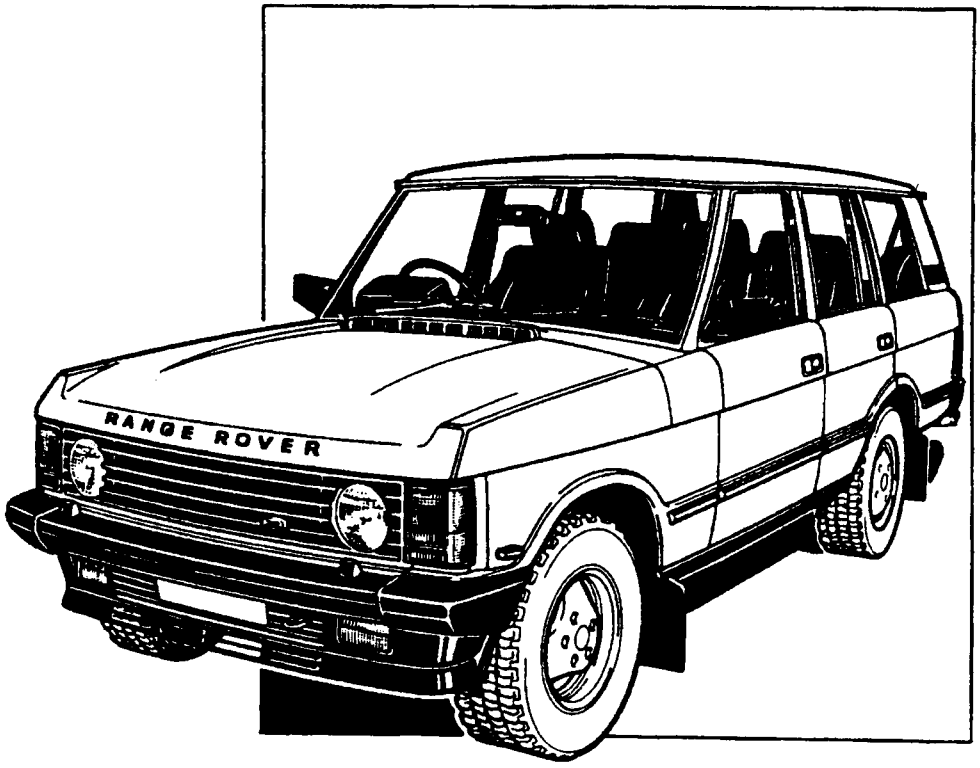
RANGE ROVER



2.4 & 2.5 Turbo Diesel Engine Supplement

RANGE ROVER
2.4 & 2.5 TURBO DIESEL ENGINES

WORKSHOP MANUAL SUPPLEMENT

Publication Number LSM180WS4 Ed 2

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Notes

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INTRODUCTION

This supplement supersedes publication No's. LSM227 WS, LSM180 WS4 and combines the existing 2.4 litre Diesel Engine with the introduction of the new 2.5 Litre Diesel Engine for the Range Rover. It should be used in conjunction with the existing Range Rover Workshop Manual publication No. LSM180 WM.

SYNTHETIC RUBBER

Many 0-ring seals, flexible pipes and other similar items which appear to be natural rubber are made of synthetic materials called Fluoroelastomers. Under normal operating conditions this material is safe, and does not present a health hazard. However, if the material is damaged by fire or excessive heat, it can break down and produce highly corrosive Hydrofluoric acid which can cause serious burns on contact with skin. Should the material be in a burnt or overheated condition handle only with seamless industrial gloves. Decontaminate and dispose of the gloves immediately after use.
If skin contact does occur, remove any contaminated clothing immediately and obtain medical assistance without delay. In the meantime, wash the affected area with copious amounts of cold water or limewater for fifteen to sixty minutes.

RECOMMENDED SEALANTS

A number of branded products are recommended in this manual for use during maintenance and repair work.
These items include: **HYLOMAR GASKET AND JOINTING COMPOUND** and **HYLOSIL RTV SILICON COMPOUND.**
They should be available locally from garage equipment suppliers. If there is any problem obtaining supplies, contact one of the following companies for advice and the address of the nearest supplier.

MARSTON LUBRICANTS LTD.
Hylo House,
Cale lane,
New Springs,
Wigan WN2 1JR,

0942 824242

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Notes

MODEL: DIESEL RANGE ROVER 2.5 LITRE ENGINE.

Type	95 A VM type HR 4924 HI	
Number of cylinders	4	
Bore	92 mm	3.62 in
Stroke	94 mm	3.7 in
Capacity	2500 cm^3	152.32 in^3
Injection order	1 - 3 - 4 - 2	
Compression ratio	22.5 : 1 (± 0.5)	

Crankshaft

Front main journal diameter	62,995 to 63,010 mm	2.4801 to 2.4807 in
Clearance in main bearing	0,05 to 0,115 mm	0.0019 to 0.0045 in
Minimum regrind diameter	62,495 mm	2.4604 in
Central main journal diameter	63,005 to 63,020 mm	2.4805 to 2.4811 in
Clearance in main bearing	0,03 to 0,088 mm	0.0012 to 0.0034 in
Minimum regrind diameter	62,52 mm	2.4614 in
Rear main journal diameter	69,985 to 70,00 mm	2.7551 to 2.7559 in
Clearance in main bearing	0,040 to 0,070 mm	0.0015 to 0.0027 in
Minimum regrind diameter	69,485 mm	2.7354 in
Crankpin journal diameter	53,94 to 53,955 mm	2.123 to 2.124 in
Clearance in big end bearing	0,022 to 0,076 mm	0.0008 to 0.0030 in
Minimum regrind diameter	53,44 mm	2.104 in
End float	0,153 to 0,304 mm	0.006 to 0.0119 in
Adjustment	Thrust washers	
Thrust washers available	2,311 to 2,362	0.090 to 0.093 in
	2,411 to 2,462 mm	0.095 to 0.097 in
	2,511 to 2,562 mm	0.099 to 0.101 in

Thrust spacer

Thickness	7,9 to 8,1 mm	0.311 to 0.319 in
Diameter	89,96 to 90 mm	3.542 to 3.543 in

Main bearings

Standard
Internal diameter:

Front	63,060 to 63,11 mm	2.4872 to 2. 4845 in
Centre	63,050 to 63,09 mm	2.4823 to 2.4838 in
Rear	70,040 to 70,055 mm	2.7574 to 2.7580 in

Bearing undersizes:
0,25 mm (0.01 in) and 0,5 mm (0.02 in) less than the dimensions given.

Main bearing carriers

Internal diameter:

Front	67,025 to 67,050 mm	2.639 to 2.640 in
Centre	66,67 to 66,687 mm	2.624 to 2.625 in
Rear	75,005 to 75,030 mm	2.953 to 2.954 in
Piston oil jet opening pressure	1,5 to 2,0 kg/cm^2	22 to 29 lb/in^2

2.5 LITRE ENGINE CONTINUED

Liners

Internal diameter:		
White		
Standard	92,000 to 92,010 mm	3.6220 to 3.6224 in
Red		
Standard	92,010 to 92,020 mm	3.6224 to 3.6228 in
Protrusion	0,01 to 0,06 mm	0.0004 to 0.002 in
Adjustment	Shims	
Shims available	0,15 mm	0.006 in
	0,20 mm	0.008 in
	0,23 mm	0.009 in
Maximum ovality	0,100 mm	0.004 in
Maximum taper	0,100 mm	0.004 in

Cylinder heads

Minimum thickness		89,95 to 90,05 mm	3.541 to 3.545 in
Gaskets			
Free thickness	Identity		
Number STC 654	No notch	1,51 to 1,59 mm	0.059 to 0.062 in
Number STC 656	1 notch	1,75 to 1,83 mm	0.069 to 0.072 in
Number STC 655	2 notches	1,65 to 1,73 mm	0.065 to 0.068 in
Fitted thickness			
Number STC 654		1,42 mm ± 0,04	0.056 in ± 0.001575
Number STC 656		1,62 mm ± 0,04	0.064 in ± 0.001575
Number STC 655		1,52 mm ± 0,04	0.059 in ± 0.001575

End plates

Height	91,26 to 91,34 mm	3.593 to 3.596 in

Connecting rods

Weights (connecting rod complete with small end bush, big-end cap and big-end bolts, but without the big-end shell).

Letter Code		
L	1156 to 1172 gr	Fully machined balanced

Pistons

Skirt diameter:
(measured at approximately 15 mm (0.6 in) above the bottom of the skirt).

Class A	91,92 to 91,93mm	3.6188 to 3.6192 in
Class B	91,93 to 91,94mm	3.6192 to 3.6196 in
Piston skirt wear limit	0,05 mm	0.0019 in
Maximum ovality of gudgeon pin bore	0,05mm	0.0019 in
Piston clearance.		
Top of piston to cylinder head	0,95 to 1,04mm	0.0374 to 0.0409 in
Piston protrusion above crankcase	0,38 to 0,47mm	0.0149 to 0.0185 in
	Fit gasket 1,42	
	0,58 to 0,67mm	0.0228 to 0.0263 in
	Fit gasket 1,62	
	0,48 to 0,57mm	0.0189 to 0.0224 in
	Fit gasket 1,52	
Maximum piston to liner clearance	0,15mm	0.006 in

2.5 LITRE ENGINE CONTINUED

Small end bush

Internal diameter:		
Minimum	30,030 mm	1.1823 in
Maximum	30,045 mm	1.1828 in
Wear limit between bush and gudgeon pin	0,100 mm	0. 004 in

Big-end bearings

Standard		
Internal diameter	53,977 to 54,016 mm	2.125 to 2.126 in
Bearing undersizes:		
0,25 mm (0.01 in) and 0,5 mm (0.02 in) less than the dimensions given.		

Piston rings

Clearance in groove:		
Top	0,080 to 0,130 mm	0.0031 to 0.0051 in
Second	0,070 to 0,102 mm	0.0027 to 0.004 in
Oil control	0,040 to 0,072 mm	0.0015 to 0.0028 in
Fitted gap:		
Top	0,25 to 0,50 mm	0.0098 to 0.0196 in
Second	0,25 to 0,45 mm	0.0098 to 0.0177 in
Oil control	0,25 to 0,58 mm	0.0098 to 0.0228 in

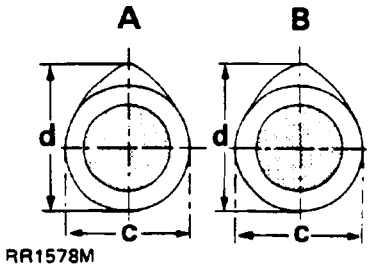
Gudgeon Pins

Type	Fully floating	
Diameter	29,990 to 29,996 mm	1.180 to 1.181 in
Clearance in connecting rod	0,034 to 0,055 mm	0.0013 to 0.0022 in
Wear limit between gudgeon pin and connecting rod bush	0,100 mm	0.004 in

Camshaft

Journal diameter: Front	53,495 to 53,51 mm	2.1061 to 2.1067 in
Bearing clearance	0,030 to 0,095 mm	0.0012 to 0.0037 in
Centre	53,45 to 53,47 mm	2.1043 to 2.1051 in
Bearing clearance	0,07 to 0,14 mm	0.0027 to 0.0055 in
Rear	53,48 to 53,50 mm	2.1055 to 2.1063 in
Bearing clearance	0,04 to 0,11 mm	0.0016 to 0.0043 in

Cam lobe minimum dimensions:



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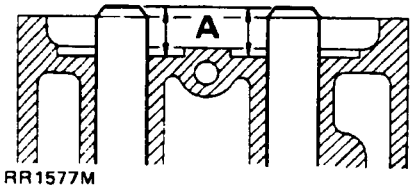
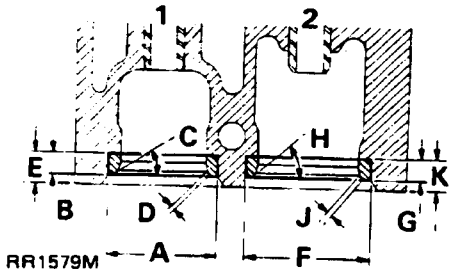
Inlet (A)		
(c)	38,5 mm	1.516 in
(d)	45,7 mm	1.799 in
Exhaust (B)		
(c)	37,5 mm	1.476 in
(d)	45,14 mm	1.777 in
Thrust plate thickness	3,95 to 4,05 mm	0.155 to 0.159 in

2.5 LITRE ENGINE CONTINUED

Tappets		
Outside diameter	14,965 to 14,985 mm	0.589 to 0.590 in
Rocker gear		
Shaft diameter	21,979 to 22,00 mm	0.865 to 0.866 in
Bush internal diameter	22,020 to 22,041 mm	0.867 to 0.868 in
Assembly clearance	0,020 to 0,062 mm	0.0.0008 to 0.0024 in
Wear limit between bush and shaft	0,2 mm	0.008 in
Valves		
Face angle:		
Inlet	55° 30'	
Exhaust	45° 30'	
Head diameter:		
Inlet	40,05 to 40,25 mm	1.576 to 1.584 in
Exhaust	33,80 to 34,00 mm	1.331 to 1.338 in
Head stand down:		
Inlet	0,80 to 1,20 mm	0.0315 to 0.0472 in
Exhaust	0,79 to 1,19 mm	0.0311 to 0.468 in
Stem diameter:		
Inlet	7,940 to 7,960 mm	0.312 to 0.313 in
Exhaust	7,920 to 7,940 mm	0.311 to 0.312 in
Clearance in guide:		
Inlet	0,040 to 0,075 mm	0.0016 to 0.0029 in
Exhaust	0,060 to 0,095 mm	0.0024 to 0.0037 in
Valve guides		
Inside diameter	8 to 8,015 mm	0.314 to 0.315 in
Fitted height (above spring plate counterbore)	13,5 to 14 mm	0.531 to 0.551 in





Valve seat inserts		
Machining dimensions		
Exhaust (1)		
A	36,066 to 36,050 mm	1.4199 to 1.4193 in
B	7,00 to 7,05 mm	0.275 to 0.277 in
C	44°30'	
D	1,65 to 2,05 mm	0.065 to 0.080 in
E	10,15 to 10,25 mm	0.399 to 0.403 in
Inlet (2)		
F	42,070 to 42,086 mm	1.6536 to 1.6569 in
G	7,14 to 7,19 mm	0.281 to 0.283 in
H	34° 30'	
J	1,8 to 2,2 mm	0.071 to 0.086 in
K	10,3 to 10,4 mm	0.405 to 0.409 in

2.5 LITRE ENGINE CONTINUED

Valve springs

Free length	44,65 mm	1.76 in
Fitted length	38,6 mm	1.52 in
Load at fitted length	34 ± 3% Kg	75 ± 3% lbf.
Load at top of lift	92,5 ± 3% Kg	204 ± 3% lbf.
Number of coils	5,33	

Valve timing

Rocker clearance: Timing		
Inlet	0,30 mm	0.012 in
Exhaust	0,30 mm	0.012 in
Inlet valve:		
Opens	22° ± 5° B.T.D.C.	
Closes	48° ± 5° A.B.D.C.	
Exhaust valve:		
Opens	60° ± 5° B.B.D.C.	
Closes	24° ± 5° A.T.D.C.	

Lubrication

System pressure with oil at 90-100° C at 4,000 rev/min	3,5 to 5,0 kgf/cm^2	50 to 70 lbf/in^2.
Pressure relief valve opens	6.38 kgf/cm^2	91 lbf/in^2.
Pressure relief valve spring - free length	57,5 mm	2.26 in.
Oil pump:		
Outer rotor end float	0,04 to 0,087 mm	0.0015 to 0.0034 in.
Inner rotor end float	0,04 to 0,087 mm	0.0015 to 0.0034 in.
Outer rotor to body diametrical clearance	0,130 to 0,230 mm	0.005 to 0.009 in.
Rotor body to drive gear clearance (pump not fitted)	0,15 to 0,25 mm	0.0059 to 0.0098 in

COOLING SYSTEM

Thermostat	80°C ± 2°C	
Pressure cap	1,05 kgf cm^2	15 lb f/in^2

DRIVE BELT TENSIONING

Installed drive belts using a recognised driving belt tension gauge to be :-

Air conditioning compressor	450N	95 lbf
Power steering pump	400N	90 lbf
Alternator/water pump	490N	110 lbf

FUEL SYSTEM

Fuel lift pump	mechanical, driven by camshaft	
Turbo charger:		
Shaft radial clearance	0,35 mm	0.0137 in
Shaft axial clearance	0,10 mm	0.0039 in
Waste gate valve:		
Opening pressure	0,9 kgf cm^2	13 lbf/in^2

CLUTCH

Make and type	Valeo, diaphragm	
Diameter	235mm	9.25 in

GEARBOX

Model	LT77 (manual)
Type	Five speed, single helical constant mesh with synchromesh on all forward gears

TRANSFER GEARBOX

Model	BORG WARNER
Type	13-61 with viscous controlled unit

STARTER MOTOR

Make and type	BOSCH 0.001. 362.092

ALTERNATOR

Make and type	Magnetti Marelli A127 - 65A
On Diesel Vogue Range Rover	Magnetti Marelli A133 - 80A

MODEL: 2.4 LITRE DIESEL RANGE ROVER ENGINE

Type	11A VM type HR 492 HI	
Number of cylinders	4	
Bore	92 mm	3.62 in
Stroke	90 mm	3.54 in
Capacity	2393 cm^3	146.03 in^3
Injection order	1 - 3 - 4 - 2	
Compression ratio	21.5 : 1 (± 0.5)	

Crankshaft

Front main journal diameter	62,98 to 63 mm	2.4795 to 2.4803 in
Clearance in main bearing	0,06 to 0,13 mm	0.0023 to 0.005 in
Minimum regrind diameter	62,48 mm	2.4498 in
Central main journal diameter	62,98 to 63 mm	2.4795 to 2.4803 in
Clearance in main bearing	0,05 to 0,113 mm	0.0019 to 0.0044 in
Minimum regrind diameter	62,48 mm	2.4498 in
Rear main journal diameter	69,98 to 70 mm	2.7551 to 2.7559 in
Clearance in main bearing	0,06 to 0,105 mm	0.0023 to 0.0041 in
Minimum regrind diameter	69,48 mm	2.7354 in
Crankpin journal diameter	53,92 to 53,94 mm	2.1228 to 2.1236 in
Clearance in big end bearing	0,035 to 0,094 mm	0.0014 to 0.0037 in
Minimum regrind diameter	53,42 mm	2.1032 in
End float	0,12 to 0,323 mm	0.005 to 0.0127 in
Adjustment	Thrust washers	
Thrust washers available	2,311 to 2,362 mm	0.090 to 0.093 in
	2,411 to 2,462 mm	0.095 to 0.097 in
	2,511 to 2,562 mm	0.099 to 0.101 in

Thrust spacer

Thickness	7,9 to 8,1 mm	0.311 to 0.319 in
Diameter	89,96 to 90 mm	3.542 to 3.543 in

Main bearings

Standard
Internal diameter:

Front	63,060 to 63,11 mm	2.4872 to 2. 4845 in
Centre	63,050 to 63,09 mm	2.4823 to 2. 4838 in
Rear	70,060 to 70,085 mm	2.7582 to 2.7592 in

Bearing undersizes:
0,25 mm (0.01 in) and 0,5 mm (0.02 in) less than the dimensions given.

Main bearing carriers

Internal diameter:

Front/centre	66,67 to 66,687 mm	2.624 to 2.625 in
Rear	75,005 to 75,030 mm	2.953 to 2.954 in
Piston oil jet opening pressure	1,5 to 2,0 kg/cm^2	22 to 29 lb/ in^2

2.4 LITRE ENGINE CONTINUED

Liners

Internal diameter:		
White		
Standard	92,000 to 92,010 mm	3.6220 to 3.6224 in
Red		
Standard	92,010 to 92,020 mm	3.6224 to 3.6228 in
Protrusion	0 to 0,05 mm	0 to 0.002 in
Adjustment	Shims	
Shims available	0,15 mm	0.006 in
	0,20 mm	0.008 in
	0,23 mm	0.009 in
Maximum ovality	0,100 mm	0.004 in
Maximum taper	0,100 mm	0.004 in

Cylinder heads

Minimum thickness	89,95 to 90,05 mm	3.541 to 3.545 in
Gaskets		
Free thickness — Identity		
Number STC 654 — No notch	1,60 mm	0.063 in
Number STC 656 — 1 notch	1,80 mm	0.071 in
Number STC 655 — 2 notches	1,70 mm	0.067 in
Fitted thickness		
Number STC 654	1,42 mm	0.056 in
Number STC 656	1,62 mm	0.064 in
Number STC 655	1,52 mm	0.059 in

End plates

Height	91,26 to 91,34 mm	3.593 to 3.596 in

Connecting rods

Weights (connecting rod complete with small end bush, big-end cap and big end bolts, but without the big-end shell).

Letter Code		
A	1100 to 1109 gr	38.80 to 39.12 oz
B	1110 to 1119 gr	39.15 to 39.47 oz
C	1120 to 1129 gr	39.51 to 39.82 oz
D	1130 to 1139 gr	39.86 to 40.17 oz
E	1140 to 1149 gr	40.21 to 40.53 oz
F	1150 to 1159 gr	40.56 to 40.88 oz
G	1160 to 1169 gr	40.92 to 41.23 oz
H	1170 to 1179 gr	41.27 to 41.58 oz
I	1180 to 1189 gr	41.62 to 41.94 oz

Small end bush

Internal diameter:		
Minimum	30,030 mm	1.1823 in
Maximum	30,045 mm	1.1828 in
Wear limit between bush and gudgeon pin	0,100 mm	0.004 in

Big-end bearings

Standard		
Internal diameter	53,975 to 54,014 mm	2.125 to 2.126 in
Bearing undersizes:		

0,25 mm (0.01 in) and 0,5 mm (0.02 in) less than the dimensions given.

2.4 LITRE ENGINE CONTINUED

Pistons

Skirt diameter:		
(measured at approximately 15 mm (0.6 in) above the bottom of the skirt).		
Class A	91,965 to 91,975 mm	3.6207 to 3.6211 in
Class B	91,975 to 91,985 mm	3.6211 to 3.6214 in
Piston skirt wear limit	0,05 mm	0.0019 in
Maximum ovality of gudgeon pin bore	0,05 mm	0.0019 in
Piston clearance.		
Top of piston to cylinder head	0,85 to 0,94 mm	0.0335 to 0.0370 in
Piston protrusion above crankcase	0,48 to 0,57 mm Fit gasket 1,42	0.0189 to 0.0224 in
Piston protrusion above crankcase	0,68 to 0,77 mm Fit gasket 1,62	0.0268 to 0.0303 in
Piston protrusion above crankcase	0,58 to 0,67 mm Fit gasket 1,52	0.0228 to 0.0263 in
Maximum piston to liner clearance	0,15 mm	0.006 in

Piston rings

Clearance in groove:		
Top	0,080 to 0,130 mm	0.0031 to 0.0051 in
Second	0,070 to 0,102 mm	0.0027 to 0.004 in
Oil control	0,030 to 0,062 mm	0.0012 to 0.0024 in
Fitted gap:		
Top	0,40 to 0,65 mm	0.0157 to 0.0256 in
Second	0,25 to 0,45 mm	0.0098 to 0.0177 in
Oil control	0,25 to 0,58 mm	0.0098 to 0.0228 in

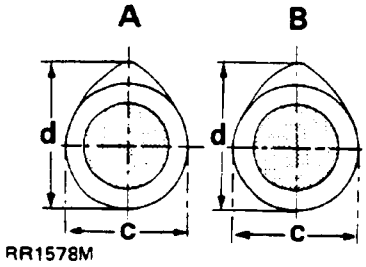
Gudgeon Pins

Type	Fully floating	
Diameter	29,990 to 29,996 mm	1.180 to 1.181 in
Clearance in connecting rod	0,034 to 0,055 mm	0.0013 to 0.0022 in
Wear limit between gudgeon pin and connecting rod bush	0,100 mm	0.004 in

Camshaft

Journal diameter	53,48 to 53,50 mm	2.105 to 2. 106 in
Clearance in bearings	0,040 to 0,11 mm	0.0016 to 0.0043 in

Cam lobe minimum dimensions:



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Inlet (A)		
(c)	38,5 mm	1.516 in
(d)	45,7 mm	1.799 in
Exhaust (B)		
(c)	37,5 mm	1.476 in
(d)	45,14 mm	1.777 in
Thrust plate thickness	3,95 to 4,05 mm	0.155 to 0.159 in

2.4 LITRE ENGINE CONTINUED

Tappets

Outside diameter	14,965 to 14,985 mm	0.589 to 0.590 in

Rocker gear

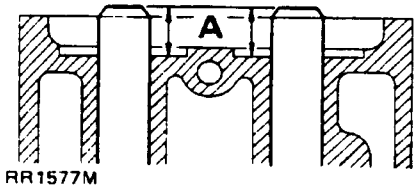
Shaft diameter	21,979 to 22,00 mm	0.865 to 0.866 in
Bush internal diameter	22,020 to 22,041 mm	0.867 to 0.868 in
Assembly clearance	0,020 to 0,062 mm	0.0.0008 to 0.0024 in
Wear limit between bush and shaft	0,2 mm	0.008 in

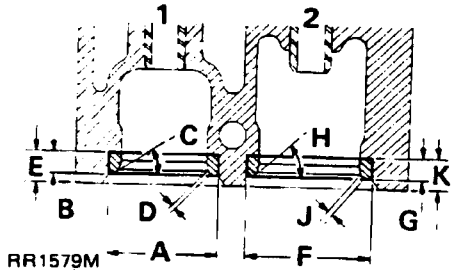
Valves

Face angle:		
Inlet	55° 30'	
Exhaust	45° 30'	
Head diameter:		
Inlet	40,05 to 40,25 mm	1.576 to 1.584 in
Exhaust	33,80 to 34,00 mm	1.331 to 1.338 in
Head stand down:		
Inlet	0,80 to 1,20 mm	0.0315 to 0.0472 in
Exhaust	0,79 to 1,19 mm	0.0311 to 0.468 in
Stem diameter:		
Inlet	7,940 to 7,960 mm	0.312 to 0.313 in
Exhaust	7,920 to 7,940 mm	0.311 to 0.312 in
Clearance in guide:		
Inlet	0,040 to 0,075 mm	0.0016 to 0.0029 in
Exhaust	0,060 to 0,095 mm	0.0024 to 0.0037 in

Valve guides

Inside diameter	8 to 8,015 mm	0.314 to 0.315 in
Fitted height (above spring plate counterbore)	13,5 to 14 mm	0.531 to 0.551 in





Valve seat inserts

Machining dimensions

Exhaust (1)

A	36,066 to 36,050 mm	1.4199 to 1.4193 in
B	7,00 to 7,05 mm	0.275 to 0.277 in
C	44° 30'	
D	1,70 to 1,80 mm	0.067 to 0.071 in
E	10,00 to 10,10 mm	0.393 to 0.397 in

Inlet (2)

F	42,070 to 42,086 mm	1.6536 to 1.6569 in
G	7,14 to 7,19 mm	0.281 to 0.283 in
H	34° 30'	
J	1,9 to 2,0 mm	0.075 to 0.079 in
K	10,25 to 10,35 mm	0.403 to 0.407 in

2.4 LITRE ENGINE CONTINUED

Valve springs

Free length	44,65 mm	1.76 in
Fitted length	38,6 mm	1.52 in
Load at fitted length	34 ± 3% Kg	75 ± 3% lbf.
Load at top of lift	92,5 ± 3% Kg	204 ± 3% lbf.
Number of coils	5,33	

Valve timing

Rocker clearance: Timing		
Inlet	0,30 mm	0.012 in
Exhaust	0,30 mm	0.012 in
Inlet valve:		
Opens	22° ± 5° B.T.D.C.	
Closes	48° ± 5° A.B.D.C.	
Exhaust valve:		
Opens	60° ± 5° B.B.D.C.	
Closes	24° ± 5° A.T.D.C.	

Lubrication

System pressure with oil at 90 - 100°C at 4,000 rev/min	3,5 to 5,0 kgf/cm^2	50 to 70 lbf/in^2.
Pressure relief valve opens	4 to 4,5 kgf/cm ^{2}	57 to 64 lbf/in^2.
Pressure relief valve spring - free length	57,5 mm	2.26 in.
Oil pump:		
Outer rotor end float	0,081 to 0,097 mm	0.003 to 0.004 in.
Inner rotor end float	0,081 to 0,097 mm	0.003 to 0.004 in.
Outer rotor to body diametrical clearance	0,130 to 0,230 mm	0.005 to 0.009 in.
Rotor body to drive gear clearance	0,050 to 0,070 mm	0.0 02 to 0.003 in.

COOLING SYSTEM

Thermostat	83°C ± 2°C	
Pressure cap	1,05 kgf cm^2	15 lb f/in^2

DRIVE BELT TENSIONING

On 'V' type installed drive belts using a recognised driving belt tension gauge to be :-

On 12,7 mm wide belts	450N	95 lbf

"In field" Tensioning - No gauge available

Deflection of belt run between longest belt centres to be:- ..... 0,5 mm per 25 mm of belt run

FUEL SYSTEM

Fuel lift pump	mechanical, driven by camshaft	
Turbo charger:		
Shaft radial clearance	0,42 mm	0.016 in
Shaft axial clearance	0,15 mm	0.006 in
Waste gate valve:		
Opening pressure	0,9 kgf/cm^2	13 lbf/in^2

CLUTCH

Make and type	Valeo, diaphragm	
Diameter	235,0 mm	9.25 in

ENGINE TUNING DATA

Model: Diesel Range Rover ..... 1990 MODEL YEAR 2.5 LITRE ENGINE

Engine

Type	95A VM Type HR 4924 HI	
Capacity	2500 cm^3	152.32 in^3
Compression pressure	24 to 26 kgf/cm^2	340 to 370 lbf/in^2
Injection order	1 - 3 - 4 - 2	
Idling speed at running temperature	750 - 800 rev/min	
Idling speed cold start temperature	1000 - 1100 rev/min	
Maximum light running speed	4700 to 4730 rev/min	
Maximum governed road speed	4200 rev/min	
Valve rocker clearances (cold)		
Inlet	0,30 mm	0.012 in
Exhaust	0,30 mm	0.012 in

Fuel injection pump

Make and type	Bosch Rotary VE 4 10F 2100 L269
Injection pump timing	3° -0 + 1° B.T.D.C.

Injectors

Make and type	Bosch KBE 58 S 4/4
Nozzle type	DNO SD 263 or SDV 4011379
Opening pressure	150 +8/-0 BAR

Heater plugs

Make and type	Bosch 0.250.201.012
Nominal voltage	11 volts

ENGINE TUNING DATA

Model: Diesel Range Rover ..... 1986 MODEL YEAR 2.4 LITRE ENGINE

Engine		
Type	11A VM Type HR 492 HI	
Capacity	2393 cm^3	146.03 in^3
Compression pressure at crank speed 150 rev/min	32 to 35 kgf/cm^2	450 to 500 lbf/in^2
Injection order	1 - 3 - 4 - 2	
Idling speed at running temperature	750 - 800 rev/min	
Maximum light running speed	4700 to 4730 rev/min	
Maximum governed road speed	4200 rev/min	
Valve rocker clearances (cold)		
Inlet	0,30 mm	0.012 in
Exhaust	0,30 mm	0.012 in
Fuel injection pump		
Make and type	Bosch Rotary VE L 168-1	
Injection pump timing	3° B.T.D.C.	
Injectors		
Make and type	Bosch KBE 58 S 4/4	
Nozzle type	DNO SD 263	
Opening pressure	150 +8/-0 BAR	
Heater plugs		
Make and type	Bosch 0.250.201.012	
Nominal voltage	11 volts	

TORQUE WRENCH SETTINGS

ENGINE	Nm
Camshaft screws	24
Connecting rod bolts	81 *
Crankshaft pulley nut	152
Cylinder head bolts	SEE SPECIAL PROCEDURE
Cylinder head oil pipe unions	8
Engine coolant rail bolts	8
Engine mountings	49
Engine sump bolts	11
Engine sump pan bolts	11
Exhaust manifold nuts	32
Exhaust pipe flange bolts	27
Flywheel bolts	108
Flywheel housing bolts	49
Fuel line unions	19
Heater plugs	23
Idler gear screws 2.4 litre engine	27
Injection pump mounting nut	31
Injection pump gear nut	88
Injector nut	27
Inlet manifold nuts	32
Main bearing carrier bolts	42
Oil drain plugs	79
Oil filter base	38
Oil pump screws	27
Oil thermostat	74
Rear main bearing carrier nuts	27
Rocker cover nuts	9
Rocker shaft pedestal nuts	108 *
Timing cover screws	12
Turbo charger to manifold nuts	26
Vacuum pump nuts	21
Vacuum pump screws 2.5 Litre Engine	28
Valve gear oil pipe unions	8
Water pump screws	24

ELECTRICAL	Nm
Alternator tie rod	49
Alternator bracket to crankcase	54
Alternator pulley nut	54
Alternator bottom fixing	54
Starter motor to flywheel housing	68

*** Apply Molyguard to threads before fitting.**

Notes

RECOMMENDED LUBRICANTS AND FLUIDS

Use only the recommended grades of oil set out below.
These recommendations apply to climates where operational temperatures are above -10°C.

Petrol engine sump Oil can	BP Visco 2000 plus Castrol Syntron X Castrol GTX -2 Castrolite TXT Duckhams Hypergrade Motor Oil Esso Superlube EX2 Mobil Super Duckhams QXR Mobil 1 Rally Formula Esso Vitra	Fina Supergrade Motor Oil Fina First Shell Super Motor Oil Shell Gemini Havoline X1 Havoline multigrade UK only - Land Rover Parts 15W/40
Diesel engine sump **	BP Vanellus C3 Extra (15W/40) Castrol Turbomax (15W/40) Duckhams Fleetmaster SHPD (15W/40) Esso Super Diesel Oil TD (15W/40)	Mobil Delvac 1400 Super (15W/40) Fina Kappa LDO (15W/40) Shell Myrina (15W/40) Texaco URSA Super TD (15W/40) UK only - Land Rover Parts SHPD
	The following list of oils to MIL - L - 2104D or CCMC D2 or API Service levels CD are for emergency use only if the above oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes.	
	BP Vanellus C3 Multigrade (15W/40) Castrol RX Super (15W/40) Duckhams Hypergrade (15W/50) Esso Essolube XD - 3 plus (15W/40) Mobil Delvac Super (15W/40)	Fina Dilano HPD (15W/40) Shell Rimula X (15W/40) Texaco URSA Super Plus (15W/40)
Automatic gearbox	BP Autran DX2D Castrol TQ Dexron IID Duckhams Fleetmatic CD Duckhams D - Matic Esso ATF Dexron IID	Mobil ATF 220D Fina Dexron IID Shell ATF Dexron IID Texamatic Fluid 9226 UK only - Land Rover Parts ATF Dexron II
Manual gearbox	BP Autran G Castrol TQF Duckhams Q - Matic Esso ATF Type G Mobil ATF 210	Fina Purfimatic 33G Shell Donax TF Texamatic Type G or Universal UK only - Land Rover Parts ATF Type 'G'
Front and Rear differential Swivel pin housings	BP Gear Oil SAE 90EP Castrol Hypoy SAE 90EP Duckhams Hypoid 90 Esso Gear Oil GX (85W/90) Mobil Mobilube HD90	Fina Pontonic MP SAE (80W/90) Shell Spirax 90EP Texaco Multigear Lubricant EP (85W/90) UK only - Land Rover Parts EP90

** **Other approved oils include:** Agip Sigma Turbo, Aral OL P327, Autol Valve - SHP, Aviation Turbo, Caltex RPM Delo 450, Century Centurion, Chevron Delo 450 Multigrade, Divinol Multimax Extra, Ecubsol CD Plus, Elf Multiperformance 4D, Esso Special Diesel, Fanal Indol X, Fuchs Titan Truck 1540, Gulf Superfleet Special, IP Taurus M, Total Rubia TIR XLD, Valvoline Super HD 4D LD, Veedol Turbostar, Gulf Superfleet (GB), Silkolene Turbolene D, Kuwait Q8 T700.

Propeller shaft Front and Rear	BP Energrease L2 Castrol LM Grease Duckhams LB 10 Esso Multi - purpose Grease H	Mobil Grease MP Fina Marson HTL 2 Shell Retinax A Marfak All Purpose Grease
Power steering box and fluid Reservoir Transfer Gearbox	BP Autran DX2D BP Autran G Castrol TQ Dexron IID Castrol TQF Duckhams Fleetmatic CD Duckhams Q - matic Esso ATF Dexron IID Esso ATF Type G Mobil ATF 220D Mobil ATF 210	Fina Dexron IID Fina Purfimatic 33G Shell ATF Dexron IID Shell Donax TF Texamatic Fluid 9226 Texamatic Type G or 4291A Universal UK only - Land Rover Parts ATF Dexron II or Type G
Brake and clutch reservoirs	Brake fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT4	
Lubrication nipples (hubs, ball joints etc.)	BP Energrease L2 Castrol LM Grease Duckhams LB 10 Esso Multi - purpose Grease H	Mobil Grease MP Fina Marson HTL 2 Shell Retinax A Marfak All Purpose Grease
Ball joint assembly Top Link	BPL21M Castrol M53 Shell Retinax AM	Duckhams LBM10 Esso MP Mobil Supergrease
Seat slides Door lock striker	BP Energrease L2 Castrol LM Grease Duckhams LB 10 Esso Multi - purpose Grease H Mobil Grease MP	Fina Marson HTL 2 Shell Retinax A Marfak All purpose grease NLGI - 2 Multi - purpose Lithium - based Grease

Recommended lubricants and fluids - All climates and conditions

			AMBIENT TEMPERATURE °C
COMPONENT	**SPECIFICATION**	**VISCOSITY**	-30 -20 -10 0 10 20 30 40 50
Petrol models Engine sump Oil can	Oils must meet: RES.22.OL.G-4 or CCMC G-4 API service level SG	5W/30	
		5W/40 5W/50	
		10W/30	
		10W/40 10W/50	
		15W/40 15W/50	
		20W/40 20W/50	
		25W/40 25W/50	
Diesel models Engine sump	RES 22 OLD-5 CCMC D-5 API CE	15W/40 10W/30	
*** Emergency use:**	MIL - L - 2104D, CCMCD2 or API CD	10W/30	
Main Gearbox Automatic	ATF Dexron IID		
Main Gearbox manual	ATF M2C33 (F or G)		
Final drive units Swivel pin housings	API GL4 or GL5 MIL - L - 2105 or MIL - L - 21-05B	90 EP	
		80W EP	
Power steering Borg Warner Transfer Box	ATF M2C 336 or ATF Dexron IID		

* Diesel Models - Engine Sump

Oils for emergency use only if the SHPD oils are not available. They can be used for topping up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes. (See previous page)

Engine cooling system	Use an ethylene glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors suitable for use in aluminium engines to ensure the protection of the cooling system against frost and corrosion in all seasons. Use one part anti-freeze to one part water for protection down to -36°C. **IMPORTANT: Coolant solution must not fall below proportions one part anti-freeze to three parts water, i.e. minimum 25% anti-freeze in coolant otherwise damage to engine is liable to occur.**
Battery lugs, Earthing surfaces where paint has been removed	Petroleum jelly. **NOTE: Do not use Silicone Grease**
Air Conditioning System Refrigerant	**METHYLCHLORIDE REFRIGERANTS MUST NOT BE USED** Use only with refrigerant 12. This includes 'Freon 12' and 'Arcton 12'
Compressor Oil	Shell Clavus 68 BP Energol LPT68 Sunisco 4GS Texaco Capella E Wax/Free 68. Castrol Icematic 99
ABS Sensor bush-rear	Silicone grease: Staborags NBU - Wabco 830 502,0634 Wacker chemie 704 - Wabco 830 502,0164 Kluber GL301

ANTI-FREEZE

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

SUPPLEMENTARY MAINTENANCE SCHEDULE FOR DIESEL - RANGE ROVER

The following supplementary schedule should be used together with the schedule in the main Workshop Manual, for the complete maintenance of Range Rover Diesel models.

The maintenance intervals in this schedule are for European highway driving conditions, for change intervals of engine oil and all filters, under severe abnormal operating conditions, consult your nearest Land Rover Dealer.

Every 500 km (250 miles)

- Check engine oil level

After first 1,500 km (1000 miles)

- Tighten inlet manifold, exhaust manifold and turbo-charger bolts
  (See **Section 06** for torque wrench settings)
- Change engine oil and filter
- Check engine coolant level
- Check drive belt tension
- General check for fluid leaks
- Check tappet clearance

Every 10,000 km (6,000 miles)

- Change engine oil and oil filter
- Drain sedimenter
- Change fuel filter
- Check for fluid leaks
- Check drive belt tension

Every 20,000 km (12,000 miles)

- Clean lift pump filter
- Clean fuel sedimenter
- Clean fuel tank breather pipe
- Change air filter element
- Check engine cold idle speed

Every 40,000 km (24,000 miles)

- Check tappet clearance
- Check glow plug operation (continuity)
- Remove diesel injectors, spray test and refit

Every 80,000 km (48,000 miles)

- Remove intercooler element and flush out using 'GENKLENE' produced by ICI Ltd

Every 96,000 km (60,000 miles)

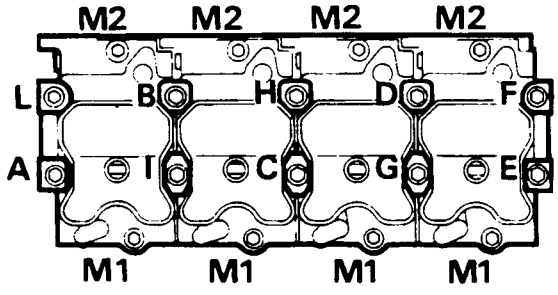
- Check turbo-charger impeller shaft axial and radial clearance
  (See **Section 04** General Specification Data)
- Check wastegate operation

SPECIAL MAINTENANCE INSTRUCTION

First 40,000Km (24,000 miles) only

NOTE: These instructions must be carried out at the first 40,000 Km (24,000 miles) service. The use of new type gasket eliminates the need to retorque head bolts at 1,500 Km (1,000 miles).

1. Centre bolts, starting with bolt A: Without slackening bolts, tighten each bolt in sequence through 10 - 15°.
2. Side bolts: Without slackening bolts cheque that torque of each bolt is 85 - 90 Nm. first M1 then M2.



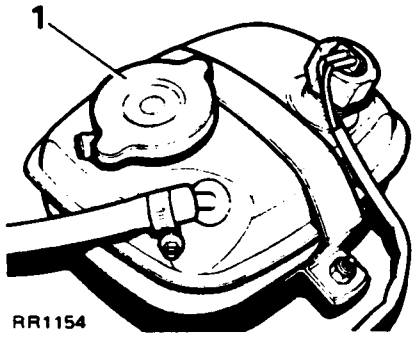
RR3804M

ENGINE COOLANT

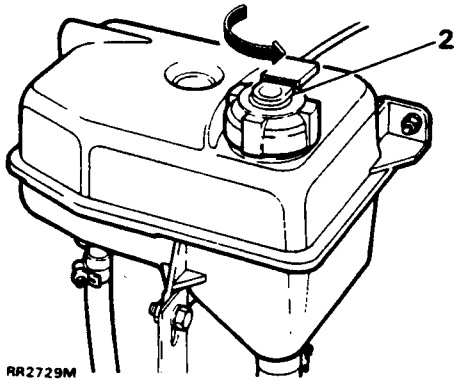
The level of coolant in the expansion tank should be checked daily or weekly dependent on the operating conditions.

The expansion tank is located in the engine compartment and:-

On 2.4 litre engines is fitted with a spring loaded filler cap. (1) Fig. RR1154



On 2.5 litre engines is fitted with a plastic filler cap and combined coolant level sensor.
(2) Fig. RR2729M



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

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 off.

With a cold engine the expansion tank should be approximately half full.

When replacing the filler cap, it is important that it is tightened down fully. Failure to tighten the filler cap properly may result in water loss, with possible damage to the engine through overheating.

Frost precautions and engine protection.

To prevent corrosion of the aluminium alloy engine parts it is imperative that the cooling system is filled with the specified strength solution of clean water and the correct type of anti-freeze, winter and summer.

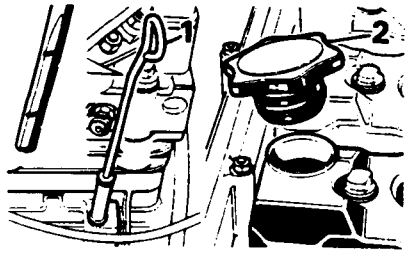
The cooling system should be drained and flushed out and refilled with anti-freeze every 40,000 km (24,000 miles) or sooner where the purity of the water is questionable.

After the second winter the system should be drained and thoroughly flushed by using a hose inserted in the radiator filler orifice.

NOTE: Whenever the cooling system has been drained and refilled, the vehicle should be run for approximately 20 minutes to ensure that the thermostat is open. Recheck the coolant level top up as necessary.

ENGINE OIL LEVEL CHECKING AND TOPPING UP - Fig. RR1155
Withdraw the dipstick (1) and wipe the blade clean.

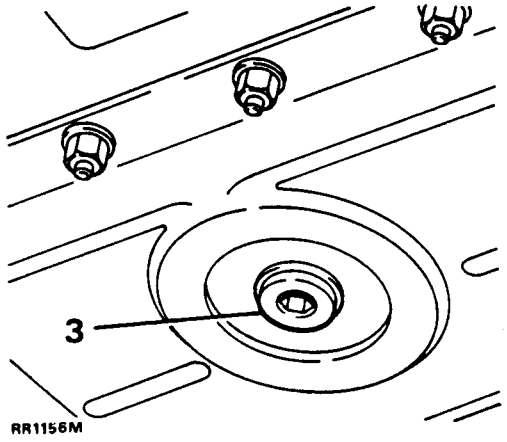
Re-insert the dipstick fully, then withdraw it and check the oil level indication, which must be between the 'MAX' (top) and 'MIN' (bottom) mark.



RR1155

To top-up, remove the filler cap (2) and top-up the engine with new oil, then repeat the checking and topping-up procedure until the oil level is correct. Do not overfill. Do not forget to replace the filler cap.

Oil draining and refilling - Fig RR1156
The oil should be drained after a run when the engine is warm. The oil filter can be renewed while the oil is draining.



RR1156M

Place a container under the engine that has a capacity of at least 7 litres (12 pints)

Unscrew the drain plug (3) and drain the oil. Clean the drain plug; use a new sealing washer if necessary and refit the drain plug.

Fill the engine with the correct quantity of new oil and recheck the level.

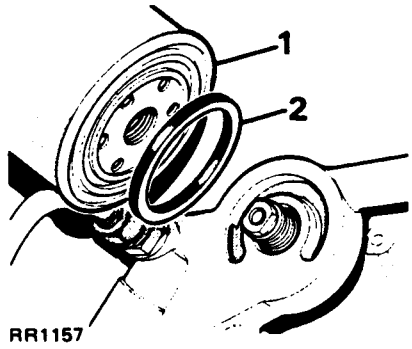
ENGINE OIL REFILL AND FILTER RENEWAL
Following any drain and refill of the engine oil or renewal of the engine oil filter cartridge the engine must be run at idle speed for a short period to allow oil pressure to build up in the turbo-charger.

CAUTION: Serious damage to the turbo-charger will result if the engine is run above idling speed before oil pressure is restored.

Oil filter cartridge renewal - Fig. RR1157
Slacken the clip and disconnect the air intake hose from the turbo-charger.

Clean the area around the filter head, and place a container beneath the engine.

Unscrew the oil filter cartridge (1) and discard it.



RR1157

Wet the seal (2) of the new oil filter with engine oil.

Screw the new filter into position, using hand force only.

Check the engine oil level.

Refit the air intake hose to the turbo-charger and tighten the clip.

Start the engine and check for leaks.

Stop the engine, wait a few minutes, then check the oil level and top-up if necessary.

MAIN FUEL FILTER - Fig. RR1161

Draining off water and sediment

It is essential that any water and sediment in the fuel filter is drained off, as water in the fuel can result in damage to the injection pump.

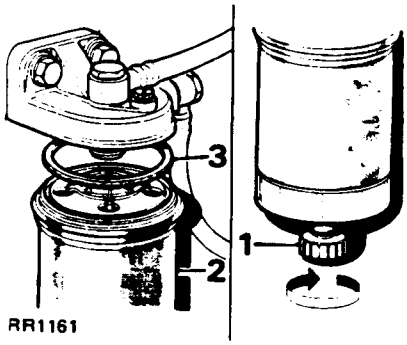
Hold a small receptacle beneath the drain cock.

Unscrew the drain cock (1) at the bottom of the filter half a turn.

Drain off water and sediment.

Immediately fuel starts to flow from the drain cock tighten the drain cock.

NOTE: Any delay in tightening the drain cock when the fuel starts to flow could possibly mean bleeding the fuel system.



RR1161

Renewing the fuel filter element

Clean the area around the filter head, and place a container beneath the filter.

Unscrew the filter (2) - a quantity of fuel will be released - and discard the filter. A hexagon is formed on the base of the filter for unscrewing it with a spanner.

Wet the seal (3) of the new filter with fuel.

Screw the new filter into position and tighten with a spanner.

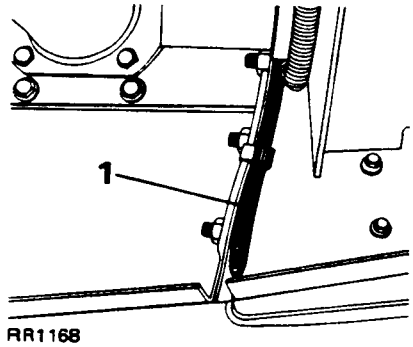
Ensure that the drain cock at the bottom of the filter is screwed up tight.

CLEANING FUEL TANK BREATHER PIPE - Fig. RR1168

The fuel tank breather pipe must be cleaned regularly to prevent diesel oil residue and road dust causing blockage. The pipe is located underneath the vehicle and runs down the body panel joint, to the rear of the fuel tank filler neck.

Clean the pipe at the intervals specified in the maintenance schedule, or more frequently if operating in dusty or muddy conditions.

Wipe clean the end of the breather pipe (1) and use a stout piece of wire to clear the inside.



RR1168

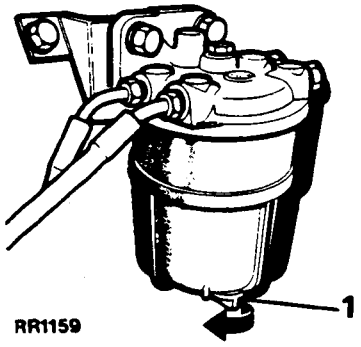
FUEL SEDIMENTER

The sedimenter is attached to the left-hand side of the chassis frame near the fuel tank, and increases the working life of the fuel filter by the larger droplets of water and larger particles of foreign matter from the fuel.

Drain off water as follows:

Drain off water - Fig. RR1159

Slacken off drain plug (1) and allow water to run out. When pure diesel fuel is emitted, tighten the drain plug.

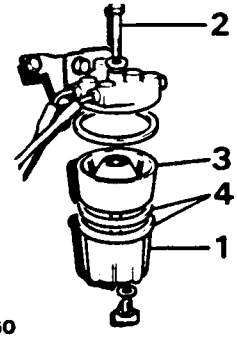


RR1159

Clean element - Fig. RR1160

If fuel is used from dubious storage facilities, the sedimenter should be removed and cleaned as circumstances require or as specified in the maintenance schedule.

Disconnect the fuel inlet pipe from the sedimenter and raise pipe above the the level of the fuel tank and support in this position to prevent fuel draining from the tank.



RR1160

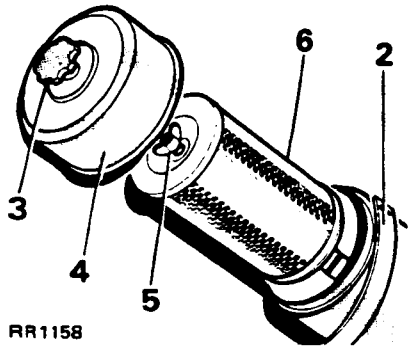
Support the sedimenter bowl (1), unscrew the bolt (2) on the top of the unit and remove the bowl.

Remove the sedimenter element (3) and clean all parts in kerosene. Fit new seals (4) and reassemble the sedimenter.

Slacken off the drain plug, when pure diesel fuel runs out, tighten plug. Start the engine and check the sedimenter for leaks.

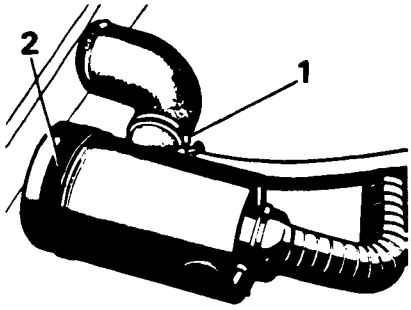
RENEW AIR CLEANER ELEMENT
- Figs. RR1158/RR1171

Disconnect the hose (1) from the air cleaner. Release the retaining strap (2) and lift up the air cleaner assembly.



RR1158

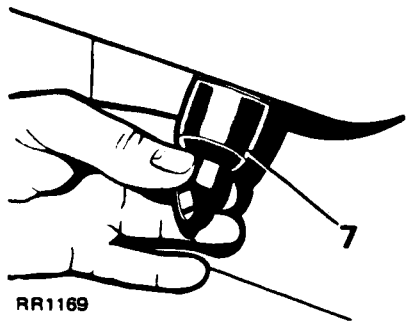
Unscrew the knob (3) and remove the end cover (4) from the air cleaner casing. Unscrew the wing nut (5), discard the element (6) and wipe clean the casing and cover.



RR1171

CHECK AIR CLEANER DUMP VALVE
- Fig. RR1169

Squeeze open the dump valve (7) and check that the interior is clean. Also, check that the rubber is flexible and in good condition. If necessary, remove the dump valve to clean the interior. Fit a new valve if the original is in poor condition



RR1169

Fit a new element, rubber seal end first, and reassemble the air cleaner.

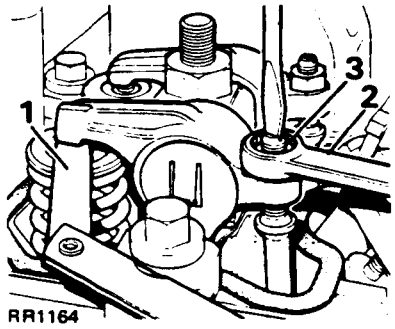
TAPPET ADJUSTMENT - Fig. RR1164

The correct clearance is: inlet and exhaust 0,30 mm (0.012 in) engine cold.

Remove rocker cover
Unscrew the centre retaining bolts and remove the rocker covers for each cylinder, taking care not to lose the seals from the top of the rocker cover.

Check and adjust the tappets
Turn the engine over until number 1 valve (counting from front of engine) is fully open.

Using a 0,30 mm (0.012 in) feeler gauge (1) check the clearance between the valve tip and rocker pad of number 7 valve.



RR1164

Adjust the clearance by slackening the lock nut (3) and turning the tappet adjusting screw clockwise to reduce clearance and anti-clockwise to increase clearance. Recheck the clearance after tightening the lock nut.

Continue to check and adjust the remaining tappets in the following sequence:

With No.1 valve fully open adjust No.7 valve.
With No.8 valve fully open adjust No.2 valve.
With No.5 valve fully open adjust No.3 valve.
With No.4 valve fully open adjust No.6 valve.
With No.7 valve fully open adjust No.1 valve.
With No.2 valve fully open adjust No.8 valve.
With No.3 valve fully open adjust No.5 valve.
With No.6 valve fully open adjust No.4 valve.

Refitting the rocker covers
Clean the rocker cover gasket seating face.

Inspect the rocker cover gaskets; renew if damaged.

Position the rocker cover with the oil filler cap on No.1 cylinder, and the rocker cover with the breather pipe to No.3 cylinder

Check that the collars and seals are located on the top of the rocker covers, then fit the rocker covers and tighten the retaining nuts.

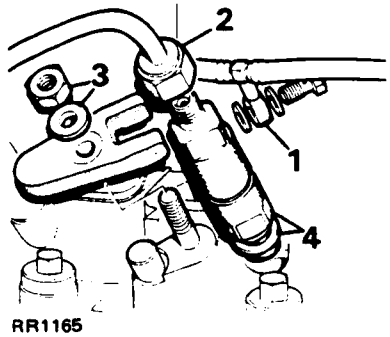
INJECTORS - Fig. RR1165

To locate a faulty injector, slacken the feed pipe union nut on the suspected injector and run the engine slowly. if there is no change in engine performance or if a faulty condition, such as a smoky exhaust, has disappeared, it can be assumed that the injector is faulty and a replacement injector should be fitted.

Unscrew the retaining nut and remove the rocker cover adjacent to the injector to be removed.

Disconnect the fuel leak-off pipe (1) and the high pressure pipe (2) from the injector.

Unscrew the mounting nut (3), and remove the mounting clamp, injector (4) and sealing washer.



RR1165

Before fitting an injector fit a new sealing washer.

Fit the injector, its mounting clamp and tighten the injector retaining nut to a torque of 1,7 kg/m.

Refit the high pressure feed pipe and leak-off pipe.

Refit the rocker cover; renew gasket if it is damaged; check that the collars and seals are located on top of the rocker cover before fitting and tightening the rocker cover.

NOTE: Fit the rocker cover with the oil filler cap on No.1 cylinder and the rocker cover with the breather pipe to No. 2 and 3 cylinders.

CHECK DRIVE BELTS - adjust or renew

Right-hand steering - Fig. RR1162

Left-hand steering - Fig. RR1163

WARNING: Disconnect the battery to prevent any possibility of the starter motor being operated.

The procedure for checking and adjusting the drive belts for the alternator (1), power steering pump (2) and the optional, air conditioning compressor (3) is similar. Examine all belts for wear and renew if necessary.

NOTE: Any marks on the outside of the air conditioning drive belt, caused by belt slipper bracket, can be ignored.

Check the tension of each drive belt, the belts should fit within the following dimensions, when checked at mid-point between the pulleys on the longest side of the belt.

Using a recognised drive belt tensioning gauge the tensions to be:-

On 'V' type drive belts:-
12,7mm wide belts ..... 450N ..... 95 lbf

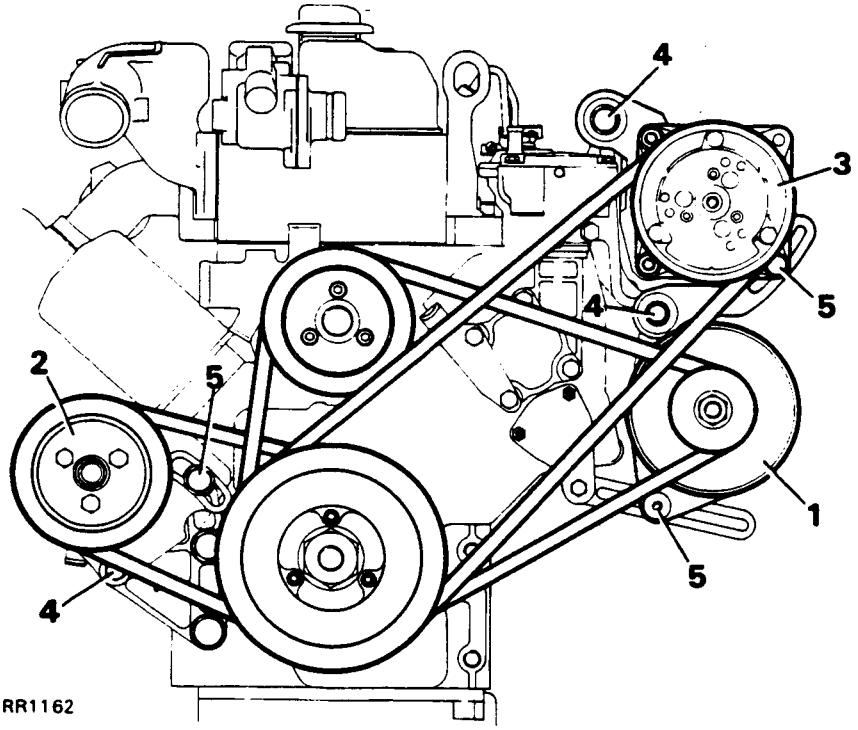
On poly 'V' drive belts 2.5 Litre Engines:-
Power steering pump ..... 400N ..... 90 lbf
Alternator/water pump ..... 490N ..... 110 lbf

"In field" Tensioning-No gauge available

Using normal hand pressure to check deflection, the belt should be tensioned to give a deflection of 0,5 mm per 25 mm of belt run between belt centres.

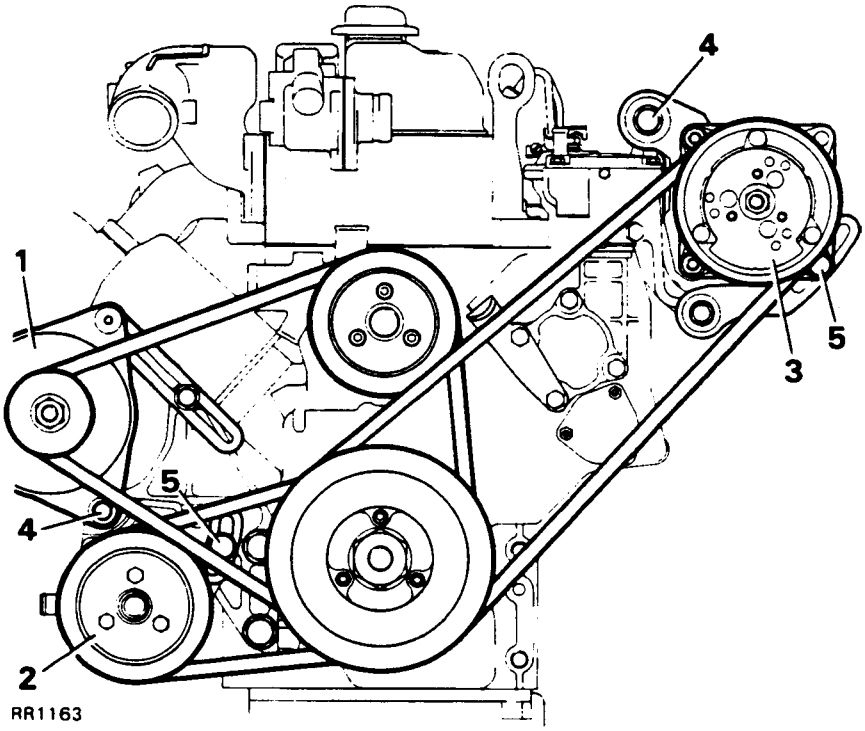
If any of the drive belts require adjustment, slacken the applicable pivot bolt (4) and the adjusting bracket nut and screw (5), pull the driven unit away from the engine until the belt is tight. Tighten the adjusting bracket then tighten the pivot bolt. Check the belt tension and readjust if necessary.

CAUTION: When fitting a new drive belt,tension the belt as described above. Reconnect the battery, start and run the engine for 3 to 5 minutes at fast idle, after which time the belt must be re-checked. If necessary retension the belt.



RIGHT HAND STEERING

LEFT HAND STEERING



CHECK COLD START ADJUSTMENT AND COLD IDLE SPEED 2.4 LITRE ENGINE

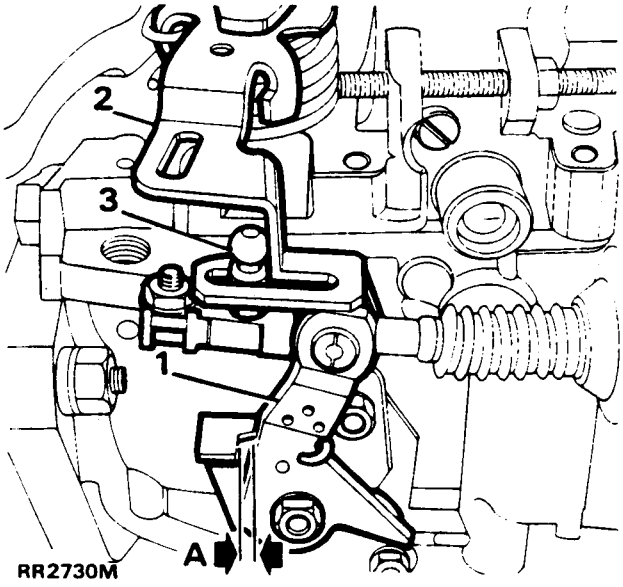
NOTE: It is important that these checks are only carried-out when the engine is cold.

Cold start adjustment

1. Check dimension 'A' which should be 3mm to 4mm.
   If adjustment is required slacken the cable clamp nut and move the clamp forward or rearward as necessary to achieve the correct dimensions and tighten the clamp nut.

Cold idle speed

2. The cold idle speed should be between 1000 and 1100 r.p.m. If adjustment is required slacken the nut and move the lever stop (3) to increase or decrease the speed accordingly and tighten the nut.



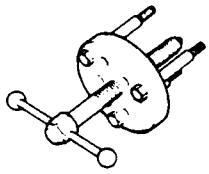
CHECK AND ADJUST FAST IDLE SETTING PROCEDURE 2.5 LITRE ENGINE.

NOTE: It is important that these checks are carried-out when the engine is warm - above 40°C.

Fast idle adjustment

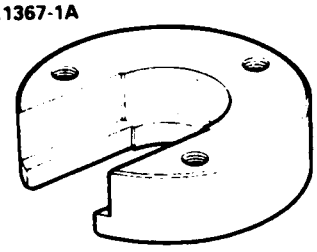
1. Dimension 'A' should be 4.5 mm. Adjust the lever inserting a 4.5mm distance piece into the gap to hold this dimension.
2. Move the accelerator lever to achieve engine speed 1000 to 1100 r.p.m. (no load).
3. Release and move the lever stop until it rests against the stop tab on the accelerator lever. Retighten the lever stop. Remove the distance piece.

18G.1367A



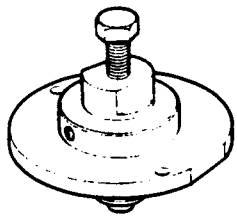
Remover crankshaft pulley

18G.1367-1A



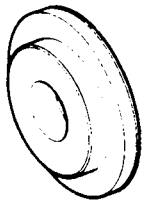
Adaptor crankshaft gear remover

18G.1368



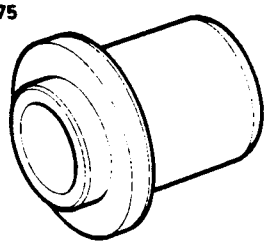
Remover and holder injection pump drive gear 2.4 engine

18G.1374



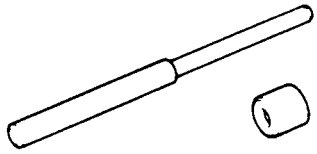
Replacer crankshaft rear oil seal

18G.1375



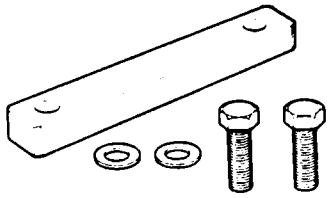
Replacer timing cover oil seal

18G.1377



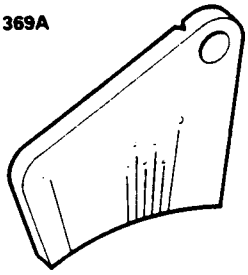
Remover/replacer valve guide

18G.1378B



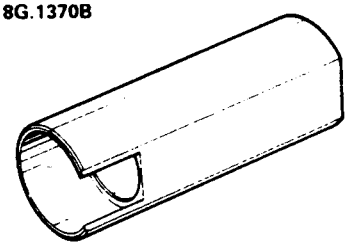
Retainer beam and gauge block cylinder liner

18G.1369A



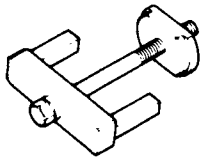
Timing gauge

18G.1370B



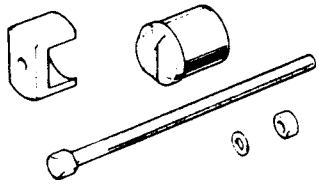
Remover/replacer sleeve crankshaft

18G.1371



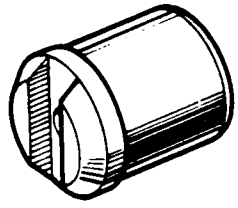
Remover cylinder liner

18G.1372B



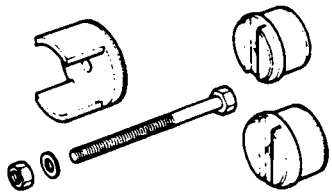
Remover/replacer crankshaft bearings

18G.1372BX



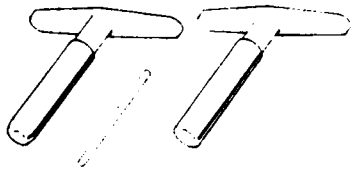
Thrust pad

18G.1373



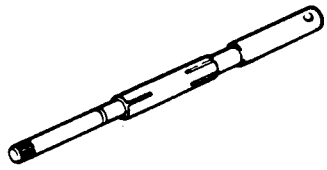
Remove/replacer front and rear crankshaft bearings

MS.76B



Basic handle set valve seat cutter

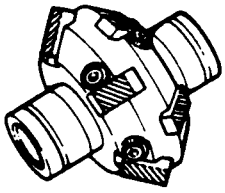
MS.150-8



Dia. 7.9 mm-8.5 mm

Adjustable pilot

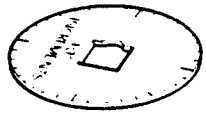
MS.621



Dia. Range 28.5 mm-44mm 15° & 45°

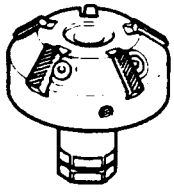
Adjustable valve seat cutter

LST 122



Angle gauge

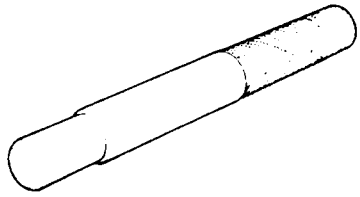
MS.690



Dia. Range 52 mm-42.5 mm 35

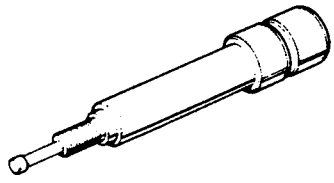
Adjustable cutter

18G.79



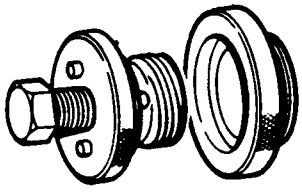
Clutch centralising tool

MS.107



Adaptor timing injector fuel pump

LST-139



Remover and holder injection pump drive gear 2.5 engine.

DIESEL ENGINE FAULT DIAGNOSIS

SYMPTOMS

Engine will not start
Start with check No. 1 and proceed as directed

Engine lacks power (ensure that the vehicle is not overloaded)
Start with check No. 34 and proceed as directed

Incorrect idling
Start with check No. 26 and proceed as directed

Excessive exhaust
Start with check No. 17 and proceed as directed

Engine misfires
Start with check No. 29 and proceed as directed

ENGINE FAULT DIAGNOSIS

	CHECK:	ACTION:
1.	Does the starter motor turn the engine?	**YES:** Check 2 **NO:** Check 4
2.	Does the starter turn the engine at normal starting speed?	**YES:** Check 6 **NO:** Check 3
3.	Is the engine oil of the correct grade?	**YES:** Check 4 **NO:** Change the oil
4.	Is the battery charged and in good condition?	**YES:** Check 5 **NO:** Charge or renew the battery as necessary
5.	Are all the cables and connections in the starter and solenoid circuit satisfactory?	**YES:** Suspect faulty starter or solenoid **NO:** Repair as necessary
6.	Are the heater plugs operating?	**YES:** Check 8 **NO:** Check 7
7.	Is the heater plug electrical circuit satisfactory?	**YES:** Check the heater plug **NO:** Repair the circuit
8.	Does the manual cold start advance operate correctly?	**YES:** Check 9 **NO:** Renew cold start device
9.	Is fuel reaching the injectors?	**YES:** Check 17 **NO:** Check 10
10.	Is the fuel cut-off solenoid working?	**YES:** Check 12 **NO:** Check 11
11.	Is the solenoid electrical circuit satisfactory?	**YES:** Suspect faulty solenoid **NO:** Repair as necessary
12.	Is there a supply of clean fuel in the tank?	**YES:** Check 13 **NO:** Fill the tank and bleed the system
13.	Are there leaks at fuel pipes or connections?	**YES:** Repair the leaks and bleed the system **NO:** Check 14
14.	Is there a blockage in the fuel system?	**YES:** Clear the blockage or renew the filter system **NO:** Check 15
15.	Is the fuel lift pump operating?	**YES:** Check 16 **NO:** Renew the lift pump
16.	Does the fuel system require bleeding?	**YES:** Bleed the fuel system **NO:** Suspect faulty injection pump
17.	Are the injector pipes connected in the correct firing order?	**YES:** Check 18 **NO:** Correct the firing order
18.	Are the correct injectors fitted?	**YES:** Check 19 **NO:** Fit correct injectors

ENGINE FAULT DIAGNOSIS

	CHECK:	ACTION:
19.	Are the injectors fitted correctly	YES: Check 20 NO: Rectify the error
20.	Is the injection timing correct?	YES: Check 21 NO: Re-set the timing
21.	Is the air cleaner or trunking blocked?	YES: Clear the blockage NO: Check 22
22.	Is the injector spray pattern, opening pressure and test performance satisfactory?	YES: Check 23 NO: Clean or renew injectors as necessary
23.	Are valve clearances correct?	YES: Check 24 NO: Adjust the valve clearances
24.	Are the cylinder compression pressures satisfactory?	YES: Check 25 NO: Locate and correct the fault
25.	Is the injection pump delivery correct?	YES: Suspect faulty turbo-charger NO: Adjust or renew the injection pump
26.	Does the throttle cable operate correctly	YES: Check 27 NO: Repair or renew the throttle cable
27.	Does the throttle cable have at least 1.5 mm (1/16") free play?	YES: Check 28 NO: Adjust the throttle cable
28.	Is the idle speed screw setting correct?	YES: Check 29 NO: Adjust the engine idle speed
29.	Is the fuel tank air vent restricted?	YES: Clear the restriction NO: Check 30
30.	Are there leaks at the fuel pipes or connections?	YES: Repair the leaks and bleed the system NO: Check 31
31.	Is there a blockage in the fuel system?	YES: Clear the blockage and bleed the system NO: Check 32
32.	Is the lift pump operating correctly?	YES: Check 33 NO: Renew the lift pump
33.	Does the fuel system require bleeding?	YES: Bleed the system NO: Check 17
34.	Are the brakes binding?	YES: Adjust the brakes NO: Check 35
35.	Is the throttle cable transmitting full travel to the throttle lever?	YES: Check 17 NO: Adjust the throttle cable

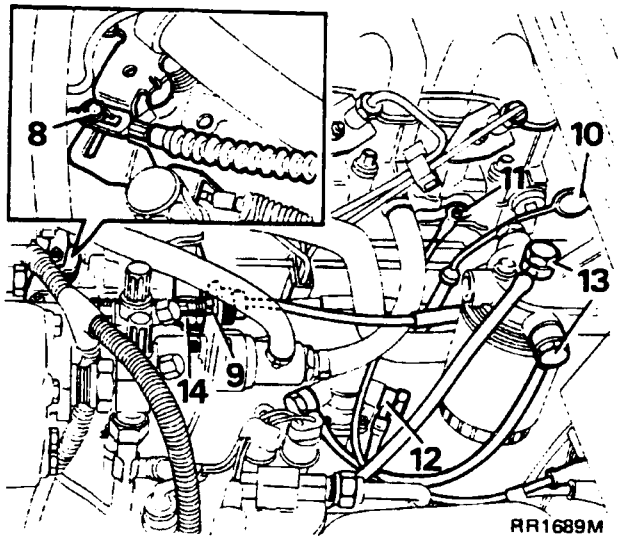
REMOVING AND REFITTING ENGINE

The procedure for engine remove and refit is similar to the petrol engine. The major component differences are highlighted in the following procedure. All instructions refer to both 2.4 and 2.5 engines unless otherwise stated.

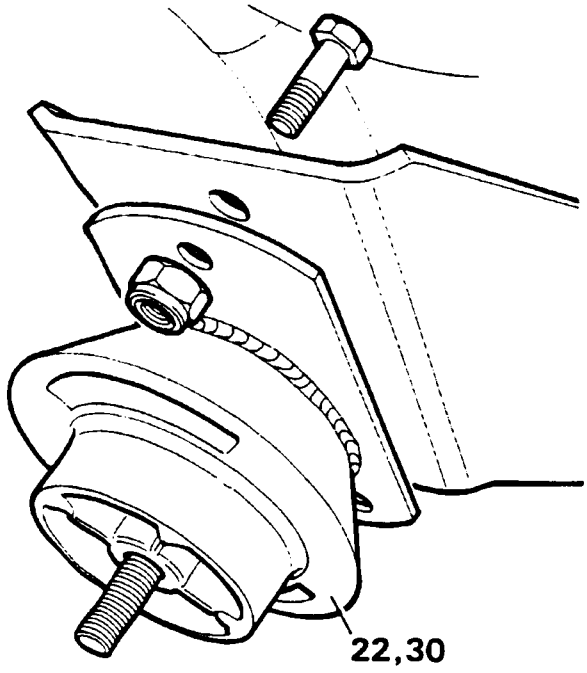
CAUTION: Seal all pipe ends against the ingress of dirt after disconnecting oil, fuel, fluid, vacuum or air conditioning pipelines.

Removing

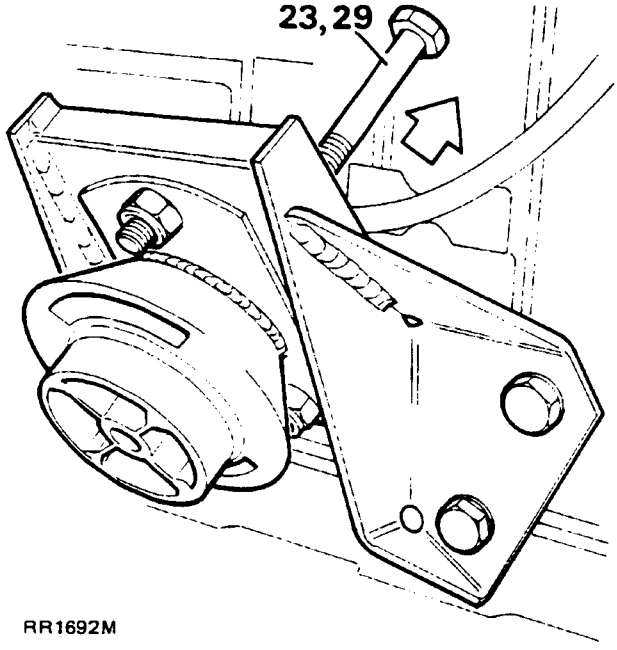
1. Remove the radiator and intercooler unit. The radiator unit has a built in engine oil cooler, access to the lower union is possible when the fan cowl is removed.
2. Remove the air cleaner assembly and connecting hoses.
3. Remove the power steering pump outlet and inlet hoses.
4. Disconnect the engine harness multiplug and, if the vehicle has air conditioning, the wiring to the compressor clutch.
5. (Air conditioning vehicles only) turn the high and low pressure compressor service valves to the OFF position (fully clockwise). Depressurise the compressor and remove the high and low pressure hoses.
6. Disconnect the heater return hose at the water pump and draw it clear.
7. Remove the heater inlet hose at the bulkhead connection.
8. Remove the split pin securing the inner throttle cable to the fuel injection pump.
9. Depress the tags on the outer cable adjusting screw to release the cable from the mounting bracket.
10. Disconnect the vacuum pipe from the vacuum pump.
11. Disconnect the glow plug feed wire.
12. Remove the main fuel line at the fuel pump, retaining the washers.



13. Remove the inlet and outlet fuel lines at the filter assembly.
14. Remove the spill return pipe union at the fuel injection pump.
15. Remove the exhaust manifold heat shield.
16. Release the exhaust flange nuts and disconnect the exhaust down pipe.
17. Remove the starter motor heat shield, wiring connections and fixings to the bell housing. Leave the starter motor attached to the engine block.
18. Remove one centre engine mounting nut from each side.
19. Remove the fixings securing the bell housing to the engine.
20. Attach a suitable lifting chain and hoist to the engine lifting hooks.
21. Raise the engine clear of the mountings and support the gearbox.
22. Remove the right hand engine mounting.



23. Remove the centre bolt from the left hand engine mounting.



RR1692M

24. Withdraw the engine from the gearbox and release the gearbox and transfer box breather pipes from their securing clip.
25. Lift the engine clear of the vehicle.

Refitting.

Before refitting the engine

Smear the splines of the primary pinion, the clutch centre and withdrawal unit abutment faces with molybdenum disulphide grease, Rocol MTS.1000. Smear the engine to gearbox joint faces with Hylomar jointing compound.

26. Attach a lifting chain and hoist to the engine lifting hooks.
27. Lower the engine into the engine bay and locate the gearbox and transfer box breather pipes in their securing clip.
28. Locate the primary pinion into the clutch and secure the engine to the bell housing with at least two bolts.
29. Fit the left hand centre engine mounting bolt.
30. Fit the right hand engine mounting and centre bolt.
31. Lower the engine on to the mountings.
32. Secure the fixings at both front engine mountings.
33. Remove the lifting equipment and the gearbox support.
34. Reverse instructions 1 to 17.
35. Prime the fuel system.

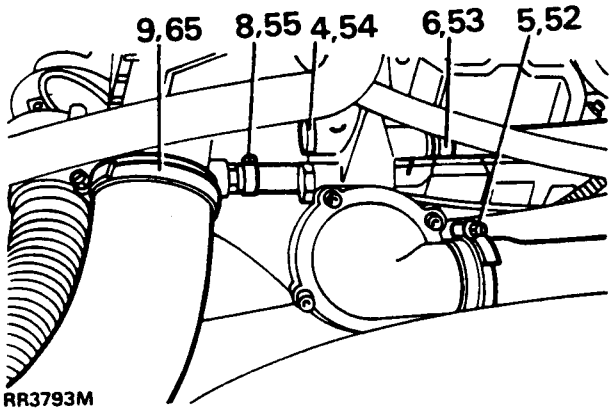
CYLINDER HEADS

NOTE: Before removing cylinder heads check alignment of heads, evidence of head gasket or manifold gasket blowing and evidence of water leaks.

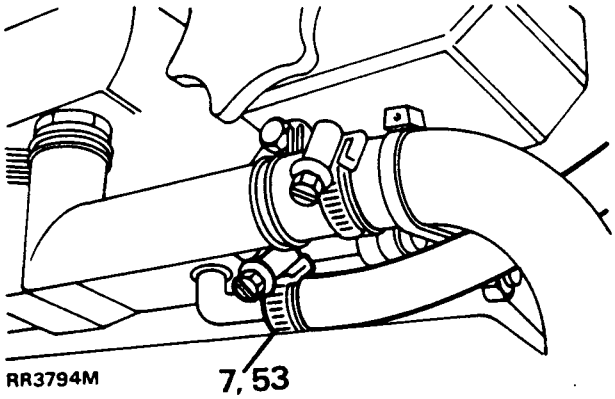
Remove and refit

Removing

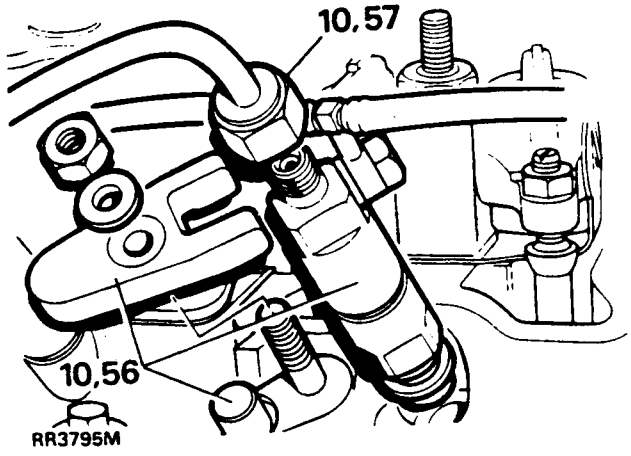
1. Disconnect battery negative lead.
2. Remove expansion tank filler cap. Drain coolant.
3. Disconnect breather hoses from rocker covers. Disconnect brake servo hose.
4. Disconnect air conditioning temperature switch.



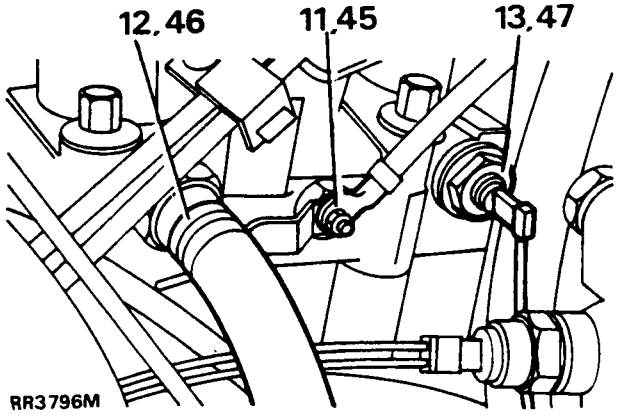
5. Disconnect by-pass hose and top hose at thermostat housing.
6. Disconnect cold start hose at water rail.
7. Disconnect bleed hose at water rail.



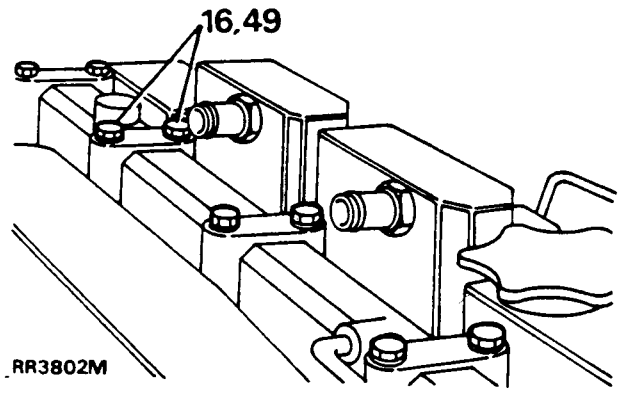
8. Disconnect vacuum pipe from inlet manifold.
9. Remove intercooler pipe.
10. Remove fuel feed pipes from injector. Remove all injectors, with spill pipe, lay aside. Retain injector dowels.



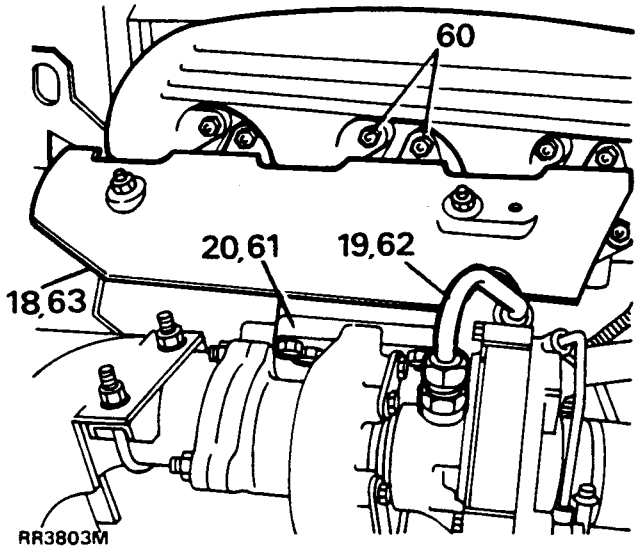
11. Remove heater plug feed wire.
12. Remove cold start hose from cylinder head.
13. Disconnect temperature sensor connector.



14. Remove rocker covers.
15. Remove rocker assemblies. Remove push rods, inspect.
16. Remove eight bolts securing water rail. Lay water rail aside on heater hose.



17. Remove oil feed banjo bolts from cylinder heads.
18. Remove exhaust heat shield.

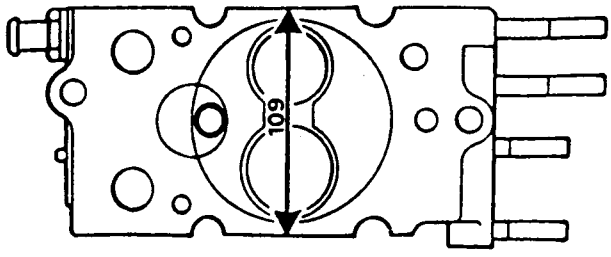


19. Remove turbocharger oil feed pipe
20. Remove four nuts securing turbocharger to exhaust manifold.
21. Remove outer cylinder head bolts.
22. Remove centre cylinder head bolts.
23. Lay cylinder head oil feed pipe against bulkhead.
24. Remove cylinder heads complete with manifolds.
25. Remove inlet and exhaust manifolds, discard gaskets. Inspect cylinder heads

INSPECT CYLINDER HEADS

Inspect cylinder heads, using the checks below. Any head that fails one or more check must be replaced with a new component, retaining those heads which pass all the checks.

a) Minimum width - 109 mm.



b) Height - 90 mm ± 0.05mm.
c) Inspect for cracks across valve bridge.
d) Distortion of mating faces.
e) Indentation of upper face caused by clamps.
f) Coolant leakage.
g) Measure end plate height - 91,26 to 91,43 mm.

If components pass above checks they may be refitted, using latest gasket and new centre bolts.

26. If new heads are being fitted, remove heater plugs, oil feed dowels, coolant adaptor and temperature transmitter. Fit these items to new cylinder heads. Fit new injector shrouds. Using an airline, check rocker oil feed drilling is free of obstruction.
27. Inspect gaskets, attempt to determine area of failure. Remove old gaskets from block. Thoroughly clean all traces of old gasket material from face of block. Check liner protrusion, see **LINER PROTRUSION CHECK.**

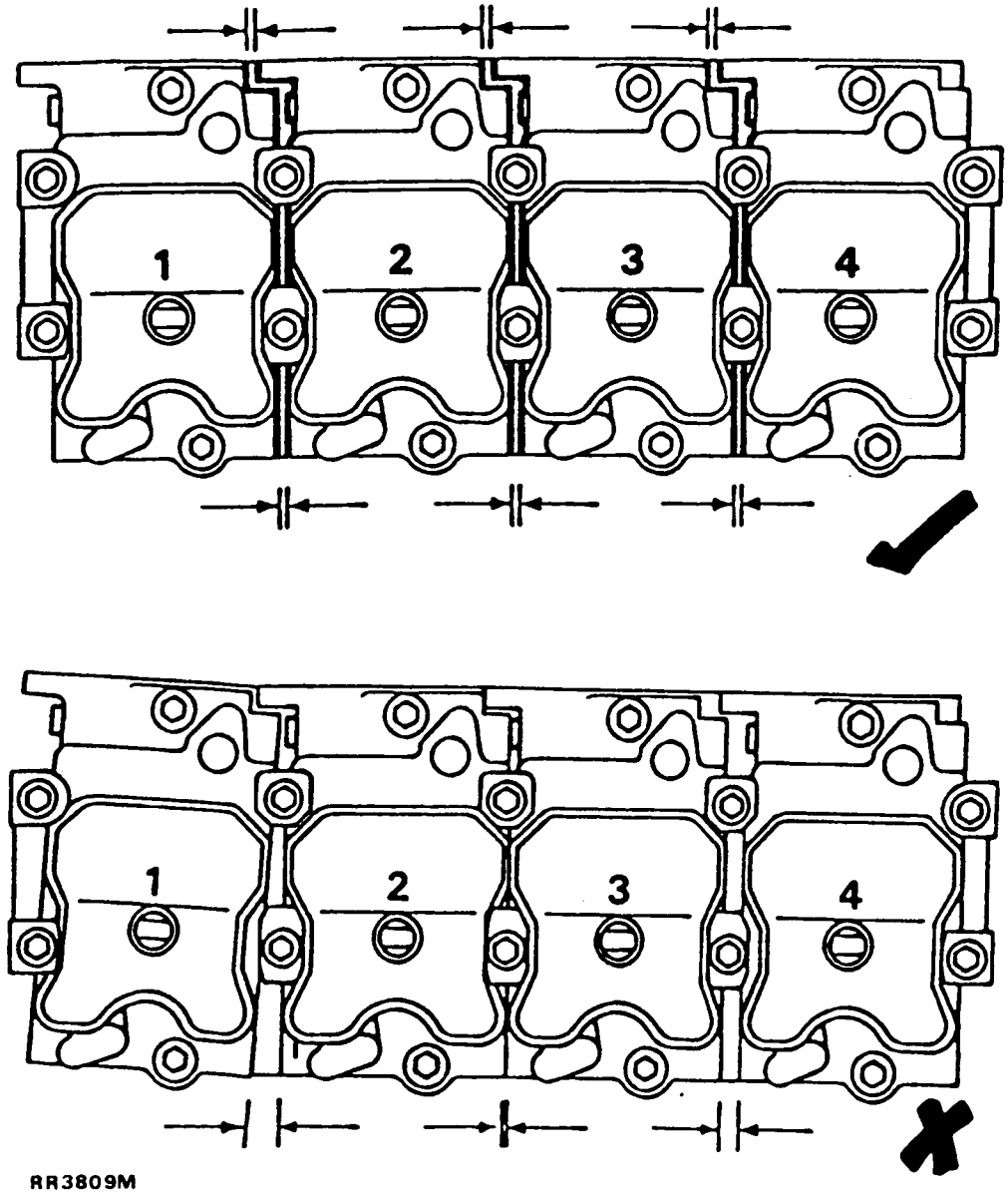
    WARNING: Failure to clean block face thoroughly could lead to head gasket failure.

28. Remove oil filter, catching any oil spillage.
29. Remove fan asembly, left hand thread.

Refitting

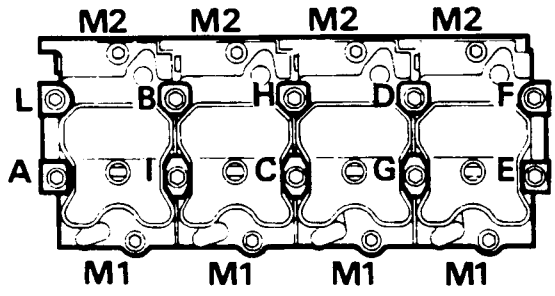
30. Fit inlet manifold loosely. Fit exhaust manifold loosely, fitting lifting eye.
31. Thoroughly clean face of new cylinder heads.
32. Determine thickness of head gasket required - see **HEAD GASKET SELECT.** Fit gaskets to cylinder block correctly.
33. Fit cylinder head assembly to block, locating studs to turbocharger.
34. Align head assembly with gaskets.
35. Ensure head side holes align with gasket and holes in block. Gaps between heads should be parallel, see RR3809M.

    NOTE: 2.4 litre models, where bulkhead clearance is limited, fit number 8 push rod into cylinder head before fitting head assembly. To ensure push rod does NOT protrude below face of cylinder head, tape it in place.



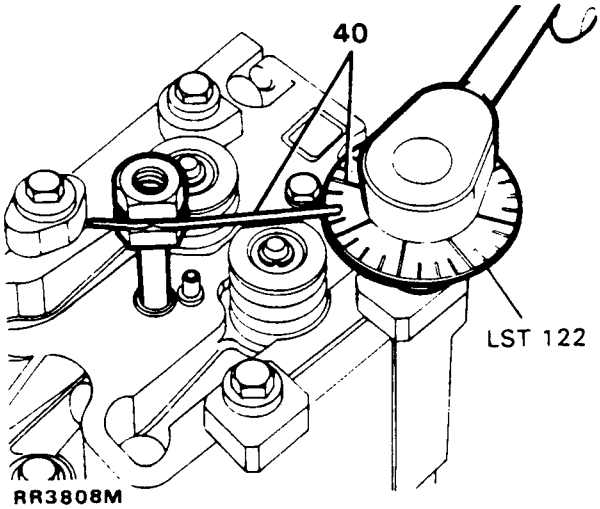
RR3809M

36. Lubricate side bolts (without washers) with engine oil, fit loosely.
37. Ensure inlet manifold is fitted square to cylinder heads to bring heads into alignment.
38. Lubricate threads and underside of central bolt heads with Molybdenum Disulphide. Fit centre bolts loosely, with end plates at front and rear. Align oil feed pipe.
39. Partially tighten centre bolts, holding end plates flush with cylinder heads. Ensure gasket positions are square and have not moved.



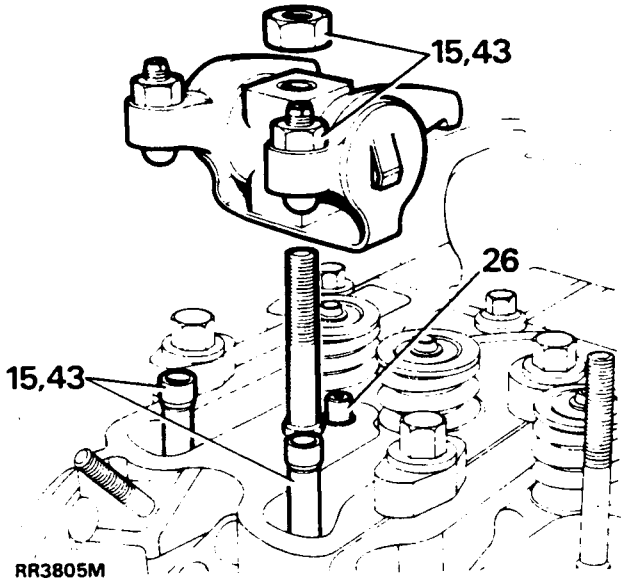
RR3804M

40. Centre bolts:
    a) Torque centre bolts to 30 Nm in sequence shown, starting from bolt A. REPEAT procedure for each bolt.
    b) Tighten each bolt through an angle of 70°, in sequence.
    c) Tighten each bolt an additional 70° in sequence.



RR3808M

41. Torque side bolts to 80 Nm, in the sequence bolts M1 then bolts M2.
42. Fit oil feed pipe, tighten bolts to 8 Nm.
43. Fit push rods and rocker assemblies, tighten single fixing to 108 Nm.



RR3805M

44. Adjust tappets.
45. Fit heater plug feed wire, tighten connector plates.
46. Fit cold start hose to cylinder head.
47. Connect temperature sensor connector.
48. Fit fan assembly.
49. Fit two rear bolts to water rail. Fit water rail attaching by pass hose. Tighten eight bolts to 8 Nm.
50. Tighten by pass hose clip.
51. Fit cold start hose to water rail, tighten clip.
52. Fit top hose, tighten clip.
53. Fit bleed hose to water rail, tighten clip.
54. Connect air conditioning temperature switch.
55. Connect vacuum pipe from inlet manifold, tighten clip.
56. Fit injectors with copper sealing washers. Locate dowels, tighten clamp nuts to 26 Nm.
57. Fit fuel supply pipes to injectors, tighten to 19 Nm.
58. Fit rocker covers, tighten to 9 Nm.
59. Fit breather pipes to rocker covers. Connect brake servo hose.
60. Tighten exhaust and inlet manifold nuts to 32 Nm.
61. Tighten four turbocharger to manifold nuts to 25 Nm.
62. Fit and tighten turbocharger oil feed pipe.
63. Fit exhaust heat shield
64. Fit oil filter.
65. Fit intercooler pipe, tighten clip.

Coolant refill

66. Remove coolant pipe from top of radiator.
67. Fill system through expansion tank until radiator is full.
68. Refit pipe to radiator and tighten.
69. Start engine, run until operating temperature is achieved, top up expansion tank as necessary.
70. Fit expansion tank filler cap, run engine for twenty minutes.

Retorque cylinder heads

71. Allow engine to cool completely.
72. Drain coolant.
73. Remove rocker covers.
74. Remove water rail.
75. Centre bolts, starting with bolt A:
    a) Loosen bolt, torque to 30 Nm,
    b) Tighten bolt through an angle of 120°.

    NOTE: 120° may be achieved by tightening through 60°, immediately followed by a further 60°. The total 120° MUST BE ACHIEVED BEFORE proceeding to next bolt.

    c) Repeat for each bolt in sequence shown.
76. Retorque outer bolts to 90 Nm. without loosening, first M1 then M2.
77. Fit rocker assemblies, tighten single fixing to 108 Nm.
78. Adjust tappets.
79. Fit water rail using new gaskets.
80. Fit hoses, tighten clips.
81. Check top up oil.
82. Refill cooling system. Run engine until operating temperature is reached, top up if necessary.

RETORQUE CYLINDER HEADS

First 40,000Km (24,000 miles) only

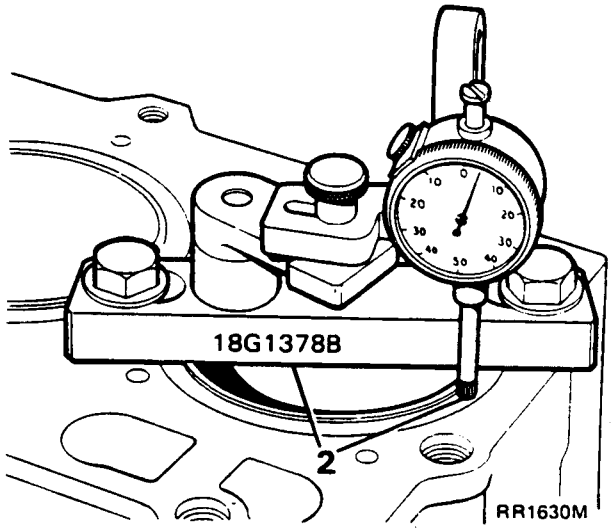
NOTE: These instructions must be carried out at the first 40,000 Km (24,000 miles) service OR 40,000 Km (24,000 miles) AFTER the above procedure has been carried out. The use of new type gasket eliminates the need to retorque head bolts at 1,500 Km (1,000 miles).

1. Centre bolts, without slackening bolts, start with bolt A, tighten each bolt in sequence through 10 - 15°.
2. Side bolts: Without slackening bolts cheque that torque of each bolt is 85 - 90 Nm. first M1 then M2.

LINER PROTRUSION CHECK

1. Ensure face is clean
   Correct reading:
   2.4 Litre and 2.5 Litre - 0,00 to 0,06 mm

2. To obtain the correct liner protrusion, attach special tool 18G 1378 B as illustrated, to the cylinder block and tighten the bolts to 30 Nm. Fit a dial test indicator so that the stylus rests in a loaded condition on the external rim of the liner and set the dial to zero. Slide the stylus across to the cylinder block and note the reading.
   Repeat the above procedure to the remaining cylinders.



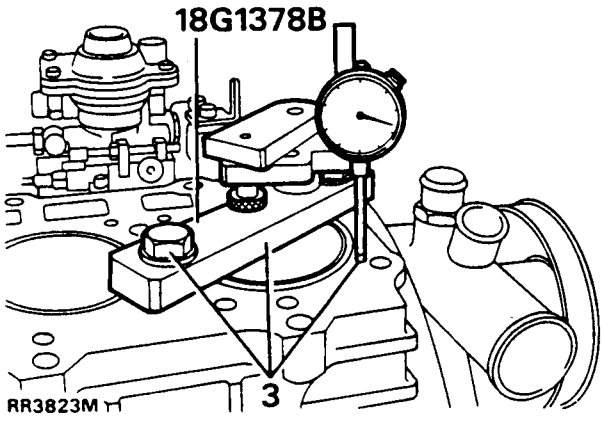
3. Remove the liners and add shims as required to achieve the protrusion.

HEAD GASKET SELECT

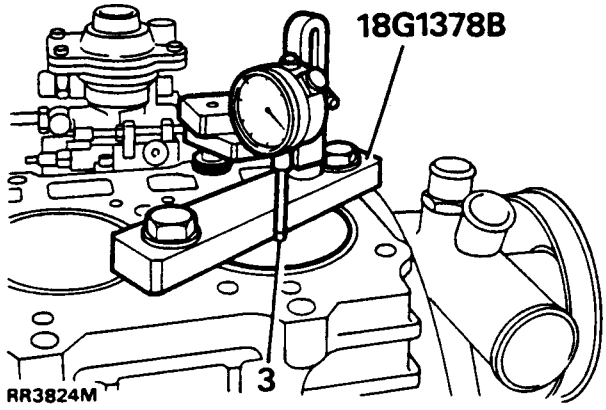
1. Before fitting the cylinder heads it is necessary to determine the thickness of gasket that must be used to achieve the correct clearance between each piston crown and cylinder head. Three thicknesses of gasket are available, see table below. The following procedure should be used to determine which size to fit. However, only one thickness of gasket must be used on all four cylinders, this being the one for the cylinder which calls for the thickest gasket.

Identification	Part no.	Fitted thickness
No notch	STC 654	142mm ± 0.04
One notch	STC 656	162mm ± 0.04
Two notches	STC 655	152mm ± 0.04

2. Turn the crankshaft to bring number one piston to T.D.C.



3. Fit special tool 18G 1378B to the cylinder block and tighten the bolts to 30 Nm Attach the dial test indicator to the tool, as illustrated, and position the stylus, in a loaded condition, on the cylinder block and zero the gauge. Slide the indicator over so that the stylus rests on the piston crown and note the reading.



Example

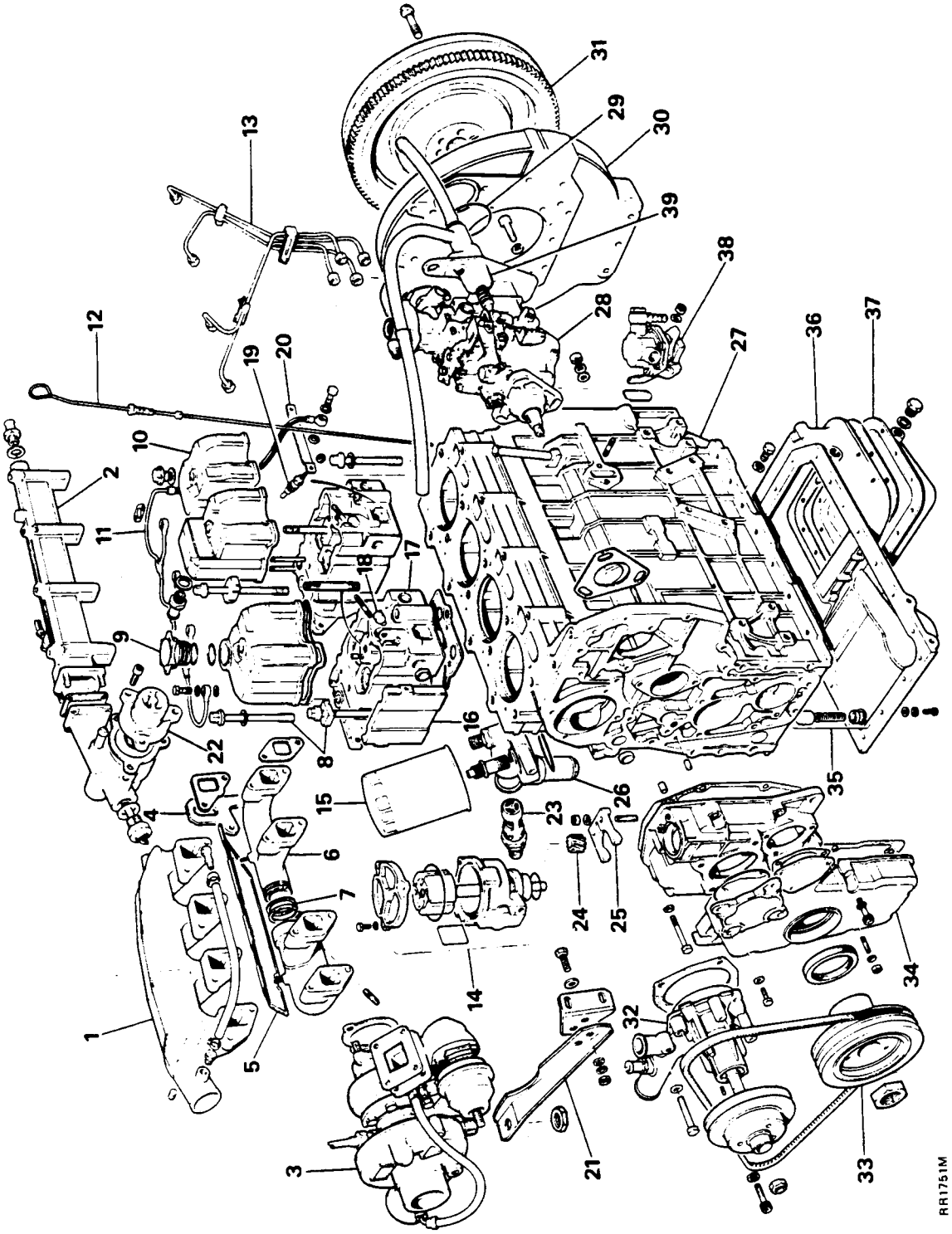
Required piston clearance	0,85	to	0,94 mm
Plus measured height	0,60		0,60 mm
Thickness of gasket required	1,45	to	1,54 mm

The nearest compressed thickness of gasket available is 1,52 mm part number STC655

4. Repeat the above instruction on the remaining cylinders. The thickest gasket required is the one which must be fitted to all cylinders.

ENGINE EXTERNAL COMPONENTS 2.4 LITRE ENGINE

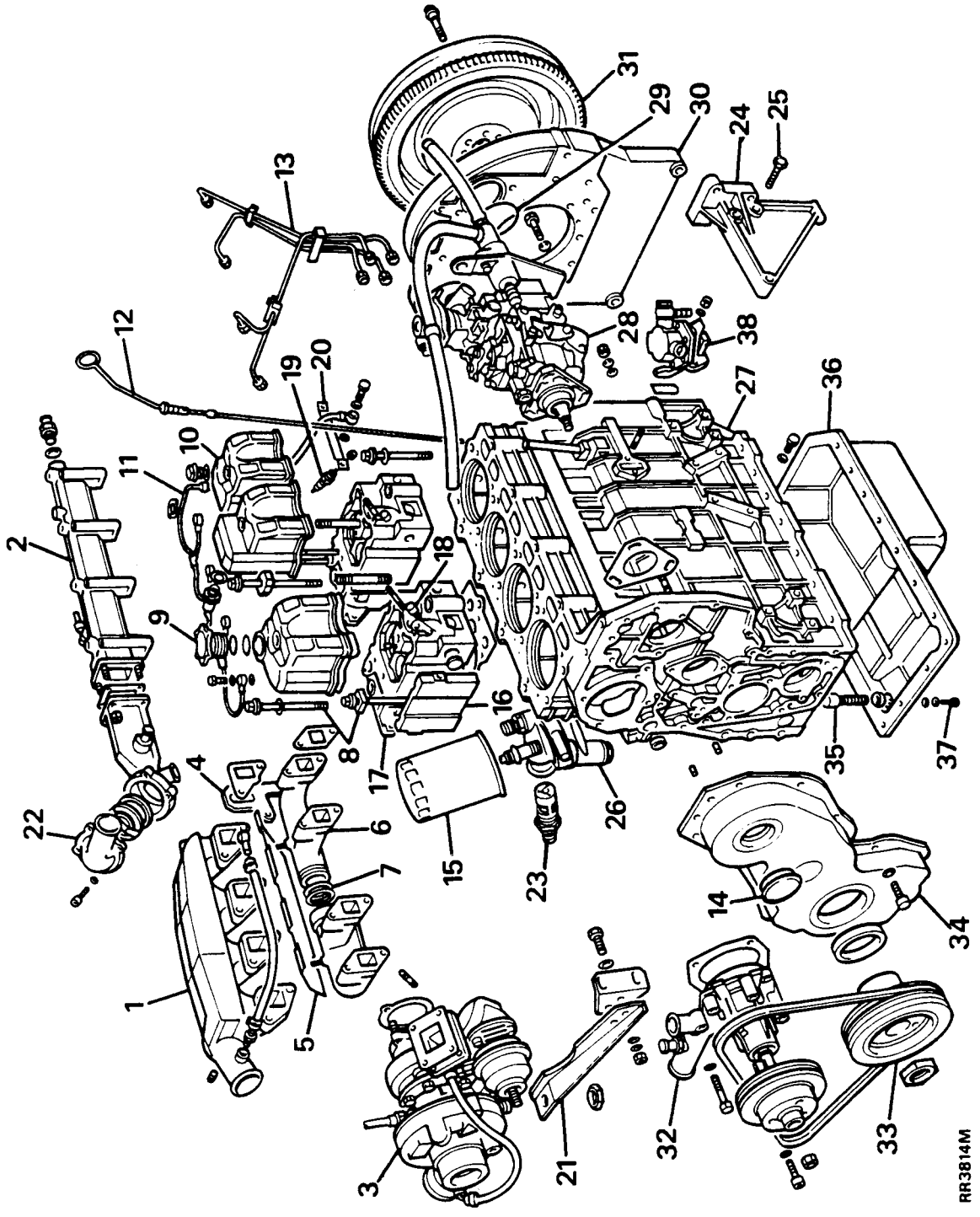
1. Inlet manifold
2. Engine coolant rail
3. Turbo-charger
4. Engine lifting eye
5. Heat shield
6. Exhaust manifold
7. Sealing rings
8. Cylinder head bolt and spacer block
9. Oil filler cap
10. Rocker cover
11. Valve gear oil feed pipe
12. Dipstick
13. Injector pipes
14. Vacuum pump
15. Oil filter element
16. Cylinder head end-plate
17. Cylinder head
18. Injector dowel
19. Heater plug
20. Heater plug copper link
21. Turbo-charger support bracket
22. Coolant thermostat
23. Oil thermostat
24. Vacuum pump gear
25. Retaining clamp - vacuum pump
26. Oil filter base adapter
27. Cylinder block
28. Fuel injection pump
29. 'O' ring
30. Flywheel housing
31. Flywheel
32. Water pump
33. Crankshaft pulley
34. Timing cover
35. Oil pressure relief valve
36. Sump
37. Sump pan
38. Fuel lift pump
39. Cold start device



2.4 LITRE ENGINE

ENGINE EXTERNAL COMPONENTS 2.5 LITRE ENGINE

1. Inlet manifold
2. Engine coolant rail
3. Turbo-charger
4. Engine lifting eye
5. Heat shield
6. Exhaust manifold
7. Sealing rings
8. Cylinder head bolt and spacer block
9. Oil filler cap
10. Rocker cover
11. Valve gear oil feed pipe
12. Dipstick
13. Injector pipes
14. Screw plug
15. Oil filter element
16. Cylinder head end-plate
17. Cylinder head
18. Injector dowel
19. Heater plug
20. Heater plug copper link
21. Turbo-charger support bracket
22. Coolant thermostat
23. Oil thermostat
24. Support bracket
25. Bolt
26. Oil filter base adapter
27. Cylinder block
28. Fuel injection pump
29. 'O' ring
30. Flywheel housing
31. Flywheel
32. Water pump
33. Crankshaft pulley
34. Timing cover
35. Oil pressure relief valve
36. Sump
37. Sump bolt
38. Fuel lift pump
39. Cold start device



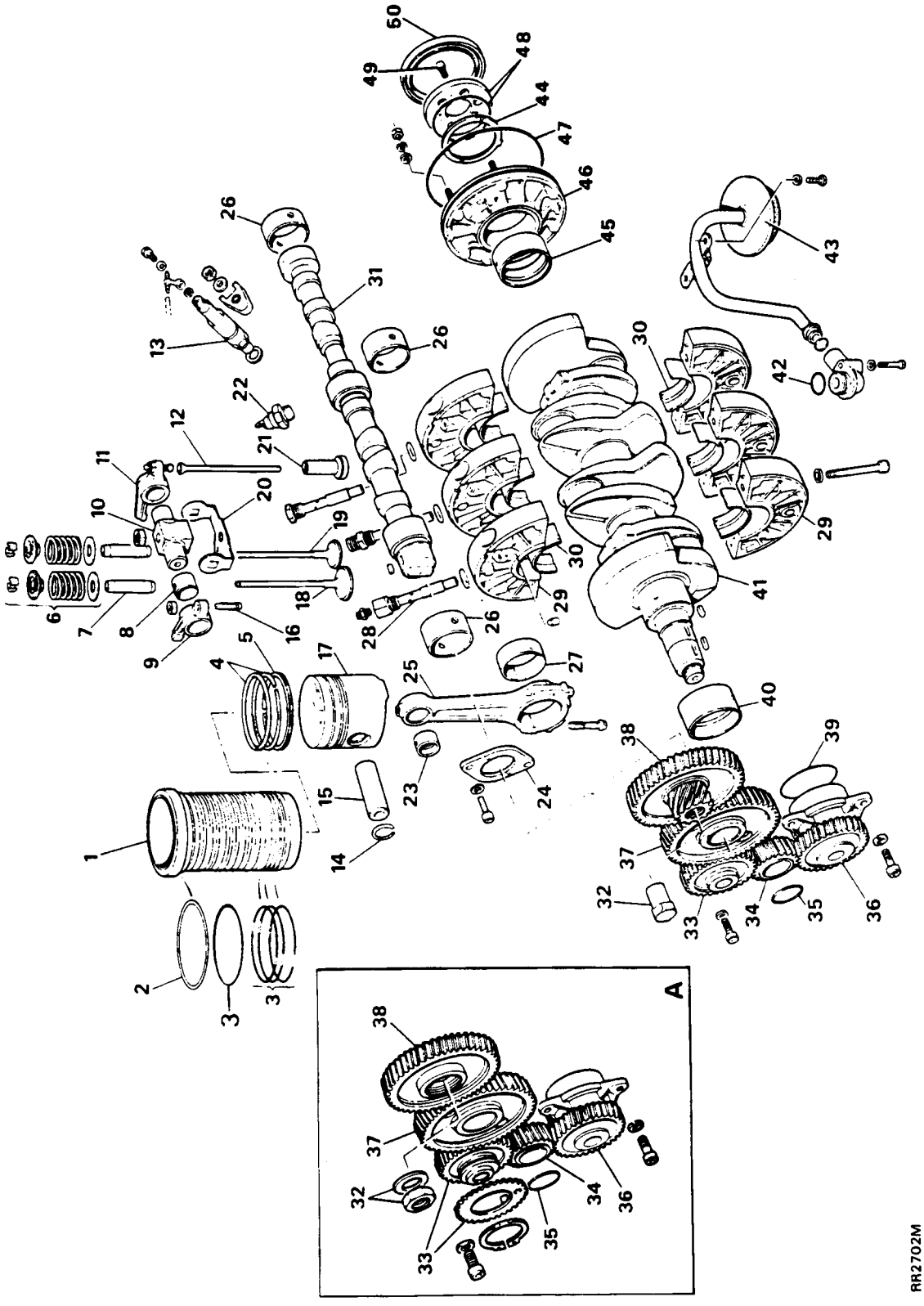
2.5 LITRE ENGINE

KEY TO ENGINE INTERNAL PARTS

1. Liner
2. Shim
3. 'O' ring seals
4. Compression rings
5. Oil control ring
6. Valve spring cap
7. Valve guide
8. Rocker shaft bush
9. Inlet rocker arm
10. Rocker shaft (pedestal)
11. Exhaust rocker arm
12. Push rod
13. Injector
14. Snap ring
15. Gudgeon pin
16. Valve clearance adjusting screw
17. Piston
18. Inlet valve
19. Exhaust valve
20. Spring clip
21. Tappet
22. Oil pressure switch
23. Small end bush
24. Thrust plate
25. Connecting rod
26. Camshaft bearings
27. Connecting rod bearing shell
28. Carrier location and lubrication shaft
29. Central main bearing carrier
30. Central main bearing shell
31. Camshaft
32. Gear retaining nut (injection pump)
33. Idler gear
34. Crankshaft gear
35. 'O' ring seal
36. Oil pump assembly
37. Camshaft gear
38. Fuel injection pump gear
39. 'O' ring seal
40. Front main bearing
41. Crankshaft
42. 'O' ring seal
43. Oil pick-up pipe and strainer
44. Thrust washer halves
45. Rear main bearing
46. Rear main bearing carrier
47. 'O' ring seal
48. Crankshaft thrust spacer and 'O' ring seal
49. Socket headed screw
50. Crankshaft rear oil seal

KEY TO 2.5 LITRE DIESEL ENGINE VARIATIONS INSET A

32. Retaining nut and washer
33. Vacuum pump and split gear assembly
34. Crankshaft gear
35. 'O'-ring seal
36. Oil pump assembly
37. Camshaft gear
38. Fuel injection pump gear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RR2702M

DISMANTLING, OVERHAUL AND REASSEMBLY

Special Tools

18G 29	Valve lapping tool
18G 55A	Piston ring compressor
18G 79	Clutch centralising tool
18G 106A	Valve spring compressor
18G 257	Circlip pliers (large)
18G 284	Impulse extractor
18G 284-10	Adaptor remover injector
18G 1004	Circlip pliers (small)
18G 1367	Remover crankshaft pulley
18G 1367-1A	Adaptor remover gear
18G 1368	Remover and holder injection pump drive gear 2.4 engine
LST - 139	Remover and holder injection pump drive gear 2.5 engine
18G 1369A	Timing marker
18G 1370B	Remover replacer sleeve crankshaft
18G 1371	Remover cylinder liner
18G 1372B	Remover replacer camshaft bearings
18G 1373	Remover replacer crankshaft front and rear main bearings
18G 1374	Replacer crankshaft rear oil seal
18G 1375	Replacer timing cover oil seal
18G 1377	Remover replacer valve guides
18G 1378B	Retainer cylinder liner
MS 70	Oil filter wrench
MS 76	Basic handle set
MS 107	Timing adaptor fuel injection pump
MS 150-7	Expandable pilot
MS 150-8	Expandable pilot
MS 621	Adjustable valve seat cutter
MS 690	Adjustable valve seat cutter
LST 122	Cylinder head bolt angle gauge

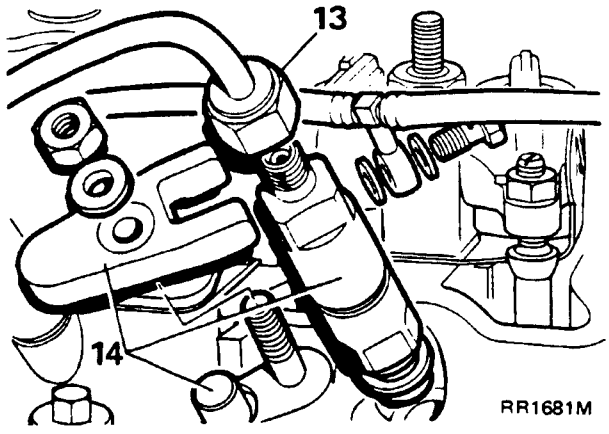
DISMANTLING

Removing ancilliary equipment

NOTE: All instructions refer to both 2.4 and 2.5 litre diesel engines unless otherwise stated.

Remove the engine from the vehicle. Clean the exterior and in the interests of safety and efficient working, secure the engine to a recognised engine stand and drain the oil from the sump. Before commencing make a careful note of the position of brackets, clips, harnesses, pipes, hoses, filters and other miscellaneous items to facilitate re-assembly.

1. Remove the alternator and mounting bracket.
2. Remove the starter motor.
3. Remove the power steering pump.
4. Remove the Air Conditioning Compressor and mounting brackets.
5. Remove the oil filter cartridge.
6. Remove the oil drain pipe from the turbo-charger and engine block union.
7. Remove the two socket headed bolts securing the turbo-charger support bracket to the cylinder block.
8. Disconnect the oil feed to the turbo-charger.
9. Remove the four bolts and release the turbo-charger from the exhaust manifold.
10. Remove the inlet and exhaust manifolds.
11. Remove the special nuts and lift off the four rocker covers and joint washers.
12. Release the six bolts and remove the coolant rail, complete with thermostat housing.
13. Disconnect the injector pipes from the injectors and injector pump.
14. Release the clamp nuts and remove the injectors complete with spill rail and collect the four dowels.



15. Turn the crankshaft in a clockwise direction to bring number one piston to T.D.C. on the firing stroke with number four cylinder valves on the "rock". This condition is necessary for removal of the injection pump at a later stage.
16. Remove the four single nuts and lift off each rocker assembly keeping them identified with their respective cylinder heads. Check that the oil feed dowels are in position in the heads and not inside the pedestals. Remove the push-rods.

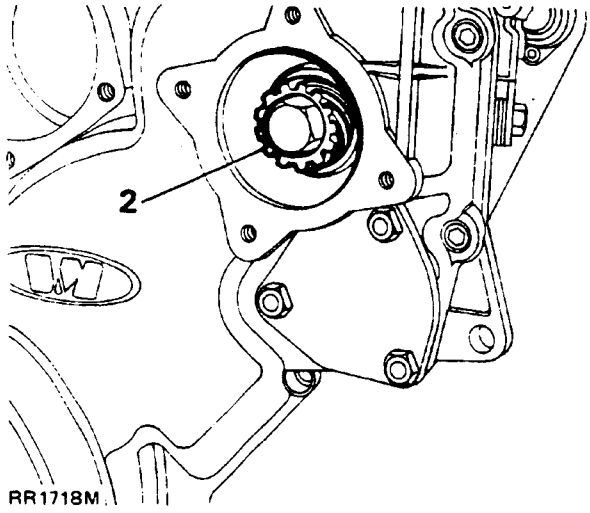
17. Remove all cylinder head bolts and clamps. Lift of each cylinder head and gasket and number it according to the bore from which it was removed.
18. Withdraw the four bolts and remove the water pump complete with pulley.

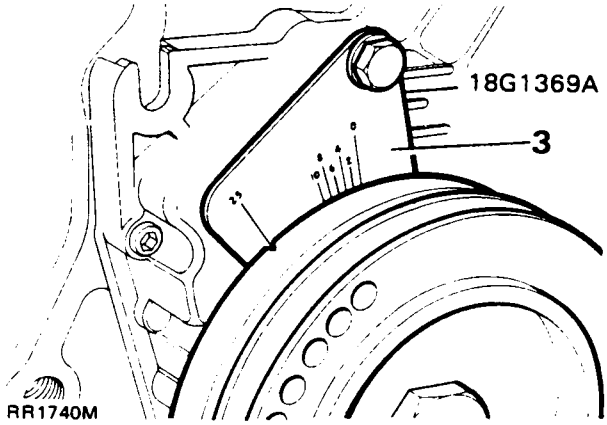
NOTE: Instructions 19 and 20 refer to 2.4 Litre engines only.

19. Remove the vacuum pump oil feed pipe.
20. Remove the two nuts and clamp plate and withdraw the vacuum pump.

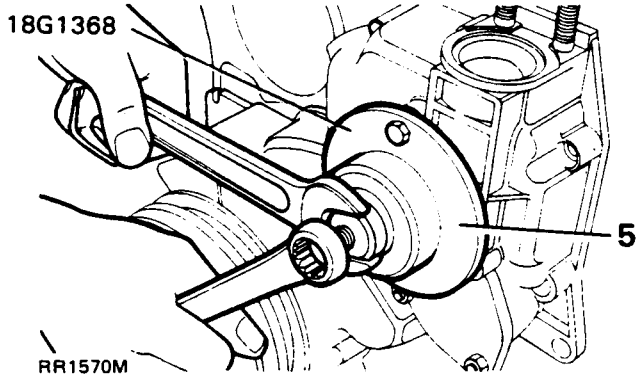
Remove injection pump 2.4 litre engines

1. Remove the injection pump drive gear access plate from front cover.
2. Remove the injection pump drive gear retaining nut.

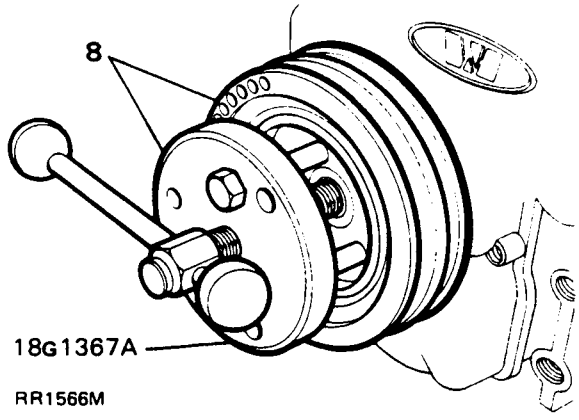




3. Fit the timing marker 18G 1369A to the front cover. The 'O' on the scale should line-up with the groove in the crankshaft pulley.
4. Turn the crankshaft anti-clockwise, beyond the 25° mark on the scale, to remove backlash, and then turn it clockwise until the groove in the crankshaft pulley is aligned with the 25° B.T.D.C. mark. The key on the injection pump shaft should now be at the 11 o'clock position.
5. Fit special tool 18G 1368 to the front cover. Lock the flywheel, and slacken the three nuts that secure the injection pump flange to the engine block.
6. Turn the centre bolt of the tool until the gear releases from the taper. Remove the tool, and pump retaining nuts and withdraw the pump complete with cold start device.



7. Lock the flywheel and remove the crankshaft pulley securing nut.
8. Using special tool 18G 1367A withdraw the crankshaft pulley.

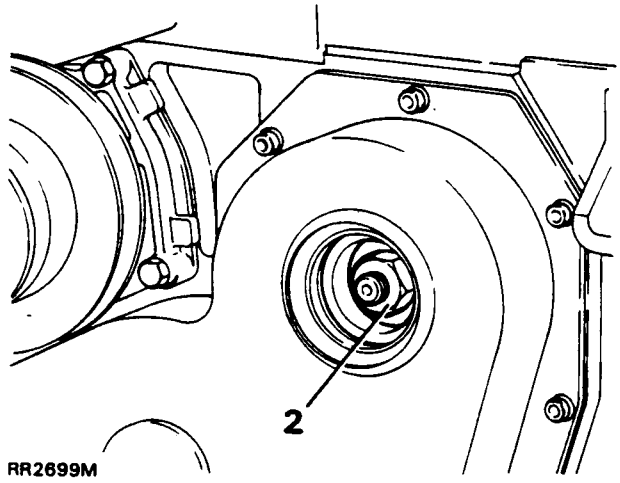


9. Remove the timing cover and retrieve the injector pump drive gear.

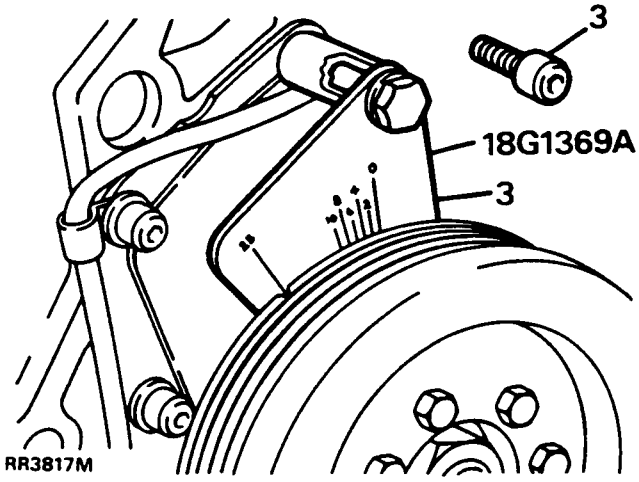
Remove injection pump 2.5 litre engines

1. Using the pegged component, item 6 of special tool LST - 139 remove the injection pump drive gear access plate from front cover.
2. Remove the injection pump drive gear retaining nut and washer.

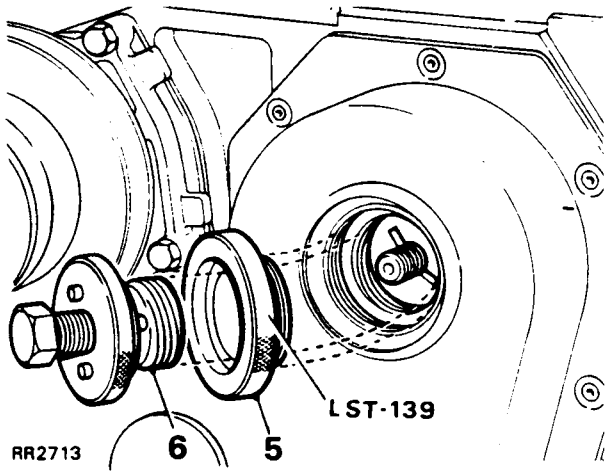
CAUTION: Ensure the washer is removed to prevent it from dropping inside the timing cover.



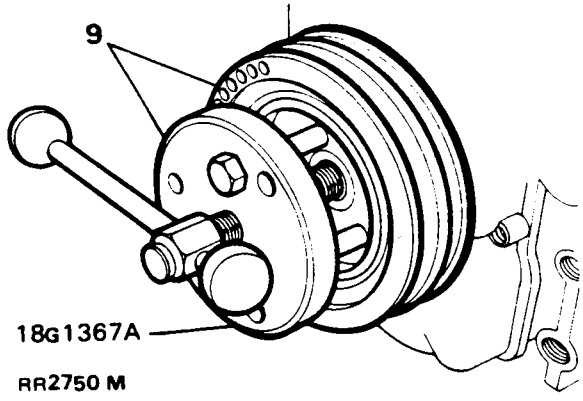
3. Remove bolt from timing cover, using a 47 mm tube spacer and M6 x 55 mm bolt, fit timing gauge 18G 1369A to front cover. The 'O' on the scale should line-up with the groove in the crankshaft pulley.



4. Turn the crankshaft anti-clockwise, beyond the 25° mark on the scale, to remove backlash, and then turn it clockwise until the groove in the crankshaft pulley is aligned with the 25° B.T.D.C. mark. The key on the injection pump shaft should now be at the 11 o'clock position viewed from the front of the engine.
5. Fit item 5 of special tool LST - 139 flush to the front cover. Lock the flywheel, and slacken the three nuts that secure the injection pump flange to the engine block.
6. Fit item 6 into the injection pump drive gear. Ensure a flush fit against item 5 and the centre bolt is fully retracted.
7. Turn the centre bolt of the tool until the gear releases from the taper. Retain the gear on the tool. Remove the injection pump retaining nuts and withdraw the pump complete with cold start device.



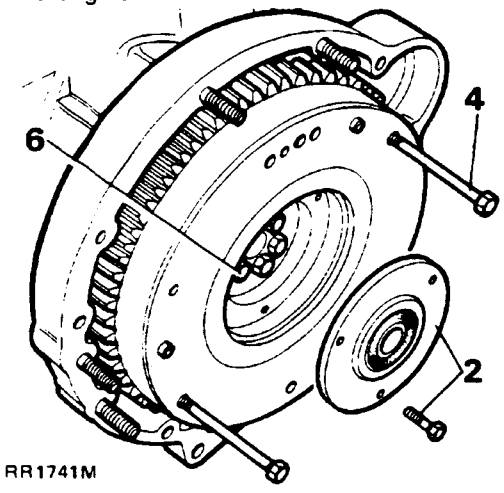
8. Lock the flywheel and remove the crankshaft pulley securing nut.
9. Using special tool 18G 1367A withdraw the crankshaft pulley.



10. Remove the timing cover with injection pump drive gear.
11. Remove the special tool from the timing cover and injection pump drive gear.
12. Reassemble the special tool LST - 139.

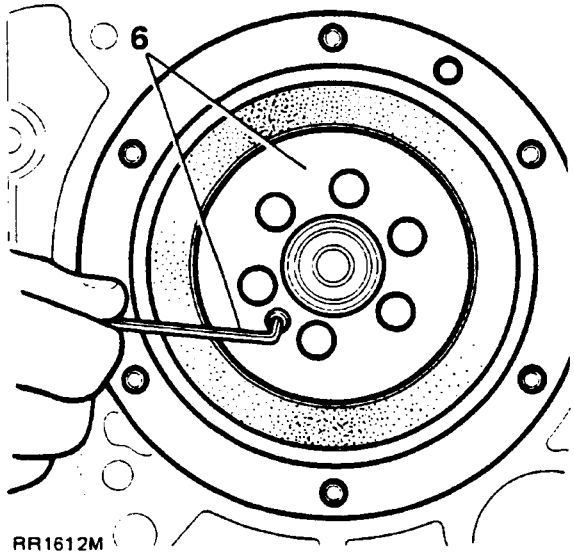
Remove remaining components both 2.4 & 2.5 engines

1. Remove the clutch pressure plate and centre plate.
2. Remove the three bolts and withdraw the spigot bearing plate.
3. Remove the six bolts and lift off the flywheel.
4. To assist with the removal of the flywheel fit two 8 mm bolts approximately 100 mm (4.0") long into the clutch retaining bolt holes, diametrically opposite, and lift the flywheel from the engine.



RR1741M

5. Remove the nine bolts and six nuts and withdraw the flywheel housing.
6. Remove the single socket-headed screw and withdraw the crankshaft thrust plate and outer thrust washer halves.

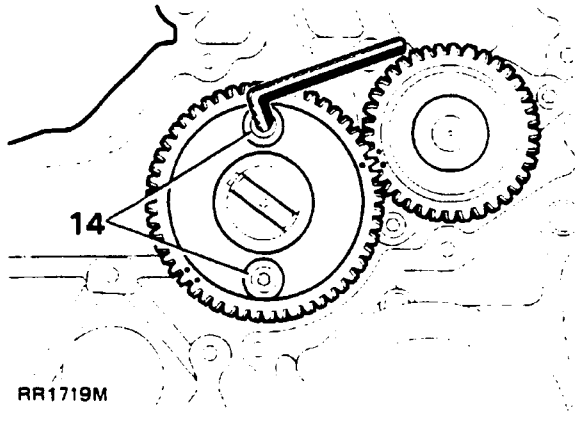


RR1612M

7. Remove the oil filter adaptor housing.
8. Remove the sump oil pan.
9. Remove the twenty-one screws and remove the sump.
10. Remove the three bolts and remove the oil pump pickup pipe and strainer and '0' ring.

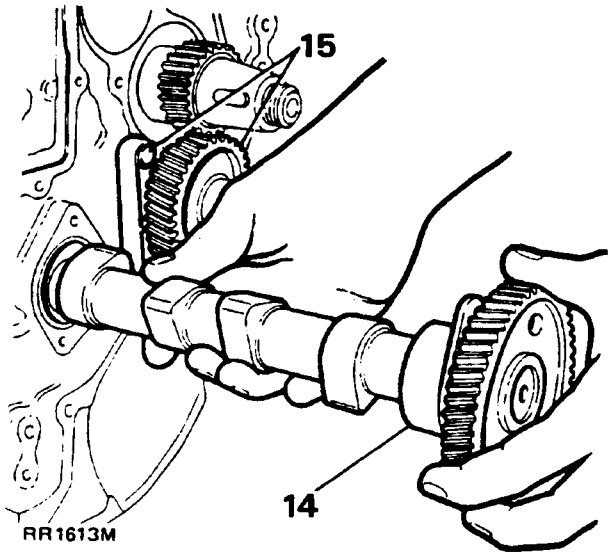
NOTE: Before performing the next instruction mark the top of each piston with the number of the bore commencing at the front of the engine. Unlike most engines the connecting rods are not numbered relative to the bores.

11. Turn the crankshaft to bring numbers one and four connecting rod caps to an accessible position. Remove each cap and lower bearing shell, in turn, and push the connecting rod and piston up the bore and withdraw from the top. Immediately refit the cap to the connecting rod with the number on the same side. Repeat the procedure for numbers two and three connecting rod assemblies.
12. Using a suitable piece of timber drift-out the rear main bearing carrier assembly complete with bearing shells and oil seal.
13. Remove the three screws retaining the oil pump to the crankcase and withdraw the pump complete with drive gear.
14. Position the cylinder block horizontal with the crankcase uppermost and remove the two screws securing the camshaft retaining plate to the cylinder block and carefully withdraw the camshaft complete with gear. It is necessary to have the cylinder block inverted so that the tappets will not drop, and foul the cams.

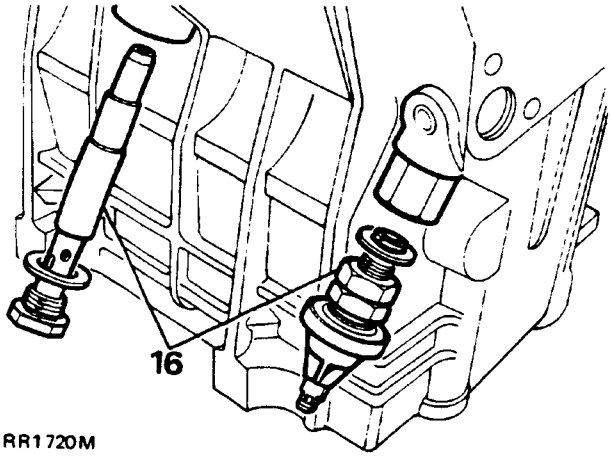


RR1719M

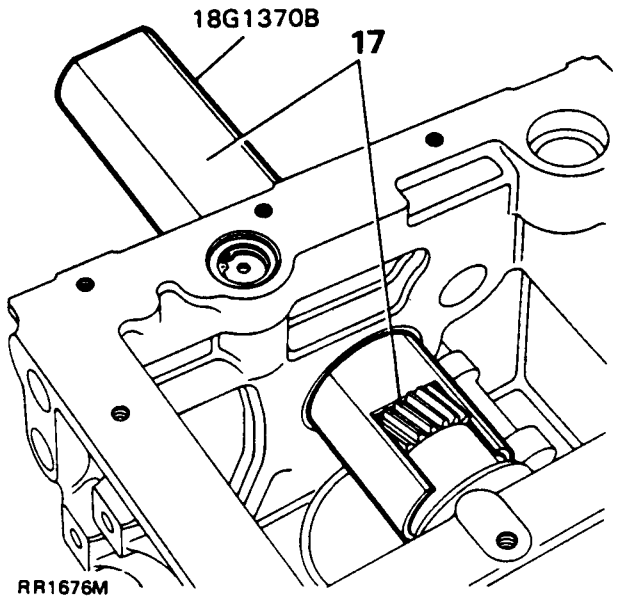
15. Remove the three screws and :-
    - On 2.4 Litre engines remove the idler gear.
    - On 2.5 Litre engines remove the vacuum pump and gear assembly.



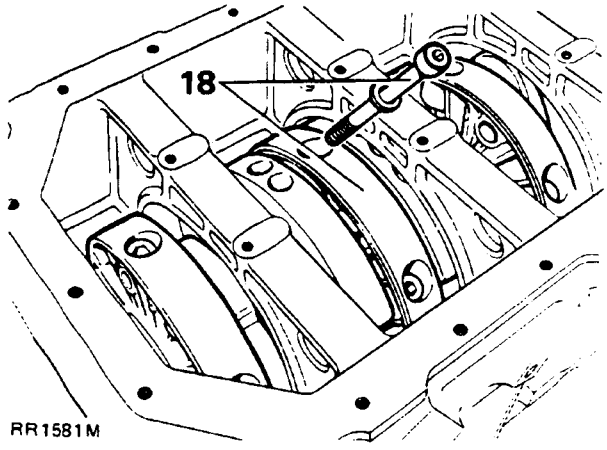
16. Mark for re-assembly and remove from the left hand side of the cylinder block the three main bearing oil feed and carrier location shafts, and identify for re-assembly. Remove the oil pressure switch.



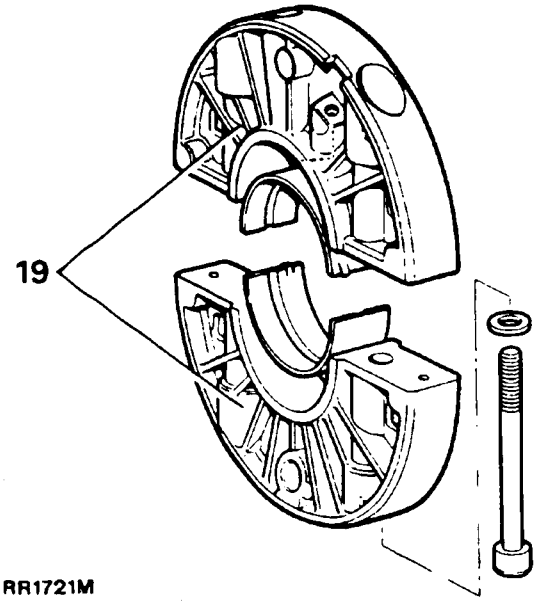
17. To remove the crankshaft and main bearing carrier assembly from the crankcase, slide special tool 18G 1370B over the crankshaft gear, as illustrated, and with assistance withdraw the complete assembly rearwards.



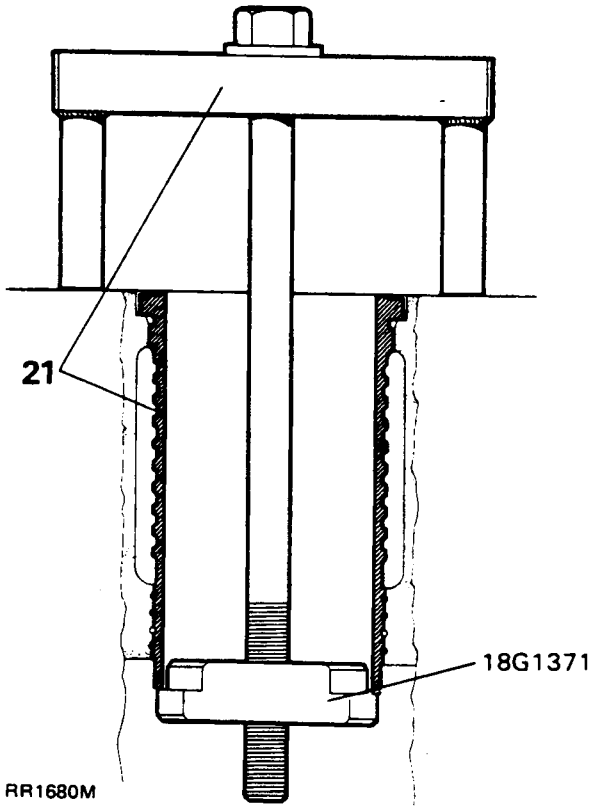
18. Should difficulty be experienced in removing the complete assembly as described above, slide the assembly rearwards sufficiently to gain access to the main bearing carrier bolts. Mark the carriers for assembly and remove the bolts, two for each carrier.



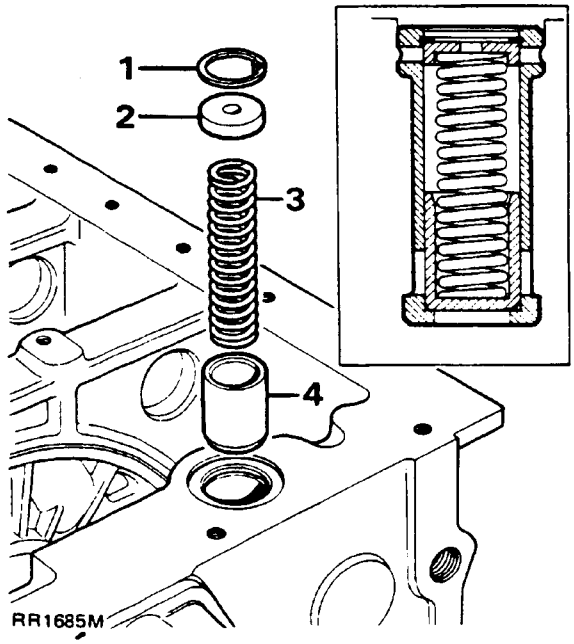
19. Separate the two halves of each carrier, remove from the crankshaft and temporarily re-assemble the carriers. Withdraw the crankshaft through the rear of the crankcase.



20. Remove the cam followers and identify for possible re-assembly to their original locations.
21. If after inspection it is necessary to renew the cylinder liners then they should be removed as follows: position special tool 18G 1371 as illustrated and turn the centre bolt clockwise to withdraw each liner from the cylinder block. Each liner is fitted with three red 'O' rings; the lower one for oil sealing and the others for coolant sealing. The shim under the lip is for achieving the correct protrusion of the liner above the cylinder block face.



22. Remove the pressure relief valve assembly by removing the circlip which will release the cap, spring and relief valve.

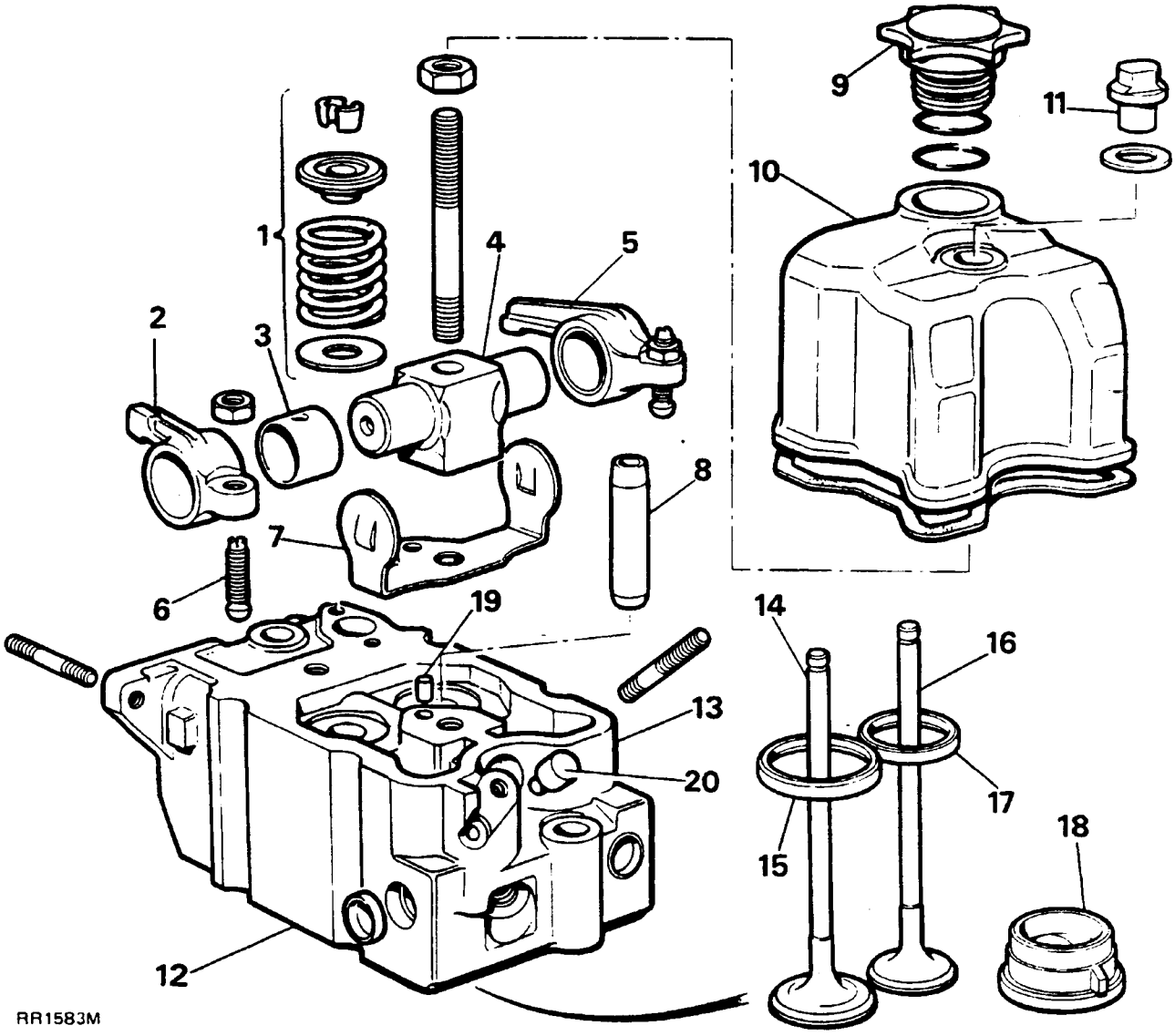


1 Circlip
2 Cap
3 Spring
4 Plunger

INSPECTION AND OVERHAUL OF COMPONENTS

Cylinder head assemblies

Ensure that the marks made when the cylinder heads were removed are maintained and that during the following instructions the various parts of the cylinder heads are similarly identified.



Key to cylinder head and associated components.

1. Valve spring, cap seat and cotters.
2. Inlet valve rocker.
3. Bush.
4. Rocker shaft. (Pedestal)
5. Exhaust valve rocker.
6. Rocker adjusting screw.
7. Spring clip.
8. Valve guide.
9. Oil filler cap.
10. Rocker cover.
11. Rocker cover nut.
12. Cylinder head.
13. Injector locating dowel.
14. Inlet valve.
15. Inlet valve seat.
16. Exhaust valve.
17. Exhaust valve seat.
18. Pre-combustion chamber.(Hot plug.)
19. Pedestal lubrication dowel.
20. Injector clamp dowel

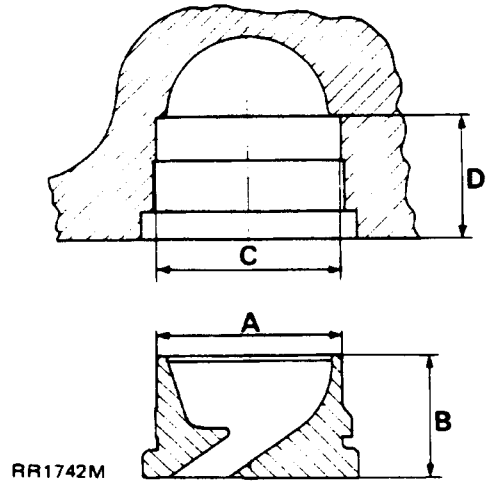
1. Using valve spring compressor 18G 106A or suitable alternative remove the collets, spring cups, springs and valves.
2. Remove the rocker arm pedestal stud and manifold studs.
3. Degrease and remove carbon deposits from the cylinder heads. Examine the cylinder head mating face for cracks pitting and distortion. Renew if necessary.

CAUTION: The cylinder heads are plated therefore the face must not be machined.

4. Cracked or burned hot plugs can be removed by heating the cylinder head uniformly in an oven to 150°C. Tap out the hot plug using a thin drift inserted through the injector hole. Clean-out the hot plug pocket in the cylinder head.
5. Measure the depth of seat (D) and the new hot plug height (B) to establish they meet the fitted tolerance detailed below. If necessary machine the outer face of the hot plug to suit.
6. To fit the new hot-plug cool in liquid nitrogen whilst maintaining the cylinder head at the above temperature fit the hot plug. Ensure that the small pip on the side of the hot plug locates in the groove in the side of the pocket. Allow the cylinder head to cool slowly.

Hot plug diameter	A	30,380 to 30,395 mm
Hot plug height	B	23,350 to 23,440 mm
Hot plug seat dia.	C	30,340 to 30,370 mm
Depth of seat	D	23,570 to 23,730 mm

Maximum protrusion above cylinder head	0,02 mm
Maximum depth below cylinder head	0,03 mm



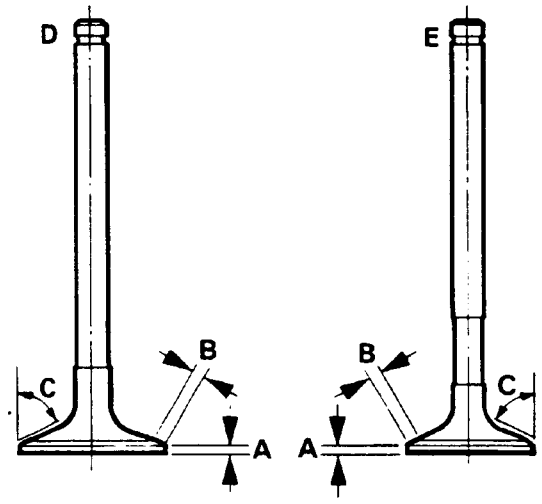
RR1742M

Valves

1. Clean the valves and renew any that are bent, have worn stems, or are burnt and damaged. Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge which must be not less than 1,30 mm (dimension A). Check the valves against the dimensions given in the data section. In addition dimensions B should be as follows:-

D. Inlet valve	2,73 to 3,44 mm
E. Exhaust valve	2,45 to 3,02 mm

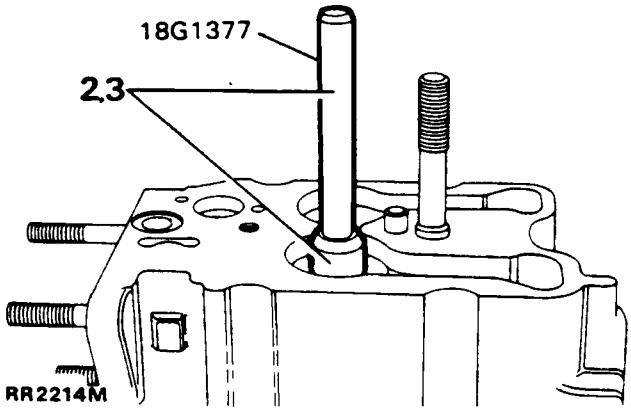
Angle C
Of inlet valve D. ..... 55° 30'
Of exhaust valve E. ..... 45° 30'



RR1702M

Valve guides

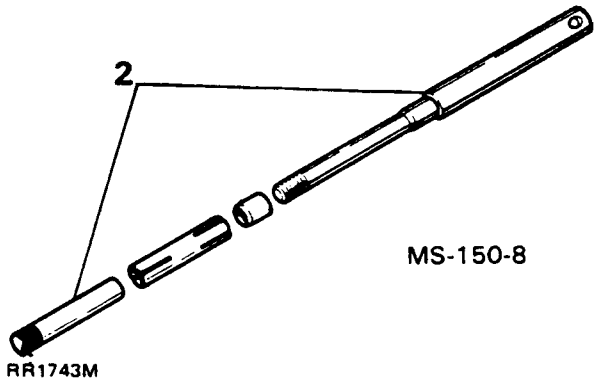
1. Visually examine the guides for damage, cracks, scores and seizure marks. Insert the appropriate servicable or new valve in the guides and check that the stem-to-guide clearance is within the tolerance given in the data.
2. To renew valve guides, heat the cylinder head to a temperature of between 80°C and 90°C and using special tool 18G 1377 without height gauge 18G 1377/2 press the guides out through the top of the cylinder head.

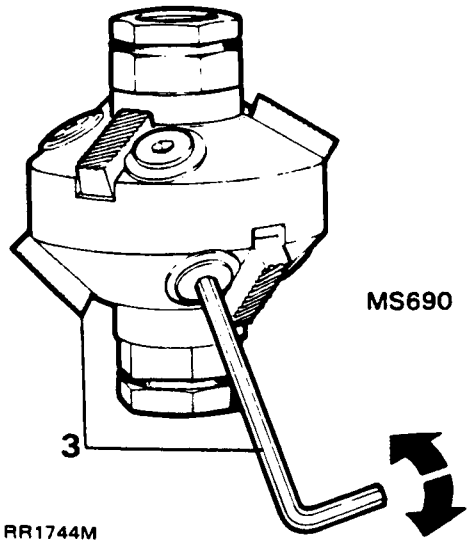


3. Whilst maintaining the above temperature and using the same tool, but with height gauge 18G 1377/2 drive-in new guides from the top of the cylinder head to the distance determined by the gauge or to dimensions in the data.

Valve seat inserts

1. Examine the valve seat inserts for damage, wear and cracks. the seats can be restored provided they are not abnormally wide due to refacing operations. If the seat cutting operation, however, excessively lowers the valve recess or if the seat cannot be narrowed to within the limits given in the data, the insert should be renewed.
2. To recut an inlet valve seat use an expandable pilot M.S. 150-8 loosely assemble the collet, expander and nut. Ensure that the chamfered end of the expander is towards the collet. Insert the assembled pilot into the valve guide from the combustion face side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide. Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.





3. Select cutter MS 690 and ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated. Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS 76.
4. Fit the wrench to the cutter head, apply it to the seat to be refaced and turn clockwise using only very light pressure. Continue cutting until the width of the seat is in accordance with the dimension J in data.
5. To check the effectiveness of the cutting operation use engineer's blue or a feeler gauge made from cellophane.
6. Smear a quantity of engineer's blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a a gap of not more than 12 mm it can be corrected by lapping.
7. Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag the seal is satisfactory at that spot. Repeat this in at least eight places. Lapping in will correct a small open spot.
8. Perform the above instructions to recut an EXHAUST valve seat using cutter MS 621 until the seat width is in accordance with dimension D in data. Check that the valve head recess is within the data limits.
9. To remove either an inlet or exhaust valve seat, hold the cylinder head firmly in a vice, wear protective goggles and grind the old insert away until thin enough to be cracked and prised out. Take care not to damage the insert pocket. Remove any burrs and swarf from the pocket. Failure to do this could cause the new insert to crack when being fitted.
10. Heat the cylinder head, uniformly in an oven, to a temperature of 150°C cool the new seat insert by dipping into liquid Nitrogen. This will enable the seat to be positioned without the use of pressure. Allow the cylinder head to cool naturally to avoid distortion.

Lapping in valves

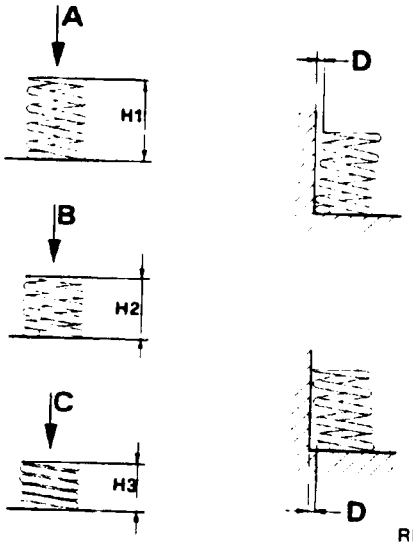
1. To ensure a gas tight seal between the valve face and the valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping in operation has been completed.
2. Unless the faces to be lapped are in poor condition it should only be necessary to use fine valve lapping paste. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil.
3. Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.

4. Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is successful, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face. Insert the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter turn a few times. If all the pencil lines are cut through no further lapping is required.
5. Wash all traces of grinding paste from the valves and cylinder head seats.

Valve springs.

1. Examine the valve springs for damage and overheating and discard any that are visually faulty.
2. New and used valve springs, in the interests of uniformity, should be subjected to load and height tests as shown in the table and diagram below.
   The amount of distortion D must not exceed 2,0 mm (0.078 in).

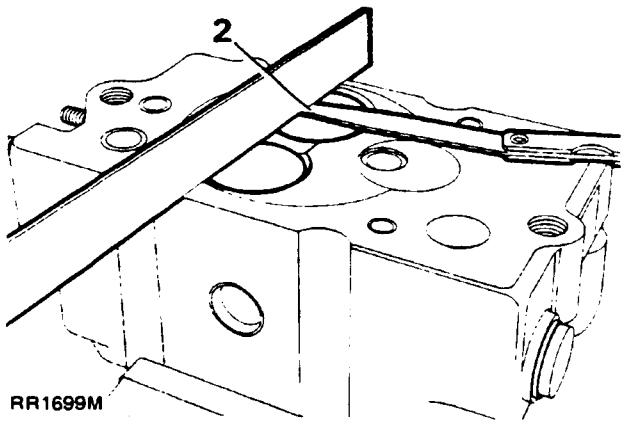
	Test load (Kg)		Height (mm)	Condition
A	0.00	H1	43.20	Free height
B	33-35	H2	37.00	Closed valve
C	88-94	H3	26.61	Open valve



RR1745M

Assembling the cylinder head

1. Assemble the valves to their respective positions in the cylinder head. Fit the spring plates, springs and cups and secure the assembly with the split collets using valve spring compressor 18G 106A or equivalent.
2. Using feeler gauges check the inlet and exhaust valve head stand down i.e clearance of valve heads below cylinder head combustion face, see data.

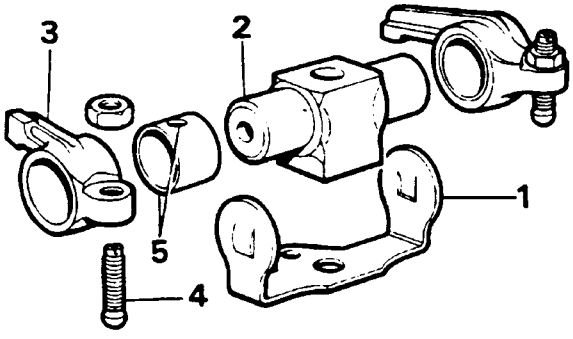


RR1699M

3. When renewing the cylinder head water jacket plugs secure them in position with Loctite 601
4. Renew the manifold retaining studs and when fitting a new pedestal stud secure it with Loctite 270.
5. Fit the rocker pedestal location and lubrication dowel into each cylinder head and ensure that the oil hole is clear. Place the heads to one side ready for assembly to the cylinder block at a later stage.

Rocker assembly and push rods.

1. Remove the spring clip and slide the rockers from the shaft.
2. Clean and examine the rocker shafts and check for ovality, overall wear taper, and surface condition. Compare the dimensions with those given in data.
3. Examine the rockers and renew any that have worn rocker pads. It is not permissible to grind a pad in an attempt to restore a rocker.
4. Examine the rocker adjusting screws and renew any that are worn.
5. Check the internal dimensions of the bushes against the figures in data. If necessary renew the bushes ensuring that the oil hole in the bush aligns with the hole in the rocker arm. Check that the rocker arm to shaft clearance is within the figures in data.
6. Assemble the rocker-arms to the shaft noting that they are handed and that when assembled the pad ends point inwards. Retain the assembly with the spring clip and place to one side for fitting to the cylinder head at a later stage.

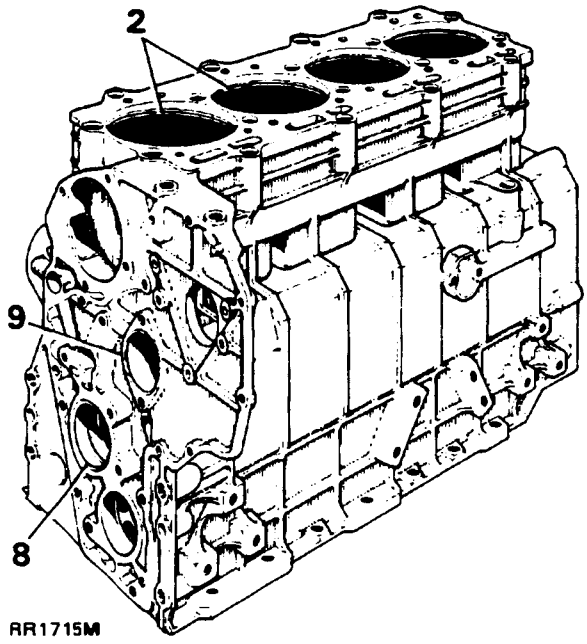


RR1688M

7. Examine the push rods and discard any that are bent or have worn or pitted ends.

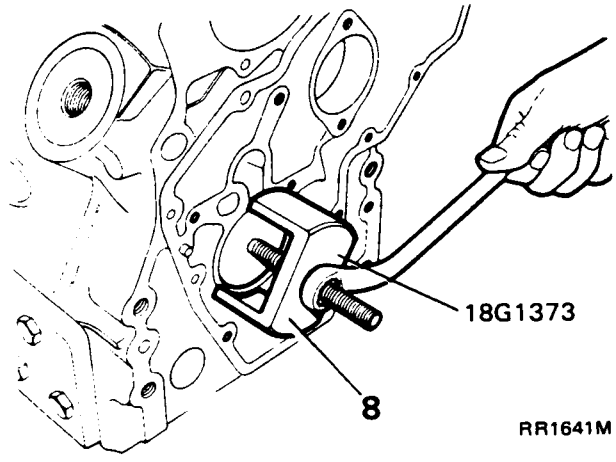
Cylinder block

1. Clean the cylinder block with kerosene or suitable solvent and blow dry with compressed air all oil passages and water ways. Carry out a careful visual examination checking for cracks and damage.
2. Measure the cylinder liner bores for ovality, taper and general wear using any suitable equipment. An inside micrometer is best for checking ovality and a cylinder gauge for taper.
3. Check the ovality of each bore by taking measurements at the top of the cylinder just below the ridge at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50 mm (2.0 in) up from the bottom of the bore so that the overall ovality may be determined.
4. The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line. The difference between the two measurements is the taper.
5. To establish maximum overall bore wear, take measurements at as many points possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder liner. (See **Section 04** General specification data).
6. If the cylinder bores are excessively worn outside the limits the cylinder liners must be renewed. See ENGINE ASSEMBLY.
7. Alternatively, if the overall wear, taper and ovality are well within the acceptable limits and the original pistons are serviceable new piston rings may be fitted. It is important however, that the bores are deglazed, with a hone, to give a cross-hatched finish to provide a seating for the new rings. It is vital to thoroughly wash the bores afterwards to remove all traces of abrasive material.



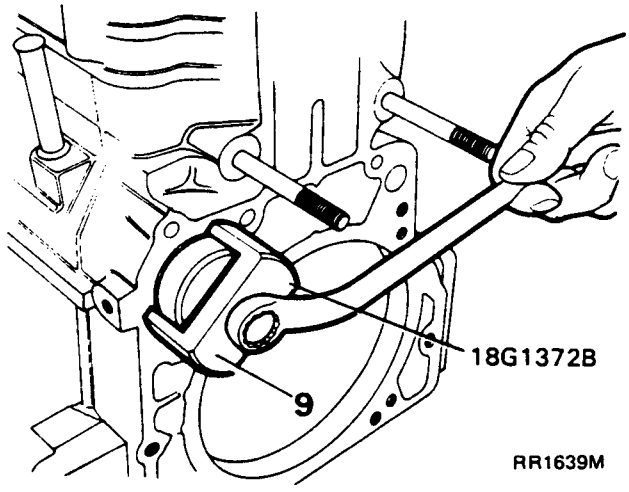
RR1715M

8. Using an inside micrometer check the front main bearings for general condition, overall wear, taper and ovality. If outside the limits given in data remove the bearing. Use special tool 18G 1373 to renew the bearing, see ENGINE ASSEMBLY.



RR1641M

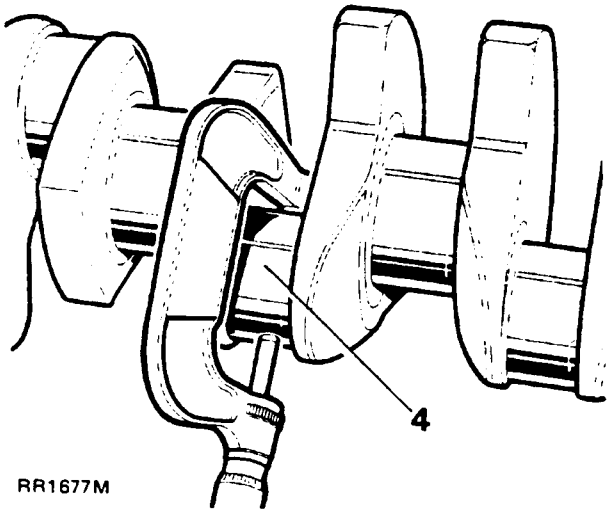
9. Measure the internal diameter of each camshaft bearing at several points using an internal micrometer. A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance is excessive or if they are scored or pitted. Use special tool 18G 1372B as illustrated, to remove the bearings.



RR1639M

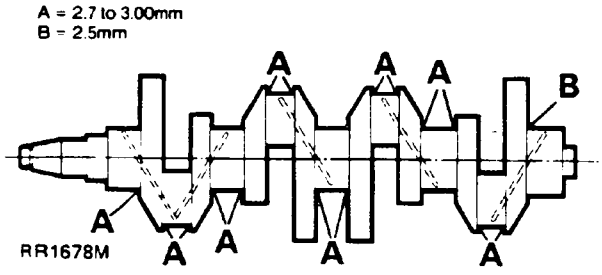
Crankshaft

1. Identify for reassembly and remove the main bearing carriers from the crankshaft.
2. Degrease the crankshaft and clear out the oil ways, which can become clogged after long service.
3. Mount the crankshaft on "V" blocks and examine visually, the crankpins and main bearing journals, for obvious wear, scores, grooves and overheating.
4. With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows:
   Ovality - Take two readings at right-angles to each other at various intervals.
   Taper - Take two readings parallel to each other at both ends of the main bearing journal and crankpin.



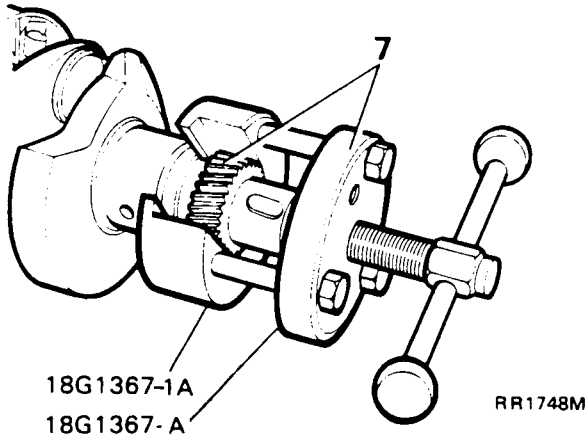
RR1677M

5. If the overall wear exceeds 0,01 mm (0.004 ins) for both main bearing journals and crankpins regrind and fit undersize bearings. When regrinding do not remove any material from thrust faces.
6. After grinding it is important to restore the journal fillet radii as illustrated.



RR1678M

7. Examine the timing gear teeth and if worn remove the gear with special tool 18G 1367-1A and 18G 1367-A

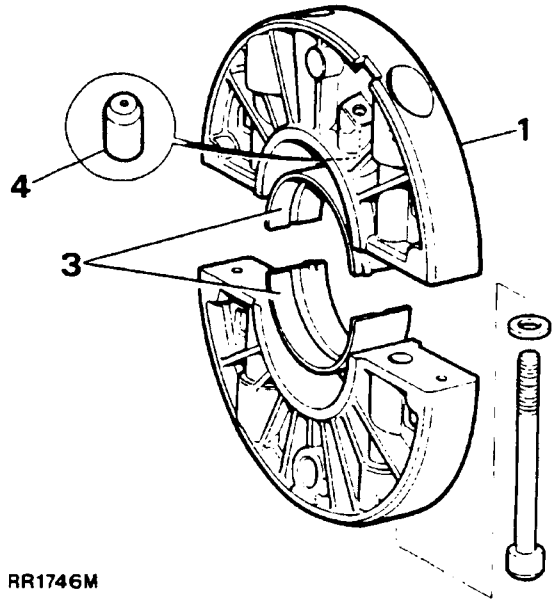


RR1748M

8. To fit a new gear, heat in an oven to 180°C to 200°C, and press-on to the shaft up to the shoulder. Fit a new key for the crankshaft pulley.

Crankshaft carriers

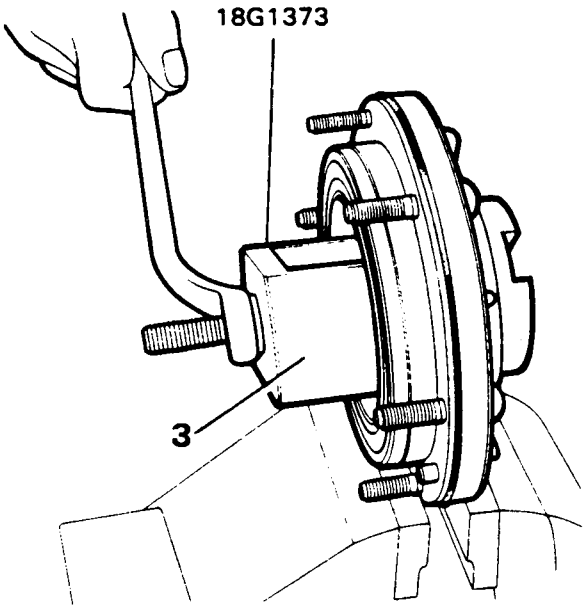
1. Assemble the three main bearing carriers with the bearings fitted and tighten to the correct torque.
2. Using an internal micrometer check the internal diameters of the bearings against the figures in data and renew if necessary or in any event if the crankshaft is being reground.
3. Remove the bearings from the carriers, reassemble and tighten bolts to correct torque. With an internal micrometer check the carrier bore against the figures in data, and for excessive ovality.
4. Check that the piston oil jets in the carriers open at the correct pressure and renew if necessary. Drift the old jet out through the carrier bore, apply a thin coat of Loctite AVX Special around the new jet before fitting.



RR1746M

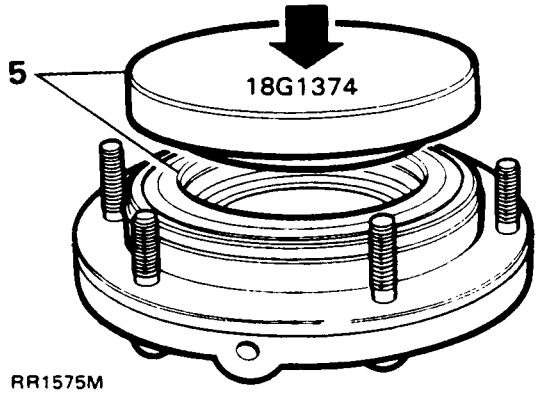
Rear main bearing carrier

1. Extract the oil seal taking care not to damage the carrier bore.
2. Using an internal micrometer check the bearing dimensions against the figures in data.
3. If required remove the bearing using special tool 18G 1373, as illustrated.



RR1642M

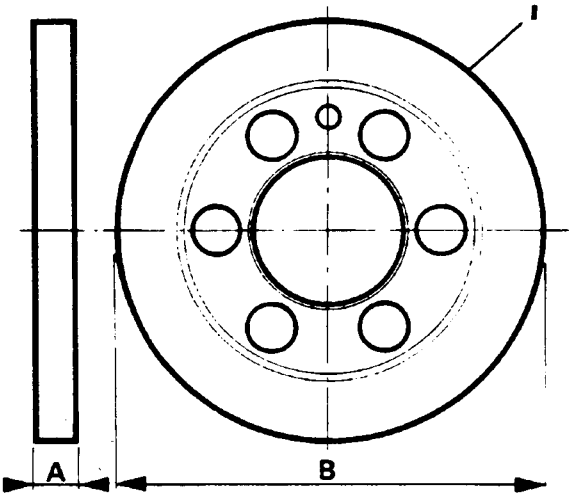
4. Check the carrier bearing bore for wear against the figures in data.
5. With special tool 18G 1374 fit a new oil seal to the rear carrier, lipside leading.



RR1575M

Thrust spacer

1. Examine the spacer thrust face for damage, scratches, cracks and seizure marks. Ensure that outer diameter on which the seal runs is free from imperfections.
2. With micrometers check the thickness A and the diameter B at four diametrically opposite points and compare with the figures in data.



RR1703M

Flywheel

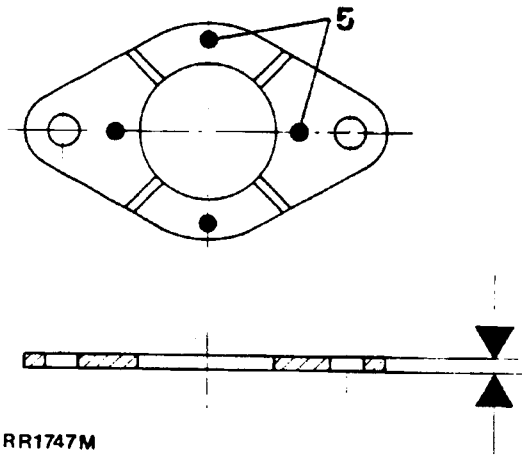
1. Examine the flywheel clutch face for cracks, grooves and signs of over-heating. If excessive damage is evident renew or reface the fly-wheel.

Flywheel face run-out

2. The above check should be carried out during engine assembly. See fitting flywheeel.

Camshaft

1. Carry-out a visual examination of the cam lobes and bearing surfaces. If these are worn, scored or cracked the shaft should be renewed.
2. If visually satisfactory, carry out the dimensional checks detailed in the data section to the cams and bearing journals.
3. Check the camshaft for straightness, by mounting between centres and checking with a dial test gauge on the centre bearing journal. The shaft may be straightened under a press if the bend exceeds 0,05 mm (0.002 in). This work, however, should be entrusted to a specialist.
4. Examine the gear teeth and if worn or damaged press the shaft from the gear, together with the thrust plate.
5. Before fitting a new gear, check the thrust plate thickness at the four points illustrated. Renew the plate if the dimensions do not conform to the limits in data.

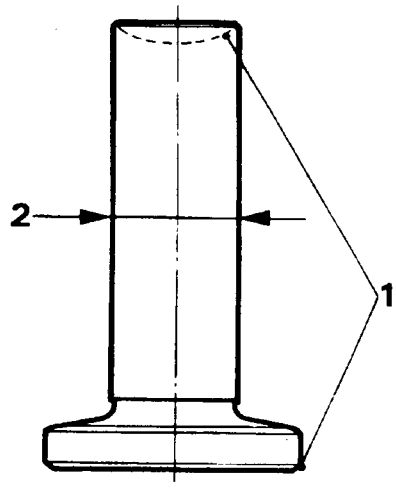


RR1747M

6. Heat the new gear in an oven to 180°C to 200°C, fit the thrust plate and press the gear onto the shaft until the gear is hard against the shoulder. If, when the gear has cooled the thrust plate turns freely on the shaft the camshaft end-float will be correct when fitted.

Cam followers (Tappets)

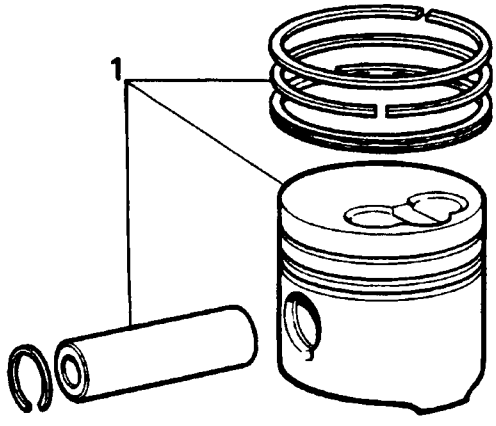
1. Examine the cam followers and discard any that are worn, pitted or scored on the cam contact face. Check also the cups in which the push rods seat.
2. Check the stem diameter for general wear, ovality and taper. Take measurements at several points round the circumference and along the length of the stem.



RR1710M

Connecting rods and pistons

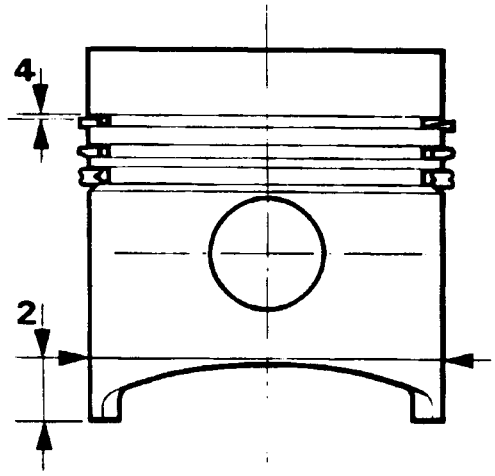
1. Whilst keeping each piston and connecting rod identified for possible refitting, separate the pistons from the rods and remove the piston rings. Degrease and decarbonise the pistons and rings ready for examination. Likewise prepare the connecting rods for inspection.



RR1683M

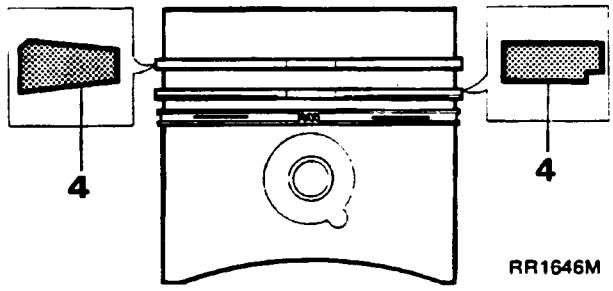
Pistons and rings

1. Examine the pistons for scores, cracks signs of overheating and general wear.
2. If visually satisfactory measure the piston skirt at right angles to the gudgeon pin 15 mm above the bottom of the piston skirt. If the wear is in excess of the maximum permitted in data and the piston to liner clearance is in excess of 0,15 mm (0.006 in) new pistons and liners must be fitted.



RR1714M

3. Check the gudgeon pins for wear, scores, pitting and signs of overheating. Check the gudgeon pin bore for ovality.
4. Examine the piston rings for damage, wear and cracks. Fit the rings to the pistons as illustrated and using a feeler gauge check the side clearance in the grooves.



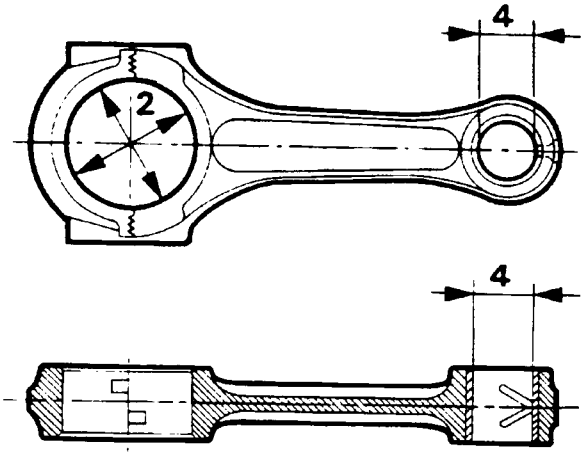
RR1646M

5. To check the piston ring fitted gap insert the ring squarely into the bottom of the bore at the lowest point of piston travel. To ensure squareness push the ring down the bore with a piston. Using an appropriate feeler gauge check the gaps of all the rings in turn. The correct gaps are given in data. If any gap is less than that specified, remove the ring and file the ends square whilst holding the ring in a filing jig or vice.
6. The previous instruction should also be carried out when new pistons and rings are fitted to new liners but the rings may be inserted squarely in any position in the bore.

NOTE: The difference in weight between the four pistons must not exceed 5 grams. When renewing pistons and liners they should all belong to the same classification A or B.

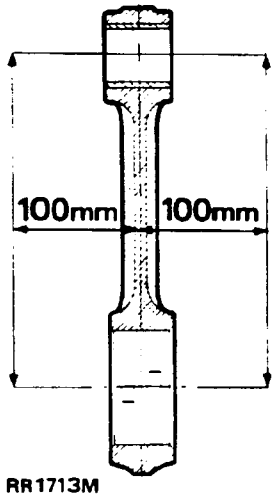
Connecting rods

1. Examine the connecting rods and caps for cracks using a recognised crack testing process.
2. Assemble the cap and rod and tighten to the correct torque. Check the crank pin bore using an inside micrometer and three different points. the bore must be 57,563 to 57,582 mm. Renew rods if the tolerance exceeds 0,02 mm.
3. Examine the connecting rod shells and discard if worn, scored or show signs of overheating. Assemble the rods, caps and shells and tighten to the correct torque. Check the internal diameter against the figures in data.
4. Inspect the small end bush for wear against the figures in data. Check that the wear limit between bush and gudgeon pin does not exceed 0,100 mm (0.004 in). When renewing the bush ensure that the oil hole aligns with the connecting rod hole.



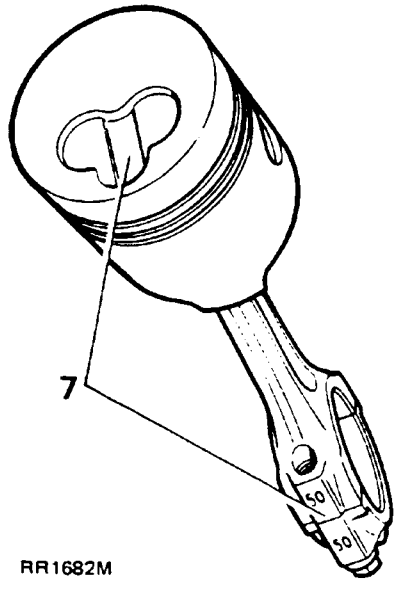
RR1712M

5. Check the rod for bend and twist, taking measurements at approximately 100 mm from the centre of the rod using a recognised alignment gauge. Twist or bend must not exceed 0,5 mm (0.019 in).



RR1713M

6. If it is necessary to renew connecting rods check that the weight difference between them does not exceed 10 grams, see letter code in data (2.4 Litre engines only).
7. Slightly warm the pistons and assemble to the connecting rods ensuring that the recess in the piston crown is on the same side as the number on the connecting rod big end. Insert the gudgeon pins and secure with the circlips.



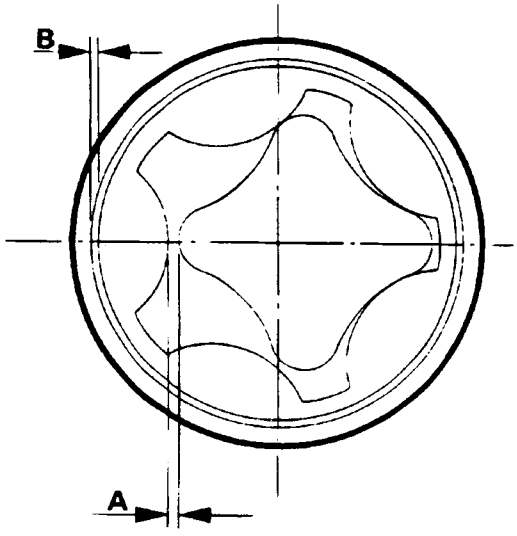
RR1682M

8. Fit the connecting rod bearing shells ensuring that the tags locate in the cutouts.

Oil pump

NOTE: The oil pump is only supplied as an assembly complete with drive gear.

1. Dismantle the oil pump and clean with kerosene or solvent. Examine the rotors and body for wear and pitting.
2. Assemble the oil pump noting that the chamfered side of the outer rotor is fitted downwards towards the drive gear.
3. Check, with a feeler gauge, the clearance between the inner and outer rotor A.
4. Check the clearance between the pump body and outer rotor B and compare the figures in data.

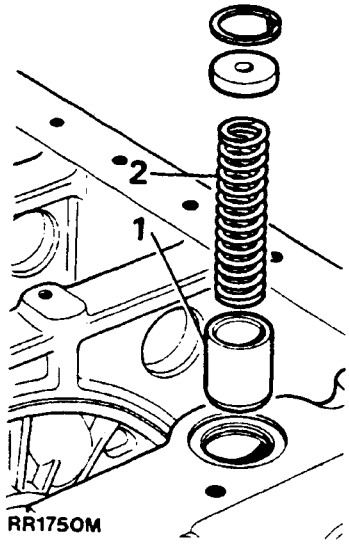


RR1711M

5. Examine the gear teeth for wear, chips and pitting.

Oil pressure relief valve

1. Examine the plunger for scores and pitting. If necessary the valve plunger may be lapped to its seat, to restore efficiency, using fine valve grinding compound. Make sure that all trace of the compound is removed before assembling valve to the crankcase.
2. Check the free length of the spring against the figure in data.



RR1750M

Idler gear assembly 2.4 litre engine only

1. Check the idler gear for wear and damage and for wear in the bushes. Check that the lubrication hole at the back of the mounting plate is clear. If the gear is unservicable the complete unit should be renewed.

Vacuum pump and gear assembly 2.5 litre engine only

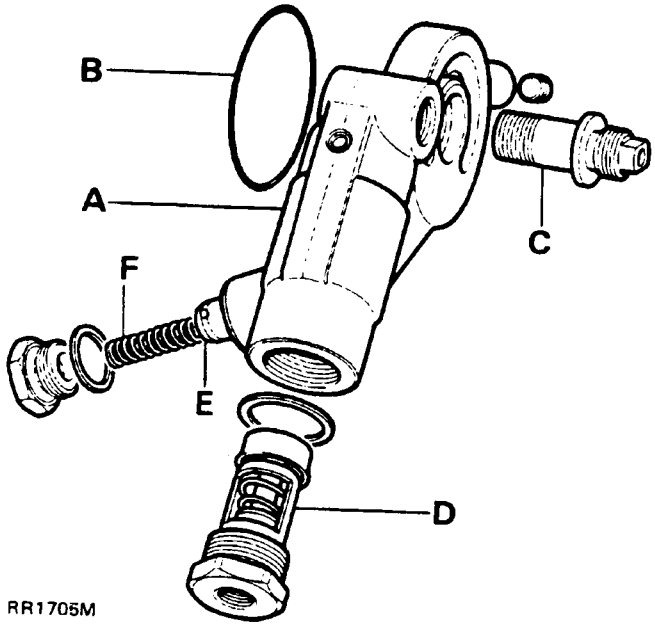
1. Inspect the gear for wear and damage. Check the vanes for wear. Examine the vacuum pump housing for scouring or damage.
   If the unit is worn or damaged the complete assembly should be renewed.

Injection pump drive gear

1. Check the injection pump gear (and combined vacuum pump gear on 2.4 litre engines) for damage, wear and pitting. Examine the bore and keyways for wear. Renew if any gear is unsatisfactory.

Oil filter adaptor housing

1. This housing contains a by-pass valve which opens to maintain oil circulation when a difference in pressure exists between the filter base outlet to the oil cooler and the main oil gallery due to a restriction in the oil cooling system. A thermostat which opens at 80°C, to allow oil to pass to the oil cooler is also incorporated in the housing.



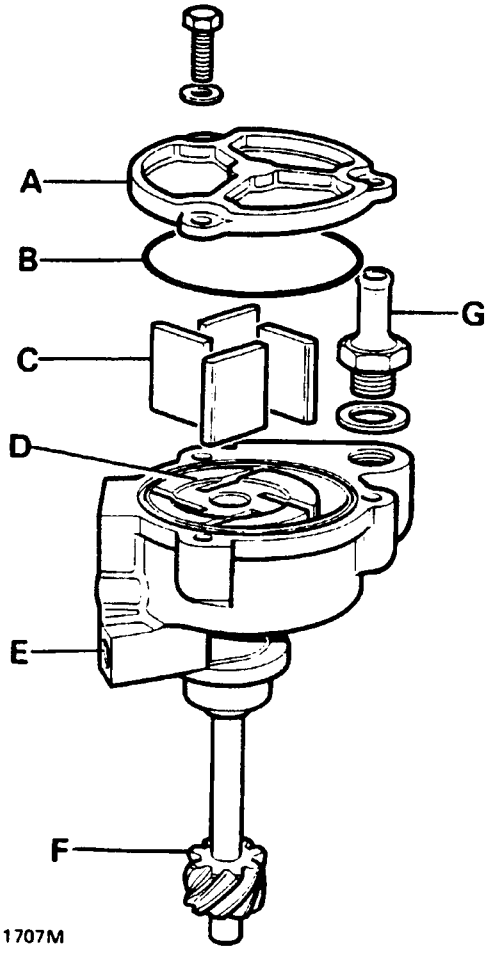
RR1705M

A Adaptor housing.
B 'O' ring
C Oil filter and adaptor housing union screws
D Thermostat
E By-pass plunger
F By-pass plunger spring

2. Remove the thermostat and check the opening temperature. Place the thermostat in vessel containing water and a thermometer. Appply heat and observe the temperature at which the thermostat opens. Refit or renew as necessary, using a new sealing washer.
3. Remove the by-pass valve plug and remove the spring and plunger. Check the plunger for scores and pitting. Refit or renew as necessary using a new sealing washer.

Vacuum pump 2.4 litre engines only

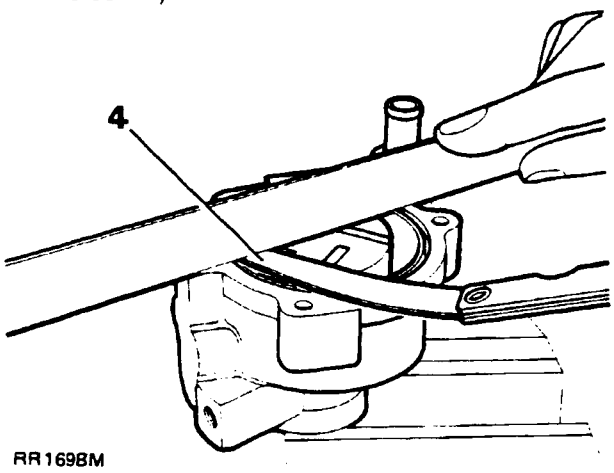
1. Remove the three screws and withdraw the top cover and "O" ring seal.
2. Check the rotor and vanes for wear.
3. Examine the drive gear for wear.



RR1707M

A Cover
B 'O' ring
C Vanes
D Rotor
E Lubrication port
F Drive gear
G Vacuum hose adapter and non return valve

4. Check the rotor end float by placing a straight edge across the pump body and with a feeler gauge measure the clearance between the machined outer diameter and straight edge. The end float should be 0,07 to 0,14 mm (0.002 to 0.004 in).



RR1698M

5. Fit the vanes, noting that the round edge must face outwards.

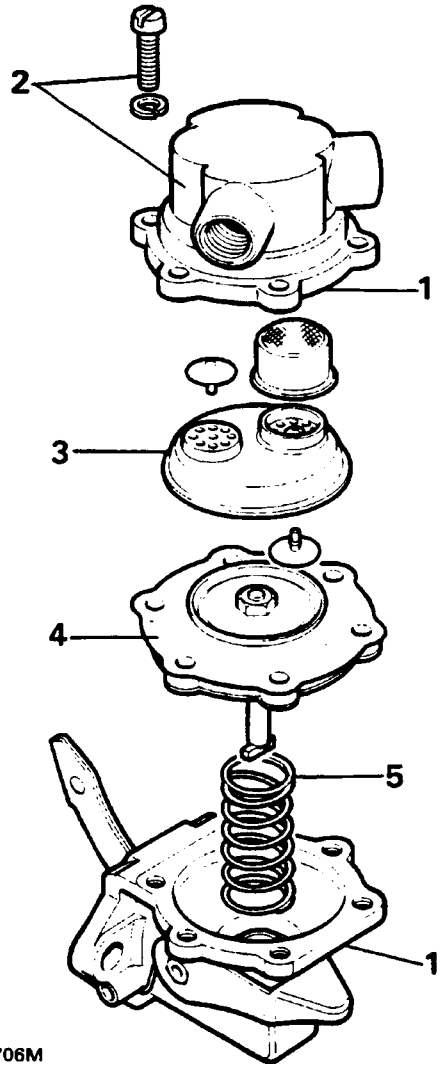
6. Check operation of vacuum non return valve.
7. Fit a new "O" ring seal and secure the cover with the three screws.

Water pump

1. Since the water pump is not serviceable the complete assembly should be renewed if the impeller is worn and corroded or if there is excessive end float or side movement in the impeller shaft.

Fuel lift pump

1. Mark the relationship of the pump cover to the body to facilitate reassembly.
2. Remove the six retaining screws and lift-off the cover.
3. Remove the valve plate.
4. Press down on the diaphragm and twist to release the diaphragm from the body.
5. Remove the diaphragm spring.
6. Clean and examine all parts. The diphragm can be renewed if faulty.

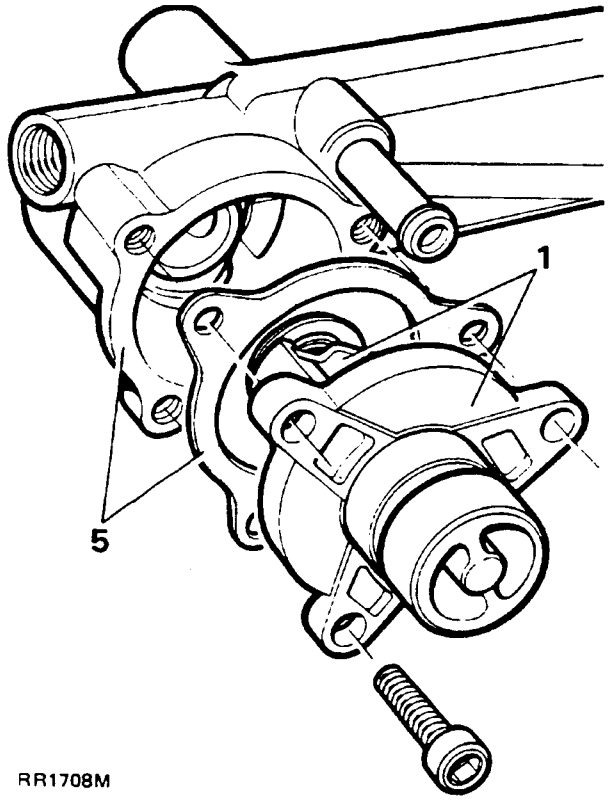


RR1706M

7. Reassemble the pump reversing the above procedure.

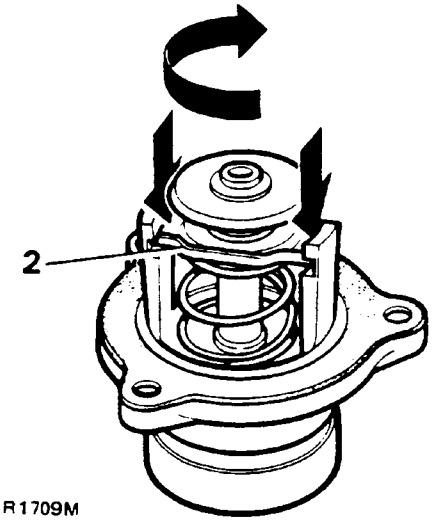
Thermostat and housing 2.4 litre engine only

1. Remove the three socket headed screws and withdraw the thermostat and body from the water rail.



RR1708M

2. Hold the body in a vice and press down upon the two "ears" of the thermostat and twist to release it from the body.

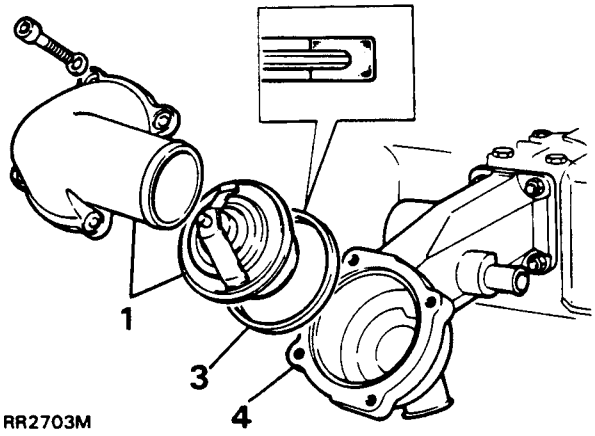


RR1709M

3. To test the thermostat, note the opening temperature stamped on the end of the thermostat and place it in a vessel containing water and a thermometer. Apply heat and observe the temperature at which the thermostat opens. Renew if necessary.
4. Fit the thermostat to the body, reversing the removal instructions.
5. Using a new joint washer, fit the thermostat and body to the water rail.

Thermostat and housing 2.5 litre engine only

1. Remove the four socket headed screws and lift the outlet elbow clear to remove the thermostat with its fitted seal from the thermostat housing.

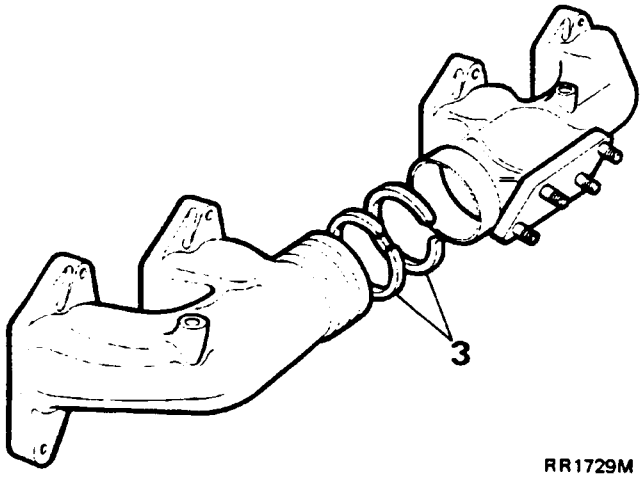


RR2703M

2. To test the thermostat, remove the seal (3) note the opening temperature stamped on the end of the thermostat and place it in a vessel containing water and a thermometer. Apply heat and observe the temperature at which the thermostat opens. Renew if necessary.
3. Fit a new joint seal onto the edge of the thermostat ensuring it is fitted evenly.
4. Refit the thermostat ensuring location of the seal into the recess of the thermostat housing.
5. Refit the outlet elbow and tighten the screws, evenly.

Inlet and exhaust manifold

1. Examine the manifold for damage and cracks.
2. Check the mating faces with the cylinder head for distortion by mounting on a surface plate and checking with feeler gauges. If necessary, the flange faces may be machined to restore maximum surface contact with the cylinder head.
3. The exhaust manifold is manufactured in two sections and piston ring type seals are used to provide a flexible gas tight seal. Renew the rings if cracked and assemble the two sections using Vaseline on the rings to facilitate assembly.

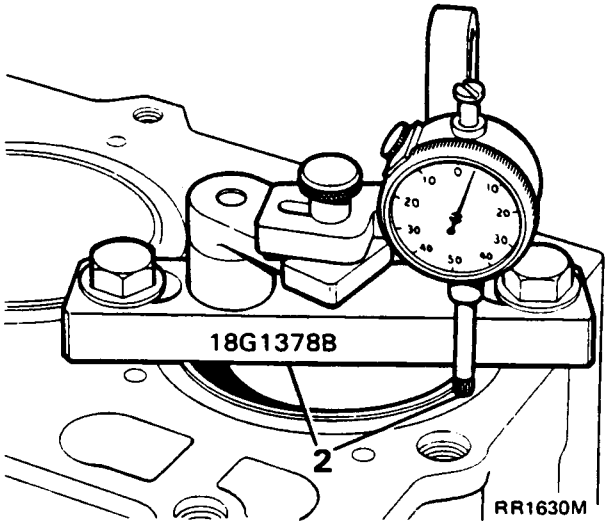


RR1729M

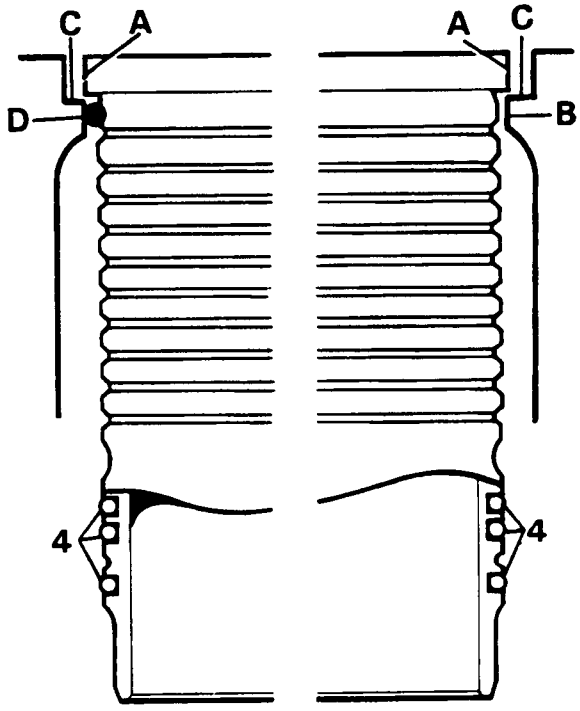
ASSEMBLING ENGINE

Fitting cylinder liners

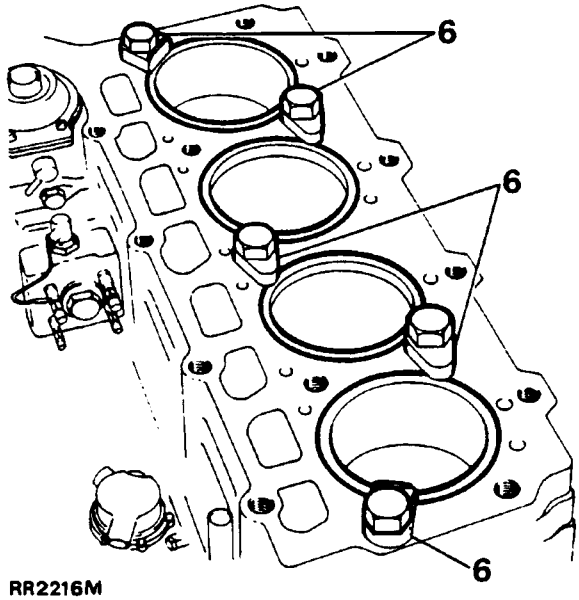
1. Clean the liners and the cylinder block areas of contact. Fit the liners without 'O' rings. The liners should drop into position under their own weight, if not, further cleaning is necessary.
2. To obtain the correct liner protrusion, attach special tool 18G 1378,B as illustrated, to the cylinder block and tighten the bolts to 30 Nm (22 lbf/ft). Fit a dial test indicator so that the stylus rests in a loaded condition on the external rim of the liner and set the dial to zero. Slide the stylus across to the cylinder block and note the reading.
   Repeat the above procedure to the remaining cylinders.



3. Remove the liners and add shims as required to achieve the protrusion given in the data **Section 04.**
4. Remove the liners and fit three new 'O' rings. Apply molybdenum disulphide grease, such as 'Marston's Molycote' to the 'O' ring contact area in the cylinder block.
5. Apply 'Loctite 275' to areas A and B. Avoid any sealant contacting the shim and face C.
   An 'O' ring is fitted to top of liner, on later 2.5 engines or when fitting new liners to 2.4 and early 2.5 engines. Fit 'O' ring seal to position D and apply Loctite to area A only. Avoid sealant contacting the shim, face C and 'O' ring.

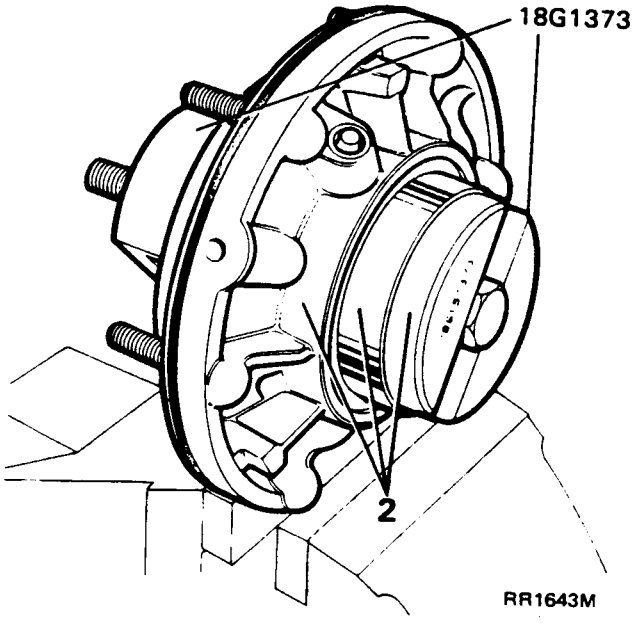


6. Fit the liners to the cylinder block and hold them in using the cylinder head spacers and slave bolts, tighten the bolts to 30 Nm (22 lb/ft), leave the spacers and slave bolts in position for approximately two hours until the Loctite is set.



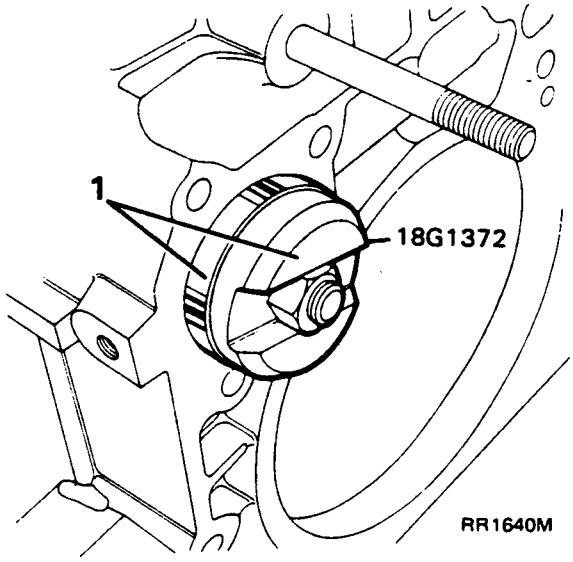
Fitting front and rear main bearings.

1. Use special tool 18G 1373 to refit the front main bearings to the cylinder block, ensuring that the oil hole in bearing aligns with oil hole in the bearing bore.
2. Use the same tool 18G 1373 to refit the rear main bearings to the carrier assembly, ensuring that the oil holes in bearing and carrier align.



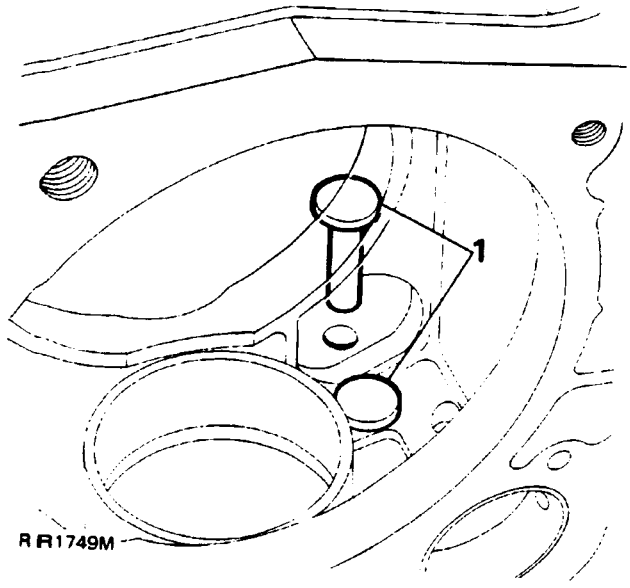
Camshaft bearings

1. Renew the camshaft bearings in the cylinder block using special tool 18G 1372.
2. Each bearing shell has two oil holes and it is essential that these align exactly with the corresponding oil drillings in the cylinder block. The illustration shows the camshaft rear bearing being fitted.



Fitting camshaft and followers

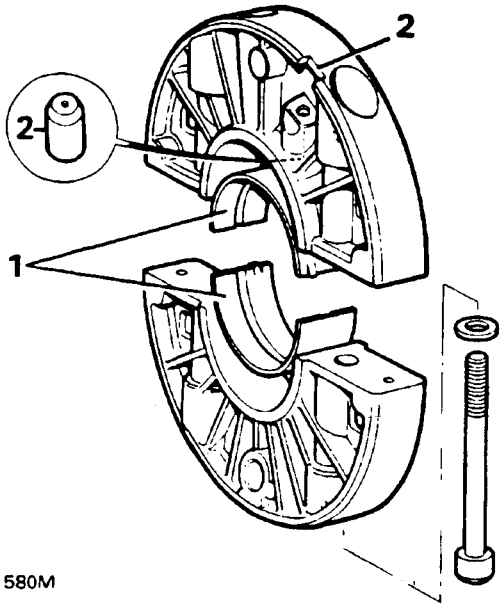
1. Invert the cylinder block and smear the cam followers with clean engine oil and fit them to their original locations in the cylinder block.



2. Smear the camshaft journals with clean engine oil and and carefully insert the camshaft complete with thrust plate and gear. Temporarily secure the camshaft to the cylinder block with the two screws.

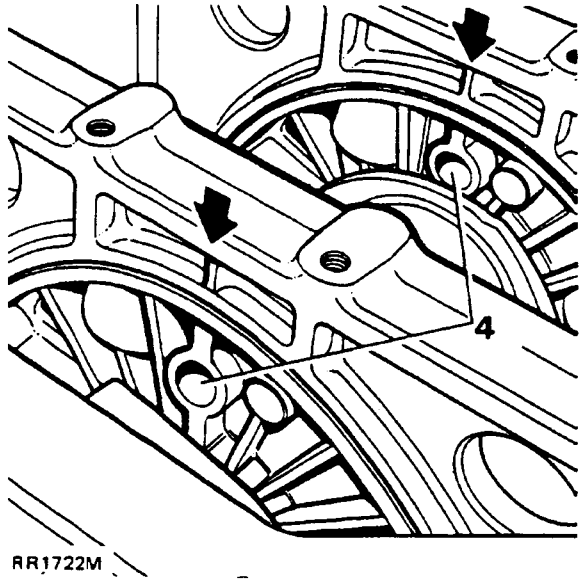
Fitting crankshaft and carrier assembly.

1. Fit new main bearing shells to each of the carrier halves.
2. Assemble the carriers to the crankshaft journals, ensuring that the same carriers are fitted to their original locations and that the piston jet cut-a-way is towards the front of the crankshaft. Secure each carrier with the two bolts tightening evenly to the correct torque. Check that the oil jet is in position.



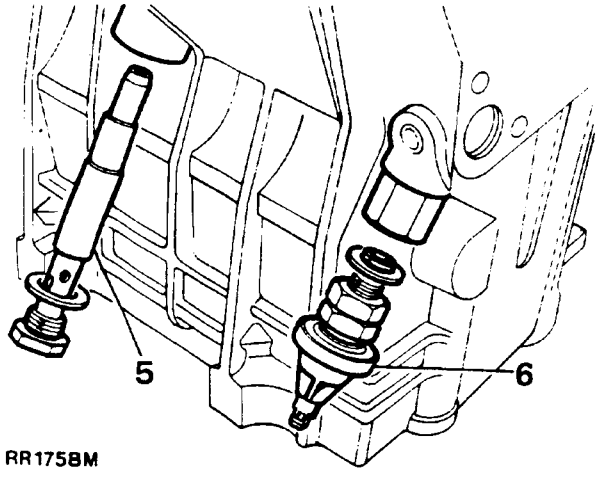
RR1580M

3. Slide special tool 18G 1370 over the crankshaft gear and, if necessary, with assistance insert the crankshaft and carrier assembly into the crankcase in the same manner as for removal.
4. Align the holes in the lower carriers, as illustrated, with the centre of the crankcase webs.



RR1722M

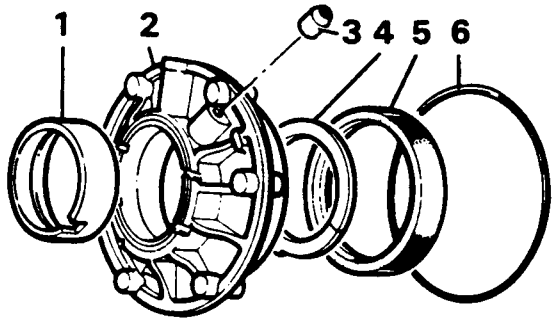
5. Secure each carrier assembly to the crankcase with the appropriate oil feed and carrier location shaft. Ensure that the shafts are fitted to their original locations with new washers.
   The correct locations are as follows:-
   Front carrier shaft - Oil feed to vacuum pump.
   Centre carrier shaft -Oil feed to turbo-charger.
   Rear carrier shaft -Blank
   Tighten the shafts to the correct torque.
6. Fit the oil pressure switch.



RR1758M

Fitting rear main carrier assembly.

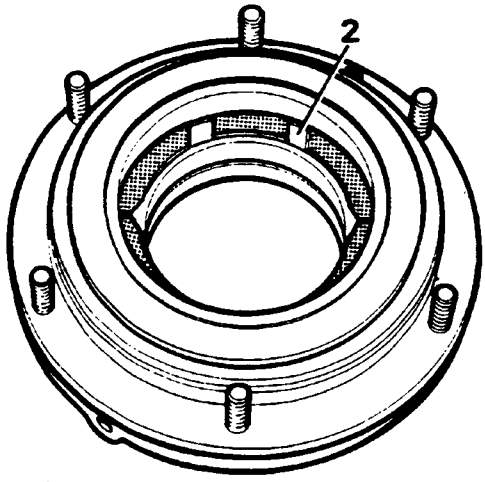
1. Fit a new 'O' ring seal to the rear main carrier.



RR2776M

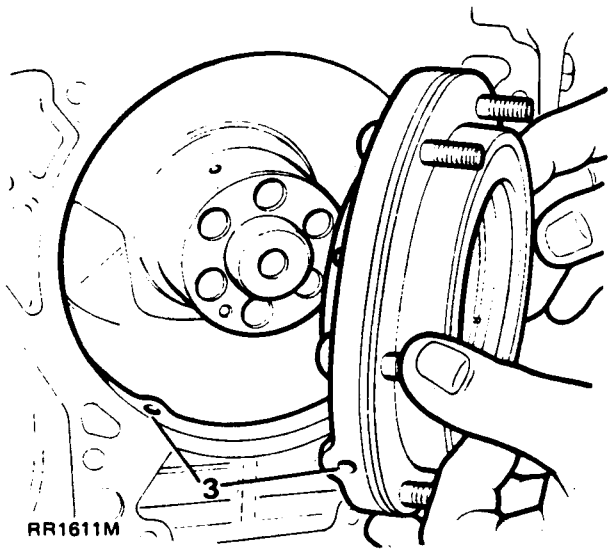
1 Bearing
2 Carrier
3 Oil jet
4 Outer thrust washers
5 Oil seal
6 'O' ring seal

2. Fit new outer thrust halves to the oil seal side with the oil grooves outwards. Ensure that both halves are of the same thickness value and that the thrust with the tag locates in the keyway in the carrier. Hold the thrusts in position with Vaseline.



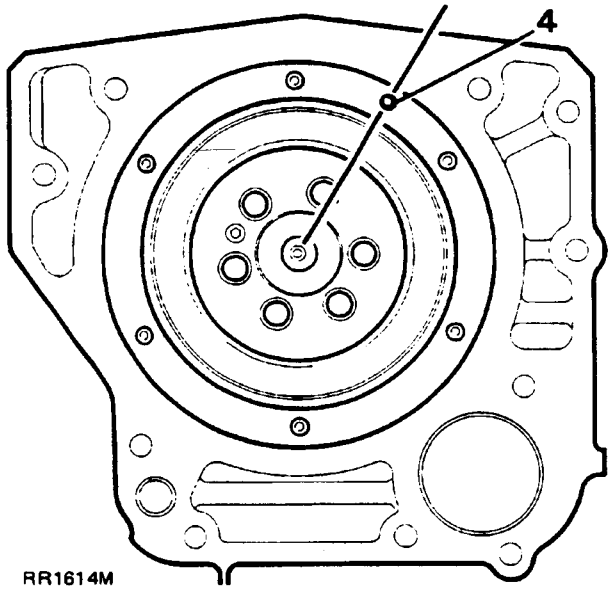
RR1572M

3. With the cylinder block still in the inverted position, lubricate the oil seal with clean engine oil and fit the carrier assembly to the crankcase. Ensure that the oil hole in the crankcase is aligned with the oil hole in the carrier as illustrated.



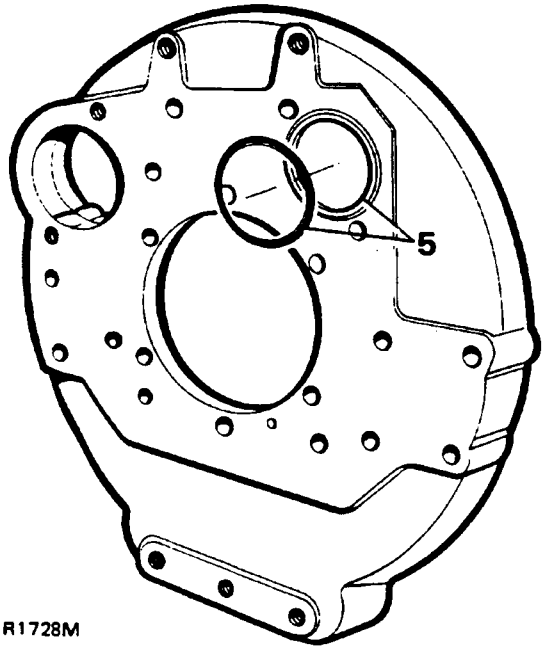
RR1611M

4. When correctly aligned the dowel in the carrier must be at the 1 o'clock position. Final alignment will be achieved when the flywheel housing is fitted.



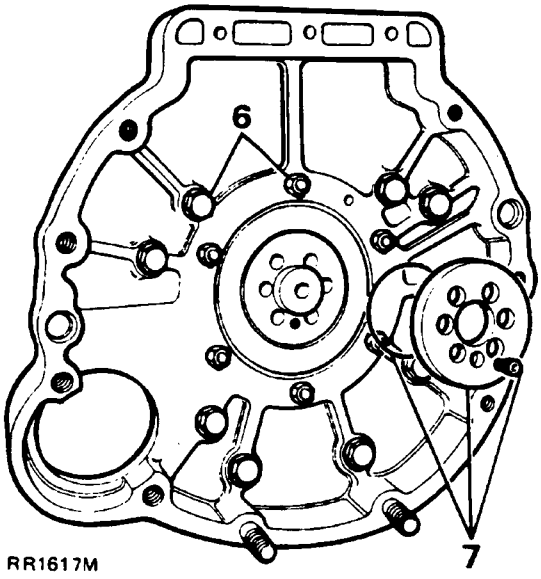
RR1614M

5. Fit a new 'O' ring seal to the rear of the flywheel housing.



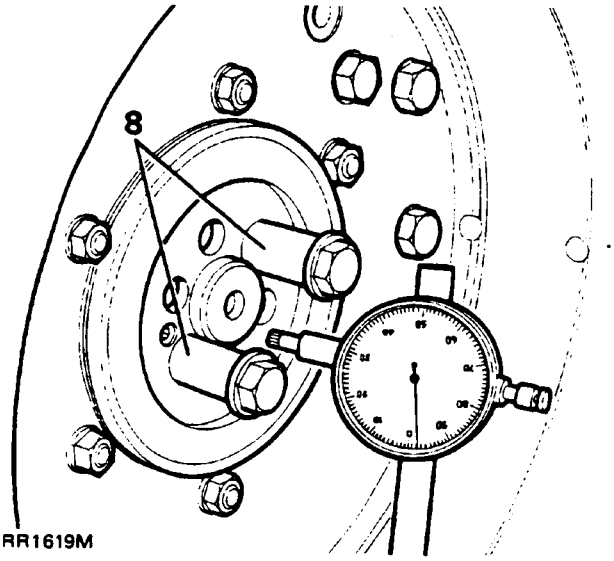
RR1728M

6. Fit the flywheel housing and secure with the nine bolts, tightening evenly to the correct torque. Fit and evenly tighten, to the correct torque, the six carrier retaining nuts.
7. Fit the thrust spacer and a new 'O' ring seal and secure with the socket headed screw.



RR1617M

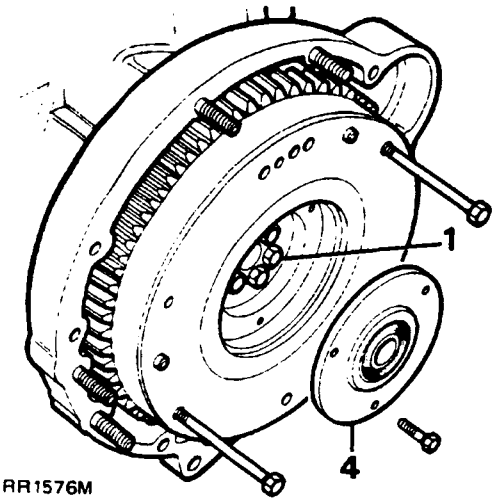
8. To check the crankshaft end-float, insert two flywheel bolts in the crankshaft using spacers equivalent to thickness of the flywheel and tighten to the correct torque. Mount a dial test indicator with the stylus resting, in a loaded condition, on the thrust spacer. Lever the crankshaft back and forth and note the reading. Adjust the end-float, if necessary, by substituting with washers of an appropriate thickness, see data section for available washers.



RR1619M

Fitting flywheel

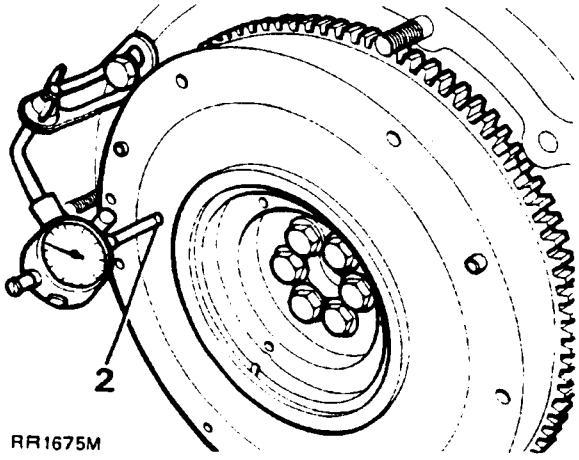
1. Fit the flywheel using the same method as for removal. Fit and evenly tighten the six retaining bolts to the correct torque.



RR1576M

Checking flywheel face run-out

2. Mount a dial test indicator on the flywheel housing with the stylus positioned in a loaded condition on the flywheel face and zero the gauge.
3. Turn the flywheel and take readings every 90°. The difference between the highest and lowest readings taken at all four points should not exceed 0,10 mm (0.004 in) which is the maximum permissible run-out.
4. Fit the spigot bearing and plate and secure with the three bolts.

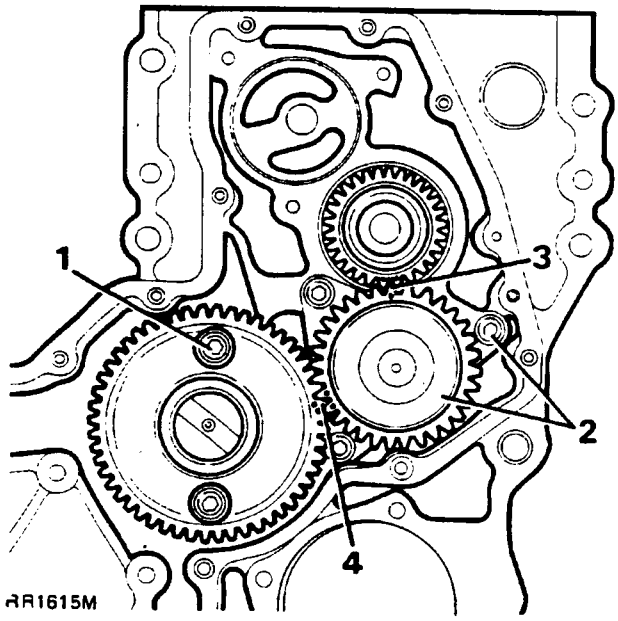


RR1675M

Fitting idler gear and oil pump 2.4 litre engine.

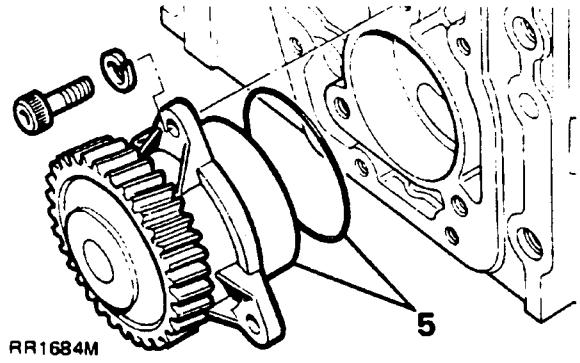
1. Whilst maintaining the cylinder block in the inverted position, remove the two socket headed screws and partially withdraw the camshaft.

2. Fit the idler gear assembly with the three socket headed screws and tighten evenly.
3. Turn the crankshaft and idler gear until the dots align, as illustrated, with the single dot on the idler gear between the two dots on the crankshaft gear.
4. Refit the camshaft and align the gears so that the single dot on the camshaft gear is between the two dots on the idler gear, as illustrated. Fit and tighten the two camshaft retaining screws.



RR1615M

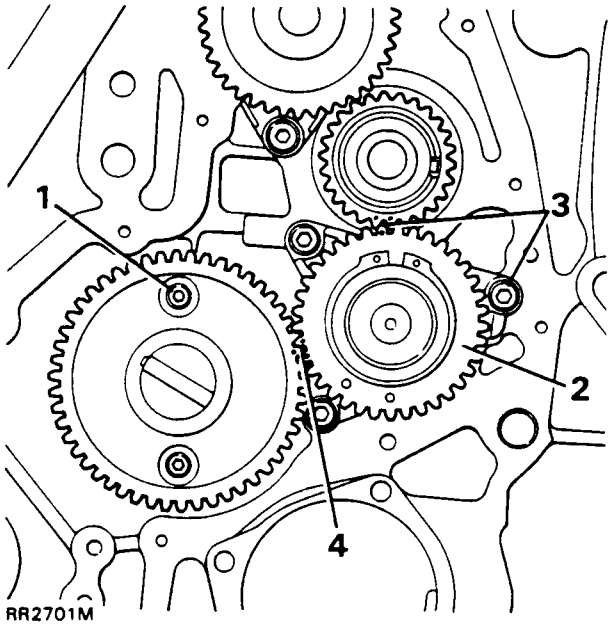
5. Using a new 'O' ring seal fit the oil pump assembly and secure with the three socket headed screws tightening evenly to the correct torque.



Fitting vacuum and oil pumps 2.5 litre engine.

1. Whilst maintaining the cylinder block in the inverted position, remove the two socket headed screws and partially withdraw the camshaft.
2. Using a new 'O' ring seal offer the vacuum pump and gear assembly into its location.
3. Turn the crankshaft and vacuum pump gear until the dots align, as illustrated, with the single dot on the vacuum pump gear between the two dots on the crankshaft gear. Fully house the vacuum pump, tightening the three socket headed screws to the correct torque.

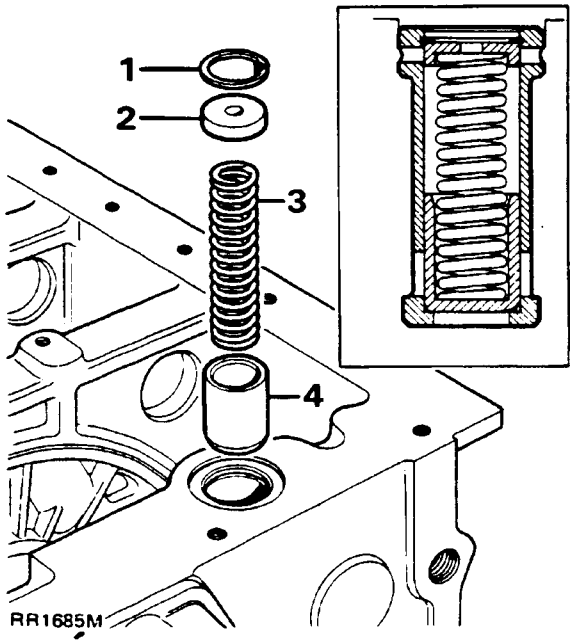
NOTE: The screw with the smaller diameter head should be fitted closest to the camshaft gear.



4. Refit the camshaft and align the gears so that the single dot on the camshaft gear is between the two dots on the vacuum pump gear, as illustrated. Fit and tighten the two camshaft retaining screws.
5. Fit the oil pump assembly and secure with the three socket headed screws tightening evenly to the correct torque.

Fitting oil pressure relief valve

1. Clean the valve seating in the crankcase and fit the relief valve, spring and cap and secure with the circlip using 18G 257 or suitable alternative pliers.



1 Circlip
2 Cap
3 Spring
4 Plunger

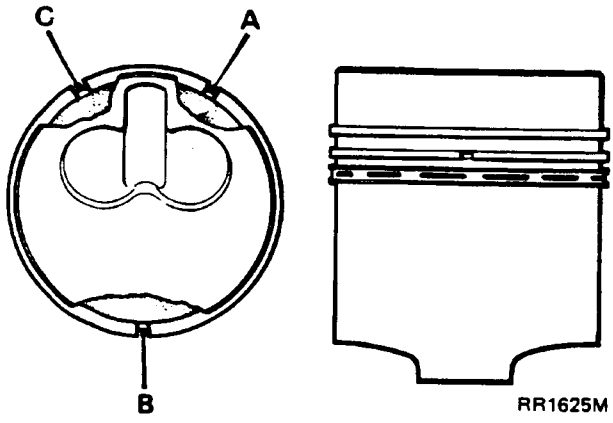
Fitting connecting rods and pistons

1. If the original pistons and connecting rods are being refitted ensure that they are returned to their original locations.
2. Turn the cylinder block over to an upright position.
3. Turn the crankshaft to bring numbers one and four crankpins to the B.D.C position.
4. Stagger the piston ring gaps as follows :__

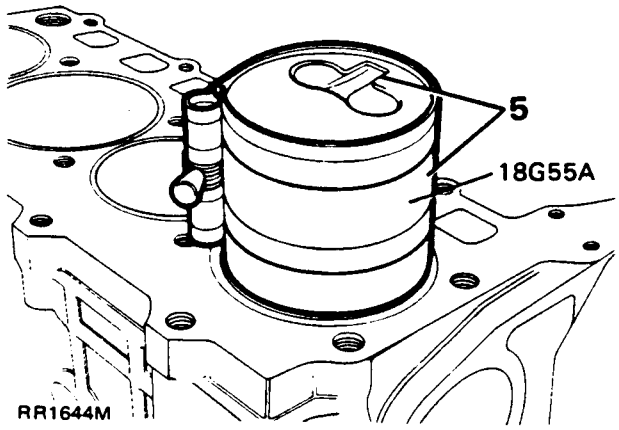
   A Compression ring gap 30° to the right of the combustion chamber recess.

   B Scraper ring gap on the opposite side of the combustion chamber recess.

   C oil control rings gap 30° to the left of the combustion chamber recess.



5. Check that the recess area in the piston crown is on the same side as the figures on the connecting rod. Fit the connecting rod bearing shells. Using piston ring compressor 18G 55A or a suitable alternative, insert number one and number four pistons into the cylinder bores ensuring that the recess area in the piston crown is toward the camshaft side of the engine. Tap the pistons into position in the bores.



6. Turn the cylinder block over and fit the connecting rod caps so that the figures are on the same side. Apply 'Molyguard' to the threads of the NEW bolts and tighten to the correct torque.
7. Repeat the above instructions to fit number two and three pistons.

Fitting oil strainer and sump.

1. Fit a new 'O' ring seal to the oil pick-up pipe and insert into the crankcase. Secure the strainer end of the pipe to the crankcase with two bolts. See items 42 and 43 on illustration of engine internal components.
2. Clean the sump and crankcase mating faces and apply 'Loctite 518' to both surfaces. Secure the sump with the twenty-one bolts tightening evenly to the correct torque.
3. Apply 'Hylosil RTV' to the oil pan and sump mating faces and secure the pan to the sump with eighteen nuts and evenly tighten to the correct torque. Tighten the drain plug to the correct torque.

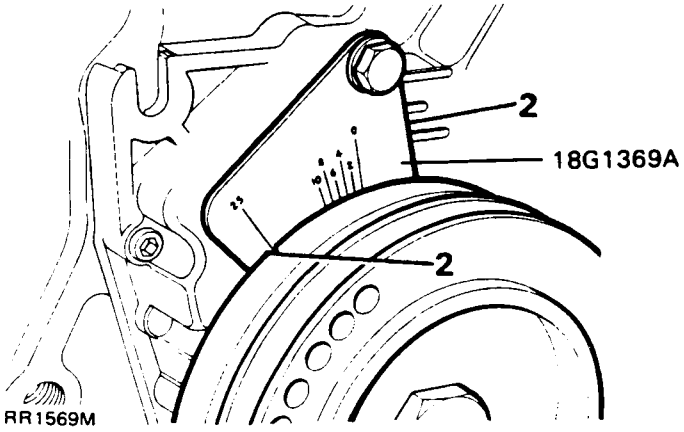
Fitting cylinder heads.

1. The fitting of the cylinder heads requires a precise sequence of instructions to be carried out. It includes - checking cylinder liner protrusion - selecting head gasket thickness and tightening the head bolts in the correct order.

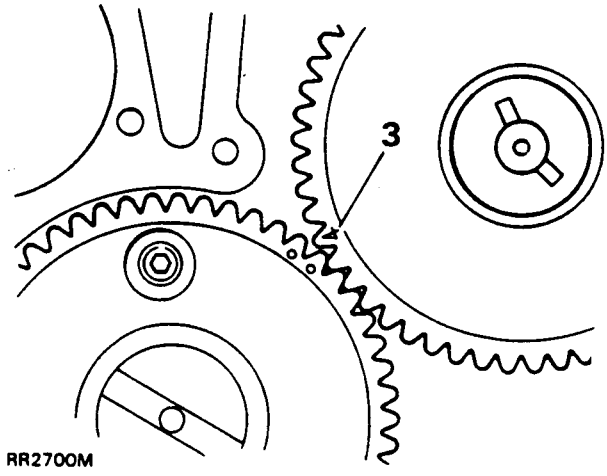
   For these details see: **CYLINDER HEADS** remove and refit. Section 12 pages 6 to 11.

Fitting and timing fuel injector pump.

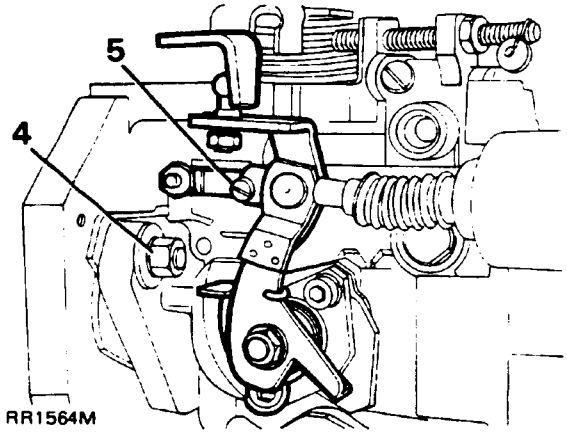
1. Temporarily fit the timing cover and crankshaft pulley and turn the crankshaft until the T.D.C. mark on the cover aligns with the groove in the crankshaft pulley so that number one piston is at T.D.C. on the compression stroke, with number four valves 'rocking'.
2. Attach the special timing gauge 18G 1369A to the timing cover and turn the crankshaft anti-clockwise until the pulley groove aligns with the 25° B.T.D.C. mark on the scale.

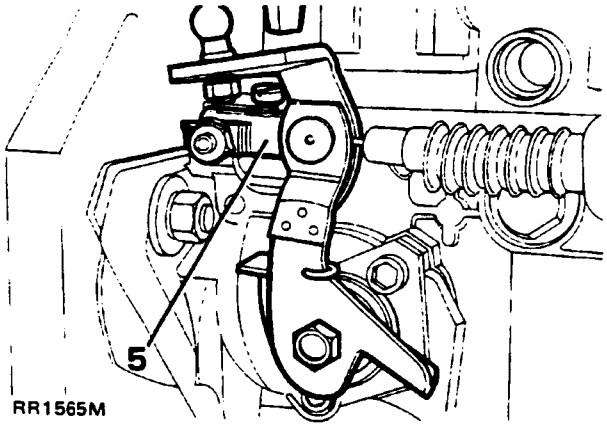


3. Remove the pulley and timing cover and mesh the injection pump and camshaft gears so the tooth marked '4' is offset from the two camshaft teeth marked with dots, also the two keyways positioned exactly as illustrated.

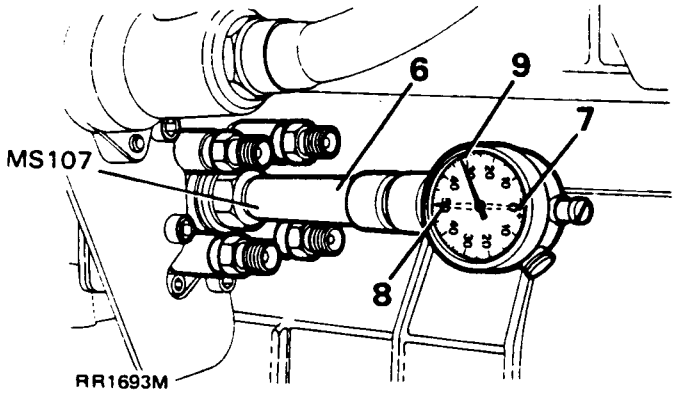


4. Whilst holding the gear in this position fit the injection pump with a new joint washer ensure the key on the shaft is at the 11 o'clock position viewed from front of engine. Secure the three nuts, finger tight only. Fully tighten the injection pump gear retaining nut to the correct torque.
5. Release the screw on the cold start cable and turn the trunnion 90° until the lever is fully released.





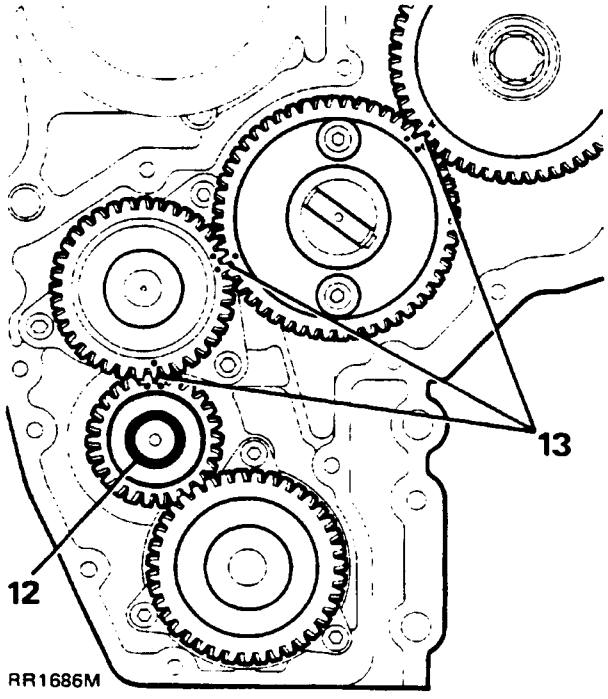
6. Fit the special tool MS107 and dial test indicator to the rear of the pump.



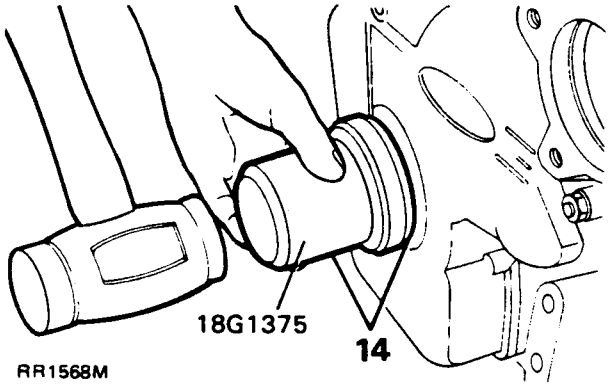
7. Fit the timing cover and scale and crankshaft pulley and turn the crankshaft to T.D.C. Then turn crankshaft anti-clockwise until the indicator needle stops and zero the indicator. The groove on the pulley should now be approximately aligned with the 25° B.T.D.C. mark.
8. Turn the crankshaft clockwise so that the pulley groove is aligned with the 3° B.T.D.C. mark. Turn the injector pump body, clockwise or anti-clockwise as necessary until the indicator reads 50 (0,5 mm).
9. Tighten the pump body retaining nuts and turn crankshaft to T.D.C. and check that the dial reads 68 (0,68 mm)
10. Move the cold start lever rearward to the normal running position prior to instruction 5, and tighten the screw. **See Maintenance Section 10** for cold start adjustment.
11. Turn the crankshaft until the T.D.C. mark on the cover or timing gauge aligns with the pulley groove.
12. Remove the pulley and timing cover and fit a new joint washer and 'O' ring seal to the crankshaft.

NOTE: Hylosil RTV is used in place of a joint washer on 2.5 Litre engines.

13. At the same time check that the timing marks on the gear train all align, as illustration.



14. Fit the timing cover and secure with the twelve socket-headed screws and one bolt and tighten evenly to the correct torque. Using special tool 18G 1375 drive in a new timing cover seal, cavity side leading.



RR1568M

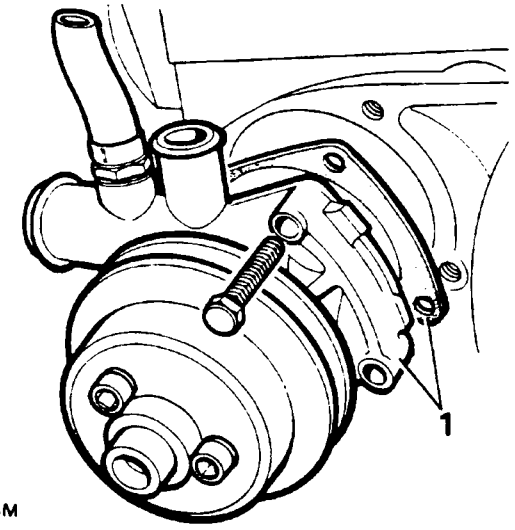
15. Fit the pump drive gear cover plate using a new 'O' ring seal. Secure with the four bolts and tighten evenly.
16. Fit the crankshaft pulley and tighten the nut to the correct torque.

Fitting vacuum pump 2.4 litre engine

Fit the vacuum pump with a new 'O' ring seal and secure with the clamp and two nuts and tighten to the correct torque. Check that the backlash between the vacuum pump drive gear and worm drive does not exceed 0,200 mm (0.008 in).

Fitting water pump

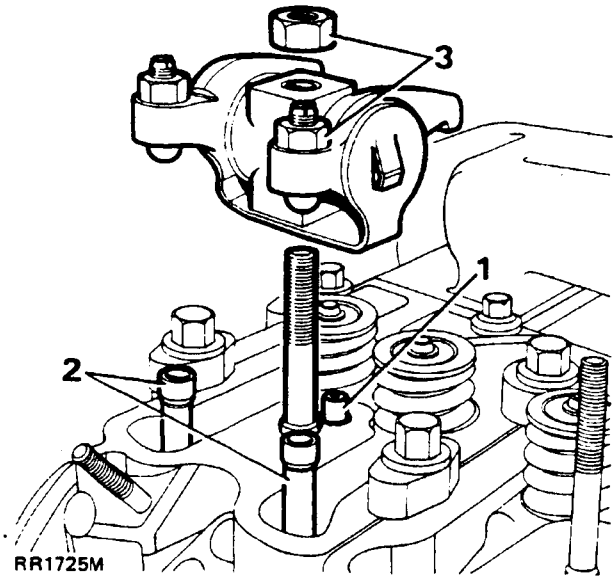
1. Using a new joint washer fit the water pump and pulley assembly and secure with the four bolts, tightening evenly to the correct torque.



RR1726M

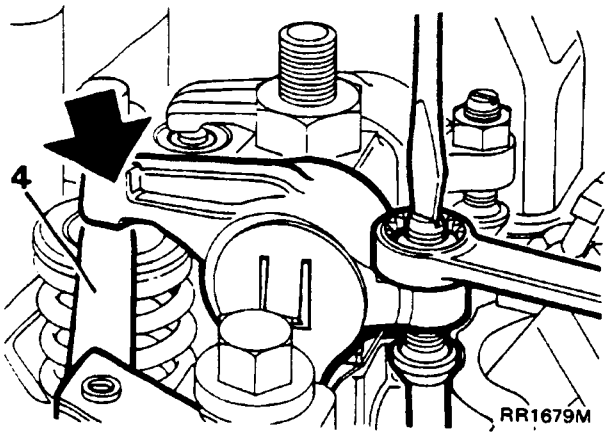
Fitting valve rocker assemblies

1. Check that the oil feed dowels are in position in each cylinder head.
2. Fit the push rods ensuring that the ball-end locates correctly in the cam follower cup.
3. Slacken-off the tappet adjusting screws. Fit the valve rocker assemblies to the cylinder head over the oil feed dowels and locate the tappet adjusting screws in the push rod cups. Secure with the single nut and tighten to the correct torque.



RR1725M

4. Adjust the inlet and exhaust valve tappet clearances to 0,30 mm (0.012 in) in the following manner and sequence. The feeler gauge should be a sliding fit between the rocker and valve tip. Slacken the rocker adjusting screw locknut and turn the screw clockwise to decrease or anti-clockwise to increase the clearance. When correct hold the screw against rotation and tighten the locknut. Two sequences to adjust the clearances may be used.



Sequence A

With No.1 valve fully open adjust No.7 valve.
With No.8 valve fully open adjust No.2 valve.
With No.5 valve fully open adjust No.3 valve.
With No.4 valve fully open adjust No.6 valve.
With No.7 valve fully open adjust No.1 valve.
With No.2 valve fully open adjust No.8 valve.
With No.3 valve fully open adjust No.5 valve.
With No.6 valve fully open adjust No.4 valve.

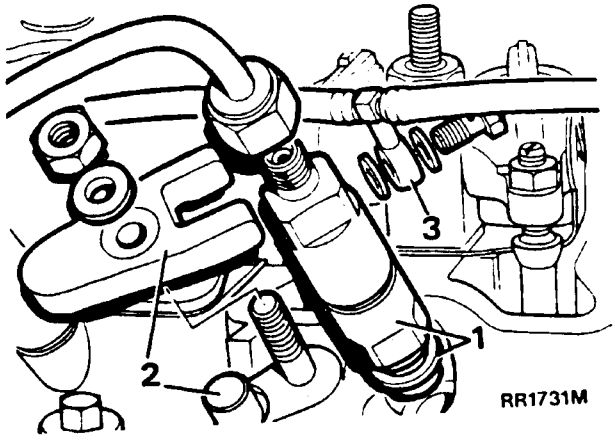
Sequence B

Rotate the crankshaft until the valves of number four cylinder are rocking then adjust the clearance of number one valve. Adjust the remaining valve clearances in the following order:-

Adjust:-
Valves of No. 3 cyl with No. 2 valves rocking
Valves of No. 4 cyl with No. 1 valves rocking
Valves of No. 2 cyl with No. 3 valves rocking

Fitting injectors and pipes

1. Fit the sealing washer the the injector to the cylinder head.
2. Locate the dowel and clamp and tighten the nut to the correct torque.
3. Fit the remaining injectors and spill rail using a new washer both sides of the banjo unions.



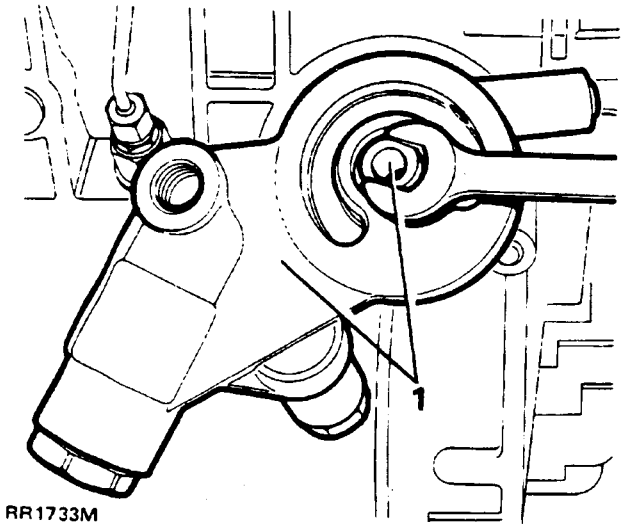
4. Fit the heater plugs and three connecting terminal bars.
5. Fit the supply pipes to the injectors and injector pump. Do not overtighten the union nuts.

Fit rocker covers and coolant rail

1. Using new gaskets fit the rocker covers noting that the tallest covers are fitted to numbers two and three cylinders and the oil filler cap to number one cylinder. Tighten the special nuts to the correct torque.
2. Fit the engine coolant rail complete with thermostat housing to the cylinder heads using new gaskets. Tighten the eight bolts evenly to the correct torque.
3. Fit the water hose from the injector pump cold start device to number three cylinder head rocker cover and the hose from the thermostat housing to cold start device.
4. Fit the by-pass hose between thermostat housing and and water pump.

Fit oil filter adaptor

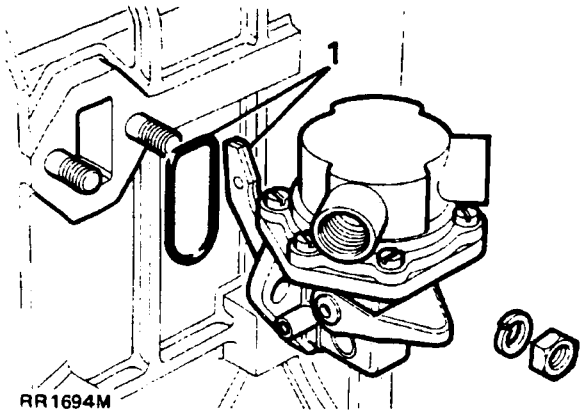
1. Fit the oil filter adaptor, using a new 'O' ring seal, to the cylinder block. Ensure that the adaptor is fitted, as illustrated, with the elongated cavity on the side facing the cylinder block at the bottom. Secure with the union screw to the correct torque.



2. Smear the oil filter canister seal with clean engine oil and screw the canister on to the adaptor until contact then turn a further half turn by hand only. See maintenance **Section 10.**
3. Connect the oil feed pipe to the front main bearing carrier adaptor union and the banjo hose end to the vacuum pump.

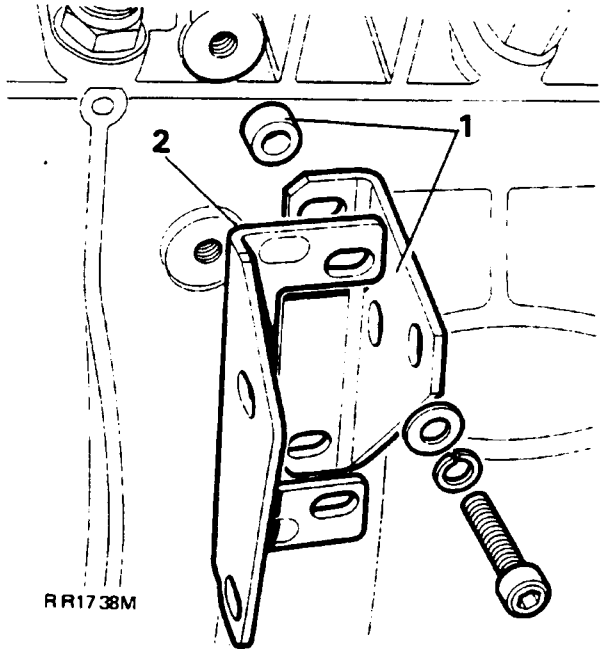
Fit fuel lift pump

1. Using a new gasket fit the fuel lift pump to the cylinder block. Ensure that the actuating lever rides on top of the cam.

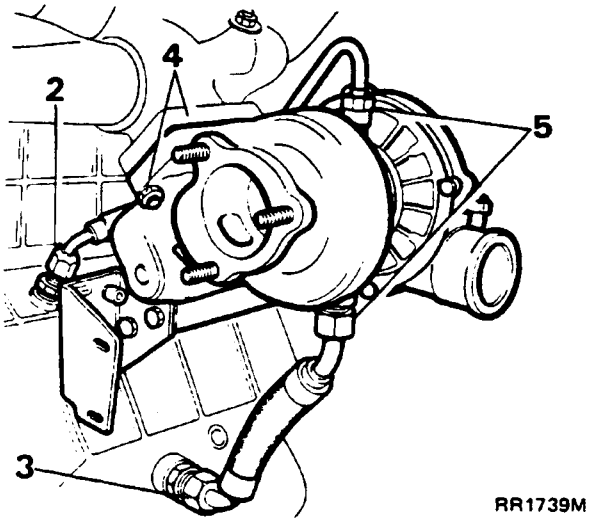


Fit the turbocharger

1. Fit the turbocharger support bracket to the cylinder block attachment bracket.
2. Also fit the starter motor heat shield rear support bracket which shares a common fixing point on the cylinder block.



3. Fit the oil feed hose to the centre union on the cylinder block.
4. Fit the oil return hose to the crankcase union.
5. Fit a new gasket to the exhaust manifold and fit the turbo-charger and tighten the four nuts evenly to the correct torque.
6. Connect the oil feed and oil return pipes to the turbocharger.



RR1739M

7. Fit the heat shield to the exhaust manifold.

Fit power steering pump

1. Fit the power steering pump and support bracket to the engine and fit the drive belt. Adjust the drive belt tension. **See Maintenance Section 10.** To tension the belt move the pump away from the engine and tighten the pivot and adjusting bolts.

Fit the alternator

1. Right hand steer vehicles have the alternator mounted on the left side of the engine. On left hand steer vehicles the alternator is mounted on the right hand side.
2. Fit the alternator and drive belt. Adjust the belt tension. **See Maintenance Section 10.** To tension the belt, lever the alternator away from the engine and tighten the pivot and adjusting nuts and bolts. Do not apply pressure to the stator or slip ring end of the alternator, whilst tensioning, or damage could result.

Fit the air conditioning compressor

1. Fit the mounting bracket to the cylinder block and attach the compressor, noting that on R.H.S. vehicles the compressor and alternator share a common pivot belt. Fit and tension the drive belt. **See Maintenance Section 10.** Pivot the compressor anti-clockwise and tighten the pivot and adjusting nuts and bolts.

CAUTION: When fitting a new drive belt,tension the belt as described above. Start and run the engine for 3 to 5 minutes at fast idle, after which time the belt must be re-checked. If necessary retension the belt.

Fitting starter motor

1. Fit the starter motor to the flywheel housing and secure with either two bolts or two nuts. Also attach the heat shield to the lower fixing, together with the earth strap.
2. Secure the rear-end of the starter motor to the rear support bracket, fitted earlier, with two bolts and attach the rear of the heat shield to the top bolt.

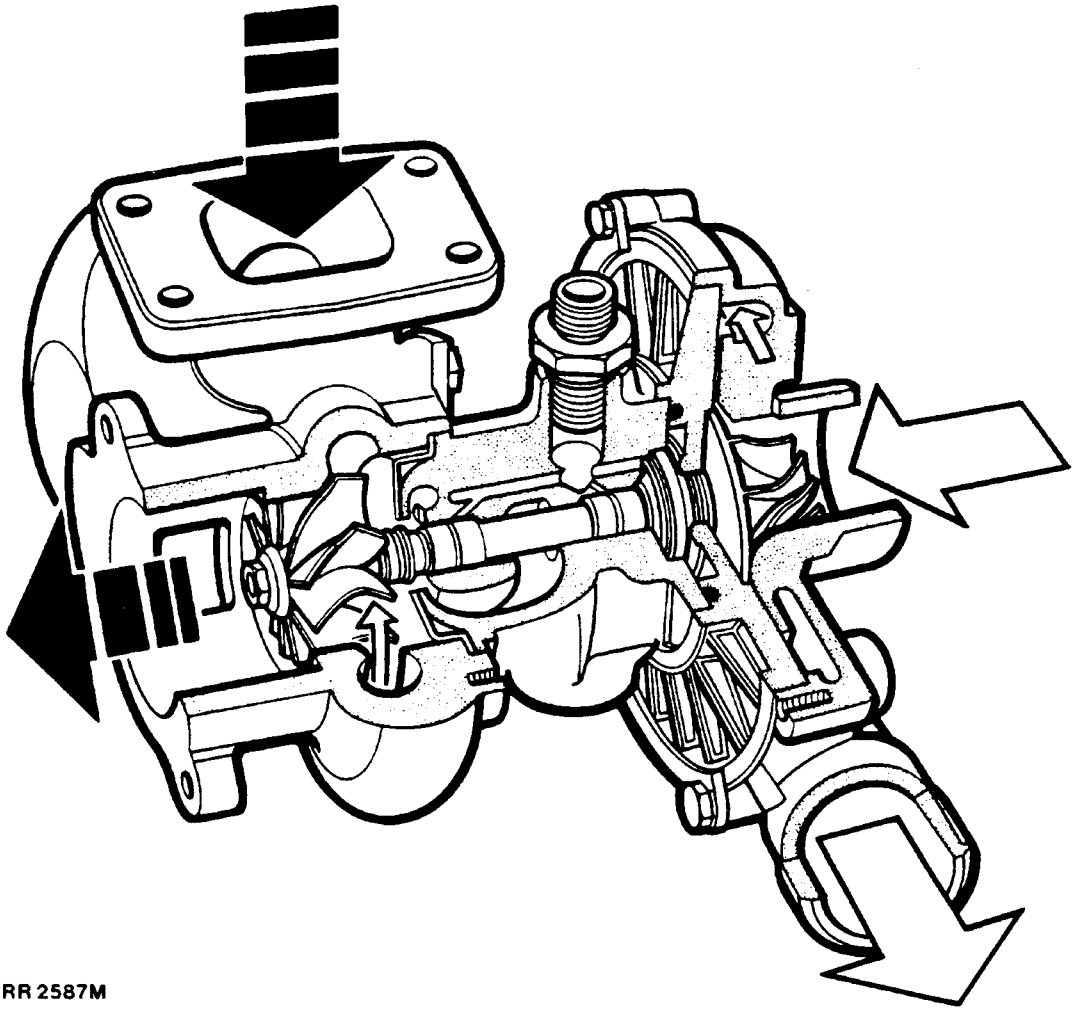
Fitting clutch

1. Clean the flywheel and clutch assembly faces.
2. Place the clutch centre friction plate in position on the flywheel with the flat side towards the flywheel.
3. Fit the clutch assembly and loosely secure with the six bolts.
4. Centralise the centre plate using special tool 18G 79 or a spare primary shaft and tighten the six bolts evenly to the correct torque.
5. Smear the splines of the centre plate with a Molybdenum disulphide grease.

TURBOCHARGER DESCRIPTION

A turbocharger is a simple but efficient means of increasing engine power. It consists of an exhaust gas driven air compressor that delivers high volumes of air into the combustion chamber, which may increase the engine's power output by up to 30%.

The turbocharger is fed by the main gallery oil pressure which lubricates and stabilises the fully floating bearings. When in operation the turbine shaft usually revolves between 1,000 and 130,000 rev/min. Therefore it is extremely important that the recommended change periods for oil and air filters are adhered to.



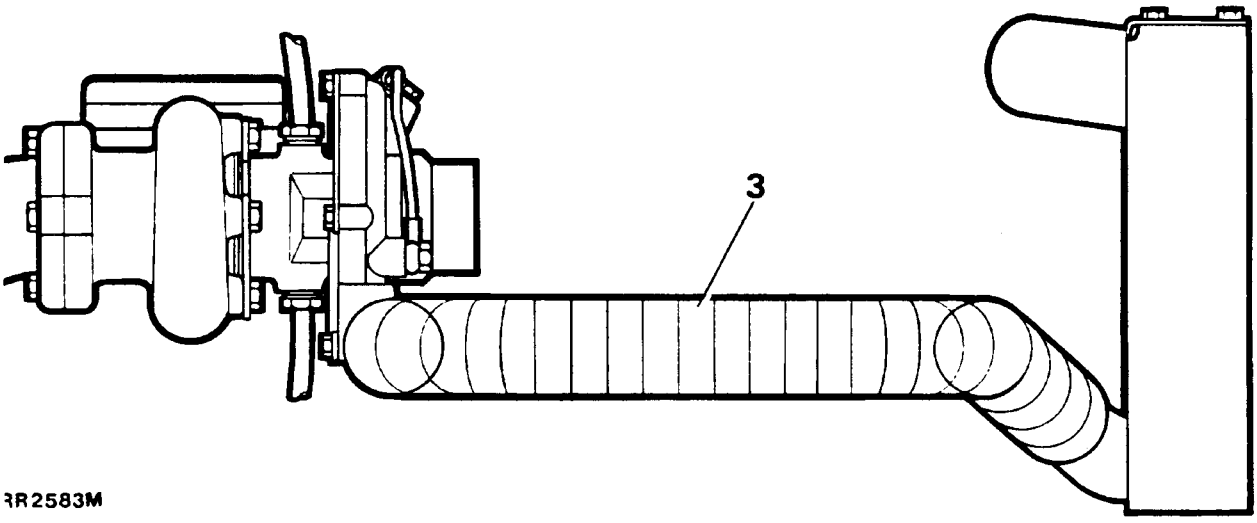
RR 2587M

TURBOCHARGER - CHECK

If the turbocharger unit is suspected of being faulty, the following simple test may be carried out. The assistance of a second operative is required to carry out this operation.

1. Open the bonnet.
2. Start the engine and allow it to idle.
3. Depress the turbocharger to intercooler feed pipe with one hand, the air pressure increase in the pipe may be detected as the second operative increases the engine revs.

NOTE: Although the above test indicates the operation of the turbocharger. it does not indicate it's efficiency.



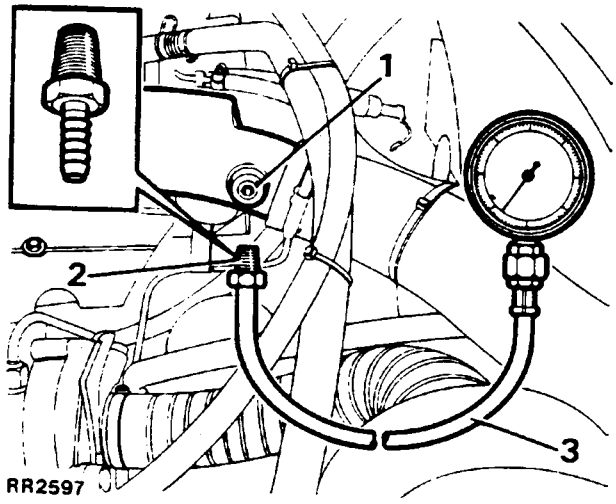
RR2583M

TURBOCHARGER BOOST PRESSURE

Service tools:
18G.1116-1 Pressure test adaptor

Check

1. Remove the grub screw, located in the inlet manifold.



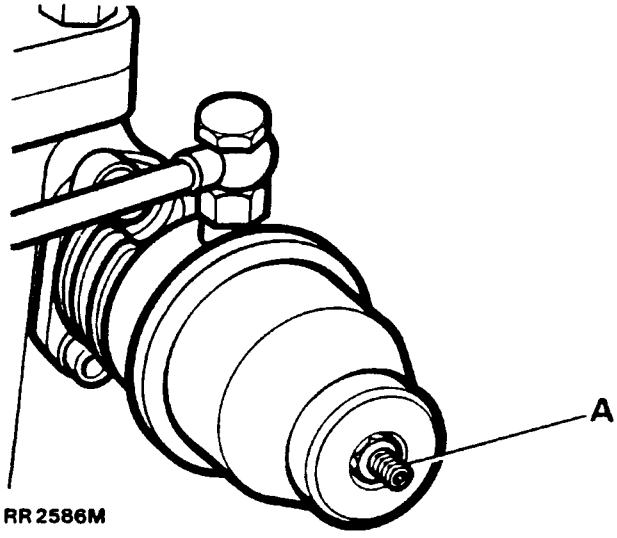
2. Insert adaptor 18G.1116-1 into the grub screw orifice
3. Attach a suitable pressure gauge, with sufficient length of tube to reach from the inlet manifold to the cab of the vehicle.
4. Drive the vehicle in 3rd gear at 3800 rev/min to give a satisfactory reading of 0.9kg/cm

WASTE GATE VALVE

The turbocharger waste gate diverts exhaust gas flow to by-pass the turbine when the boost pressure is higher than 0.9kg/cm.

Adjust

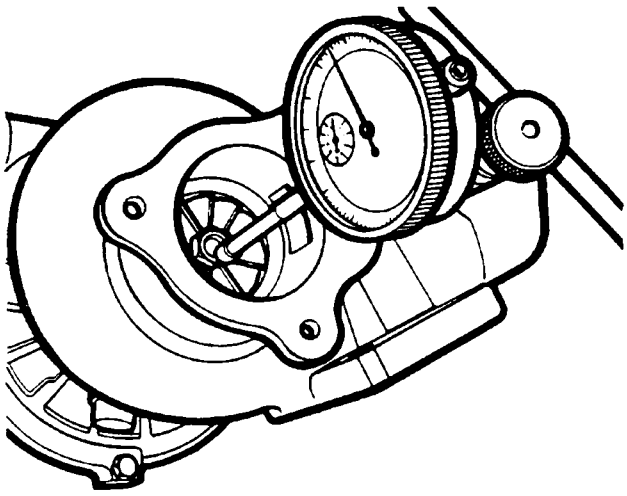
The boost pressure may be adjusted by loosening the lock nut and turning the screw marked 'A' in the diagram. Turn the screw clockwise to increase the spring load on the valve and consequently increase the boost pressure. Unscrew to decrease both spring load and boost pressure.



NOTE: There is a small hole located in the waste gate housing. To ensure efficient operation of the waste gate diaphragm it is neccessary to clean this hole. A small piece of sturdy wire, or a similar object, is a suitable tool for this operation. Take care not to insert the wire too far in to the waste gate housing, as the diaphram is made of a heat resistant rubber and is subsequently easily damaged.

TURBOCHARGER 'END FLOAT' CHECK

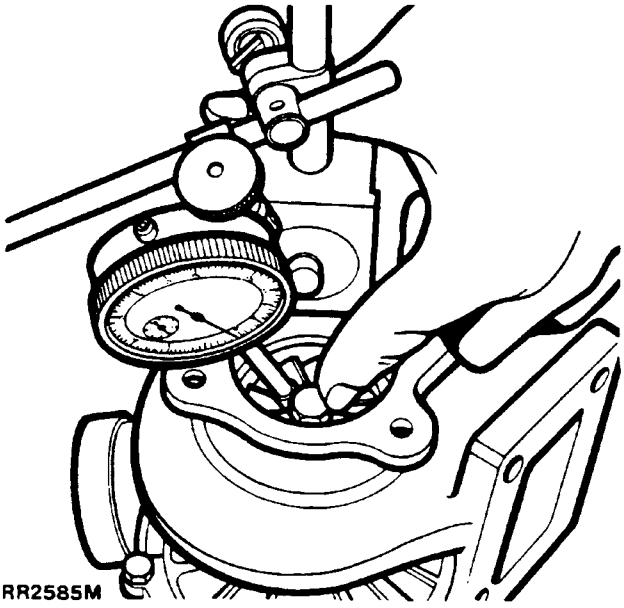
Use a dial test gauge and the set up shown in the diagram. Set the gauge to zero on the turbine wheel, and by moving the shaft in a linear motion the end play may be established. The maximum allowable end play is 0,15mm (0.006in).



RR2584M

Radial clearance

Push the turbine wheel to the extreme side position and set the dial test gauge to zero, on the indicator, as shown in the diagram. Check the side clearance of the turbine shaft by observing total radial movement of the turbine wheel. Maximum side clearance allowable is 0,42mm (0.016in).



RR2585M

AIR FILTER CHECK

To ensure that the correct volume of air is supplied to the turbocharger unit, the air filter should be checked for cleanliness. Firstly remove the filter box from the securing brackets. Then remove the air filter from it's housing. A visual inspection of the filter will verify it's condition. Fit a new air filter if there are any signs of oil contamination or blockage of any description.

TURBOCHARGER FAULTFINDING

This workshop bulletin has looked at the principles on which the turbocharger operates, and the fundamentals of maintenance. It is now necessary to identify symptoms and probable causes of a suspect turbocharger. As the exhaust gas drives the turbocharger, it is capable of speeds up to 130,000 rev/min and temperatures of up to 650°C. In order to ensure that the bearings are lubricated and cooled, the turbocharger is connected to the normal engine lubrication system. Obviously very high quality seals must be used in the turbocharger, to prevent lubricating oil entering the inlet or exhaust system.

Should oil leak past a seal into the exhaust system, dense pale blue smoke will be emitted continuously. If however the oil leaks into the inlet system it will be burnt at a higher temperature and produce a darker shade of blue smoke. The engine speed may also be permanently higher than normal, as the engine will burn the oil as extra fuel and an excessive oil leak in to the inlet system may even cause the engine to accelerate, however for this to occur the operator would have to ignore all earlier signs of impending trouble.

Blockage of the large oil drain pipe from the turbocharger, though very unlikely, is certainly the worst condition as oil under pressure would be forced past the seals and into both inlet and exhaust systems. If grey or black smoke is being emitted, the turbocharger may be partly blocked or the shaft may not be perfectly free to spin. This will cause a restriction in the air inlet and result in grey/black exhaust smoke, which usually increases at higher engine speeds.

CAUTION: If the driver is in the habit of accelerating the engine before switching the engine off, the turbine will continue to spin after the engine has come to rest and the lubrication to the turbine bearings ceased. It is therefore possible that this practice will cause damage or seizure of the bearings.

Other symptoms of turbocharger faults

A change in the normal noise level is usually the first indication of a fault in the turbocharger or its hose connections. A higher pitched sound usually indicates a possible air leak into the suction side of the compressor and the inlet system, or an escape of compressed air between the compressor and the inlet manifold. Obviously an excessive escape of compressed air from the manifold is not only noisy but will also cause some loss of power.

Slight leaks from the turbine housing or exhaust manifold, whilst noisy, are easily detected and have, little effect on the power output. Cyclic sounds (e.g. a continuous rubbing noise) are an indication of air restriction to the compressor or that the compressor wheel is coated in dirt.

If the waste gate valve sticks in the open position the engine will be down on power.

INJECTION PUMP TIMING

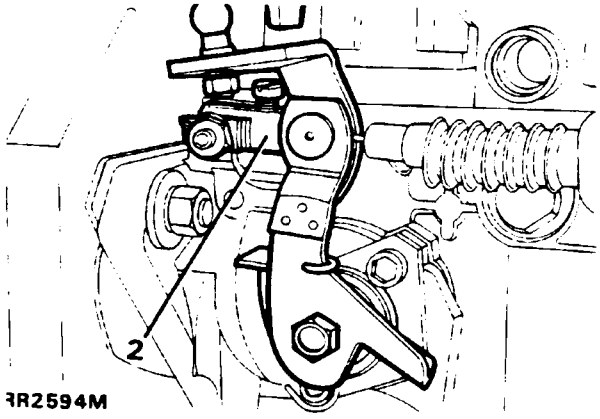
Check and adjust

Service tools:

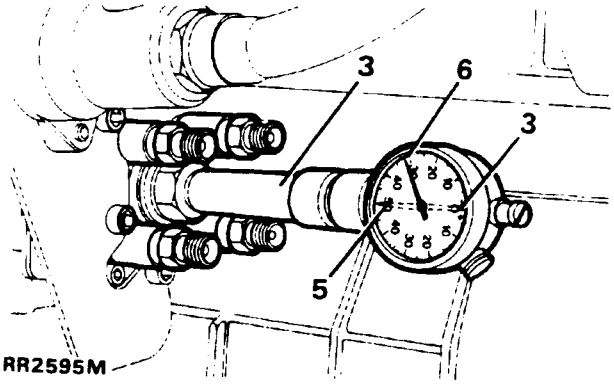
18G.1376 Timing adaptor
18G.1369A Timing gauge

When it has been established that the injection pump requires a timing check the following procedure should be followed.

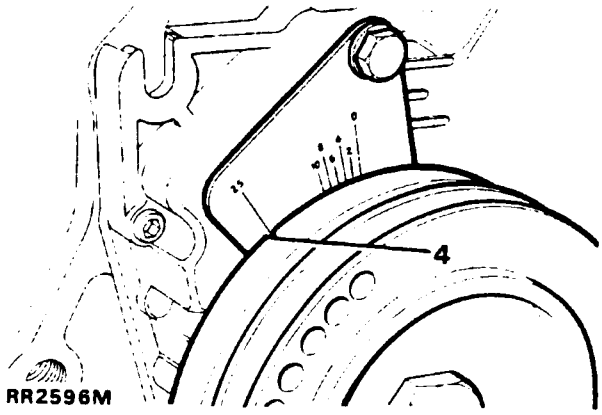
1. Attach the timing gauge 18G.1369A to the engine front cover. Rotate the engine until the mark on the crankshaft pulley lines up with the top dead centre TDC mark on the timing gauge.
2. Release the cable tensioner on the cold start mechanism to ensure an accurate result.



3. Remove the blanking plug from the rear of the pump assembly and insert adaptor 18G. 1376. Attach a dial test gauge to allow a reading to be obtained.



4. Rotate the engine again until the pulley mark is lined up with the 25° BTDC mark. The dial on the test gauge should then be zeroed. Ensure at this stage that there is sufficient pressure being applied to the stylus to give a deflection on the indicator.



5. The engine should be turned again to 3° BTDC and the needle deflection noted. A deflection of 50 (0,5mm) should be read.
6. To adjust the dimension, slacken the three locking nuts, which secure the pump to the front cover. Then rotate the injection pump assembly until a correct reading has been established, retighten the locking nuts. As a double check the deflection on the dial test gauge should be a further 16-18 (0,16-0,18mm) when the engine is turned to TDC.
7. When adjustment is complete remove the service tools and refit the blanking plug to injection pump and the engine front cover bolt.
8. Finally retension the cable on the cold start mechanism and tighten the retaining screw.

FIT COOLANT SYSTEM KIT

- 2.4 VM diesel.

Part No. RTC 6863

This kit should be used where the engine is prone to overheating, or requires new cylinder heads/gaskets. Prior to fitting the kit, it is essential to check if a non-factory air conditioning system has been installed. If such a system is fitted, check that a 16 fin/inch radiator, part number BTP 1742 has also been fitted.

Expansion tank

Removing

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

1. Remove expansion tank filler cap. Turn expansion cap a quarter turn anti-clockwise, allow pressure to escape, continue turning in same direction to remove cap.
2. Drain cooling system.
3. Disconnect hose to radiator.
4. Disconnect overflow pipe.
5. Disconnect wiring to low coolant sensor.
6. Remove pinch bolt.
7. Remove expansion tank.

Refitting

8. Fit new low coolant sensor (in kit) to new expansion tank.
9. Fit new expansion tank and tighten pinch bolt.
10. Fit radiator hose, tighten clip

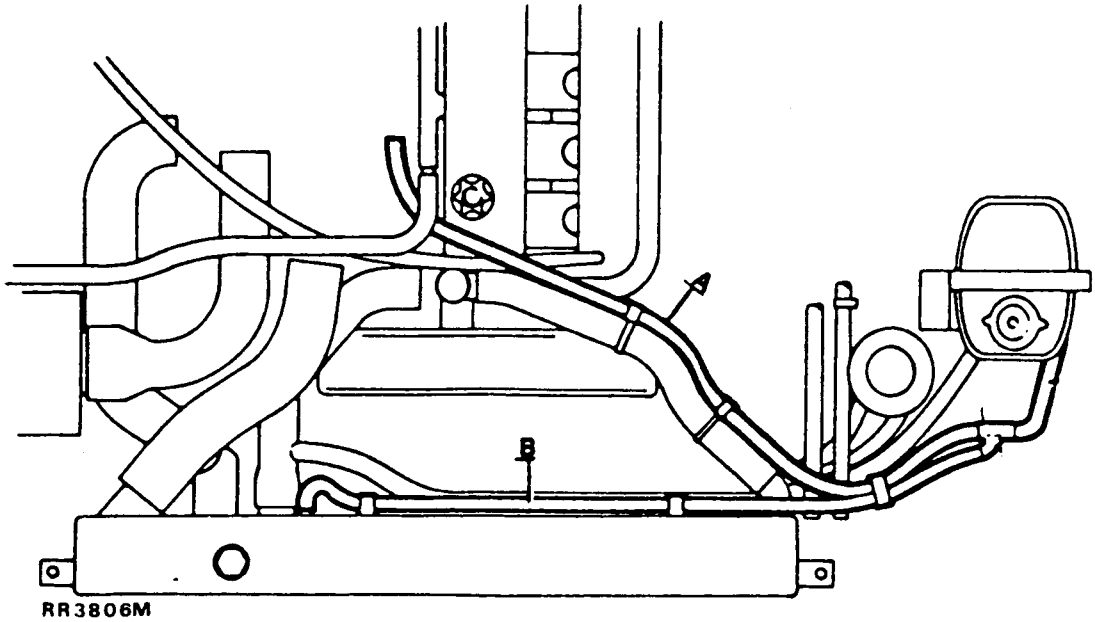
Bleed pipe (Y piece) - see RR3806M

NOTE: Passage of coolant along hose A causes air to be extracted from radiator along hose B.

11. Remove existing bleed pipe from vehicle.
12. Fit new bleed pipe from kit. Place pipe assembly on vehicle. Fit shortest hose to expansion tank, tighten clip.

CAUTION: It is essential that the new bleed pipe is installed correctly. Interchanging postion of hoses A and B will render the air bleed function of the Y piece inoperative. The shorter of the two long hoses, identified by a blue plastic tag, MUST be fitted to the engine.

13. Identify hose A and B. Fit correctly to engine and radiator, tighten clips.
14. Fit bleed pipe to front left hand inner wing, by the M8 screw washer and nut, using one of two existing holes.



RR3806M

Coolant temperature sensor

15. Remove coolant temperature sensor from thermostat. Blank off hole using blank plug supplied.
16. Remove blank plug from No. 4 cylinder head. Fit adaptor from kit, applying Loctite Superfast 572.
17. Fit coolant temperature sensor to adaptor.
18. Re-route sensor wiring. Ensure that cables are protected where necessary with PVC electrical tape to prevent chafing.

Cooling system fill

NOTE: If cooling system is dry, fill radiator with correct quantity and solution of coolant before carrying out this fill procedure.

WARNING: Do not remove radiator filler plug unless system is cold and expansion tank filler cap is first removed. The system is pressurised and personal scalding could result.

19. With system cold remove header tank filler cap.
20. Remove radiator filler plug.
21. Start engine run at 1500 rev/min while carrying out instructions 22 to 24.
22. Add coolant to radiator until full.
23. Refit radiator filler plug.
24. Add coolant until it is within 25 mm of bottom of filler neck. Disregard level plate.
25. Refit header tank filler cap.

VISCOUS FAN - CHECK

When investigating instances of engine or cylinder head overheating on the VM 2.4 litre diesel engine, it is important that you check the operation of the viscous coupling to ensure it is functioning correctly. The following procedure should be used.

NOTE: When an engine is cold, for instance on the first start-up of the day, some noise will be evident from the fan. This noise is normal and is evident that the unit functioning correctly. After a few minutes the fan noise will reduce.

1. Remove the viscous coupling assembly from the drive shaft

NOTE: The hexagonal coupling on the input shaft is a left hand thread.

2. Examine the assembly for general damage and especially for fluid leakage from either the valve on the front of the unit or from the rear in the area of the input shaft/hexagonal coupling. The viscous fluid is normally dark grey in appearance, although if the leak is fresh and the fluid has not been contaminated it will appear transparent.
3. Inspect the bimetallic spring, which operates the valve on the front of the viscous assembly to ensure that it is not damaged and is properly secured. The spring is fixed to a pressed steel bracket by silicon rubber adhesive and the bracket is in turn rivetted to the aluminium housing of the viscous coupling.
4. Ensure that the input shaft rotates smoothly with no evidence of tight spots or grating, and also that a significant degree of constant resistance is felt during rotation - the shaft must not run too freely.

NOTE: If there is evidence of a fault with the viscous fan coupling it must be replaced. Do not attempt to dismantle or overhaul the unit.

NOTE: The circuit diagram RR1166 is for 2.4 litre, 1986 Model Year Diesel Range Rovers. For later circuit diagrams refer to main workshop manual or supplements.

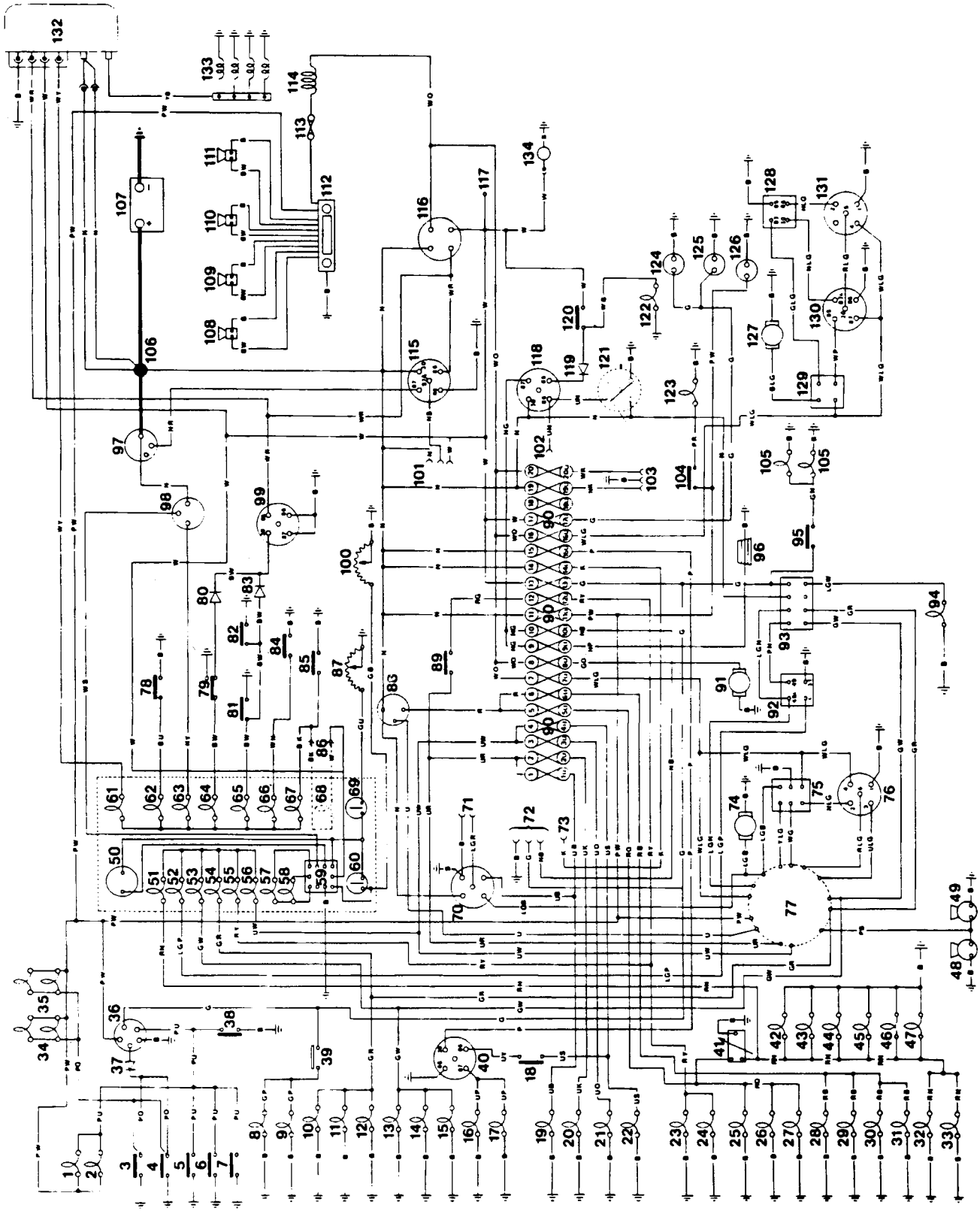
Supplements	Publication No.
1987 Model Year	LSM180 WS1 ed2
1988 Model Year	LSM180 WS2
1989 Model Year	LSM180 WS3
1990 Model Year	LSM180 WS5 ed2
1991 Model Year	LSM180 WS6

KEY TO CIRCUIT DIAGRAM - Fig. RR1166

1. Front interior lamp
2. Rear interior lamp
3. LH front door switch
4. RH front door switch
5. Tailgate switch
6. LH rear door switch
7. RH rear door switch
8. RH stop lamp
9. LH stop lamp
10. LH front indicator lamp
11. LH rear indicator lamp
12. LH side repeater lamp
13. RH front indicator lamp
14. RH rear indicator lamp
15. RH side repeater lamp
16. RH auxiliary driving lamp
17. LH auxiliary driving lamp
18. Auxiliary driving lamp switch
19. RH headlamp dip
20. LH headlamp dip
21. RH headlamp main
22. LH headlamp main
23. RH rear fog lamp
24. LH rear fog lamp
25. RH number plate lamp
26. RH side lamp
27. RH tail lamp
28. LH number plate lamp
29. LH side lamp
30. LH tail lamp
31. Radio illumination
32. Switch illumination
33. Switch illumination
34. LH door lamps
35. RH door lamps
36. Interior lamp delay
37. Diode
38. Interior lamp switch
39. Stop lamp switch
40. Auxiliary lamps relay
41. Rheostat
42. Front cigar lighter illumination
43. Clock illumination
44. Heater illumination
45. Heater illumination
46. Heater illumination
47. Heater illumination
48. LH Horn
49. RH Horn
50. Tachometer
51. Instrument illumination (6 bulbs)
52. Trailer warning light
53. RH indicator warning light
54. LH indicator warning light
55. Rear fog warning light
56. Headlamp warning light
57. Not used
58. Low fuel warning light
59. Multifunction unit in binnacle
60. Fuel indicator gauge
61. Cold start warning light (carburetter versions only)
62. Differential lock warning light
63. Ignition warning light
64. Brake failure warning light
65. Brake pad wear warning light
66. Oil pressure warning light
67. Park brake warning light
68. Park brake warning light (Australia)
69. Water temperature gauge
70. Headlamp washer timer (option)
71. Headlamp wash pump (option)
72. Heated electric mirrors (option)
73. Trailer socket (option)
74. Front screen wash
75. Front wiper delay
76. Wiper motor
77. Steering column switches
78. Differential lock switch
79. Brake failure switch
80. Diode
81. Front brake pad wear
82. Rear brake pad wear
83. Diode
84. Oil pressure switch
85. Park brake switch
86. Pick up point - park brake warning light (Australia)
87. Water temperature transducer
88. Light switch
89. Rear fog lamp switch
90. Main fuse box
91. Heater motor and switch unit
92. Flasher unit
93. Hazard switch
94. Hazard warning lamp
95. Reverse lamp switch
96. Heated rear screen
97. Starter solenoid
98. Alternator
99. Brake failure warning lamp check relay
100. Fuel tank unit
101. Air conditioning (option)
102. Split charge relay (option)
103. Electric windows and central door locking (option)
104. Under bonnet illumination switch
105. Reverse lamps
106. Terminal post
107. Battery
108. LH rear speaker (option)
109. RH rear speaker (option)
110. LH front speaker
111. RH front speaker
112. Radio (option)
113. Radio fuse
114. Radio choke
115. Starter solenoid relayon)
116. Ignition heat start switch
117. Split charge relay (option)
118. Heated rear windows relay
119. Diode
120. Heated rear window switch
121. Voltage switch (option)
122. Heated rear window warning lamp
123. Bonnet lamp
124. Cigar lighter (dash)
125. Cigar lighter (cubby box)
126. Clock
127. Rear screen wash motor
128. Rear wiper delay
129. Rear wash wipe switch
130. Rear wiper relay
131. Rear wiper motor
132. Timer for glow plugs
133. Glow plugs
134. Fuel shut off solenoid

KEY TO CABLE COLOURS

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



RR1166