plug to inset graphics panel, withdraw panel off main gearbox selector.
8. Remove split pin, plain washer and clevis pin.
9. Remove four bolts and plain washers.



RR2010E

10. Raise parking brake lever. Ease glove box and console assembly rearwards to release from radio housing. Remove assembly.
11. Disconnect electrical lead from parking brake warning switch.
12. Release parking brake cable outer retaining nut.
13. Remove remaining single bolt and plain washer securing parking brake mounting bracket.
14. Remove parking brake lever assembly from parking brake outer cable.



RR2011E

Refit

15. Position parking brake lever, secure in position with single bolt and plain washer, forward of lever mounting bracket.
16. Secure outer cable to mounting plate, tighten nut securely.
17. Refit glove box/console assembly, secure in position, tightening remaining bolt and two screws securely.
18. Fit inner parking brake cable to parking brake lever using a **new** split pin.
19. Reverse remaining removal instructions. Ensure electrical wiring does not become trapped between mating faces.

PARKING BRAKE REPAIR

WARNING: Do not use an air line to remove dust from brake assembly. Asbestos dust from brake linings can be a serious health risk, if inhaled.

Dismantling

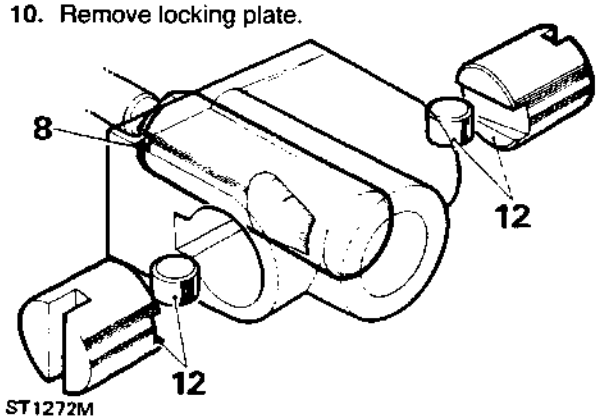
1. Disconnect the battery negative lead. Chock road wheels for safety. Release parking brake, select 'P' or a gear in main gearbox and release parking brake.
2. Disconnect propeller shaft from output flange.
3. Loosen brake adjuster, remove two screws and withdraw brake drum. Inspect friction surface of drum, skim if excessively scored or oval.

NOTE: If drum requires skimming maximum diameter is 255.65 mm.

4. Remove split pin and clevis pin connecting inner cable to brake lever.
5. Remove brake shoes with pull-off springs. Note position of springs in relation to shoes.
6. Remove four bolts securing back plate to transfer box. Remove back plate complete with oil catcher.

Remove expander assembly

7. Remove rubber dust cover.
8. Remove expander and drawlink.
9. Remove retainer spring plate.
10. Remove locking plate.



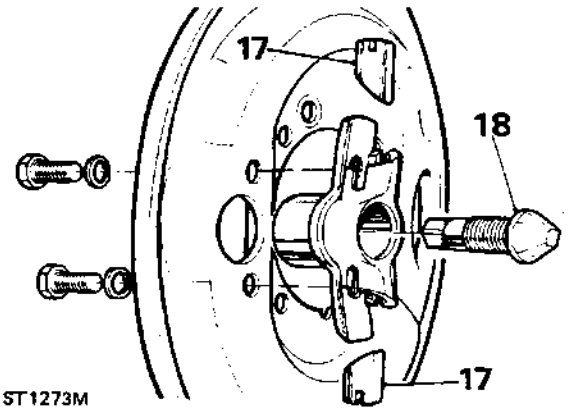
11. Remove packing plate and withdraw expander assembly from back plate.
12. Remove two plungers and rollers.
13. Clean all parts in aerosol brake cleaner, allow to dry. Examine components for wear, discard if unsatisfactory.

Assemble expander assembly

14. Grease and fit expander and drawlink.
15. Grease and fit plungers and rollers, fitting plungers with highest end of roller groove towards backplate.

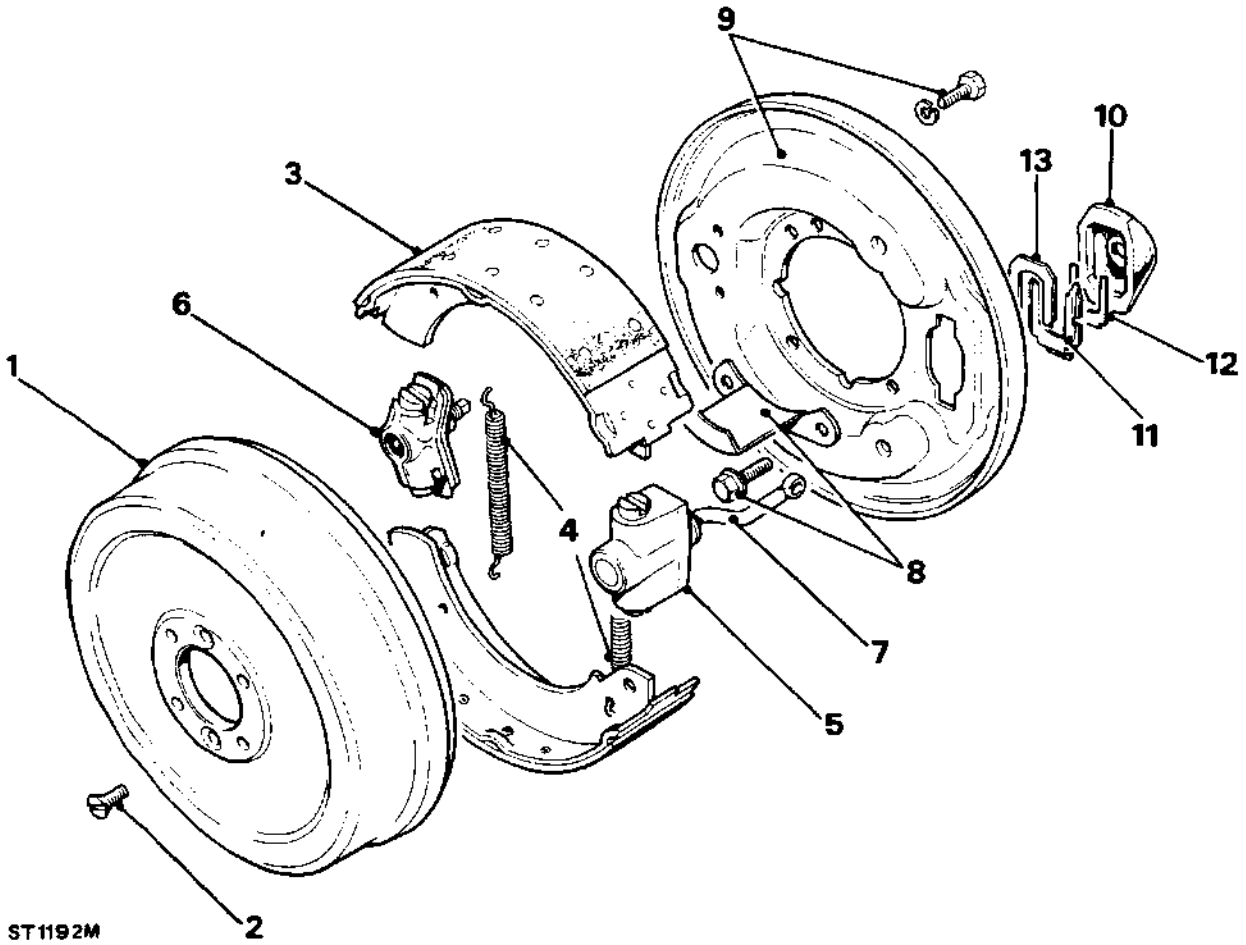
Remove adjuster assembly

16. Remove two bolts and withdraw adjuster assembly from back plate.
17. Remove plungers.
18. Screw adjuster cone inwards to remove from housing.



19. Clean parts in aerosol brake cleaner and discard any unsatisfactory components.

PARKING BRAKE ASSEMBLY



Key to parking brake

1. Brake drum
2. Brake drum retaining screws
3. Brake shoes
4. Brake shoes pull-off springs
5. Expander assembly
6. Adjuster assembly
7. Drawlink
8. Oil catcher
9. Back plate and retaining bolts
10. Dust cover
11. Locking plate
12. Packing plate
13. Spring plate

Adjuster assembly

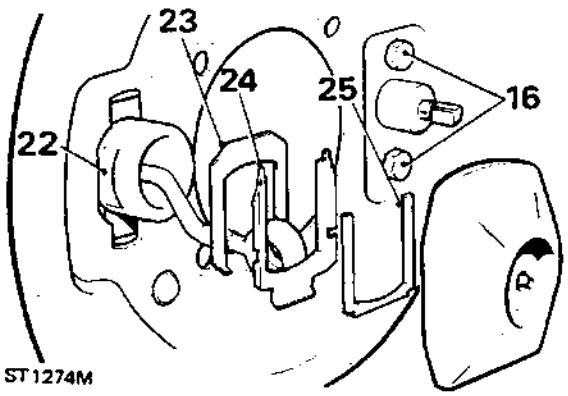
20. Grease and screw in adjuster cone.
21. Grease and fit adjuster plungers aligning chamfered ends with adjuster cone. Note two plungers are identical and can be fitted to either bore. Secure assembly with rubber band to prevent plungers falling out.

Assemble

△ **NOTE: If brake linings are oil-soaked, fit new brake shoes. Check output shaft oil seal, fit a new seal if necessary.**

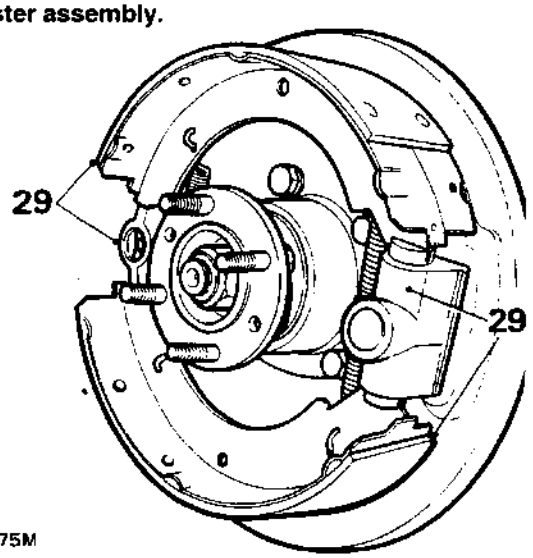
22. Position expander assembly on back plate. Secure using following plates on rear of back plate.

23. Spring plate.
24. Locking plate.
25. Packing plate.
26. Fit rubber dust cover.



27. Fit adjuster assembly to back plate with two bolts. Do not fully tighten.
28. Fit back plate assembly and oil catcher to transfer box with four bolts. Tighten to *75 Nm.*
29. Fit new pull-off springs to brake shoes and fit to back plate.

△ **NOTE: Fully lined end of LOWER SHOE must be toward expander assembly with fully lined end of UPPER SHOE towards adjuster assembly.**



30. Fit brake drum and tighten two screws to *25 nm.*
31. Connect actuating lever to brake cable using a new split pin.
32. Turn adjuster cone fully in, finally tighten two retaining bolts.
33. Loosen adjuster two 'clicks', firmly apply and release parking brake lever to centralise shoes. Drum should rotate freely.
34. Adjust parking brake cable lock nuts until parking brake lever is fully operational on second or third notch of parking brake ratchet.
35. Connect propeller shaft, evenly tighten retaining nuts to *45 Nm.*
36. Remove chocks from wheels, reconnect battery.

PARKING BRAKE CABLE

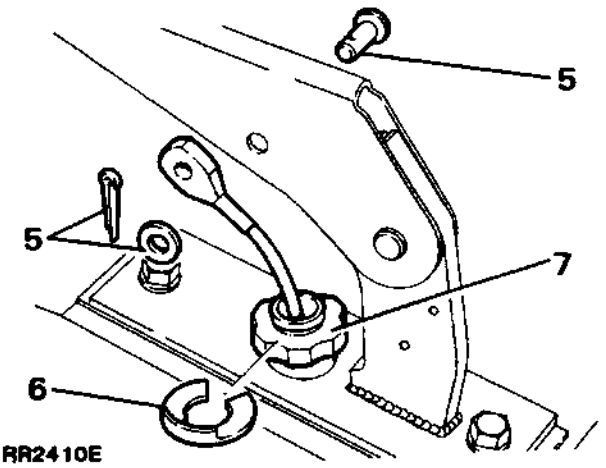
Service repair no - 70.35.25

Remove, refit and adjust

Remove

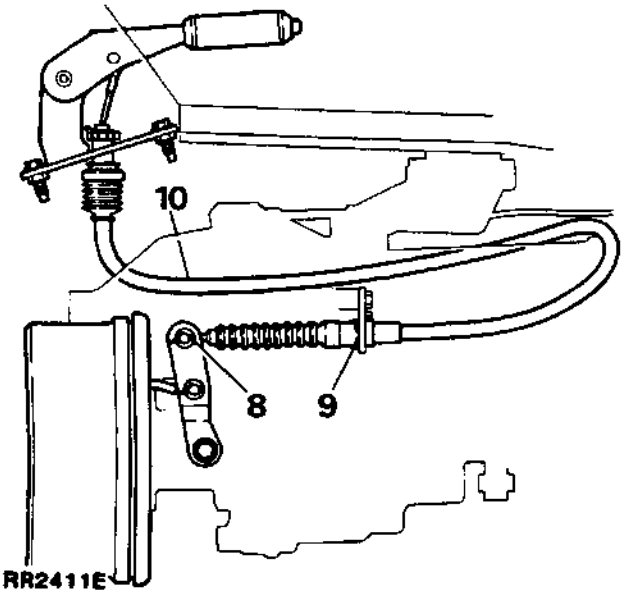
Inside vehicle

1. Place vehicle on level ground or ramp. Select a gear or 'P' in main gearbox. Disconnect the battery negative lead.
2. Chock road wheels.
3. Release parkbrake lever.
4. Remove four retaining screws and lift out glove box liner.
5. Remove split pin, clevis pin and washer from parkbrake lever.
6. Remove clip from adjustment thumbwheel, push inner and outer cable to underside of vehicle.
7. Pull thumbwheel from outer sleeve.



Underneath vehicle

8. Remove split pin, clevis pin and washer.
9. Detach retaining clip from transfer gearbox.
10. Release cable from retaining clip.



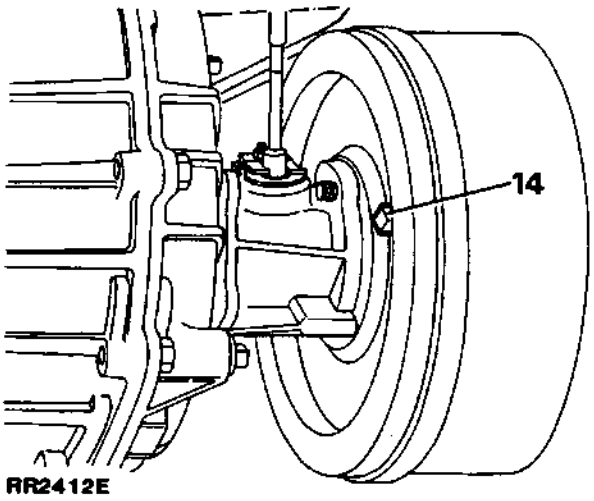
11. Withdraw cable.

Refit

12. Reverse removal procedure. 5 to 11.

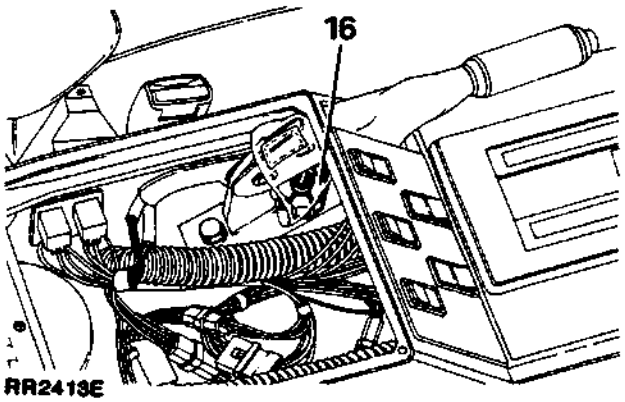
Parkbrake adjust

13. Ensure parkbrake lever is fully released.
14. Underneath vehicle, rotate brake adjuster clockwise until brake shoes are fully expanded against drum.



15. Back off adjuster until drum is free to rotate.
16. Rotate adjustment thumbwheel below parkbrake lever until parking brake is fully operational on third notch of ratchet.

△ **NOTE: Adjustment thumbwheel must ONLY be used for initial setting and to compensate for cable stretch. It MUST NOT be used to take up brake shoe wear, which MUST be adjusted at brake drum.**



17. Operate parking brake to settle shoes. Recheck parkbrake is fully operational on third notch of ratchet. Readjust if necessary.
18. Refit glove box liner.
19. Reconnect the battery negative lead. Remove wheel chocks.

ANTI-LOCK BRAKE SYSTEM - ABS

CLAYTON DEWANDRE - WABCO POWER ASSISTED HYDRAULIC BRAKE SYSTEM WITH INTEGRATED ANTI-LOCK BRAKE SYSTEM - ABS

Introduction

The purpose of ABS is to prevent vehicle wheels locking during brake application, thus maintaining vehicle steerability and stability. This allows vehicle to be steered whilst brakes are applied, even under emergency conditions, and to avoid obstacles where there is sufficient space to redirect the vehicle.

WARNING: ABS is an aid to retaining steering control and stability while braking.

- ABS cannot defy the natural laws of physics acting on the vehicle.

- ABS will not prevent accidents resulting from excessive cornering speeds, following another vehicle too closely or aquaplaning, i.e. where a layer of water prevents adequate contact between tyre and road surface.

- The additional control provided by ABS must never be exploited in a dangerous or reckless manner which could jeopardise the safety of driver or other road users.

SYSTEM DESCRIPTION

The brake system is hydraulically power assisted with an integrated, electronically controlled four channel anti-lock brake system (ABS).
The use of a power assisted brake system means that, during brake application, additional hydraulic energy is provided by a hydraulic power unit.
This hydraulic power unit consists of an electrically driven pump and an accumulator which stores hydraulic energy in readiness for brake application. A pressure switch controls hydraulic pump to maintain fluid pressure in accumulator.

The hydraulic system comprises two completely independent circuits. The rear calipers and upper pistons of front calipers form POWER CIRCUIT. The lower pistons in front calipers form COMBINED POWER/HYDROSTATIC CIRCUIT.

CAUTION: Thoroughly clean all brake components, calipers, pipes and fittings before commencing work on brake system. Failure to do so could cause foreign matter to enter system and damage seals and pistons, which will seriously impair brake system efficiency.

WARNING:

DO NOT use brake fluid previously bled from system.

DO NOT use old or stored brake fluid.

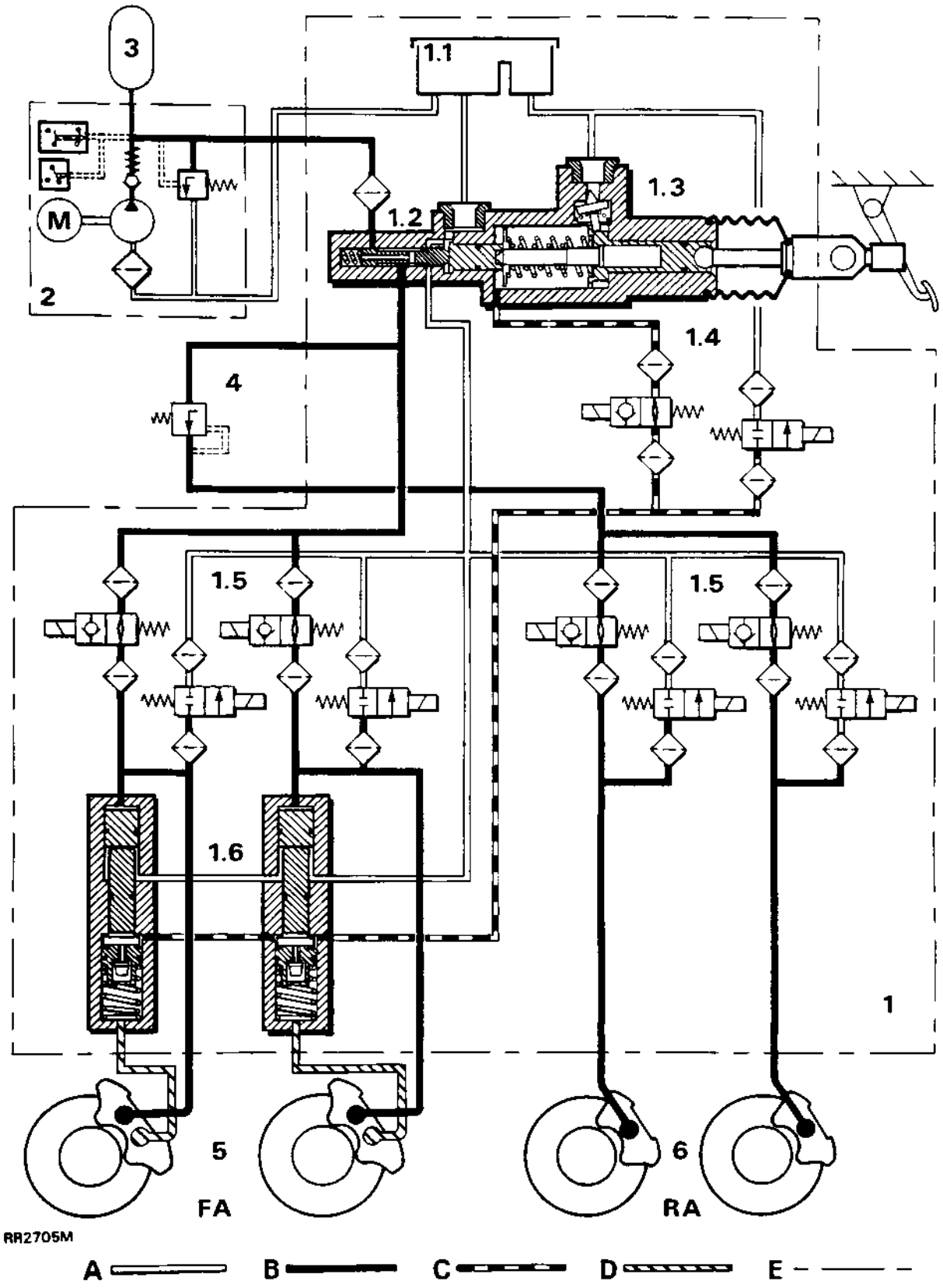
ENSURE that only new fluid is used and that it is taken from a clean sealed container.

DO NOT flush brake system with any fluid other than recommended brake fluid.

Brake system must be drained and flushed at recommended service intervals.

Fluid pressures of 170 bar (2466 psi) are produced by hydraulic pump. It is essential that procedure for depressurising system is carried out where instructed.

HYDRAULIC COMPONENTS



Hydraulic circuits - RR 2705M

Key to diagram

A - Fluid feed/return
B - Power circuit
C - Hydrostatic (master cylinder) circuit
D - Combined hydrostatic/power circuit
E - Component enclosure

Hydraulic components

Hydraulic booster unit (1)

Mounted in same position as conventional master cylinder/servo unit, booster unit contains following components: Fluid reservoir, power valve, master cylinder, isolating valve, ABS solenoid control valves, servo cylinder.

△ **NOTE: Hydraulic booster unit is not a serviceable item, if internal failure occurs a new unit must be fitted. The fluid reservoir and its seals may be changed in the event of damage. Extreme care must be taken when changing reservoir seals to avoid ingress of debris.**

Fluid reservoir (1.1)

Mounted on top of booster unit, the plastic reservoir is subdivided internally to provide separate capacity for brake fluid used in the hydrostatic and power circuits. A central tube incorporates a filter and low fluid warning level switch.

Power valve (1.2)

The power valve is an extension of master cylinder, it controls fluid pressure in power circuit in direct proportion to pressure in master cylinder. Power valve is of spool valve design.

Master cylinder (1.3)

Operation of master cylinder displaces a volume of brake fluid into servo cylinders and increases fluid pressure. Piston movement inside master cylinder will also activate power valve. A tilt valve is incorporated to supply fluid to master cylinder from the reservoir connection.

Isolating valve (1.4)

Isolating valve consists of two solenoid valves controlling fluid inlet and outlet. Their function is to disconnect master cylinder from servo cylinder and to connect servo cylinder to reservoir return during ABS function.

ABS solenoid control valves - 8 off (1.5)

Each pair, comprising inlet and outlet solenoid valves, controls ABS braking to each wheel. In response to signals from ECU, the valves decrease, hold or increase brake pressure according to need to retain wheel rotation and obtain optimum braking. The solenoid valves are designed to respond rapidly to ECU signals.

Servo cylinders - 2 off (1.6)

Servo cylinders have four functions:

1. To provide combined energy from both hydrostatic and power circuit to brake calipers.
2. To provide 'brake feel' at brake pedal.
3. To provide hydrostatic (master cylinder) braking through servo cylinder to calipers in event of no power circuit pressure to servo cylinder.
4. To provide braking from both power circuit and from hydrostatic fluid remaining in servo cylinder, in event of no hydrostatic circuit pressure from master cylinder.

Hydraulic power unit (2)

Hydraulic power unit comprises an electrically driven pump and a pressure switch. Pressure switch incorporates three electro-mechanical switches: one for pump, another, at a different presure setting, to illuminate pressure warning light. The latter switch plus third switch inform ECU of low pressure and that ABS function should cease whilst pressure remains low.
The pump also incorporates a non-return valve, a low pressure inlet filter, and a pressure relief valve to protect the system.

Accumulator (3)

Diaphragm accumulator is precharged with nitrogen at up to 80 bar, its function is to store hydraulic energy.

Pressure conscious reducing valve (PCRV) (4)

PCRV valve is located between power valve and ABS solenoid valves for rear axle. Its function is to limit brake pressure to rear axle.

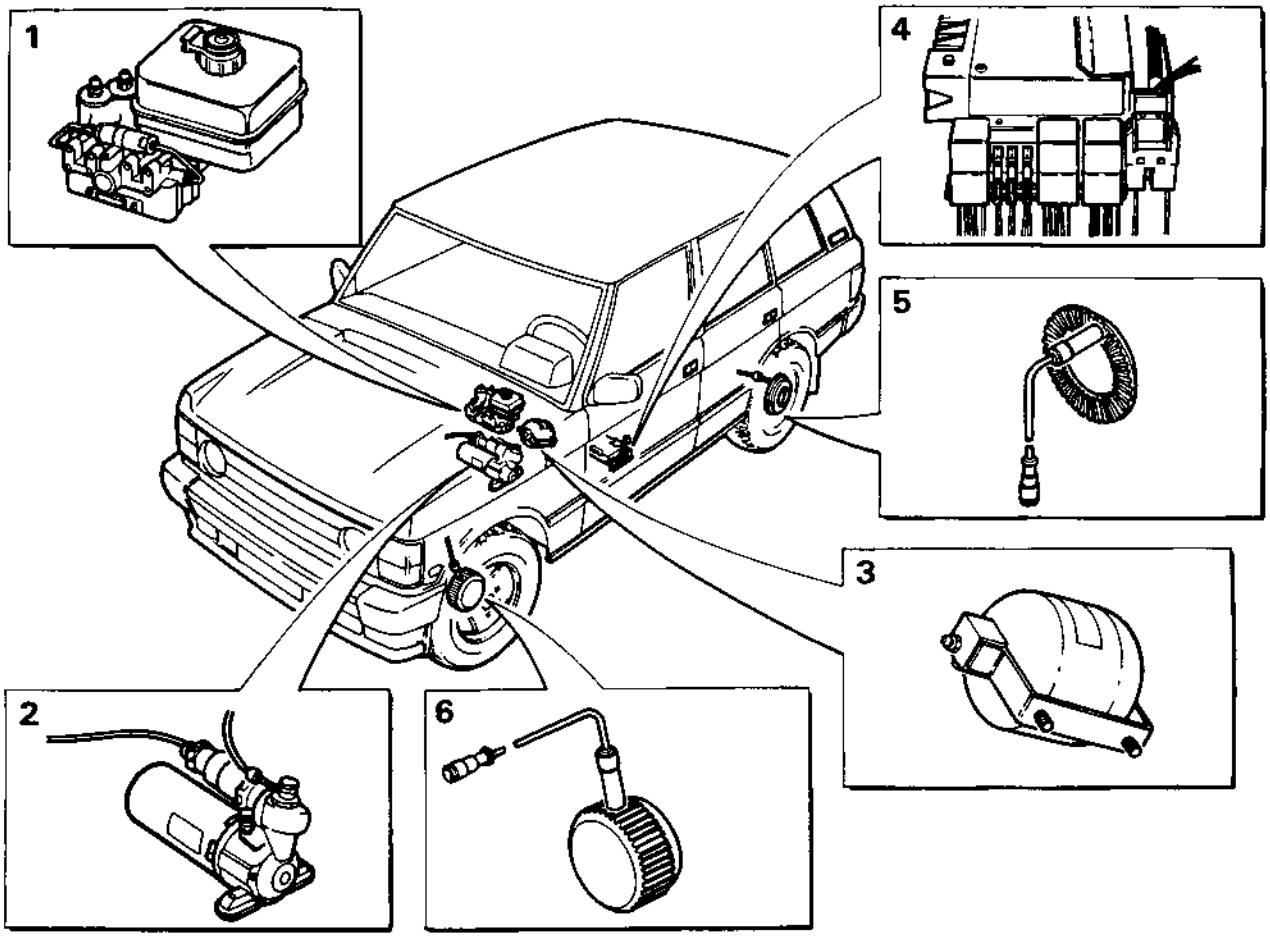
Brake calipers - front - (5) rear - (6)

△ **NOTE: To identify separate hydraulic circuits, they are referred to as HYDROSTATIC and POWER circuits.**

Power circuit - Consists of rear calipers and upper pistons in the front calipers, supplied by direct hydraulic power from power valve.

Hydrostatic circuit - Lower pistons in the front calipers form this circuit, supplied with hydraulic energy from servo cylinders comprising a combination of master cylinder pressure and direct hydraulic power.

LOCATION OF COMPONENTS



RR2706M

Key to diagram (RR2706M)

1. Hydraulic booster unit.
2. Power unit - hydraulic pump.
3. Accumulator.
4. Electronic control unit (ECU), relays and fuses.
5. Rear sensors/exciter rings.
6. Front sensors/exciter rings.

Electronic control unit - ECU

ABS operation is controlled by ECU located under left hand front seat, and earthed to centre tunnel.

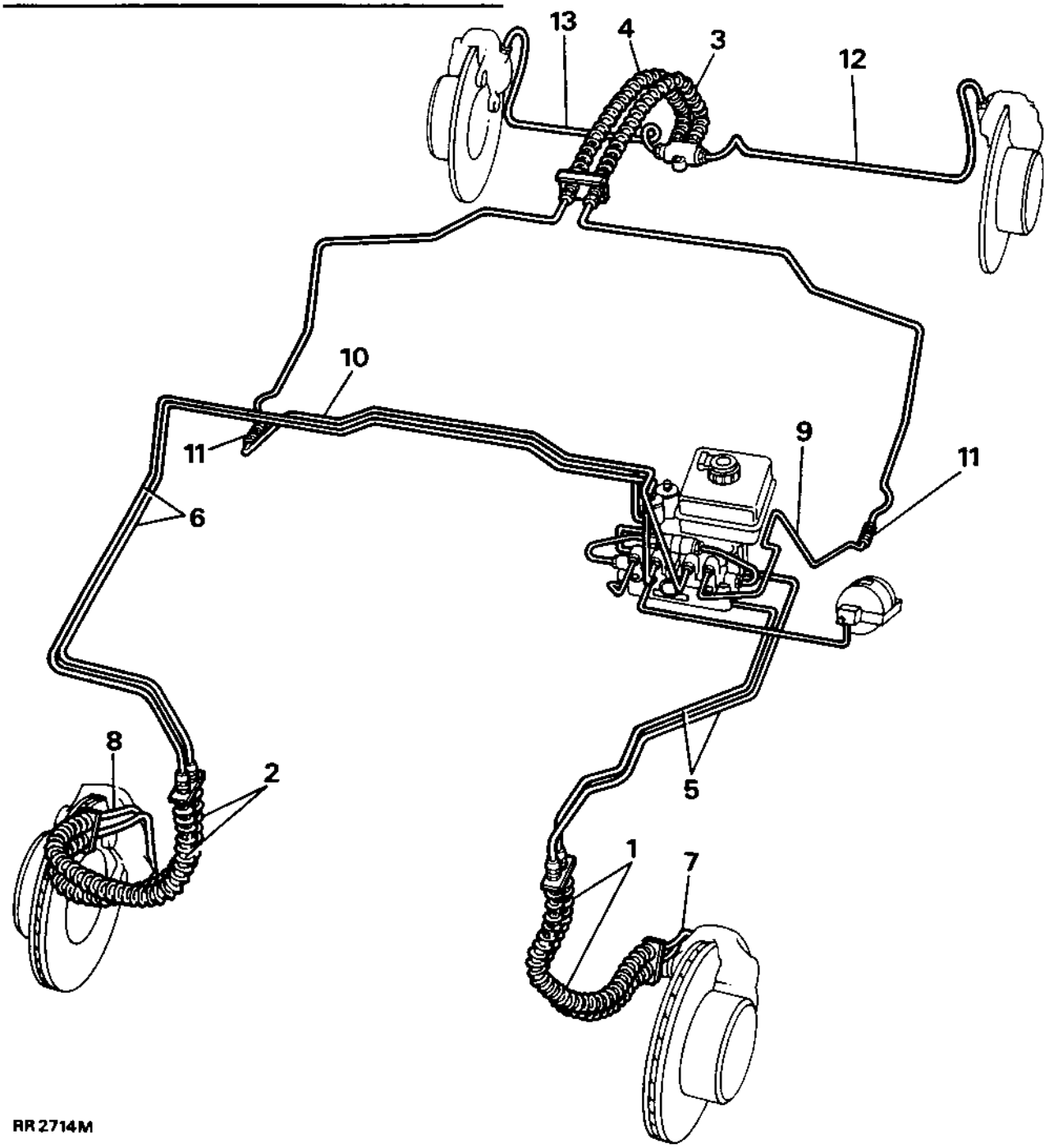
ECU is connected to ABS harness by a 35 way connector.

The ECU is a non-serviceable item, it must be replaced if failure occurs.

Sensors, exciter rings - 4 off

A sensor is mounted at each wheel, sensing a 60 tooth exciter ring. When vehicle is in motion inductive sensors send signals to ECU. Front exciter ring is fitted to outside diameter of constant velocity joint in each front hub. Rear exciter ring is bolted to rear of each brake disc bell.

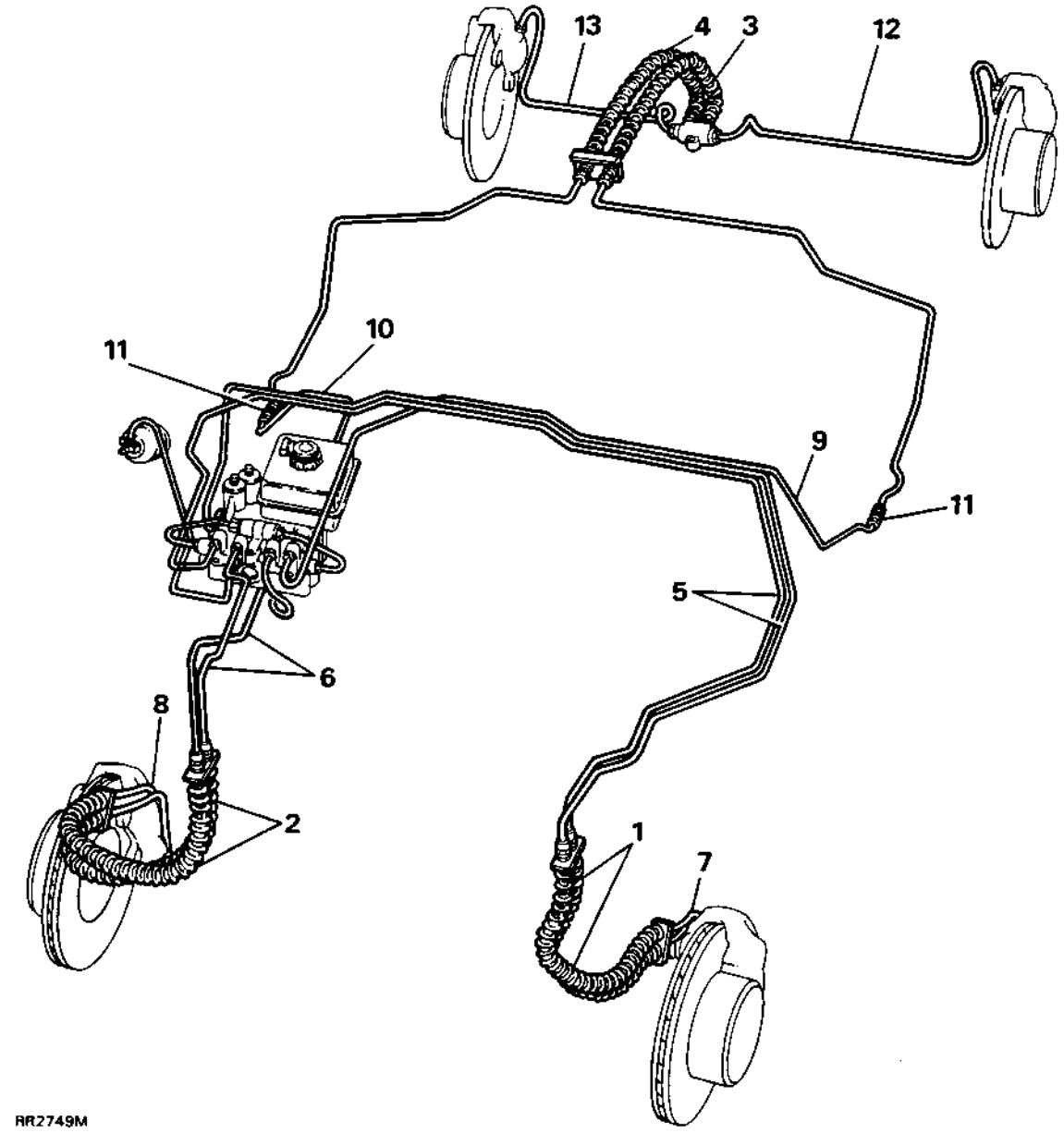
BRAKE PIPE LAYOUT - LEFT HAND DRIVE



HOSES

1. Front left hand flexible hoses.
2. Front right hand flexible hoses.
3. Left hand intermediate hose
4. Right hand intermediate hose

BRAKE PIPE LAYOUT - RIGHT HAND DRIVE



PIPES

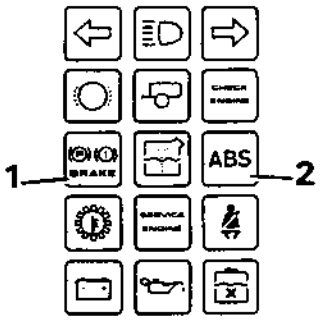
1. Feed to front left hand hose connector.
2. Feed to front right hand hose connector.
3. Feed to front left hand caliper.
4. Feed to front right hand caliper.
5. Feed to left hand intermediate hose.
6. Feed to right hand intermediate hose.
7. Two way connector.
8. Feed to rear left hand caliper.
9. Feed to rear right hand caliper.

WARNING LIGHTS

Brake fluid pressure/level and parking brake warning light - (red) - 1

The warning light situated in instrument binnacle indicates insufficient pressure in system and/or low fluid level. Warning light will illuminate when ignition is switched ON as part of initial bulb check, and when parking brake is applied.
If pressure in hydraulic system is lower than cut-in pressure for warning light, light will illuminate. When light is on hydraulic pump will run. Note, if light remains illuminated after bulb check and releasing park brake, DO NOT drive vehicle until light extinguishes.

WARNING: If light illuminates while vehicle is in motion, investigate fault immediately. Braking will be available after loss of pressure, but greater force will be required at pedal to slow vehicle.



RR2756E

ABS warning light - (amber) - 2 USA vehicles - (red) - 2

WARNING: Power assisted braking is not available if ignition is switched off. An increase in effort at brake pedal will be required to apply brakes.

The ABS warning light situated in instrument binnacle indicates a failure in ABS system. Warning light will illuminate when ignition is switched ON, it will extinguish when vehicle speed exceeds 7 km/h (5 mph). This indicates that system self monitoring check was successful, and system performs correctly.
If light remains on or subsequently illuminates with ignition ON a fault in ABS system is indicated. The self monitoring procedure is repeated frequently while ignition is ON. If a fault is detected during self monitoring, light will illuminate indicating that one or more wheels are not under ABS control.

WARNING: Reduced ABS control is possible with ABS warning light illuminated depending on severity and type of fault. If both ABS and brake failure warning lights are illuminated, loss of system pressure or hydraulic pump failure is indicated.
IT IS ESSENTIAL THAT FAULT IS IMMEDIATELY INVESTIGATED.

ABS warning light - 1993 introduction

On 1993 model year vehicles a feature has been added to indicate whether or not the ABS ECU has recorded any faults which have not been repaired. If no faults are recorded the ABS warning light will switch off for half a second after ignition is switched on and the ECU has completed its self checks. This will occur during the time that the light is on between switching on and driving above 7 kph (5 mph).
This enables a vehicle tester to check ABS without driving the vehicle.

NOTE: On a small number of early USA vehicles, the bulb check masks this feature.

DRIVING VEHICLE

WARNING: On surfaces which are soft and deep, for example deep powdery snow, sand or gravel, braking distance may be greater than with non ABS braking. In these conditions wheel lock and the build up of snow or gravel under wheels may be an aid to shorter stopping distance. However it is still an advantage to maintain the stability and manouevrability available with ABS control.

1. Switch on ignition, system will automatically carry out self test function. This will be felt as a slight movement in brake pedal and a short, rapid series of clicks indicating that solenoid valves have been checked.
2. Observe warning lights, check parking brake/fluid pressure/level warning light extinguishes after initial bulb check or when parking brake is released, indicating that power assistance is available. Note time taken to pressurise system is approximately 20 seconds.
3. Start vehicle and drive away, at 7 km/h (5 mph) the ABS warning light must be extinguished - see Warning Lights.
4. In road conditions where surface friction is sufficient to slow or stop the vehicle without wheel lock, ABS does not operate.
5. In an emergency braking situation, if one or more wheels begin to slow rapidly in relation to vehicle speed, ABS will detect wheel locking tendency and will regulate brake pressure to maintain wheel rotation.
6. ABS operation will be felt as a vibration through pedal, at same time solenoid cycling will be heard.

NOTE: Constant pressure on foot pedal whilst ABS is operating is more effective than cadence braking. Do not pump brake pedal, this may reduce ABS efficiency and increase stopping distance.

7. Downward travel of pedal will also feel hard at point at which ABS operates. Little further pedal travel is possible at this point, BUT, force on the pedal can be varied to influence braking force while ABS retains control.

BRAKE APPLICATION WITH PARTIAL FAILURE

WARNING: If a fault develops in brake system it is essential that fault is investigated immediately.

NOTE: If, during braking, a drastically reduced resistance is detected at pedal and braking effectiveness is very much reduced, failure of the non-powered (master cylinder) portion of system is indicated. When this occurs DO NOT PUMP BRAKE PEDAL. Push the pedal through free movement to obtain braking effort. It is essential that brake pedal travel is not obstructed by items such as extra footwell mats.

1. When power assistance is not available, ABS braking is not operative. Both warning lights are illuminated. Braking effort is available from master cylinder only. This results in longer pedal travel and greater pedal effort required to decelerate vehicle.

WARNING: Foot pressure on pedal, using master cylinder only, will not achieve same degree of braking as is available from power assistance.

2. If master cylinder fails, i.e. there is insufficient fluid in master cylinder to create pressure, braking to all four wheels is retained and ABS remains operative. The red warning light will be illuminated if cause of master cylinder failure is a fluid leak and level in master cylinder is low enough to actuate fluid level switch.

WARNING: Longer pedal travel is required, but power assisted braking is available at reduced efficiency.

3. If brake failure occurs due to a fractured brake pipe between a servo unit and a wheel, there may be no pressure in master cylinder. The fluid warning light will illuminate when level in master cylinder is low enough to actuate fluid level switch. Master cylinder and power valve will operate as for master cylinder failure, BUT, fluid from power circuit will push all moving parts in servo cylinder associated with failure to limit of travel. No pressurised fluid passes to those brake pistons served by servo cylinder, but all other pistons in front and rear calipers will be supplied with direct pressure from power valve. Pistons served by other servo cylinder retain braking as fluid from master cylinder is retained in servo cylinder not associated with the leakage.

WARNING: Brake pedal travel will be greater and extra pedal effort will be required, accompanied by the vehicle pulling to one side.

ABS FAULT DIAGNOSIS

If a fault has occurred, or has been identified by ECU self diagnostic function and ABS warning light is illuminated, system and components must be checked to locate and rectify fault, enabling faulty component or harness to be replaced.

△ **NOTE: If warning lamp has indicated a fault in system, and no fault code has been stored in memory, cause of fault is:**

a) Failure in electrical supply
b) Loss of hydraulic pressure
c) Faulty pressure switch
d) Bad ECU ground
e) Faulty warning light relay
f) System not fully charged before driving away
g) ECU not connected

Before commencing fault diagnosis procedure following items must be checked:

1. Inspect all exposed cables for damage or abrasion.
2. Check ground on ABS system.
3. Battery - state of charge.
4. Fluid level in reservoir.
5. All ABS fuses and electrical connections.
6. Check hub end-float.

Fault rectification

1. Complete harness must be replaced if faults are found in wiring harness.
2. DO NOT use unspecified cables or connectors, as this could jeopardise safe function of ABS.
3. DO NOT attempt to open sealed 35 way connector to ECU.

Recommended equipment

Wabco diagnostic controller
- 446 300 300 0 - LRP No. STC2

English STC3
French STC4
German STC5
Italian STC6
Spanish STC7

FAULT DIAGNOSIS PROCEDURE

△ **NOTE: If ABS warning light illuminates due to large sensor air gap, fault will be retained by the ECU memory. Where wheel sensors have been pushed fully home prior to test, blink code will indicate a fault that has been rectified.**

△ **NOTE: After any steering adjustment, bearing replacement/adjustment, brake disc replacement: Check hub end-float and sensor clearance.**

△ **NOTE: Having fixed faults clear ALL memory codes and road test vehicle.**

CONTINUNITY TEST USING A MULTI-METER

Recommended equipment

⚠ **CAUTION: USE ONLY a multi-meter with compatible male blades to match female spring sockets. Damaged female sockets will necessitate unnecessary component replacement.**

To avoid damage to contacts of 35 way connector, use of adaptor plug shown in illustrations is recommended.
When adaptor is fully engaged with 35 way connector, multimeter probes can be inserted into numbered contacts on face of adaptor. Adaptor plug is supplied as a spares item.

MULTI-METER CHECK PROCEDURE

See ETM, D1

⚠ **CAUTION: Ensure multi-meter is correctly set to VOLTS or OHMS, dependant on test being carried out. Ensure ignition is switched ON or OFF as required.**

1. Disconnect 35 way connector from ECU, connect adaptor plug. Commence check at appropriate pin on 35 way on wiring harness.
2. Check harness wires for continuity, check fuses and relays.
3. Test related components.
4. If intermittent contact is suspected, attempt to locate fault by flexing harness and cables or moving contacts.

ACCUMULATOR PRECHARGE

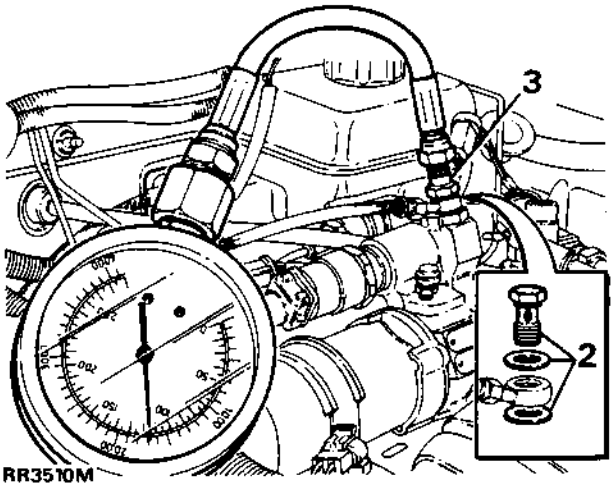
Check

The diaphragm type accumulator is precharged with nitrogen at 80 bar, its function is to store hydraulic energy. Over a period of several years a normal loss of precharge will occur. This procedure will indicate extent to which precharge pressure has fallen.

△ **NOTE: A new accumulator at 68° F has a nominal presure of 80 bar + 2. Minimum acceptable pressure is 50 bar.**

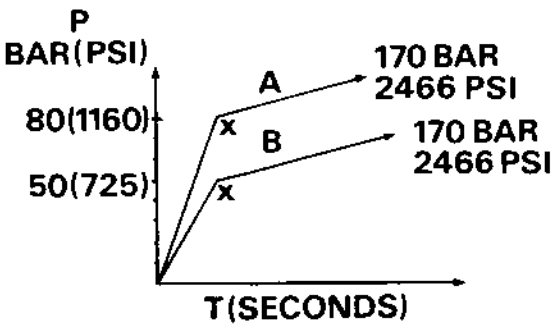
Equipment - LRT.70.001 ABS pressure test equipment

1. Depressurise brake system. ***See Repair, depressurise system***
2. Remove banjo bolt securing high pressure hose, use a second spanner on large hexagon to prevent it being loosened.



RR3510M

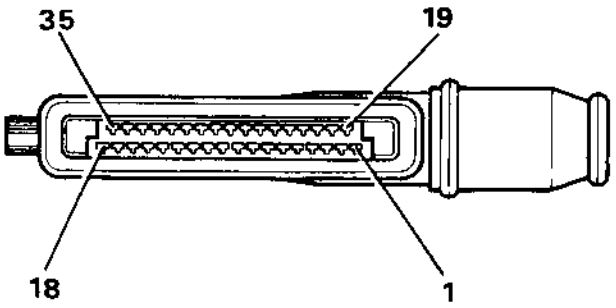
3. Fit pressure gauge adaptor, using sealing washers. Connect pressure gauge.
4. Switch ignition on and observe pressure gauge.
5. There should be a rapid rise in pressure to accumulator precharge, point X, of 80 bar, then a slowing down in rate of increase as pressure rises to system pressure, 170 bar - see graph A.



RR2743M

6. Accumulator has lost precharge if point x occurs below 80 bar, see graph B.
7. Fit new accumulator if point X occurs below 50 bar.
8. Depressurise system, remove pressure gauge and adaptor.
9. Fit banjo bolt securing high pressure hose, use NEW sealing washers. Tighten to ***15 Nm.***
10. Bleed pump.
11. Check/top up fluid level.

ECU HARNESS PLUG



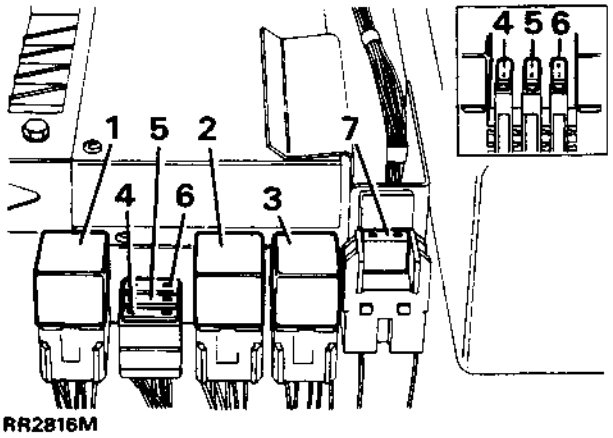
RR2690M

ECU harness plug wiring details - RR2690M

1. Brown/pink
2. Not used
3. Not used
4. Slate/yellow
5. Slate/white
6. Slate/red
7. Slate/blue
8. Black/green
9. Green/pink
10. White/slate
11. Slate/orange
12. Slate/black
13. White/pink
14. Black/pink
15. Brown
16. Black/green
17. Black/brown
18. Black/white
19. Brown/pink
20. Not used
21. Slate/green
22. Slate/purple
23. Slate/pink
24. Slate/brown
25. Green/purple
26. Black/slate
27. Black
28. Not used
29. Not used
30. White/black
31. Black/yellow
32. Black/orange
33. Brown/black
34. Brown/blue
35. Brown/yellow

RELAYS AND FUSES

Incorporated in the ABS electrical system are three relays, located beneath the left hand front seat adjacent to the ABS ECU. Access to the relays is gained by removing the seat side trim.



Inset shows fuse position on early 1990 vehicles.

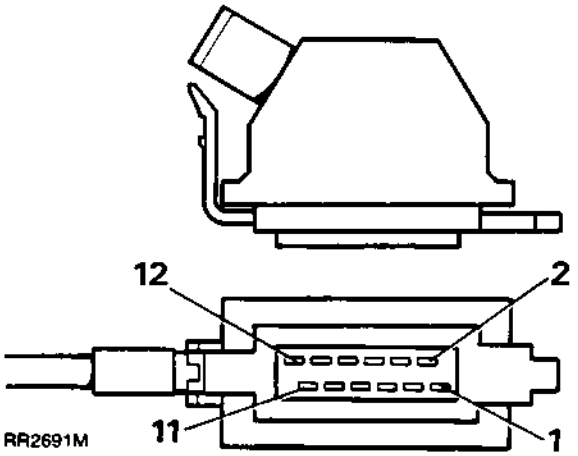
Relay and fuse identification (RR2816M)

1. ABS warning light relay, green base - AB12
2. Valve relay, black base - AB14
3. Hydraulic pump relay, black base - AB2
4. Hydraulic pump relay fuse, 5amp tan - AB10
5. Stop light switch, diagnostic plug, ECU pin 9 fuse, 5 amp tan - AB11
6. Valve relay fuse, 25 amp white - AB13
7. Hydraulic pump relay fuse 30 amp green MAXI type fuse - AB1

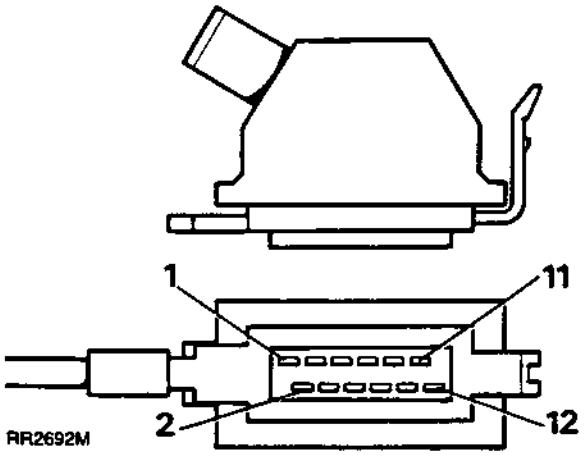
BOOSTER HARNESS PLUG WIRING DETAILS

CAUTION: ABS harness plugs are sealed units and must not be dismantled. The ABS harness is a non-serviceable item, in the event of failure a new harness MUST be fitted.

Right hand drive - RR2691M



Left hand drive - RR2692M



1. Slate/yellow.
2. Not used.
3. Slate/white.
4. Slate/green.
5. Slate/black.
6. Slate/purple.
7. Slate/orange.
8. Slate/brown.
9. Slate/blue.
10. Slate/pink.
11. Slate/red.
12. Not used.

CIRCUIT DIAGRAM ABS 1990/91 MY

Illustration RR2689M

ST1. Battery
ST2. Terminal post
ST5. Ignition switch
AB1. 30 amp MAXI fuse - pump relay
AB2. Pump relay - black
AB3. Hydraulic pump
AB4. Hydraulic pump pressure cut off switch
AB5. Pump low pressure warning switch
AB6. Reservoir fluid level switch
AB7. Diode
AB8. Brake fluid pressure/level warning light
AB9. ABS warning light
AB10. 5 amp fuse, pump relay
AB11. 5 amp fuse, pin 9 ECU, diagnostic plug, brake light switch
AB12. ABS warning light relay - green
AB13. 25 amp fuse, valve relay
AB14. Valve relay - black
AB15. Diagnostic plug
AB16. Electronic control unit (ECU)
AB17. 35 way connector to ECU
AB18. Brakelight switch
AB19. Brakelights
AB20. Multiplug to booster unit

Booster unit components AB21-25

IV Inlet valve
OV Outlet valve

AB21. Isolating valve
AB22. Front left solenoid valves
AB23. Front right solenoid valves
AB24. Rear left solenoid valves
AB25. Rear right solenoid valves
AB26. Sensor connectors (4)
AB27. Front left sensor
AB28. Front right sensor
AB29. Rear left sensor
AB30. Rear right sensor

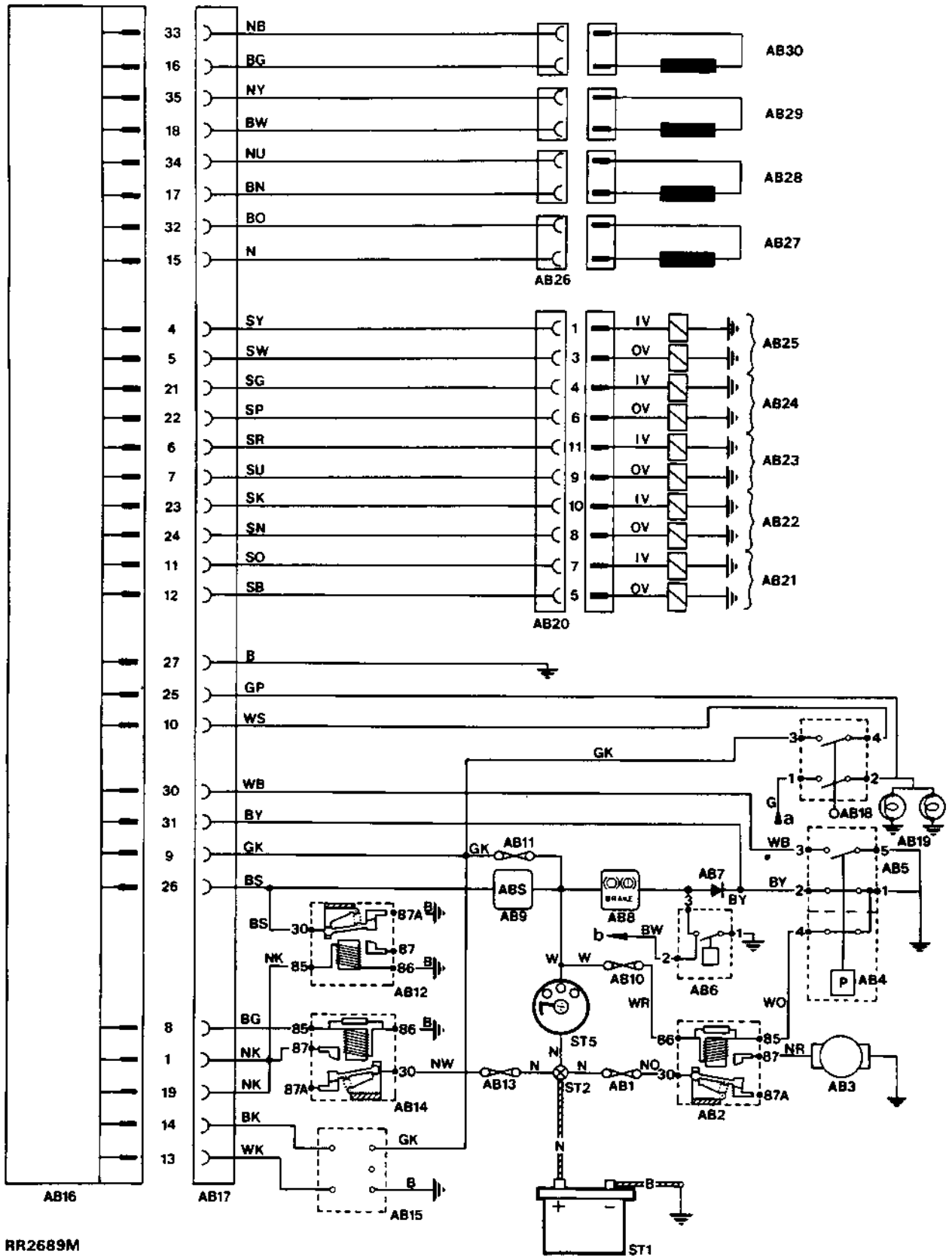
a. 12 volts from fuse A5
b. To bulb check

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

ABS - Circuit diagram



ABS FAULT AND REMEDY CHART

SYMPTOM	POSSIBLE CAUSE	CHECK	REMEDY
ABS warning light on	ABS electrical fault High sensor air gaps	Check ABS electrical circuit to identify fault	Change component if necessary Push in sensors
Both warning lights ON. Pedal travel and pedal force increased	No booster pressure (fluid loss) No booster pressure (pump not operating) Pump faulty	Check reservoir fluid level and inspect system for leaks Check electrical supply to pump	Rectify as necessary and refill reservoir Rectify electrical supply if necessary Change hydraulic pump
Both warning lights ON (no additional symptoms)	Malfunction of pressure switch	Disconnect pressure switch a) If light remains illuminated vehicle wiring faulty b) If lights extinguish pump defective	a) Test wiring change harness if necessary b) Change pump
Brake fluid warning light ON	Fluid loss Reservoir fluid level switch malfunction Pressure switch malfunction	Check reservoir fluid level and inspect system for leaks Check fluid level switch Check switch with pressure gauge a) If wiring faulty b) If switch faulty	Rectify leakage, refill reservoir Change reservoir cap/switch a) Replace harness b) Change hydraulic pump
Brake fluid warning light ON. Pedal travel increased, foot pressure normal	Fluid loss from hydrostatic circuit	Check reservoir level and inspect system for leaks	Rectify leakage and refill reservoir Rebleed as necessary

SYMPTOM	POSSIBLE CAUSE	CHECK	REMEDY
Brake fluid warning light OFF. Pedal travel increased, foot pressure normal	Insufficient bleeding Master cylinder malfunction		Rebleed master cylinder circuit Change booster and bleed system
Hydraulic pump runs constantly	Fluid loss Pump non-return valve faulty	Check reservoir level and inspect system for leaks	Rectify leakage as necessary, refill reservoir Change hydraulic pump
Hydraulic pump runs constantly with warning lights OFF. Pedal travel normal.	Malfunction of pressure switch Relay switch malfunction	Disconnect pressure switch a) If pump stops b) If pump continues running	 a) Change hydraulic pump b) Change relay or cable
Pedal can be moved downwards under constant pressure	Seal leaking in master cylinder Seal leaking in servo unit	Inspect system for leaks	Change booster unit Change booster unit

Notes

GENERAL SERVICE INFORMATION

NOTE: ABS components ARE NOT serviceable. Replace components found to be faulty.

Brake fluid precautions

WARNING: Do not allow brake fluid to come into contact with eyes or skin.

CAUTION: Brake fluid can damage paintwork, if spilled wash off immediately with plenty of clean water.

CAUTION: Use only correct brake fluid. If an assembly fluid is required use ONLY brake fluid. Do NOT use mineral oil, i.e. engine oil etc.

FLUID LEVEL CHECK / TOP UP

1. Park vehicle on level ground.
2. Turn ignition ON, to activate hydraulic pump. If pump does not activate depress brake pedal several times until pump operates.
3. When pump stops, check level is between 'MIN' and 'MAX' marks.
4. If level is below 'MIN' mark top up fluid level to 'MAX' mark on reservoir, using correct fluid - ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and Fluids***

WARNING: Clean reservoir body and filler cap before removing cap. Use only fluid from a sealed container.

DO NOT OVER FILL RESERVOIR

DEPRESSURISE SYSTEM

WARNING: Before bleeding the system or working on any component in the brake system the following procedure MUST be carried out to depressurise the accumulator.

1. Switch off ignition.
2. Operate the brake pedal 30 times. Pedal travel will increase slightly and reduced resistance will be felt as pressure decreases.
3. Wait for 60 seconds, press the brake pedal four more times. This procedure will ensure that all pressure is evacuated from the system.

BRAKE SYSTEM BLEED (ABS)

Service repair no - 70.25.02

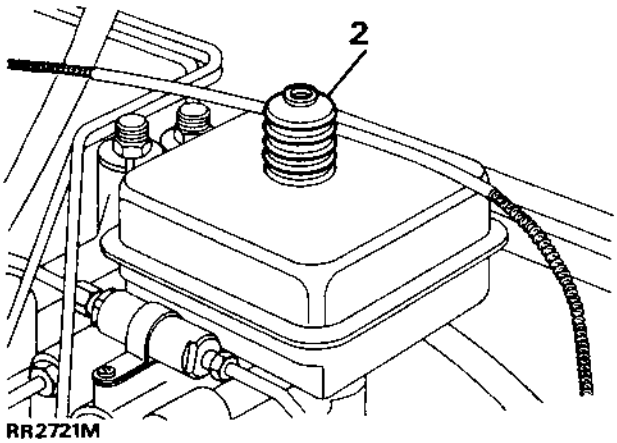
Equipment: Bleed tube and a clean bottle containing a small amount of clean liquid.

CAUTION: Clean all bleed screws, filler cap and connections thoroughly using clean brake fluid only. DO NOT USE MINERAL OIL I.E. ENGINE OIL ETC. MAINTAIN CLEANLINESS THROUGHOUT.

NOTE: Do not allow reservoir fluid level to fall below 'MIN' level during bleeding. Regularly check level and keep topped up to 'MAX' level.

WARNING: Do not use previously used brake fluid. Ensure only new fluid is used, taken from a clean sealed container. Carefully dispose of unwanted fluid in a sealed container, marked USED BRAKE FLUID.

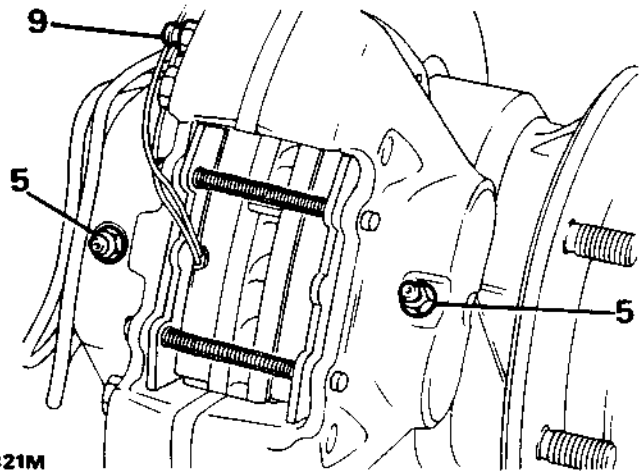
1. Switch off ignition and depressurise system. Ensure ignition remains OFF until instruction 7.
2. Fill fluid reservoir with specified fluid to 'MAX' level.



RR2721M

NOTE: Time consumed in filling booster may be reduced by fitting a rubber bellows unit to filler neck, using hand pressure to pressurise the reservoir. A spare bellows unit from booster push rod is suitable for this purpose. Ensure bellows unit is perfectly clean to avoid foreign matter entering system. Raising rear of vehicle will assist fill procedure.

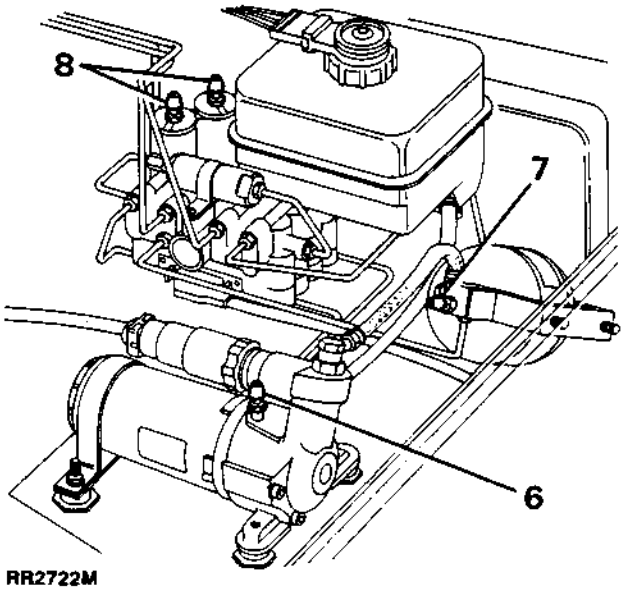
3. Depress brake pedal slowly and progressively five times, using full pedal stroke. Release pedal for five to ten seconds, air bubbles will rise into reservoir.
4. Repeat instruction 3. until some resistance is felt. If no resistance is felt check clevis pin is connected to correct (UPPER) hole in brake pedal
5. Bleed four front caliper lower (hydrostatic) bleed screws in the conventional manner. In the order: outer bleed screw driver's side, opposite caliper outer bleed screw, inner bleed screw, inner bled screw driver's side. Depress brake pedal slowly and progressively, locking bleed screw at bottom of each stroke.



RR2821M

6. Bleed hydraulic pump - open bleed screw on pump and allow fluid to flow until clear of air bubbles. Do not use bleed bottle, use a clean absorbant cloth to prevent fluid spillage.

7. Bleed accumulator - open bleed screw. If vehicle has ETC, accumulator bleed screw is on top of ETC valve block. Switch on ignition, run pump for 3-4 secs, switch off and repeat procedure until fluid is clear of air bubbles. Switch off ignition. Close bleed screw.
8. Bleed two hydraulic booster bleed screws. Open one bleed screw, depress brake pedal, switch on ignition, run pump until fluid is clear of air bubbles. Close booster bleed screw, switch off ignition, release pedal. Repeat for other bleed screw.



RR2722M

9. Bleed power circuit at four calipers in turn. Depress pedal, open bleed screw, (upper bleed screw on front calipers). Switch on ignition, run pump for 3-4 secs, switch off and repeat procedure until fluid is clear of air bubbles. Switch off ignition, close caliper bleed screw, release pedal.
10. Bleed master cylinder - switch ignition on. System pressure will increase until pump cuts out. If pump does not cut out after running for 45 secs, check system for leaks.
11. Bleed hydrostatic circuit calipers - open one front lower caliper bleed screw. Actuate brake pedal several times, using only lower two thirds of pedal travel, until fluid is clear of air bubbles. Stop actuation if fluid warning light comes on and allow pressure to build up.
12. Close caliper bleed screw before releasing pedal, repeat for remaining three hydrostatic bleed screws.
13. Check/top up reservoir fluid level. ***See Fluid level check/top up***
14. Dry all connections, fully pressurise system, check for leaks. If two full brake applications switch on pump, from fully charged, rebleed system.

HYDRAULIC BOOSTER UNIT

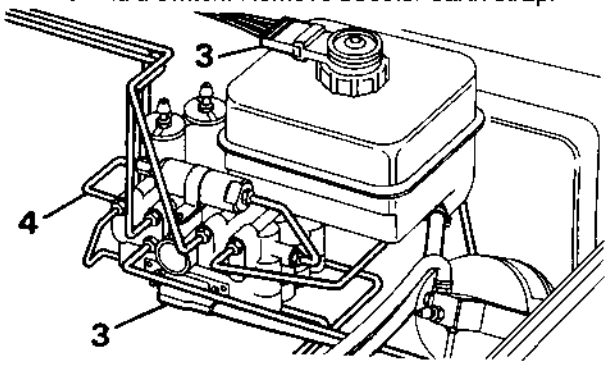
Service repair no - 70.65.20

Remove and refit

Remove

CAUTION: Do not allow booster unit to be dropped or rested on its front face. Damage to plastic tangs of multiplug could occur, requiring fitting a new booster unit

1. Disconnect the battery negative lead. depressurise system.
2. Thoroughly clean area around booster unit outlet ports and electrical connector.
3. Disconnect electrical multiplug and connector low fluid switch. Remove booster earth strap.

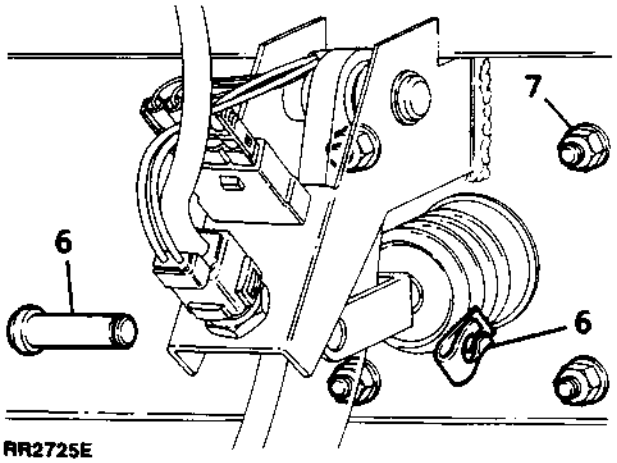


RR2723M

4. Remove brake pipes and hydraulic pipes to accumulator and hydraulic power unit.

NOTE: Each outlet port is numbered, each brake pipe is marked with corresponding number for reassembly. Immediately seal each pipe and outlet port to prevent ingress of foreign matter.

5. Inside vehicle remove lower dash panel. ***See CHASSIS AND BODY, Repair, lower dash panel***



RR2725E

6. Release spring clip and clevis pin.
7. Remove four nuts and plain washers securing booster unit.
8. Remove booster unit.

Refit

NOTE: New booster units are supplied in a sealed pack marked with a 'use by' date. DO NOT fit a booster if date has elapsed, or if pack is not sealed. DO NOT open sealed pack until ready to fit unit.

9. Reverse removal procedure. Ensuring correct fitment of pipes. Tighten booster fixings to *25 Nm* and pipes to *15 Nm.*
10. Fit clevis pin into UPPER of two holes in brake pedal.
11. Adjust brake light switch: pull red (later vehicles, white) sleeve and black plunger fully forward. Pull brake pedal back fully to reset switch.
12. Bleed brake system. ***See Brake system bleed (ABS)***

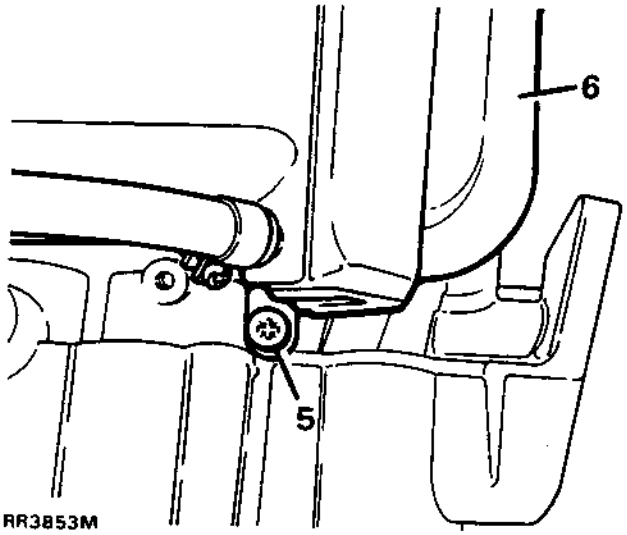
RESERVOIR (INCLUDES SEALS)

Service repair no - 70.65.22

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Depressurise system. ***See Depressurise system***
3. Disconnect low fluid warning plug.
4. Remove reservoir cap. Remove hose from pump, plugging exposed apertures.
5. Remove securing bolt, adjacent to low pressure hose.
6. Ease reservoir from booster unit.



RR3853M

7. Remove two seals from top of booster unit. Avoid damage to seals which could result in rubber particles entering system. Plug booster unit apertures

Refit

8. Lubricate and fit new seals. Refit reservoir. Tighten securing bolt to *10 Nm.*
9. Bleed pump. Check/top up fluid level.

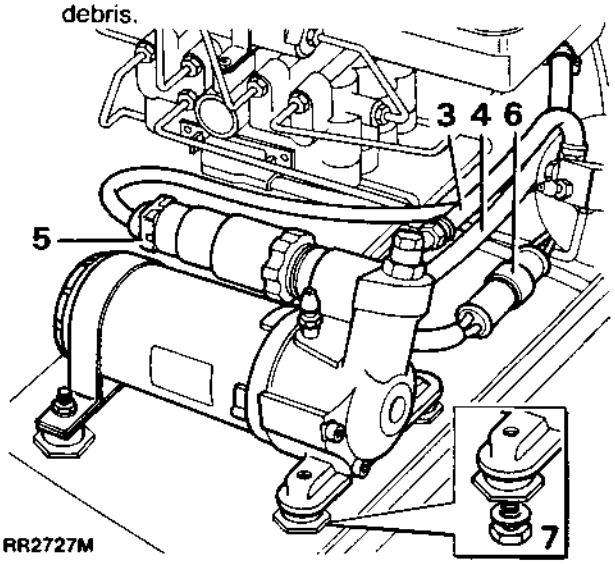
HYDRAULIC POWER UNIT

Service repair no - 70.65.20

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Depressurise system. ***See Depressurise system***
3. Disconect braided hose to accumulator.
4. Disconnect low pressure hose to reservoir, clamp hose to prevent fluid loss and ingress of debris.



RR2727M

5. Disconnect pressure switch plug.
6. Disconnect power unit connector.
7. Working below unit remove four nuts and plain washers.
8. Remove hydraulic power unit complete with mountings. Note position of earth strap, if fitted, when removing mountings.

Refit

9. Reverse removal procedure. Fit new sealing washers on high pressure hose.
10. Bleed system. ***See Brake system bleed (ABS)***

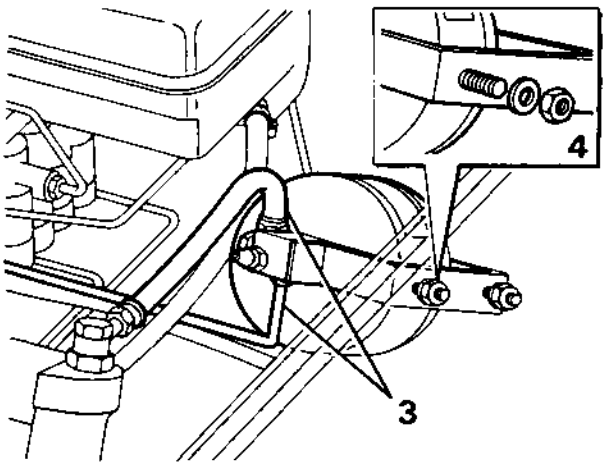
ACCUMULATOR

Service repair no - 70.65.21

WARNING: The accumulator is precharged with nitrogen at up to 80 bar. Handle with extreme caution. DO NOT puncture or burn if disposal is necessary.

Remove, refit and disposal

1. Disconnect the battery negative lead.
2. Depressurise system.
3. Remove fluid inlet and outlet pipes from accumulator.



RR2728M

4. Remove wheelarch inner liner and remove two nuts and plain washers securing accumulator.
5. Remove accumulator.

Refit

6. Reverse removal procedure. Fit new sealing washers on high pressure hose.
7. Bleed brakes. ***See Brake system bleed (ABS)***

Disposal

WARNING: It is essential that safety goggles and gloves are worn when carrying out this procedure.

8. Secure accumulator firmly using a suitable vice.
9. Drill 5 mm diameter hole in accumulator, opposite hole fluid ports, to depressurise nitrogen chamber.
10. Dispose of accumulator in normal way.

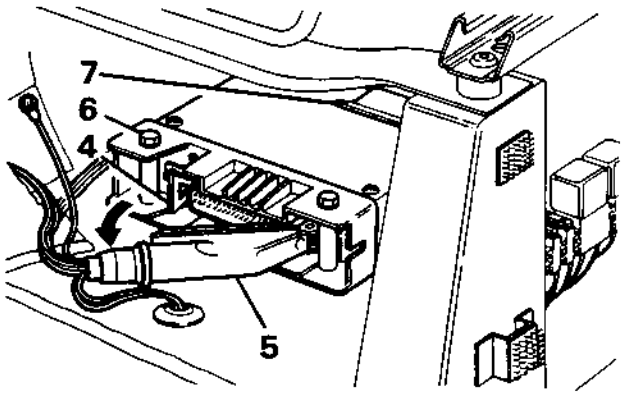
ELECTRONIC CONTROL UNIT - ECU

Service repair no - 70.65.01

Remove and refit

Remove

1. Remove front and side trim from left hand front seat.
2. Adjust seat to its most rearward position and raise seat cushion height to allow accesss to ECU.
3. Disconnect the battery negative lead.
4. Release ECU plug retaining clip.
5. Manoeuvre plug in direction of arrow and detach hooked end of plug from retaining post.
6. Remove two screws securing ECU to mounting bracket.
7. Remove ECU from retaining clip.



RR2726M

Refit

8. Refit ECU securely in retaining bracket, fit and tighten two screws.
9. Reconnect ECU harness plug. Ensure plug is firmly located and that retaining clip secures plug.
10. Reverse removal procedure.

SENSORS - FRONT

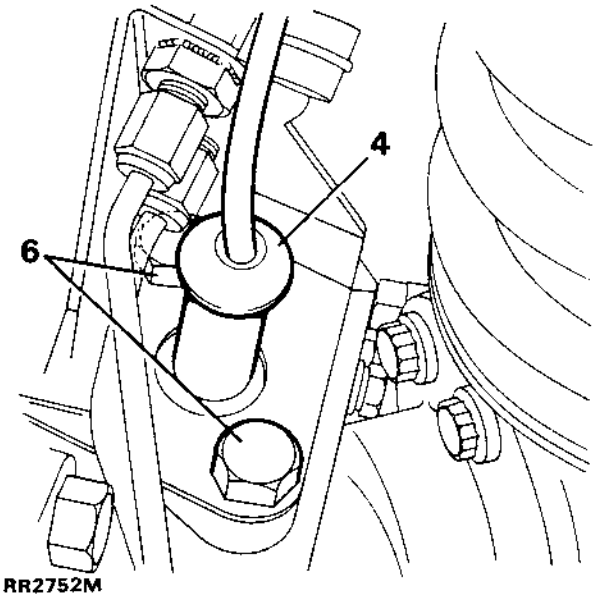
Service repair no - 70.65.32

Remove and refit

CAUTION: If a sensor is removed for any reason, a NEW sensor bush and seal must be fitted.

Remove

1. Disconnect the battery negative lead.
2. Disconnect required sensor electrical connection, located on inner wing panel adjacent to decker panel.
3. Remove sensor lead and pad wear harness plug from clips.
4. Clean area surrounding sensor to prevent ingress of dirt. Using a suitable lever pry sensor from mounting bush.



RR2752M

5. Release harness cable ties, remove sensor lead from vehicle.
6. Remove top swivel retaining bolts complete with brake jump hose and sensor seal. Remove sensor bush.

Refit

7. Insert new sensor bush and seal.
8. Refit brake jump hose bracket, coat bolts with Loctite 270.
9. Lightly coat new sensor using EP 90 oil. Push sensor through bush until it contacts exciter ring. Rotate wheel, turning steering from lock to lock to set sensor air gap.
10. Secure sensor lead in original position.
11. Reconnect sensor electrical connection.
12. Clear error code ***See Fault diagnosis, fault diagnosis procedure***
13. Drive vehicle to ensure ABS warning light is extinguished.

SENSORS - REAR

Service repair no - 70.65.31

Remove and refit

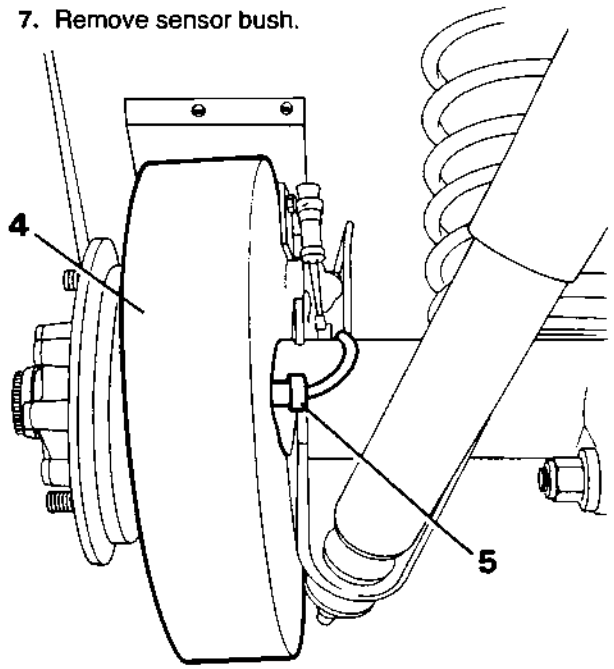
CAUTION: If a sensor is removed for any reason, a NEW sensor bush must be fitted.

Remove

1. Disconnect the battery negative lead.
2. Disconnect sensor electrical connections, located above rear axle.
3. Remove sensor from its locating clip.
4. Remove bolts securing mudshield.
5. Using a suitable lever, pry sensor from mounting bush.
6. Release harness cable ties, remove sensor lead from vehicle.

NOTE: The two rear sensor leads are integral with pad wear harness. In case of sensor failure complete harness must be changed.

7. Remove sensor bush.



RR2753M

Refit

8. Fit new sensor bush.
9. Lightly grease new sensor using silicone grease. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
10. Push sensor through bush until it touches exciter ring. Sensor will be 'knocked back' to correct position when vehicle is driven.
11. Secure harness in position.
12. Reconnect sensor electrical connection.
13. Clear error code - ***See Fault diagnosis, Fault diagnosis procedure***
    Drive vehicle to ensure ABS warning light is extinguished.

STOP LIGHT SWITCH

Service repair no - 76.65.10

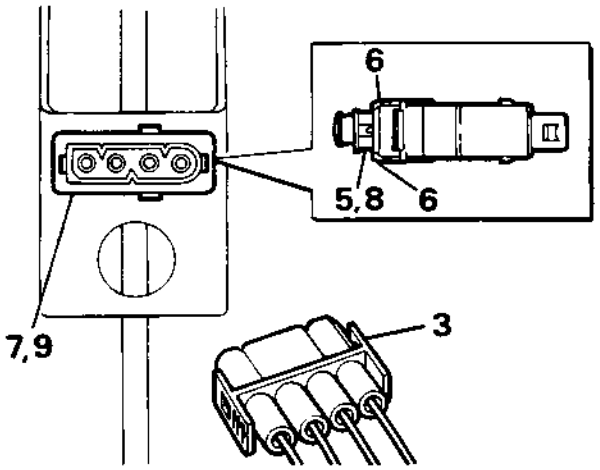
Remove and refit

Remove

1. Turn ignition off. Disconnect the battery negative lead.
2. Remove lower fascia panel. ***See CHASSIS AND BODY, Repair, Lower dash panel***
3. Disconnect multi-plug to switch.
4. Depressurise system. ***See Depressurise system***
5. Depress brake pedal, pull red sleeve (later vehicles, white) and black plunger of switch FULLY forward.
6. Release switch retaining clips.

△ **NOTE: If clips are difficult to release, check red sleeve is FULLY forward.**

7. Remove switch.



RR2898M

Refit

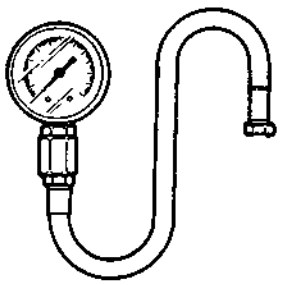
8. Pull red sleeve (later vehicles, white) and black plunger of switch fully forward.
9. Depress brake pedal, fit switch. Ensure retaining clips are FULLY located.
10. Hold switch firmly in place, pull brake pedal back fully to set switch.
11. Turn ignition on. Wait for ABS pump to shut off.
12. Check switch adjustment by slowly depressing brake pedal and checking that the switch clicks at least once before booster hisses.
13. If incorrect, adjust switch by depressing brake pedal and pushing black plug in one detent at a time.
14. Check that stop lamps go off when pedal is released. If not, depress pedal and pull black plunger out one detent at a time.

EXCITER RINGS

See REAR AXLE AND FINAL DRIVE, Repair, rear hub assembly (ABS) or See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel with ABS

Notes

ABS BRAKES SERVICE TOOLS



LST140

LRT-70-001 ABS pressure test adaptor
LST 140

Notes

ELECTRONIC TRACTION CONTROL - ETC

- WABCO DIFFERENTIAL BRAKING

WABCO, manufacturers of Range Rover ABS brake system have developed a differential braking system, ETC, available as an extension to ABS. The system operates on the rear axle only, to prevent loss of traction where one wheel has more grip than the other.
The system works by applying the brake to a spinning rear wheel. This transfers torque to the wheel with the grip. The brake supplies the torque resistance which the wheel cannot.

An example of when the system would operate is where one side of the vehicle is on ice and the other side on tarmac. ETC will control the spinning rear wheel.

If both wheels spin the system does not operate, as braking one wheel will not aid traction.

The system switches itself out at 50 kph (30 mph) since a vehicle travelling above this speed will not need ETC.

System operation is smooth and continuous and will not affect the comfort of the vehicle.

ETC is inhibited when the brakes are applied.

COMPONENTS

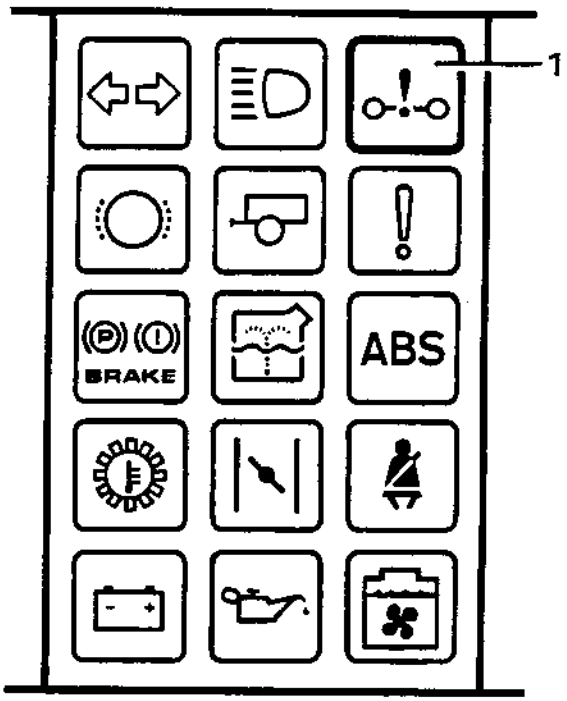
As ETC is an extension of the ABS unit it is only available on ABS equipped vehicles.

ECU - the system uses an extended ABS ECU. The same ECU is used on both ETC and non ETC vehicles. If ETC valve block is not connected electrically the ECU assumes the vehicle does not have ETC.

Two solenoid valves - similar to ABS control valves, incorporated in a valve block fitted to the ABS booster. In case of failure the valve block may be removed from the booster unit and a new unit fitted.

Brake pipes - three additional brake pipes to the ETC valve block are required.

ETC Warning light (1) - situated in the instrument binnacle, the warning light works in three different ways:



RR3901M

ETC active - The light will illuminate for a minimum of two seconds or as long as the system is active. In practice this time will rarely exceed ten seconds. This warns the driver that traction is becoming limited.

Protection mode - In the unlikely event that the system remains active continuously for more than sixty seconds, the system shuts down to protect brakes and solenoid valves from overheating. The warning light will flash at half second intervals for a minimum of ten seconds while ETC is shut down. If ETC is shut down, but NOT required by conditions, the light will not flash.

ETC fault - If a fault occurs which disables ETC, the warning light is constantly illuminated, (even when there is no wheel spin,) until ignition is switched off.

Bulb check - The light will illuminate for three seconds when ignition is switched on and ABS/ETC self checks completed.

USA - early vehicles - the warning light will be illuminated as part of warning light bulb check.

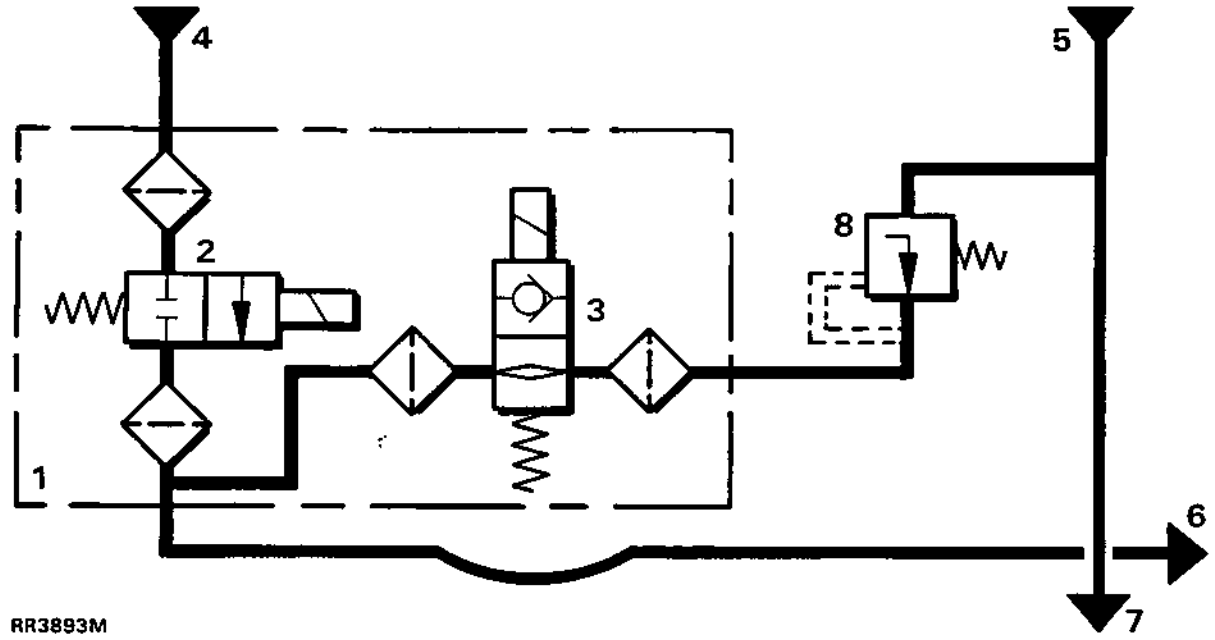
USA - later vehicles - the warning light will NOT be illuminated as part of warning light bulb check.

CHANGES TO ACCOMODATE ETC

PCRV valve - moved to below booster unit, mounted on inner wing panel.

Accumulator - has direct feed to ETC valve block. Accumulator bleed valve is relocated to ETC valve block.

ETC HYDRAULIC COMPONENTS - RR3893M



RR3893M

For full details of ABS components, ***See ABS brakes, HYDRAULIC COMPONENTS***

1. ETC valve block
2. Power circuit solenoid valve - normally closed
3. Master cylinder isolating solenoid valve - normally open
4. From accumulator
5. From master cylinder power valve
6. Power circuit to rear brakes
7. Power circuit to front brakes
8. PCRV valve

ETC OPERATION - see RR3893M

When the wheelspeed sensors detect a rear wheel is spinning at above vehicle speed, solenoid valve 3. closes, isolating the master cylinder from the rear brakes. Solenoid valve 2. is pulsed open, allowing accumulator pressure to the rear brakes. The rear brake ABS valves operate to apply or release the brake at the spinning wheel as required.

FAULT DIAGNOSIS

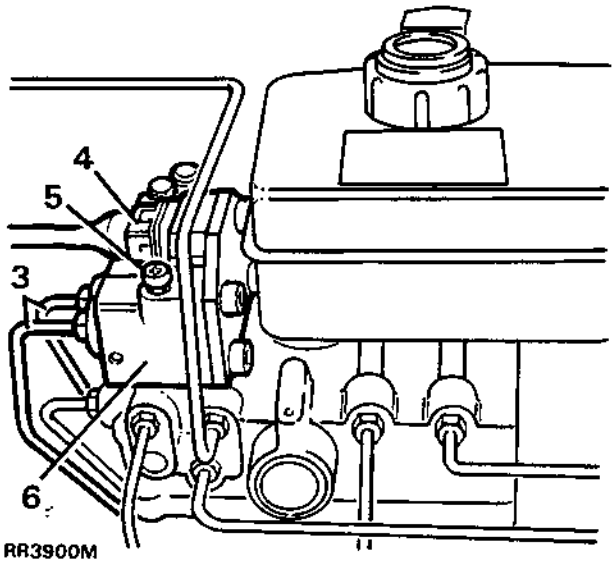
Diagnosis is by Wabco Diagnostic Controller - STC 2 with new software card, for both ETC and non ETC vehicles. See also Range Rover Electrical Trouble Shooting Manual.

ETC VALVE BLOCK

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Depressurise brake system, ***See ABS Brakes, depressurise system***
3. Remove three hydraulic pipes from ETC valve block.



RR3900M

4. Disconnect ETC multi-plug.
5. Remove two valve block securing bolts.
6. Remove ETC valve block.

Refit

7. Reverse removal procedure.
8. Bleed brakes, ***See ABS brakes, brake system bleed (ABS)***

NOTE: Bleed screw on ETC valve block is used when bleeding accumulator.

Notes

74 - WHEELS AND TYRES

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REPAIR

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WHEELS INSPECTION 2
VALVES INSPECTION 2
TYRE PRESSURES 2
WHEEL BALANCING 3
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Notes

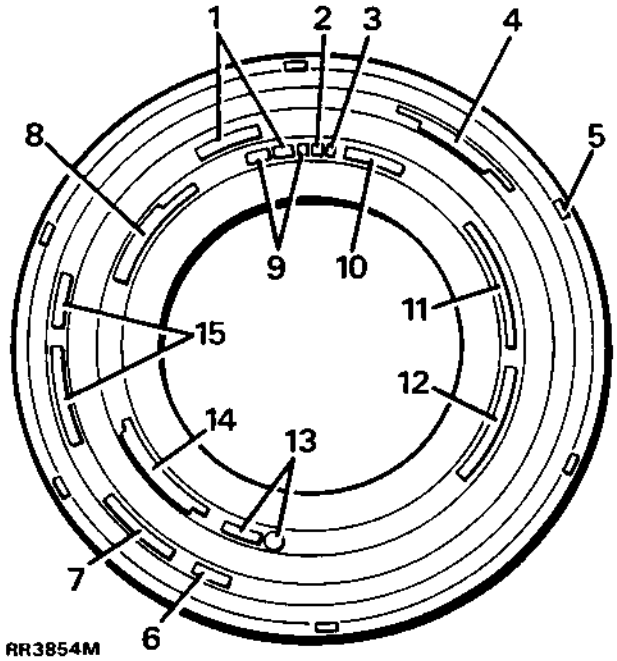
TYPES OF WHEEL RIMS AND TYRES

Description

The Range Rover, dependent on specification, is equipped with alloy wheel rims and tubeless radial ply tyres or, pressed steel rims which must be fitted with inner tubes, and tubed radial ply tyres. The alloy rims have a positive location cast into the rim contour which is designed specifically for tubeless tyres. Pressed steel rims however which are designed for tubed tyres must always have a tube fitted.

Tyre codes

The writing, codes and numbers moulded into the tyre wall vary between tyre manufacturers, however most tyres are marked with the information shown in the illustrated example.



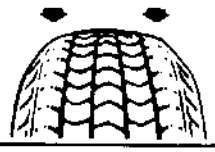
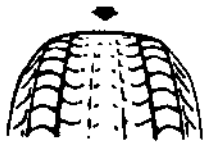
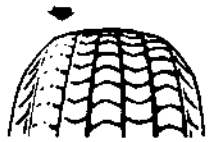
RR3854M

NOTE: The illustration is an example of the type of markings moulded into tyres and is for guidance only. For specific tyre specifications. ***See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres***

1. Type of tyre construction - **Radial Ply**
2. Load index - **76**
3. Speed symbol - **S or T**
4. USA Tyre quality grading - **Tread wear 160 Traction A temperature B**
5. Tread wear indicators moulded into tread pattern are located at intervals around the tyre and marked by a code - **E66 103S6**
6. Tyres with 'Mud Snow' type tread pattern are marked - **M&S**
7. Tyre reinforcing mark - **Reinforced**
8. USA Load and pressure secification - **(900Kg(1984LBS) at 340KA (50PSI) MACS PRESS**
9. Tyre size - **205 16**
10. As applicable the words - **TUBE or TUBELESS**
11. Country of manufacture - **MADE IN GREAT BRITAIN**
12. USA Compliance symbol and identification - **DOT AB7C DOFF 267**
13. European type approval identification - **E11 01234**
14. Tyre construction - **SIDE WALL 2 PLIES RAYON. TREAD 2 RAYON 2 STEEL**
15. Manufacturers brand name/type - **TRACTION PLUS mzx M**

Notes

TYRE WEAR CHART

FAULT	CAUSE	REMEDY
Rapid wear at shoulders 	Tyres under-inflated Worn suspension components i.e. ball joints, Panhard rod bushes,steering damper Excessive cornering speeds	Inflate to correct pressure Replace worn components
Rapid wear at centre of tread 	Tyres over-inflated	Inflate to correct pressure
Wear at one shoulder 	Track out of adjustment Bent Panhard rod	Adjust track to correct figure Check and replace worn or damaged components
Bald spots or tyre cupping 	Wheel out of balance Excessive radial runout Shock absorber worn Excessive braking	Balance wheel and tyre assembly Check runout and replace tyre if necessary Replace shock
Tyre scalloped  RR2136E	Track out of adjustment Worn suspension components Excessive cornering speeds	Adjust wheel alignment to correct figure. Replace as necessary

CAUTION: This diagnosis chart is for general guidance only and does not necessarily include every cause of abnormal tyre wear.

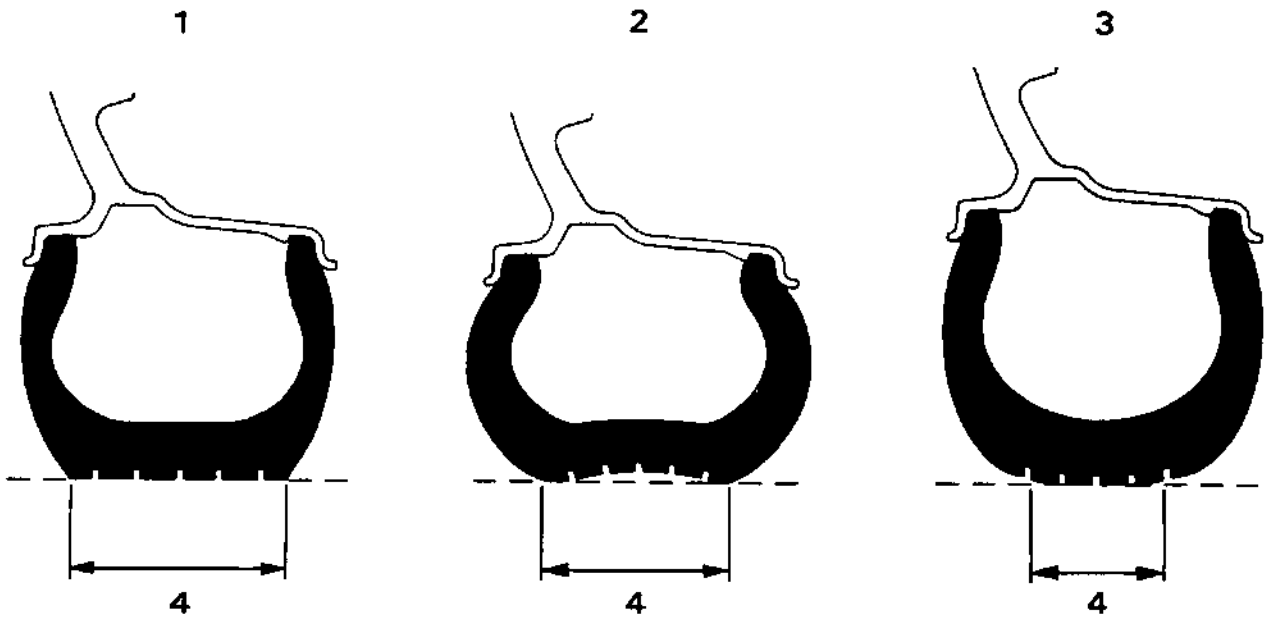
FAULT - SYMPTOMS

Vibration through steering wheel

1. Check tyre pressures. ***See Repair, Tyre pressures***
2. Check condition of tyres. ***See Tyre wear chart***
3. Check front wheel alignment. ***See STEERING, Adjustment, Front wheel alignment***
4. Check wheel balance. ***See Repair, Wheel balancing***

△ **NOTE: In the event that any apparent vibration is not eliminated at this stage.** ***See PROPELLER SHAFTS, Fault diagnosis, Vibration harshness***

△ **NOTE: In the event that any apparent vibration is not eliminated at this stage, go to steering Fault Diagnosis, Fault - Symptom (Steering vibration, road wheel shimmy/wobble).** ***See STEERING, Fault diagnosis, Steering Faults***



RR2133E

△ **NOTE: Radial ply tyres have a flexible sidewall, which produces a sidewall bulge making the tyre appear under-inflated. This is a normal condition for radial ply tyres. Do not attempt to reduce this bulge bu over-inflating the tyre.**

1. Correct inflation.
2. Under-inflation.
3. Over-inflation.
4. Tread contact with road.

GENERAL INFORMATION

WARNING: The Range Rover is a multi-purpose vehicle with wheels and tyres designed for both on and off road usage. Only use wheels and tyres specified for use on the vehicle.

The Range Rover is equipped with tubeless 'S' rated radial ply tyres as standard equipment. The tyres are of European metric size and must not be confused with the "P" size metric tyres available in North America.

Vehicle wheel sets, including spare wheel, must be fitted with the same make of tyre to the correct specification and tread pattern. Under no circumstances must cross-ply or bias-belted tyres be used.

For tyre specification and pressures. ***See GENERAL SPECIFICATION DATA, Information, Wheels and tyres***

Alloy Wheels

Tubeless tyres are mounted on 7.0 inch wide by 16 inch diameter cast aluminium alloy wheels.The surface has a paint finish covered with a clear polyurethane lacquer. Care must be taken when handling the wheel to avoid scratching or chipping the finish.

The alloy wheel rim is of the asymmetric hump type incorporating a safety hump to improve location of the tyre bead in its seat. If difficulty is experienced in fitting tyres to this type of rim. ***See Tyre fitting***

WARNING: Do not fit an inner tube to an alloy wheel.

Steel wheels

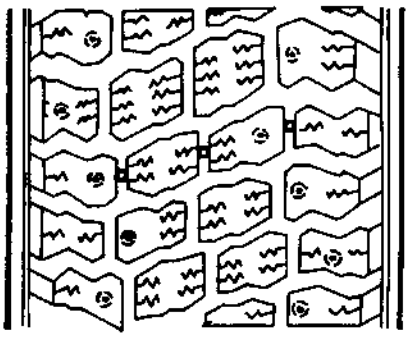
Tubed tyres are mounted on 6.0 inch wide by 16 inch diameter steel wheels. Note that tubed tyres must be used.

TYRE INSPECTION

Inspect tyres at weekly intervals to obtain maximum tyre life and performance and to ensure compliance with legal requirements. Check for signs of incorrect inflation and uneven wear, which may indicate a need for balancing or front wheel alignment. ***See Fault diagnosis, Tyre Wear Chart*** if the tyres have abnormal or uneven wear patterns.

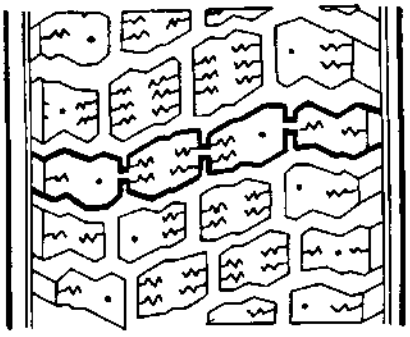
Check tyres at least weekly for cuts, abrasions, bulges and for objects embedded in the tread. More frequent inspections are recommended when the vehicle is regularly used in off road conditions.

To assist tyre inspection, tread wear indicators are moulded into the bottom of the tread grooves, as shown in the illustration below.



RR2145E

When the tread has worn to a remaining depth of 1.6 mm the indicators appear at the surface as bars which connect the tread pattern across the width of the tread as shown in the illustration below.



RR2146E

When the indicators appear in two or more adjacent grooves, at three locations around the tyre, a new tyre must be fitted.

△ **NOTE: Do not attempt to interchange tyres, e.g. from front to rear, as tyre wear produces characteristic patterns depending on their position. If tyre position is changed after wear has occured, the performance of the tyre will be adversely affected.**

△ **NOTE: Territorial vehicle regulations governing tyre wear MUST be adhered to.**

WHEELS INSPECTION

Regularly check the condition of the wheels. Replace any wheel that is bent, cracked, dented or has excessive runout.

VALVES INSPECTION

Check condition of inflation valve. Replace any valve that is worn, cracked, loose, or leaking air.

TYRE PRESSURES

Maximum tyre life and performance will be obtained only if tyres are maintained at the correct pressures.

Tyre pressures must be checked at least once a month and at least once a week, preferably daily, if the vehicle is used off road.

The tyre inflation pressure is calculated to give the vehicle satisfactory ride and steering characteristics without compromising tyre tread life. For recommended tyre pressures in all conditions. ***See GENERAL SPECIFICATION DATA, Information, Wheels and tyres***

American vehicles - A label attached to the inside edge of the driver's door also provides tyre pressure information.

Always check tyre inflation pressures using an accurate gauge and inflate tyres to the recommended pressures only.

Check and adjust tyre pressures **ONLY** when the tyres are cold, vehicle parked for three hours or more, or driven for less than 3.2 km (2 miles) at speeds below 64 km/h (40 mph). Do not reduce inflation pressures if the tyres are hot or the vehicle has been driven for more than 3.2 km (2 miles) at speeds over 64 km/h (40 mph), as pressures can increase by 0.41 bars (6 p.s.i) over cold inflation pressures.

Check **ALL** tyre pressures including the spare. Refit the valve caps as they form a positive seal and keep dust out of the valve.

WHEEL BALANCING

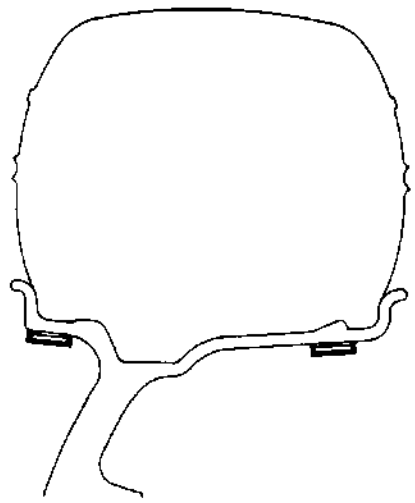
CAUTION: It is essential that all wheel balancing is carried out off the vehicle. The use of on the vehicle balancing could cause component damage or personal injury and MUST NOT be attempted.

NOTE: Before attempting to balance a wheel and tyre assembly clean all mud and dirt deposits from both inside and outside rims and remove existing balance weights.

Remove stones from the tyre tread in order to avoid operator injury during dynamic balancing and to obtain the correct balance.

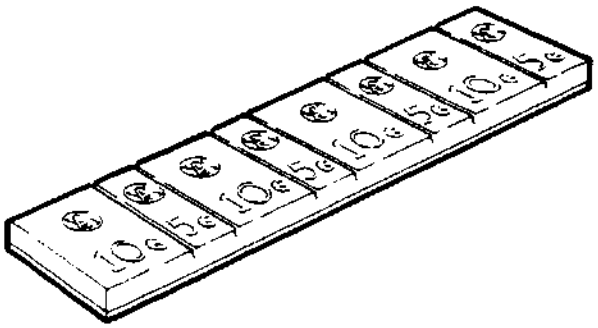
Inspect tyres for damage and correct tyre pressures and balance according to the equipment manufacturer's instructions.

Alloy wheels



RR2138E

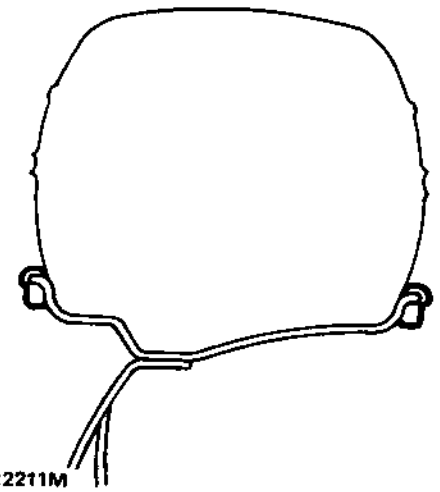
Clean area of wheel rim and attach adhesive balance weights in position shown. Cut through rear face of weight strip to detach required weights.



RR2137E

CAUTION: Use only correct adhesive balance weights to avoid damage to aluminium wheel rim. DO NOT attempt to use a steel wheel weight on an aluminium wheel.

Steel wheels

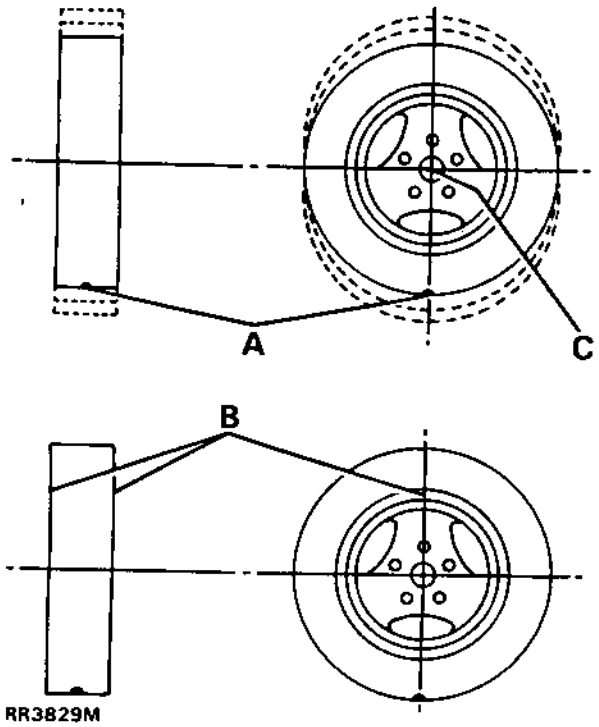


RR2211M

Clean area of wheel rim and attach balance weights in position shown.

Static balance

Wheel tramp



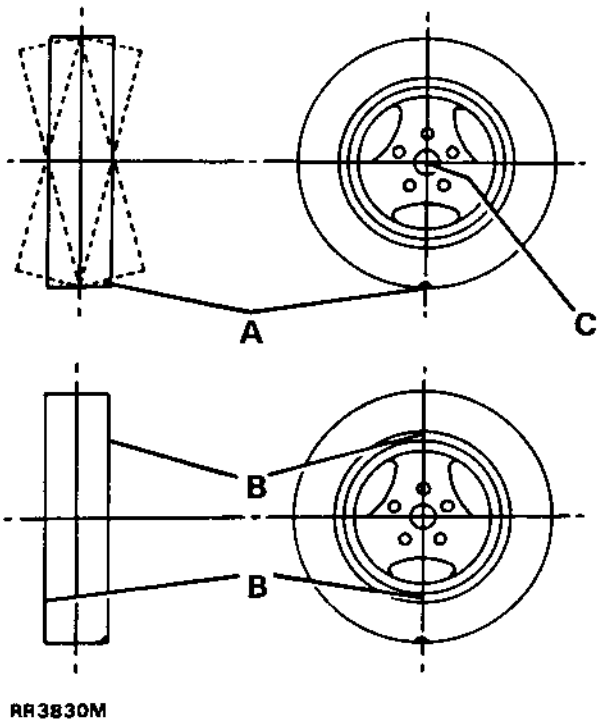
RR3829M

A. Heavy spot.
B. Add balance weights here.
C. Centre line of spindle.

Static balance is the equal distribution of weight around the wheel. A statically unbalanced wheel will cause a bouncing action called wheel tramp. This condition will eventually cause uneven tyre wear.

Dynamic balance

Wheel shimmy



RR3830M

A. Heavy spot.
B. Add balance weights here.
C. Centre line of spindle.

Dynamic balance is the equal distribution of weight on each side of the centre line so that when the wheel spins there is no tendency for side to side movement. A dynamically unbalanced wheel will cause wheel shimmy.



Off vehicle balancing

Balance wheel assembly referring to equipment manufacturer's instructions.

It is essential that the wheel is located by the centre hole **NOT** the stud holes. To ensure positive wheel location the diameter of the locating collar on the machine shaft must be 112.80 to 112.85 mm (4.441 to 4.443 in). This diameter will ensure that the collar fits correctly within the centre hole of the wheel.

Where possible always use the vehicle wheel retaining nuts to locate the wheel on the balancer, to avoid damaging the wheel. If this is not possible, the locating nuts must be of a similar pattern to the original wheel nuts. The use of conical type wheel nuts for this purpose may damage the aluminium alloy.

Cleaning

Wash the aluminium wheels using a suitable wash and wax concentrate correctly diluted and rinse with cold clear water. **DO NOT** use abrasives or aluminium wheel cleaners containing acid, as they will destroy the lacquer finish.

Tyre changing

Use only tyre changing equipment to mount or demount tyres, following the equipment manufacturer's instructions. **DO NOT** use hand tools or tyre levers, as they may damage tyre beads or the aluminium wheel rim.

Puncture repair

Remove punctured tyre from wheel and repair using a combination service plug and vulcanising patch. Always follow manufacturer's instructions when using a puncture repair kit.

Only punctures in tread area are repairable, **DO NOT** attempt to repair punctures in tyre shoulders or sidewalls.

Do not attempt to repair a tyre that has sustained the following: bulges or blisters, ply separation, broken or cracked beads, wear indicators visible and punctures larger than 6 mm diameter.

CAUTION: Do not use tyre sealants that are injected through valve stem to repair punctured tyres, they may produce wheel corrosion and tyre imbalance.

Aluminium wheel rim bead seats should be cleaned using a non-abrasive cleaner to remove the mounting lubricants and old rubber. Before mounting or demounting a tyre, bead area should be well lubricated with a suitable tyre lubricant.

TYRE FITTING

Alloy wheels

1. Install a new valve assembly.
2. Ensure wheel and tyre is adequately lubricated.
3. Mount tyre in normal manner. Inflate tyre and at same time apply hand pressure to area around valve to aid seating over valve first.

NOTE: Stop inflation immediately if tyre seats opposite valve, as this will result in valve being blocked by tyre beading, making further inflation impossible, and carry out following procedure.

4. Deflate tyre, unseat and rotate it around the rim until valve is in line with that part of tyre which seated initially. This part of beading having seated over hump previously will automatically seat first when tyre is re-inflated.
5. Inflate tyre to seat beads correctly, finally inflate to correct pressure.

WHEELS

Remove and refit

Remove

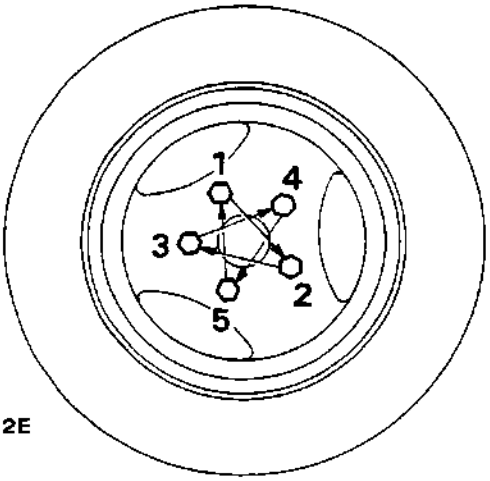
WARNING: The parking brake acts on transmission, not rear wheels, and may not hold vehicle when jacking unless following procedure is used. If one front wheel and one rear wheel is raised no vehicle holding or braking effect is possible. Wheels MUST be chocked in all circumstances.

Apply parking brake, select 'P' or a gear in main gearbox and engage low gear in transfer box.

1. Loosen five wheel nuts.
2. Using a suitable trolley jack raise vehicle and place on axle stands. ***See INTRODUCTION, Information, Jacking***
3. Remove wheel nuts and carefully withdraw wheel over studs.

Refit

4. Ensure that retaining studs and nuts are clean.
5. Alloy wheels: Lightly coat wheel mounting spigot face with a suitable anti-seize compound to minimise possibility of adhesion between wheel and spigot face.
6. Apply a drop of oil to wheel studs.
7. Refit wheel taking care not to damage stud threads.
8. Fit wheel nuts and turn by hand for at least three full threads before using any form of wheel spanner.
9. Tighten nuts as much as possible using a suitable spanner.



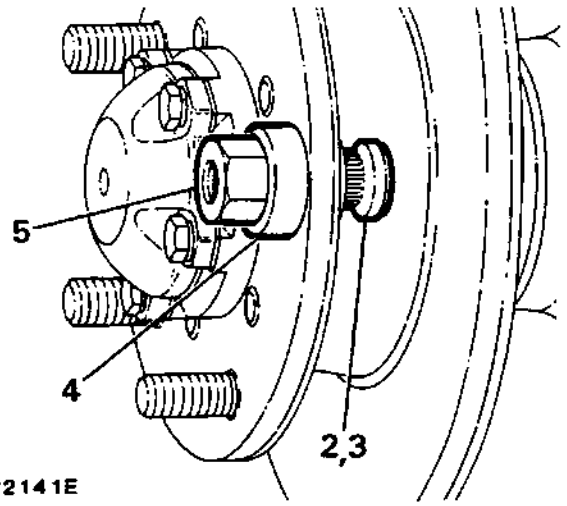
RR2142E

10. Lower vehicle and finally tighten nuts to correct torque sequence shown. Alloy wheels: ***125 Nm.*** Steel wheels: ***110 Nm.***

WHEEL STUD

Remove

1. Remove wheel. ***See Wheels***
2. Drive stud out of driveshaft flange.



RR2141E

Refit

3. Position stud in flange.
4. Install a suitable spacer over stud.
5. Using a M16 x 1.5P nut, a slave Range Rover wheel nut is suitable, pull stud into flange until shoulder of stud abuts flange.
6. Refit wheel.

Notes

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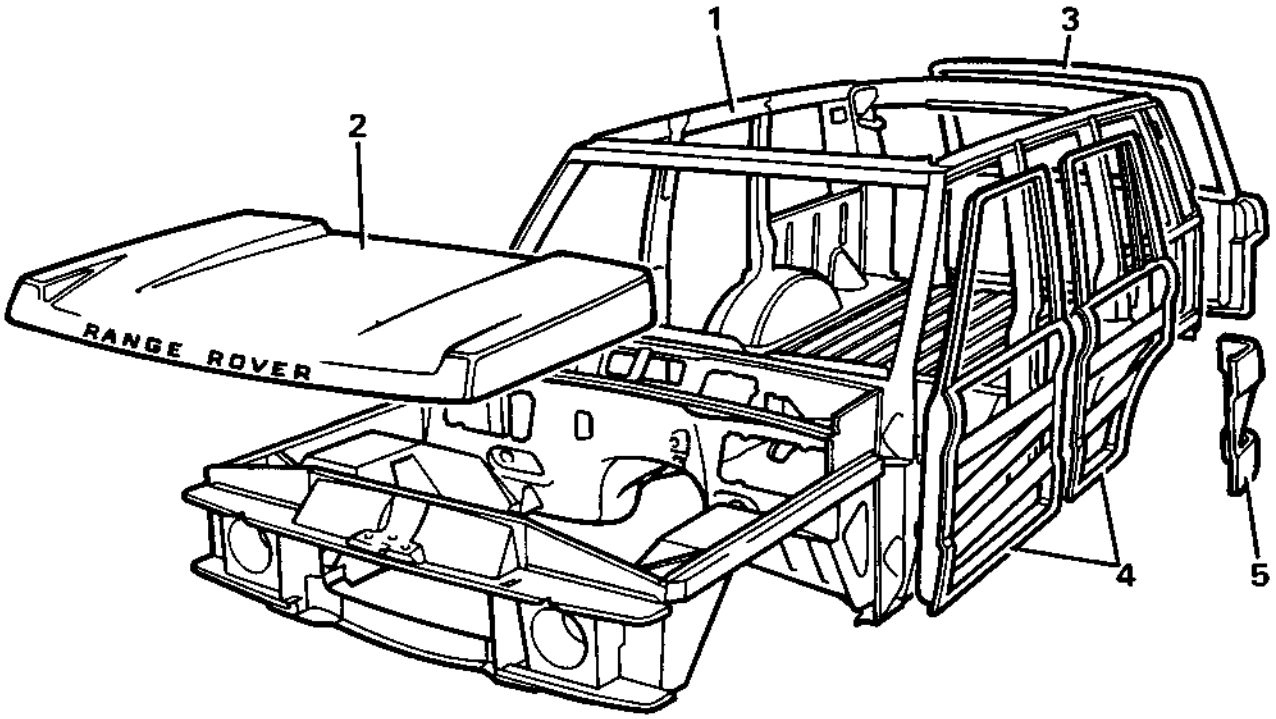
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BODY CONSTRUCTION

Description

The Range Rover body consists of a steel frame to which alloy outer panels are attached. The decker panel, front wings, side door outer panels, body side outer panels and roof are made from a special light magnesium aluminium alloy.

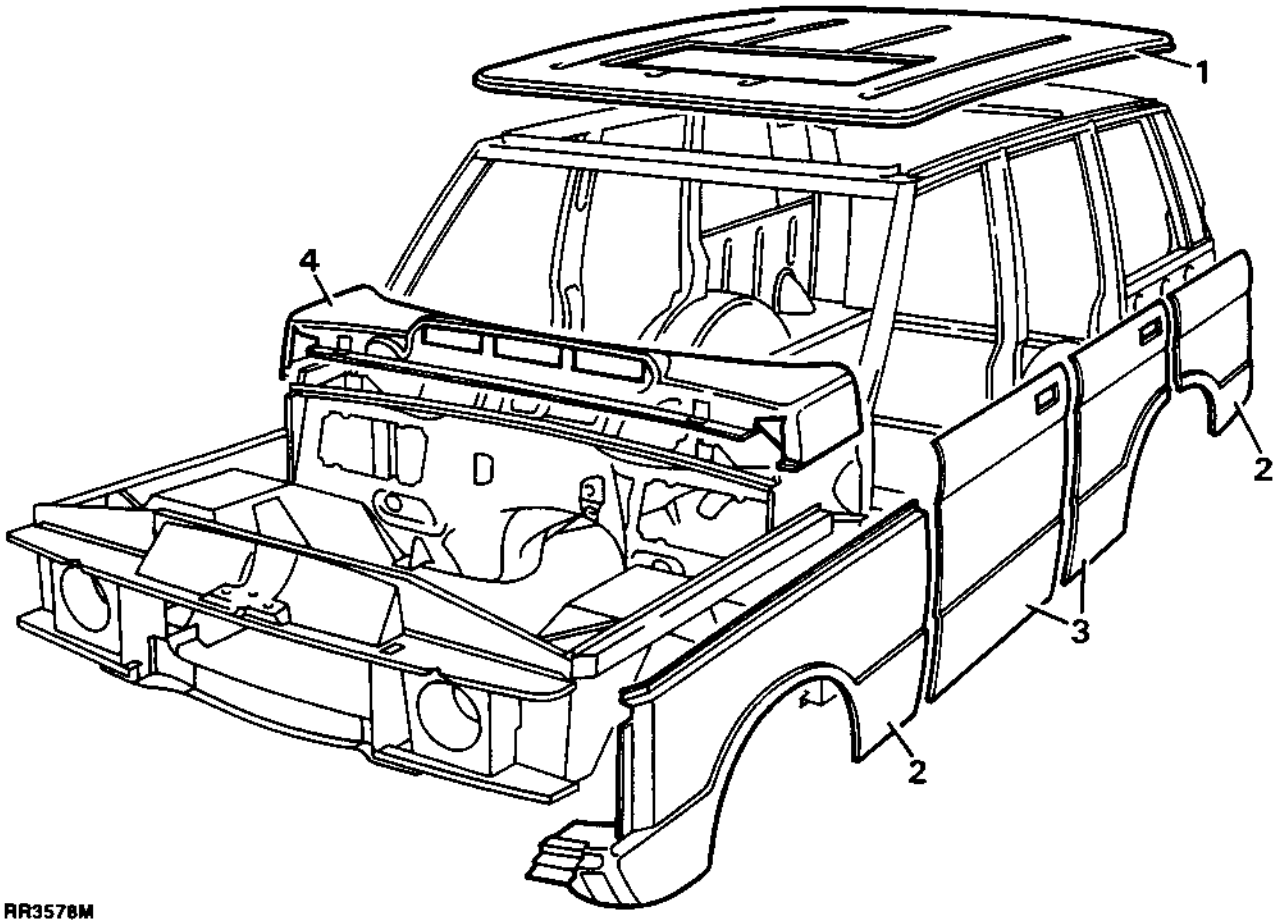
The manufacture of body panels from aluminium has two distinct advantages, the first of which is a much better resistance to corrosion, the second being a decrease in the gross vehicle weight.



RR3577M

Steel components

1. Body shell.
2. Bonnet.
3. Tailgate.
4. Door frames
5. Quarter panel.



RR3578M

Aluminium alloy components

1. Roof.
2. Wings.
3. Door panels.
4. Decker panel.

PAINT CODES - 1993

The following information should be used when ordering paint for 1993 model year vehicles.

COLOUR	TYPE	LRC	INTERIOR	DECALS
100"				
ARLES	SOLID	424	W	MS
ALPINE	SOLID	456	W S	DG
EASTNOR	SOLID	419	S	MS
PEMBROKE	SOLID	476	W	MS
PORTOFINO	SOLID	390	W S	MS
BELUGA	SOLID COB	416	W S	MS
ARDENNES	MICATALLIC	413	W S	MS
SONORAN	MICATALLIC	508	S	MS
TROCADERO	MICATALLIC	467	W S	MS
ROMAN BRONZE	METALLIC	479	S	DG
ASPEN	METALLIC	458	S	DG
PLYMOUTH BLUE	MICATALLIC	434	W	MS
AEGEAN BLUE	MICATALLIC	490	W	MS
WESTMINSTER	MICATALLIC	445	W	MS
VOGUE SE				
ALPINE	SOLID	456	W S DS	DG
BELUGA	SOLID COB	416	W S	MS
ARDENNES	MICATALLIC	413	W S	MS
ASPEN	METALLIC	458	S	DG
PLYMOUTH BLUE	MICATALLIC	434	W	MS
WESTMINSTER	MICATALLIC	445	W	MS
LSE 108"				
ALPINE	SOLID	456	SA	DG
BELUGA	SOLID COB	416	SA	MS
ARDENNES	MICATALLIC	413	SA	MS
MOSSWOOD	MICATALLIC	987	SA	MS
ROMAN BRONZE	MICATALLIC	479	SA	DG
PLYMOUTH BLUE	MICATALLIC	434	SA	MS

KEY TO COLOURS:

INTERIOR: S - SORREL, W - WINCHESTER, DS - DARK SABLE, SA - SADDLE
DECALS: MS - MID SILVER, DG - DARK GREY

Notes

BODY REPAIRS, GENERAL INFORMATION

Aluminium panels can be effectively repaired using the 'Argon Arc' process of welding, because the afore mentioned is a specialist operation it is necessary that only a skilled operator or specialist body shop undertake such repairs.

Under certain conditions it may not be practical to repair an exterior damaged panel, if this is the case, then panels can be easily removed and replaced with new ones.

Panel beating

WARNING: Before applying heat to any panel ensure that the panel is clean and free from underseal and that the area to be worked on is well clear of any combustible materials. Ensure that all precautions are taken against fire. On pre 1991 model year vehicles a fuel expansion tank is located between the rear right wing and inner body side.

1. Aluminium alloy panels can be beaten out after accidental damage in the same way as sheet steel. Hammering causes metal to work harden, and requires annealing to prevent the possibility of cracking. To anneal, apply spread of heat to the area, until the heated metal will char a piece of soft wood when touched on it. Followed by slow air cooling.

Welding

WARNING: The battery ground lead MUST be disconnected before commencing welding.

WARNING: Before applying heat to any panel ensure that the panel is clean and free from underseal and that the area to be worked on is well clear of any combustible materials. Ensure that all precautions are taken against fire. On pre 1991 model year vehicles a fuel expansion tank is located between the rear right wing and inner body side.

1. Clean off all grease and paint, dry thoroughly and 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. Cleanliness is essential. Also clean the welding rod or strip with steel wool.
2. It is strongly recommended that a few welds are made on scrap metal before the actual repair is undertaken if the operator is not already experienced in welding aluminium and its alloys.
3. Use only 5 per cent magnesium aluminium welding rod (5 Mg/A).

Welding tears and patching

1. If a tear extends to the edge of a panel, start the weld from the end away from the edge and also at this point drill a small hole to prevent the crack spreading, then work towards the edge.
2. When welding a long tear, or making a long welded joint, tack the edges to be welded at intervals of 50 to 100 mm. After this, weld continuously along the joint, increasing the speed of the weld as the material heats up.
3. When patching, cut the patch to the correct shape for the hole to be filled, but of such sizes as to leave a gap 0.80 mm between it and the panel, and then weld as described above. Never apply an 'overlay' patch.

Spot welding

1. Spot welding is mainly used in the manufacture of the Range-Rover inner steel body frame and exterior magnesium-aluminium alloy panels, and is a process which can be carried out satisfactorily by the use of the proper apparatus in a specialist body shop. Aluminium and its alloys are very good conductors of heat and electricity, and thus it is most important to maintain the right conditions for successful spot welding. The correct current density must be maintained, and so must the 'dwell' of the electrodes. Special spot welding machines have been developed, but they are expensive, and though the actual work can be carried out by comparatively unskilled labour, supervision and machine maintenance must be in the hands of properly qualified persons.

Riveting

1. Where both sides of the metal 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 head on the work. For riveting blind holes, 'pop-rivets' must be used. These are inserted and closed by special 'Lazy-Tong' 'pop-rivet' pliers.

PAINTWORK

General Information

Before undertaking any paintwork process on the exterior body of Range Rover, firstly ascertain which is the best method of repair either by panel repair or replacement.

The initial preparation of a panel is very important to ensure that when finished it is of a standard that meets and matches existing bodywork. Panels must be thoroughly degreased with Berger Preclean 802.0516 or a suitable equivalent, any unsound paint to be stripped using Berger Double strength Meltic 301.8051. Always refer to the paint manufacturers instructions.

Paintwork processes should be performed by a specialist bodyshop where paint spraying can be undertaken in a controlled environment whereby temperatures are kept constant and the atmosphere dust free.

The flow chart on the following page gives a guide to preparing and painting a panel. Wherever possible refer to the Berger Vehicle Refinishes Product Data and Application Sheets for further information.

SUBSTRATE	ALUMINIUM PANELS	
	PANEL REPAIR	REPLACEMENT PANEL
PREPARATION	Wet for using P60 Grade paper or dry sand using P240 grit discs.	Wet flat using P60 Grade paper or dry sand using P240 grit discs. Care must be taken to avoid cutting through to bare aluminium.
BODY FILLING	If filling is required, thoroughly abrade bare aluminium area to be filled and apply Standox Polyester	If filling is required, fill small indentations with Standox Polyster stopper 430-5029.
ETCHING	Etch the bare aluminium and filler with auto-speed self etch primer 414-1171, mixed 1:1 with activator 801-7995. Apply one coat and allow to dry for approximately 20 minutes. Recoat within 1 hour.	This process is not required if the original electrocoat primer is in sound condition. **IF NOT**
PRIMING	To obtain maximum adhesion and excellent build, apply Standox 2K 4:1 full primer 405-0381. Coats of 30-40 microns can be wet flatted with P60 grade paper after 45 minutes at 20°C.	
COLOUR COATING	Apply either Standox 2K Standocryl or Standox Metallic Basislack to the colour required. Hardeners and thinners will vary depending upon system employed, conditions available, temperature and size of vehicle etc. Refer to paint manufacturers Technical Information Sheet for correct selection.	

BODY

Introduction:

The information which follows is concerned solely with the 'Monocoque' assembly of the inner body shell on Range Rover models.

Body repairs often require the removal of mechanical and electrical units and associated wiring. Where necessary, reference should be made to the relevant section of the Repair Manual for removal and refitting instructions.

The inner body shell is of 'Monocoque' construction and to gain access to the repair area, it may be necessary to remove exterior body panels, all exterior body panels are bolted to the inner body shell to facilitate easier panel removal and replacement or repair.

It is expected that a repairer will select the best and most economic repair method possible, making use of the facilities available. The instructions given are intended to assist a skilled body repairer by expanding approved procedures for panel replacement with the objective of restoring the car to a safe running condition and effecting a repair which is visually acceptable.

WELDING

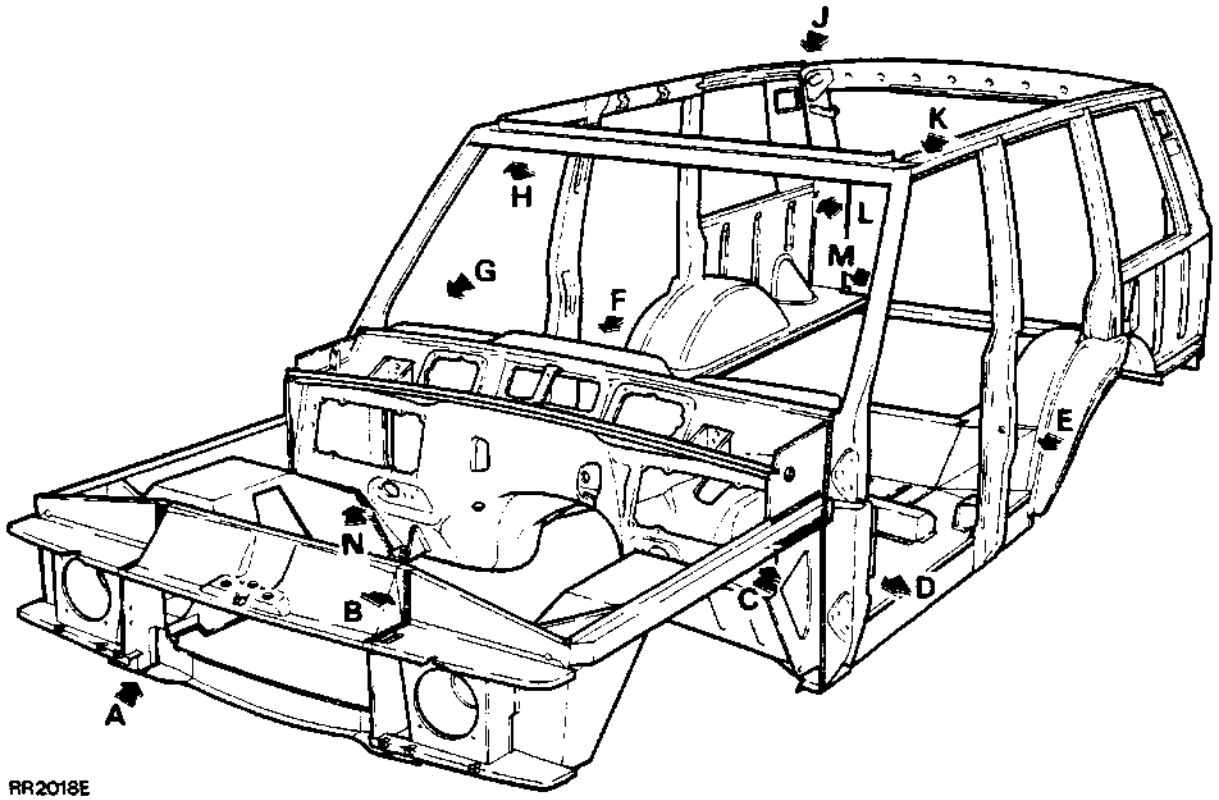
The following charts and illustrations show the locations and types of weld for securing the body side assembly, tailgate frame assembly and the front valance and wheel arch assembly. Before undertaking any spot weld joints to the inner body, it is advisable to make a test joint using offcuts of the damaged components, and to use this test piece to perform a weld integrity test.

Spot welding is satisfactory if the joints do not pull apart. If the weld pulls a hole or tears the metal the weld is satisfactory. It is defective if the weld joint pulls apart or if there are signs of burning, porosity or cracking evident.

PREPARATION

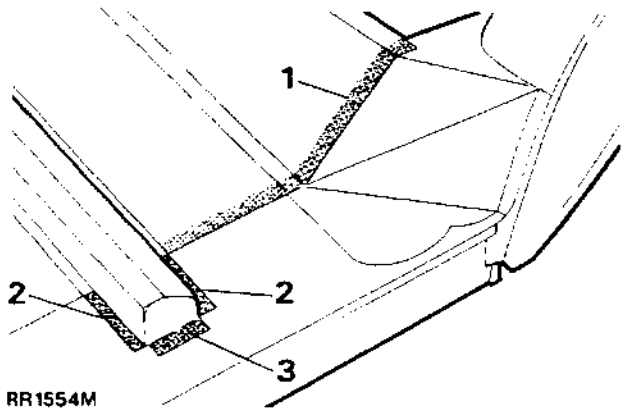
Thoroughly clean all areas to be welded, remove any sealants and corrosion protectives from around original panels. Align and clamp all new panels in position and check relationship to one another.

INNER BODY SHELL ASSEMBLY



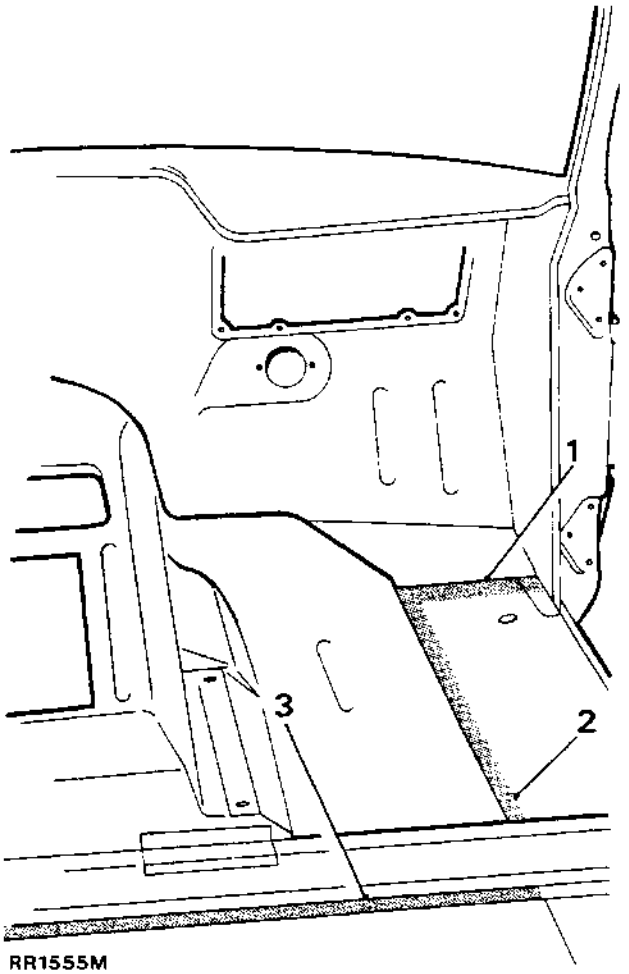
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	LOCATION	FACTORY JOINT (minimum number of spot welds quoted)
A.	Front cross member to valance and wheel arch assembly	6 spot welds, 20 mm pitch
B.	Bonnet locking platform to valance and wheel arch assembly	10 spot welds, 25 mm pitch
C.	Valance and wheel arch assembly to dash and tunnel assembly	16 spot welds, 25 mm pitch
D.	Body side complete to dash and tunnel assembly	10 spot welds, 65 mm pitch



RR1554M

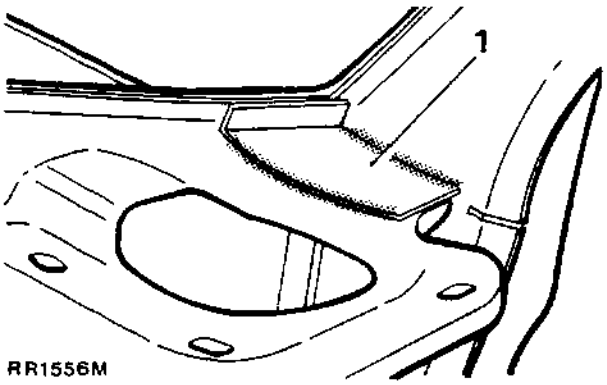
LOCATION E

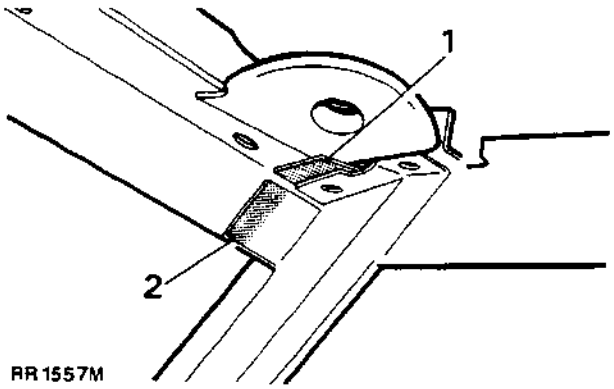


RR1555M

LOCATION F

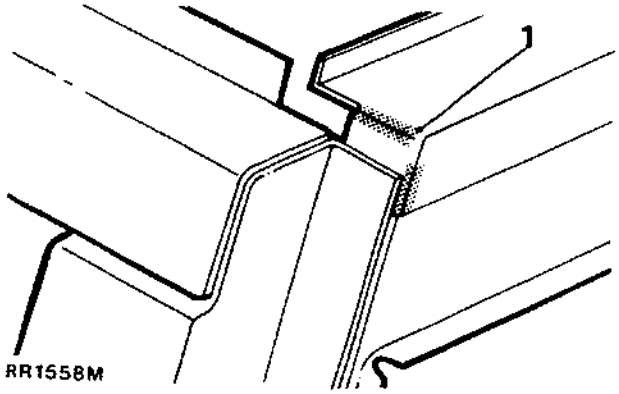
LOCATION	
E. 1. Body side complete to heelboard panel assembly.	14 spot welds, 35 mm pitch
2. Body side complete to dash and tunnel assembly complete.	10 spot welds, 25 mm pitch
3. Body side complete to dash and tunnel assembly	3 spot welds, 30 mm pitch
F. 1. Body side complete to dash and tunnel assembly complete	7 spot welds, 30 mm pitch
2. Body side complete to dash and tunnel assembly complete	18 spot welds, 40 mm pitch
3. Body side complete to dash and tunnel assembly complete	30 spot welds, 34 mm pitch



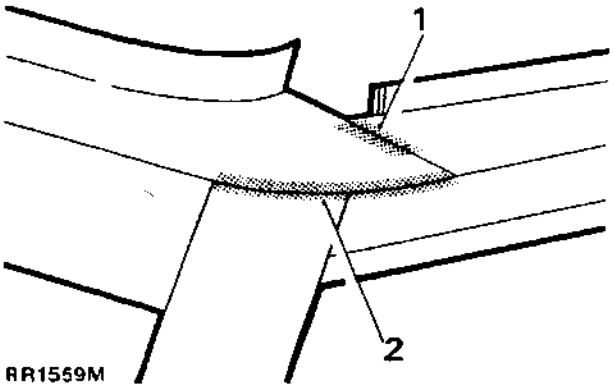


LOCATION G **LOCATION H**

	LOCATION	FACTORY JOINT (minimum weld requirement quoted)
G.	1. Reinforcement plate to dash and tunnel assembly and body side assemblycomplete	CO^2 weld, 2 places 75 mm long each weld
H.	1. Body side complete to roof header panel assembly (internal joint)	3 spot welds, 15 mm pitch
	2. Body side complete to roof header panel assembly (internal joint)	3 spot welds, 15 mm pitch

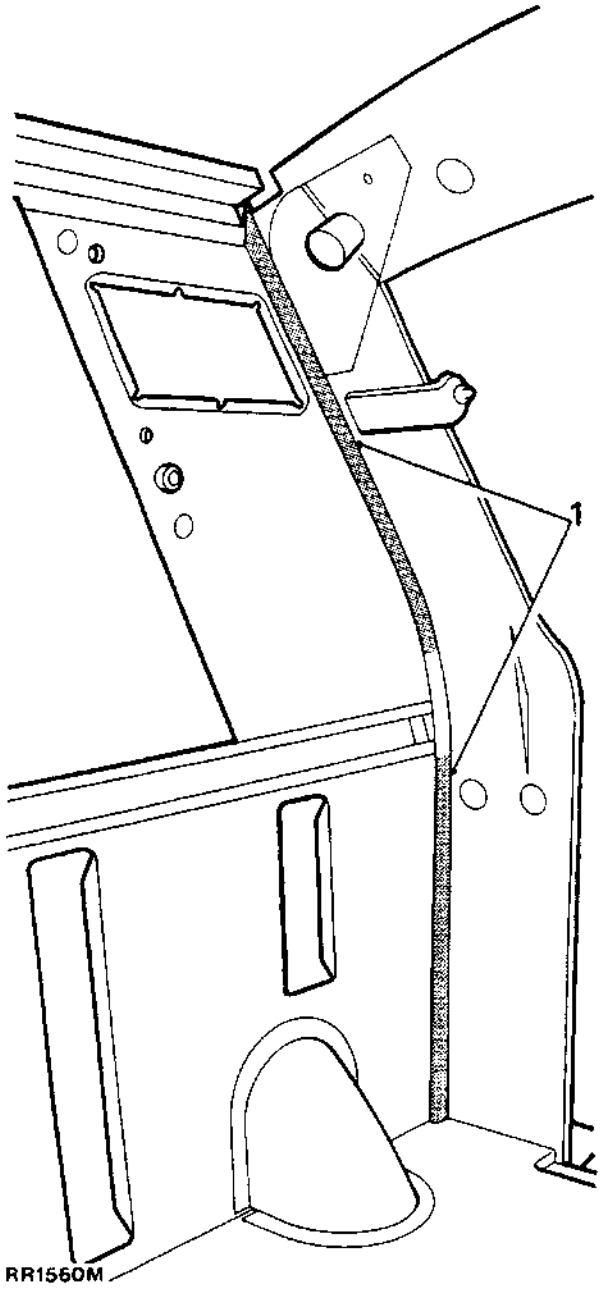


LOCATION J

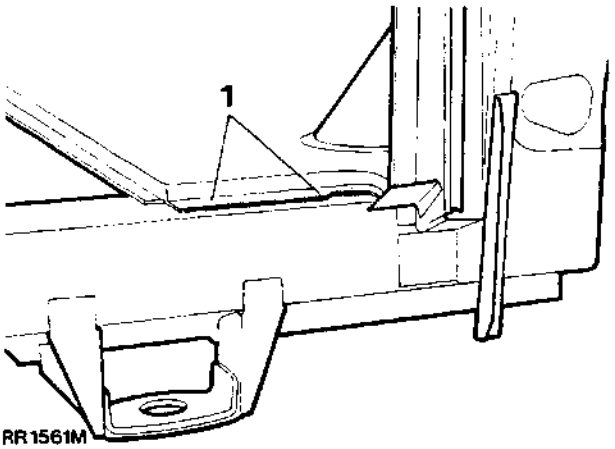


LOCATION K

LOCATION	FACTORY JOINT (minimum weld requirement quoted)
J. 1. Body side complete to rear tailgate frame assembly	CO^2 weld, one run 40 mm long
K. 1. Body side complete to roof header panel assembly (external joint)	CO^2 weld, one run 20 mm long
2. Body side complete to roof header panel assembly (external joint)	CO^2 weld, one run 100 mm long

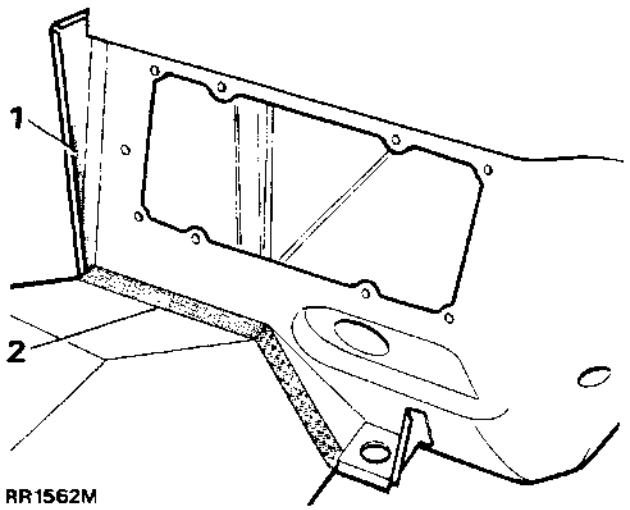


LOCATION L



LOCATION M

LOCATION	FACTORY JOINT (minimum weld requirement quoted)
L. 1. Body side complete to rear tailgate side member	32 spot welds, 30 mm pitch
M. 1. Body side complete to rear tailgate bottom cross member	CO^2 weld, 2 runs 40 mm long



LOCATION N

LOCATION	FACTORY JOINT (minimum number of spot welds quoted)
N. 1. Valance and wheel arch assembly to dash and tunnel assembly	4 spot welds, 45 mm pitch
2. Valance and wheel arch assembly to dash and tunnel assembly.	15 spot welds, 25 mm pitch

HEADLINING

Service repair no - 76.64.01.

Remove and refit

Remove

1. Remove spare wheel.
2. Remove rear seat belt upper guide brackets and inertia reel assemblies.
3. Fold rear seat backrest forward. Recline front seats.
4. Disconnect the battery negative lead.
5. Remove two roof lamp assemblies. Remove interior lamp mounting panel if sunroof is fitted.
6. Remove rear view mirror.
7. Remove two sun visors and centre retaining bracket.
8. Remove passenger grab handles.
   Sunroof vehicles: Remove edge trim and clips from roof opening.
9. With assistance support front of headlining. Remove two plastic retaining clips above rear door.
10. Remove two plastic retaining clips securing rear end of headlining near upper tailgate hinges.
11. Pull headlining forward to clear rear quarter trim. Lower headlining,disconnect electrical leads from speakers.
12. Remove headlining through tailgate.

CAUTION: To assist removal tilt headlining at an angle. DO NOT flex headlining as damage may occur.

Refit

13. Reverse removal procedure.
    Sunroof vehicles: Secure headlining around roof opening with edging finisher.

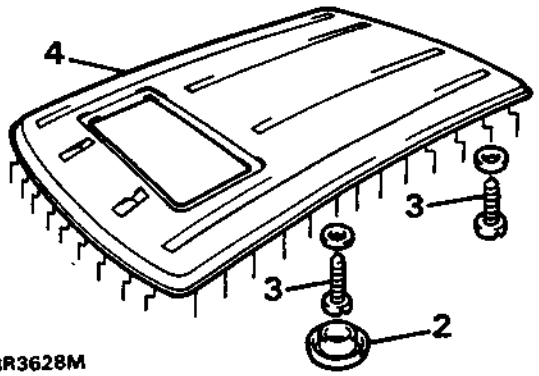
ROOF PANEL

Service repair no - 76.10.13.

Remove and refit

Remove

1. Remove headlining. ***See Headlining***
2. Remove blanking plugs from rail above door frames to access screws.
3. Remove the screws washers from around inner edge of roof panel.



RR3628M

4. With assistance lift roof panel from body. Remove sealant from roof and body mating faces.

Refit

5. Apply sealant to roof and body mating faces.
6. Reverse removal procedure.

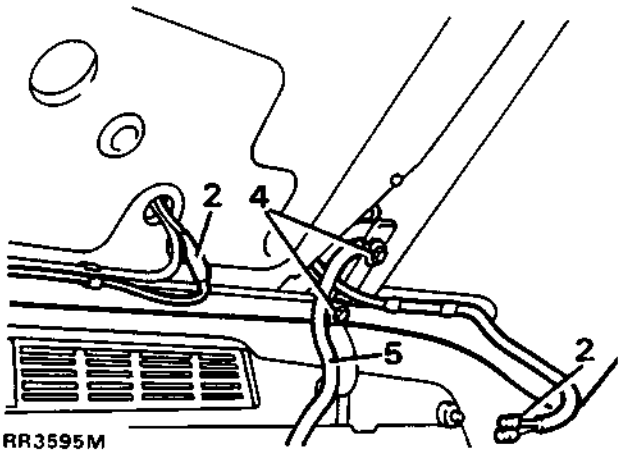
BONNET

Service repair no - 76.16.01.

Remove and refit

Remove

1. Disconnect the battery negative lead.



RR3595M

2. Disconnect electrical leads to under bonnet lamp and heated washer jets.
3. Disconnect windscreen washer tube at 'T' joint.
4. With assistance release four bolts securing bonnet to hinges. Note ground strap located onto left hinge for reassembly. Lift bonnet clear of vehicle.

Refit

5. Fit bonnet ensure ground strap is refitted. Before final tightening of bolts align bonnet with decker panel, wing and front grille.
6. Reverse the remaining removal instructions.

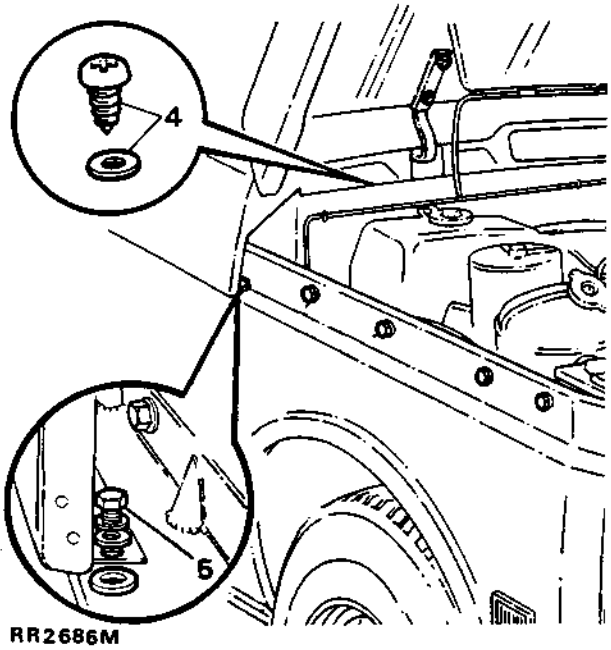
DECKER PANEL

Service repair no - 76.10.35.

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove bonnet. ***See Bonnet***
3. Remove wiper arms and two nuts securing wheel boxes to decker panel. Remove two exterior sealing rubbers.
4. Remove nine screws securing front of decker panel.
5. Remove four bolts,spring and plain washers retaining decker panel to wings.



RR2686M

6. With assistance place a tube over each hinge and lower to enable decker panel to be removed. Slowly return hinges to upright position.

WARNING: Gradually let hinges return to upright position to prevent possibility of personal injury or damage.

Refit

7. Reverse removal procedure.
8. Using a soft blunt instrument ease windscreen rubber onto top of decker panel.

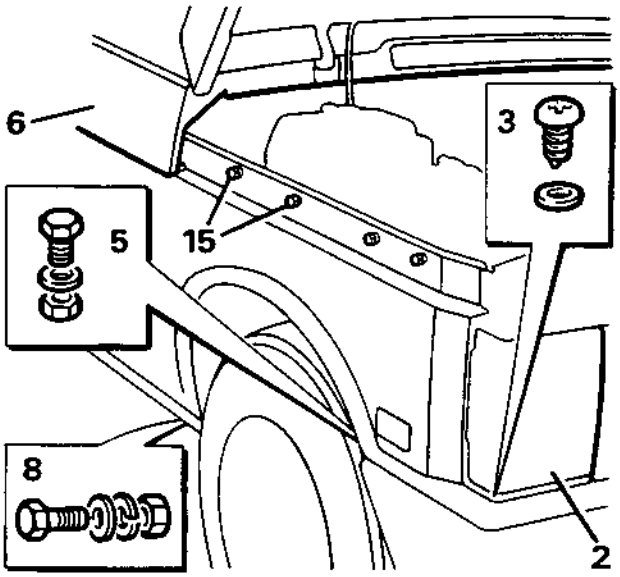
FRONT WING

Service repair no - 76.10.24.

Remove and refit

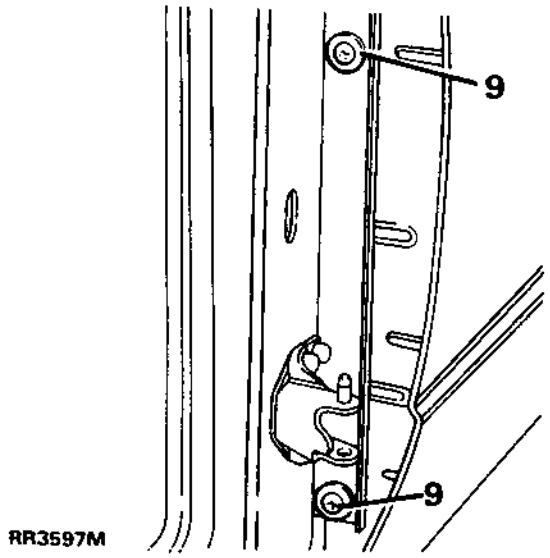
Remove

1. Remove wheel arch liner. ***See Front wheel arch liner***
2. Remove side light and flash lamp assembly. ***See ELECTRICAL, Repair, Side light and flasher lamp assembly and bulb.***



RR3596M

3. Remove screws, plain washers from bottom of side light recess.
4. Remove fixings securing bumper end cap. Remove moulding from bumper.
5. Remove bolt which secures spoiler to front wheel arch.
6. Release decker panel. ***See Decker panel***
7. Remove five nuts, bolts, plain and spring washers securing wing to valance.
8. Remove two bolts, plain washers, securing sill finisher to bottom of wing.



9. Remove two screws securing wing to 'A' post. Located near door hinges.

Refit

10. Apply suitable protection to wing inner. Apply sealant to mating faces.
11. Before tightening wing bolts ensure wing aligns with edge of front door.
12. Reverse remaining removal instructions.

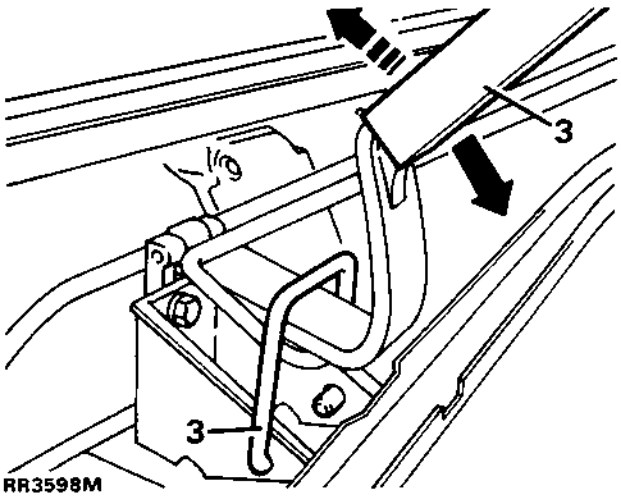
ASSISTED BONNET LIFT

Service repair no - 76.16.11.

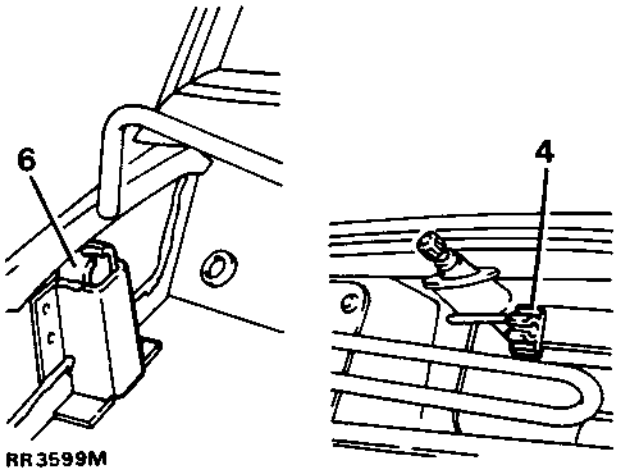
Remove and refit

Remove

1. Remove bonnet. ***See Bonnet***
2. Remove decker panel. ***See Decker panel***
3. Place a tube over each hinge and lower to remove stop bracket. Slowly return hinges to upright position.



4. Release torsion bar from retaining clip.
5. Move torsion bar so it releases from hinge.
6. Release torsion bar from retaining bracket.



7. Remove 2 bolts and plain washers securing hinge to mounting bracket.
8. Withdraw hinge.

Refit

9. Fit hinge and securely tighten 2 retaining bolts
10. Fit torsion bar ensure secure location into retaining clip and bracket.
11. Reverse removal procedure.

FUEL FILLER FLAP

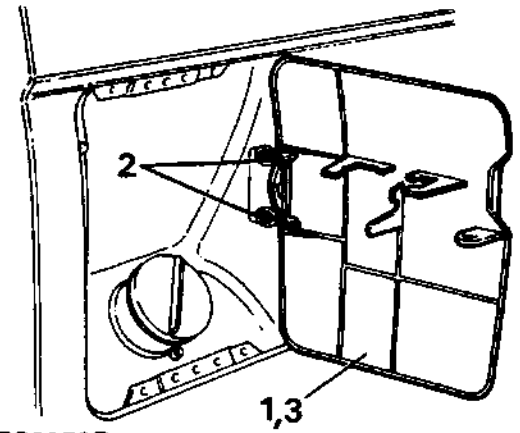
Service repair no - 76.10.25.

From 1991 model year the filler flap is revised. Remove and refit instructions remains same.

Remove and refit

Remove

1. Open fuel filler flap.
2. Release 2 screws with plain washers.
3. Remove flap.



RR2073E

Refit

4. Fit flap, loosely fit screws.
5. Check outer profile of flap aligns with wing. Adjust hinge flap in or out of opening.
6. Tighten screws.

REAR CORNER PANEL AND WING

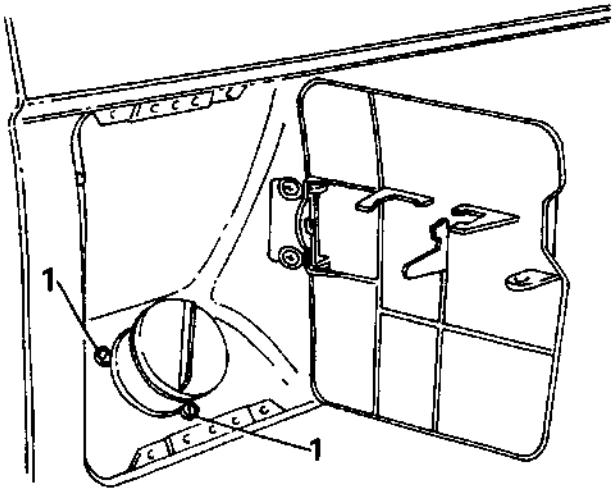
Service repair no - 76.10.20 / 76.10.27.

WARNING: On pre 1991 model year vehicles a fuel expansion tank is located between right wing and inner body side. The wing must be removed before any repair requiring heat onto rear corner panel or wing.

Remove and refit

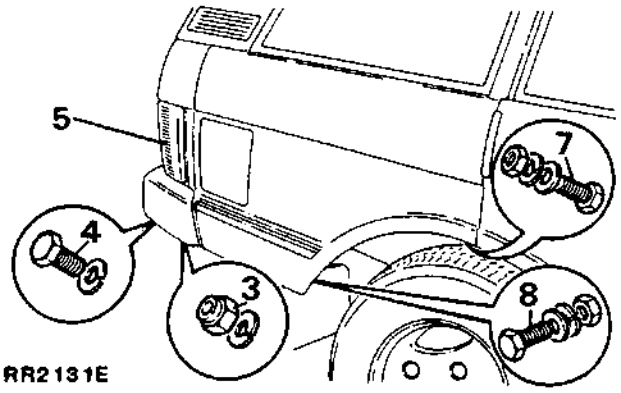
Remove

1. If applicable, remove 3 filler tube screws and fuel filler flap. ***See Fuel Filler flap***



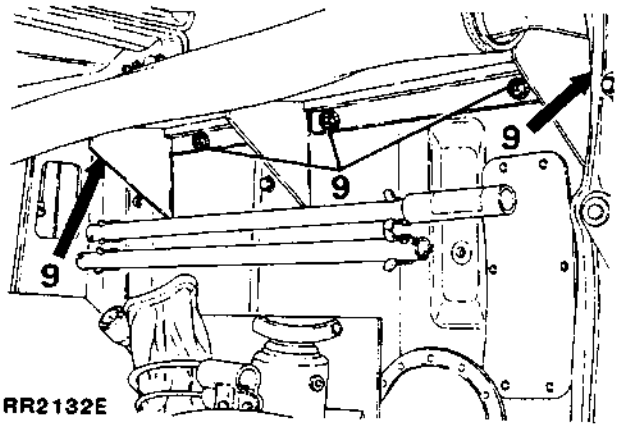
RR2130E

2. Remove load space cover and spare wheel.
3. Remove 2 nuts and washers securing bumper end cap to corner panel.
4. Remove bolt securing end cap to bumper.



RR2131E

5. Remove rear lamp assembly. ***See ELECTRICAL, Repair, Tail lamp assembly***
6. Drill out pop rivets securing corner panel to tailgate frame.
7. Remove 2 nuts and bolts securing wing to 'D' post, located beneath wheel arch.
8. Loosen nut and bolt retaining mud-flap bracket to wing.
9. Remove 5 screws securing wing to bodyside panel. To access screw adjacent to 'D' post, fold rear seat forward and remove seat locking mechanism housing.



RR2132E

10. Remove rear wing with corner panel.
11. Remove 7 bolts, plain and spring washers securing wing to corner panel.

Refit

12. Assemble corner panel to rear wing with bolts. Align panels before tightening.
13. Coat underside of panels with body protection.
14. Fit assembly to vehicle. Align door shut face to wing edge and corner panel to tailgate, before tightening screws and fitting pop rivets.
15. Reverse remaining removal instructions.

REAR QUARTER PANEL-INTERIOR

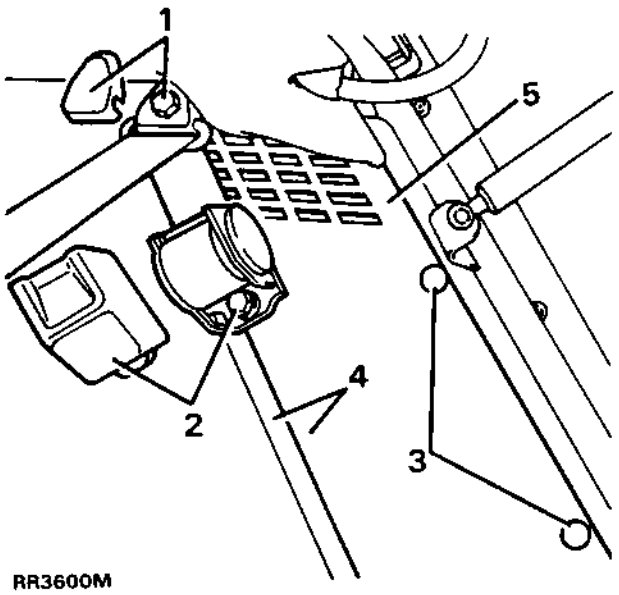
Service repair no - 76.13.43.

Remove and refit

Remove

NOTE: Remove spare wheel when removing left rear quarter panel.

1. Remove cover and bolt from seat belt guide bracket.
2. Remove clip on cover from seat belt inertia reel. Remove bolt and place inertia reel to one side.
3. Remove clips securing trim panel to body side.
4. Ease trim panel from behind rubber moulding.
5. Remove panel.



RR3600M

Refit

6. Ease top of trim panel under lip of rubber moulding.
7. Push panel up behind headlining until clip holes are visible.
8. Ease rubber moulding lip over remainder of trim panel.
9. Ensure electrical harness locates in channel behind trim panel. Fit 2 trim clips.
10. Fit seat belt guide bracket and inertia reel. Tighten to ***20 Nm.***
11. Refit covers to guide bracket and inertia reel.

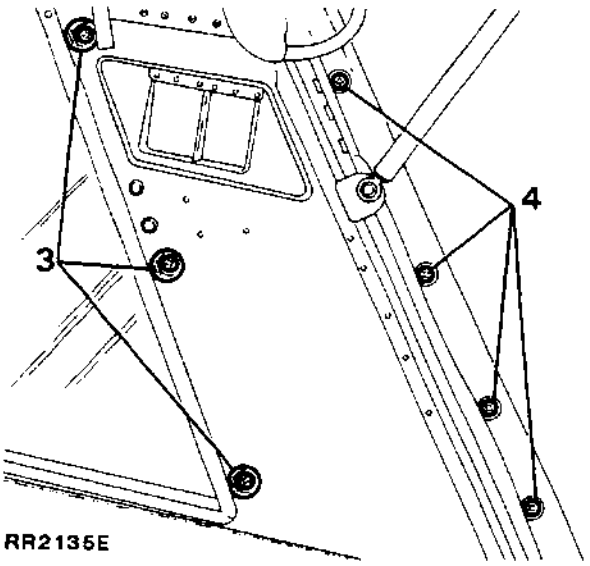
REAR QUARTER PANEL-EXTERIOR

Service repair no - 76.13.22.

Remove and refit

Remove

1. Remove spare wheel if removing left rear quarter panel.
2. Remove interior quarter panel. ***See Rear Quarter panel-interior***
3. Remove 3 nuts with plain washers securing exterior quarter panel to bodyside.
4. Remove 4 screws securing quarter panel to tailgate opening.
5. Remove panel.



RR2135E

Refit

6. Reverse removal procedure.

TAILGATE UPPER

Service repair no - 76.28.29.

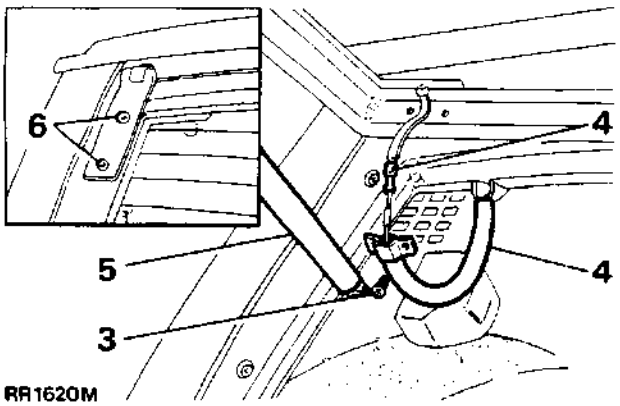
Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove tailgate wiper arm.
3. Open tailgate and remove screws from electrical wiring shrouds.
4. Move shroud away from screen and headlining. Disconnect electrical wiring.

WARNING: DO NOT repair worn tailgate stays. Fit a replacement.

5. Pry stays off tailgate.
6. With assistance support tailgate, remove screws from hinge.



RR1620M

Refit

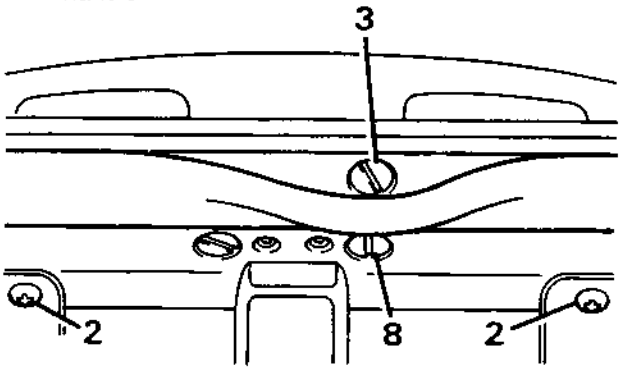
7. Reverse removal procedure.

TAILGATE UPPER LOCK

Remove and refit

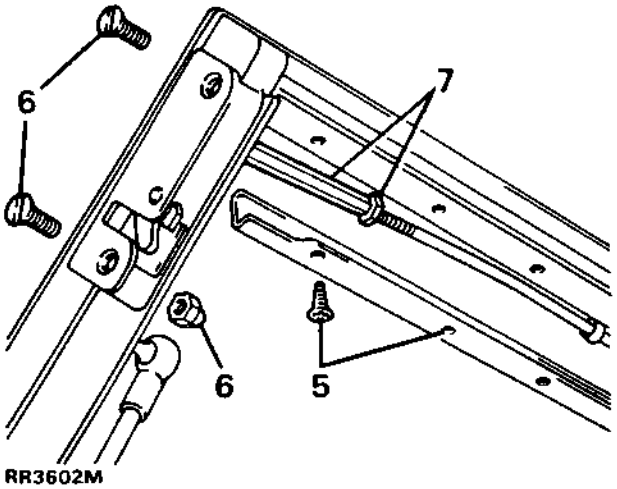
Remove

1. Remove upper tailgate lock actuator unit. ***See ELECTRICAL, Repair, Upper tailgate actuator unit***
2. Remove 2 screws securing release handle.
3. Move sealing rubber, remove screw to detach handle.



RR3601M

4. If required, remove key barrel by removing 2 screws at joint. Remove retaining plate and release spring.
5. Remove 8 screws securing operating rod covers either side of lock mechanism.
6. Remove 4 screws and 2 nuts securing lock catches to sides of tailgate.



RR3602M

7. Release 2 locknuts on operating rods. Rotate connecting rod until side catches can be removed.
8. Remove 2 screws securing lock mechanism. Remove unit complete with operating rods.

Refit

9. Reverse removal procedure.
10. To adjust side catches release locknuts on operating rods. Rotate hexagonal link to shorten or extend length as necessary.

TAILGATE UPPER GLASS

Remove and refit

Remove

1. Tailgate upper glass and frame assembly are serviced as one unit.
2. Remove tailgate upper. ***See Tailgate upper***
3. Remove high level stop lamp. ***See ELECTRICAL, Repair, High level stop lamp***
4. Remove lock actuator unit. ***See ELECTRICAL, Repair, Upper tail gate actuator unit***
5. Remove lock assembly. ***See Tailgate upper lock.***

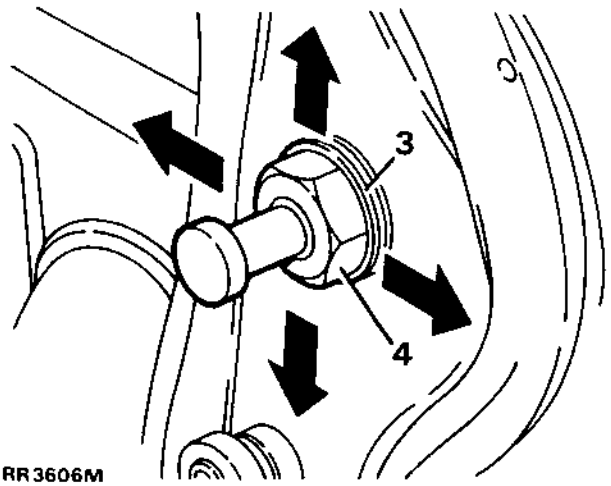
Refit

6. Reverse removal procedure.

TAILGATE LOWER STRIKER

Adjust

1. Adjustment is correct when tailgate profile aligns with rear body corner panels.
2. Open lower tailgate.
3. Add or remove spacing washers between striker and tailgate opening.
4. Move striker in appropriate direction and tighten.



RR3606M

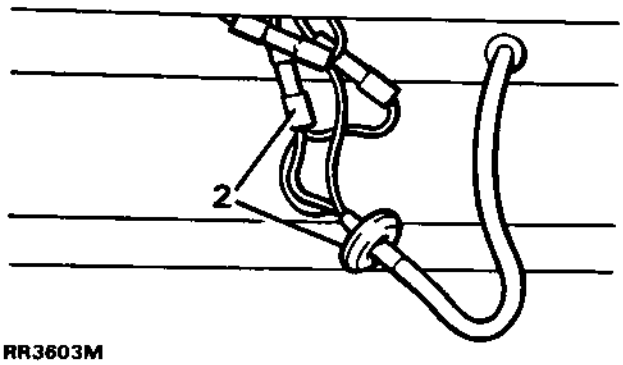
TAILGATE LOWER

Service repair no - 76.28.30.

Remove and refit

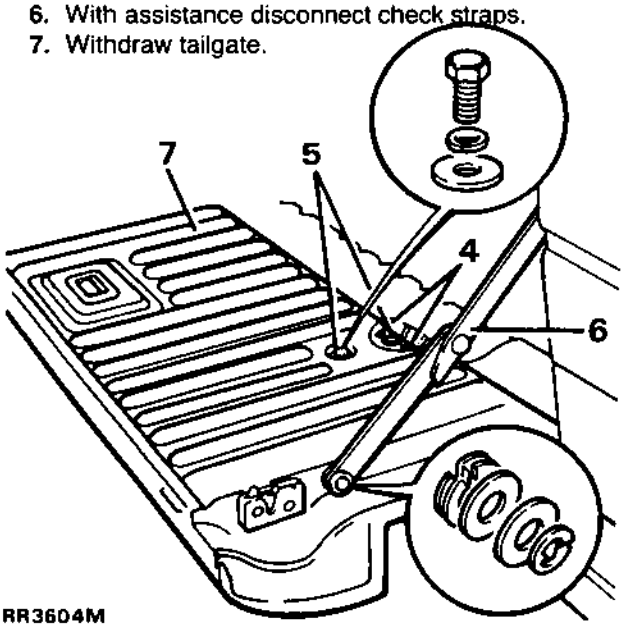
Remove

1. Disconnect the battery negative lead.
2. Remove grommet and withdraw electrical leads from tailgate. Disconnect connectors.



RR3603M

3. Remove tailgate trim panel.
4. Remove 4 screws securing seal around tailgate hinge.
5. Remove tailgate to hinge bolts.
6. With assistance disconnect check straps.
7. Withdraw tailgate.



RR3604M

Refit

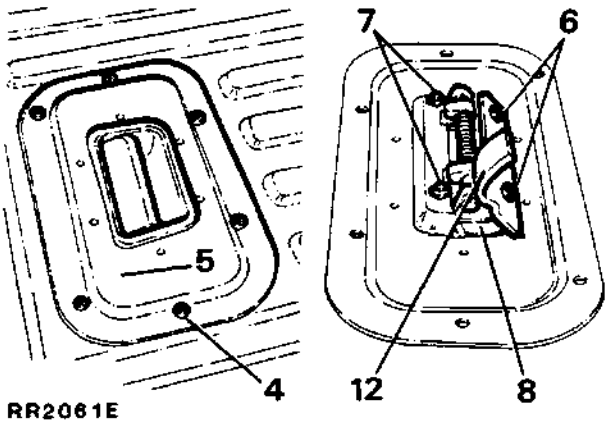
8. Reverse removal procedure. Ensure grommet is refitted onto tailgate.

TAILGATE LOWER RELEASE MECHANISM

Remove and refit

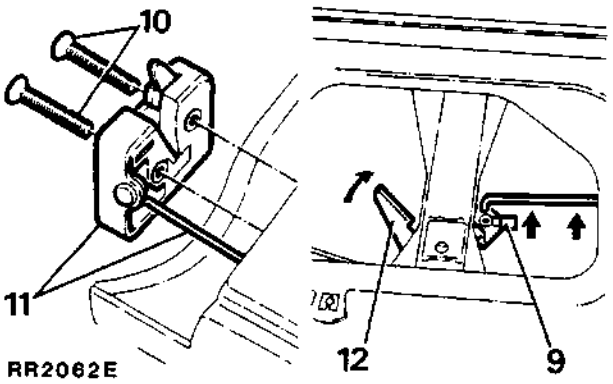
Remove

1. Open lower tailgate.
2. Lever trim from handle surround.
3. Remove 4 clips, remove tailgate trim panel.
4. Remove screws securing lock cover plate.
5. Remove cover plate with release mechanism.
6. Remove 2 screws and detach handle release actuator lever.
7. Remove 2 nuts and detach handle release retaining bracket.
8. Withdraw handle release mechanism from cover plate.



RR2061E

9. Release spring clips securing operating rods to tailgate release mechanism.



RR2062E

10. Remove screws securing 2 exterior locks on tailgate side.
11. Withdraw exterior locks with operating rods.

Refit

12. Reverse removal procedure. Grease handle release actuator lever and internal tailgate operating lever.

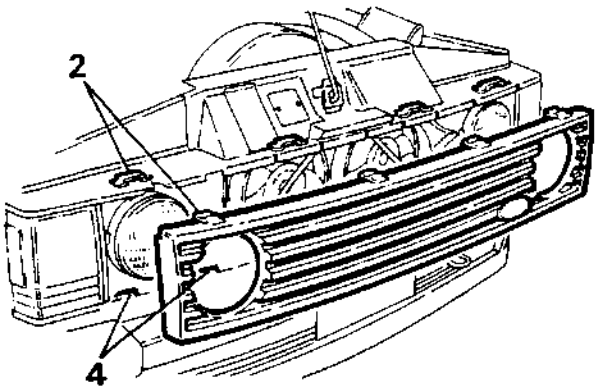
RADIATOR GRILLE

Service repair no - 76.55.06.

Remove and refit

Remove

1. Open and support bonnet.
2. Depress 4 retaining lugs and ease grille forward.
3. Lift grille to remove.



RR2068E

Refit

4. Locate lower lugs of grille into slots.
5. Ensure upper retaining lugs of grille locate behind bracket.

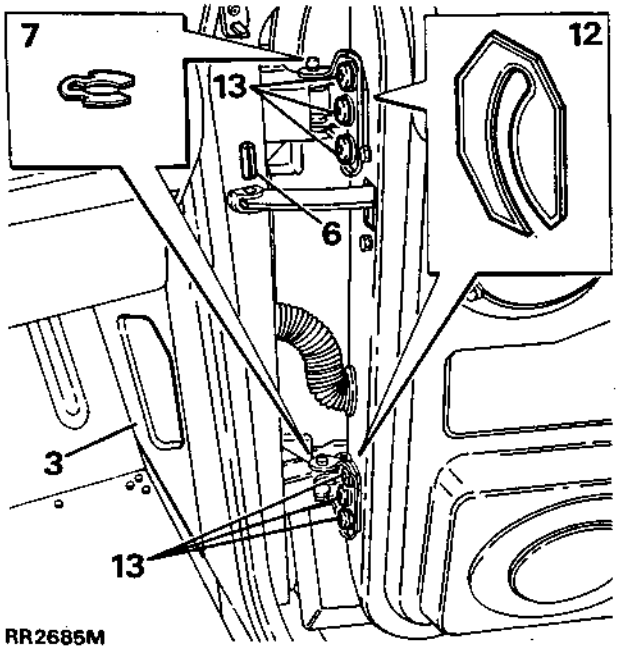
FRONT DOOR

Service repair no - 76.28.07.

Remove, refit and adjust

Remove

1. Disconnect the battery negative lead.
2. Open door to be removed.
3. Remove 2 clips securing trim panel to side of footwell.
4. Locate and disconnect door wiring plugs.



RR2685M

5. Disengage grommets either side of A' post. Feed wiring out.
6. Drive out roll pin from door check link.
7. Remove 'C' clips from hinge pins.

WARNING: Instruction 8 MUST BE carried out with assistance.

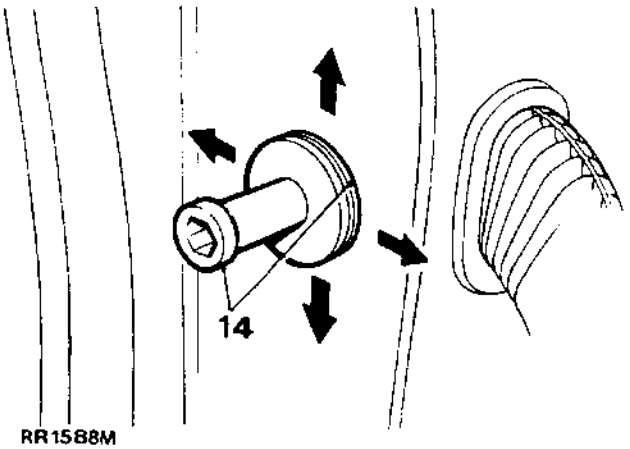
8. Lift opened door off hinge pins.

Refit

9. Reverse removal procedure. Renew clips if worn or distorted.
10. Open door, connect wiring plugs. Ensure they locate above trim panel.
11. Check operation of door and lock. If necessary, adjust door and striker plate.

Adjust

12. Adjust door by shims between hinge and door to move door forward or rearward in opening.
13. Loosen 6 screws securing hinges to door to adjust door up and down or in and out of opening. Tighten to ***25 Nm.***
14. Adjust door lock striker by adding and subtracting spacing washers or moving in required direction.



RR1588M

15. Note: If it is necessary to remove hinges from 'A' post. Refit in exactly same position using same thickness of shims.

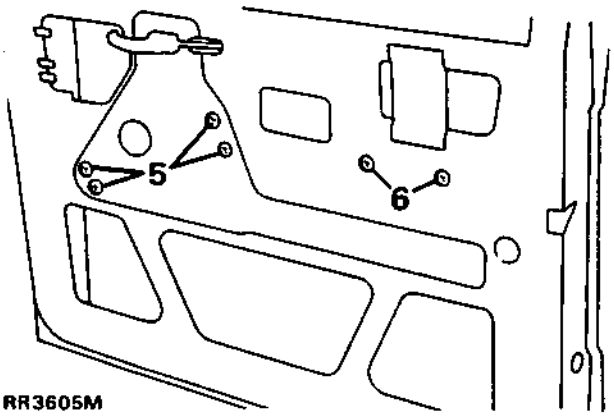
FRONT DOOR GLASS AND REGULATOR

Service repair no - 76.31.01. - 76.31.45.

Remove and refit

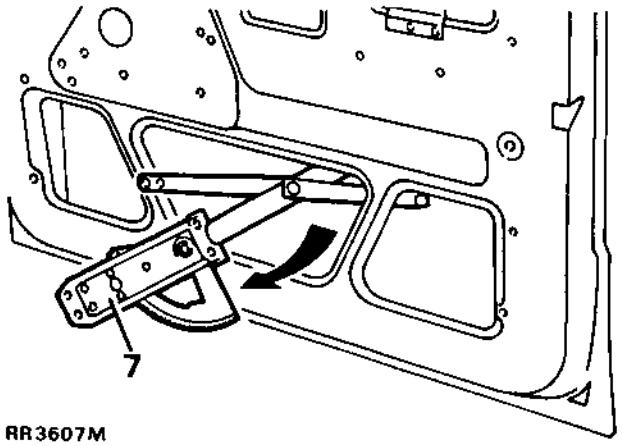
Remove

1. Fully close window and secure with tape to prevent window from dropping.
2. Remove trim panel. ***See Front door - Trim panel***
3. Remove vapor barrier.
4. Remove window lift motor. ***See ELECTRICAL, Repair, Window lift motor - Front doors***



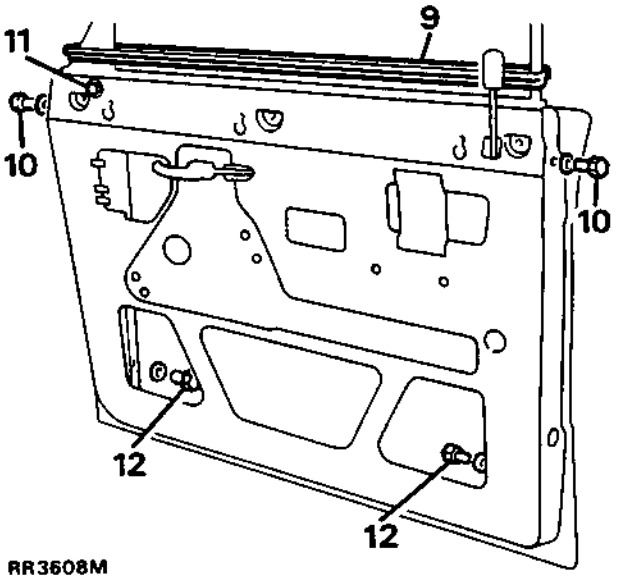
RR3605M

5. Remove 4 window regulator retaining bolts with shakeproof washers from door panel.
6. Remove 2 screws with shakeproof washers retaining lower window lift channel. Slide channel off stud.



RR3607M

7. Disengage lifting arm stud from upper lifting channel. Remove window regulator through opening in door panel.
8. Remove exterior driving mirror. ***See ELECTRICAL, Repair, Exterior driving mirrors***
9. Remove waist rail seal from top of door.



RR3608M

10. Remove bolt, shakeproof and plain washer from both end faces of door which secure door frame.
11. Remove bolt, spring and plain washer from recessed hole under mirror mounting plate.
12. Remove bolt spring and plain washer securing each lower side of door frame.
13. Remove glass and frame out of door panel.
14. Remove tape securing glass to frame.
15. Slide glass out of door frame.

Refit

16. Reverse removal procedure. When fitting door frame align to suit door opening. Then tighten door frame securing bolts.

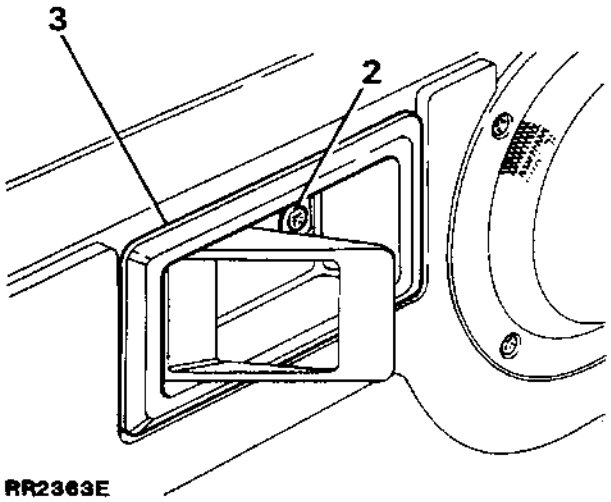
FRONT DOOR - TRIM PANEL

Service repair no - 76.34.01.

Remove and refit

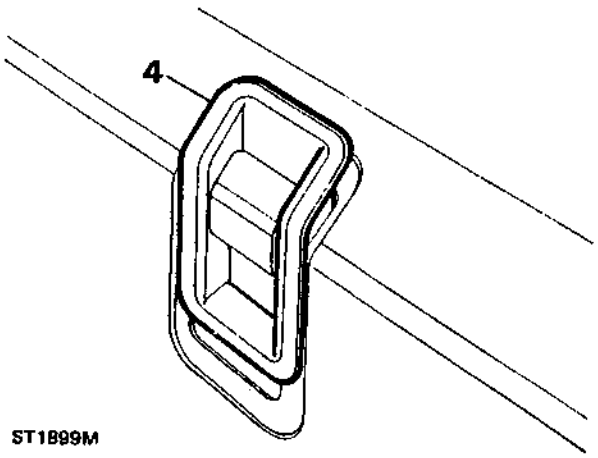
Remove

1. Disconnect the battery negative lead.
2. Remove screw securing handle surround.
3. Remove surround.



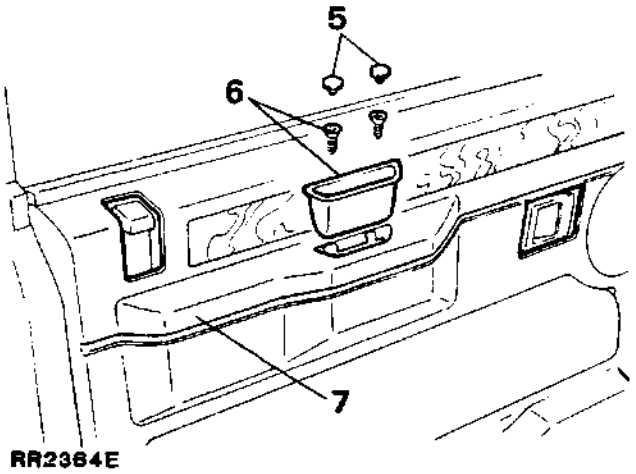
RR2363E

4. Pry sill button surround from trim panel.



ST1899M

5. Remove buttons from bottom of door pull pocket.
6. Remove screws, withdraw pocket from trim panel.



RR2364E

7. Pry trim panel from door.

NOTE: Support trim panel while speaker leads are disconnected.

8. Remove stowage bin by releasing screws behind trim panel.

Refit

9. Reverse removal procedure.

FRONT DOOR LOCK, OUTSIDE AND INSIDE DOOR RELEASE HANDLES

Service repair no - 76.37.12.

Remove and refit

Remove

1. Remove trim panel. ***See Front door - trim panel***
2. Remove plastic vapor barrier sheet.
3. Remove window lift motor. ***See ELECTRICAL, Repair, Window lift motor - Front Doors***
4. Remove door glass and regulator. ***See Front door glass and regulator***
5. Remove door lock actuator. ***See ELECTRICAL, Repair, Front door actuator unit***
6. Disconnect control rod from key operated lock. Release metal clip at bottom of rod.
7. Disconnect control rod from outside door release handle.
8. Disconnect rod between door release handle and door lock by releasing clip and pulling rod out of connecting block.
9. From inside door remove pin which secures quadrant to inner panel. Remove quadrant.
10. Remove screws securing sill button to door. Remove sill button from control rod.
11. Remove door lock by removing three screws as shown.
12. Withdraw lock through cut out below.

Continue for removal of outside release handle.

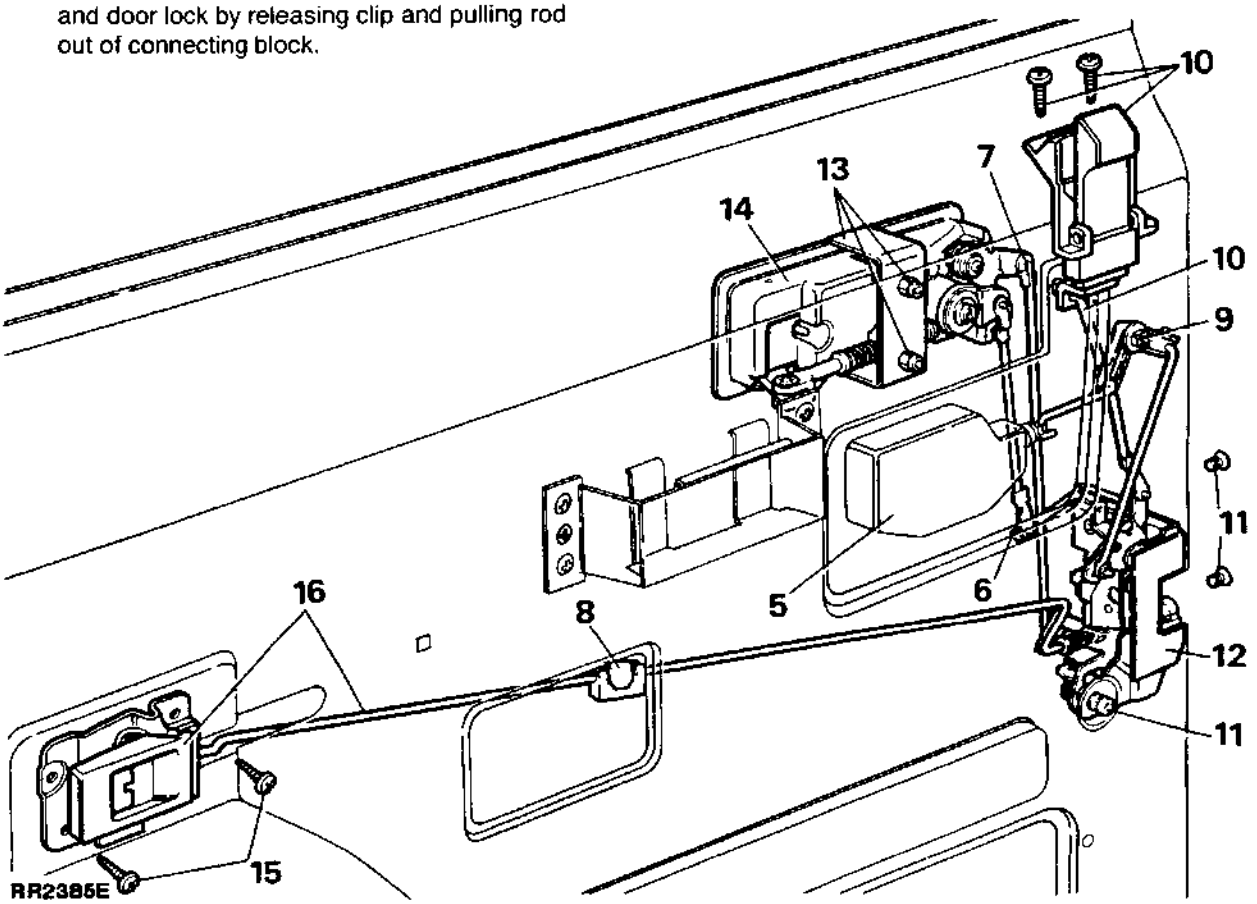
13. Remove nuts, shakeproof washers and retaining bracket.
14. Remove door release handle from outer panel.

Continue for removal of inside release handle.

15. Remove screws securing to door panel.
16. Withdraw handle with connecting rod attached.

Refit

17. Reverse removal procedure. 1 to 16.

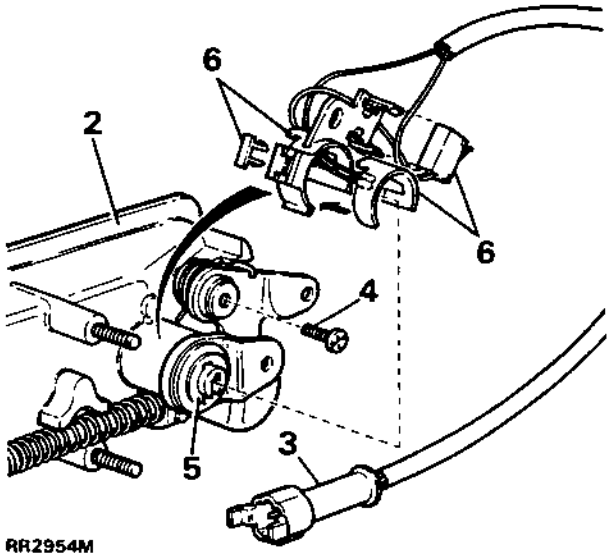


FRONT DOOR HEATED LOCK ASSEMBLY - 1991 MODEL YEAR

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove outside front door handle assembly. ***See Front door lock outside and inside door release handles.***



RR2954M

3. Disconnect heater electrical wiring at multiplug.
4. Remove heater retaining bracket screw.
5. Remove 'C' clip and colored cam link from end of barrel assembly.

⚠ **CAUTION: Ensure loose barrel assembly remains in position, to avoid components falling apart.**

6. Remove heater retaining bracket, complete with de-icing element, switch and wiring assembly.

Refit

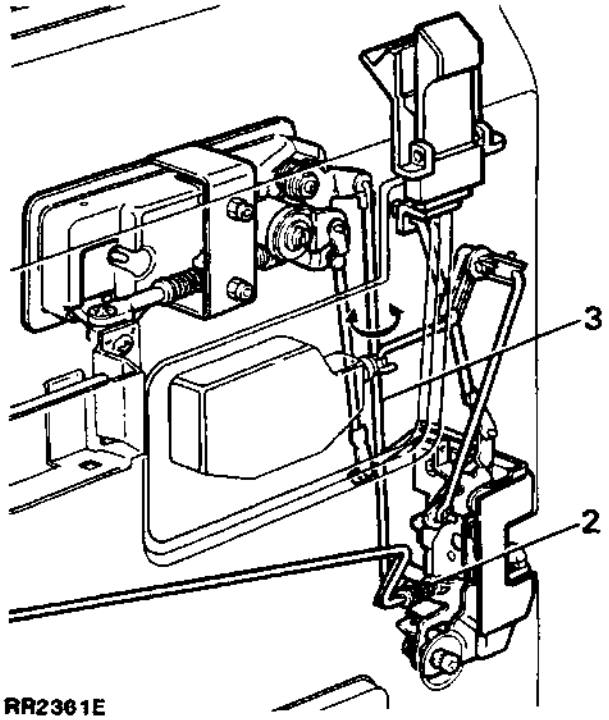
7. Hold de-icing element in position and fit heater retaining bracket assembly.
8. Reverse removal procedure. 1 to 5.

FRONT DOOR LOCK AND HANDLE ASSEMBLY

Service repair no - 76.37.47.

Inside door release handle to lock

1. Ensure inside door release handle is in fitted position.
2. Adjust spring tensioned nut at door lock to shorten or extend rod as required, so door release occurs before maximum handle movement.



RR2361E

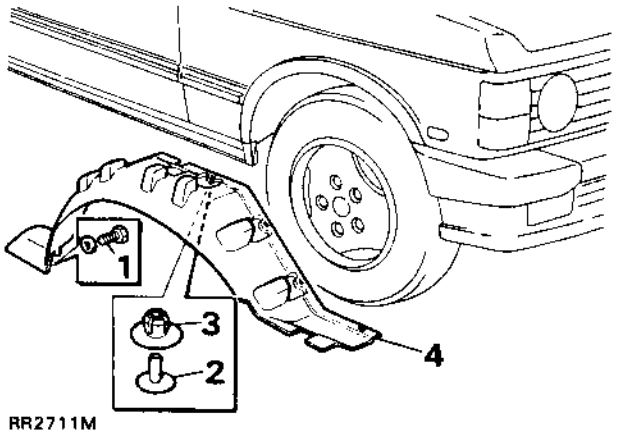
Outside door release handle to lock

3. Disconnect rod at outer door release handle by releasing plastic olive. Rotate rod to shorten or extend operating length as required, so door release occurs before maximum handle movement. Refit rod.

FRONT WHEEL ARCH LINER

Service repair no - 76.10.48.

Remove and refit



RR2711M

Remove

1. Remove bolt and washer securing rear lower edge of liner.
2. Pry out centre studs of eight plastic clips spaced around liner.
3. Pry out plastic clips.
4. Remove liner.

Refit

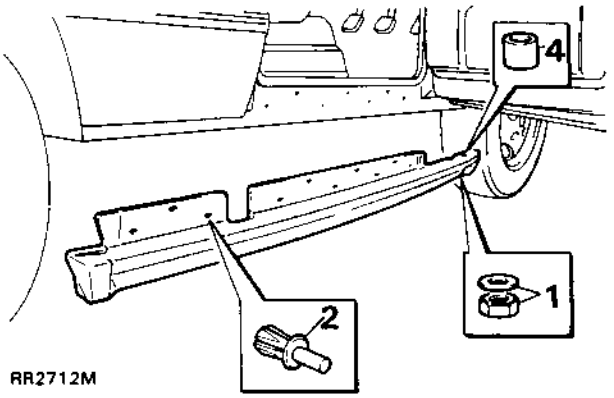
5. Reverse removal procedure. Renew clips as necessary.

SILL FINISHER

Remove and refit

Remove

1. Remove nut and washer from underneath front of sill finisher.
2. Tap out centre piece of ten Rocut fixing rivets.
3. Pry out Rocut rivets and remove sill finisher.



RR2712M

Refit

4. Reverse removal procedure. renewing Rocut rivets. Ensure metal tube insert is refitted into sill finisher where bolt goes through.

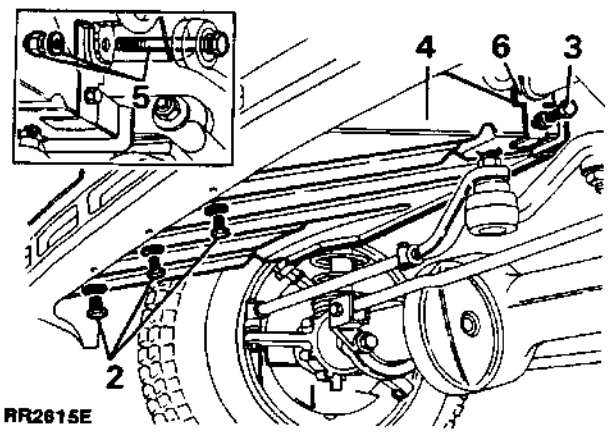
ENGINE UNDERTRAY

Service repair no - 76.10.50.

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove three screws, securing undertray to spoiler.
3. Remove two screws, one each side, securing rear of undertray to chassis mounting brackets.
4. Remove undertray by flexing to clear rear mountings.
5. Removal of one or both rear mounting brackets may be necessary. For example when removing steering box. Remove nut and washer from chassis bolt.
6. Withdraw undertray mounting bracket.



RR2615E

Refit

7. Reverse removal procedure.

REAR DOOR

Service repair no - 76.28.08.

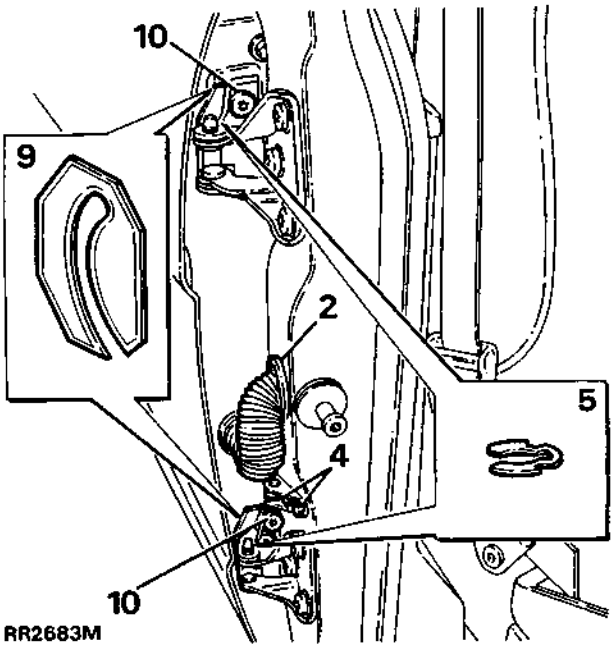
Remove, refit and adjust

Remove

1. Disconnect the battery negative lead.
2. Remove wiring grommet from 'B' post.
3. Withdraw door wiring plugs from 'B' post and disconnect.
4. Remove two bolts securing the check strap to 'B' post.
5. Remove 'C' clips from grooves in hinge pins.

WARNING: Instruction 6. MUST BE carried out with assistance.

6. Lift opened door off hinge pins.



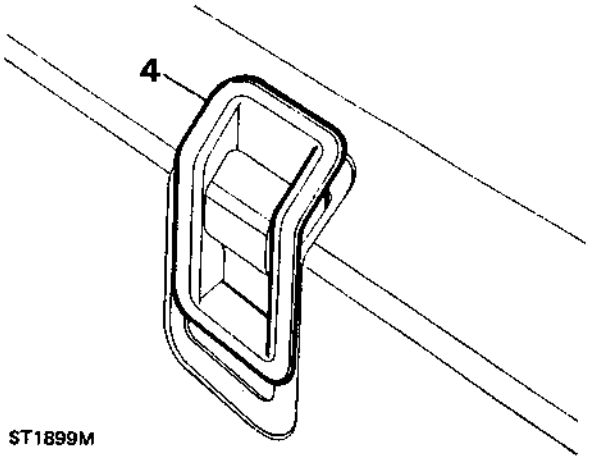
RR2683M

Refit

7. Reverse removal procedure. Renew 'C' clips if worn or distorted.

Adjust

8. Adjust door by means of shims between hinge and door to move door forward or rearward in the opening.
9. Loosen six screws securing hinges to door to adjust door up and down or in and out of opening. Retighten screws to ***25 Nm.***
10. Adjustment to door striker is identical to front doors.
11. Note: If it is necessary to remove hinges from 'B' post they should be refitted in exact same position using same thickness of shims.



ST1899M

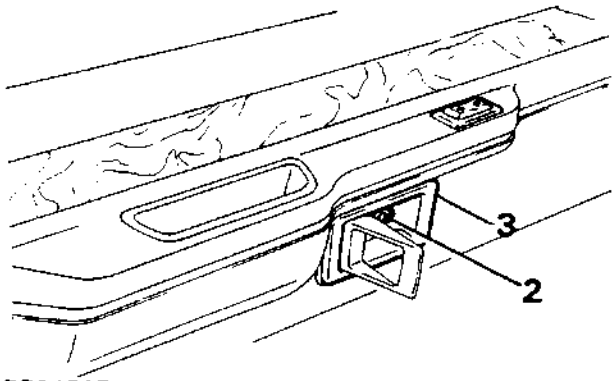
REAR DOOR - TRIM PANEL

Service repair no - 76.34.04/98

Remove and refit

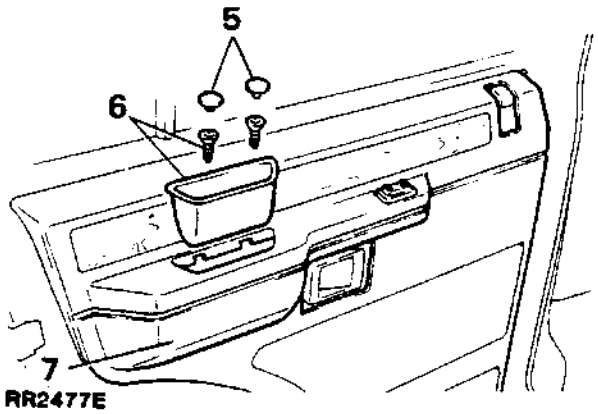
Remove

1. Disconnect the battery negative lead.
2. Remove screw securing handle surround.
3. Remove surround.



RR2476E

4. Pry door locking button surround from trim panel.
5. Remove two finisher buttons from door pull pocket to reveal securing screws.
6. Remove screws and withdraw pocket.
7. Pry trim panel away from door.
8. Disconnect electrical plug from window lift switch.
9. Remove window lift switch.



RR2477E

Refit

10. Reverse removal procedure.

REAR DOOR LOCK, OUTSIDE AND INSIDE DOOR RELEASE HANDLES

Service repair no - 76.37.13.

Remove and refit

Remove

1. Fully close window.
2. Disconnect the battery negative lead.
3. Remove trim panel. ***See Rear door - trim panel.***
4. Remove plastic vapor barrier sheet.
5. Disconnect inside door release control rod from door lock.
6. Disconnect sill locking control rod from door lock by releasing metal clip.
7. Disconnect control rod from outside door release handle by pulling it out of plastic olive.
8. Remove door lock by removing two screws from door shut face and single screw with shakeproof washer on inside of door. Retrieve any spacing washers which may be fitted.
9. Remove lock through upper rear opening of panel.
10. Remove two nuts with shakeproof washers and retaining bracket securing outside door release handle.
11. Remove outside door release handle from outer door panel.
12. Remove two screws with plain washers securing inside door release handle to inner door panel.
13. Remove handle with connecting rod attached.
14. Remove two screws securing sill locking button to inner door panel and detach sill button from bellcrank.

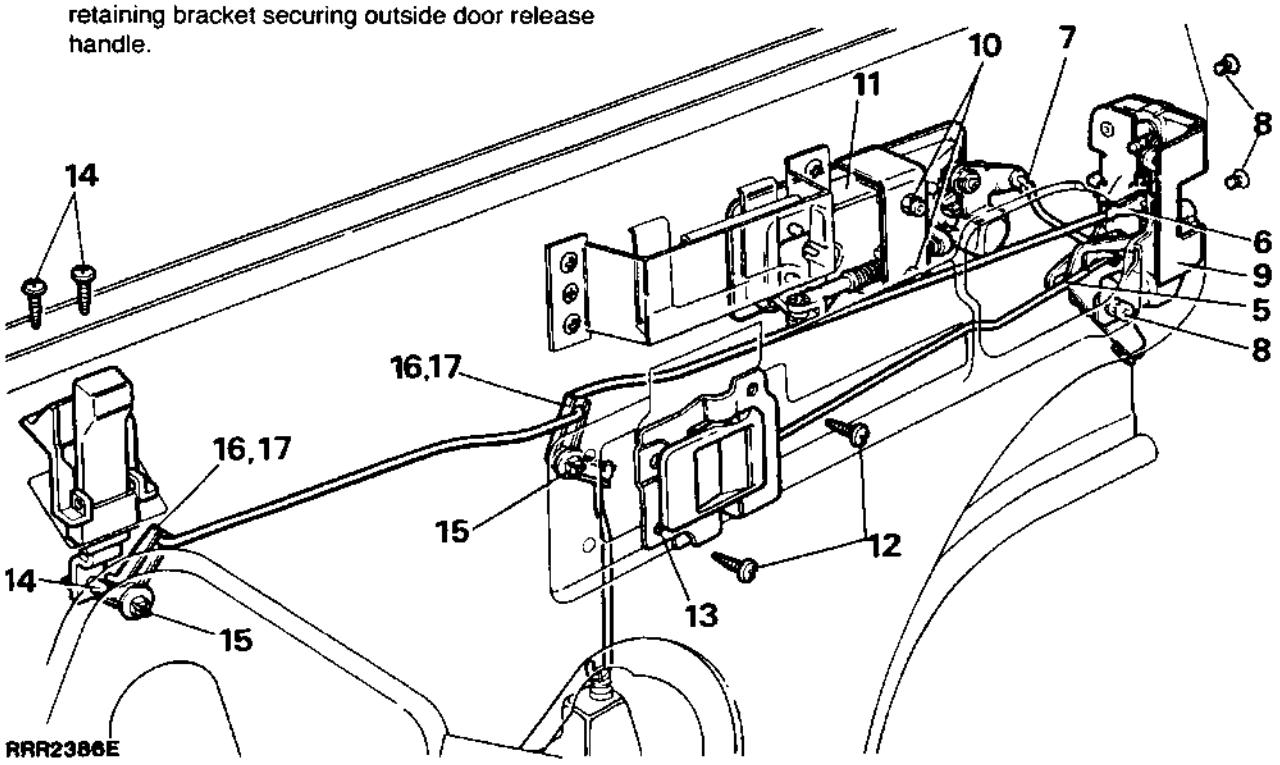
Sill locking bellcranks

15. Press out plastic locking pins from inner door panel.
16. Release bellcranks from inner door panel and unhook respective connecting rods.
17. Withdraw bellcranks from inner door panel.

△ **NOTE: When fitting bellcranks, locking pins are entered into square insert from outside and pressed in flush.**

Refit

18. Reverse removal procedure. 1 to 17.

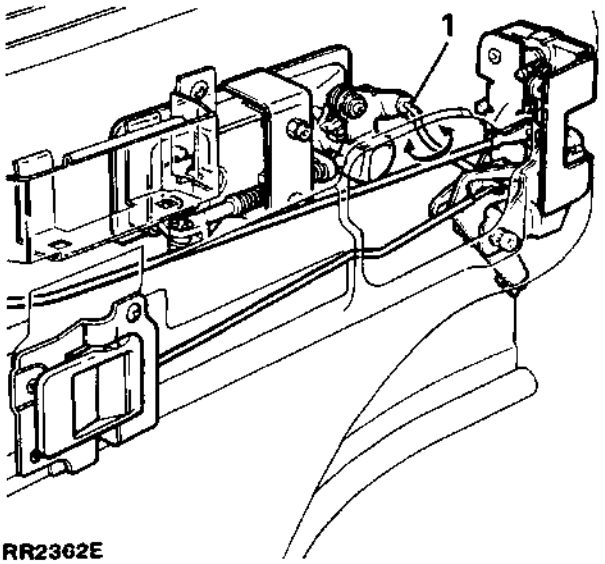


REAR DOOR LOCK AND HANDLE ASSEMBLY

Service repair no - 76.37.48.

Outside door release handle to lock

1. Disconnect connecting rod at rear of door outer release handle.
2. Rotate rod to adjust operating length as required, so that door release occurs before maximum handle movement.



RR2362E

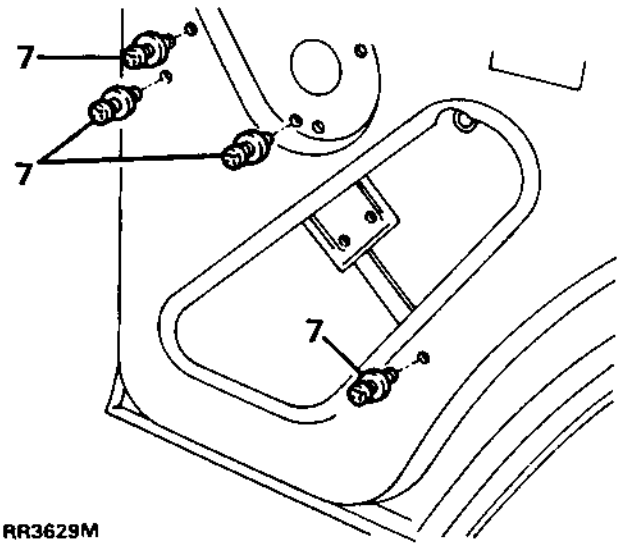
REAR DOOR GLASS AND REGULATOR

Service repair no - 76.31.02.
Service repair no - 76.31.46.

Remove and refit

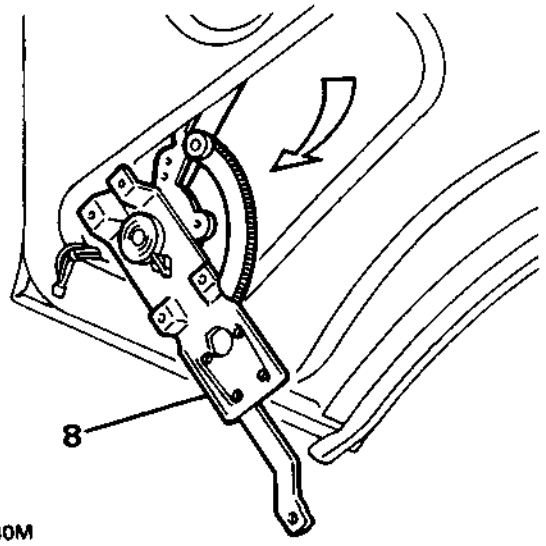
Remove

1. Fully close window and secure with tape.
2. Disconnect the battery negative lead.
3. Remove trim panel. ***See Rear door - trim panel***
4. Remove sill button.
5. Remove plastic vapour barrier.
6. Remove window lift motor. ***See ELECTRICAL, Repair, Window lift motor - Rear Doors***
7. Remove four window regulator screws with shakeproof washers.



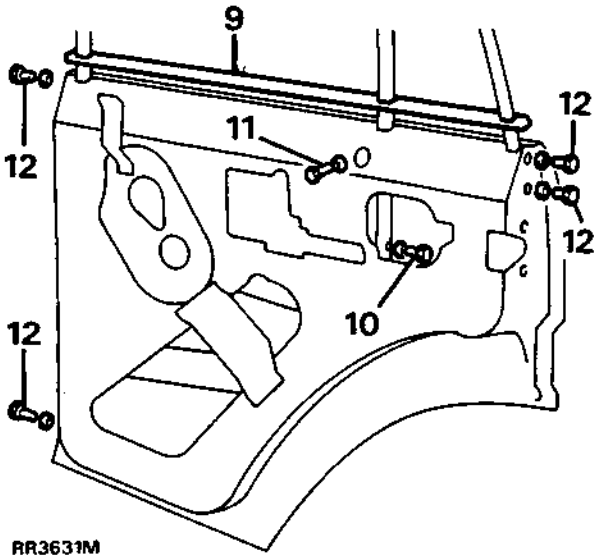
RR3629M

8. Disengage lifting arm stud from channel and remove window regulator.



RR3630M

9. Remove waist rail seal from top of door panel.
10. Remove bolt, spring and plain washers which secures bottom of door frame.



RR3631M

11. Remove bolt, spring and plain washer from door frame, as shown.
12. Remove two bolts, spring and plain washers from both door faces.
13. Remove door frame with glass in position.
14. Remove tape and slide glass out of door frame.

Refit

15. Reverse removal procedure. When fitting door frame align to suit door opening. Then tighten door frame securing bolts.

WINDSCREEN GLASS

Service repair no - 76.81.01.

Remove and refit

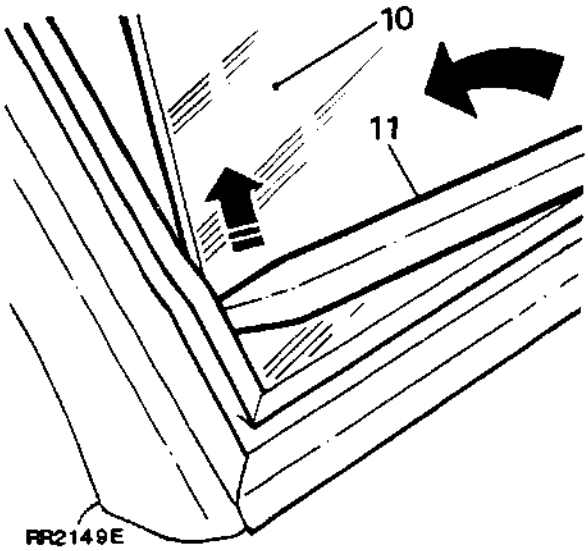
Remove

1. Remove windscreen wiper arms. ***See WIPERS AND WASHERS, Repair, Wiper arms - windscreen***
2. Remove expander strip from rubber moulding around glass.
3. Remove rubber moulding from windscreen opening.
4. Remove old sealant from around opening.
5. Clean windscreen opening and remove any broken glass.

Refit

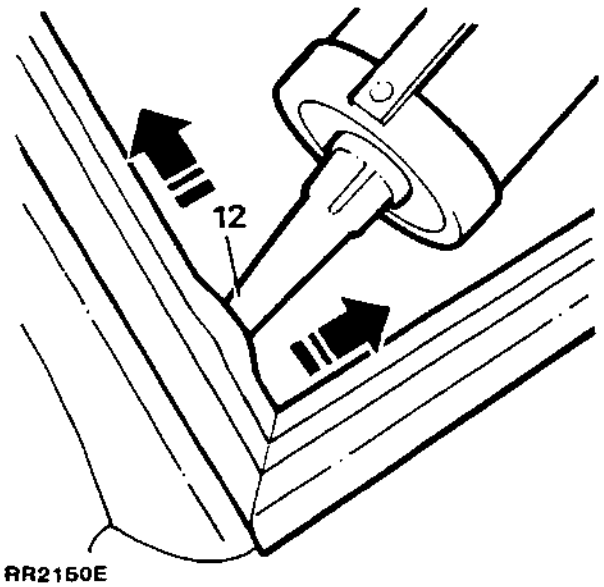
⚠ **CAUTION: To ensure bonding between windscreen and rubber DO NOT use petroleum based solvents or liquid soap to clean or aid assembly of windscreen to rubber.**

6. Apply Sikaflex 207 cleaner primer to windscreen and rubber to remove any oil based film.
7. Apply Sikaflex 221 or 255 adhesive sealant to exterior channel of new rubber moulding. Ensure sealant is applied to bottom of channel.
8. Fit rubber moulding to windscreen opening.
9. Ensure edge of 'A' post interior trim panels are fitted under lip of rubber moulding.
10. Fit windscreen into bottom corner of rubber moulding channel.
11. Work glass into bottom of windscreen rubber using a wedged blunt lever. Working up and around seal, at same time pushing screen onto rubber. Ease lip of seal over windscreen glass.



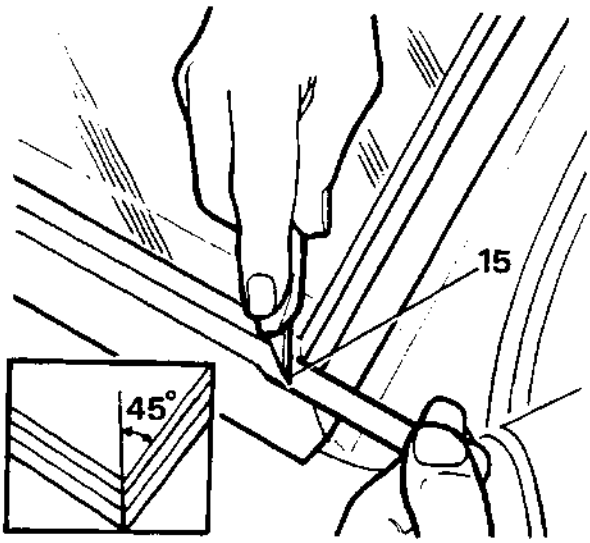
RR2149E

12. Apply Sikaflex 221 or 255 adhesive sealant between outer lip of moulding and exterior of windscreen. Ensure sealant is applied to bottom of channel.



RR2150E

13. To aid assembly of expander strip apply a small amount of soap solution to recieving channel. Contain soap solution to channel only.
14. Fit expander strip to channel, do not overstretch.
15. Trim excess expander strip at 45° with a sharp knife.



RR2151E

16. Remove surplus sealant from screen using Sikadur cleaner.
17. Ease bottom of moulding onto decker panel.
18. Ease bottom of moulding onto dashboard.
19. Refit wiper arms.
20. Reverse remaining removal instructions.

REAR QUARTER LIGHT GLASS

Service repair no - 76.81.25.

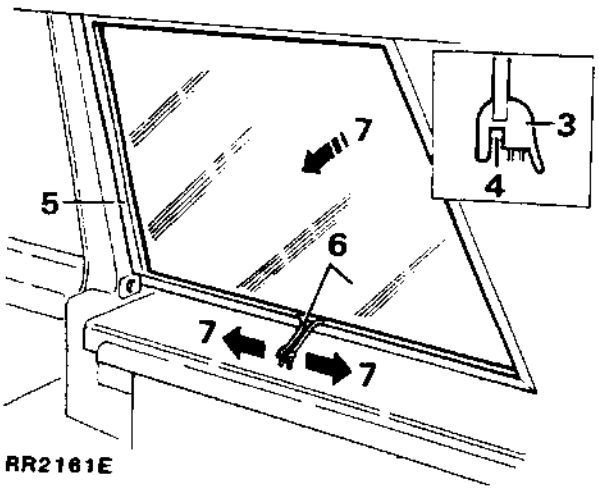
Remove and refit

Remove

1. Remove and discard moulding from flange around opening.
2. Clean area where moulding contacts body.

Refit

3. Fit new moulding to glass.
4. Fit a draw cord around moulding retaining channel.
5. Coat flange around opening with liquid soap to aid assembly.
6. Hold glass and moulding to opening. Site draw cords inside vehicle.
7. With assistance push glass and moulding into opening. Pull draw cords enabling seal to ride over flange.
8. Ensure interior trim fits under moulding.
9. Ensure moulding is settled and contacts body.



RR2161E

FRONT SEAT ELECTRICAL

Service repair no - 76.77.01.

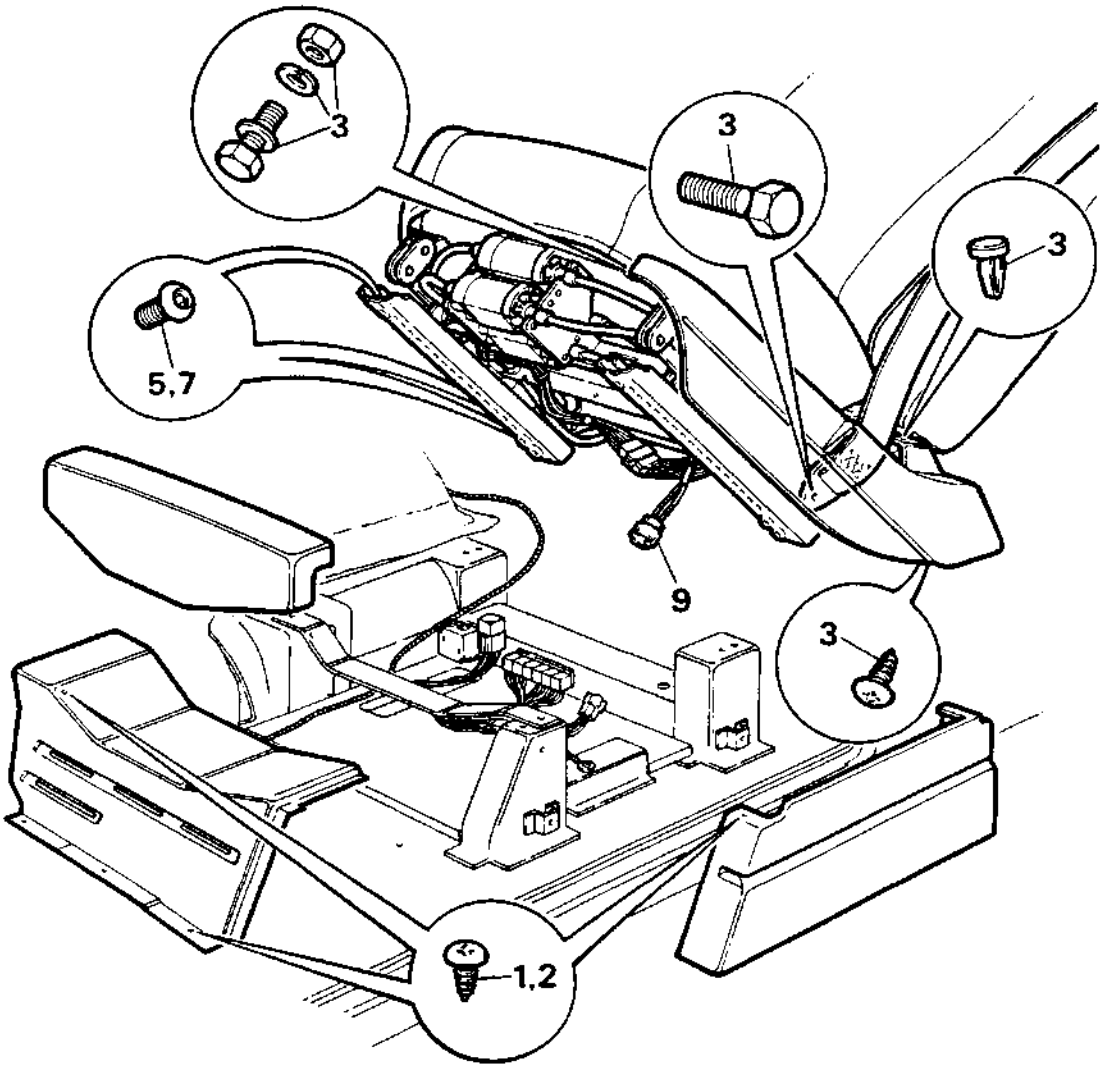
Remove and refit

Remove

1. Remove screw securing seat side trim panel and remove panel.
2. Remove three screws from seat front trim panel. Remove screw from top of trim panel to seat base, located below seat base cushion. Remove panel.
3. Remove three fixings securing cushion side trim panel. Remove panel. Remove bolt securing seat belt.
4. Move seat to rearward position. If seat will not move ***See ELECTRICAL, Repair, Electrical seat failure.***
5. Remove two screws at front of each slide channel.
6. Move seat to most forward position.
7. Remove four screws at rear of each slide channel.
8. Disconnect the battery negative lead.
9. Disconnect all electrical multiplugs to seat electrics.
10. Remove seat.

Refit

11. Reverse removal procedure. Arrange electrical leads so they can not become trapped by seat slide mechanism.



RR2152E

FRONT SEAT MANUAL

Service repair no - 76.70.01.

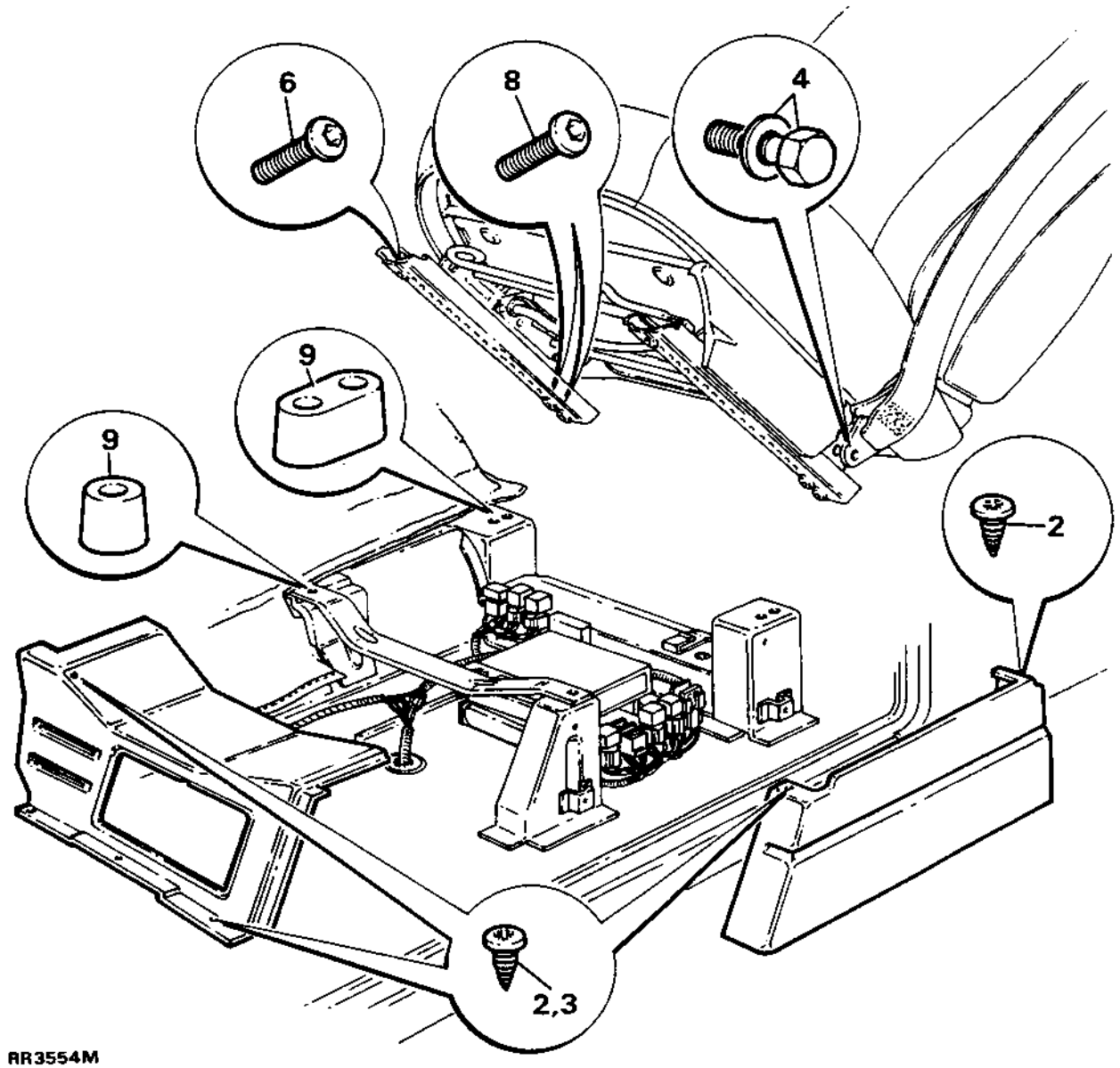
Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove two screws securing side panel and remove panel.
3. Remove three screws from front trim panel. Remove screw from top of trim panel to seat base. Remove panel.
4. Remove bolt and washer securing seat belt.
5. Move seat to rearward position.
6. Remove two screws at front of each slide channel.
7. Move seat to most forward position.
8. Remove four screws at rear of each slide channel.
9. Remove seat, retaining spacers between slide channel and seat base.

Refit

10. Reverse removal procedure.



RR3554M

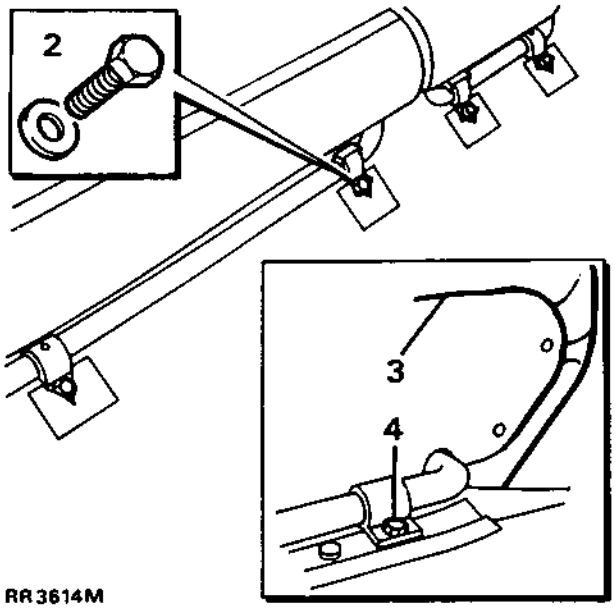
ASYMMETRIC SPLIT REAR SEAT

Service repair no - 76.70.38.

Remove and refit

Remove

1. Lift footwell carpet to access front hinge bolts.
2. Remove hinge bolts.
3. Fold seat fully forward.
4. Remove rear hinge bolts.



RR3614M

5. Remove seat from vehicle

Refit

6. Reverse the removal procedure. Ensure seat folds and latches smoothly.

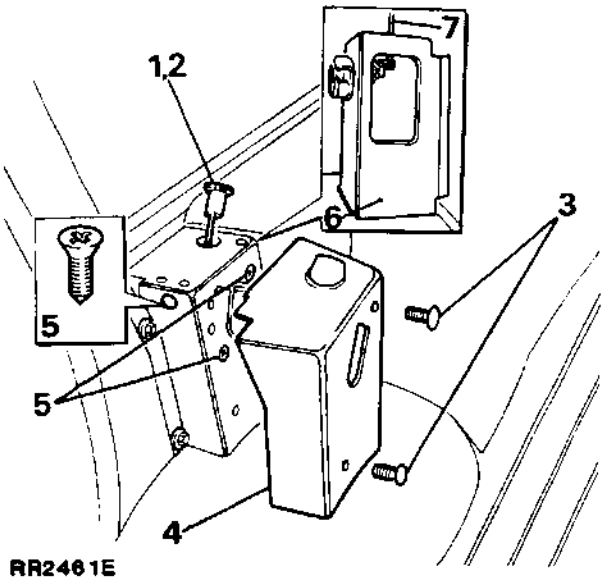
ASYMMETRIC SPLIT REAR SEAT - LOCKING MECHANISM

Service repair no - 76.70.51.

Remove and refit

Remove

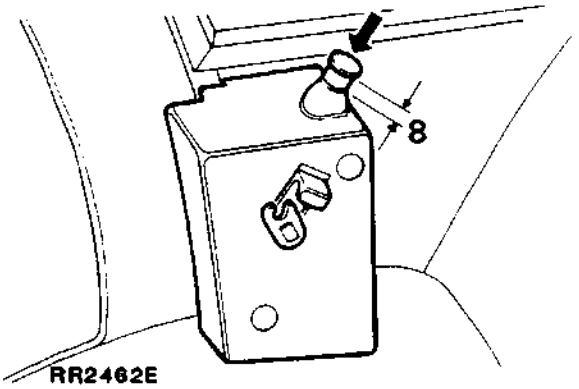
1. Depress release button and fold seat forward.
2. Unscrew and remove release button.
3. Remove two trim buttons securing trim cover.
4. Remove trim cover.
5. Remove three screws securing latch to tower. One screw is accessed through hole in tower.
6. Retrieve latch from opening rear of tower.
7. Remove operating rod by releasing plastic clip.



RR2461E

Refit

8. Reverse removal procedure. When release button is depressed there must be a gap from 5 to 8 mm between head of button and lip of trim cover.



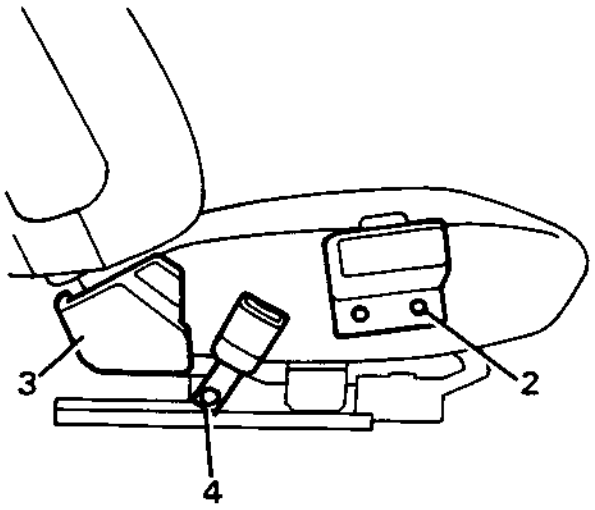
RR2462E

FRONT SEAT HEATED CUSHION AND SQUAB

Service repair no - 76.77.05. -76.77.14.

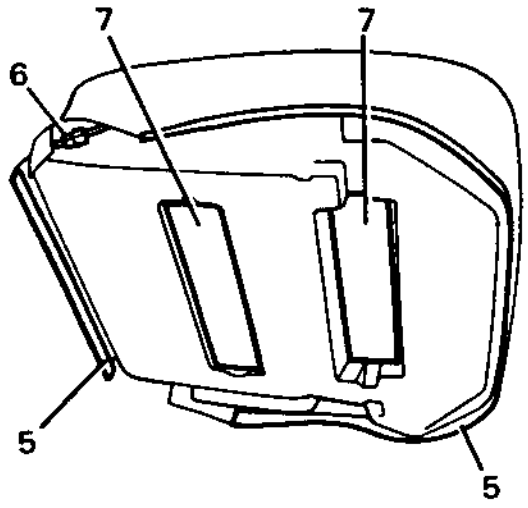
Remove heated cushion.

1. Remove front seat assembly. ***See Front seat electrical***



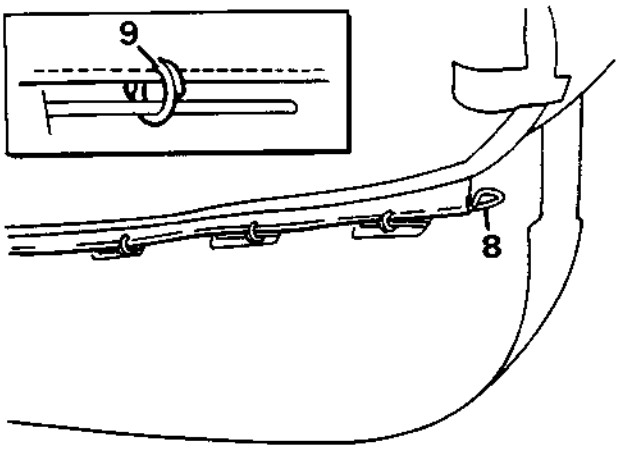
RR3645M

2. Remove two screws securing seat control adjustment unit.
3. Remove two screws securing corner trim.
4. Release seat belt buckle bracket.
5. Release trim from seat frame.



RR3646M

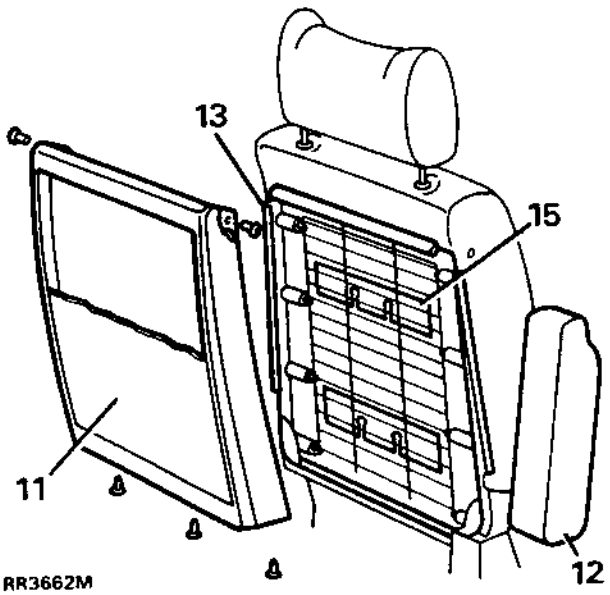
6. Disconnect heater wiring at multiplug to seat squab. Remove cushion and trim from seat frame.
7. Turn 90° two seat trim retention plates and push through slot in cushion foam.



RR3647M

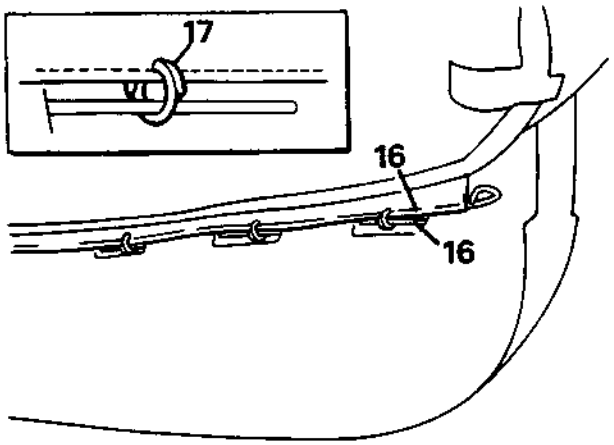
8. Fold seat trim over cushion to reveal stapled wire retention rods.
9. Pry open staples and release seat trim from seat cushion.

Continue for removal of heated squab.



RR3662M

10. Remove headrest.
11. Remove squab panel rear. Three screws at base. Peel back trim to remove screw from each top corner.
12. Remove armrest assembly.
13. Release trim from edge of seat frame.
14. Remove squab foam with trim from seat frame.
15. Turn 90° two trim retention plates and push through slot in foam.
16. Fold trim over squab foam to reveal two wire retention rods.



RR3663M

17. Pry open staples and release trim from squab cushion.

Refit

18. Reverse removal procedure.

SEAT BELTS

Introduction

Seat belt assemblies are factory fitted. If removal is necessary follow procedures in this section. All seat belt fixings **MUST** be tightened to correct torque values.

Seat belt assemblies **MUST** be replaced after they have been subjected to loading such as in a collision.

A lamp warning is incorporated to alert user. The warning lamp will illuminate for eight seconds when ignition is switched on regardless of seat belt usage.

On American specification vehicles a audible warning will sound with an high and low note from four to eight seconds unless driver seat belt is fitted.

A lap belt is provided for occupant of the centre rear seat.

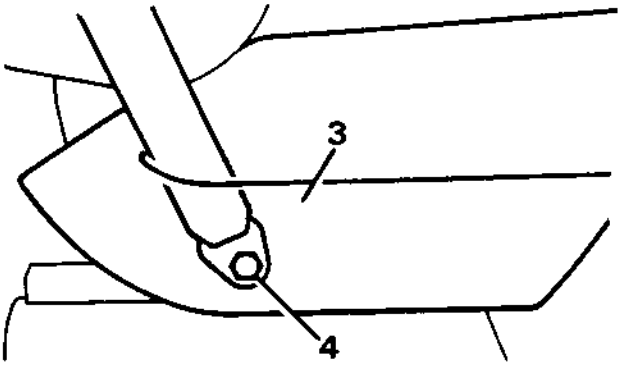
FRONT SEAT BELT

Service repair no - 76.73.10.

Remove and refit

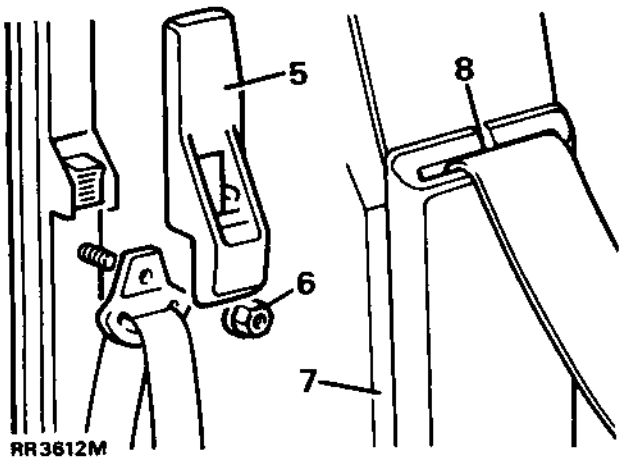
Remove

1. Move seat to access belt mountings.
2. Disconnect the battery negative lead.
3. Remove seat side trim panel. ***See Front Seat Electrical See Front Seat Manual***



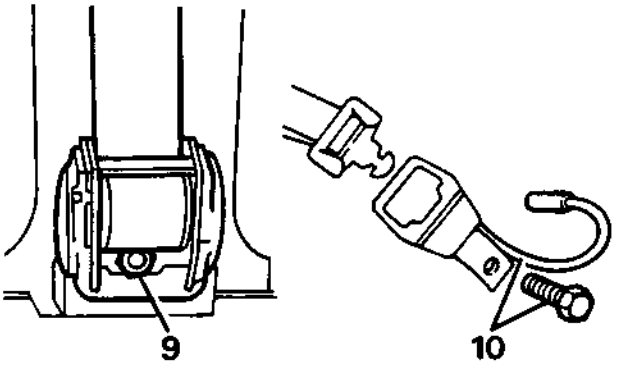
RR3611M

4. Remove bolt, plain washer and spacer from belt to seat base.
5. Remove moulding from adjustable seat belt mounting.
6. Remove nut and spacer securing seat belt to 'B'post.



RR3612M

7. Pull door deal away to remove lower 'B' post trim.
8. Remove seat belt through slot in lower 'B' post trim.



RR3613M

9. Remove bolt and spring washer from inertia reel assembly to 'B' post.
10. Disconnect electrical plug and remove bolt securing buckle to seat base.

Refit

11. Reverse removal procedure. Ensure belts are not twisted. Tighten bolts to ***20 Nm.***

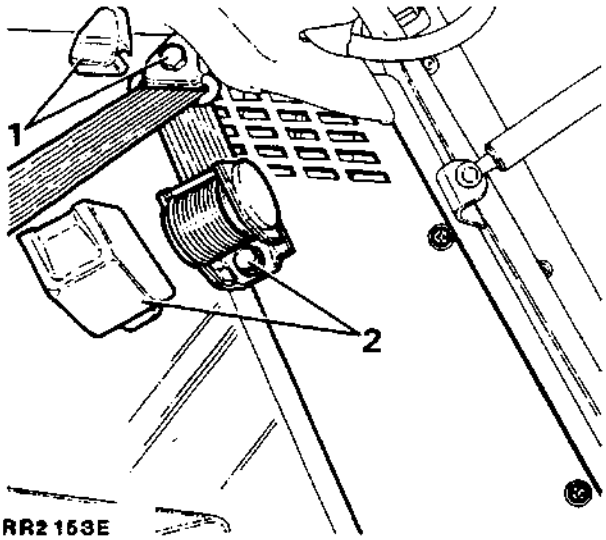
REAR SEAT BELT

Service repair no - 76.73.18.

Remove and refit

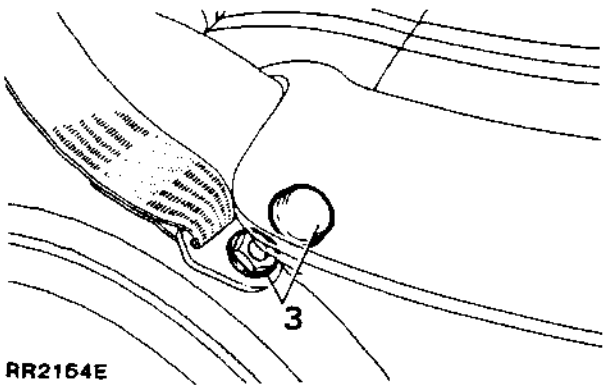
Remove

1. Remove plastic cover from upper guide bracket. Remove bolt, spacer, plain and wavy washer.
2. Unclip cover from inertia reel assembly. Remove bolt, spring washer. Place reel to one side.



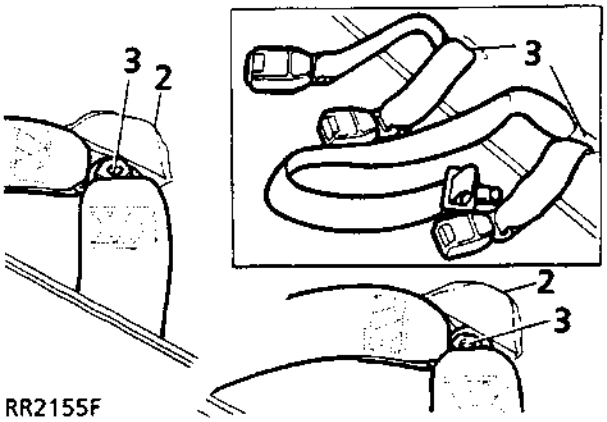
RR2153E

3. Remove plastic cover and bolt securing belt assembly to wheel arch.



RR2154E

4. Remove belt assembly.



RR2155F

5. Remove bolt and plain washer securing belt bracket to load space floor.
6. Centre lap strap only: Remove bolts securing lap strap and buckle assembly and withdraw both components.

Refit

7. Reverse removal procedure. Ensure belts are not twisted. Tighten bolts to ***20 Nm.***

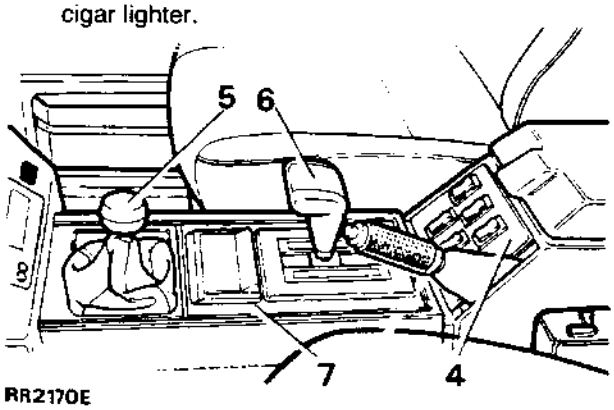
GLOVE BOX AND FLOOR MOUNTED CONSOLE ASSEMBLY

Service repair no - 76.52.03.

Remove and refit

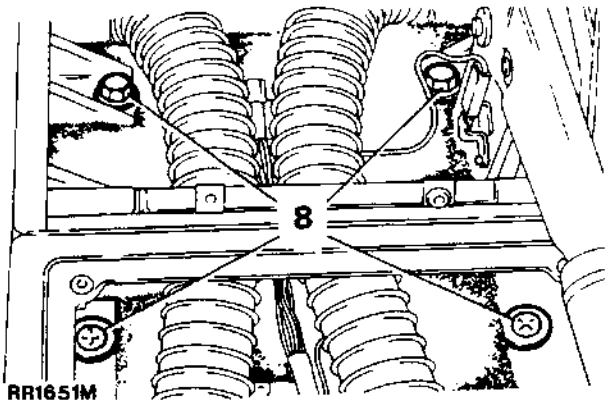
Remove

1. Disconnect the battery negative lead.
2. Remove screws securing glove box liner and withdraw liner.
3. Disconnect electrical leads to rear passenger cigar lighter.



RR2170E

4. Remove switch panel. ***See ELECTRICAL, Repair, Window lift switches***
5. Remove transfer gear knob.
6. Remove automatic gear selector knob. ***See ELECTRICAL, Repair, Automatic gear selector-Panel illumination***
7. Remove illumination panel gear selector.
8. Remove two bolts and two screws securing console to gearbox tunnel.



RR1651M

9. Move assembly rearwards to detach location tab at front of console from radio housing.
10. Move assembly over parking brake and gear levers. Remove from vehicle.

Refit

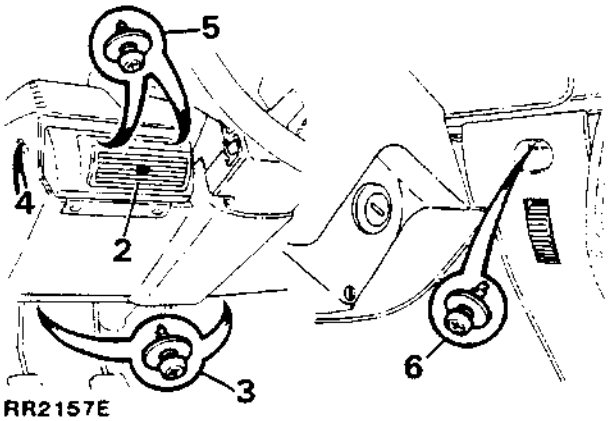
11. Reverse removal procedure. Ensure electrical plugs are fitted correctly and electrical wiring does not become trapped.

LOWER DASH PANEL

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pry louvre from dash.
3. Remove two screws from base of panel.
4. Remove screw from side of panel.
5. Remove two screws from top of louvre opening.
6. Remove screw above rheostat switch.



RR2157E

7. Lower dash panel and disconnect electrical plug from rheostat and detach bulb check unit from spring clip.
8. Remove panel from vehicle.

Refit

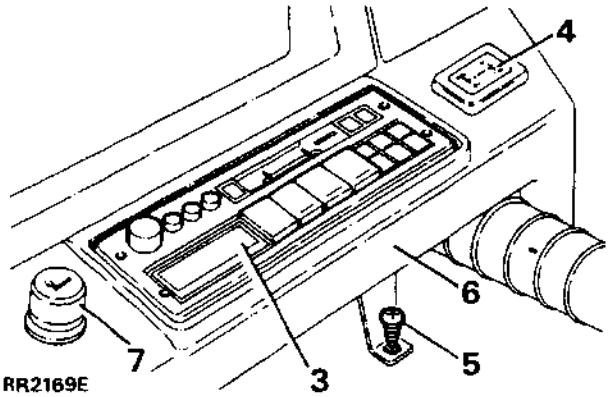
9. Reverse removal procedure.

RADIO HOUSING

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove console assembly. ***See Glove box and floor mounted console assembly***
3. Remove radio from housing. See Manufacturers instructions for removal and installation.



RR2169E

4. Where applicable remove switches and disconnect electrical leads.
5. Remove screw securing housing to tunnel.
6. Tilt front of housing upwards to access cigar lighter electrical leads.
7. Disconnect leads from cigar lighter and remove radio housing.

Refit

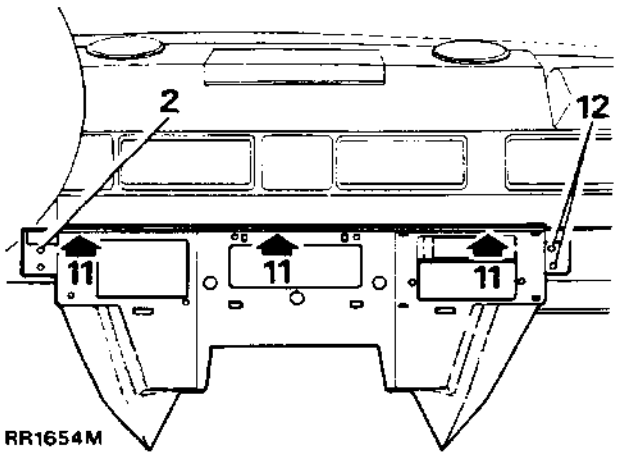
8. Reverse removal procedure.

CENTRE DASH PANEL

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel. ***See Lower dash panel***
3. Remove console assembly. ***See Glove box and floor mounted console assembly***
4. Remove radio housing. ***See Radio housing***
5. Remove fuse cover and remove three screws securing main and auxiliary fuse box.
6. Remove heater control knobs.
7. Remove screws securing heater graphics panel. Pull panel away from dash and remove bulbs from their locations.
8. Remove heater graphics panel.
9. Remove auxiliary switch panel.
10. Identify each multiplug to aid reassembly. Disconnect multiplugs from switches.



RR1654M

11. Remove three screws securing centre dash to louvre dash panel.
12. Remove two screws securing side of centre dash.
13. Remove centre dash panel.

Refit

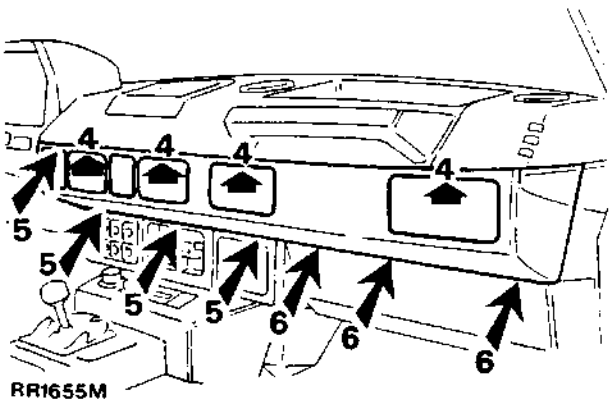
14. Reverse removal procedure. Ensure all electrical multiplugs are fitted and secure.

LOUVRE DASH PANEL

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pry clock out of dash, disconnect electrical leads. Remove bulb and holder.
3. Remove screw securing end of dash panel.
4. Pry four louvres out then remove eight screws securing louvre dash panel to dash.
5. Pry out mirror control switch. Disconnect electrical multiplugs and remove screw.
6. Remove three screws securing bottom of the panel. Remove remaining three screws above blower motor trim panel.



RR1655M

7. Remove louvre dash panel.

Refit

8. Reverse removal procedure.

DASHBOARD

Service repair no - 76.46.04.

Remove and refit

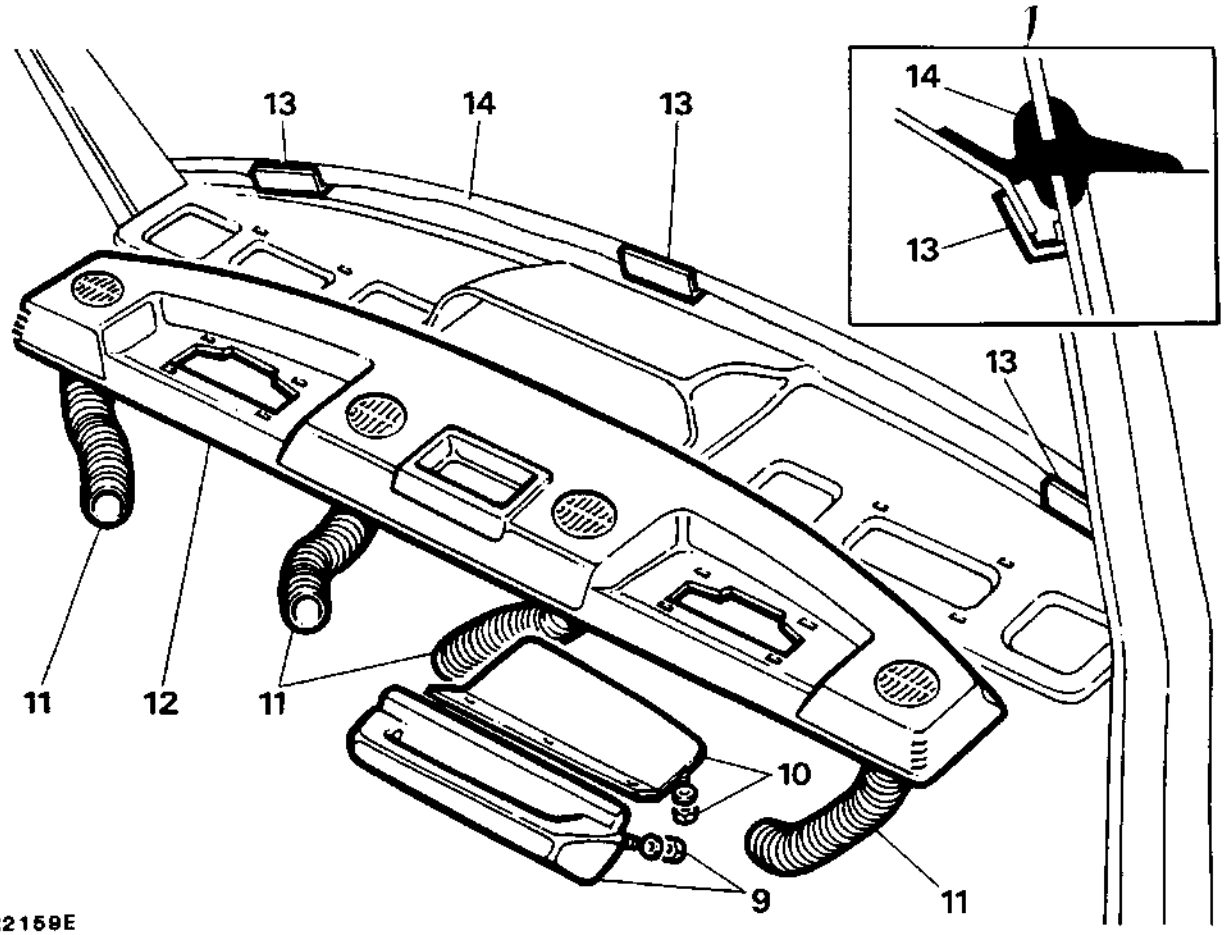
Remove

1. Disconnect the battery negative lead.
2. Remove the steering wheel. ***See STEERING, Repair, Steering wheel***
3. Remove lower dash panel. ***See Lower dash panel***
4. Remove instrument binnacle. ***See ELECTRICAL, Repair, Instrument binnacle***
5. Remove glove box console assembly. ***See Glove box and floor mounted console assembly***
6. Remove radio housing. ***See Radio housing***
7. Remove centre dash panel. ***See Centre dash panel***
8. Release evaporator case assembly if fitted. With hoses still attached lower assembly to footwell area. ***See AIR CONDITIONING, Repair, Evaporator assembly***
9. Remove three nuts securing passenger grab handle.
10. Remove five nuts with washers securing map tray.
11. Disconnect side and centre air vent hoses.
12. Remove dashboard.

Refit

CAUTION: When refitting avoid trapping of electrical wiring.

13. Reverse removal procedure. Ensure dashboard locates on three brackets.
14. Ease sealing rubber over dashboard.



RR2159E

FRONT SPOILER

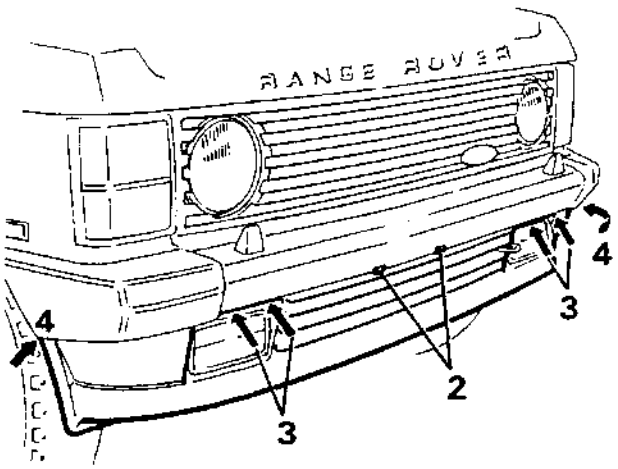
Service repair no - 76.10.46.

The spoiler will reduce the vehicle approach angle by approximately 10°. Where the vehicle is expected to perform on rough or hilly terrain, it is advisable to remove the spoiler to prevent any damage which may occur due to ground contact.

Remove and refit

Remove

1. Disconnect electrical connections from auxiliary driving lamps.
2. Remove two screws with spring washers securing centre of spoiler.
3. Remove four nuts with spring washers located behind front bumper above driving lamp pockets.
4. Remove two bolts, nuts and washers securing outer edges of spoiler to front wings.
5. Remove spoiler.

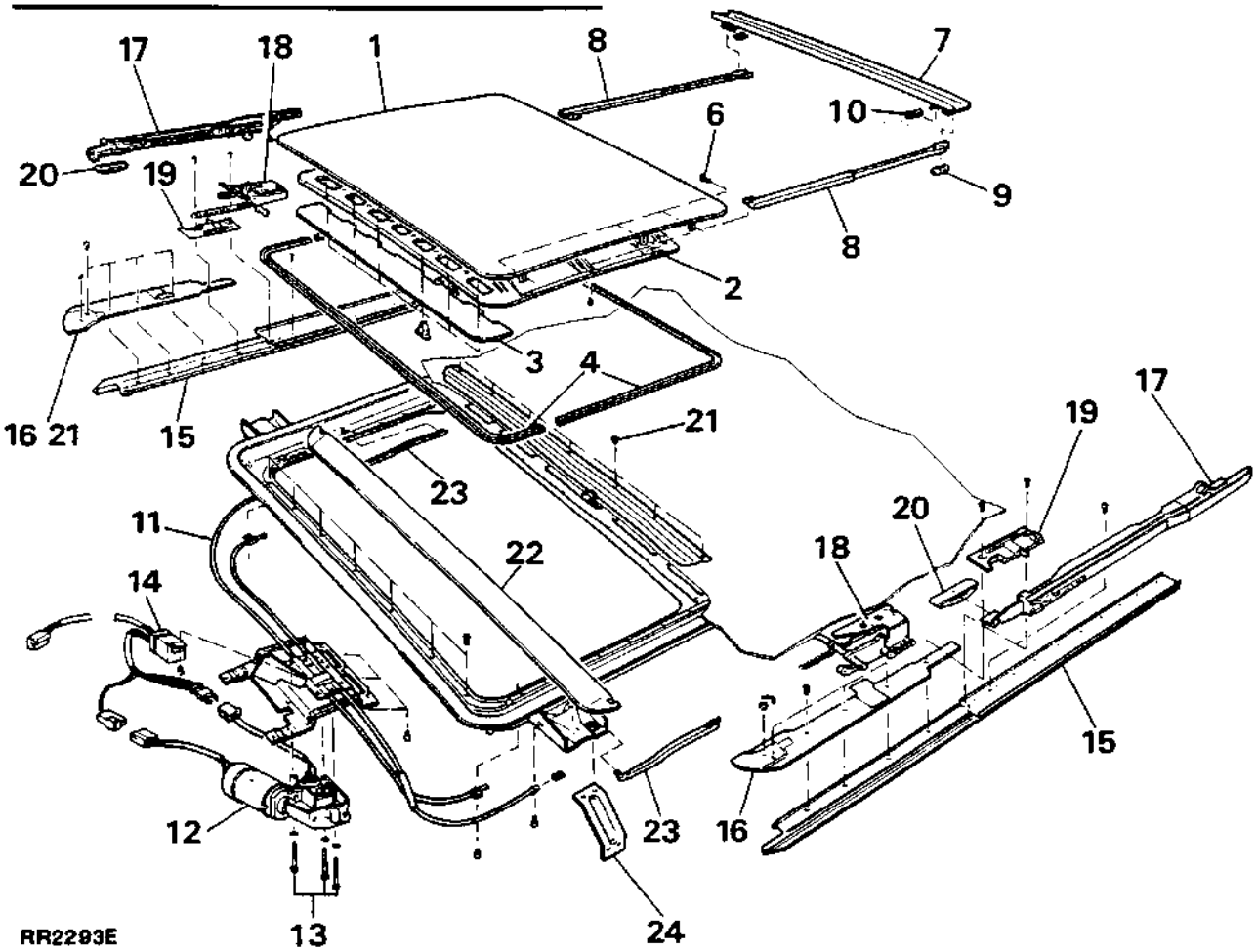


RR2160E

Refit

6. Reverse removal procedure.

METAL SUNROOF ASSEMBLY



KEY

1. Roof panel
2. Sunroof headliner
3. Insulation pad
4. Roof seals (front and rear)
5. Sunroof headliner retaining clips (quantity - 6)
6. Roof panel retaining screws (quantity - 6)
7. Water channel
8. Water channel connectors
9. Support bracket-water channel
10. Slide shoe-water channel
11. Motor bracket/guide tube assembly
12. Operating motor
13. Motor retaining screws
14. Relay
15. Lower guide rails
16. Front guide rails
17. Slide mechanism
18. Rear guide
19. Pivot bracket
20. Slide shoe
21. Rear edge trim finisher
22. Wind deflector assembly
23. Wind deflector operating arms
24. Support bracket (quantity - 6)

OPERATION

Sunroof operation is a tilt and slide action controlled by a rocker switch adjacent to roof lamp, with ignition switched **'ON'.**

1. Depress front of switch to lift rear edge of sunroof into **'Tilt'** position.
2. Depress rear edge of switch to close roof.
3. Depress rear of switch to slide sunroof into **'Open'** position.
4. Depress front of switch to slide sunroof into **'Close'** position.

△ **NOTE: The electric drive cuts out automatically in closed, tilt and open positions. If switch is operated in wrong direction in one of these positions, press switch once to reset and again to operate.**

EMERGENCY OPERATION

If the sunroof fails to operate, check fuse. To close carry out following procedure.

1. Lower interior lamp mounting panel by releasing two turnbuckles.
2. Remove emergency handle from vehicle tool kit.
3. Engage handle in motor drive spindle and turn to close roof.

MAINTENANCE

At each service, water test drain tubes to ensure they are not blocked or kinked. Blow air up rear drain tubes which are clipped to rear mud flap supports. Blow down front drain tubes which run down 'A' post and out of engine bay.
Annually: Clean sunroof opening thoroughly.

△ **NOTE: When vehicle is operated in extremely dusty conditions more frequent cleaning is recommended.**

OPERATING MOTOR, MICRO-SWITCH AND RELAY

Remove and refit

△ **NOTE: The motor drive spindle retaining nut is set to correct torque value. If roof fails to operate check retaining nut torque. Tighten to *5 Nm.***

Remove

1. Ensure sunroof is closed. Disconnect the battery negative lead.
2. Remove interior lamp mounting panel to gain access to motor.
3. Disconnect two wiring connectors.
4. Remove three securing screws and withdraw motor.
5. Remove screw and withdraw relay.
6. Remove microswitch from motor by drilling out rivets, if required.

Refit

7. Secure new microswitch using nuts and bolts to replace rivets. Tighten nuts and apply a spot of paint to threads.
8. Ensure motor is in 'park' position, i.e. hole on driven gear aligned with drive spindle.
9. Reverse removal procedure.
10. Check operation of sunroof in all positions.

SUNROOF PANEL SEALS

Remove and refit

Remove

1. Position sunroof in tilt position and Disconnect the battery negative lead.
2. Unclip sunroof headliner from roof panel front and slide headliner back.
3. Remove three roof panel screws from each side and remove panel.
4. Remove both seals from roof panel.

Refit

5. Fit front seal to front edge of panel. Ensure there is an equal length of seal each side of centre point.
6. Butt rear seal against front seal fit tight around panel edge. Trim excess seal to produce a close joint with front seal.
7. Refit sunroof panel.

SUNROOF ASSEMBLY

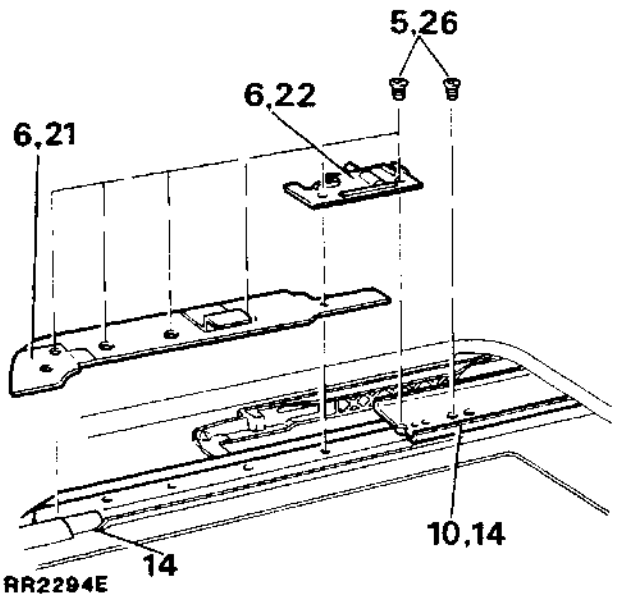
Remove and refit

Including roof panel. Slide mechanism. Wind deflector. Motor mounting bracket. Guide tubes.

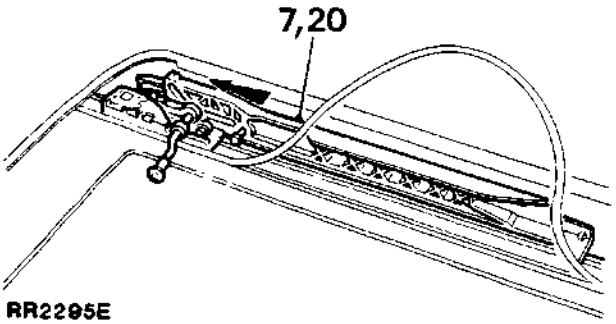
Remove

△ **NOTE: Remove vehicle headlining ONLY if removing motor mounting bracket and guide tubes.** ***See Headlining***

1. Partially open sunroof and unclip sunroof headliner from roof panel front. Slide sunroof headliner back.
2. Move sunroof to tilt position. Disconnect the battery negative lead.
3. Remove three roof panel screws from each side and remove panel.
4. Remove motor screws and withdraw motor.

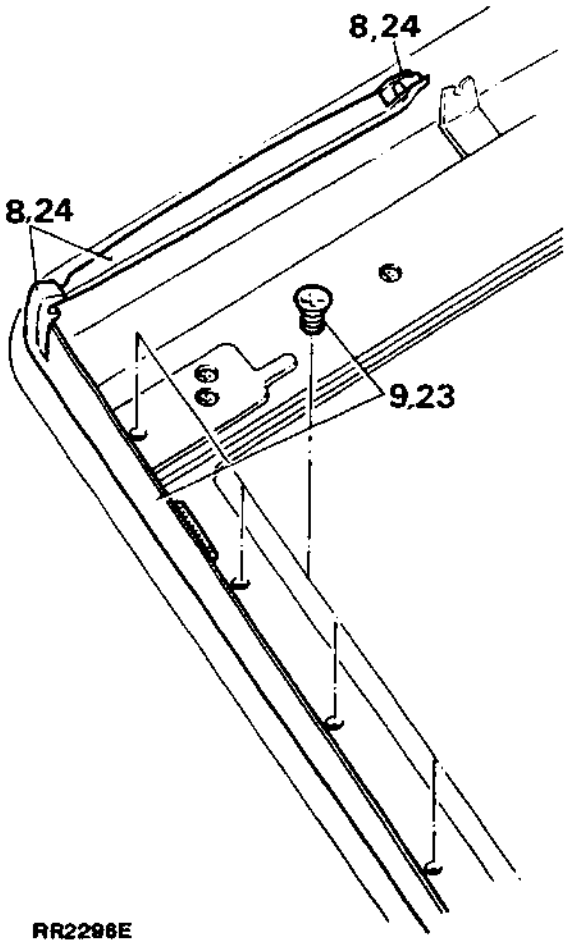


5. Remove guide rail screws, seven each side.
6. Remove pivot bracket and remove front guide rail .
7. Remove slide and tilt mechanism with flexible drive cable from both sides. Only disassemble if replacement parts are required.



RR2295E

8. Unclip both wind deflector operating arms from rear mounting brackets. Remove arms from deflector, if required.



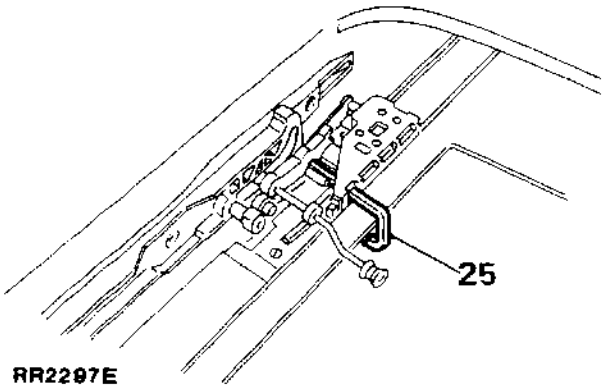
RR2296E

9. Remove seven screws, and withdraw wind deflector.
10. Remove lower guide rails and rear edge finisher, seven screws.
11. Remove screws from guide tubes, two each side. Remove five screws and withdraw motor mounting bracket.
12. Pull sunroof headliner assembly forward and remove.

Refit

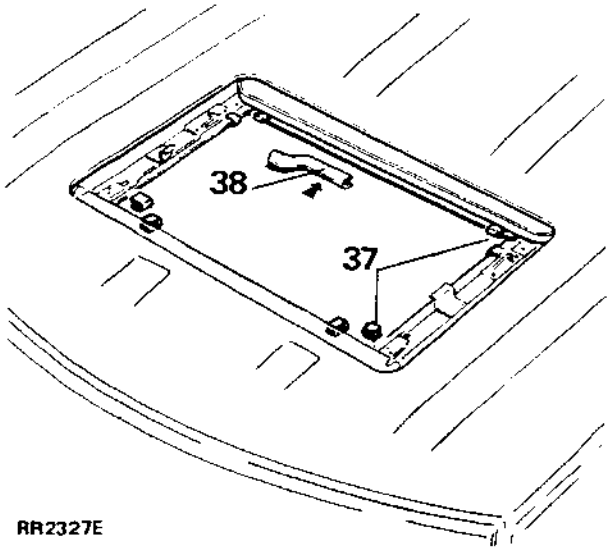
△ **NOTE: During assembly lightly lubricate all sliding parts using a silicon spray.**

13. Position motor bracket and guide tube assembly. Fit and tighten securing screws.
14. Position right guide rail in rear retaining bracket. Push rearwards fully and locate leading edge under drive cable opening. Repeat operation for left hand guide rail.
15. Align fixing holes, and loosely fit screw in seventh hole from front.
16. Position finisher to rear edge of sun roof opening and secure using seven screws.
17. Position sunroof headliner assembly into outer guide runners, and push fully rearwards.
18. Lubricate drive cables. Ensure slide and tilt mechanism is fully assembled.
19. Push cable fully into right side guide tube. Loop remaining cable and enter rear end into right inner side runner.
20. Repeat operation 19. for left side. Push both assemblies rearwards to take up slack in cables, and push a further 75 mm to rear.
21. Position both front guide rails, aligning with four forward holes. Fit screws, do not tighten.
22. Position both pivot brackets, loosely fit screws.
23. Fit wind deflector and tighten fixings.
24. Position right operating arm in locating slot in deflector. Secure opposite end in frame bracket. Repeat for left side.
25. Pull right slide and tilt mechanism forward, align with pivot bracket and secure in position using setting key. Repeat operation for left side.
26. Tighten screws to guide rails, seven each side.
27. Fit and secure relay.
28. Ensure operating motor is in park position i.e. hole on driven gear aligned with drive spindle. Fit and secure to mounting bracket.



RR2297E

29. Remove setting keys. Temporarily connect operating switch and electrics.
30. Operate switch to 'tilt' position.
31. Position roof panel into roof opening with six screws, do not tighten.
32. Move roof to 'closed' position and adjust roof profile. The panel profile should be 0.5 mm low at forward edge, 1 mm high at rear edge.
33. Tighten roof panel screws.
34. Tilt sunroof, pull sunroof headliner forward and locate rear brackets in tilt mechanism. Align front six clips and push to secure.
35. Check operation of sunroof.



RR2327E

36. Refit vehicle headlining. ***See Headlining***

SUNROOF HEADLINER ASSEMBLY

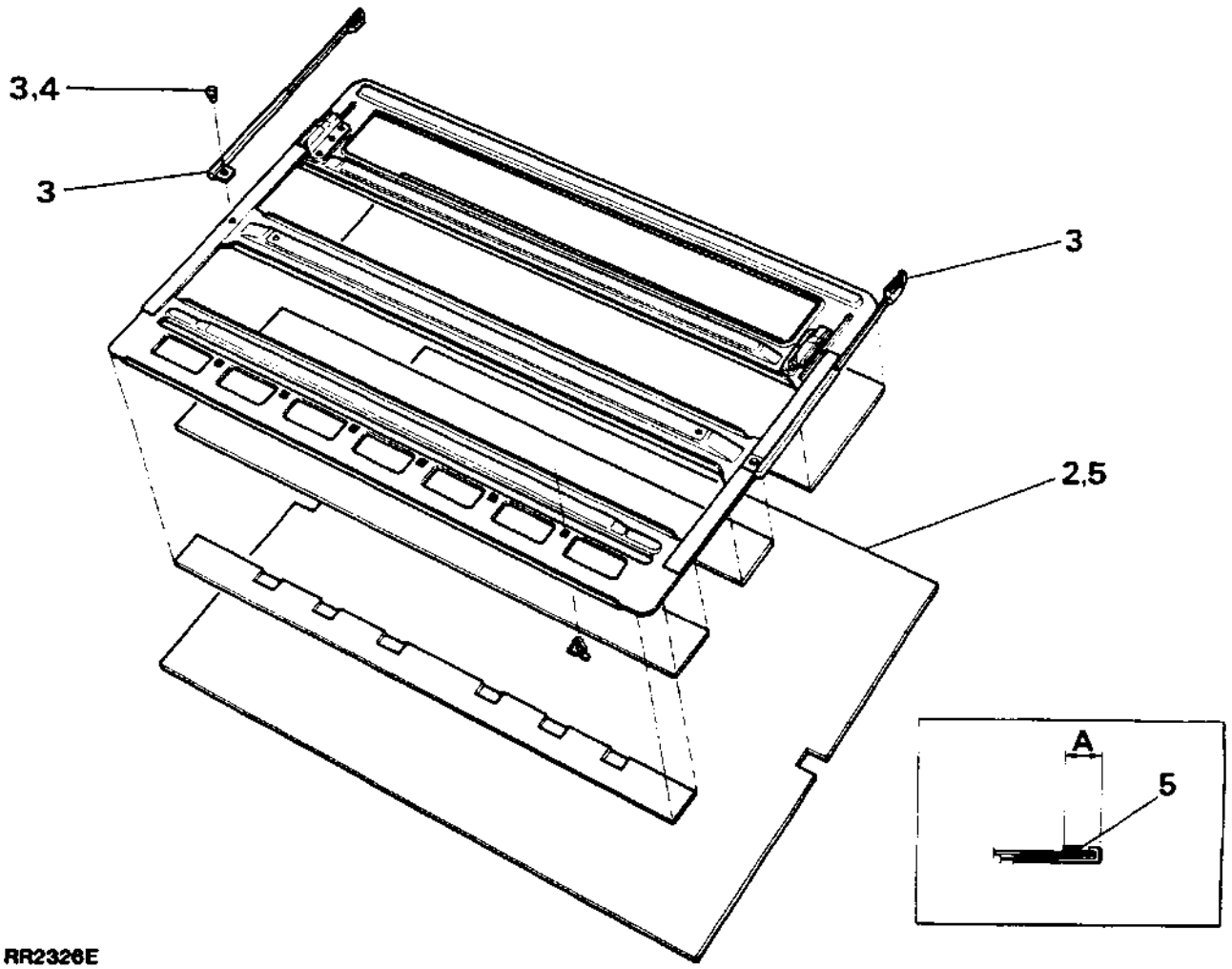
Remove, retrim and refit

Remove and retrim

1. Remove sunroof headliner assembly. ***See Sunroof Assembly***
2. Remove trim covering from frame assembly. It is not necessary to remove three pads and insulation pad shown.
3. If required: remove water channel by unclipping connecting arms. Drill out rivets securing connecting arms to frame.
4. Secure connecting arms to frame using suitable rivets before retrimming frame.
5. Trim frame using a new headliner cover. Inset shows section through frame indicating where adhesive is applied. Dimension 'A' should be radially constant.

Refit

6. Refit sunroof headliner assembly and reassemble sunroof.



RR2326E

GLASS SUNROOF 1991 MODEL YEAR

Operation

The sunroof operates in a tilt and slide action controlled by a rocker switch near the interior lamp.

A drive motor and control unit is located behind the switch and interior lamp panel. The control units function is to stop the drive motor at the full tilt and slide positions.

Removal and refit of sunroof assemblies shown can be carried out without removing complete sunroof assembly.

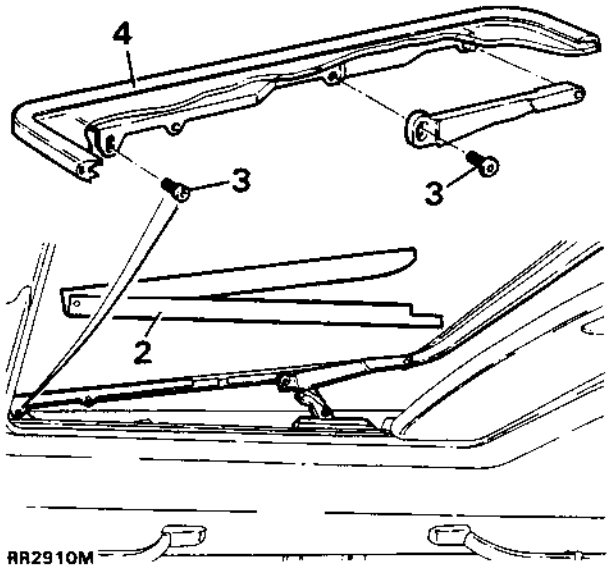
GLASS PANEL ASSEMBLY

Service repair no - 76.82.64.

Remove, refit and adjust

Remove

1. Open sunroof to tilt position.
2. Remove mechanism covers. Slide rearwards to disengage from location and lift out.
3. Remove two screws from each side as shown.
4. Remove glass sunroof.



Refit and adjust

1. Fit glass sunroof.
2. Fit four screws but do not tighten.
3. Close sunroof
4. Check height of sunroof panel against roof aperture. The trimmed edge of glass sunroof to stand **1mm** above roof aperture.
5. Adjust by moving sunroof panel up or down. Tighten screws.
6. Fit mechanism covers.
7. Check sunroof operates correctly.

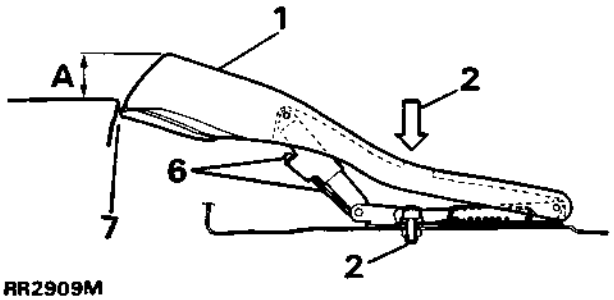
WIND DEFLECTOR ASSEMBLY

Service repair no - 76. 82. 31.

Remove, refit and adjust

Remove

1. Open sunroof.
2. Remove two screws accessed through slot in deflector.
3. Remove wind deflector.



RR2909M

Refit

4. Fit wind deflector assembly
5. Fit two screws firmly but do not tighten.

Adjust

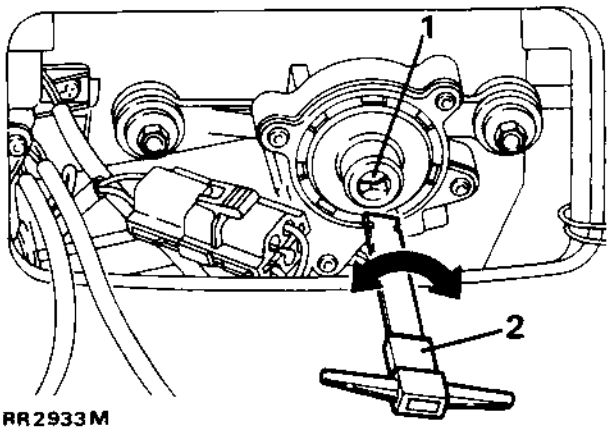
Adjustment and attachment of deflector is by same two screws.

6. Adjust wind deflector rearwards or forwards into position shown. At same time adjust height 'A' to **15-20 mm** by moving slotted metal strip rearwards or forwards. Tighten two screws.
7. Ensure deflector does not catch front edge of roof aperture when operated.
8. Fully check that sunroof operates correctly.

MANUAL OPERATION

If sunroof fails to operate it can be opened or closed manually with key provided.

1. Remove two turnbuckles to access sunroof motor spindle located behind switch plate.
2. Engage key into motor spindle and turn to open or close sunroof panel.
3. After manual operation motor spindle MUST BE TURNED BACK A QUARTER TURN TO ENGAGE ELECTRICAL DRIVE MOTOR.



RR2933M

MOTOR DRIVE ASSEMBLY AND CONTROL UNIT

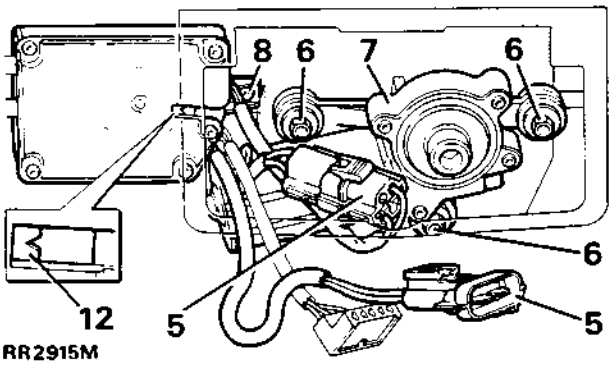
Service repair no - 76.82.72. -76.82.73.

Remove and refit

NOTE: The following servicing of sunroof assembly can be carried out without removing complete sunroof assembly.

Remove

1. Close sunroof. Disconnect the battery negative lead.
2. Release two turnbuckles to access motor drive assembly and control unit, located behind switchplate.
3. Remove switchplate and disconnect two multiplugs.
4. Release front of roof headlining to access motor drive assembly and control unit.
5. Disconnect two multiplugs from control unit to motor drive and to main harness.



RR2915M

6. Remove three screws securing motor drive assembly.
7. Remove motor drive assembly.
8. To remove control unit undo screw. Lower then move control box inwards to release from mounting.
9. Inspect motor drive assembly and control unit for wear and damage, renew as necessary.

Refit

10. Refit motor drive assembly ensuring metal insert is fitted.

CAUTION: The motor drive assembly gear will not mesh correctly with drive cables if metal insert is NOT refitted.

11. Refit control unit.
12. Check timing of the control unit to sunroof:

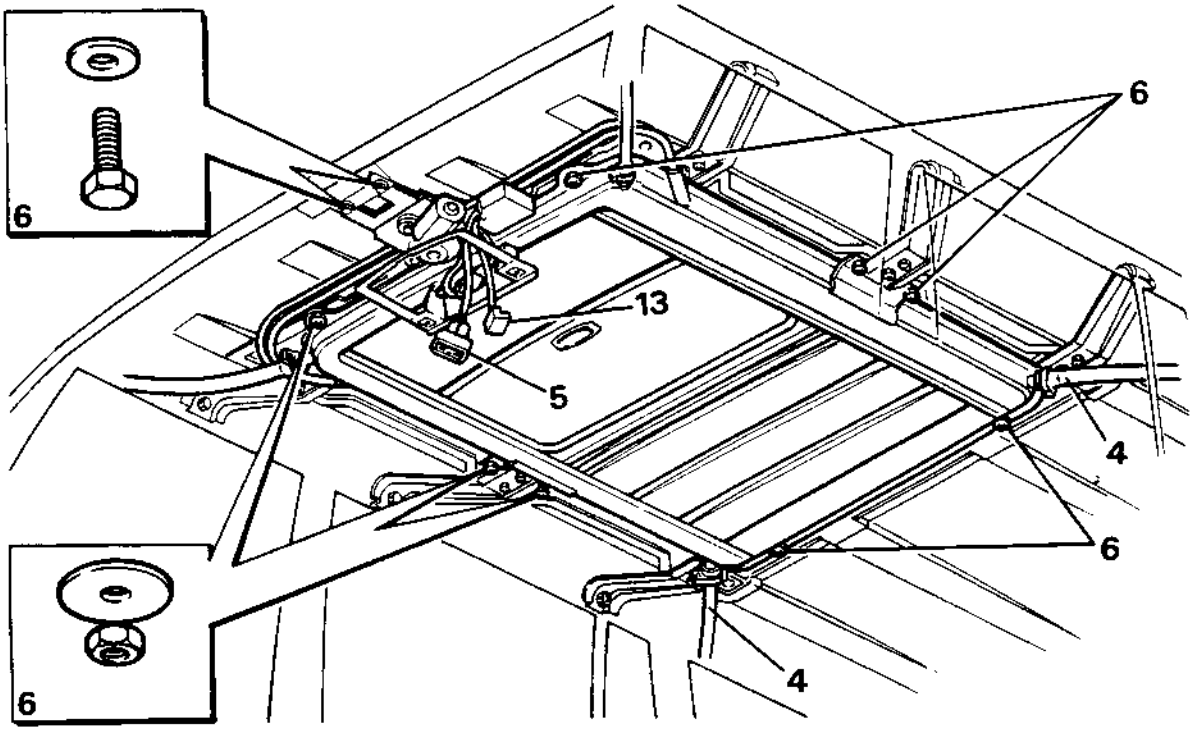
A 'V' shaped notch should be visible through slot in control unit when sunroof is fully closed.

13. Reverse the removal instructions 2 to 5.
14. Check sunroof operates correctly.

GLASS SUNROOF COMPLETE ASSEMBLY

Service repair no - 76. 82.59.

Remove and refit



RR2914M

Remove

1. Open sunroof rearwards. Disconnect the battery negative lead.
2. Remove switchplate and disconnect two multiplugs from switch and courtesy light.
3. Remove headlining. ***See Headlining***
4. Remove four clips and disconnect drain tubes.
5. Disconnect multiplug from control unit to main harness.
6. With assistance remove eight nuts and washers and two bolts. Lower sunroof assembly remove through rear of vehicle.

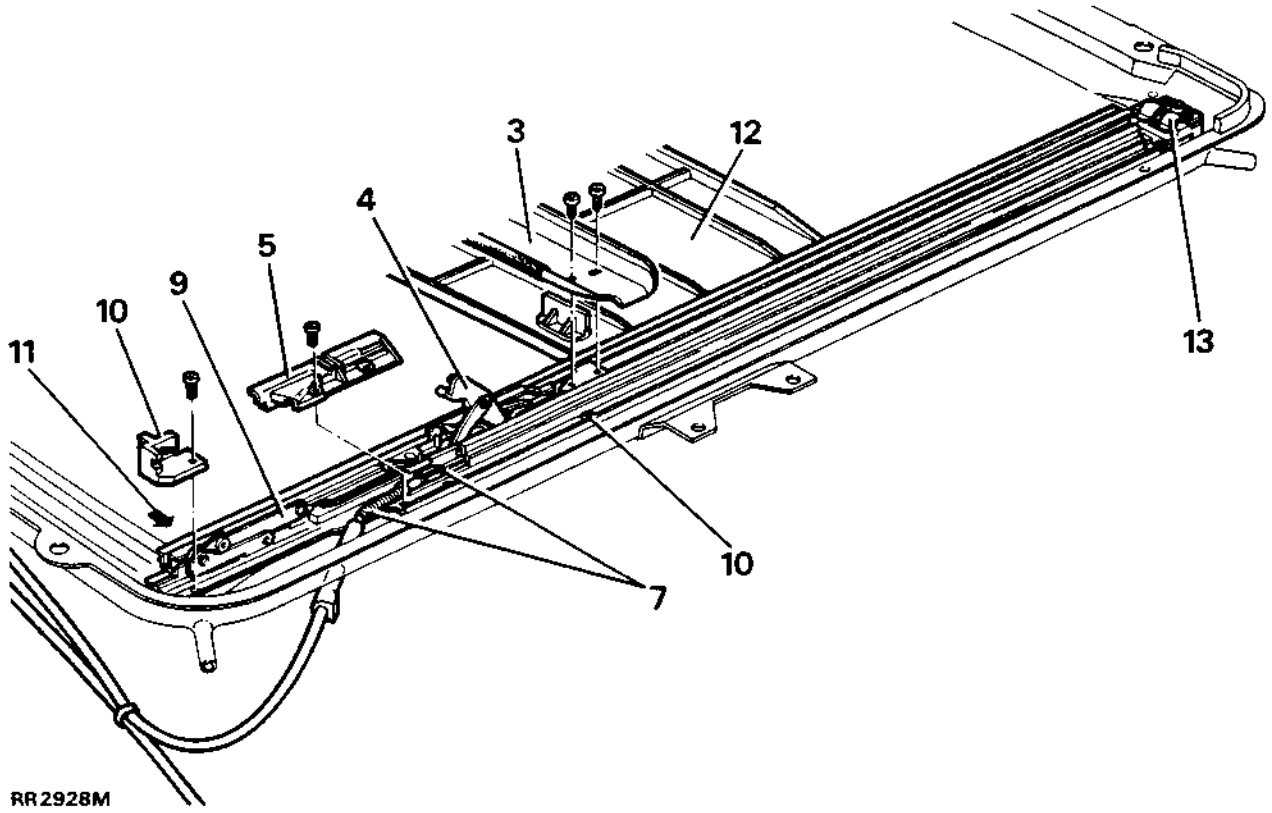
Refit

7. Manually close sunroof. ***See Manual operation***
8. Lift complete sunroof assembly to roof panel.
9. Fit loosely eight retaining nuts and washers and two bolts.
10. Ensure closed sunroof fits equally positioned in roof panel aperture. Tighten retaining nuts and bolts, recheck fit.
11. Connect electrical multiplugs to main harness and sunroof switch.
12. Check sunroof operates correctly and leave in open position.
13. Disconnect sunroof switch
14. Fit drain tubes with retaining clips.Water test to ensure watertight seal.
15. Fit headlining and sunroof trim.
16. Reconnect electrical multiplugs to sunroof switch and interior light then fit switchplate.
17. Close sunroof and draw sunshade.

SLIDE AND GUIDE CHANNEL ASSEMBLIES OR SUNSHADE PANEL

Service repair no - 76. 82.71. -76.82.03.

Remove and refit



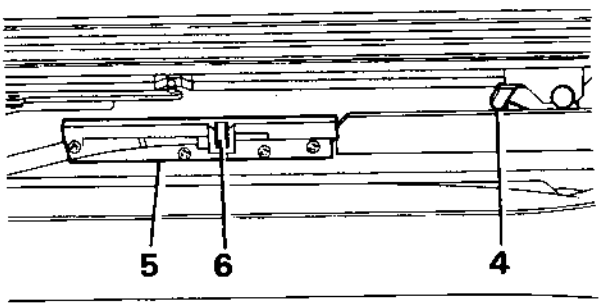
RR2928M

NOTE: The following can be carried out without removing complete sunroof assembly.

The sunshade panel is removed by releasing, either left or right slide and guide channel assembly, instructions 1. to 12.

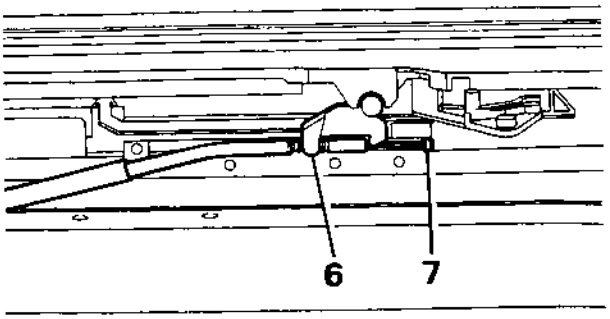
Remove

1. Remove glass panel assembly. ***See Glass panel assembly.***
2. Remove sunroof wind deflector assembly. ***See Wind deflector assembly.***
3. Remove rear crossmember drain channel.
4. Move tilt slide rearwards until location cam is clear of locator block.
5. Remove locator block.



RR2929M

6. Move tilt slide forwards until location cam has reached position it normally locates into locator block. Manually adjust the cam outwards to allow tilt slide to pass and attain full tilt position.



RR2930M

7. The drive cable end is now accessible. Disconnect drive cable from slide assembly.
8. Push tilt slide rearwards reversing instruction 6.
9. Push complete slide assembly rearwards approximately 2".
10. Remove front end stop and attaching screw from centre of guide channel.
11. Push guide channel assembly out sideways to release guide channel from roof panel.
12. Slide sunshade panel forward and lift out of runner to remove.

Continue for removal of slide and guide channel assembly.

13. Using a flashlight directed between roof panel and sunroof assembly. Observe for reassembly guide channel rear spring fixing point.
14. Pull guide channel forward to release from rear spring fixing point. Remove guide channel asembly

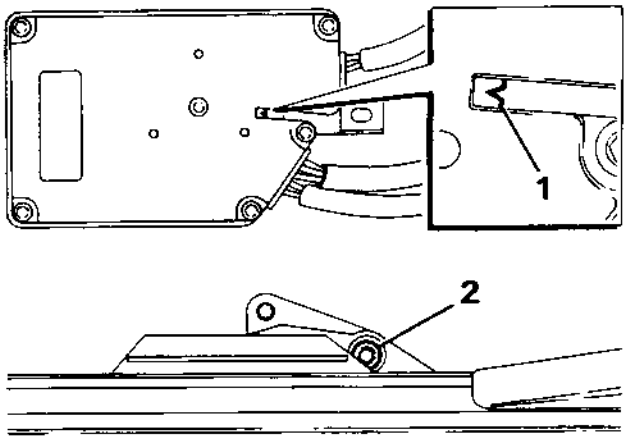
Refit

15. Reverse removal procedure.
16. Check sunroof operates correctly.

TIMING OF CONTROL UNIT TO SUNROOF OPERATION

The timing of control unit to sunroof operation will be disturbed:-
If sunroof position is altered when control unit is removed.
Or control unit is removed and control unit gear is moved.

1. To check timing of control unit to sunroof. A 'V' shaped notch should be visible through slot in control unit when sunroof is in fully closed position.



RR2927M

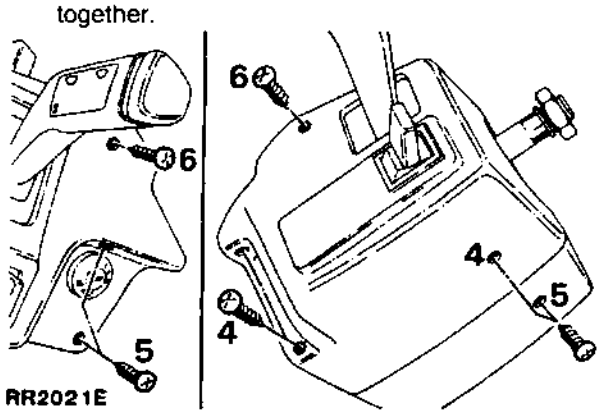
2. To check control unit timing when glass panel is removed. A 'V' shaped notch should be visible through slot in control unit when sunroof tilt mechanism rivet is at a tangent to angle on guide channel. Viewed from inside vehicle.

STEERING COLUMN SHROUD

Remove and refit
Unless removal of both sides of shroud is required, remove ONLY one side.

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel.
3. Disconnect electrical multiplugs to master lighting switch or rear screen wash wipe switch.
4. Left hand shroud-remove three screws and remove shroud over indicator switch arm.
5. Right hand shroud-remove three screws and remove shroud over windscreen wipe switch arm.
6. Remove screw securing two halves of shroud together.



RR2021E

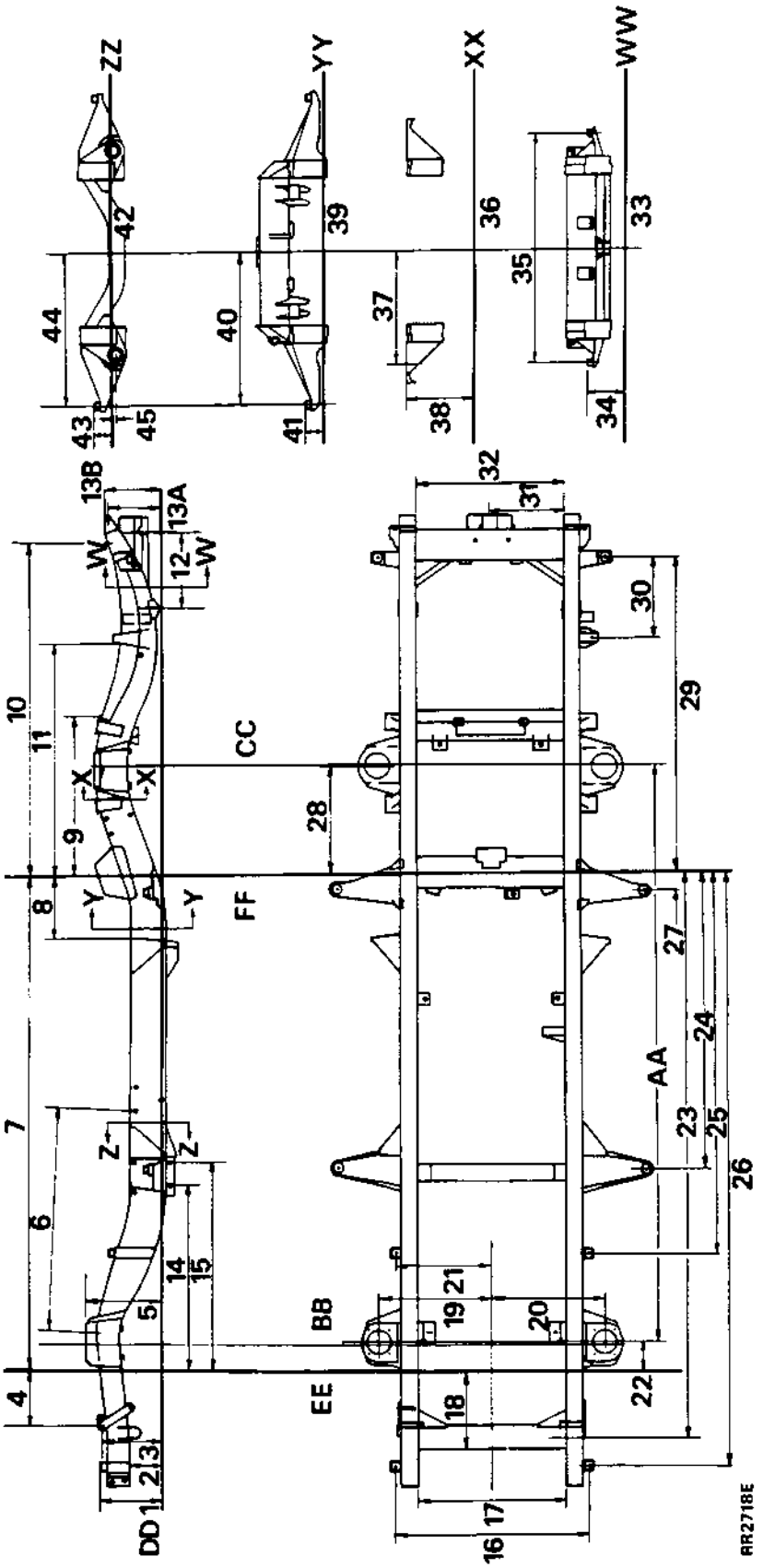
Refit

7. If both halves of shroud are removed ensure plate on steering column locates slot in shroud.
8. Reverse removal procedure.

CHASSIS AMERICA ONLY - 1990 ONWARDS

Alignment check - RR2718E

	Diagram reference	millimeters
AA	Wheelbase reference dimension	2540,00
BB	Centre line of front axle	
CC	Centre line of rear axle	
DD	Frame datum line	
EE	Side member datum line	
FF	Datum line	
1		264,525 ± 1,27
2	Frame datum to underside of cross-member	150,80
3		266,70 ± 2,54
4		237,74 ± 1,27
5		327,81 ± 2,54
6		979,94
7		2179,73 ± 2,54
8		291,74 ± 2,54
9		707,96 ± 2,54
10		1468,49 ± 2,54
11		1025,27 ± 2,54
12		338,84 ± 2,54
13A		222,25 ± 2,54
13B		252,984 ± 2,54
14	Reference dimension	824,92
15	To face of boss (both sides)	35,43 ± 2,54
16		838,2 ± 0,38
17	Check figure	630,94 ± 1,27
18		344,17 ± 1,27
19		485,77 ± 2,54
20		485,77 ± 2,54
21		828,68 ± 0,38
22		129,03 ± 2,54
23		2479,45 ± 0,25
24		1290,34 ± 0,38
25		1657,04 ± 0,38
26		2598,44 ± 0,38
27		79,09 ± 0,38
28		465,48 ± 2,54
29		1398,88 ± 0,38
30		368,30 ± 2,54
31	Reference dimension	317,50
32	Reference dimension	635,00


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RR2718E

CHASSIS - RR2718E

Diagram reference		millimeters
SECTION W - W		
33	Frame datum line DD	
34		155,91 ± 1,27
35		990,6 ± 0,38
SECTION X - X		
36	Frame datum line DD	
37		488,95 ± 2,54
38		295,27 ± 2,54
SECTION Y - Y		
39	Frame datum line DD	
40		660,40 ± 0,25
41		80,39 ± 1,27
SECTION Z - Z		
42	Frame datum line DD	
43		80,39 ± 1,27
44		660,40 ± 0,25
45		9,53 ± 2,54

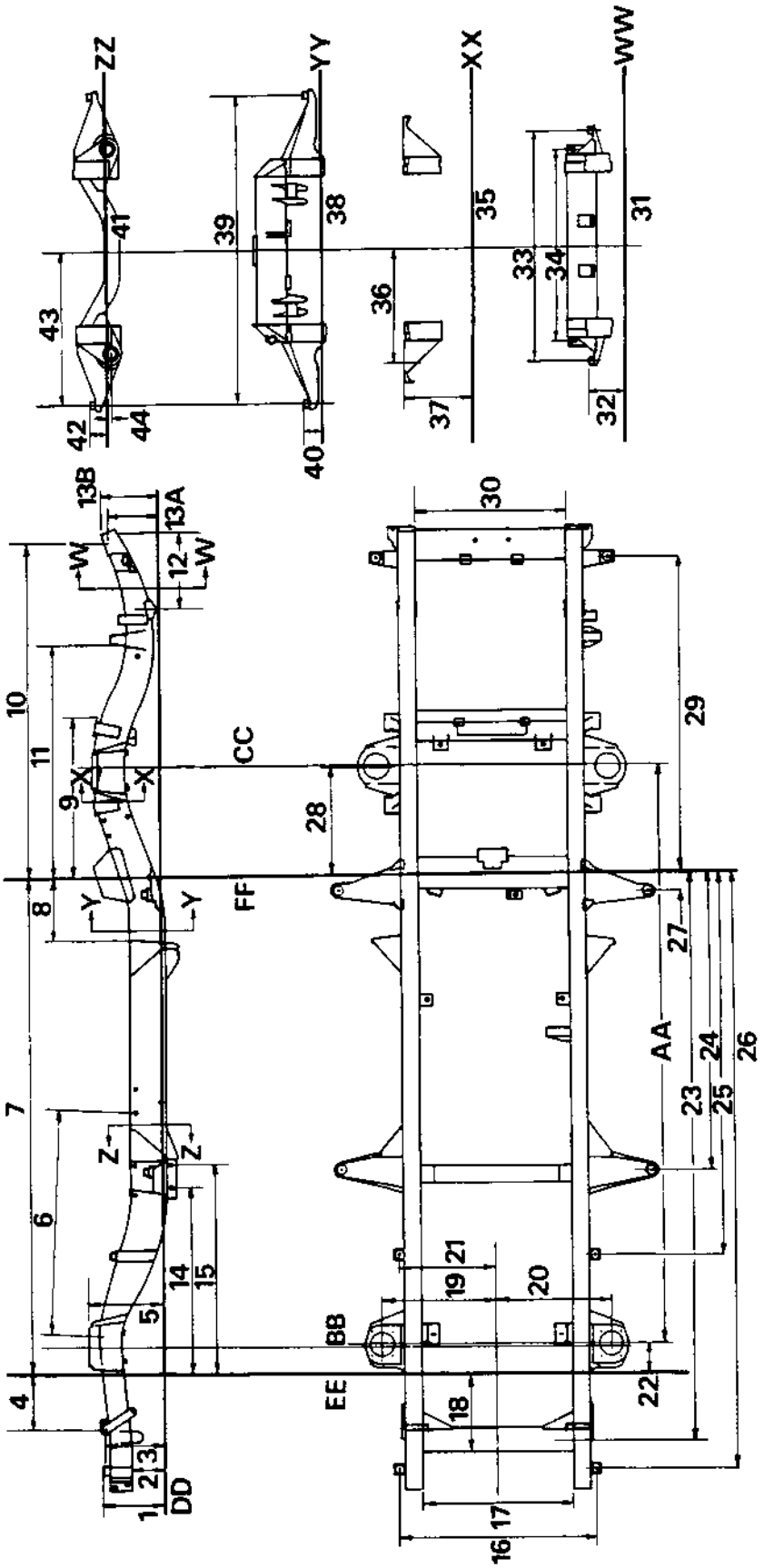
CHASSIS NON AMERICAN - 1990 ONWARDS

Alignment check - RR2751M

	Diagram reference	millimeters
AA	Wheelbase reference dimension	2540,00
BB	Centre line of front axle	
CC	Centre line of rear axle	
DD	Frame datum line	
EE	Side member datum line	
FF	Datum line	
1		264,525 ± 1,27
2	Frame datum to underside of cross-member	150,80
3		266,70 ± 2,54
4		237,74 ± 1,27
5		327,81 ± 2,54
6		979,94
7		2179,73 ± 2,54
8		291,74 ± 2,54
9		707,96 ± 2,54
10		1468,49 ± 2,54
11		1025,27 ± 2,54
12		338,84 ± 2,54
13A		222,25 ± 2,54
13B		252,984 ± 2,54
14	Reference dimension	824,92
15	To face of boss (both sides)	935,43 ± 2,54
16		838,2 ± 0,38
17	Check figure	630,94 ± 1,27
18		344,17 ± 1,27
19		485,77 ± 2,54
20		485,77 ± 2,54
21		828,68 ± 0,38
22		129,03 ± 2,54
23		2479,45 ± 0,25
24		1290,34 ± 0,38
25		1657,04 ± 0,38
26		2598,44 ± 0,38
27		79,09 ± 0,38
28		465,48 ± 2,54
29		1398,88 ± 0,38
30	Reference dimension	635,00

CHASSIS - RR2751M

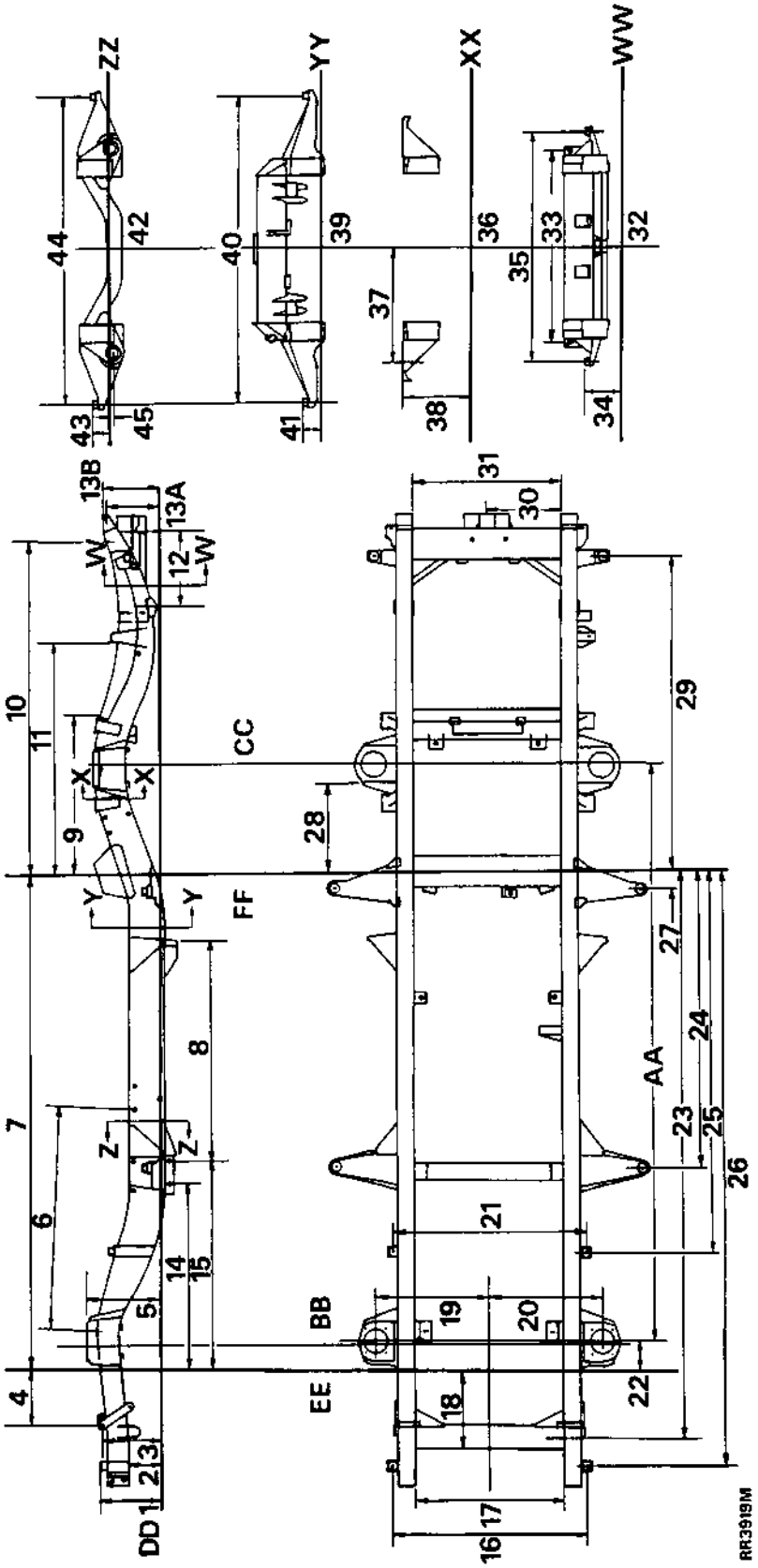
Diagram reference		millimeters
SECTION W - W		
31	Frame datum line DD	
32		155,91 ± 1,27
33		990,6 ± 0,38
34		825,5 ± 2,54
SECTION X - X		
35	Frame datum line DD	
36		488,95 ± 2,54
37		295,27 ± 2,54
SECTION Y - Y		
38	Frame datum line DD	
39		660,40 ± 0,25
40		80,39 ± 1,27
SECTION Z - Z		
41	Frame datum line DD	
42		80,39 ± 1,27
43		660,40 ± 0,25
44		9,53 ± 2,54


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RR2751M

CHASSIS - AMERICAN COUNTY LWB (108") MODELS

Alignment check - RR3919M

	Diagram reference	millimeters
AA	Wheelbase - Reference dimension	2743,20
BB	Centre line of front axle	
CC	Centre line of rear axle	
DD	Frame datum line	
EE	Sidemember datum holes	
FF	Datum line	
1		264,16 ± 1,27
2	Frame datum to underside of crossmember	150,80
3		266,70 ± 2,54
4		237,74 ± 1,00
5		337,34 ± 1,00
6		974,57 ± 1,00
7		2382,93 ± 2,54
8		1155,75 ± 1,00
9		707,96 ± 2,54
10		1468,49 ± 2,54
11		1025,27 ± 2,54
12		338,84 ± 2,54
13A		240,03 ± 2,54
13B		252,98 ± 2,54
14	Reference dimension	824,92
15	To face of boss (both sides)	935,43 ± 1,00
16		838,20 ± 0,50
17	Check figure	630,94 ± 1,27
18		344,17 ± 1,27
19		485,77 ± 2,54
20		485,77 ± 2,54
21		828,65 ± 0,50
22		129,03 ± 2,54
23		2682,65 ± 0,25
24		1493,54 ± 0,75
25		1860,24 ± 0,75
26		2801,64 ± 0,75
27		79,09 ± 0,75
28		390,88 ± 2,54
29		1398,88 ± 0,75
30	Reference dimension	317,50
31	Reference dimension	635,00


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RR3919M

CHASSIS - RR3919M

Diagram reference		millimeters
SECTION W - W		
32	Frame datum line DD	
33		825,50 ± 2,54
34		155,91 ± 1,27
35		990,60 ± 0,50
SECTION X - X		
36	Frame datum line DD	
37		488,95 ± 2,54
38		309,83 ± 1,00
SECTION Y - Y		
39	Frame datum line DD	
40		1320,80 ± 0,50
41		80,39 ± 1,27
SECTION Z - Z		
42	Frame datum line DD	
43		80,39 ± 1,27
44		1320,8 ± 0,50
45		9,53 ± 2,54

CHASSIS - LSE (108") AIR SUSPENSION MODELS

Alignment check - RR3918M

	Diagram reference	millimeters
AA	Wheelbase - Reference dimension	2743,20
BB	Centre line of front axle	
CC	Centre line of rear axle	
DD	Frame datum line	
EE	Sidemember datum holes	
FF	Datum line	
1		264,16 ± 1,27
2	Frame datum to underside of crossmember	150,80
3		266,70 ± 2,54
4		237,74 ± 1,00
5		337,34 ± 1,00
6		974,57 ± 1,00
7		2382,93 ± 2,54
8		1155,75 ± 1,00
9		707,96 ± 2,54
10		1468,49 ± 2,54
11		1025,27 ± 2,54
12		338,84 ± 2,54
13A		222,25 ± 2,54
13B		240,03 ± 2,54
14	Reference dimension	824,92
15	To face of boss (both sides)	935,43 ± 1,00
16		838,20 ± 0,50
17		630,94 ± 1,27
18		344,17 ± 1,27
19		485,77 ± 2,54
20		485,77 ± 2,54
21		828,65 ± 0,50
22		129,03 ± 2,54
23		2682,65 ± 0,25
24		1493,54 ± 0,75
25		1860,24 ± 0,75
26		2801,64 ± 0,75
27		79,09 ± 0,75
28		390,88 ± 2,54
29		1398,88 ± 0,75
30	Reference dimension	635,00

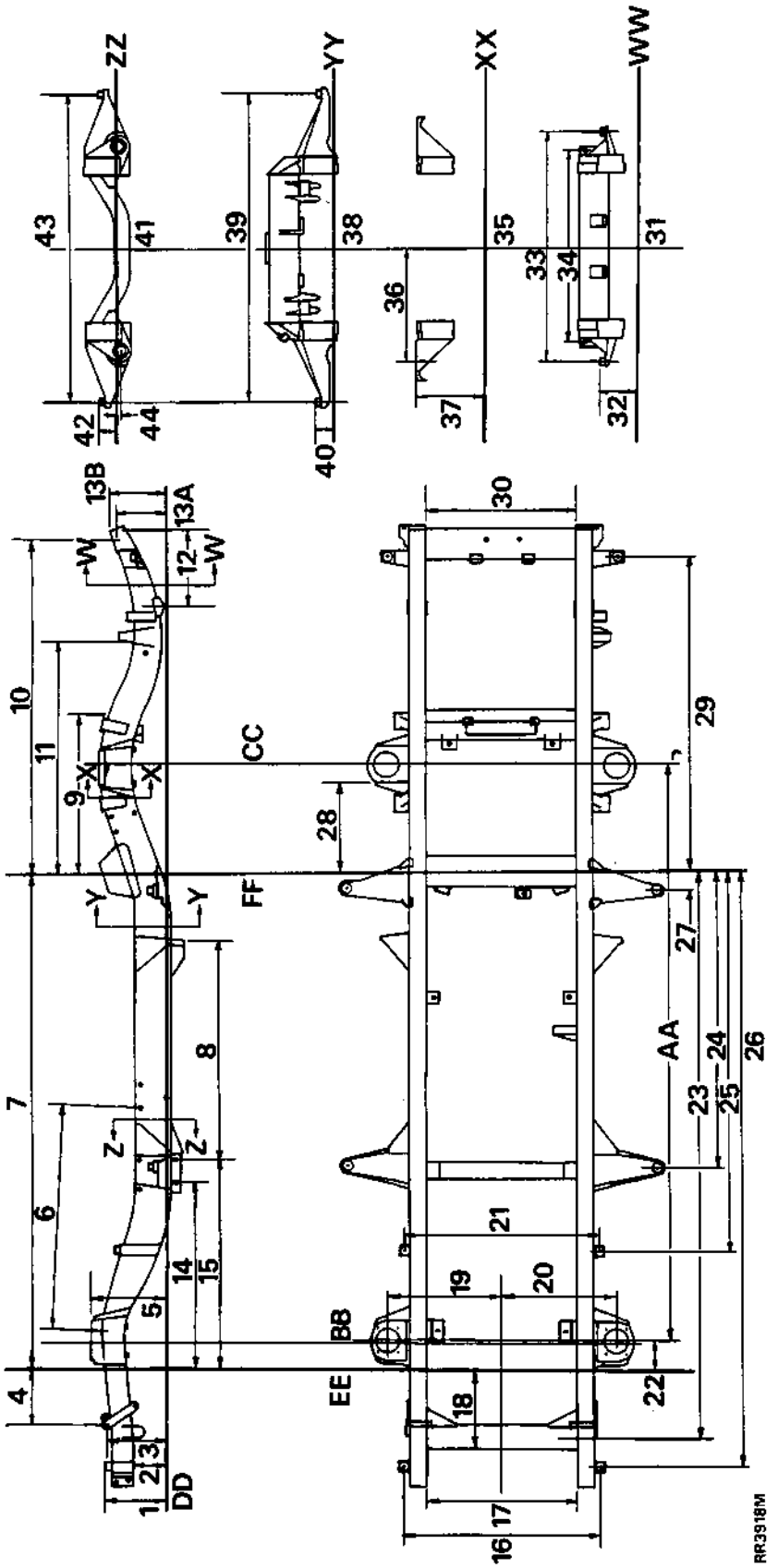

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RR3918M

Diagram reference		millimeters
SECTION W - W		
31	Frame datum line DD	
32	.....	155,91 ± 1,27
33	.....	990,6 ± 0,50
34	.....	825,5 ± 2,54
SECTION X - X		
35	Frame datum line DD	
36	.....	488,95 ± 2,54
37	.....	309,83 ± 1,00
SECTION Y - Y		
38	Frame datum line DD	
39	.....	1320,8 ± 0,50
40	.....	80,39 ± 1,27
SECTION Z - Z		
41	Frame datum line DD	
42	.....	80,39 ± 1,27
43	.....	660,4 ± 0,25
44	.....	9,53 ± 2,54

Notes

80 - HEATING AND VENTILATION

CONTENTS

Page

DESCRIPTION AND OPERATION

HEATING AND VENTILATION UNIT 1
AIR CONDITIONING SYSTEM (WHERE APPLICABLE) 4

FAULT DIAGNOSIS

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REPAIR

HEATER ASSEMBLY 1
RECIRCULATING/FRESH AIR SOLENOID SWITCH AND VACUUM UNIT 2
HEATER AND AIR CONDITIONING CONTROLS 2
HEATER FAN MOTOR, ROTOR AND RESISTANCE UNIT 3
VACUUM RESERVOIR 5
HEATER CORE 6

SPECIFICATIONS, TORQUE

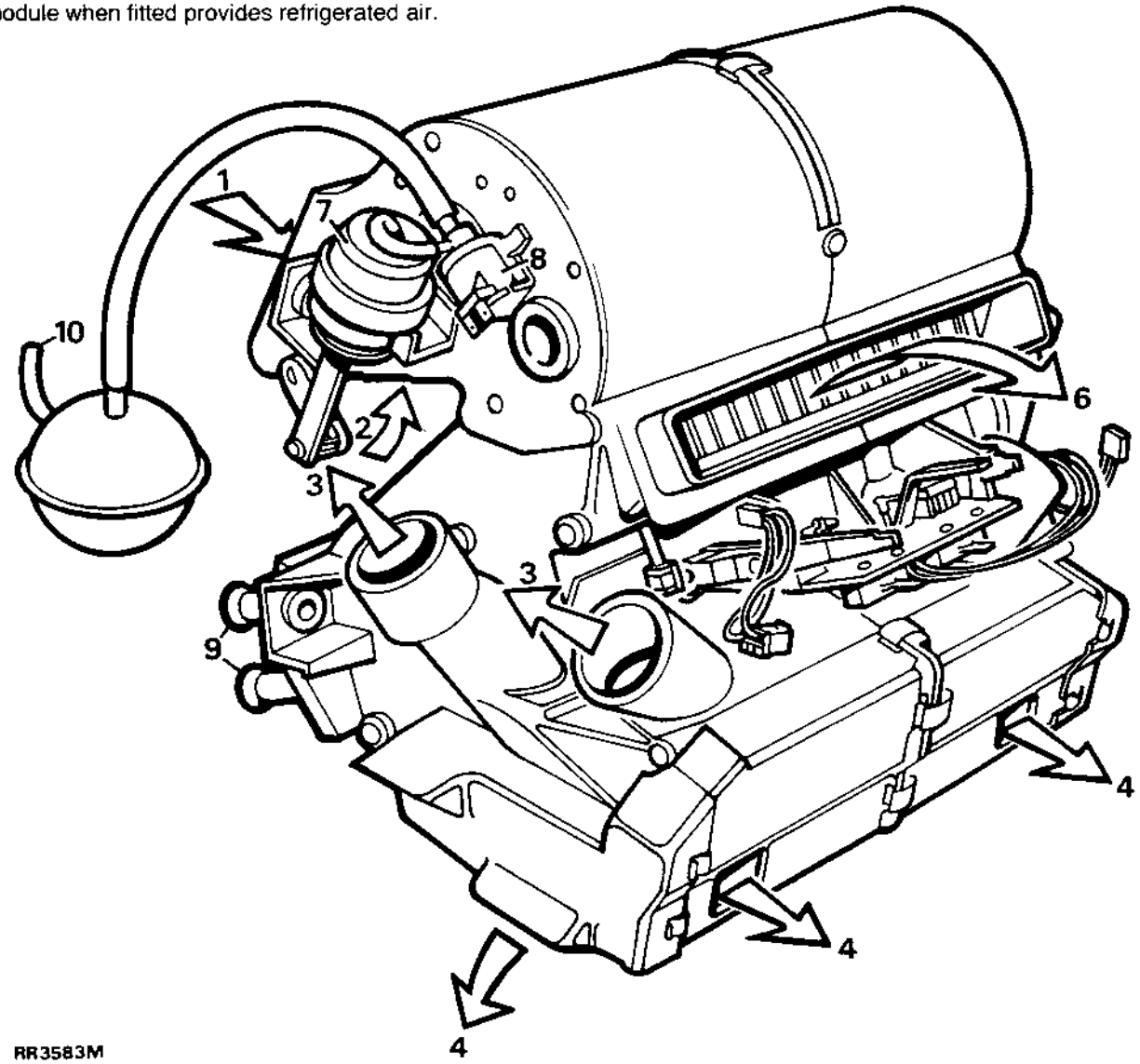
TORQUE VALUES 1

Notes

HEATING AND VENTILATION UNIT

The heating and ventilation unit is standard on all models. Air conditioning system is an optional module, which when fitted provides fully integrated climate control for the vehicle interior.

The 'Heating Ventilation Unit' controls the vehicles interior heating and air distribution, while the air conditioning module when fitted provides refrigerated air.



RR3583M

1. Fresh air inlet
2. Recirculation air inlet
3. Air outlets screen de-mist
4. Air outlet front/rear foot wells
6. Air outlet face level vents
7. Fresh/recirculation air flap servo
8. Fresh/recirculation air flap control valve
9. Water connections to heater
10. Inlet manifold connection to reservoir and servo valve

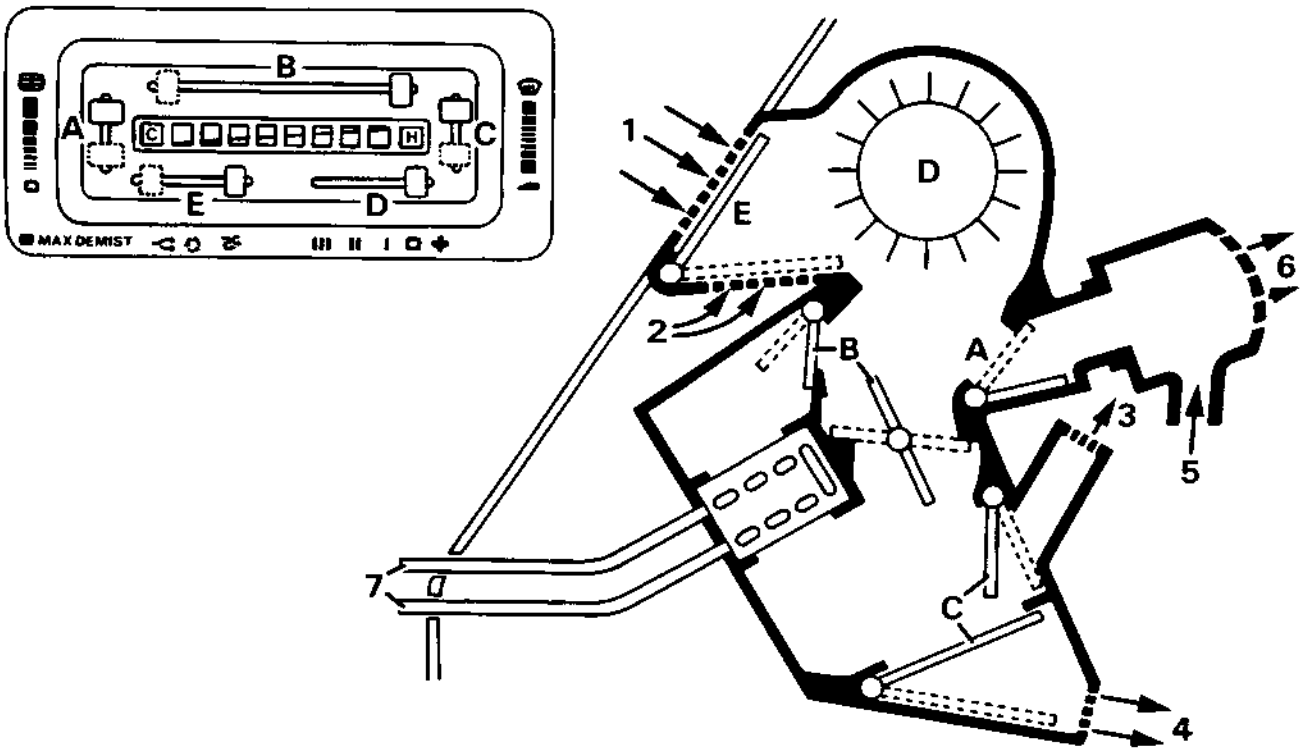
Through-flow ventilation

Through-flow ventilation is achieved by means of one-way air extraction vents incorporated in both rear quarter body panels. The vents open and close automatically dependent upon the heating and ventilation unit control settings and the volume of air entering the vehicle.

Heating and ventilation unit, controls

The 'Heating Ventilation Unit' is centrally located and concealed by the dash assembly. When air conditioning is fitted, an evaporator with twin fans is mounted to the right or left of the 'Heating Ventilating Unit' dependent upon the driving position.

The dash mounted central controls are used to operate both systems.



RR3584M

Heating and ventilation flaps and controls

1. Fresh air vent (outside vehicle)
2. Recirculation vent (inside vehicle)
3. Air outlets screen de-mist
4. Air outlet front/rear foot wells
5. Air outlet for air conditioning (when fitted)
6. Air outlet face level vents
7. Heater radiator connections

A Face level flap and control
B Air temperature coupled flaps and control
C Screen demist/foot wells coupled flaps and control
D Fanspeed control
E Fresh and recirculation air flap and control

△ **NOTE: Control E also switches on the air conditioning system when fitted.**



Heater operation

The heating and ventilating unit consists of a heater radiator which is connected to the engine cooling system and a three speed fan for air circulation. As water is circulated through the radiator continuously, selection of hot or cold air is achieved by the operation of air flaps which direct the air flow through the unit.

Control 'E' operation Recirculated air

This control when fully to the right operates an electrical switch, vacuum valve and servo, which when the engine is started causes flap E to close fresh air vent 1 and open recirculation air vent 2.

Fresh air

Moving the control to the left switches off the vacuum and flap E which is spring loaded, opens the fresh air vent 1 and closes the recirculation vent 2.

△ **NOTE: Air leakage into the vacuum system controlling flap E, will effect engine performance.** ***See FUEL SYSTEM, Fault diagnosis, Engine Tuning***

Control 'A' operation Face level vent

This control is mechanically connected to the face level flap A and controls the volume of air exiting vent 6.

Only fresh or re-circulated air is available from the face level vents 6 when the vehicle is fitted with a 'Heater Ventilation Unit'.

Control 'B' operation

This control mechanically operates two flaps B which are coupled and divert the flow of air through the heater radiator to vary the temperature.

Control 'C' operation

This control mechanically operates two coupled flaps C which distribute air to the screen and foot wells.

Control 'D' operation

This is an electrical control for fan D and provides three speeds and an OFF position.

Air conditioning

When air conditioning is fitted the mechanical operation of the controls remains unaltered. However the air conditioning ON OFF switch is operated by control E and an electronic thermostat is connected to control B.

Controls E must be moved fully to the left to switch on the air conditioning system and moving control B to the left selects the degree of cooling required.

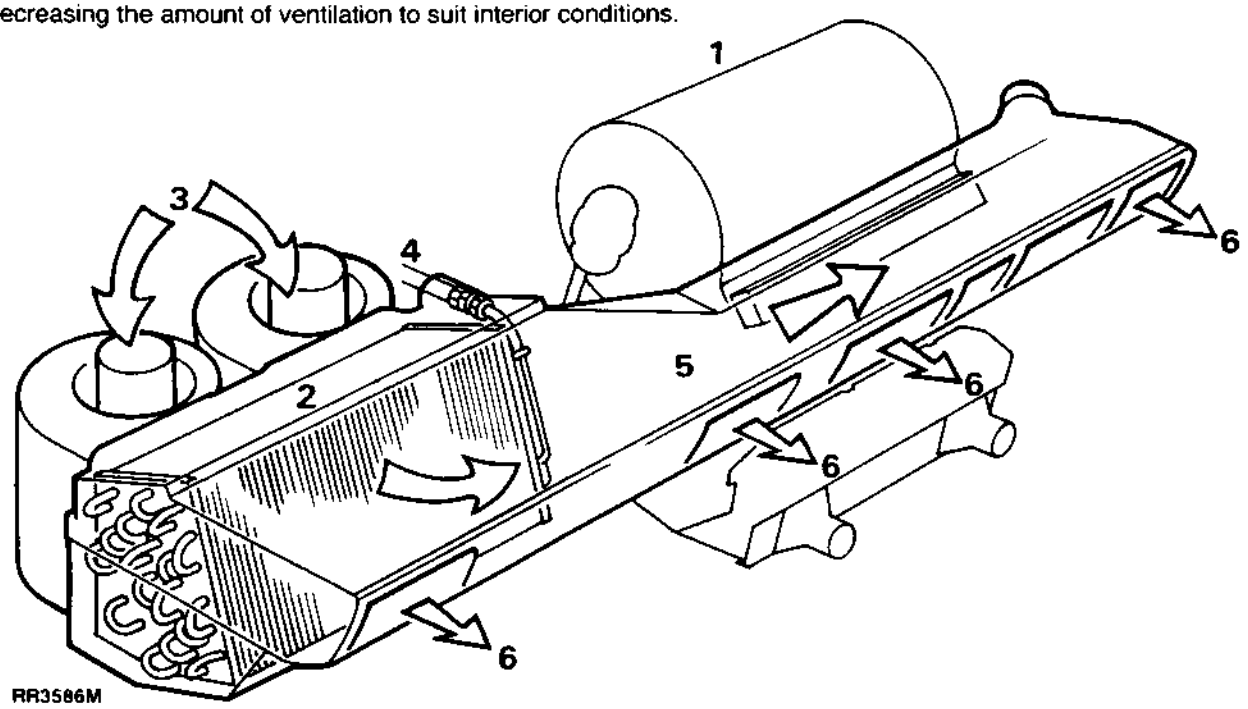
AIR CONDITIONING SYSTEM (WHERE APPLICABLE)

For control of the air conditioning system. ***See Heating and ventilation unit***

Air conditioning evaporator
Air (3) drawn only from the vehicle interior is blown through air conditioning evaporator (2) where it is cooled and then discharged through the face level vents 6 via trunking connection 5 as seen in RR3586M.

Highway driving
During a long journey when the ambient temperature and humidity are extremely high and the air conditioning is in use, frost may form on the cooling coils of the evaporator. The unit is equipped with an automatic defrost system which normally will prevent this. However if the temperature control is maintained in its coldest position for extended periods, the defrost system will not operate and the unit will not function correctly. Therefore, whenever possible, move the temperature selector (control 'B' shown in RR3584M) slightly away from its extreme left (cold) position.

Through-flow ventilation
A through-flow ventilation system is achieved in the Range Rover by means of one-way air extraction vents (1) incorporated in both rear quarter panels. Each vent is automatically opened or closed progressively increasing or decreasing the amount of ventilation to suit interior conditions.



Air conditioning evaporator

1. Heating ventilating unit
2. Air conditioning evaporator
3. Air intake and fans (inside vehicle)
4. Refrigerant connection
5. Cold air trunking to face level vents 6

HEATER OUTPUT

Symptom:-

Heater emits cold air

1. Check for engine running cold. ***See COOLING SYSTEM, Fault diagnosis, Engine runs cold***
2. Check heater pipes and hoses for blockage or restriction.
3. Check heater radiator for blockage or restriction, flush system.

Notes

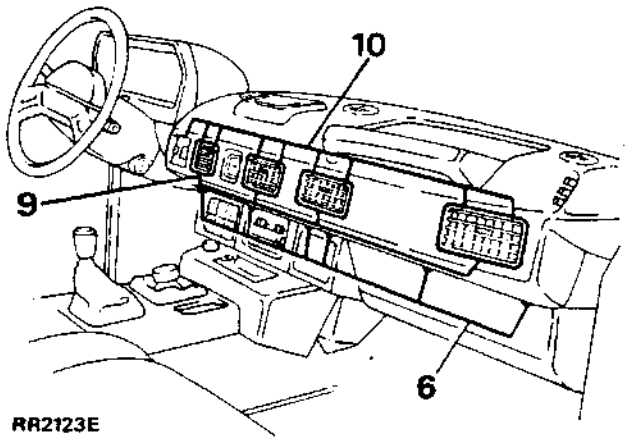
HEATER ASSEMBLY

Service repair no - 80.20.01/20.

Remove and refit

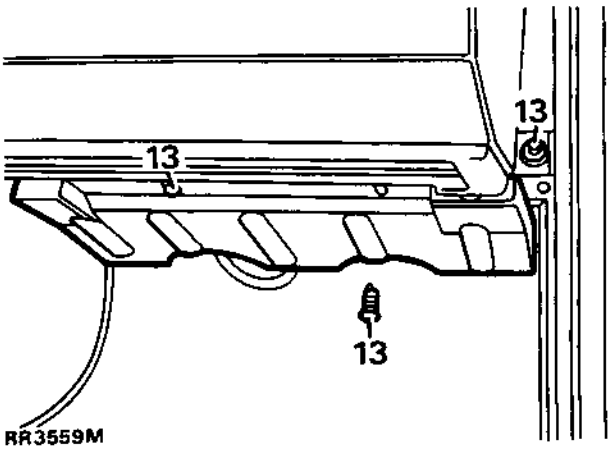
Remove

1. Disconnect the battery negative lead.
2. Drain cooling system. ***See COOLING SYSTEM, Adjustment, Coolant***
3. Identify and disconnect water inlet and outlet hoses from heater.
4. Working inside vehicle withdraw lower dash. ***See CHASSIS AND BODY, Repair, Lower dash panel***
5. Remove screws securing lower edge of centre console.



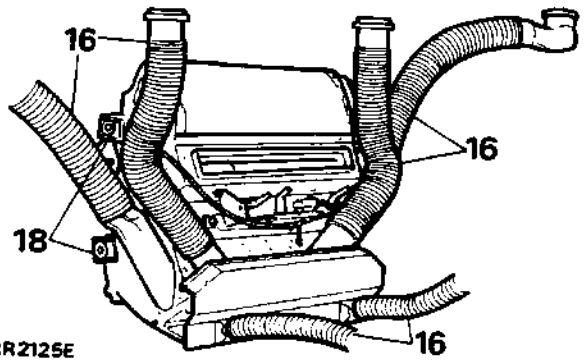
RR2123E

6. Remove six screws securing lower edge of louvre panel to console and evaporator case.
7. Remove heater control panel and knobs from centre console.
8. Remove centre dash panel. ***See CHASSIS AND BODY, Repair, Centre dash panel***
9. Carefully pry out four air vents.
10. Remove screws securing evaporator plenum and louvre panel to dash top panel.
11. Disconnect electrical connection from heater to electrical thermostat. Sited at rear of evaporator housing.
12. Disconnect electrical connectors at rear of exterior driving mirror control switches and clock. Withdraw panel clear of dash.



RR3559M

13. Remove screws securing blower closing panel and nut from mounting bracket.
14. Support evaporator case and remove two nuts securing case and reinforcing strip to upper mounting bracket.
15. Remove cover bracket and carefully lower evaporator assembly to floor.



RR2125E

16. Disconnect hoses from heater unit.
17. Disconnect electrical leads from heater unit at multiplugs.
18. Remove four heater mounting bolts.
19. Remove heater unit.

Refit

20. Check that seal for fresh air intake is in place on back of heater unit.
21. Check that seal for heater core is in place on hoses.
22. Reverse removal procedure. Ensure that all openings are adequately sealed against ingress of dust and moisture.

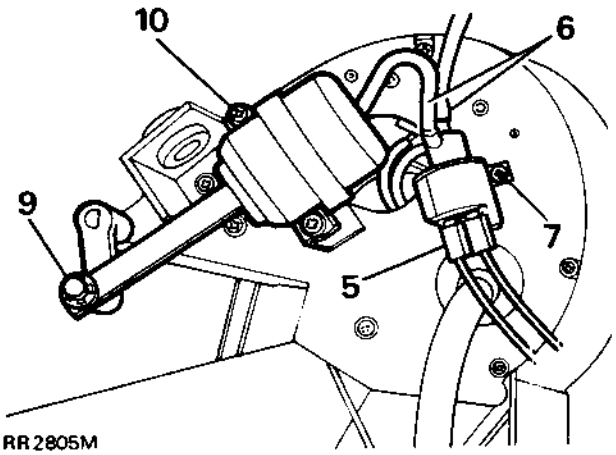
RECIRCULATING/FRESH AIR SOLENOID SWITCH AND VACUUM UNIT

Service repair no - 80.10.24.

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove transmission lever surround.
3. Remove radio mounting console.
4. Remove centre dash unit and lower dash panel.
5. **Solenoid switch:** disconnect electrical leads to solenoid.



RR2805M

6. Disconnect two vacuum hoses.
7. Remove two screws and withdraw solenoid.
8. **Vacuum unit:** remove vacuum hose.
9. Remove actuating rod securing clip.
10. Remove two retaining screws and remove vacuum unit.

Refit

11. Reverse removal procedure.

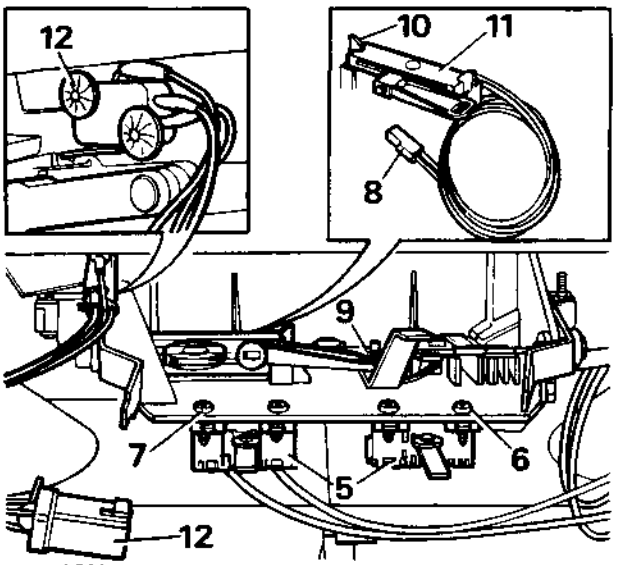
HEATER AND AIR CONDITIONING CONTROLS

Service repair no - 80.10.02.

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove transmission lever surround and radio housing.
3. Remove lower dash panel.
4. Remove centre dash unit.



RR2808M

5. Disconnect electrical plugs from fan speed and recirculate/fresh air switches.
6. **Fan speed switch:** remove fixing screws and withdraw switch.
7. **Air conditioning / fresh air / recirculating switch:** remove fixing screws and withdraw switch.
8. **Potentiometer:** disconnect electrical connector to electronic thermostat sited at rear of the evaporator housing.
9. Prise wire cable connection from the heat control lever.
10. Release potentiometer from its location.

11. Remove potentiometer with connecting arm to heat control lever. Withdraw the attached electrical leads through the grommet.
12. **Microswitch:** disconnect multiplug, lift vent lever, remove two retaining clips and withdraw microswitch.

Refit

13. Reverse removal procedure. Check the satisfactory function of the controls before fitting dash and trim panels.

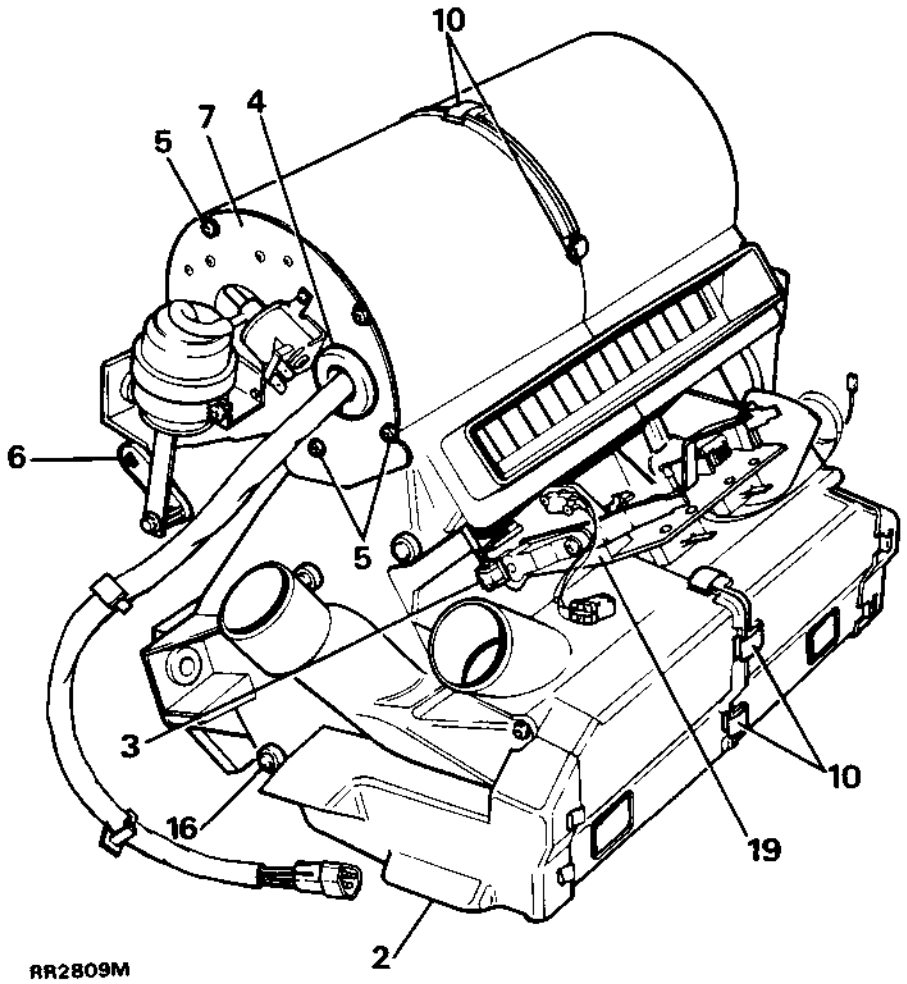
HEATER FAN MOTOR, ROTOR AND RESISTANCE UNIT

Service repair no - 80.20.17/20.

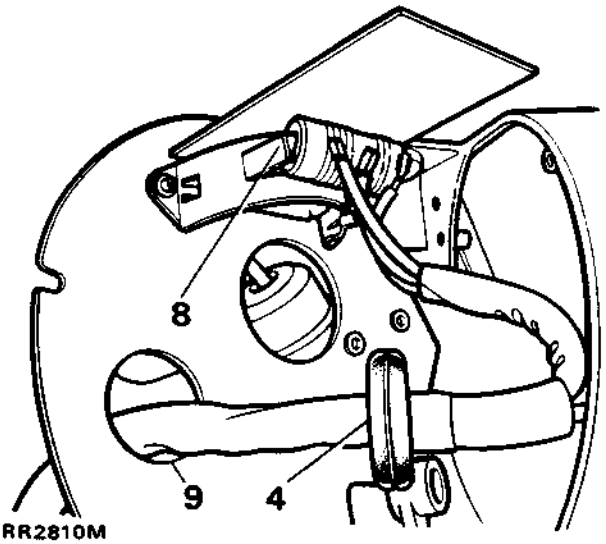
Remove and refit

Remove

1. Remove the heater assembly. ***See Heater assembly***
2. Remove left duct to footwell outlet.
3. Mark the position of vent control rod for reassembly. Disconnect by prising open the plastic clip.

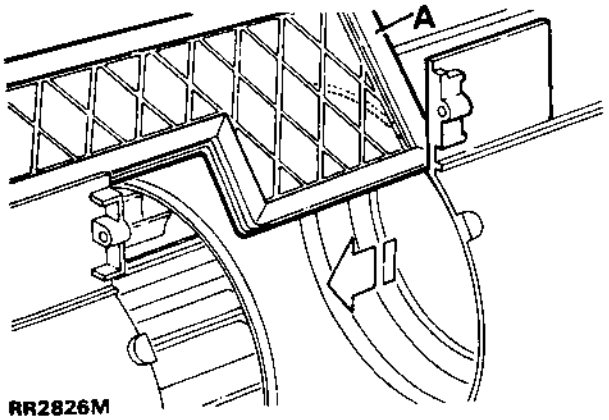


RR2809M



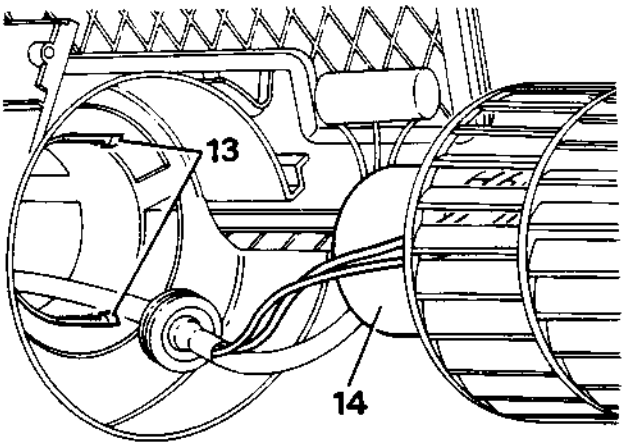
RR2810M

4. Disengage grommet from side cover.
5. Remove six screws retaining the side cover.
6. Remove vacuum unit to air flap linkage.
7. Withdraw side cover to expose electric wires to the fan motor and resistance unit.
8. Release resistance unit by tensioning back the metal mounting straps.
9. Remove side cover feeding electrical leads and multiplug through the hole.
10. Remove ten spring clips, three circlips and two screws that secure the halves of heater casing together. Ensure all fixings and foam gaskets are removed.



RR2826M

11. Position flap (A) as shown, prise and slide its lower edge through gap between motor housing and outer case. While separating each half of the heater casing.
12. Note the location of air flap pivots, for reassembly.



RR2825M

13. The motor assembly is held into the left half of the casing by two plastic tabs, locate and prise them away from motor.
14. Note for reassembly the position and layout of electrical wiring. Then withdraw the motor assembly including attached wires and resistance unit from its housing.

Refit

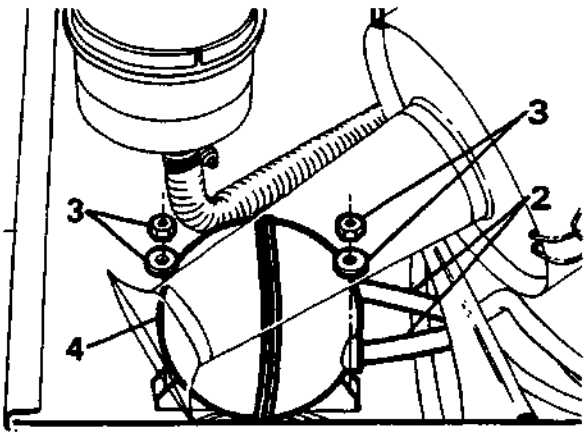
15. Feed wiring and resistance unit through motor housing and fit motor assembly. Ensure wiring is positioned correctly, to avoid entangling rotor, and the plastic tabs locate to secure motor.
16. Mark a white spot on the end of each air flap pivot to be reassembled into heater casing.
17. Offer heater casing halves together. Ensure the flap (A) is positioned to reverse instruction 11.
18. Point remaining air flap pivots in the direction of their location.
19. Locate and slot into left casing the heater control panel assembly. Examine closely to ensure that both fixings engage and slide into their housing.
20. Slowly and firmly push casing halves together checking that all components are aligned. Any solid resistance felt suggests a component is not locating correctly. Rectify and continue until casing halves are together.
21. Refit all fixings holding the heater casing halves together.
22. Reverse removal procedure. 4 to 9.
23. Connect the rod to the vent control lever to its marked position.
24. Check all controls operate and flaps seal against the heater casing.
25. Refit the left duct to footwell outlet.
26. Renew foam gaskets.
27. Refit heater assembly.

VACUUM RESERVOIR

Remove and refit

Remove

1. Disconnect the battery negative lead.



RR2187E

2. Remove the two vacuum hoses.
3. Loosen the reservoir fixings.
4. Withdraw vacuum reservoir.

Refit

5. Reverse removal procedure. Note that the larger diameter hose, from inlet manifold fits the inlet marked VAC on the reservoir.

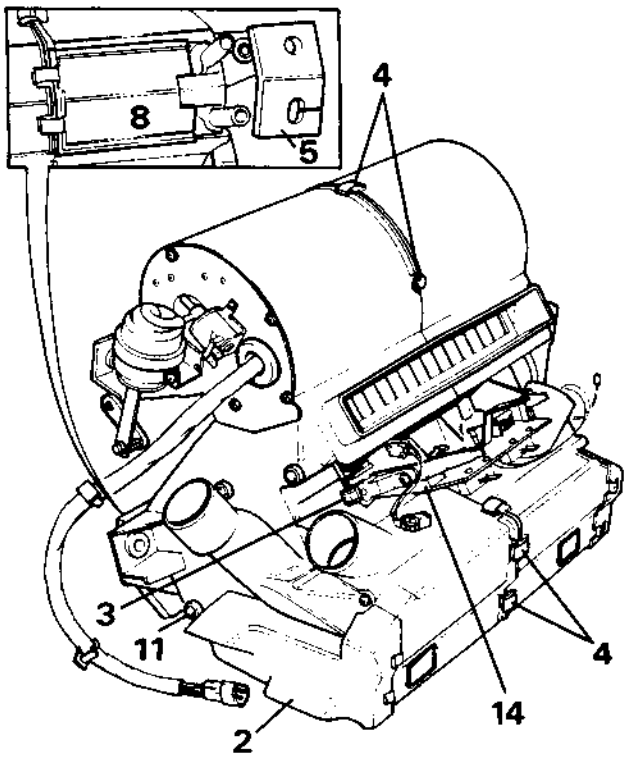
HEATER CORE

Service repair no - 80.20.29.

Remove and refit

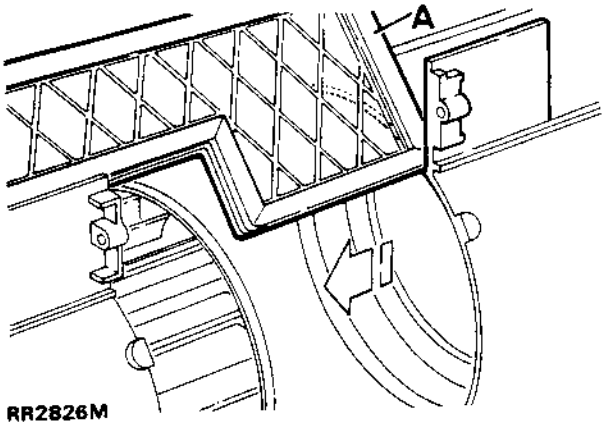
Remove

1. Remove heater assembly. ***See Heater assembly***



RR2827M

2. Remove left duct to footwell outlet.
3. Mark the position of vent control rod, for reassembly. Disconnect by prising open the plastic clip.
4. Remove ten spring clips, three circlips and two screws that secure the halves of heater casing together. Ensure all fixings and foam gaskets are removed.
5. Remove pad from around the two coolant hose connections.
6. Position flap (A) as shown, prise and slide its lower edge through the gap between motor housing and outer case. While separating each half of heater casing.
7. Note for reassembly the location of air flap pivots.



RR2826M

8. Slide out the separate panel.
9. Remove heater core complete with sponge packing.

Refit

10. Fit heater core into the left half of casing. Slide in separate panel (8) up to coolant hose connections.
11. Mark a white spot on the end of each air flap pivot to be reassembled into heater casing.
12. Offer heater casing halves together. Ensure flap (A) is positioned to reverse instruction 6.
13. Point remaining air flap pivots in the direction of their location.
14. Locate and slot into left casing the heater control panel assembly. Examine closely to ensure that both fixings engage and slide into their housing.
15. Slowly and firmly push casing halves together checking that all components are aligning. Any solid resistance felt suggests a component is not locating correctly. Rectify and continue until the casing halves are together.
16. Refit all of the fixings that hold heater casing halves together.
17. Connect rod to the vent control lever to its marked position.
18. Check all controls operate and air flaps seal against heater casing.
19. Renew the pad around the two coolant hose connections.
20. Refit the left duct to footwell outlet.
21. Renew foam gaskets.
22. Refit heater assembly.

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
METRIC	
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180
UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

Torque values above are for all screws and bolts used except for those that are specified otherwise.

Notes

82 - AIR CONDITIONING

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SPECIFICATIONS, TORQUE

TORQUE VALUES 1

AIR CONDITIONING - REFRIGERANT SYSTEM

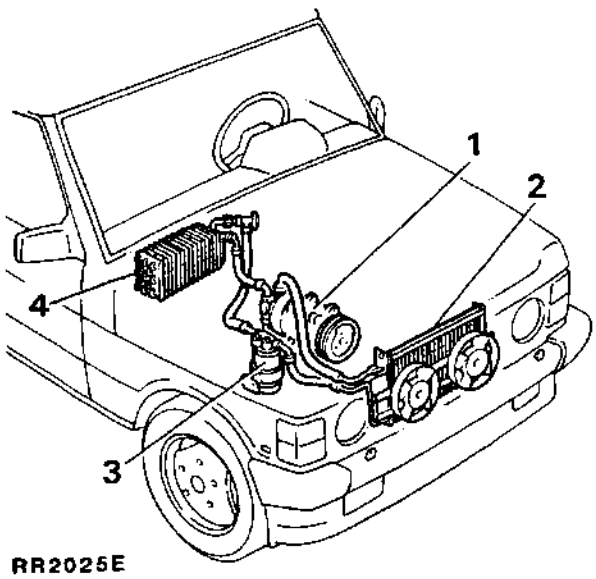
Description

For air conditioning air distribution system. ***See HEATING AND VENTILATION, Description and operation, Air conditioning system (where applicable)***

The air conditioning system comprises four major units:

1. An engine-mounted compressor.
2. A condenser mounted in front of the radiator.
3. A receiver/drier unit located in the engine compartment.
4. An evaporator unit mounted behind the dashboard.

The four units are interconnected by hoses carrying refrigerant, and the evaporator is linked into the vehicle ventilation system.



RR2025E

Refrigeration cycle

The function of the refrigeration circuit is to cool the evaporator.

1. Compressor

The compressor draws vaporized refrigerant from the evaporator. It is compressed, and thus heated, and passed on to the condenser as a hot, high pressure vapour.

2. Condenser

The condenser is mounted directly in front of the vehicle radiator. It consists of a refrigerant coil mounted in a series of thin cooling fins to provide the maximum heat transfer in a minimum amount of space. Airflow across condenser is induced by vehicle movement and is assisted by two electric condenser fans. The refrigerant enters the inlet at the top of the condenser as a heat laden high pressure vapour.

As this vapour passes down through the condenser coils, heat will follow its natural tendency and flow from the hot refrigerant vapour into the cooler air flowing across the condenser coils and fins.

When the refrigerant vapour reaches the temperature and pressure that will induce a change of state, a large quantity of latent heat will be transferred to the outside air. The refrigerant will change from a high pressure **HOT VAPOUR** to a high pressure **WARM LIQUID.**

3. Receiver drier

This unit filters, removes moisture, and acts as a reservoir for the liquid. To prevent icing inside the system, extreme precautions are taken during servicing to exclude moisture. The receiver drier should be considered as a second stage insurance to prevent the serious consequences of ice obstructing the flow.

△ **NOTE: A sight glass provided in the unit top enables a visual check to be made of the high pressure liquid flow.**

⚠ **WARNING: Under no circumstances should refrigerant hoses be disconnected without first discharging the system**

4. Expansion valve and evaporator

High pressure liquid refrigerant is delivered to the expansion valve. A severe pressure drop occurs across the valve and as the refrigerant enters the evaporator space at a temperature of approximately -6°C it boils and vaporizes. As this change of state occurs, a large amount of latent heat is absorbed. The evaporator is therefore cooled and as a result heat is extracted from the air flowing across the evaporator. The air flow is controlled by two evaporator fans regulated by the air conditioner fan control.

Second cycle

Low pressure vaporized refrigerant is drawn from the evaporator by the compressor and a second cycle commences.

AIR CONDITIONING - ELECTRICAL - MECHANICAL FAULTS

FAULT	CAUSE	REMEDY
A. MOTOR INOPERATIVE OR SLOW RUNNING	1. Incorrect voltage. 2. Open or defective fuse or relay. 3. Loose wire connection including ground. 4. Switch open or defective. 5. Tight, worn, or burnt motor bearings. 6. Open rotor windings. 7. Worn motor brushes. 8. Shaft binding-blade misaligned. 9. Defective resistors	1. Check voltage. 2. Check and replace as necessary. 3. Check system wires; tighten all connections. 4. Replace switch. 5. Replace motor. 6. Replace motor. 7. Replace motor. 8. Check alignment. Repair or replace as necessary. 9. Rectify or replace.
B. CLUTCH INOPERATIVE	1. Incorrect voltage. 2. Open or defective fuse or relay. 3. Defective thermostat control or pressure switch. 4. Shorted or open field coil. 5. Bearing seized (clutch will not disengage). 6. Refrigeration circuit problem causing heavy load and excessive drive torque.	1. Check voltage. 2. Check and replace as necessary. 3. Replace thermostat or pressure switch. 4. Replace coil. 5. Replace bearing. 6. Check and rectify.
C. CLUTCH NOISY	1. Incorrect alignment. 2. Loose belt. 3. Compressor not mounted securely. 4. Bearing in clutch-pulley assembly not pressed in. 5. Low voltage to clutch. 6. Clutch will not spin freely. 7. Oil on clutch face. 8. Slipping clutch. 9. Overloaded or locked compressor. 10. Icing.	1. Check alignment; repair as necessary. 2. Adjust to proper tension. 3. Repair as necessary. 4. Remove clutch and replace bearing. 5. Check connections and voltage. 6. Refer to B5 above. 7. Check compressor seals for leaks. 8. Refer to C5 above. 9. Repair or replace compressor. 10. Check for suction line frosting. Replace expansion valve if necessary. Replace receiver/drier if necessary.
D. CONDENSER AND/OR EVAPORATOR VIBRATION	1. Motor and/or blades improperly mounted. 2. Foreign matter build-up on blades. 3. Excessive wear of motor bearings.	1. Check mountings, adjust as necessary. 2. Clean blades with a suitable non-inflammable cleaner. 3. Replace motor.

REFRIGERATION SYSTEM FAULTS

For any refrigeration system to function properly all components must be in good working order. The unit cooling cycle and the relationship between air discharge temperature and ambient temperature and the pressures at the compressor can help to determine proper operation of the system.
The length of any cooling cycle is determined by such factors as ambient temperature and humidity, thermostat setting, compressor speed and air leakage into the cooled area, etc. With these factors constant, any sudden increase in the length of the cooling cycle would be indicative of abnormal operation of the air conditioner.
The low and high side pressures at the compressor will vary with changing ambient temperature, humidity, in-car temperature and altitude.
The following items should be checked before operating the system:

1. Compressor drive belt tension.
2. Compressor magnetic clutch operation.
3. Condenser fan operation.
4. Condenser fins, dirt will cause poor cooling and higher operating temperatures.

The following conditions should be checked after operating the system for several minutes:

1. All high pressure lines and components should be hot to the touch.
2. All low pressure lines should be cool to the touch.
3. Inlet and outlet temperatures at the receiver/drier should be at the same temperature (warm). Any very noticeable temperature difference indicates a blocked receiver/drier.
4. Heavy frost on the inlet to the expansion valve may indicate a defective valve or moisture in the system.
5. With ambient humidity between 30% and 60%, compressor pressures and evaporator air discharge temperature should fall within the general limits given in the table below.

Type of Weather	Evaporator Air Temp °F (°C)	Low Side Pressure p.s.i. (bar)	High Side Pressure p.s.i. (bar)
70-80°F (21-27°C)	35-45°F (1.7-7.2°C)	15-20 (1.1-1.4)	160-200 (11.2-14)
80-90°F (27-32°C)	40-50°F (4.4-10°C)	20-25 (1.4-1.8)	190-240 (13.4-16.9)
Over 90°F (Over 32°C)	45-60°F (7.2-15.6°C)	25-30 (1.8-2.1)	220-270 (15.5-19)

1. Low and high side pressures are guides not specific limits.
2. Evaporator air temperatures will be lower on dry days, higher on humid days.

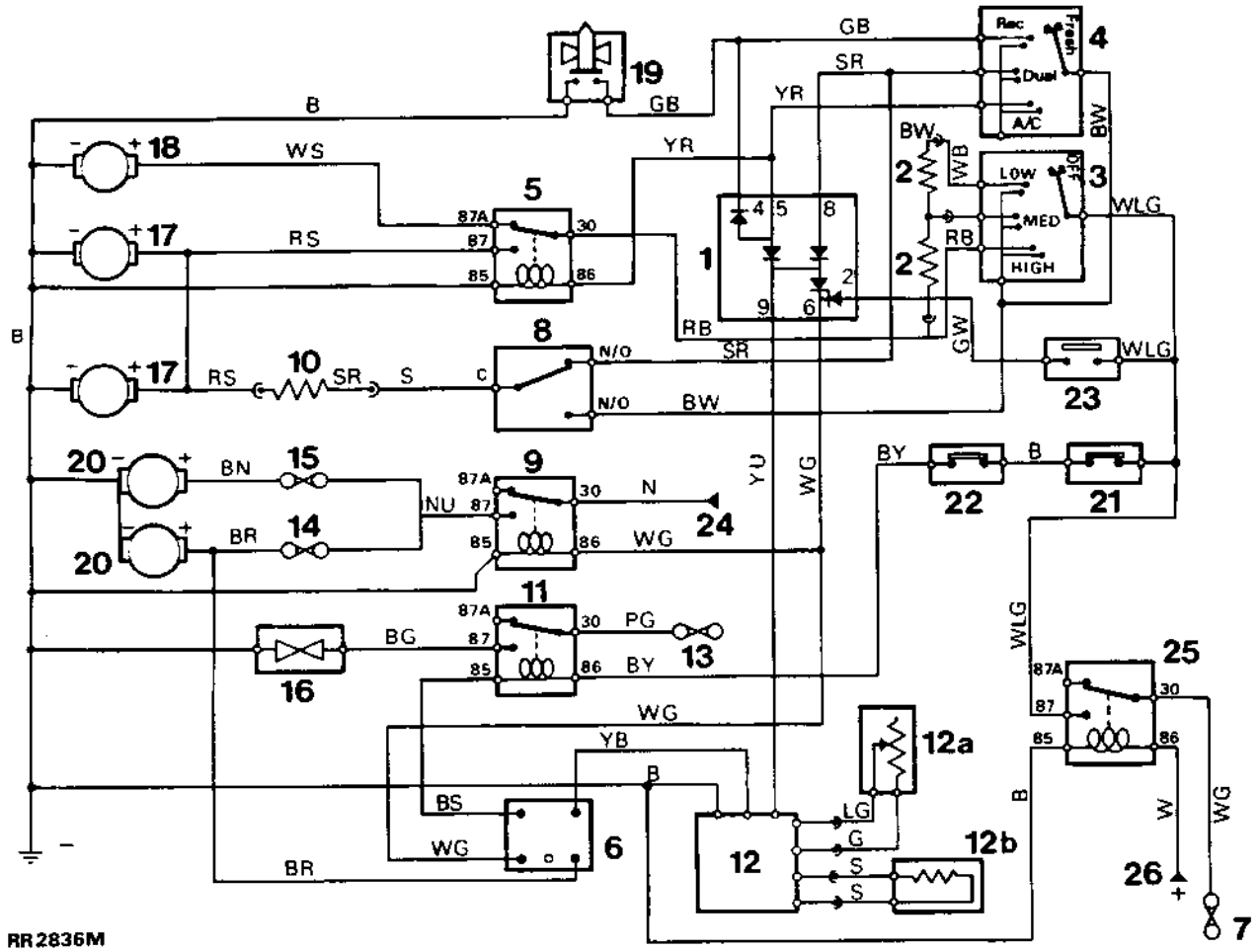
FAULT	CAUSE	REMEDY
A. HIGH HEAD PRESSURE	1. Overcharge of refrigerant. 2. Air in system. 3. Condenser air passage clogged with dirt or other foreign matter. 4. Condenser fan motor defective.	1. Discharge, evacuate and charge system. 2. Discharge system, fit new drier, evacuate and charge system. 3. Clean condenser of debris. 4. Replace motor.
B. LOW HEAD PRESSURE	1. Undercharge of refrigerant; evident by bubbles in sight glass while system is operating 2. Split compressor gasket or leaking valves. 3. Defective compressor.	1. Evacuate and charge system. Check for leakage. 2. Replace gasket and/or reed valve. Fit new drier, evacuate and charge system. 3. Repair or replace compressor.
C. HIGH SUCTION PRESSURE	1. Loose compressor belt 2. Refrigerant flooding through evaporator into suction line; evident by ice on suction line and suction service valve. 3. Expansion valve stuck open. 4. Compressor suction valve strainer restricted. 5. Leaking compressor valves, valve gaskets and/or service valves. 6. Receiver/drier stopped; evident by temperature difference between input and output lines.	1. Adjust belt tension. 2. Check thermobulb. Bulb should be securely clamped to clean horizontal section of copper suction pipe. 3. Replace expansion valve. 4. Remove and clean or replace strainer. 5. Replace valves and/or gaskets. Fit new drier evacuate and charge system. 6. Fit new drier, evacuate and charge system.
D. LOW SUCTION	1. Expansion valve thermobulb not operating. 2. Expansion valve sticking closed. 3. Moisture freezing in expansion valve orifice. Valve outlet tube will frost while inlet hose tube will have little or no frost. System operates periodically. 4. Dust, paper scraps, or other debris restricting evaporator blower grille 5. Defective evaporator blower motor, wiring, or blower switch.	1. Warm thermobulb with hand. Suction should rise rapidly to 20 lb or more. If not replace expansion valve. 2. Check inlet side screen. Clean if clogged. Refer to C-2 and C-3. 3. Fit new drier, evacuate and charge system. 4. Clean grilles as required. 5. Refer to Fault Diagnosis Chart for blower motor.

FAULT	CAUSE	REMEDY
E. NOISY EXPANSION VALVE (steady hissing)	1. Low refrigerant charge; evident by bubbles in sight glass.	1. Leak test. Repair or replace components as required.
F. INSUFFICIENT COOLING	1. Expansion valve not operating properly. 2. Low refrigerant charge-evident by bubbles in sight glass. 3. Compressor not pumping.	1. Refer to C-2, C-3, D-1 and E. 2. Refer to B-1 and E. 3. Refer to B-2 and B-3
G. COMPRESSOR BELT SLIPPING	1. Belt tension. 2. Excessive head pressure. 3. Incorrect alignment of pulleys or worn belt not riding properly. 4. Nicked or broken pulley. 5. Seized compressor.	1. Adjust belt tension. 2. Refer to A-1 through A-4 and C-6. 3. Repair as needed. 4. Replace as needed. 5. Replace compressor.
H. ENGINE NOISE AND/OR VIBRATION	1. Loose or missing mounting bolts. 2. Broken mounting bracket. 3. Loose flywheel or clutch retaining bolt. 4. Rough idler pulley bearing. 5. Bent, loose, or improperly mounted engine drive pulley. 6. Defective compressor bearing. 7. Insecure mountings of accessories; generator, power steering, air filter, etc. 8. Excessive head pressure. 9. Incorrect compressor oil level.	1. Repair as necessary. 2. Replace bracket. 3. Repair as necessary. 4. Replace bearing. 5. Repair as necessary. 6. Replace bearing. 7. Repair as necessary. 8. Refer to A-1, A-2, A-3 A-4 and C-6. 9. Refer to compressor Oil Level Check.

HEATER AND AIR CONDITIONING - CIRCUIT DIAGRAM ON 1992 MODEL YEAR

1. For details of heating and air conditioning electrics, for 1992 Models on, see separate publication Range Rover Electrical Trouble Shooting Manual.

HEATER AND AIR CONDITIONING - CIRCUIT DIAGRAM 1990 MODEL YEAR



RR2836M

1. Diode pack.
2. Resistors.
3. Fan speed switch.
4. Air conditioning/re-circ/fresh air switch.
5. Heater/air conditioning relay.
6. Cable connection to ECU (EFI).
7. Fuse C9 - main fuse panel.
8. Face vent switch.
9. Condenser fan relay.
10. Two level resistor.
11. Compressor clutch relay.
12. Thermostat.
13. Fuse B7.
14. Fuse B8.
15. Fuse B9.
16. Compressor clutch.
17. Air conditioning motors (2) - dashboard unit.
18. Heater motor.
19. Fresh air solenoid.
20. Condensor fan motors.
21. High pressure switch.
22. Low pressure switch.
23. Engine coolant temperature switch.
24. 12V from terminal post.
25. Heater/air con load relay
26. 12V from ignition load relay

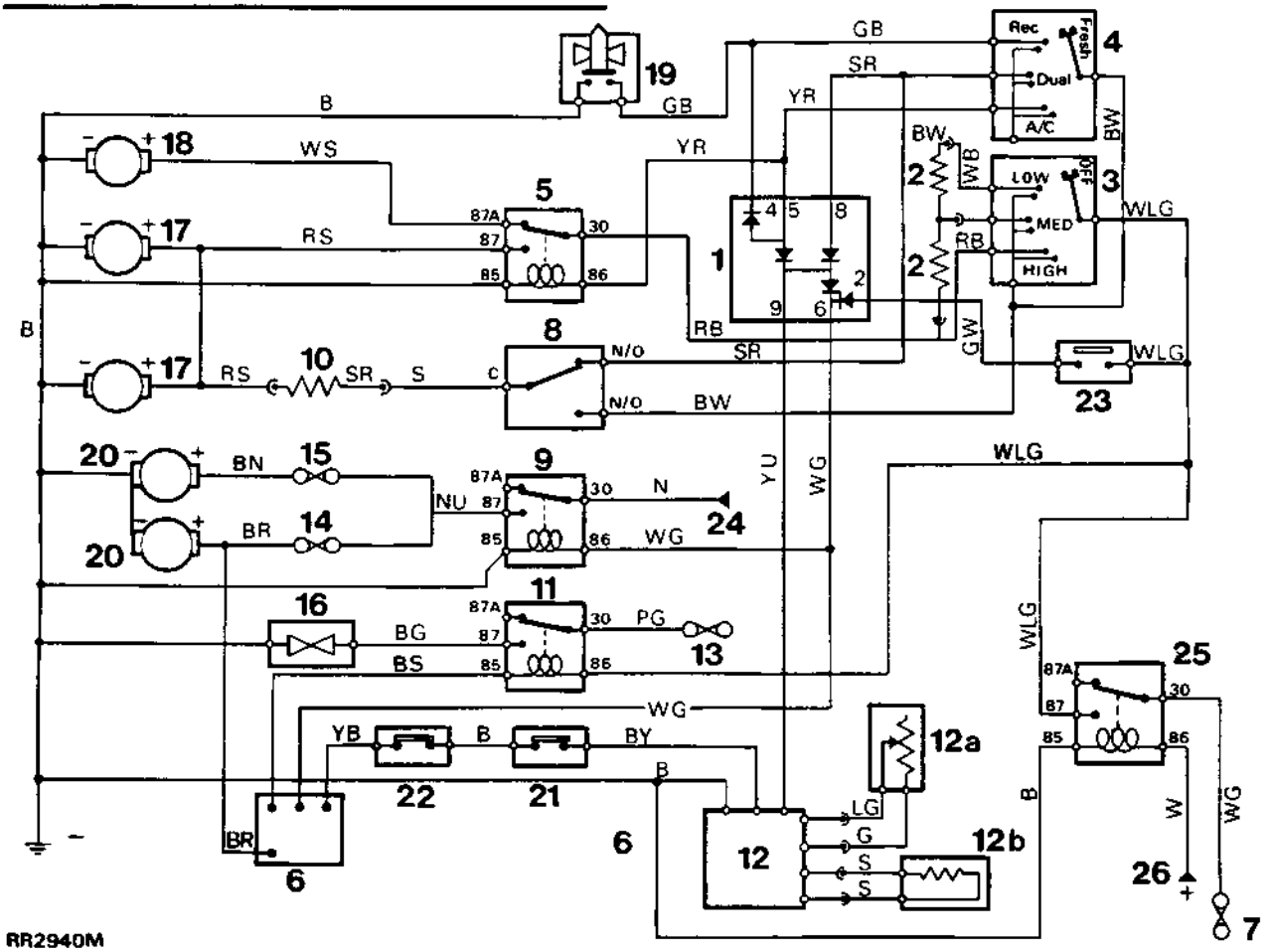
NOTE: For details of air conditioning inputs to ECU. ***See FUEL SYSTEM, Fault diagnosis, Fuel injection - circuit diagram - 1990 - 1991***

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

HEATER AND AIR CONDITIONING - CIRCUIT DIAGRAM 1991 MODEL YEAR



RR2940M

1. Diode pack.
2. Resistors.
3. Fan speed switch.
4. Air conditioning/re-circ/fresh air switch.
5. Heater/air conditioning relay.
6. Cable connection to ECU (EFI).
7. Fuse C9 - main fuse panel.
8. Face vent switch.
9. Condenser fan relay.
10. Two level resistor.
11. Compressor clutch relay.
12. Thermostat.

12a. Temperature control potentiometer.

12b. Evaporator temperature sensor.

13. Fuse B7.
14. Fuse B8.
15. Fuse B9.
16. Compressor clutch.
17. Air conditioning motors (2) - dashboard unit.
18. Heater motor.
19. Fresh air solenoid.
20. Condensor fan motors.
21. High pressure switch.
22. Low pressure switch.
23. Engine coolant temperature switch.
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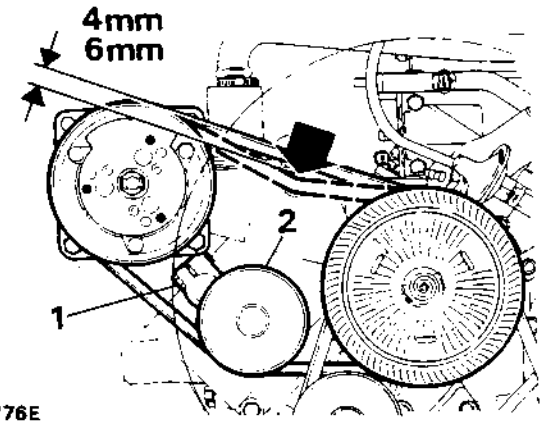
The last letter of a colour denotes the tracer colour.

COMPRESSOR DRIVE BELT

Service repair no - 82.10.01.

Adjust

1. Slacken idler pulley securing bolt.



RR1776E

2. Adjust position of idler pulley until correct tension is obtained. The belt must be tight with 4 to 6 mm total deflection when checked by hand midway between pulleys on the longest run.
3. Tighten securing bolt and recheck tension.

Notes

GENERAL SERVICE INFORMATION

INTRODUCTION

Before any component of the air conditioning system is removed, the system must be discharged. When the component is replaced, the system must be evacuated to remove all traces of old refrigerant and moisture. The system must then be recharged with refrigerant.

WARNING: All work involving the handling of refrigerant requires special equipment, a knowledge of its proper use and attention to safety measures.

SERVICING EQUIPMENT

The following equipment is required for full servicing of the air conditioning system.

Charging station
Leak detector
Safety goggles and gloves
Refrigerant charging line seals
Thermometer +20°C to -60°C
Compressor dipstick
Recovery and recycling equipment

SERVICING MATERIALS

Refrigerant: Refrigerant 12, which includes Freon 12 or Arcton 12.

CAUTION: Methychloride refrigerants must not be used.

Compressor oil: ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***

PRECAUTIONS IN HANDLING REFRIGERANT

Refrigerant 12 is transparent and colourless in both the gaseous and liquid state. It has a boiling point of -29.8°C at atmospheric pressure and at all normal pressures and temperatures it becomes a vapour. The vapour is heavier than air, non-flammable, and non-explosive. It is non-poisonous except when in contact with an open flame, and non-corrosive until it comes in contact with water.

FIRST AID: If refrigerant should contact the eyes or skin, splash the eyes or affected area with cold water for several minutes. Do not rub. As soon as possible thereafter, obtain treatment from a doctor or eye specialist.

The following precautions in handling Refrigerant 12 should be observed at all times.

DO NOT:

- Leave refrigerant container open to atmosphere.
- Carry refrigerant container inside a vehicle.
- Subject refrigerant containers to high temperature.
- Weld or steam clean near an air conditioning system.
- Expose eyes or skin to liquid refrigerant.
- Discharge refrigerant vapour into an area with an exposed flame or into an engine intake. Heavy concentrations of refrigerant in contact with naked flame produce a toxic gas, phosgene.
- Allow liquid refrigerant to contact bright metal, it will tarnish metal and chrome surfaces, and combined with moisture can seriously corrode all metal surfaces.

PRECAUTIONS IN HANDLING REFRIGERANT LINES

WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

1. When disconnecting any hose or flexible 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.
2. Lines, flexible end connections and components must be capped immediately they are opened to prevent the entrance of moisture and dirt.
3. 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.
4. All replacement components and flexible end connections must be sealed, and only opened immediately prior to making the connection.
5. Ensure the components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters.
6. Components must not remain uncapped for longer than fifteen minutes. In the event of delay, the caps must be fitted.
7. Receiver/driers 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.
8. The compressor shaft must not be rotated until the system is entirely assembled and contains a charge of refrigerant.
9. A new compressor contains an initial charge of 135 ml of oil when received, part of which is distributed throughout the system when it has been run. The compressor contains a holding charge of gas when received which should be retained until the hoses are connected.
10. The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
11. 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.
12. Always use two wrenches of the correct size, one on each fitting when releasing and tightening refrigeration unions.
13. 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.
14. All lines must be free of kinks. The efficiency of the system is reduced by a single kink or restriction.
15. Flexible hoses should not be bent to a radius less than ten times the diameter of the hoses.
16. Flexible connections should not be within 50mm of the exhaust manifold.
17. 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

Routine servicing, apart from visual checks, is not necessary. The visual inspections are as follows:

Condenser

With a garden hose or air line, clean the fins of the condenser to remove flies, leaves, etc. Check the hose connection for signs of oil leakage.

Compressor

Check hose connections for signs of oil leakage. Check flexible hoses for swelling. Examine the compressor belt for tightness and condition. Checking the compressor oil level and topping-up is only necessary after charging the system or in the event of a malfunction of the system.

Receiver/Drier

Examine the sight glass for bubbles with the system operating. Check connections for leakage.

Evaporator

Examine the refrigeration connections at the unit. If the system should develop a fault, or if erratic operation is noticed, refer to the fault diagnosis chart.

SERVICE VALVES

These are secured to the head of the compressor, and the suction and discharge flexible end connections are secured to them by unions.

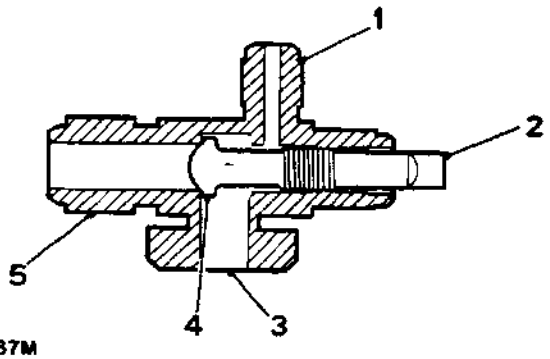
The service valves are identified as suction or low pressure, and discharge or high pressure. Whilst they are identical in operation they are not interchangeable, as the connections are of different sizes.

The valve with the larger connections fits the suction side. As the name suggests, these valves are for service purposes, providing connections to external pressure/vacuum gauges for test purposes. In combination with charging and testing equipment they are used to charge the system with refrigerant.

Stem type

Stem type service valves allow for the isolation of the compressor from other parts of the system. When these valves are used in conjunction with the liquid line quick-disconnect fittings, the three major assemblies of the system can be removed from the vehicle with a minimal loss of refrigerant. In addition, it is possible to remove major assemblies for repair of components which are not part of the refrigeration system, or provide access to parts of the vehicle which are obstructed by the air conditioning system, without fully discharging the system.

WARNING: A thorough understanding of the stem type service valve is necessary before undertaking servicing or repair involving the air conditioning system.

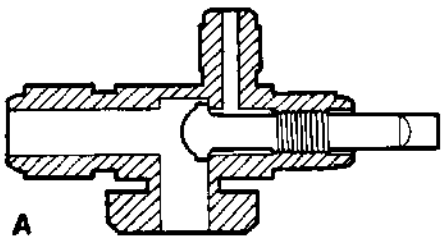


ST1387M

Service valve key

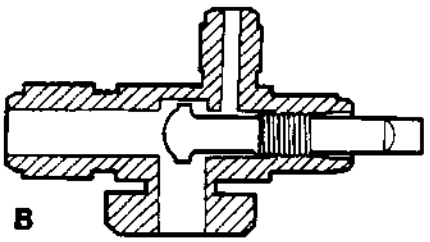
1. Service port.
2. Valve stem.
3. Compressor port.
4. Valve seat.
5. Hose connector.

Service valve positions



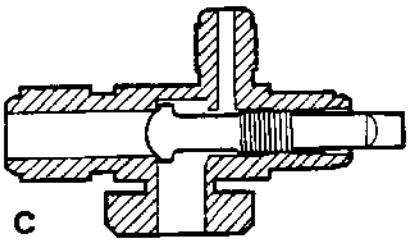
RR1734M

A. **ON: FULLY COUNTER-CLOCKWISE** - Normal operating position, and the position which is used for connecting and disconnecting the manifold gauge set, is the 'on' position. The stem is turned fully counter-clockwise. This seals the service gauge port from receiving any refrigerant flow.



RR1735M

B. **MID (Test) POSITION** - After the service gauge manifold has been installed (the valve stem is in the on position), turn the valve stem the required number of turns clockwise. This will put the valve stem seat midway in the service valve and allow full system operation while permitting refrigerant pressure to reach the gauges.



RR1736M

C. **OFF: FULLY CLOCKWISE** - With the service valve stem turned fully clockwise, the valve will block passage of refrigerant flow through the system. As illustrated, the refrigerant flow to or from the compressor (depending on whether it is high side or low side) is blocked.

WARNING: NEVER operate the air conditioning system with the service valves in the OFF POSITION, it will cause severe damage to the compressor.

CHARGING AND TESTING EQUIPMENT

Service repair no - 82. 30. 02/01

This is standard equipment for the servicing of automotive air conditioning systems, and is used for all testing, trouble shooting, evacuating and charging operations.
It is recommended that the operator adheres to the appropriate manufacturers' instructions for the equipment in use.

WARNING: The air conditioning system is charged with a high pressure, potentially toxic refrigerant. Repairs or servicing must only be carried out by an operator familiar with both the vehicle system and the charging and testing equipment.

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.

Connecting

1. Check both service valves are fully open.
2. Remove dust caps from gauge connections on service ports.
3. Coat threads and flares with compressor oil.
4. Connect the charging and testing equipment referring to manufacturer's instructions.

Remove

5. Engine must be stopped prior to disconnecting equipment.
6. Close both service ports.
7. Disconnect charging lines.
8. Refit dust caps to compressor valve stems, service ports and charging lines.

DISCHARGING SYSTEM

NOTE: Before discharging, see General service information. Always use refrigerent recovery and recycling equipment where available following manufacturers instructions.

WARNING: Wear eye and hand safety protection. Open connections slowly in case liquid or pressure is present. Allow to bleed off slowly.

Discharging

1. Connect manifold gauge set according to manufacturer's instructions.
2. Connect recycling and recovery of refrigerant equipment.
3. Slowly open high side valve until refrigerant flow stops, open low side valve to remove any residual pressure.
4. When discharging refrigerant, maintain a gentle flow.
5. Measure the amount of oil discharged from the system. Add an equal amount of new oil to system during charging operation.

CAUTION: When disconnecting compressor hoses, the compressor should be sealed by closing relevant service valve. It is essential to ensure that both service valves are open before operating compressor.

EVACUATE SYSTEM

If air conditioning system is opened to atmosphere it must be evacuated to remove all air and moisture. Evacuating is necessary before charging system and also provides a system check for leaks.

Evacuating

1. Discharge system. ***See Discharging system***
2. Connect charging and testing equipment referring to manufacturer's instructions.
3. Slowly open vacuum control valve to avoid removing residual oil in system.
4. Low side gauge should indicate a vacuum of 660mm Hg in five minutes.
5. If this is not achieved it shows system leaks or vacuum pump is defective.
6. Check vacuum pump, if working properly, then leak test air conditioning system.
7. Continue evacuating for 30 minutes to ensure removal of all moisture.
8. Stop vacuum pump and check vacuum holds for few minutes. Any pressure rise denotes a leak or moisture remaining in system. Remedy as necessary.
9. Once system is evacuated, it is ready for charging.

QUICK FLUSHING

△ **NOTE: This operation is in addition to evacuating, and removes excess moisture content from systems left open to atmosphere.**

1. Fit a new receiver drier. ***See Receiver drier***
2. Connect charging and testing equipment and follow the equipment manufacturer's instructions for quick flushing.
3. Evacuate system.
4. Charge system with about 0.35 Kg of refrigerant.
5. Allow refrigerant introduced to remain for ten minutes.
6. Evacuate system. ***See Evacuate system***

CHARGING SYSTEM

⚠ **CAUTION: Do not charge liquid refrigerant into compressor. Liquid cannot be compressed. If liquid refrigerant enters compressor inlet valve, severe damage is possible. Also compressor oil may be absorbed into refrigerant, causing damage when compressor is operated.**

Charging

1. Evacuate system. ***See Evacuate system***
2. Follow manufacturer's instructions for charging system with refrigerant.
3. Ensure that full charge of refrigerant: **1.19 kg** is drawn into system.
4. Check system operates satisfactorily with a pressure test. ***See Pressure test system***

⚠ **CAUTION: Overcharging air conditioning system will cause excessive head pressure.**

LEAK TEST SYSTEM

The following instructions refer to an electronic type refrigerant leak detector which is the safest, most sensitive and widely used.

1. Place the vehicle in a well ventilated area but free from draughts, as leakage from the system could be dissipated without detection.
2. Follow the instructions issued by the manufacturer of the particular leak detector being used.
3. Commence searching for leaks by passing the detector probe around all joints and components, refrigerant gas is heavier than air.
4. 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.
5. Insert the probe between the magnetic clutch and compressor to check the shaft seal for leaks.
6. Check all service valve connections, valve plate, head and base plate joints and back seal plate.
7. Check the condenser for leaks at the hose connections.
8. If any leaks are found, the system must be discharged before rectification.
9. Rectify any leaks and recheck for leaks during evacuation prior to charging.

PRESSURE TEST SYSTEM

1. Fit charging and test equipment.
2. Start engine.
3. Run engine at 1,000 to 1,200 rev/min. Adjust heat controls: Set to cold, close air supply to dash vents, slide levers to air conditioning **'ON'** and fan speed to maximum.
4. Note ambient temperature in immediate test area check high pressure gauge readings. Discharge side - against Table 1.

Pressure gauge readings will vary within range quoted with rate of flow of air over condenser, higher readings resulting from a low air flow. A blower fan is recommended for additional air flow over condenser if temperatures are over 27°C, so consistent analysis can be made of readings.

5. If pressure readings are outside limits quoted, refer to fault diagnosis. ***See Fault diagnosis, Air conditioning - electrical - mechanical faults***
6. Stop engine.
7. Close both service ports and close all valves on charging and test equipment. Disconnect charging lines from compressor. Refit dust caps to compressor valve stems, port connections and charging lines.

Table 1

Ambient Temperature		Compound Gauge Readings		High Pressure Gauge Readings	
°C	°F	bar	p.s.i.	bar	p.s.i.
16	60	1,03-1,4	15-20	6,9-10,3	100-150
26,7	80	1,4-1,72	20-25	9,6-13,1	140-190
38	100	1,72-2,1	25-30	12,4-15,5	180-225
43,5	110	2,1-2,4	30-35	14,8-17,2	215-250

SYSTEM TEST

1. Place the vehicle in a ventilated, shaded area free from excessive draught, with the doors and windows open.
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.
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.
4. Check that the evaporator condensate drains are open and clear.
5. Check the tension of the compressor driving belt, and adjust if necessary.
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 12 and is deposited when the refrigerant evaporates from a leak.**

7. Start the engine.
8. Set the temperature control switch to maximum cooling 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.
9. With the temperature control at maximum cooling and the blower control at high speed, warm up the engine and fast idle at 1,000 rev/min. Check the sight glass for bubbles or foam. The sight glass should be generally clear after five minutes running, occasional bubbles being acceptable. Continuous bubbles may appear in a serviceable system on a cool day, or if there is insufficient air flow over the condenser at a high ambient temperature.
10. Repeat at 1,800 rev/min.
11. Gradually increase the engine speed to the high range, and check the sight glass at intervals.
12. Check for frosting on the service valves and evaporator fins.
13. Check the high pressure hoses and connections by hand for varying temperature. Low temperature indicates a restriction or blockage at that point.
14. Switch off the air conditioning blower and stop the engine.
15. If the air conditioning equipment is still not satisfactory, proceed with the pressure test as previously described in this section.

COMPRESSOR

Service repair no - 82.10.20.

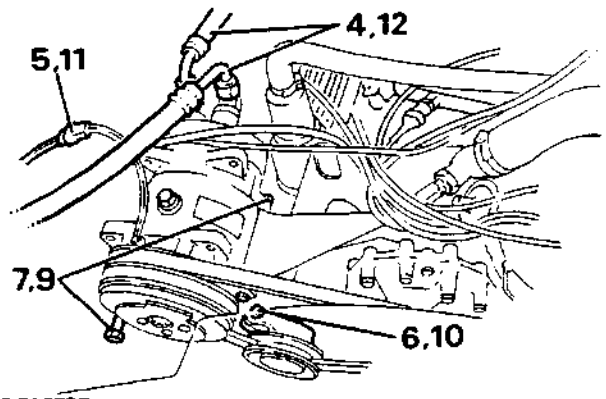
Remove and refit

Remove

1. Site vehicle in a ventilated area.
2. Disconnect the battery negative lead.
3. Discharge the air conditioning system. ***See Discharging system***

WARNING: Wear eye and hand protection when disconnecting components containing refrigerant.Plug all exposed connections immediately.

4. Disconnect suction and discharge unions from compressor.
5. Disconnect electrical lead to compressor clutch.
6. Slacken idler pulley and release drive belt.
7. Remove the two compressor mounting bolts and lift compressor clear.



Refit

8. If a new compressor is being fitted, drain oil from new compressor. Drain and measure oil from old compressor. Measure new oil equal to amount drained from old compressor. Add 30 ml of new oil to this amount and refill new compressor.
9. Locate compressor in position, fit and tighten mounting bolts.
10. Fit compressor drive belt. ***See Adjustment, Compressor drive belt***
11. Connect electrical lead to compressor clutch at the connector.
12. Evacuate air conditioning system. ***See Evacuate system***
13. Charge air conditioning system. ***See Charging system***

COMPRESSOR OIL LEVEL

Type: Sanden 709

Check

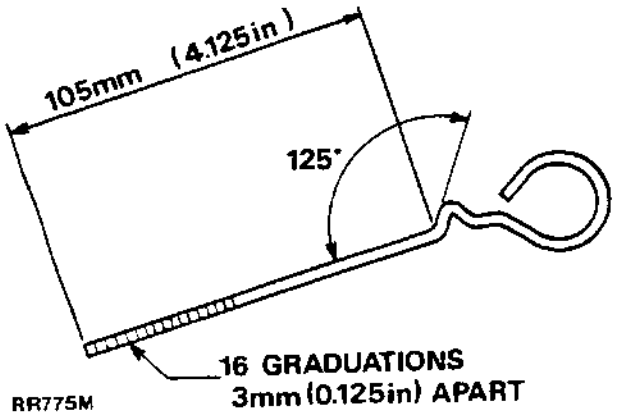
It is **not** necessary to check compressor oil level as part of routine maintenance.

NOTE: The compressor oil level should be checked whenever any components, are removed and refitted, or when a pipe or hose has been removed and reconnected or, if a refrigerant leak is suspected.

All compressors are factory charged with 135 ± 15 ml of oil. When air conditioning equipment is operated some of the oil circulates throughout the system with the refrigerant, the amount varying with engine speed. When the system is switched off oil remains in the pipe lines and components, so the level of oil in compressor is reduced, by approximately 30 ml.

The compressor oil level must finally be checked after the system has been fully charged with refrigerant and operated to obtain a refrigerated temperature of the car interior. This ensures correct oil balance throughout the system.

The compressor is not fitted with an oil level dipstick, and a suitable dipstick must be made locally from 3mm diameter soft wire in accordance with accompanying illustration. After shaping, mark the end of dipstick with sixteen graduations 3mm apart.



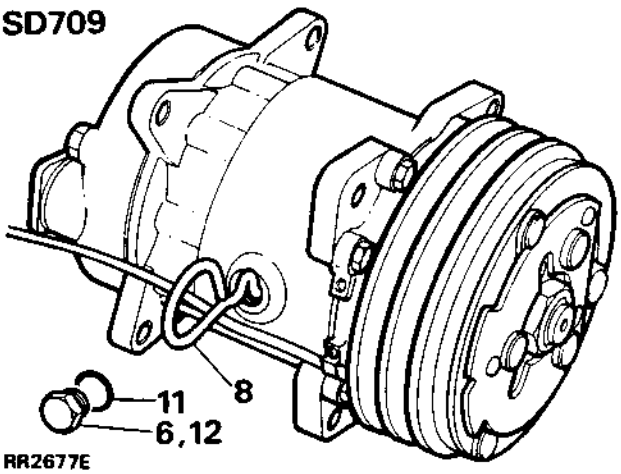
RR775M

Procedure

1. Open the bonnet.
2. Fit charging and testing equipment.
3. Start engine and turn temperature control to maximum cooling position, and the air flow control to **HIGH** speed. Operate system for ten minutes at engine idle speed.

CAUTION: Open valve slowly to avoid sudden pressure reduction in compressor crankcase that could cause oil to leave the compressor.

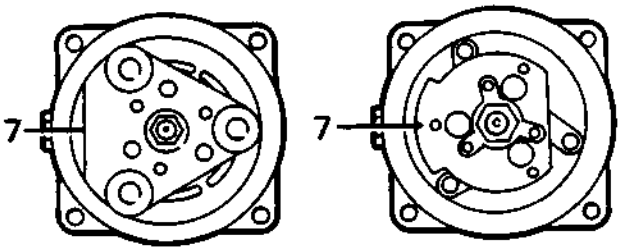
4. Reduce engine speed to idling, and **SLOWLY** open suction side valve on the test equipment until the compound gauge reads 0 or below.
5. Stop engine at this point and quickly open suction valve and discharge valve.



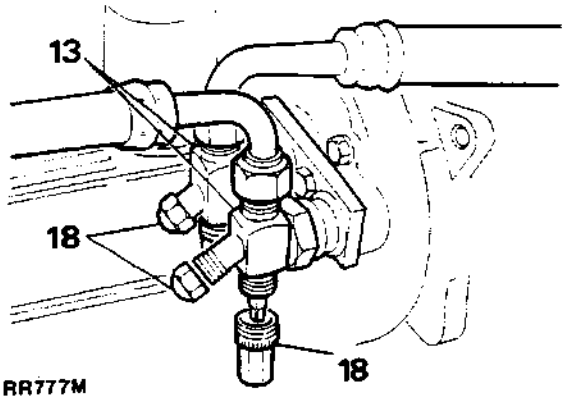
RR2677E

6. Slacken oil filler plug and unscrew it slowly by five turns to bleed off crankcase pressure.

NOTE: The oil filler plug on compressors fitted to Diesel engines is opposite side to that shown. Oil check procedure is the same.



RR3786M



RR777M

7. Remove oil filler plug. Align counterweight to position shown to enable dipstick to be inserted to its full length.
8. Wipe dipstick and insert to its stop position, ensuring the angle of dipstick is flush with the surface of fille orifice.
9. Withdraw dipstick and count the number of graduations to determine depth of oil.
10. **Oil level - SD 709:** fifteen to sixteen graduations. Add or remove oil as necessary until the mid-range figure is obtained. It is recommended that a syringe is used for adding or removing oil. Use only the correct compressor oil. ***See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended lubricants and fluids***
11. Lubricate new 'O' ring with compressor oil, fit to level plug and install loosely.
12. Evacuate air from compressor. Tighten filler plug to ***10 Nm. See Evacuate system***
13. Close suction and discharge valves.
14. Run the engine at 1,200 rev/min and check for leaks at the compressor level plug. Do not overtighten to correct a leak. In the event of a leak isolate compressor as described in instructions 4 to 6. Check 'O' ring seals for dirt, etc.
15. Stop engine.
16. Close all valves on charging and testing equipment.
17. Disconnect charging lines from compressor.
18. Refit dust caps to compressor valve stems and gauge connections, and to the charging lines.

CONDENSER

Service repair no - 82.15.07.

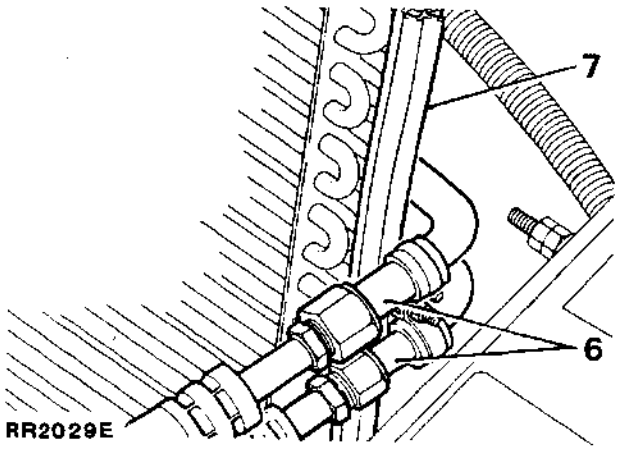
Remove and refit

Remove

1. Disconnect the battery negative lead.

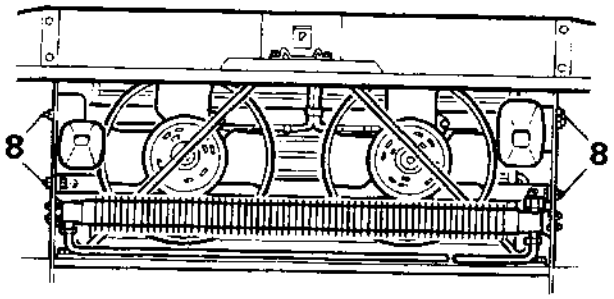
WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

2. Discharge air conditioning system. ***See Disharging system***
3. Remove front grille panel.
4. Remove radiator. ***See COOLING SYSTEM, Repair, Radiator/oil coolers - RR2591E***
5. Disconnect two fan motor wiring connections.



RR2029E

6. Disconnect hoses at condenser end.
7. Remove each vertical radiator seal.



RR1859E

8. Remove four bolts securing condenser, remove condenser and fan motor assembly.

Refit

9. Reverse removal procedure. 3 to 8 above.
10. Add 30 ml of oil to compressor to compensate for oil loss if a new condenser is fitted.
11. Evacuate air conditioning system. ***See Evacuate system***
12. Charge the system. ***See Charging system***
13. Carry out leak test on disturbed joints. ***See Leak test system***
14. Check air conditioning operation by carrying out a System Test. ***See System test***

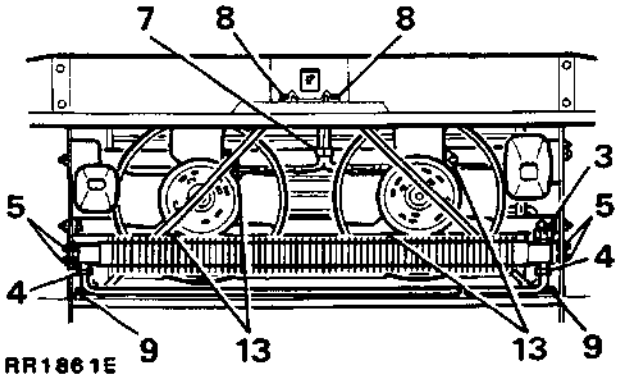
CONDENSER FANS AND MOTORS

Service repair no - 82.15.01.

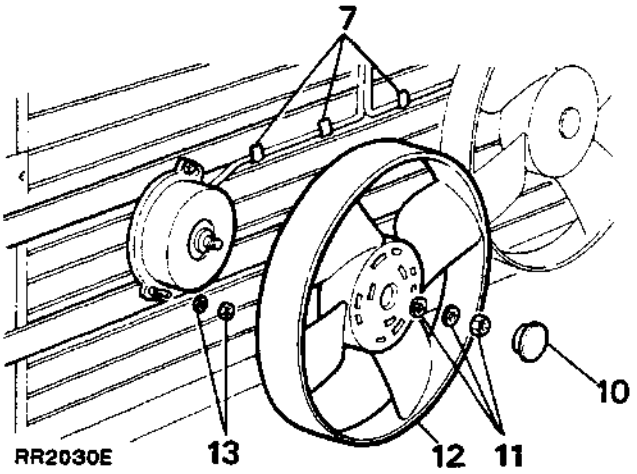
Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove grille panel.
3. Disconnect wiring connectors to transmission oil cooler.
4. Loosen fittings and detach oil cooler hoses.
5. Remove two mounting bolts from each side and withdraw transmission oil cooler.



6. Disconnect two fan motor wiring connectors.
7. Release wiring securing clips.
8. Loosen two bolts securing upper striker support stays.
9. Remove bolts securing lower ends of support stays and pivot both stays forward.
10. Remove dust caps from fan centres.



11. Remove securing nut and washers.
12. Withdraw fan blade from motor shaft.
13. Remove nuts and washers securing each motor and withdraw fan motor assemblies.

Refit

14. Reverse removal procedure. Ensuring that wiring is clipped and no fouling of fan blades occurs.
15. Check gearbox fluid level, refill if necessary.

EVAPORATOR ASSEMBLY

Service repair no - 86.25.00.

Remove and refit

WARNING: All work involving the service and maintenance of air conditioning requires special equipment, knowledge, experience and a full awareness and adhesion to the safety precautions.

Expansion valve

To remove expansion valve follow instructions 1 to 21 and to refit follow instructions 31 to 49.

Hose-Compressor to evaporator

To remove hose - compressor to evaporator follow instructions 1 to 19 and to refit follow instructions 35 to 49.

Hose-receiver drier to evaporator

To remove hose - receiver drier to evaporator follow instructions 1 to 19 and to refit follow instructions 35 to 49.

Blower assembly

To remove blower assembly follow instructions 1 to 22 and to refit follow instructions 30 to 49.

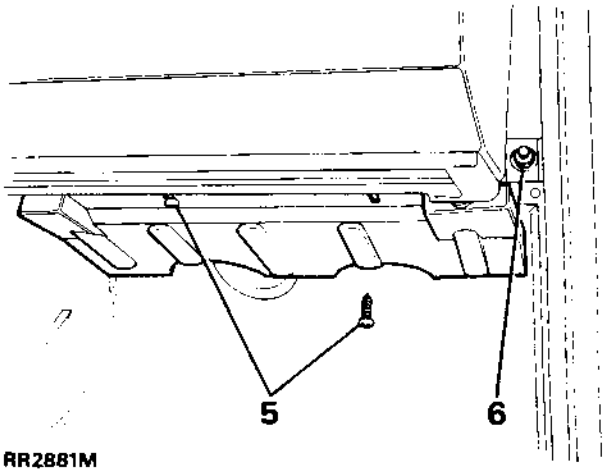
Evaporator assembly

Remove

1. Open bonnet and connect gauge set.

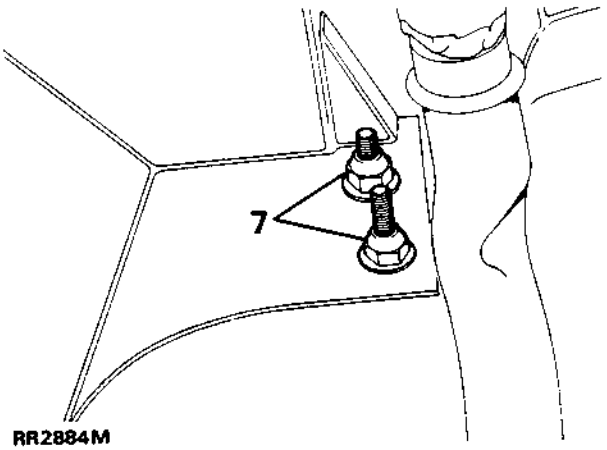
WARNING: Wear eye and hand protection when disconnecting components containing refrigerant.Plug all exposed connections immediately.

2. Discharge system. ***See Discharging system***
3. Disconnect the battery negative lead.
4. Disconnect evaporator hoses from compressor and receiver drier.
5. Working underneath dash unit remove two screws securing blower closing panel. Slide panel out of two lower retaining clips.



RR2881M

6. Remove nut and washer from evaporator case mounting bracket.
7. Remove two nuts securing, both centre dash panel and evaporator case mounting bracket.



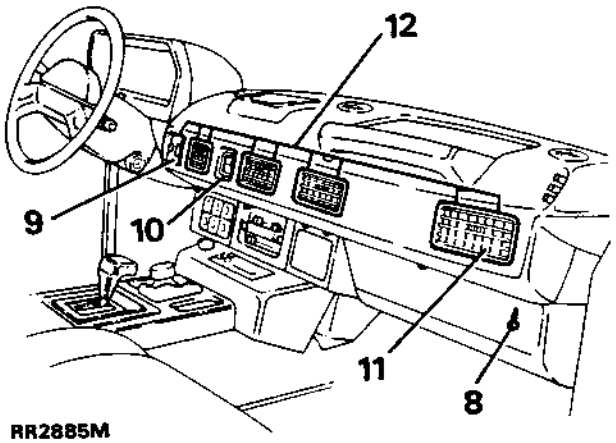
RR2884M

8. Remove six screws securing lower edge of louvre panel to evaporator case.

CAUTION: Dash components can easily be scratched or damaged by incorrect leverage and excessive force.

9. Pry out, using equal leverage top and bottom, mirror control switch. Disconnect the two multiplugs.
10. Repeat instruction 9 for removal of clock. Disconnect electrical leads and bulb holder.

11. Pry out, along the lower edge, four air vents.
12. Remove nine screws securing the evaporator housing and louvre panel to dash top.



RR2885M

13. Withdraw panel clear of dash top.
14. Withdraw refrigerant hoses and evaporator condensation drain tubes through bulkhead.
15. Remove air hose from the end of evaporator case upper.
16. Disconnect electric wiring to blower motor and electronic thermostat at multiplugs.
17. Remove evaporator case assembly from vehicle.

Disassemble

18. Remove insulation from evaporator and expansion valve hose connections.
19. Disconnect hoses from expansion valve and evaporator. Use a second wrench to support hose adaptors and plug connections.
20. Unclamp sensor coil from evaporator outlet pipe.
21. Unscrew expansion valve from evaporator. Plug connection.
22. Remove eight securing screws and detach blower units from evaporator case.
23. Remove screws securing upper evaporator casing to evaporator lower case.
24. Remove thermister probe and lift off upper casing.
25. Remove insulation pad and screws securing evaporator to lower casing.
26. Withdraw evaporator from casing.

Assemble

27. Secure evaporator to lower casing.
28. Fit insulation pad.
29. Screw casing together and fit thermister probe.
30. Refit and secure blower units to evaporator casing.

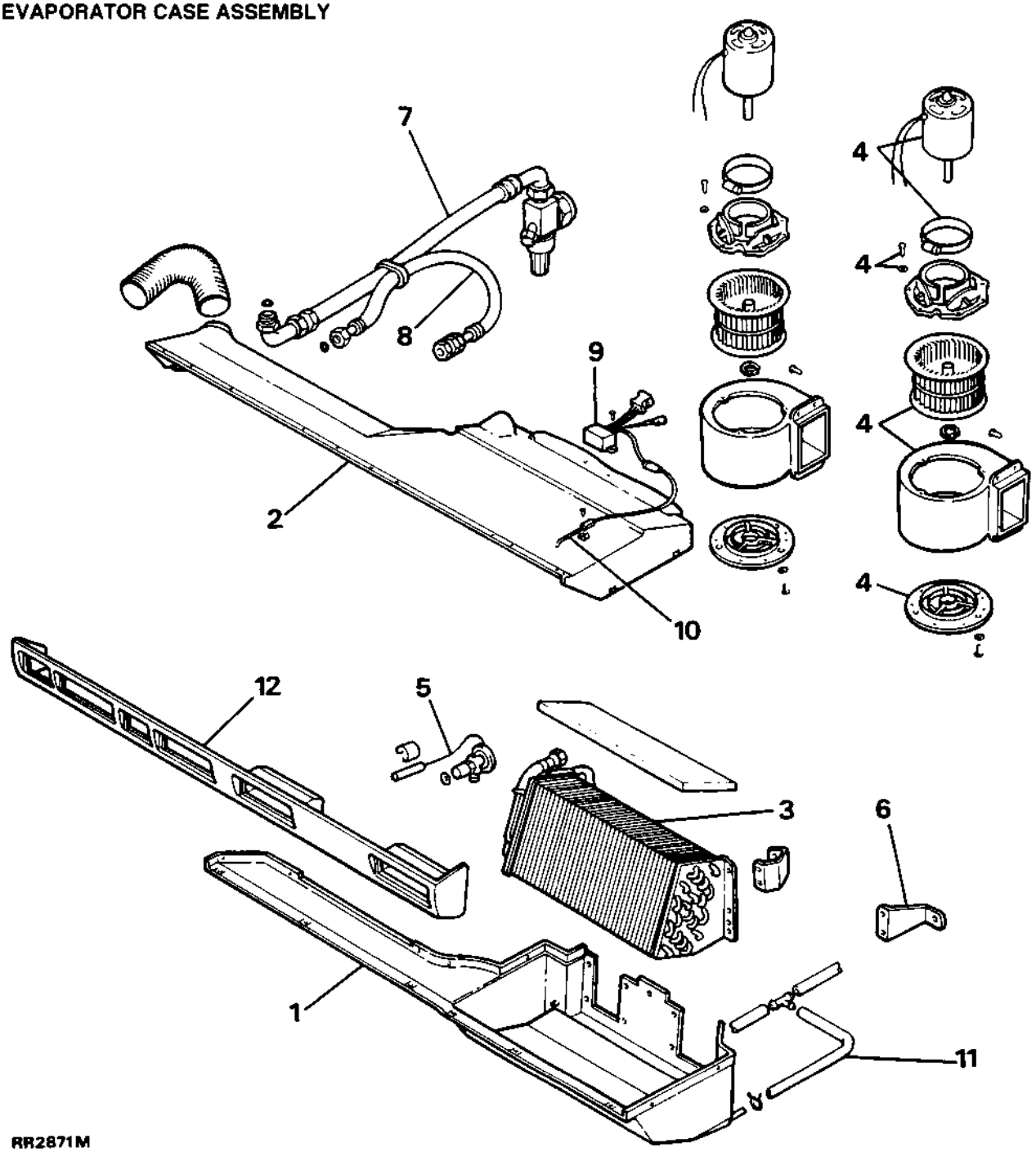
△ **NOTE: Use refrigerant compressor oil on all mating surfaces. Tighten connections to correct torque.**

31. Assemble expansion valve to evaporator with inlet facing downwards.
32. Clamp sensor coil to evaporator outlet pipe.
33. Connect hoses to evaporator and expansion valve. Use new 'O' rings.
34. Wrap all exposed metal at hose connections with prestite tape.

Refit

35. Place evaporator assembly in vehicle, reconnect two wiring connectors disconnected at instruction 16.
36. Feed hoses and evaporator condensation tubes through bulkhead. Ensure that openings and grommets are sealed against ingress of dust and moisture.
37. Fit evaporator assembly to its location and reconnect air hose at the end of evaporator casing. Ensure centre dash panel is eased over evaporator case mounting bracket on shared fixing point.

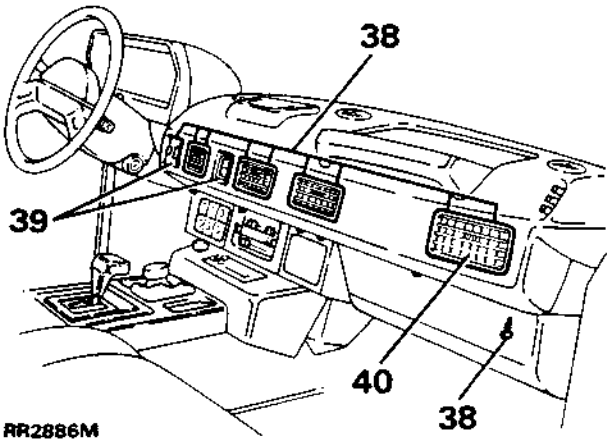
EVAPORATOR CASE ASSEMBLY



RR2871M

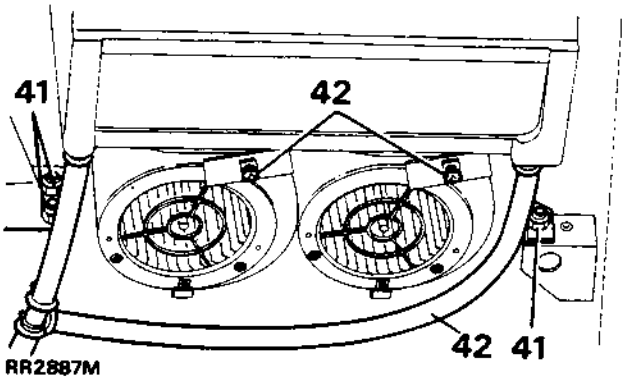
1. Evaporator case lower
2. Evaporator case upper
3. Evaporator
4. Blower Assy
5. Expansion Valve
6. Mounting Bracket
7. Hose Assy Suction
8. Hose Assy Liquid
9. Thermostat
10. Thermister Probe
11. Drain Hose Assy
12. Louvre Panel

38. Feed electrical connections to clock and mirror control switch through their apertures in louvre panel. Refit louvre panel.
39. Reconnect electrics to clock and mirror control switch, fit them to louvre panel.
40. Fit air vents.



RR2886M

41. Secure, using new nuts and plain washers, evaporator case mounting brackets.
42. Ensure condensation tubes are free from kinks and able to drain water. Fit blower closing panel.
43. Connect two refrigerant hoses to compressor and receiver drier. Tighten to *37 Nm*.



RR2887M

44. Evacuate system. ***See Evacuate system***
45. Charge complete system. ***See Charging system***
46. Leak test any disturbed joints. ***See Leak test system***
47. Perform a functional check.
48. Check compressor oil level. ***See Compressor oil level***
49. Disconnect gauge set.

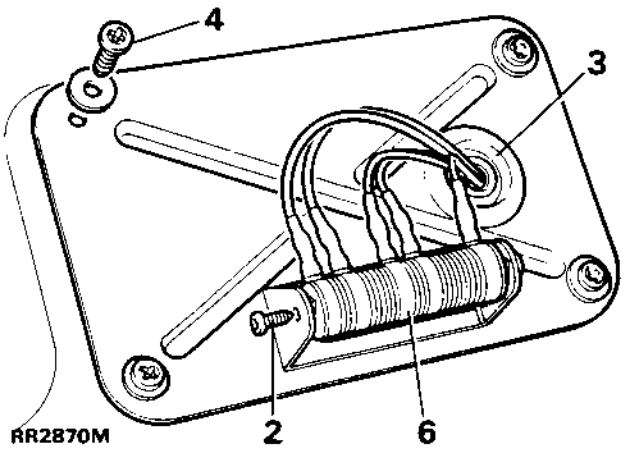
RESISTOR UNIT

Remove and refit

The resistor unit is located on front dash closing panel underneath decker panel.

Remove

1. Disconnect the battery negative lead. Remove decker panel. ***See CHASSIS AND BODY, Repair, Decker panel***
2. Remove two screws securing resistor.
3. Release grommet from housing.
4. Remove four screws from front dash closing panel.
5. Disconnect resistor electrical wiring at multiplug.
6. Remove resistor complete with wiring and multiplug.



RR2870M

Refit

7. Reverse removal procedure.

RECEIVER DRIER

Service repair no - 82.17.01.

Remove and refit

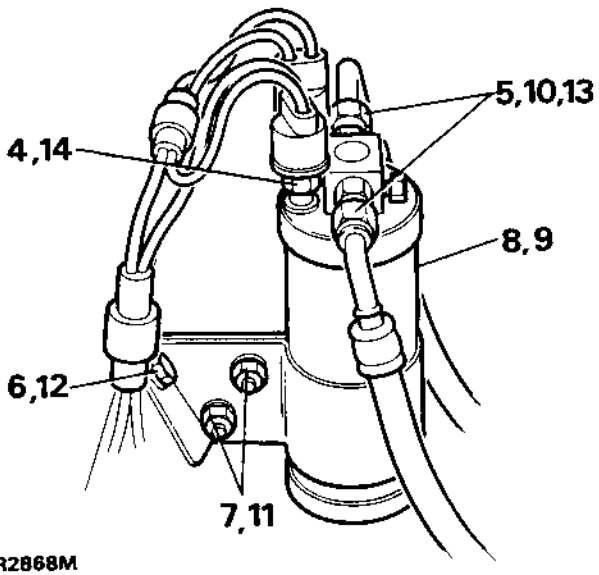
CAUTION: Immediate blanking of receiver drier is important. Exposed life of unit is only 15 minutes.

Remove

1. Connect gauge set. ***See Charging and testing equipment***

WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

2. Discharge system. ***See Discharging system***
3. Disconnect the battery negative lead.
4. Disconnect electrical leads at two plug connectors and unscrew, at hexagon nut, the pressure switches from receiver drier.



RR2868M

5. Disconnect two hose connections. Use a second spanner to support hose adaptor.
6. Remove bolt, nut and washers securing mounting bracket to wing valance.
7. Remove clamp bolts, washers and nuts.
8. Withdraw receiver drier from mounting bracket.

Refit

9. Fit receiver drier into mounting bracket with inlet and outlet connections correctly fitted.
10. Connect two hose connections finger tight.

△ **NOTE: Use refrigerant compressor oil on all mating surfaces to prevent leakage.**

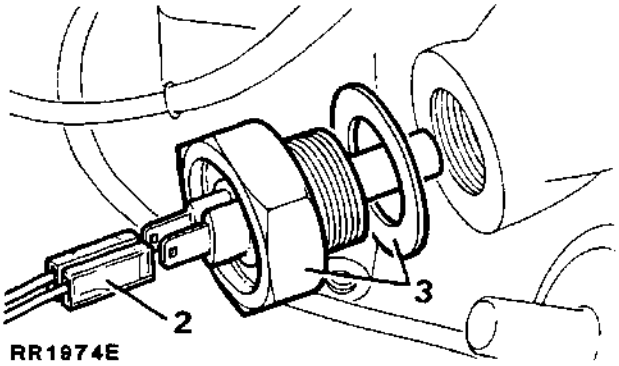
11. Fit clamp bolts, washer and nuts.
12. Secure mounting bracket to wing valance.
13. Tighten two hose connections to ***18 Nm. Use a second spanner to support hose adaptor.***
14. Refit pressure switches to receiver drier. Tighten to ***23 Nm.***
15. Reconnect electrical leads as shown.
16. Evacuate complete system. ***See Evacuate system***
17. Charge complete system. ***See Charging system***
18. Perform a leak test on any disturbed joints.
19. Carry out a functional check.
20. Check compressor oil level. ***See Compressor oil level***
21. Disconnect gauge set.

COOLANT TEMPERATURE SENSOR

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect electrical leads from sensor.
3. Remove sensor from thermostat housing.



RR1974E

Refit

4. Reverse removal procedure. Using a **NEW** joint washer.

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
AIR CONDITIONING	
Compressor hose	37
Receiver drier hose	18
Receiver drier switch	23
Compressor oil filler plug	10

Notes

84 - WIPERS AND WASHERS

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Notes

FRONT SCREEN WIPER AND WASHER CIRCUIT OPERATION

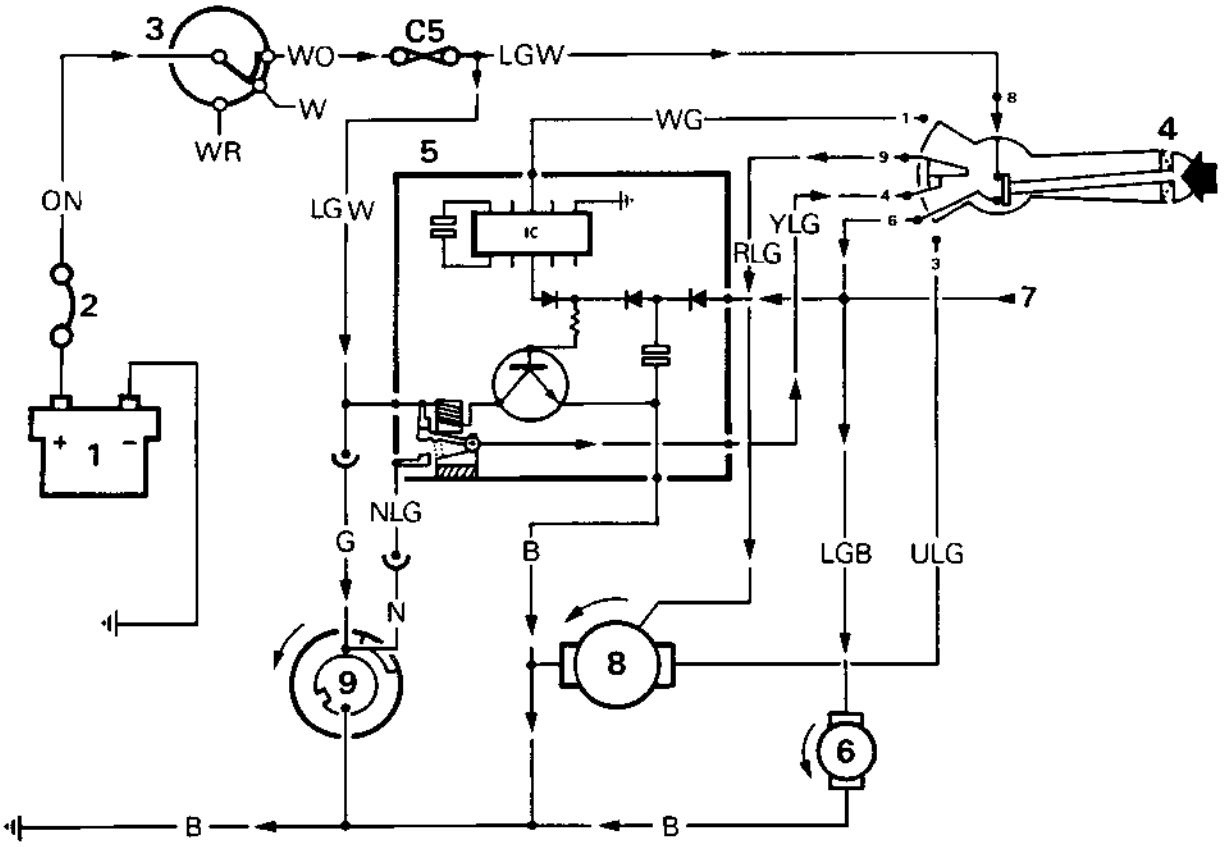
The system is operated by the multi position wiper switch, which is located on the right side of the steering column.
All functions of the switch and circuit are explained in the following paragraphs by reference to diagrams RR3694M and RR3720M.

Wash wipe function (timed) RR3694M

With the ignition switched ON, power is supplied via Fuse C5 to the multi position switch 4, control unit 5, and park switch 9 which is driven by the wiper motor 8.

Momentary depression of switch 4 connects the power supply at terminal (8) to terminal (6) causing the washer pump 6 to operate for as long as switch 4 is held depressed. Depression of switch 4 will also energize the relay inside the control unit 5 which powers the wiper motor 8 via terminals (4) and (9). The earth for the relay windings in control unit 5 is timed to allow the wipers to make three return sweeps of the screen before parking. The timed cycle begins at the moment switch 4 is released.

See head lamp power wash circuit, connection 7.



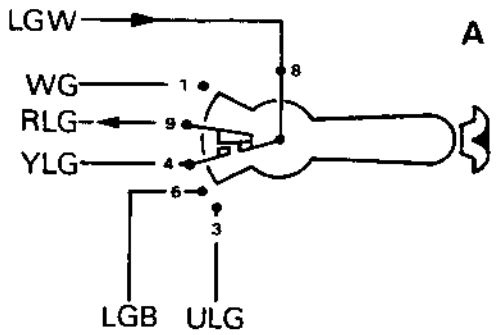
RR3694M

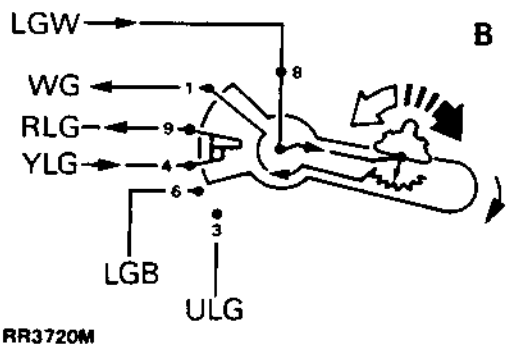
1. Battery
2. Fuse link
3. Ignition switch
4. Wiper/washer, multi position switch
5. Delay/timer control unit
6. Front screen washer motor/pump
7. Connection to head lamp power wash
8. Wiper motor
9. Park switch, driven by wiper motor

C5. Fuse 20 amp

Manual wiper function (A) RR3720M

Lifting the lever towards the driver causes the wipers to operate for as many sweeps as required, parking when the switch is released.



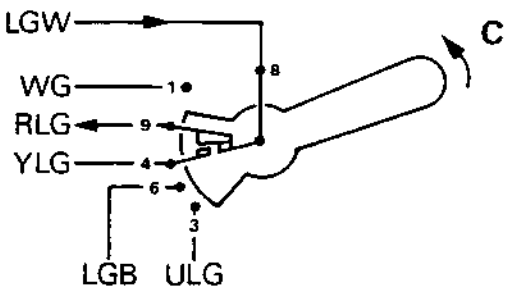


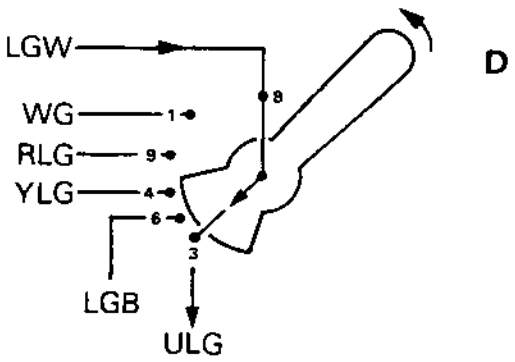
Intermittent variable delay wiper function (B) RR3720M

Moving switch 4 downwards as seen in (B) RR3720M, to the intermittent variable delay wiper function, causes the wipers to perform one return sweep of the screen with a time delay. The time between each sweep of the screen is adjusted by the rheostat in the switch lever.

Continuous slow speed function (C) RR3720M

When the lever is moved upwards to the first position, the wipers are caused to operate continuously at slow speed.





Continuous fast speed function (D) RR3720M

When the lever is moved fully upwards the wipers operate continuously at fast speed.

HEATED WASHER JETS AND LOW WATER INDICATOR

Operation

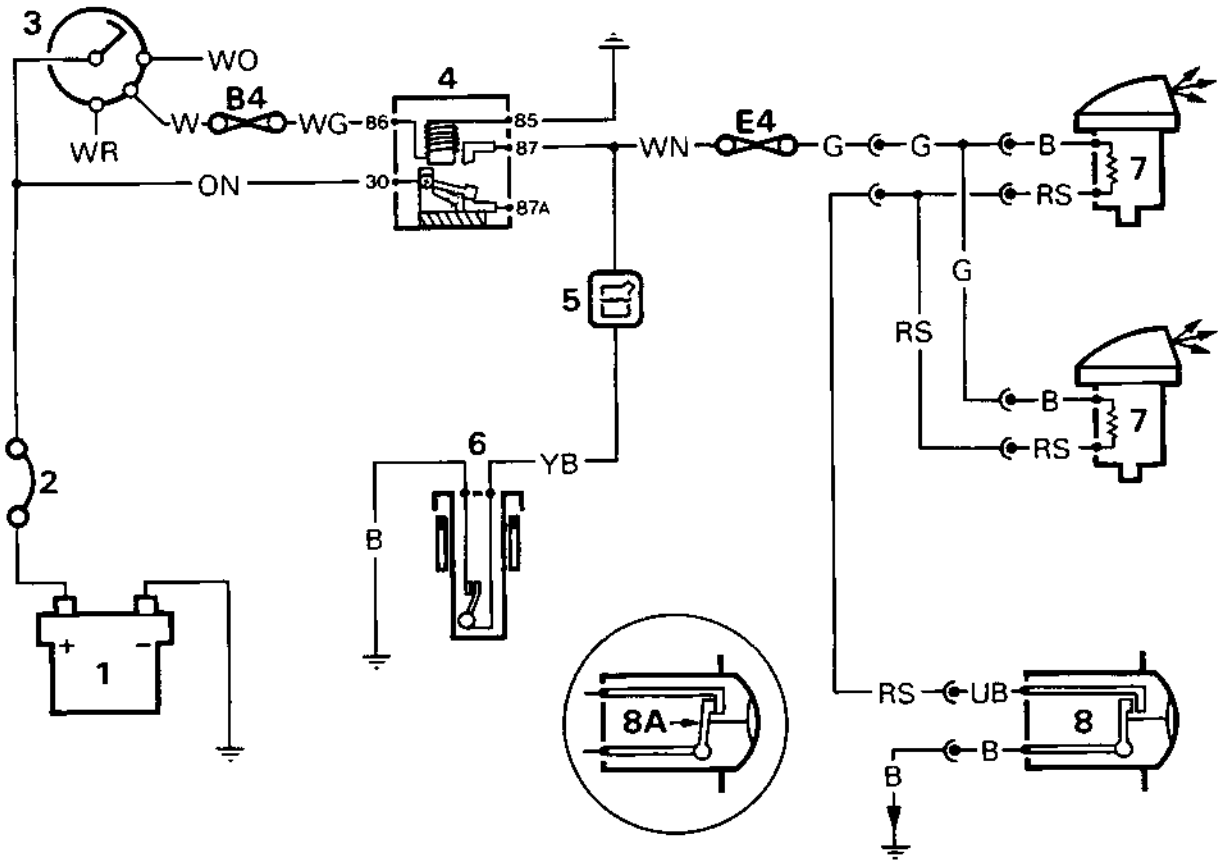
The heated washer jets and low water indicator circuit is provided with power via Fuse B4 and the ignition load relay 4. The water level indicator has a direct feed from the ignition load relay and the heated washer jets are supplied by Fuse E4.

Low water indicator

The low water monitor 6 which is located in the water bottle, consists a magnetic float which will close the switch contacts and provide an earth for the warning indicator 5, when the water level falls.

Heated jets

To prevent freezing of the washer jets 7, both jets are fitted with heating elements which are automatically earthed by the thermostat 8 when the temperature nears freezing. The thermostat which is located at the right hand end of the radiator grill is shown in operation in 8A.



RR3685M

1. Battery
2. Fuse link
3. Ignition switch
4. Ignition load relay
5. Low water indicator
6. Low water monitor
7. Heated jets
8. Thermostat, contacts open

8a. Thermostat, contacts closed

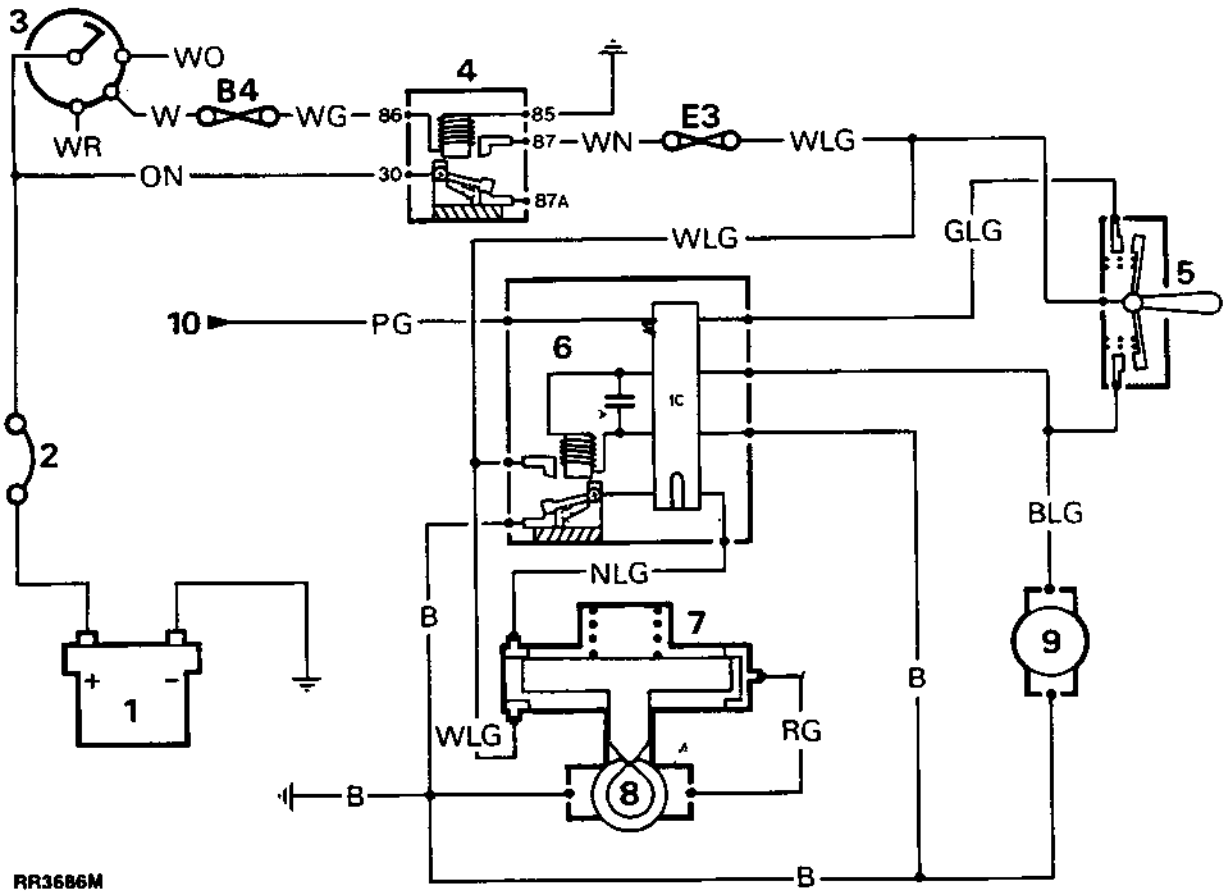
REAR WINDOW WASH WIPE

Operation

The rear window wash wipe circuit is provided with power only when the ignition is switched on via Fuse **B4**, the operation of the ignition load relay 4 and Fuse **E3**. A permanent supply to the park switch is also supplied through **Fuse B5.**

The circuit is operated by a double pole centre biased switch 5 located to the right of the steering column.

When the switch 5 is moved away from the steering wheel, the washer 9 and wiper 8 will operate for as long as the switch 5 is held. However when the switch is released the washer 9 will stop, but the wiper motor 8 through the action of the timer/delay unit 6, will continue to make three complete sweeps of the screen before parking. The parking switch 7 is cam operated by the wiper motor 8.



1. Battery
2. Fuse link
3. Ignition switch
4. Ignition load relay
5. Centre biased switch
6. Timer/delay unit
7. Park switch
8. Wiper motor
9. Wash motor/pump
10. Connection to (interior light circuit connection 16)

When switch 5 is momentarily lifted towards the steering wheel the wiper will operate and make four sweeps of the screen before parking for approximately five seconds, after which the wipe cycle will repeat. The wipe cycle will continue intermittently until the switch is again momentarily lifted to switch the system off.

The rear wiper system is connected to the courtesy light switch via connection 10. This ensures that the wiper automatically switches off when any door is opened and prevents possible damage to the wiper arm which might occur if the rear window was opened with the wiper in operation.
When the doors are again closed, the wiper will re-commence operation after approximately 15 seconds.

Notes

WIPER MOTOR CHECKING

NOTE: These instructions apply to Windscreen and Tailgate wiper motors.

If unsatisfactory operation of wiping equipment is experienced, a systematic check to determine fault should be carried out:

1. Check blades for signs of excessive friction. This reduces wiping speed of motor and cause increased current draw which may damage armature. Check by substitution.
2. Check windscreen wiper motor light running current and speed with motor coupling link disconnected from wiper shaft transmission linkage.

Check tailgate glass wiper motor with wiper connected and glass wet. Connect a ammeter in series with motor supply. Measure current consumption when motor is switched on. Check operating speed by timing speed of rotation of motor coupling link. The results should compare with figures given in 'General Specification Data'.

NOTE: If vehicle wiring connections are disconnected and an alternative supply source is applied it is essential that correct polarity is observed. Failure to observe this will cause motor to rotate in reverse direction, which may result in limit switch contacts being damaged.

3. If motor does not run satisfactorily or takes higher than normal current, a fault exists and must be remedied.
4. If current consumption and speed of motor are satisfactory. A check should be carried out for proper functioning of transmission linkage and wiper arm shafts.

NOTE: Service parts are not available for windscreen and tailgate wiper motors with exception of windscreen wiper rotary connecting link.

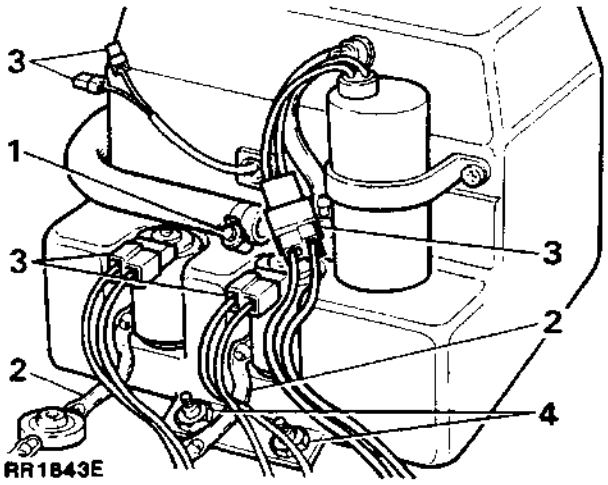
Notes

WASHER RESERVOIR

Service repair no - 84.10.03.

Remove and refit

Remove



1. Loosen hose clamp and remove power wash hose.
2. Disconnect tubing from washer pumps.
3. Disconnect electrical leads from pumps and low level warning unit.
4. Remove 3 bolts and withdraw reservoir.

Refit

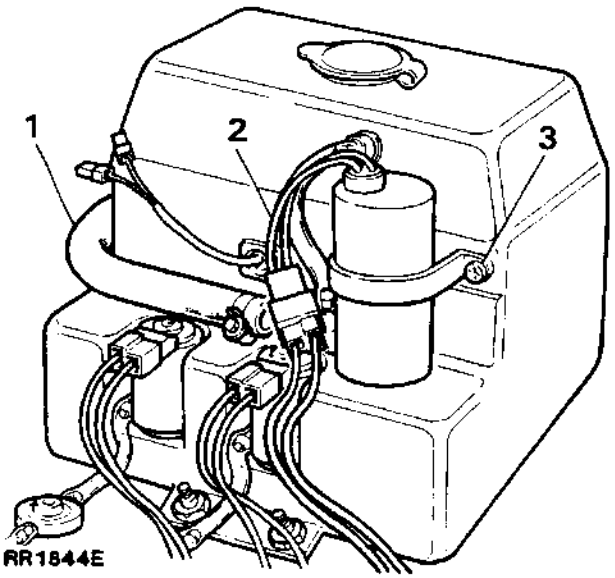
5. Reverse removal procedure.

POWER WASH PUMP

Service repair no - 84.20.21.

Remove and refit

Remove



1. Disconnect hose from power wash pump.
2. Disconnect electrical leads from pump.
3. Remove two screws and withdraw power wash pump.

Refit

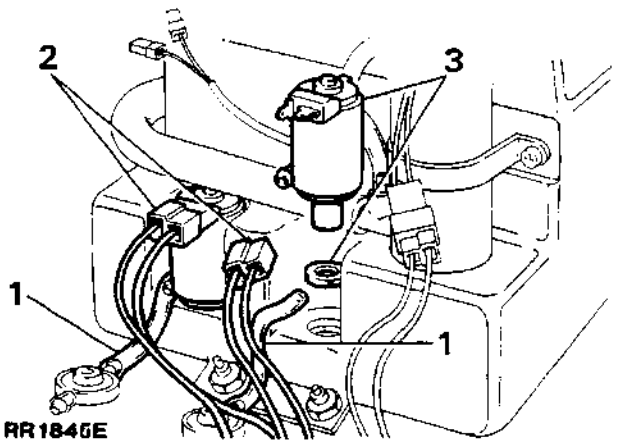
4. Reverse removal procedure.

WASHER PUMP - WINDSCREEN OR TAILGATE

Service repair no - 84.10. 21.

Remove and refit

Remove



1. Disconnect washer tubing from pump.
2. Disconnect electrical leads from pump.
3. Pull top of pump away from its location in reservoir and remove pump. Note position of sealing gasket in reservoir.

Refit

4. Reverse removal procedure.

HEATED WINDSCREEN WASHER JETS

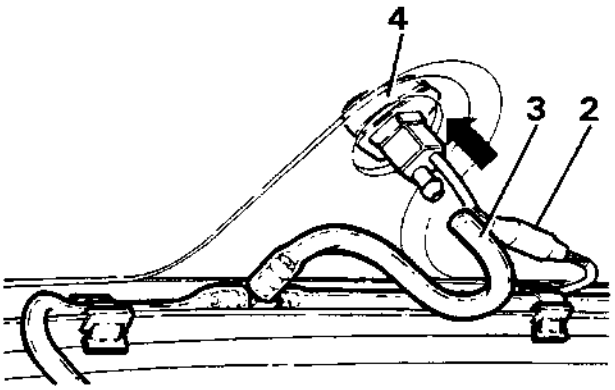
Service repair no - 84.10. 09.

Remove and refit

Remove

△ **NOTE: The thermostat will close at 4°C ± 3°C and re-open at 10°C ± 3°C.**

1. Disconnect the battery negative lead.



2. Disconnect electrical connection at plug.
3. Withdraw washer tube from jet.
4. Push jet upwards to remove from its mounting.
5. Remove washer jet mounting from bonnet, if necessary.

Refit

6. Reverse removal procedure.

HEATED WINDSCREEN WASHER JETS THERMOSTAT

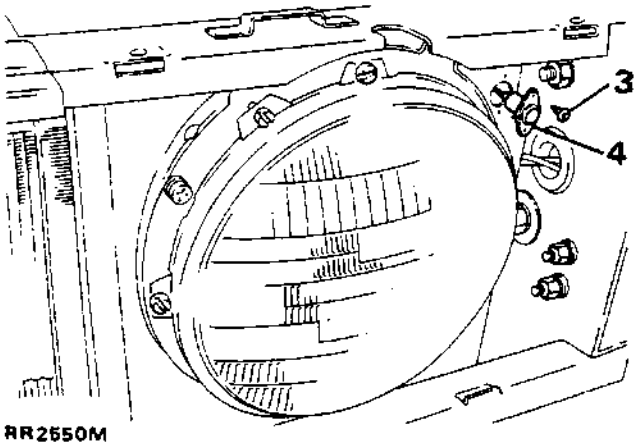
Service repair no - 84.10.12.

Remove and refit

The thermostat is located on right headlamp mounting panel.

Remove

1. Disconnect the battery negative lead.
2. Remove radiator grill. ***See CHASSIS AND BODY, Repair, Radiator grill***



RR2550M

3. Remove two screws securing thermostat to right hand headlamp mounting panel.
4. Withdraw thermostat, disconnecting electrical connector.

Refit

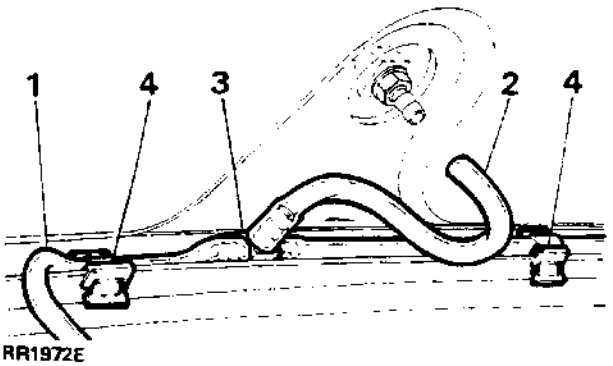
5. Reverse removal procedure.

WINDSCREEN WASHER TUBES

Service repair no - 84.10.15.

Remove and refit

Remove



RR1972E

1. Disconnect tubing from reservoir pump.
2. Disconnect tubing from washer jets.
3. Disconnect tubing from three-way tee piece.
4. Release tubing from edge clips.

Refit

5. Reverse removal procedure.

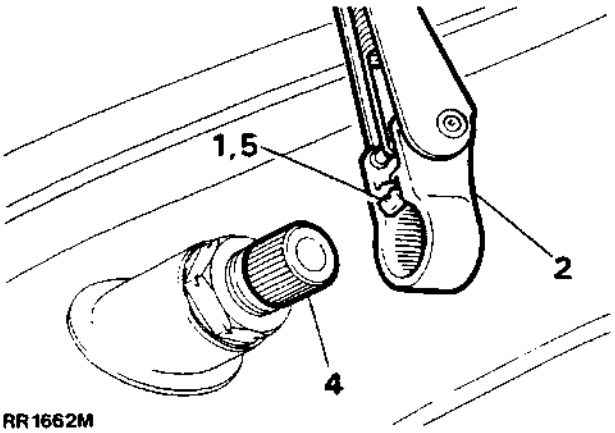
WIPER ARMS - WINDSCREEN

Service repair no - 85.15.01

Remove and refit

Remove

1. Hold back small spring clip which retains wiper arm on shaft boss using a suitable tool.
2. Gently pry off wiper arm from shaft boss.



RR1662M

Refit

3. Allow motor to move to '**park**' position.
4. Push arm on to boss, locating it on splines so that wiper blades are clear of screen rail.
5. Ensure that spring retaining clip is located in retaining groove on shaft boss.
6. Operate wiper on a wet screen to ensure blades do not over travel.

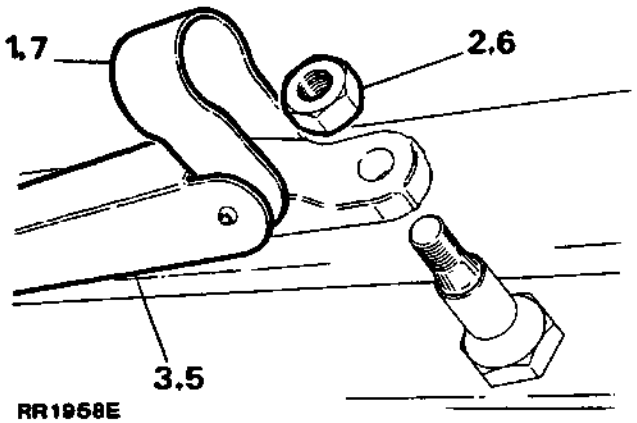
WIPER ARM - TAILGATE

Service repair no - 84.35.01.

Remove and refit

Remove

1. Lift wiper arm end cap to access wiper motor shaft.
2. Remove wiper arm securing nut.



RR1958E

3. Withdraw wiper arm from shaft.

Refit

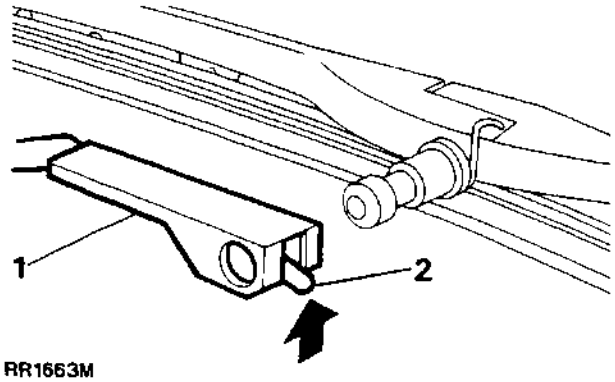
4. Allow motor to move to '**park**' position.
5. Fit wiper arm to shaft,locating it on the splines so that wiper blade is clear of screen surround.
6. Fit and tighten securing nut.
7. Push end cap back into position.
8. Check correct operation of wiper.

WIPER BLADES - WINDSCREEN AND TAILGATE

Service repair no - 84.15.05.

Remove and refit

Remove



RR1663M

1. Pull wiper arm away from glass.
2. Lift spring clip and withdraw blade from arm.

Refit

3. Reverse removal procedure.

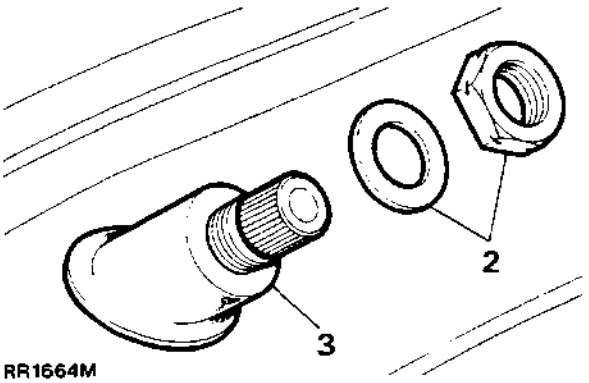
WINDSCREEN WIPER MOTOR, LINKAGE AND WHEEL BOXES

Service repair no - 84.15.12.

Remove and refit

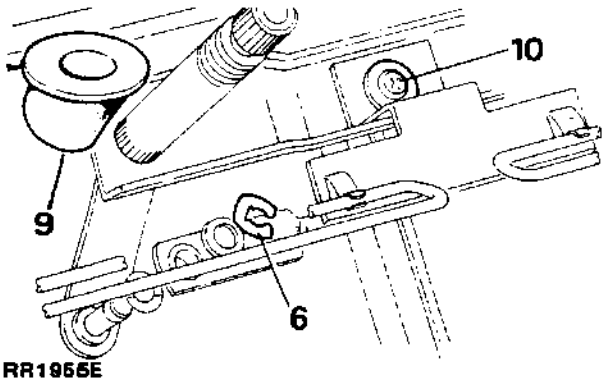
Remove

1. Disconnect the battery negative lead. Remove wiper arms.



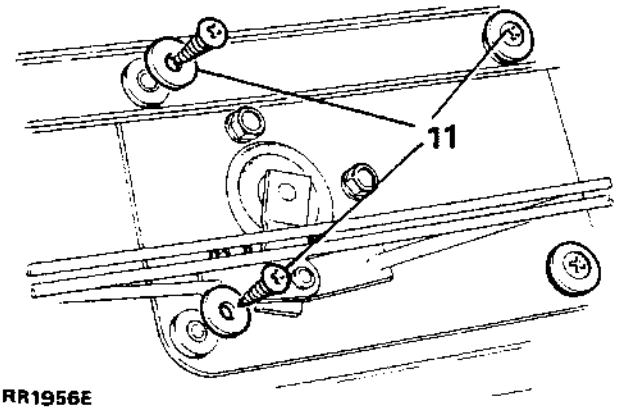
RR1664M

2. Remove locknuts from wheel boxes.
3. Remove grommet from wheel boxes.
4. Remove bonnet. ***See CHASSIS AND BODY, Repair, Bonnet***
5. Remove front decker panel. ***See CHASSIS AND BODY, Repair, Decker panel***



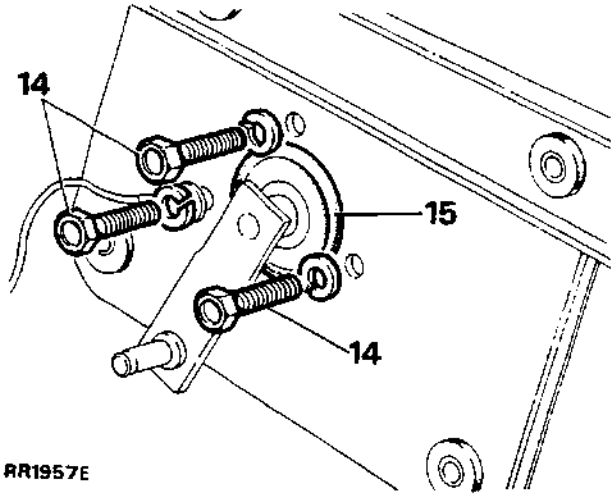
RR1955E

6. Remove spring clips securing primary links to wheelbox shaft links.
7. Remove spring clips securing primary links to motor crank.
8. Remove primary links.
9. Remove lower grommet from wheelboxes.
10. Remove screw securing bonnet torsion bar bracket. Unclip bracket from torsion bar.



RR1956E

11. Remove remaining screws securing motor and linkage assembly to bulkhead.
12. Ease unit from mounting location and disconnect electrical leads at plug and socket.
13. Withdraw unit.



RR1957E

14. Remove three bolts securing motor to mounting plate.
15. Separate motor from mounting plate by pulling motor crank through grommet.

Refit

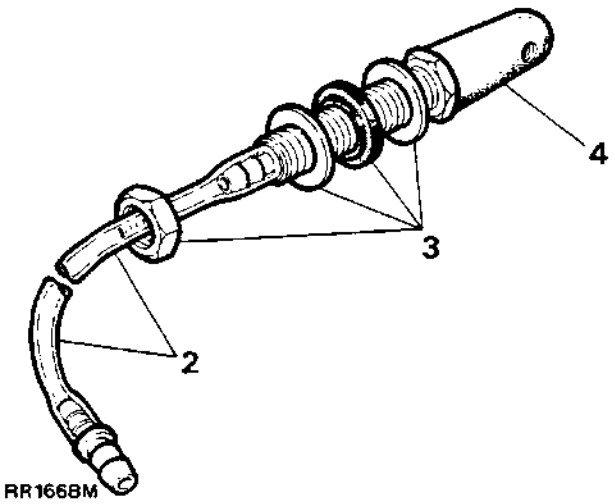
16. Reverse removal procedure.
17. Ensure primary links are mounted with bushes on inside, towards wiper motor. The shorter primary link is mounted on driver side.
18. Replace front decker panel.
19. Replace bonnnet.
20. Replace wiper arms.

TAILGATE GLASS WASHER JET

Remove and refit

Remove

1. Lower or remove headlining rear section to gain access to jet securing nut and washer tube connection.



RR1668M

2. Disconnect washer tube. Remove grommet. Drain away water in tube to avoid damaging trim.
3. Hold base of jet and remove nut and washer.
4. Withdraw washer jet from outside vehicle.

Refit

5. Reverse removal procedure.

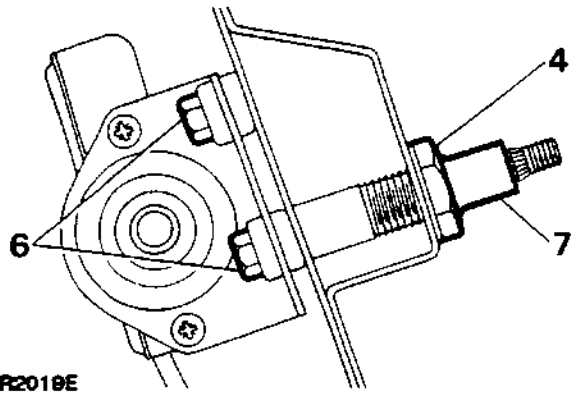
TAILGATE GLASS WIPER MOTOR

Service repair no - 84.35.12.

Remove and refit

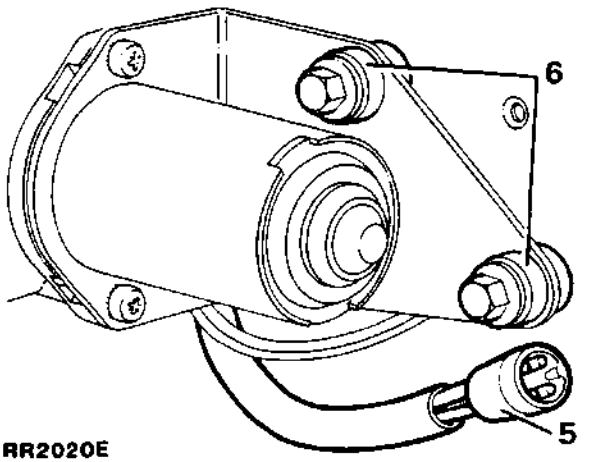
Remove

1. Disconnect the battery negative lead.
2. Lower headlining rear section to access wiper motor assembly.
3. Remove wiper arm and blade.



RR2019E

4. Loosen nut securing wiper motor to body. **DO NOT** remove at this stage.



RR2020E

5. Disconnect electrical leads at multi-plug.
6. Remove two bolts securing wiper motor to inner body.
7. Support wiper motor remove nut loosened at instruction 4, complete with protective cover, washer and seal. Simultaneously withdraw wiper motor.

Refit

8. Reverse removal procedure. Ensuring that spacer is correctly positioned before fitting motor.

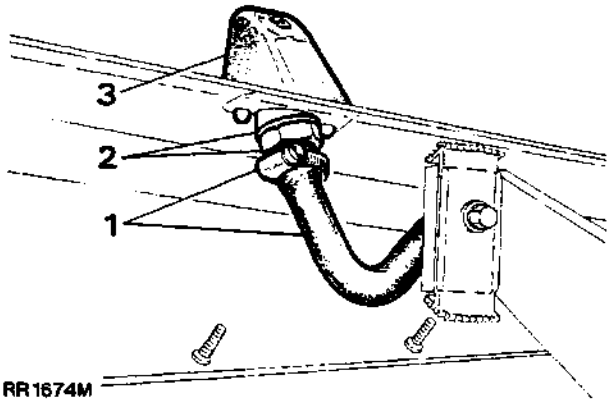
HEADLAMP POWER WASH JET

Service repair no - 84.20.08.

Remove and refit

Remove

1. Disconnect hose from power wash jet.
2. Remove nut securing jet to bumper.
3. Remove power wash jet.



Refit

4. Reverse removal procedure.

POWER WASH HOSE

Remove and refit

Remove

1. Disconnect hoses from jets and washer pump.
2. Release clamps locating hose.
3. Remove power wash hose.

Refit

4. Reverse removal procedure. Locating hose in its original position.

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TORQUE VALUES 1

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ELECTRICAL EQUIPMENT

DESCRIPTION

The electrical system is Negative ground, and it is most important to ensure correct polarity of the electrical connections at all times. Any incorrect connections made when reconnecting cables may cause irreparable damage to the semi-conductor devices used in the alternator and regulator. Incorrect polarity would also seriously damage any transistorized equipment such as radio and tachometer etc.

WARNING: During battery removal or before carrying out any repairs or maintenance to electrical components always disconnect the battery negative lead if the positive lead is disconnected with the negative lead in place, accidental contact of the wrench to any grounded metal part could cause a severe spark, possibly resulting in personal injury. Upon installation of the battery the positive lead should be connected first.

ALTERNATOR - LUCAS A133/80

The alternator is a three phase, field sensed unit. The rotor and stator windings produce three phase alternating current, AC, which is rectified to direct current, DC. The electronic voltage regulator unit controls the alternator output voltage by high frequency switching of the rotor field circuit. Use only the correct Range Rover replacement fan belt. Occasionally check that the engine and alternator pulleys are accurately aligned.

It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.

Do not disconnect battery cables while the engine is running or damage to the semi-conductor devices may occur. It is also inadvisable to break or make any connections in the alternator charging and control circuits while the engine is running.

The Model 15TR electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse effects of temperature, dust, and moisture etc.

The regulating voltage is set during manufacture to give the required regulating voltage range of 14.2 ± 0.2 volts, and no adjustment is necessary. The only maintenance needed is the occasional check on terminal connections and wiping with a clean dry cloth.

The alternator system provides for direct connection of a charge (ignition) indicator warning light, and eliminates the need for a field switching relay or warning light control unit. As the warning lamp is connected in the charging circuit, lamp failure will cause loss of charge. Lamp should be checked regularly and spare carried.

When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.

NOTE: For description and operation of 1992 model year electrical circuits see separate publication:- Electrical troubleshooting manual.

ANTI THEFT ALARM SYSTEM

For 1993 models a vehicle alarm system is available as original equipment. The main function of the system is to offer easy to use remote locking and unlocking of the vehicle without having to actively select the alarm function.

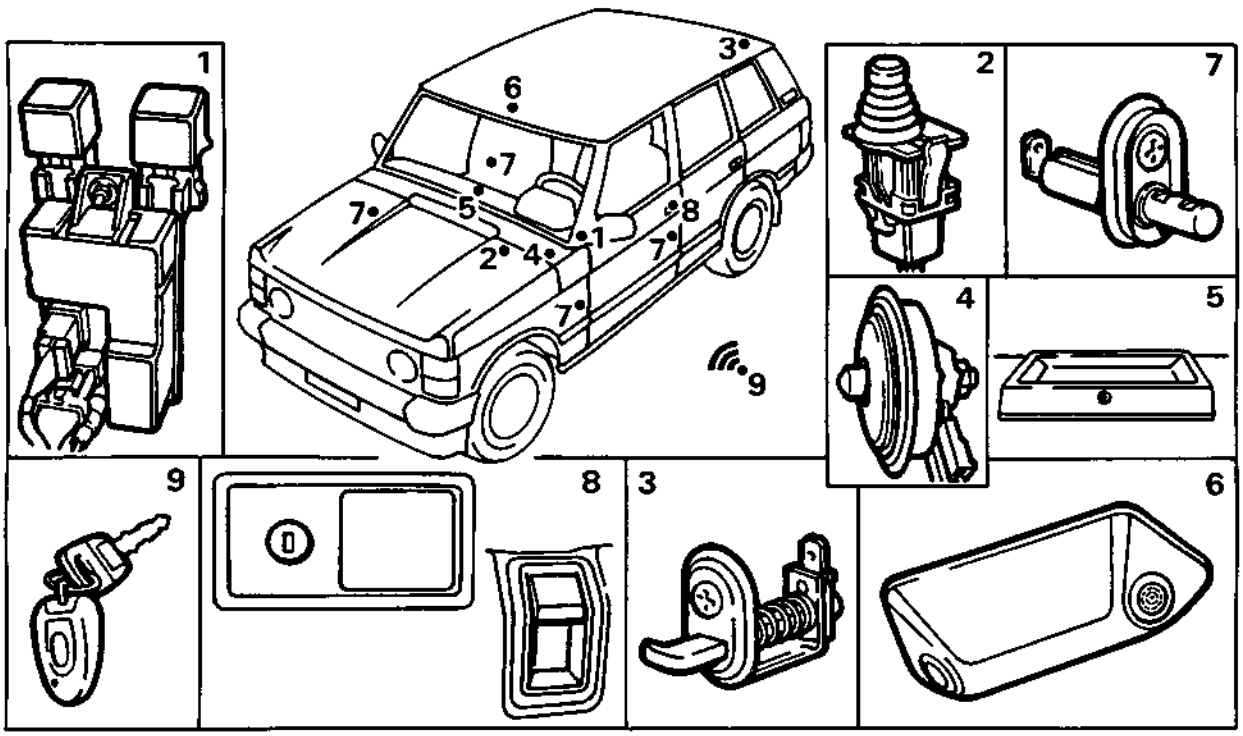
ANTI-THEFT SYSTEM FUNCTION

Perimetric protection

Using the key in the correct sequence will turn on and off perimetric protection only. When fully perimetrically armed, all doors, tailgate, and bonnet are protected against unauthorised access. If the door key is used in the normal manner the driver will be unaware of the door key sequence. The time taken to lock or unlock with the key must be less than 5 seconds. To prevent unauthorised tampering, the alarm will sound if the key is held in the unlocked position for longer than 5 seconds when armed. Cranking is disabled when perimetric protection is armed.

△ **NOTE: When key is turned left or right the keyswitch input will be activated, in conjunction with the sill button switch when links are operated.**

ALARM COMPONENTS



RR3911M

1. Electronic control unit (ECU) and relays
2. Bonnet switch
3. Tailgate switch
4. Alarm horn
5. Light emitting diode (LED)
6. Ultrasonic unit
7. Door switches
8. Lock barrel, sill buttons
9. Handset transmitter (two supplied)

Volumetric protection

Using the handset transmitter will turn on and off volumetric protection. In volumetric mode the vehicle interior is protected using the ultrasonic sensor. Using the handset also arms and disarms the vehicle perimetrically. Cranking is disabled when volumetric and perimetric protection is armed.

NOTE: If armed volumetrically the vehicle CANNOT be disarmed using the key.

Alarm horn

When an intrusion is detected the alarm horn will sound intermittently (Switzerland and Denmark continuous horn sound) and the hazard lights flash (where territorial regulations allow) for 30 seconds. The alarm must be retriggered before alarm horn will sound again.

Vehicle status indication

Vehicle status is indicated by up to three devices: (a) alarm horn, (b) hazard lights, (c) dash board LED. When the vehicle arms in either mode the hazard lights will flash three times and the LED will flash rapidly for 10 seconds. LED will then flash at a slower rate while vehicle is armed. When the vehicle disarms, hazard lights will flash once and LED will extinguish. If LED remains lit, it indicates that the alarm has been triggered. Turning on ignition or arming the alarm will extinguish LED. The LED will give a long pulse flash to indicate the ultrasonic unit being activated.

Radio frequency system

The RF system uses four frequencies according to market. If the coaxial aerial is not fitted system performance will be impaired. Both ECU and handset have a colour coded label.

Central locking

Central locking is controlled by the alarm ECU and may be operated by the key, sill button(s) or handset. The system works on both front doors on four door vehicles or driver's door on two door vehicles.

NOTE: The central door locking system will shut down for a short period after more than 15 consecutive operations.

Inertia switch

An inertia switch is incorporated in the alarm system ECU. If ignition is on and the vehicle receives an impact sufficient to activate the inertia switch, the ECU will signal to unlock central locking actuators and flash hazard lights. Central locking will remain disabled for 30 seconds. To reset turn ignition off and then on after the 30 second period has elapsed.

Ultrasonic unit

The unit operates by emitting an air pressure carrier wave and receiving the wave back. Any disturbance within the vehicle which disturbs the wave will be detected, triggering the alarm.
When the volumetric sensor is activated it monitors movement within the vehicle for 15 seconds before detecting and responding to intrusions. If the sensor detects movement within the vehicle it delays arming until a 15 seconds quiet period has elapsed. If continuous movement is detected the alarm will not arm volumetrically.

Frequency	Colour ECU/Handset	Territory
418.0 MHz	Pink/pink	UK, Ireland
224.5 MHz,	Yellow/yellow	France
433.92 MHz	Blue/blue	Europe, not France, Switzerland, Italy, Denmark
433.92 MHz	White/Blue	Switzerland, Denmark
315.0 MHz	Green/green	Rest of world, Italy, Australia
315.0 MHz	Orange/Green	Gulf, Japan

Partially armed mode

If a door, tailgate or bonnet is left open when the system is armed, the LED will not light for 10 seconds indicating a mislock condition. Hazard lights will not flash. If an open door or tailgate is causing the mislock, the starter motor is disabled. The alarm will sound if ignition is turned to start position. If an open bonnet is causing the mislock the starter motor is disabled. The alarm will arm the volumetric part of the system. If the door tailgate or bonnet is subsequently closed, after a 5 second delay, the doors will unlock and immediately lock and the system will fully arm.

Handset transmitter

The handset LED will give one short flash when button is pressed momentarily.
If button is held down the LED will light again after 2 seconds for 2 seconds, and extinguish until button is released and repressed. The handset contains unique information distinguishing it from other transmitters. It also contains a set of 'random' rolling codes programmed into the ECU before leaving the factory. Each time the handset is pressed a different code is transmitted to the ECU.
If handset is operated more than four times outside the vehicle range (6 metres) or power supply is removed, it will be necessary to re-sychronise handset and the ECU by pressing the handset three times within range and within 5 seconds.

△ **NOTE: If both handsets are lost or damaged when system is armed it will be necessary to fit a new ECU with two matching handsets.**

Handset batteries

If handset LED flashes continuously when button is pressed, the batteries need replacing. The hazard lights will flash one 3 second pulse, instead of three times upon arming vehicle.

Power up mode

The alarm system always remembers the state it was left in when power was removed. If the alarm powers up in an armed state and is subsequently triggered it will give a warning that it will fully trigger unless disarmed. This warning consists of short horn pulses every two seconds for 15 seconds.

New born mode

When the ECU is first produced, it will be in its 'new born' mode. In this mode it will respond to any remote of the right frequency. This mode will be cancelled when the ECU has received ten valid handset signals without power interruption.

Engine cranking

It is only possible to crank the engine when ignition is ON and alarm disabled.

BUILT IN TEST PROCEDURE

The built in test procedure is accessed as follows:

1. Starting conditions: ignition off, doors unlocked, bonnet switch depressed.
2. Carry out instructions 3 to 7 within 8 seconds.
3. Release bonnet switch
4. Switch ignition ON.
5. Lock doors.
6. Switch ignition OFF.
7. Switch ignition ON.

If alarm is correctly accessed, horn will sound and LED will flash. The following checks can be made:

8. Open and close any door or tailgate - LED will light.
9. Depress bonnet switch - hazards will flash.
10. Check engine cranking is disabled. Do not turn off ignition.
11. Check ultrasonic by operating handset, LED will emit one 5 second flash, and will flash if interior is disturbed.

△ **NOTE: If ECU is in new born mode any handset of the right frequency will work. If not an initialised handset is required see Handset Initialisation.**

12. Turn OFF ignition or press handset to end test procedure. Horn will sound as before to indicate end of test mode.

IN CAR ENTERTAINMENT (ICE)

For 1993 model year three levels of factory fitted in car entertainment are available.

New features are as follows:
Side screen antenna, new head units, subwoofer assembly, new speakers and new CD autochanger.

The Mid/low line radio has the following features:
Radio data system (RDS), electronic tuning, one touch memory, automatic programme control (APC), Dolby, subwoofer line output, CATS coded, manual tape deck.

High line radio is as above with the folowing exceptions:
Logic tape deck, blank skip/repeat, 5 channel line output, CD ready (this unit is fitted when the CD option is called for).

Subwoofer

The subwoofer unit is located in the right hand side of the luggage compartment. It amplifies frequencies between 20 and 150 Hz to give an enhanced bass sound.

Subwoofer amplifier

The amplifier is fitted on top of the subwoofer unit.

Speaker amplifier

A remote 4 x 20 amp speaker amplifier is part of high line ICE specification.
This is also fitted on top of the subwoofer.

Side screen antenna

The antenna is now printed into the rear side screen on four door models. For America and Japan the element is fitted in both rear side screens, known as diversity antenna system. Other markets have a single element in the right hand side screen only. Diversity reception means that if vehicle movement results in a loss of signal due to reflections from buildings (known as multipath distortion), the radio will switch to the antenna receiving the strongest signal. This results in less interference and better stereo performance.

Antenna amplifiers

New antenna amplifiers are located behind the headlining above the side screen antenna(s). Right hand side fitment is an FM + AM amplifier, left hand side, diversity, is an FM only amplifier.

Speakers

Trim level 1 - Two door vehicles have two front twin cone speakers Four door vehicles have two coaxial front speakers and two twin cone rear speakers.
Trim level 2 - Four coaxial speakers, two front, two rear and a subwoofer.
Trim level 3 - Four coaxial speakers, two front, two rear, two bass speakers and crossover unit front, a subwoofer and amplifier. Twin cone speakers have a mid range and tweeter cone driven by the same coil. Coaxial speakers have two cones and two coils. Where front doors have bass speakers a crossover unit is fitted which effectively splits the frequency between bass and coaxial.

CD autochanger

The CD autochanger is fitted underneath the subwoofer unit.

Notes

ALTERNATOR TESTING

Service repair no - 86.10.01

Charging system check

1. Check battery is in good condition, with an open circuit voltage of at least 12.6 V. Recharge or substitute battery to carry out test.
2. Check drive belt adjustment and condition, see ***See SECTION 10, Maintenance, under bonnet maintenance***
3. Check battery connections are clean and tight.
4. Check alternator connections are clean and tight.
5. Ensure there is no drain on battery from, for example, interior, under bonnet or door edge lamps.

Alternator test

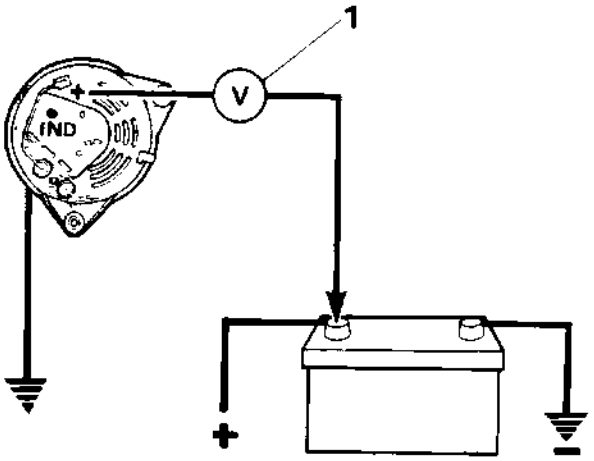
Following instructions refer to use of suitable test equipment using a carbon pile rheostat.

6. Connect test equipment referring to manufacturer's instructions.
7. Start engine and run at 3000 rev/min without accessory load.
8. Rotate carbon pile load control to achieve greatest output (amps) without allowing voltage to fall below 12.0 V. A reading in amps, of alternator output, minus 10% to allow for EFI and ignition loss, should be obtained.
9. Run engine at 3000 rev/min, switch selector to regulator test, read voltmeter. A reading of 13.6 to 14.4 V s hould be obtained.
10. Switch selector to diode/stator test, switch on headlamps to load alternator. Raise engine speed to 3000 rev/min, read voltmeter, needle must be within 'OK' range.

TESTING IN POSITION

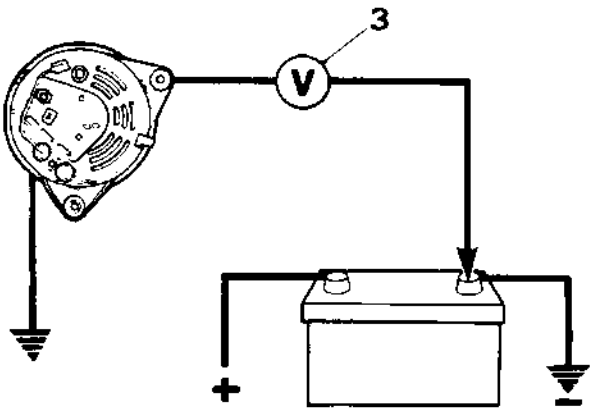
Charging circuit resistance test.

1. Connect a low range voltmeter between alternator terminal marked + and positive terminal of battery.



RR2317E

2. Switch on headlamps, start engine. Run engine at approximately 3000 rev/min. Note voltmeter reading.
3. Transfer voltmeter connections to frame of alternator and negative terminal of battery, and again note voltmeter reading.



RR2318E

4. If reading exceeds 0.5 volt on positive side or 0.25 volt on negative side, there is a high resistance in charging circuit which must be traced and remedied.

LUCAS CONSTANT ENERGY IGNITION SYSTEM 35DLM8-PRELIMINARY CHECKS

Inspect battery cables and connections to ensure they are clean and tight. Check battery state of charge.

Inspect all L.T. connections, ensure they are clean and tight. Check H.T. leads are correctly positioned and not shorting to ground against any engine components. Wiring harness and individual cables should be firmly fastened to prevent chaffing.

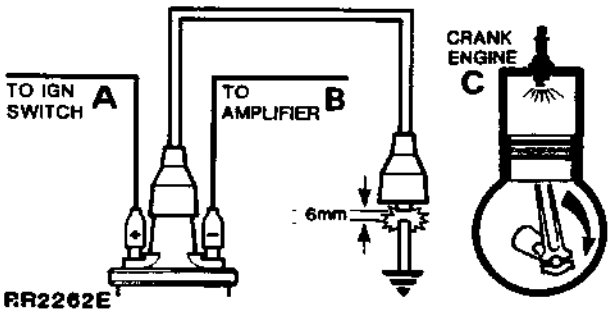
Pick-up air gap

Check air gap between pick-up limb and reluctor teeth is 0.20 - 0.35 mm, using a non-ferrous gauge.

△ **NOTE: Air gap is set initially at factory and will only require adjusting if tampered with or when pick-up module is replaced.**

TEST 1:

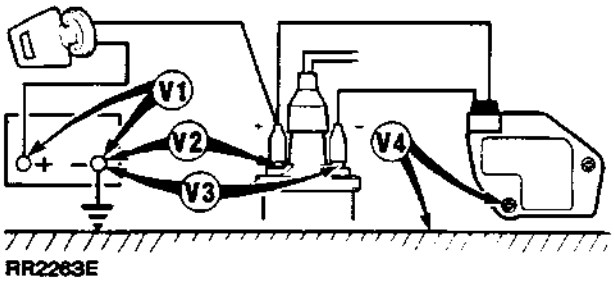
H.T. Sparking



Remove coil/distributor H.T. lead from distributor cover and hold approximately 6mm (0.25 in) from engine block, using suitable insulated pliers. Switch ignition 'On' and operate starter.
Regular sparking indicates fault in H.T. distribution, plugs, timing or fuelling, proceed to Test 6. If no spark or weak spark occurs proceed to Test 2.

TEST 2:

L.T. Voltage



Switch ignition 'On' - engine stationary.

(a) Connect voltmeter to points in circuit indicated by V1 to V4 and make a note of voltage readings.

(b) Compare voltages obtained with specified values listed below:

Expected readings

V1 More than 12 volts.
V2 1 volt maximum below volts at V1.
V3 1 volt maximum below volts at V1.
V4 0 volt - 0.1 volt.

(c) If all readings are correct proceed to Test 3.
(d) Check incorrect reading(s) with chart to identify area of possible faults, i.e. faults listed under heading SUSPECT and rectify.
(e) If coil and amplifier is suspected, disconnect L.T. lead at coil, repeat V3. If voltage is still incorrect, fit new coil. If voltage is now correct, check L.T. lead, if satisfactory fit new amplifier.
(f) If engine will not start proceed to Test 3.

1	2	3	4	SUSPECT
L	*	*	*	DISCHARGED BATTERY
*	L	L	*	IGN. SWITCH AND/OR WIRING
*	*	L	*	COIL OR AMPLIFIER
*	*	*	H	AMPLIFIER GROUND

Key

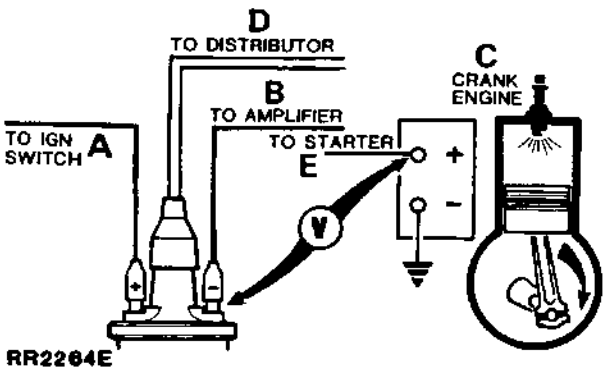
* Expected Voltage

H Voltage higher than expected

L Voltage lower than expected

TEST 3:

Amplifier Switching



RR2264E

Connect voltmeter between battery positive (+ve) terminal and H.T. coil negative (-ve) terminal. Voltmeter should register 0 volts.

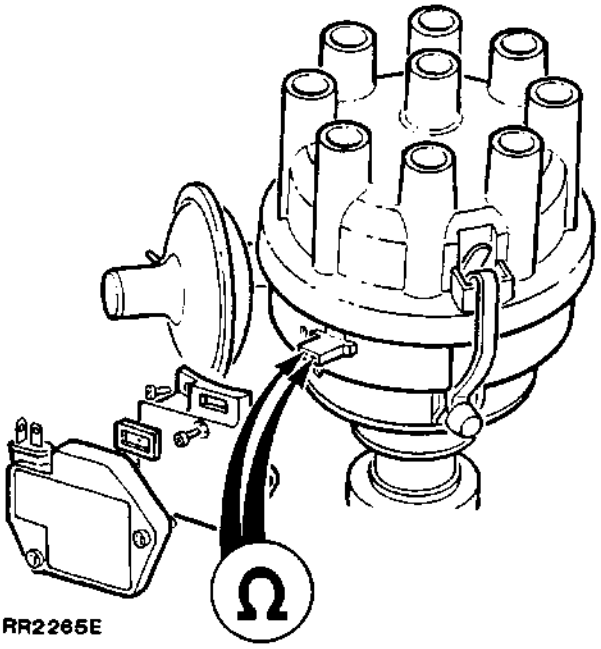
Switch ignition 'On', voltmeter should still register 0 volts.

Crank engine, voltmeter reading should increase when cranking, in which case proceed to Test 5.

If no increase in voltage during cranking proceed to Test 4.

TEST 4:

Pick-up Coil Resistance



RR2265E

Remove amplifier.

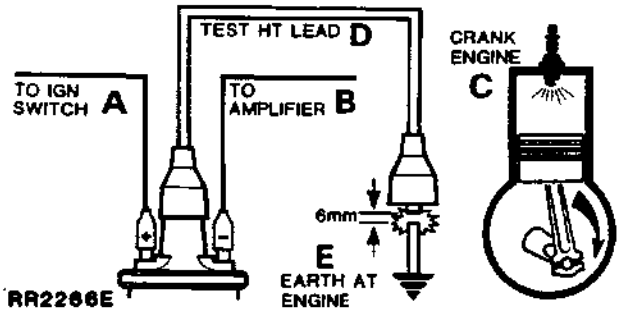
Connect ohmmeter leads to two pick-up terminals in body of distributor.

The ohmmeter should register between 2k and 5k ohm if pick-up is satisfactory. If ohmmeter reading is correct, check all connections between pick-up and amplifier, if satisfactory, fit new amplifier. If engine still does not start carry out Test 5.

Change pick-up if ohmmeter reading is incorrect. If engine still does not start proceed to Test 5.

TEST 5:

Coil H.T. Sparking



Remove existing coil/distributor H.T. lead and fit test H.T. lead to coil tower. Using suitable insulated pliers, hold free end about 6mm from engine block and crank engine. There should be good H.T. sparking.

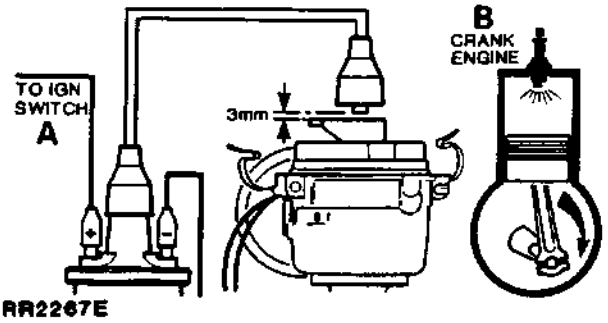
If weak or no sparking, fit new coil, repeat test.

H.T. sparking good, repeat test with original H.T. lead. If sparking is good carry out Test 6.

If weak or no sparking, fit new H.T. lead, if engine will not start carry out Test 6.

TEST 6:

Rotor Arm



Remove distributor cover. Disconnect coil H.T. lead from cover, using insulated pliers hold about 3mm (0.13 in) above rotor arm electrode and crank the engine.

There should be no H.T. sparking between rotor and H.T. lead. If satisfactory carry out Test 7.

If H.T. sparking occurs, an earth fault on rotor arm is indicated. Fit new rotor arm. If engine will not start carry out Test 7.

TEST 7:

Visual and H.T. Cable Checks

Examine:		**Should be:**
1.	Distributor Cover	Clean, dry, no tracking marks
2.	Coil Top	Clean, dry, no tracking marks.
3.	H.T. Cable Insulation	Must not be cracked, chafed or perished
4.	H.T. Cable Continuity	Must not be open circuit
5.	Sparking Plugs	Clean, dry, and set to correct gap

NOTE:

1.	Reluctor	Must not foul pick-up or leads
2.	Rotor and Insulation Cover	Must not be cracked or show signs of tracking marks

MEMORY SEAT / MIRROR SYSTEM SERVICE CHECK

The correct operation of memory position store and recall must be checked to ensure correct and safe operation of memory system

Manual transmission vehicles

Memory position, store and recall is only possible when following conditions apply:

- Driver's door open **OR** ignition AUX or IGN, **AND** park brake applied, vehicle speed less than 6 kph.

⚠ **CAUTION: It is potentially hazardous if memory store or recall is possible without park brake applied or with vehicle speed above 6 kph. The cause must be immediately investigated,** ***See ETM, M5***

1. If memory position recall/store is possible without park brake applied (vehicle stationary), it is essential to check following:

   - Park brake signal to ECU
   - ECU

2. If memory recall is possible when vehicle speed is over 6 kph, regardless of park brake position, it is essential to check following:

   - Speed signal to ECU
   - Park brake signal to ECU
   - ECU

3. Memory position store/recall function inoperative when park brake applied, check following:

   - Park brake signal to ECU
   - ECU

Automatic transmission vehicles:

Memory position, store and recall is only possible when following conditions apply:

Driver's door open OR ignition AUX or IGN, AND park brake applied, OR park/neutral engaged, vehicle speed less than 6 kph.

⚠ **CAUTION: It is potentially hazardous if memory store or recall is possible without park brake or park/neutral applied or with vehicle speed above 6 kph. The cause must be immediately investigated,** ***See ETM, M5***

1. If memory position recall/store is possible without park brake applied (vehicle stationary), it is essential to check following:

   - Park brake signal to ECU
   - Park/neutral signal to ECU
   - ECU

2. If memory recall is possible with park brake applied or park/neutral engaged, and vehicle speed above 6 kph, it is essential to check following:

   - Park/neutral signal to ECU
   - Speed signal to ECU
   - ECU

3. If memory position store/recall function is NOT possible after applying park brake or engaging park/neutral, check following:

   - Park brake signal system continuity check
   - Park/neutral signal
   - ECU

MEMORY SEAT / MIRROR SYSTEM - FAULT FINDING

△ **NOTE: The following chart lists care points referring to possible faults / remedies in the memory seat system.**

SYMPTOMS	CAUSE	REMEDY
Seat or mirrors inoperative	Fuses blown, not inserted or drivers seat load relay	Reinsert or replace fuses under seat and courtesy light fuse, main fuse panel. Refit or fit new relay.
System only operative with door open	Passenger seat relay	Refit or replace
Mirrors and clock inoperative	Mirror/clock harness not connected to main harness	Connect mirror/clock harness behind mirror switch pack and dash
Mirror or mirrors inoperative	Pins backed out in 5-way Espa connector	Repair connector in mirror mounting
Mirrors inoperative	Non connection of 24-way Sumitomo connector	Connect 24-way to memory seat ECU under driver's seat
Mirrors operative but in wrong planes	Mirror switch assy in wrong position or elevation	Fit mirror switch in correct elevation
System partially functional	ECU link harness broken	Replace ECU
Seat inoperative	Non connection of 10-way Sumitomo connector	Reconnect, under driver's seat
Seat operating in different planes and travels to that demanded	Wrongly handed link harness fitted in seat	Fit correct link harness, between seat switch and ECU
Seat pulsing to position in more than one plane	Non connection of 6-way Sumitomo Connect	6-Way, under driver's seat
Seat pulsing to position	No connection at sensor/gear box (ECU input or output)	Make connection to sensor unit, at relevant gearbox

IMPORTANT: For correct wiring installation. ***See Repair, Memory Seat - harness layout***

If fault has not been located. ***See Memory seat / Mirror system fault diagnosis***

MEMORY SEAT / MIRROR SYSTEM FAULT DIAGNOSIS

Manual and memory seat / mirror system totally inoperative -

1. Seat system losing memory position - 7.

Memory recall function inoperative - 12.

Incorrect manual electric seat control operation - 17.

Incorrect manual mirror operation/movement - 28.

Service checks - 44.

Manual and memory seat / mirror system totally inoperative

1. Are 30 amp fuses and fuse B2 inserted correctly and intact?
   Yes, go to 2.
   No, replace fuse or reinsert, check system.
2. Is drivers seat load relay inserted correctly?
   Yes, go to 3.
   No, insert correctly, check system.
3. Does system operate after replacing drivers seat load relay?
   Yes, check system.
   No, go to 4.
4. Is fusible link inserted correctly and intact?
   Yes, go to 6.
   No, go to 5.
5. Upon replacing fusible link does system operate correctly?
   Yes, check system.
   No, go to 6.
6. See memory seat system continuity checks: 4, 5, 6, 7 8 and 9.

Seat system losing memory position

7. Does the seat system lose memory positions upon IGN/AUX being switched off and door closed?
   Yes, go to 8.
   No, check system.
8. Is 3A stand alone fuse inserted correctly and intact?
   Yes, go to 9.
   No, check 11.
9. Is fusible link intact?
   Yes, go to 10.
   No, go to 11.
10. See memory seat system continuity check 3.
11. Does system retain position 24 hours after replacing or reinserting fuse or fusible link?
    Yes, check system
    No, go to 10.

Memory recall function inoperative

12. Does system attempt to go through calibration sequence?
    Yes, is recall function inoperative? Go to 7.
    No, go to 13.
13. Does system attempt to go through calibration sequence after replacing original seat switch?
    Yes, check system. Clean original switch, and recheck. ***See Repair, Memory Seat Switch - Clean***
    No, go to 14.
14. Are connectors / connections to seat switch via seat switch harness to ECU intact?
    Yes, go to 16.
    No, go to 15.
15. Does system attempt to go through calibration sequence after repairing connections to base of seat switch or reconnecting / replacing seat switch link harness, (between switch and ECU)?
    Yes, check system.
    No, go to 16.
16. See memory seat system continuity check.
    Incorrect manual electric seat control operation

Incorrect manual electric seat control operation

17. Are 30 amp fuses intact and inserted correctly?
    Yes, go to 18.
    No, reinsert / replace fuses correctly, check system
18. Is fusible link intact and inserted correctly?
    Yes, go to 20.
    No, reinsert / replace fusible link correctly, check system.
19. Does seat operate or attempt to operate under calibrate sequence?
    Yes, go to 20.
    No, go to 13, then 21.
20. Does seat move under manual electric control in all demanded directions? (pulsing or not pulsing to demanded position)?
    Yes, go to 22.
    No, go to 21.
21. Does seat switch move seat under manual electric control in all demanded directions, after replacing seat switch?
    Yes, check system
    No, go to 14 or check seat motor operation.
22. Observe non movement of seat in plane/s where seat did not go through full movement or stop at mid positions under calibrate routine.
    Go to 23
23. Does manual electric seat movement in this plane pulse to position demanded?
    Yes, go to 24.
    No, check motor operation.
24. Are connections between gearbox sensor unit and ECU secure (and electrically sound)?
    Yes, go to 25.
    No, go to 26.
25. Does manual movement in this plane pulse in demanded direction after replacing gearbox sensor unit?
    Yes, check 27.
    No, check system
26. Secure connections, re-check 22. and 23.
27. See memory seat system continuity check.

Incorrect manual mirror operation or movement

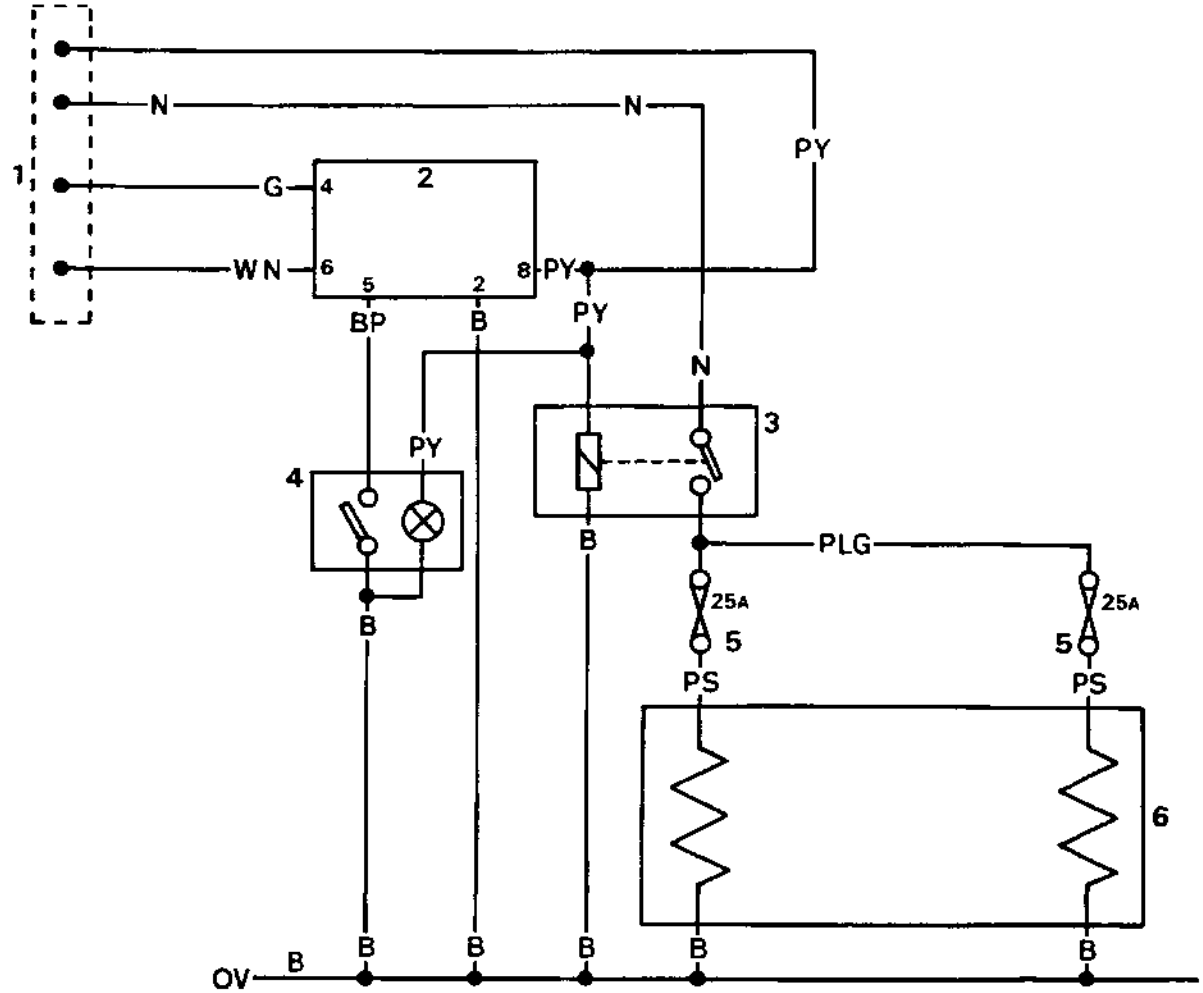
28. Are 3 amp fuses under driver's seat inserted correctly and intact?
    Yes, go to 29.
    No, replace or reinsert fuse, check system.
29. Do mirrors work correctly under calibrate sequence (both mirrors going through full movement and stopping near mid position)?
    Yes, go to 30.
    No, go to 33, 37, and 41.
30. Is mirror switch assembly mounted in correct elevation in dash?
    Yes, go to 31
    No, mount mirror correctly.
31. Does L.H. mirror work correctly under manual control without pulsing to position?
    Yes/No, go to 32.
32. Does R.H. mirror work correctly under manual control without pulsing to position?
    Yes/No, go to 33.
33. Is same fault common to both L.H. and R.H. mirrors?
    Yes, go to 34.
    No, go to 37.

34. Is connection made from manual mirror switches to main harness?
    Yes, go to 35.
    No, re-make connection and check system.
35. Do mirrors work correctly after replacing mirror joystick?
    Yes, check system
    No, go to 36.
36. See continuity checks.
37. Are connections to mirror faulty? (check for pin backout on 5 way ESPA connector)?
    Yes, re-make connections and check system
    No, go to 38.
38. Does mirror function correctly upon replacing mirror?
    Yes, check system
    No, go to 39.
39. Does mirror still exhibit same fault after replacing mirror changeover switch?
    Yes, go to 41.
    No, check system
40. See continuity checks
41. Does mirror movement still pulse in demanded direction under manual mirror electric control?
    Yes, possible feed back from mirror missing, go to 40.
    No, check system
42. Does mirror move, pulsing in opposite direction to that demanded under manual mirror electric control?
    Yes, possible feedback short to vehicle ground, check 40, continuity to vehicle ground
    No, check system
43. Are mirror or mirrors still inoperative?
    Yes, go to 40.

Service checks

44. Do seats operate under manual control when driver's door is open?
    Yes, check system fully, go to 47.
    No, go to 45.
45. Is interior light on when driver's door is open?
    Yes, check 30 amp fuses, then go to 46.
    No, go to 48.
46. Does door switch have a tendency to stick in off position when opening door?
    Yes, replace switch, check system
    No, go to 48.
47. Do manual electric seats operate when door open, but NOT when either IGN or AUX are engaged and door closed?
    Yes, check fuse and seat relays, go to 53.
    No, check 48.
48. Are connections to door switch made, including fuse B2?
    Yes, check 49.
    No, make connections, check system.
49. Does door switch make a good electrical contact?
    Yes, go to 53.
    No, replace switch, check system.
50. Does memory position recall function operate when park brake or park / neutral is not engaged?
    Yes, go to 53.
    No, is system OK?
51. Does memory position recall function operate when either park brake or park / neutral engaged?
    Yes, is system OK?
    No, go to 53.
52. Does speed signal inhibit memory recall function?
    Yes, is system OK?
    No, go to 53.
53. See memory seat system continuity check.

HEATED FRONT SCREEN - 1990



RR2593E

Circuit diagram - RR2593E

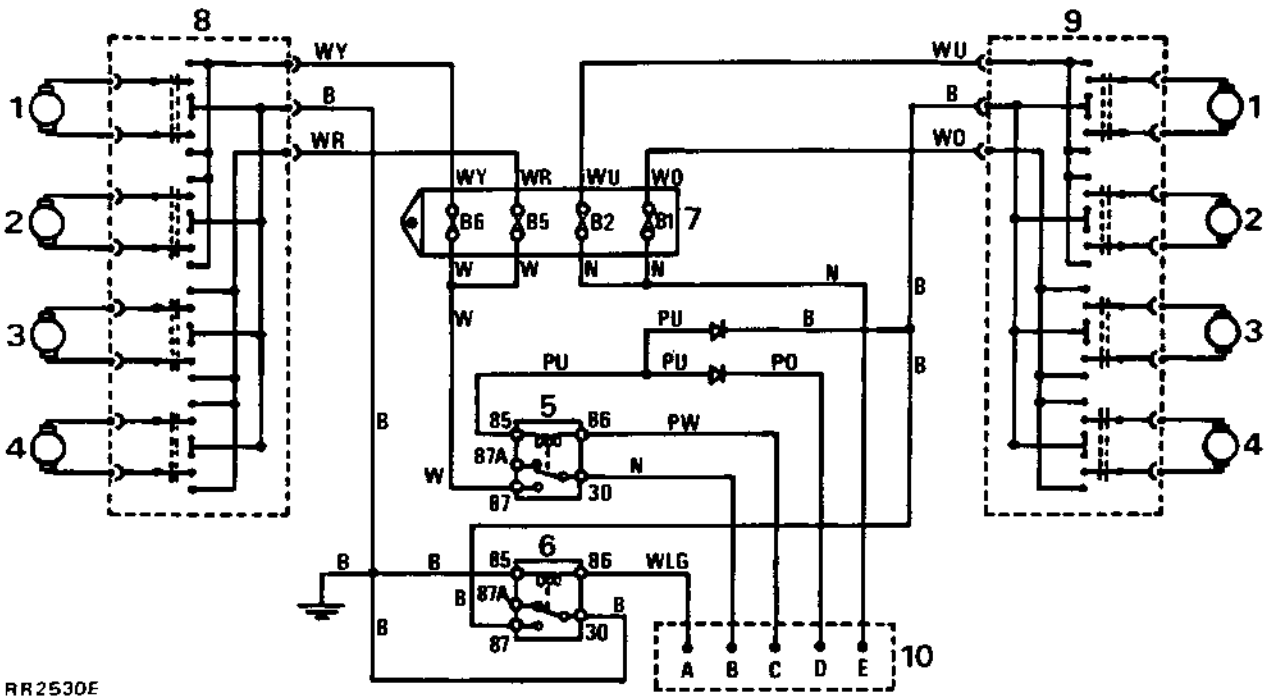
1. Main harness connections
   Brown - live positive feed
   Green - ignition positive feed
   Purple / yellow - EFI harness plug
   White / brown - oil pressure switch
   Black - earth
2. Timer unit
3. Load relay
4. Switch / warning light
5. In line fuses - 25 Amp.
6. Heated front screen

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

ELECTRIC SEAT ADJUSTMENT - 1990



Circuit diagram - RR2530E

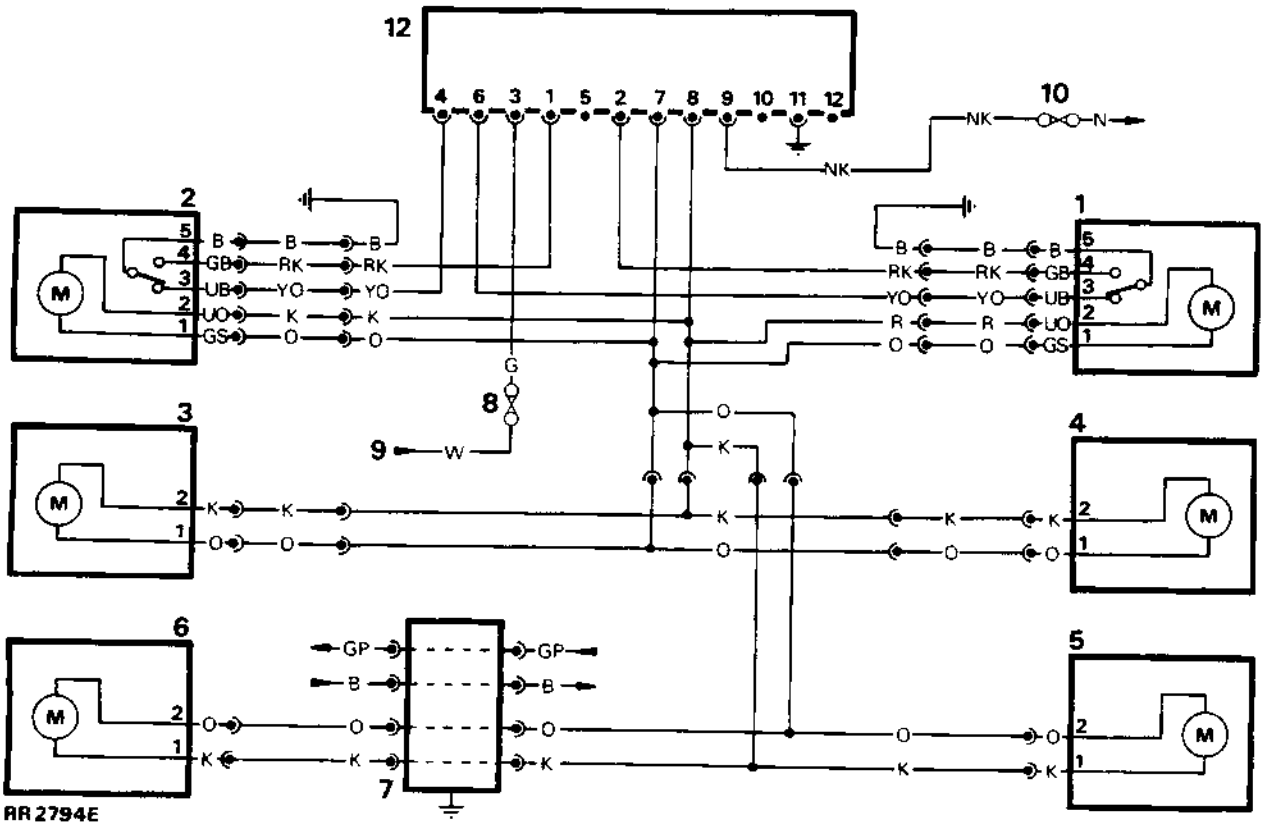
1. Seat recline motor
2. Seat height (rear) motor
3. Seat base adjust motor
4. Seat height (front) motor
5. Load relay-from driver's door courtesy switch
6. Load relay-fused auxiliary feed controled
7. Auxiliary fuse box (B)
8. Driver's seat control
9. Passenger's seat control
10. Main cable connections:
    - A: Fused auxiliary feed
    - B: Battery feed
    - C: Fused 12 volt
    - D: Courtesy switch earth
    - E: Battery feed

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

CENTRAL DOOR LOCKING - 1990



Circuit diagram - RR2794E

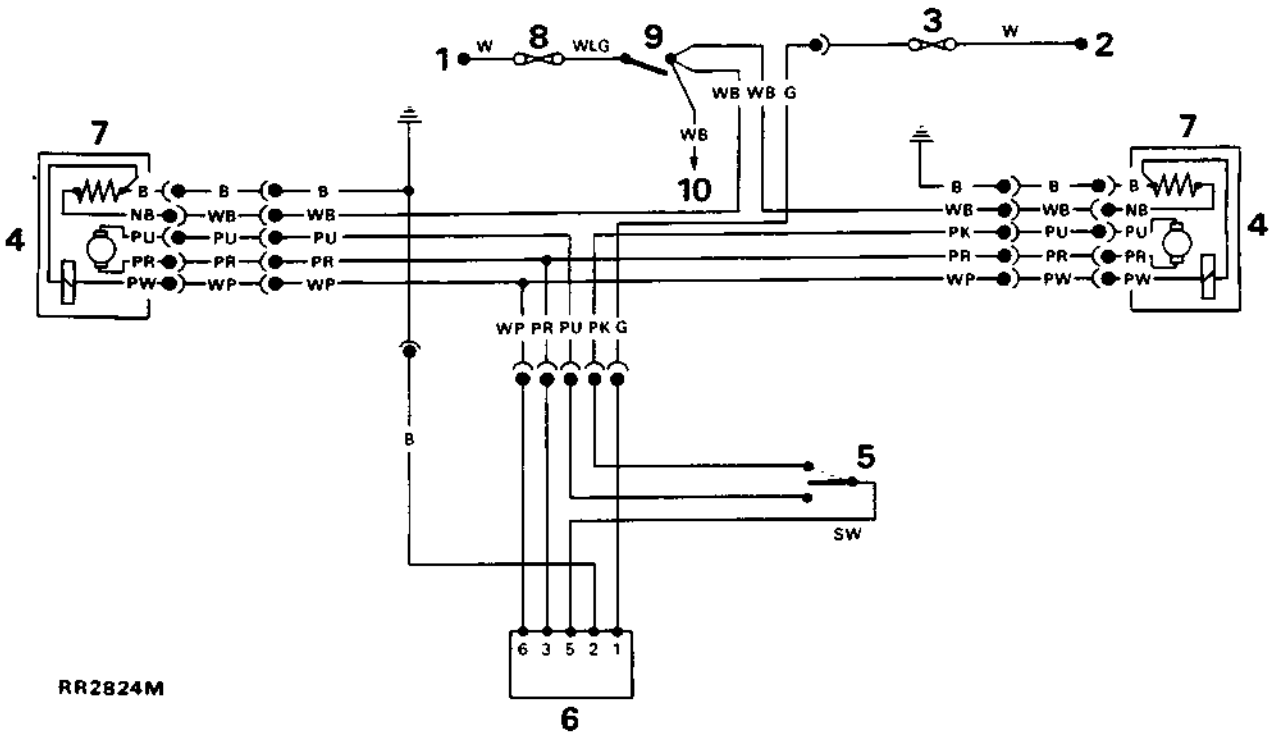
1. Switch / lock unit right hand front door
2. Switch / lock unit left hand front door
3. Lock unit left hand rear door relay
4. Lock unit right hand rear door relay
5. Fuel flap actuator
6. Lock unit tailgate
7. Suppressor
8. Fuse A5
9. Feed from ignition load relay
10. Fuse C7
11. Battery 12V + ve
12. Central door locking control unit

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

ELECTRIC MIRRORS - 1990



Circuit diagram - RR2824M

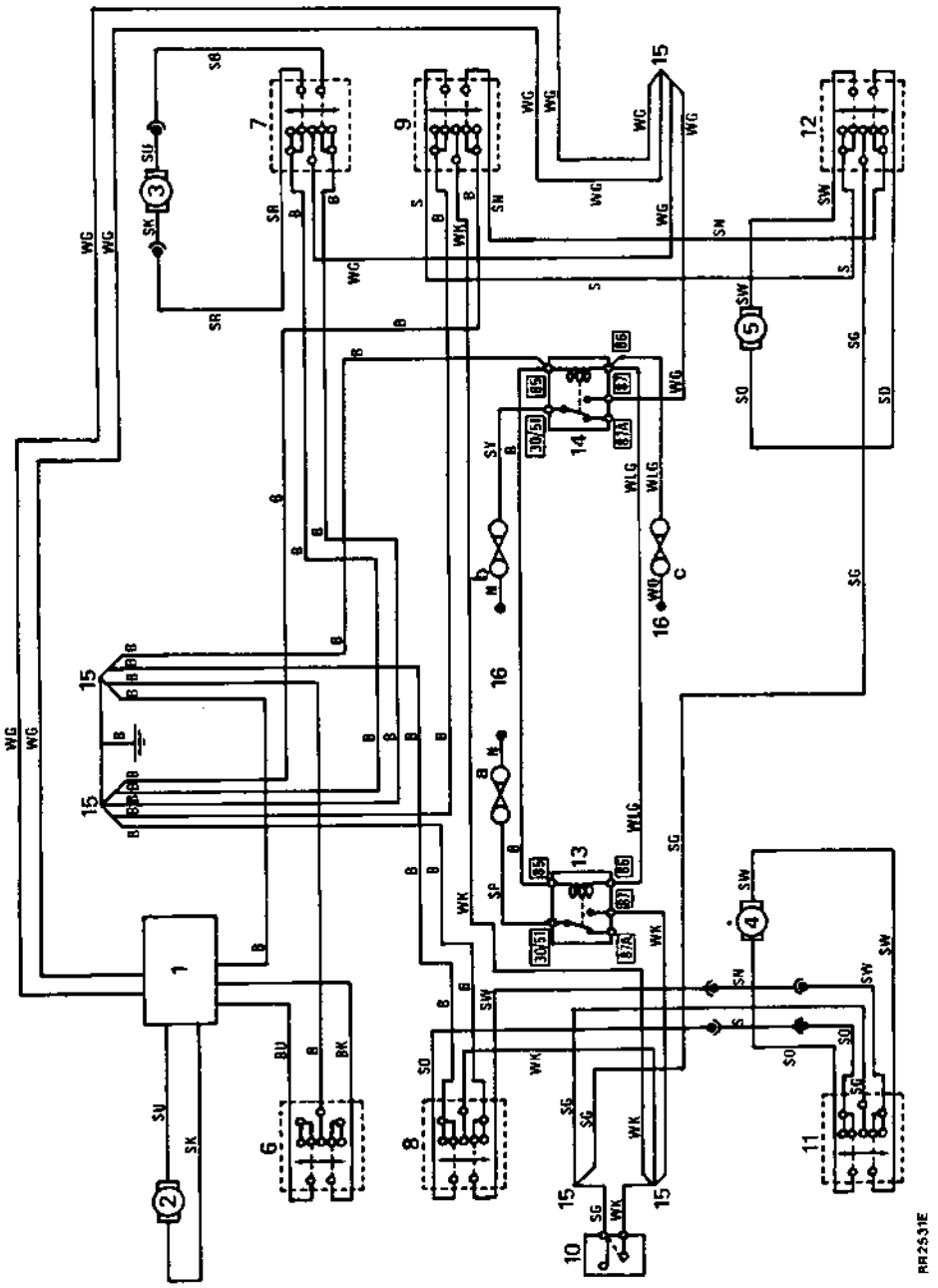
1. Ignition 12V.
2. Ignition load relay.
3. Fuse C5 - mirror motors.
4. Mirror motors.
5. Change over switch.
6. Mirror control switch.
7. Mirror heating elements - active with heated rear screen.
8. Fuse C3 - heating elements.
9. Heated rear screen switch.
10. Feed to heated screen relay.

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

ELECTRIC WINDOW LIFT - 1990



ELECTRIC WINDOW LIFT

Circuit diagram - RR2531E

1. One touch control unit-drivers window
2. Window lift motor-drivers window
3. Window lift motor-front passengers side
4. Window lift motor LH rear
5. Window lift motor RH rear
6. Window lift switch drivers window
7. Window lift switch front passengers window
8. Window lift switch LH rear door
9. Window lift switch RH rear door
10. Isolator switch
11. Window lift switch in LH rear door
12. Window lift switch in RH rear door
13. Relay-rear windows
14. Relay-front windows
15. Clinches
16. Main cable fuses
    - a: Fuse C2
    - b: Fuse C8
    - c: Fuse B1

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

CIRCUIT DIAGRAM - 1990 MY - RIGHT HAND STEERING - illustrations RR2830M & RR2831M

Numerical key

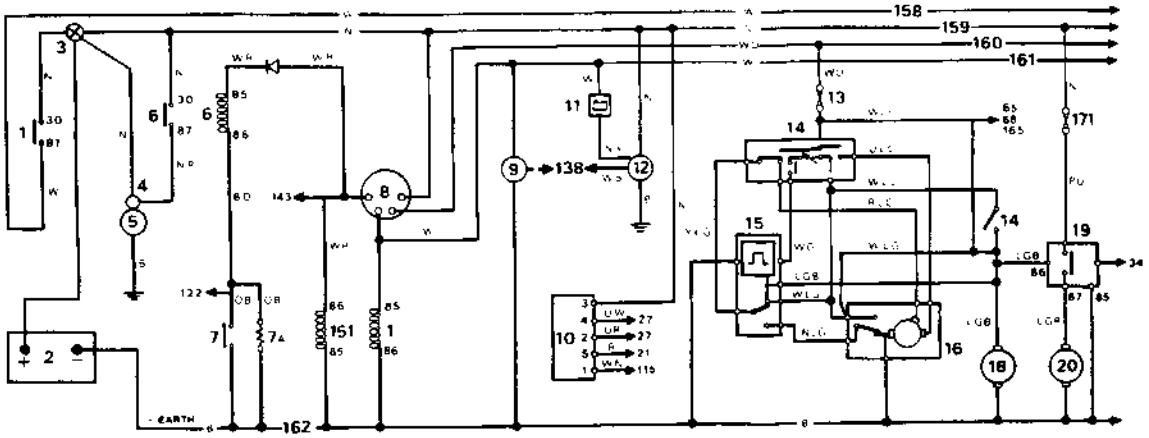
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch
7a. Resistor (manual)
8. Ignition switch
9. Tachometer
10. Voltage transformer (dim dip)
11. Ignition warning lamp
12. Alternator
13. Fuse B1
14. Front wipe/wash switch
15. Front wipe delay unit
16. Front wiper motor
17. Headlamp relay
18. Front wash pump
19. Headlamp wash timer unit
20. Headlamp wash pump
21. Main lighting switch
22. Fuse A3
23. Fuse A7
24. LH side lamp
25. LH tail lamp
26. LH number plate lamp
26a. RH number plate lamp
27. High beam dip/flash switch
28. Fuse B2
29. RH side lamp
30. RH tail lamp
31. Rheostat
32. Fuse A8
33. Fuse A2
34. Fuse A9
35. Fuse A1
36. Rear fog switch
37. Fuse A4
38. Switch illumination (2 off)
39. Cigar lighter illumination (2 off)
40. Heater illumination (4 off)
41. Clock illumination
42. Auto gear selector illumination (2 off) - post April 1990 condition
42a. Auto gear selector illumination (2 off) - pre April 1990 condition
43. Instrument illumination (4 off)
43a. Column switch illumination
44. Rear fog warning lamp
45. LH rear fog lamp
46. RH rear fog lamp
47. LH dip beam
48. RH dip beam
49. LH high beam
50. RH high beam
51. High beam warning lamp
52. Fuel gauge
53. Fuel gauge sender unit
54. Water temperature gauge
55. Water temperature sender unit
56. Fuse B3
57. Horn switch
58. RH horn
59. LH horn
60. Under bonnet illumination switch
61. Under bonnet light
62. Clock
63. Fuse C7
64. Fuse C8
65. Pick-up point central locking/window lift
66. Fuse C1
67. Heated rear screen relay
68. Radio aerial amplifier
69. Heated rear screen
70. Heated rear screen switch
71. Heated rear screen warning lamp
72. Voltage sensitive switch
73. Fuse A5
74. Hazard switch
75. Flasher unit
76. Direction indicator switch
77. LH indicator warning lamp
77a. RH indicator warning lamp
78. LH rear indicator lamp
79. LH front indicator lamp
80. LH side repeater lamp
81. RH side repeater lamp
82. RH front indicator lamp
83. RH rear indicator lamp
84. Trailer warning lamp
85. Fuse A6
86. Stop lamp switch
87. Reverse lamp switch
88. Front auxilary lamp relay
89. LH stop lamp
90. RH stop lamp
91. LH reverse lamp
92. RH reverse lamp
93. LH front auxilary lamp
94. RH front auxilary lamp
95. Front auxilary lamp switch
96. Fuse B4
97. Dash cigar lighter
98. Glove box cigar lighter
99. Front interior lamp
100. Rear interior lamp
101. Interior lamp delay unit
102. LH door edge lamp
103. LH puddle lamp
104. RH door edge lamp
105. RH puddle lamp
106. Interior lamp switch
107. LH rear door switch
108. RH rear door switch
109. Tailgate switch
110. LH front door switch
111. RH front door switch
112. Heated washer jets (front screen)
113. Thermostat heated jets
114. Oil pressure warning lamp
115. Oil pressure switch
116. Fuse C4
117. Heated front screen connections
118. Fuel pump (petrol models)
119. Ignition coil
120. Capacitor
121. Distributor
122. EFI Harness plug
123. Fuel shut off solenoid (Diesel)
124. Sun roof relay
124a. Fuse B5
125. Radio fuse
126. Radio and four speakers
-LF-left hand front speaker
-LR-left hand rear speaker
-RF-right front speaker
-RR-right hand rear speaker
127. Sun roof pick up point
128. Auto transmission and transfer box oil temperature warning lamp
129. Auto transmission oil temperature switch
129a. Transfer box oil temperature switch
130. Fuse C3
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Electronic speedo and instrument controls
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. Glow plug warning lamp (Diesel)
142. E.F.I. warning lamp
143. Glow plug timer unit
144. Glow plugs (Diesel)
145. ABS warning lamp
146. Handbrake/brake fluid level/pressure warning lamp
147. Handbrake warning switch
148. Brake fluid level warning switch
149. Brake pad wear warning lamp
150. Brake pad wear sensors
151. Brake check relay
152. Split charge relay (option)
153. Split charge terminal post (option)
154. Heater/air conditioning connections
155. Fuse C9
156. Coil negative (engine RPM input to ECU)
157. Not used
158. Ignition load relay (+)
159. Battery feed (+)
160. Ignition auxiliary (+)
161. Ignition on (+)
162. Earth (-)
163. Heater/air con. load relay
164. Trailer pick up point
165. Electric seats pick up point (option)
166. Fuse C2
167. Electric mirrors pick up point
168. Alarm pick up point
169. Fuse C5
170. ABS pick up point
171. Fuse B6
172. Fuse B7
173. Condenser fan relay
174. Fuse B8
175. Fuse B9
176. Inertia switch
177. Speed transducer

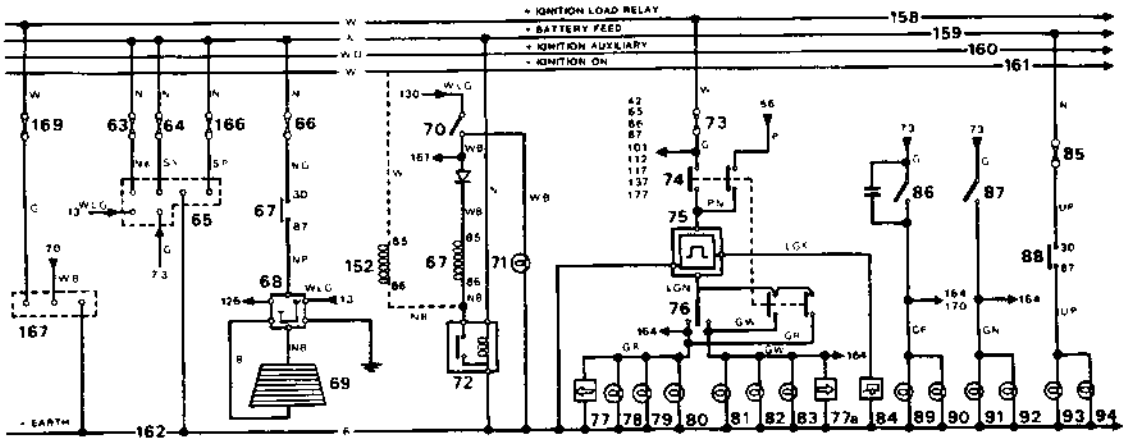
Circuit diagram - 1990 MY - RIGHT HAND STEERING - illustrations RR2830M & RR2831M

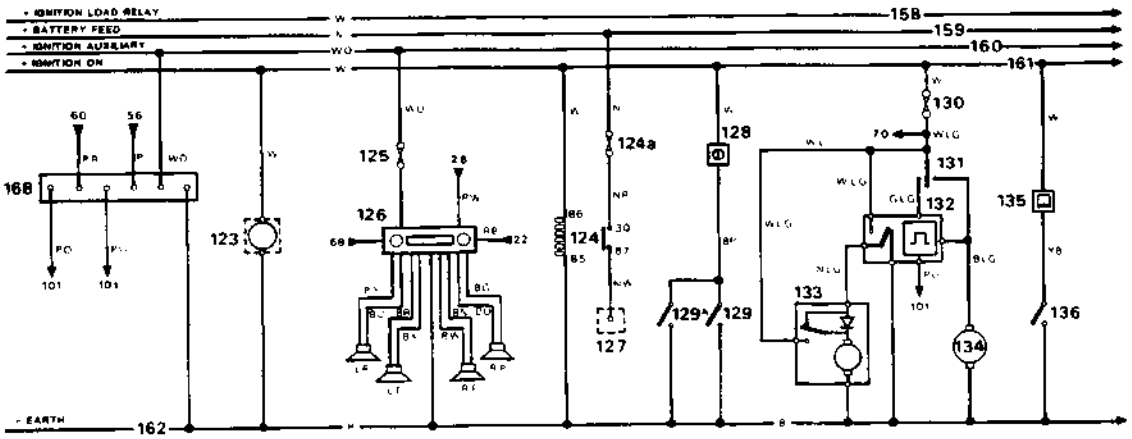
Alphabetical key

170. ABS pick up point
145. ABS warning lamp
168. Alarm pick up point
12. Alternator
42. Automatic gear selector illumination (2 off)
129. Automatic transmission oil temperature switch
128. Automatic transmission/transfer box oil temperature warning lamp
2. Battery
148. Brake fluid level warning switch
150. Brake pad wear sensors
149. Brake pad wear warning lamp
151. Brake check relay
120. Capacitor
39. Cigar lighter illumination (2 off)
62. Clock
41. Clock illumination
156. Coil negative, engine speed signal to ECU
43a. Column switch illumination
173. Condenser fan relay
97. Dash cigar lighter
76. Direction indicator switch
121. Distributor
167. Electric mirrors pick up point (option)
165. Electric seats pick up point (option)
138. Electronic speedo and instrument controls
122. EFI Harness plug
142. EFI warning lamp
75. Flasher unit
88. Front auxiliary lamp relay
95. Front auxiliary lamp switch
99. Front interior lamp
18. Front wash pump
15. Front wipe delay unit
14. Front wipe/wash switch
16. Front wiper motor
52. Fuel gauge
53. Fuel gauge sender unit
118. Fuel pump (petrol models)
123. Fuel shut off solenoid (Diesel)
35. Fuse A1
33. Fuse A2
22. Fuse A3
37. Fuse A4
73. Fuse A5
85. Fuse A6
23. Fuse A7
32. Fuse A8
34. Fuse A9
13. Fuse B1
28. Fuse B2
56. Fuse B3
96. Fuse B4
124a. Fuse B5
171. Fuse B6
172. Fuse B7
174. Fuse B8
175. Fuse B9
66. Fuse C1
166. Fuse C2
130. Fuse C3
116. Fuse C4
169. Fuse C5
63. Fuse C7
64. Fuse C8
155. Fuse C9
98. Glove box cigar lighter
144. Glow plugs (Diesel)
143. Glow plug timer unit (Diesel)
141. Glow plug warning lamp (Diesel)
146. Handbrake/brake fluid level/pressure warning lamp
147. Handbrake warning switch
74. Hazard switch
17. Headlamp relay
20. Headlamp wash pump
19. Headlamp wash timer unit
117. Heated front screen connections
69. Heated rear screen
67. Heated rear screen relay
70. Heated rear screen switch
71. Heated rear screen warning lamp
112. Heated washer jets
40. Heater illumination (4 off)
154. Heater/air con. connections
163. Heater/air con. load relay
27. High beam dip/flash switch
51. High beam warning lamp
57. Horn switch
119. Ignition coil
1. Ignition load relay
8. Ignition switch
11. Ignition warning lamp
176. Inertia switch
43. Instrument illumination (4 off)
101. Interior lamp delay unit
106. Interior lamp switch
47. LH dip beam
102. LH door edge lamp
93. LH front auxiliary lamp
110. LH front door switch
79. LH front indicator lamp
49. LH high beam
59. LH horn
77. LH indicator warning lamp
25. LH number plate lamp
103. LH puddle lamp
107. LH rear door switch
45. LH rear fog lamp
78. LH rear indicator lamp
91. LH reverse lamp
24. LH side lamp
80. LH side repeater lamp
89. LH stop lamp
25. LH tail lamp
139. Low coolant level warning lamp
137. Low coolant switch
140. Low fuel level warning lamp
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
21. Main lighting switch
115. Oil pressure switch
114. Oil pressure warning lamp
65. Pick up point-central locking/window lift
68. Radio aerial amplifier
126. Radio and four speakers
125. Radio fuse
36. Rear fog switch
44. Rear fog warning lamp
100. Rear interior lamp
134. Rear screen wash pump
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
7a. Resistor (manual)
87. Reverse lamp switch
48. RH dip beam
104. RH door edge lamp
94. RH front auxiliary lamp
111. RH front door switch
82. RH front indicator lamp
50. RH high beam
58. RH horn
77a. RH indicator warning lamp
26a. RH number plate lamp
105. RH puddle lamp
108. RH rear door switch
46. RH rear fog lamp
83. RH rear indicator lamp
92. RH reverse lamp
29. RH side lamp
81. RH side repeater lamp
90. RH stop lamp
30. RH tail lamp
31. Rheostat
177. Speed transducer
152. Split charge relay (option)
153. Split charge terminal post (option)
7. Starter inhibit switch
5. Starter motor
6. Starter relay
4. Starter solenoid
86. Stop lamp switch
127. Sunroof pick up point
124. Sunroof relay
38. Switch illumination (2 off)
9. Tachometer
109. Tailgate switch
3. Terminal post
113. Thermostat - heated washer jets
164. Trailer pick up point
84. Trailer warning lamp
129a. Transfer box oil temperature switch
60. Under bonnet illumination switch
61. Under bonnet light
72. Voltage sensitive switch
10. Voltage transformer (dim-dip)
54. Water temperature gauge
55. Water temperature sender unit

Circuit diagram - 1990 MY - Right hand steering

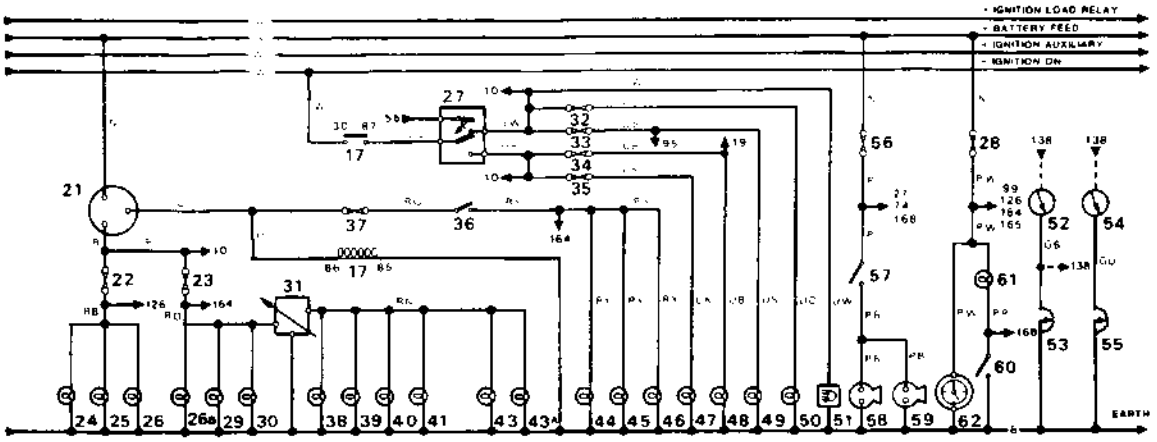


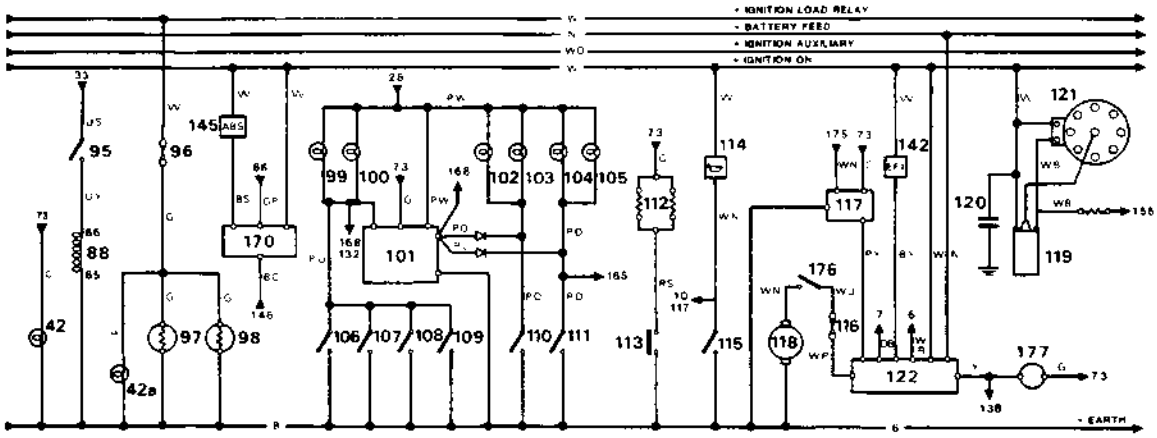


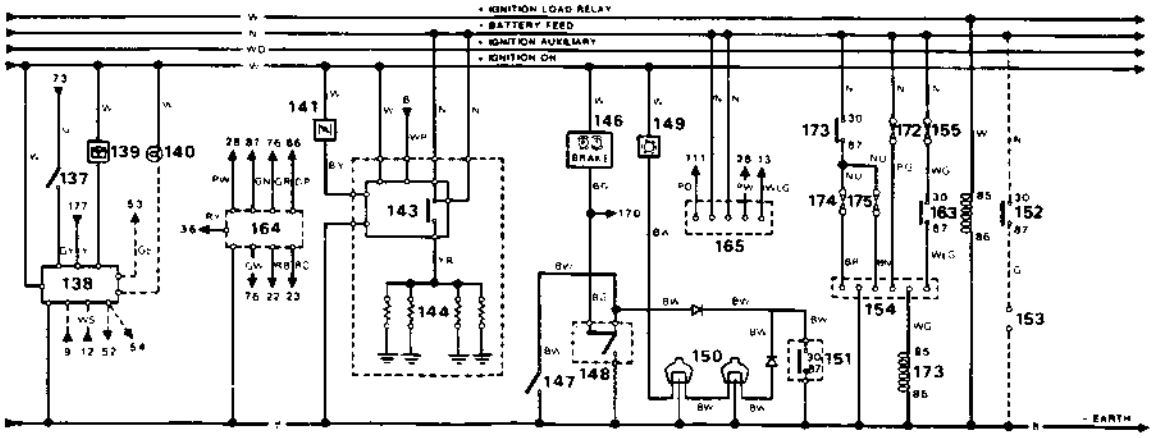


RR2830M

Illustrations RR2830M & RR2831M







RR2831M

CIRCUIT DIAGRAM - 1990 MY - LEFT HAND STEERING - illustrations RR2828M & RR2829M

Numerical key

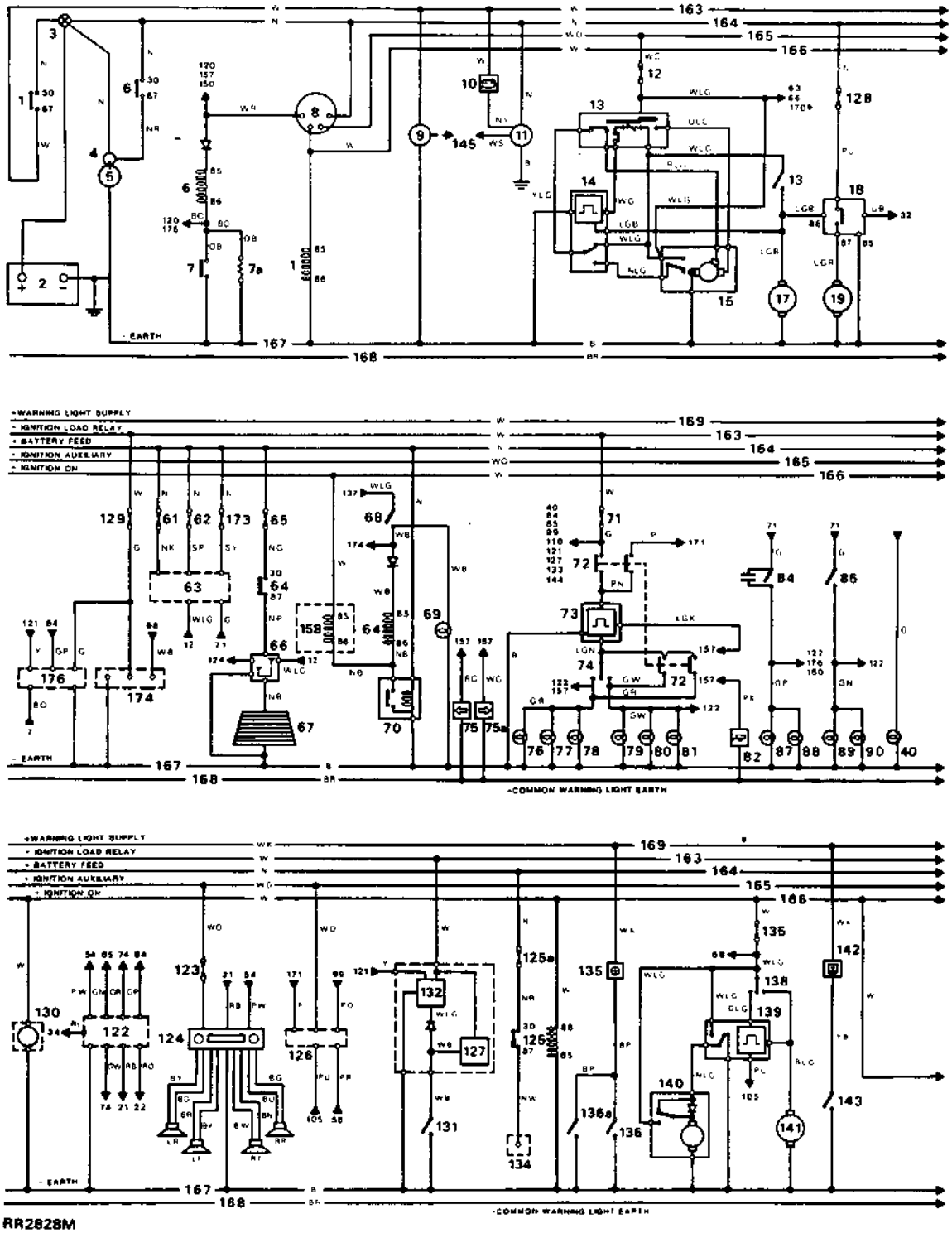
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (auto)
7a. Resistor (manual transmission)
8. Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse B1
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Headlamp relay
17. Front wash pump
18. Headlamp wash timer unit
19. Headlamp wash pump
20. Main lighting switch
21. Fuse A3
22. Fuse A7
23. LH side lamp
24. LH tail lamp
25. LH number plate lamp
25a. RH number plate lamp
26. High beam dip/flash switch
27. RH side lamp
28. RH tail lamp
29. Rheostat
30. Fuse A8
31. Fuse A2
32. Fuse A9
33. Fuse A1
34. Rear fog switch
35. Fuse A4
36. Switch illumination (2 off)
36a. Headlamp levelling switch illumination (Germany)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Auto gear selector illumination (2 off) - post April 1990 condition
40a. Auto gear selector illumination (2 off) - pre April 1990 condition
41. Instrument illumination (4 off)
41a. Column switch illumination
42. Rear fog warning lamp
43. LH rear fog
44. RH rear fog
45. LH dip beam
46. RH dip beam
47. LH high beam
48. RH high beam
49. High beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53. Water temperature sender unit
54. Fuse B2
55. Horn switch
56. RH horn
57. LH horn
58. Under bonnet illumination switch
59. Under bonnet light
60. Clock
61. Fuse C7
62. Fuse C2
63. Pick-up point central locking/window lift
64. Heated rear screen relay
65. Fuse C1
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse A5
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. LH indicator warning lamp
75a. RH indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. LH side repeater lamp
79. RH side repeater lamp
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse A6
84. Stop lamp switch
85. Reverse lamp switch
86. Front auxilary lamp relay (option)
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH front auxilary lamp (option)
92. RH front auxilary lamp (option)
93. Front auxilary lamp switch
94. Fuse B4
95. Dash cigar lighter
96. Glove box cigar lighter
97. Front interior lamp
98. Rear interior lamp
99. Interior lamp delay unit
100. LH door edge lamp
101. LH puddle lamp
102. RH door edge lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110. Heated washer jets (front screen)
111. Thermostat-heated washer jets
112. Oil pressure warning lamp
113. Oil pressure switch
114. Fuse C4
115. Inertia switch
116. Fuel pump (petrol models)
117. Ignition coil (petrol models)
118. Capacitor (petrol models)
119. Distributor (petrol models)
120. EFI Harness plug
121. Speed transducer
122. Trailer pick up point
123. Radio fuse
124. Radio and four speakers
-LF-left hand front speaker
-LR-left hand rear speaker
-RF-right front speaker
-RR-right hand rear speaker
125. Sun roof relay
125a. Fuse B5
126. Alarm pick up point
127. Overspeed warning (Saudi only)
128. Fuse B6
129. Fuse C5
130. Fuel shut off solenoid (Diesel)
131. Seat buckle switch (Saudi only)
132. Overspeed monitor (Saudi only)
133. Heated front screen pick up point (option)
134. Sunrool pick up point (option)
135. Auto transmission/transfer box oil temperature warning lamp
136. Auto transmission oil temperature switch
136a. Transfer box oil temperature switch
137. Fuse C3
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
141. Rear screen wash pump
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
144. Low coolant switch
145. Electronic speedo and instrument controls
146. Low coolant level warning lamp
147. Low fuel level warning lamp
148. E.F.I. warning lamp
149. Glow plug warning lamp (Diesel)
150. Glow plug timer unit(Diesel)
151. Glow plugs (Diesel)
152. ABS warning lamp
153. Handbrake/brake fluid level/pressure warning lamp
153a. Brake fluid level warning switch
154. Handbrake warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157. Brake check unit
158. Split charge relay (option)
159. Split charge terminal post (option)
160. Heater/air conditioning connections
161. Fuse C9
162. Coil negative (engine RPM input to ECU)
163. Ignition load relay (+)
164. Battery feed (+)
165. Ignition auxiliary (+)
166. Ignition on (+)
167. Earth (-)
168. Warning lights supply common earth (-)
169. Warning lights supply (+)
170. Electric seats pick up point
171. Fuse B3
172. Fuse B8
173. Fuse C8
174. Electric mirrors pick up point (option)
175. Heater/air conditioning load relay
176. Cruise control pick up points (option)
177. Fuse B9
178. Condenser fan relay
179. Fuse B7
180. ABS pick up point
181. Headlamp levelling switch connection (German)
182. Headlamp levelling actuator (2) (German)

CIRCUIT DIAGRAM - 1990 MY - LEFT HAND STEERING - ILLUSTRATIONS RR2828M & RR2829M

Alphabetical key

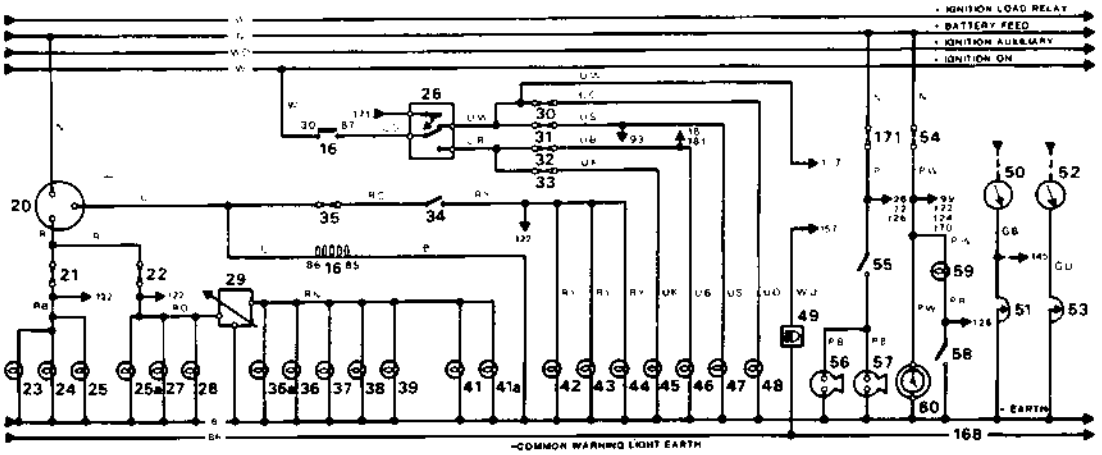
180. ABS pick up point
152. ABS warning lamp
126. Alarm pick up point
11. Alternator
40. Automatic gear selector illumination (2 off)
136. Automatic transmission oil temperature switch
135. Automatic transmission/transfer box oil temperature warning lamp
2. Battery
153a. Brake fluid level warning switch
157. Brake check unit
156. Brake pad wear sensors
155. Brake pad wear warning lamp
118. Capacitor (petrol models)
37. Cigar lighter illumination (2 off)
60. Clock
39. Clock illumination
162. Coil negative, engine speed signal to ECU
41a. Column switch illumination
178. Condenser fan relay
176. Cruise control pick up point (option)
95. Dash cigar lighter
74. Direction indicator switch
119. Distributor (petrol models)
174. Electric mirrors pick up point (option)
170. Electric seats pick up point (option)
145. Electronic speedo and instrument controls
120. EFI harness plug
148. EFI warning lamp
73. Flasher unit
86. Front auxiliary lamp relay (option)
93. Front auxiliary lamp switch
97. Front interior lamp
17. Front wash pump
14. Front wipe delay unit
13. Front wipe/wash switch
15. Front wiper motor
50. Fuel gauge
51. Fuel gauge sender unit
116. Fuel pump (petrol models)
130. Fuel shut off solenoid (Diesel)
33. Fuse A1
31. Fuse A2
21. Fuse A3
35. Fuse A4
71. Fuse A5
83. Fuse A6
22. Fuse A7
30. Fuse A8
32. Fuse A9
12. Fuse B1
54. Fuse B2
171. Fuse B3
94. Fuse B4
125a. Fuse B5
128. Fuse B6
179. Fuse B7
172. Fuse B8
177. Fuse B9
65. Fuse C1
162. Fuse C2
137. Fuse C3
114. Fuse C4
129. Fuse C5
61. Fuse C7
173. Fuse C8
161. Fuse C9
96. Glove box cigar lighter
151. Glow plugs (Diesel)
150. Glow plug timer unit (Diesel)
149. Glow plug warning lamp (Diesel)
153. Handbrake/brake fluid level/pressure warning lamp
154. Handbrake warning switch
72. Hazard switch
182. Headlamp levelling actuator (2) (Germany)
181. Headlamp levelling switch connection (Germany)
36a. Headlamp levelling switch illumination (Germany)
16. Headlamp relay
19. Headlamp wash pump
18. Headlamp wash timer unit
133. Heated front screen pick up point (option)
67. Heated rear screen
64. Heated rear screen relay
68. Heated rear screen switch
69. Heated rear screen warning lamp
110. Heated washer jets
38. Heater illumination (4 off)
160. Heater/air con. connections
175. Heater/air con. load relay
26. High beam dip/flash switch
49. High beam warning lamp
55. Horn switch
117. Ignition coil
1. Ignition load relay
8. Ignition switch
10. Ignition warning lamp
115. Inertia switch
41. Instrument illumination (4 off)
99. Interior lamp delay unit
104. Interior lamp switch
45. LH dip beam
100. LH door edge lamp
91. LH front auxiliary lamp
108. LH front door switch
77. LH front indicator lamp
47. LH high beam
57. LH horn
75. LH indicator warning lamp
25. LH number plate lamp
101. LH puddle lamp
105. LH rear door switch
43. LH rear fog lamp
76. LH rear indicator lamp
89. LH reverse lamp
23. LH side lamp
78. LH side repeater lamp
87. LH stop lamp
24. LH tail lamp
146. Low coolant level warning lamp
144. Low coolant switch
147. Low fuel level warning lamp
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
20. Main lighting switch
113. Oil pressure switch
112. Oil pressure warning lamp
132. Overspeed monitor (Saudi only)
127. Overspeed warning (Saudi only)
63. Pick up point-central locking/window lift
66. Radio aerial amplifier
124. Radio and four speakers
123. Radio fuse
34. Rear fog switch
42. Rear fog warning lamp
98. Rear interior lamp
141. Rear screen wash pump
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
7a. Resistor (manual)
85. Reverse lamp switch
46. RH dip beam
102. RH door edge lamp
92. RH front auxiliary lamp
109. RH front door switch
80. RH front indicator lamp
48. RH high beam
56. RH horn
75a. RH indicator warning lamp
25a. RH number plate lamp
103. RH puddle lamp
106. RH rear door switch
44. RH rear fog lamp
81. RH rear indicator lamp
90. RH reverse lamp
27. RH side lamp
79. RH side repeater lamp
88. RH stop lamp
28. RH tail lamp
29. Rheostat
121. Speed transducer
158. Split charge relay (option)
159. Split charge terminal post (option)
7. Starter inhibit switch
5. Starter motor
6. Starter relay
4. Starter solenoid
84. Stop lamp switch
134. Sunroof pick up point
125. Sunroof relay
36. Switch illumination (2 off)
9. Tachometer
107. Tailgate switch
3. Terminal post
111. Thermostat - heated washer jets
122. Trailer pick up point
82. Trailer warning lamp
136a. Transfer box oil temperature switch
58. Under bonnet illumination switch
59. Under bonnet light
70. Voltage sensitive switch
52. Water temperature gauge
53. Water temperature sender unit

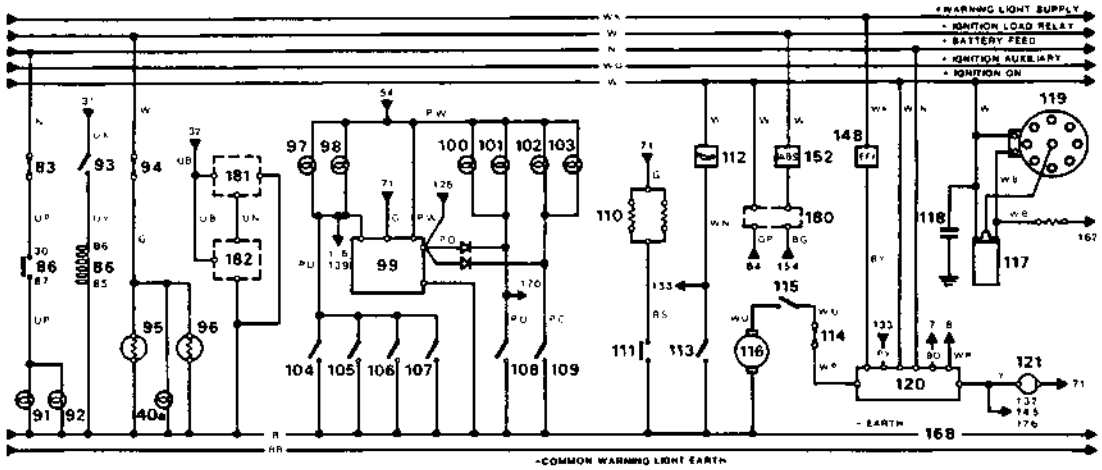
Circuit diagram - 1990 MY - Left hand steering

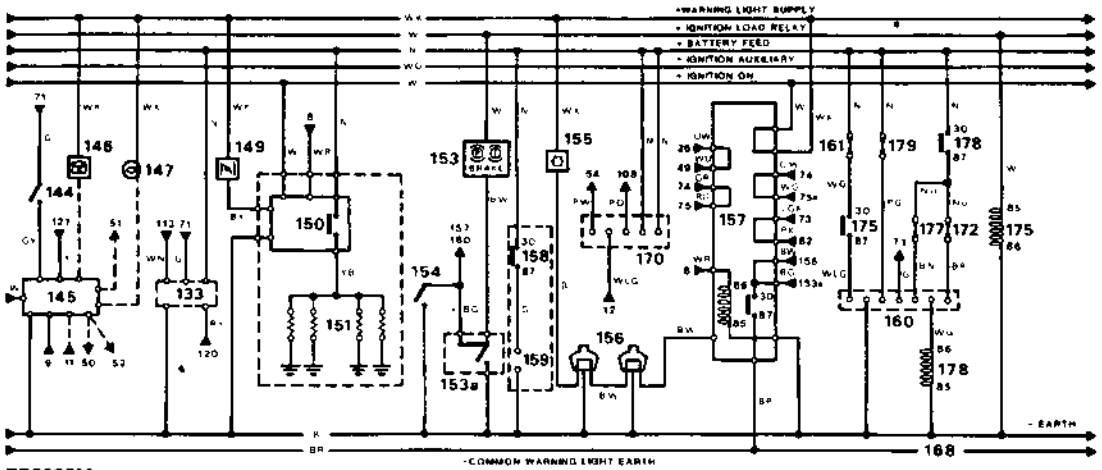


RR2828M

Illustrations RR2828M & RR2829M







RR2829M

CIRCUIT DIAGRAM - 1990 MY - USA AND CANADA - Illustrations RR2945E & RR2946E

Numerical key

1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch
8. Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse B1
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Headlamp relay
17. Front wash pump
18. Headlamp wash timer unit
19. Headlamp wash pump
20. Main lighting switch
21. Fuse A3
22. Fuse A7
23. LH side lamp
24. LH tail lamp
25. LH license plate lamp
25a. RH license plate lamp
26. High beam dimmer/flash switch
27. RH side lamp
28. RH tail lamp
29. Rheostat
30. Fuse A8
31. Fuse A2
32. Fuse A9
33. Fuse A1
34. Fuse B6
35. Not used
36. Switch illumination (2 off)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Auto gear selector illumination (2 off)
40a. Auto gear selector illumination relay.
41. Instrument illumination (4 off)
42. Column switch illumination
42. Not used
43. Not used
44. Fuse C5
45. LH low beam
46. RH low beam
47. LH high beam
48. RH high beam
49. High beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53. Water temperature sender unit
54. Fuse B2
55. Horn switch
56. RH horn
57. LH horn
58. Under hood illumination switch
59. Under hood light
60. Clock
61. Fuse C7
62. Fuse C2
63. Pick-up point central locking/window lift
64. Heated rear window relay
65. Fuse C1
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse A5
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. LH indicator warning lamp
75a. RH indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. Not used
79. Not used
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse A6
84. Stop lamp switch
85. Reverse lamp switch
86. Front fog lamp relay
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH front fog lamp
92. RH front fog lamp
93. Front fog lamp switch
94. Fuse B4
95. Dash cigar lighter
96. Glove box cigar lighter
97. Front interior lamp
98. Rear interior lamp
99. Interior lamp delay unit
100. LH door edge lamp
101. LH puddle lamp
102. RH door edge lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110. Heated washer jets
111. Thermostat heated jets
112. Oil pressure/level warning lamp
113. Oil pressure switch
114. Fuse C4
115. Inertia switch
116. Fuel pump
117. Ignition coil
118. Capacitor
119. Distributor
120. EFI Harness plug
121. Speed transducer
122. Trailer pick up point
123. Radio fuse
124. Radio and six speakers
125. Sun roof relay
125a. Fuse B5
126. Alarm pick up point
127. Seat belt warning lamp
128. 'Key-in switch'
129. Resistor
130. Audible warning unit
131. Seat buckle switch
132. Transfer box neutral switch
133. Heated front screen pick up point
134. Sunroof connection point (option)
135. Auto transmission and transfer box oil temperature warning lamp
136. Auto transmission oil temperature switch
136a. Transfer box oil temperature switch
137. Fuse C3
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
141. Rear screen wash pump
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
144. Low coolant switch
145. Electronic speedo and instrument controls
146. Low coolant level warning lamp
147. Low fuel level warning lamp
148. E.F.I. warning lamp
149. Low oil level logic unit
150. Low oil level probe
151. Not used
152. ABS warning lamp
153. Parking brake/brake fluid loss warning lamp
153a. Brake fluid level warning switch
154. Park brake warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157. Warning lamp control unit
158. Check engine warning lamp
159. Emission maintenance reminder unit
160. Heater/air conditioning connections
161. Fuse C9
162. Coil negative (engine RPM input to ECU)
163. Ignition load relay (+)
164. Battery feed (+)
165. Ignition auxiliary (+)
166. Ignition on (+)
167. Earth (-)
168. Warning lights supply common earth (-)
169. Warning lights supply (+)
170. Electric seats pick up point
171. Fuse B3
172. Fuse B8
173. Fuse C8
174. Electric mirrors pick up point
175. Heater/air conditioning relay
176. Cruise control connection points
177. Fuse B9
178. Condenser fan relay
179. Fuse B7
180. ABS pick up point

CIRCUIT DIAGRAM - 1990 MY - USA AND CANADA - Illustrations RR2945E & RR2946E

Alphabetical key

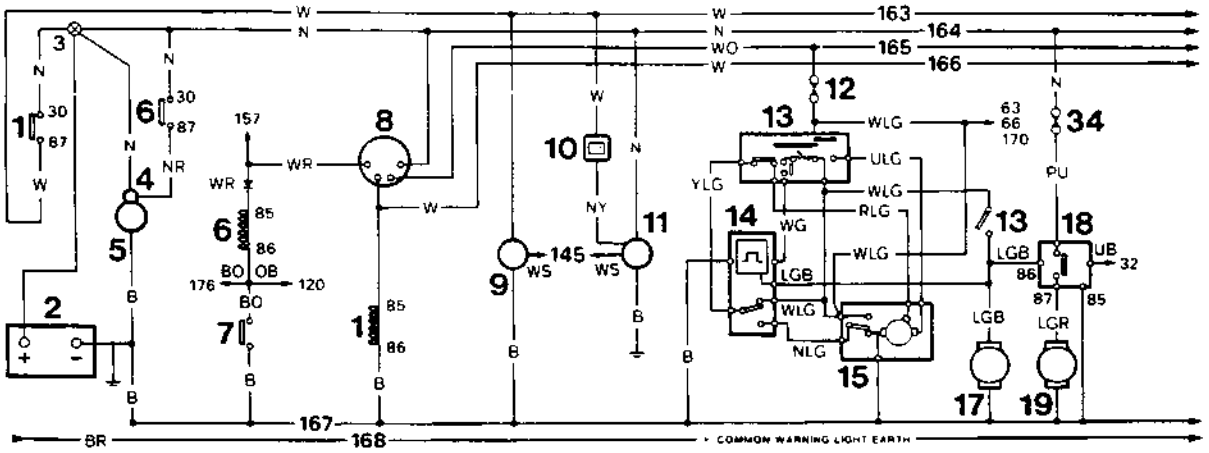
180. ABS pick up point
152. ABS warning lamp
126. Alarm pick up point
11. Alternator
130. Audible warning unit
40. Auto gear selector illumination (2 off)
40a. Auto gear selector illumination relay.
135. Auto transmission and transfer box oil temperature warning lamp
136. Auto transmission oil temperature switch
2. Battery
164. Battery feed (+)
153a. Brake fluid loss warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
118. Capacitor
163. Check engine warning lamp
37. Cigar lighter illumination (2 off)
60. Clock
39. Clock illumination
162. Coil negative (engine RPM input to ECU)
42. Column switch illumination
178. Condenser fan relay
176. Cruise control connection points
95. Dash cigar lighter
74. Direction indicator switch
119. Distributor
148. E.F.I. warning lamp
120. EFI Harness plug
167. Earth (+)
174. Electric mirrors pick up point
170. Electric seats pick up point
145. Electronic speedo and instrument controls
159. Emission maintenance reminder
73. Flasher unit
86. Front fog lamp relay
93. Front fog lamp switch
97. Front interior lamp
17. Front wash pump
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
51. Fuel gauge sender unit
50. Fuel gauge
116. Fuel pump
33. Fuse A1
31. Fuse A2
21. Fuse A3
71. Fuse A5
83. Fuse A6
30. Fuse A8
22. Fuse A7
32. Fuse A9
12. Fuse B1
54. Fuse B2
171. Fuse B3
94. Fuse B4
125a. Fuse B5
34. Fuse B6
179. Fuse B7
172. Fuse B8
177. Fuse B9
65. Fuse C1
62. Fuse C2
137. Fuse C3
114. Fuse C4
44. Fuse C5
61. Fuse C7
173. Fuse C8
161. Fuse C9
96. Glove box cigar lighter
72. Hazard switch
16. Headlamp relay
19. Headlamp wash pump
18. Headlamp wash timer unit
133. Heated front screen pick up point
68. Heated rear screen switch
64. Heated rear window relay
69. Heated rear screen warning lamp
67. Heated rear screen
110. Heated washer jets
38. Heater illumination (4 off)
175. Heater/air conditioning relay
160. Heater/air conditioning connections
26. High beam dimmer/flash switch
49. High beam warning lamp
55. Horn switch
165. Ignition auxiliary (+)
117. Ignition coil
1. Ignition load relay
163. Ignition load relay (+)
166. Ignition on (+)
8. Ignition switch
10. Ignition warning lamp
115. Inertia switch
41. Instrument illumination (4 off)
104. Interior lamp switch
99. Interior lamp delay unit
128. 'Key-in switch'
100. LH door edge lamp
108. LH front door switch
91. LH front fog lamp
77. LH front indicator lamp
47. LH high beam
57. LH horn
75. LH indicator warning lamp
25. LH license plate lamp
45. LH low beam
101. LH puddle lamp
105. LH rear door switch
76. LH rear indicator lamp
89. LH reverse lamp
23. LH side lamp
87. LH stop lamp
24. LH tail lamp
146. Low coolant level warning lamp
144. Low coolant switch
147. Low fuel level warning lamp
150. Low oil level probe
149. Low oil level logic unit
143. Low screen wash switch
142. Low screen wash fluid level warning lamp
20. Main lighting switch
151. Not used - will illuminate on initial bulb check
113. Oil pressure switch
112. Oil pressure/level warning lamp
154. Park brake warning switch
153. Parking brake/brake fluid loss warning lamp
63. Pick-up point central locking/window lift
102. RH door edge lamp
109. RH front door switch
92. RH front fog lamp
80. RH front indicator lamp
48. RH high beam
56. RH horn
75a. RH indicator warning lamp
25a. RH license plate lamp
46. RH low beam
103. RH puddle lamp
106. RH rear door switch
81. RH rear indicator lamp
90. RH reverse lamp
27. RH side lamp
88. RH stop lamp
28. RH tail lamp
66. Radio aerial amplifier
124. Radio and six speakers
123. Radio fuse
98. Rear interior lamp
141. Rear screen wash pump
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
129. Resistor
85. Reverse lamp switch
29. Rheostat
127. Seat belt warning lamp
131. Seat buckle switch
121. Speed transducer
7. Starter inhibit switch
5. Starter motor
6. Starter relay
4. Starter solenoid
84. Stop lamp switch
125. Sun roof relay
134. Sunroof connection point (option)
36. Switch illumination (2 off)
9. Tachometer
107. Tailgate switch
3. Terminal post
111. Thermostat heated jets
122. Trailer pick up point
82. Trailer warning lamp
136a. Transfer box oil temperature switch
132. Transfer box neutral switch
58. Under hood illumination switch
59. Under hood light
70. Voltage sensitive switch
157. Warning lamp control unit
168. Warning lights supply common earth (-)
169. Warning lights supply (+)
53. Water temperature sender unit
52. Water temperature gauge temperature warning lamp

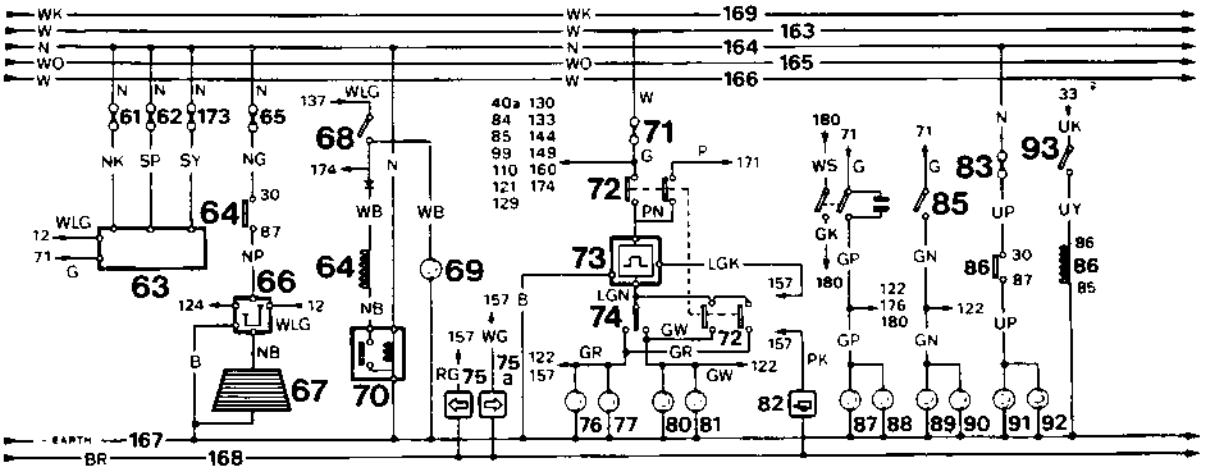
Cable colour code

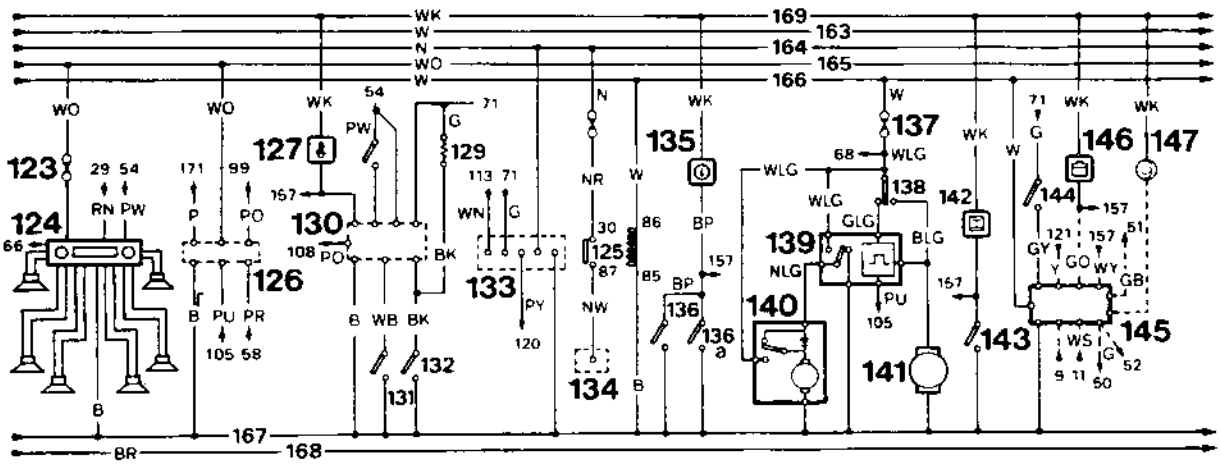
B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

Circuit diagram - 1990 MY - USA and CANADA

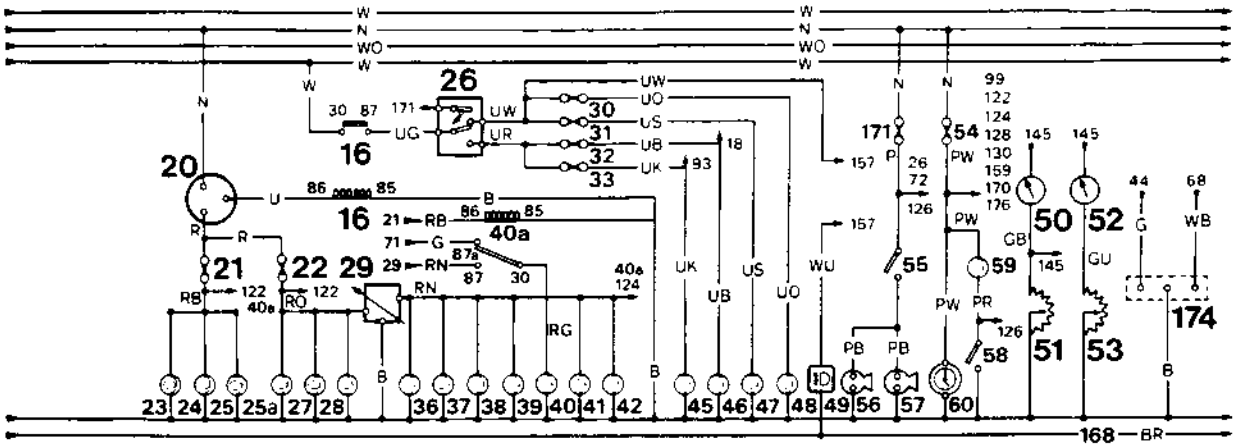


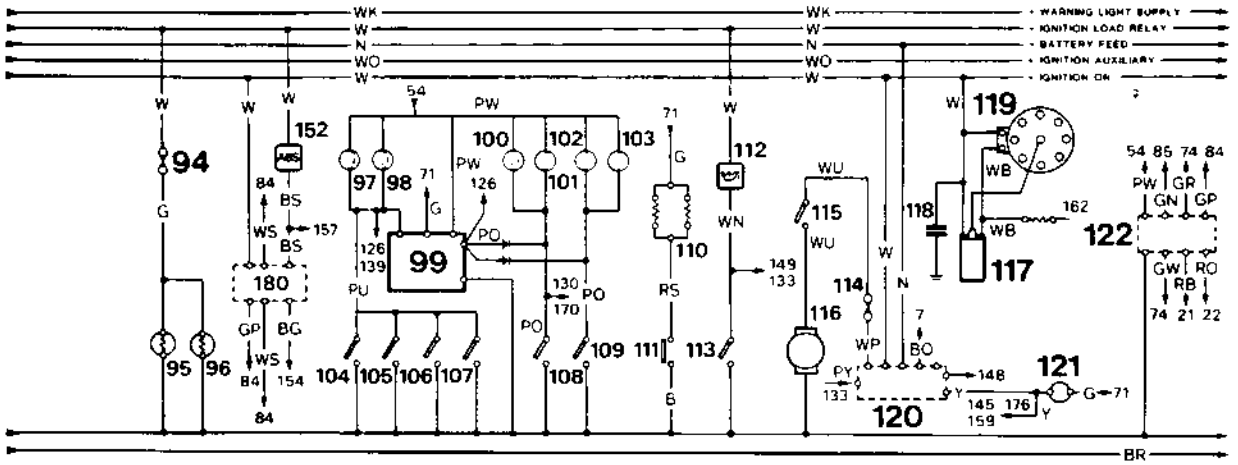


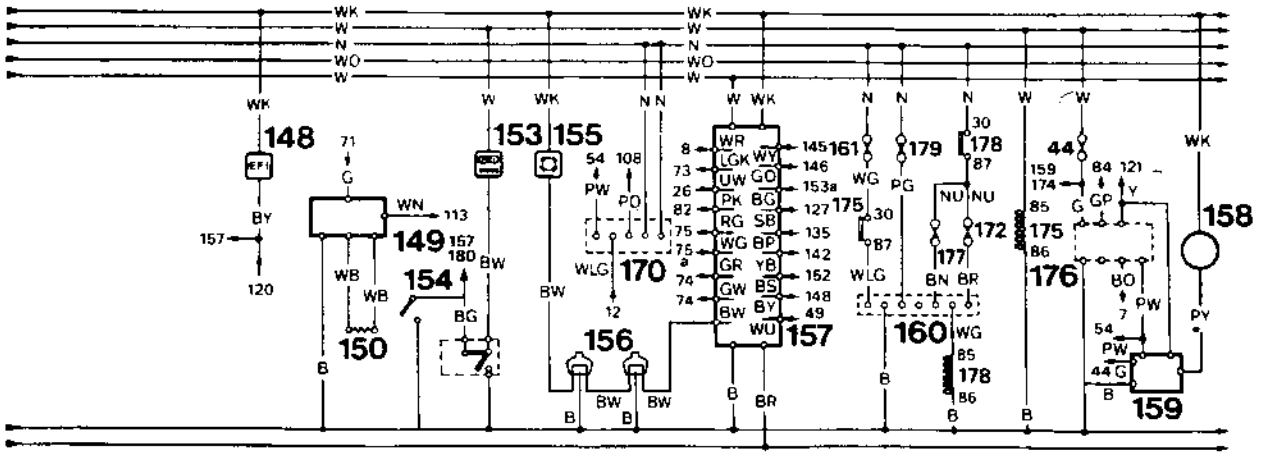


RR2945E — REVISED. SEPT. 90

Illustrations RR2945E & RR2946E

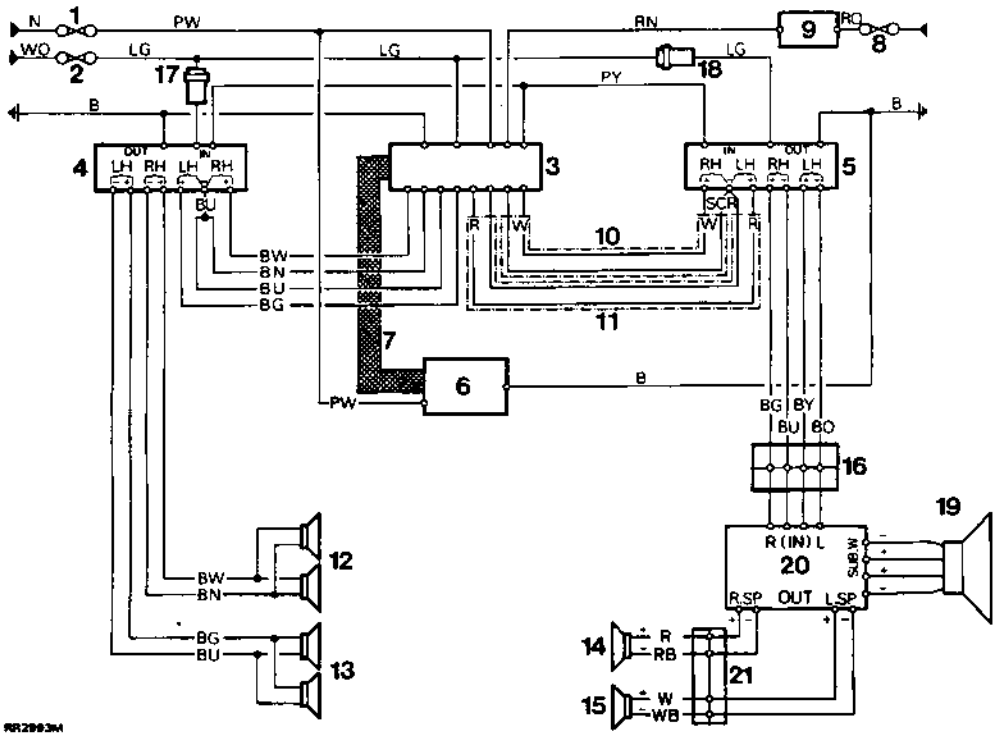






RR2946E

CD PLAYER WITH POWER AMPLIFIERS - 1991



Circuit diagram - RR2993E

1. Fuse B2
2. Fuse B4
3. Radio - head unit
4. Front power amplifier
5. Rear power amplifier
6. CD auto changer
7. Data link cable
8. Fuse A4
9. Rheostat
10. Screened cable, RH rear speaker signal
11. Screened cable, LH rear speaker signal
12. RH front door speaker
13. LH front door speaker
14. RH rear speaker
15. LH rear speaker
16. In-line connector, cross-over unit IN
17. 4 amp in-line fuse, front amplifier
18. 4 amp in-line fuse, rear amplifier
19. Sub-woofer
20. Cross-over assembly
21. In line connecter cross-over unit OUT

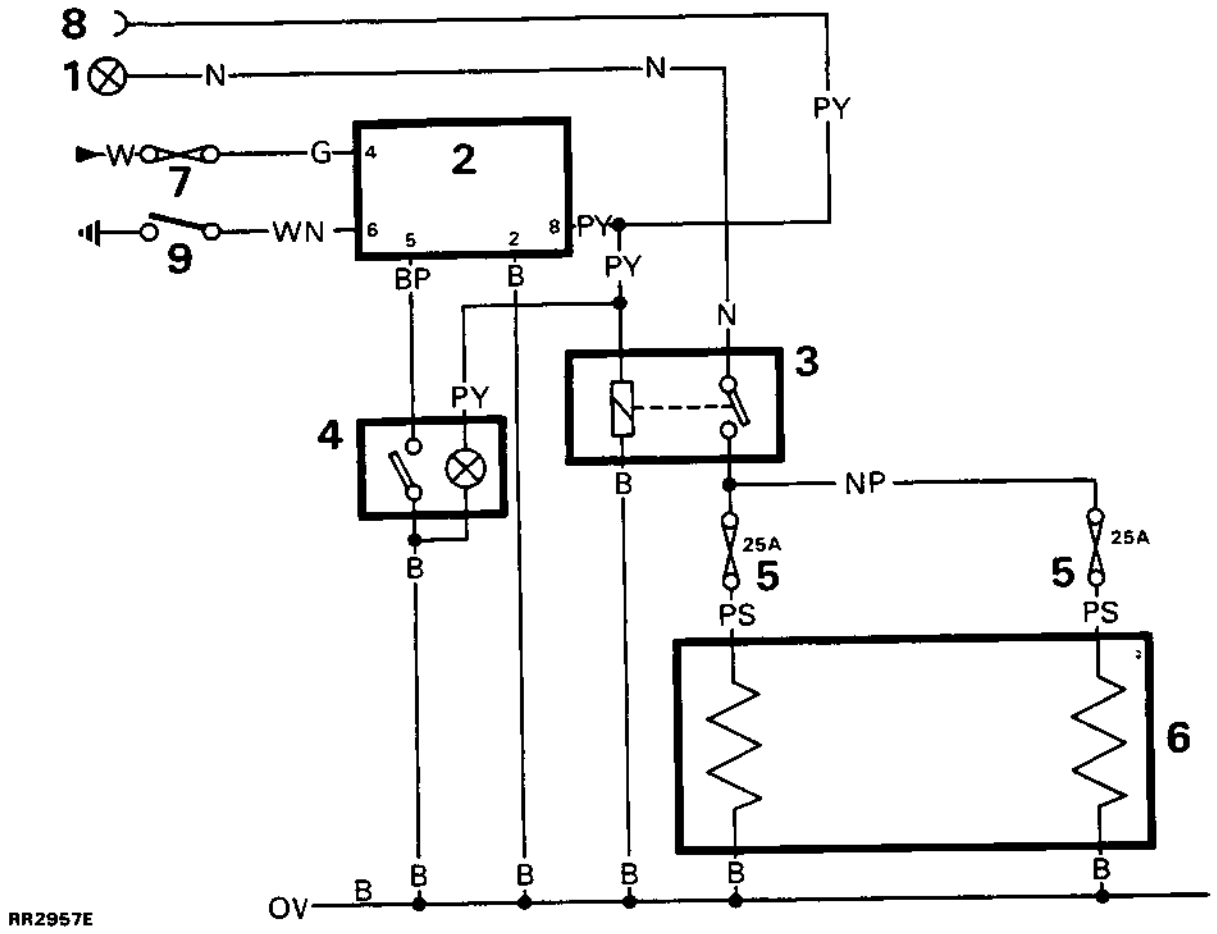
NOTE: SCR denotes screen

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

HEATED FRONT SCREEN - 1991



Circuit diagram - RR2957E

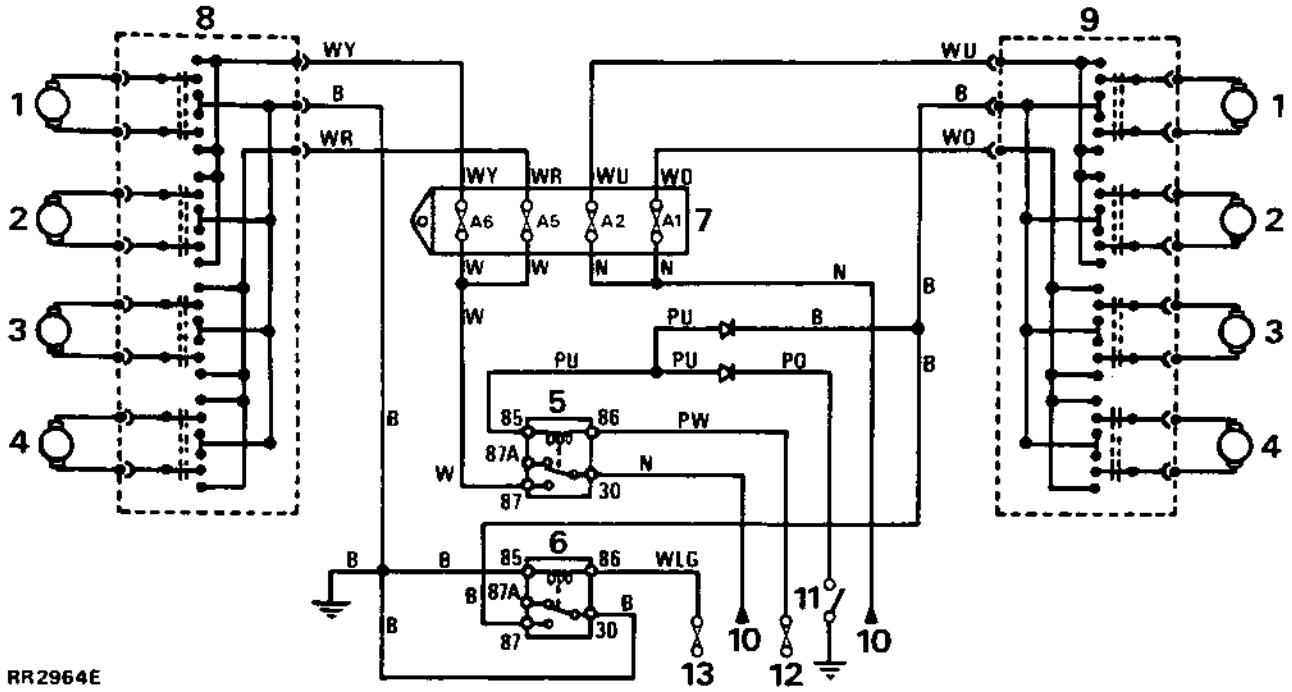
1. Terminal post
2. Timer unit
3. Load relay
4. Switch/warning light
5. In line fuses - 25 Amp
6. Heated front screen
7. Fuse A5
8. EFI ECU pin 8
9. Oil pressure switch

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

ELECTRIC SEAT ADJUSTMENT - 1991



Circuit diagram - RR2530E

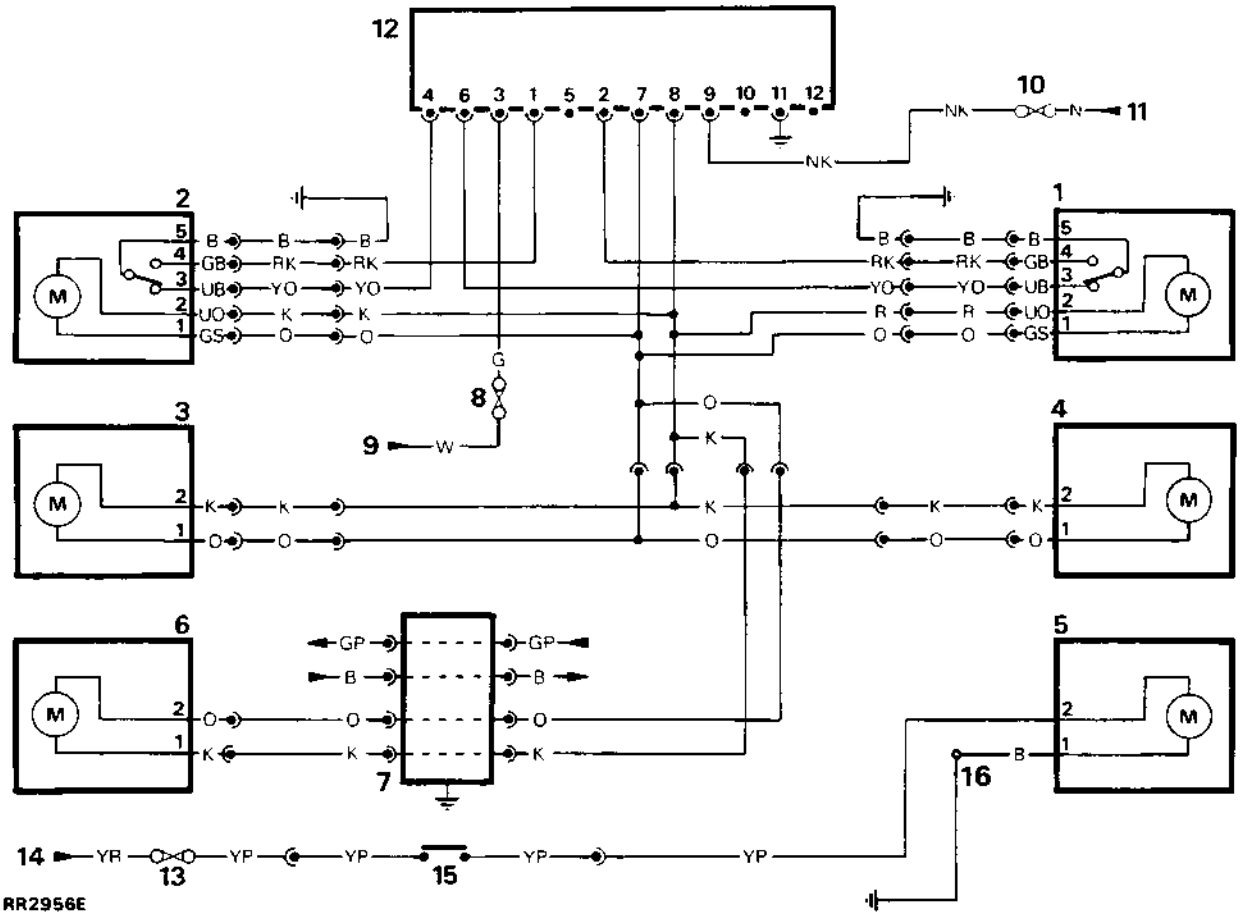
1. Seat recline motor
2. Seat height (rear) motor
3. Seat base adjust motor
4. Seat height (front) motor
5. Load relay-from driver's door courtesy switch
6. Load relay-fused auxiliary feed controled
7. Auxiliary fuse box (B)
8. Driver's seat control
9. Passenger's seat control
10. Terminal post
11. Drivers door switch
12. Fuse B2
13. Fuse B1

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

DOOR LOCKS / FUEL FILLER FLAP - 1991



Circuit diagram - RR2956E

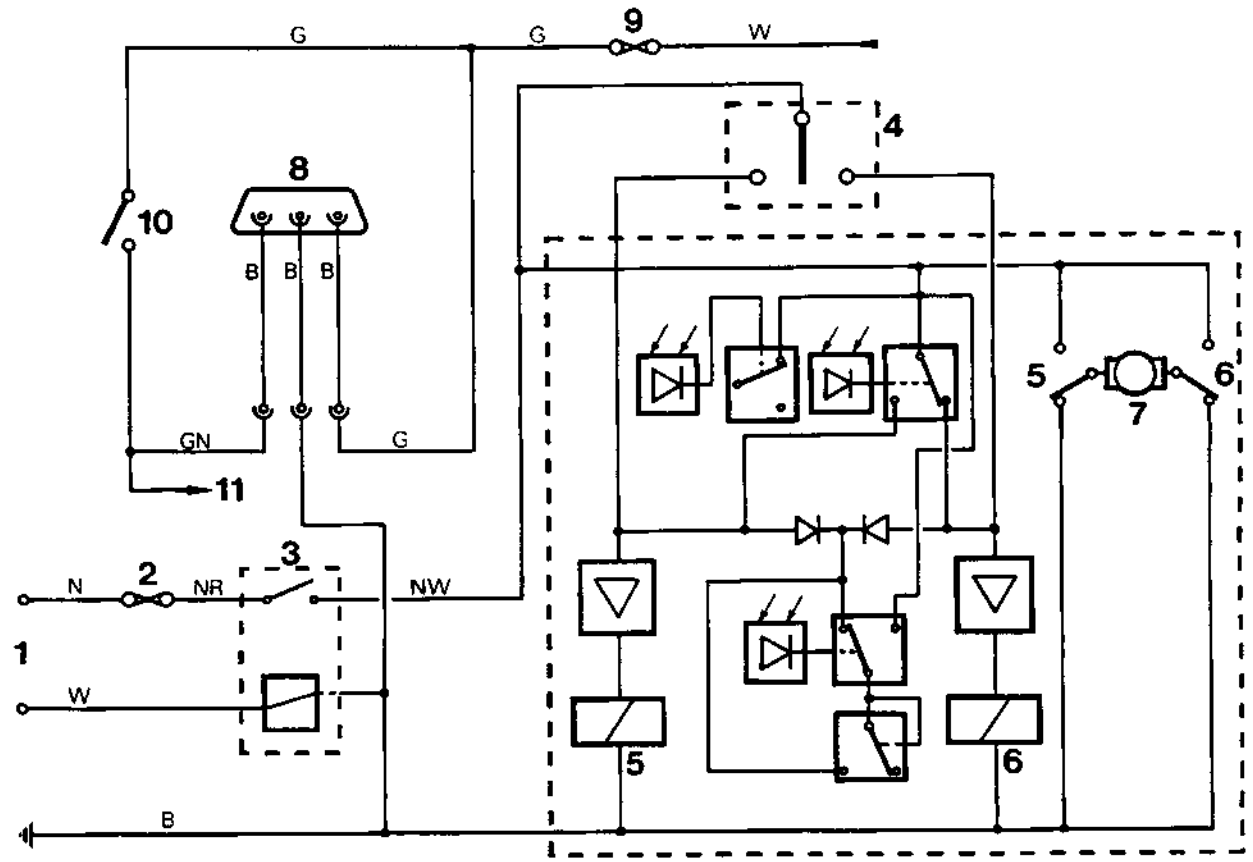
1. Switch/lock unit right hand front door
2. Switch/lock unit left hand front door
3. Lock unit left hand rear door relay
4. Lock unit right hand rear door
5. Fuel flap actuator
6. Lock unit tailgate
7. Suppressor
8. Fuse A5
9. Feed from ignition load relay - pin 87
10. Fuse C7
11. Battery 12V +ve
12. Central door locking control unit
13. Fuse C6
14. Feed from ignition load relay - pin 87A
15. Fuel flap release switch
16. Fuel tank filler pipe ground

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

SUNROOF / AUTOMATIC GLARE CONTROL MIRROR - 1991



RR2958E

Circuit diagram - RR2958E

1. Main harness connections
   Brown - live positive feed
   White - ignition positive feed
   Black - ground
2. Fuse B5
3. Auxiliary relay
4. Operating switch
5. Relay - tilt, open to closed
   - slide, closed to open
6. Relay - slide, open to closed
   - tilt, closed to open
7. Drive motor
8. Mirror connection
9. Fuse A5
10. Reverse lamps switch
11. Reverse lamps

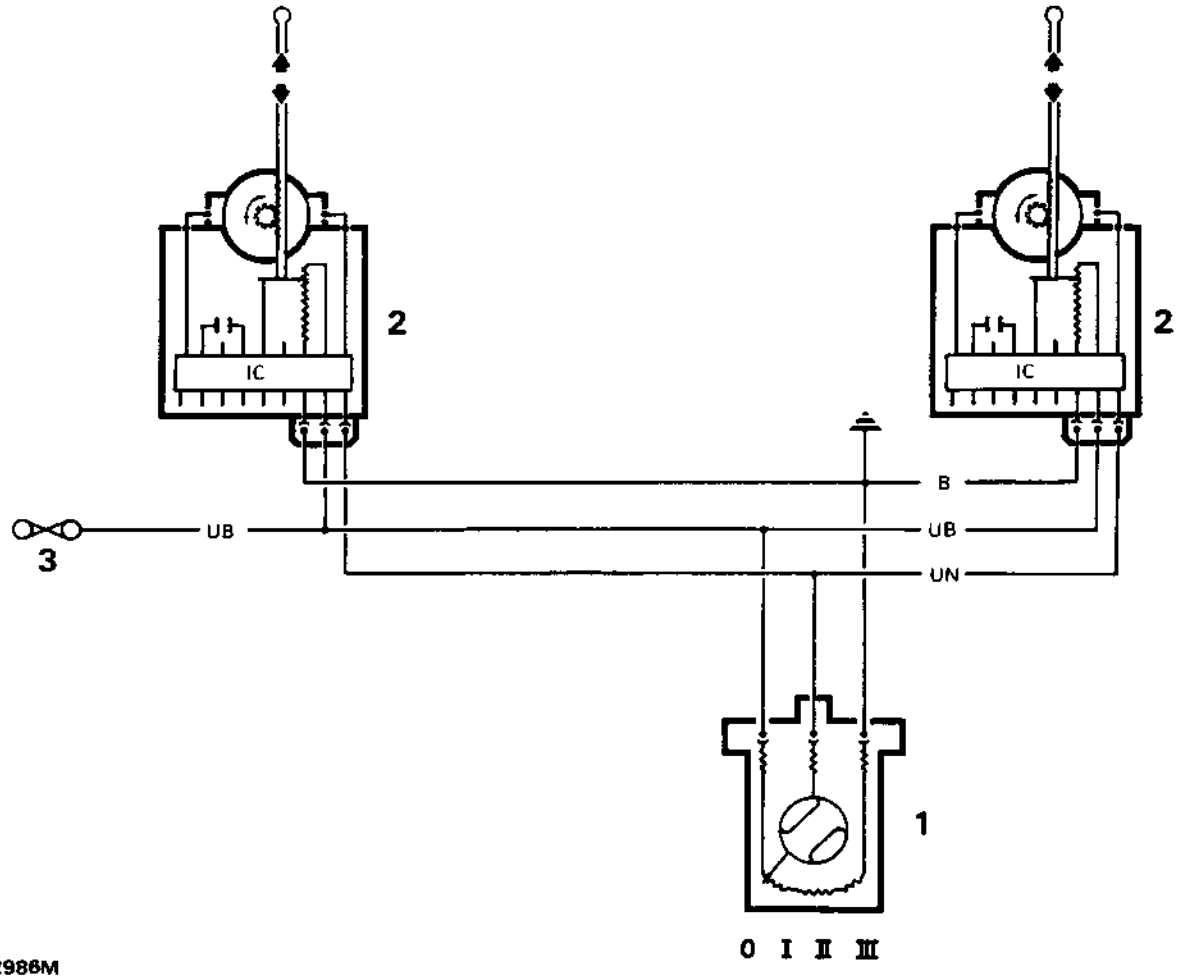
Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

------- Denotes component enclosure

HEADLAMP LEVELLING - 1991



RR2986M

Circuit diagram - RR2986M

1. Headlamp levelling switch
2. Headlamp levelling actuator/motor
3. Fuse A9

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

CIRCUIT DIAGRAM - 1991 MY - RIGHT HAND STEERING - Illustrations RR2976M & RR2977M

Numerical key

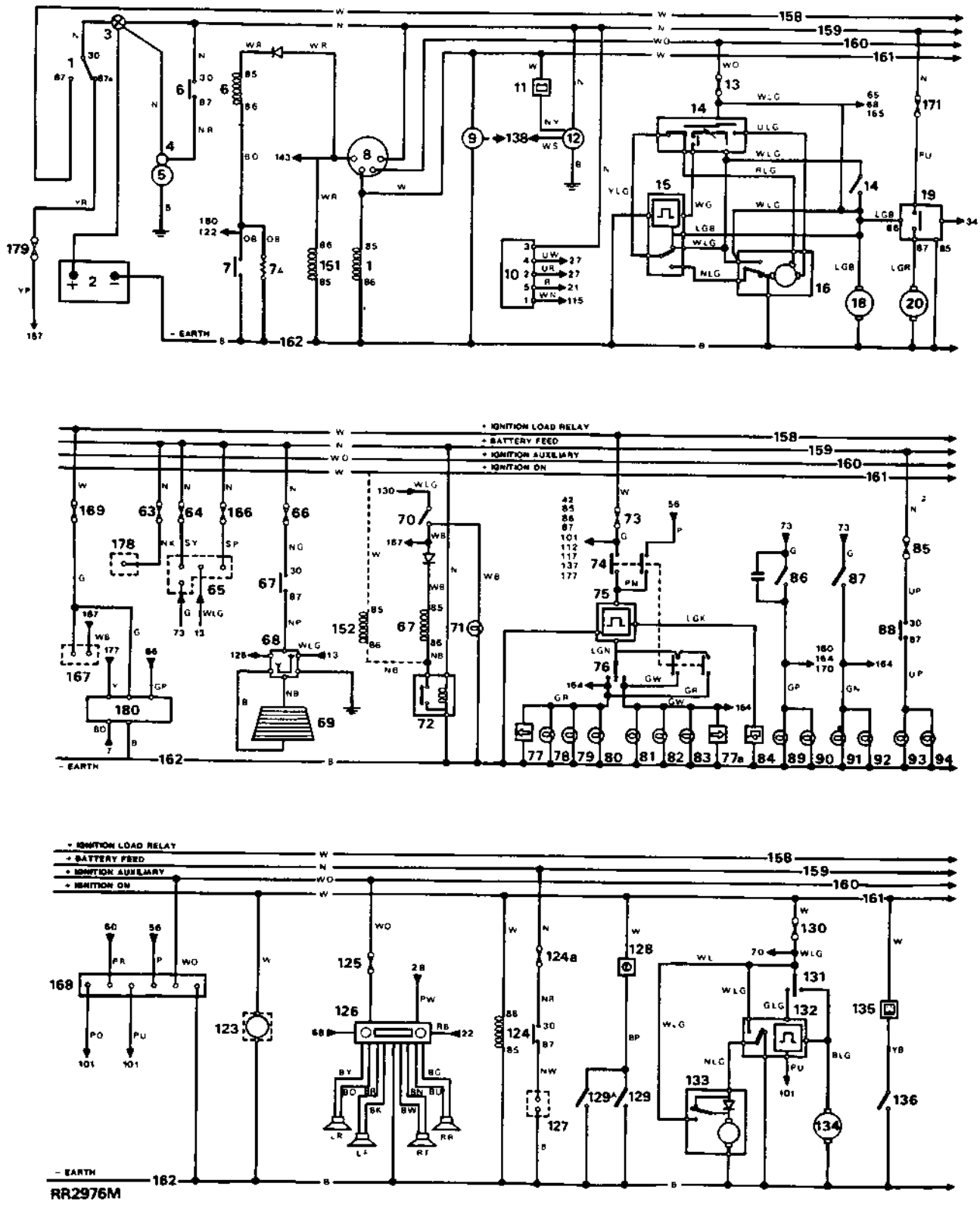
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch
7a. Resistor (manual)
8. Ignition switch
9. Tachometer
10. Voltage transformer (dim dip)
11. Ignition warning lamp
12. Alternator
13. Fuse B1
14. Front wipe/wash switch
15. Front wipe delay unit
16. Front wiper motor
17. Headlamp relay
18. Front wash pump
19. Headlamp wash timer unit
20. Headlamp wash pump
21. Main lighting switch
22. Fuse A3
23. Fuse A7
24. LH side lamp
25. LH tail lamp
26. LH number plate lamp
26a. RH number plate lamp
27. High beam dip/flash switch
28. Fuse B2
29. RH side lamp
30. RH tail lamp
31. Rheostat
32. Fuse A8
33. Fuse A2
34. Fuse A9
35. Fuse A1
36. Rear fog switch
37. Fuse A4
38. Switch illumination (2 off)
39. Cigar lighter illumination (2 off)
40. Heater illumination (4 off)
41. Clock illumination
42. Auto gear selector illumination
43. Instrument illumination (4 off)
43a. Column switch illumination
44. Rear fog warning lamp
45. LH rear fog lamp
46. RH rear fog lamp
47. LH dip beam
48. RH dip beam
49. LH high beam
50. RH high beam
51. High beam warning lamp
52. Fuel gauge
53. Fuel gauge sender unit
54. Water temperature gauge
55. Water temperature sender unit
56. Fuse B3
57. Horn switch
58. RH horn
59. LH horn
60. Under bonnet illumination switch
61. Under bonnet light
62. Clock
63. Fuse C7
64. Fuse C8
65. Window lift pick-up point
66. Fuse C1
67. Heated rear screen relay
68. Radio aerial amplifier
69. Heated rear screen
70. Heated rear screen switch
71. Heated rear screen warning lamp
72. Voltage sensitive switch
73. Fuse A5
74. Hazard switch
75. Flasher unit
76. Direction indicator switch
77. LH indicator warning lamp
77a. RH indicator warning lamp
78. LH rear indicator lamp
79. LH front indicator lamp
80. LH side repeater lamp
81. RH side repeater lamp
82. RH front indicator lamp
83. RH rear indicator lamp
84. Trailer warning lamp
85. Fuse A6
86. Stop lamp switch
87. Reverse lamp switch
88. Front auxilary lamp relay
89. LH stop lamp
90. RH stop lamp
91. LH reverse lamp
92. RH reverse lamp
93. LH front auxilary lamp
94. RH front auxilary lamp
95. Front auxilary lamp switch
96. Fuse B4
97. Dash cigar lighter
98. Glove box cigar lighter
99. Front interior lamp
100. Rear interior lamp
101. Interior lamp delay unit
102. LH door edge lamp
103. LH puddle lamp
104. RH door edge lamp
105. RH puddle lamp
106. Interior lamp switch
107. LH rear door switch
108. RH rear door switch
109. Tailgate switch
110. LH front door switch
111. RH front door switch
112. Heated washer jets (front screen)
113. Thermostat heated jets
114. Oil pressure warning lamp
115. Oil pressure switch
116. Fuse C4
117. Heated front screen connections
118. Fuel pump (petrol models)
119. Ignition coil
120. Capacitor
121. Distributor
122. EFI Harness plug
123. Fuel shut off solenoid (Diesel)
124. Sun roof relay
124a. Fuse B5
125. Radio fuse
126. Radio and four speakers
-LF-left hand front speaker
-LR-left hand rear speaker
-RF-right front speaker
-RR-right hand rear speaker
127. Sun roof pick up point
128. Auto transmission and transfer box oil temperature warning lamp
129. Auto transmission oil temperature switch
129a. Transfer box oil temperature switch
130. Fuse C3
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
134. Rear screen wash pump
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
137. Low coolant switch
138. Electronic speedo and instrument controls
139. Low coolant level warning lamp
140. Low fuel level warning lamp
141. Glow plug warning lamp (Diesel)
142. E.F.I. warning lamp
143. Glow plug timer unit
144. Glow plugs (Diesel)
145. ABS warning lamp
146. Handbrake/brake fluid level/pressure warning lamp
147. Handbrake warning switch
148. Brake fluid level warning switch
149. Brake pad wear warning lamp
150. Brake pad wear sensors
151. Brake check relay (Australia only)
152. Split charge relay (option)
153. Split charge terminal post (option)
154. Heater/air conditioning connections
155. Fuse C9
156. Coil negative (engine RPM input to ECU)
157. Fuel filler flap (see door cable circuit diagram)
158. Ignition load relay (+)
159. Battery feed (+)
160. Ignition auxiliary (+)
161. Ignition on (+)
162. Earth (-)
163. Heater/air con. load relay
164. Trailer pick up point
165. Electric seats pick up point (option)
166. Fuse C2
167. Electric mirrors
168. Alarm pick up point
169. Fuse C5
170. ABS pick up point
171. Fuse B6
172. Fuse B7
173. Condenser fan relay
174. Fuse B8
175. Fuse B9
176. Inertia switch
177. Speed transducer
178. Central locking
179. Fuse C6
180. Cruise control pick-up point (option)

CIRCUIT DIAGRAM - 1991 MY - RIGHT HAND STEERING - Illustrations RR2976M & RR2977M

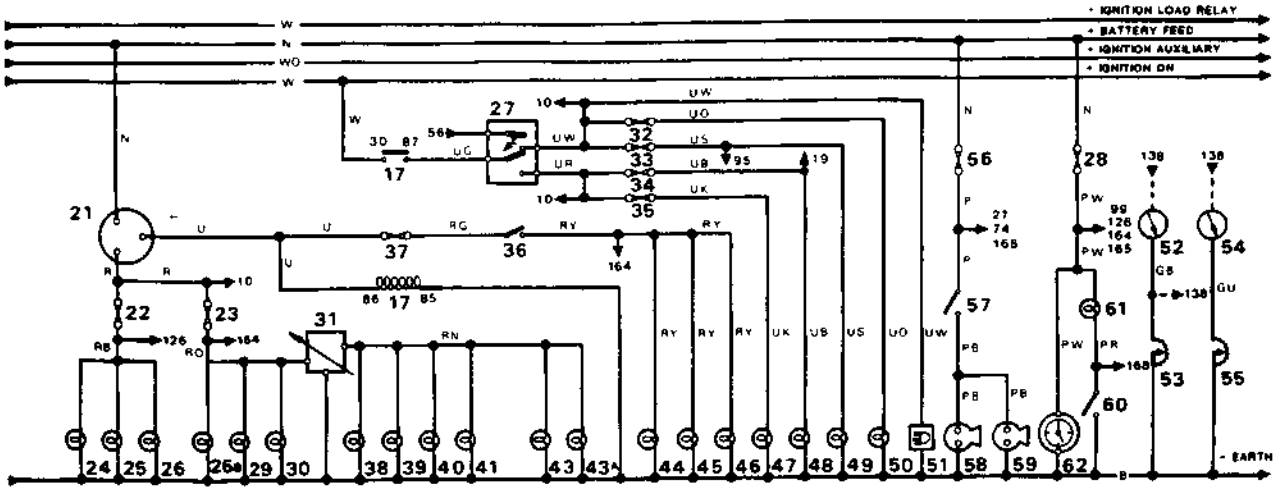
Alphabetical key

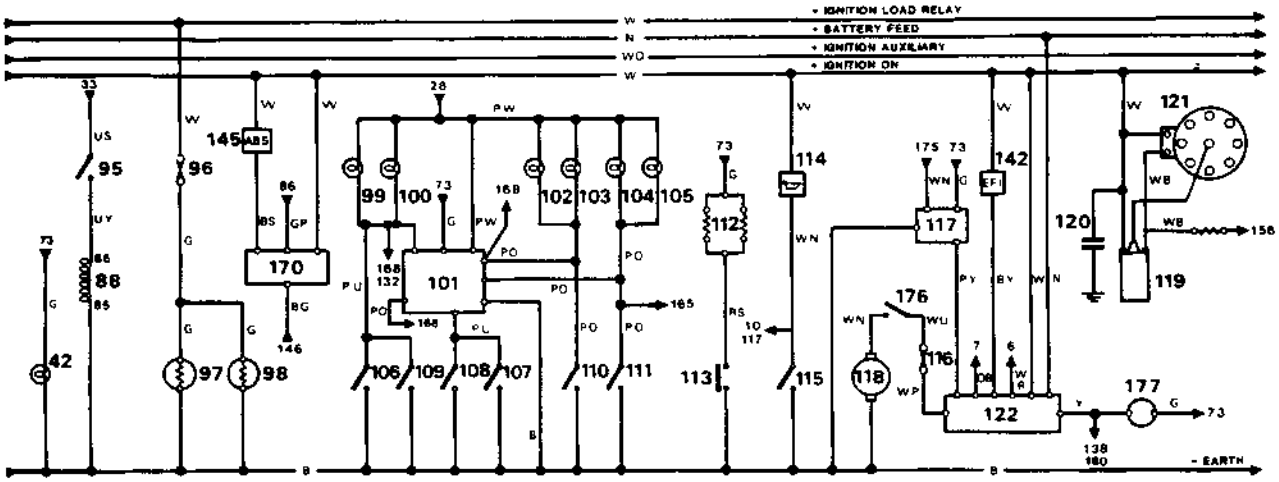
170. ABS pick up point
145. ABS warning lamp
168. Alarm pick up point
12. Alternator
42. Automatic gear selector illumination (2 off)
129. Automatic transmission oil temperature switch
128. Automatic transmission/transfer box oil temperature warning lamp
2. Battery
148. Brake fluid level warning switch
150. Brake pad wear sensors
149. Brake pad wear warning lamp
151. Brake check relay (Australia only)
120. Capacitor
178. Central locking
39. Cigar lighter illumination (2 off)
62. Clock
41. Clock illumination
156. Coil negative, engine speed signal to ECU
43a. Column switch illumination
173. Condenser fan relay
180. Cruise control pick-up point (option)
97. Dash cigar lighter
76. Direction indicator switch
121. Distributor
167. Electric mirrors
165. Electric seats pick up point (option)
138. Electronic speedo and instrument controls
122. EFI Harness plug
142. EFI warning lamp
75. Flasher unit
88. Front auxiliary lamp relay
95. Front auxiliary lamp switch
99. Front interior lamp
18. Front wash pump
15. Front wipe delay unit
14. Front wipe/wash switch
16. Front wiper motor
52. Fuel gauge
53. Fuel gauge sender unit
118. Fuel pump (petrol models)
123. Fuel shut off solenoid (Diesel)
157. Fuel filler flap
35. Fuse A1
33. Fuse A2
22. Fuse A3
37. Fuse A4
73. Fuse A5
85. Fuse A6
23. Fuse A7
32. Fuse A8
34. Fuse A9
13. Fuse B1
28. Fuse B2
56. Fuse B3
96. Fuse B4
124a. Fuse B5
171. Fuse B6
172. Fuse B7
174. Fuse B8
175. Fuse B9
66. Fuse C1
166. Fuse C2
130. Fuse C3
116. Fuse C4
169. Fuse C5
179. Fuse C6
63. Fuse C7
64. Fuse C8
155. Fuse C9
98. Glove box cigar lighter
144. Glow plugs (Diesel)
143. Glow plug timer unit (Diesel)
141. Glow plug warning lamp (Diesel)
146. Handbrake/brake fluid level/pressure warning lamp
147. Handbrake warning switch
74. Hazard switch
17. Headlamp relay
20. Headlamp wash pump
19. Headlamp wash timer unit
117. Heated front screen connections
69. Heated rear screen
67. Heated rear screen relay
70. Heated rear screen switch
71. Heated rear screen warning lamp
112. Heated washer jets
40. Heater illumination (4 off)
154. Heater/air con. connections
163. Heater/air con. load relay
27. High beam dip/flash switch
51. High beam warning lamp
57. Horn switch
119. Ignition coil
1. Ignition load relay
8. Ignition switch
11. Ignition warning lamp
176. Inertia switch
43. Instrument illumination (4 off)
101. Interior lamp delay unit
106. Interior lamp switch
47. LH dip beam
102. LH door edge lamp
93. LH front auxiliary lamp
110. LH front door switch
79. LH front indicator lamp
49. LH high beam
59. LH horn
77. LH indicator warning lamp
25. LH number plate lamp
103. LH puddle lamp
107. LH rear door switch
45. LH rear fog lamp
78. LH rear indicator lamp
91. LH reverse lamp
24. LH side lamp
80. LH side repeater lamp
89. LH stop lamp
25. LH tail lamp
139. Low coolant level warning lamp
137. Low coolant switch
140. Low fuel level warning lamp
135. Low screen wash fluid level warning lamp
136. Low screen wash switch
21. Main lighting switch
115. Oil pressure switch
114. Oil pressure warning lamp
68. Radio aerial amplifier
126. Radio and four speakers
125. Radio fuse
36. Rear fog switch
44. Rear fog warning lamp
100. Rear interior lamp
134. Rear screen wash pump
131. Rear wash wipe switch
132. Rear wipe delay unit
133. Rear wiper motor
7a. Resistor (manual)
87. Reverse lamp switch
48. RH dip beam
104. RH door edge lamp
94. RH front auxiliary lamp
111. RH front door switch
82. RH front indicator lamp
50. RH high beam
58. RH horn
77a. RH indicator warning lamp
26a. RH number plate lamp
105. RH puddle lamp
108. RH rear door switch
46. RH rear fog lamp
83. RH rear indicator lamp
92. RH reverse lamp
29. RH side lamp
81. RH side repeater lamp
90. RH stop lamp
30. RH tail lamp
31. Rheostat
177. Speed transducer
152. Split charge relay (option)
153. Split charge terminal post (option)
7. Starter inhibit switch
5. Starter motor
6. Starter relay
4. Starter solenoid
86. Stop lamp switch
127. Sunroof pick up point
124. Sunroof relay
38. Switch illumination (2 off)
9. Tachometer
109. Tailgate switch
3. Terminal post
113. Thermostat - heated washer jets
164. Trailer pick up point
84. Trailer warning lamp
129a. Transfer box oil temperature switch
60. Under bonnet illumination switch
61. Under bonnet light
72. Voltage sensitive switch
10. Voltage transformer (dim-dip)
54. Water temperature gauge
55. Water temperature sender unit
65. Window lift pick-up point

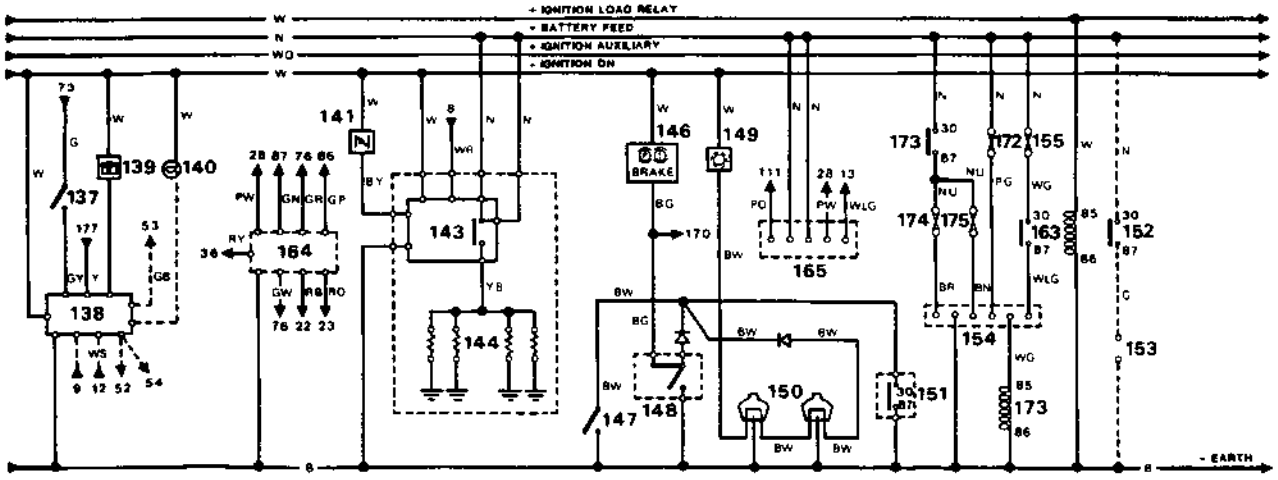
Circuit diagram - 1991 MY - Right hand steering



Illustrations RR2976M and RR2977M







RR2977M

CIRCUIT DIAGRAM - 1991 MY - LEFT HAND STEERING - Illustrations RR2978M & RR2979M

Numerical key

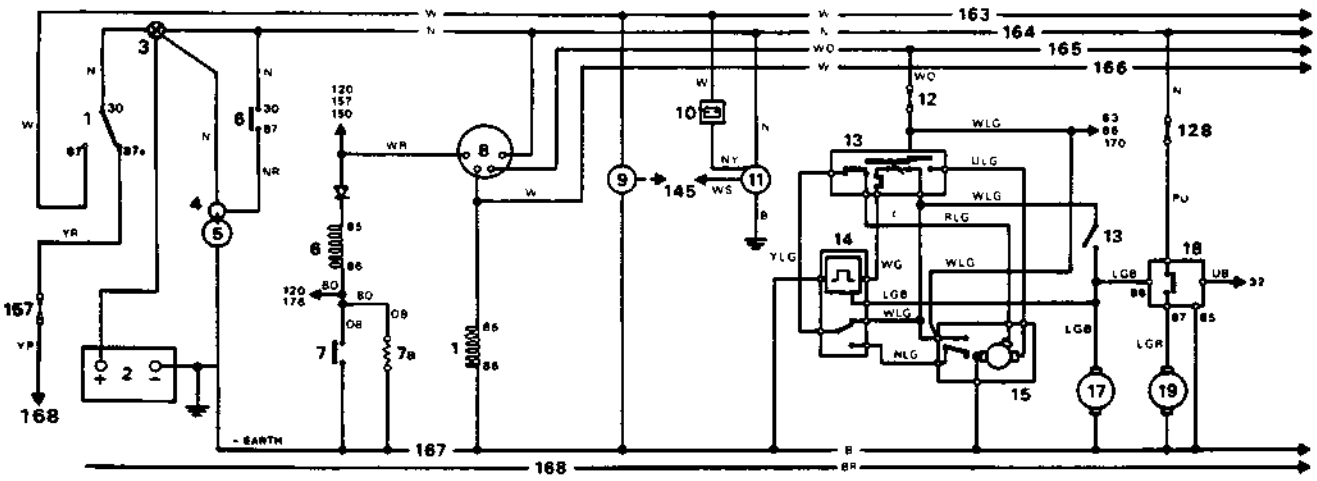
1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch (auto)
7a. Resistor (manual transmission)
8. Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse B1
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Headlamp relay
17. Front wash pump
18. Headlamp wash timer unit
19. Headlamp wash pump
20. Main lighting switch
21. Fuse A3
22. Fuse A7
23. LH side lamp
24. LH tail lamp
25. LH number plate lamp
25a. RH number plate lamp
26. High beam dip/flash switch
27. RH side lamp
28. RH tail lamp
29. Rheostat
30. Fuse A8
31. Fuse A2
32. Fuse A9
33. Fuse A1
34. Rear fog switch
35. Fuse A4
36. Switch illumination (2 off)
36a. Headlamp levelling switch illumination (Germany)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Auto gear selector illumination (2 off)
41. Instrument illumination (4 off)
41a. Column switch illumination
42. Rear fog warning lamp
43. LH rear fog
44. RH rear fog
45. LH dip beam
46. RH dip beam
47. LH high beam
48. RH high beam
49. High beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53. Water temperature sender unit
54. Fuse B2
55. Horn switch
56. RH horn
57. LH horn
58. Under bonnet illumination switch
59. Under bonnet light
60. Clock
61. Fuse C7
62. Fuse C2
63. Pick-up point central locking/window lift
64. Heated rear screen relay
65. Fuse C1
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse A5
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. LH indicator warning lamp
75a. RH indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. LH side repeater lamp
79. RH side repeater lamp
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse A6
84. Stop lamp switch
85. Reverse lamp switch
86. Front auxilary lamp relay (option)
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH front auxilary lamp (option)
92. RH front auxilary lamp (option)
93. Front auxilary lamp switch
94. Fuse B4
95. Dash cigar lighter
96. Glove box cigar lighter
97. Front interior lamp
98. Rear interior lamp
99. Interior lamp delay unit
100. LH door edge lamp
101. LH puddle lamp
102. RH door edge lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110. Heated washer jets (front screen)
111. Thermostat-heated washer jets
112. Oil pressure warning lamp
113. Oil pressure switch
114. Fuse C4
115. Inertia switch
116. Fuel pump (petrol models)
117. Ignition coil (petrol models)
118. Capacitor (petrol models)
119. Distributor (petrol models)
120. EFI Harness plug
121. Speed transducer
122. Trailer pick up point
123. Radio fuse
124. Radio and four speakers
-LF-left hand front speaker
-LR-left hand rear speaker
-RF-right front speaker
-RR-right hand rear speaker
125. Sun roof relay
125a. Fuse B5
126. Alarm pick up point
127. Overspeed warning (Saudi only)
128. Fuse B6
129. Fuse C5
130. Fuel shut off solenoid (Diesel)
131. Seat buckle switch (Saudi only)
132. Overspeed monitor (Saudi only)
133. Heated front screen pick up point (option)
134. Sunroof pick up point (option)
135. Auto transmission / transfer box oil temperature warning lamp
136. Auto transmission oil temperature switch
136a. Transfer box oil temperature switch
137. Fuse C3
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
141. Rear screen wash pump
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
144. Low coolant switch
145. Electronic speedo and instrument controls
146. Low coolant level warning lamp
147. Low fuel level warning lamp
148. E.F.I. warning lamp
149. Glow plug warning lamp (Diesel)
150. Glow plug timer unit(Diesel)
151. Glow plugs (Diesel)
152. ABS warning lamp
153. Handbrake / brake fluid level / pressure warning lamp
153a. Brake fluid level warning switch
154. Handbrake warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157. Fuse C6
158. Split charge relay (option)
159. Split charge terminal post (option)
160. Heater/air conditioning connections
161. Fuse C9
162. Coil negative (engine RPM input to ECU)
163. Ignition load relay (+)
164. Battery feed (+)
165. Ignition auxiliary (+)
166. Ignition on (+)
167. Earth (-)
168. Fuel filler flap (see door locks circuit diagram)
169. Central locking
170. Electric seats pick up point
171. Fuse B3
172. Fuse B8
173. Fuse C8
174. Electric mirrors
175. Heater/air conditioning load relay
176. Cruise control pick up points (option)
177. Fuse B9
178. Condenser fan relay
179. Fuse B7
180. ABS pick up point
181. Headlamp levelling switch connection (option)
182. Headlamp levelling actuator (2) (option)

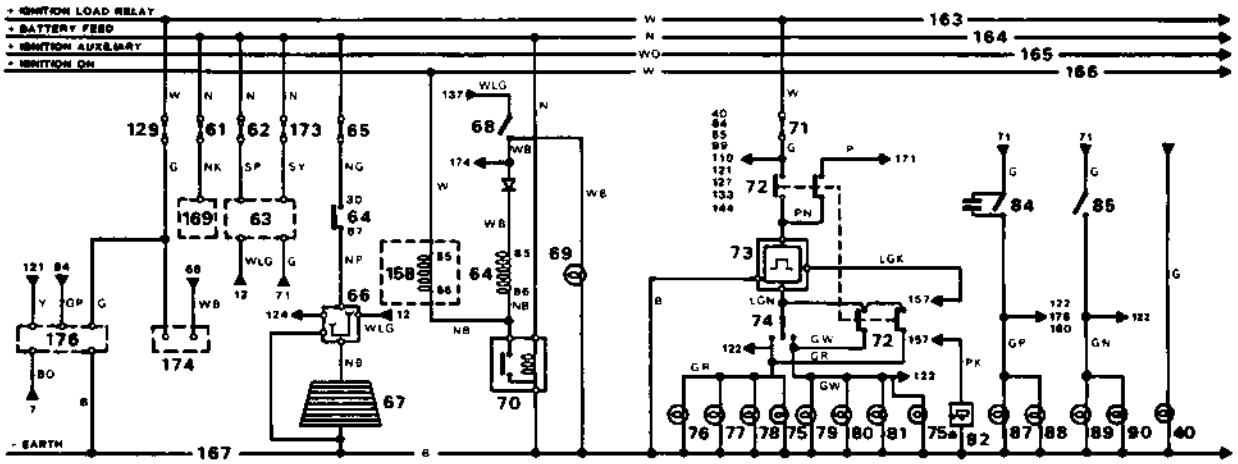
CIRCUIT DIAGRAM - 1991 MY - LEFT HAND STEERING - Illustrations RR2978M & RR2979M

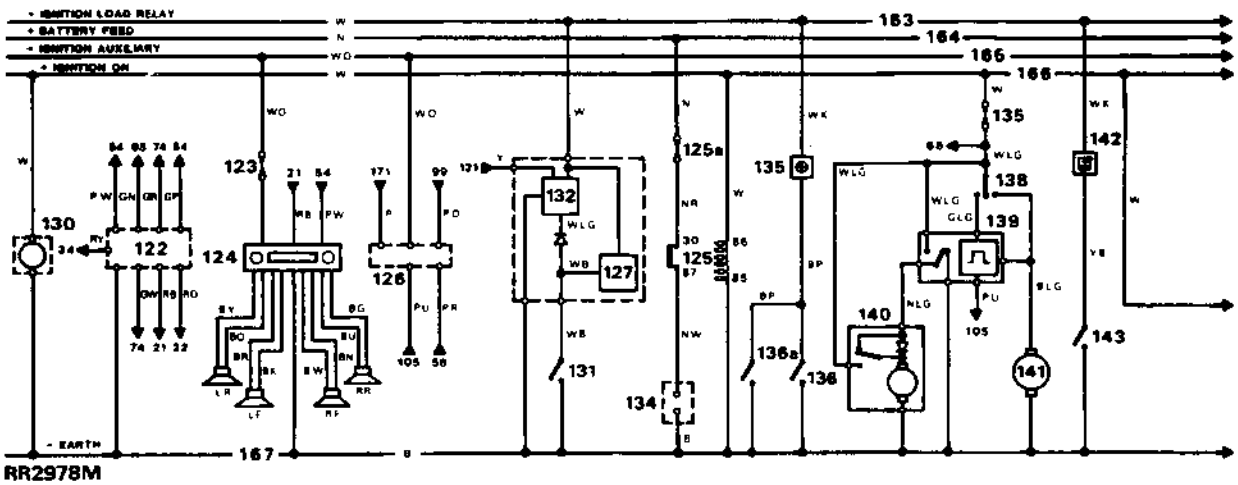
Alphabetical key

180. ABS pick up point
152. ABS warning lamp
126. Alarm pick up point
11. Alternator
40. Automatic gear selector illumination (2 off)
136. Automatic transmission oil temperature switch
135. Automatic transmission/transfer box oil temperature warning lamp
2. Battery
153a. Brake fluid level warning switch
156. Brake pad wear sensors
155. Brake pad wear warning lamp
118. Capacitor (petrol models)
169. Central locking
37. Cigar lighter illumination (2 off)
60. Clock
39. Clock illumination
162. Coil negative, engine speed signal to ECU
41a. Column switch illumination
178. Condenser fan relay
176. Cruise control pick up point (option)
95. Dash cigar lighter
74. Direction indicator switch
119. Distributor (petrol models)
174. Electric mirrors
170. Electric seats pick up point (option)
145. Electronic speedo and instrument controls
120. EFI harness plug
148. EFI warning lamp
73. Flasher unit
86. Front auxiliary lamp relay (option)
93. Front auxiliary lamp switch
97. Front interior lamp
17. Front wash pump
14. Front wipe delay unit
13. Front wipe/wash switch
15. Front wiper motor
168. Fuel filler flap
50. Fuel gauge
51. Fuel gauge sender unit
116. Fuel pump (petrol models)
130. Fuel shut off solenoid (Diesel)
33. Fuse A1
31. Fuse A2
21. Fuse A3
35. Fuse A4
71. Fuse A5
83. Fuse A6
22. Fuse A7
30. Fuse A8
32. Fuse A9
12. Fuse B1
54. Fuse B2
171. Fuse B3
94. Fuse B4
125a. Fuse B5
128. Fuse B6
179. Fuse B7
172. Fuse B8
177. Fuse B9
65. Fuse C1
162. Fuse C2
137. Fuse C3
114. Fuse C4
129. Fuse C5
157. Fuse C6
61. Fuse C7
173. Fuse C8
161. Fuse C9
96. Glove box cigar lighter
151. Glow plugs (Diesel)
150. Glow plug timer unit (Diesel)
149. Glow plug warning lamp (Diesel)
153. Handbrake / brake fluid level / pressure warning lamp
154. Handbrake warning switch
72. Hazard switch
182. Headlamp levelling actuator (2) (Germany)
181. Headlamp levelling switch connection (option)
36a. Headlamp levelling switch illumination (option)
16. Headlamp relay
19. Headlamp wash pump
18. Headlamp wash timer unit
133. Heated front screen pick up point (option)
67. Heated rear screen
64. Heated rear screen relay
68. Heated rear screen switch
69. Heated rear screen warning lamp
110. Heated washer jets
38. Heater illumination (4 off)
160. Heater/air con. connections
175. Heater/air con. load relay
26. High beam dip/flash switch
49. High beam warning lamp
55. Horn switch
117. Ignition coil
1. Ignition load relay
8. Ignition switch
10. Ignition warning lamp
115. Inertia switch
41. Instrument illumination (4 off)
99. Interior lamp delay unit
104. Interior lamp switch
45. LH dip beam
100. LH door edge lamp
91. LH front auxiliary lamp
108. LH front door switch
77. LH front indicator lamp
47. LH high beam
57. LH horn
75. LH indicator warning lamp
25. LH number plate lamp
101. LH puddle lamp
105. LH rear door switch
43. LH rear fog lamp
76. LH rear indicator lamp
89. LH reverse lamp
23. LH side lamp
78. LH side repeater lamp
87. LH stop lamp
24. LH tail lamp
146. Low coolant level warning lamp
144. Low coolant switch
147. Low fuel level warning lamp
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
20. Main lighting switch
113. Oil pressure switch
112. Oil pressure warning lamp
132. Overspeed monitor (Saudi only)
127. Overspeed warning (Saudi only)
63. Pick up point-central locking/window lift
66. Radio aerial amplifier
124. Radio and four speakers
123. Radio fuse
34. Rear fog switch
42. Rear fog warning lamp
98. Rear interior lamp
141. Rear screen wash pump
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
7a. Resistor (manual)
85. Reverse lamp switch
46. RH dip beam
102. RH door edge lamp
92. RH front auxiliary lamp
109. RH front door switch
80. RH front indicator lamp
48. RH high beam
56. RH horn
75a. RH indicator warning lamp
25a. RH number plate lamp
103. RH puddle lamp
106. RH rear door switch
44. RH rear fog lamp
81. RH rear indicator lamp
90. RH reverse lamp
27. RH side lamp
79. RH side repeater lamp
88. RH stop lamp
28. RH tail lamp
29. Rheostat
121. Speed transducer
158. Split charge relay (option)
159. Split charge terminal post (option)
7. Starter inhibit switch
5. Starter motor
6. Starter relay
4. Starter solenoid
84. Stop lamp switch
134. Sunroof pick up point
125. Sunroof relay
36. Switch illumination (2 off)
9. Tachometer
107. Tailgate switch
3. Terminal post
111. Thermostat - heated washer jets
122. Trailer pick up point
82. Trailer warning lamp
136a. Transfer box oil temperature switch
58. Under bonnet illumination switch
59. Under bonnet light
70. Voltage sensitive switch
52. Water temperature gauge
53. Water temperature sender unit

Circuit diagram - 1991 MY - Left hand steering

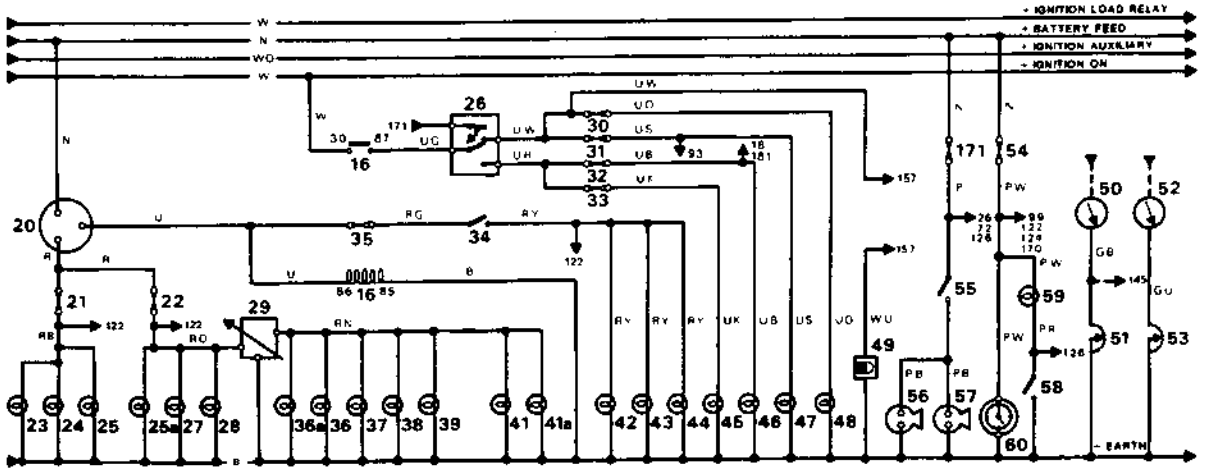


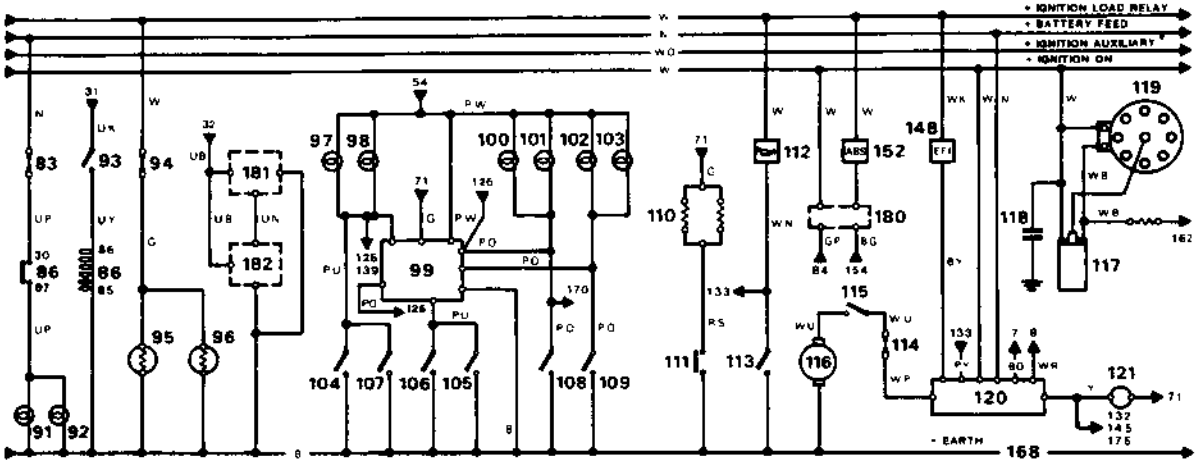


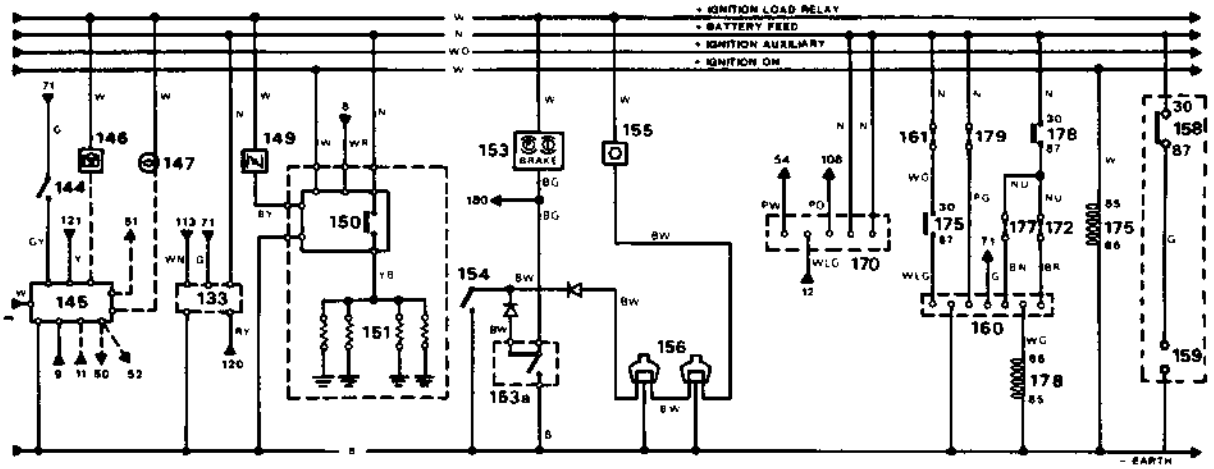


RR2978M

Illustrations RR2978M & RR2979M







RR2979M

CIRCUIT DIAGRAM - 1991 MY - USA AND CANADA - Illustrations RR2970E & RR2971E

Numerical key

1. Ignition load relay
2. Battery
3. Terminal post
4. Starter solenoid
5. Starter motor
6. Starter relay
7. Starter inhibit switch
8. Ignition switch
9. Tachometer
10. Ignition warning lamp
11. Alternator
12. Fuse B1
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
16. Headlamp relay
17. Front wash pump
18. Headlamp wash timer unit
19. Headlamp wash pump
20. Main lighting switch
21. Fuse A3
22. Fuse A7
23. LH side lamp
24. LH tail lamp
25. LH license plate lamp
25a. RH license plate lamp
26. High beam dimmer/flash switch
27. RH side lamp
28. RH tail lamp
29. Rheostat
30. Fuse A8
31. Fuse A2
32. Fuse A9
33. Fuse A1
34. Fuse B6
35. Window lift connections
36. Switch illumination (2 off)
37. Cigar lighter illumination (2 off)
38. Heater illumination (4 off)
39. Clock illumination
40. Auto gear selector illumination (2 off)
40a. Auto gear selector illumination relay.
41. Instrument illumination (4 off)
41a. Column switch illumination
42. Not used
43. Not used
44. Fuse B3
45. LH low beam
46. RH low beam
47. LH high beam
48. RH high beam
49. High beam warning lamp
50. Fuel gauge
51. Fuel gauge sender unit
52. Water temperature gauge
53. Water temperature sender unit
54. Fuse B2
55. Horn switch
56. RH horn
57. LH horn
58. Under hood illumination switch
59. Under hood light
60. Clock
61. Fuse C7
62. Fuse C2
63. Central door locking unit
64. Heated rear window relay
65. Fuse C1
66. Radio aerial amplifier
67. Heated rear screen
68. Heated rear screen switch
69. Heated rear screen warning lamp
70. Voltage sensitive switch
71. Fuse A5
72. Hazard switch
73. Flasher unit
74. Direction indicator switch
75. LH indicator warning lamp
75a. RH indicator warning lamp
76. LH rear indicator lamp
77. LH front indicator lamp
78. Not used
79. Not used
80. RH front indicator lamp
81. RH rear indicator lamp
82. Trailer warning lamp
83. Fuse A6
84. Stop lamp switch
85. Reverse lamp switch
86. Front fog lamp relay
87. LH stop lamp
88. RH stop lamp
89. LH reverse lamp
90. RH reverse lamp
91. LH front fog lamp
92. RH front fog lamp
93. Front fog lamp switch
94. Fuse B4
95. Dash cigar lighter
96. Glove box cigar lighter
97. Front interior lamp
98. Rear interior lamp
99. Interior lamp delay unit

100. LH door edge lamp
101. LH puddle lamp
102. RH door edge lamp
103. RH puddle lamp
104. Interior lamp switch
105. LH rear door switch
106. RH rear door switch
107. Tailgate switch
108. LH front door switch
109. RH front door switch
110. Heated washer jets
111. Thermostat heated jets
112. Oil pressure/level warning lamp
113. Oil pressure switch
114. Fuse C4
115. Inertia switch
116. Fuel pump
117. Ignition coil
118. Capacitor
119. Distributor
120. EFI Harness plug
121. Speed transducer
122. Trailer pick up point
123. Fuse A4
124. Radio and six speakers
125. Sun roof relay
125a. Fuse B5
126. Alarm pick up point
127. Seat belt warning lamp
128. 'Key-in switch'
129. Resistor
130. Audible warning unit
131. Seat buckle switch
132. Transfer box neutral switch
133. Condenser fan motors
134. Sunroof connection point (option)
135. Auto transmission and transfer box oil temperature warning lamp
136. Auto transmission oil temperature switch
136a. Transfer box oil temperature switch
137. Fuse C3
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
141. Rear screen wash pump
142. Low screen wash fluid level warning lamp
143. Low screen wash switch
144. Low coolant switch
145. Electronic speedo and instrument controls
146. Low coolant level warning lamp
147. Low fuel level warning lamp
148. Check engine warning lamp
149. Low oil level logic unit
150. Low oil level probe
151. Compressor clutch relay
152. ABS warning lamp
153. Parking brake/brake fluid loss warning lamp
153a. Brake fluid level warning switch
154. Park brake warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
157. Warning lamp control unit
158. Service engine warning lamp
159. Emission maintenance reminder unit
160. Diode pack (air con)
161. Fuse C9
162. Coil negative (engine RPM input to ECU)
163. Ignition load relay (+) circuit
164. Battery feed (+) circuit
165. Ignition auxiliary (+) circuit
166. Ignition on (+) circuit
167. Earth (-) circuit
168. Warning lights supply common earth (-) circuit
169. Warning lights supply (+) circuit
170. Fuse C6
171. Fuse C5
172. Fuse B8
173. Fuse C8
174. Fuel filler flap release
175. Heater/air conditioning relay
176. Cruise control connection points
177. Fuse B9
178. Condenser fan relay
179. Fuse B7
180. ABS ECU
181. Front amplifier audio
182. Rear amplifier audio
183. Electric seat relays
184. Heated front screen timer unit
185. Electric mirror elements
186. Glare control mirror

Cable colour code

B	Black	**L**	Light	**P**	Purple	**U**	Blue
G	Green	**N**	Brown	**R**	Red	**W**	White
K	Pink	**O**	Orange	**S**	Grey	**Y**	Yellow

The last letter of a colour denotes the tracer colour.

NOTE: The following items are now incorporated into the main harness assembly, ABS, air conditioning, CD player, cruise control, electric mirrors, door locks, heated front screen and window lift. These items are shown on the main circuit diagram as a box containing the relevant number, or indicated by an arrow and the item number. Refer to the appropriate circuit diagram for details of these items.

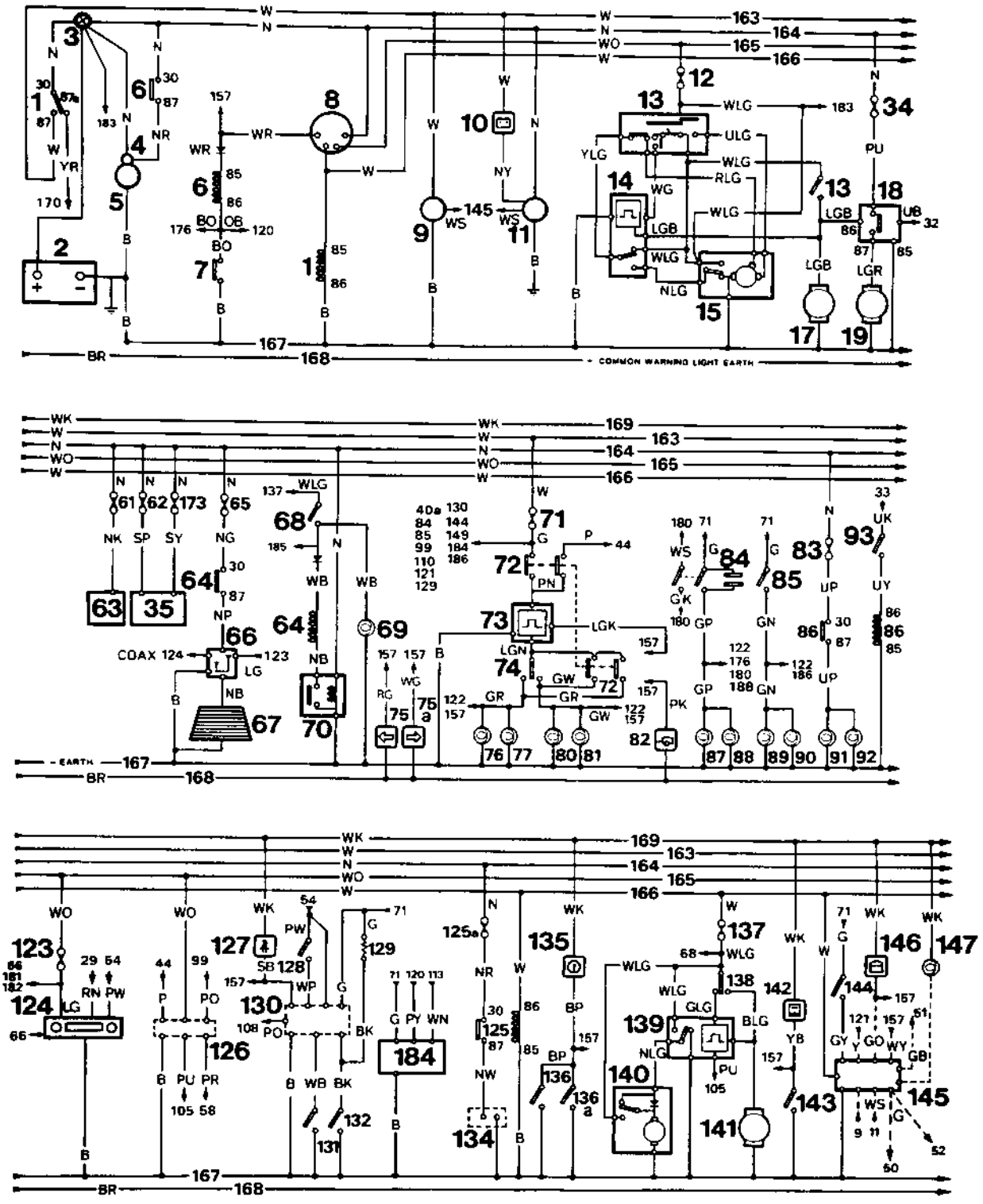
Circuit diagram - 1991 MY - USA and CANADA
Illustrations RR2970E & RR2971E

Alphabetical key

180. ABS ECU
180. ABS pick up point
152. ABS warning lamp
126. Alarm pick up point
11. Alternator
130. Audible warning unit
40. Auto gear selector illumination (2 off)
40a. Auto gear selector illumination relay.
135. Auto transmission and transfer box oil temperature warning lamp
136. Auto transmission oil temperature switch
2. Battery
164. Battery feed (+)
153a. Brake fluid loss warning switch
155. Brake pad wear warning lamp
156. Brake pad wear sensors
118. Capacitor
63. Central door locking unit
163. Check engine warning lamp
37. Cigar lighter illumination (2 off)
60. Clock
39. Clock illumination
162. Coil negative (engine RPM input to ECU)
42. Column switch illumination
151. Compressor clutch relay
133. Condenser fan motors
178. Condenser fan relay
176. Cruise control connection points
95. Dash cigar lighter
160. Diode pack (air con)
74. Direction indicator switch
119. Distributor
148. E.F.I. warning lamp
120. EFI Harness plug
167. Earth (+)
185. Electric mirror elements
183. Electric seat relays
145. Electronic speedo and instrument controls
159. Emission maintenance reminder
73. Flasher unit
181. Front amplifier audio
66. Front fog lamp relay
93. Front fog lamp switch
97. Front interior lamp
17. Front wash pump
13. Front wipe/wash switch
14. Front wipe delay unit
15. Front wiper motor
174. Fuel filler flap release
51. Fuel gauge sender unit
50. Fuel gauge
116. Fuel pump
33. Fuse A1
31. Fuse A2
21. Fuse A3
123. Fuse A4
71. Fuse A5
83. Fuse A6
22. Fuse A7
30. Fuse A8
32. Fuse A9
12. Fuse B1
54. Fuse B2
44. Fuse B3
94. Fuse B4
125a. Fuse B5
34. Fuse B6
179. Fuse B7
172. Fuse B8
177. Fuse B9
65. Fuse C1
62. Fuse C2
137. Fuse C3
114. Fuse C4
171. Fuse C5
170. Fuse C6
61. Fuse C7
173. Fuse C8
161. Fuse C9
186. Glare control mirror
96. Glove box cigar lighter
72. Hazard switch
16. Headlamp relay
19. Headlamp wash pump
18. Headlamp wash timer unit
184. Heated front screen timer unit
68. Heated rear screen switch
64. Heated rear window relay
69. Heated rear screen warning lamp
67. Heated rear screen
110. Heated washer jets
38. Heater illumination (4 off)
175. Heater/air conditioning relay
160. Heater/air conditioning connections
26. High beam dimmer/flash switch
49. High beam warning lamp
55. Horn switch
165. Ignition auxiliary (+)
117. Ignition coil
1. Ignition load relay
163. Ignition load relay (+)
166. Ignition on (+)
8. Ignition switch
10. Ignition warning lamp
115. Inertia switch
41. Instrument illumination (4 off)
104. Interior lamp switch
99. Interior lamp delay unit

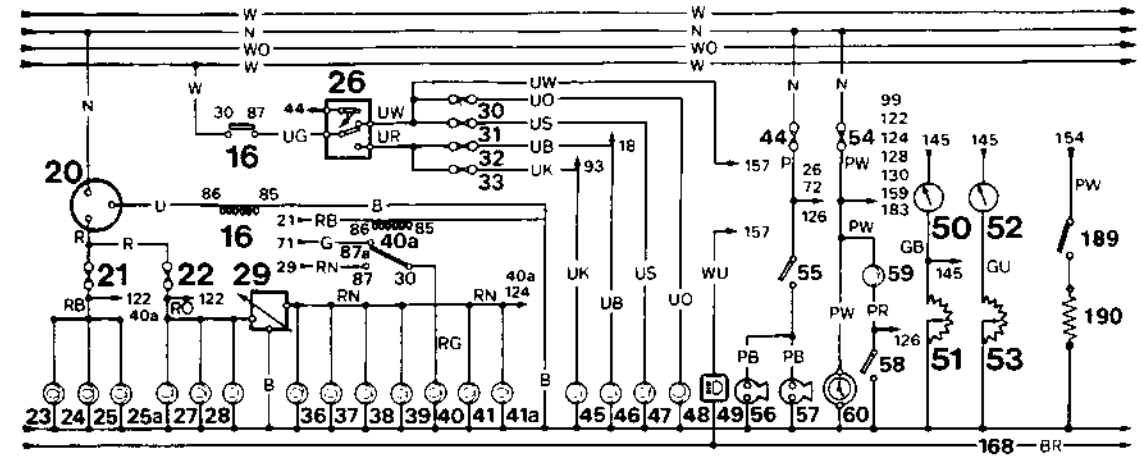
128. 'Key-in switch'
100. LH door edge lamp
108. LH front door switch
91. LH front fog lamp
77. LH front indicator lamp
47. LH high beam
57. LH horn
75. LH indicator warning lamp
25. LH license plate lamp
45. LH low beam
101. LH puddle lamp
105. LH rear door switch
76. LH rear indicator lamp
89. LH reverse lamp
23. LH side lamp
87. LH stop lamp
24. LH tail lamp
146. Low coolant level warning lamp
144. Low coolant switch
147. Low fuel level warning lamp
150. Low oil level probe
149. Low oil level logic unit
143. Low screen wash switch
142. Low screen wash fluid level warning lamp
20. Main lighting switch
151. Not used - will illuminate on initial bulb check
113. Oil pressure switch
112. Oil pressure/level warning lamp
154. Park brake warning switch
153. Parking brake/brake fluid loss warning lamp
182. Rear amplifier audio
102. RH door edge lamp
109. RH front door switch
92. RH front fog lamp
80. RH front indicator lamp
48. RH high beam
56. RH horn
75a. RH indicator warning lamp
25a. RH license plate lamp
46. RH low beam
103. RH puddle lamp
106. RH rear door switch
81. RH rear indicator lamp
90. RH reverse lamp
27. RH side lamp
88. RH stop lamp
28. RH tail lamp
66. Radio aerial amplifier
124. Radio and six speakers
123. Radio fuse
182. Rear amplifier audio
98. Rear interior lamp
141. Rear screen wash pump
138. Rear wash wipe switch
139. Rear wipe delay unit
140. Rear wiper motor
129. Resistor
85. Reverse lamp switch
29. Rheostat
127. Seat belt warning lamp
131. Seat buckle switch
121. Speed transducer
7. Starter inhibit switch
5. Starter motor
6. Starter relay
4. Starter solenoid
84. Stop lamp switch
125. Sun roof relay
134. Sunroof connection point (option)
36. Switch illumination (2 off)
9. Tachometer
107. Tailgate switch
3. Terminal post
111. Thermostat heated jets
122. Trailer pick up point
82. Trailer warning lamp
136a. Transfer box oil temperature switch
132. Transfer box neutral switch
58. Under hood illumination switch
59. Under hood light
70. Voltage sensitive switch
157. Warning lamp control unit
168. Warning lights supply common earth (-)
169. Warning lights supply (+)
53. Water temperature sender unit
52. Water temperature gauge temperature warning lamp
35. Window lift connections

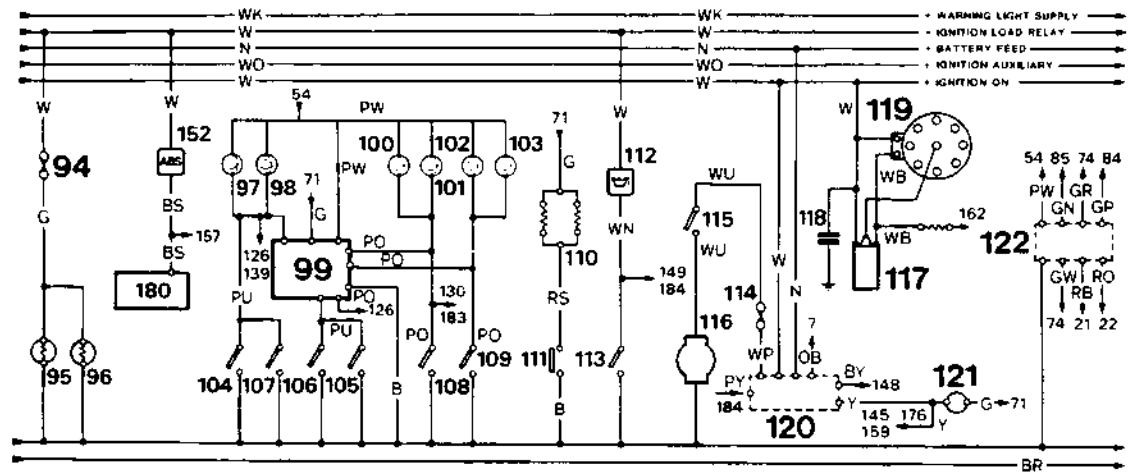
Circuit diagram - 1991 MY - USA and CANADA

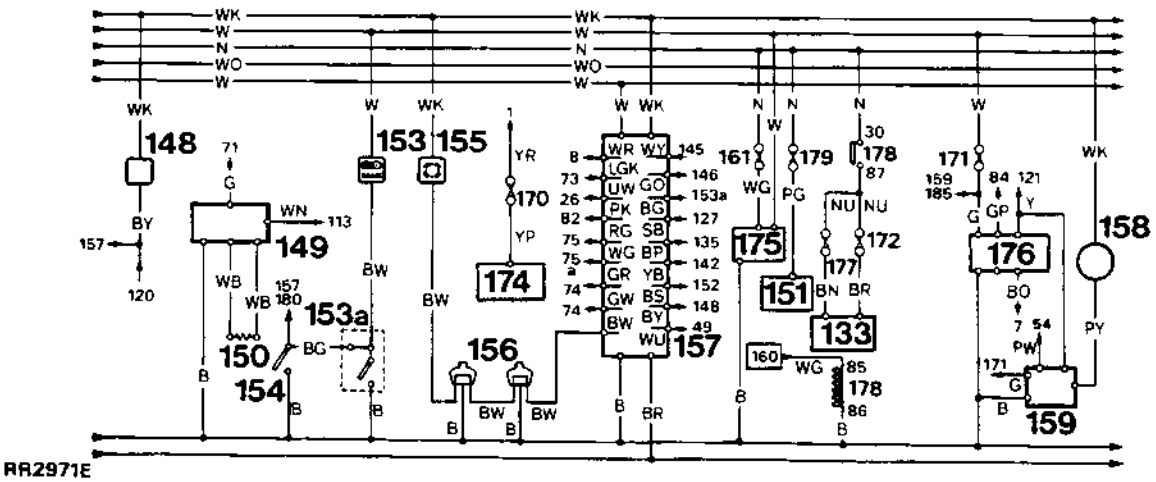


RR2970E

Illustrations RR2970E & RR2971E







RR2971E

Notes

IGNITION TIMING

Service repair no - 86.35.15

Adjust

1. It is essential that following procedures are adhered to. Inaccurate timing can lead to serious engine damage and additionally create failure to comply with emission regulations. If timing is being checked in vehicle, air conditioning compressor must be disengaged.
2. On initial engine build, or if distributor has been disturbed for any reason, ignition timing must be set statically to 6° B.T.D.C.

NOTE: This approximate setting is made only to ensure that engine may be started.

CAUTION: On no account must engine be started before this operation is carried out.

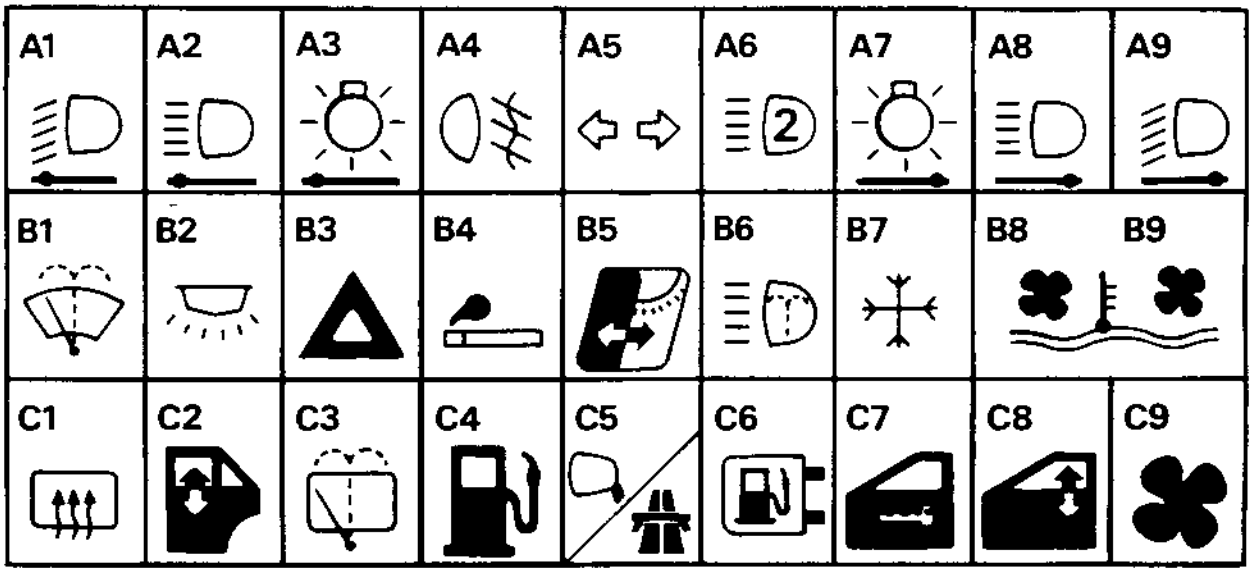
Equipment required :-

Calibrated Tachometer
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following manufacturer's instructions.
4. Disconnect vacuum hose from distributor.
5. Start engine. With no load, and without exceeding 3,000 rev/min run engine until normal operating temperature is reached. (Thermostat open). Check that engine idles within tolerance specified in data section.
6. Idle speed for timing purposes must not exceed 800 rev/min.
7. With distributor clamping bolt loosened, turn distributor until timing flash coincides with timing pointer and correct timing mark on rim of torsional vibration damper.
8. Retighten distributor clamping bolt securely. Recheck timing, to ensure retightening has not disturbed distributor position.
9. Refit vacuum hose.
10. Disconnect stroboscopic timing lamp and tachometer from engine.

Notes

FUSE BOX - 1990 & 91 MY



RR2984M

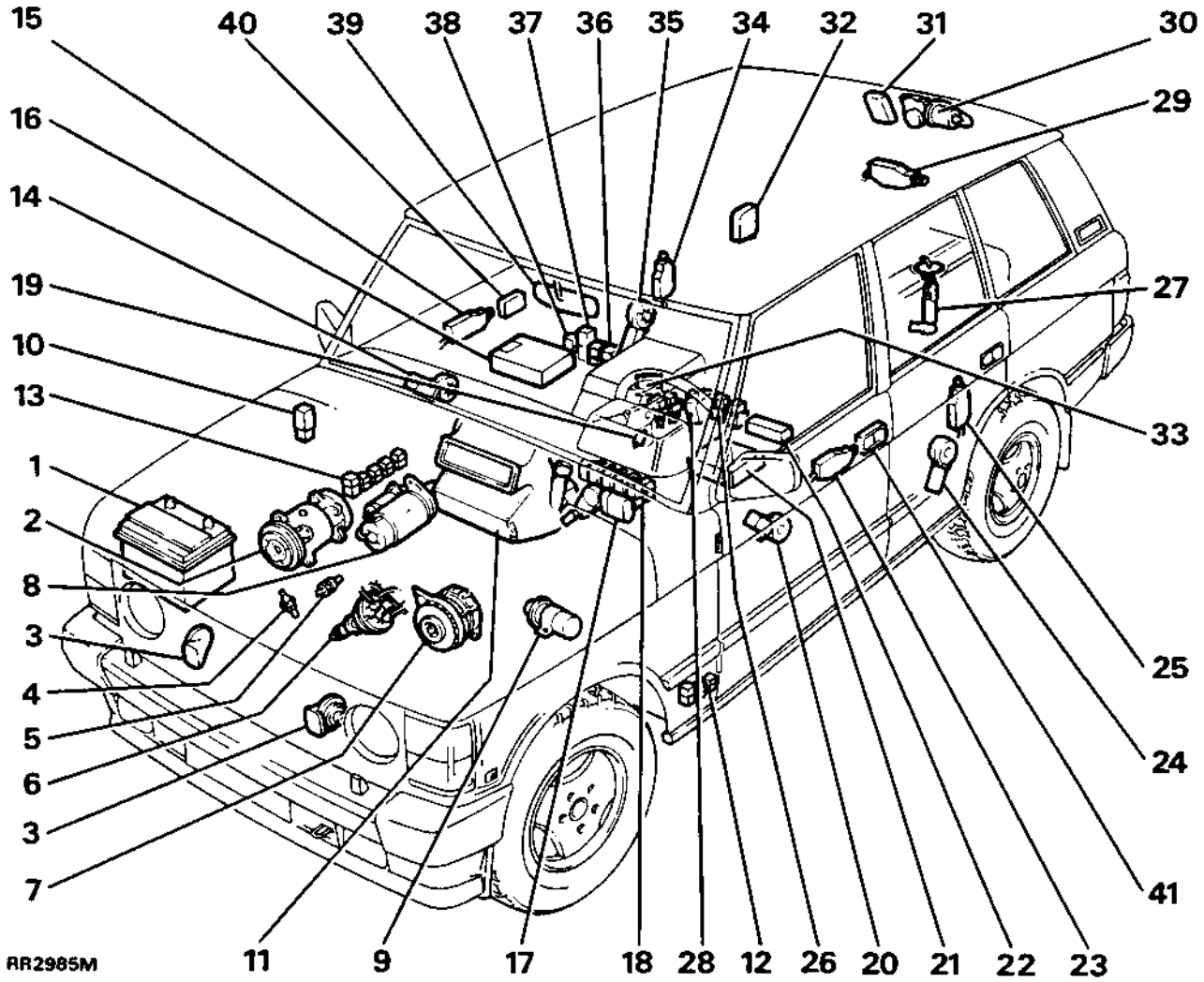
FUSE NUMBER	COLOUR CODE	RATING AMPS	IGN. KEY POSITION	FUNCTION
A1	Red	10	II	LH dipped beam
A2	Red	10	II	LH main beam, auxiliary lamp relay
A3	Tan	5	O	LH sidelamps, radio ill., trailer pickup
A4	Red	10	O	Rear fog guard (headlamp switch controlled) (Not USA)
A5	Yellow	20	II	Direction ind., resistor, heated jets, thermo., heated front screen timer, air con. low coolant, speed transducer, interior lamp delay, reverse lights, stop lights, dimming rear view mirror (1991)
A6	Red	10	II	Auxiliary driving lamps (from main beam)
A7	Tan	5	O	RH sidelamps, rheostat controlled instrument/switch illumination, trailer pick up
A8	Red	10	II	RH main beam
A9	Red	10	II	RH dipped beam, headlamp levelling (option)
B1	Yellow	20	I	Front wash/wipe, seat relays, window lift relays, antenna amplifier
B2	Yellow	20	O	Interior light, clock, underbonnet ill., elec. seat relays, radio, door lamps, heated door locks (1991)
B3	Yellow	20	O	Hazard switch, alarm, main beam/dip flash, horns
B4	Yellow	20	II	Cigar lighters
B5	Yellow	20	II	Sunroof motor
B6	Yellow	20	II	Headlamp wash
B7	Tan	5	II	Air conditioning compressor clutch
B8	Yellow	20	II	Air conditioning/radiator cooling fan
B9	Yellow	20	II	Air conditioning/radiator cooling fan
C1	Green	30	II	Heated rear screen (voltage switch controlled)
C2	Green	30	II	Window lifts - rear
C3	Red	10	II	Rear wash wipe motor, heated rear screen relay, mirror heaters
C4	Red	10	II	Fuel pump
C5	Red	10	II	Mirror motors, cruise control (option)
C6	Tan	5	O or I	Fuel filler flap (1991)
C7	Blue	15	O	Central locking
C8	Green	30	II	Window lifts - front
C9	Green	30	II	Heater/air conditioning motor

Key to RR2985M

1. Battery
2. Air conditioning compressor (option)
3. Horns
4. Oil pressure switch
5. Water temperature switch
6. Electronic distributor
7. Alternator
8. Starter motor
9. Coil
10. Headlamp wash timer unit
11. Heater
12. Relays/flasher units
13. Air con relays/diode unit (option)
14. Window lift motor (front RH door)
15. Door lock actuator (front RH door)
16. Electronic control unit (EFI)
17. Wiper motor - front screen
18. Relays/delay units
19. Park brake warning light switch
20. Window lift motor (front LH door)
21. Electronic control unit and relays (ABS) (option)
22. Seat adjustment fusebox (option)
23. Door lock actuator (front LH door)
24. Window lift motor (rear LH door)
25. Door lock actuator (rear LH door)
26. Seat adjustment relays - two (option)
27. Electrical in-tank fuel pump
28. Inertia switch
29. Tailgate lock actuator
30. Wiper motor - rear screen
31. Radio aerial amplifier
32. Fuel filler flap lock actuator
33. Window lift relays and one touch control unit
34. Door lock actuator (rear RH door)
35. Window lift motor (rear RH door)
36. EFI relays (two)
37. Condenser fan timer unit (option)
38. Cruise control relay (option)
39. Dimming mirror (option)
40. RH door lock heater
41. LH door lock heater

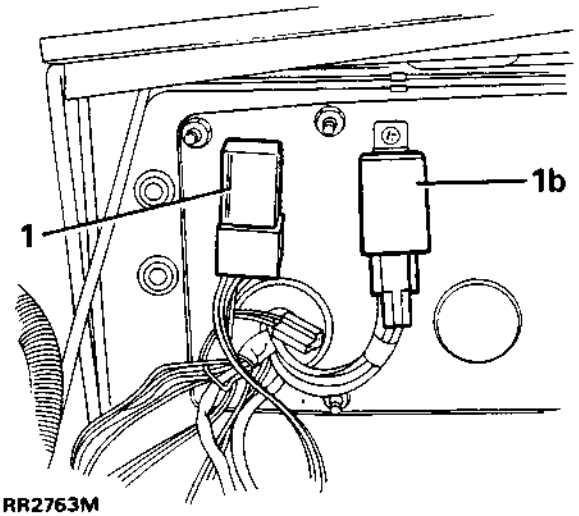
△ **NOTE: Left hand drive vehicle shown. Items 10, 12, 13, 17 and 18 located symmetrically opposite on right hand drive vehicles.**

LOCATION OF ELECTRICAL EQUIPMENT



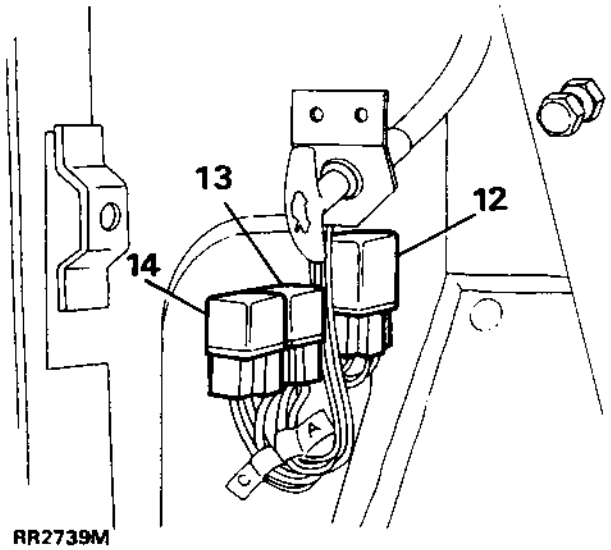
RELAYS, DELAY UNITS, TIMER UNITS, DIODE PACK - 1990 / 91 - IDENTIFICATION

Left hand drive vehicle shown, right hand drive symmetrically opposite.



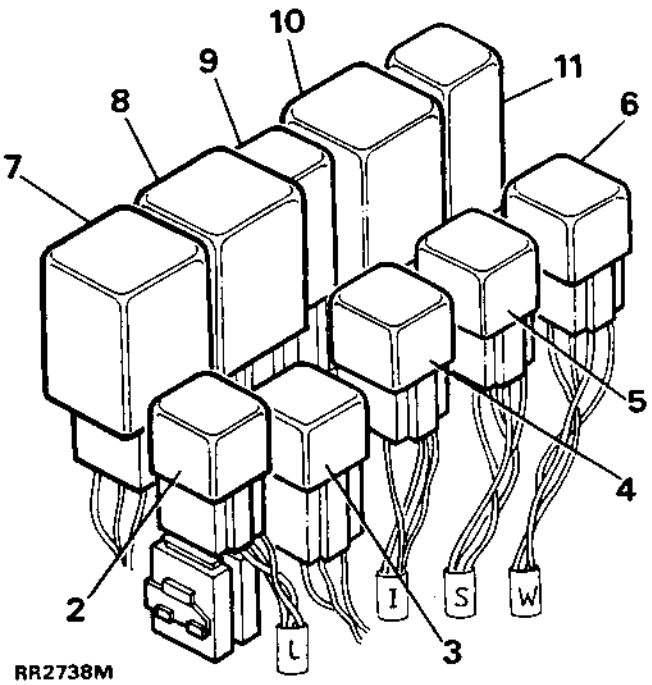
RR2763M

Closure panel viewed from the engine bay compartment, with protective cover removed.



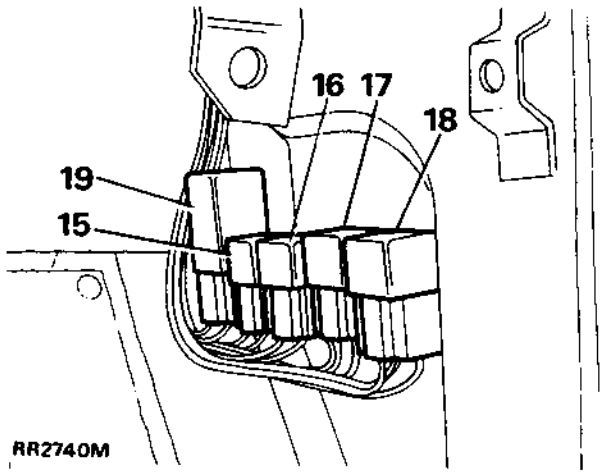
RR2739M

RR2379M shows relays mounted in left hand side of footwell, trim panel removed, left hand drive.



RR2738M

Steering column mounted relays viewed with the lower dash panel removed.



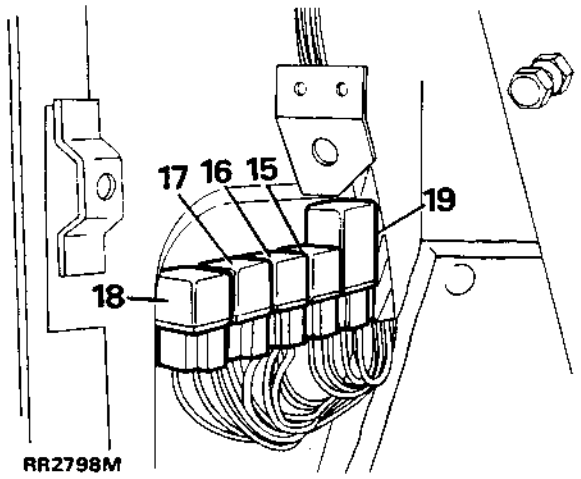
RR2740M

RR2740M shows relays mounted in right hand side of footwell, trim panel removed, left hand drive

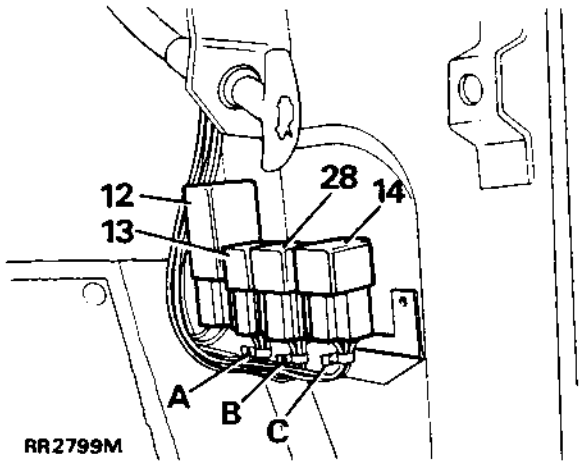
	Relay/delay/timer/diode unit	Colour	Circuit Diagram Item Number	
			Right hand steer	Left hand steer
1.	Headlamp wash timer unit	Black	19.M	18.M
1b.	Glow plug timer unit (diesel)	Black	143.M	150.M
2.	Headlamp relay	Natural	17.M	16.M
3.	Heated front screen relay	Black	3.HF	3.HF
4.	Ignition load relay	Natural	1.M	1.M
5.	Starter soleniod relay	Natural	6.M	6.M
6.	Heated rear window relay	Natural	67.M	64.M
7.	Rear wiper delay	Blue	132.M	139.M
8.	Interior lamp delay/timer	Red	101.M	99.M
9.	Heated front screen timer unit	Grey	2.HF	2.HF
10.	Voltage sensitive switch	Yellow	72.M	70.M
11.	Front wiper delay	Red	15.M	14.M
12.	Flasher/hazard unit	Blue	75.M	73.M
13.	Auxiliary lamp relay	Natural	88.M	86.M
14.	Sunroof auxiliary relay	Natural	124.M	125.M
15.	Air con./heater relay	Natural	5.A	5.A
16.	Compressor clutch relay	Natural	11.A	11.A
17.	Heater/air con. load relay	Natural	163.M	175.M
18.	Condenser fan relay	Natural	9.A	9.A
19.	Air con. diode pack	Orange	1.A	1.A
20.	Seat adjustment relays - two	Natural	5.6.F	5.6.F
21.	Main EFI relay	Silver	22.E	22.E
22.	Fuel pump relay	Silver	21.E	21.E
23.	Cruise control relay	Natural	16.C	16.C
24.	Condenser fan timer unit	Green	33.E	33.E
25.	Rear window lift relay	Natural	13.W	13.W
26.	Front window lift relay	Natural	14.W	14.W
27.	Window lift one touch unit	Black	1.W	1.W
28.	Brake check relay (RH steering)	Natural	151.M	. . .

M Main circuit diagram
A Air conditioning circuit diagram
S Seat adjustment circuit diagram
HF Heated front screen circuit diagram
E EFI circuit diagram
SR Sunroof circuit diagram
W Window lift circuit diagram
C Cruise control circuit diagram

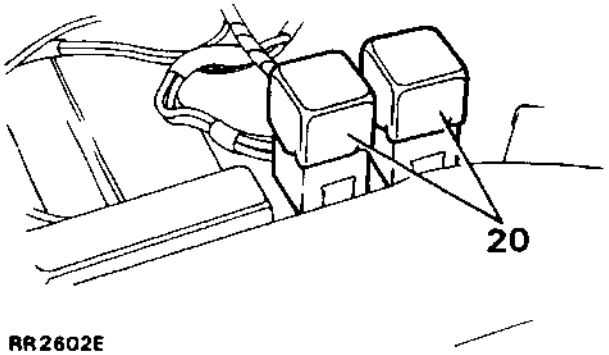
Relays cont'd



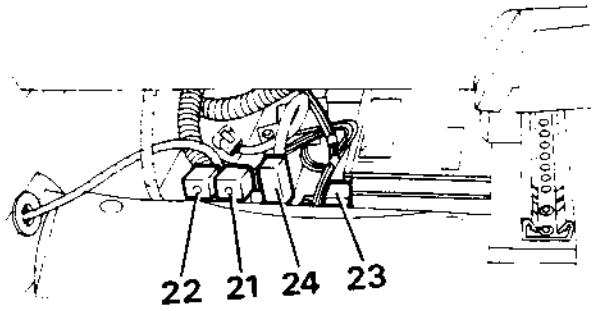
RR2798 shows relays mounted in left hand side of footwell, trim panel removed, right hand drive.



RR2799 shows relays mounted in right hand side of footwell, trim panel removed, right hand drive



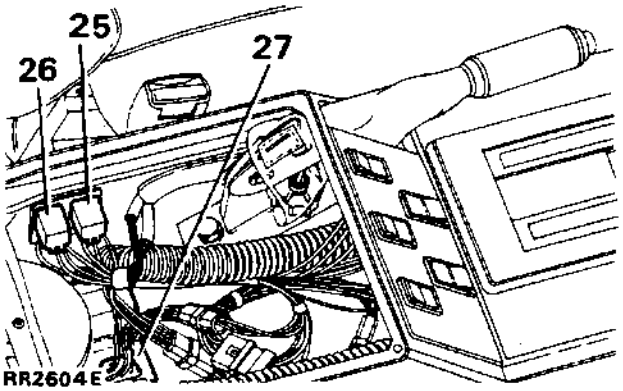
Seat adjustment relays (load control) located beneath the left hand front seat adjacent to fuse box (B).



EFI (black terminal block) and fuel pump relays (blue terminal block) mounted beneath right hand front seat (21 and 22).

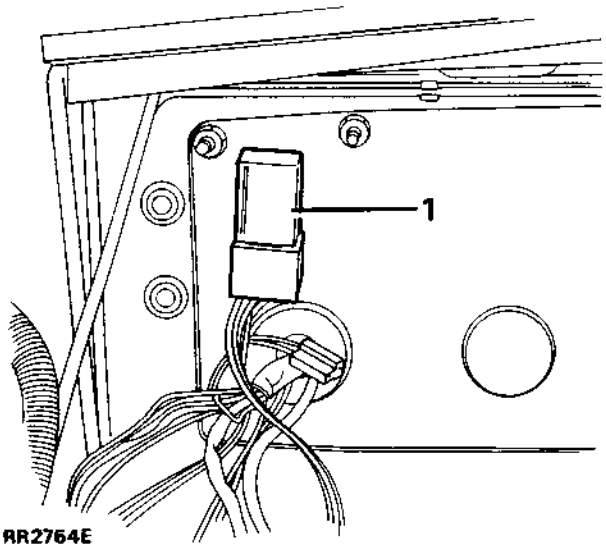
Condenser fan timer unit (24) mounted beneath right hand front seat.

Cruise control relay (23).

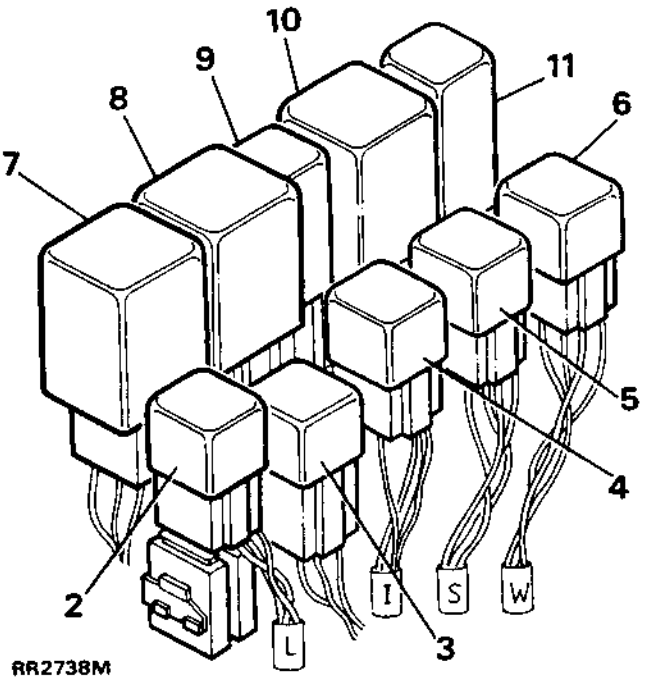


Front (black terminal block) and rear (blue terminal block) window relays. One touch control unit (27) is located inside the glove box, accessible by removing glove box liner.

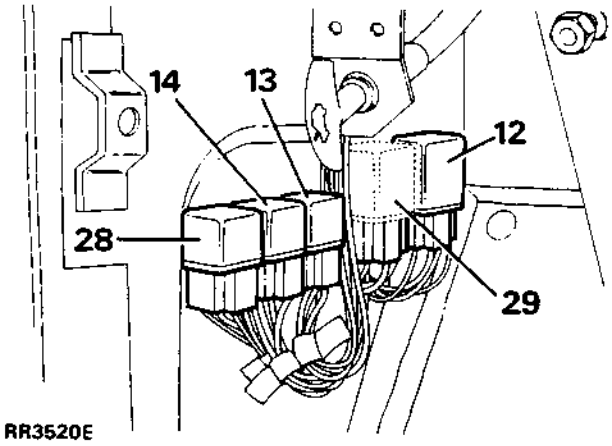
RELAYS, DELAY UNITS, TIMER UNITS, DIODE PACK - USA AND CANADA 1990 / 91 - IDENTIFICATION



Closure panel viewed from the engine bay compartment, with protective cover removed.

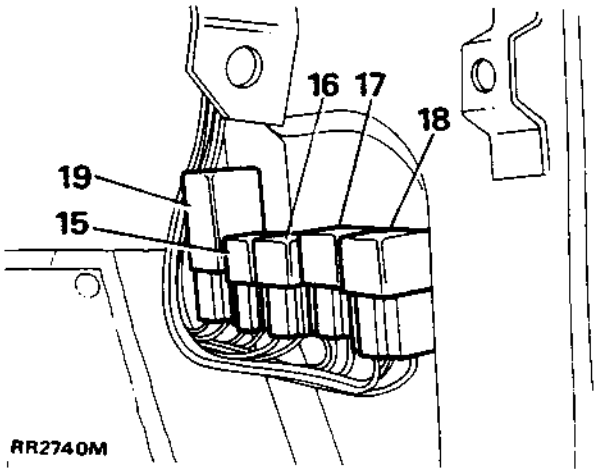


Steering column mounted relays viewed with the lower dash panel removed.



RR3520M shows relays mounted in left hand side of footwell, trim panel removed.

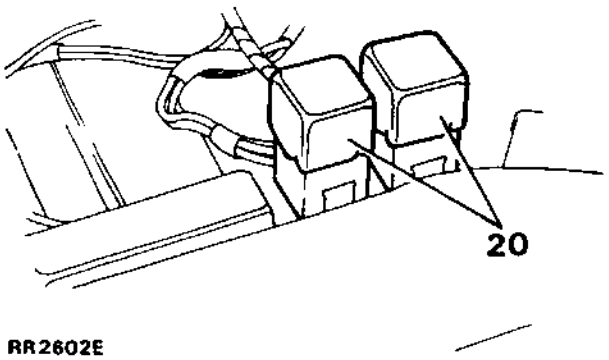
1990 vehicles have gear selector illumination (28) relay inside the glove box - see RR2906E



RR2740M shows relays mounted in right hand side of footwell, trim panel removed.

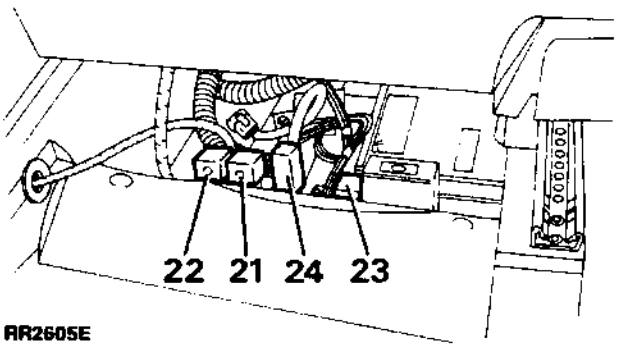
Relay/delay/timer/diode unit	Circuit diagram item number	Colour Unit	Colour Base
1. Headlamp wash timer unit	18. Main	Black	Black
2. Headlamp relay	16. Main	Yellow	Black
3. Heated front screen relay	3. Heated front screen	Black	Black
4. Ignition load relay	1. Main	Green	Black
5. Starter soleniod relay	6. Main	Yellow	Black
6. Heated rear window relay	64. Main	Yellow	Black
7. Rear wiper delay	139. Main	Blue	Black
8. Interior lamp delay/timer	99. Main	Yellow	Black
9. Heated front screen timer unit	2. Heated front screen	Grey	White
10. Voltage sensitive switch	70. Main	Yellow	Yellow
11. Front wiper delay	14. Main	Red	Black
12. Flasher/hazard unit	73. Main	Blue	Blue
13. Auxiliary lamp relay	86. Main	Yellow	Yellow
14. Sunroof auxiliary relay	3. Sunroof	Yellow	Yellow
15. Air con./heater relay	175. Main	Green	Yellow
16. Compressor clutch relay	11. Air conditioning	Yellow	Yellow
17. Heater/air con. load relay	5. Air conditioning	Yellow	Yellow
18. Condenser fan relay	9. Air conditioning	Yellow	Yellow
19. Air con. diode pack	1. Air conditioning	Orange	Red
20. Seat adjustment relays - two	5 & 6. Seat adjustment	Yellow	Yellow
21. Main EFI relay	22. EFI	Silver	Black
22. Fuel pump relay	21. EFI	Silver	Blue
23. Cruise control relay	16. Cruise control	Green	Black
24. Condenser fan timer unit	33. EFI	Green	Black
25. Rear window lift relay	13. Window lift	Yellow	Black
26. Front window lift relay	14. Window lift	Yellow	Blue
27. Window lift one touch unit	1. Window lift	Black	-
28. Gear selector illumination relay	40a Main	Green	Green
* 29. Daytime lights control (Canada)	-	Black	Black

*** Control unit ONLY fitted when daytime running lights are required.**



RR2602E

Seat adjustment relays (load control) located beneath the left hand front seat.

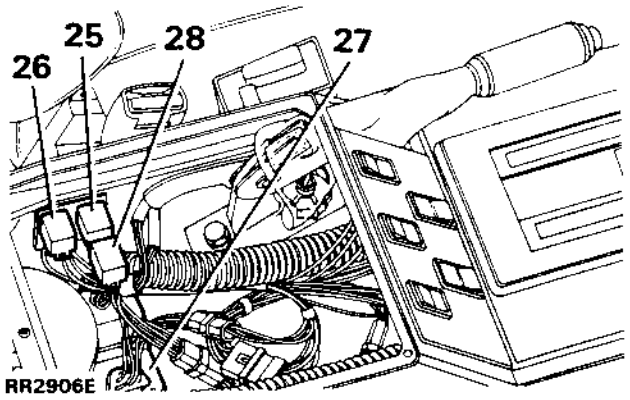


RR2605E

EFI (black terminal block) and fuel pump relays (blue terminal block) mounted beneath right hand front seat (21 and 22).

Condenser fan timer unit (24) mounted beneath right hand front seat.

Cruise control relay (23).



RR2906E shows relays located inside the glove box, accessible by removing the glove box liner. Front (black terminal block) and rear (blue terminal block) window relays (25 and 26) window lift one touch control unit (27).

Gear selector illumination relay (28) shown in 1990 position.

BATTERY

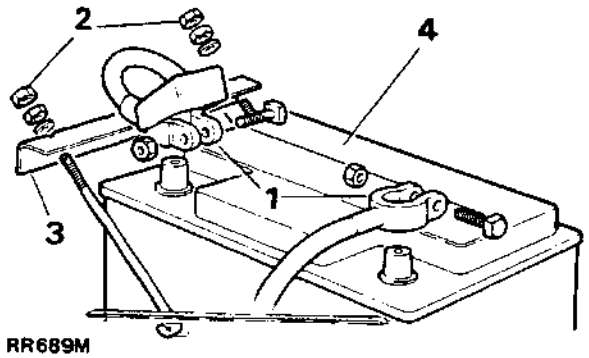
Service repair no - 86.15.01

Remove and refit

Remove

WARNING: During battery removal or before carrying out any repairs or maintenance to electrical components always disconnect battery negative lead first. If positive lead is disconnected with negative lead in place, accidental contact of wrench to any grounded metal partcould cause a severe spark, possibly resulting in personal injury. Upon installation of battery connect positive lead first.

1. Disconnect the battery negative lead. And positive lead.
2. Release four nuts securing battery bracket in position.
3. Remove bracket.
4. Remove battery.



RR689M

Refit

5. Reverse removal procedure.

NOTE: Coat battery clamps and terminals with petroleum jelly before refitting.

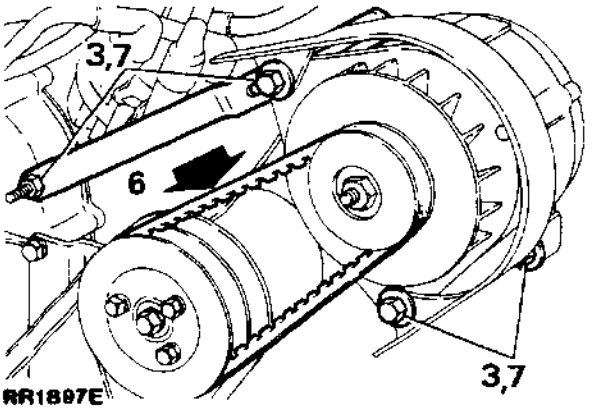
ALTERNATOR

Service repair no - 86.10.01

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect leads from alternator.



RR1897E

3. Loosen alternator pivot bolt.
4. Loosen adjusting bolt and adjusting strut pivot bolt.
5. Pivot alternator inwards, remove drive belt.
6. Remove mounting bolts and remove alternator.

NOTE: The radiator cowl has a hole to allow removal of alternator pivot bolt. Loosen cowl fixings and move cowl if hole is not sufficiently aligned to allow removal of bolt.

Refit

7. Fit alternator and mounting bolts.

NOTE: The fan guard is attached to the front mounting and adjustment bolts.

8. Fit drive belt, adjust tension. ***See alternator drive belts***
9. Partially tighten alternator fixing to adjusting strut.
10. Partially tighten mounting bolt.
11. Partially tighten adjusting strut pivot bolt.
12. Finally tighten alternator fixings to correct torque, in following sequence:

    Adjusting bolt ..... ***12 Nm.***
    Alternator mounting bolt ..... ***25 Nm.***
    Adjusting strut pivot bolt ..... ***25 Nm.***

13. Connect wiring leads to alternator.
14. Reconnect battery.

ALTERNATOR DRIVE BELTS

For Alternator drive belts ***See SECTION 10, Maintenance, Under Bonnet Maintenance***

DISTRIBUTOR-LUCAS 35 DLM8

Service parts

1. Cap
2. HT brush and spring
3. Rotor arm
4. Insulation cover
5. Pick-up module and base plate assembly
6. Vacuum unit
7. Amplifier module
8. 'O'-ring oil seal
9. Gasket

ELECTRONIC IGNITION

A Lucas 35DLM8 distributor is employed. This has a conventional vacuum advance unit and centrifugal automatic advance mechanism.

A pick-up module, in conjunction with a rotating timing reluctor inside distributor body, generates timing signals. These are applied to an electronic ignition amplifier module mounted on side of distributor body.

△ **NOTE: Pick-up air gap is factory set. Do not adjust gap unless pick-up is being changed or base plate has been moved. Use a non-ferrous feeler gauge to set air gap.**

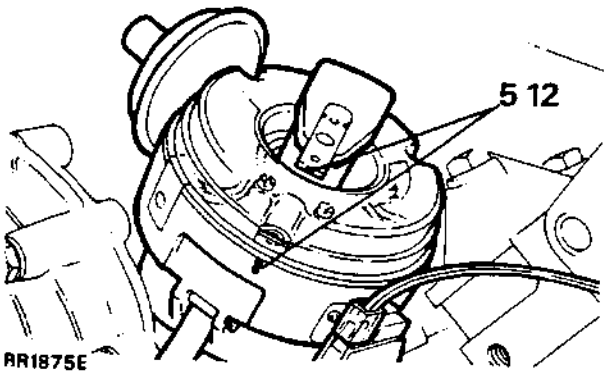
DISTRIBUTOR

Service repair no - 86.35.20

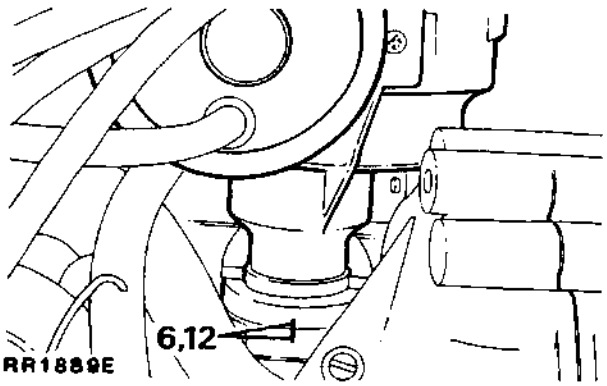
Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect vacuum hose.
3. Remove distributor cap.
4. Disconnect low tension lead from coil.
5. Mark distributor body and centre line of rotor arm.

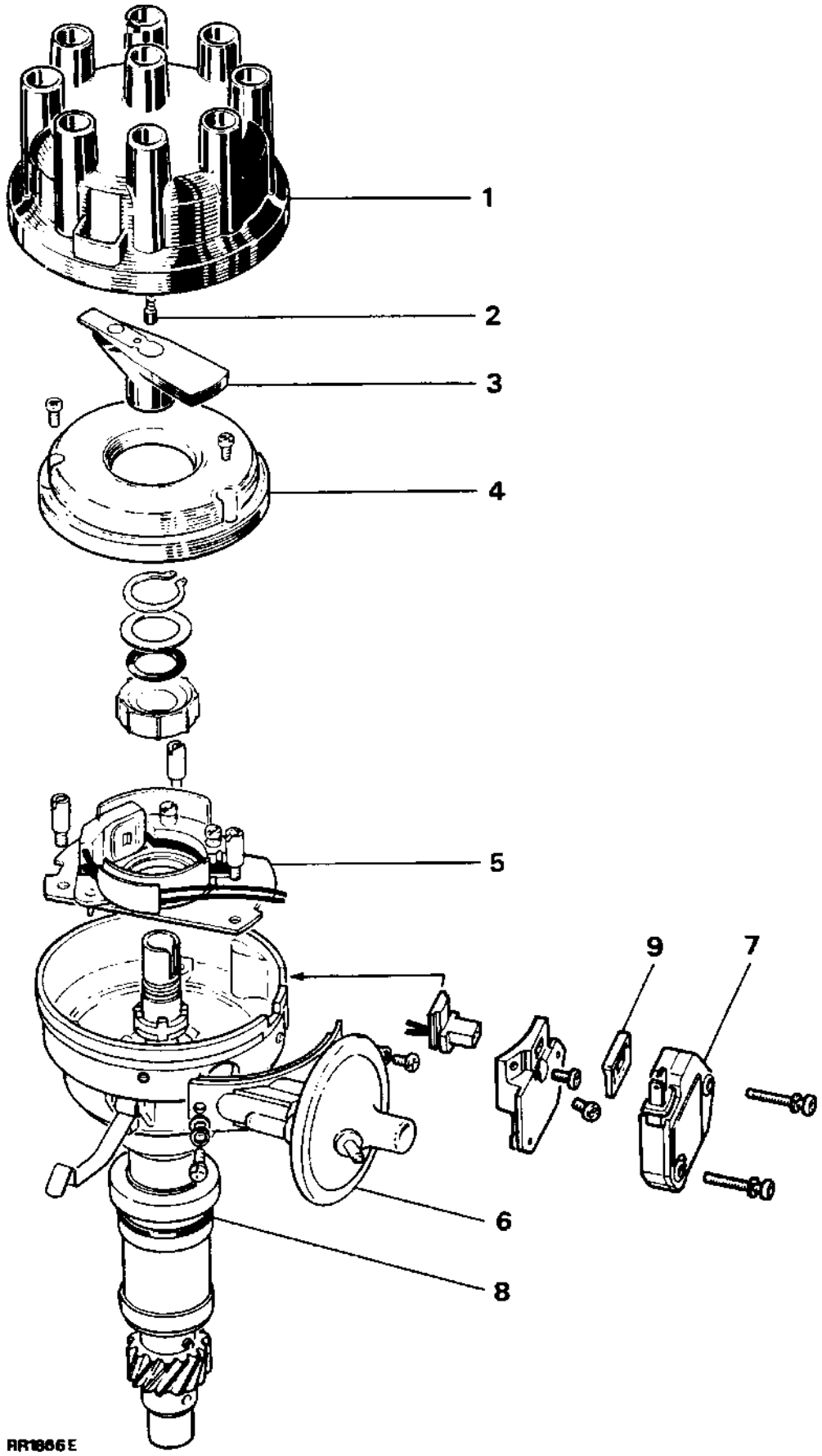


6. Add alignment marks to distributor and front cover.



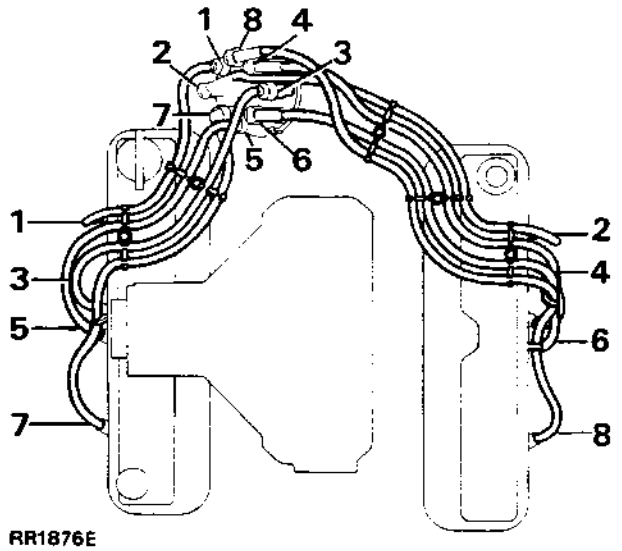
△ **NOTE: Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.**

7. Release distributor clamp and remove distributor.


1
2
3
4
5
9
7
6
8
RR1866E

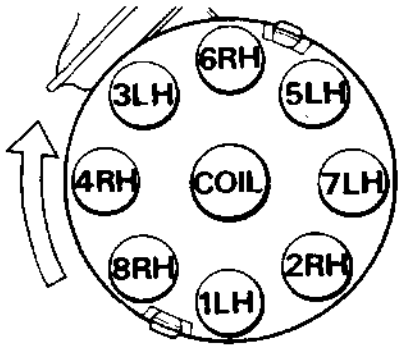
Refit

△ **NOTE: If a new distributor is being fitted, mark body in same relative position as distributor removed.**



RR1876E

8. Leads for distributor cap should be connected as illustrated.
   Figures 1 to 8 inclusive indicate plug lead numbers.
   RH-Right hand side of engine, when viewed from rear.
   LH-Left hand side of engine, when viewed from rear.



RR616M

9. If engine has not been turned while distributor has been removed, carry out instructions 10. to 17. Alternatively proceed to instruction 18.
10. Fit new 'O' ring seal to distributor housing.
11. Turn distributor drive until centre line of rotor arm is 30° anti-clockwise from mark made on top edge of distributor body.
12. Fit distributor in accordance with alignment markings.

△ **NOTE: It may be necessary to align oil pump drive shaft to enable distributor drive shaft to engage in slot.**

13. Fit clamp and bolt. Secure distributor in exact original position.
14. Connect vacuum hose to distributor and low tension lead to coil.
15. Fit distributor cap.
16. Reconnect battery.
17. Using suitable electronic equipment, set ignition timing. ***See Adjustment, IGNITION TIMING***
18. If engine has been turned with distributor removed, carry out instructions 19. to 30.
19. Set engine-No. 1 piston to static ignition timing figure. ***See ENGINE TUNING DATA, Information, Engine Tuning Data***
20. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
21. Fit distributor to engine.
22. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
23. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
24. Fit clamp and bolt, do not tighten.
25. Set ignition timing statically to 6° B.T.D.C.
26. Connect vacuum hose to distributor.
27. Fit low tension lead to coil.
28. Fit distributor cap.
29. Reconnect battery.
30. Using suitable electronic equipment set the ignition timing. ***See Adjustment, IGNITION TIMING***

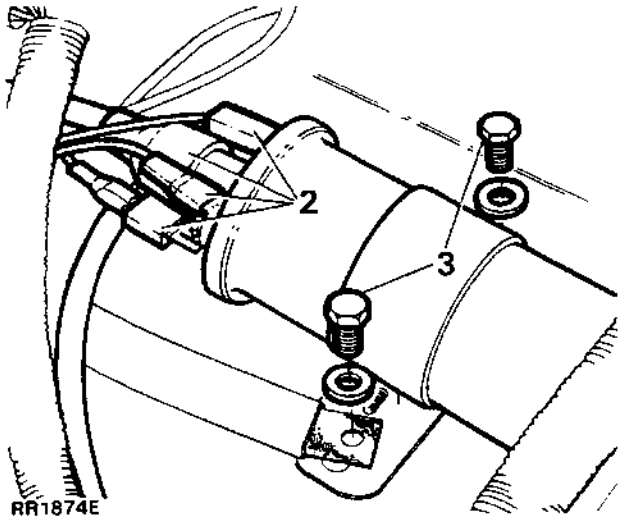
IGNITION COIL

Service repair no - 86.35.32

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect High Tension and Low Tension electrical leads from ignition coil.



3. Remove two bolts securing coil, noting position of ground strap.
4. Remove coil.

Refit

5. Reverse removal procedure. Ensure that location for ground strap is free from paint and grease. Coat area around bolt with Petroleum Jelly.

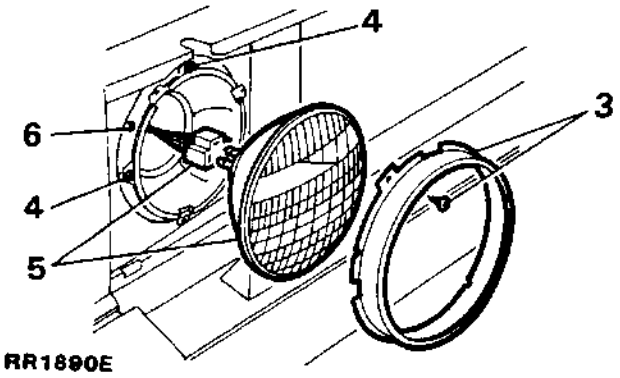
HEADLAMP ASSEMBLY / SEALED BEAM UNIT

Service repair no - 86.40.02

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove radiator grille. ***See CHASSIS AND BODY, Repair, radiator grille***
3. Remove three screws and headlamp retaining rim.



4. **DO NOT** disturb beam adjusting screws.
5. Withdraw sealed beam unit. Disconnect wiring plug from rear of unit.
6. Remove three securing screws, pry away grommet. Remove headlamp bowl.

Refit

7. Reverse removal procedure.

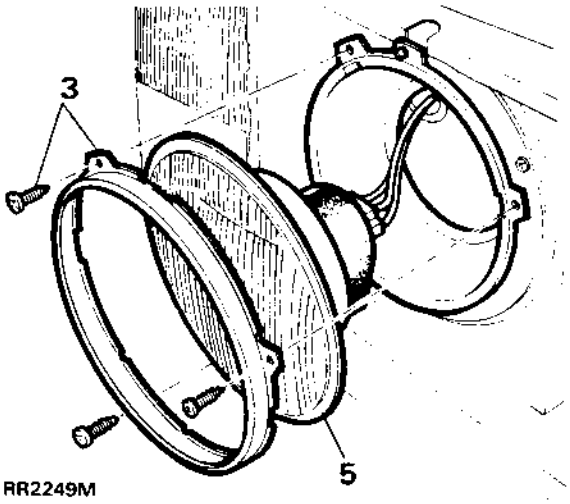
HEADLAMP ASSEMBLY/BULB RELACEMENT

Service repair no - 86.40.02

Remove and refit

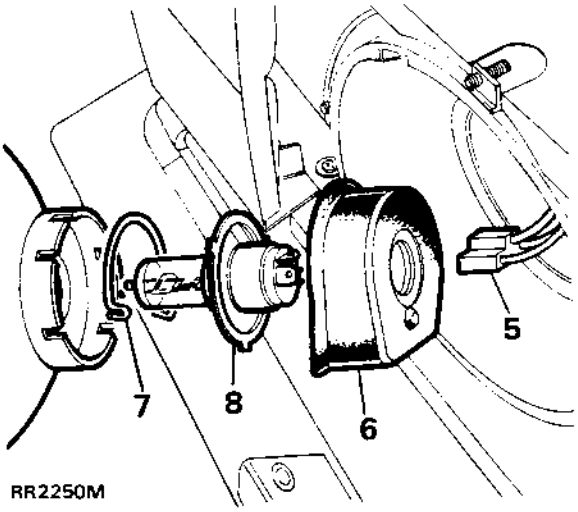
Remove

1. Disconnect the battery negative lead.
2. Remove radiator grille. ***See CHASSIS AND BODY, Repair, radiator grille***
3. Remove three screws and headlamp retaining rim.



RR2249M

4. **DO NOT** disturb beam adjusting screws.
5. Withdraw headlamp unit. Disconnect wiring plug from rear of unit.
6. Remove rubber dust cover.



RR2250M

7. Release retaining clip, remove bulb
8. Remove three securing screws, pry away grommet. Remove headlamp bowl.

Refit

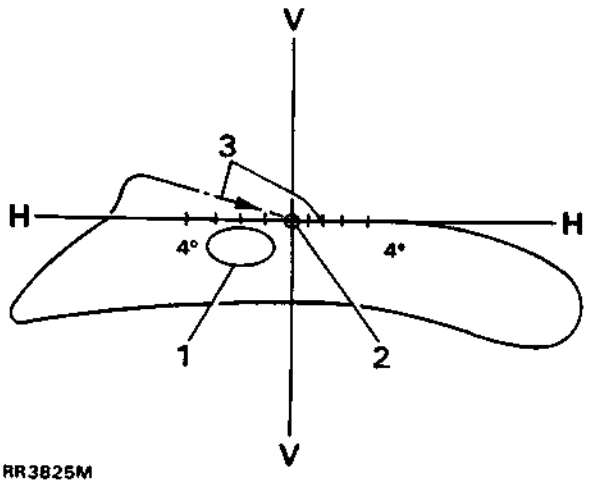
9. Reverse removal procedure. DO NOT touch quartz envelope of bulb. Gently clean using methylated spirits if contact does occur.

HEADLAMP ALIGNMENT

Service repair no - 86.40.17

Headlamp beam setting should only be carried out by qualified personnel using suitable beam setting equipment, for example the Lucas Beamtester.

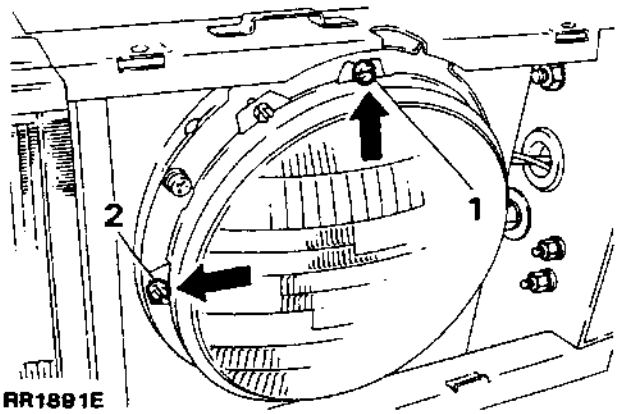
RR3825M shows right hand drive beam pattern, left hand drive is symetrically opposite.



RR3825M

Guide to beam pattern:

1. Maximum intensity zone.
2. Beam aim kink point.
3. Aiming datum lines.



RR1891E

Adjust

1. Turn top adjusting screw anti-clockwise to lower beam, clockwise to raise beam.
2. Turn side adjusting screw anti-clockwise to move beam to left, clockwise to move beam to right.

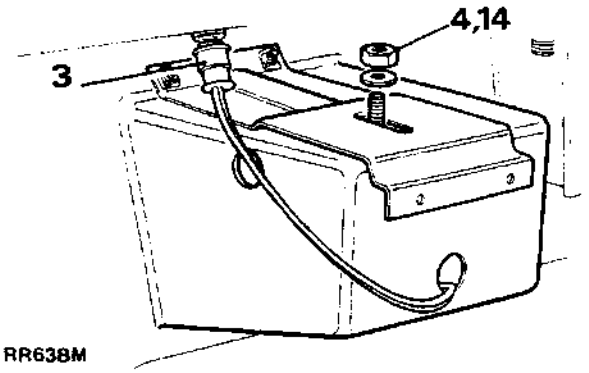
AUXILIARY DRIVING LAMP

Service repair no - 86.40.96

Remove, refit and adjust

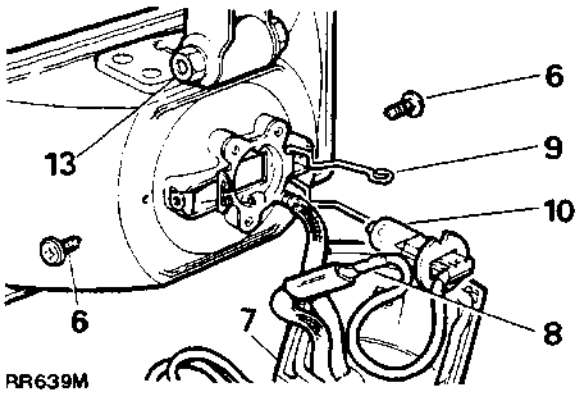
Bulb replacement

1. Disconnect the battery negative lead.
2. Securing nut is located beneath front bumper, adjacent to front body fixing. Access to lamp is gained through front wheel arch.
3. Disconnect electrical plug.
4. Remove single nut and washer.



RR638M

5. From front of vehicle, manoeuvre lamp. Remove lamp from spoiler opening.
6. Remove two screws securing cover to rear of lamp.
7. Withdraw cover.
8. Disconnect lucar connector.
9. Release spring clip securing bulb to lamp unit.
10. Remove bulb.



Refit

11. Fit a new bulb. Ensure two notches on bulb body locate with registers on lamp unit.
12. Reverse removal procedure.

Adjust

Correct adjustment is beam horizontal (parallel to ground) and parallel to vehicle axis.

13. Loosen lamp adjusting bolt to lower or raise beam.
14. Loosen lamp securing bolt to move beam to left or right.
15. Tighten fixing bolts to ***15 Nm.***

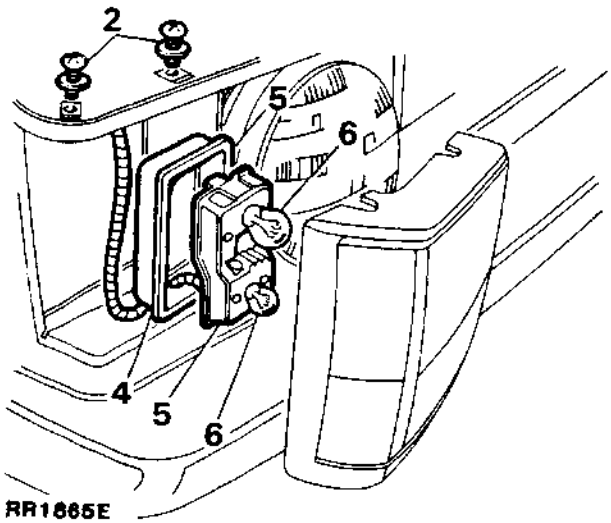
SIDELIGHT AND FLASHER LAMP ASSEMBLY AND BULB

Service repair no - 86.40.24

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove two screws and plain washers securing lamp assemly.
3. Lift assembly away sufficiently to gain access to rear of lamp.
4. Remove waterproof cover.
5. Depress two retaining clips and withdraw bulb holder.
6. Remove required bulb. Direction indicator bulb is located in upper section of bulb holder, side lamp bulb in lower.
7. Disconnect multi-plug. Remove complete assembly.



Refit

8. Reverse removal procedure. Ensure waterproof cover is correctly located.

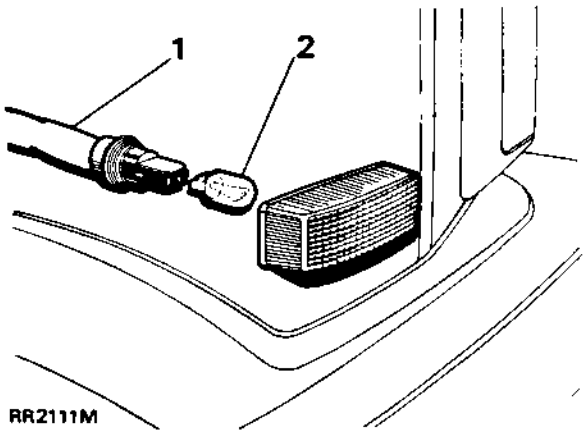
DIRECTION INDICATOR SIDE REPEATER LAMP BULB REPLACEMENT

Service repair no - 86.40.65

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. At back of lamp, twist bulb holder anti-clockwise to remove from lamp assembly.
3. Remove bulb.



Refit

4. Reverse removal procedure. Correct bulb type is 5 watt wedge base.

TAIL LAMP ASSEMBLY

Service repair no - 86.40.74

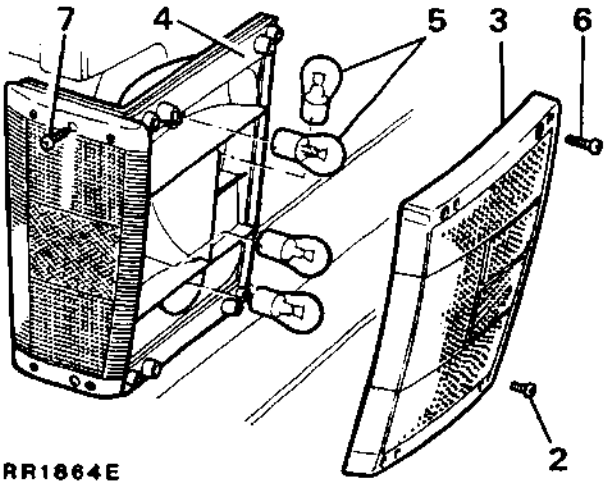
Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove four lens retaining screws.
3. Remove lens.
4. Remove sealing rubber, if required.

NOTE: To remove sealing rubber complete it is necessary to remove side marker lens.

5. Remove bulbs.
6. Remove four screws securing lamp unit to body.
7. Remove two through-screws from reflector side, which also secure lamp unit to body.
8. Ease lamp unit forward and disconnect leads at moulded connectors.



Refit

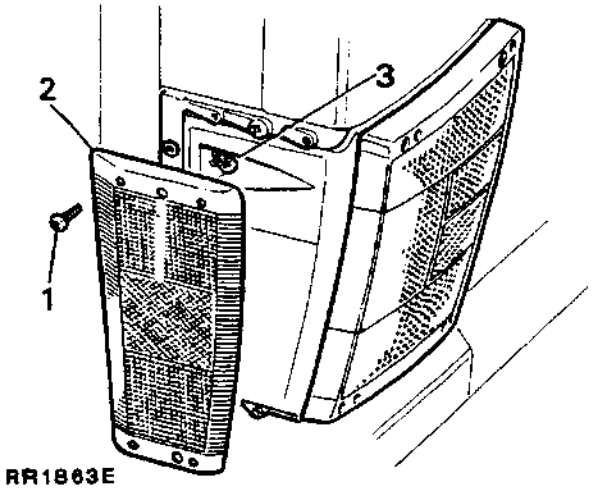
9. Reverse removal procedure.

REFLECTORS/SIDE MARKER LAMP ASSEMBLY AND BULB

Remove and refit

Remove

1. Remove four screws securing lens.
2. Remove lens.
3. Remove bulb.



RR1863E

NOTE: To remove rubber seal completely it is necessary to remove tail light lens.

Refit

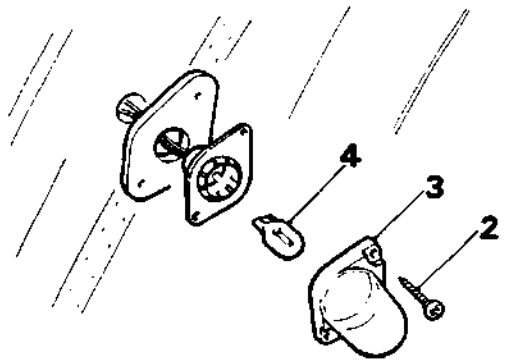
4. Reverse removal procedure.

UNDER BONNET LAMP ASSEMBLY

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove two securing screws.
3. Remove lamp glass.
4. Pull five-watt 'wedge' type bulb from bulb holder.



RR483M

5. Disconnect electrical leads located below bonnet lamp switch attached to inner fender.
6. Pull rubber grommet off leads and pull lamp and leads up through hood stiffener channel.

Refit

7. Reverse removal procedure. 1 to 6.

NOTE: A piece of bent wire will be needed to pull electrical leads out of channel exit hole when fitting a new lamp assembly.

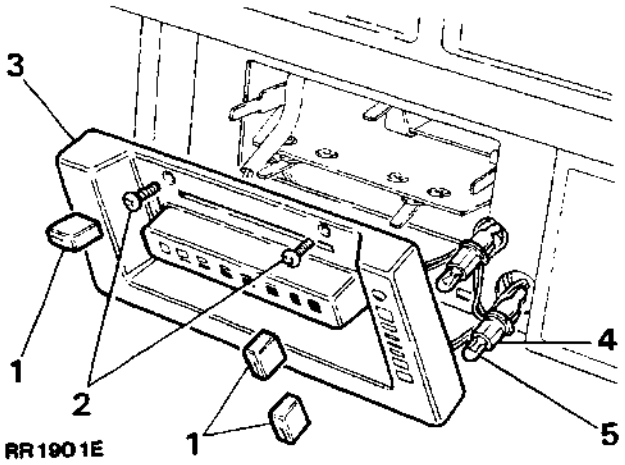
HEATER/VENTILATION AND AIR CONDITIONING CONTROL PANEL

Service repair no - 86.45.73

Bulb replacement

The heater/ventilation control panel is illuminated by four 12-volt 1.2 watt 'wedge' type (capless) bulbs.

1. Pull five finger tip knobs off control levers.
2. Remove two screws at top of panel.
3. Carefully ease panel away from centre console only as far as electrical leads will permit.
4. Pull appropriate bulb holder out of rear of panel.
5. Pull bulb from holder.
6. Fit a new bulb and push bulb holder firmly back into its location at rear of panel.



Refit

7. Ensuring that electrical leads do not become trapped between panel console and operating levers, refit panel.

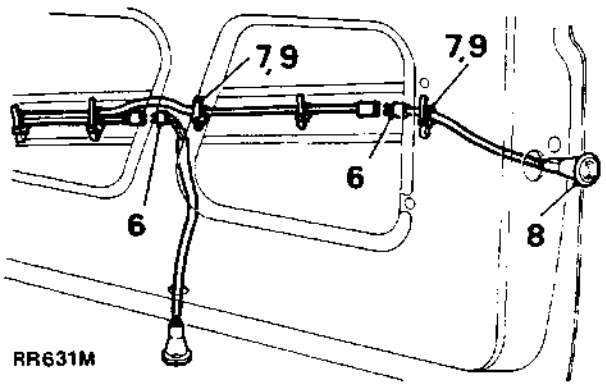
DOOR EDGE LAMPS / PUDDLE LAMPS

Remove and refit

Incorporated into front door assemblies are door edge lamps and puddle lamps, located on door edge and bottom of door. The lamps are activated by courtesy light switches when either front door is opened and will immediately switch off when both doors are closed.

Remove

1. Ensure side door glass is fully closed.
2. Disconnect the battery negative lead.
3. Remove interior door handle and arm rest/door pull from door.
4. Carefully release interior door trim pad from inner door panel.
5. Peel back lower half of plastic vapour barrier.
6. Disconnect electrical connectors within door, accessible through lower centre and outer openings of inner door panel.
7. Release door edge lamp electrical leads from retaining clips.
8. Remove lens and pry lamps out of door and withdraw electrical leads.



Refit

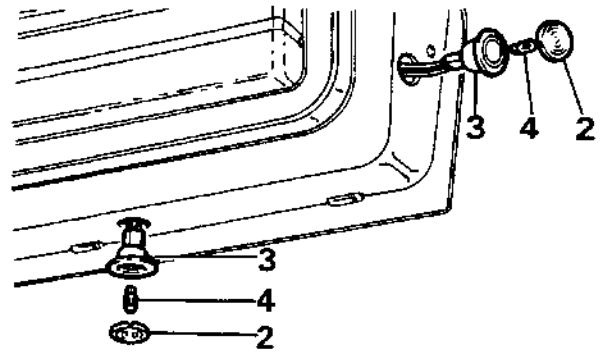
9. Reverse removal procedure.

△ **NOTE: Ensure door lamp wiring harness is securely clipped to lower stiffener plate within door to prevent damage occurring to electrical leads when door glass is in its lowest position.**

DOOR EDGE LAMPS/PUDDLE LAMPS

Bulb replacement

1. Disconnect the battery negative lead.
2. Carefully pry out lamp lens.
3. Withdraw lamp body from door **ONLY** as far as electrical leads will permit.
4. Pull bulb from holder.



RR2120E

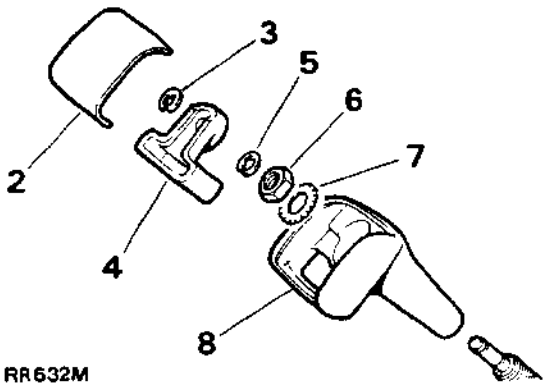
5. Fit new bulb, refit lamp lens. Correct bulb type is a 12-volt, 5-watt capless.
6. Push lamp into door.

AUTOMATIC GEAR SELECTOR-PANEL ILLUMINATION

Service repair no - 86.45.40

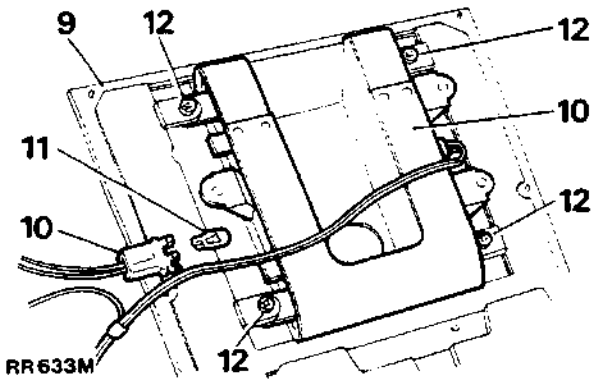
Bulb replacement

1. Disconnect the battery negative lead.
2. Unclip cover from top of gear selector knob.
3. Remove circlip retaining detent button.
4. Withdraw detent button.
5. Remove lower circlip above gear selector knob securing nut.
6. Remove securing nut.
7. Withdraw serrated washer.



RR632M

8. Slide selector knob off shaft.
9. Pry inset panel out of floor mounted console. Remove complete with selector illumination panel and ash tray.
10. Two bulbs are located on reverse side of illumination panel.
11. Pull appropriate bulb holder from its location.
12. To facilitate removal of bulb holders, remove four screws securing illumination panel to outer surround panel.



13. Remove bulb from holder. Correct bulb type is a 24-volt, 5-watt 'wedge' base (capless).

Refit

14. Reverse removal procedure. Ensuring electrical leads beneath console do **NOT** become trapped between mating surfaces.
15. To prevent damage to gear selector knob on reassembly do **NOT** overtighten retaining nut.

NUMBER PLATE LAMP ASSEMBLY AND BULB

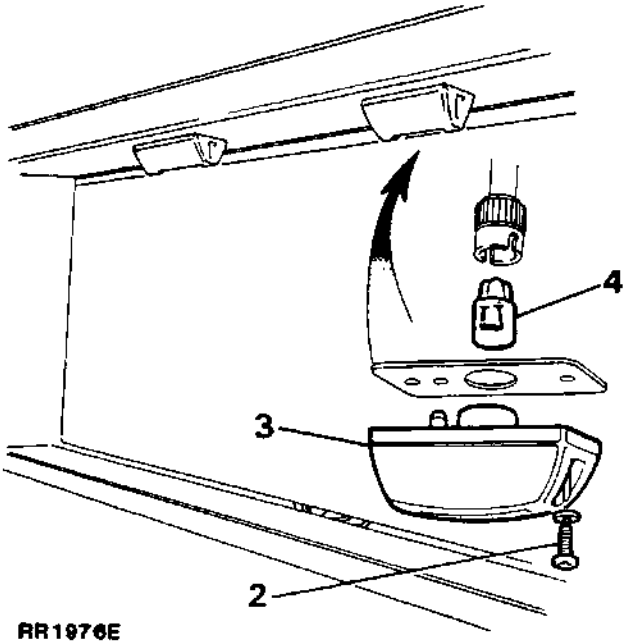
Service repair no - 86.40.86

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove two self-tapping screws with washers.
3. Remove lamp assembly.
4. Disconnect bulb holder, remove bulb.

△ **NOTE: Carefully pull electrical leads out of bottom of lower tailgate panel to reveal snap connectors.**



5. Disconnect electrical connections located at bottom of lower tailgate.
6. Remove bulb holder.
7. Carefully pull electrical leads up through inside of lower tailgate panels.

Refit

8. Reverse removal procedure. Correct bulb 'type' is 12-volt, 5 watt wedge base (capless).

INTERIOR ROOF LAMPS

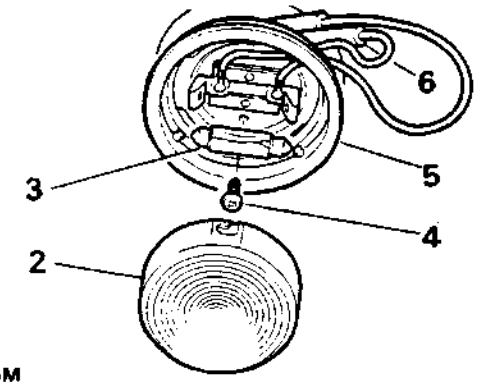
Service repair no - 86.45.01

Remove and refit

Remove

Interior roof lamps are operated automatically via side door and tailgate courtesy switches or by an independent switch in auxiliary switch panel.

1. Disconnect the battery negative lead.
2. Remove lens from courtesy lamp by pressing upward and turning it counter-clockwise.
3. Withdraw bulb from spring clip holder.
4. Remove screws securing lamp base to roof panel.
5. Lower lamp to reveal cable snap connections.
6. Disconnect electrical connections.



RR485M

Refit

7. Reverse removal procedure.

INTERIOR ROOF LAMPS CIRCUIT DELAY

Service repair no - 86.45.49

Remove and refit

Remove

The roof lamp circuit incorporates a delay function which is designed to allow lamps to remain on for 12 to 18 seconds after either front door is closed.

△ **NOTE: Switching on ignition (with both doors closed) will immediately over-ride this feature, switching interior lamps off.**

1. Disconnect the battery negative lead.
2. Remove six screws securing lower dash panel.
3. Lower dash panel to gain access to delay unit attached to steering column support bracket.
4. Remove delay unit from retaining bracket.
5. Pull multi-plug off delay unit.

Refit

6. Reverse removal procedure.

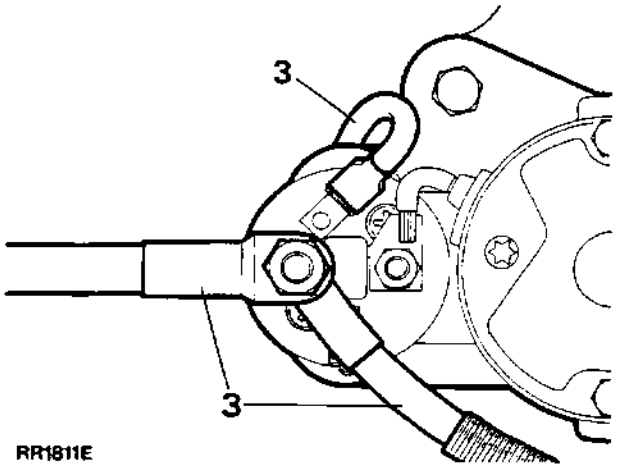
STARTER MOTOR-LUCAS M78R

Service repair no - 86.60.01

Remove and refit

Remove

1. Place vehicle on a suitable hoist.
2. Disconnect the battery negative lead.
3. Disconnect leads from solenoid and starter motor. Remove exhaust heat shield.
4. Remove two bolts, starter motor to flywheel housing.
5. Remove starter motor.



RR1811E

Refit

6. Reverse removal procedure.

AUXILIARY SWITCH PANEL

Remove and refit

The auxiliary switch panel contains up to six switches depending on vehicle specification. Each switch incorporates integral symbols for identification. Unused switch openings are fitted with blank covers, which are removable, to facilitate fitting extra switches if required.
The symbols are illuminated by two bulbs which become operational when vehicle lights are on.

The heated rear screen switch is provided with an individual warning light, illuminated when the switch is operated.

Remove

1. Disconnect the battery negative lead.
2. Carefully pry auxiliary switch panel surround away from centre console.
3. Withdraw switch panel as far as electrical leads will permit.
4. Unclip multi-plugs at rear of switches by depressing retaining lugs.
5. Pull plugs from the switches.
6. Remove switch assembly complete.
7. Depress small retaining lugs on top and bottom of switch and push switch(es) through front of switch surround.

Refit

8. Reverse removal procedure.

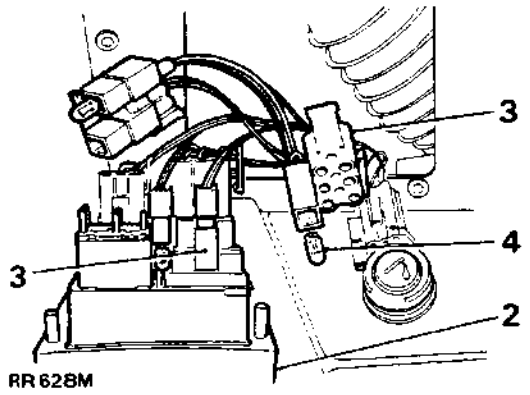
△ **NOTE: To aid identification and location of multi-plug to switch, a coloured plastic tab is attached to each body which corresponds with an appropriate coloured multi-plug. If removed, switches must be refitted in original positions.**

AUXILIARY SWITCH PANEL WARNING LIGHT

Service repair no - 86.45.29

Bulb replacement

1. Disconnect the battery negative lead.
2. Carefully pry switch panel surround away from centre console.
3. Unclip multi-plug from rear of switch, disconnect plug.



4. Warning light bulb is located in multi-plug. Remove by pulling bulb from its location.
5. Fit a new bulb and refit multi-plug.
6. Press auxiliary switch panel into centre console. Correct bulb type is an amber 12-volt 1.2-watt 'wedge' base (capless).

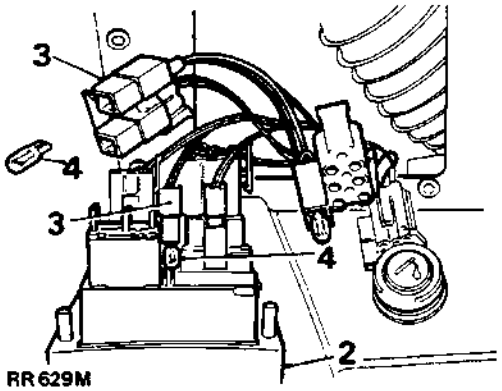
AUXILIARY SWITCH PANEL ILLUMINATION

Service repair no - 86.45.29

Bulb replacement

Auxiliary panel green illumination bulbs are located in interior lamp/heated rear screen multi-plugs. Each bulb is positioned in centre of four switches.

1. Disconnect the battery negative lead.
2. Carefully pry switch panel surround away from centre console to give access to multi-plugs at rear of switches.



3. Unclip and pull multi- plugs from rear of appropriate switch.
4. Pull green illumination bulb from its location.
5. Fit new bulb, refit multi-plug.
6. Press auxiliary panel surround back in to centre console.
   Correct bulb type is a 12-volt 1.2-watt 'wedge' base (capless).

STEERING COLUMN CONTROLS

Steering column switch layout is as follows:

LEFT HAND CONTROLS

Lower switch-Main lighting switch.
Upper switch-High and low beam, direction indicators and horn.

RIGHT HAND CONTROLS

Lower switch - Rear screen programmed wash/wipe.
Upper switch - Windscreen programmed wash/wipe.

STEERING WHEEL

The following operations for steering column controls show steering wheel removed, this is for clarity only, and is not a necessary part of procedure. If steering wheel removal is required. ***See STEERING, Repair, Steering wheel***

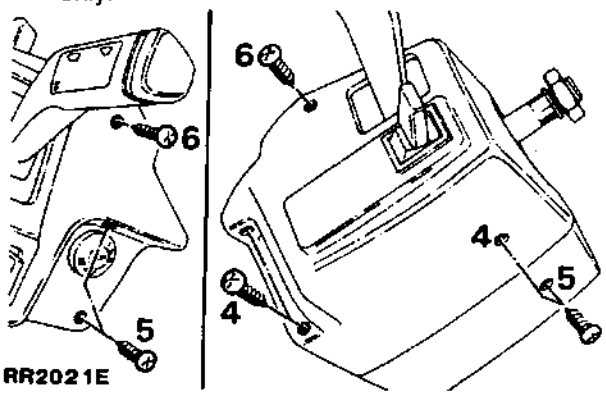
STEERING COLUMN SHROUD

Remove and refit

Certain operations within this section necessitate removal of steering column shroud. Unless removal of both sides of shroud is required, remove ONLY side necessary for access.

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel. ***See CHASSIS AND BODY, Repair, Lower dash panel***
3. Disconnect electrical connections to either master lighting switch or rear screen wash wipe switch. (Disconnect both if removing complete shroud).
4. Left hand shroud - remove three securing screws and remove shroud over indicator/high beam switch.
5. Right hand shroud - remove three securing screws and remove shroud over windscreen wash wipe switch.
6. To facilitate reassembly remove screw securing two halves of shroud together from one side only.



RR2021E

Refit

7. If both sides of shroud have been removed ensure that plate on steering column is correctly located in slot in shroud.
8. Reverse removal procedure.

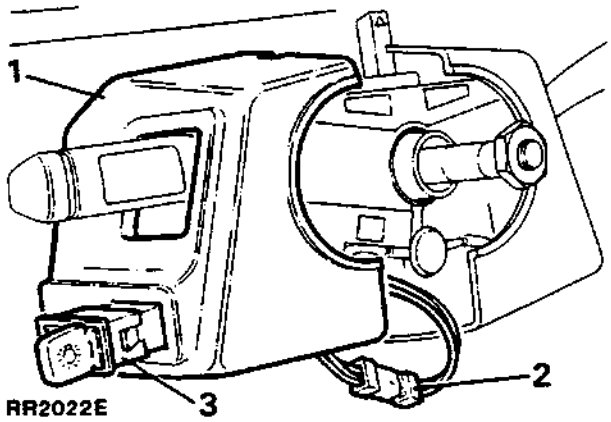
MAIN LIGHTING SWITCH OR REAR SCREEN PROGRAMMED WASH WIPE SWITCH

Service repair no - 86.65.10/84.35.34

Remove and refit

Remove

1. Remove steering column shroud from required side.
2. Disconnect cables at snap connectors.
3. Push two spring clips locating switch inwards and remove switch from mounting.



RR2022E

Refit

4. Reverse removal procedure.

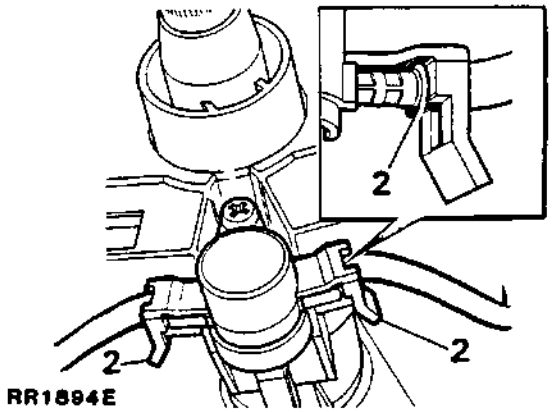
WINDSCREEN PROGRAMMED WASH WIPE SWITCH OR HIGH AND LOW BEAM, DIRECTION INDICATORS AND HORN SWITCH

Service repair no - 84.15.34/86.65.55

Remove and refit

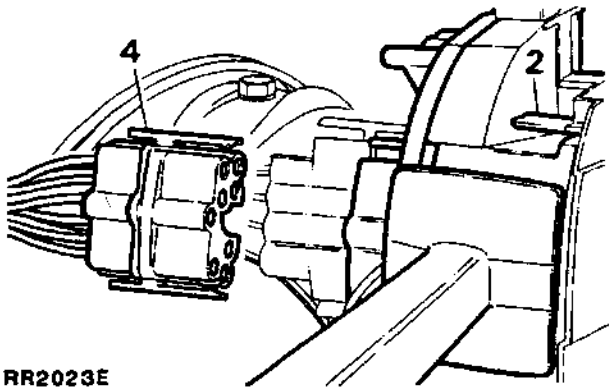
Remove

1. Remove steering column shroud from required side.
2. Release appropriate retaining clip and pull fibre optic guide from housing.



RR1894E

3. Depress retainers at top and bottom of switch and pull combined switch assembly away from steering column switch housing.



RR2023E

4. Lighting, indicator and horn switch: release two harness multi-plugs from back of switch and remove switch assembly.
   Wiper and washer switch: release harness multi-plug from back of switch and remove switch assembly.

Refit

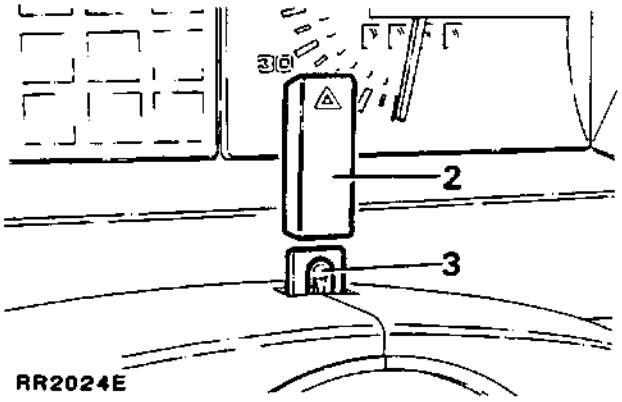
5. Reverse removal procedure.

HAZARD WARNING SWITCH BULB REPLACEMENT

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pull hazard switch cover upwards, remove it to gain access to bulb.



3. Remove bulb by pulling it upwards. A piece of rubber tubing or adhesive tape attached to bulb may facilitate removal and refitting.

Refit

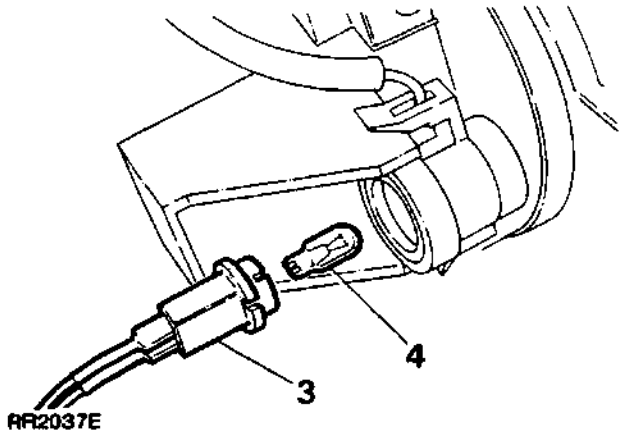
4. Locate bulb in its holder and reverse instructions 1 to 3.
   Correct bulb is a 12V, 1. 2 watt 'wedge' base (capless).

COLUMN SWITCH ILLUMINATION BULB REPLACEMENT

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove left hand side steering column shroud.
3. Working behind column switch housing twist bulb holder through 90° to remove.
4. Remove bulb.



Refit

5. Reverse removal procedure. Correct bulb type is a 12-volt, 1.2-watt 'wedge' base (capless).

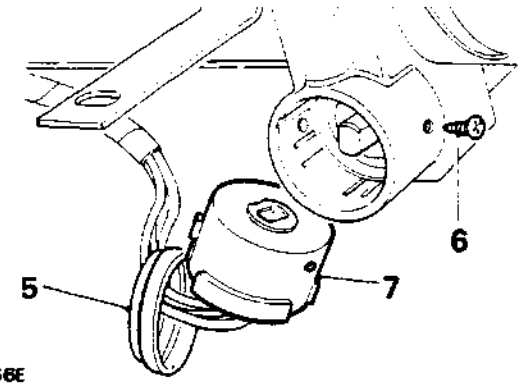
IGNITION STARTER SWITCH

Service repair no - 86.65.02

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel.
3. Remove steering column shroud, left hand side.
4. Disconnect ignition switch cable at multi-plug.
5. Remove rubber cover protecting switch.



RR1966E

6. Remove single screw securing ignition/starter switch to housing.
7. Remove switch.

Refit

8. Reverse removal procedure.

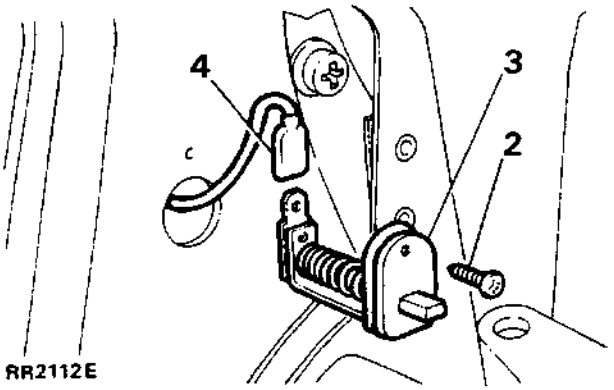
DOOR PILLAR SWITCH

Service repair no - 86.65.15

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove screw securing switch to door pillar.
3. Remove switch.
4. Disconnect electrical lead from connector blade.



RR2112E

Refit

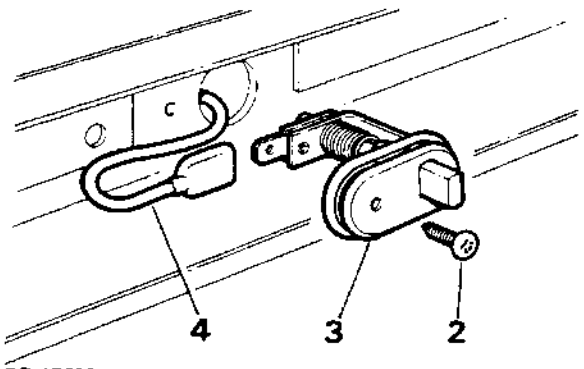
5. Reverse removal procedure.

REAR TAILGATE SWITCH

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove single screw securing switch to tailgate opening.
3. Withdraw switch.
4. Disconnect electrical lead.



RR498M

Refit

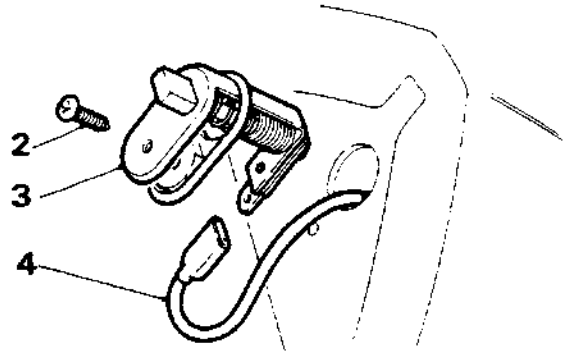
5. Reverse removal procedure.

UNDER BONNET ILLUMINATION SWITCH

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove single screw securing switch to decker panel.
3. Withdraw switch.
4. Disconnect electrical lead.



RR499M

Refit

5. Reverse removal procedure.

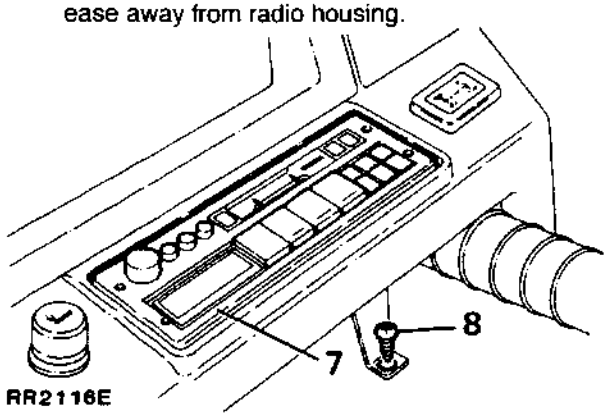
CIGAR LIGHTER-RADIO HOUSING

Service repair no - 86.65.60

Remove and refit

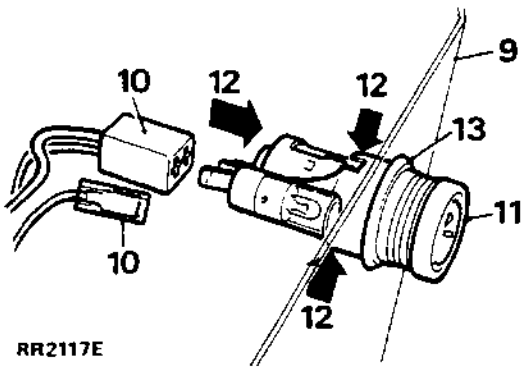
Remove

1. Disconnect the battery negative lead.
2. Remove transfer gear lever knob.
3. Remove main gear lever knob. ***See Automatic gear selector-panel illumination***
4. Remove glove box liner. Release park brake cable from lever. Pry inset panel out of floor mounted console. Pull two illumination bulbs from selector panel.
5. Release glove box from four fixings.
6. Raise front of glove box and console assembly, ease away from radio housing.



RR2116E

7. Remove radio, referring to Manufacturer's instructions.
8. Remove single screw securing housing to top of gearbox tunnel.
9. Pull housing away from lower dash panel.
10. Disconnect electrical leads at rear of cigar lighter.
11. Remove push in switch from lighter outer body.
12. Depress outer plastic surround where denoted by arrows and push outer body through surround.
13. Manoeuvre plastic surround, remove from radio housing.



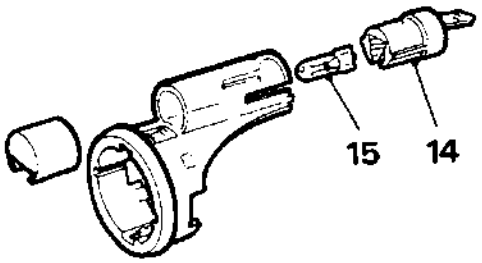
RR2117E

Refit

14. Reverse removal procedure.

CIGAR LIGHTER ILLUMINATION - BULB REPLACEMENT
Service repair no - 86.45.55

15. Remove bulb holder from plastic surround.
16. Pull bulb from holder. Correct bulb type is a 12V 1.2-watt wedge base (capless).



RR2118E

Refit

17. Reverse removal procedure.

CIGAR LIGHTER - GLOVE BOX

Service repair no - 86.65.61

Rear cigar lighter is located in bottom of glove box, access to rear of lighter is gained by removing glove box liner.
Follow instructions 10 to 16 of **CIGAR LIGHTER-radio housing** to remove lighter from glove box. ***See CIGAR LIGHTER-radio housing***

REVERSE LIGHT SWITCH

Service repair no - 37.27.01

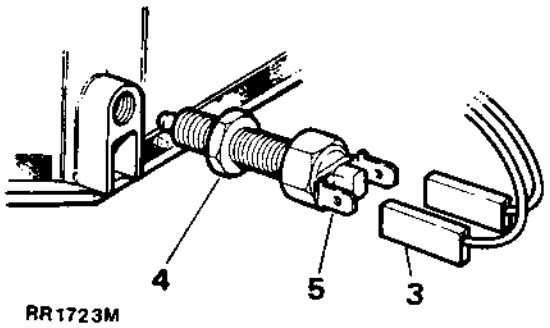
Remove and refit

Manual gearbox

Remove

Reverse light switch is located at rear of selector housing, accesible from beneath vehicle.

1. Place vehicle on suitable ramp.
2. Disconnect the battery negative lead.
3. Disconnect electrical leads.
4. Release lock-nut.
5. Remove switch.



Refit

NOTE: Reverse light switch requires re-setting on reassembly.

6. Select reverse gear.
7. Connect 12 volt supply and test lamp across switch terminals.
8. Screw switch into housing until test lamp is illuminated. Screw switch in a further half turn, tighten locknut.
9. Connect electrical lead.
10. Reconnect battery.

START INHIBIT / REVERSE LIGHT SWITCH

Service repair no - 44.15.19

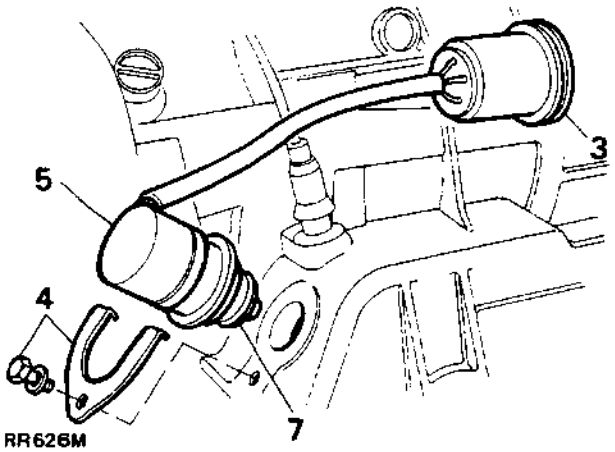
Remove and refit

Automatic gearbox

Remove

Reverse light switch is an integral part of start inhibitor switch. It is located on left hand side of gearbox, accessible from beneath vehicle.

1. Place vehicle on suitable ramp.
2. Disconnect the battery negative lead.
3. Disconnect multi-plug.
4. Release clamp bolt, remove clamp.
5. Remove switch.



RR626M

Refit

6. Fit a NEW 'O' ring to switch.
7. Reverse removal procedure.

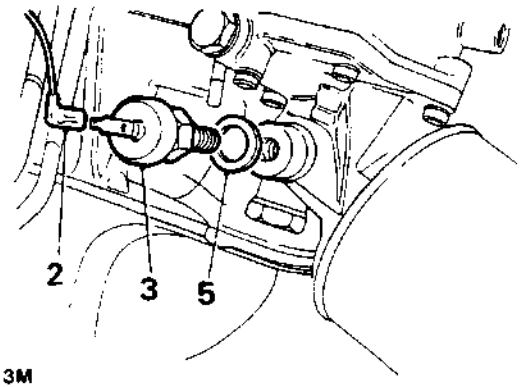
OIL PRESSURE WARNING SWITCH

Service repair no - 86.65.30

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect electrical lead.
3. Unscrew switch unit.
4. Remove switch and sealing washer.



RR513M

Refit

5. Reverse removal procedure. Using a NEW sealing washer.

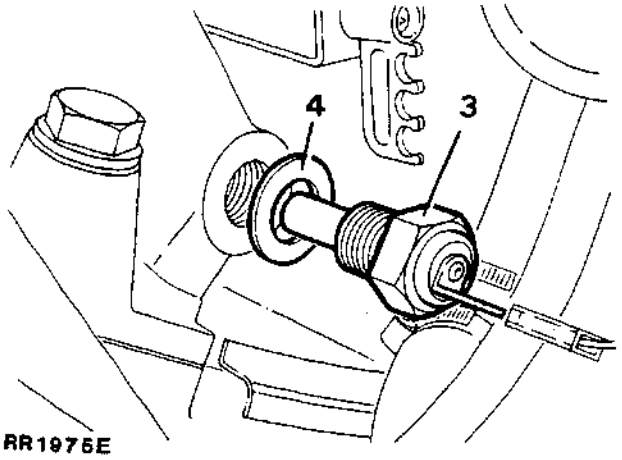
COOLANT TEMPERATURE TRANSMITTER

Service repair no - 26.10.02

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Disconnect electrical lead.
3. Remove transmitter from inlet manifold.



RR1975E

Refit

4. Reverse removal procedure. Using a **NEW** sealng washer.

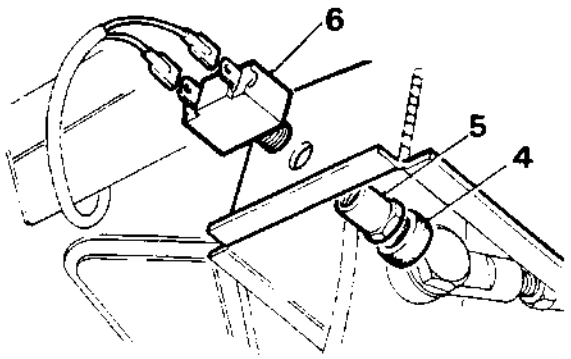
STOP LIGHT SWITCH

Service repair no - 86.65.51

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel. ***See CHASSIS AND BODY, Repair, lower dash panel***
3. Depress foot brake.
4. Remove rubber protector from switch, if fitted.
5. Remove hexagon nut.
6. Withdraw switch.
7. Disconnect electrical leads.



RR509M

Refit

8. Reverse removal procedure.

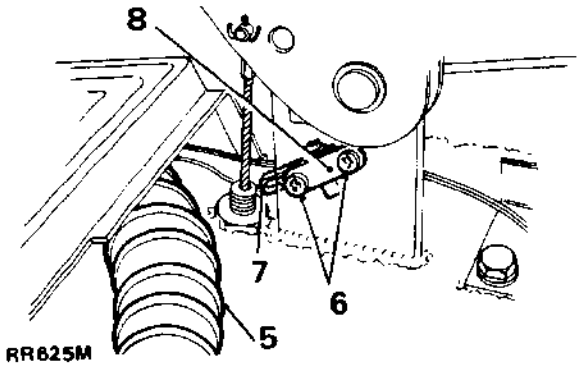
PARK BRAKE WARNING SWITCH

Service repair no - 86.65.45

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Apply park brake.
3. Remove four screws.
4. Remove glove box liner.
5. Carefully pull hose away from side of park brake mounting bracket.
6. Remove two screws.
7. Manoeuvre switch around front of mounting bracket. Disconnect electrical lead.
8. Remove switch.



RR625M

Refit

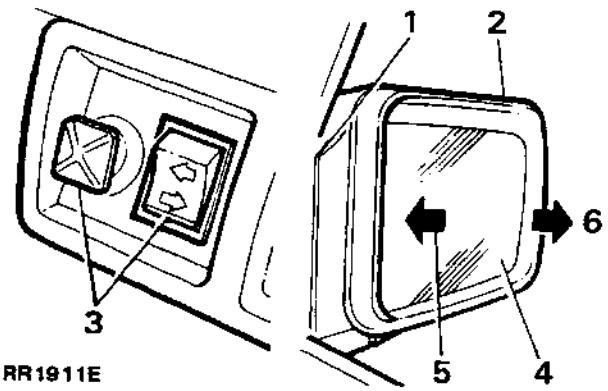
9. Reverse removal procedure.

EXTERIOR DRIVING MIRRORS

1. Mirror housing is hinged vertically. It should be set in one of two fixed angle positions provided to suit left or right side location.
2. For safety and convenience, mirror housing is designed to fold completely forwards or rearwards against vehicle body.

Adjust

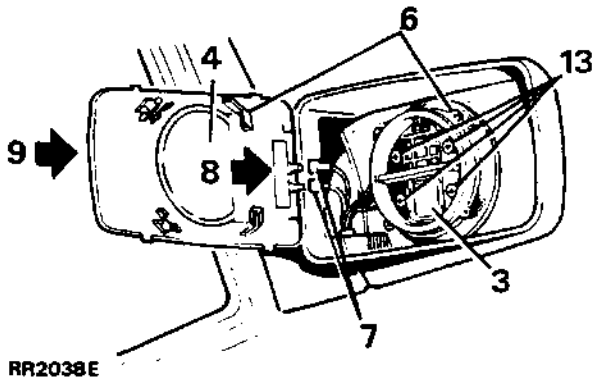
3. Adjustment is controlled by an electric motor inside mirror housing. This is operated by two controls fitted in dash panel. To adjust, select left or right hand mirror. Move head of finger tip control to left, right, up or down as required.
4. Mirror also incorporates a demist facility, activated by operation of rear window demist switch.



RR1911E

Replacing mirror glass

5. Press inner (wider) end of glass to full extent inwards.
6. Insert fingers under outer (narrower) end of glass. Pull outwards until glass is released from four retaining clips.
7. Disconnect two leads from back of glass.
8. To replace glass, locate inner (wider) end in mirror housing.



9. Carefully press outer (narrower) end of glass inwards until it locates on four retaining clips.
10. Adjust mirror as required.

ELECTRIC MOTORS

Remove and refit

Remove

11. Disconnect the battery negative lead.
12. Remove mirror glass, as described in items 5 to 7.
13. Remove four self-tapping screws securing motor assembly to mirror body.
14. Manoeuver motor assembly to reveal electrical connections on rear of motor.
15. Pull leads from rear of motor assembly.

Refit

16. Reverse removal procedure. 11 to 15, ensuring that electrical leads are correctly refitted.

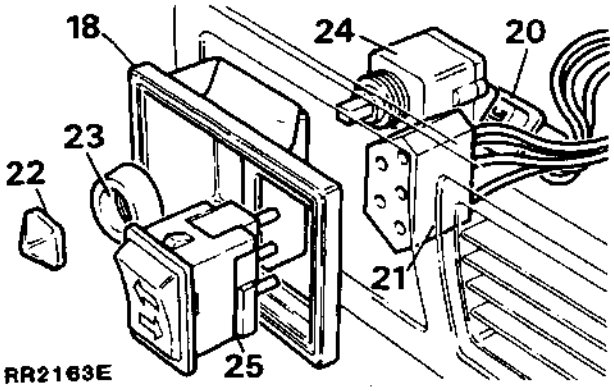
CONTROL SWITCHES

Service repair no - 86.65.75

Remove and refit

Remove

17. Disconnect the battery negative lead.
18. Remove switch retaining panel from fascia.
19. Withdraw panel to access electrical leads.



20. Pull multi-plug from rear of fingertip switch.
21. Disconnect multi-plug at rear of selector switch. Remove panel.
22. Carefully pry off fingertip button from switch.
23. Unscrew black plastic retaining collar securing switch.
24. Remove switch from panel. Note position of locating hole in panel retaining clip.
25. Depress two spring clips securing selector switch, push it through panel.

Refit

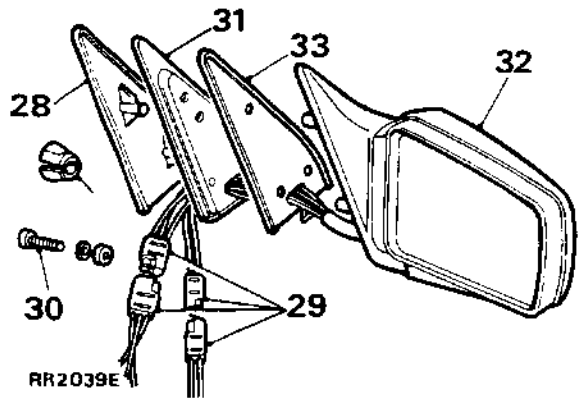
26. Reverse removal procedure. 17 to 25.

COMPLETE ASSEMBLY
Service repair no - 76.11.10

Remove and refit

Remove

27. Disconnect the battery negative lead.
28. Pry off interior finisher plate.
29. Disconnect two electrical plugs.
30. Support exterior mirror assembly, remove three securing screws, plain and spring washers.
31. Pull inner mounting plate from inner door frame complete with two retaining clips.
32. Detach mirror assembly from outer door frame.
33. Remove sealing rubber.



Refit

34. Reverse removal procedure. 27 to 33.

CAUTION: To prevent damage to electrical wiring do not push leads down inside door casing.

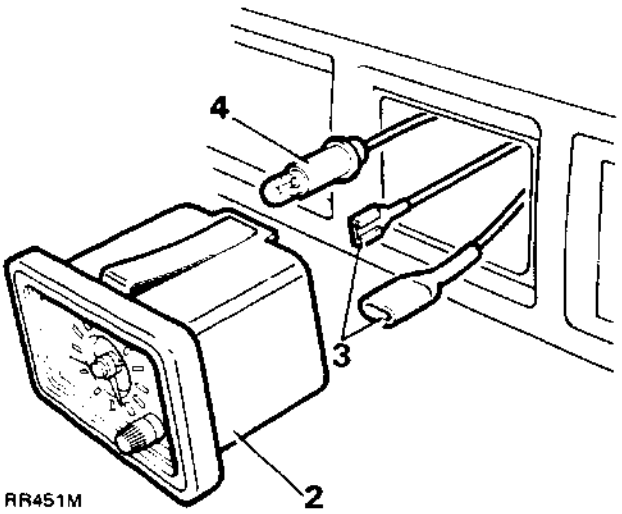
CLOCK

Service repair no - 88.15.07

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Carefully pry clock out of dash panel.



3. Disconnect electrical leads.
4. Remove bulb holder and bulb. Correct bulb is a 2-watt bayonet type.

Refit

5. Reverse removal procedure.

WARNING LAMP CONTROL UNIT - USA

Service repair no - 86.55.45

Remove and refit

Introduction

The fifteen warning light symbols in binnacle will all be illuminated when ignition key is turned to position II as an initial check to ensure that all bulbs are operational. All bulbs, except for Brake Failure / Parking Brake, ABS (if fitted), Engine Oil Pressure' and 'Ignition On' symbols will estinguish automatically after 12 + 4 seconds.

If engine is cranked during bulb check, check will terminate in 0,75 + 0,25 seconds.

'Engine Oil Pressure' and 'Ignition On' symbols will remain on when engine is cranked extinguished when engine is running.

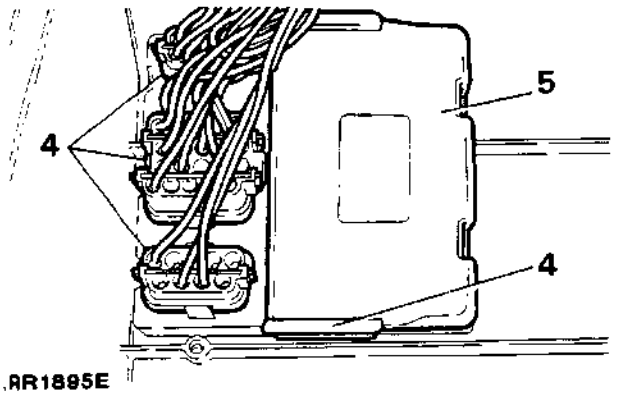
ABS symbol will estinguish when vehicle reaches 8 kph (5 mph).

The 'Brake Failure/Transmission Parking Brake' symbol will extinguish when parking brake lever is released.

△ **NOTE: Should ignition key be turned directly to engine crank position, bulb check procedure will be overridden.**

Remove

1. Disconnect the battery negative lead.
2. Remove six screws from lower dash panel.
3. Lower dash panel, disconnect multi-plug from rheostat switch.
4. Pull warning lamp control unit from spring clip on underside of dash panel, disconnect three multi-plugs from unit.
5. Remove warning lamp control unit.



.AR1895E

Refit

6. Reverse removal procedure. Ensure multi-plugs and unit are securely located.

INSTRUMENT ILLUMINATION ELECTRONIC DIMMER / RHEOSTAT

Service repair no - 86.65.07

Remove and refit

Electronic dimming control switch is located on lower dash panel adjacent to steering column. Rotate control upwards to fully illuminate instruments and downwards to reduce intensity.
Dimmer control unit also controls clock, heater and cigar lighter illumination.

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel. ***See CHASSIS AND BODY, Repair, lower dash panel***
3. Disconnect dimmer control multi-plug.
4. Remove two screws securing dimmer control switch.

Refit

5. Reverse removal procedure. 1 to 4.

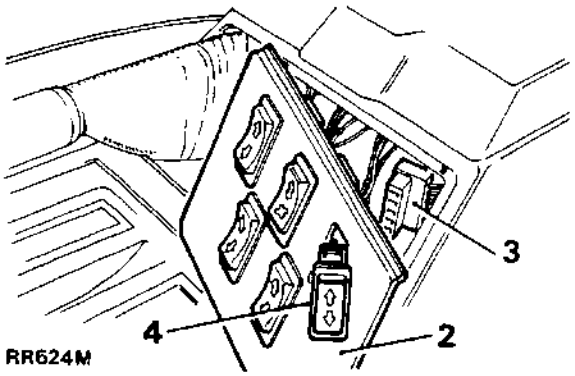
WINDOW LIFT SWITCHES

Service repair no - 86.25.16

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pry window lift switch surround from glove box.
3. Disconnect multi-plug at rear of switch(es).
4. Apply pressure to rear of switch, push it through surround.



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Refit

5. Reverse removal procedure.

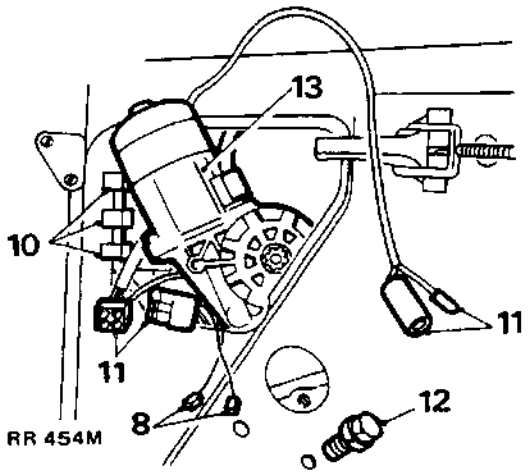
WINDOW LIFT MOTOR - FRONT DOORS

Service repair no - 86.25.04

Remove and refit

Remove

1. Ensure that side door glass is fully closed, secure with adhesive tape.
2. Remove front door trim panel. ***See CHASSIS AND BODY, Repair, front door - trim panel***
3. Peel back front top corner of plastic vapour barrier to reveal window lift motor.
4. Release window lift motor wiring harness from three retaining clips to allow harness to be pulled out of opening at front of inner door panel.
5. Disconnect window lift motor multi-plug from main door harness.



6. Support motor, remove three securing bolts.
7. Remove motor through top front opening of door.

Refit

8. Reverse removal procedure. 1 to 7.

NOTE: Ensure that drive gear is engaged and correctly aligned with window lift linkage before fitting securing bolts.

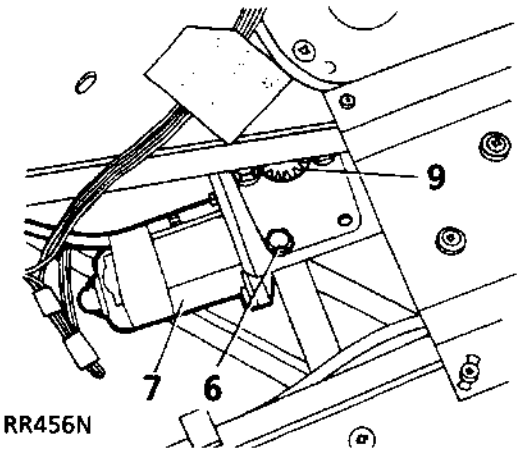
WINDOW LIFT MOTOR - REAR DOORS

Service repair no - 86.25.09

Remove and refit

Remove

1. Ensure that side door glass is fully closed, secure with adhesive tape.
2. Remove rear door trim panel. ***See CHASSIS AND BODY, Repair, rear door - trim panel***
3. Carefully detach bottom half of vapour barrier to reveal window lift motor.
4. Release motor wiring harness from retaining clips.
5. Disconnect lift motor harness snap connections from main door harness.
6. Support motor, release three securing bolts.
7. Remove lift motor from lower opening in inner door panel.



Refit

8. Reverse removal procedure. 1 to 7.
9. Ensure lift motor drive gear is engaged and correctly aligned with window lift linkage before fitting securing bolts.

CENTRAL DOOR LOCKING

The central door locking system on four door models is activated from both driver and front passenger doors. A switch/lock actuator is fitted in both front doors. The system is controlled by an electronic unit situated on steering column support bracket.

Locking or unlocking front doors from outside by key operation, or from inside by sill knob automatically locks or unlocks all four doors, upper tailgate and, vehicles up to 1991 model year fuel filler flap.

Vehicles from 1991 model year: Fuel filler flap is released by pressing button on steering column shroud.

Front and rear passenger doors can be independently locked or unlocked from inside vehicle by sill knob operation but can be overridden by further operation of driver's door locking control.

On rear doors only, a child safety lock is provided which can be mechanically pre-set to render interior door handles inoperative.

Failure of an actuator will not affect locking of remaining three doors, tailgate or fuel filler flap. A door with inoperative actuator can still be locked or unlocked manually, but not fuel filler flap.

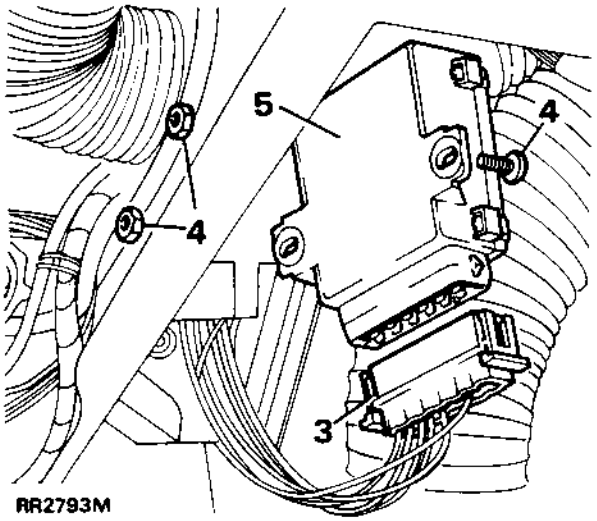
△ **NOTE: Actuator units contain non-serviceable parts. If a fault occurs, fit a new unit.**

CENTRAL DOOR LOCK CONTROL UNIT

Remove and refit

Remove

1. Disconnect the battery negative lead. .
2. Remove the lower fascia panel.
3. Disconnect the harness multi-plug.
4. Remove the securing screws.
5. Remove the control unit.



RR2793M

Refit

6. Reverse removal procedure.

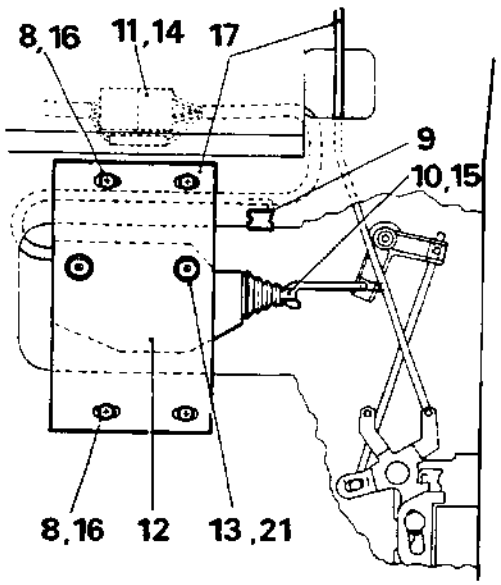
FRONT DOOR ACTUATOR UNIT

Service repair no - 86.26.08

Remove and refit

Remove

1. Ensure window is in its fully closed position.
2. Remove front door trim panel. ***See CHASSIS AND BODY, Repair, front door - trim panel***
3. Peel back plastic vapour barrier to expose actuator unit.
4. Remove four screws and plain washers securing lock actuator mounting plate to inner door panel.
5. Release cable tie, at trailing edge of door, retaining electrical cable.
6. Manoeuvre actuator assembly from actuator link.



RR369M

7. Withdraw actuator assembly, disconnect multi-plug.
8. Remove actuator assembly.
9. Remove actuator unit by loosening two screws securing it to mounting plate.

Refit

10. Fit actuator unit to mounting plate.
11. Connect multi-plug.
12. Manoeuvre actuator assembly to engage actuator link.
13. Loosely fit actuator mounting plate to inner door panel with four screws. Set mounting plate in centre of slotted holes.
14. Ensure that manual operation of sill locking control is not restricted by operation of actuator operating rod and vice versa. Reset mounting plate as necessary.
15. Reconnect vehicle battery.
16. Check that electrical operation of door lock occurs when sill locking control is moved through half of total movement. Reset mounting plate if necessary, tighten four screws.

△ **NOTE: Above adjustment ensures that full tolerance on switching operation is utilised.**

REAR DOOR ACTUATOR UNITS

Service repair no - 86.26.09

Remove and refit

Instructions as for front doors with following exceptions:

17. Electrical cable and plug is retained and is accessible through large opening in door.
18. Instruction 16 does not apply to rear actuator units which are not fitted with switches.

△ **NOTE: Actuator may be detached from mounting plate to facilitate removal of lock actuator from connector rod.**

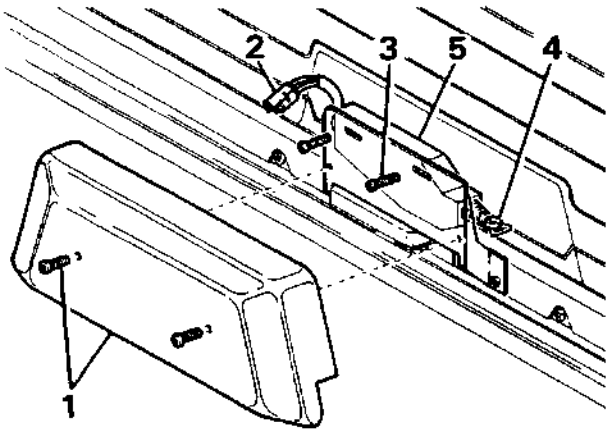
UPPER TAILGATE ACTUATOR UNIT

Service repair no - 86.26.10

Remove and refit

Remove

1. Remove two screws and trim covering to gain access to actuator.
2. Disconnect electrical connection.
3. Remove two actuator retaining screws.
4. Manouevre actuator assembly link from actuator link.
5. Withdraw tailgate actuator unit.



RR2570E

Refit

6. Reverse removal procedure.
7. Check operation of central locking system.

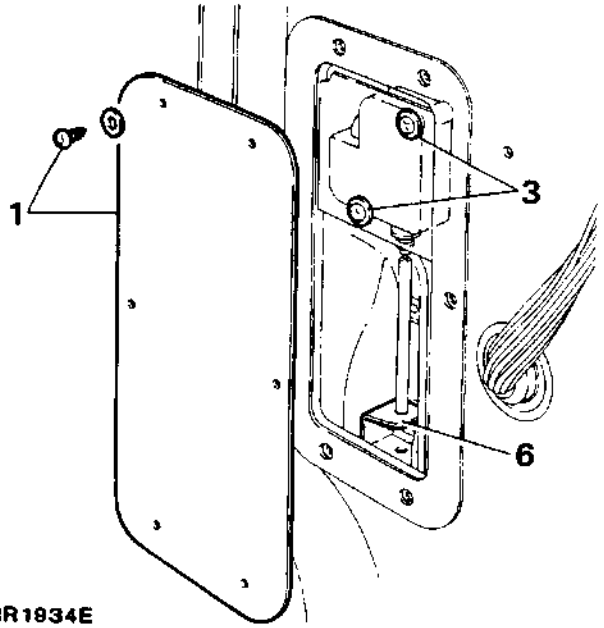
FUEL FILLER FLAP ACTUATOR UNIT - PRE 1991 MODEL YEAR

Service repair no - 86.26.16

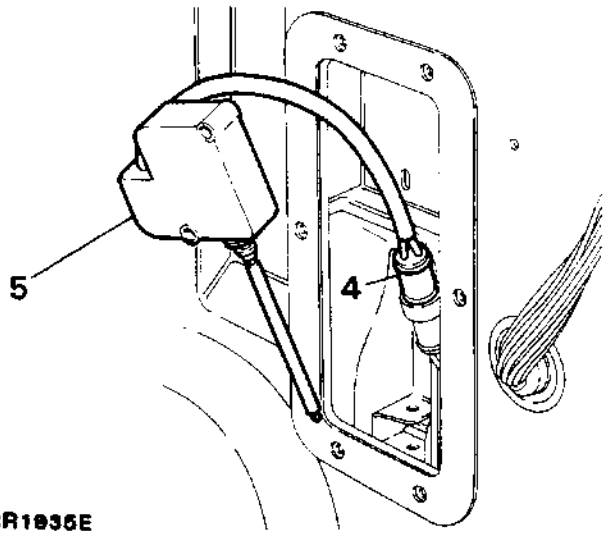
Remove and refit

Remove

1. Remove six screws to withdraw closure panel, situated in tool stowage area.
2. Ensure that actuator is in unlocked position and fuel filler flap is open.
3. Release two screws and manoeuvre actuator unit clear of its mounting.



RR1934E



RR1935E

4. Disconnect wiring plug.
5. Withdraw actuator.

Refit

6. Reverse removal procedure. Actuator mounting holes in body are elongated. Adjust position of actuator to ensure that rod will pass through guide brackets without fouling.
7. Check operation of central locking system.

FUEL TANK GAUGE UNIT - PRE 1991 MODEL YEAR

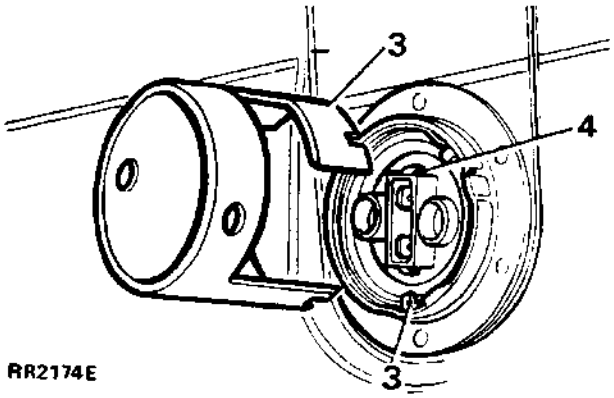
Service repair no - 88.25.32

Remove and refit

Remove

Service tool-RO 600964 Locking wrench.

1. Disconnect the battery negative lead.
2. Remove fuel tank. ***See FUEL SYSTEM, Repair, fuel tank - pre 1991***
3. Release tank unit locking ring, using service tool RO 600964.
4. Remove gauge unit and sealing washer.



RR2174E

Refit

5. Coat mating faces with Bostik 772 adhesive. Fit a NEW sealing washer. Locate gauge unit ensuring that notch in gauge unit locates with register in tank.
6. Retighten locking ring.
7. Refit fuel tank.

TRAILER SOCKET

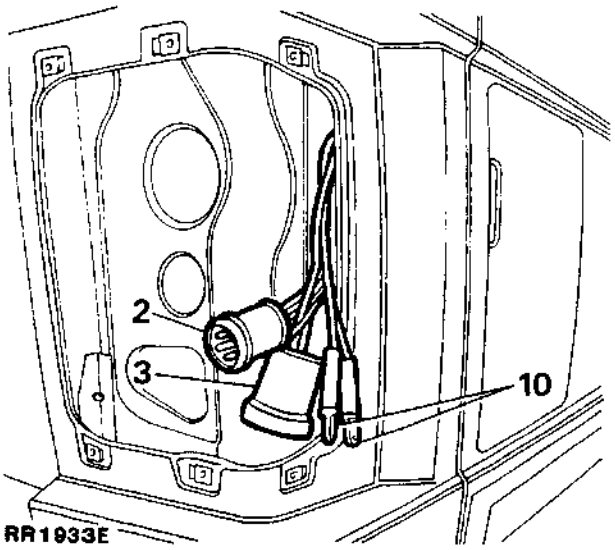
Incorporated in vehicle electrical harness is a facility for fitting a seven pin trailer lighting socket.
Pick-up point is located behind right hand tail lamp cluster assembly.
Pick-up point consists of a seven pin pre-wired plug, a separate auxiliary fused line feed and reverse light lead.

⚠ **CAUTION: Fitting trailer socket and associated wiring MUST be carried out by a qualified vehicle electrician.**

1. Disconnect the battery negative lead.
2. Remove tail lamp. ***See tail lamp assembly***
3. Remove protective cap from trailer pick-up point plug.

△ **NOTE: Cable colours in this plug correspond to main circuit diagram. Red / yellow is unused.**

4. Feed seven core cable Part No. PRC4143 (fitted with a pre-wired plug to one end-suitable for connection to pick-up point) down between inner and outer body panels through rear light opening.



5. Feed cable alongside existing rear lighting harness.
6. Pull cable through opening between chassis side member and fuel tank.
7. Fit two retaining clips to cable and secure it to rear end cross member.
8. Connect electrical leads to vehicle trailer socket. (Refer to current trailer wiring regulations).
9. Secure trailer socket to tow bar.
10. Two extra leads in rear light opening provide a line feed and reverse light feed.

Electrical lead identification

Single leads - item 10, RR1933E.

Pink - Fused auxiliary line feed.
Green/Brown - Reverse light feed.

Pre-wired cable and plug - Part No. PRC4143

Yellow - Left indicator.
Green - Right indicator.
Red/Yellow - Unused.
White - Ground.
Brown - Right-hand tail lights.
Black - Left-hand tail lights.
Red - Stop lamps.

11. Refit tail lamp.
12. Reconnect battery.

AUDIBLE WARNING UNIT - USA

Service repair no - 86.55.13

Remove and refit

Audible warning unit will sound with varying notes to warn driver of following conditions:

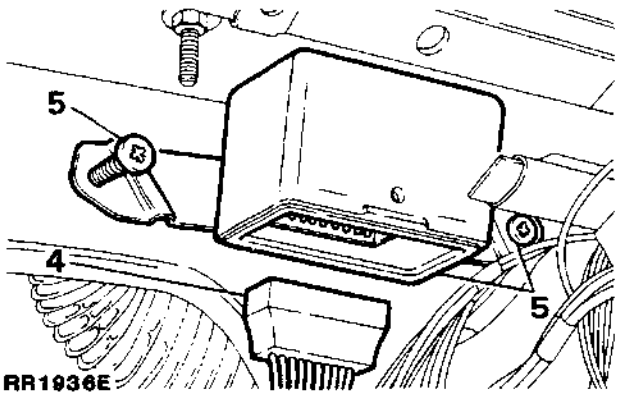
(a) Intermittent high and low notes for a period of 4 to 8 seconds:
- key in ignition position 'II' AND driver's seat belt unfastened.

(b) Interrupted low note:
- driver's door open with key in switch but not in ignition position.

(c) Constant high note:
- ignition switched on with transfer gearbox lever in neutral.

Remove

1. Disconnect the battery negative lead.
2. Remove steering column shroud. ***See steering column shroud***
3. Remove lower dash panel. ***See CHASSIS AND BODY, Repair, lower dash panel***
4. Disconnect multi-plug.
5. Remove two securing screws, remove audible warning unit.



Refit

6. Reverse removal procedure.

LOW OIL LEVEL SENSOR UNIT - USA

Service repair no - 12.60.54

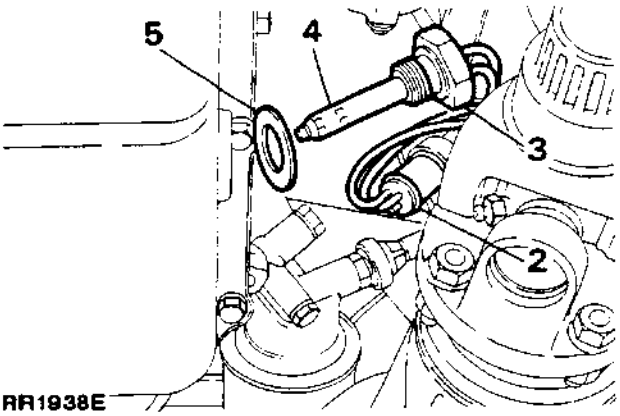
Remove and refit

The low oil level sensor unit is fitted into right hand side of engine sump.

Remove

△ **NOTE: Ensure oil level is below sensor before removal.**

1. Disconnect the battery negative lead.
2. Disconnect wiring connector.



3. Remove securing nut.
4. Remove sensor unit.

Refit

5. Fit new sealing washer.
6. Reverse removal procedure.
7. Top up engine oil level. Run engine and check for leaks around sensor unit.

LOW OIL LEVEL WARNING LOGIC UNIT - USA

Service repair no - 86.55.64

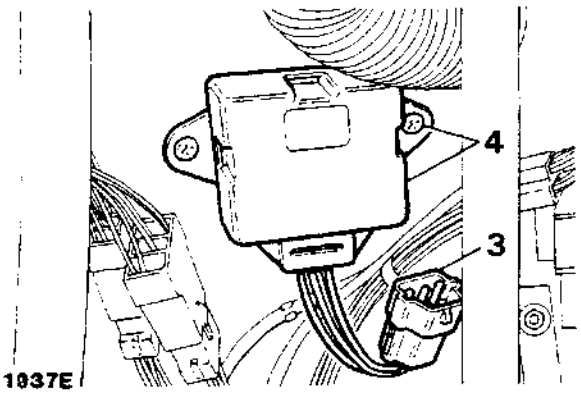
Remove and refit

When ignition is switched **'ON'** warning lamp in binnacle will flash for 10 to 20 seconds if low oil level is detected. Warning will not be repeated until ignition is again switched **'ON'.**

If ignition is switched **'ON'** within 15 to 30 seconds of preceeding sequence, warning lamp will not operate.

Remove

1. Disconnect the battery negative lead.
2. Remove lower dash panel. ***See CHASSIS AND BODY, Repair, lower dash panel***
3. Disconnect wiring at multi-plug.
4. Remove securing screws, remove logic control unit.



Refit

5. Reverse removal procedure.

FRONT SEAT - MOTORS

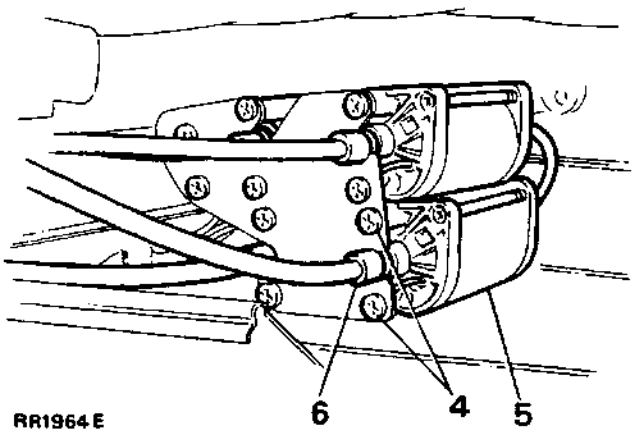
Service repair no - 86.75.06

Remove and refit

Remove

Four electric motors, mounted beneath each front seat, control fore and aft movement, cushion height front and rear, and angle of recline. Adjustment is possible with either front door open, or with ignition switched **ON.**

1. Position seat to give access to motors.
2. Disconnect the battery negative lead.
3. Remove seat base trim.
4. Remove two securing screws from each side of required motor.



5. Remove motor from mounting.
6. Disconnect drive cables by unscrewing ferrule.
7. Disconnect wires from multi-plug, remove motor.

Refit

8. Reverse removal procedure.
9. Check seat adjustment for correct operation.

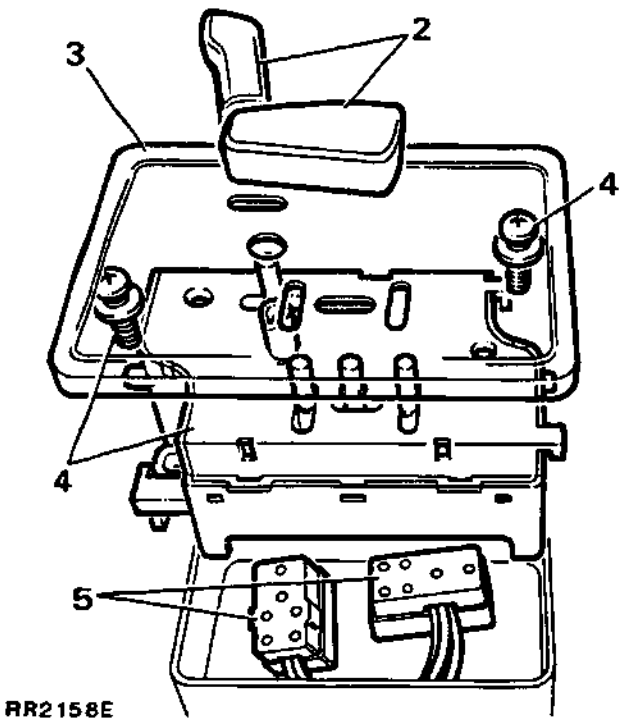
FRONT SEAT - SWITCH

Service repair no - 86.75.03

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pry two finger tip controls from switch housing.
3. Remove switch housing cover by lightly depressing sides of cover to disengage clips. Remove diaphragm fitted to later models.
4. Remove two crosshead screws and washers. Lift switch assembly to gain access to two multi-plugs.
5. Disconnect multiplugs, remove switch assembly.



RR2158E

Refit

6. Reverse removal procedure. 1 to 5.

△ **NOTE: If switch housing removal is required it is necessary to remove seat to gain access to two securing screws.** ***See CHASSIS AND BODY, Repair, front seat electrical.***

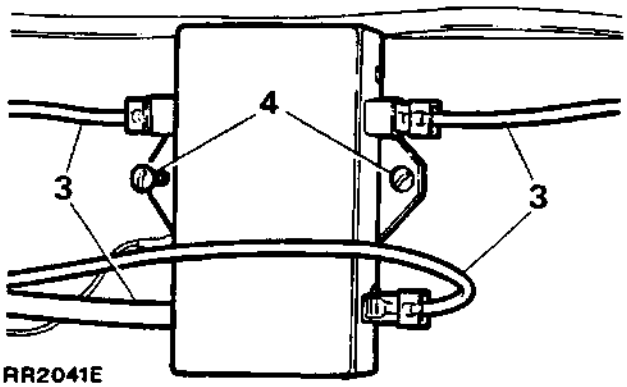
RADIO ANTENNA AMPLIFIER

Service repair no - 86.50.29

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Lower or remove headlining. ***See CHASSIS AND BODY, Repair, Headlining***
3. Remove electrical leads and radio antenna lead.
4. Remove two screws, remove amplifier unit.



RR2041E

Refit

5. Reverse removal procedure.

RELAYS

To identify individual relays. ***See Relays, delay units, timer units, diode pack - 1990 / 91 - identification See Relays, delay units, timer units, diode pack - USA and Canada 1990 / 91 - identification***

For relays 1992 onwards ***See ETM, Z5***

Mounted on engine compartment closure panel.

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove relay protective cover.
3. Pull appropriate relay off its base.

Refit

4. Reverse removal procedure.

Mounted on steering column support bracket

Remove and refit

Remove

1. Remove lower fascia panel. ***See CHASSIS AND BODY, Repair, lower dash panel***
2. Locate appropriate relay on mounting bracket, remove relay from base.

Refit

3. Reverse removal procedure.

Floor mounted beneath front seats

Remove and refit

Remove

1. Position seat to gain access to relay.
2. Disconnect the battery negative lead.
3. Remove relay from base.

Refit

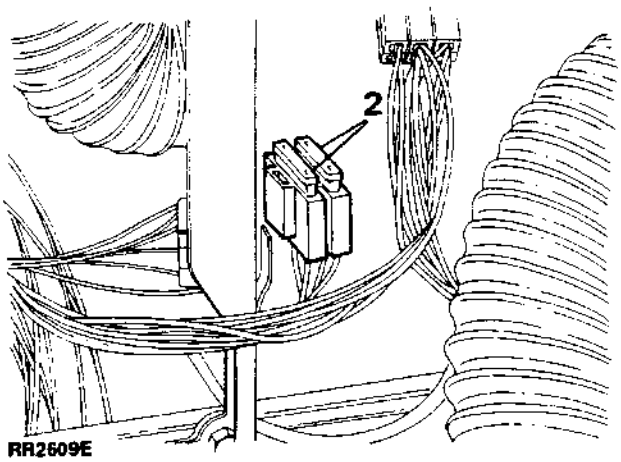
4. Reverse removal procedure.
5. Heated front screen

HEATED FRONT SCREEN

Heated front screen will operate when switch is operated, with engine running. Timer unit will provide a preset time cycle of 7 1/2 minutes ± 20%.

To identify timer unit. ***See Relays, delay units, timer units, diode pack - 1990 / 91 - identification See Relays, delay units, timer units, diode pack - USA and Canada 1990 / 91 - identification.***
Switching OFF ignition, or further operation of heated front screen switch during cycle will switch off screen and cancel, reset and switch off timer unit.

Fuses



RR2609E

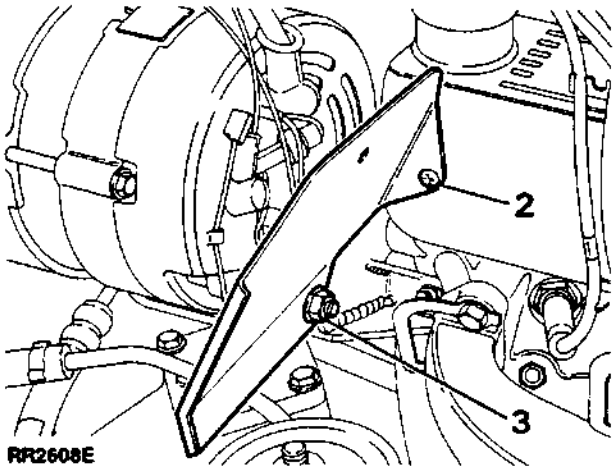
Heated front screen (2) has two 25 amp white, blade type fuses mounted adjacent to the bank of steering column mounted relays.

ALTERNATOR HEAT SHIELD

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove fixing screw to rocker cover.
3. Remove nut from alternator rear mounting bolt. Remove heat shield.



RR2608E

Refit

4. Reverse removal procedure. Check and adjust drive belt tension if required. ***See Alternator drive belts***

HIGH LEVEL STOP LAMP

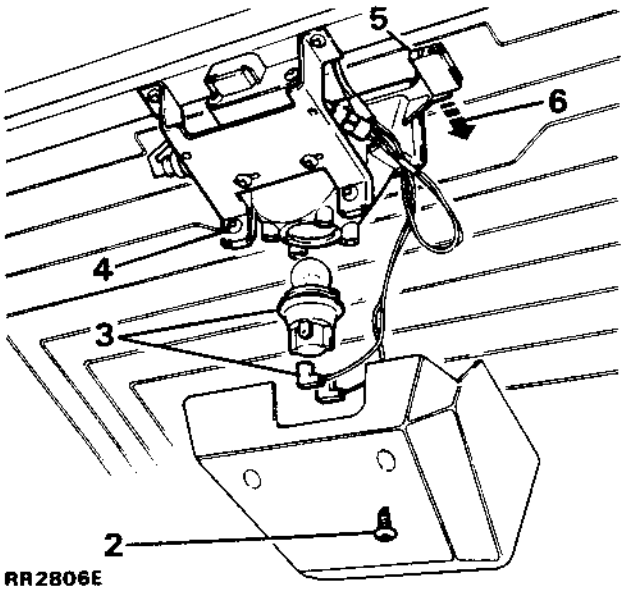
Service repair no - 86.41.35

Includes bulb renewal
Service repair no - 86.41.34

Remove and refit

Remove

1. Disconnect the battery negative lead.



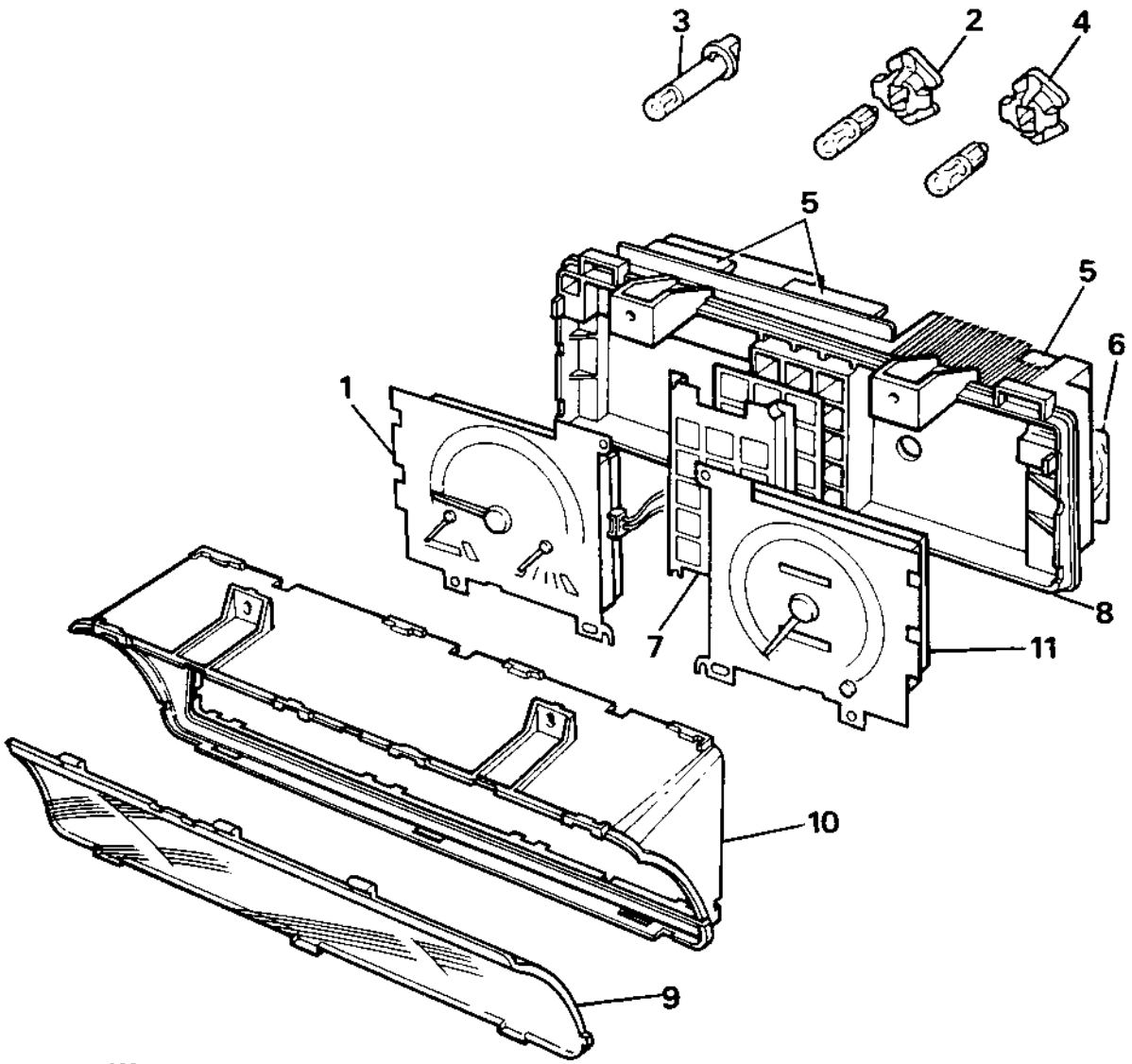
RR2806E

2. Remove two cover retaining screws. Remove cover.
3. Disconnect electrical leads to bulb holder. Remove bulbholder and bulb by twisting anti-clockwise.
4. Remove two screws, mounting plate to stop lamp.
5. Observe position of stop lamp on rear screen. Carefully release tabs on stop lamp from rear screen mountings.
6. Remove stop lamp.

Refit

7. Renew bulb if necessary, correct bulb is a 12V, 21 watt, bayonet type.
8. Reverse removal procedure.

INSTRUMENT BINNACLE

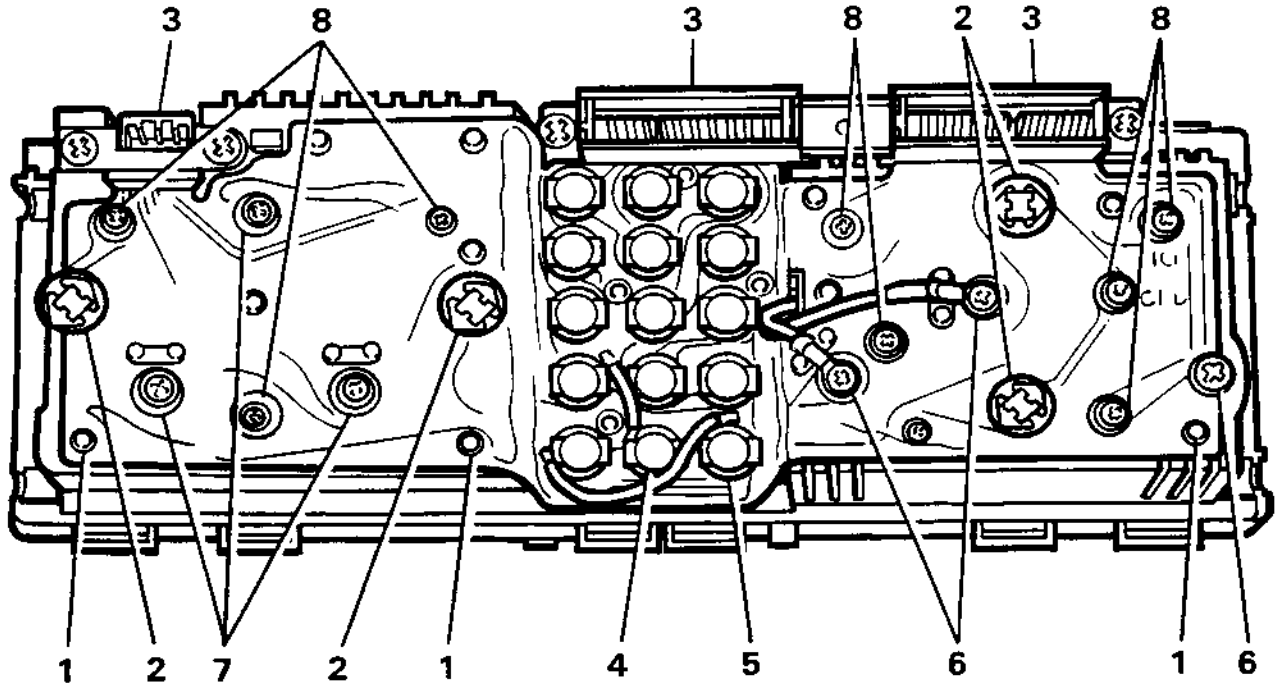


RR2732M

A revised instrument pack was fitted to 1990 model year vehicles. An electronic speedometer is fitted, deleting the requirement for a speedometer cable between speed transducer and speedometer. The instruments are restyled to improve the clarity of graphics.

Instrument pack - RR2732M

1. Tachometer, fuel and temperature gauge.
2. Ignition warning bulb (with separate blue holder unit)
3. Panel illumination bulb and holder.
4. Warning lights bulb and holder.
5. Printed circuit input tags (for harness connection).
6. Printed circuit.
7. Warning light panel.
8. Instrument case (front).
9. Curved lens.
10. Binnacle housing.
11. Speedometer.

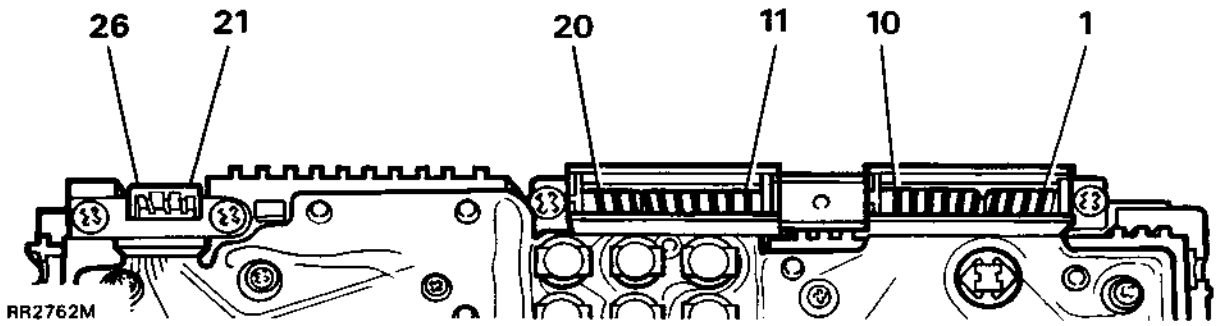


RR2733M

Instrument case back - RR2733M

1. Printed circuit locating pegs.
2. Panel illumination bulbs - 4.
3. Harness connectors.
4. Warning light bulbs.
5. No charge warning light bulb (blue holder).
6. Tachometer/fuel/temperature gauge securing screws - 3.
7. Speedometer securing screws - 3.
8. Printed circuit securing screws 8.

Printed circuit harness connections - RR2762



RR2762M

Connection sequence looking towards BACK of instrument case.

CIRCUIT SERVED

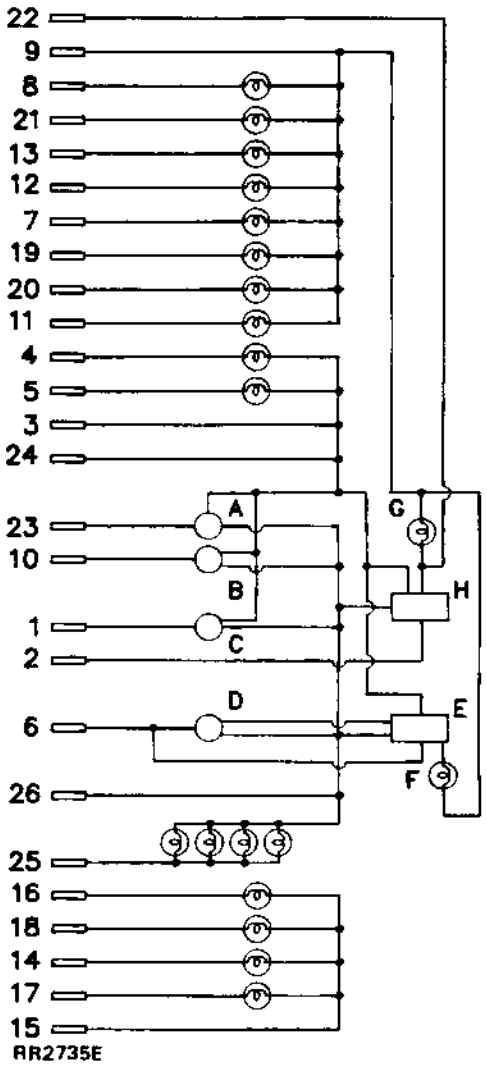
Numbers refer to pin number on instrument pack circuit diagram RR2735M and illustration RR2762M

Coolant temperature 1
Low coolant input 2
Ignition switch 12V+ 3
Ignition warning light 4
Oil pressure warning light 5
Fuel tank unit 6
Transmission oil temperature 7
Cold start warning (diesel) 8
12V+ ignition 9
Tachometer signal 10
Brake fail/handbrake warning light 11
Brake pad wear warning light 12
Low wash fluid 13
Direction indicator - left 14
Zero volts from dimmer 15
Main beam warning light 16
Trailer warning light 17
Direction indicator - right 18
EFI warning light 19
ABS warning light 20
Seat belt warning light 21
Low coolant check 22
Speed signal 23
Photo transistor 24
Panel illumination bulbs (4) 25
Earth -ve 26

Instrument pack

Key

A. Speedometer
B. Tachometer
C. Temperature gauge
D. Fuel gauge
E. Low fuel warning unit
F. Low fuel warning light
G. Low coolant warning light
H. Low coolant warning unit



RR2735E

PANEL AND WARNING LIGHT BULBS

Service repair no - 86.45.31 panel
Service repair no - 86.45.61 warning light

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Unclip cowl from back of instrument binnacle.
3. Rotate appropriate bulb holder anti-clockwise to remove.

△ **NOTE: 'No Charge/Ignition On' warning light, identified by BLUE bulb holder, is a 2 watt capless type.**

4. Fit new bulb. Rotate bulb holder clockwise to lock in position. Correct bulb type is: warning lights, 1.4 watt capless type, panel illumination, 3 watt capless type.
5. Refit cowl.
6. Refit battery negative lead.

△ **NOTE: Difficulty may be experienced in changing bulbs due to limited space. Instrument binnacle fixings may be removed to enable binnacle to be raised as far as connections permit. See 'Instrument Binnacle - remove and refit' below for details of binnacle mounting bracket fixing.**

INSTRUMENT BINNACLE

Service repair no - 88.20.13

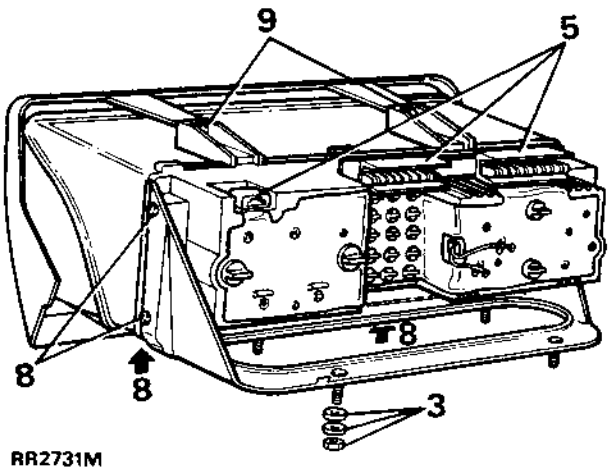
Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove lower fascia by releasing six retaining screws.
3. Remove four nuts, spring and plain washers securiong instrument.
4. Remove binnacle cowl.
5. Disconnect two multi-plugs and single plug.
6. Remove instrument binnacle.

Refit

7. Reverse removal procedure. 1 to 6.



RR2731M

Removing instrument pack

8. Remove binnacle mounting bracket.
9. Remove two screws, remove bezel.
10. Detach curved lens from binnacle housing by depressing four tabs and easing top of lens out, then depressing three tabs and easing lower edge of lens out.
11. Remove instrument case from binnacle housing by releasing upper and lower locating tabs.

Refitting Instrument Pack to Binnacle

12. Reverse removal procedure. 9 to 11.

TACHOMETER, FUEL AND TEMPERATURE GAUGE UNIT
Service repair no - 88.25.17

NOTE: Tachometer, fuel and temperature gauges are replaced as a unit.

13. Remove two panel illumination bulb holders.
14. Remove three larger screws retaining tachometer, fuel and temperature gauges. Note position of black and white leads secured by two screws.
15. Remove unit from instrument case.

Refit

16. Reverse removal procedure. Items 13 to 15.

SPEEDOMETER
Service repair no - 88.30.01

17. Remove two panel illumination bulb holders.
18. Remove three screws securing speedometer.
19. Remove speedometer from instrument case.

Refit

20. Reverse removal procedure. Items 16 to 18.

PRINTED CIRCUIT
Service repair no - 88.20.19

21. Remove Speedometer and Tachometer units as described above. Remove all warning light bulbs. Note position of no charge warning light, blue bulb holder.
22. Remove two harness connectors, retained by four screws release printed circuit tags and input plug.
23. Remove eight screws and plain washers, securing printed circuit.
24. Carefully remove printed circuit from locating pegs.

Refit

25. Reverse removal procedure. Items 21 to 24.

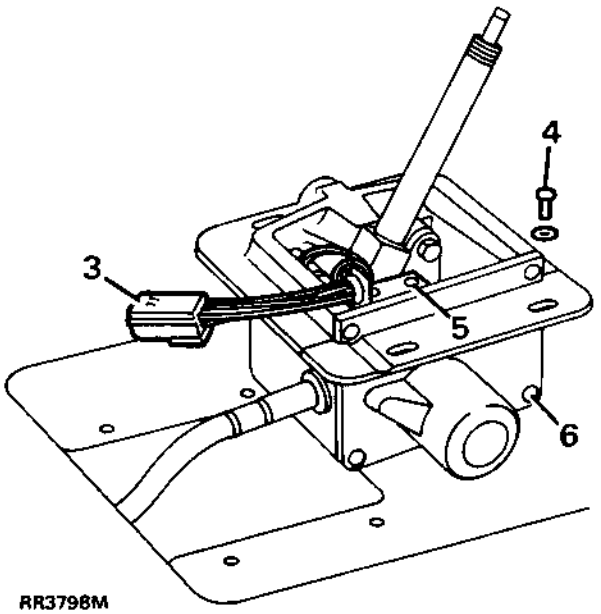
GEAR SELECTOR-INTERLOCK

Interlock solenoid

Remove and refit

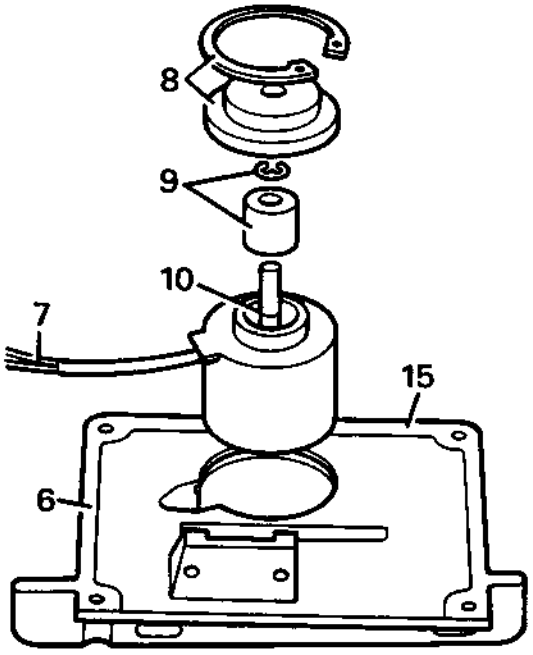
Remove

1. Disconnect the battery negative lead.
2. Remove gear selector head and illumination panel. ***See Automatic gear selector-panel illumination***
3. Disconnect electrical multiplug.



RR3798M

4. Remove screws and lift gear selector mechanism above housing.
5. Remove screws from microswitch support bracket.
6. Remove screws and separate side cover from housing.
7. Disconnect wiring solenoid to multiplug.
8. Remove circlip and retainer plate.
9. Remove clip and centre sleeve.
10. Refit clip into groove on spindle and lever against it to remove solenoid from housing.



RR3800M

Refit

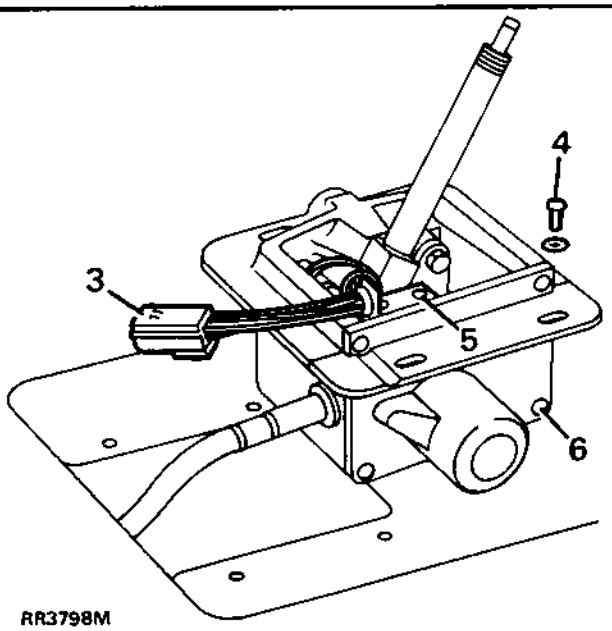
11. Fit solenoid with wiring positioned into side cover recess.
12. Fit sleeve and new clip.
13. Fit retaining plate and circlip.
14. Connect wiring to multiplug.
15. Apply sealant and fit side cover to housing. Use Silcoset 152 sealant or equivalent.
16. Grease all moving parts of gear selector mechanism. Use Rocol E1A or equivalent grease.
17. Reverse instructions 1 to 5.

Interlock microswitch onto castellated plate.

Remove and refit

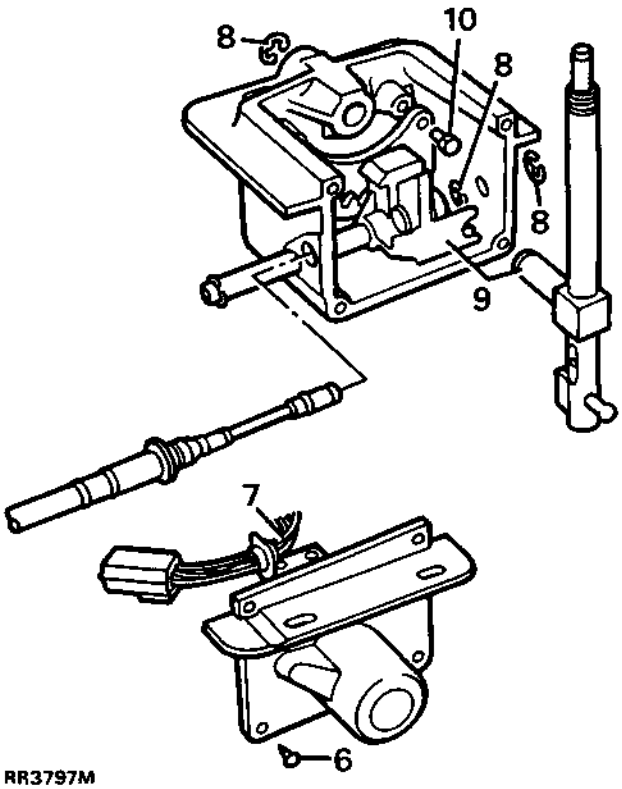
Remove

1. Disconnect the battery negative lead.
2. Remove gear selector head and illumination panel. ***See Automatic gear selector-panel illumination***
3. Disconnect electrical multiplug.



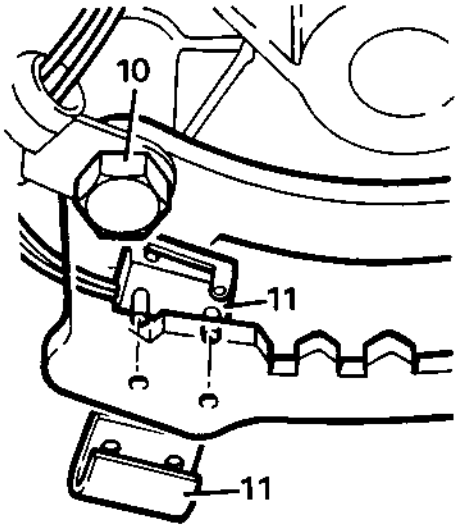
RR3798M

4. Remove screws and lift gear selector mechanism above housing.
5. Remove screws from microswitch support bracket.
6. Remove screws and separate side cover from housing.
7. Disconnect wiring microswitch to multiplug.



RR3797M

8. Remove 3 clips as shown.
9. Slide trunnion forward and remove gear selector arm.



RR3799M

10. Remove bolts securing coxcomb.
11. Remove microswitch retaining clip and microswitch.

Refit

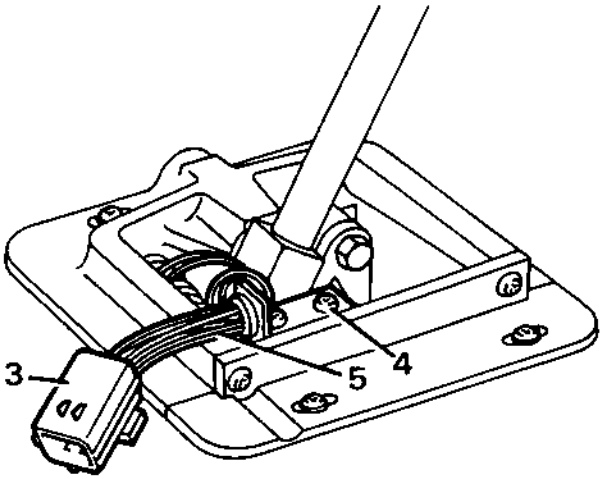
12. Reverse removal procedure. correctly positioning microswitch.
13. Apply Loctite 242E to castellated plate bolts and Tighten to ***9 Nm.***
14. Grease all moving parts of gear selector mechanism. Use Rocol E1A or equivalent grease.
15. Apply Silcoset 152 sealant or equivalent and fit side cover to housing.

Interlock microswitch onto side cover

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove gear selector head and illumination panel. ***See Automatic gear selector-panel illumination***



RR3801M

3. Disconnect electrical multiplug.
4. Remove screws from microswitch support bracket.
5. Disconnect wiring microswitch to multiplug.

Refit

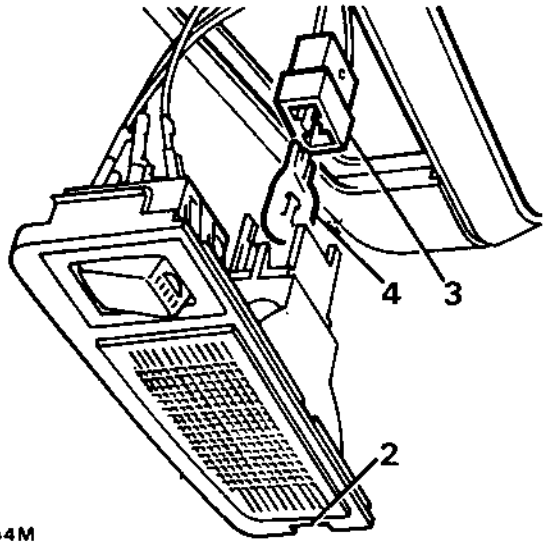
6. Reverse removal procedure. correctly positioning microswitch.
7. Grease all moving parts of gear selector mechanism. Use Rocol E1A or equivalent grease.

MAP LIGHT BULB RENEWAL

Remove and refit

Remove

1. Disconnect the battery negative lead.



RR3644M

2. Pry slot to open cover.
3. Remove bulbholder.
4. Remove bulb from holder.
5. Replace bulb with 12v 5w capless.

Refit

6. Reverse removal procedure.

ELECTRICAL SEAT FAILURE

NOTE: Carry out following procedure if seat failure occurs with seat obscuring fixing bolts.

1. Check 30A fuses and courtesy lamp fuse B2.
2. Disconnect 9 way connector between seat ECU and motors (memory seat). Power motor from a seperate battery source.
3. If partial failure occurs in forward and reverse travel only, change drive cable as required to move seat to desired position.
4. If 2. and 3 is not possible, move seat by driving cables manually.

DRIVE CABLE - ELECTRIC SEAT

Remove and refit

Remove

1. Remove seat. ***See CHASSIS AND BODY, Repair, Front Seat Electrical***
2. Cut cable tie, remove drive cable securing clips.
3. Remove drive cable from gearbox.
4. Remove drive cable from motor by unscrewing ferrule.
5. Cut cable ties from drive cable. Note position for reassembly.
6. Remove drive cable. If cable has failed, 'twist' may have occurred in seat. To rectify this, use a small screwdriver to turn gearbox of failed cable until twist is removed.

Refit

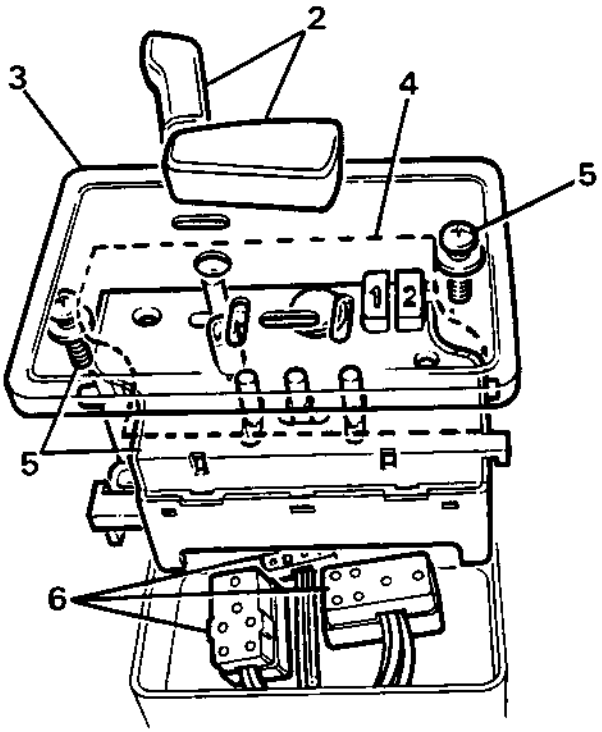
7. Reverse removal procedure. Ensuring new cable ties are fitted in original positions.
8. Operate seats to full extent of travel. To ensure that 'twist' has been removed, check that both gearboxes stop simultaneously.

MEMORY SEAT - SWITCH

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Pry finger tip controls from top of switch housing.



RR3762M

3. Remove switch housing cover by lightly depressing sides of switch housing to disengage clips.
4. Remove sealing diaphragm.
5. Remove switch securing screws, lift switch to gain access to multiplugs.
6. Disconnect multiplugs and remove switch.

Refit

7. Reverse removal procedure. Fitting a new sealing diaphragm.

MEMORY SEAT SWITCH - CLEAN

NOTE: If a seat switch problem is diagnosed, the cause may be liquid spillage or ingress of foreign matter. The switch may be cleaned using the following procedure.

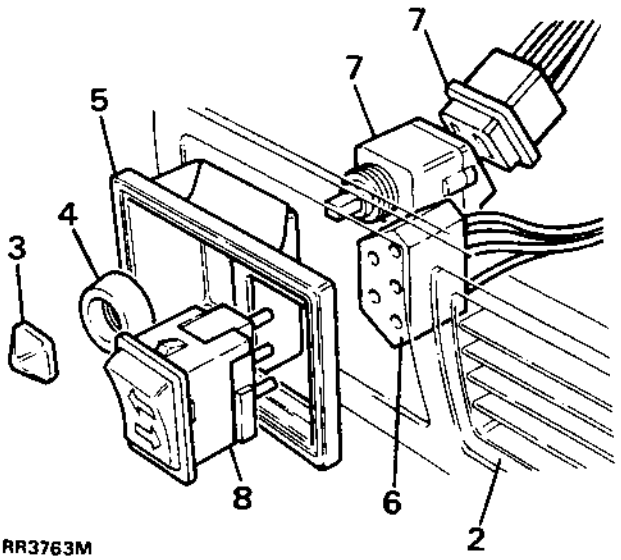
1. Remove seat switch. ***See Memory Seat - Switch***
2. Discard sealing membrane.
3. Clean affected area of switch using a slightly damp clean cloth.
4. If contamination still exists, clean switch using a clean cloth slightly dampened with methylated spirits.
5. Allow switch to dry completely.
6. Refit switch using a new membrane.
7. Check seat switch for satisfactory operation.

EXTERIOR MIRROR SWITCHES - MEMORY TYPE

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove air vent adjacent to switches.
3. Carefully pry button from mirror adjustment switch.



RR3763M

4. Unscrew locking ring from switch.
5. Withdraw switch retaining panel, noting position of adjustment switch in panel retaining clip.
6. Disconnect multiplug at rear of changeover switch, remove panel.
7. Disconnect multiplug to remove mirror adjustment switch.
8. Depress two spring clips and remove change over switch.

Refit

9. Reverse removal procedure. 1 to 8.

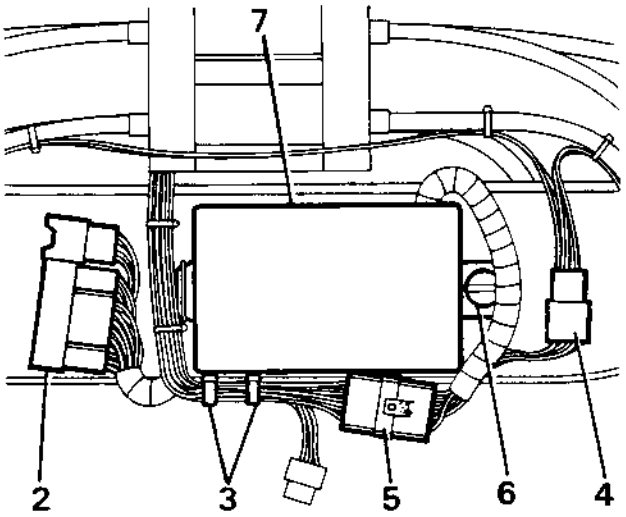
NOTE: The mirror adjustment switch is located on the multiplug connector in the 12 o'clock position. (On non memory mirrors this connector is in the 9 o'clock position).

ECU - MEMORY SEAT

Remove and refit

Remove

1. Remove driver's seat. ***See CHASSIS AND BODY, Repair, Front seat Electrical***
2. Disconnect connector from seat.



RR3761M

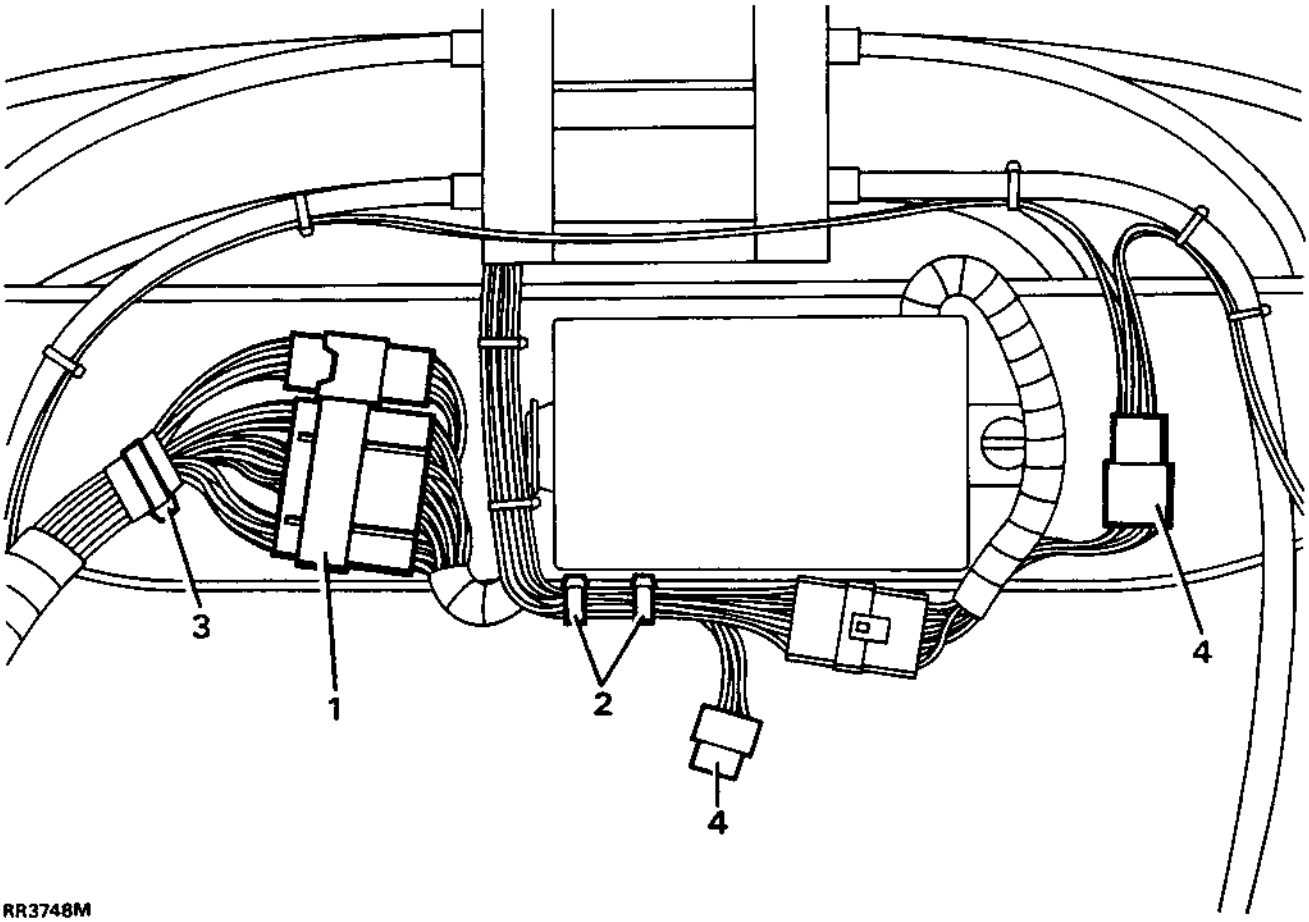
3. Remove cable ties.
4. Disconnect sensor and seat switch multiplug, remove from seat.
5. Disconnect seat motor multiplug.
6. Turn ECU retaining turnbuckle half a turn.
7. Remove ECU.

Refit

8. Reverse removal procedure. Ensuring cable retaining clips are correctly located. ***See Memory Seat - harness layout***
9. Initialise system. ***See Fault diagnosis, Memory Seat / Mirror System Service Check***

MEMORY SEAT - HARNESS LAYOUT

WARNING: To prevent damage to wiring under driver's seat and subsequent failure, the wiring must be installed as shown in RR3748M



RR3748M

1. ECU link harness connector has retaining clip to seat base.
2. Link harness has two cable ties to seat motor harness, one if which is secured to seat base.
3. Main harness has P-clip securing it to seat base.
4. Sensor connector to link harness has retaining clip to seat base.

HANDSET INITIALISATION

NOTE: New handsets are supplied in pairs. If a new handset is required, it will require initialisation to the ECU using the following procuedure:

1. Starting conditions: ignition off, doors unlocked, bonnet switch depressed.
2. Carry out instructions 3. to 9. within 8 seconds.
3. Switch ignition ON.
4. Switch ignition OFF.
5. Lock doors.
6. Unlock doors.
7. Release bonnet switch.
8. Switch ignition ON.
9. Switch ignition OFF.

If alarm is correctly accessed, horn will sound and LED will light. It is now possible to programme two handsets of correct frequency to vehicle alarm ECU. This must be carried out within two minutes.

10. Press and hold down button on first handset until dash LED flashes.
11. Repeat instruction 10. for second handset.
12. The LED will extinguish if both handsets have been initialised correctly.

HANDSET BATTERIES

Replace

1. Gently prise handset apart using a coin or small flat bladed screwdriver.
2. Hold the board in one hand, cup other hand, clap hands together to jar batteries from clip.
3. Leave batteries out, operate handset by pressing button for 10 seconds to allow integrated circuit to reset itself.

CAUTION: Handle new batteries as little as possible. Hands should be clean, dry and free from grease.

4. Fit new batteries in clip, positive side uppermost.
5. Clip handset case together.

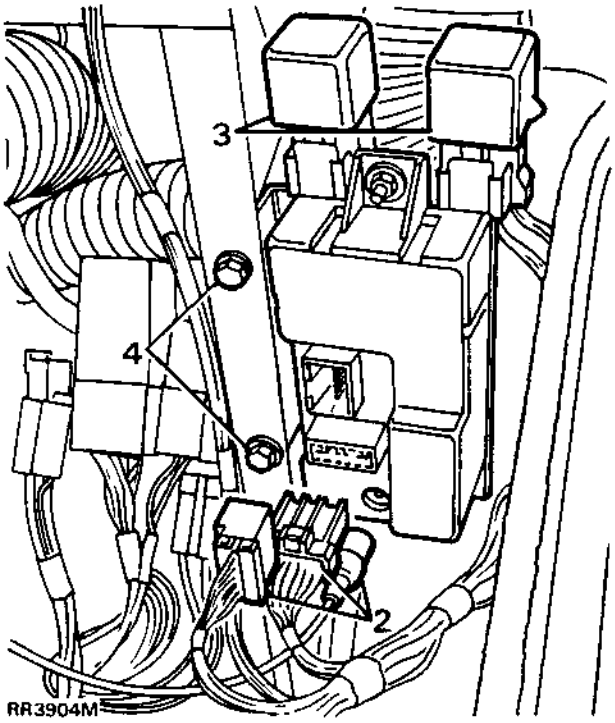
ALARM ECU

Service repair no - 86.77.01

Remove and refit

Remove

1. Remove lower dash panel, ***See CHASSIS AND BODY, Repair, lower dash panel***
2. Remove multiplugs and aerial lead from ECU.



3. Remove relays and bases from bracket.
4. Remove ECU bracket fixings.
5. Remove ECU with bracket.

Refit

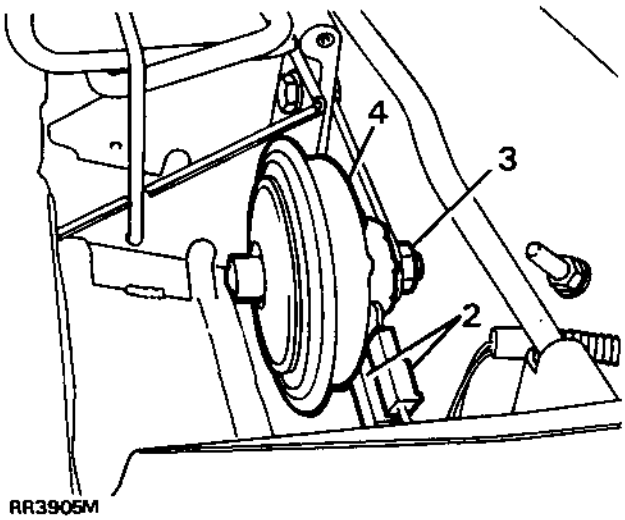
6. Reverse removal procedure. Ensure aerial and multiplugs are fitted securely to ensure alarm functions correctly.

ALARM HORN

Remove and refit

Remove

1. Remove decker panel, ***See CHASSIS AND BODY, Repair, decker panel***



2. Disconnect two Lucar connectors.
3. Remove single nut securing horn.
4. Remove horn.

Refit

5. Reverse removal procedure.

SUBWOOFER BOX

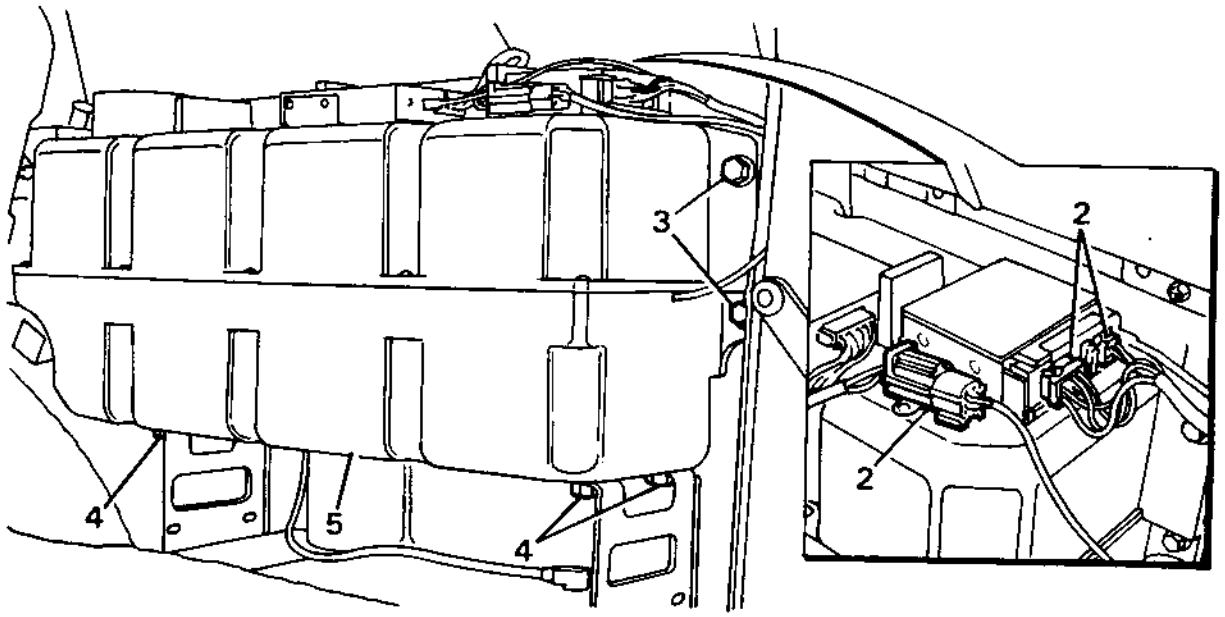
Remove and refit

Remove

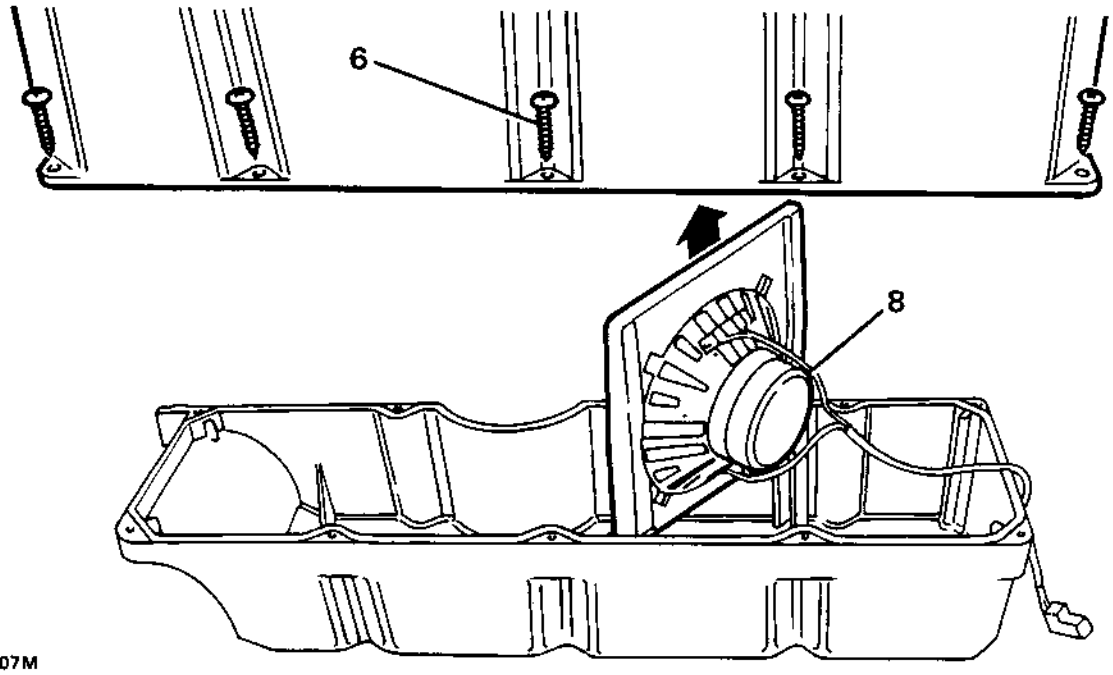
1. Disconnect the battery negative lead.
2. Disconnect electrical leads.
3. Remove four bolts from upper fixing.
4. Remove four bolts from lower fixing.
5. Remove subwoofer box from vehicle.
6. Remove ten screws securing two halves of subwoofer.
7. Remove top half of unit.
8. Remove subwoofer speaker.

Refit

9. Reverse removal procedure.



RR3906M



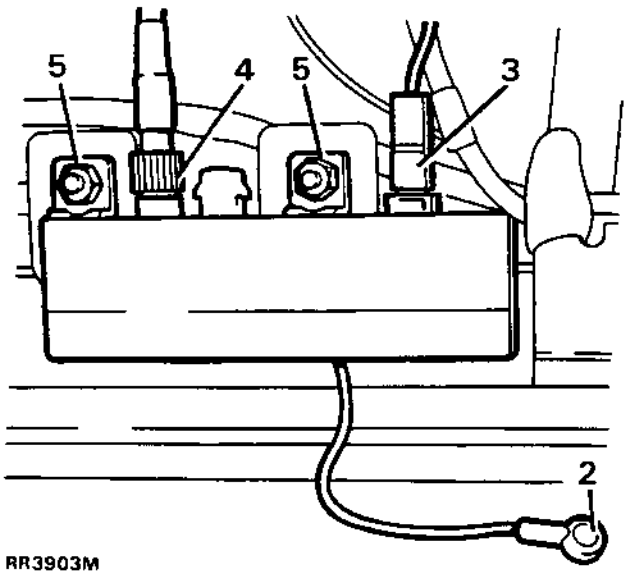
RR3907M

ANTENNA AMPLIFIER

Remove and refit

Remove

1. Remove headlining sufficiently to gain access to signal amplifier. ***See CHASSIS AND BODY, Repair, headlining***
2. Remove 'RF in' lead from antenna.



RR3903M

3. Remove '+ VE' lead from amplifier.
4. Unscrew 'RF out' lead, disconnect.
5. Remove two securing nuts.
6. Remove amplifier.

Refit

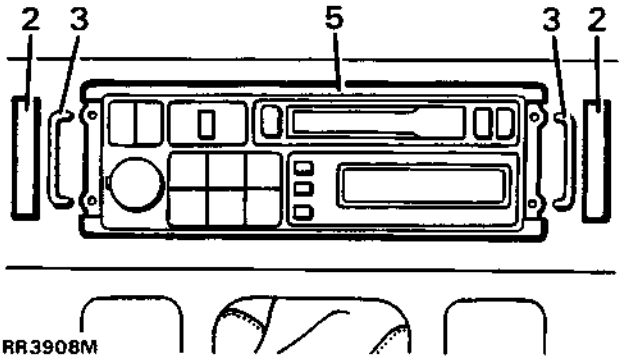
7. Reverse removal procedure. To ensure 'RF out' lead is correctly located, hold centre lead down in position while tightening knurled nut.

RADIO

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove access covers from radio.



RR3908M

3. Insert suitable radio removal tools e.g. SMD 4091 into access holes.
4. Press removal tools to release radio.
5. Remove radio, disconnect aerial and multiplugs from rear of radio.

Refit

6. Reverse radio code.
7. Reactivate radio code.

ALTERNATOR - MAGNETTI MARELLI - TYPE A133/80

Service repair no - 86.10.08

Overhaul

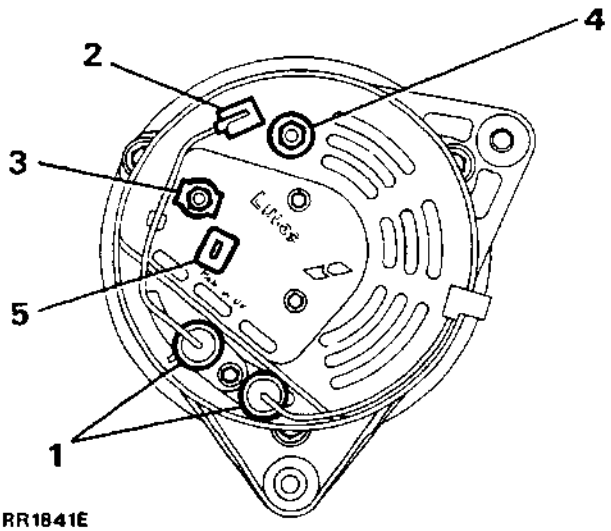
Including Test (Bench)

NOTE: Alternator charging circuit ignition warning light is connected in series with alternator field circuit. Bulb failure would prevent alternator charging, except at very high engine speeds. Therefore, bulb MUST be checked before suspecting alternator failure.

Precautions

Battery polarity is **NEGATIVE GROUND**, which must be maintained at all times.
No separate control unit is fitted; instead a voltage regulator of micro-circuit construction is incorporated on slip ring end bracket, inside alternator cover.
Battery voltage is applied to alternator output cable even when ignition is switched off, battery must be disconnected before commencing any work on alternator. Disconnect battery when repairing body structure using electric welding equipment.

Sequence of connections



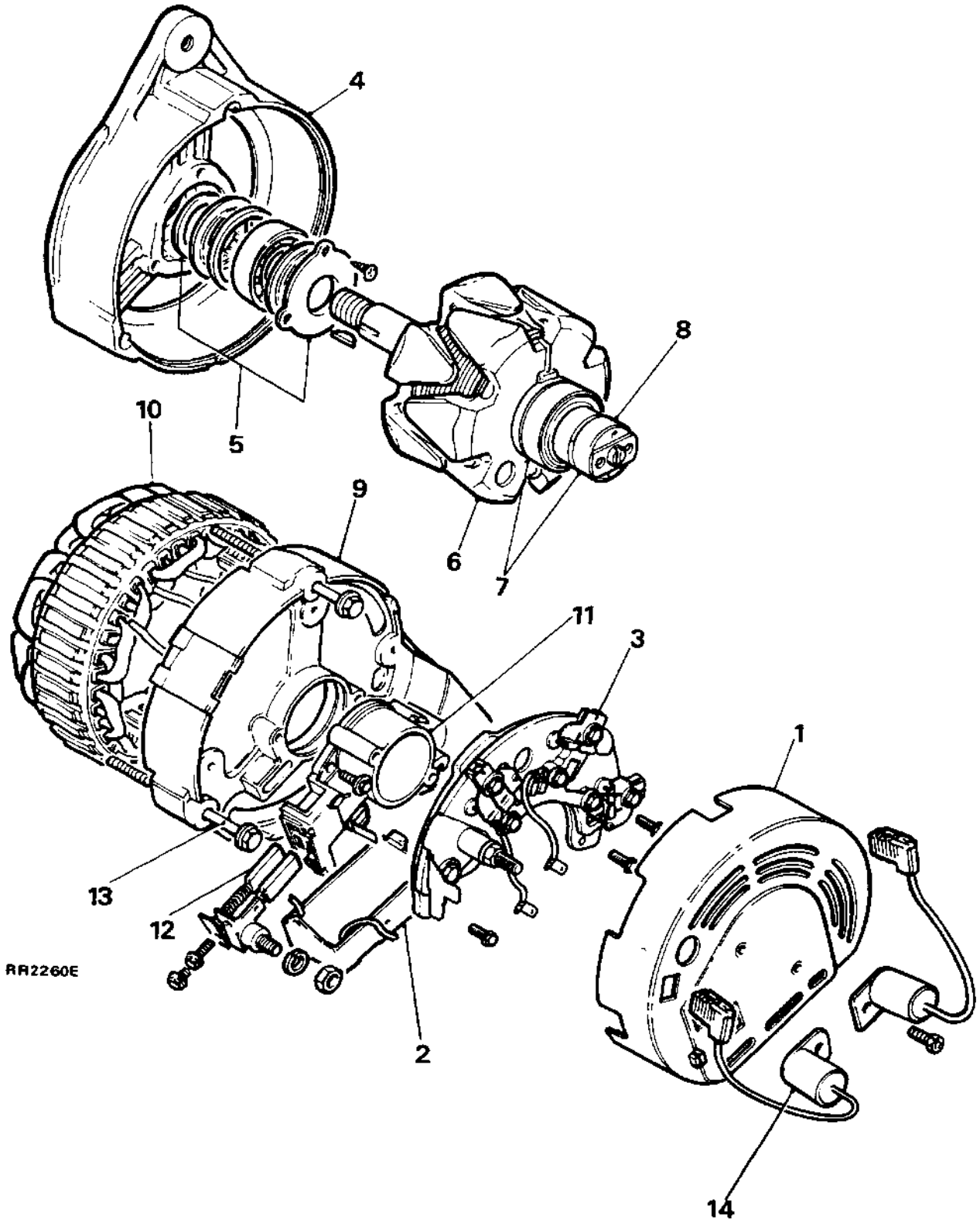
RR1841E

1. Suppression capacitors (two)
2. Positive suppression terminal
3. IND terminal
4. + output terminal
5. Sensing terminal

ALTERNATOR - MAGNETTI MARELLI - TYPE A133/80 - RR2260E

1. Cover
2. Regulator
3. Rectifier
4. Drive end bracket
5. Bearing assembly
6. Rotor
7. Slip ring end bearing
8. Slip rings
9. Slip ring end bracket
10. Stator
11. Brush box
12. Brushes
13. Through bolts (three)
14. Suppressors

ALTERNATOR - A133/80



ALTERNATOR TESTING

Service repair no - 86.10.01

Charging system check

1. Check battery is in good condition, with an open circuit voltage of at least 12.6 V. Recharge or substitute battery to carry out test.
2. Check drive belt adjustment and condition, ***See SECTION 10, Maintenance, Under Bonnet Maintenance***
3. Check battery connections are clean and tight.
4. Check alternator connections are clean and tight.
5. Ensure there is no drain on battery from, for example, interior, under bonnet or door edge lamps.

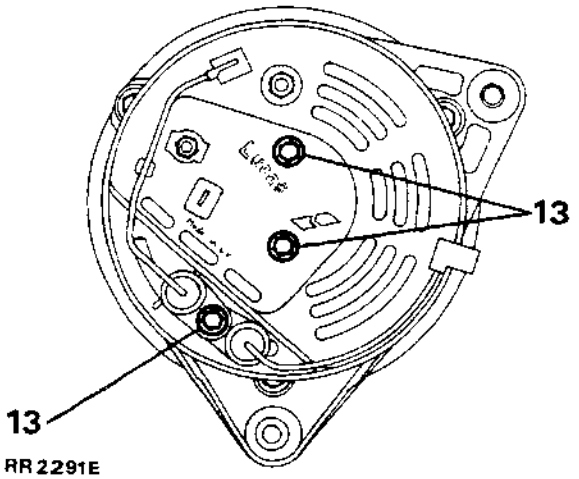
Alternator test

Following instructions refer to use of suitable test equipment using a carbon pile rheostat.

6. Connect test equipment referring to manufacturer's instructions.
7. Start engine and run at 3000 rev/min without accessory load.
8. Rotate carbon pile load control to achieve greatest output (amps) without allowing voltage to fall below 12.0 V. A reading in amps, of alternator output, minus 10% to allow for EFI and Ignition loss, should be obtained.
9. Run engine at 3000 rev/min, switch selector to regulator test, read voltmeter. A reading of 13.6 to 14.4 V should be obtained.
10. Switch selector to diode/stator test, switch on headlamps to load alternator. Raise engine speed to 3000 rev/min, read voltmeter, needle must be within 'OK' range.

TESTING-ALTERNATOR REMOVED

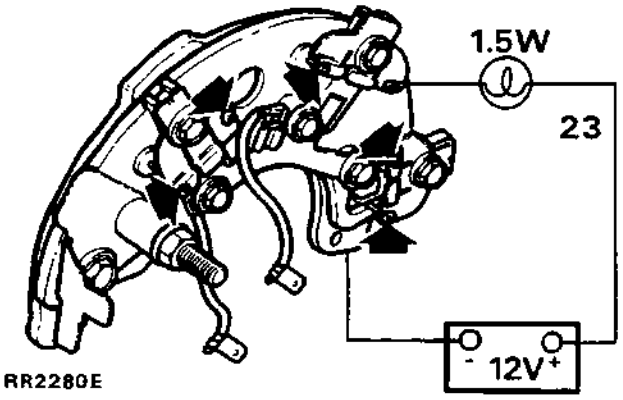
11. Withdraw connectors from alternator.
12. Remove alternator. ***See Repair, alternator***
13. Disconnect suppressor and remove alternator cover.



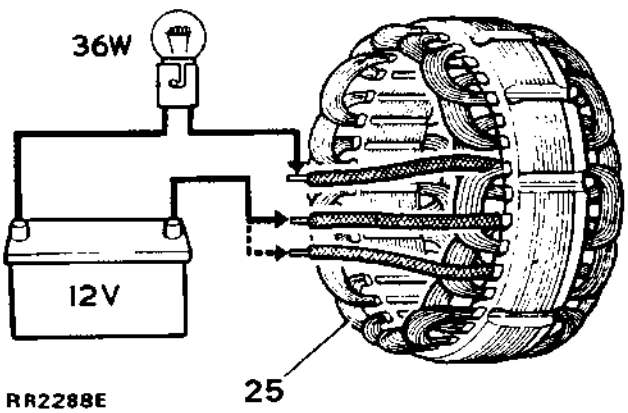
RR2291E

14. Disconnect lead and remove rectifier assembly.
15. Note arrangement of brush box connections. Remove screws securing regulator to brush box and withdraw.
16. Remove screw retaining outer brush box in position and withdraw both brushes.
17. Check brushes for wear by measuring length of brush protruding beyond brush box moulding. Fit new brushes if length is 10mm or less.
18. Check brushes move freely in holders. If sticking, clean with a mineral spirit moistened cloth or polish sides of brush with fine file.
19. Check brush spring pressure using push-type spring gauge. Gauge should register 136 to 279g when brush is pulled back until face is flush with housing. Fit new brush assembly if reading is outside these limits, .
20. Remove two screws securing brush box to slip ring end bracket and lift off brush box assembly.
21. Securely clamp alternator in a vice. Release stator win ding cable ends from rectifier by applying a hot soldering iron to terminal tags of the rectifier. Pry out cable ends when solder melts.

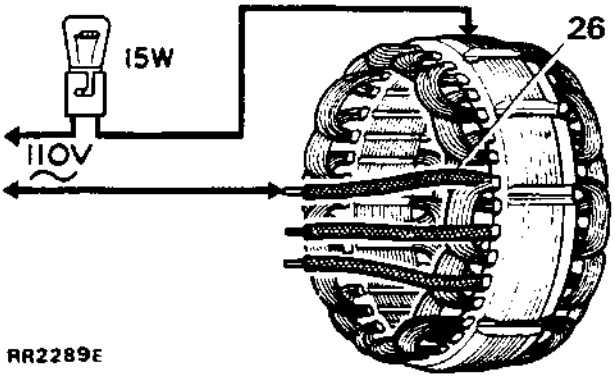
22. Remove two remaining screws securing rectifier assembly to slip ring end bracket and lift off rectifier assembly. Further dismantling of rectifier is not required.
23. Check diodes. Connect test equipment as shown and test each diode in turn, note whether lamp lights, then reverse test lead connections. The lamp should light in one direction only. Renew rectifier assembly if a faulty diode is diagnosed.



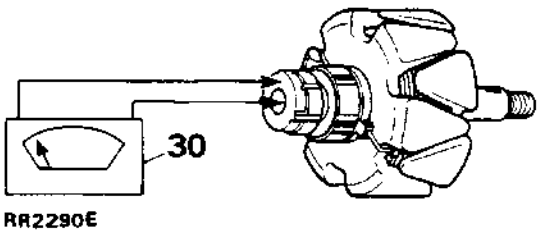
24. Remove slip ring end bracket bolts, remove bracket.
25. Connect a 12 volt battery and a 36 watt test lamp to two stator connections. Repeat test replacing one of two stator connections with the third. If test lamp fails to light in either test, fit a new stator.



26. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between any one of three stator connections and stator laminations. If test lamp lights, fit a new stator.



27. Clean surfaces of slip rings using a solvent moistened cloth.
28. Inspect slip ring surfaces for signs of burning, remove burn marks using very fine sandpaper. On no account should emery cloth or similar abrasives be used, or any attempt made to machine the slip rings.
29. Note position of stator output leads in relation to alternator fixing lugs, and lift stator from drive end bracket.
30. Connect ohmmeter to slip rings. A reading of 2.6 ohms should be obtained.



31. Using a 110 volt a.c. supply and a 15 watt test lamp, test for insulation between one slip ring and one rotor pole. Fit a new rotor if test lamp lights.

32. To separate drive end bracket and rotor, remove shaft nut, washers, woodruff key and spacers from shaft.
33. Remove bearing retaining plate by removing three screws. Using a press, drive rotor shaft from drive end bearing.
34. If necessary, to remove slip rings or slip ring end bearing on rotor shaft, unsolder outer slip ring connection and gently pry slip ring off shaft, repeat procedure for inner slip ring connection. Using a suitable extraction tool, withdraw slip ring bearing from shaft.

Reassemble

35. Reverse dismantling procedure, noting following points.

    (a) Use Shell Alvania 'RA' to lubricate bearings.
    (b) When refitting slip ring end bearing, ensure it is fitted with open side facing rotor.
    (c) Use Fry's H.T.3 solder on slip ring field connections.
    (d) When refitting rotor to drive end bracket, support inner track of bearing. Do not use drive end bracket to support bearing when fitting rotor.
    (e) Tighten through bolts evenly to ***5 Nm.***
    (f) Fit brushes into housings before fitting brush moulding.
    (g) Tighten shaft nut to ***40 Nm.***
    (h) Refit regulator pack to brush moulding.

36. Reconnect leads between regulator, brush box and rectifier.
37. Refit alternator.

DISTRIBUTOR-LUCAS 35DLM8

Overhaul

DISTRIBUTOR CAP

Service repair no - 86.35.10

1. Unclip and remove cap
2. Fit a new cap if faulty.
3. Clean cap and HT brush with a lint free cloth.

ROTOR ARM

Service repair no - 86.35.16

4. Pull rotor arm from shaft.
5. Fit a new rotor arm if faulty.

INSULATION COVER (FLASH SHIELD)

Service repair no - 86.35.40

6. Remove cover secured by three screws.
7. Fit a new cover if faulty.

VACUUM UNIT

Service repair no - 86.35.21

8. Remove two screws from vacuum unit securing bracket. Disengage vacuum unit connecting rod from pick-up base plate connecting peg. Withdraw vacuum unit from distributor body.

AMPLIFIER MODULE

Service repair no - 86.35.30

9. Remove two screws and withdraw module.
10. Remove gasket.
11. Remove two screws and cast heatsink.

WARNING: Amplifier module is a sealed unit containing Beryllia. This substance is extremely dangerous if handled. DO NOT attempt to open or crush module.

PICK-UP AND BASE PLATE ASSEMBLY

Service repair no - 86.35.42

12. Use circlip pliers to remove circlip retaining reluctor on rotor shaft.
13. Remove flat washer, and 'O' ring recessed in top of reluctor.
14. Gently withdraw reluctor from shaft, taking care not to damage teeth.

NOTE: Coupling ring fitted beneath reluctor.

15. Remove three support pillars and cable grommet. Lift out pick-up and base plate assembly.

NOTE: Do not disturb two barrel nuts securing pick-up module, otherwise air gap will need re-adjustment.

16. Fit a new pick-up and base plate assembly if module is known to be faulty, otherwise check pick-up winding resistance (2k-5k ohm).

Reassemble

17. This is mainly a reversal of dismantling procedure, noting following points:

LUBRICATION

Apply clean engine oil:

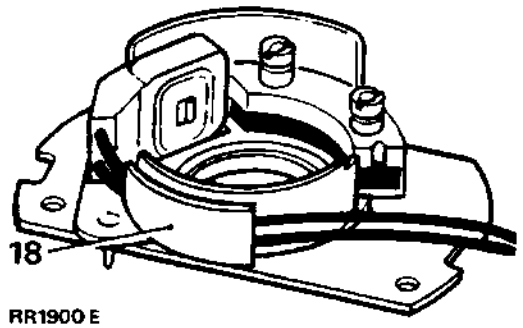
a. A spot into rotor spindle before fitting rotor arm.

Apply Omnilube 2 (or equivalent) grease.

b. Auto advance mechanism.
c. Pick-up plate centre bearing.
d. Pre tilt spring and its rubbing area (pick-up and base plate assembly).
e. Vacuum unit connecting peg (pick-up and base plate assembly).
f. Connecting peg hole in vacuum unit connecting rod.

Fitting pick-up and base plate assembly

18. Pick-up leads must be prevented from fouling rotating reluctor. Both leads should be located in plastic guide as illustrated. Check during re-assembly.



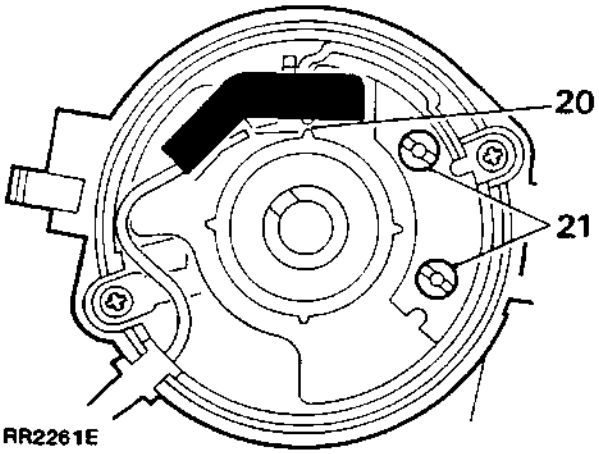
RR1900E

Fitting reluctor

19. Slide reluctor as far as it will go on rotor shaft, rotate reluctor until it engages with coupling ring beneath pick-up base plate. Distributor shaft, coupling ring and reluctor are 'keyed' and rotate together. Fit 'O' ring, flat washer and retaining circlip.

Pick-up air gap adjustment

20. Air gap between pick-up limb and reluctor teeth must be set within specified limits, using a non-ferrous feeler gauge.



RR2261E

21. If adjustment is necessary, slacken two barrel nuts to set the air gap. ***See ENGINE TUNING DATA, Information, Engine Tuning Data***

△ **NOTE: When original pick-up and base plate assembly has been refitted, air gap should be checked, and adjusted if necessary.**

When fitting a new assembly air gap will require adjusting to within specified limits.

Amplifier module

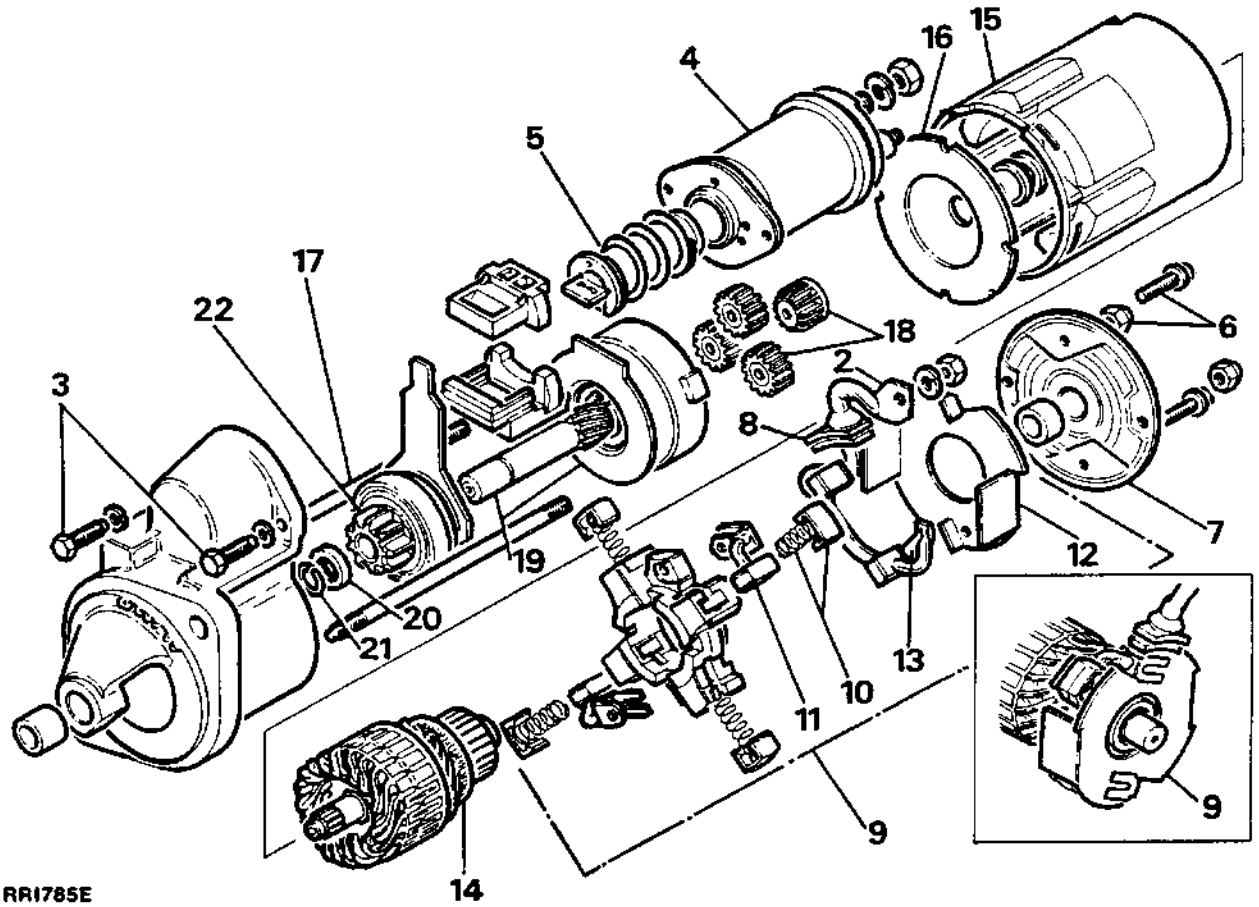
22. Before fitting module, apply MS4 Silicone grease or equivalent heat-conducting compound to amplifier module backplate, seating face on distributor body and both faces of heatsink casting.

STARTER MOTOR-LUCAS M78R

Overhaul

Dismantling

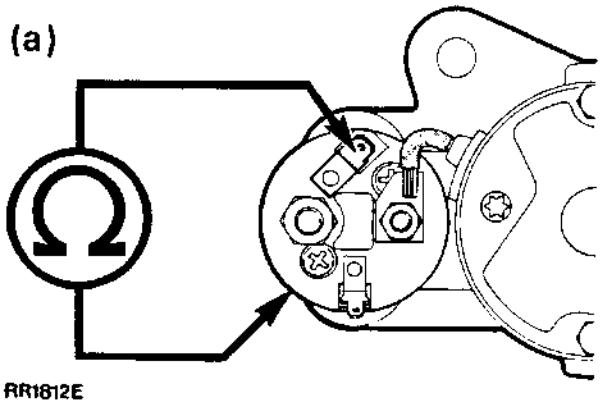
1. Remove starter motor.
2. Remove braid between starter and solenoid terminal.
3. Remove two solenoid fixings.
4. Withdraw solenoid body.
5. Lift and remove solenoid plunger.
6. Remove two nuts and two screws from commutator end bracket.
7. Remove commutator end bracket.
8. Remove grommet from yoke.
9. Lift brushbox assembly clear of armature.
10. Remove brush springs.
11. Unclip and remove ground brushes.
12. Remove insulating plate.
13. Withdraw brushes and bus bar.
14. Remove armature from yoke.
15. Remove yoke.
16. Remove intermediate bracket.
17. Loosen and remove through bolts from drive end bracket.
18. Remove sun and planet gears.
19. Push out drive shaft sprocket assembly from drive end bracket.
20. Carefully tap thrust collar from over jump ring back towards drive.
21. Pry snap ring from locating groove.
22. Remove drive assembly from drive shaft.



Inspecting

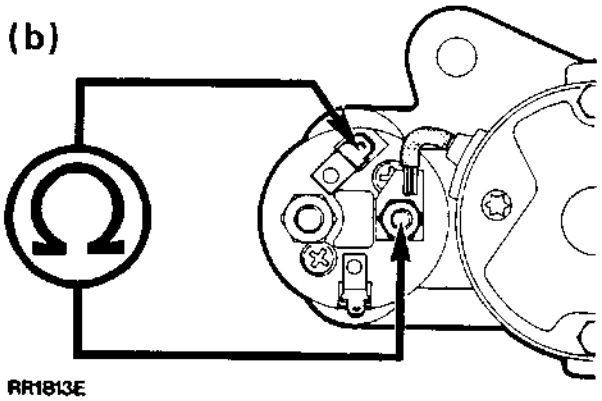
Solenoid

23. Check continuity and resistance value of windings by connecting an ohmmeter as shown.



RR1812E

(a) Resistance value should be: 1.074 ± 0.035 ohms

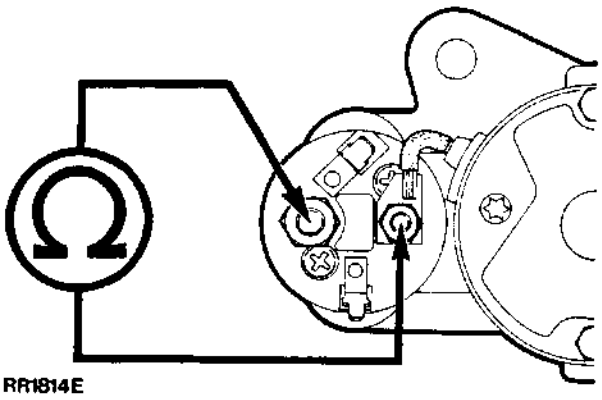


RR1813E

(b) Resistance value should be: 0.298 ± 0.015 ohms

Incorrect results: replace solenoid.
Correct results: proceed to 24.

24. Check contacts by connecting an ohmmeter as shown. Solenoid plunger removed, ohmmeter should read infinity.



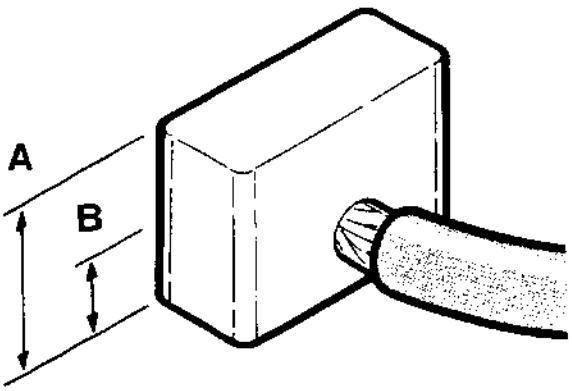
RR1814E

Solenoid plunger operated by hand, ohmmeter should read zero. Incorrect results: replace solenoid. Correct results: proceed to 25.

25. Check operation of spring for freedom of movement.

Brush gear

26. Check brush springs and ensure brushes move freely in holders. Clean brushes with a solvent moistened cloth, if required.

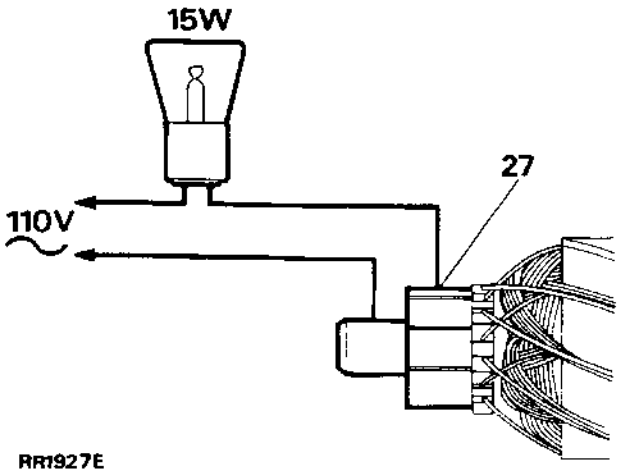


RR1815E

Brush length new, Dimension A is 9 mm.
Minimum brush length, Dimension B is 3.5 mm.

Armature

27. Check armature insulation. The method illustrated uses a 110V, 15W test lamp. Connect tester between any one commutator segment and shaft. If lamp illuminates armature is faulty, and a replacement component is required.



RR1927E

28. If necessary, the commutator may be machined, providing a finished surface can be obtained without reducing diameter below 28.8 mm. Otherwise a new commutator must be fitted. Finish surface with fine emery cloth. Do not undercut insulation slots.

Drive assembly

29. Test roller clutch. Pinion should rotate in one direction only, independent of clutch body. Replace unit if unsatisfactory, or if teeth are damaged or worn.

Bearings

30. Fit new bearing bushes if there is evidence of armature fouling magnets or if there is perceptible side play between shaft and bush.
31. Drive end/intermediate end bracket: press out bush using a suitable press and mandrel.
32. Press new bush in, ensuring that on drive end bracket, bush is flush with casting.
33. Commutator end bracket: thread a 9/16" Whitworth or suitable similar tap firmly into bush. Extract bush with tap using a power press in reverse.

△ **NOTE: Soak new bushes in engine oil for thirty minutes before fitting.**

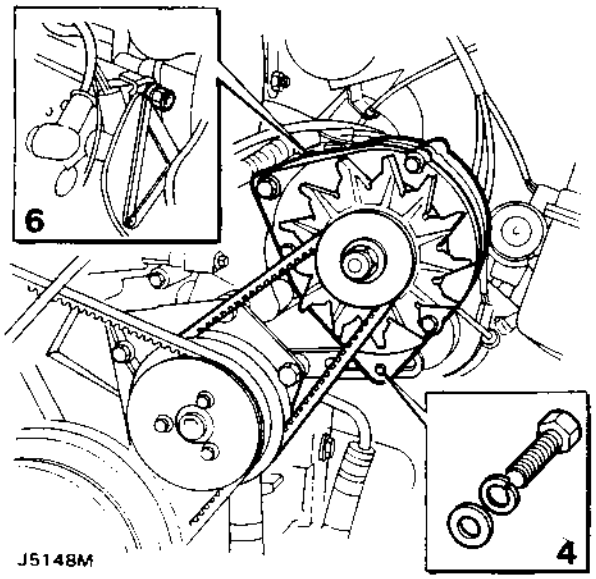
Reassemble

34. Reverse instructions 1 to 22. Smear teeth and operating collar of roller clutch with Shell Retinax 'A' grease. Smear pivot lever of drive assembly with Mobil 22 grease. Smear drive shaft sun and planet gears with Rocol BRB1200 grease.
35. Tighten fixings to correct torque: Starter motor through bolts - ***6.2 Nm.*** *Solenoid screws* - ***6.1 Nm.***

ALTERNATOR - 200 Tdi

Remove

1. Disconnect the battery negative lead.
2. Disconnect the electrical leads from the alternator.
3. Slacken the alternator securing bolts, pivot the alternator inwards and remove the drive belt.
4. Remove the adjustment bolt from under the alternator.
5. Remove the nut from the pivot bolt and detach the heat shield.
6. Support the alternator, withdraw the pivot bolt and detach the alternator from the engine.



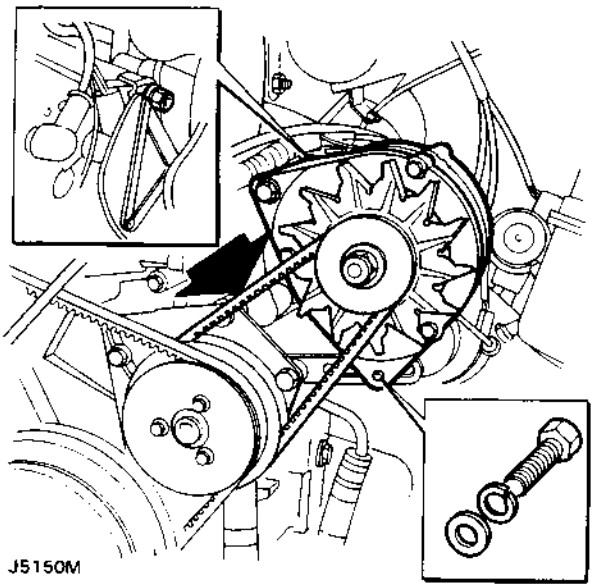
Refit

7. Position the alternator on the engine and insert the pivot bolt.
8. Fit the heat shield and secure with the nut. Do not fully tighten the nut at this stage.
9. Fit the adjustment bolt and the drive belt.
10. Adjust the belt tension and tighten the adjustment and pivot bolts.
11. Connect the electrical leads to the alternator.
12. Reconnect the battery negative lead.

ALTERNATOR DRIVE BELT TENSIONING - Tdi ENGINE

Adjust tension

1. Slacken the alternator pivot and adjustment bolts.
2. Adjust the alternator to give the correct belt tension.



3. Tight the adjustment and pivot bolts.

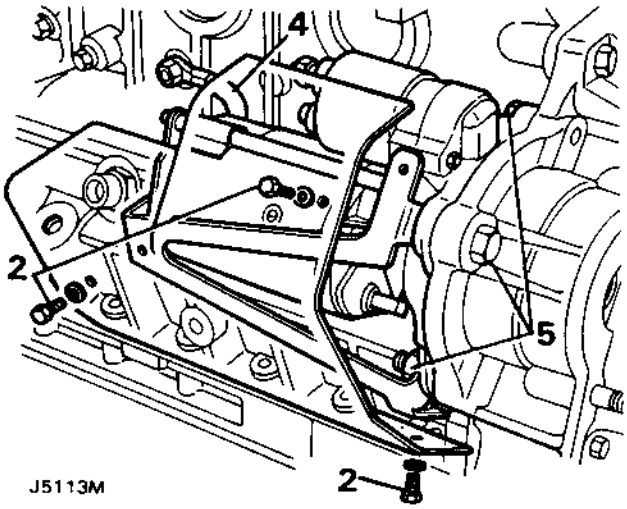
△ **NOTE: If a new drive belt has been fitted, run the engine at fast idle speed for 3 to 5 minutes; then check the tension.**

STARTER MOTOR - Tdi ENGINE

Remove and refit

Remove

1. Disconnect the battery negative lead.
2. Remove the securing bolts and detach the starter motor heat shield.
3. Disconnect electrical leads from the solenoid and detach the plastic tie.
4. Disconnect the earth leads from the starter motor.
5. Remove the securing nuts and bolts and detach the starter motor complete with heat shield mounting bracket.



J5113M

Refit

6. Refit the starter motor to the engine in reverse order to removal.

STARTER MOTOR OVERHAUL - Tdi ENGINE

Dismantling

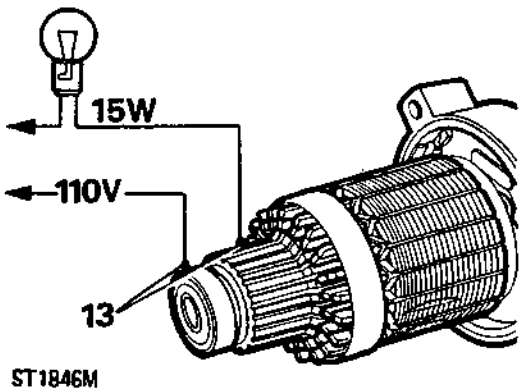
1. Remove the starter motor from the engine.
2. Disconnect the field winding lead from the solenoid.
3. Remove the two securing nuts and washers and withdraw the solenoid and spring, leaving the plunger in place.
4. Remove the two outer nuts from the through studs and withdraw the terminal strap.
5. Remove the inner nuts from the two through studs.
6. Remove the two nuts securing the brush plate assembly to the cover and detach the cover.
7. Withdraw the yoke complete with the brush plate assembly, noting the position of the yoke location plate in the reduction gear housing.
8. Remove the socket head screw and withdraw the armature and the reduction gear housing from the drive end bracket.
9. Remove the clutch drive and pinion assembly and detach the solenoid plunger from the lever.
10. Withdraw the brushes from their boxes.

Inspection and test

11. Clean and examine all parts for condition. Check bearings, bushes and the pinion drive assembly for wear. Examine the reduction drive pinion and drive gear internal teeth. Check that the field coil and armature brushes are satisfactory for continued use.

ARMATURE

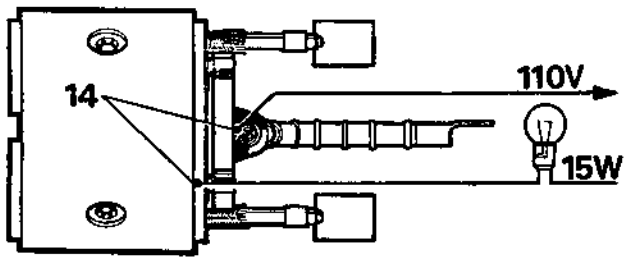
12. Using very fine glass paper, clean the commutator and wipe the surface with a petrol moistened cloth. Do not undercut the insulation slots.
13. Check the armature insulation by connecting a 100V AC 15 watt test lamp between each segment in turn and the armature shaft. The lamp should not light.



ST1846M

FIELD COIL INSULATION

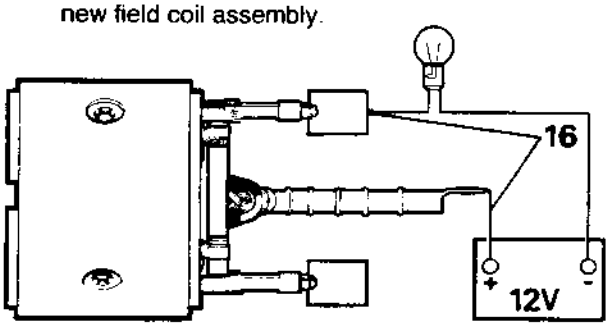
14. Connect a 110V AC 15 watt test lamp between the disconnected end of the winding and a clean unpainted part of the yoke, ensuring that the brushes or leads do not touch the yoke during the test.
15. The lamp should not light; if it does light fit a new field coil assembly.



ST1847M

FIELD COIL CONTINUITY

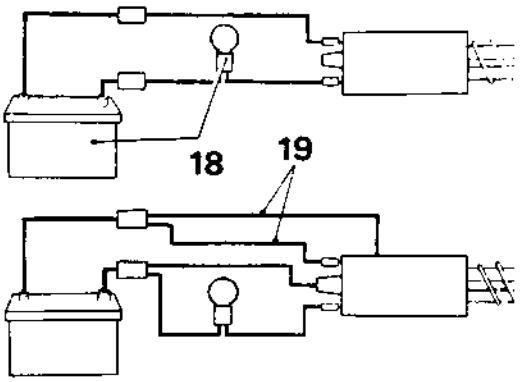
16. Connect a 12V battery operated 60 watt test lamp between each brush in turn and a link lead.
17. The lamp should not light; if it does light, fit a new field coil assembly.



J5203M

SOLENOID

18. Connect a 12 V battery operated 60 watt test lamp across the solenoid main terminals. The lamp should not light: if it does light, fit a new solenoid assembly.
19. Leave the test lamp connected and, using the same 12V battery supply, energise the solenoid by connecting the 12V supply between the small solenoid operating Lucar terminal blade and a good earth point on the solenoid body.

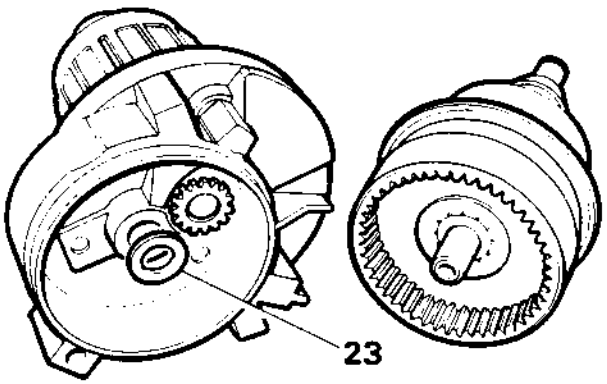


J5204M

20. The solenoid should be heard to operate and the test lamp should light with full brilliance, otherwise fit a new solenoid, assembly.

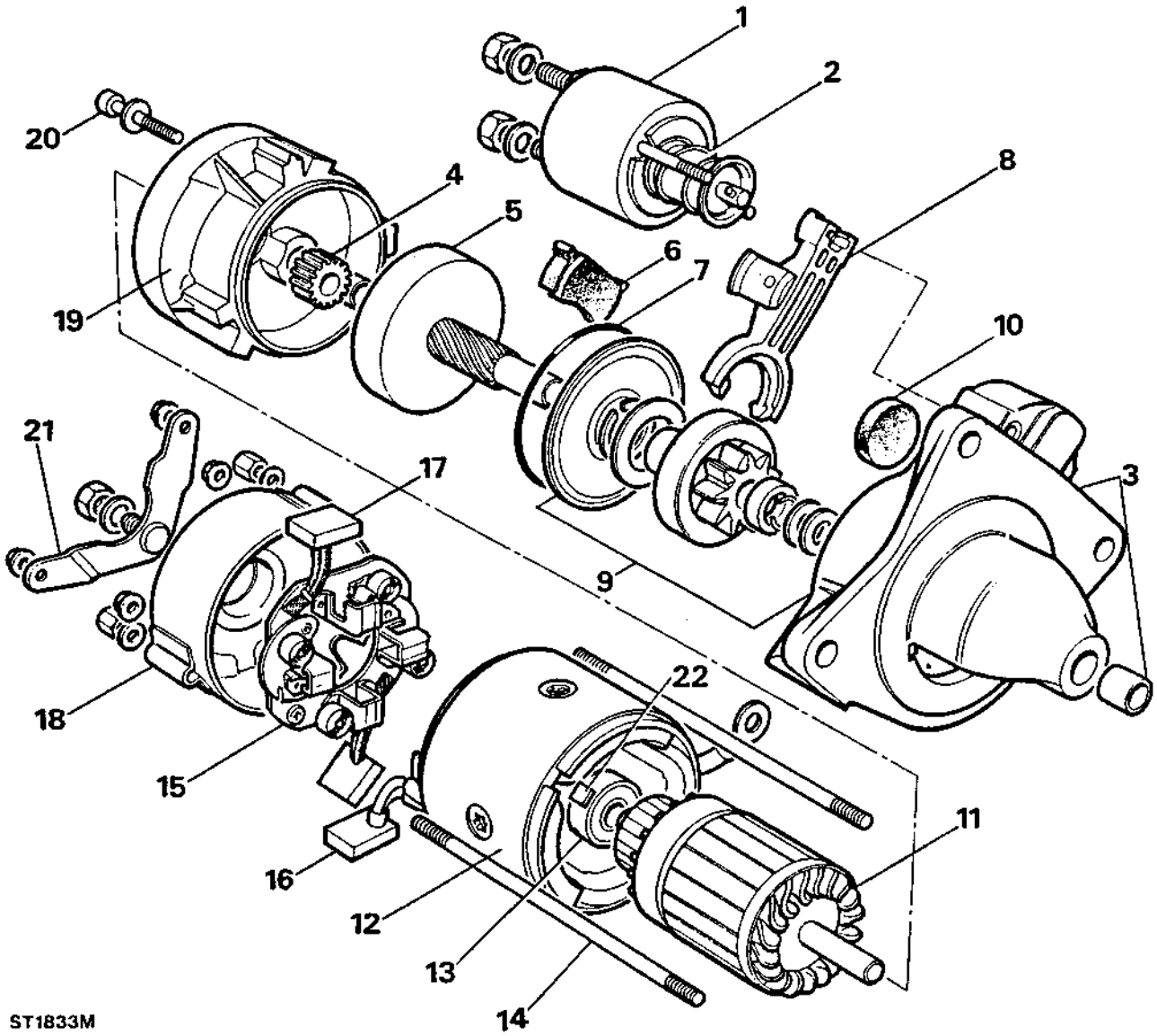
REASSEMBLY

21. If removed fit the round rubber pad to the drive end bracket.
22. Fit the lever to the clutch drive and pinion assembly, locate the solenoid plunger in the end of the lever and fit the assembly to the drive-end bracket, ensuring that the two washers are in position on the shaft.
23. Position the fibre washer on the shaft inside the reduction gear.



J5205M

24. Position the rubber pad, plain side towards the drive-end bracket, fit the 'O' ring seal and assemble the reduction gear housing to the drive-end bracket and secure with the socket head bolt.
25. Place the yoke location plate in position in the reduction gear housing, ensuring that it is fitted in the slot noted during dismantling, and fit the yoke and brush plate to the armature.



STARTER MOTOR

1. Solenoid
2. Solenoid plunger and spring
3. Drive end bracket and bush
4. Reduction gear pinion
5. Reduction gear
6. Rubber pad
7. 'O'ring seal
8. Lever
9. Clutch drive and pinion assembly
10. Rubber pad
11. Armature
12. Yoke
13. Roller bearing
14. Through-studs
15. Brush plate
16. Field coil brushes
17. Armature brushes
18. Brush plate cover
19. Reduction gear housing
20. Socket headed screw
21. Terminal strap
22. Yoke location key



26. Insert the brushes into their boxes and release the retaining springs, ensuring that the brushes rest correctly on the commutor.
27. If removed refit the through studs to the drive end bracket.
28. Fit the brush plate cover and secure to the brush plate with the two nuts.
29. Secure the assembly with the through studs nuts.
30. Fit the terminal strap to the through studs and secure with the two nuts.
31. Fit the coil spring to the solenid plunger, assemble the solenoid to the drive-end bracket and secure with the two nuts.
32. Check that the starter motor turns freely without tight spots.

Notes

TORQUE VALUES

NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Alternator mounting bracket to cylinder head	34
Alternator to mounting bracket	24
Alternator to adjusting link	24
Alternator shaft nut	35
Alternator through bolts	5
Alternator rectifier bolts	3.5
Amplifier module screws	1.2
Amplifier heat sink screws	1.2
Auxiliary driving lamp mounting bolts	15
Distributor clampbolt	20
Distributor pick-up bearing plate support pillars	1.2
Distributor pick-up barrel nuts	1.2
Distributor vacuum unit	2
Spark plug	20
Starter motor to engine bolts	45
Starter motor through bolts	6.2
Solenoid fixing screws	6.1
Solenoid battery terminal nut	4
Solenoid statter terminal nut	3.2
Reverse light switch	25
Wiper motor yoke retaining bolts	1.5

Torque values below cover all screws and bolts used, unless specified otherwise.

METRIC	**Nm**
M5	6
M6	9
M8	25
M10	45
M12	90
M14	105
M16	180

UNC / UNF	
1/4	9
5/16	24
3/8	39
7/16	78
1/2	90
5/8	136

Typeset by Land Rover Technical Communication (02/93)