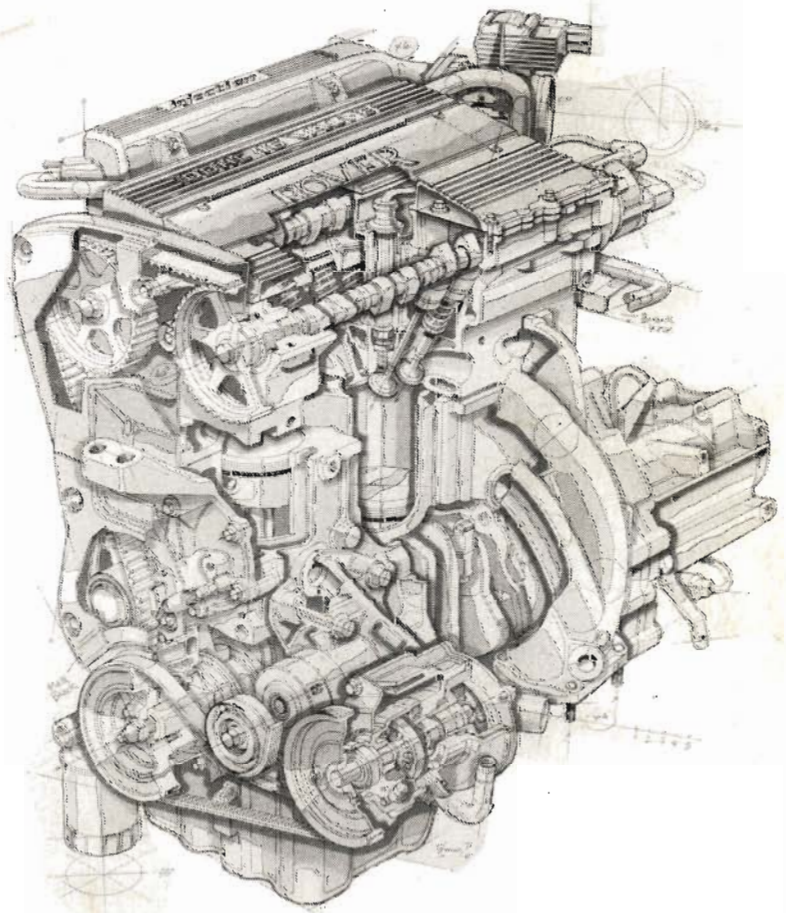




ROVER

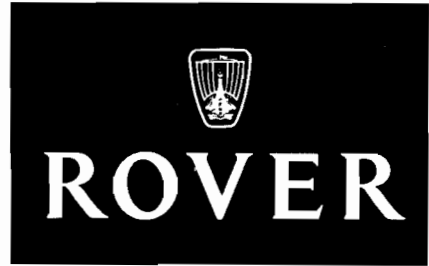
SERVICE



T SERIES ENGINE

OVERHAUL MANUAL

AKM 6766 2nd edition



S E R V I C E

'T' SERIES

ENGINE

OVERHAUL

MANUAL

INTRODUCTION

INTRODUCTION

How to use this manual

To assist in the use of this manual the section title is given at the top and the relevant sub – section is given at the bottom of each page.

This manual contains procedures for overhaul of the 'T' Series engine on the bench with the gearbox, clutch and coolant pump housing removed. For all other information regarding General Information, Adjustments, Removal of oil seals, engine units and ancillary equipment, consult the Repair Manual for the model concerned.

This manual is divided into 3 sections, Description and Operation, Overhaul and Data, Torque & Tools. To assist filing of revised information each sub – section is numbered from page 1.

The individual overhaul items are to be followed in the sequence in which they appear. Items numbered in the illustrations are referred to in the text.

Overhaul operations include reference to Service Tool numbers and the associated illustration depicts the tool. Where usage is not obvious the tool is shown in use. Operations also include reference to wear limits, relevant data, torque figures, and specialist information and useful assembly details.

WARNINGS, CAUTIONS and Notes have the following meanings:

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

CAUTION: *Calls attention to procedures which must be followed to avoid damage to components.*

Note: *Gives helpful information.*

References

With the engine and gearbox assembly removed, the crankshaft pulley end of the engine is referred to as the front.

Operations covered in this manual do not include reference to testing the vehicle after repair. It is essential that work is inspected and tested after completion and if necessary a road test of the vehicle is carried out particularly where safety related items are concerned.

Dimensions

The dimensions quoted are to design engineering specification with Service limits where applicable.

REPAIRS AND REPLACEMENTS

When replacement parts are required it is essential that only Rover recommended parts are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories.

Safety features and corrosion prevention treatments embodied in the car may be impaired if other than Rover recommended parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the manufacturer's specification.

Torque wrench setting figures given in this Manual must be used. Locking devices, where specified, must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

The Terms of the vehicle Warranty may be invalidated by the fitting of other than Rover recommended parts. All Rover recommended parts have the full backing of the vehicle Warranty.

Rover Dealers are obliged to supply only Rover recommended parts.

SPECIFICATION

Rover are constantly seeking to improve the specification, design and production of their vehicles and alterations take place accordingly. While every effort has been made to ensure the accuracy of this Manual, it should not be regarded as an infallible guide to current specifications of any particular component or vehicle.

This Manual does not constitute an offer for sale of any particular component or vehicle. Rover Dealers are not agents of Rover and have no authority to bind the manufacturer by any expressed or implied undertaking or representation.

ENGINE

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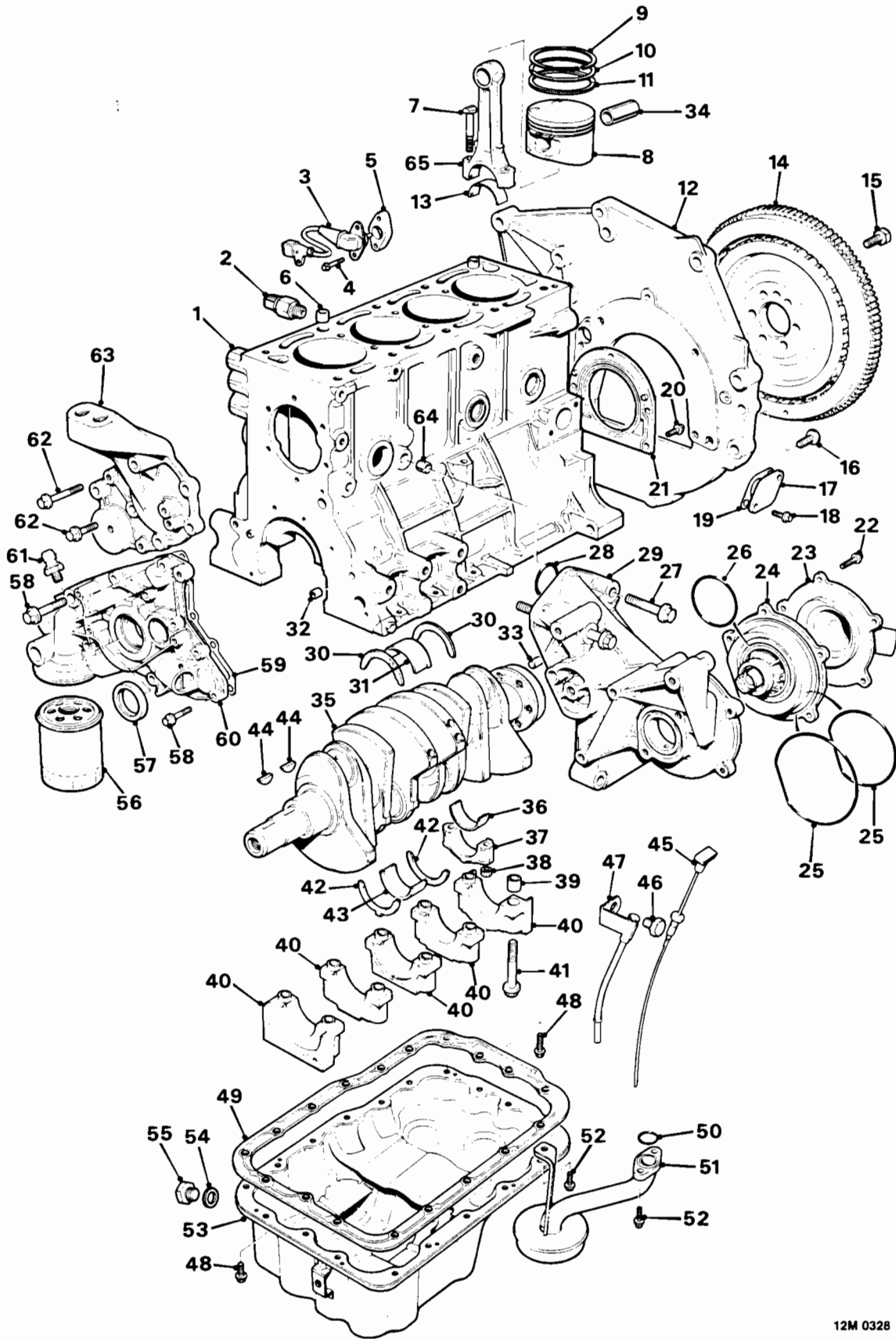
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ENGINE



12M 0328

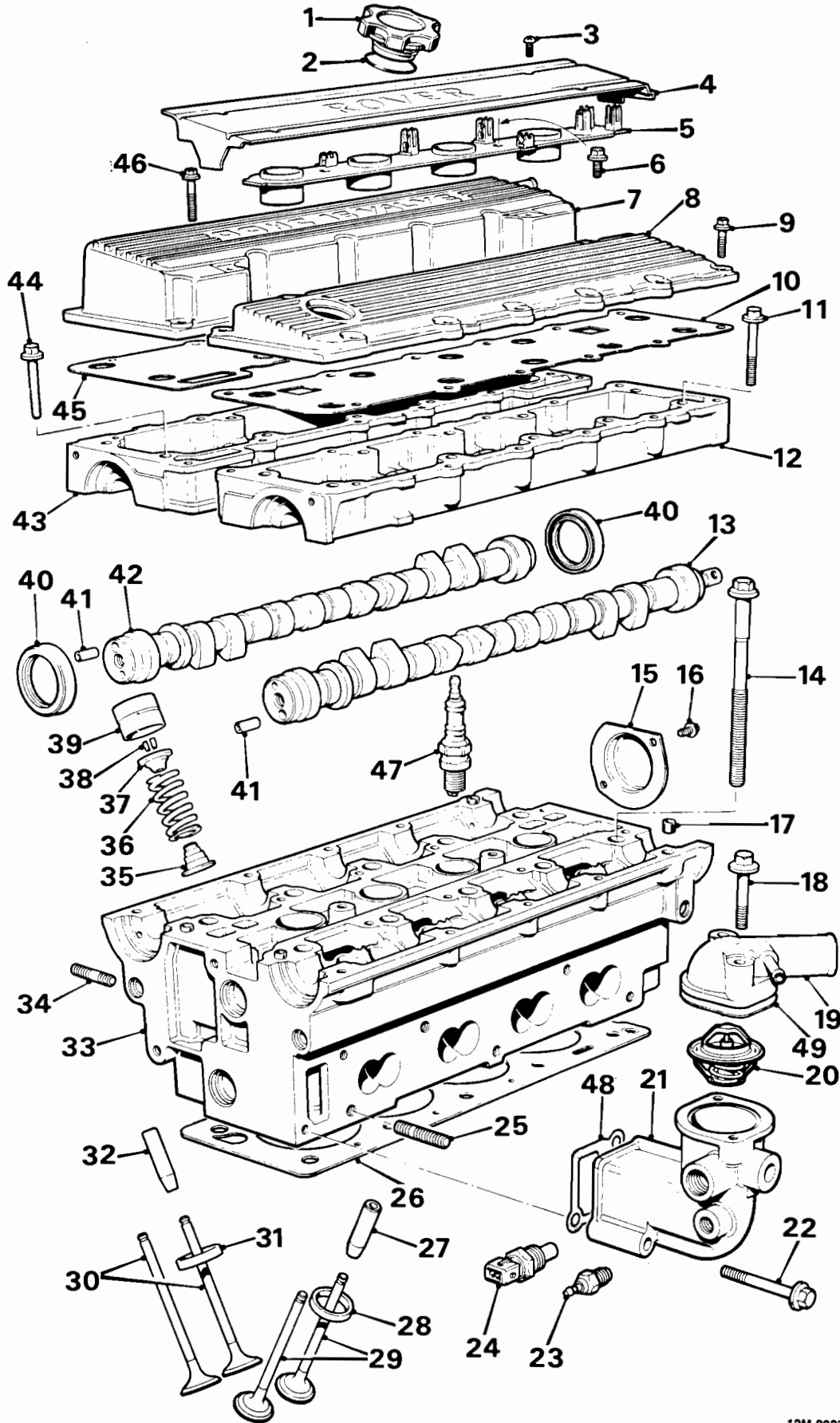


CYLINDER BLOCK COMPONENTS

Manual transmission, naturally aspirated model illustrated

1. Cylinder block
2. Knock sensor
3. Crankshaft sensor
4. Bolt - crankshaft sensor
5. Spacer - crankshaft sensor
6. Locating dowel - cylinder head
7. Bolt - connecting rod
8. Piston
9. Piston ring - top compression
10. Piston ring - 2nd compression
11. Piston ring - oil control
12. Gearbox adapter plate
13. Bearing shell - big end - upper
14. Flywheel
15. Bolt - flywheel
16. Torx screw - gearbox adapter plate
17. Blanking plate
18. Bolt - blanking plate
19. Gasket
20. Bolt - crankshaft rear oil seal housing
21. Crankshaft rear oil seal and housing
22. Bolt - coolant pump cover
23. Coolant pump cover
24. Impeller
25. Sealing rings
26. 'O' ring
27. Bolts - coolant pump
28. 'O' ring
29. Coolant pump body
30. Thrust washer halves - upper
31. Bearing shell - main bearing - upper
32. Locating dowel - oil pump
33. Locating dowel - flywheel
34. Gudgeon pin
35. Crankshaft
36. Bearing shell - big end - lower
37. Bearing cap - big end
38. Nut - big end bearing cap
39. Locating dowel - main bearing cap
40. Bearing caps - main bearings
41. Bolt - main bearing cap
42. Thrust washer halves - lower
43. Bearing shell - main bearing - lower
44. Woodruff keys
45. Dipstick
46. Bolt - dipstick tube
47. Dipstick tube
48. Bolts - sump
49. Gasket - sump
50. 'O' ring
51. Oil strainer
52. Bolts - oil strainer
53. Sump
54. Washer - drain plug
55. Drain plug
56. Oil filter element
57. Crankshaft front oil seal
58. Bolts - oil pump
59. Gasket - oil pump
60. Oil pump
61. Oil pressure switch
62. Bolts - engine R.H. mounting
63. Engine R.H. mounting
64. Locating dowel - coolant pump
65. Connecting rod

ENGINE

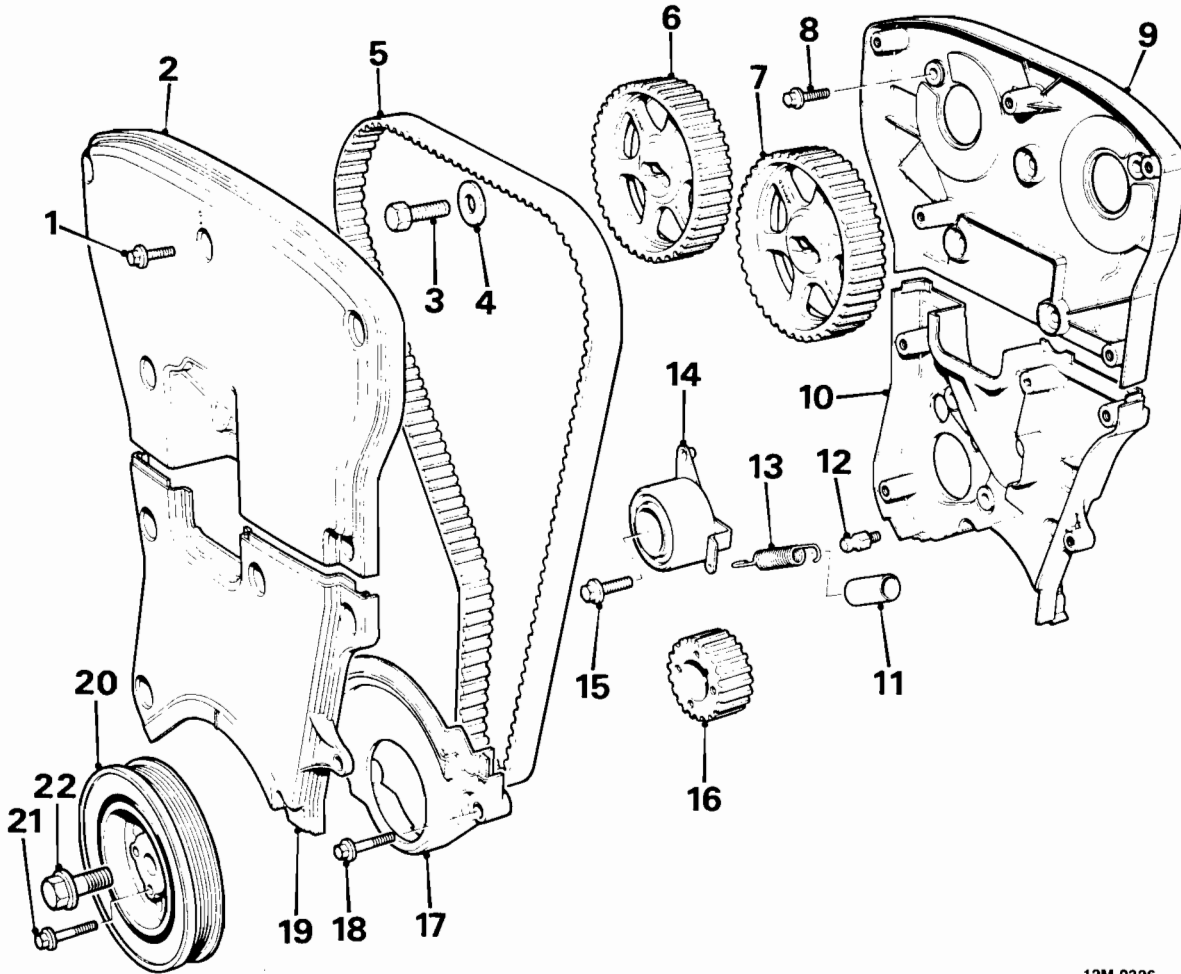


12M 0327



CYLINDER HEAD COMPONENTS

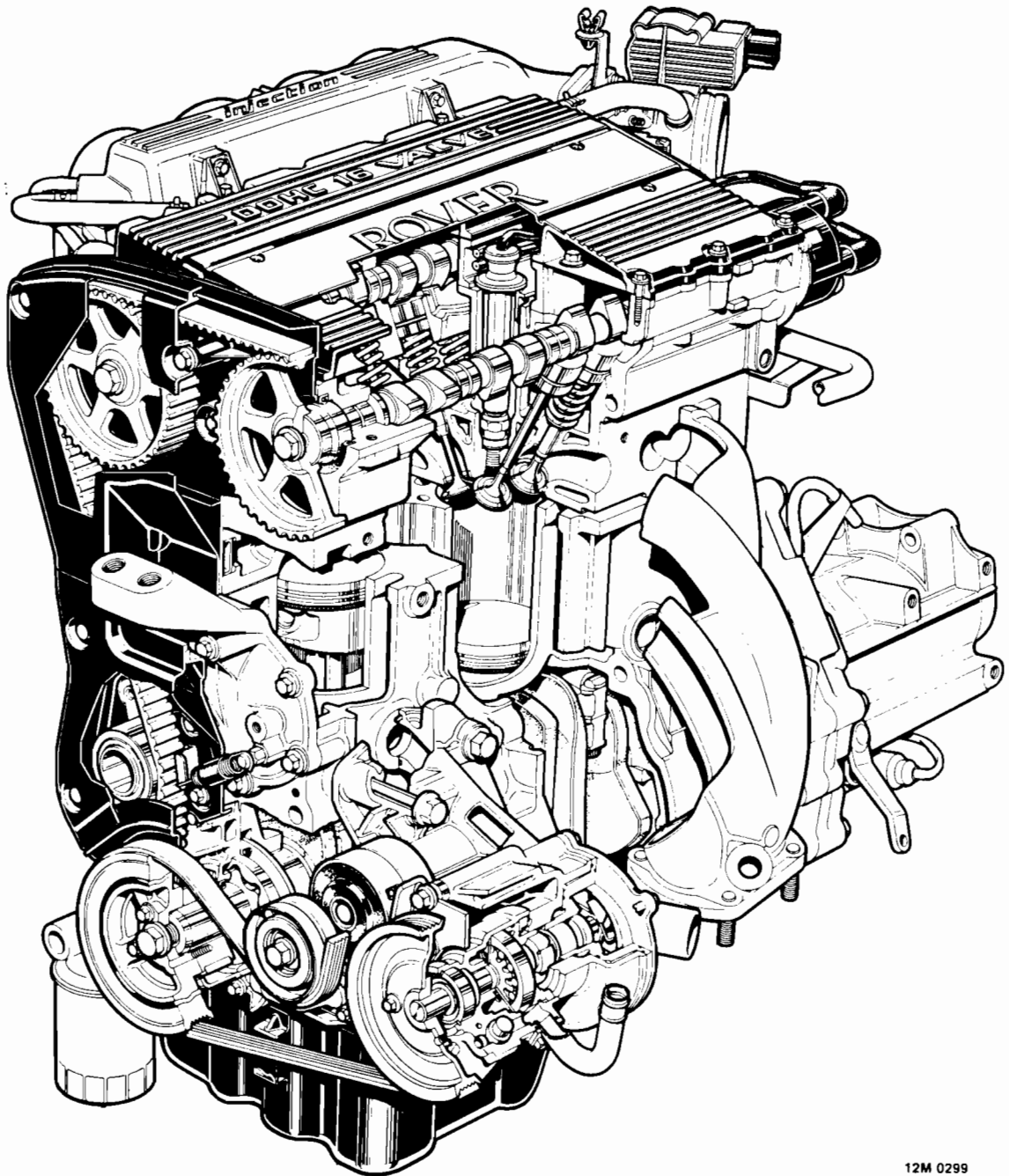
1. Engine oil filler cap
2. Filler cap seal
3. Screw - spark plug cover
4. Spark plug cover
5. h.t. lead plate
6. Screw - h.t. lead plate
7. Inlet camshaft cover
8. Exhaust camshaft cover
9. Bolt - exhaust camshaft cover
10. Exhaust camshaft cover gasket/baffle plate
11. Bolt - exhaust camshaft carrier
12. Exhaust camshaft carrier
13. Exhaust camshaft
14. Cylinder head bolt
15. Blanking plate (naturally aspirated models)
Camshaft sensor housing (turbo models)
16. Bolt - blanking plate
17. Locating dowel - camshaft carrier
18. Bolt - thermostat housing cover
19. Thermostat housing cover
20. Thermostat
21. Thermostat housing
22. Bolt - thermostat housing
23. Coolant temperature transmitter -
instruments
24. Coolant temperature sensor - engine
management
25. Stud - exhaust manifold
26. Cylinder head gasket
27. Guide - exhaust valve
28. Insert - exhaust valve seat
29. Exhaust valves
30. Inlet valves
31. Insert - inlet valve seat
32. Guide - inlet valve
33. Cylinder head
34. Stud - inlet manifold
35. Valve stem oil seal
36. Valve spring
37. Valve spring cap
38. Collets
39. Tappet
40. Camshaft oil seals
41. Drive pins - camshaft timing gears
42. Inlet camshaft
43. Inlet camshaft carrier
44. Bolt - inlet camshaft carrier
45. Inlet camshaft cover gasket/baffle plate
46. Bolt - inlet camshaft cover
47. Spark plug
48. Thermostat housing gasket
49. Thermostat housing cover gasket



12M 0326

TIMING BELT COMPONENTS

- | | |
|--|--|
| 1. Bolt – timing belt upper cover | 13. Tensioner spring |
| 2. Timing belt upper cover | 14. Tensioner pulley |
| 3. Bolt – camshaft timing gear | 15. Tensioner clamp bolt |
| 4. Plain washer | 16. Crankshaft timing gear |
| 5. Timing belt | 17. Timing belt lower cover |
| 6. Inlet camshaft timing gear | 18. Bolt – timing belt lower cover |
| 7. Exhaust camshaft timing gear | 19. Timing belt centre cover |
| 8. Bolt – upper timing cover backplate | 20. Crankshaft pulley |
| 9. Upper timing cover backplate | 21. Crankshaft pulley/timing gear bolt |
| 10. Lower timing cover backplate | 22. Crankshaft pulley bolt |
| 11. Tensioner spring sleeve | |
| 12. Anchorage bolt | |



12M 0299

OPERATION

The 'T' Series engine is a four cylinder, water cooled unit comprising a cast iron cylinder block, aluminium alloy cylinder head and twin aluminium alloy camshaft carriers.

The cylinder block incorporates direct bored, siamesed cylinder bores which provide good structural rigidity. The crankshaft is carried in five main bearings, end - float being controlled by thrust washers positioned each side of the centre

main bearing. The main bearing caps are located to the cylinder block by dowels; the bearings shells fitted to Nos. 1, 3 and 5 bearings are fully grooved whilst those fitted to Nos. 2 and 4 bearings are plain.

The cylinder head carries twin camshafts operating four valves per cylinder via hydraulic tappets. Both camshafts are driven by the timing belt and run directly in journals line bored in the cylinder head and camshaft carriers. The plastic camshaft covers are bolted to the camshaft carriers.

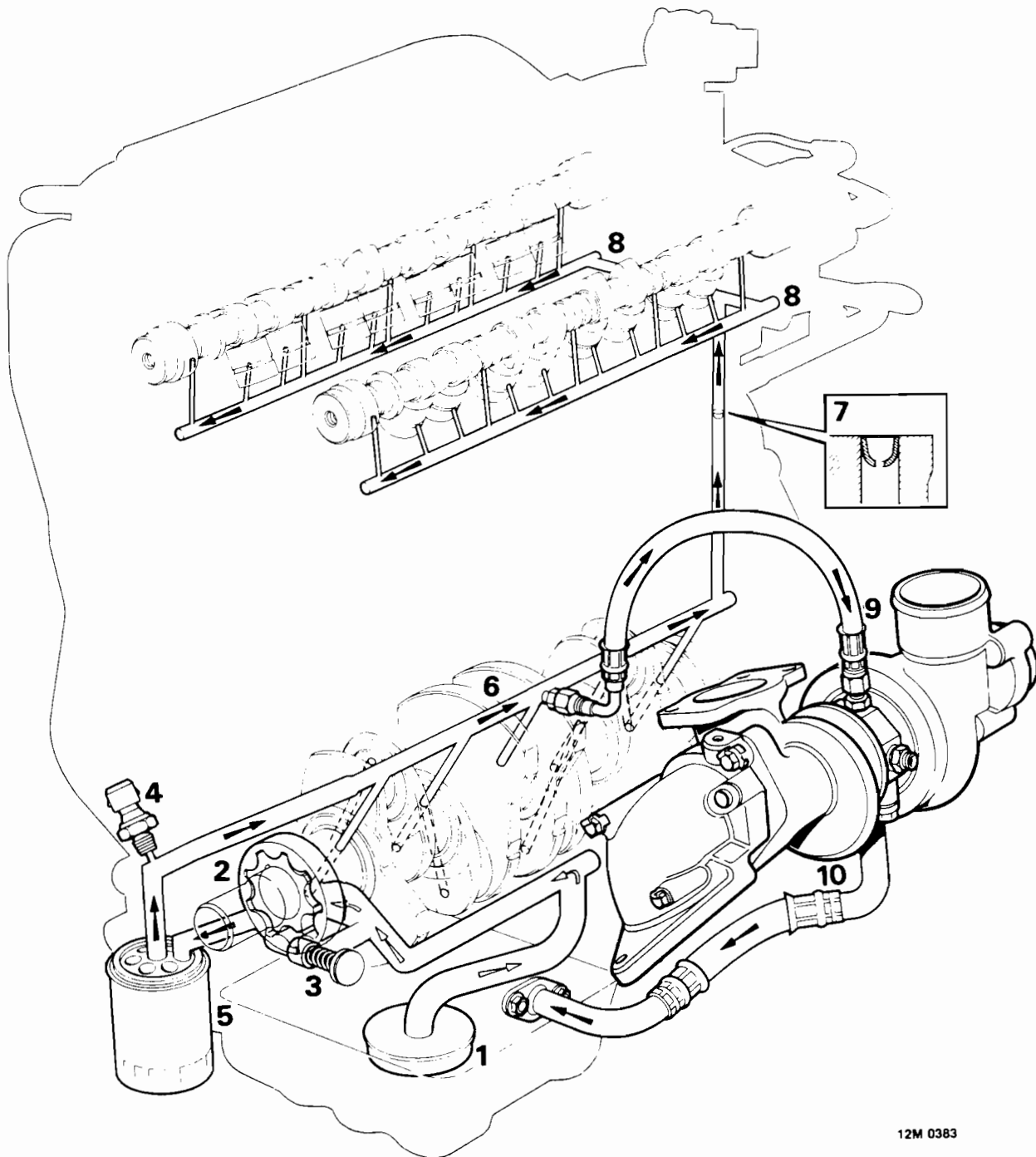
ENGINE

The aluminium alloy, tin coated pistons have two compression and an oil control ring and are secured to the connecting rods by semi-floating gudgeon pins which are an interference fit in the small-end bush. Gudgeon pins are offset towards the thrust side of the pistons to reduce frictional drag. Pistons fitted to turbo engines have a bowl in the piston crown to reduce the compression ratio.

Plain, big-end bearing shells having a drilling for lubrication purposes are fitted to each connecting rod.

The internally toothed timing belt is driven from a gear which is keyed to the crankshaft, belt tension being controlled by a semi-automatic tensioner.

The trochoidal type oil pump is mounted on the front of the engine and carries the crankshaft front oil seal. Drive to the pump is via a Woodruff key inserted in the crankshaft.



12M 0383

**Lubrication**

Oil is drawn from the pressed steel sump through a strainer (1) and into the oil pump (2); excess pressure being relieved by a pressure relief valve (3) integral with the pump. The low oil pressure sensor (4) is screwed into the adapter and registers the oil pressure in the main oil gallery on the outflow side of the filter. Pressurised oil passes through the full flow oil filter (5) to internal drillings in the crankshaft where it is directed to each main bearing and to the big end bearings via Nos. 1, 3 and 5 main bearings (6). An internal drilling in the cylinder block directs oil, via a restrictor (7) to the cylinder head where it passes through further internal drillings to the hydraulic tappets and camshaft journals (8). Gudgeon pin and small – end bush lubrication is via oil holes in the big – end bearing and an internal drilling in the crankshaft.

Turbo models

A take off (9) from the main gallery is directed to the turbocharger shaft bearings and then passes through the return pipe (10) to the sump.

Crankcase ventilation

With the exception of two hoses connected from the inlet camshaft cover and the inlet manifold and throttle housing, all crankcase ventilation is via internal voids in the cylinder head and block. The inlet camshaft cover carries a wire gauze flame trap located over the breather pipe connections.

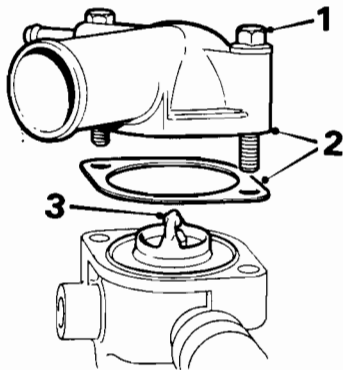
Turbo models

The breather pipe at the timing belt end of the engine is connected to a non – return valve. As turbocharger boost pressure increases, the non – return valve closes to prevent pressurisation of the crankcase and engine breathing is then via the pipe connected between the camshaft cover and air intake.



THERMOSTAT

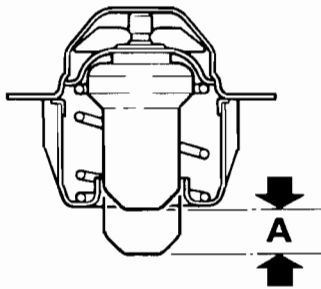
Remove



12M 0285

1. Remove 2 bolts securing thermostat housing cover.
2. Remove thermostat housing cover, discard gasket.
3. Remove thermostat.

Inspection



12M 0286

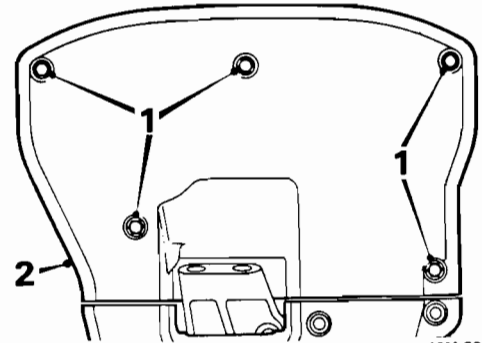
1. Test thermostat using thermostat test equipment, renew thermostat if necessary.
Starts to open = 82 to 86° C.
Thermostat fully open = 88° C.
Open travel A = 9 mm.

Refit

1. Remove all traces of gasket from thermostat housing and cover.
2. Fit thermostat.
3. Position a new gasket to thermostat housing.
4. Fit thermostat housing cover, fit bolts and tighten to 25 Nm.

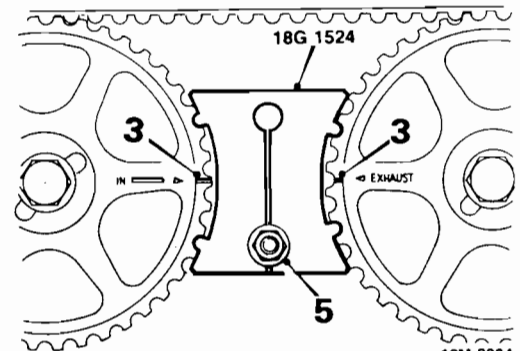
CAMSHAFT TIMING BELT AND TENSIONER

Camshaft timing belt - remove



12M 0233

1. Remove 5 bolts securing timing belt upper cover.
2. Remove upper cover

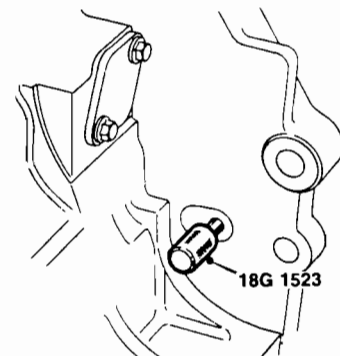


12M 0234

3. Using a socket and extension bar on crankshaft pulley bolt, rotate crankshaft until timing marks on camshaft gears are in positions shown - 90° B.T.D.C.

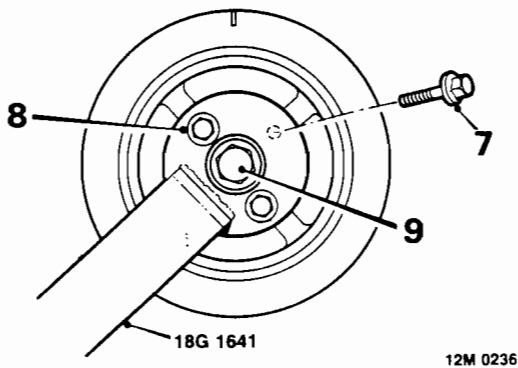
CAUTION: Do not use camshaft gears or retaining bolts to rotate engine.

4. Position camshaft locking tool 18G 1524 to camshaft gears.
5. Tighten nut on tool 18G 1524 to retain tool.



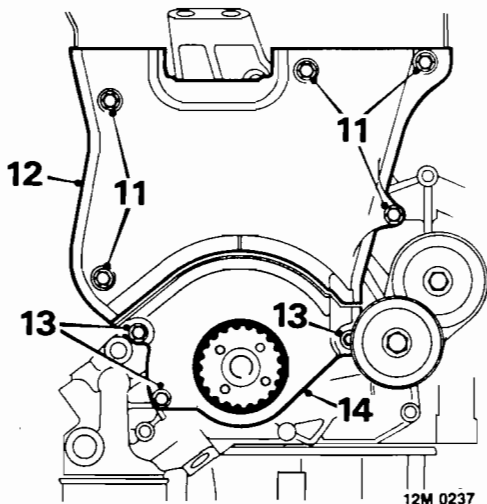
12M 0235

6. Insert timing pin 18G 1523 through hole in gearbox adapter plate and into hole in flywheel drive plate.



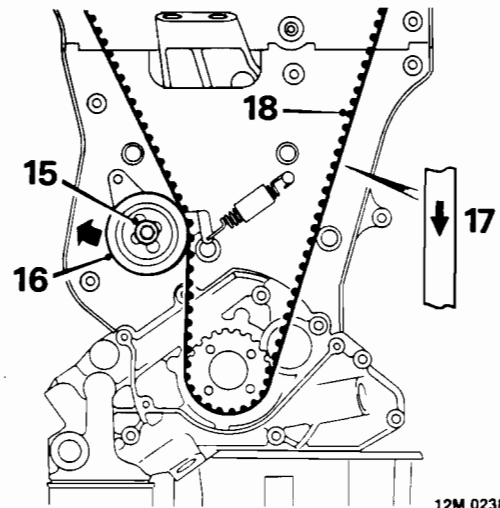
12M 0236

7. Remove 4 bolts securing crankshaft pulley to crankshaft timing gear.
8. Position tool **18G 1641** to crankshaft pulley, fit and tighten 2 pulley bolts to retain tool.
9. Restrain crankshaft pulley using tool **18G 1641** and remove crankshaft pulley bolt.
10. Remove bolts retaining tool **18G 1641**, remove crankshaft pulley.



12M 0237

11. Remove 5 bolts securing timing belt centre cover.
12. Remove centre cover.
13. Remove 3 bolts securing timing belt lower cover.
14. Remove lower cover.

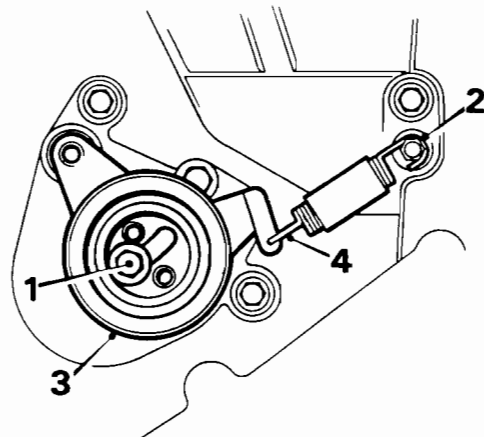


12M 0238

15. Slacken but do not remove timing belt tensioner clamp bolt.
16. Move timing belt tensioner pulley away from timing belt; tighten clamp bolt sufficiently to prevent tensioner pulley moving.
17. If timing belt is to be refitted, mark direction of rotation of belt using chalk or crayon.
18. Using fingers only, ease timing belt off gears.

CAUTION: Do not rotate crankshaft or camshafts with timing belt removed and cylinder head fitted.

Timing belt tensioner - remove



12M 0239

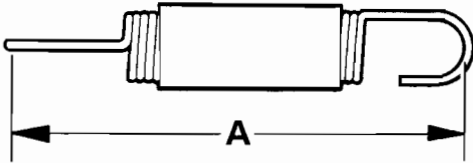
1. Slacken but do not remove timing belt tensioner clamp bolt, allow tensioner to operate.
2. Unhook tensioner spring from anchorage bolt.
3. Remove tensioner clamp bolt, remove tensioner.
4. Release tensioner spring from tensioner.



Inspection

1. Inspect timing belt for signs of splits at base of teeth, fraying, oil contamination or uneven wear. Renew timing belt if it fails inspection or has been used for more than 48,000 miles, 80,000 km.

CAUTION: If timing belt is contaminated with oil, cause of oil contamination must be rectified. Timing belts must be stored and handled with care. Always store a belt on its edge with a bend radius greater than 30 mm. Do not use a timing belt which has been twisted or bent double as this can fracture the reinforcing fibres. Do not use a belt that has been contaminated with oil.



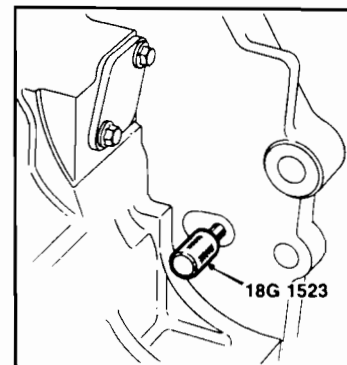
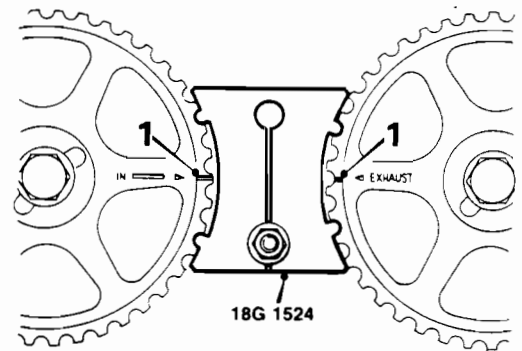
12M 0240

2. Check free length of tensioner spring: Tensioner spring free length **A** = 57.5 to 58.5 mm.
3. Renew tensioner spring if free length is greater than specified.
4. Clean timing gears, timing belt tensioner pulley, timing belt covers and backplate.
5. Check timing belt covers for damage, renew as necessary.
6. Clean crankshaft pulley.

Timing belt tensioner - refit

1. Attach tensioner spring to timing belt tensioner arm.
2. Position timing belt tensioner to cylinder block, fit but do not tighten clamp bolt.
3. Connect tensioner spring to anchorage bolt.
4. Move timing belt tensioner to minimum tension position, tighten clamp bolt.

Timing belt - refit



12M 0295

1. Ensure timing marks on camshaft gears are correctly aligned and camshaft locking tool **18G 1524** is fitted.
2. Ensure timing pin **18G 1523** is inserted in hole in flywheel/drive plate.
3. Ensure timing belt tensioner is at minimum tension position and clamp bolt is tightened sufficiently to prevent tensioner operating.
4. Fit timing belt to crankshaft timing gear, exhaust camshaft gear, inlet camshaft gear keeping belt taut between crankshaft timing gear and exhaust camshaft gear.

CAUTION: If original timing belt is to be refitted, ensure direction of rotation mark is facing correct way.

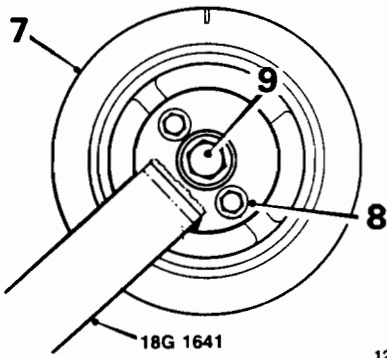
5. Slacken timing belt tensioner clamp bolt just sufficiently to allow tensioner to operate and tension timing belt.

CAUTION: Do not tighten clamp bolt at this stage.

6. Fit timing belt lower cover, fit securing bolts and tighten to 6 Nm.

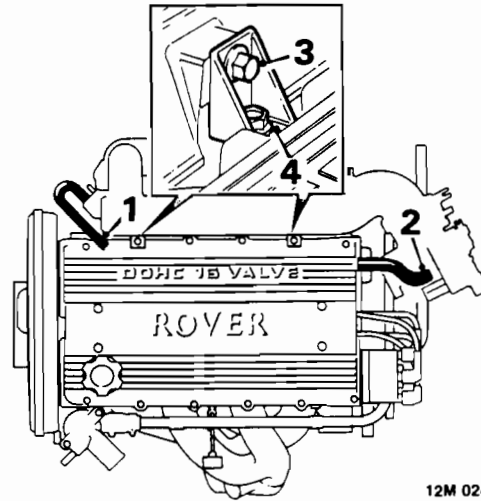
CYLINDER HEAD

Inlet manifold - remove



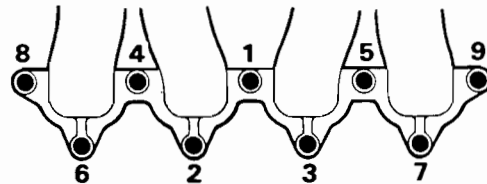
12M 0296

7. Position crankshaft pulley on crankshaft, align bolt holes with timing gear.
8. Position tool **18G 1641** to crankshaft pulley, fit and tighten 2 bolts to retain tool.
9. Fit crankshaft pulley bolt and using tool **18G 1641** to restrain crankshaft, tighten bolt to 85 Nm.
10. Slacken nut retaining camshaft locking tool **18G 1524**; remove tool.
11. Remove timing pin **18G 1523**.
12. Using tool **18G 1641** rotate crankshaft 2 complete turns in a clockwise direction (viewed from front of engine).
13. Tighten timing belt tensioner clamp bolt to 30 Nm.
14. Remove bolts retaining tool **18G 1641**, remove tool.
15. Fit crankshaft pulley to timing gear bolts and tighten to 8 Nm.
16. Fit timing belt centre cover, fit securing bolts and tighten to 6 Nm.
17. Fit timing belt upper cover, fit securing bolts and tighten to 6 Nm.



12M 0241

1. Disconnect breather pipe from inlet camshaft cover.
2. Disconnect breather pipe from throttle housing.
3. Remove 2 bolts securing inlet manifold to support brackets.
4. Remove bolt securing each support bracket to camshaft cover; remove brackets.

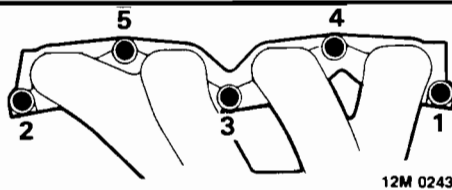
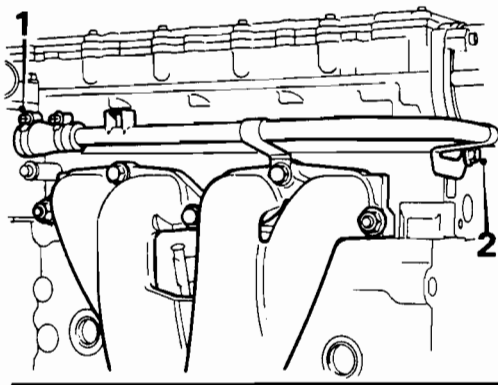


12M 0242

5. Remove 7 bolts and 2 nuts securing inlet manifold to cylinder head in sequence shown, remove manifold, discard gasket.



Exhaust manifold - remove

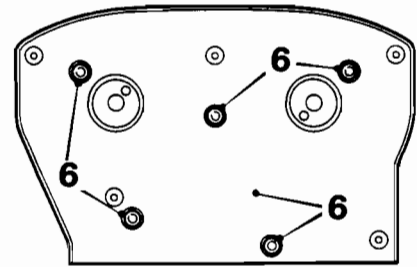


12M 0243

1. Slacken clip, disconnect heater hose from thermostat housing.
2. Remove bolt securing coolant rail to cylinder head.
3. Remove 3 bolts and 2 nuts securing exhaust manifold to cylinder head in sequence shown, remove coolant rail, exhaust manifold and discard gasket.

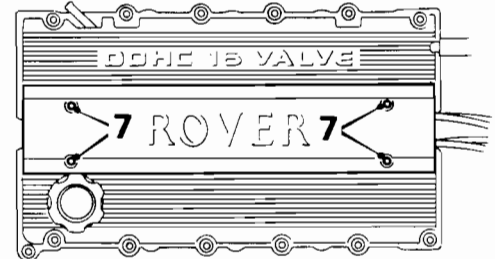
5. Remove camshaft timing gears.

CAUTION: Camshaft timing gears are not interchangeable between turbo and naturally aspirated engines.



12M 0245

6. Remove 5 bolts securing upper timing cover backplate, remove backplate.

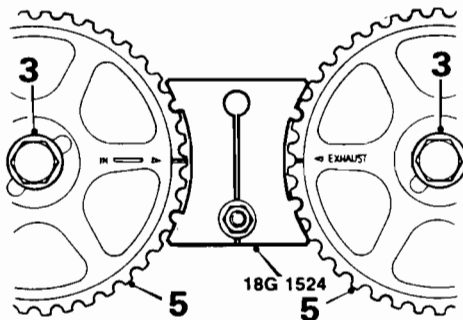


12M 0246

7. Remove 4 screws securing spark plug cover; remove cover.

Cylinder head - remove

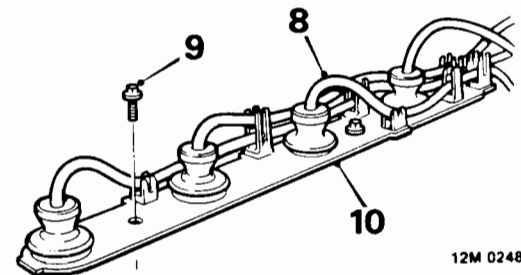
1. Remove camshaft timing belt and tensioner
2. Suitably identify each timing gear to its appropriate camshaft.



12M 0244

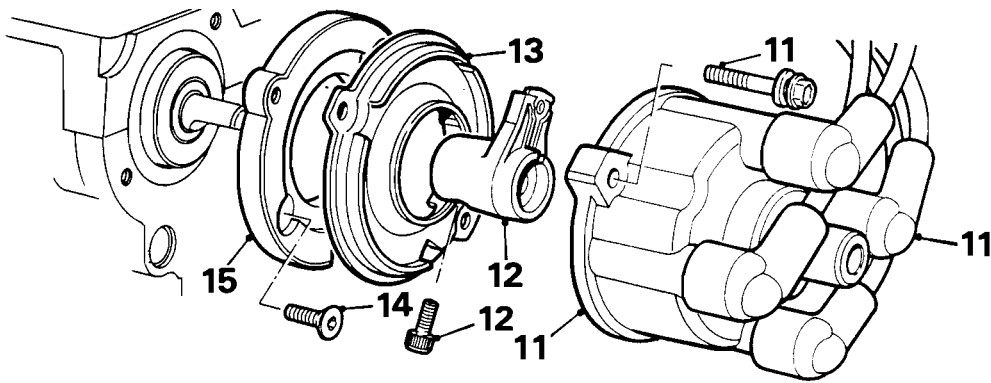
3. Remove bolt and washer securing each timing gear.
4. Remove tool 18G 1524.

CAUTION: Do not rotate crankshaft or camshaft with timing belt removed and cylinder head fitted.



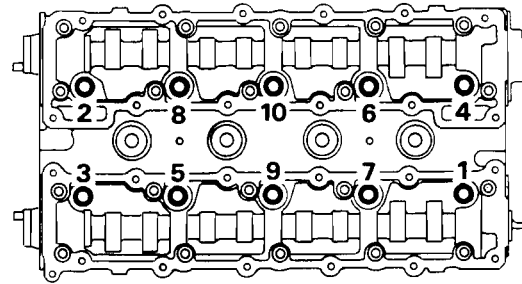
12M 0248

8. Disconnect h.t. leads from spark plugs
9. Remove 2 screws securing h.t. lead plate
10. Remove h.t. lead plate.



12M 0247

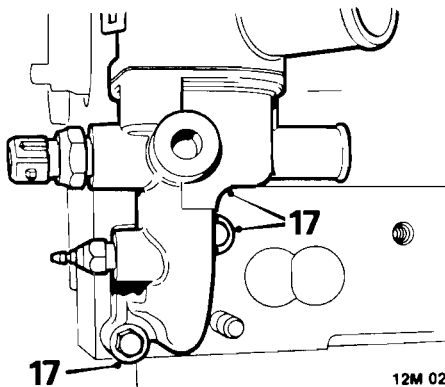
11. Slacken 2 captive screws securing distributor cap; remove cap and h.t. leads.
12. Remove Patchlock screw securing rotor arm, remove rotor arm, discard screw.
13. Remove flash shield.
14. Remove 2 screws securing distributor adapter plate.
15. Remove adapter plate.
16. Remove 4 spark plugs.



12M 0251

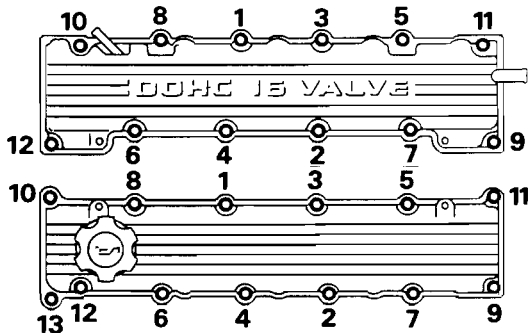
20. Working in sequence shown, progressively slacken then remove 10 bolts securing cylinder head.
21. Remove cylinder head, discard gasket.

CAUTION: Support cylinder head on wooden blocks to prevent damaging valves.



12M 0249

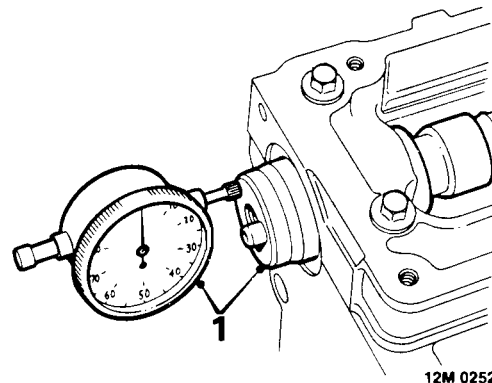
17. Remove 2 bolts securing thermostat housing to cylinder head, remove housing and discard gasket.



12M 0250

18. Working from centre outwards, slacken then remove 10 bolts securing inlet camshaft cover and 13 bolts securing exhaust camshaft cover in sequence shown.
19. Remove camshaft covers, discard gaskets/baffle plates if damaged.

Camshafts end float - check

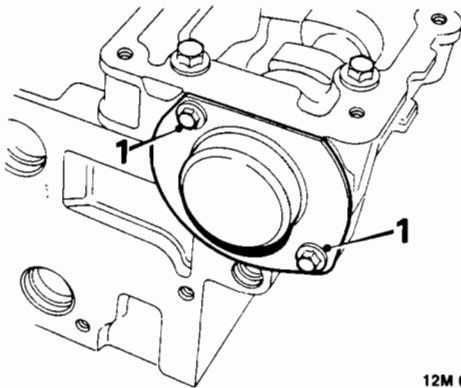


12M 0252

1. Check end - float of each camshaft using a D.T.I. Gauge.
Camshaft end - float = 0.06 to 0.25 mm
Renew components to regain tolerance.



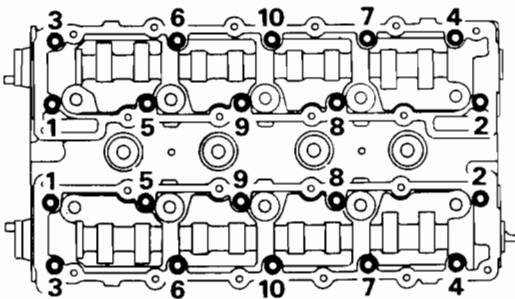
Remove



12M 0253

Naturally aspirated model illustrated

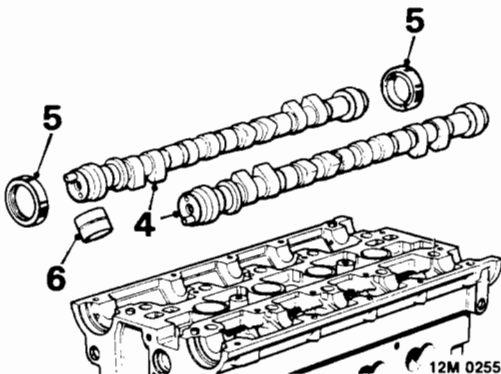
1. *Naturally aspirated models:* Remove 2 bolts securing blanking plate to inlet camshaft carrier; remove plate.
Turbo models: Remove 2 bolts securing camshaft sensor housing to inlet camshaft carrier; remove housing.



12M 0254

2. Working from centre outwards, progressively slacken then remove 10 bolts securing each camshaft carrier to cylinder head in sequence shown.
3. Remove camshaft carriers from cylinder head.

Note: Carriers are located by dowels.



12M 0255

4. Remove 2 camshafts.
5. Remove and discard 2 oil seals from each camshaft.
6. Using a magnet, remove 16 tappets.

CAUTION: Store tappets in their fitted order and invert to prevent oil loss.

Camshaft identification

Naturally aspirated models

Camshafts are identified by red or green paint adjacent to the rear journal; both types are interchangeable.

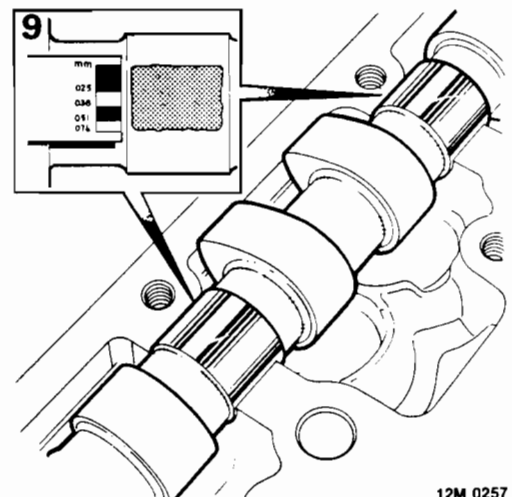
Turbo models

Camshafts are identified by means of a paint band adjacent to the rear journal. Inlet camshafts have a green paint band and are fitted with the camshaft sensor. Exhaust camshafts have a yellow band and carry the distributor drive spindle.

Inspection

Note: Carry out camshaft inspection after removal of valves and springs.

1. Clean camshafts and bearing journals in camshaft carriers and cylinder head.
2. Inspect cams and camshaft bearing journals, replace camshaft(s) if scoring, pitting or excessive wear is evident.
3. Inspect bearing journals in cylinder head and camshaft carriers, replace components if scoring, pitting or excessive wear is evident.
4. Lightly oil bearing journals in cylinder head, camshaft carriers and on camshafts.
5. Position camshafts on cylinder head.
6. Position a piece of Plastigauge across each camshaft bearing journal.
7. Fit camshaft carriers, fit securing bolts and working from the centre outwards, progressively tighten bolts to 25 Nm. Do not rotate camshafts.
8. Remove camshaft carrier securing bolts, remove carriers.



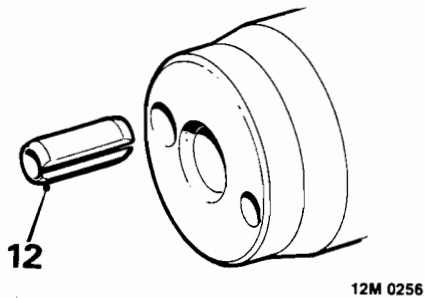
12M 0257

9. Measure widest portion of Plastigauge on each bearing journal and from dimensions obtained, calculate camshaft bearing clearance.
Camshaft bearing clearance = 0.060 to 0.094 mm
Service limit = 0.15 mm
10. If bearing clearance is excessive, fit new camshaft(s) and repeat check; if excessive

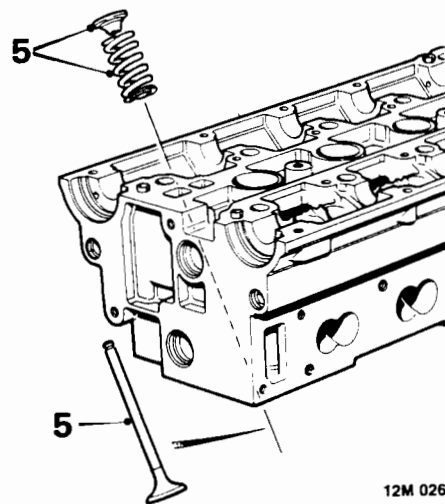
ENGINE

clearances still exist, renew cylinder head and camshaft carriers.

11. Remove all traces of Plastigauge using an oily rag.



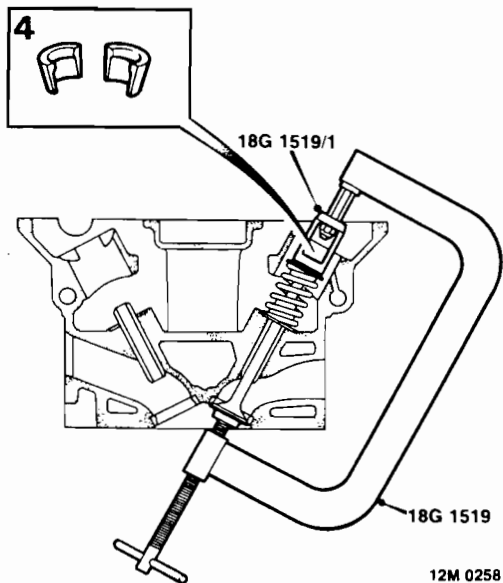
12. Transfer drive pins from old camshafts to new with its split fitted towards centre of camshaft.



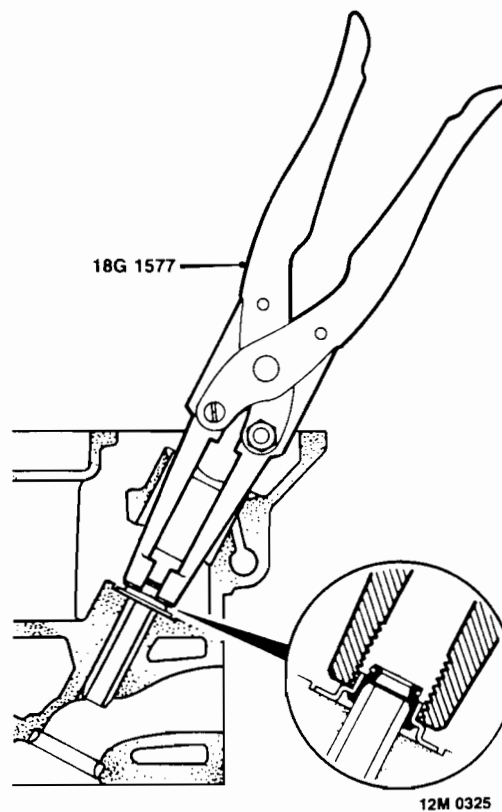
5. Release tool **18G 1519** and remove valve, valve spring cap and valve spring.

Valves and springs – remove

1. Using a hollow drift, tap each valve spring cap to free collets.
2. Position cylinder head on its exhaust manifold face.



3. Using tool **18G 1519** and adapter **18G 1519/1**, compress inlet valve spring.
4. Remove 2 collets using a magnet.



6. Using tool **18G 1577**, remove valve stem oil seal.
7. Repeat above operations for remaining inlet valves.

CAUTION: Keep valves, springs, caps and collets in fitted order.

8. Position cylinder head on its inlet manifold face.
9. Remove exhaust valves and valve stem oil seals using the above procedures.

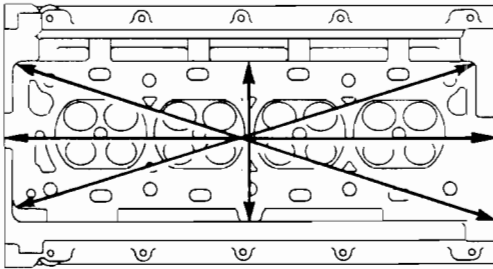


Cylinder head - inspection

1. Clean all traces of gasket material and sealant from cylinder head using suitable gasket removal spray and a plastic scraper.

CAUTION: If locating dowels have been removed with cylinder head, they must be refitted in cylinder block.

2. Check cylinder head for damage, cracks or burning.
3. Check condition of 10 core plugs, renew any plug showing signs of cracks, corrosion or weeping, seal new plugs using Loctite 601 (retainer).



12M 0262

4. Check cylinder head face for warping.
Longitudinal warp = 0.1 mm max.
Transverse warp = 0.1 mm max.
Diagonal warp = 0.1 mm max.

CAUTION: If warpage exceeds the figures given, a new cylinder head must be fitted.

5. Check cylinder head height measured from face of head to camshaft carrier face.
Cylinder head height = 135.0 to 135.1 mm

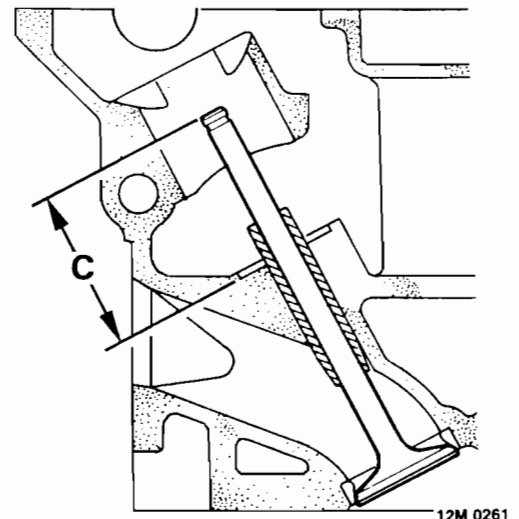
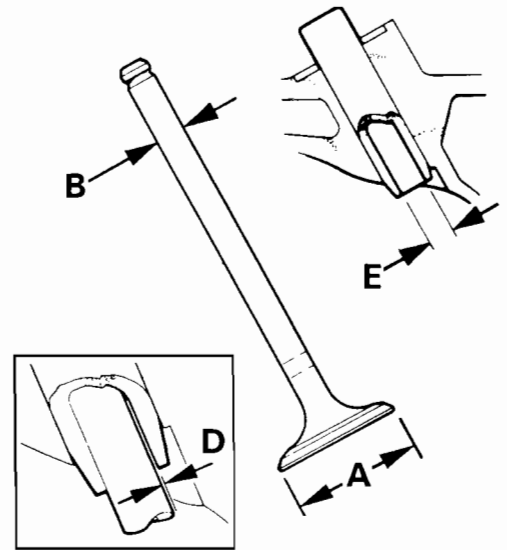
CAUTION: Cylinder heads must not be refaced.

Valve springs

1. Check condition of valve springs:
Free length = 46.25 mm
Fitted length = 37.0 mm
Load at fitted length = 255 ± 12 N
Load at valve open length = 560 ± 22.5 N

CAUTION: Valve springs must be replaced as a complete set.

Valves and guides - inspection



12M 0261

1. Check existing valve stem and head diameters.
2. Check valve stem to guide clearance using new valves.
3. Renew valves and guides as necessary.
Valve head diameter A:
Inlet = 31.7 to 31.95 mm
Exhaust = 29.2 to 29.43 mm
Valve stem diameter B:
Inlet = 7.09 to 7.10 mm
Exhaust = 7.07 to 7.09 mm
4. Check installed height of each valve.
Valve installed height C: = 43.4 mm max.

CAUTION: If valve installed height exceeds dimension given, valve/valve seat insert must be replaced.

5. **Valve stem to guide clearance D:**
Inlet = 0.04 to 0.06 mm
Service limit = 0.09 mm
Exhaust = 0.06 to 0.07 mm
Service limit = 0.10 mm

6. Valve guide internal diameter E:

Inlet and exhaust = 7.137 to 7.162 mm

7. Valve guide overall length

Inlet = 48.5 mm

Exhaust = 52.9 mm

Renew

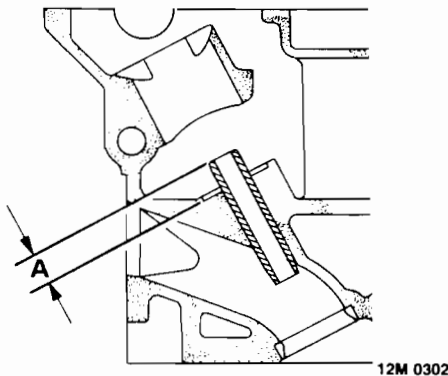
1. Heat cylinder head evenly to 100°C.

WARNING: Wear protective gloves when handling cylinder head.

2. Place cylinder head face downwards and using a piloted mandrel, press valve guide into combustion chamber for a distance of 2.0 mm.
3. Invert cylinder head and remove all traces of carbon from periphery of valve guide.
4. Re-heat cylinder head to 100°C.
5. Using a piloted mandrel, press valve guide out from the combustion chamber side of the cylinder side.

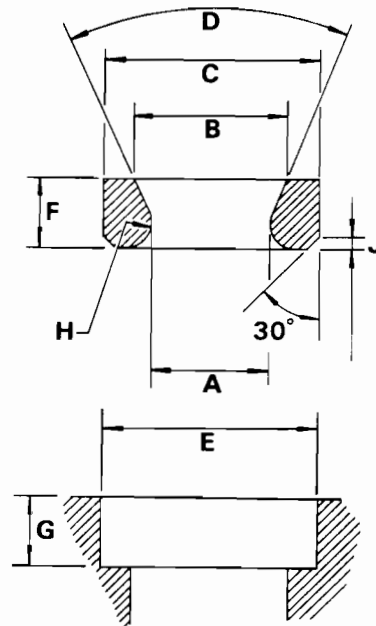
Note: The tapered portion of the valve guide is either plain or has a series of grooves machined around the circumference and it is essential that replacement guides are identical to those removed i.e. plain, one, two or three grooves.

6. Place replacement valve guide in a deep freeze for one hour.
7. Re-heat cylinder head to 100°C.



8. Using a piloted mandrel, press valve guide into cylinder head from the combustion chamber side until top of guide is 12.0 mm 'A' from valve spring seat face.
9. Allow cylinder head to air cool.

Valve seat inserts - inspection



12M 0300

1. Check valve seat inserts, check valve seats for pitting, burning; replace inserts as necessary.

CAUTION: Where valve installed height exceeds dimension given, seat inserts must be replaced.

Inlet

- A: 27.425 to 27.575 mm
- B: 29.42 to 29.67 mm
- C: 33.060 to 33.073 mm
- D: 30°
- E: 32.975 to 33.00 mm
- F: 5.45 to 5.50 mm
- G: 5.5 mm
- H: 2 mm
- J: 0.90 to 1.15 mm

Exhaust

- A: 25.125 to 25.275 mm
- B: 26.73 to 26.99 mm
- C: 30.560 to 30.573 mm
- D: 25° to 27°
- E: 30.475 to 30.50 mm
- F: 5.58 to 5.63 mm
- G: 5.5 mm
- H: 2 mm
- J: 0.90 to 1.15 mm

Renew

1. Renew valve seat inserts as necessary.

CAUTION: Valve guide renewal must be carried out before renewal of valve seat inserts.

2. Grind a crescent 5 mm deep into valve seat insert, break insert using a cold chisel.

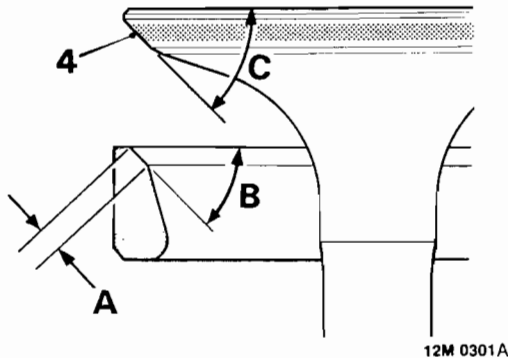
CAUTION: Do not damage counterbore.



3. Remove all traces of carbon from counterbore.
4. Place valve seat insert in a deep freeze for one hour.
5. Using a suitable mandrel, drift valve seat insert fully into counterbore.
6. Cut valve seats.

Valve seats – renew

1. Check condition of valve seats and existing valves that are to be re-used.
2. Remove carbon from valves and valve seats.



3. Cut valve seats using tools **MS 621** and **MS 150-7**.

Valve seat:

Width **A** = 1.5 to 2.0 mm

Angle **B** = 45°

Valve face angle **C**

Inlet and exhaust = 45° to 45° 15'

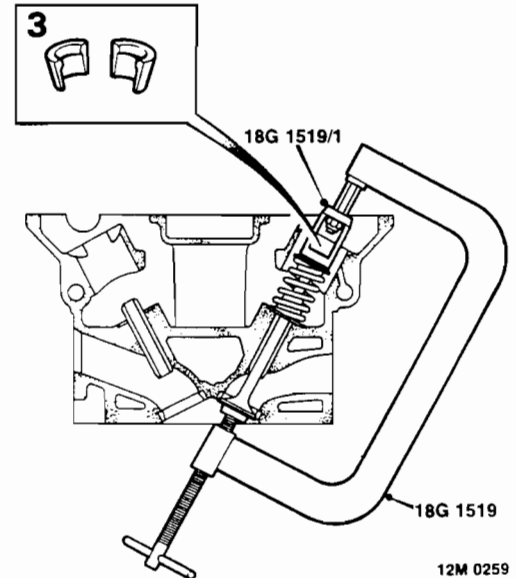
4. Lap each valve to its seat using fine grinding paste.
5. Apply Prussian Blue to valve seat, insert valve and press it into position several times without rotating. Remove valve and check for even and central seating. Seating position shown by Prussian Blue should be in centre of valve face.
6. Check valve installed height if valve seats have been re-cut or new valves or valve seat inserts fitted

Cylinder head – assembly

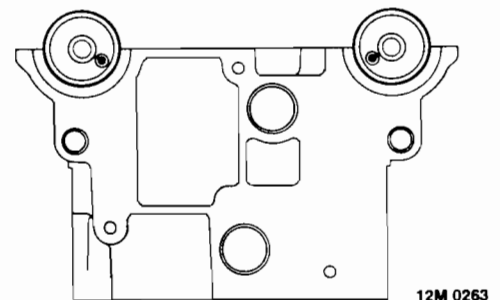
1. Thoroughly clean cylinder head, blow out oilways and waterways.
2. Ensure camshaft carriers locating dowels are fitted.

Valves and camshafts – assembly

1. Lubricate valve guides, valve stems, springs, caps, spring seats and valve stem oil seals with engine oil.
2. Insert each inlet valve in its respective guide and fit valve stem oil seals.

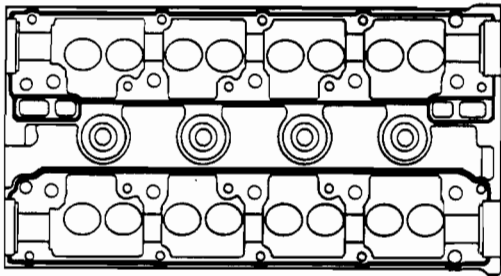


3. Fit valve springs and caps, use tool **18G 1519** and adapter **18G 1519/1** to compress valve springs; fit collets.
4. Using a wooden dowel and mallet, lightly tap each valve stem two or three times to seat valve cap and collets.
5. Fit exhaust valves using above procedures.
6. Support each end of cylinder head on blocks of wood.
7. Lubricate outside diameter of tappets, fit each tappet to its original bore.
8. Lubricate camshaft journals.



9. Fit camshafts and rotate to position drive pins as follows:
Inlet pin at 4 o'clock.
Exhaust pin at 8 o'clock.

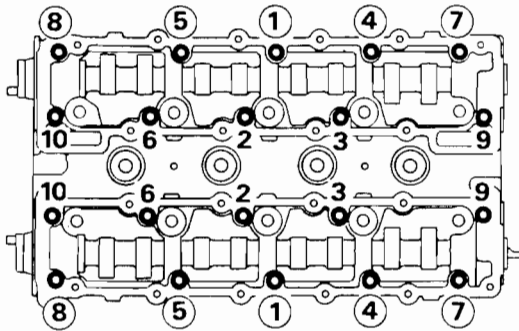
Camshaft carriers and oil seals - assembly



12M 0264

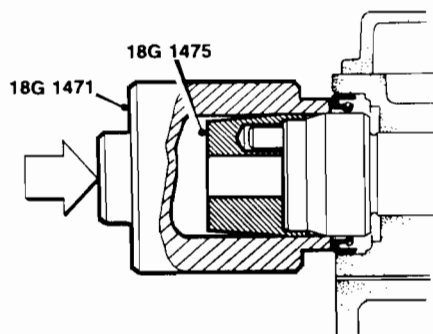
1. Using an M8 x 1.25 tap, remove all traces of sealant from camshaft cover bolts and clean camshaft carriers.
2. Apply a 3 mm wide bead of Liquid Sealant LDV 10002 to cylinder head as shown.

CAUTION: Ensure grooves adjacent to each bearing journal are clear of sealant.



12M 0265 A

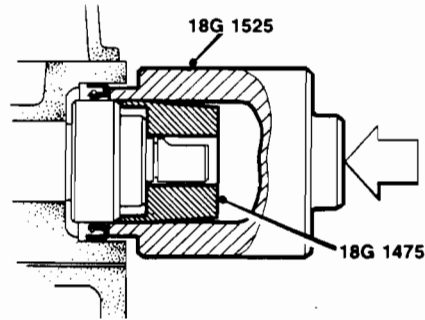
3. Fit camshaft carriers, fit new Patchlock bolts (shown circled) and plain bolts in all other positions.
4. Working in sequence shown, progressively tighten bolts to 25 Nm.



12M 0266

CAUTION: Check condition of tool and remove any burrs from lip.

5. Fit front oil seals using tools **18G 1475** and **18G 1471**.



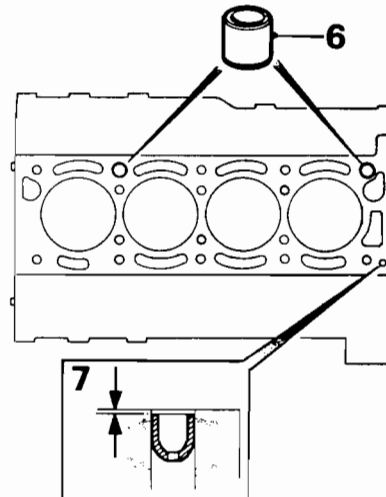
12M 0267

CAUTION: Check condition of tool and remove any burrs from lip.

6. Fit rear oil seals using tools **18G 1475** and **18G 1525**.
7. Fit blanking plate to inlet camshaft carrier, fit 2 bolts and tighten to 8 Nm.

Cylinder head - refit

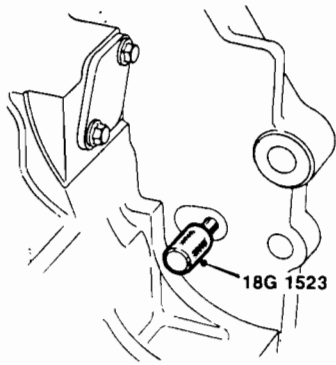
1. Clean cylinder head bolt threads, replace any bolt showing signs of damage.
2. Screw each cylinder head bolt by hand into bolt holes in cylinder block.
3. Clean any tight threads using an M11 x 1.5 tap.
4. Thoroughly clean bolt holes ensuring all traces of oil and dirt are removed.
5. Check oil restrictor is clear and fitted below face of cylinder block.



12M 0268

6. Ensure 2 nylon locating dowels are fitted in cylinder block.
7. Ensure oil restrictor is clean and below level of block face.
8. Clean gasket face of cylinder block and cylinder head; position a new gasket on locating dowels.

Note: Gaskets must be fitted dry. Gaskets are not interchangeable between turbo and naturally aspirated engines.

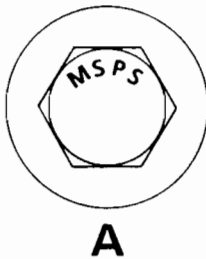
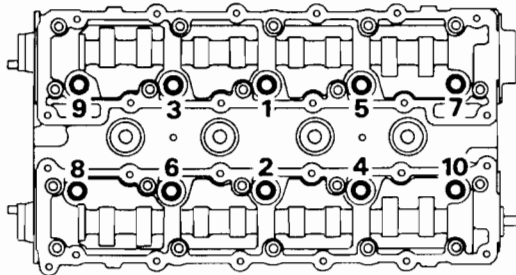


12M 0298

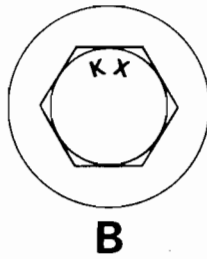
9. Ensure timing pin **18G 1523** is inserted in hole in flywheel/drive plate.

Note: If flywheel/drive plate is not fitted, turn crankshaft until pistons are half-way up cylinder bores.

10. Fit cylinder head ensuring it is located on dowels.
11. Apply a light film of oil to bolt threads and underside of heads.



A



B

12M 0269 A

12. Fit 10 cylinder head bolts and tighten in sequence shown to **A** or **B** torque figures depending on type of bolt fitted.

A:

- Stage 1 - 45 Nm
- Stage 2 - 80 Nm
- Stage 3 - Further 90°

B:

- Stage 1 - 45 Nm
- Stage 2 - 70 Nm
- Stage 3 - Further 90°

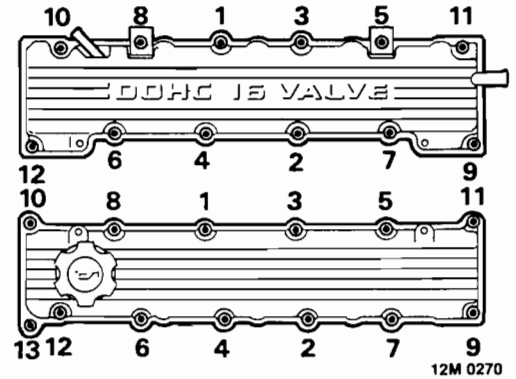
Note: For stage 3 use angular torque gauge and 150 mm extension. Fit pointer on an adjacent bolt, adjust pointer length and align zero on disc with pointer.

Camshaft covers and timing gears - refit

1. Clean camshaft covers ensuring gauze filter panels and breather pipes are unobstructed.
2. Clean timing gears.
3. Fit new gasket to each camshaft carrier.

Note: Gaskets must be fitted dry.

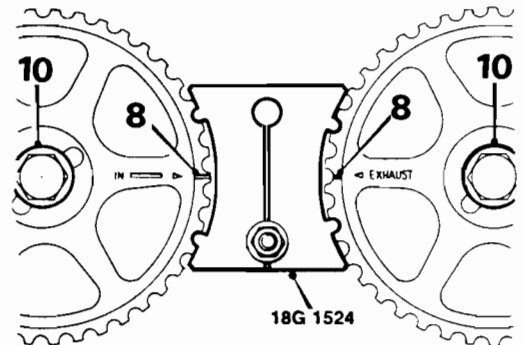
4. Fit camshaft covers, position inlet manifold support brackets to inlet camshaft cover.



12M 0270

5. Fit bolts to camshaft covers; tighten bolts working in sequence shown to 8 Nm.
6. Fit timing cover upper backplate, fit securing bolts and tighten to 6 Nm.
7. Fit timing gears.

CAUTION: Ensure each gear is fitted to its respective camshaft. Timing gears are not interchangeable between turbo and naturally aspirated engines.



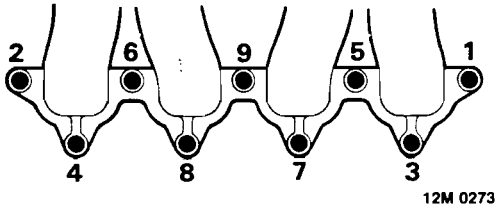
12M 0271

8. Check that timing marks on gears are aligned.
9. Position camshaft locking tool **18G 1524** to timing gears; tighten nut to retain tool.
10. Fit bolt and washer to retain each camshaft gear, tighten bolts to 65 Nm.
11. Fit timing belt and adjust tension

ENGINE

Inlet manifold - refit

1. Clean mating surface of inlet manifold.
2. Position new gasket on studs, fit inlet manifold.



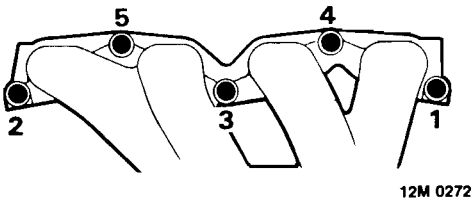
3. Fit 7 bolts and 2 nuts and working in sequence shown, tighten to 25 Nm.
4. Fit 2 support bracket bolts and tighten to 8 Nm.
5. Connect breather pipes.

Exhaust manifold - refit

1. Clean mating surface of exhaust manifold.
2. Position new gasket on studs, fit exhaust manifold.

CAUTION: Metal face of gasket must face towards manifold.

3. Position coolant rail to exhaust manifold and cylinder head.



4. Fit 3 bolts and 2 nuts and working in sequence shown, tighten to 45 Nm.
5. Tighten coolant rail to cylinder head bolt to 25 Nm.
6. Connect heater hose.

Thermostat housing - refit

1. Clean mating surface of thermostat housing.
2. Fit thermostat housing, use a new gasket.

Note: Gasket must be fitted dry.

3. Fit 2 bolts and tighten to 25 Nm.

Distributor - refit

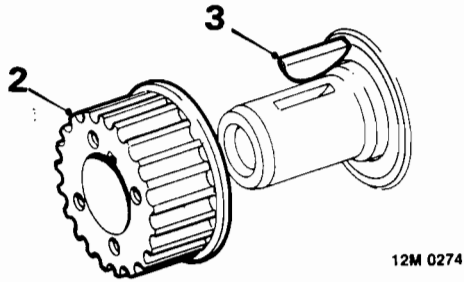
1. Fit distributor adapter plate, secure with 2 new Patchlock screws; tighten screws to 6 Nm.
2. Fit flash shield.
3. Fit rotor arm, secure with new Patchlock screw; tighten screw to 5 Nm.
4. Fit distributor cap and h.t. leads.
5. Fit spark plugs.
6. Fit h.t. lead plate, tighten 2 screws.
7. Connect h.t. leads to spark plugs.
8. Fit spark plug cover, tighten 4 screws.



OIL PUMP

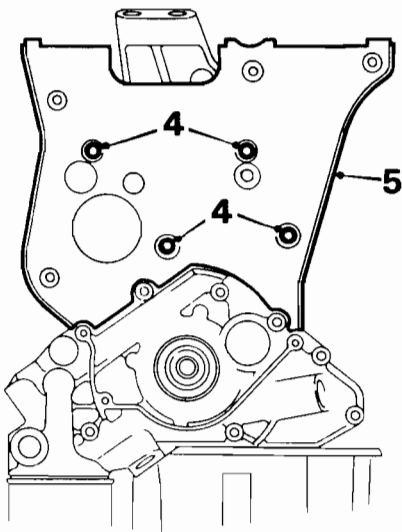
Remove

1. Remove camshaft timing belt and tensioner



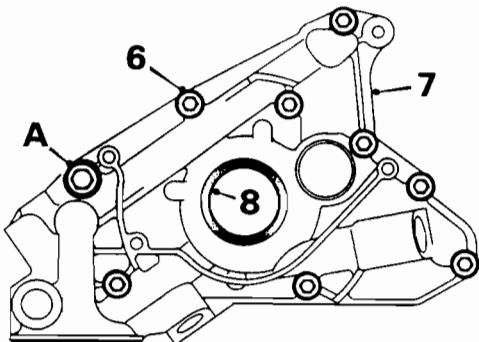
12M 0274

2. Slide crankshaft timing gear off crankshaft.
3. Remove Woodruff key from crankshaft.



12M 0275

4. Remove 4 bolts securing timing belt lower backplate.
5. Remove lower backplate.

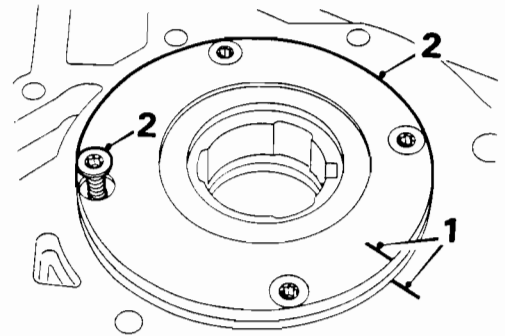


12M 0276

6. Noting fitted position of M6 x 20 bolt A, remove 9 bolts securing oil pump to cylinder block.
7. Slide oil pump off crankshaft, discard gasket.
8. Carefully prise crankshaft front oil seal out of oil pump body; discard oil seal.

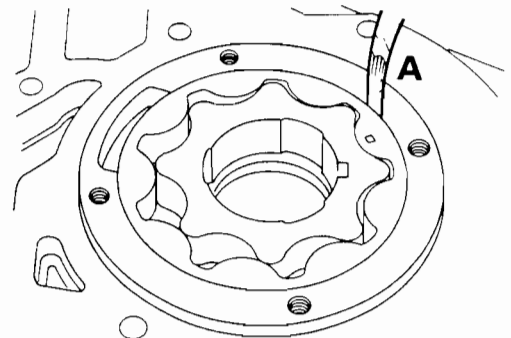
Inspection

Note: The oil pump is serviced as an assembly. The following checks can be carried out to determine serviceability.



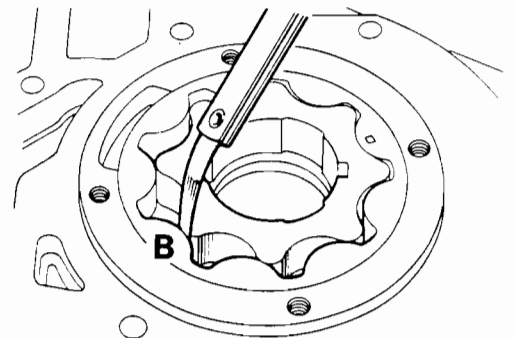
12M 0277

1. Make suitable alignment marks between oil pump body and cover plate.
2. Remove 4 Torx screws securing cover plate, remove plate.



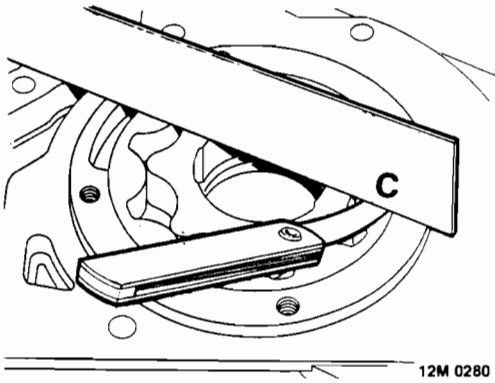
12M 0279

3. Check Outer rotor to body clearance.
A = 0.05 to 0.10 mm



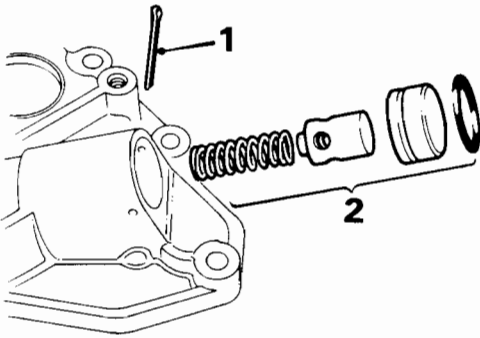
12M 0278

4. Check inner rotor lobe tip clearance.
B = 0.025 to 0.12 mm



5. Check outer rotor end float.
 $C = 0.03$ to 0.08 mm
 Renew oil pump assembly if clearances are excessive or scoring of components is evident.

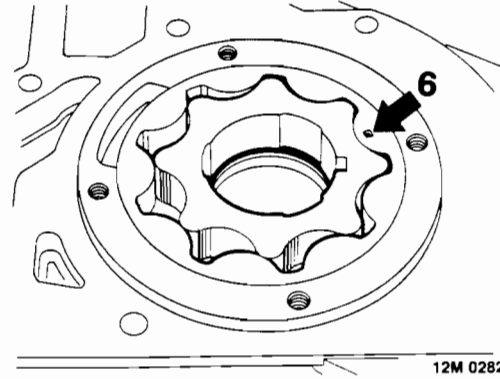
Oil pressure relief valve



1. Remove and discard split pin securing relief valve cap.
2. Remove relief valve cap, spring and plunger, discard relief valve cap 'O' ring.
3. Check that plunger is not scored and slides freely in bore.
4. Check free length of spring:
 Spring free length = 42 mm
 Renew relief valve as an assembly if scoring of plunger is evident or free length of spring is less than specified.

Assembly

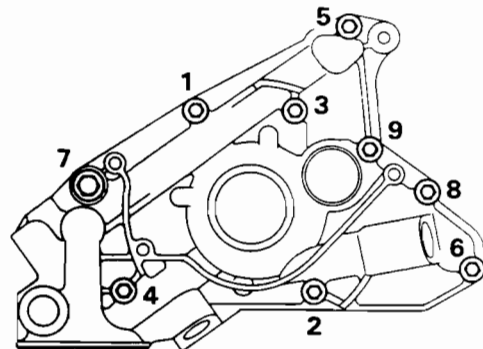
1. Clean relief valve components and ensure bore in oil pump body is clean.
2. Remove all traces of sealant and gasket from oil pump body and cover plate.
3. Smear a new 'O' ring with engine oil and fit to relief valve cap.
4. Lubricate spring, plunger and bore in oil pump body with engine oil.
5. Fit plunger, spring and relief valve cap; secure assembly with a new split pin.



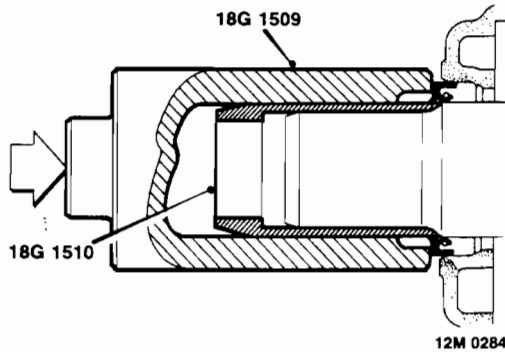
6. Ensure identification mark on outer rotor is facing outwards.
7. Lubricate rotors with engine oil.
8. Apply Loctite 574 to cover plate.
9. Fit cover plate ensuring reference marks are correctly aligned.
10. Fit Torx screws and tighten in diagonal sequence to 6 Nm.

Refit

1. Remove all traces of gasket from cylinder block and sealant from front main bearing cap; ensure 2 oil pump locating dowels are in position.
2. Remove all traces of Loctite from threads of oil pump securing bolts and bolt holes.
3. Clean timing belt lower backplate.
4. Position a new gasket to oil pump body.
5. Apply a 1.0 mm bead of RTV sealant along vertical joint of front main bearing cap.
6. Fit oil pump, ensuring inner rotor is correctly engaged with Woodruff key and pump body is located on dowels.
7. Apply Loctite 222 to threads of oil pump securing bolts.



8. Fit securing bolts ensuring that M6 x 20 bolt is in correct position; tighten bolts in sequence shown to:
 M6 bolt – 8 Nm
 M10 bolts – 45 Nm.
9. Lubricate oil seal running surface of crankshaft with engine oil.



10. Slide tool **18G 1510** on to crankshaft.
11. Lubricate a new oil seal with multi - purpose grease; fit seal using tool **18G 1509**.
12. Remove tool **18G 1510**.
13. Position timing belt lower backplate to cylinder block.
14. Fit and tighten bolts to 6 Nm.
15. Fit Woodruff key to crankshaft.
16. Slide crankshaft timing gear on to crankshaft.
17. Fit camshaft timing belt and tensioner

PISTONS, RINGS AND CYLINDER BORES

Pistons - remove

1. Remove cylinder head.
2. Remove big - end bearing caps and bearing shells.
3. Remove carbon ridge from top of each cylinder bore.
4. Suitably identify each piston to its respective cylinder bore.
5. Push pistons to top of cylinder bores; withdraw each piston and connecting rod assembly.

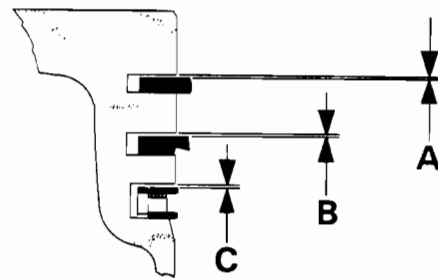
CAUTION: Ensure connecting rod big - end bosses do not contact cylinder bores. Keep bearing shells and caps with their respective connecting rods.

Piston rings - remove

1. Using a suitable expander remove piston rings.
2. Using squared off end of an old piston ring, remove carbon from piston ring grooves.

CAUTION: Do not use a wire brush.

Piston rings - inspection



12M 0306

1. Check new ring to groove clearance:

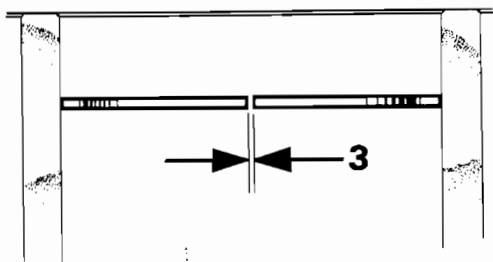
Naturally aspirated models

Top compression **A** = 0.06 to 0.09 mm
 2nd compression **B** = 0.05 to 0.07 mm
 Oil control **C** = 0.03 to 0.05 mm

Turbo models

Top compression **A** = 0.08 to 0.09 mm
 2nd compression **B** = 0.05 to 0.06 mm
 Oil control **C** = 0.02 to 0.05 mm

ENGINE



12M 0307

2. Insert new piston rings in turn 20 mm from top of cylinder bore.
3. Check new ring gap:

Naturally aspirated models

Top compression = 0.25 to 0.35 mm
 Second compression = 0.3 to 0.5 mm
 Oil control rails = 0.38 to 1.14 mm

Turbo models

Top compression = 0.3 to 0.45 mm
 2nd compression = 0.3 to 0.5 mm
 Oil control rails = 0.25 to 0.5 mm

Pistons - inspection

1. Clean carbon from pistons.
2. Check pistons for distortion and cracks.
3. From markings on piston crown, determine which grade of piston - **A** or **B** is fitted.

Naturally aspirated models

4. Measure piston diameter at 90° to gudgeon pin axis and 10 mm from bottom of skirt.
 Grade A = 84.409 to 84.422 mm
 Grade B = 84.423 to 84.436 mm

Turbo models

5. Measure piston diameter at 90° to gudgeon pin axis and 8 mm from bottom of skirt.
 Grade A = 84.412 to 84.426 mm
 Grade B = 84.426 to 84.440 mm

All models

6. Measure piston/cylinder bore clearance 20 mm from bottom of cylinder bore.
 Grade A or B clearance in cylinder bore = 0.03 mm

Note: Oversize pistons are not available.

Cylinder bores - inspection

1. Clean carbon deposits from cylinder bore.
2. Measure wear in two axis 60 mm from top of cylinder bore.
 Cylinder bore
 Grade A = 84.442 to 84.455 mm

Grade B = 84.456 to 84.469 mm

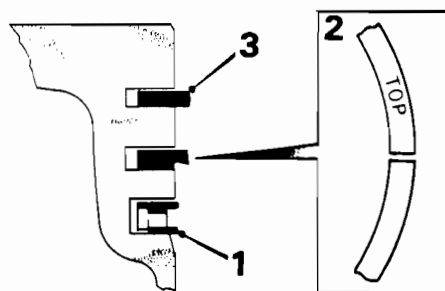
Note: Cylinder bore grade is stamped on a machined lug at the rear, R.H. side of cylinder block. Grade A cylinder bores may be machined to Grade B dimensions and grade B pistons fitted.

3. Break cylinder bore glazing, use fine grit to produce a 60° cross hatch.

CAUTION: Ensure all traces of grit are removed.

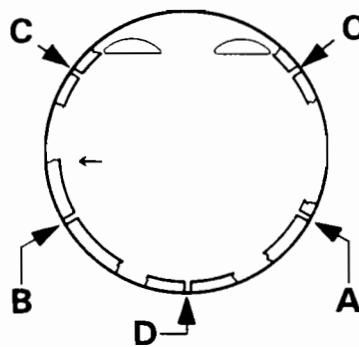
Pistons - assembly

Naturally aspirated models



12M 0308

1. Using a suitable expander fit oil control spring rails and expander.
2. Using a suitable expander fit 2nd compression ring with 'TOP' towards top of piston.
3. Using a suitable expander fit top compression ring either way up.

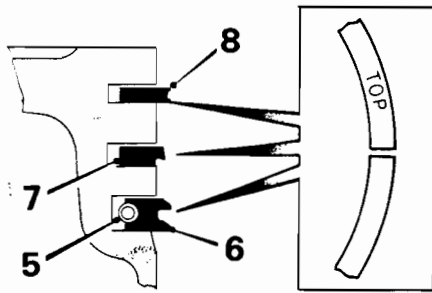


12M 0309

4. Position ring gaps as follows:
 Compression ring gaps **A** and **B** at 120° to each other and away from the inlet valve cut out side of the piston.
 Oil control rail gaps **C** at 120° to each other.
 Oil control expander gap **D** at 120° to oil control rail gaps.

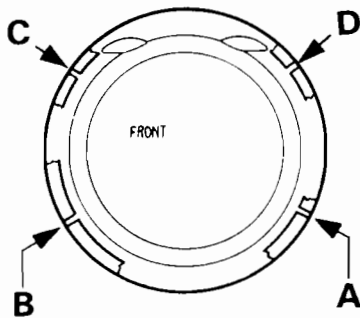


Turbo models



12M 0381

5. Fit oil control spring.
6. Using a suitable expander fit oil control ring with 'TOP' towards top of piston.
7. Using a suitable expander fit 2nd compression ring with 'TOP' towards top of piston.
8. Using a suitable expander fit top compression ring with 'TOP' towards top of piston.

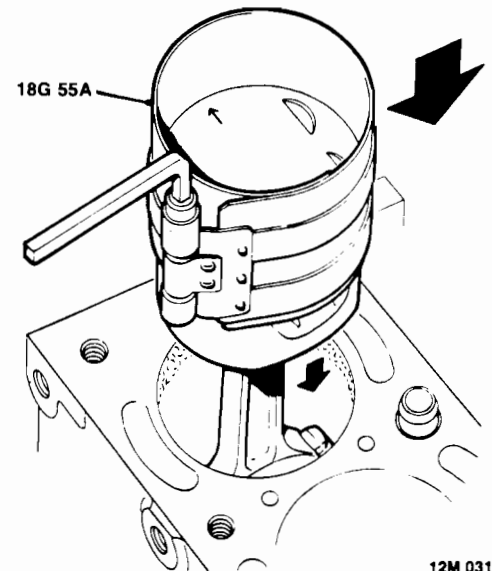


12M 0382

9. Position ring gaps as follows:
Compression ring gaps **A** and **B** at 120° to each other and away from the inlet valve cut out side of the piston.
Oil control rail gap **C** and spring gap **D** at 30° on opposite side of gudgeon pin axis.

All models

10. Fit big - end bearing shell to connecting rod.
11. Lubricate big - end bearing shell, piston rings and gudgeon pin with engine oil.
12. Lubricate cylinder bores and crankshaft big - end journal with engine oil.



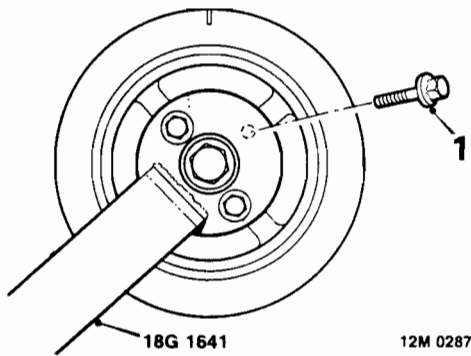
12M 0310

13. Fit ring clamp **18G 55A** to each piston in turn and compress piston rings.
14. Insert each piston and connecting rod into its respective cylinder bore ensuring arrow on piston crown points towards timing belt end of engine.
15. Fit big - end bearing caps and shells.
16. Fit cylinder head.

ENGINE

CRANKSHAFT, MAIN AND BIG - END BEARINGS

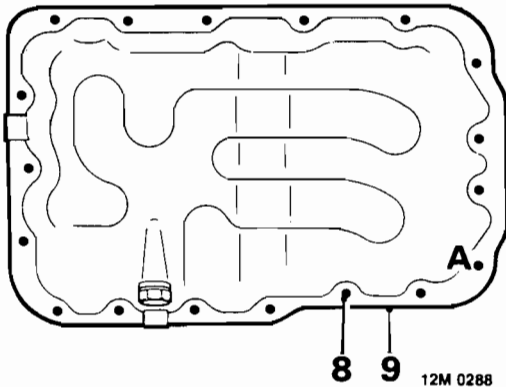
Remove



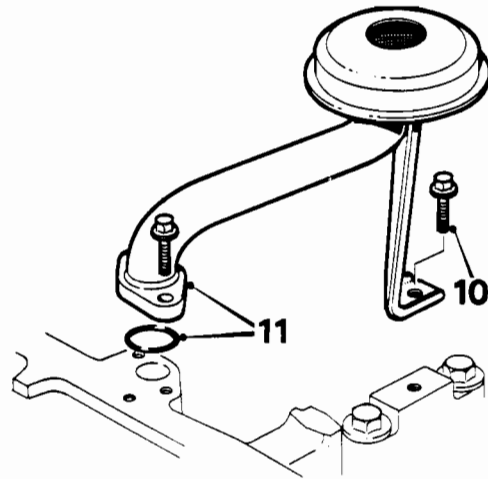
1. Remove 4 bolts securing crankshaft pulley to timing gear.
2. Fit holding tool **18G 1641** to crankshaft pulley, use 2 pulley bolts to retain tool.
3. Remove timing pin **18G 1523** from flywheel/drive plate.
4. Restrain crankshaft using holding tool **18G 1641** and remove 6 bolts securing flywheel/drive plate to crankshaft; discard bolts.
5. Remove flywheel/driveplate.

CAUTION: Do not allow crankshaft to rotate.

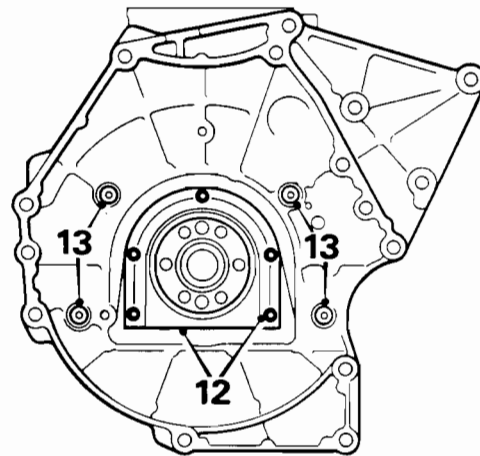
6. *Automatic gearbox:* Remove spacer from crankshaft boss.
7. Remove oil pump



8. Remove 18 bolts securing sump to crankcase noting fitted position of longest bolt 'A'.
9. Remove sump, discard gasket.



10. Remove 3 bolts securing oil strainer.
11. Remove strainer, discard 'O' ring.



12. Remove 5 bolts securing crankshaft rear oil seal housing, remove and discard housing and oil seal.

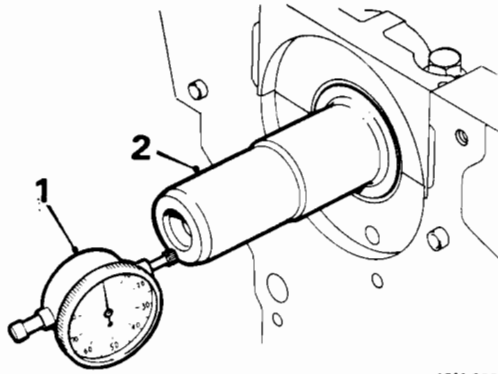
Note: Housing is located by dowels.

13. Remove 4 Torx screws securing gearbox adapter plate to cylinder block; remove plate.

Note: Adapter plate is dowel located.



Crankshaft end - float - check

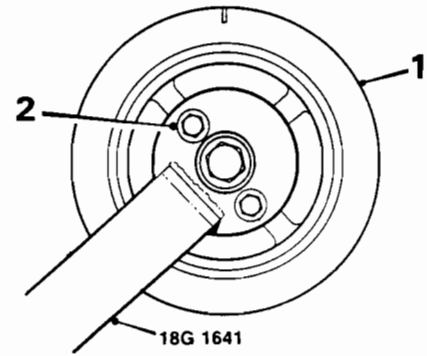


12M 0291

1. Attach a magnetic base D.T.I. gauge to front of cylinder block with stylus of gauge on end of crankshaft.
2. Move crankshaft rearwards and zero gauge.
3. Move crankshaft forwards, record end - float reading obtained; remove D.T.I. gauge.
Crankshaft end - float = 0.03 to 0.2 mm
Thrust washer halves thickness = 2.31 to 2.36 mm
Renew thrust washers to achieve correct end - float.

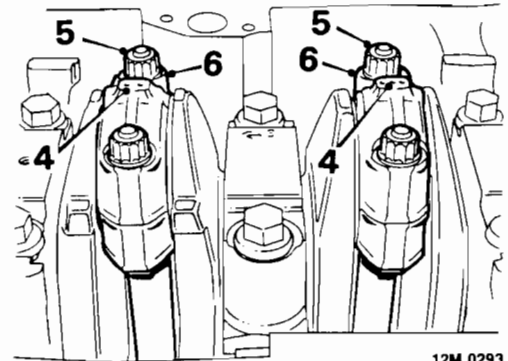
CAUTION: Thrust washers must be renewed in complete sets only.

Big - end bearings - remove



12M 0292

1. Position timing gear and crankshaft pulley on crankshaft.
2. Fit holding tool **18G 1641** to crankshaft pulley, use 2 pulley bolts to retain tool.



12M 0293

3. Rotate crankshaft to gain access to No. 2 and 3 big - end bearing cap nuts.

CAUTION: Do not rotate crankshaft more than 45°.

4. Suitably identify bearing caps to their respective connecting rods; make alignment marks to ensure correct refitting.
5. Remove 2 nuts securing each bearing cap.
6. Remove bearing cap and bearing shell.

CAUTION: Keep bearing caps and shells in their fitted order.

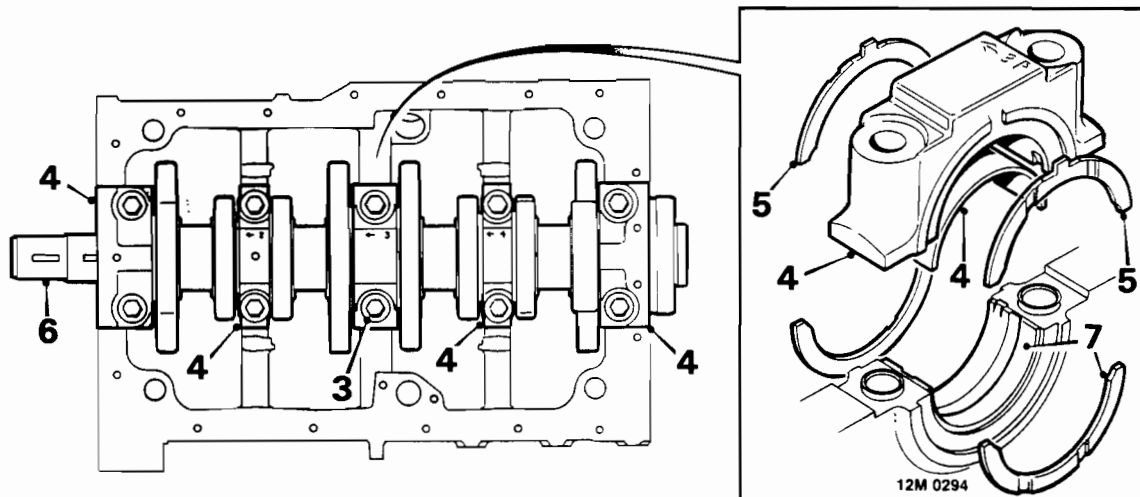
7. Repeat above operations for Nos. 1 and 4 big - end bearings.
8. Fit a length of plastic tubing over each connecting rod bolt.
9. Push each piston up its respective bore and remove bearing shells from connecting rods.

CAUTION: Do not allow pistons to contact valves; keep bearing shells in their fitted order.

10. Clean bearing caps and bearing shell recesses in connecting rods.

Crankshaft - remove

1. Remove big - end bearings.
2. Remove holding tool **18G 1641**, from crankshaft pulley and timing gear.



3. Starting at centre main bearing cap and working outwards, progressively slacken then remove 10 main bearing cap bolts.
4. Remove 5 main bearing caps and bearing shells, retain bearings with their caps.

CAUTION: Do not knock bearing caps sideways to remove them or locating dowels will be damaged.

5. Recover 2 thrust washer halves from centre main bearing cap.
6. Lift crankshaft from cylinder block.
7. Remove 5 bearing shells and 2 thrust washer halves, retain bearing shells in their fitted order.
8. Remove 2 Woodruff keys from crankshaft.
9. Clean crankshaft, blow out oil passages.
10. Clean bearing shell recesses and mating surfaces of cylinder block.
11. Clean main bearing caps.

Main bearings and journals – inspection

1. Check main bearing shells for wear and damage.
Bearing diametric clearance = 0.03 to 0.07 mm

Note: Oversize bearings are not available, new bearings and/or crankshaft must be fitted to regain tolerances. Crankshafts must not be reground.

2. Check crankshaft main and big – end journals for wear and ovality.

Main bearing journal diameter = 54.005 to 54.026 mm
 Maximum out of round = 0.010 mm
 Big – end bearing journal diameter = 47.648 to 47.661 mm

Maximum out of round – 0.010 mm

Note: Ovality checks should be made at 120° intervals around each journal.

Big – end bearings – inspection

1. Check big – end bearing shells for wear and damage. Bearing diametric clearance = 0.04 to 0.08 mm
2. Renew big – end bearing shells as necessary.

Note: Oversize bearings are not available, new bearings and/or crankshaft must be fitted to regain tolerances.

Assembly

1. Check fit of big – end bearing cap nuts on connecting rod bolts; if threads show signs of binding both bolt and nut must be replaced.

Note: Arrow on bolt head must face away from connecting rod.

2. Lubricate big – end bearing shells and fit to connecting rods and bearing caps.
3. Lubricate main bearing shells and fit to cylinder block and bearing caps.

Note: Front, centre and rear main bearing shells have an oil groove, intermediate main bearing shells are plain.

4. Lubricate thrust washer halves and fit to cylinder block and centre main bearing cap with the oil grooves facing away from the cap.

Note: The two tagged thrust washers are fitted in cylinder block.

5. Lubricate crankshaft journals and position crankshaft in cylinder block.



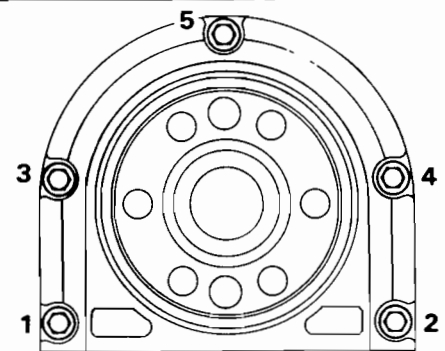
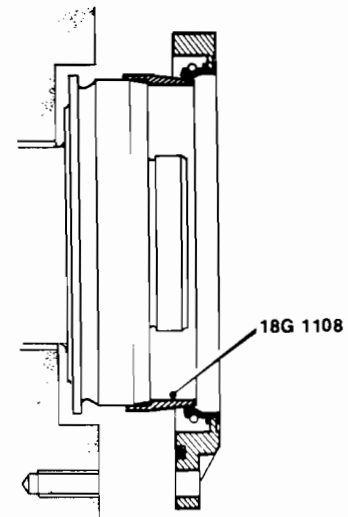
6. Fit main bearing caps and shells.

Note: Bearing caps are numbered from 1 to 5 with No. 1 bearing cap being nearest to timing belt. Ensure arrows on bearing caps point towards timing belt.

7. Lightly oil main bearing cap bolts.
8. Fit bearing cap bolts and starting from centre main bearing cap and working outwards, tighten bolts progressively to 110 Nm.
9. Fit 2 Woodruff keys in crankshaft.
10. Fit gearbox adapter plate, fit 4 Torx screws and tighten to 45 Nm.
11. Position timing gear and crankshaft pulley on crankshaft.
12. Fit holding tool **18G 1641** to crankshaft pulley, use 2 pulley bolts to retain tool.
13. Rotate crankshaft until Nos. 1 and 4 connecting rods can be located on crankshaft journals.
14. Fit Nos. 1 and 4 big - end bearing caps ensuring reference marks on connecting rods and bearing caps are aligned.
15. Fit bearing cap nuts and tighten to 55 Nm.
16. Repeat above operations for Nos. 2 and 3 big - end bearings.

CAUTION: Do not rotate crankshaft more than 45° either way.

17. Check crankshaft rear oil seal housing locating dowels are fitted in cylinder block.
18. Lubricate new crankshaft rear oil seal, sealing surface and tool **18G 1108**.



12M 0304

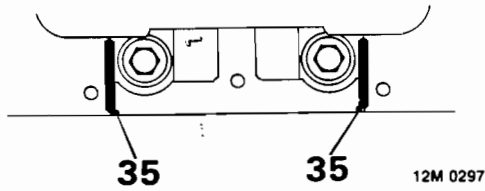
19. Position tool **18G 1108** on crankshaft.
20. Fit crankshaft rear oil seal and housing.
21. Fit housing securing bolts and working in sequence shown, tighten bolts to 8 Nm.
22. Remove tool **18G 1108**.
23. *Refitting original crankshaft:* Using an old flywheel bolt with two saw cuts at an angle of 45° to the bolt shank, clean flywheel drive plate bolt holes in crankshaft.

CAUTION: Do not use a tap.

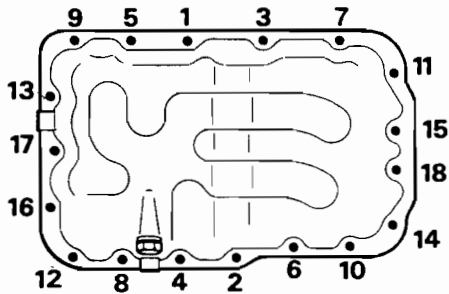
24. *Automatic gearbox:* Fit spacer to crankshaft.
25. Position flywheel/drive plate on crankshaft.
26. *Automatic gearbox:* Fit locking plate. Convex side of plate must face drive plate.
27. Fit new flywheel/drive plate securing bolts restrain crankshaft using tool **18G 1641**; tighten bolts to 110 Nm.
28. Ensure camshaft gear timing marks are aligned and fit camshaft locking tool **18G 1524**; tighten nut to retain tool.
29. Rotate crankshaft until timing pin **18G 1523** can be inserted into hole in flywheel/drive plate.
30. Remove crankshaft holding tool **18G 1641**, crankshaft pulley and timing gear.
31. Fit oil pump.
32. Ensure oil strainer is clean.
33. Lubricate a new 'O' ring and fit to oil strainer pipe.

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34. Fit oil strainer, fit securing bolts and tighten to 8 Nm.



35. Apply beads of RTV sealant to front main bearing cap.
36. Fit a new sump gasket ensuring nipples on gasket are located in sump flange recesses.
37. Fit sump.



38. Fit sump securing bolts ensuring longest bolt is fitted at position 14.
39. Tighten sump bolts:
Stage 1 = 3 Nm. work around sump in a clockwise direction starting at position 1.
Stage 2 = 8 Nm. work around sump in an anti-clockwise direction starting at position 1.
Stage 3 = 10 Nm. in numbered sequence.

**DATA****Oil pump**

Outer rotor to body clearance	0.05 to 0.10 mm
Inner rotor tip clearance	0.025 to 0.12 mm
Outer rotor end float	0.03 to 0.08 mm

Oil pressure relief valve

Spring free length	42.0 mm
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Cooling system

Starts to open	82 to 86°C
Thermostat fully open	88°C
Open travel A	9 mm

Camshaft

Camshaft end - float	0.06 to 0.25 mm
Bearing clearance	0.060 to 0.094 mm
Service limit	0.15 mm

Timing belt tensioner

Spring free length	57.5 to 58.5 mm
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Cylinder head

Longitudinal warp - maximum	0.1 mm
Transverse warp - maximum	0.1 mm
Diagonal warp - maximum	0.1 mm
Cylinder head height	135.0 to 135.1 mm

Valve springs

Free length	46.25 mm
Fitted length	37.0 mm
Load at fitted length	255 ± 12 N
Load at valve open length	560 ± 22.5 N

Valves

Valve stem diameter:

Inlet	7.09 to 7.10 mm
Exhaust	7.07 to 7.09 mm

Valve head diameter:

Inlet	31.7 to 31.95 mm
Exhaust	29.2 to 29.43 mm

Valve installed height - maximum

	43.4 mm
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Valve stem to guide clearance:

Inlet	0.04 to 0.06 mm
Service limit	0.09 mm
Exhaust	0.06 to 0.07 mm
Service limit	0.10 mm

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Valve guides

Internal diameter – Inlet and Exhaust	7.137 to 7.162 mm
Overall length:	
Inlet	48.5 mm
Exhaust	52.9 mm

Valve seats

Valve seat angle – Inlet and Exhaust	45°
Valve seat width – Inlet and Exhaust	1.5 to 2.0 mm
Valve face angle:	
Inlet and Exhaust	45° to 45° 15'

Crankshaft

End – float	0.03 to 0.2 mm
Thrust washer halves thickness	2.31 to 2.36 mm
Main journal diameter	54.005 to 54.026 mm
Maximum out of round	0.010 mm
Main bearing diametric clearance	0.03 to 0.07 mm
Big – end journal diameter	47.648 to 47.661 mm
Maximum out of round	0.010 mm
Big – end bearing diametric clearance	0.04 to 0.08 mm

Piston rings – naturally aspirated models

New ring to groove clearance:	
Top compression	0.06 to 0.09 mm
2nd compression	0.05 to 0.07 mm
Oil control rails – expander fitted	0.03 to 0.05 mm
Ring fitted gap:	
Top compression	0.25 to 0.35 mm
2nd compression	0.3 to 0.5 mm
Oil control rails	0.38 to 1.14 mm

Piston rings – turbo models

New ring to groove clearance:	
Top compression	0.08 to 0.09 mm
2nd compression	0.05 to 0.06 mm
Oil control	0.02 to 0.05 mm
Ring fitted gap:	
Top compression	0.3 to 0.45 mm
2nd compression	0.3 to 0.5 mm
Oil control rails	0.25 to 0.5 mm

Pistons – naturally aspirated models

Piston diameter:	
Grade A	84.409 to 84.422 mm
Grade B	84.423 to 84.436 mm
Clearance in bore	0.01 to 0.03 mm

Pistons – turbo models

Piston diameter:	
Grade A	84.412 to 84.426 mm
Grade B	84.426 to 84.440 mm
Clearance in bore	0.01 to 0.03 mm

Cylinder bore

Grade A	84.442 to 84.455 mm
Grade B	84.456 to 84.469 mm

