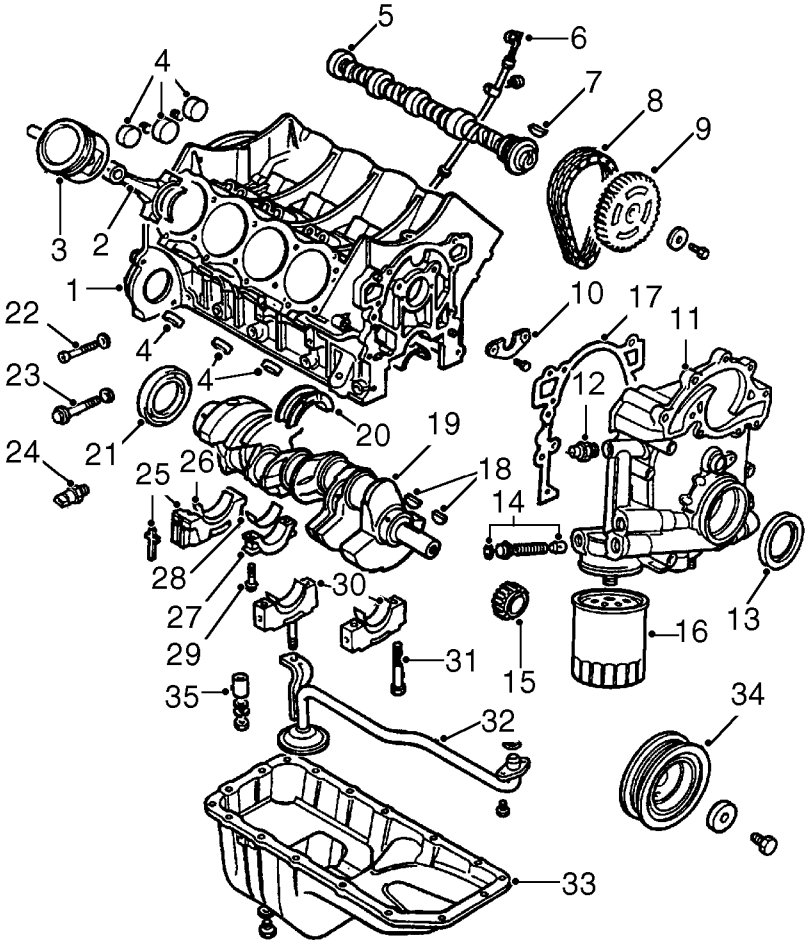
DATA

Firing order	1, 8, 4, 3, 6, 5, 7, 2 Cylinders 1, 3, 5, 7 - LH side of engine Cylinders 2, 4, 6, 8 - RH side of engine	
Cylinder heads		
Maximum warp	0.05 mm	0.002 in
Reface limit	0.50 mm	0.02 in
Valve springs		
Free length	48.30 mm	1.90 in
Fitted length	40.40 mm	1.60 in
Load - valve open	736 ± 10 N	165 ± 2 lbf
Load - valve closed	339 ± 10 N	76 ± 2 lbf
Valves		
Valve stem diameter:		
Inlet	8.664 to 8.679 mm	0.341 to 0.342 in
Exhaust	8.651 to 8.666 mm	0.340 to 0.341 in
Valve head diameter:		
Inlet	39.75 to 40.00 mm	1.5 to 1.6 in
Exhaust	34.226 to 34.480 mm	1.3 to 1.4 in
Valve installed height - maximum	47.63 mm	1.9 in
Valve stem to guide clearance:		
Inlet	0.025 to 0.066 mm	0.001 to 0.002 in
Exhaust	0.038 to 0.078 mm	0.0015 to 0.003 in
Valve guides		
Valve guide installed height	15.0 mm	0.590 in
Inside diameter after reaming	8.7 mm	0.34 in
Valve seats		
Valve seat angle	46° to 46° 25’	
Valve seat width:		
Inlet	36.83 mm	1.45 in
Exhaust	31.50 mm	1.24 in
Valve seating width:		
Inlet	0.89 to 1.4 mm	0.035 to 0.055 in
Exhaust	1.32 to 1.83 mm	0.052 to 0.072 in
Valve seating face angle	45°	
Oil pump		
Inner to outer rotor clearance - maximum	0.25 mm	0.01 in
Rotors to cover plate clearance - maximum	0.1 mm	0.004 in
Drive gear wear step depth - maximum	0.15 mm	0.006 in
Oil pressure relief valve		
Spring free length	60.0 mm	2.4 in
Camshaft		
End-float	0.05 tc	
Maximum run-out	0.05 m	

SERVICE TOOLS

Land Rover Number	Rover Number	Description
LRT-12-013	18G1150	Remover/replacer - gudgeon pin
LRT-12-126/1	-	Adapter - remover/replacer - gudgeon pin
LRT-12-126/2	-	Adapter - remover/replacer - gudgeon pin
LRT-12-126/3	-	Parallel sleeve - gudgeon pin
LRT-12-034	18G1519A	Valve spring compressor
LRT-12-037	RO274401	Drift - remover - valve guide
LRT-12-038	RO600959	Drift - replacer - valve guide
LRT-12-055	-	Distance piece - valve guide
LRT-12-089	-	Replacer - timing cover oil seal
LRT-12-090	-	Retainer - oil pump gears
LRT-12-091	-	Replacer - crankshaft rear oil seal
LRT-12-095	-	Protection sleeve - crankshaft rear oil seal
LRT-12-501	MS76B	Basic handle set - valve seat cutters
LRT-12-503	MS150-8.5	Adjustable valve seat pilot
LRT-12-515	RO605774A	Distance piece - valve guide
LRT-12-517	-	Adjustable valve seat cutter

Service tools must be obtained direct from the manufacturers:
V.L. Churchill,
P.O. Box No 3,
London Road,
Daventry,
Northants, NN11 4NF
England.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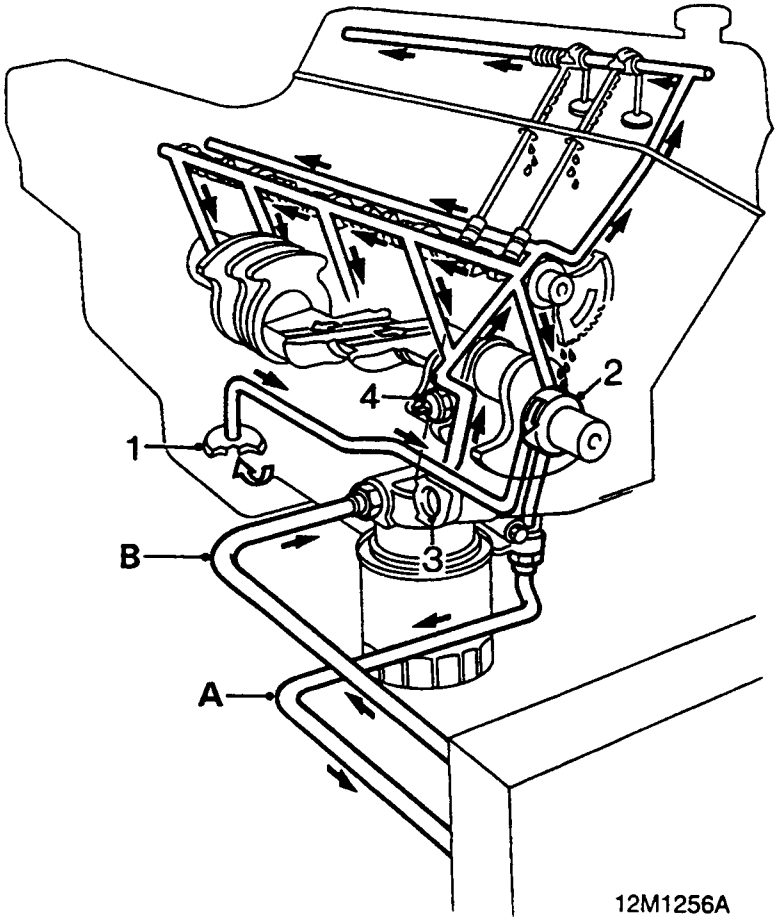
12M1374B



1. Oil strainer
2. Oil pump
3. Pressure relief valve
4. Oil pressure switch
A Oil to cooler
B Oil from cooler

Lubrication

The full flow lubrication system uses a gear type oil pump driven from the crankshaft. The assembly is integral with the timing cover which also carries the full flow oil filter, oil pressure switch and pressure relief valve.

Oil is drawn from the pressed steel sump through a strainer and into the oil pump, excess pressure being relieved by the pressure relief valve. The oil pressure warning light switch is screwed into the timing cover and registers the oil pressure in the main oil gallery on the outflow side of the filter.

Pressurised oil passes through an oil cooler mounted in front of the radiator to the full flow oil filter. The oil then passes through internal drillings to the crankshaft where it is directed to each main bearing and to the big end bearings via numbers 1, 3 and 5 main bearings.

An internal drilling in the cylinder block directs oil to

5. Clean gasket surface in rocker cover.

NOTE: Gaskets fitted to early engines were manufactured from cork whilst those fitted to later engines are manufactured from rubber. The later type gaskets should be fitted as replacements to all engines. Cork gaskets were retained by an adhesive whereas rubber gaskets do not need an adhesive. If cork gaskets were originally fitted, remove all traces of adhesive using Bostik Cleaner 6001 or equivalent.

6. Fit new gasket, dry to rocker cover.
7. Fit rocker cover to cylinder head, fit bolts and tighten in diagonal sequence to:
   Stage 1 - 4 Nm (3 lbf.ft)
   Stage 2 - 8 Nm (6 lbf.ft)
   Stage 3 - Re-torque to 8 Nm (6 lbf.ft)

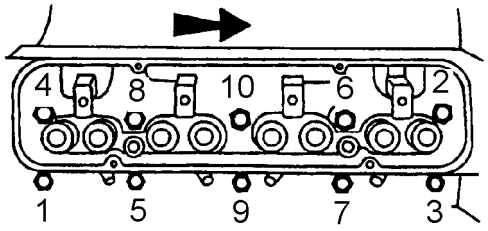
CAUTION: The 2 short bolts must be fitted on side of cover nearest centre of engine.

8. *LH rocker shaft only:* Align dipstick tube to rocker cover, fit and tighten screw.

CYLINDER HEAD

Cylinder head - remove

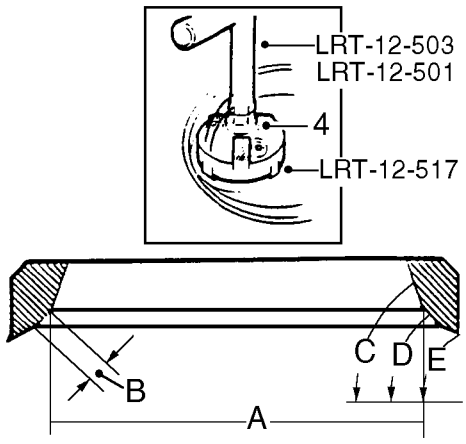
1. Remove rocker shaft assembly.
2. Mark heads LH and RH for reassembly.



12M1249A

NOTE: RH cylinder head illustrated.

3. Using sequence shown, remove and discard 10 bolts securing cylinder head to cylinder block.
4. Release cylinder head from 2 dowels and remove cylinder head.
5. Remove and discard cylinder head gasket.
6. Repeat above procedures for remaining cylinder head.



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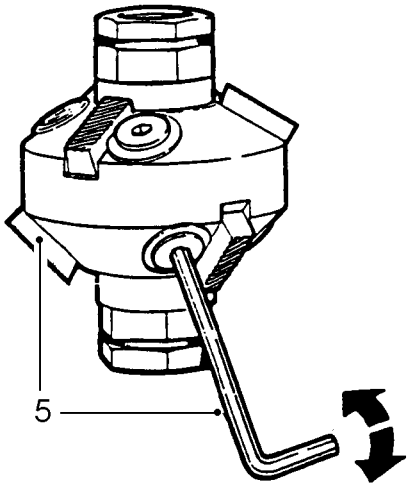


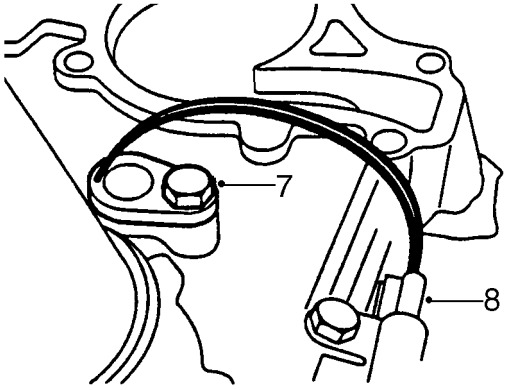
12M0902

4. Cut valve seats using **LRT-12-501** with **LRT-12-503** and **LRT-12-517.**
Valve seat:
Width **A:**
Inlet = 36.83 mm (1.45 in)
Exhaust = 31.50 mm (1.24 in)

Seating width **B:**
Inlet = 0.89 to 1.4 mm (0.035 to 0.055 in)
Exhaust = 1.32 to 1.83 mm (0.052 to 0.072 in)

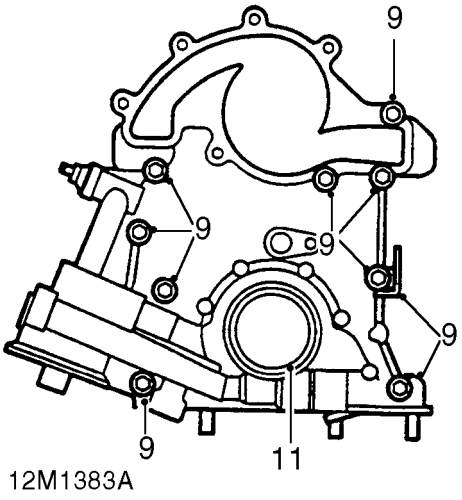
Angle **C**= 56° to 70°
Angle **D**= 46° to 46° 25'
Angle **E**= 20°

5. Ensure cutter blades are correctly fitted to cutter head with angled end of blade downwards, facing work, as illustrated. Check that cutter blades are adjusted so that middle of blade contacts area of material to be cut. Use light pressure and remove only minimum of material necessary.
6. Remove all traces of swarf on completion.



12M1380A

7. Remove bolt securing camshaft sensor to timing cover, withdraw sensor; remove and discard 'O' ring.
8. Release harness connector from mounting bracket.



12M1383A

NOTE: New Range Rover timing cover illustrated.

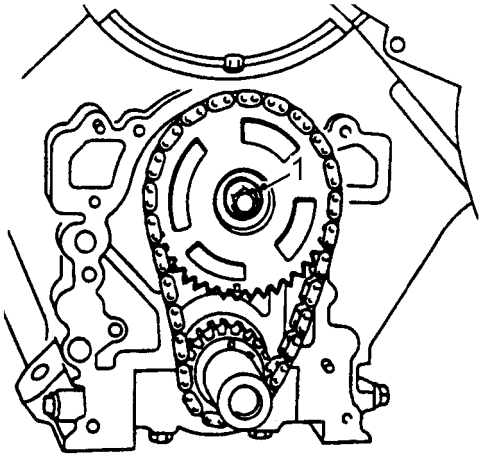
9. Noting their fitted position, remove 9 bolts securing timing cover to cylinder block; remove cover; collect camshaft sensor harness mounting bracket.

NOTE: Timing cover is dowel located.

CAUTION: Do not attempt to remove oil pump drive gear at this stage.

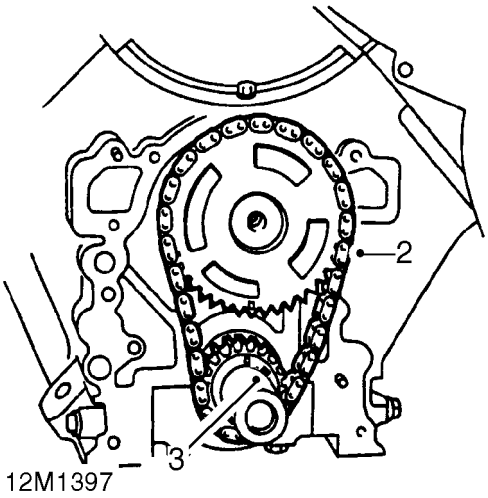
10. Remove and discard gasket.
11. Remove and discard oil seal from timing cover.

Timing gears - remove



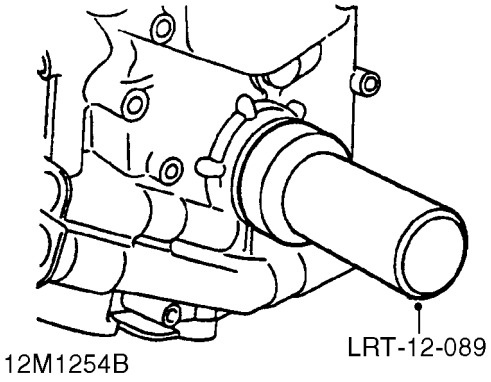
12M1396A

1. Restrain camshaft gear and remove bolt securing gear.



12M1397

2. Remove timing chain and gears as an assembly.
3. Collect Woodruff key from crankshaft.

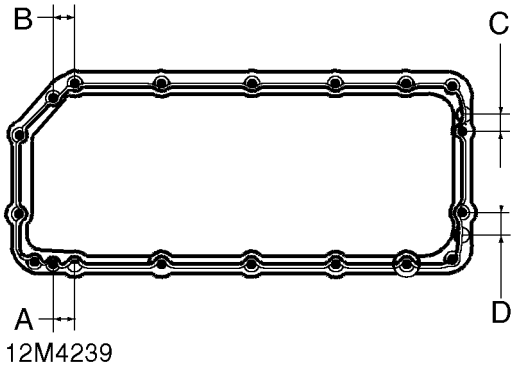


12. Fit timing cover oil seal using tool **LRT-12-089.**
13. Smear a new 'O' ring with engine oil and fit to oil pick-up pipe.
14. Position oil pick-up pipe spacer on number 4 main bearing cap stud.
15. Fit oil pick-up pipe ensuring that end of pipe is correctly inserted in oil pump body.
16. Fit oil pick-up pipe to oil pump body bolts and tighten to 8 Nm (6 lbf.ft).
17. Fit washers and nut securing oil pick-up pipe to stud, tighten nut to 24 Nm (18 lbf.ft).
18. Smear a new 'O' ring with engine oil and fit to camshaft sensor.
19. Insert camshaft sensor into timing cover, fit bolt and tighten to 8 Nm (6 lbf.ft).
20. Position camshaft sensor harness connector on mounting bracket.
21. Fit sump.
22. Fit crankshaft pulley, fit bolt and spacer washer - if fitted; tighten bolt to 270 Nm (200 lbf.ft).

NOTE: Crankshaft pulleys which incorporate a mud flinger can be fitted to all engines.

Sump - refit

1. Remove all traces of old sealant from mating faces of cylinder block and sump.



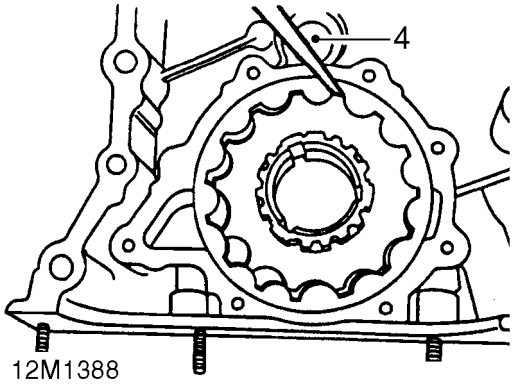
2. Clean mating faces with suitable solvent and apply a bead of Hylosil Type 101 or 106 sealant to sump joint face as shown:
   Bead width - areas A, B, C and D = 12 mm (0.5 in)
   Bead width - remaining areas = 5 mm (0.20 in)
   Bead length - areas A and B = 32 mm (1.23 in)
   Bead length - areas C and D = 19 mm (0.75 in)

CAUTION: Do not spread sealant bead. Sump must be fitted immediately after applying sealant.

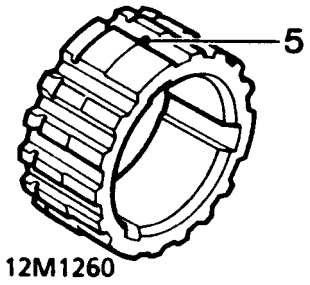
3. Fit sump, taking care not to damage sealant bead.

Oil pump - inspection

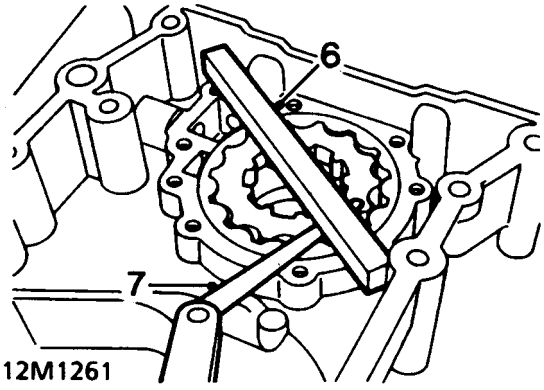
1. Thoroughly clean oil pump drive gear, cover plate, rotors and housing. Remove all traces of Loctite from cover plate securing screws; ensure tapped holes in timing cover are clean and free from oil.
2. Check mating surfaces of cover plate, rotors and housing for scoring.
3. Assemble rotors and oil pump drive gear in housing ensuring that reference marks are aligned.



4. Using feeler gauges, check clearance between teeth of inner and outer rotors:
   Maximum clearance = 0.25 mm (0.01 in)

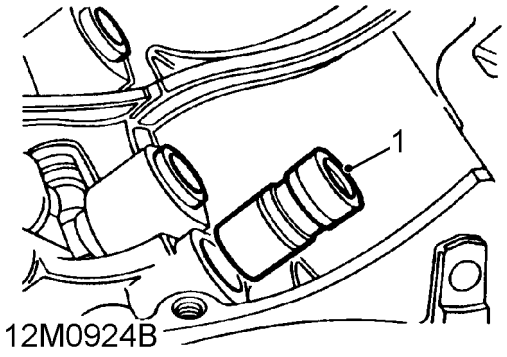


5. Remove oil pump drive gear, check depth of any wear steps on gear teeth:
   Wear step maximum depth = 0.15 in (0.006 in)

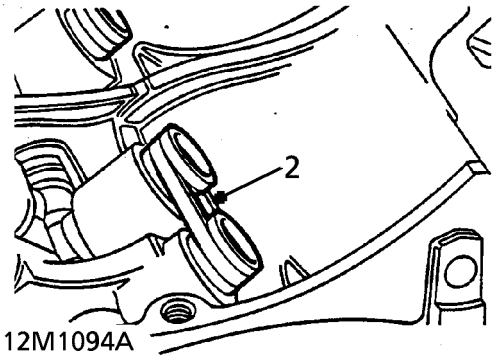


6. Place a straight edge across housing.
7. Using feeler gauges, check clearance between straight edge and rotors:
   Maximum clearance = 0.1 mm (0.004 in).

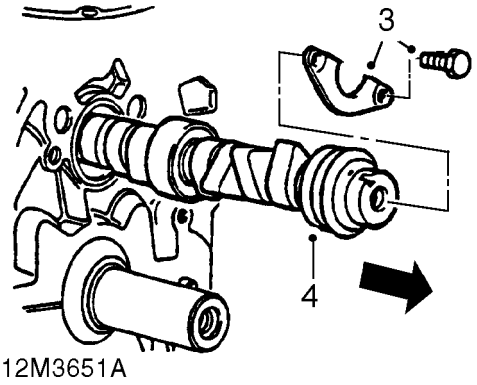
Camshaft and tappets - remove



1. Remove tappets and retain with their respective pushrods.



2. When tappets prove difficult to remove due to damaged camshaft contact area, proceed as follows. Lift tappets in pairs to the point where damaged face is about to enter tappet bore and fit rubber bands to retain tappets. Repeat until all tappets are retained clear of camshaft lobes. The tappets can then be withdrawn out the bottom of their bores when the sump and camshaft are removed.



3. Remove 2 bolts securing camshaft thrust plate to cylinder block, remove plate.
4. Withdraw camshaft, taking care not to damage bearings in cylinder block.

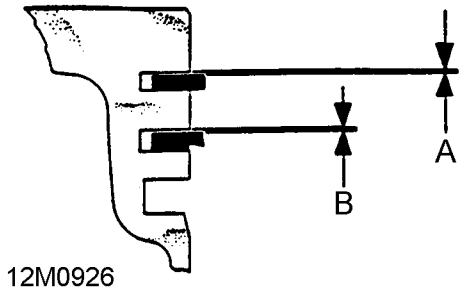
NOTE: Camshafts fitted to 4.0 litre engines are colour coded ORANGE whilst those fitted to 4.6 litre engines are colour coded RED.

Piston rings - inspection

1. Temporarily fit new compression rings to piston.

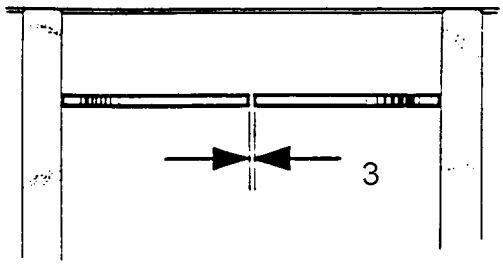
NOTE: If replacement pistons are to be fitted, ensure rings are correct for piston.

The 2nd compression ring marked 'TOP' must be fitted, with marking uppermost, into second groove. The 1st compression ring fits into top groove and can be fitted either way round.



12M0926

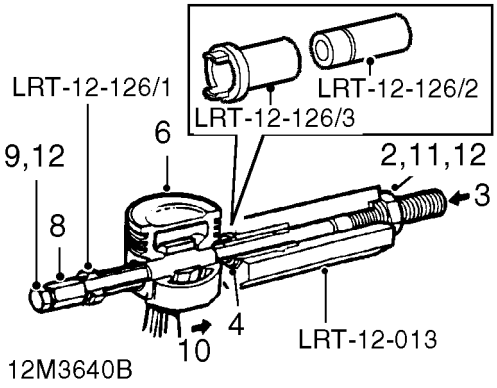
2. Check compression ring to groove clearance:
   1st compression ring **A** = 0.05 to 0.10 mm (0.002 to 0.004 in).
   2nd compression ring **B** = 0.05 to 0.10 mm (0.002 to 0.004 in).



12M0927

3. Insert piston ring into its relevant cylinder bore, held square to bore with piston and check ring gaps.
   1st compression ring = 0.3 to 0.5 mm (0.01 to 0.02 in)
   2nd compression ring = 0.40 to 0.65 mm (0.016 to 0.03 in)
   Oil control ring rails = 0.38 to 1.40 mm (0.014 to 0.05 in)
4. Retain rings with their respective pistons.

Pistons- remove



12M3640B

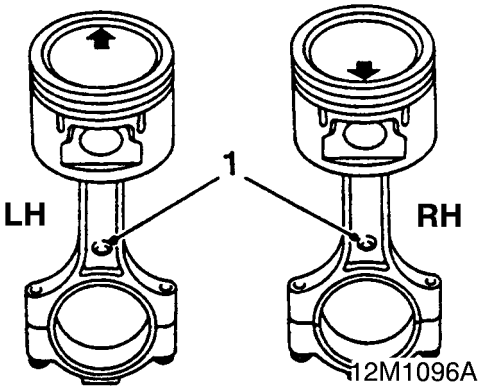
1. Clamp hexagon body of **LRT-12-013** in vice.
2. Screw large nut back until flush with end of centre screw.
3. Push centre screw forward until nut contacts thrust race.
4. Locate remover/replacer adapter **LRT-12-126/2** with its long spigot inside bore of hexagon body.
5. Position remover/replacer adapter **LRT-12-126/3** on **LRT-12-126/2** with cut-out facing away from body of **LRT-12-013** .
6. Locate piston and connecting rod assembly on centre screw and up to adapter **LRT-12-126/2.**
7. Position cut-out of adapter **LRT-12-126/3** to piston.

CAUTION: Ensure cut-out does not contact gudgeon pin.

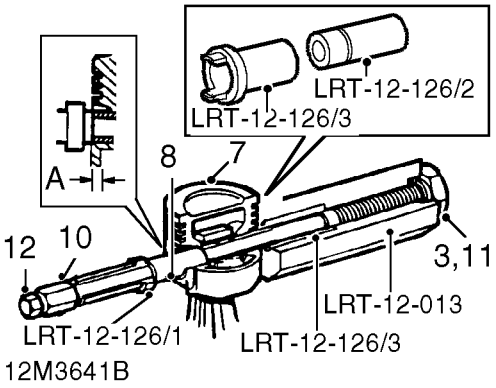
8. Fit remover/replacer bush **LRT-12-126/1** on centre screw with flanged end away from gudgeon pin. Screw stop nut on to centre screw.
9. Lock the stop nut securely with lockscrew.
10. Push connecting rod to right to locate end of gudgeon pin in adapter **LRT-12-126/2.**
11. Screw large nut up to **LRT-12-013** .
12. Hold lockscrew and turn large nut until gudgeon pin is withdrawn from piston.
13. Dismantle tool and remove piston, connecting

Pistons - refit

CAUTION: Pistons have a 0.5 mm (0.02 in) offset gudgeon pin which can be identified by an arrow mark on the piston crown. This arrow MUST always point to the front of the engine.



1. Assemble pistons to connecting rods with arrow on piston pointing towards domed shaped boss on connecting rod for RH bank of cylinders, and arrow pointing away from dome shaped boss for LH bank of cylinders.

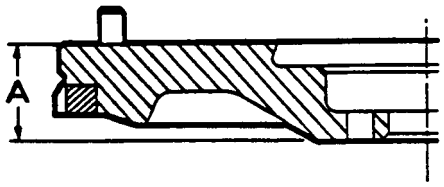


2. Clamp hexagon body of **LRT-12-013** in vice.
3. Slacken large nut and pull the centre screw 50.8 mm (2.0 in) out of hexagon body.
4. Locate remover/replacer adapter **LRT-12-126/2** with its long spigot inside bore of hexagon body.
5. Fit remover/replacer adapter **LRT-12-126/3** with cut-out towards piston, up to shoulder on centre screw.
6. Lubricate gudgeon pin and bores of connecting rod and piston with graphited oil.
7. Locate connecting rod and piston to centre screw with connecting rod entered on sleeve up to groove.
8. Fit gudgeon pin on to centre screw and into piston bore up to connecting rod.
9. Fit remover/replacer bush **LRT-12-126/1** with flanged end towards gudgeon pin.
10. Screw the stop nut onto centre screw and position piston against cut-out of adapter **LRT-12-126/3.**
11. Lubricate centre screw threads and thrust race with graphited oil, screw large nut up to **LRT-12-013.**
12. Lock the stop nut securely with lockscrew.
13. Set torque wrench to 16 Nm (12 lbf.ft), and using socket on large nut, pull gudgeon pin in until flange of **LRT-12-126/1** is distance **A** from face of piston.
    Distance **A** = 0.4 mm (0.016 in).

CAUTION: If torque wrench 'breaks' during above operation, fit of gudgeon pin to connecting rod is not acceptable and components must be replaced. The centre screw and thrust race must be kept well lubricated throughout operation.

14. Dismantle tool, remove piston, check no damage has occurred during pressing and piston moves freely on gudgeon pin.
15. Repeat above operations for remaining pistons.

Flywheel and starter ring gear - inspection



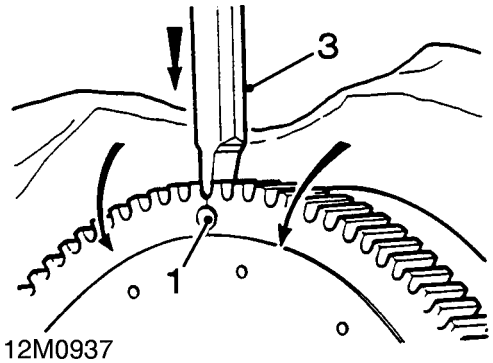
12M0936

1. Inspect flywheel face for cracks, scores and overheating. The flywheel can be refaced on the clutch face providing thickness does not go below minimum.
   Flywheel minimum thickness **A** = 40.45 mm (1.6 in)
2. Inspect starter ring gear for worn, chipped and broken teeth.

CAUTION: Do not attempt to remove reluctor ring.

3. Renew starter ring gear if necessary.

Starter ring gear - renew



12M0937

1. Drill a 6 mm (0.250 in) diameter hole at root of 2 teeth.

CAUTION: Do not allow drill to enter flywheel.

2. Secure flywheel in soft jawed vice.
3. Split ring gear using a cold chisel.

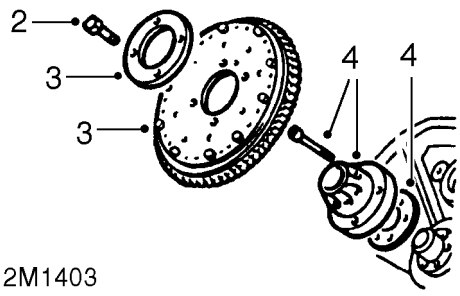
WARNING: Wear safety goggles and take precautions against flying fragments when splitting ring gear.

4. Remove flywheel from vice, remove old ring gear, and place flywheel, clutch side down, on a flat surface.

DRIVE PLATE AND RING GEAR ASSEMBLY

Drive plate and ring gear assembly - remove - Up to engine nos. 42D00593A and 46D00450A

1. Suitably identify each component to its fitted position.



12M1403

NOTE: 4.0 litre drive plate illustrated.

2. Remove 4 bolts securing drive plate assembly.
3. Remove buttress ring and drive plate assembly.

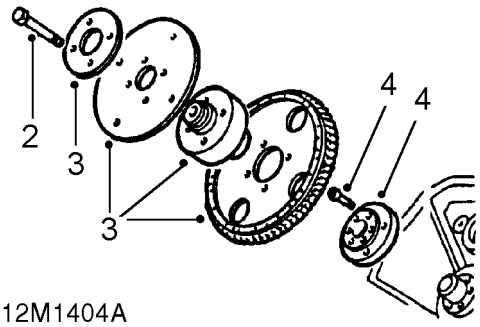
NOTE: Drive plate assembly is dowel located.

4. Remove 6 socket head cap screws securing hub aligner to crankshaft, remove hub aligner and selective shim; retain shim.

NOTE: Dowel located.

Drive plate and ring gear assembly - remove - From engine nos. 42D00594A, 46D00451A and all engines having serial no. prefixes 47D to 51D

1. Suitably identify each component to its fitted position.



12M1404A

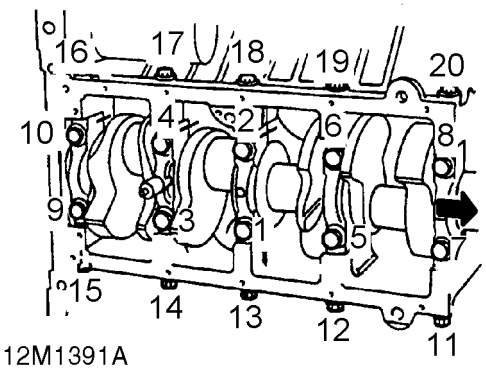
NOTE: 4.0 litre drive plate illustrated.

2. Remove 4 bolts securing buttress ring, drive plate, spacer and ring gear assembly to hub aligner.
3. Remove buttress ring, drive plate, spacer and ring gear assembly.

NOTE: Ring gear assembly is dowel located.

4. Remove 6 socket head cap screws securing hub aligner to crankshaft, remove hub aligner.

NOTE: Dowel located.



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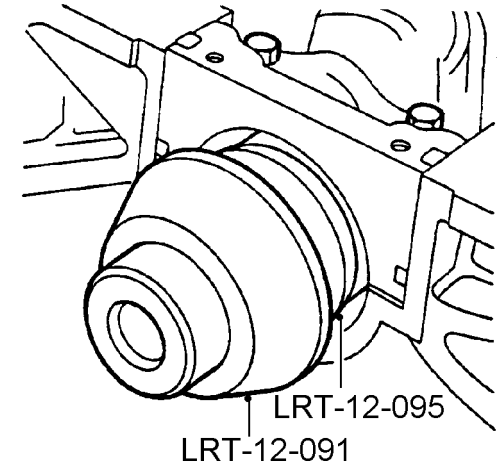

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12. Using sequence shown, tighten bolts to:
Stage 1 - Initial torque
Main bearing cap bolts - 13.5 Nm (10 lbf.ft)
Main bearing cap side bolts - 13.5 Nm (10 lbf.ft)
Stage 2 - Final torque
Main bearing cap bolts numbers 1 to 8 - 72 Nm (53 lbf.ft)
Main bearing cap bolts numbers 9 and 10 - 92 Nm (68 lbf.ft)
Main bearing cap side bolts 11 to 20 - 45 Nm (33 lbf.ft)
13. Trim off excess material from rear main bearing cap side seals.
14. Clean seal location and running surface on crankshaft.
15. Clean seal protector **LRT-12-095** and lubricate with engine oil.
16. Lubricate oil seal lip with engine oil.
17. Position seal protector **LRT-12-095** to crankshaft.
18. Fit seal using tool **LRT-12-091.**
19. Fit Woodruff key to crankshaft.
20. Check crankshaft end-float.

NOTE: If 0.508 mm (0.02 in) oversize main bearings have been fitted, it may be necessary to machine thrust faces of crankshaft centre main bearing location to achieve correct end-float. Ensure an equal amount of material is removed from each thrust face.

21. Fit big-end bearings.
22. Fit timing cover and gears.
23. Fit flywheel or drive plate and ring gear assembly.
24. Fit sump.