

**RANGE ROVER
1988
CATALYTIC EXHAUST SYSTEM
WORKSHOP MANUAL SUPPLEMENT**

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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/cm ² (34-37 p.s.i.)
Fuel filter	Bosch in-line filter 'canister' type

Airflow Sensor

Make and type	Lucas 'Hot Wire' 3AM
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Injectors

Make and type	Lucas 8NJ
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Electronic Control Unit

Make and type	Lucas 13CU
---------------------	------------

Fuel pressure regulator

Make and type	Lucas 8RV
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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
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Throttle potentiometer

Make and type	Lucas 215SA
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Lambda sensor

Make and type	Lucas 3LS
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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.		ENGINE SPEED APPROX. (RPM)
		MPH	KPH	
KICKDOWN				
KD4-3	D	78-95	125-153	4750-5200 4600-5250
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	
KD1-2	D (3,2)	34-39	55-63	
FULL THROTTLE				
FT4-3	D	60-66	97-106	3980-4330 4350-4800 3950-4650
FT3-2	3 (D)	39-45	63-72	
FT3-4	D	73-79	117-127	
FT2-3	D (3)	54-59	87-95	
FT1-2	D (3,2)	29-34	47-55	
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 1420-1820 1180-1220
LT2-3	D (3)	18-22	29-35	
LT1-2	D (3,2)	9-10	14-16	
TORQUE CONVERTER				
Lock Up (IN)	D	50-53	80-85	1875-2000 1825-1930
Unlock (OUT)	D	48-51	77-82	

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		
Opens	Inlet 24° BTDC	Exhaust 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

06 TORQUE VALUES

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

		AMBIENT TEMPERATURE								
COMPONENT	SPECIFICATION	°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	Check front wheel alignment
Renew transfer box oil	Check PCV system for leaks and hoses for security and condition (Positive crankcase ventilation).
Renew front axle oil	Check operation of throttle mechanical linkage and transmission cable
Renew rear axle oil	Check ignition wiring and HT leads for security, and fraying
Renew steering swivel housing oil	Check/adjust all drive belts
Check/top up power steering fluid	Check operation of all instruments fuel and temperature gauges, warning indicators, lamps, horns and audio unit
Check/top up automatic transmission fluid	Check operation of front and rear screen and headlamp wash/wipers
Check for oil/fluid leaks from:- Suspension, dampers and self levelling unit, engine and transmission units, front and rear axles	Check operation of rear view mirrors and for security, cracks and crazing
Check brake pipes/unions for security, chafing, leaks and corrosion	Check condition and security of seats, seat belt mountings, belts and buckles
Check power steering system for leaks, hydraulic pipes/unions for security, chafing and corrosion	Check exhaust system for leaks, security and damage
Check fuel system for leaks	Check tyres comply with Manufacturers specification
Check cooling and heater systems for leaks, hoses for security and condition	Check tyres for cuts, lumps, bulges, uneven wear, tread depth and road wheels for damage
Check security and operation of park brake	Check and adjust tyre pressures including spare
Check foot brake operation	Check and tighten road wheel retaining nuts
Check condition and security of steering unit, joints and gaiters	
Check/adjust steering box	

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 maintenance 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.

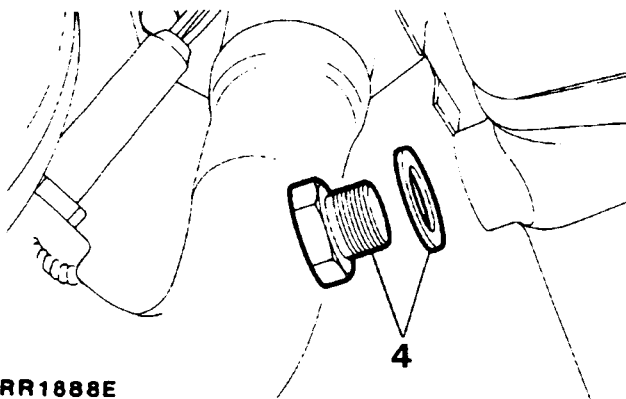
Allow as much time as possible for the oil to drain completely except where blown sand or dirt can enter the drain holes. In these conditions clean and refit the drain plugs immediately the main bulk of oil has drained.

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

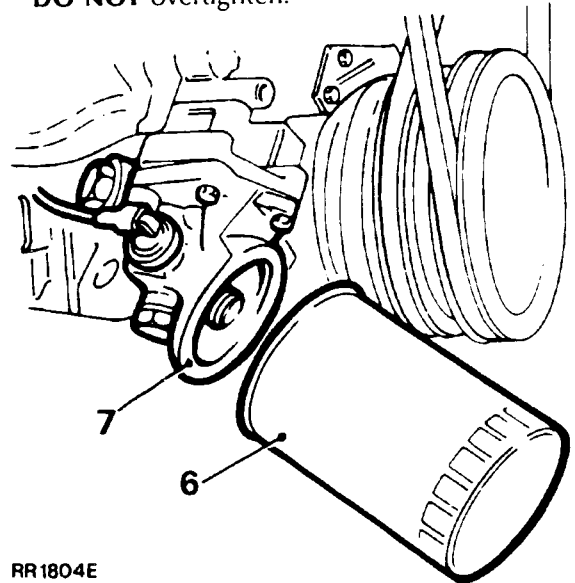
1. Before changing the oil ensure that the vehicle is level on either hoist or ground.
2. Run the engine to warm the oil; switch off the ignition and disconnect the battery for safety.
3. Place an oil tray under the drain plug.
4. Remove the drain plug in the bottom of the sump at the left-hand side. 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

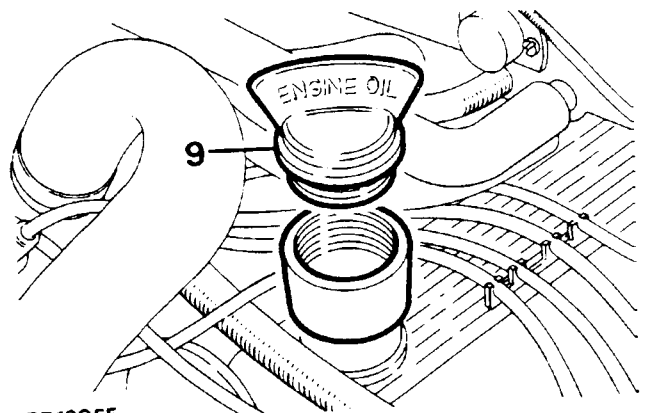
5. Place an oil tray under the engine.
6. Unscrew the filter counter-clockwise, using a strap wrench as necessary.
7. Clean the oil pump mating face and coat the rubber washer of the new filter with clean engine oil, screw the filter on clockwise until the rubber sealing ring touches the machined face, 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.

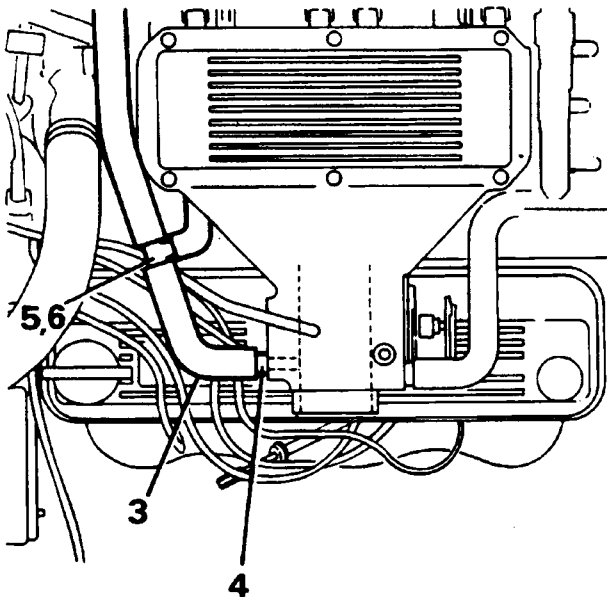
**CLEAN PLENUM CHAMBER VENTILATION
PASSAGEWAY**

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.



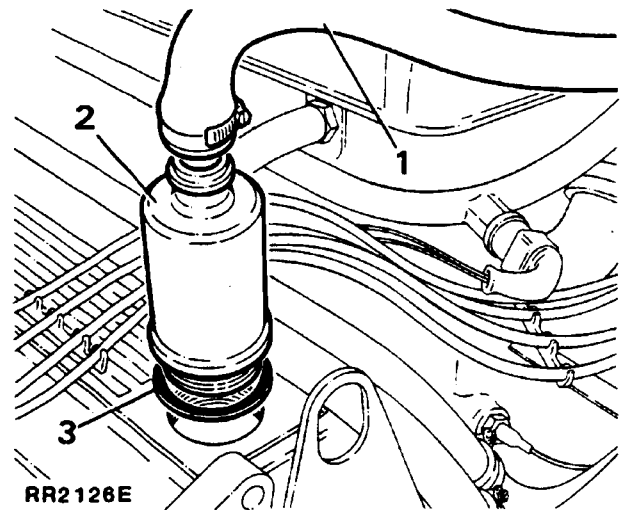
RR2337S

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 it 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:



RR2128E

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

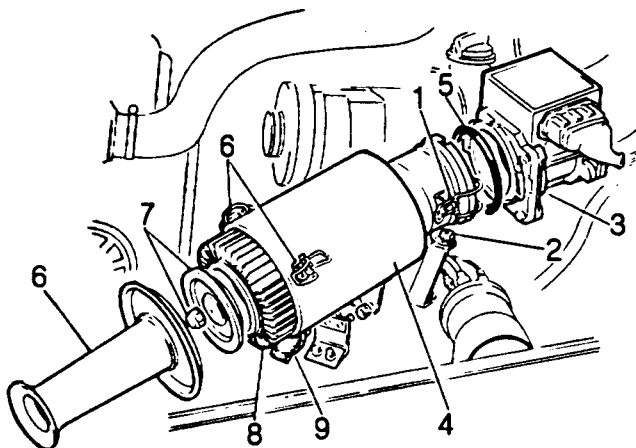
7. Fit a new rubber 'O' ring.
8. Screw the flame trap canister into the rocker cover, hand tight only.
9. Refit hose and tighten hose clamp securely.

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

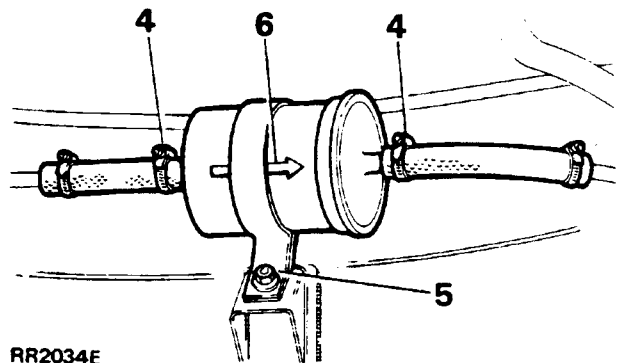
Refitting

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.



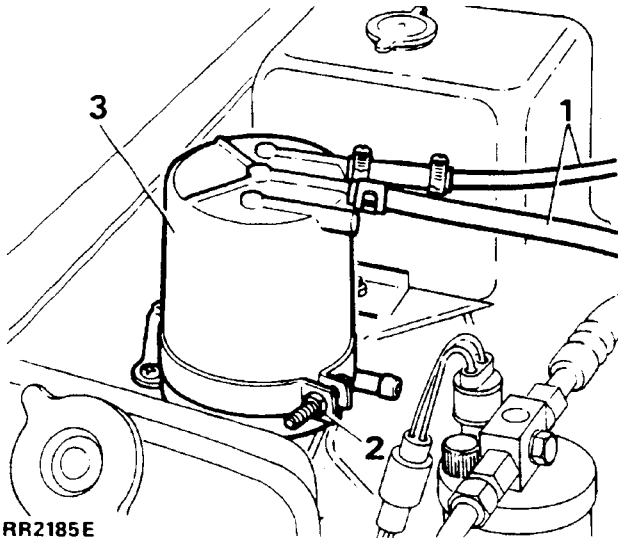
RR2034E

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.



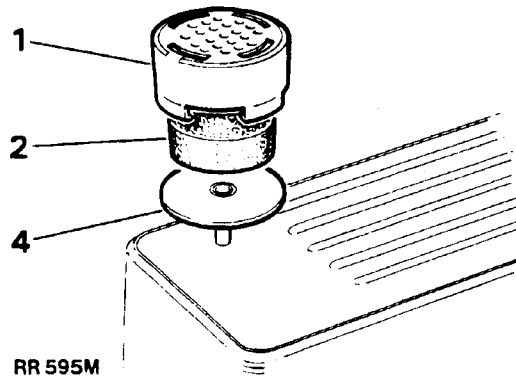
Fit new canister

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 $6^{\circ} \pm 1^{\circ}$ 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.

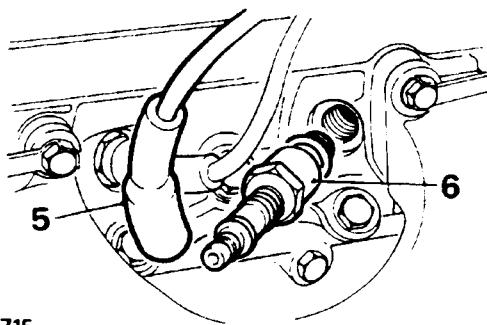
IGNITION

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.

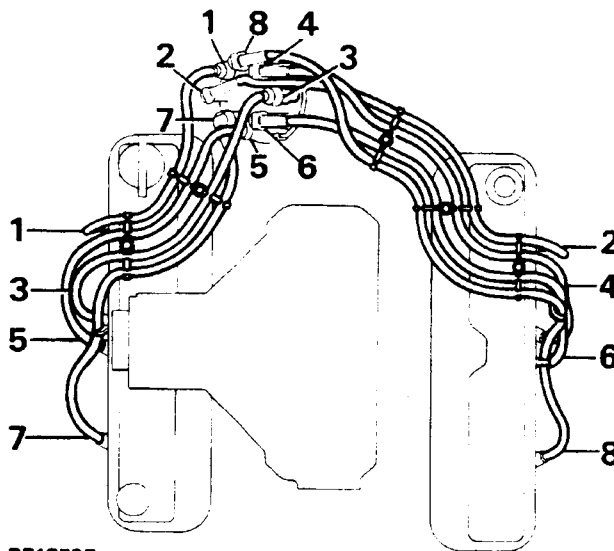


RR2171E

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.

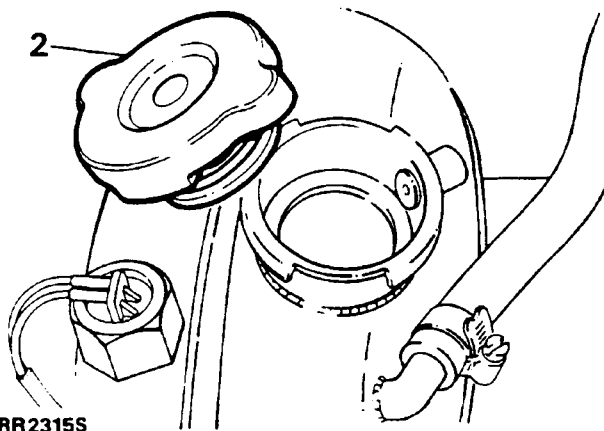
DO NOT DISTURB the clear plastic insulating cover (flash shield) which protects the magnetic pick-up module.

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.



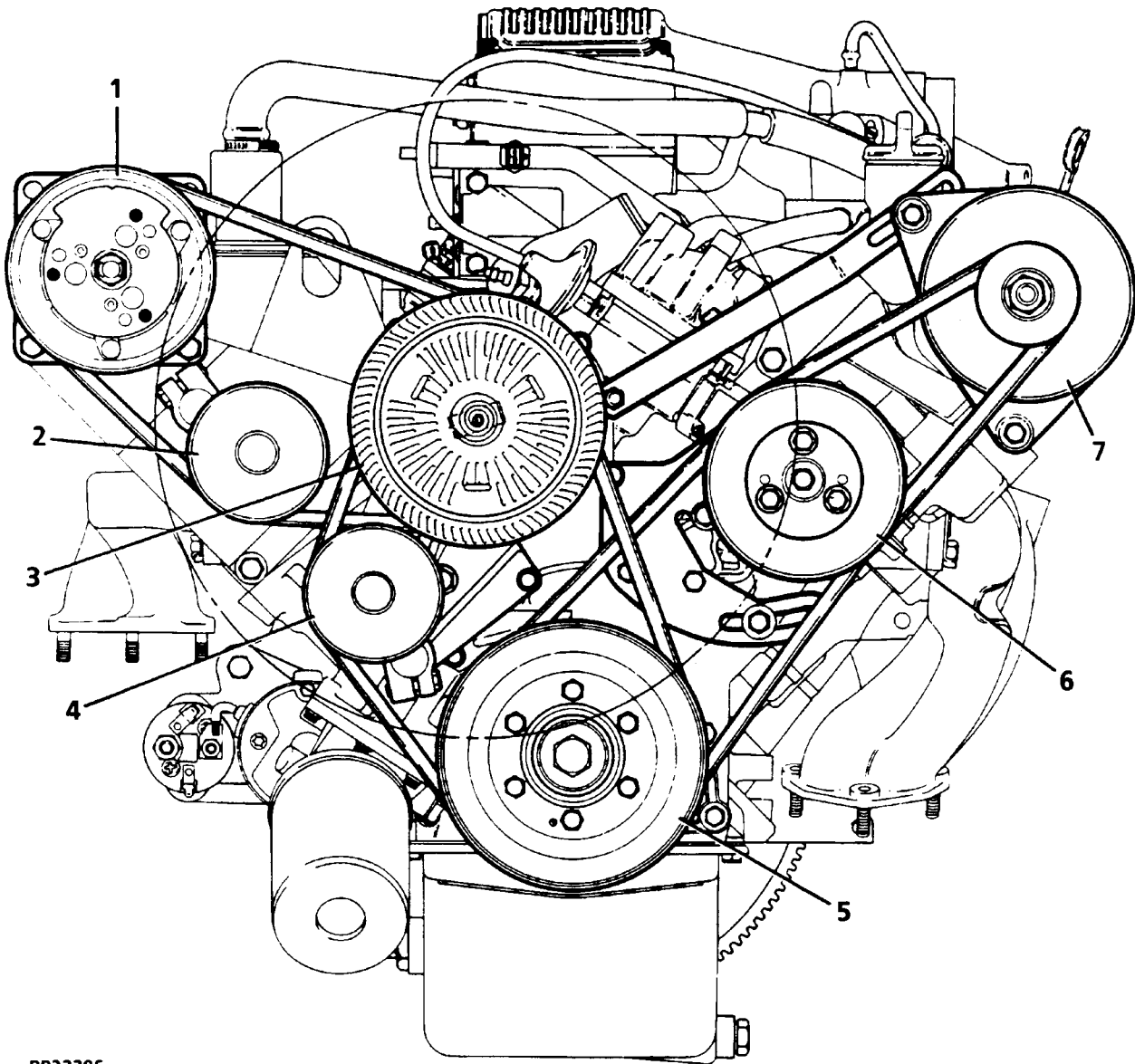
RR2315S

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.

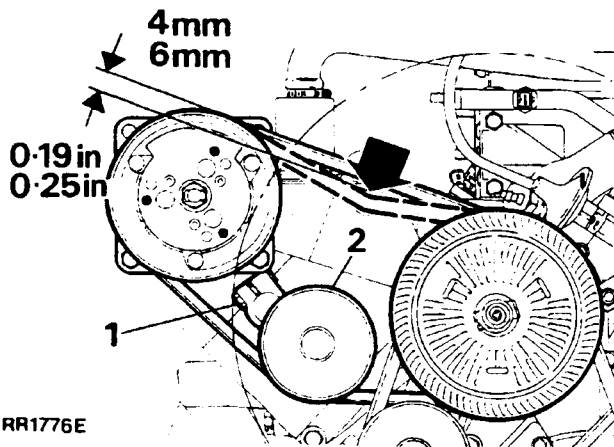
DRIVE BELTS-adjust or fit new belts

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:

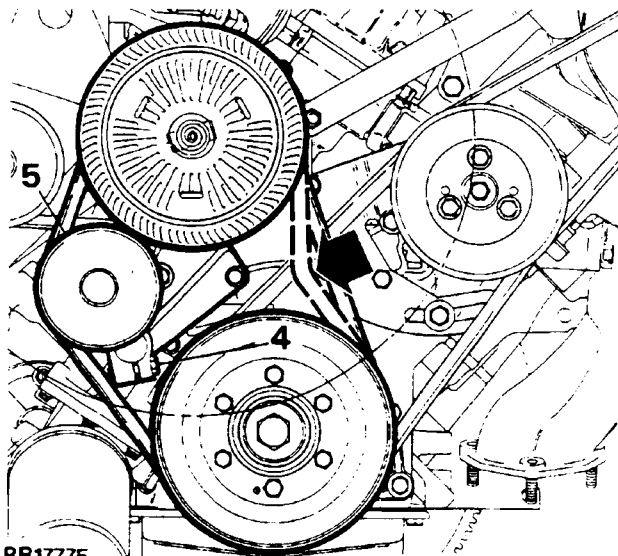
1. Loosen the idler pulley securing bolt.
2. Adjust the position of the idler pulley until the correct tension is obtained.
3. Tighten the securing bolt and recheck the belt tension.



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



RR1777E
14

ILLUSTRATION B

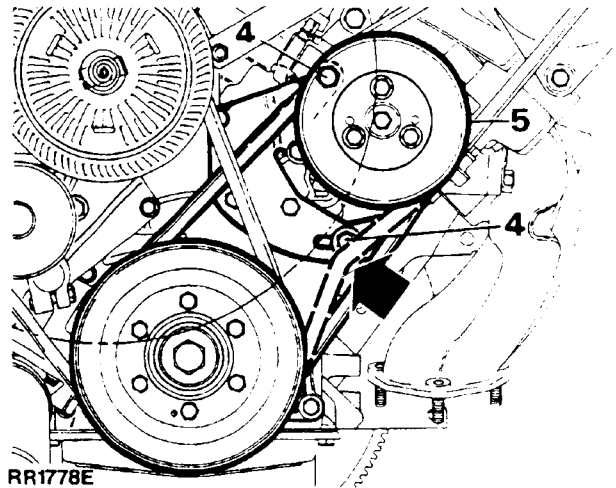
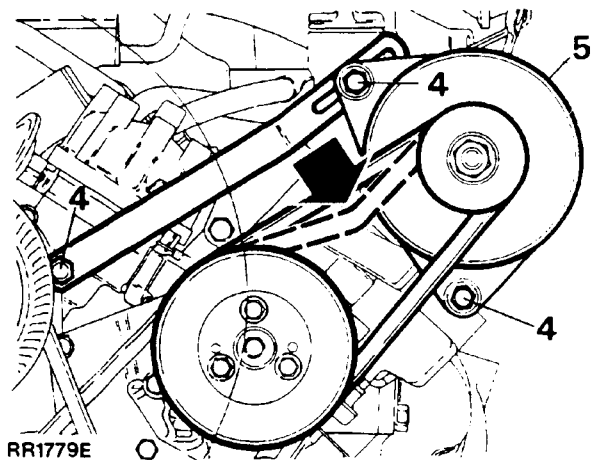


ILLUSTRATION C



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

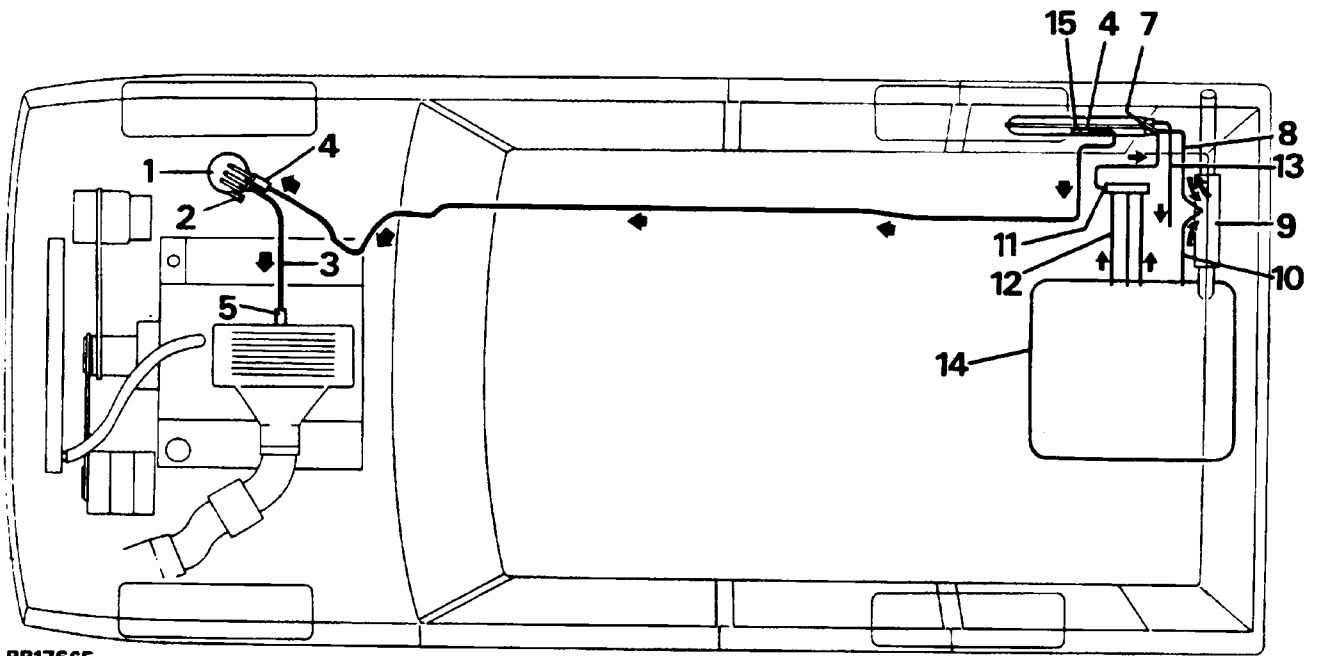
This system prevents fuel vapour from reaching the atmosphere. The system consists of a fuel expansion tank located between the inner right hand body side and rear right hand wing, and an adsorption canister located in the engine compartment attached to the front right hand valance.

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.

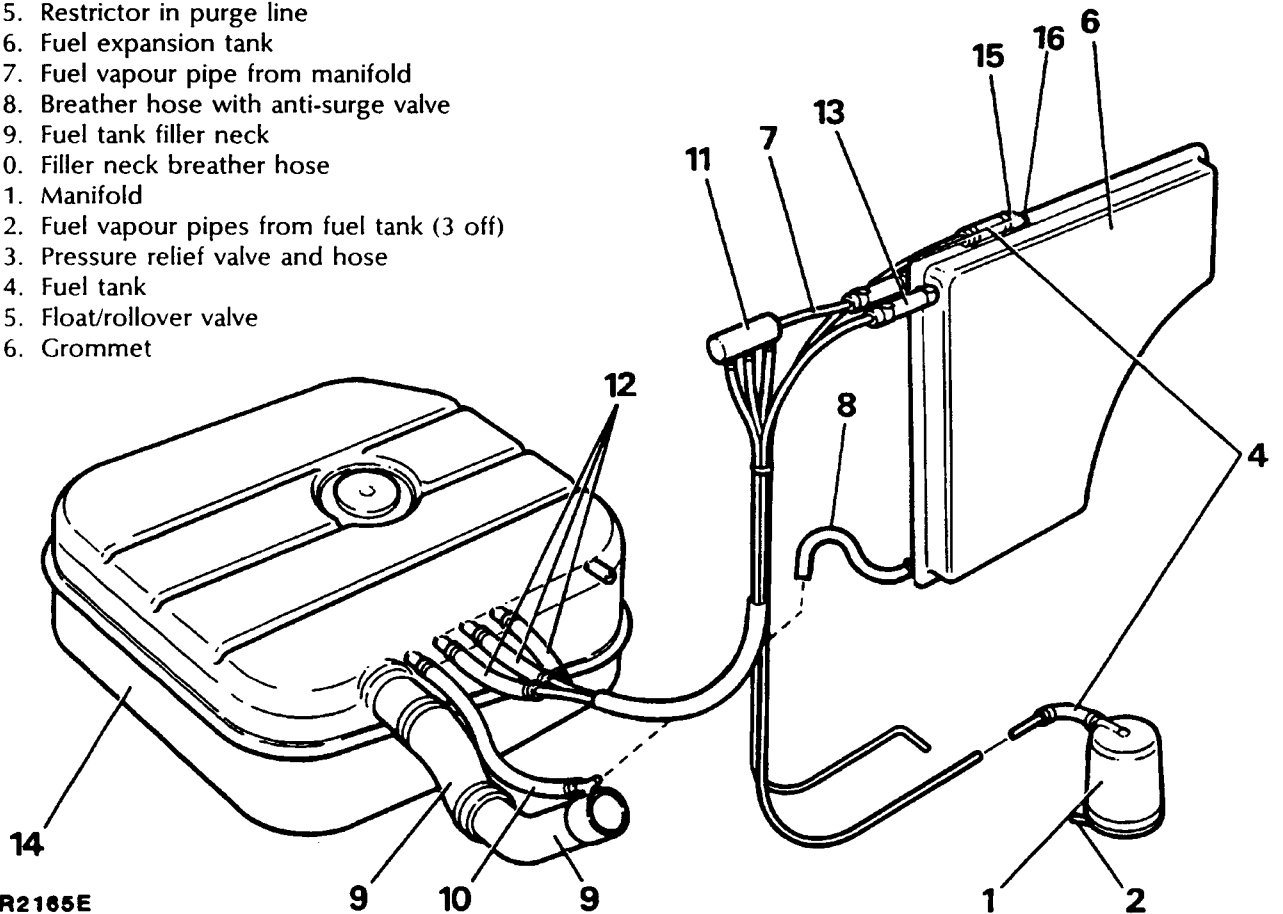
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RR1766E

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.

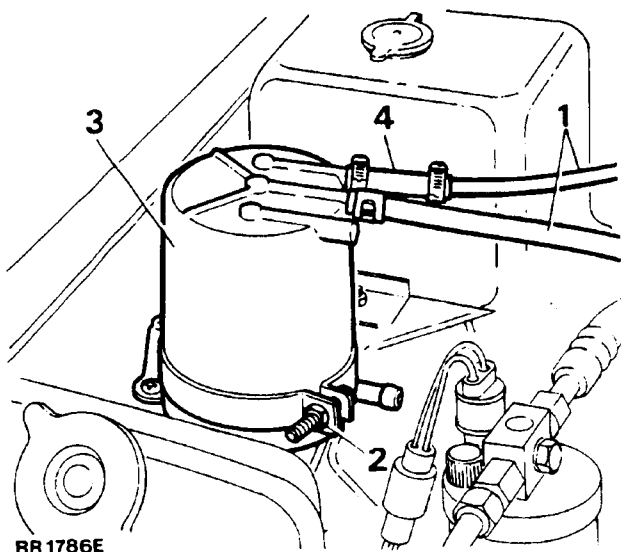
The emission control system fitted to this engine is designed to keep emissions within legislated limits, providing the engine is correctly maintained and is in sound mechanical condition.

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

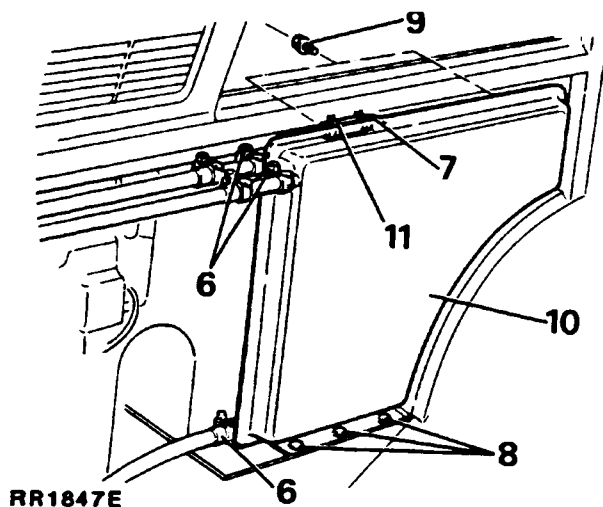
Remove and Refit

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

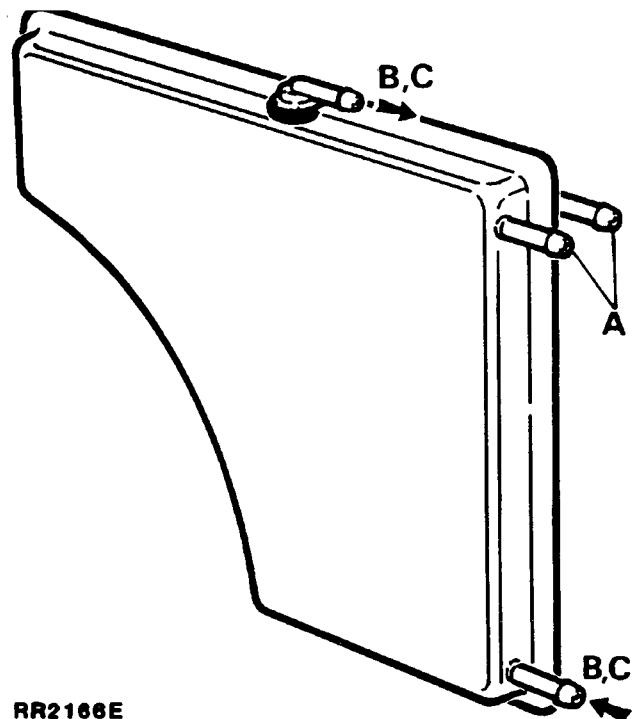
1. Depressurise the fuel system. (see Depressurising procedure in Fuel Injection System-section 19 page 34)
2. Disconnect negative battery terminal.
3. Remove the rear lamp cluster.
4. Remove the wrap around bumper end cap.
5. Remove the rear wing and corner panel assembly.
6. Release the three hose 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.



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.



Continued

- 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

- 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

- Attach a 10.00 ± .250 cu.inch vacuum tank to the coloured side of the valve.
- Expose the black side to atmospheric pressure.
- 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.
- Vacuum recovery air flow: Attach a 22.75 ± .5 cu.inch vacuum tank to the black side of the valve.
- Expose the coloured side to atmospheric pressure.
- Expected result:** The time required for the vacuum to drop from 16 inch Hg to 8 inch Hg will be 240 to 360 seconds.

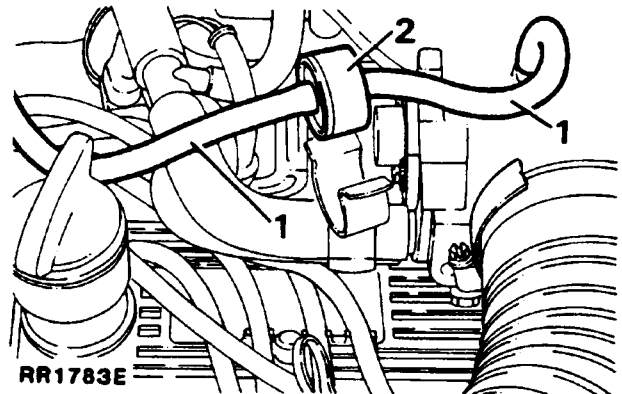
Test: External Leakage Check

- Seal the coloured side of the valve and attach a short flexible pipe to the other end.
 - Submerge the valve in water and orally blow through the valve.
 - 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

- Pull the two flexible hoses from the delay unit.
- Remove the unit from its retaining clip and withdraw it from the engine compartment.



Refitting

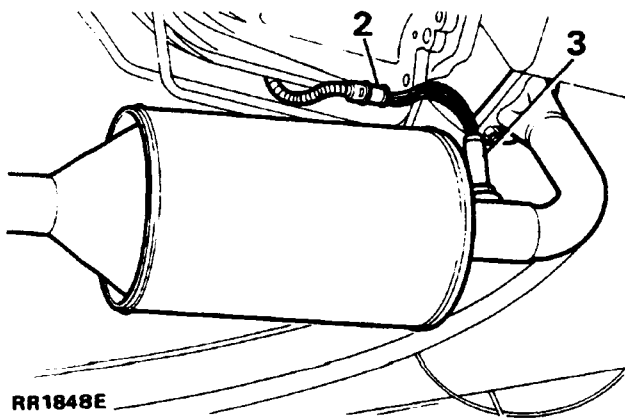
- Reverse the removal instructions ensuring that the coloured side of the valve is fitted to the longer hose from the distributor.

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

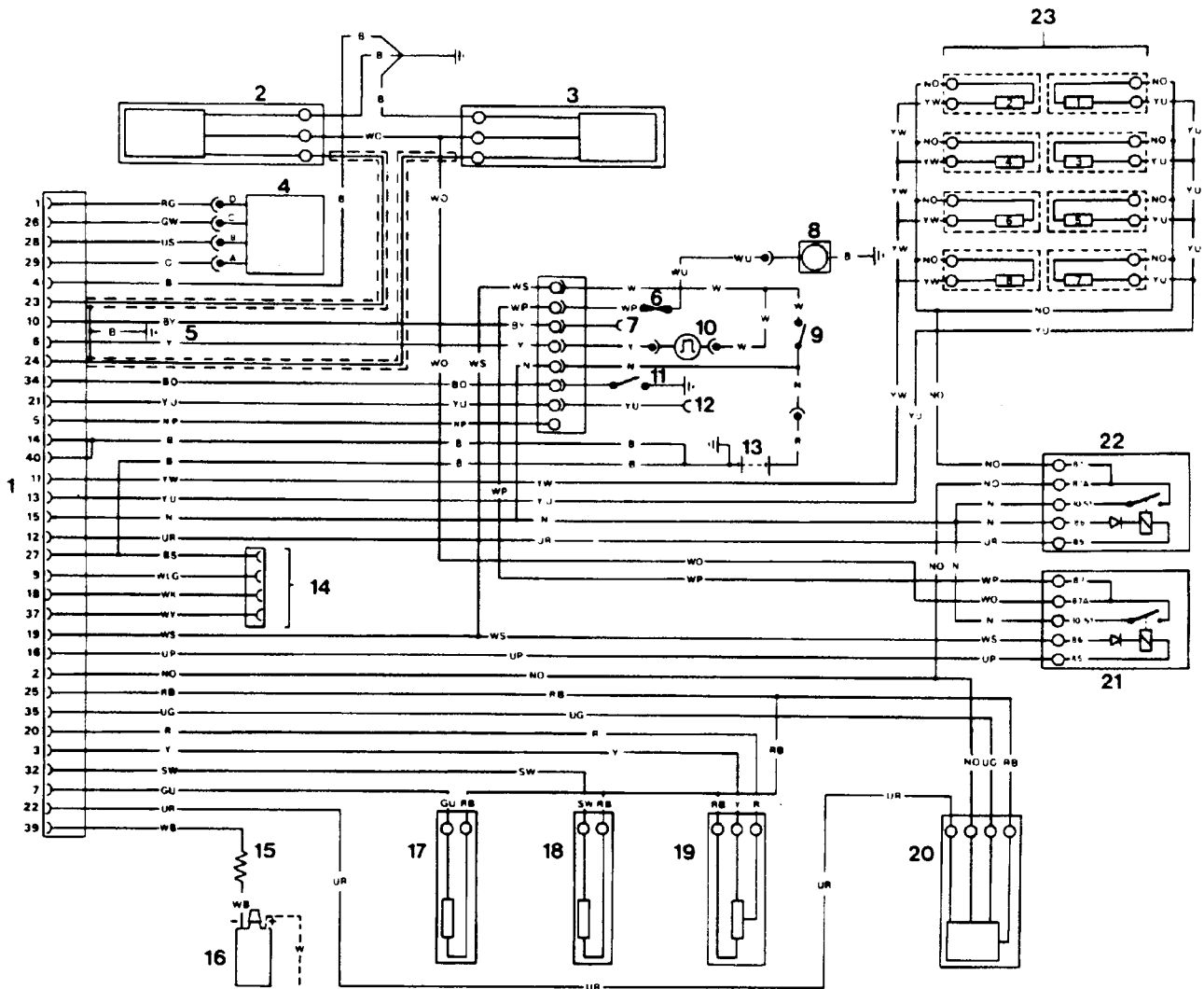
1. Disconnect the battery negative lead.
2. Disconnect the electrical plugs from the sensors.
3. Unscrew and remove the sensors from the two exhaust downpipes.

**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

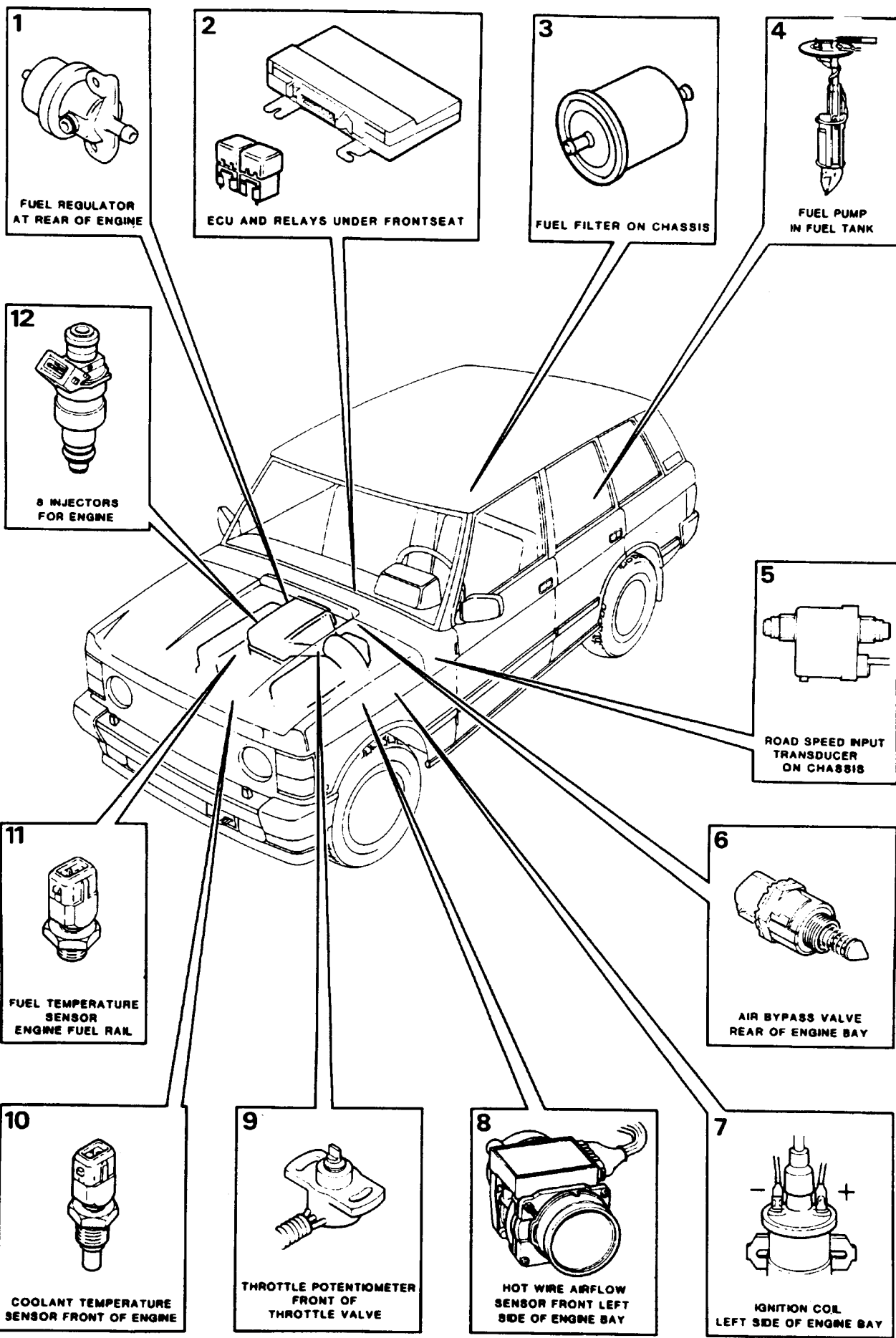
- | | |
|---|--|
| 1. 40 way connector to Electronic Control Unit (ECU). | 12. Pick-up point-air conditioning circuit (load input). |
| 2. Lambda sensor (left side - bank A). | 13. Battery. |
| 3. Lambda sensor (right side - bank B). | 14. Diagnostic plug. |
| 4. By-pass air valve (stepper motor) (fast idle). | 15. In-line resistor. |
| 5. Lambda sensor screened ground. | 16. Coil/-ve (engine RPM input). |
| 6. Fuse 18 - main fuse panel. | 17. Coolant temperature thermistor (sensor) (input). |
| 7. Pick-up point E.F.I. warning symbol (instrument binnacle). | 18. Fuel temperature thermister (sensor) (input). |
| 8. Fuel pump. | 19. Throttle potentiometer. |
| 9. Ignition switch. | 20. Air flow sensor. |
| 10. Speed transducer (road speed input). | 21. Fuel pump relay. |
| 11. Neutral switch (automatic gearbox) (load input). | 22. Main relay. |
| | 23. Injectors-1 to 8. |
- = = = Denotes screened ground.

Cable colour code

B Black	C 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.

19 FUEL INJECTION SYSTEM



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 (O₂ 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 circuitry 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 - 54744754

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.

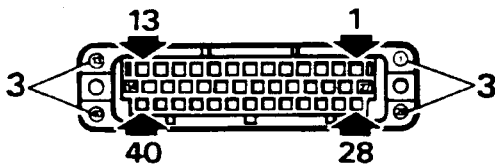
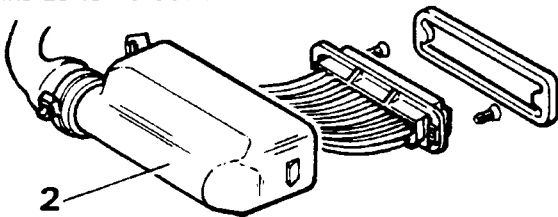
To enable the tests to be carried out when the 40 way multi-plug is connected to the E.C.U., it is necessary to remove the two screws securing the shroud to the plug to enable the multi-meter probes to be inserted into the back of the appropriate pin.

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. Maneuver 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

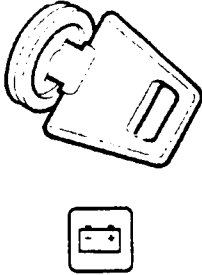
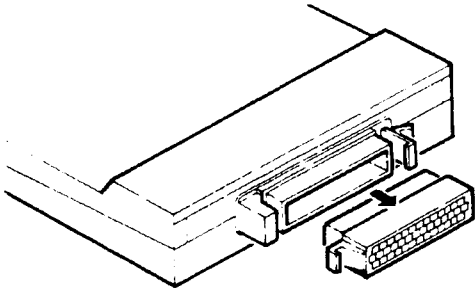



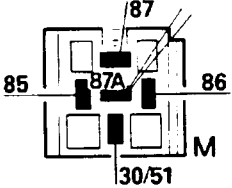
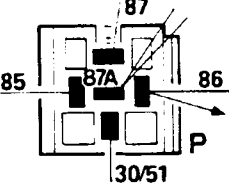
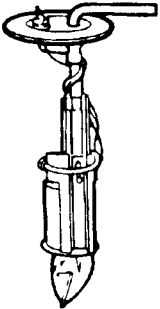
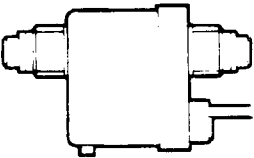
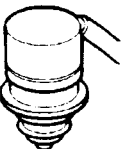
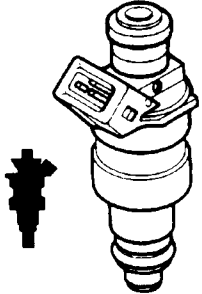
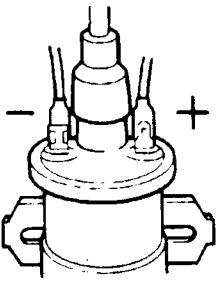
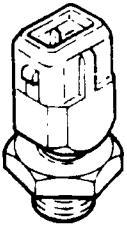
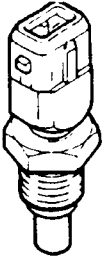
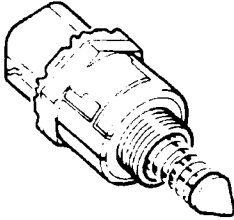
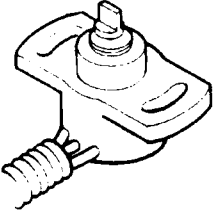
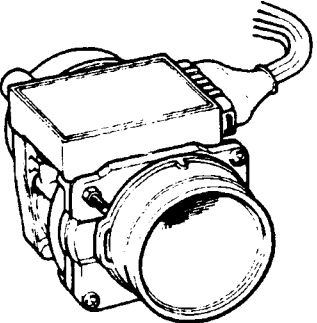
1. Red/green
2. Brown/orange
3. Yellow
4. Black
5. Brown/purple
6. Yellow
7. Green/blue
8. Not used
9. White/light green
10. Black/Yellow
11. Yellow/white
12. Blue/red
13. Yellow/blue
14. Black
15. Brown
16. Blue/purple
17. Not used
18. White/pink
19. White/grey
20. Red
21. Yellow/blue
22. Blue/red
23. 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.

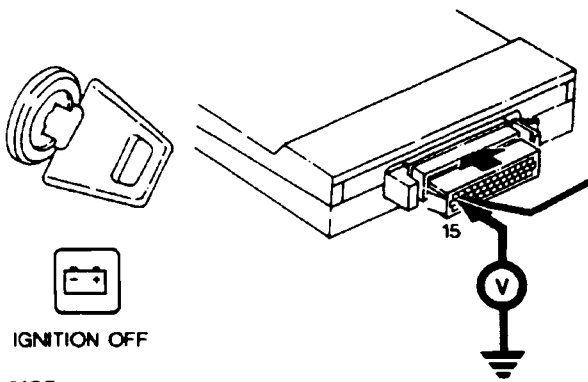
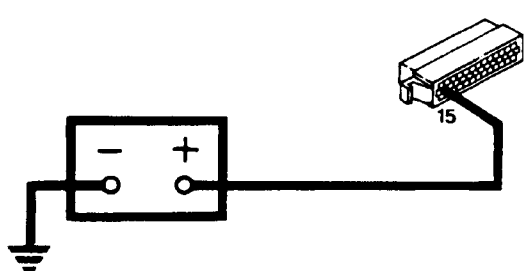
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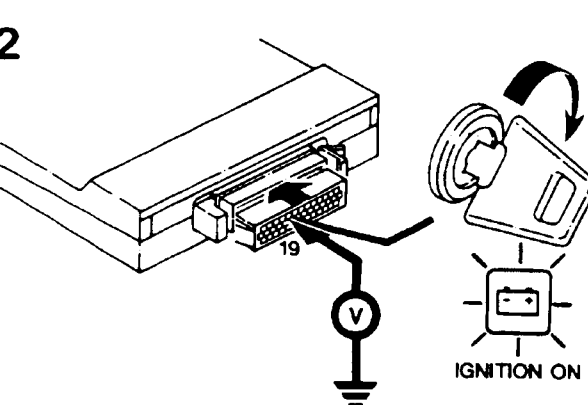
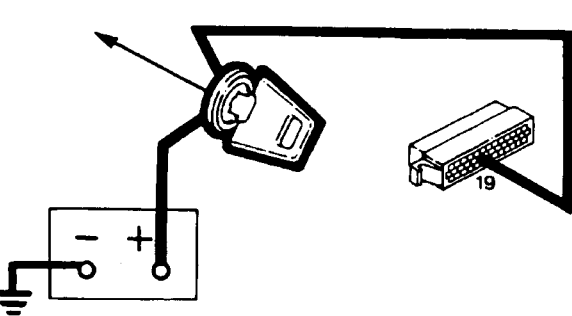
TESTS - Using a Multi-Meter

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.

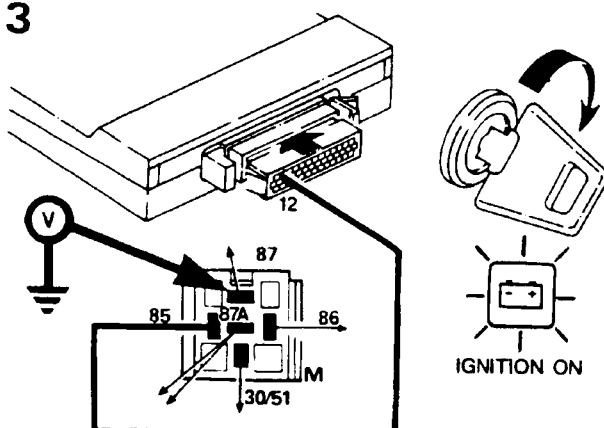
<p>KEY TO SYMBOLS</p>	 <p>IGNITION SWITCH</p>	 <p>ELECTRONIC CONTROL UNIT AND MULTIPLUG</p>		 <p>TEMPORARY CONNECTION</p>
 <p>OHMMETER CONNECTIONS</p>	 <p>VOLTMETER CONNECTIONS</p>	 <p>MAIN RELAY</p>	 <p>PUMP RELAY</p>	 <p>FUEL PUMP</p>
 <p>ROAD SPEED INPUT (SPEED TRANSDUCER)</p>	 <p>GEAR INPUT SWITCH (INHIBITOR SWITCH)</p>	 <p>INJECTOR</p>	 <p>IGNITION COIL</p>	 <p>FUEL TEMPERATURE SENSOR</p>
 <p>COOLANT TEMPERATURE SENSOR</p>	 <p>AIR BYPASS VALVE</p>	 <p>THROTTLE POTENTIOMETER</p>	 <p>HOT WIRE AIRFLOW SENSOR</p>	

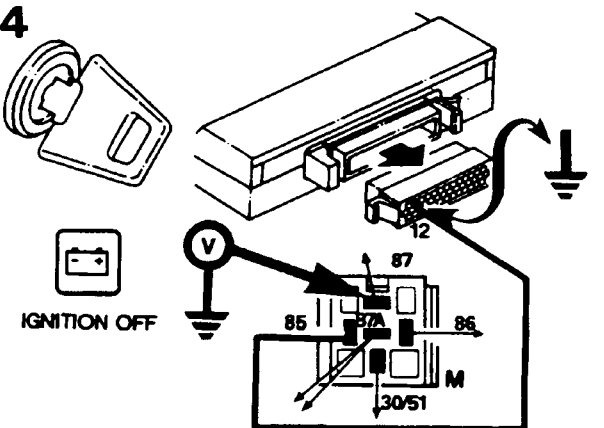
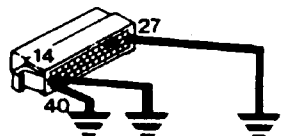
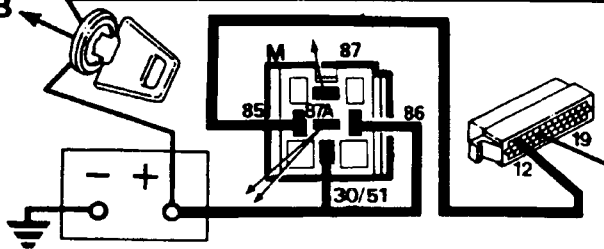
NOTE: All tests are carried out from the electronic control unit (ECU) harness multi-plug unless stated otherwise in the test procedure.

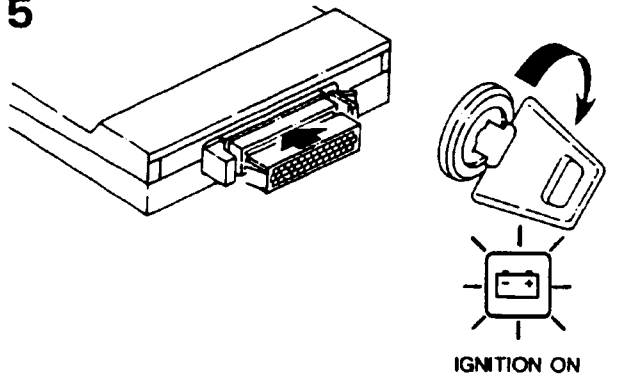
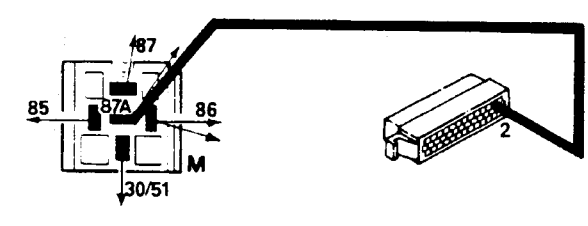
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>1. Check battery supply to ECU</p>	<p>Voltmeter reading of battery volts - (minimum battery voltage 10 volts) Proceed to Test 2 Voltmeter reading of zero volts Check:-</p>
<p>1</p>  <p>IGNITION OFF</p> <p>RR1816E</p>	

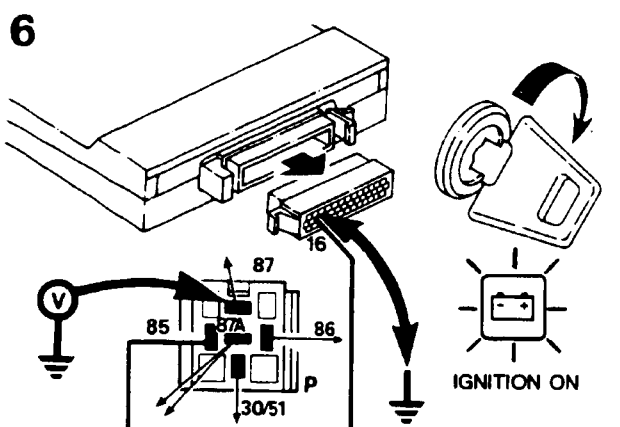
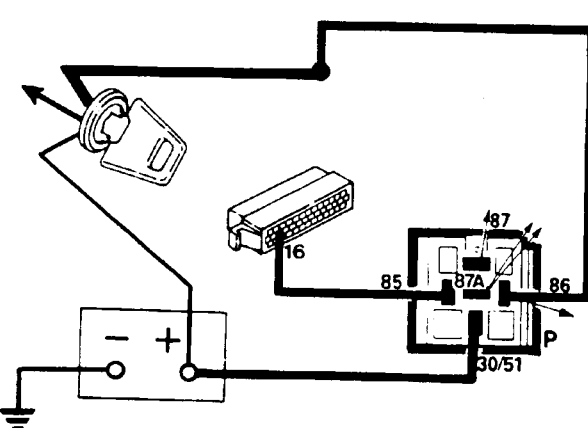
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>2. Check ignition supply to ECU</p>	<p>Voltmeter reading of battery volts - (minimum battery voltage 10 volts) Proceed to Test 3 Incorrect reading check:-</p>
<p>2</p>  <p>IGNITION ON</p> <p>RR1817E</p>	

Continued

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>3. Check operation of Main relay</p>	<p>Voltmeter reading of battery volts - Proceed to Test 5</p> <p>Voltmeter reading of zero volts - Proceed to Test 4</p>
<p>3</p>  <p>RR1818E</p>	

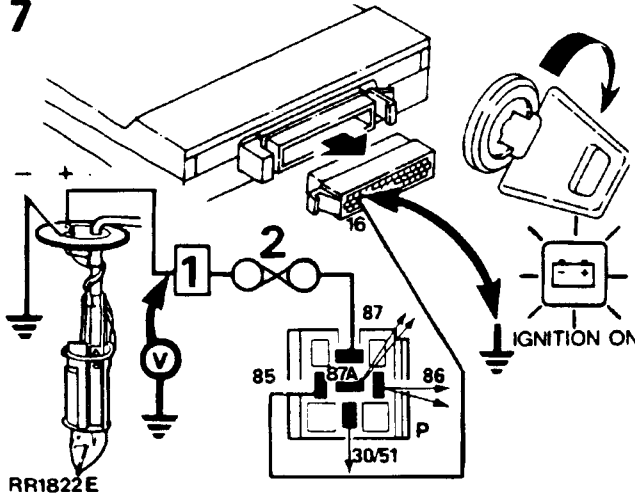
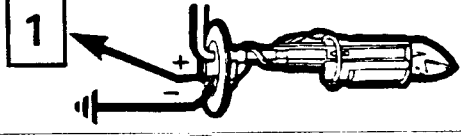
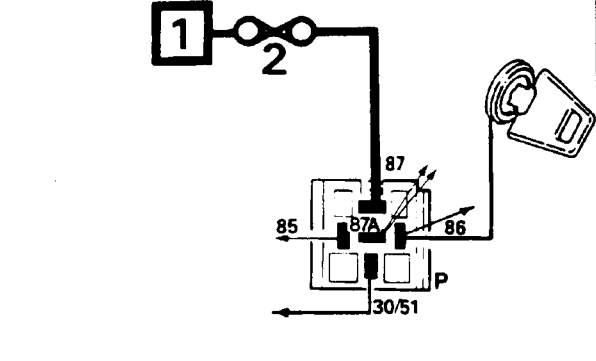
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>4. Fault Diagnosis Main relay circuits</p>	<p>A. Voltmeter reading of battery volts - Check:- If OK Suspect ECU</p> <p>B. Voltmeter reading of zero volts Check:-</p>
<p>4</p>  <p>RR1819E</p>	<p>A</p>  <p>B</p> 

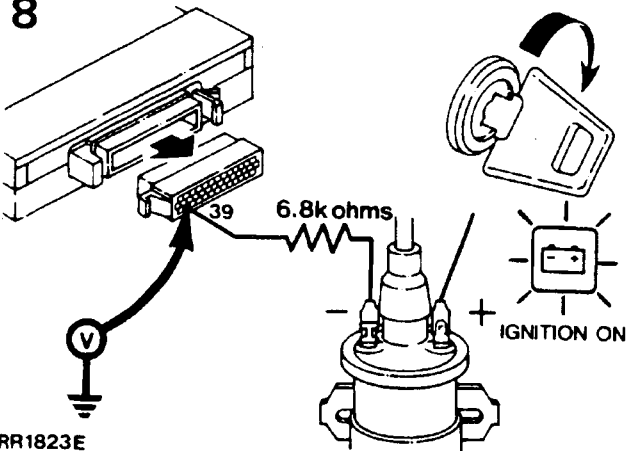
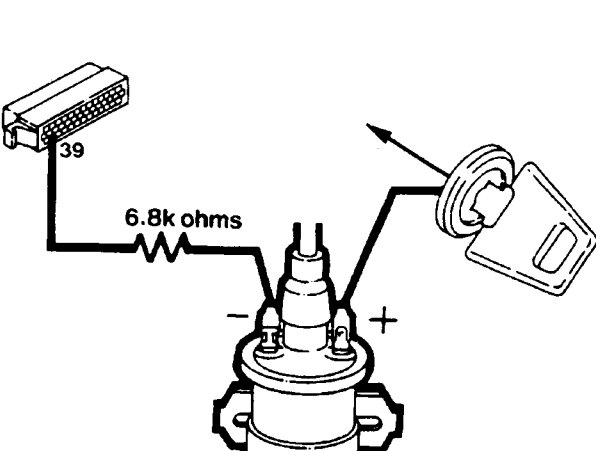
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>5. Check operation of pump relay</p>	<p>Listen for audible 'click' from pump relay. If O.K - Proceed to Test 7</p> <p>No audible 'click' from pump relay Check:- If OK proceed to Test 6.</p>
<p>5</p>  <p>RR1820E</p>	

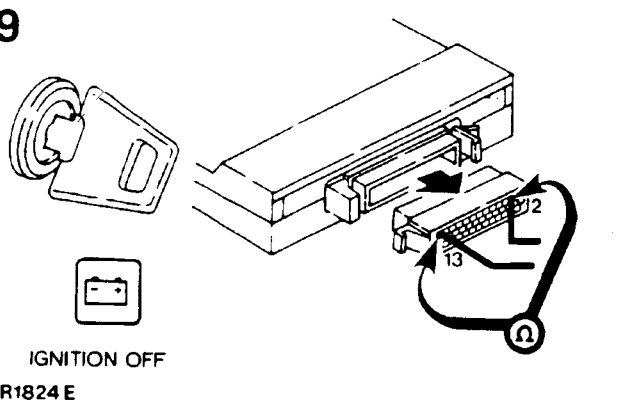
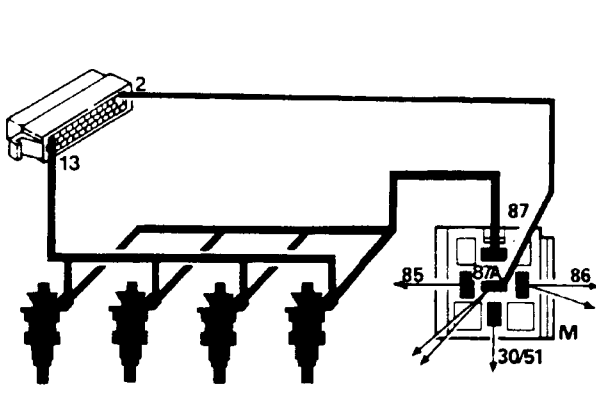
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>6. Fault diagnosis Pump relay circuits</p>	<p>Voltmeter reading of battery volts - Suspect ECU</p> <p>Voltmeter reading of zero volts Check:-</p>
<p>6</p>  <p>RR1821E</p>	

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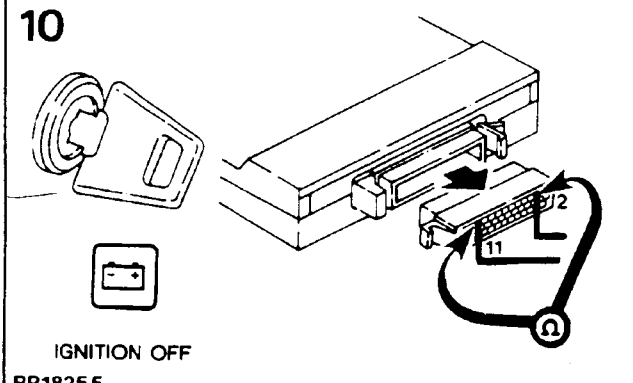
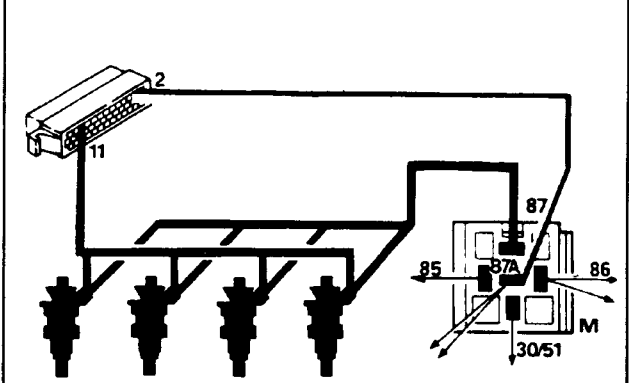
19 FUEL INJECTION SYSTEM

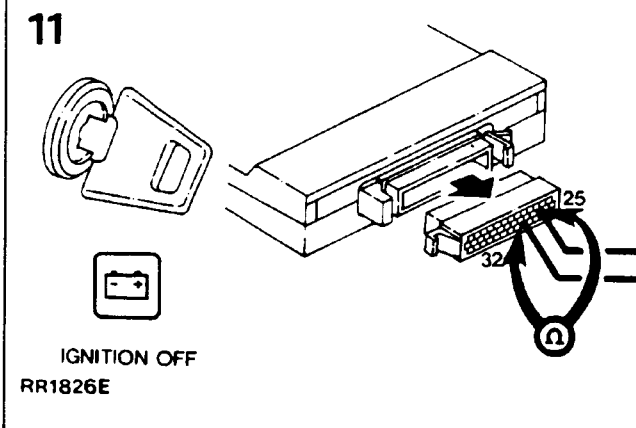
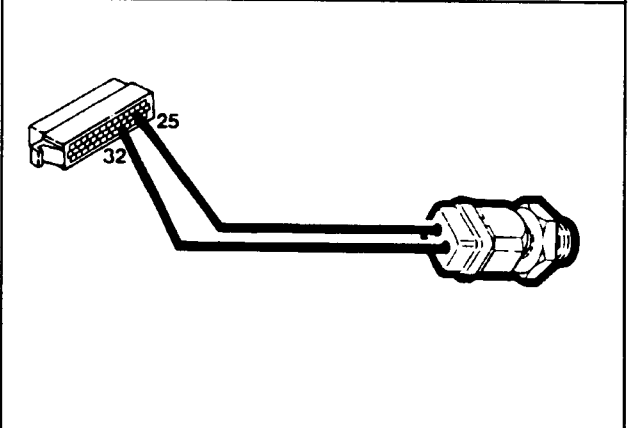
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>7. Check operation of Fuel pump</p> <p>NOTE: It is not possible to place the multi-meter probes directly onto the pump terminals. A link lead attached to the pump is accessible behind the rear left hand wheel located between the chassis and stowage area floor panel.</p> <p>KEY: 1. Harness plug - link lead 2. Fuse 18</p>	<p>Voltmeter reading of battery volts - Pump operating - Proceed to Test 8</p> <p>(A) Voltmeter reading of battery volts - Pump not operating Check:-</p> <p>(B) Voltmeter reading of zero volts Check:-</p>
<p>7</p>  <p>RR1822E</p>	<p>A.</p>  <p>B.</p> 

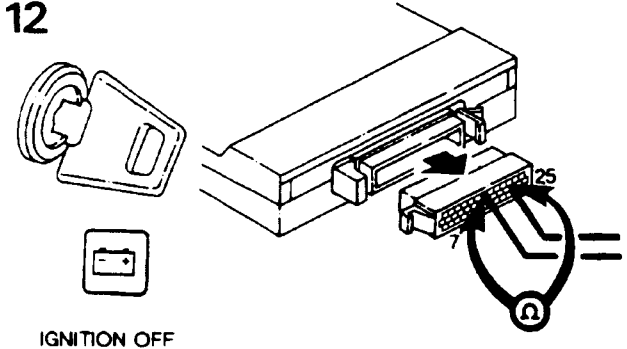
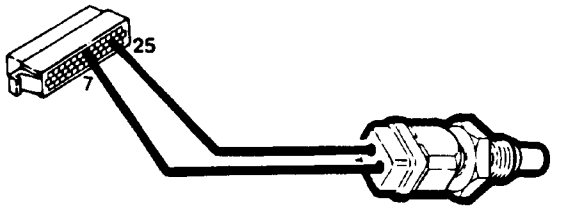
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>8. Check engine speed signal Cable and resistor</p>	<p>Voltmeter reading of battery volts - Proceed to Test 9</p> <p>Voltmeter reading of zero volts Check:-</p>
<p>8</p>  <p>RR1823E</p>	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>9. Check injectors, Injector circuit</p> <p>(Pin 13 left bank injectors 1,3,5,7).</p>	<p>Ohm-meter reading of 4-5 Ohms - Proceed to Test 10</p> <p>Ohm-meter reading of 5-6 Ohms - Suspect 1 injector</p> <p>Ohm-meter reading of 8-9 Ohms - Suspect 2 injectors</p> <p>Ohm-meter reading of 16-17 Ohms - Suspect 3 injectors</p> <p>Check for open circuit injector(s) or wiring faults.</p> <p>Ohm-meter reading of Infinity Check:</p>
<p>9</p>  <p>RR1824 E</p>	

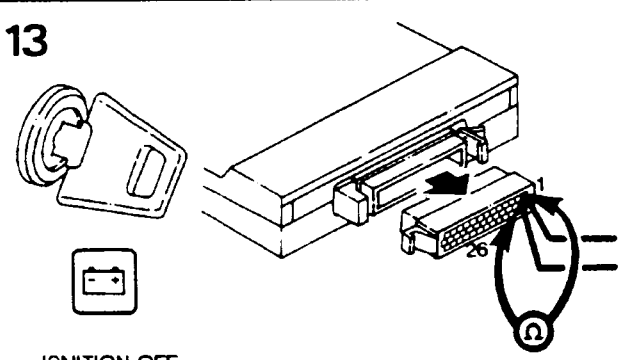
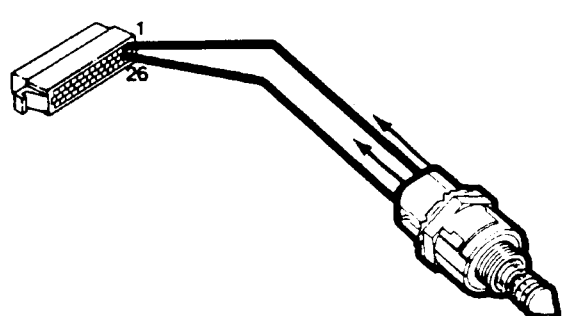
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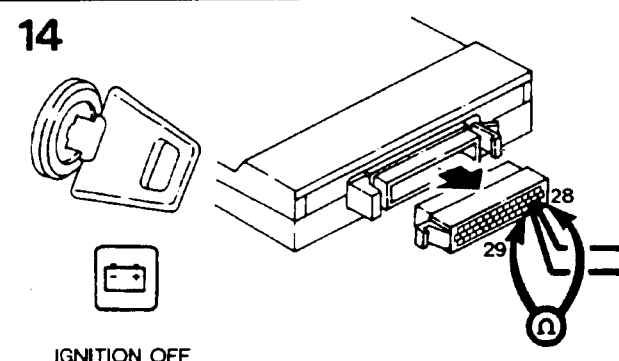
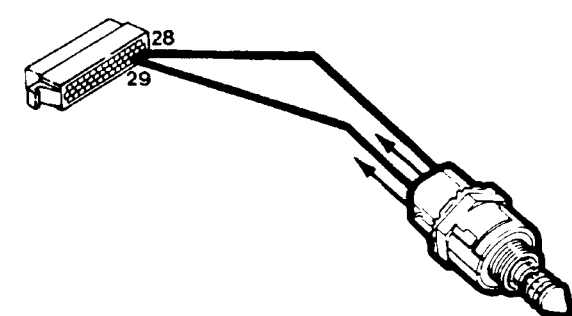
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>10. Check injectors Injector circuit</p> <p>(Pin 11 rightbank injectors 2,4,6,8)</p>	<p>Ohm-meter reading of 4-5 Ohms - Proceed to Test 11.</p> <p>Ohm-meter reading of 5-6 Ohms - Suspect 1 injector</p> <p>Ohm-meter reading of 8-9 Ohms - Suspect 2 injectors</p> <p>Ohm-meter reading of 16-17 Ohms - Suspect 3 injectors</p> <p>Check for open circuit injector(s) or wiring faults.</p> <p>Ohm-meter reading of Infinity</p> <p>Check:</p>
<p>10</p>  <p>IGNITION OFF RR1825E</p>	

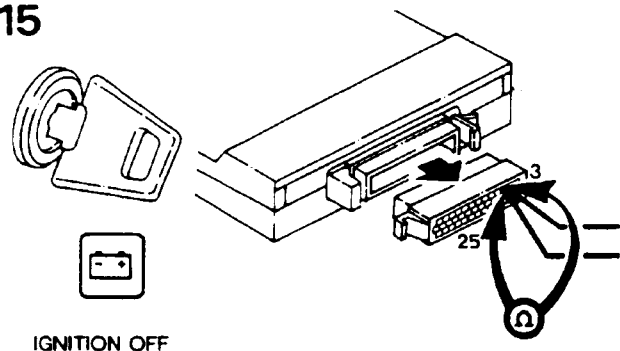
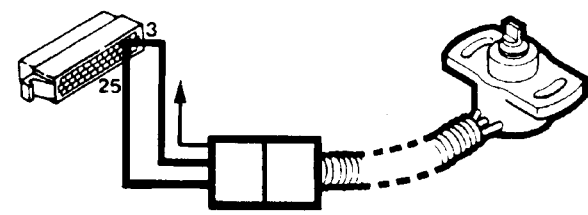
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>11. Check fuel temperature thermistor (sensor)</p>	<p>Correct reading-temperature to resistance</p> <p>- Proceed to Test 12</p> <p>(Refer to Temperature Conversion Charts in Test 12)</p> <p>Incorrect Ohm-meter reading</p> <p>Check</p>
<p>11</p>  <p>IGNITION OFF RR1826E</p>	

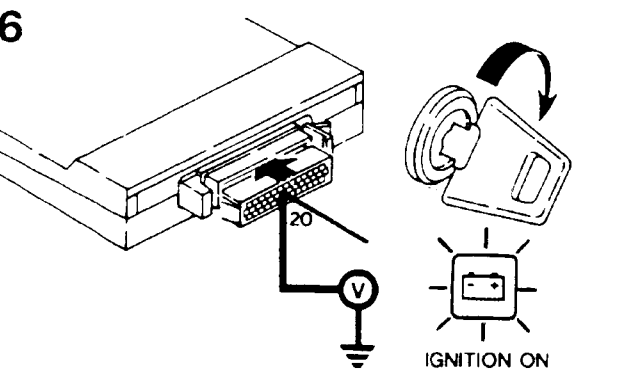
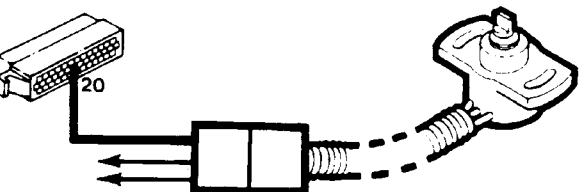
TEST PROCEDURE	RESULTS - Check cables and units shown in bold																											
<p>12. Check coolant temperature thermistor (sensor)</p>	<p>Correct reading-Temperature to resistance - Proceed to Test 13 (Refer to Temperature Conversion Chart below).</p> <table border="1" data-bbox="821 436 1412 728"> <thead> <tr> <th colspan="2">Fuel and Coolant Temperature</th> <th>Ohm-meter Reading Should be</th> </tr> <tr> <th>°C</th> <th>°F</th> <th>Ohms</th> </tr> </thead> <tbody> <tr> <td>-10°</td> <td>14°</td> <td>9100 - 9300</td> </tr> <tr> <td>0°</td> <td>32°</td> <td>5700 - 5900</td> </tr> <tr> <td>20°</td> <td>68°</td> <td>2400 - 2600</td> </tr> <tr> <td>40°</td> <td>104°</td> <td>1100 - 1300</td> </tr> <tr> <td>60°</td> <td>140°</td> <td>500 - 700</td> </tr> <tr> <td>80°</td> <td>176°</td> <td>300 - 400</td> </tr> <tr> <td>100°</td> <td>212°</td> <td>150 - 200</td> </tr> </tbody> </table> <p>Incorrect Ohm-meter reading Check:-</p>	Fuel and Coolant Temperature		Ohm-meter Reading Should be	°C	°F	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
Fuel and Coolant Temperature		Ohm-meter Reading Should be																										
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80°	176°	300 - 400																										
100°	212°	150 - 200																										
<p>12</p>  <p>IGNITION OFF RR1827E</p>																												

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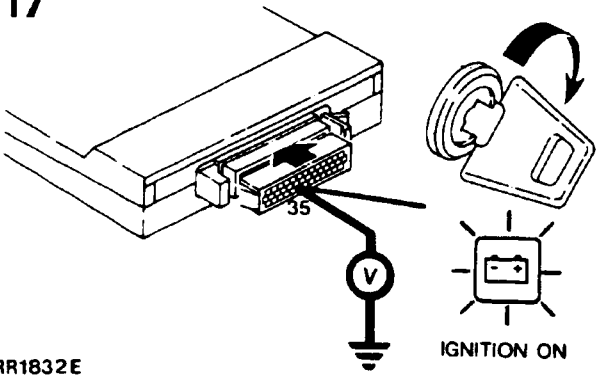
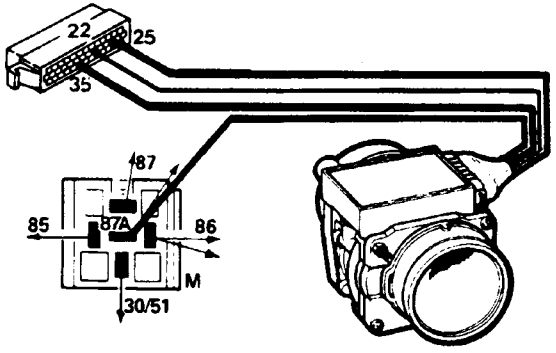
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>13. Check air bypass valve - Part 1</p>	<p>Ohm-meter reading of 48-58 Ohms - Proceed to Test 14</p> <p>Incorrect reading Check:-</p>
<p>13</p>  <p>IGNITION OFF RR1828E</p>	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>14. Check air bypass valve - Part 2</p>	<p>Ohm-meter reading of 48-58 Ohms - Proceed to Test 15</p> <p>Incorrect reading Check:-</p>
<p>14</p>  <p>IGNITION OFF RR1829E</p>	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>15. Check throttle potentiometer - Part 1</p>	<p>Ohm-meter reading of 5000 Ohms - Proceed to Test 16</p> <p>Incorrect reading of Infinity Check:-</p>
<p>15</p>  <p>IGNITION OFF RR1830E</p>	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold												
<p>16. Check throttle potentiometer - Part 2</p>	<p>Correct voltmeter readings- Proceed to Test 17</p> <table border="0" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Throttle closed</td> <td></td> <td style="text-align: center;">Throttle open</td> </tr> <tr> <td style="text-align: center;">0.29)</td> <td style="text-align: center;">smooth</td> <td style="text-align: center;">(4.6 Volts</td> </tr> <tr> <td style="text-align: center;">) -----</td> <td></td> <td style="text-align: center;">(</td> </tr> <tr> <td style="text-align: center;">0.36)</td> <td style="text-align: center;">swing</td> <td style="text-align: center;">(5.0 Volts</td> </tr> </table> <p>Incorrect voltmeter readings Check:-</p>	Throttle closed		Throttle open	0.29)	smooth	(4.6 Volts) -----		(0.36)	swing	(5.0 Volts
Throttle closed		Throttle open											
0.29)	smooth	(4.6 Volts											
) -----		(
0.36)	swing	(5.0 Volts											
<p>16</p>  <p>RR1831E</p>													

Continued

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>17. Check output of Airflow sensor</p>	<p>Voltmeter reading of 0.3-0.6 volts- Proceed to Test 18</p> <p>Incorrect voltmeter reading Check:-</p>
<p>17</p>  <p>RR1832E</p>	

PRECAUTION:

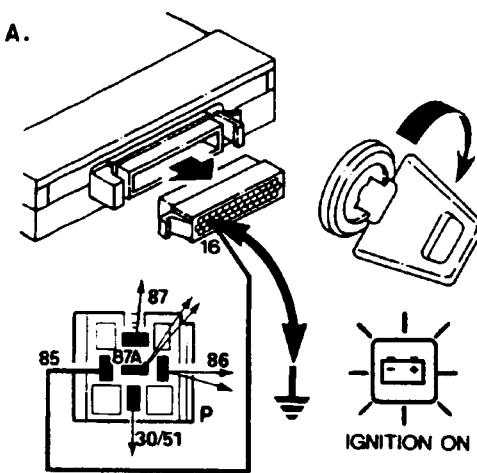
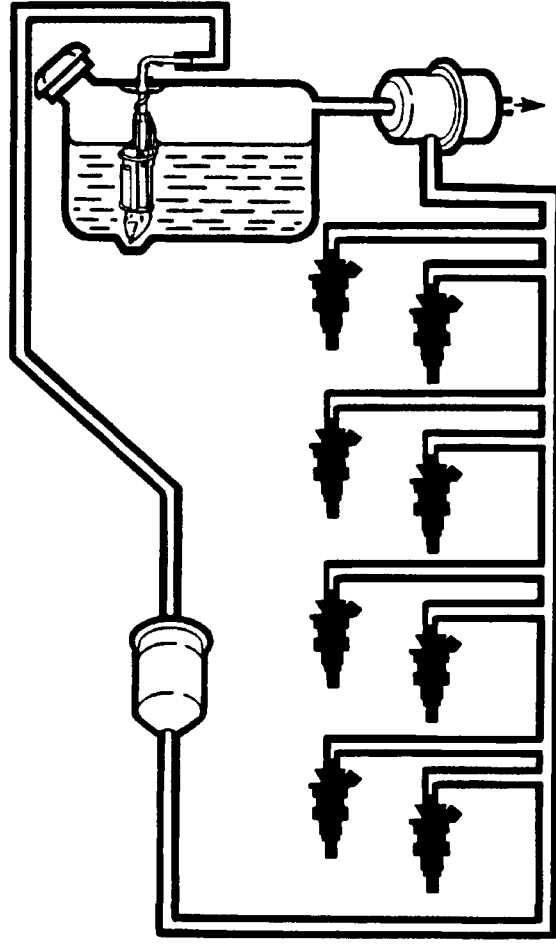
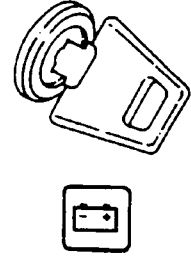
Depressurise the fuel system when fitting the fuel pressure gauge or disconnecting/replacing fuel system components.

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.

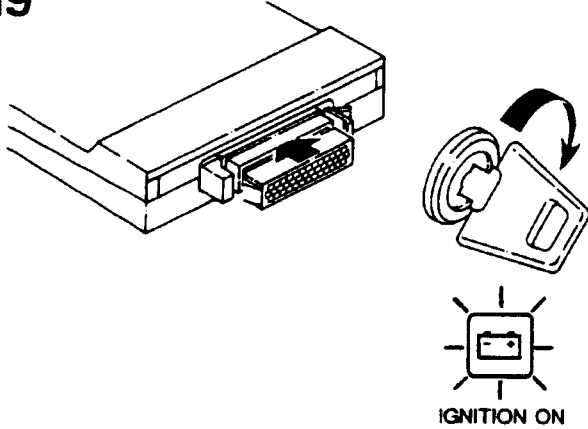
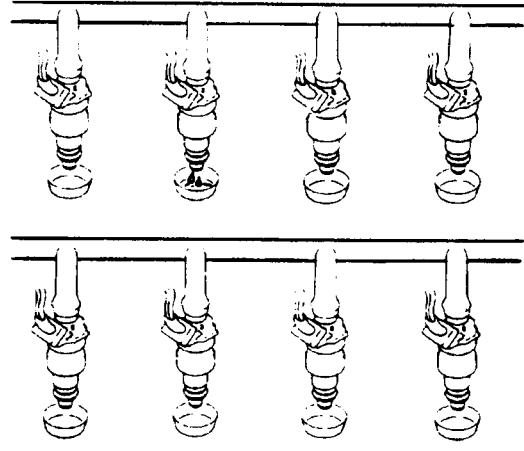
WARNING: The spillage of fuel from the fuel filter is unavoidable when disconnecting the fuel feed line, ensure that all necessary precautions are taken to prevent fire and explosion due to fuel vapour and fuel seepage.

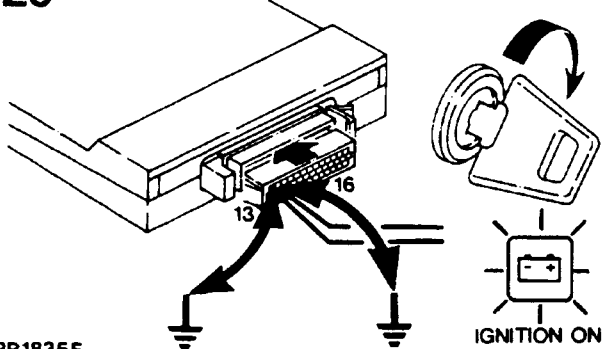
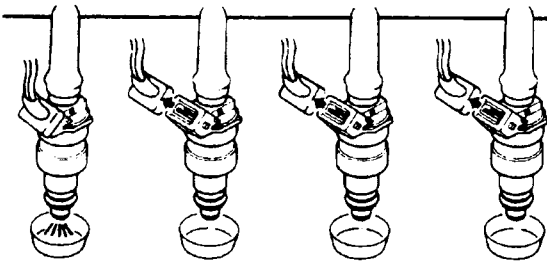
DEPRESSURISING PROCEDURE

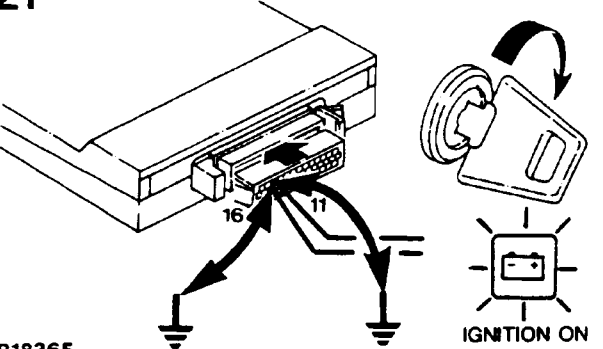
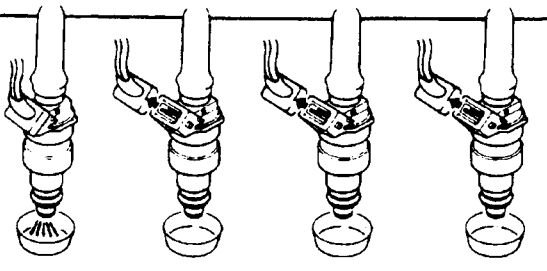
- a) Ignition off, pull pump relay off its terminal block.
- b) Crank engine for a few seconds - engine may fire and run until fuel pressure is reduced.
- c) Switch off the ignition.
- d) Connect fuel pressure gauge in the fuel supply line between the fuel rail and the fuel filter, adjacent to the filter (see Test 18).
- e) Reconnect the pump relay.

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>18. Check fuel system pressure Service tool 18G 1500</p> <p>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</p>	<p>(A) Expected reading 2,4-2,6 kgf/cm² (34.0-37.0 p.s.i.)</p> <p>(B) Pressure drop-max 0.7 kgf/cm² (10 p.s.i.) in one minute</p>
<p>18</p> <p>A.</p>  <p>IGNITION ON</p>	
<p>B.</p>  <p>IGNITION OFF</p> <p>RR1833E</p>	

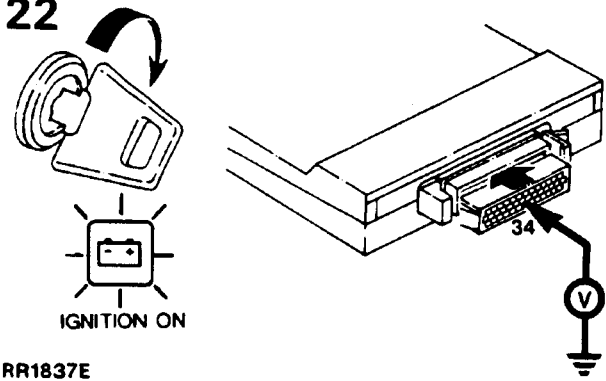
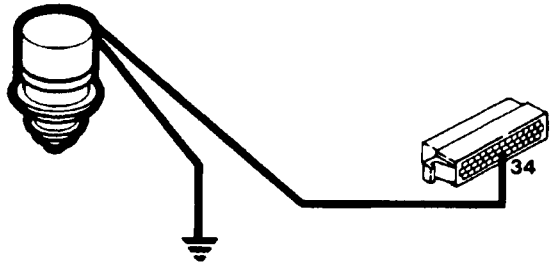
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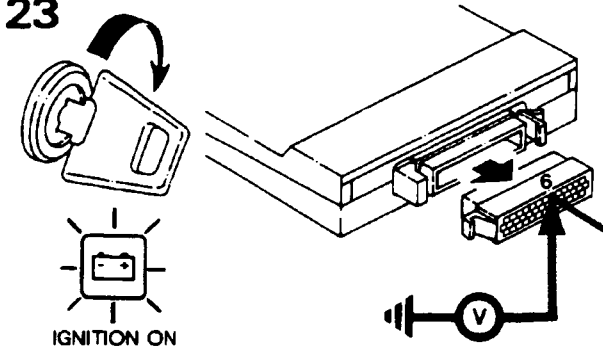
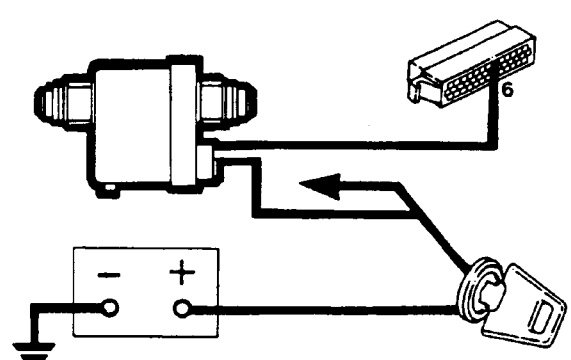
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>19. Check for leaking injector</p> <p>NOTE: Before removing any of the injectors, remove and examine the spark plugs, check for consistent colouration of plugs. A leaking injector will result in the appropriate spark plug being 'sooted up'.</p> <p>Remove all injectors from manifold but do not disconnect from fuel rail</p>	<p>WARNING: Ensure that all necessary precautions are taken to prevent fire and explosion.</p> <p>Replace any injector which leaks more than 2 drops of fuel per minute.</p>
<p>19</p>  <p>RR1834E</p>	

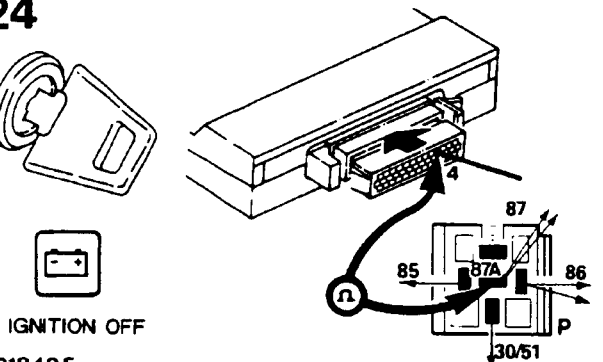
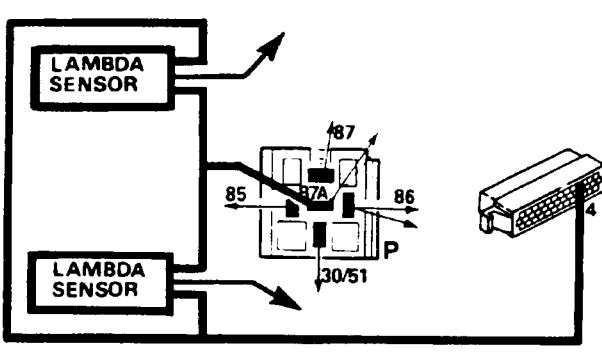
TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>20. Check for injector operation Left bank injectors 1,3,5,7</p>	<p>WARNING: Ensure that all necessary precautions are taken to prevent fire and explosion.</p> <p>Repeat test for other injectors Replace any injector which does not operate. NOTE: Fuel flow is 167cc minimum per minute per injector</p>
<p>20</p>  <p>RR1835E</p>	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>21. Right bank injectors 2,4,6,8</p>	<p>WARNING: Ensure that all necessary precautions are taken to prevent fire and explosion.</p> <p>Repeat test for other injectors Replace any injector which does not operate. NOTE: Fuel flow is 167cc minimum per minute per injector</p>
<p>21</p>  <p>RR1836E</p>	

Continued

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>22. Check gear switch input</p>	<p>Voltmeter reading of zero volts- Neutral and park</p> <p>Voltmeter reading of 4.5-5.0 Volts -R.D.3.2.1 - Proceed to Test 23</p> <p>Incorrect reading Check:</p>
<p>22</p>  <p>RR1837E</p>	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>23. Check road speed input</p> <p>NOTE: Raise and rotate the left hand rear road wheel slowly</p>	<p>Voltmeter reading of 0 to 12V fluctuating 6 times per revolution - Proceed to Test 24</p> <p>Incorrect reading Check:</p>
<p>23</p>  <p>IGNITION ON</p> <p>RR1838E</p>	

TEST PROCEDURE	RESULTS - Check cables and units shown in bold
<p>24. Check Lambda sensor heater coils</p> <p>NOTE: Remove pump relay from its connector</p>	<p>Ohm-meter reading of 2.65-3.35 Ohms</p> <p>Incorrect reading Check:</p> <p>NOTE: A reading of 5.3 to 6.7 Ohms indicates a faulty Lambda sensor</p>
<p>24</p>  <p>IGNITION OFF</p> <p>RR1840E</p>	

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 correctly set; all hoses correctly fitted and secured.

These checks should be carried out with the engine coolant temperature between 80° to 95°C (176° to 203°F).

CHECK AND ADJUST IGNITION TIMING

1. Check that ignition timing is at $6^{\circ} \pm 1^{\circ}$ 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 catalyts.
- B. If the engine is misfiring, it should be immediately shut down and the cause rectified.

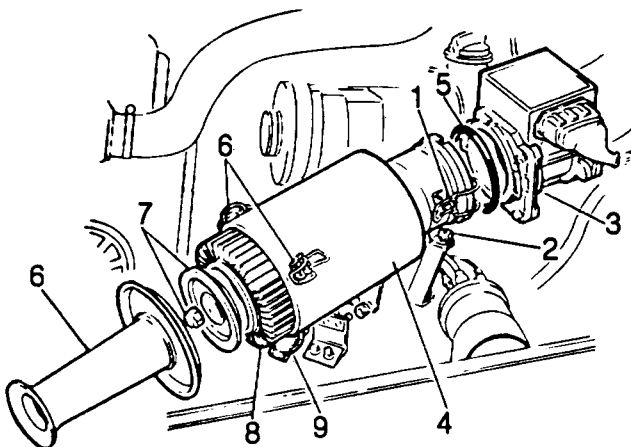
Failure to comply with A or B will result in irreparable damage to the catalyts.

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.

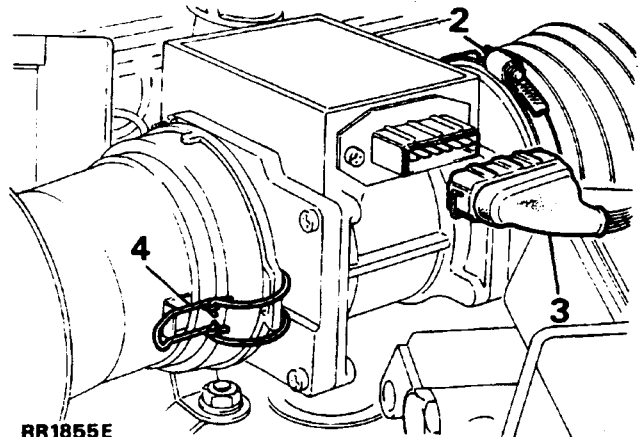
AIR FLOW SENSOR

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.



RR1855E

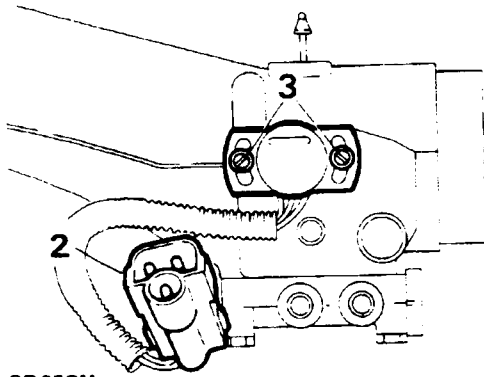
Refitting

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.



RR659M

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 ± 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

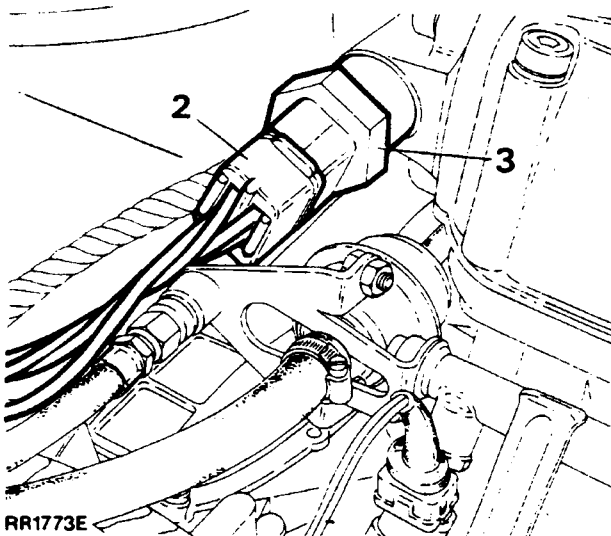
NOTE: After setting the potentiometer, lock and tamperproof each screw head by coating them with yellow paint.

**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.

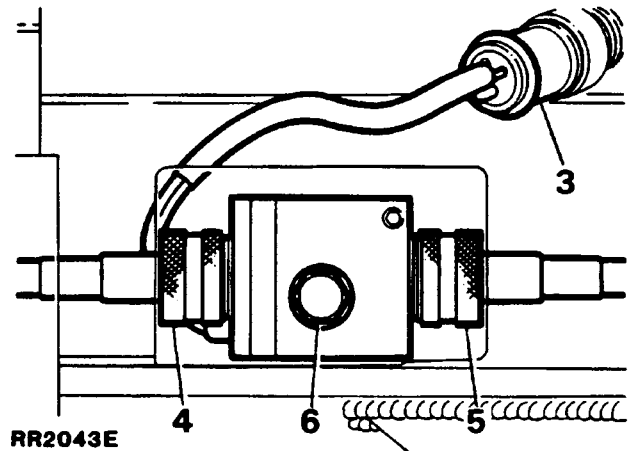
6. Tighten the valve to the specified torque (see Torque values-section 06).
7. Reverse the remaining removal instructions.

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.



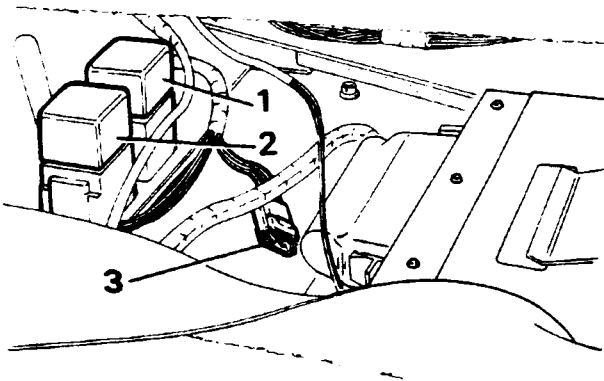
Refitting

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.

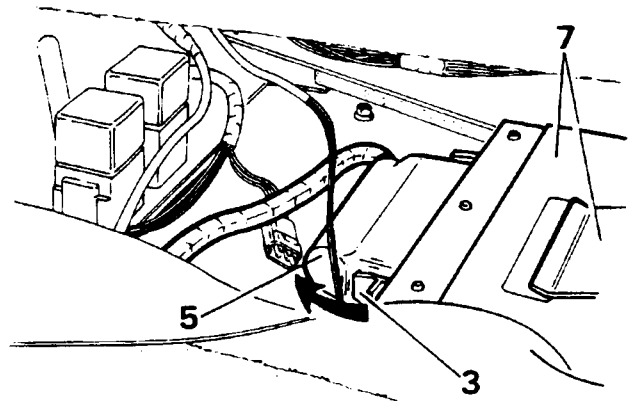
ELECTRONIC CONTROL UNIT-ECU

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. Maneuver 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.

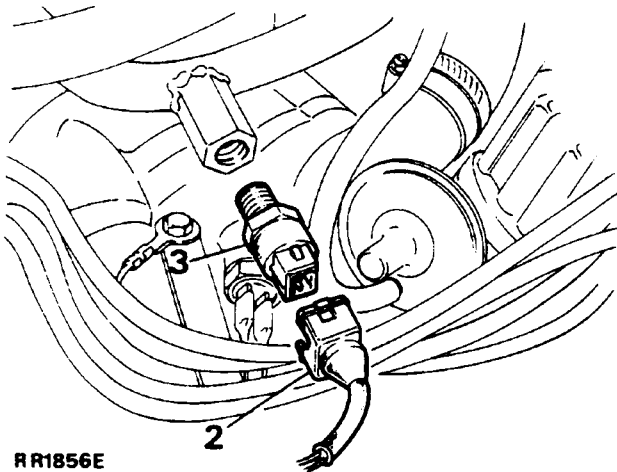
FUEL TEMPERATURE THERMISTOR (SENSOR)

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.

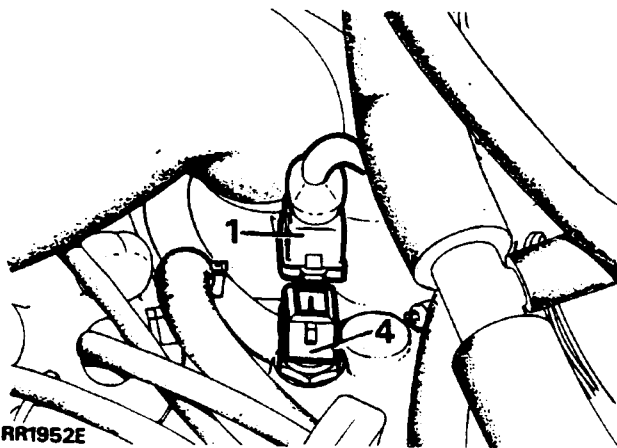


Refitting

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.

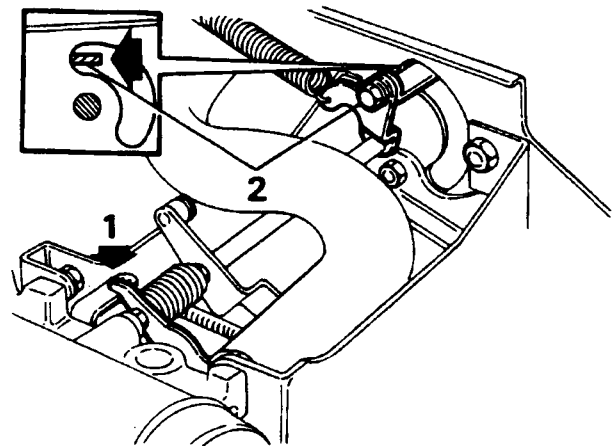
**Refitting**

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.



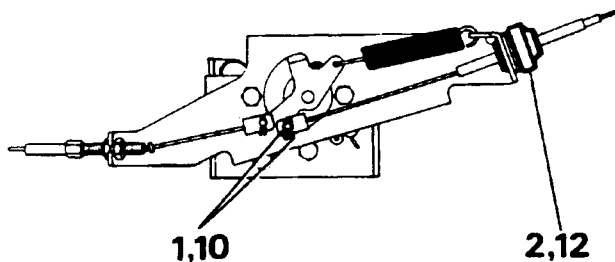
RR2339S

THROTTLE CABLE

Remove and refit

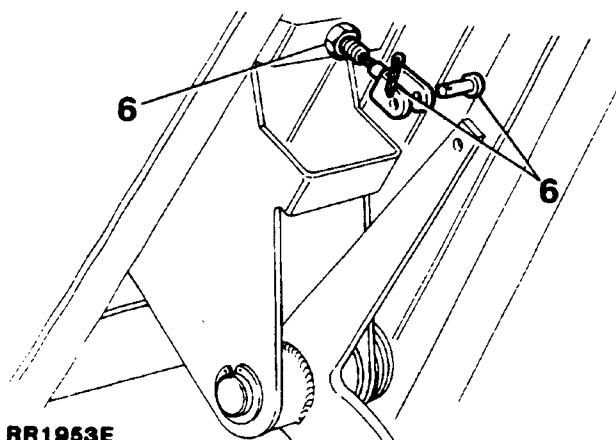
Removing

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

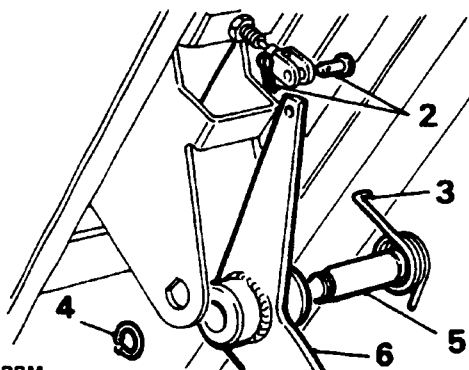
Remove and refit

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

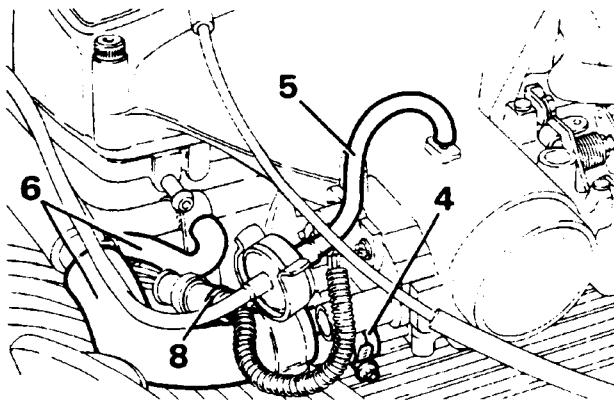
7. Lightly grease the pivot pin and clevis pin before re-assembly.
8. Fit a **NEW** cotter pin to the clevis pin.
9. Reverse the remaining removal instructions.

PLENUM CHAMBER

Remove and refit

Removing

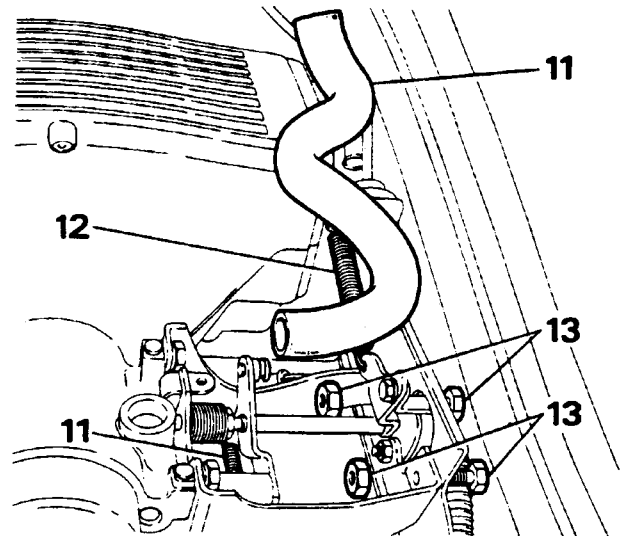
1. Disconnect the battery negative terminal.
2. Release the radiator bottom hose and partially drain the cooling system, reconnect the hose to the radiator.
3. Release the two large hose clamps from the neck of the plenum chamber and outlet bore of the airflow sensor and remove the hose from its location.
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.

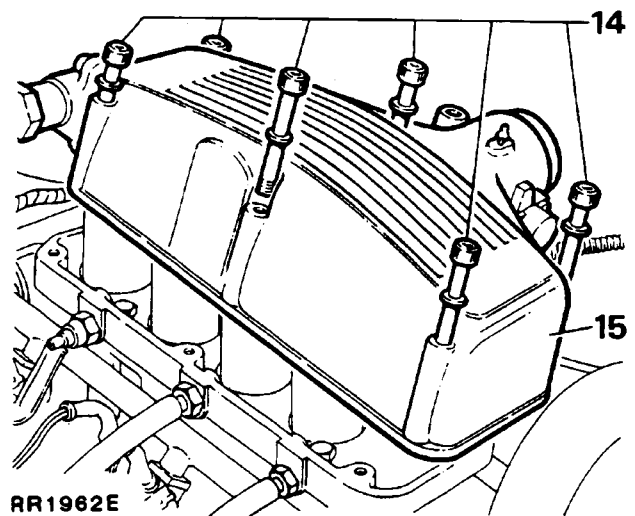
12. Release the two throttle return springs.
13. Remove the two bolts (with spring washers) securing the throttle cable and kick-down cable anchor bracket to the throttle lever support bracket, lay the assembly to one side.



RR2341S

14. Remove the six socket head bolts (with plain washers) securing the plenum chamber to the ram housing.
15. Maneuver the plenum chamber and remove it from the ram housing.

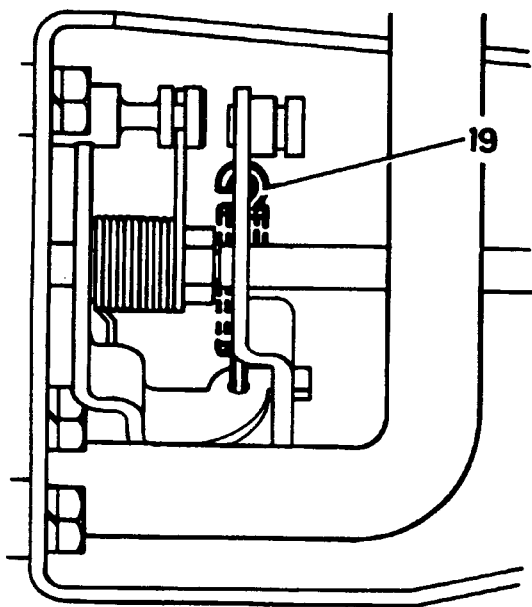
NOTE: To prevent ingress of dirt into the ram tubes, place a protective cover over the ram tube openings.



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.

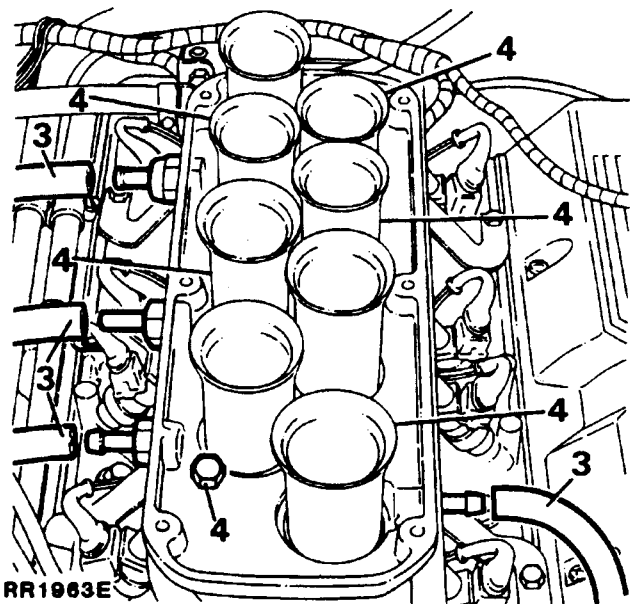
NOTE: Ensure that all hoses are connected securely to prevent un-metered air entering the engine.

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.



RR1983E

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).

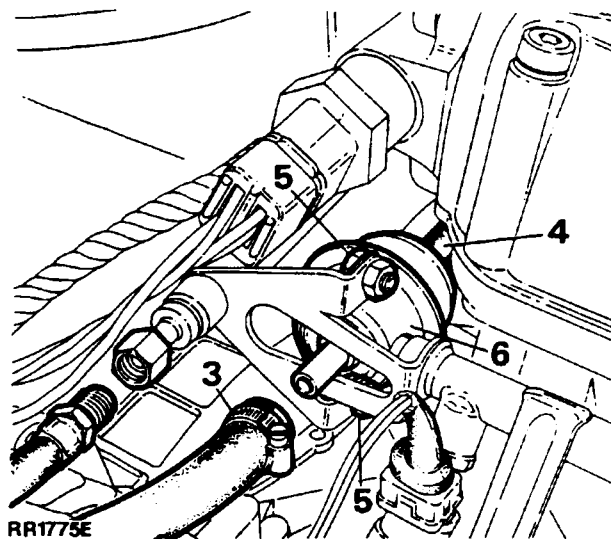
FUEL PRESSURE REGULATOR

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.



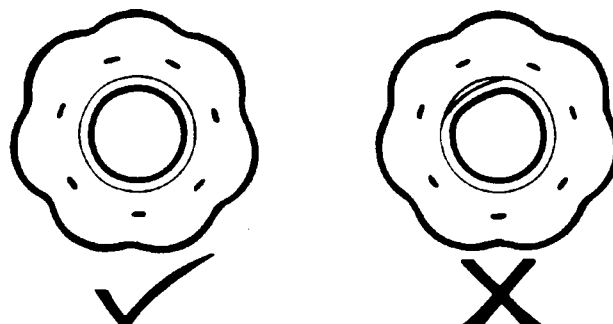
NOTE: If the original regulator is being refitted, fit a NEW 'O' ring to the fuel inlet pipe.

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

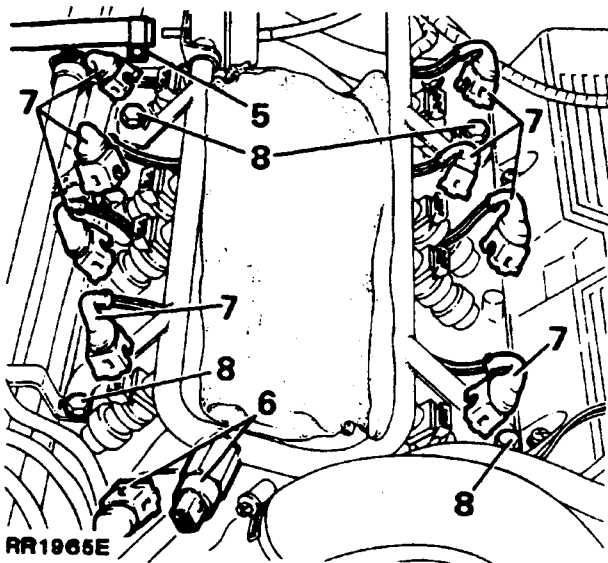
Remove and refit

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).

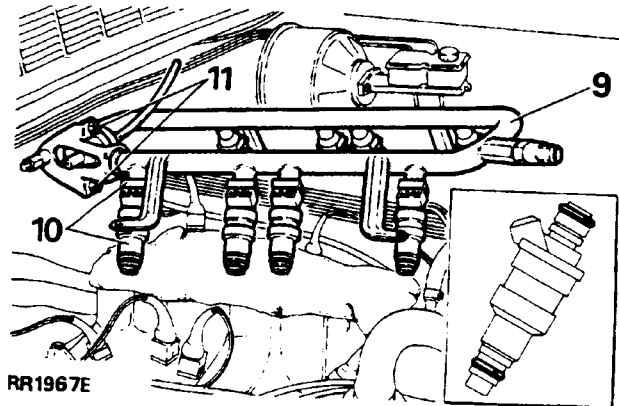
NOTE: Place a cloth over the ram tube openings to prevent ingress of dirt into the engine.

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

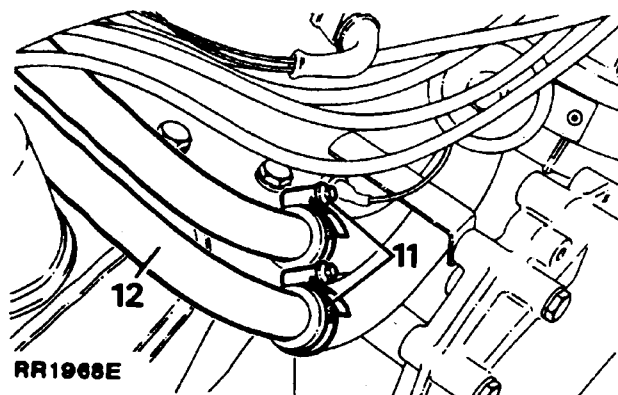
1. Depressurise the fuel system.
2. Disconnect the battery negative terminal.
3. Release the hose clamp and remove the radiator bottom hose to enable the cooling system to be partially drained, so that coolant level is below the thermostat housing, refit the hose and secure in position with the hose 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.

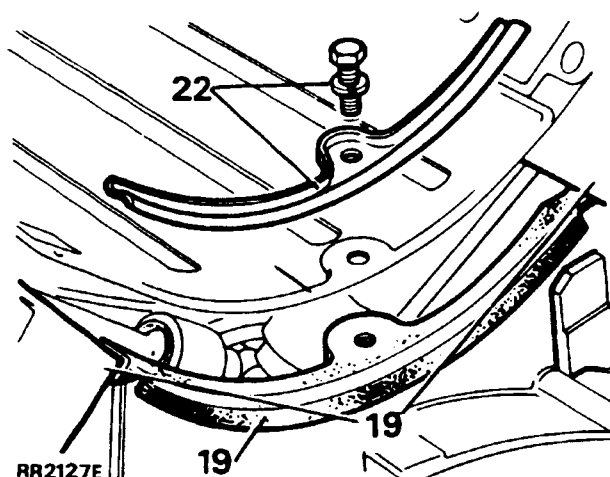
8. Disconnect the electrical leads from the air-conditioning engine coolant sensor located on the thermostat elbow.
9. Disconnect the electrical leads to the coolant temperature transmitter (sensor) located at the front of the intake manifold.
10. Remove the injector harnesses from behind the fuel rail 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.



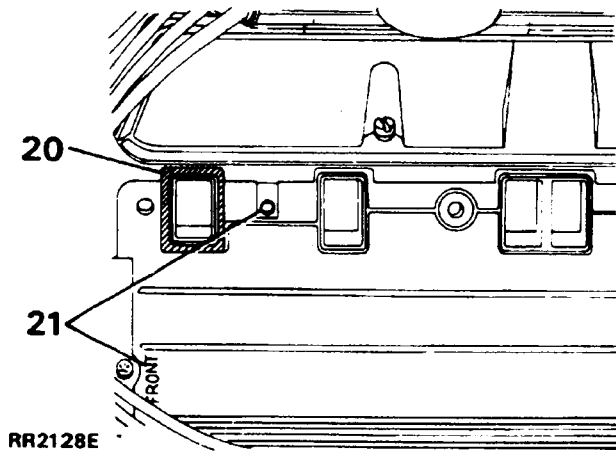
13. Lay the heater pipe assembly to one side.
14. Release the twelve bolts securing the intake manifold to the cylinder heads.
15. Lift the manifold off the cylinder heads and remove from the engine compartment.
16. Remove the two gasket clamps from the top of the cylinder block.
17. Lift off the gasket 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.



RR2128E

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.

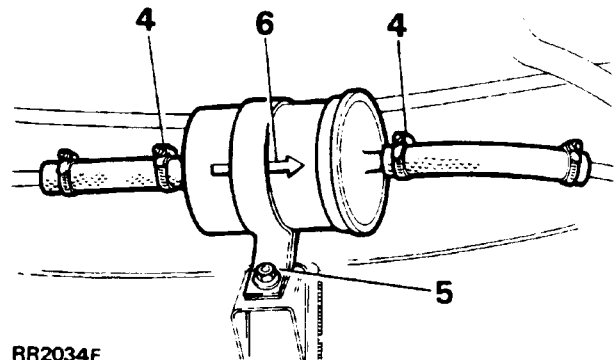
FUEL LINE FILTER

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.



RR2034E

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

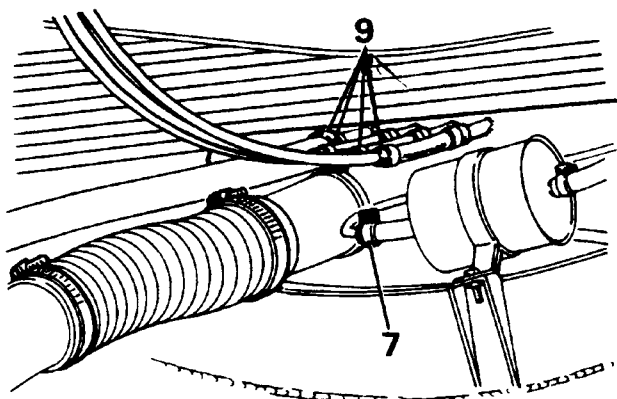
WARNING: Ensure that all the necessary precautions are taken against fuel spillage and fuel vapour to prevent fire or explosion.

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).

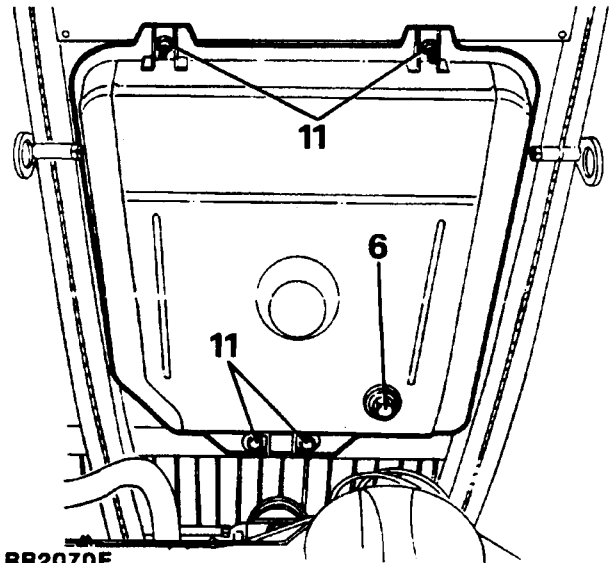
From underneath the vehicle

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, manoeuvre 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 manoeuvre 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.

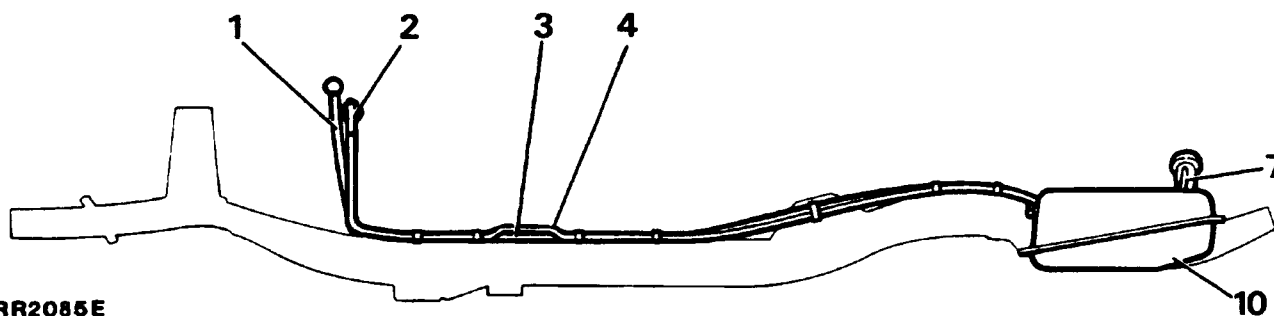
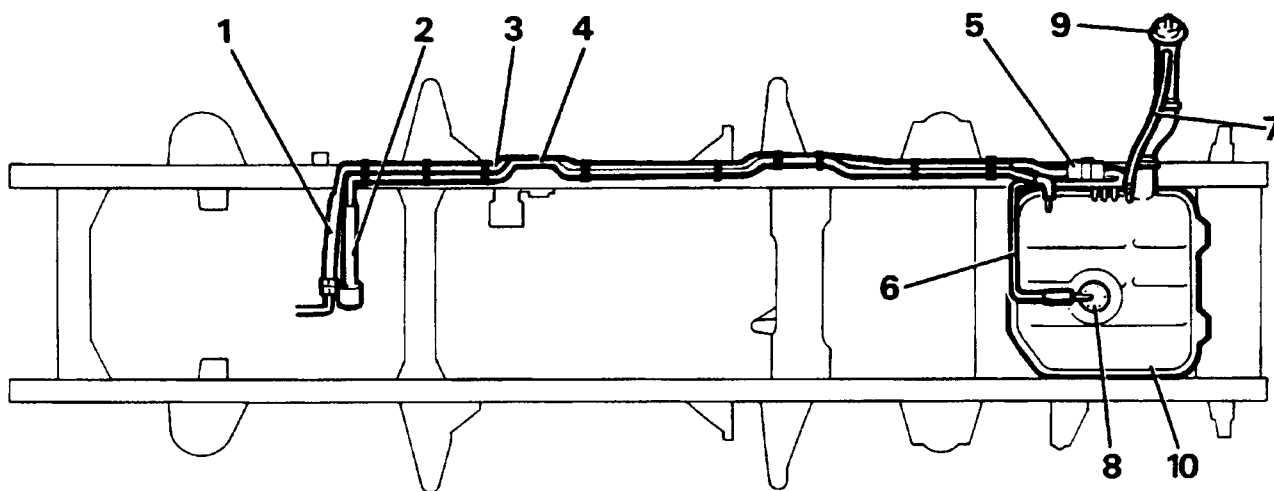
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FUEL PIPES

WARNING: Depressurise fuel system before disconnecting any of the fuel pipes and ensure that all necessary precautions are taken against fuel spillage.

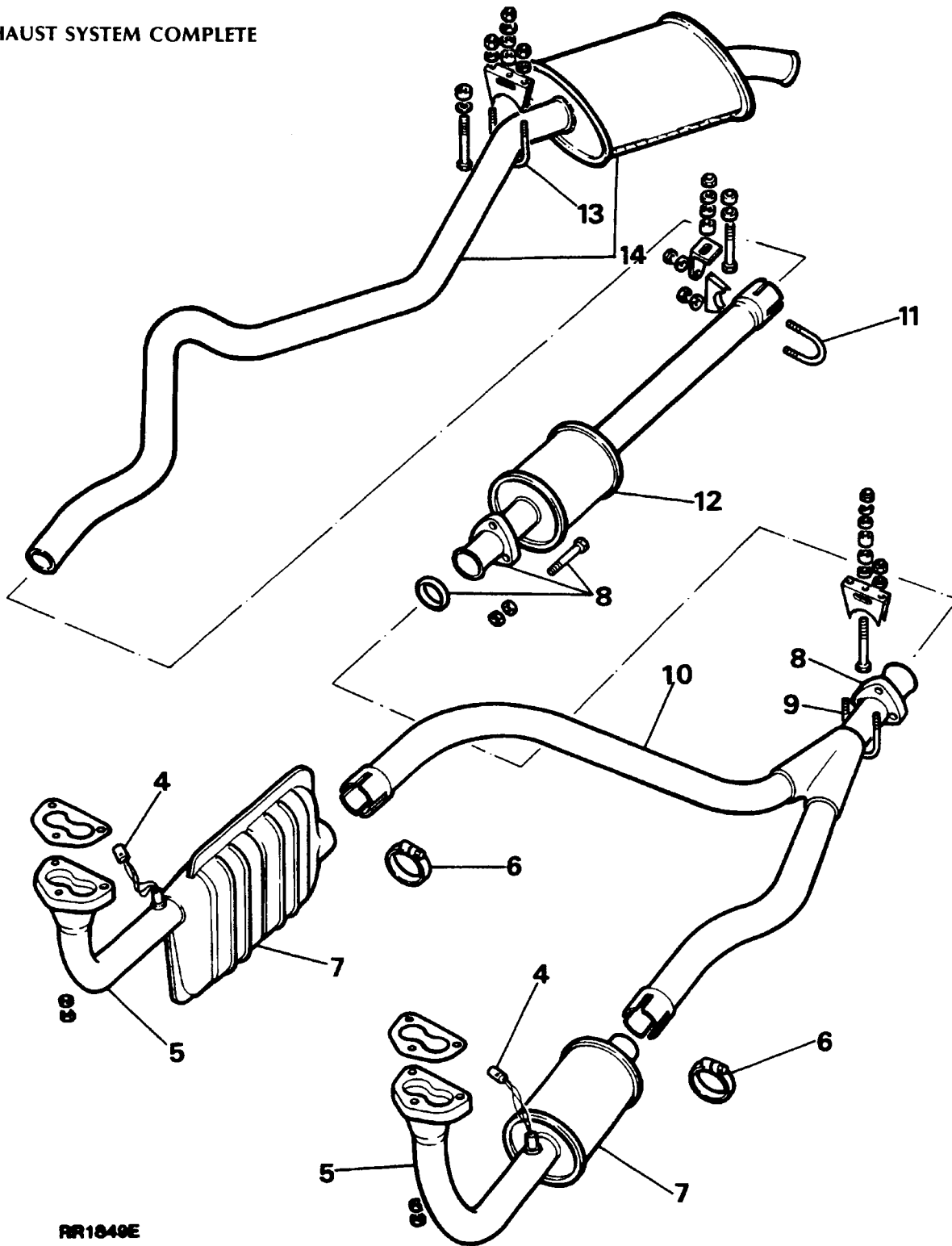
KEY

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.



RR2085E

EXHAUST SYSTEM COMPLETE



RR1840E

EXHAUST SYSTEM COMPLETE

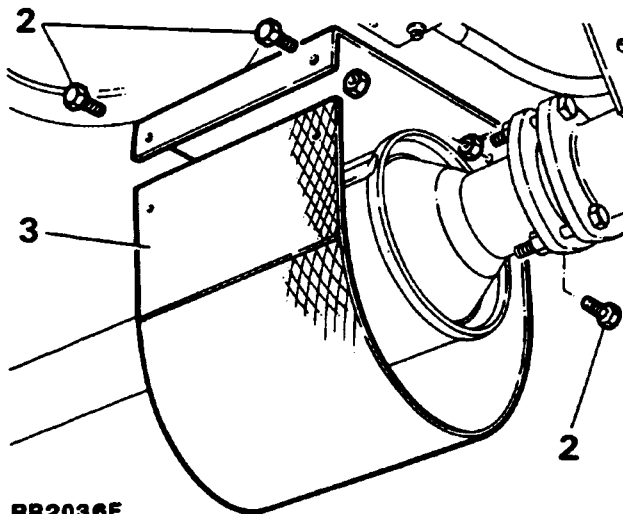
NOTE: Ensure that no exhaust leaks are evident in either a new or an old exhaust system, as this will affect vehicle performance, and could contravene local emission regulations.

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.

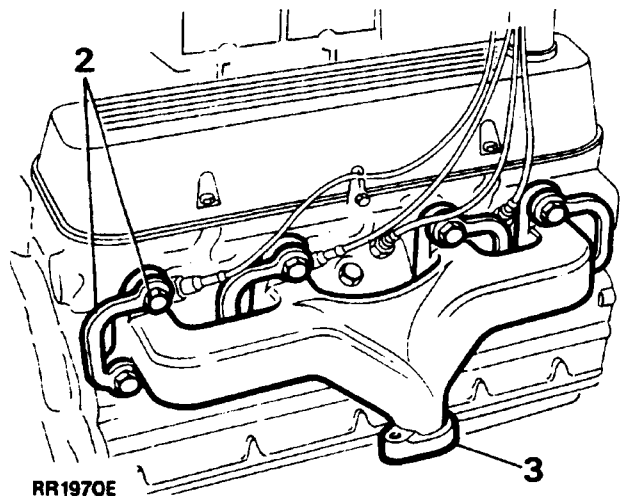
Refitting

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

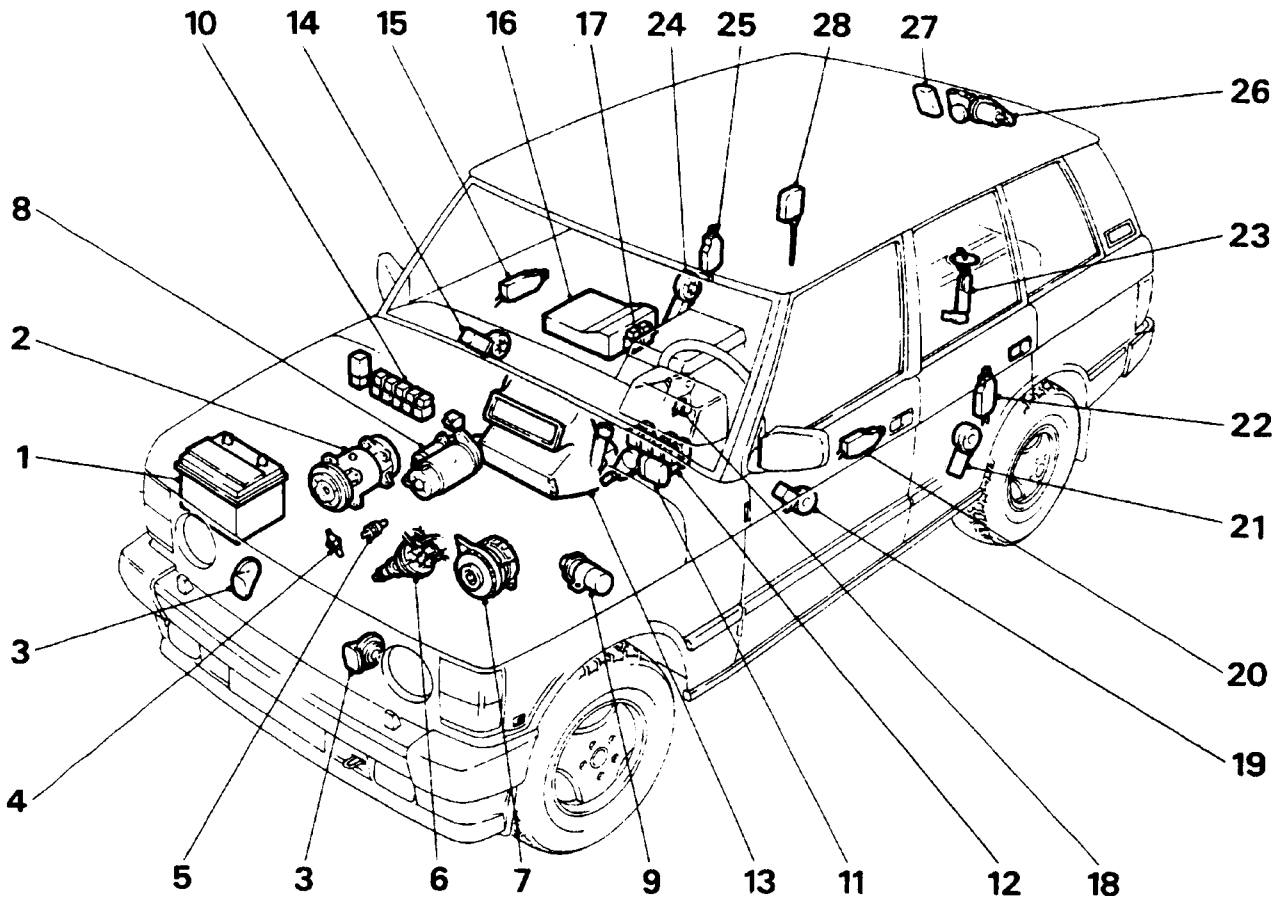
Front propeller shaft

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.



RR2308S

LOCATION OF ELECTRICAL EQUIPMENT

- | | |
|--|---|
| <ul style="list-style-type: none"> 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) | <ul style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Current voltage regulator not functioning correctly 	<ol style="list-style-type: none"> 1. Fit new unit
C-Lamps giving insufficient illumination	<ol style="list-style-type: none"> 1. Battery discharged 2. Bulbs discoloured through prolonged use 3. Fan belt broken 	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Battery discharged 	<ol style="list-style-type: none"> 1. Charge the battery from an independent supply or by a long period of daylight running
E-Lights flicker	<ol style="list-style-type: none"> 1. Loose connection 	<ol style="list-style-type: none"> 1. Tighten/clean
F-Failure of lights	<ol style="list-style-type: none"> 1. Battery discharged 2. Loose broken connection 3. Fan belt broken 	<ol style="list-style-type: none"> 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
<p>G-Starter motor lacks power or fails to turn engine</p>	<ol style="list-style-type: none"> 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 	<ol style="list-style-type: none"> 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
<p>H-Starter noisy</p>	<ol style="list-style-type: none"> 1. Starter pinion or flywheel teeth chipped or damaged 2. Starter motor loose on engine 3. Armature shaft bearing 	<ol style="list-style-type: none"> 1. Fit new components 2. Rectify, checking pinion and the flywheel for damage 3. Fit new bearing
<p>J-Starter operates but does not crank the engine</p>	<ol style="list-style-type: none"> 1. Pinion of starter does not engage with the flywheel 	<ol style="list-style-type: none"> 1. Check operation of starter solenoid. If correct, remove starter motor and investigate
<p>K-Starter pinion will not disengage from the flywheel when the engine is running</p>	<ol style="list-style-type: none"> 1. Starter pinion jammed in mesh with the flywheel 	<ol style="list-style-type: none"> 1. Remove starter motor and investigate

SYMPTOM	POSSIBLE CAUSE	CURE
<p>L-Engine will not start</p>	<ol style="list-style-type: none"> 1. The starter will not turn the engine due to a discharged battery 2. The starter will not turn due to incorrect gear selection. 3. Sparking plugs faulty, dirty or incorrect plug gaps 4. Defective coil or distributor 5. A fault in the low tension wiring circuit 6. Faulty amplifier 7. Air gap out of adjustment 8. Fuel system fault 	<ol style="list-style-type: none"> 1. Recharge battery by running the car for a long period during daylight or from an independent electrical supply 2. Select 'P' or 'N' 3. Rectify/ fit new plugs 4. Carry out ignition checks. Fit a new coil or distributor 5. Examine all the ignition cables and check that the terminals are secure and not corroded. 6. Check/fit new component if necessary. 7. Adjust 8. See Fuel System Section.
<p>M-Engine misfires/ stalls</p>	<ol style="list-style-type: none"> 1. Faulty sparking plugs 2. Air gap incorrectly set 3. Distributor cap cracked 4. Faulty pick-up or reluctor 5. Excessive wear in distributor shaft brushes, etc. 6. Rotor arm and flash shield cracked or showing signs of tracking 	<ol style="list-style-type: none"> 1. Rectify 2. Adjust 3. Fit new cap 4. Fit new components 5. Fit a new components 6. Fit new component

SYMPTOM	POSSIBLE CAUSE	CURE
<p>N-Frequent recharging of the battery necessary</p>	<ol style="list-style-type: none"> 1. Alternator inoperative 2. Loose or corroded connections 3. Slipping fan belt 4. Voltage regulator faulty 5. Excessive use of the starter motor 6. Vehicle operation confined largely to night driving 7. Abnormal accessory load 8. Internal discharge of the battery 	<ol style="list-style-type: none"> 1. Check the brushes, cables and connections or fit a new alternator 2. Examine all connections especially the battery terminals and ground cables 3. Adjust 4. Fit new component 5. In the hands of the operator, advise 6. In the hands of the operator, advise 7. Superfluous electrical fittings such as extra lamps, etc. 8. Fit new battery
<p>P-Alternator not charging correctly</p>	<ol style="list-style-type: none"> 1. Slipping fan belt 2. Voltage control not operating correctly 3. Greasy, charred or glazed slip rings 4. Brushes worn, sticking or oily 5. Shorted, open or burnt-out field coils 	<ol style="list-style-type: none"> 1. Adjust 2. Rectify/ fit new component 3. Clean 4. Rectify/fit new brushes 5. Fit new field coils
<p>Q-Alternator noisy</p>	<ol style="list-style-type: none"> 1. Worn, damaged or defective bearings 2. Cracked or damaged pulley 3. Alternator out of alignment 4. Alternator loose in mounting 5. Excessive brush noise 	<ol style="list-style-type: none"> 1. Fit new bearings 2. Fit new pulley 3. Rectify 4. Rectify 5. Check for rough or dirty slip rings, badly seating brushes, incorrect brush tension, loose brushes and loose field magnets. Rectify/fit new components
<p>R-Poor performance of horns</p>	<ol style="list-style-type: none"> 1. Low voltage due to discharged battery 2. Bad connections in wiring 3. Loose mounting nut 4. A faulty horn 	<ol style="list-style-type: none"> 1. Recharge 2. Carefully inspect all connections and horn push 3. Rectify 4. Fit new horn

SYMPTOM	POSSIBLE CAUSE	CURE
S-Central door locking does not operate (on all doors)	<ol style="list-style-type: none"> 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 	<ol style="list-style-type: none"> 1. Recharge 2. Fit new unit 3. Locate and rectify 4. Rectify
T-Central door locking does not operate (on one door only)	<ol style="list-style-type: none"> 1. Loose or broken connection 2. Lock actuator failure 3. Faulty lock 4. Mechanical linkages disconnected 	<ol style="list-style-type: none"> 1. Locate and rectify 2. Fit new actuator 3. Rectify 4. Locate and rectify
U-Window lift will not operate	<ol style="list-style-type: none"> 1. Motor failure 2. Loose or broken connection 3. Faulty switch 4. Mechanical linkage faulty 	<ol style="list-style-type: none"> 1. Fit new motor 2. Locate and rectify 3. Fit new switch 4. Rectify
V-Exterior mirrors fail to operate	<ol style="list-style-type: none"> 1. Loose or broken connection 2. Faulty switch 3. Mirror motor failure 	<ol style="list-style-type: none"> 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.

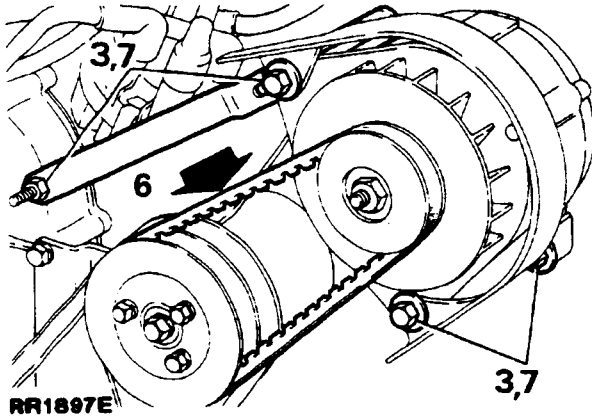
When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.

ALTERNATOR

Remove and refit

Removing

1. Disconnect battery ground lead
2. Disconnect leads from alternator.



3. Loosen alternator 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.

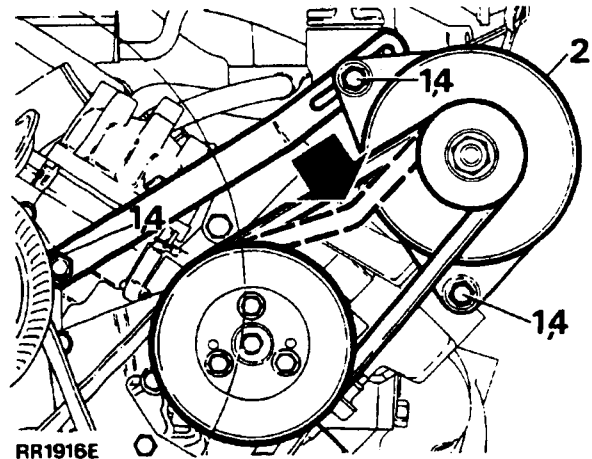
NOTE: The fan guard is attached to the front fixing and the adjustment bracket bolt.

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

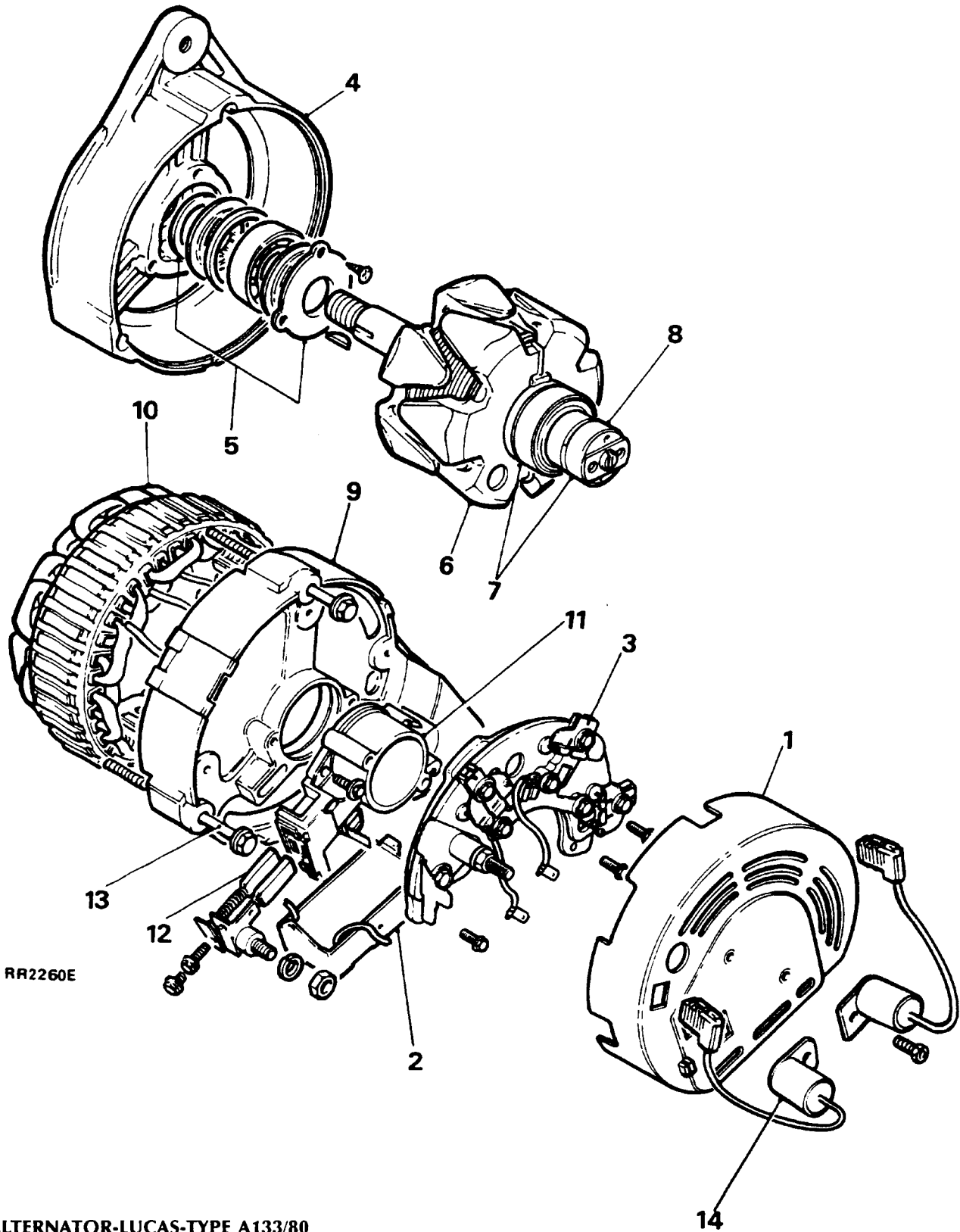
Adjust

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 the engine at fast idle for 3 to 5 minutes, if a new belt has been fitted.



ALTERNATOR-LUCAS-TYPE A133/80

- | | |
|--------------------------|--------------------------|
| 1. Cover | 8. Slip rings |
| 2. Regulator | 9. Slip ring end bracket |
| 3. Rectifier | 10. Stator |
| 4. Drive and bracket | 11. Brush box |
| 5. Bearing assembly | 12. Brushes |
| 6. Rotor | 13. Through bolt |
| 7. Slip ring end bearing | 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.

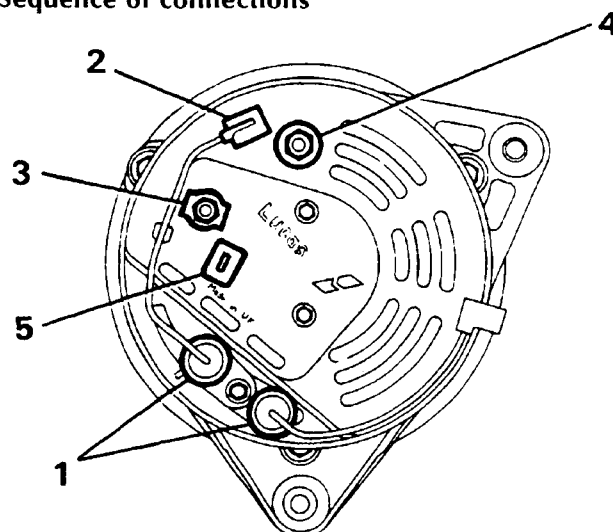
Precautions

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, underhood or door edge lamps being left on.

Alternator test

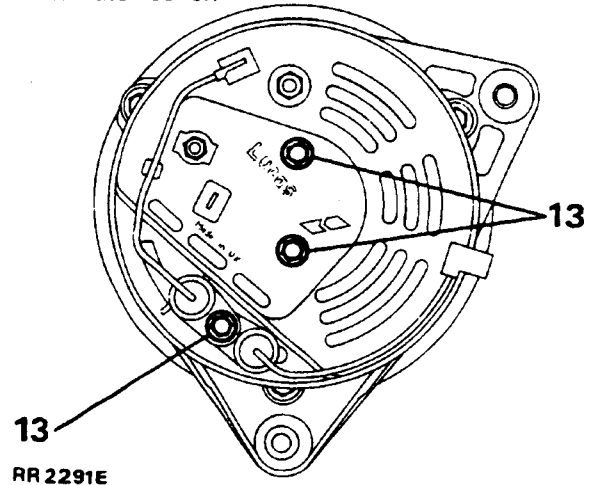
The following instructions refer to the use of suitable test equipment using a carbon pile rheostat.

6. Connect test equipment referring to the manufacturer's instructions.
7. Start engine and run at 3000 rev/min without accessory 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.

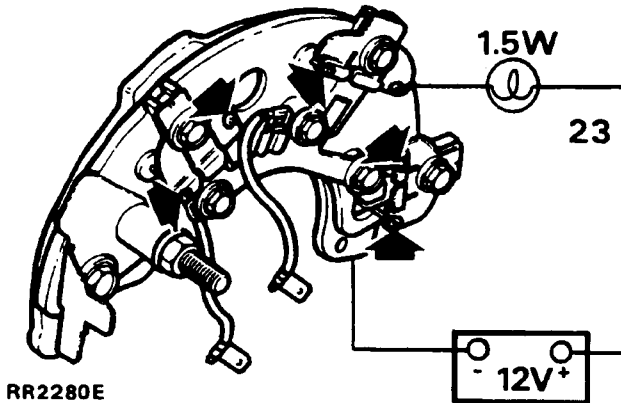
Testing-alternator removed

11. Withdraw the connectors from the alternator.
12. Remove the alternator.
13. Disconnect the suppressor and remove the alternator cover.



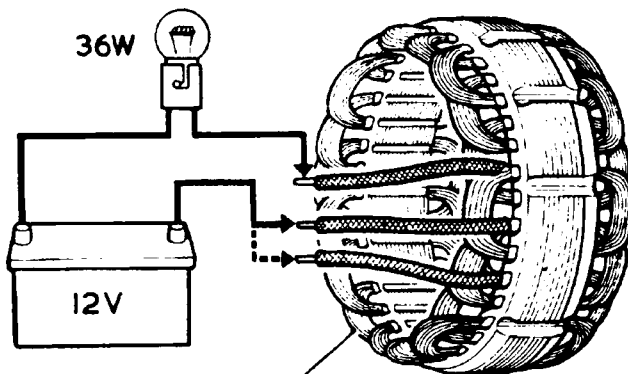
14. Disconnect the lead and remove the rectifier assembly.
15. Note the arrangement of the brush box connections and remove the screws securing the regulator to the brush box and withdraw. This screw also retains the inner brush mounting plate in position.
16. Remove the screw retaining the outer brush 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.



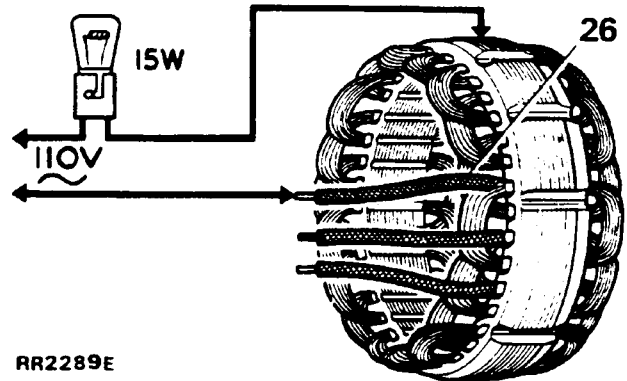
RR2280E

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.



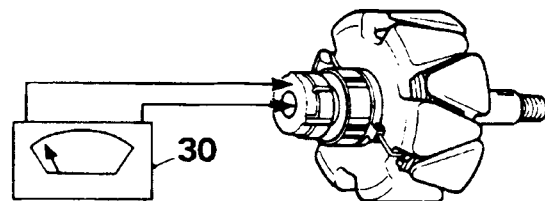
RR2288E

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.

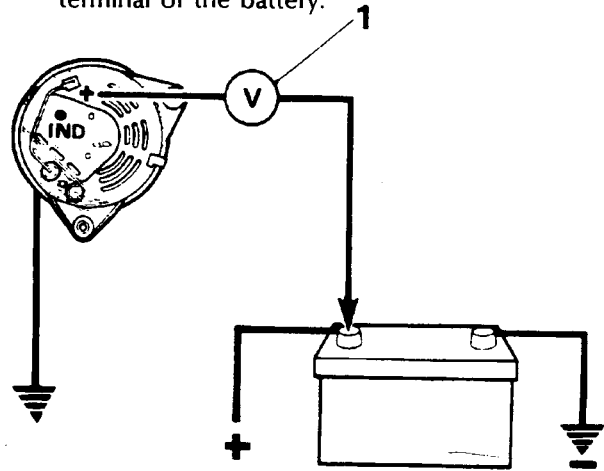
Reassembling

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

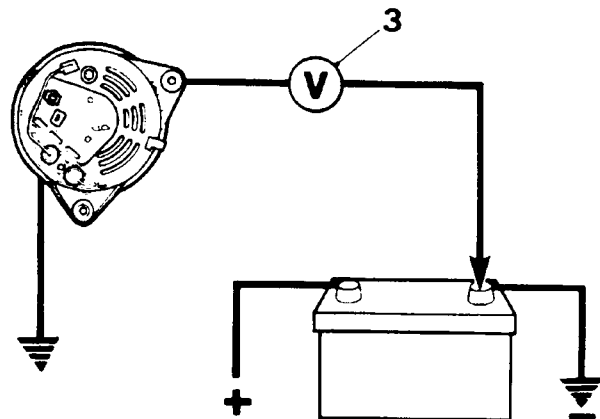
Charging circuit resistance test

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.



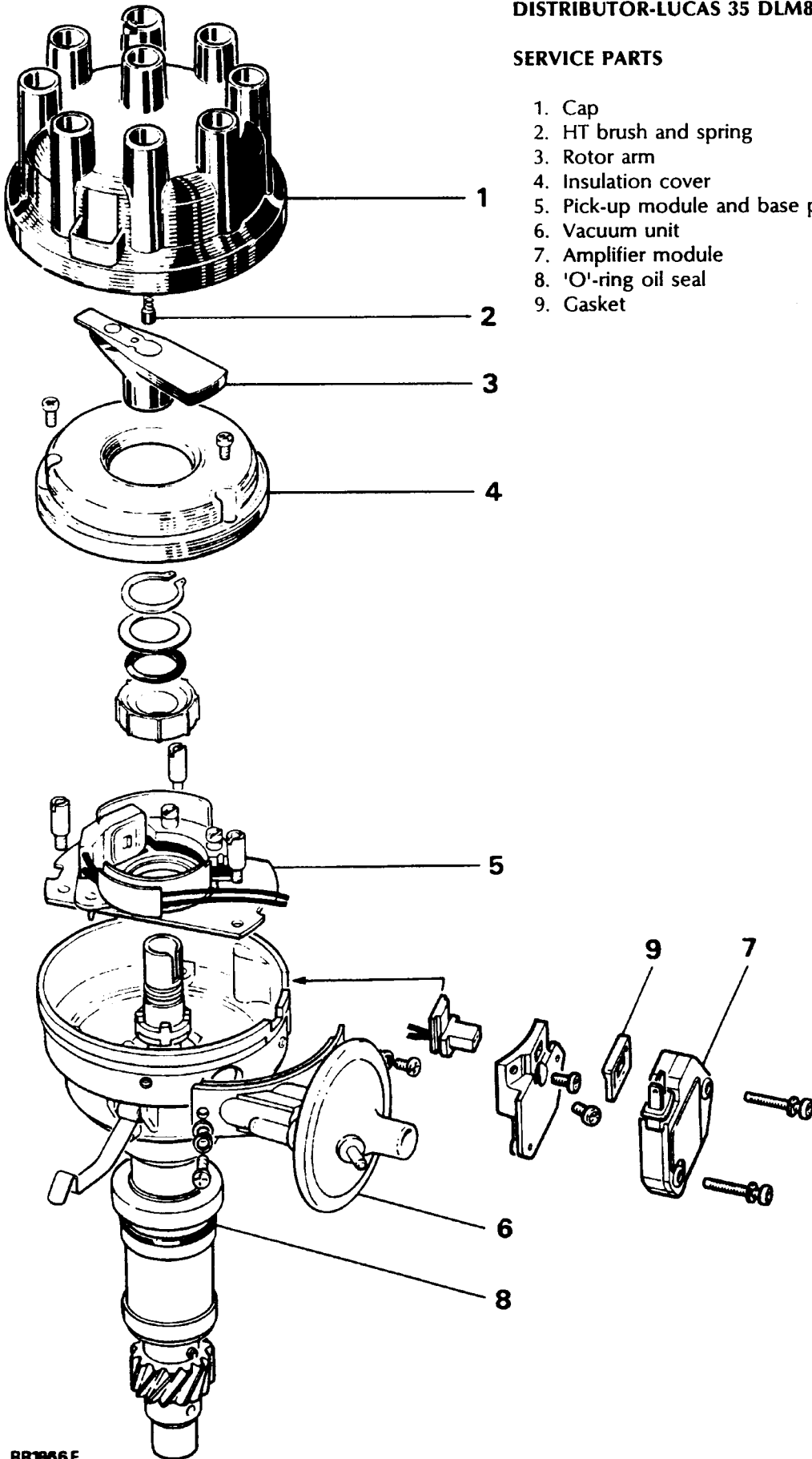
RR2318E

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



RR1B66E

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.

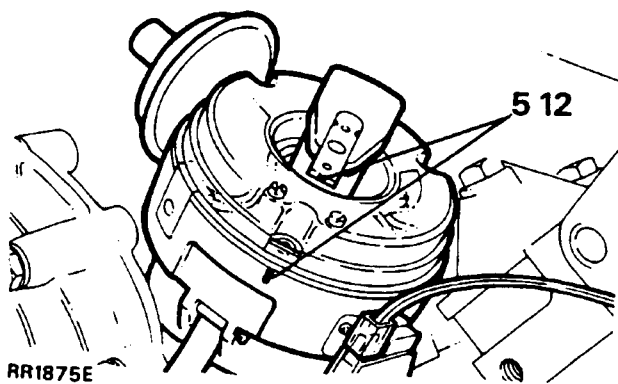
NOTE: The pick-up air gap is factory set. Do not adjust the gap unless the pick-up is being changed or the base plate has been moved. Use a non-ferrous feeler gauge to set the air gap.

DISTRIBUTOR

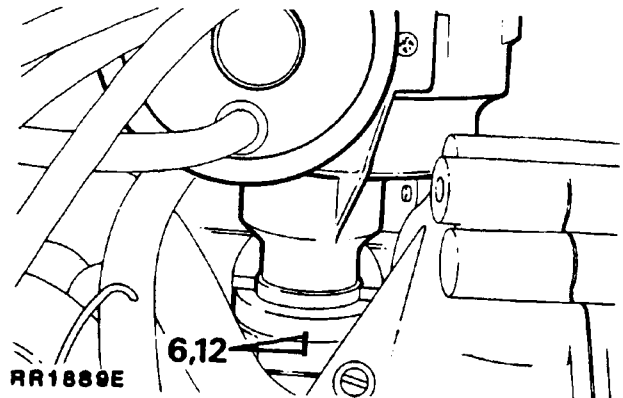
Remove and refit

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.

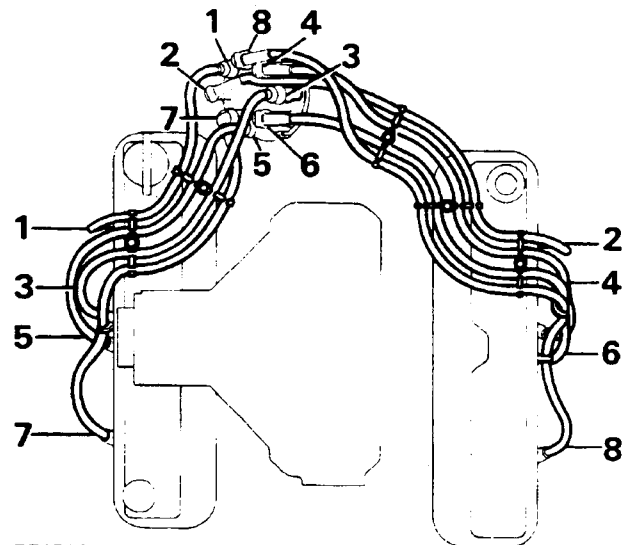


NOTE: Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

7. Release the distributor clamp and remove the distributor.

Refitting

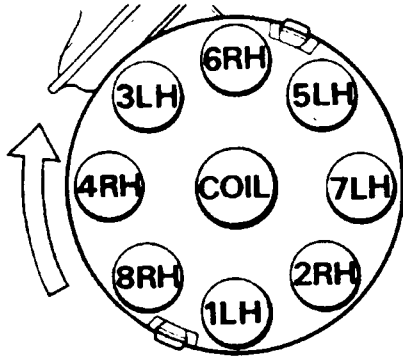
NOTE: If a new distributor is being fitted, mark body in same relative position as distributor removed.



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 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:

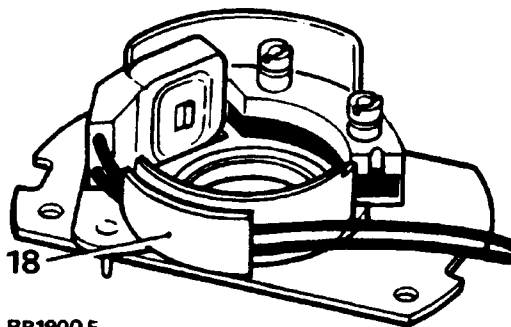
- a. A spot into the rotor spindle before fitting rotor arm.

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.



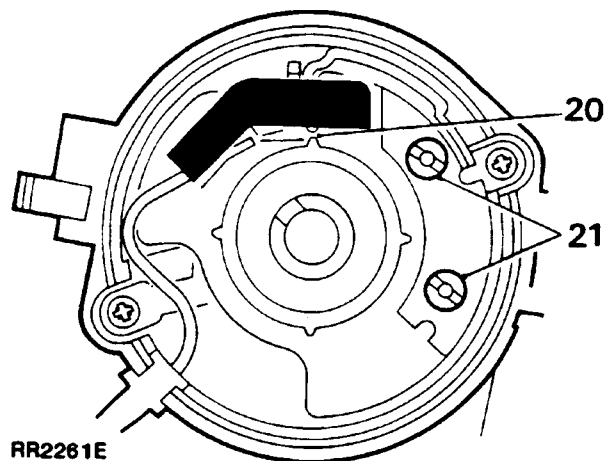
RR1900 E

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.



RR2261 E

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

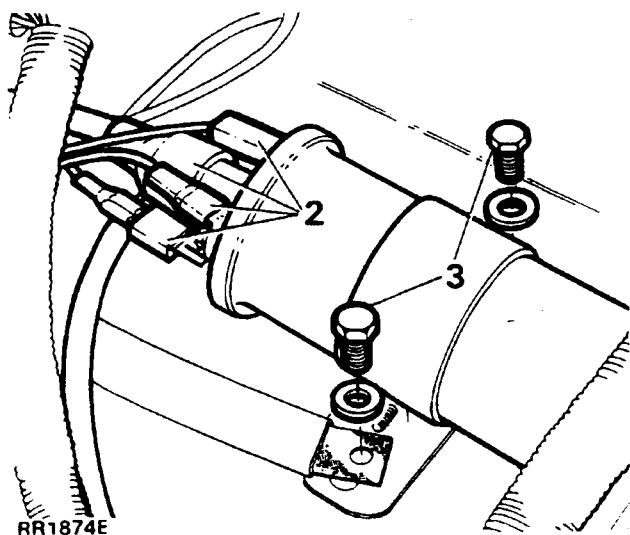
22. Before fitting the module, apply MS4 Silicone grease or equivalent heat-conducting compound to the amplifier module backplate, the seating face on distributor body and both faces of the heatsink casting.

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.

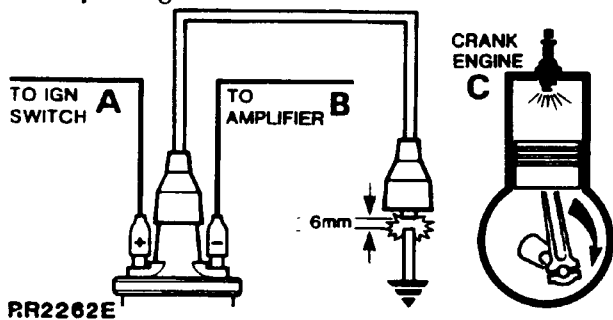
PICK-UP AIR GAP

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 initially at the factory and will only require adjusting if tampered with or when the pick-up module is replaced.

TEST 1:

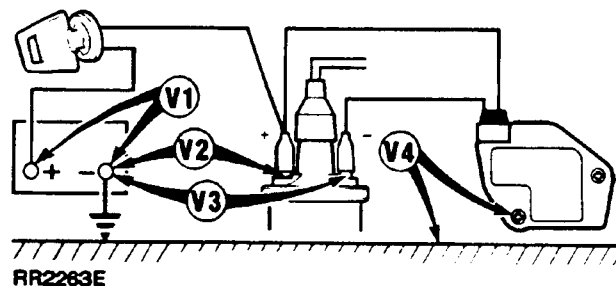
HT Sparking



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



Switch the ignition '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

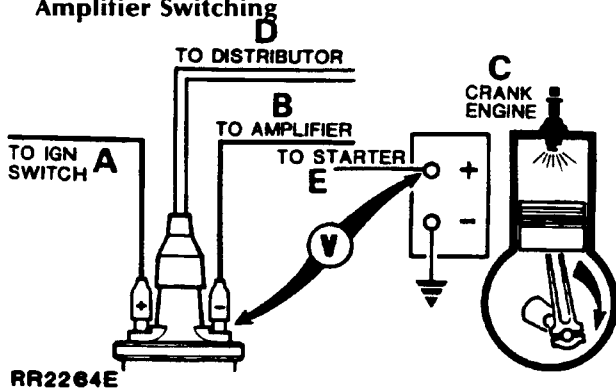
1	2	3	4	SUSPECT
L	*	*	*	DISCHARGED BATTERY
*	L	L	*	IGN. SWITCH AND/OR WIRING
*	*	L	*	COIL OR AMPLIFIER
*	*	*	H	AMPLIFIER GROUND

KEY

- * Expected Voltage
- H Voltage higher than expected
- L Voltage lower than expected

TEST 3:

Amplifier Switching



RR2264E

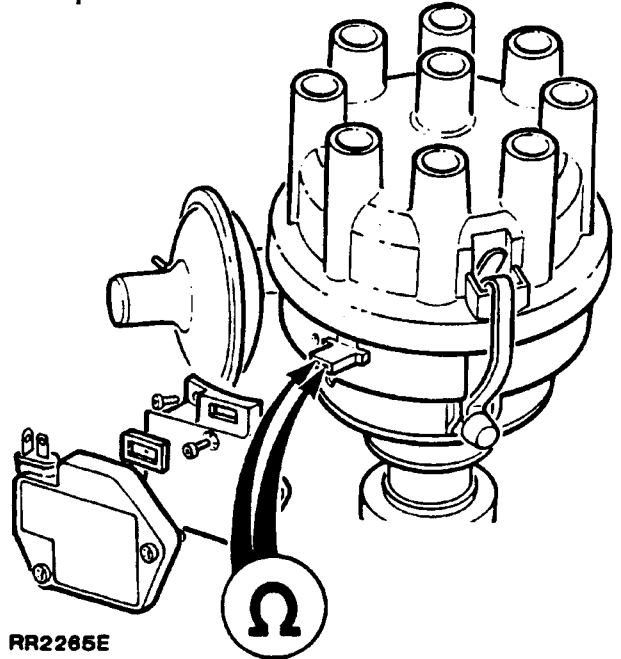
Connect the voltmeter between battery positive (+ve) terminal and H.T. coil negative (-ve) terminal, the voltmeter should register 0 volts.

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.

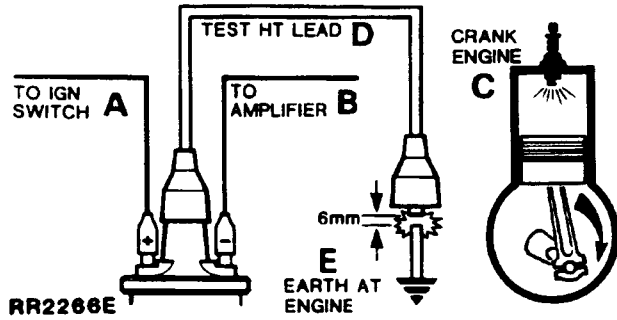
The ohmmeter should register between 2k and 5k ohm if pick-up is satisfactory. If ohmmeter reading is correct, check all connections between pick-up and amplifier, if satisfactory, fit new amplifier. If the engine still does not start carry out Test 5.

Change the pick-up if ohmmeter reading is incorrect. If the engine still does not start proceed to Test 5.

Continued

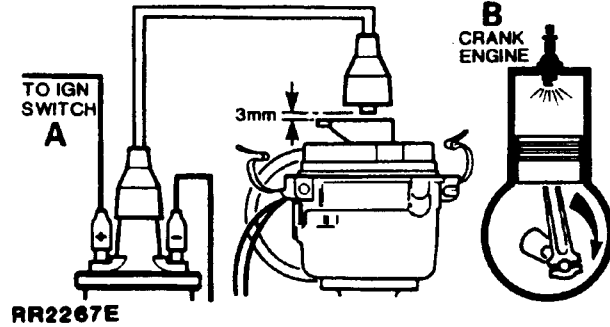
TEST 5:

Coil H.T. Sparking



TEST 6:

Rotor Arm



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 weak or no sparking, fit new H.T. lead, if engine will not start carry out Test 6.

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:

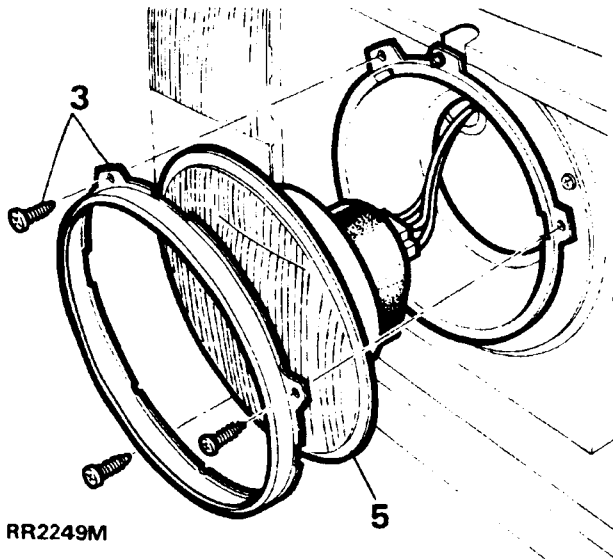
- | | |
|-------------------------------|---|
| 1. Reluctor | Must not foul pick-up or leads |
| 2. Rotor and Insulation Cover | Must not be cracked or show signs of tracking marks |

HEADLAMP ASSEMBLY/BULB REPLACEMENT

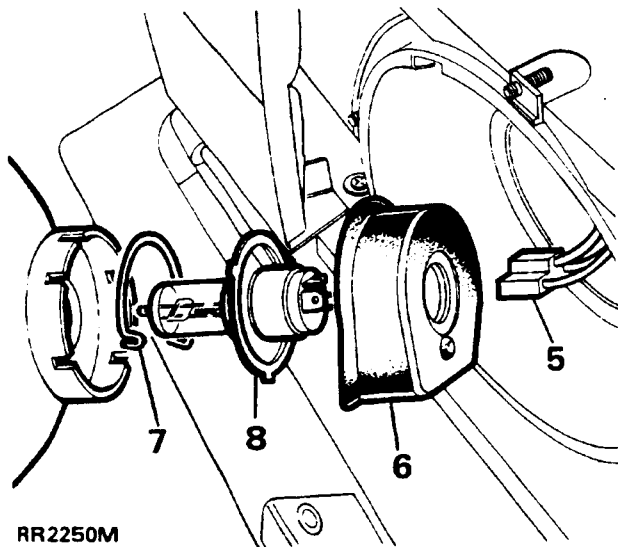
Remove and refit

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.

















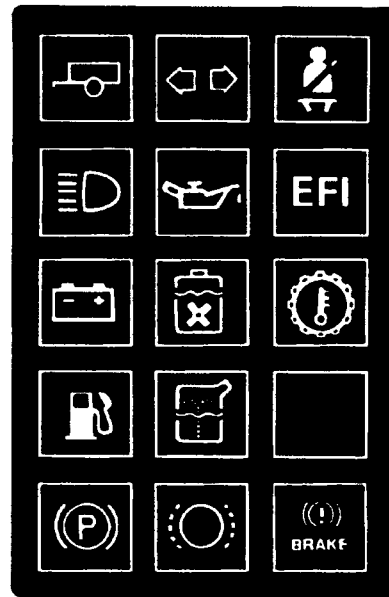
6. Remove the rubber dust cover.
7. To remove bulb: release the bulb retaining clips and withdraw the halogen bulb.
8. Remove three securing screws, prise away the grommet and withdraw the headlamp bowl.

Refitting

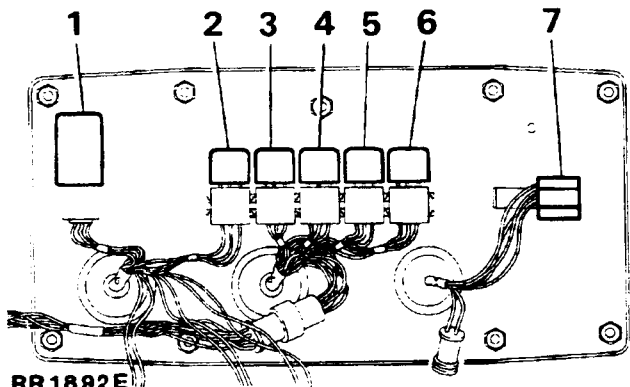
9. Reverse removal procedure ensuring that the quartz envelope of the bulb is not touched. Wipe the bulb gently using methylated spirits if contact does occur.

INSTRUMENT BINNACLE WARNING LIGHT SYMBOLS

- | | | | |
|---|---|---|----------------------------------|
|  | Trailer connected-flashes with direction indicators (green) |  | Transmission hand brake on (red) |
|  | Direction indicator- left turn / right turn (green) |  | Brake pad wear (amber) |
|  | Seat belt (red) |  | Brake fluid level low (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) | | |

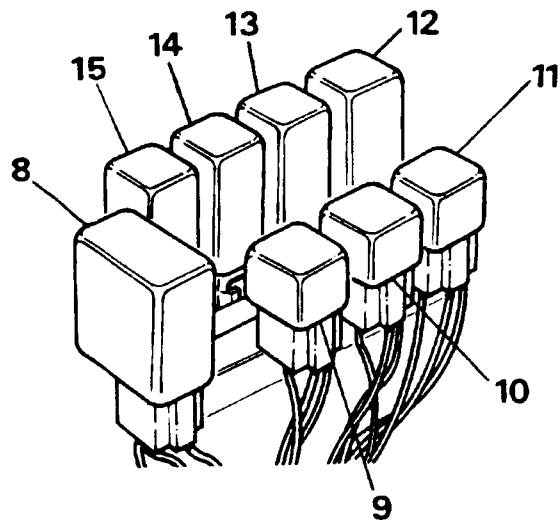


RR2044E



RR1892E

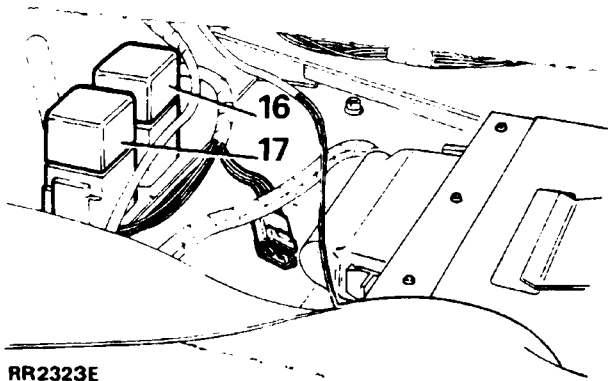
Closure panel viewed from the engine compartment, with protective cover removed.



RR2309S

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



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)

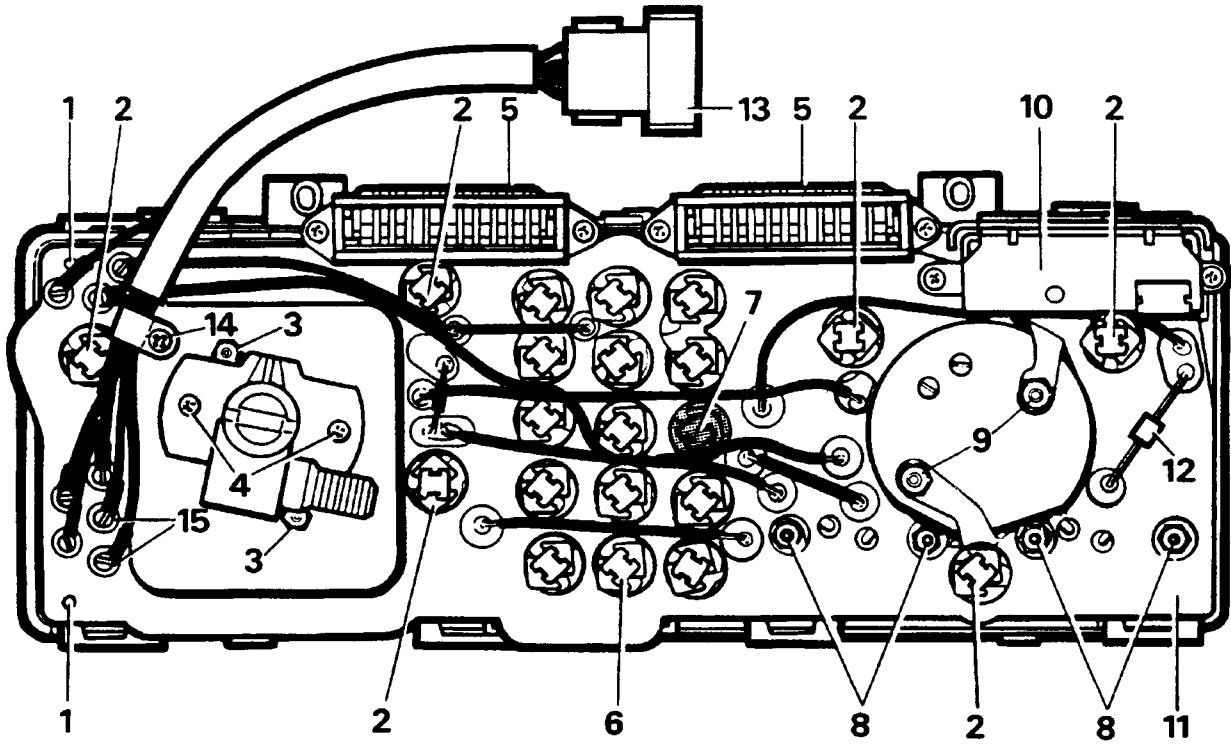
Remove and refit

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.

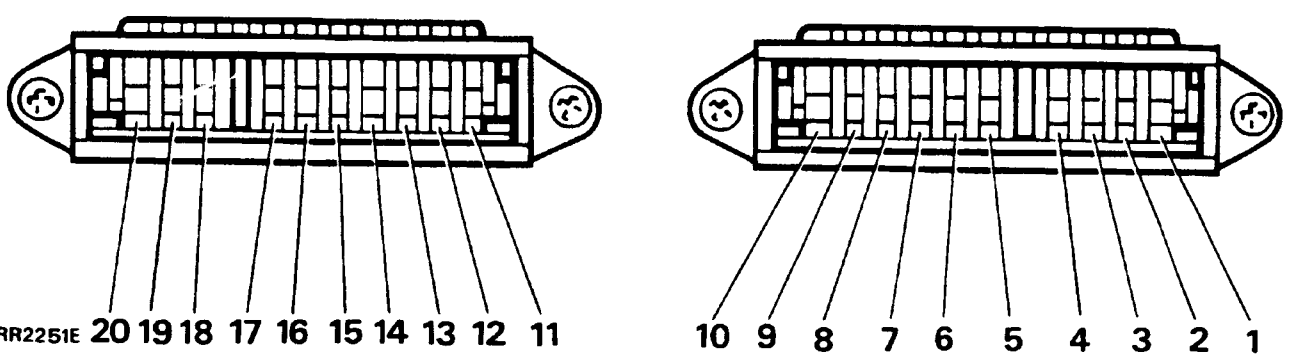


RR2109M

Instrument case (back)

- | | |
|---|---|
| <ul style="list-style-type: none"> 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 | <ul style="list-style-type: none"> 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

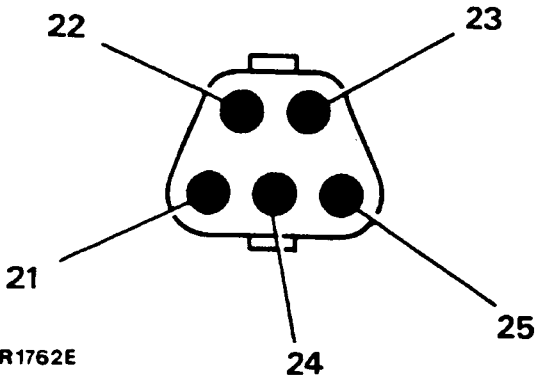
Sequence of connections looking towards the back of instrument case.

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

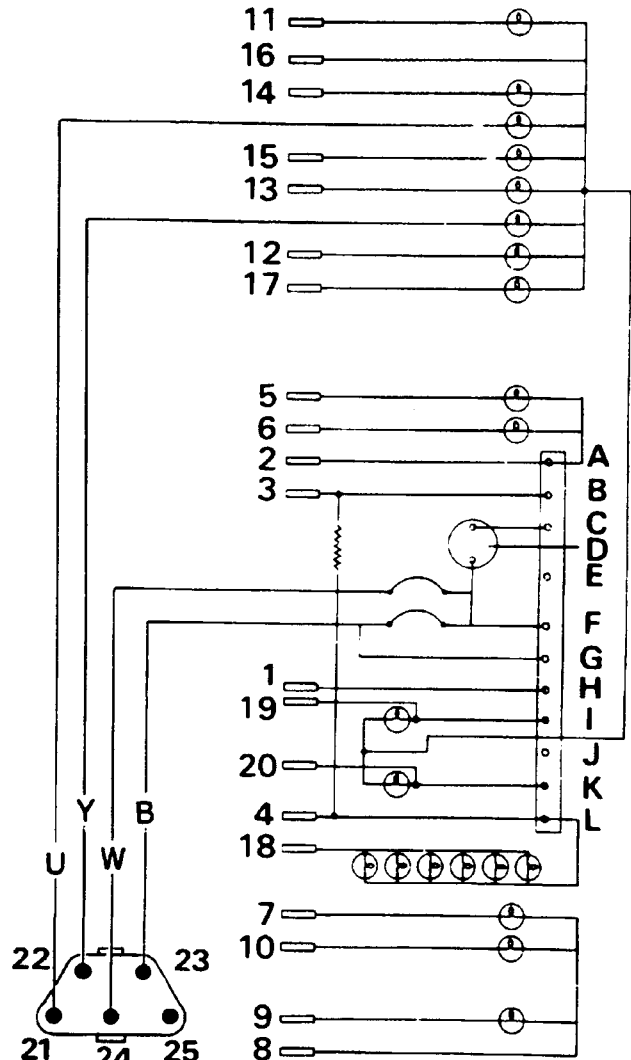
NOTE: The following 21 to 25 are connected at the single multi-plug located behind the binnacle

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.

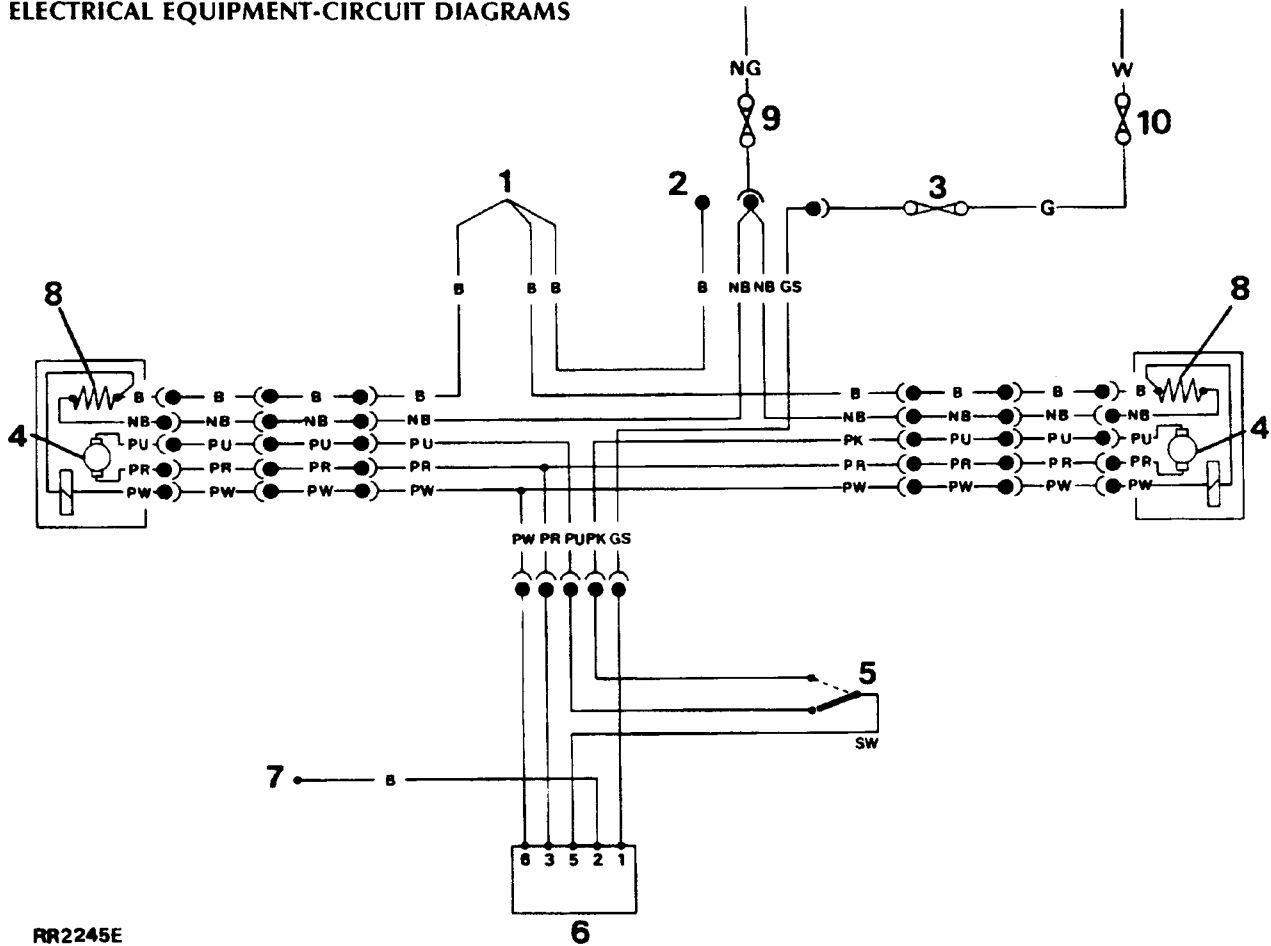


RR2310S

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 | 6. Mirror control switch |
| 2. Main cable connections | 7. Ground - via main cable |
| 3. Fuse A5 - mirror motors | 8. Mirror heating elements - active with heated rear screen |
| 4. Mirror motors | 9. Fuse 10 - heating elements |
| 5. Change over switch | 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 | 9. Window lift switch L/H front |
| 2. Clinches | 10. Window lift switch R/H front |
| 3. Switch unit-central door locking (drivers door) | 11. Window lift switch L/H rear |
| 4. Fuel flap actuator | 12. Window lift switch R/H rear |
| 5. Lock unit-central door locking (front passenger door) | 13. Window lift motor L/H rear |
| 6. Window lift motor L/H front | 14. Window lift motor R/H rear |
| 7. Window lift motor R/H front | 15. Window lift switch L/H rear door |
| 8. Isolator switch | 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.

MAIN CIRCUIT DIAGRAM

Left hand steering - RR2334S and RR2335S

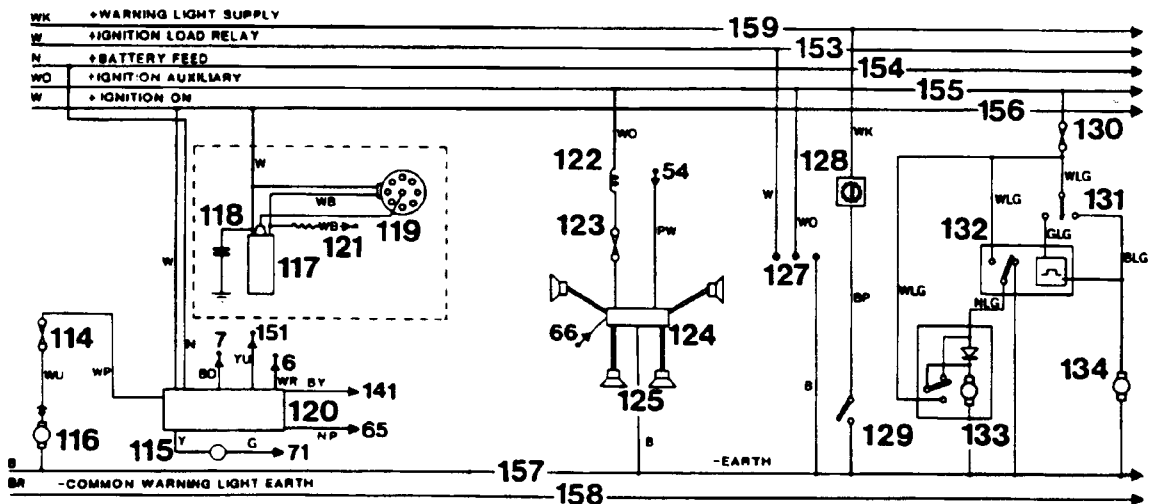
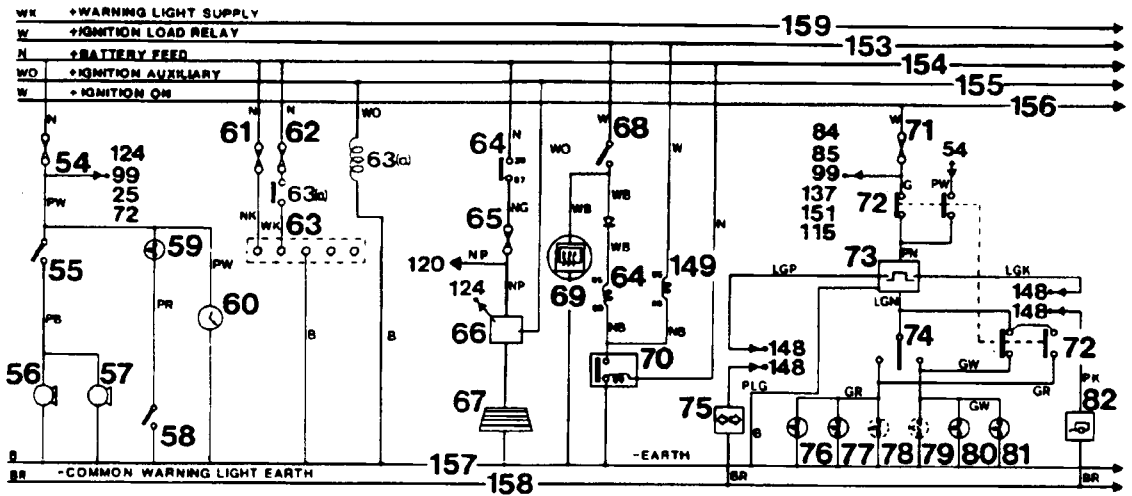
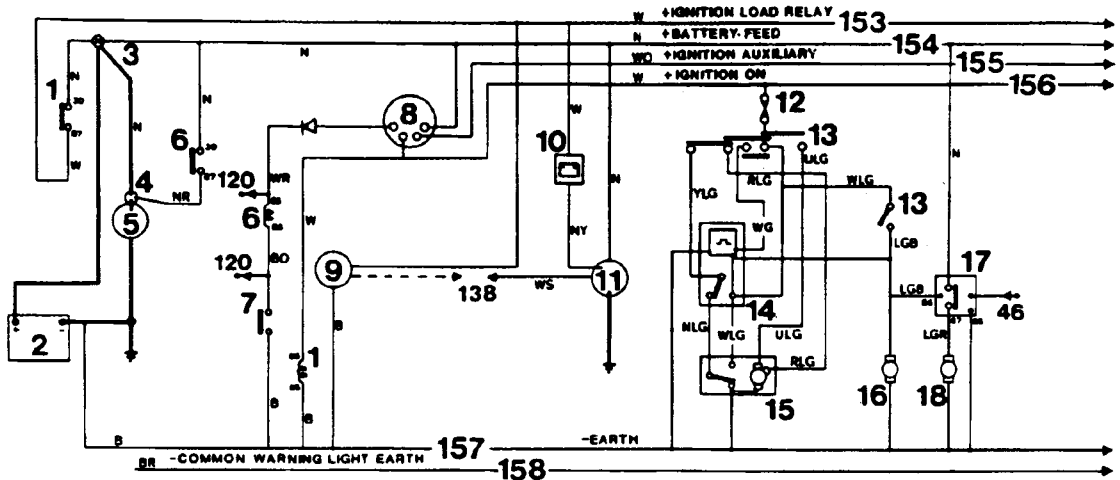
- | | | |
|--|---|--|
| 1. Ignition load relay | 56. RH horn | 110. Differential lock warning lamp |
| 2. Battery | 57. LH horn | 111. Differential lock switch |
| 3. Terminal post | 58. Under bonnet illumination switch | 112. Oil pressure warning lamp |
| 4. Starter solenoid | 59. Under bonnet light | 113. Oil pressure switch |
| 5. Starter motor | 60. Clock | 114. Fuse 18 |
| 6. Starter relay | 61. Fuse 19 | 115. Speed transducer |
| 7. Starter inhibit switch (automatic) | 62. Fuse 20 | 116. Fuel pump |
| 8. Ignition switch | 63. Pick-up point central locking/window lift | 117. Ignition coil |
| 9. Tachometer | 63 (a). Window lift relay | 118. Capacitor |
| 10. Ignition warning lamp | 64. Heated rear window relay | 119. Distributor |
| 11. Alternator | 65. Fuse 9 | 120. EFI Harness plug |
| 12. Fuse 7 | 66. Radio aerial amplifier | 121. Coil negative (engine RPM input to ECU) |
| 13. Front wipe/wash switch | 67. Heated rear screen | 122. Radio choke |
| 14. Front wipe delay unit | 68. Heated rear screen switch | 123. Radio fuse |
| 15. Front wiper motor | 69. Heated rear screen warning lamp | 124. Radio |
| 16. Front wash pump | 70. Voltage sensitive switch | 125. Four speakers |
| 17. Headlamp wash timer unit (option) | 71. Fuse 13 | 126. Not used |
| 18. Headlamp wash pump (option) | 72. Hazard switch | 126 (a). Not used |
| 19. Main lighting switch | 73. Flasher unit | 127. Sunroof connection point |
| 20. Fuse 6 | 74. Direction indicator switch | 128. Automatic transmission oil temperature warning lamp |
| 21. Fuse 5 | 75. Hazard/indicator warning lamp | 129. Automatic transmission oil temperature switch |
| 22. LH side lamp | 76. LH rear indicator lamp | 130. Fuse 16 |
| 23. LH tail lamp | 77. LH front indicator lamp | 131. Rear wash wipe switch |
| 24. Number plate lamp (2 off) | 78. LH side repeater lamp | 132. Rear wipe delay unit |
| 25. Main beam dip/flash switch | 79. RH side repeater lamp | 133. Rear wiper motor |
| 26. Radio illumination | 80. RH front indicator lamp | 134. Rear screen wash pump |
| 27. RH side lamp | 81. RH rear indicator lamp | 135. Low screen wash fluid level warning lamp |
| 28. RH tail lamp | 82. Trailer warning lamp | 136. Low screen wash switch |
| 29. Rheostat | 83. Fuse 15 | 137. Low coolant switch |
| 30. Fuse 3 | 84. Stop lamp switch | 138. Multi-function unit in binnacle |
| 31. Fuse 4 | 85. Reverse lamp switch | 139. Low coolant level warning lamp |
| 32. Fuse 1 | 86. Auxiliary lamp relay | 140. Low fuel level warning lamp |
| 33. Fuse 2 | 87. LH stop lamp | 141. E.F.I. warning lamp |
| 34. Rear fog switch | 88. RH stop lamp | 142. Handbrake warning lamp |
| 35. Fuse 12 | 89. LH reverse lamp | 143. Handbrake warning switch |
| 36. Switch illumination (2 off) | 90. RH reverse lamp | 144. Brake fluid level warning switch |
| 37. Cigar lighter illumination (2 off) | 91. LH auxiliary lamp | 145. Brake fluid level warning lamp |
| 38. Heater illumination (4 off) | 92. RH auxiliary lamp | 146. Brake pad wear warning lamp |
| 39. Clock illumination | 93. Auxiliary lamp switch | 147. Brake pad wear sensors |
| 40. Automatic gear selector illumination (2 off) | 94. Fuse 17 | 148. Brake check unit |
| 41. Instrument illumination (6 off) | 95. Dash cigar lighter | 149. Split charge relay (option) |
| 42. Rear fog warning lamp | 96. Cubby box cigar lighter | 150. Split charge terminal post (option) |
| 43. LH rear fog | 97. LH interior lamp | 151. Heater/air conditioning connections |
| 44. RH rear fog | 98. RH interior lamp | 152. Fuse 8 |
| 45. LH dip beam | 99. Interior lamp delay unit | 153. Ignition load relay (+) |
| 46. RH dip beam | 100. LH door edge lamp | 154. Battery feed (+) |
| 47. LH main beam | 101. RH door edge lamp | 155. Ignition auxiliary (+) |
| 48. RH main beam | 102. LH puddle lamp | 156. Ignition on (+) |
| 49. Main beam warning lamp | 103. RH puddle lamp | 157. Earth (-) |
| 50. Fuel gauge | 104. Interior lamp switch | 158. Warning lights common earth (-) |
| 51. Fuel gauge sender unit | 105. LH rear door switch | 159. Warning lights supply (+) |
| 52. Water temperature gauge | 106. RH rear door switch | |
| 53. Water temperature sender unit | 107. Tailgate switch | |
| 54. Fuse 11 | 108. LH front door switch | |
| 55. Horn switch | 109. RH front door switch | |

CABLE COLOUR CODE

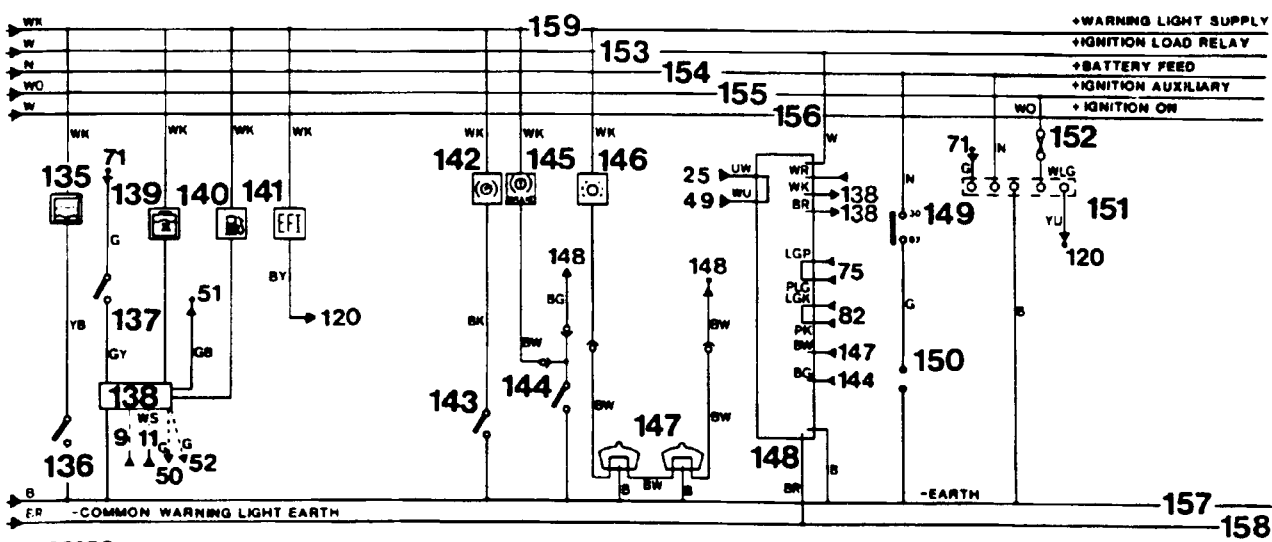
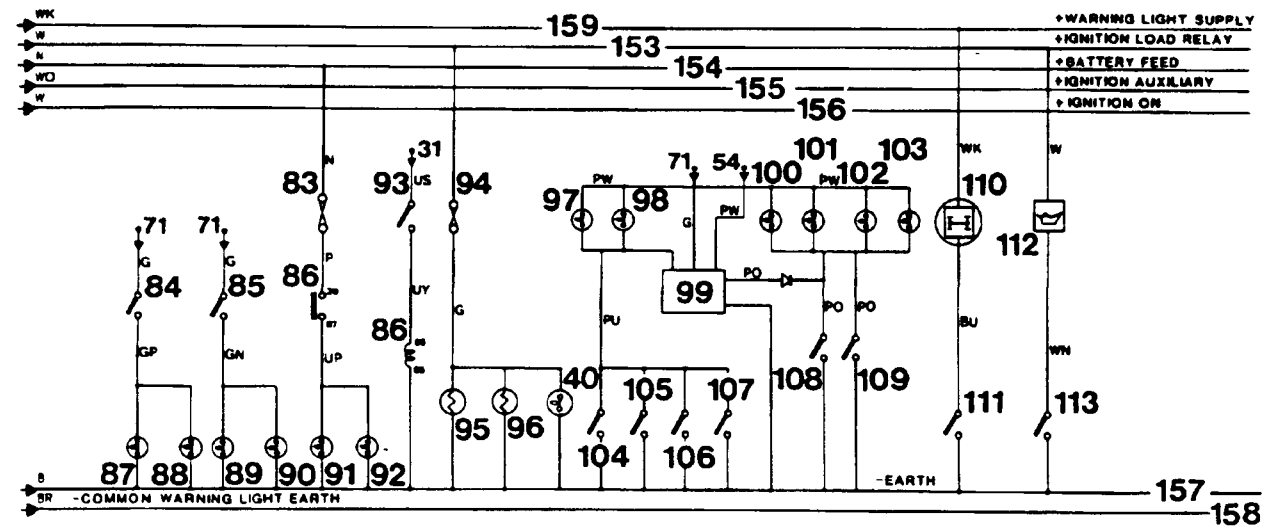
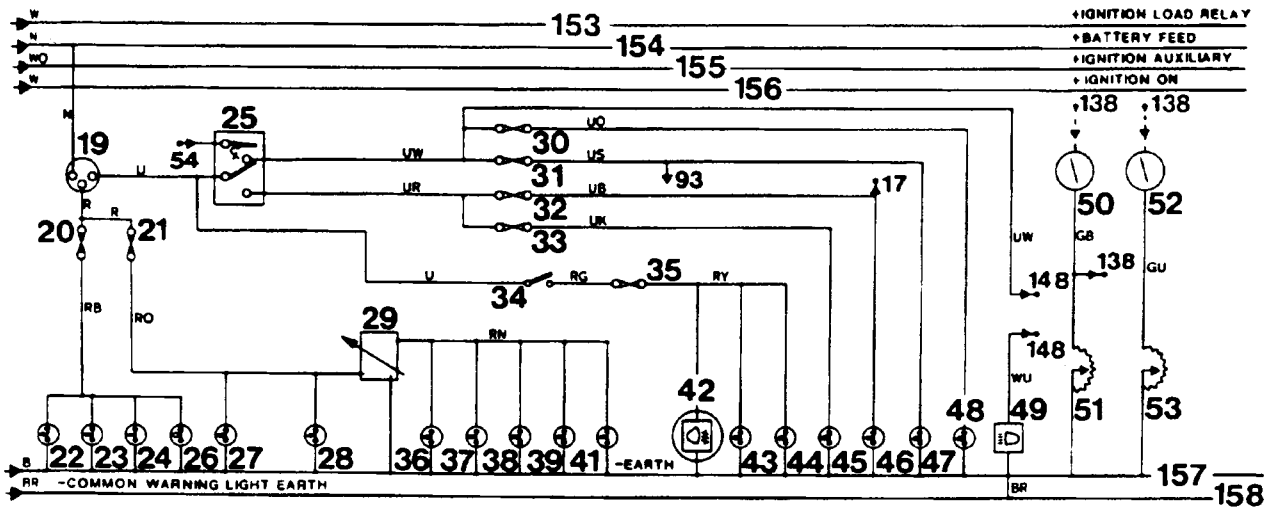
B Black	N Brown	R Red	W White
G Green	O Orange	S Grey	Y Yellow
K Pink	P Purple	U Blue	

The last letter of a colour code denotes the tracer.

MAIN CIRCUIT DIAGRAM
Left hand steering - RR2334S and RR2335S



RR2334S



RR2335S

