

Service Manual

Repairs and maintenance

Section 2 (21)

Reconditioning
engine
B 27, B 28

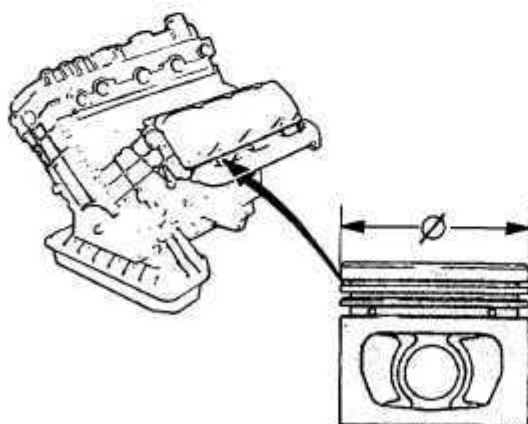
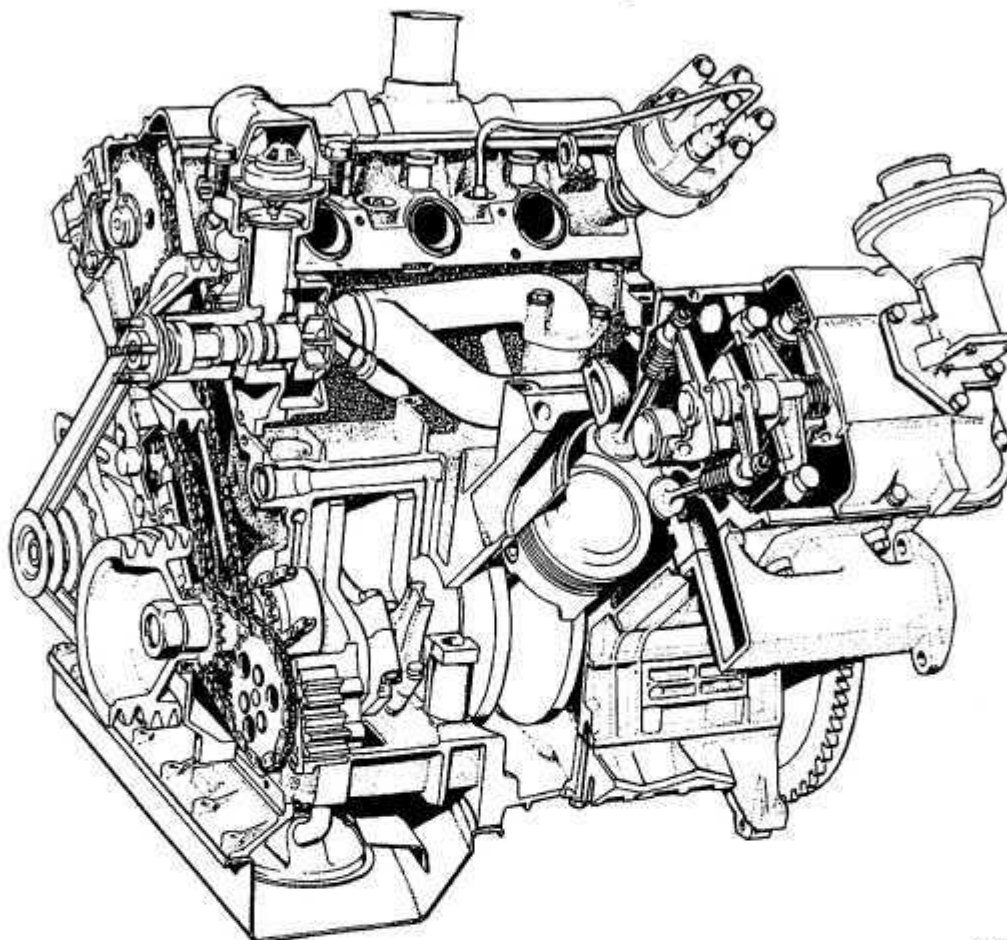
260 1975-1983

VOLVO



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Seattle, WA 98118 U.S.A.

B 27 A – B 27 E – B 27 F – B 28 A – B 28 E – B 28 F



The B 28 is in principle a B 27 with a larger bore.

What do these designations mean?

B 28 E

↓
A = carburetted engine
E = fuel injected engine
F = fuel injected engine "USA models"

↓
28(27) = capacity

↓
B = petrol (gasoline)

Engine type	Model year
B 27 A	1976–1979
B 28 A	1980–1982
B 27 E	1975–1980
B 28 E	1981–1983
B 27 F	1976–1979
B 28 F	1980–1982

Volvos are sold in versions adapted for different markets. These adaptations depend on many factors including legal, taxation and market requirements.

This manual may therefore show illustrations and text which do not apply to cars in your country.

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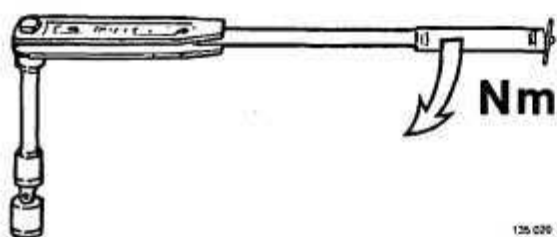
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This manual deals exclusively with the overhaul of the engine.
For work carried out on the engine when fitted in the car, and for engine removal and installation, please refer to the separate manuals.

Order number: TP 30447/1

We reserve the right to make alterations.

Important information



Tightening torques

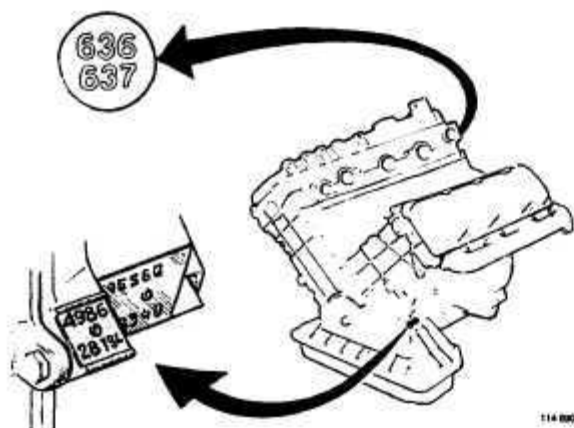
Nearly all of the B 27/28 engine is made of aluminium alloy. The threads are tapped directly into the alloy. For this reason it is extremely important that all of the bolts are tightened to specified torque.

Two types of tightening torques are used in this manual:

- I. Tightening torque **40 Nm (30 ft.lbs)** = a torque wrench must be used.
- II. Tightening torque **40 Nm (30 ft.lbs)** = correct value, however it is not necessary to use a torque wrench.

Specifications

Group 20 General



Engine serial number and part number

Located on a plate in front of the oil filter.

On B 28 E/F 1981- models: located on the rear of the right-hand cylinder head, shows the last three digits of the part number.

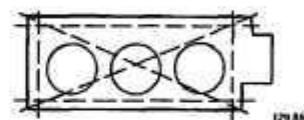
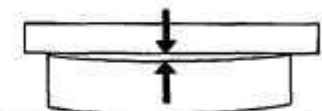
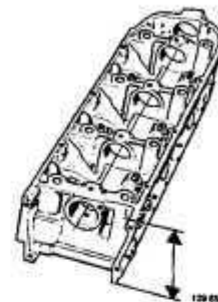
Group 21 Engine block

CYLINDER HEAD

Height New = 111.07 mm (4.373 in)

Max. warp is 0.05 mm over 100 mm.

NOTE! Do not level a warped cylinder head, replace it.



Cylinder head gasket thickness 1.14–1.50 mm (0.045–0.059 in)

CYLINDER BLOCK

Cylinder liners

Pistons and liners are matched sets.

Cylinder liners are marked by 1, 2 or 3 cuts in the upper edge of the liner.

Bore, liners marked 1 (A-marked piston).....	B 27 88.00–88.01 mm (3.4646–3.4650 in)	B 27 91.00–91.01 mm (3.5826–3.5830 in)
2 (B-marked piston).....	88.01–88.02 mm (3.4650–3.4654 in)	91.01–91.02 mm (3.5830–3.5835 in)
3 (C-marked piston).....	88.02–88.03 mm (3.4654–3.4657 in)	91.02–91.03 mm (3.5835–3.5838 in)
Liner height above block face.....	0.16–0.23 mm (0.0063–0.009 in)	
Shims for adjustment of liner height:		
thickness, blue paint marking.....	0.070–0.105 mm (0.0027–0.0041 in)	
white paint marking.....	0.085–0.120 mm (0.0033–0.0047 in)	
red paint marking.....	0.105–0.140 mm (0.0041–0.0055 in)	
yellow paint marking.....	0.130–0.165 mm (0.0051–0.0064 in)	

PISTONS

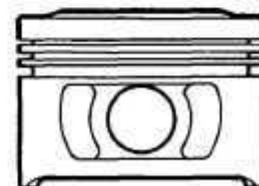
Pistons for B 27

Pistons and liners are matched sets.

Two different manufacturers supply pistons, see next page for specifications.



Demolin

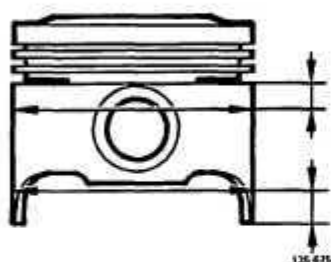


Mahle

Specifications

DEMOLIN PISTONS (B 27)

	B 27 A	1976–1979	
	B 27 E	1975–1978	
	B 27 F	1979	1976–1978
Height, overall		74 mm (2.9134 in)	63.4 mm (2.9960 in)
from gudgeon pin centre to piston crown		40 mm (1.5748 in)	39.4 mm (1.5512 in)
Weight		445±3 gram	
Max weight difference between pistons in same engine		6 gram	
Piston float		0.090–0.110 mm (0.0035–0.0043 in)	
Piston diameter, A-marked pistons		87.900–87.910 mm (3.4606–3.4610 in)	
B-marked pistons		87.910–87.920 mm (3.4610–3.4614 in)	
C-marked pistons		87.920–87.930 mm (3.4614–3.4618 in)	



Piston diameter is measured at right angles to gudgeon pin bore and:

11 mm (0.43 in) from lower edge of piston for B 27 F 1976–1978

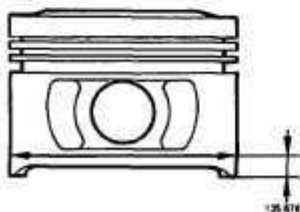
8.5 mm (0.33 in) from lower edge of oil scraper ring for other engines.

Diameter, gudgeon pin bore:

Marking piston	Marking gudgeon pin	
1	Blue	23.514–23.517 mm (0.9257–0.9259 in)
2	White	23.511–23.514 mm (0.9256–0.9257 in)
3	Red	23.508–23.511 mm (0.9255–0.9256 in)

MAHLE PISTONS (B 27)

	B 27 A	1976–1979	
	B 27 E	1975–1978	1979–1980
	B 27 F	1979	1976–1978
Height, overall		63.4 mm (2.4960 in)	62.2 mm (2.4488 in)
from gudgeon pin centre to piston crown		39.4 mm (1.5521 in)	38.2 mm (1.5039 in)
Weight		445±3 gram	65.3 mm (2.5709 in)
Max weight difference between pistons in same engine		6 gram	41.3 mm (1.6260 in)
Piston float		0.020–0.040 mm (0.0008–0.0016 in)	
Piston diameter, A-marked pistons		87.970–87.980 mm (3.4634–3.4638 in)	
B-marked pistons		87.980–87.990 mm (3.4638–3.4642 in)	
C-marked pistons		87.990–88.000 mm (3.4642–3.4646 in)	



Piston diameter is measured at right-angles to gudgeon pin bore, **8 mm (0.31 in)** from bottom edge.

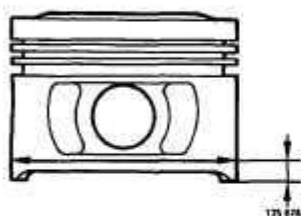
Diameter, gudgeon pin bore:

Marking piston	Marking gudgeon pin	
Blue	Blue	23.510 mm–23.513 mm (0.9255–0.9257 in)
White	White	23.507–23.510 mm (0.9254–0.9255 in)
Red	Red	23.504–23.507 mm (0.9253–0.9254 in)

Pistons for B 28

Pistons and liners are matched sets.
Only Mahle pistons are in use.

Weight.....	455±3 grams
Max weight difference between pistons in same engine.....	6 grams
Height, overall A- and F-engines.....	62.8 mm (2.4724 in)
E-engine.....	65.3 mm (2.5709 in)
from gudgeon pin centre to piston crown	
A- and F-engines.....	38.8 mm (1.5276 in)
E-engine.....	41.3 mm (1.6260 in)
Piston float.....	0.020–0.040 mm (0.0007–0.0015 in)
Piston diameter, A-marked pistons.....	90.970–90.980 mm (3.5814–3.5818 in)
B-marked pistons.....	90.980–90.990 mm (3.5818–3.5822 in)
C-marked pistons.....	90.990–91.000 mm (3.5822–3.5826 in)

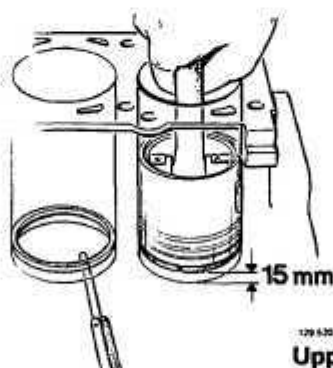
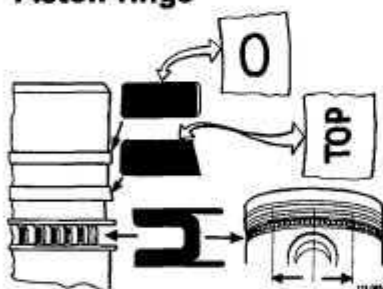


Piston diameter is measured at right-angles to gudgeon pin bore, 8 mm (0.31 in) from bottom edge.

Diameter, gudgeon pin bore:

Marking, piston	Marking, gudgeon pin	
Blue.....	Blue.....	23.510–23.513 mm (0.9255–0.9257 in)
White.....	White.....	23.507–23.510 mm (0.9254–0.9255 in)
Red.....	Red.....	23.504–23.507 mm (0.9253–0.9254 in)

Piston rings



Ring gap measured 15 mm (0.6 in) from lower edge of cylinder

	mm	Upper compression ring	Lower compression ring	Oil ring
Height.....		1.478–1.490	1.978–1.990	2.629–2.731
Side clearance (measured with ring on piston).....	in	9.0582–0.0587	0.0779–0.0783	0.1035–0.1075
	mm	0.045–0.074	0.025–0.054	0.009–0.233
	in	0.0017–0.0029	0.0009–0.0212	0.0003–0.0091
Ring gap when checked in 91 mm (3.5826 in) cylinder (B 28),				
88 mm (3.4646 in) (B 27), see fig.....	mm	0.40–0.60	0.40–0.60	0.38–1.45
	in	0.0157–0.0236	0.0157–0.0236	0.0150–0.0570

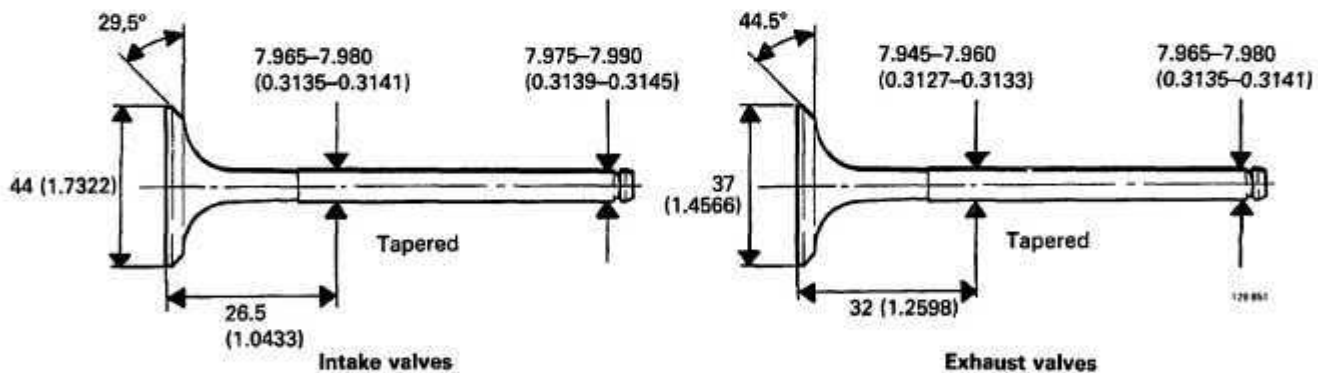
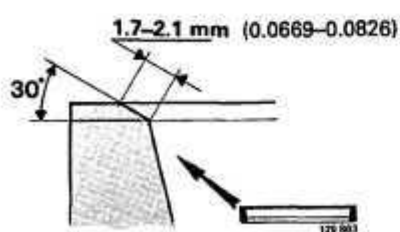
Gudgeon (piston) pins

Diameter

Marking, gudgeon pin	Marking, piston	
Blue.....	Blue (1).....	23.500–23.497 mm (0.9251–0.9250 in)
White.....	White (2).....	23.497–23.494 mm (0.9250–0.9249 in)
Red.....	Red (3).....	23.494–23.491 mm (0.9249–0.9248 in)
Clearance in connecting rod.....		0.020–0.041 mm (0.0007–0.0016 in)
piston, Mahle.....		0.010–0.016 mm (0.0003–0.0006 in)
Demolin.....		0.014–0.020 mm (0.0006–0.0008 in)

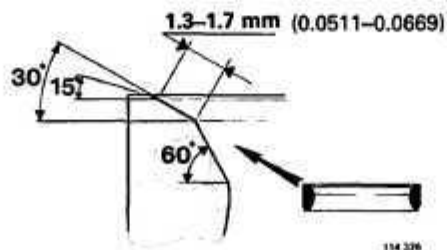
Valve clearances (varies with engine type)

Valve clearance mm (in)	Type 1	Type 2
Intake valves, cold engine.....	0.10–0.15 (0.004–0.006)	0.20–0.25 (0.008–0.010)
warm engine.....	0.15–0.20 (0.006–0.008)	0.25–0.30 (0.010–0.012)
Exhaust valve, cold engine.....	0.25–0.30 (0.010–0.012)	0.30–0.35 (0.012–0.014)
warm engine.....	0.30–0.35 (0.012–0.014)	0.35–0.40 (0.014–0.016)
Engine type – model year		
B 27 A 1976–1979.....	X	
B 28 A 1980.....		X
1981–1982.....	X	
B 27 E 1975–1978.....	X	
1979–1980 Sweden + Australia.....	X	
1979–1980 Other markets.....		X
B 28 E 1981–1983.....	X	
B 27 F 1976–1979.....	X	
B 28 F 1980.....		X
1981–1982.....	X	

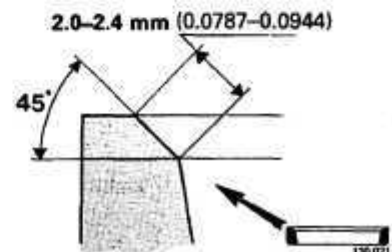
Valves mm (in)**Valve seats** mm (in)

Intake valve seat

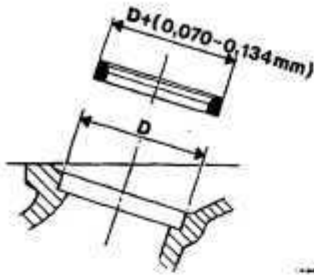
Early types



Intake valve seat
Late types (venturi seat): 15° and 60° are correct angles to reduce seat width.



Exhaust valve seat

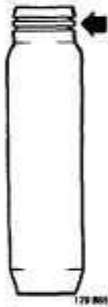


Note! When replacing valve seats: the interference between the valve seat and its bore in the cylinder head must be 0.070–0.134 mm, (0.0027–0.0052 in), i.e. the valve seat diameter must be 0.070–0.134 mm greater than the diameter of the bore in the cylinder head.

Valve seats are available in three oversizes.

Valve guides mm (in)

Length	50.1–51.3 (1.2725–1.3030)
Inner diameter	8.000–8.022 (0.3149–0.3158)
Press-in measurement to cylinder head contact surface against block:	
intake	39.5–40.5 (1.5551–1.5944)
exhaust	36.9–37.9 (1.4527–1.4921)



Valve guides are available in three oversizes, and are marked with grooves.

	Marking	Reamer for seat
Standard	No groove	—
Over size 1	1 groove	5166
2	2 grooves	5167
3	3 grooves	5168

Valve springs

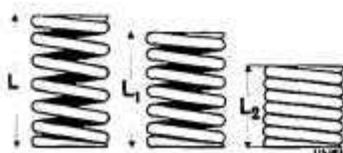
Two types of valve springs are in use. The springs are colour coded as follows:

Grey springs:

B 27 A	1976–1979
B 27 E	1975–1978
	1979–1980 Sweden + Australia
B 27 F	1976–1979

Green springs:

B 28 A	1980–1982
B 27 E	1979–1980 (excluding Sweden, Australia)
B 28 E	1981–1982
B 28 F	1980–1982



Grey springs:				Green springs:			
Length mm	in	Load N (kp)	lbs.	Length mm	in	Load N (kp)	lbs.
47.2	1.86	0	0	47.1	1.85	0	0
40.0	1.57	233–268 (23.3–26.8)	52–60	40.0	1.57	23.0–26.6	51–59
32.2	1.27	521–585 (52.1–58.5)	116–131	30.0	1.18	613–689 (61.3–68.9)	137–154

Specifications

Rocker arm mechanism

The rocker arm contact surface against the camshaft is surface-hardened and must not be ground.

Diameter, rocker arm shaft	19.959–19.980 mm (0.7857–0.7866 in)
Hole diameter, rocker arm	19.992–20.013 mm (0.7870–0.7879 in)
Clearance, shaft-rocker arm	0.012–0.054 mm (0.0005–0.0021 in)

TIMING GEARS

Camshaft



Three types of camshafts with different lift heights are in use.
The part number is marked on the front end.

Camshaft	Type 1	Type 2	Type 3
Marking (part number), left	79 10 245 522 (-143 or -144)	74 01 269 138	74 01 269 615
right	79 10 245 412	74 01 269 139	74 01 269 616
Max. lift height, left	5.144 (0.202 in)	6.004 (0.236 in)	5.96 (0.234 in)
right	5.059 (0.199 in)	6.004 (0.236 in)	5.96 (0.234 in)
Check of camshaft setting (cold engine): Adjust valve clearance on 1st and 6th intake valves to 0.7 mm (0.027 in), the intake valves should then open at,			
1st	BTDC	9°±3°	8°±3°
6th	BTDC	7°±3°	9°±3°
Engine type			
B 27 A 1976–1979	X		
B 28 A 1980		X	
1981–1982			X
B 27 E 1975–1978	X		
1979–1980 Sweden + Australia	X		
1979–1980 Other markets		X	
B 28 E 1981–1983			X
B 27 F 1976–1979	X		
B 28 F 1980		X	
1981–1982			X

Journal diameter, counting from front (all types): mm (in)

1st	40.440–40.465 (1.5921–1.5931)
2nd	41.040–41.065 (1.6157–1.6167)
3rd	41.640–41.665 (1.6393–1.6403)
4th	42.240–42.265 (1.6629–1.6639)
Radial play	0.035–0.085 (0.0013–0.0033)
End float, new	0.070–0.144 (0.0027–0.0056)
max.	0.5 (0.0196)

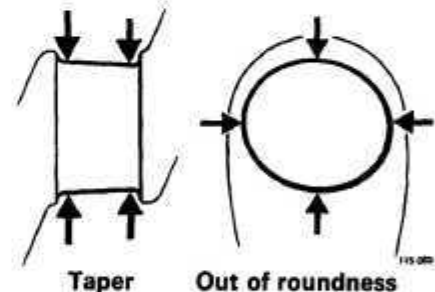
CRANK MECHANISM

Crankshaft

Max run-out (measured on two centre main bearing journals) .	0.02 mm	(0.0007 in)
Crankshaft, end float	0.070–0.270 mm	(0.0027–0.0106 in)
clearance (main bearings)	0.038–0.088 mm	(0.0014–0.0034 in)
Crank journals, side clearance	0.20–0.38 mm	(0.0078–0.0149 in)
clearance	0.030–0.080 mm	(0.0011–0.0031 in)
Rear sealing ring diameter, standard	79.926–80.000 mm	(3.1466–3.1496 in)
undersized	79.726–79.800 mm	(3.1388–3.1417 in)

Main bearing journals

Out of roundness, max.	0.007 mm	(0.0002 in)
Taper, max	0.01 mm	(0.0003 in)
Diameter, standard	70.043–70.062 mm	(2.7575–2.7583 in)
undersized	69.743–69.762 mm	(2.7457–2.7465 in)
Main bearing shells, thickness, standard	1.961–1.967 mm	(0.0772–0.0774 in)
oversized	2.111–2.117 mm	(0.0831–0.0833 in)
Width of crankshaft journal for thrust bearing (rear main bearing journal):		
standard	29.20–29.25 mm	(1.1496–1.1515 in)
oversized 1	29.40–29.45 mm	(1.1574–1.1594 in)
2	29.50–29.55 mm	(1.1614–1.1633 in)
3	29.60–29.65 mm	(1.1653–1.1673 in)
Thrust bearing washer, thickness, standard	2.30–2.35 mm	(0.0905–0.0925 in)
oversized 1	2.40–2.45 mm	(0.0944–0.0964 in)
2	2.45–2.50 mm	(0.0964–0.0984 in)
3	2.50–2.55 mm	(0.0984–0.1003 in)



Connecting rod bearing journals

Out of roundness, max.	0.007 mm	(0.0002 in)
Taper, max	0.01 mm	(0.0003 in)
Diameter, standard	52.267–52.286 mm	(2.0577–2.0585 in)
undersized	51.967–51.986 mm	(2.0456–2.0466 in)
Connecting rod bearing shells, thickness, standard	1.842–1.848 mm	(0.0725–0.0727 in)
undersized	1.992–1.998 mm	(0.0784–0.0788 in)
Bearing journal width	39.99–40.09 mm	(1.5744–1.5783 in)

Connecting rods

End float on crankshaft (both con rods fitted)	0.20–0.38 mm	(0.0078–0.0149 in)
Length between centres	146.15 mm	(5.7539 in)
Max weight difference between con rods in same engine	±2.5 grams	

Flywheel

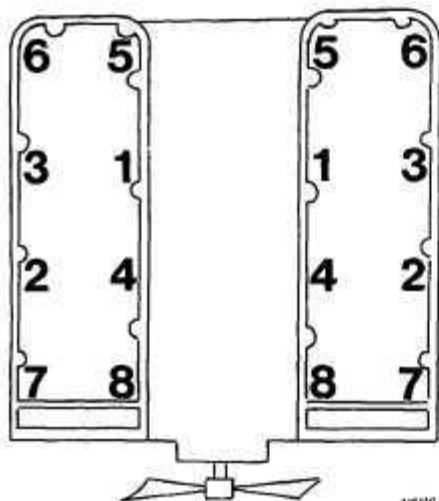
Axial throw, max	0.05 mm	(0.0019 in)
Radial throw, max (measured at diameter 282.4 mm)	0.15 mm	(0.0059 in)

Specifications

TIGHTENING TORQUES

The tightening torques shown below apply to oiled nuts and bolts.

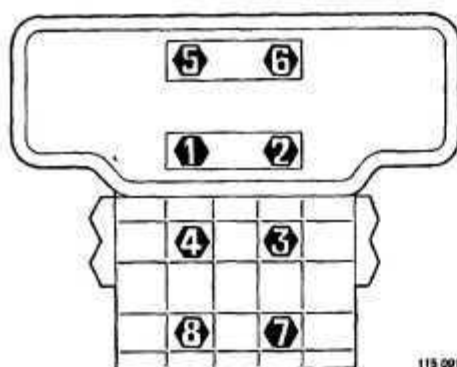
Degreased (washed) parts must be oiled prior to assembly.



Tightening sequence for cylinder head bolts

Tighten all bolts in stages according to below:

- 1 = 10 Nm (1 kpm = 7 ft. lbs)
 - 2 = 30 Nm (3 kpm = 22 ft. lbs)
 - 3 = 60 Nm (6 kpm = 44 ft. lbs)
 - 4 = Wait 10–15 minutes
 - 5 = Slacken bolts
 - 6 = 15–20 Nm (1.5–2.0 kpm = 11–15 ft. lbs)
 - 7 = Angle-tighten to 113–117°
 - 8 = Warm-up engine to operating temperature
 - 9 = Cool block 30 minutes
 - 10 = Slacken and then retighten bolts one at a time in specified tightening order.
- Retighten according to stages 6 and 7.



Tightening sequence for main bearings (via lower crankcase)

Main bearings

Tighten all nuts in stages:

- 1 = 30 Nm (22 ft. lbs)
- 2 = Slacken nut 1
- 3 = Tighten nut 1 to 30–35 Nm (22–26 ft. lbs.)
- 4 = Angle-tighten nut 1 73°–77°
- 5 = Slacken and retighten the other nuts in the order specified in stages 2–4.

Cylinder head (see below)

Connecting rod bearings

Crankshaft front end, 1975–1977

1978–

Nm

ft. lbs.

45–50

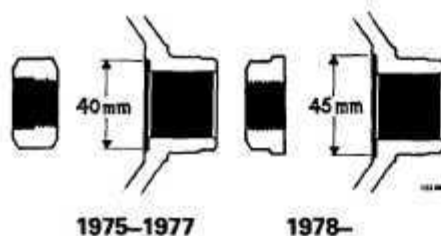
33–37

160–180

118–133

240–280

177–207



40 mm = 1.575 in

45 mm = 1.772 in

1975–1977

1978–

Camshaft sprocket

Flywheel (always use new bolts)

Spark plugs (do not oil)

Valve cover

Nm

ft. lbs.

70–90

52–66

45–50

33–37

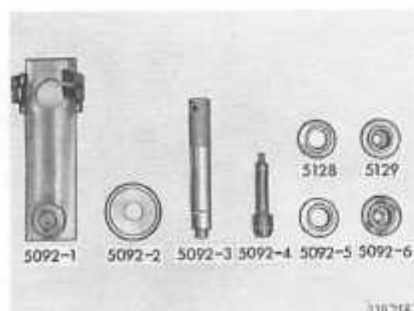
12±2

9±1.5

15

11

999	Description – use
5092-5	Combined tools: (6 parts) removing – fitting gudgeon (piston) pins 5128 and 5129 also required for Mahle pistons.
5093-3	Retainer: (4 x) for cylinder liners
5096-6	Spacer sleeve: main bearings
5098-2	Protractor: for angle-tightening cylinder head bolts and main bearing nuts
5099-0	Fixture: for engine. Used with 2520
5101-4	Drift: fitting pilot bearing in crankshaft (early type). Used with 1801
5103-0	Drift: fitting crankshaft front oil seal
5108-9	Drift: fitting valve guide – intake
5109-7	Drift: fitting valve guide – exhaust
5111-3	Centering drift: clutch, M45/46 gearboxes (late type)
5112-1	Locking sector: locking flywheel
5113-9	Centering drift: clutch, M50/51 gearboxes
5128-7	Piston support: removing gudgeon pin from Mahle piston. Used with 5092
5129-5	Piston support: fitting gudgeon pin in Mahle piston. Used with 5092
5165-9	Reamer kit: valve guides: contains 5164 (early type), 5224 (late type), 5166, 5167 and 5168
5166-7	Reamer: valve guide seat oversize 1
5167-5	Reamer: valve guide seat oversize 2
5168-3	Reamer: valve guide seat oversize 3
5192-3	Support: for dial indicator. Measuring cylinder liner height and piston height. Also 5094 can be used
5218-6	Drift: removing valve guides. Fitting oil seal on valve guide
5220-2	Drift: fitting valve seat – exhaust
5224-4	Reamer: cleaning valve guides. Also 5164 can be used
5953-8	Drift: fitting crankshaft rear oil seal. Used with 1801



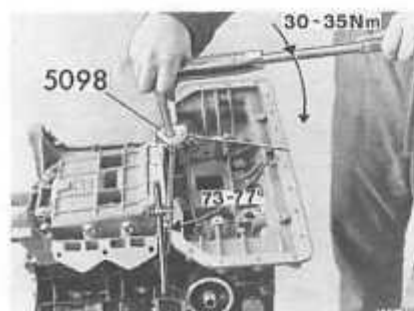
5092



5093



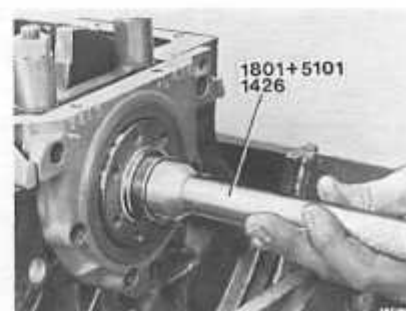
5096



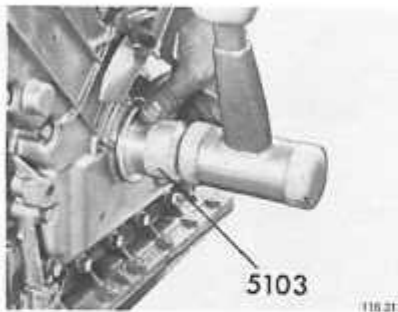
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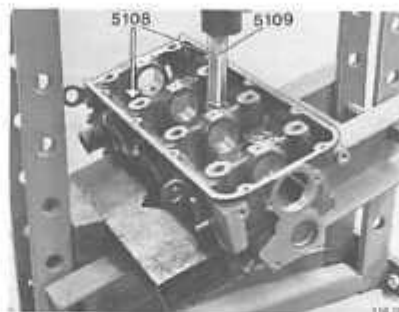
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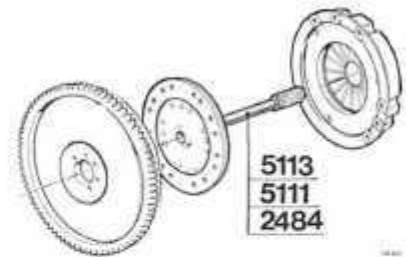
5101



5103



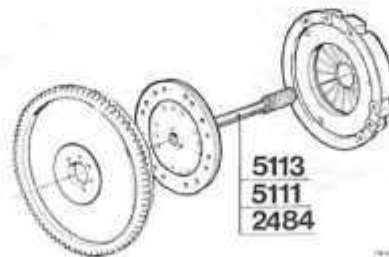
5108, 5109



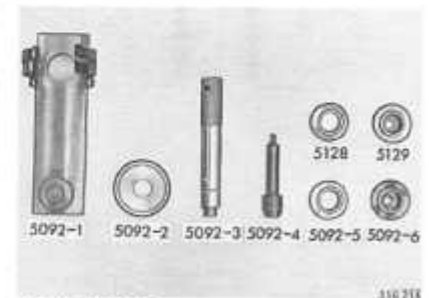
5111



5112



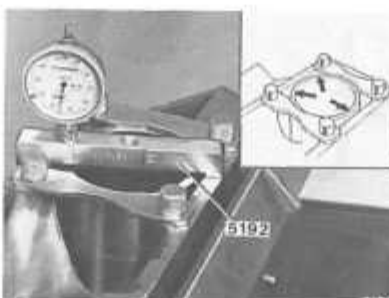
5113



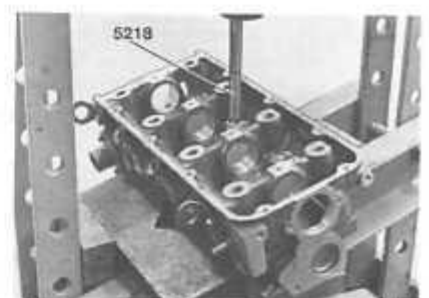
5128, 5129



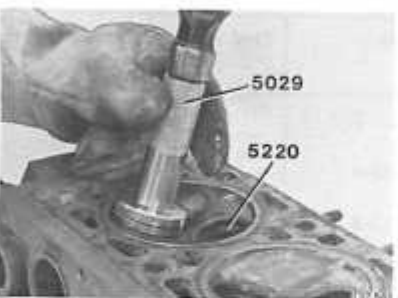
5165 (5166, 5167, 5168)



5192



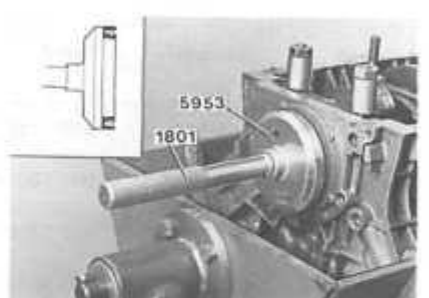
5218



5220

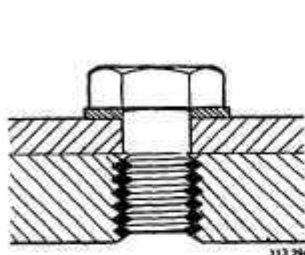


5224



5953

A. Thread repairs



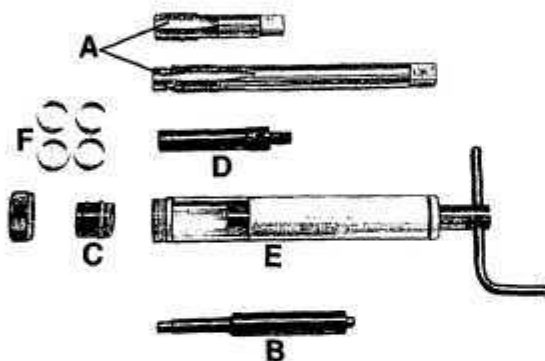
A1

General

A damaged thread can usually be repaired with a thread insert. Thread inserts and installation tools are available from Volvo Parts.

Note! Some threads can/may not be repaired with thread inserts, see next page.

A2



130 364

Installation tools

Tools to install thread repair inserts are supplied in kits. Some thread inserts are also included in the kits. See the table below.

Note! Each tool can be ordered separately.

Thread	Complete kit	Contents of complete kit					
		Tap A	Tang B	Mandrel C	Crank D	Tool E	Thread inserts (10 x) F
M 6x1	998 5840-9	998 5802-9	998 5803-7	998 5804-5	998 5805-2	4)	956014-5 + 956015-2
M 7x1	998 5841-7	998 5806-0	998 5807-8	998 5808-6	998 5809-4	4)	948015-3 + 941843-5
M 8x1.25	998 5842-5	998 5810-2	998 5811-0	998 5812-8	998 5813-6	4)	956018-6 + 956019-4
M 10x1.5	998 5843-3	998 5814-4	998 5815-1	998 5816-9	998 5817-7	4)	956022-8 + 956023-6
M 12x1.5	998 5844-1	998 5818-5	998 5819-3	998 5820-1	998 5821-9	4)	948094-8 + 948095-5
M 14x1.25	998 5845-8 ¹⁾	998 5823-5	2)	998 5824-3	998 5825-0	4)	948756-2
M 14x1.25	998 5846-6	998 5826-8	2)	998 5824-3	998 5825-0	4)	948756-2
M 14x1.5	998 5847-4	998 5827-6	2)	998 5828-4	998 5829-2	4)	948758-8
M 16x1.5	998 5848-2	998 5831-8	2)	3)	3)	998 5832-6	947847-0
M 18x1.5	998 5849-0	998 5833-4	2)	3)	3)	998 5834-2	947843-9
5/8"- 18UNF	998 5850-8	998 5860-7	2)	3)	3)	998 5861-5	948755-4

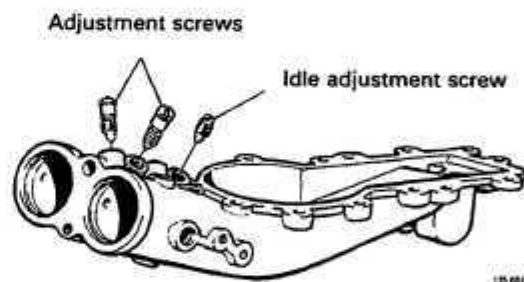
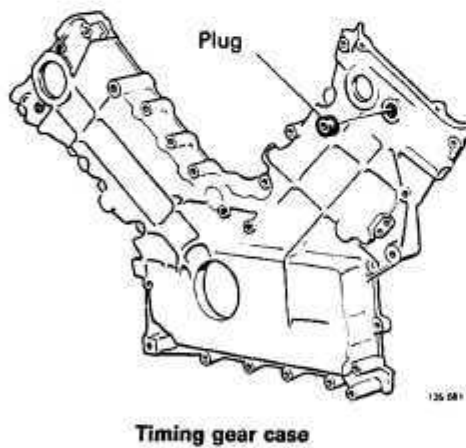
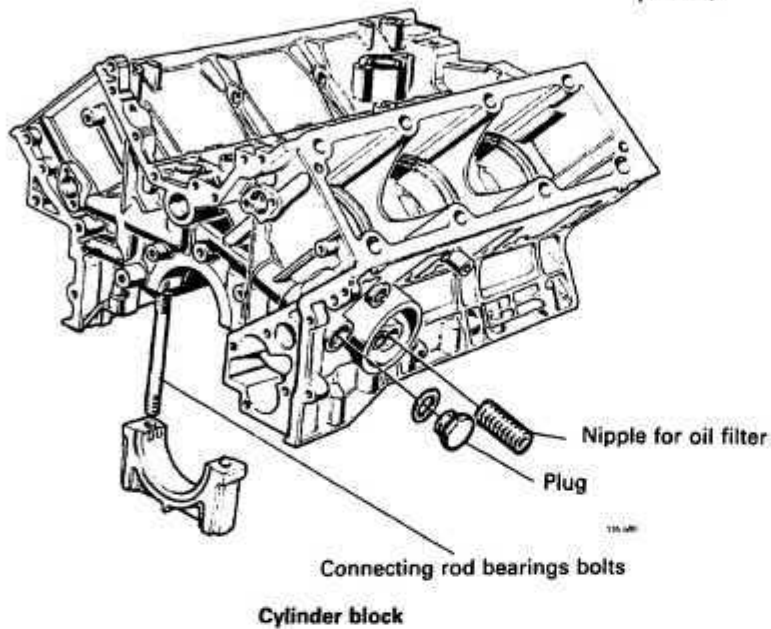
Notes:

- ¹⁾ Designed especially for spark plug threads (do not drill).
- ²⁾ Use flat nosed pliers or similar tool.
- ³⁾ Supplied with set.
- ⁴⁾ Tool 998 5830-0 is not supplied with complete kit, but may be ordered separately.

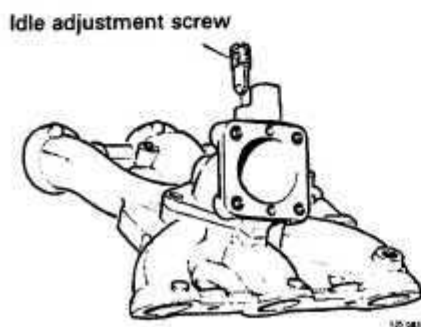
A3

Do not repair these threads

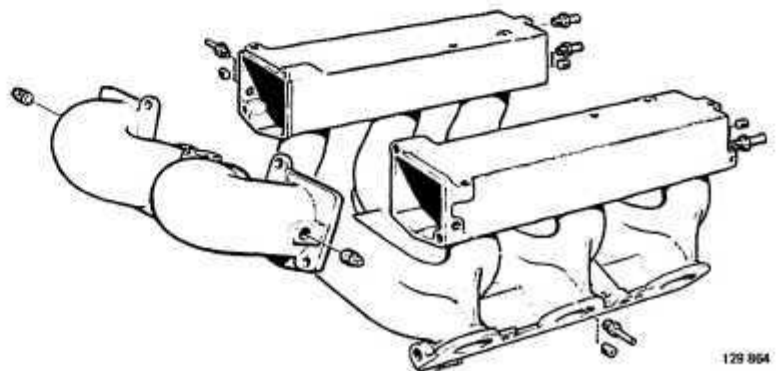
(Threads shown below cannot or must not be repaired)



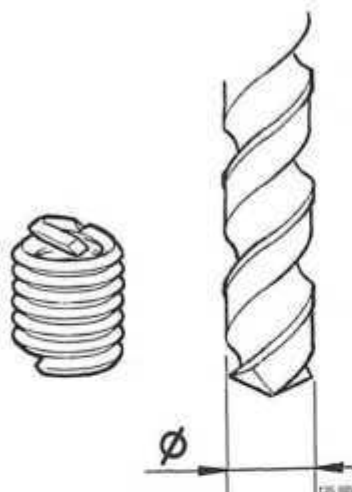
Lower section of air-fuel control unit
B 27 E 1979-, B 28 E, B 27/28 F



Intake manifold B27/B28



All conical threads such as plugs and nipples in intake manifold (also B 28/B 28 A)

Thread repair insert,
drill diameter

Thread	Length mm	P/N	Drill dia mm
M 6x1	9.0	956014-5	6.3
	12.0	956015-2	6.3
M 7x1	10.5	948015-3	7.3
	14.0	941843-5	7.3
M 8x1.25	8.0	956017-8	8.4
	11.4	956018-6	8.4
	16.0	956019-4	8.4
M 10x1.5	10.0	956021-0	10.5
	15.0	956022-8	10.5
	20.0	956023-6	10.5
	25.0	956024-4	10.5
M 12x1.5	12.0	948094-8	12.5
	24.0	948095-5	12.5
	30.0	956028-5	12.5
M 14x1.25	14.5	948756-2	14.3
M 14x1.5	10.0	948758-8	14.5
M 16x1.5	12.0	947847-0	16.5
Mx18x1.5	13.5	947843-9	18.5
5/8"x18UNF	8.0	948755-4	16.4

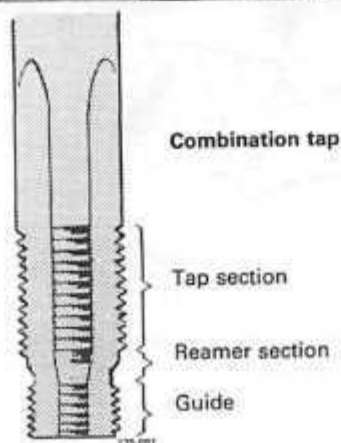
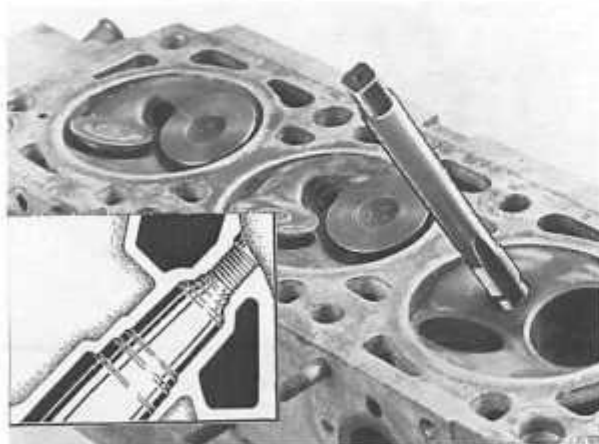
Repairing spark plug threads

Cylinder head must be removed first. Tap hole from inside to avoid damaging seat for spark plug.

Do not drill the hole. Use tap 998 5823-5.

Re-cut old threads only. Do not cut further into cylinder head. Spark plug bore must not be threaded along entire length.

Screw in thread insert (P/N 948756-2).

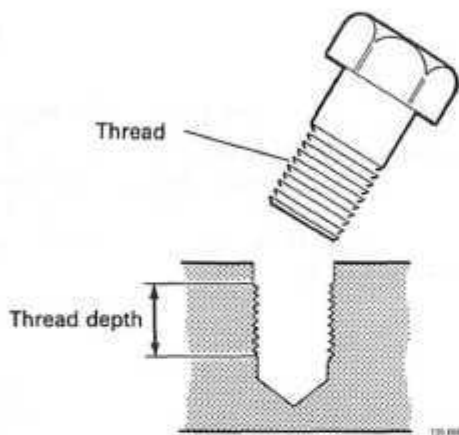


Installing thread inserts

A6

Select drill size, tap and insert

Measure length and thread of old hole.



A7

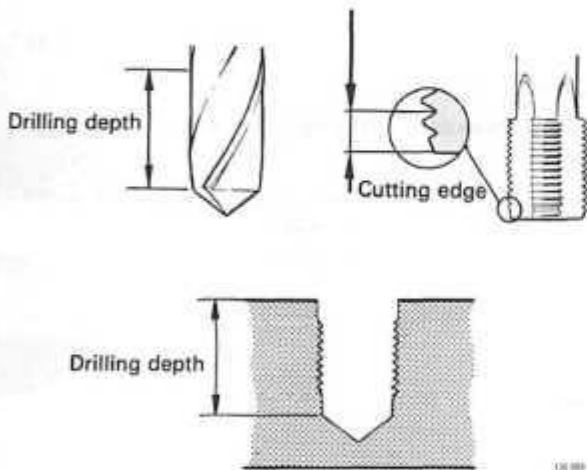
Tap hole

NOTE! Special instructions for spark plug holes, see page 16.

Measure depth of hole. Drill out hole to this depth.

Cut the screw thread to such a depth that the thread insert makes contact with fully cut screw thread along its entire length.

Clean the hole.



A8

Assemble installation tool

M6-M14 threads: fit correct mandrel and crank in installation tool 998 5830-0.

M16 and coarser threads: use the prescribed complete installation tool.



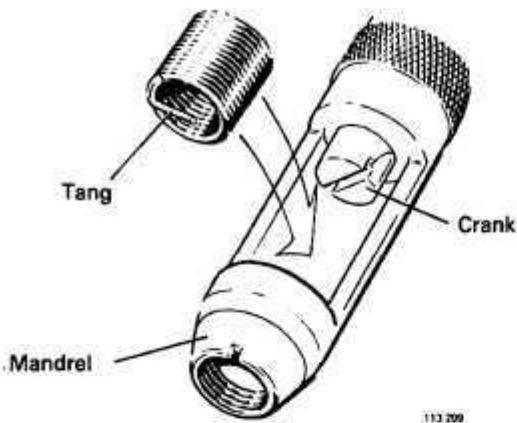
A9

Fit thread insert in installation tool

Fit the thread insert in the tool with the tang facing downwards.

Turn the crank clockwise until the tang of the thread insert engages the slot in the crank.

Without pressing, screw the thread insert into the mandrel until the first thread of the insert is flush with the opening of the mandrel.

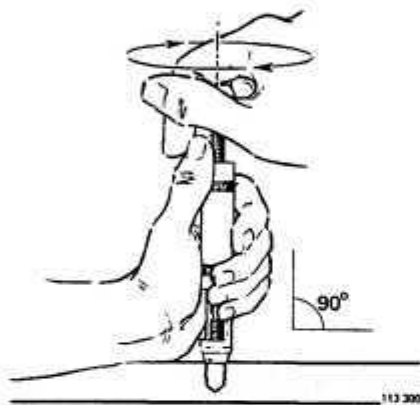


A10

Install thread insert

Hold the tool vertically above the centre of the hole.

Without pressing, screw in the thread insert until the top thread of the insert is at least 1/2 a thread below the working surface (0.5 x pitch). The insert must not be screwed in to the bottom otherwise it will not be possible to break off the tang.



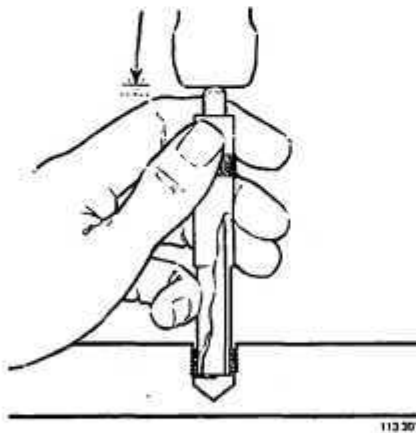
A11

Break off tang

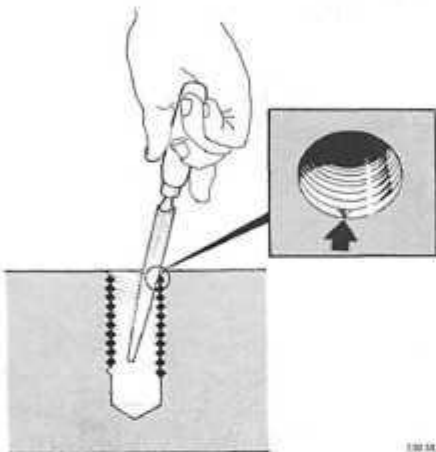
M16-M12 threads: use the tang breaker in the installation kit.

M14 and coarser threads: use a pair of flat nosed pliers to break off the tang downwards.

Remove the tang from the hole.



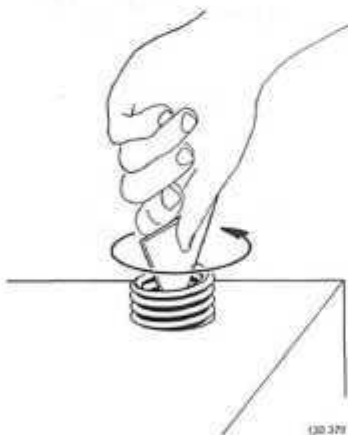
Removing thread repair inserts



A12

File groove in thread insert

Using a triangular file make a groove in the top thread of the insert, approx. 1/4 of a thread from the end. Take care not to damage the thread holding the insert.



A13

Remove thread insert

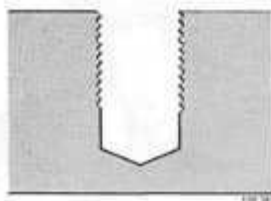
Insert a sharp edge of a triangular scraper in the groove. Press downwards and rotate anti-clockwise until the insert is removed.



A14

Fit new thread insert

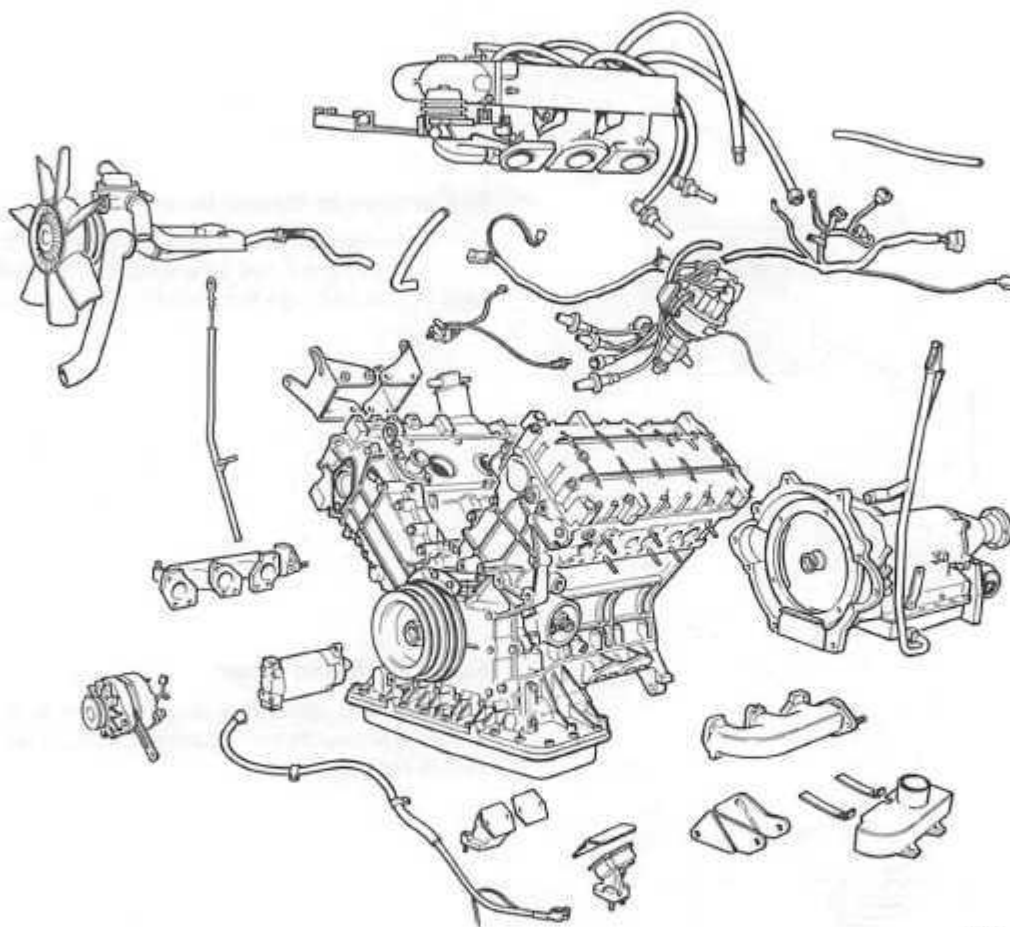
Clean the hole with a tap and fit a new insert.



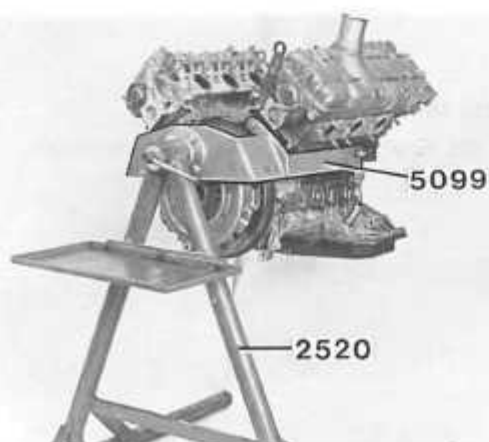
Reconditioning engine

Special tools: 1426, 1801, 2484, 2520, 4090, 5029, 5092, 5093, 5096, 5098, 5099, 5101, 5103, 5108, 5109, 5111, 5112, 5128, 5129, 5165, 5192, 5218, 5220, 5953

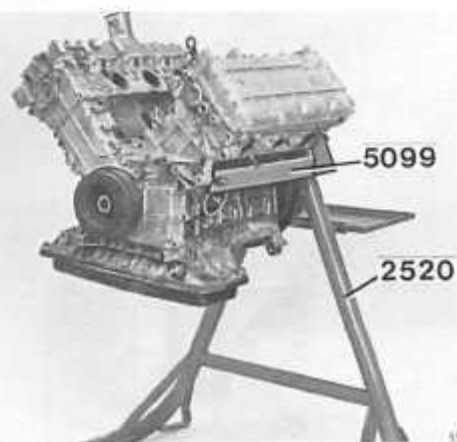
For the overhaul of the engine it is presumed that the components shown in the illustration below have already been removed. Also that the engine is mounted on universal stand 2520 with support 5099.



138 061



139 600



139 101

B. Engine, disassembly

B1

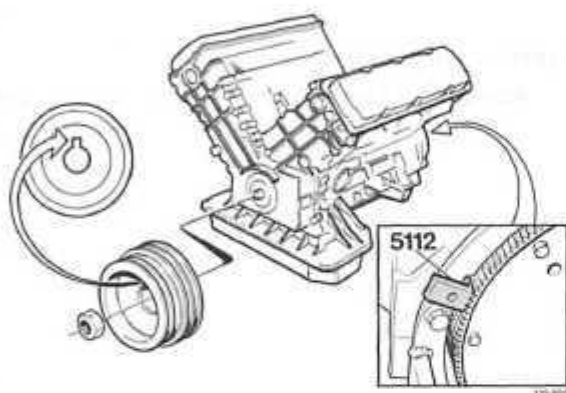
TIMING GEARS

Remove crankshaft pulley

36 mm socket.

Use locking sector **5112** to prevent engine from rotating.

Pulley key must point upwards when pulley is removed otherwise it will drop into crankcase.



B2

Remove:

- valve covers
- timing gear case
- seal from timing gear case.

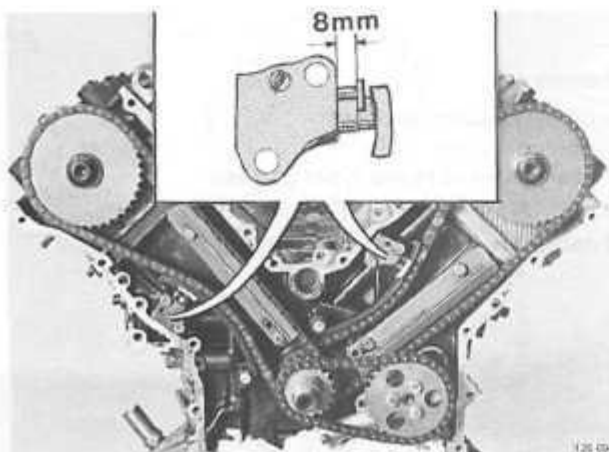
Cover holes in crankcase with e.g. paper to prevent dirt from entering.



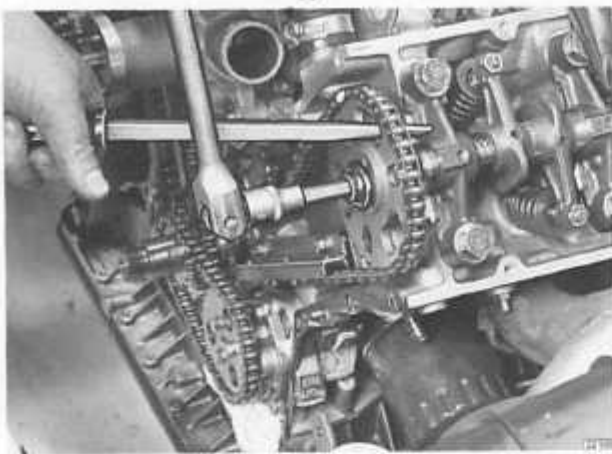
B3

Check chain wear

Check position of belt tensioners. If tensioner pin protrudes by 4 or more notches (8 mm = 0.32") chains should be renewed.



IMPORTANT! If chains are replaced, sprockets and oil strainers must also be replaced.

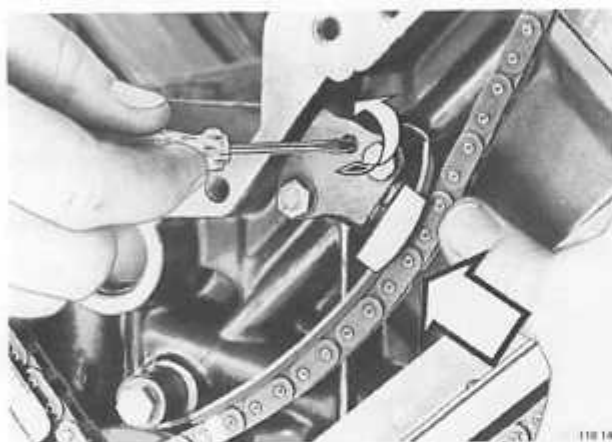


B4

Slacken camshafts centre bolts

Allen key 10 mm.

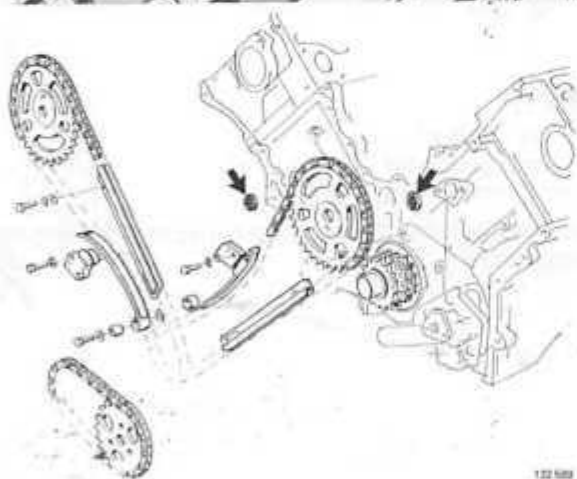
If necessary prevent sprocket from rotating with a screwdriver.



B5

Slacken timing gear chains

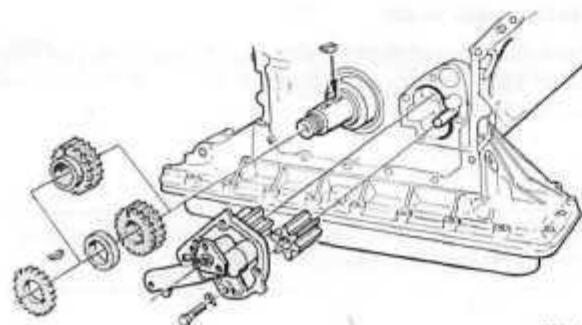
Turn each lock 1/4 turn anti-clockwise and push in piston.



B6

Remove:

- oil pump sprocket and chain
- chain tensioners and oil strainers (see arrows)
- bent and straight chain dampers
- camshaft sprockets and chains.

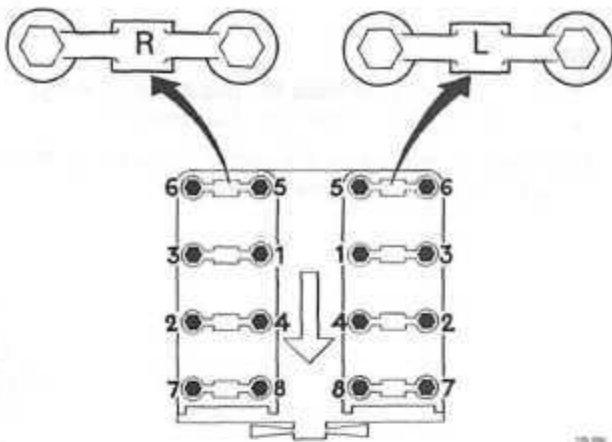


B7

Remove:

- oil pump with sprocket
- outer sprocket
- spacer sleeve (early type) and key
- inner sprocket and key.

If necessary use a puller to remove sprockets.

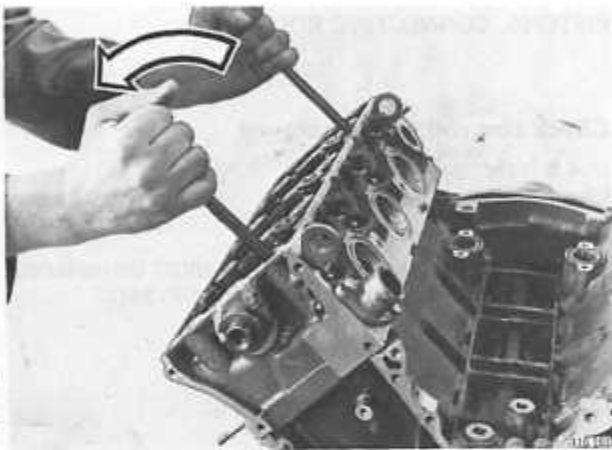
**CYLINDER HEAD**

B8

Remove rocker arms

Mark left and right rocker arms.

Slacken bolts in sequence shown adjacent.



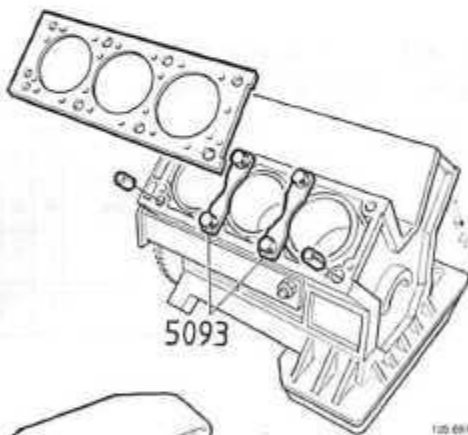
B9

Remove cylinder heads

Do not lift cylinder head directly up otherwise cylinder liners may lift as well.

Use two bars (Ø 12 mm, length 300 mm) and lift off cylinder head as illustrated.

Place cylinder heads on wooden blocks to prevent damage.



B10

Remove:

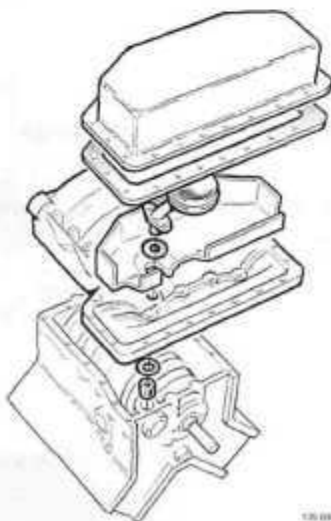
- cylinder head gaskets
- guide sleeves, use a pair of pliers.

B11

Fit liner holders 5093

Two per side.

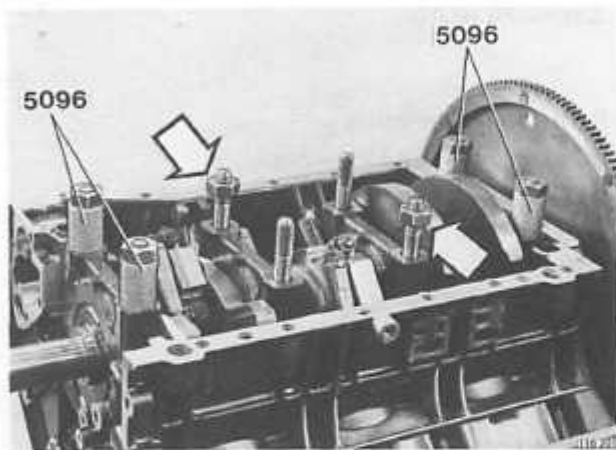
Liner holders must always be used when cylinder head is removed.

**OIL SUMP, LOWER CRANKCASE**

B12

Remove:

- oil sump with gasket
- oil strainer with O-ring
- splash panel
- lower crankcase
- O-ring for oil channels and guide sleeve.

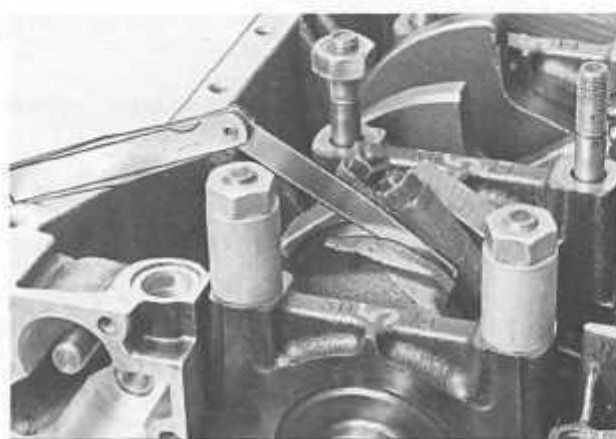


B13

Install:

- main bearing holder **5096** for two outer bearings
- a nut for the two centre main bearings.

This is to prevent the crankshaft/main bearings from falling out when the engine is turned.



PISTONS, CONNECTING RODS

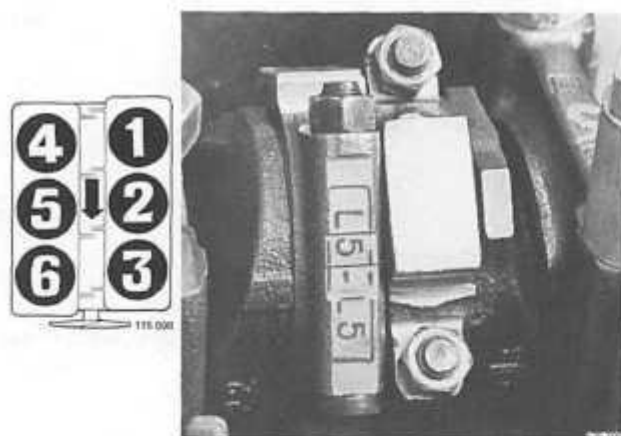
B14

Check con rod side clearance

Use a feeler gauge.

Clearance, new parts **0.20–0.38 mm**
(0.008–0.015")

If clearance is too great, con rods must be replaced.
Note that con rods must be replaced in sets.



B15

Check marking of con rod and cap

If necessary mark as follows:

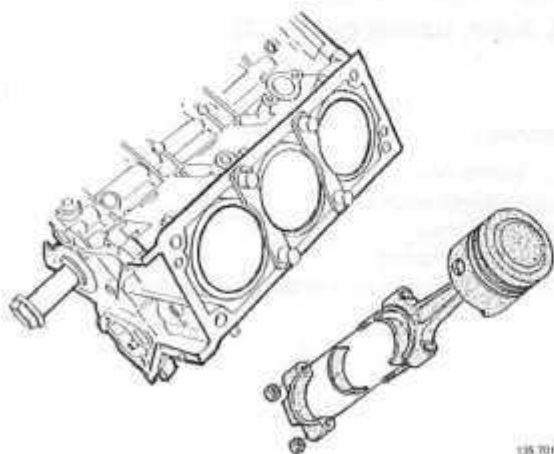
Cylinder	1	4	2	5	3	6
Marking of con rod and cap	early type					
	A	B	C	D	E	F
	late type					
	1	2	3	4	5	6
Crank webs (from rear)	1		2		3	

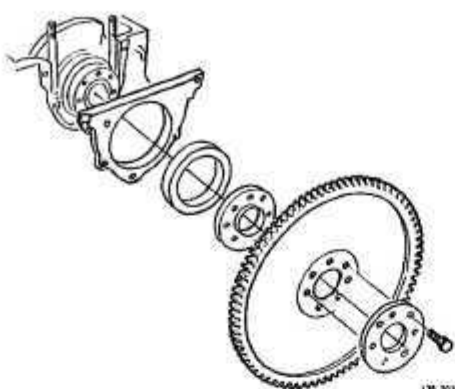
B16

Remove pistons with con rods and bearings

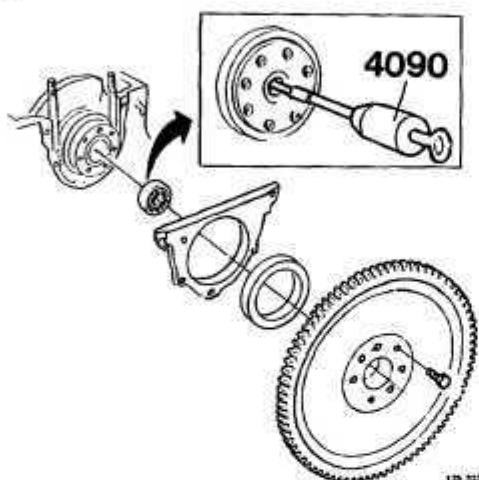
Clean cylinder liners.

Assemble con rod, cap and bearing shells to prevent interchange of parts.

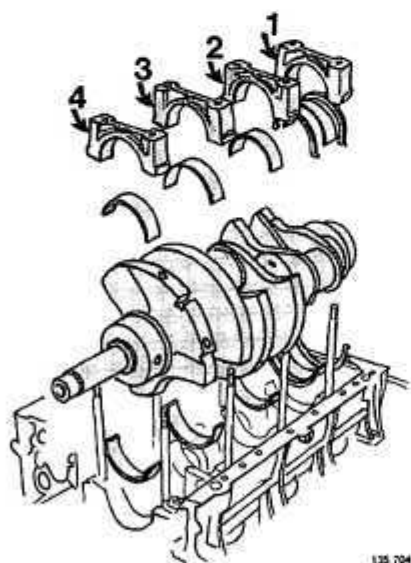




Automatic



Manual

**FLYWHEEL, CRANKSHAFT****Automatic transmission****B17****Remove:**

- carrier plate. Use locking sector **5112** to lock flywheel when bolts are removed
- rear sealing flange. Tap out seal from flange.

Manual gearbox**B18****Remove:**

- pressure plate and clutch disc. Slacken pressure plate bolts crosswise, a few turns at a time to prevent warp.
- flywheel. Use locking sector **5112** to prevent engine from rotating
- rear sealing flange. Tap out bearing from flange
- pilot bearing from crankshaft. Use puller **4090**.

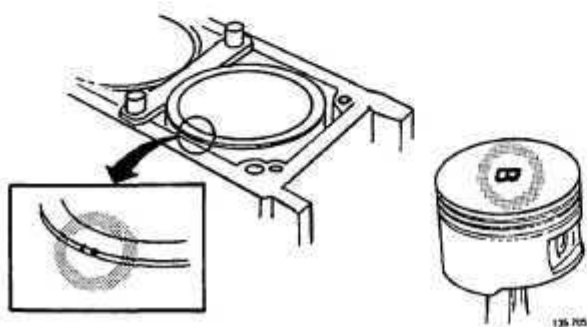
B19**Remove crankshaft, main bearings and thrust bearings**

Check marking of bearing caps, mark if necessary. Caps are marked 1–4, counting from rear.

IMPORTANT! Do not interchange bearing shells and caps.

C. Cleaning, checking

C1

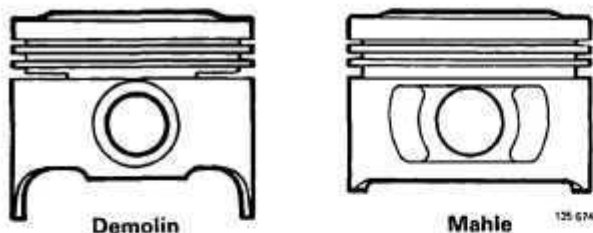


Check type of piston and cylinder liner

Pistons and liners are matched sets, based on diameter. Three types are available as follows:

Liner, marking	Piston, marking
1 notch	A
2 notches	B
3 notches	C

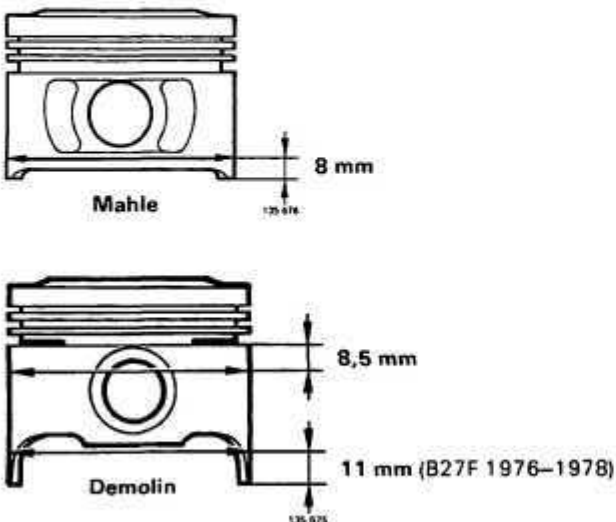
C2



Check make of pistons

B 27 engines = Demolin or Mahle.
B 28 engines = Mahle.

C3



Measure piston diameter

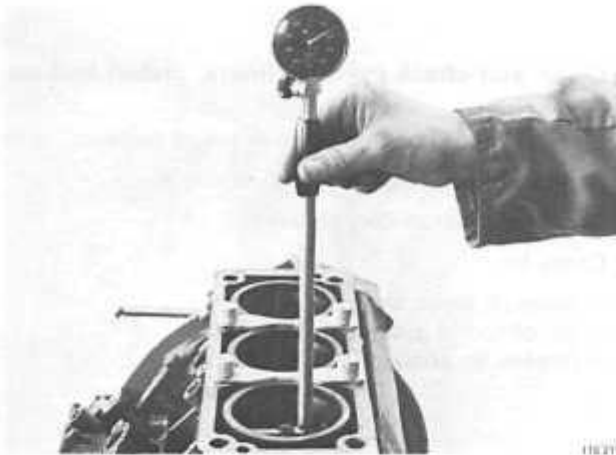
Measure at right angles to gudgeon (piston) pin bore.

Diameter must be measured at different heights depending on make and model year.

- All Mahle pistons = 8 mm (0.31 in) from lower edge
- B 27 F 1976-1978 with Demolin pistons = 11 mm (0.43 in) from lower edge
- Other Demolin pistons = 8.5 mm (0.33 in) from lower edge of oil ring groove.

See specifications on pages 4-5 for diameters of new parts.

C4

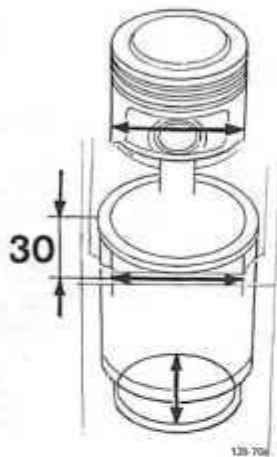
**Measure cylinder diameter**

Use a dial indicator (50–100 mm = 1.97–3.94 in).

Measure **max. wear** 30 mm (1.18 in) from block surface.

Measure **min. wear** at lower turning point of piston.

See specifications on page 3 for diameter of new parts.

**Calculate piston clearance**

Example:

Cylinder bore, measured diameter.....	min. 91.010	max. 91.035
Piston diameter, measured.....	90.085	90.985
Piston clearance.....	min. 0.025	max. 0.050

Piston clearance for new parts:

B 27 Demolin piston	0.090–0.110 mm (0.0035–0.0043 in)
Mahle piston	0.020–0.040 mm (0.0008–0.0016 in)
B 28 Mahle piston	0.020–0.040 mm (0.0008–0.0016 in)

If clearance is too large replace liners, piston and gudgeon pin. These parts are matched and can only be purchased in kits of six.

Remove liner if piston/liner is to be replaced.

Proceed to

C12



116 208

C5

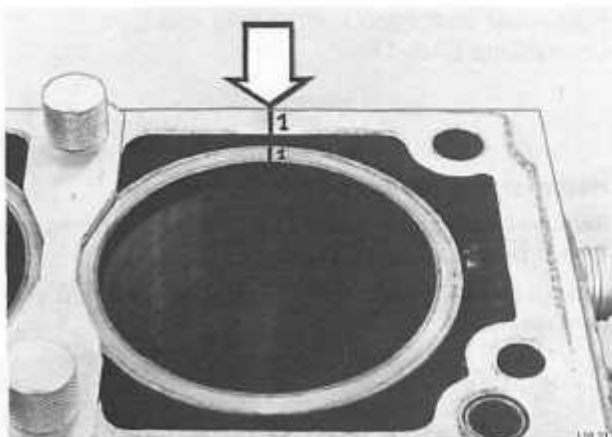
Clean mating surface on cylinder block and liner

Use a plastic putty knife to avoid damage.

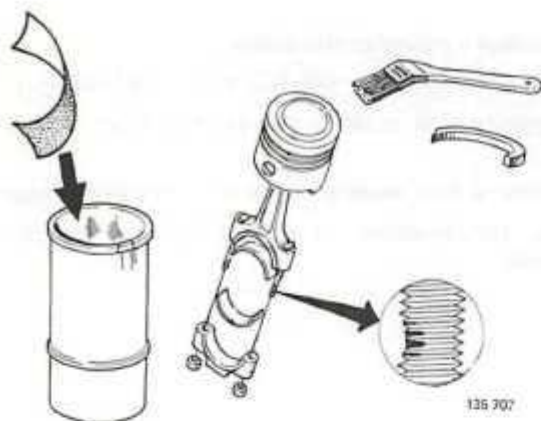
C6

Mark position of cylinder liner before removing liner

Mark position and number of each liner. Do not scratch surface.



116 209



135 707

C7

Clean and check cylinder liners, piston and con rods

Clean cylinder bores to remove bright surfaces.

Remove piston rings with piston ring pliers.

Scrape out piston ring grooves.

Check for:

- damage, wear, cracks
- out-of-round gudgeon pin bores
- threads on connecting rod bolts.

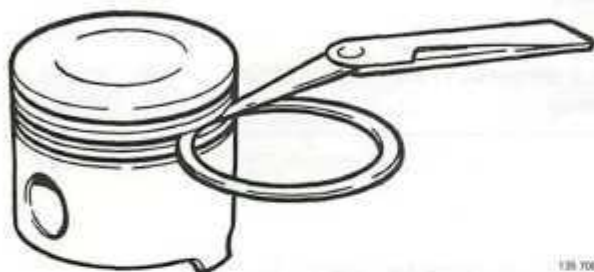
C8

Measure axial play of piston rings

Use a feeler gauge.

Axial clearance, new rings:

- upper compression ring **0.045–0.074 mm**
(0.0018–0.0029 in)
- lower compression ring **0.025–0.054 mm**
(0.0010–0.0021 in)
- oil scraper ring (fitted)..... **0.009–0.233 mm**
(0.0004–0.0092 in)



135 708

C9

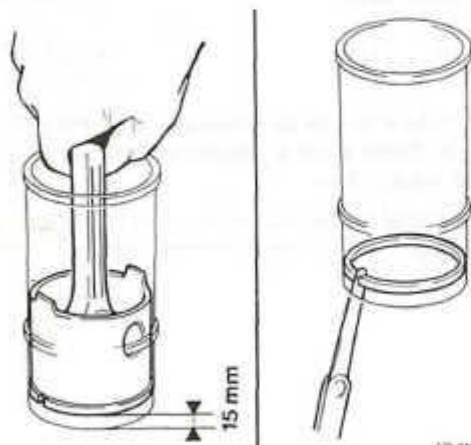
Measure piston ring gap

Insert piston ring in bore, one at a time. Use an inverted piston to ensure that rings take up correct position.

Measure gap with ring **15 mm** (0.6 in) from lower edge. Use a feeler gauge.

Piston ring gap, new parts measured in 88 mm (3.4646 in) (B 27) or 91 mm (3.5826 in) (B 28) cylinder diameter:

- upper and lower compression rings. **0.40–0.58 mm**
(0.0157–0.0228 in)
- oil scraper ring..... **0.38–1.43 mm**
(0.0150–0.0563 in)



135 709

Replacing damaged connecting rod bolt Operations C10–11

C10

Hammer out old bolt

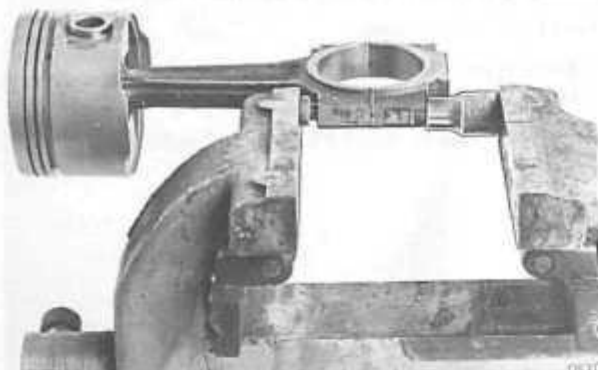
Remove bearing cap and shells. Mount connecting rod in vice protected by soft jaws.

Tap out bolt with a plastic mallet. Hold piston to prevent damage.



135 710

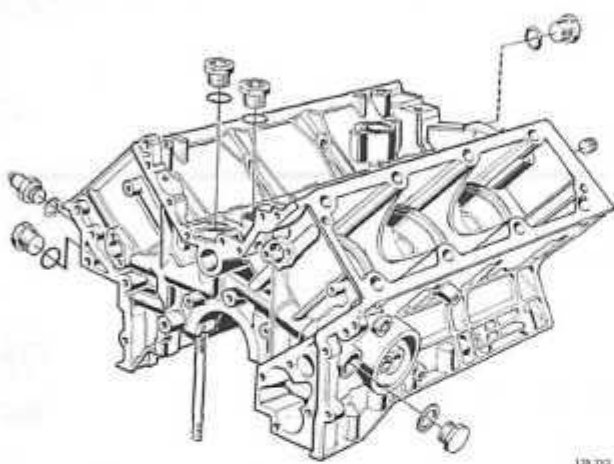
C11



Press in new bolt

Position bearing cap, observe identification marks.
Place a 12 mm socket beneath cap.
Press in bolt.

C12



Clean and inspect cylinder block

Remove all plugs before cleaning block. Do not remove identification marks for cylinder liners when cleaning.

Clean:

- sealing surfaces. Use a plastic putty knife
- bearing seats
- oil and water channels
- cylinder head bolt holes.

Check for damage, cracks and wear. Also check threads on main bearing bolts.

Re-fit plugs using new seals.

Note! Carry out operation C13 before installing block in fixture.

Tightening torque:

- M12 bolts	15-20 Nm (11-15 ft.lbs.)
- M18 plugs	30-40 Nm (22-30 ft.lbs.)
- M25 plugs	40-45 Nm (29-33 ft.lbs.)
- oil pressure sender	30-40 Nm (22-30 ft.lbs.)
- adapter for oil dipstick	20-30 Nm (15-22 ft.lbs.)

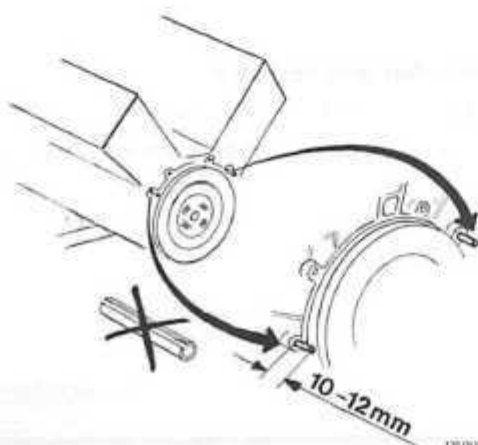
C13

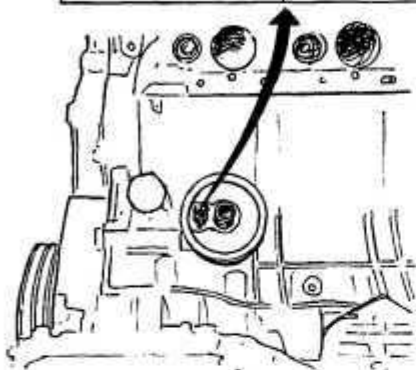
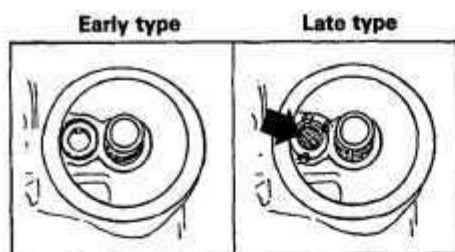
Check guide pins for gearbox

Guide pins must protrude **10-12 mm** (0.39-0.47 in) from cylinder block.

If tubular pins are fitted replace these with solid type (P/N 1232544-5).

Secure pins with locking fluid.





114 926

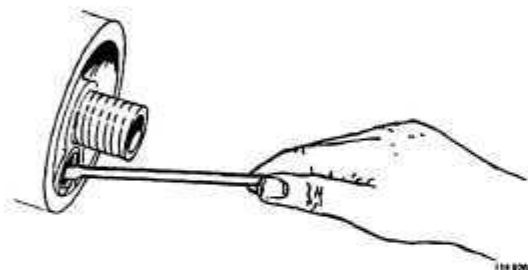
C14

Check overflow valve in cylinder block

Two types are in use:

- early type = **without** filter
- late type = **with** filter

Early type valves must be replaced with new type.



114 920

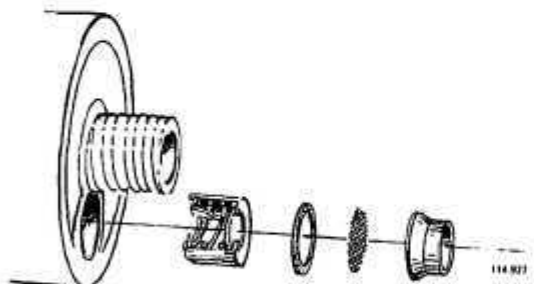
Overflow valve, replacement Operations C15–17

C15

Remove old valve and clean seat

Use a screwdriver.

Important! Take care not to damage the oil filter mating surfaces and make sure that dirt does not enter the oil-ways.

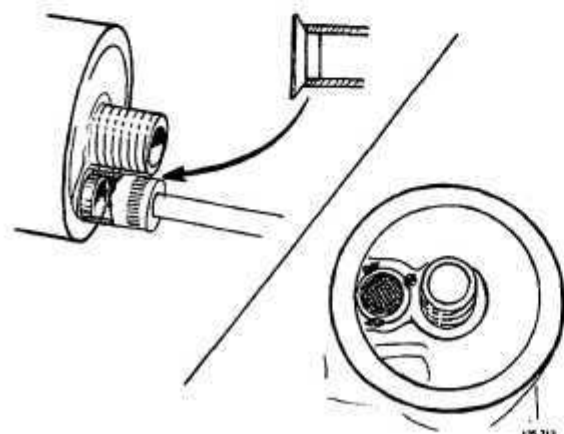


114 927

C16

Install new parts

Install valve with spring facing inwards.



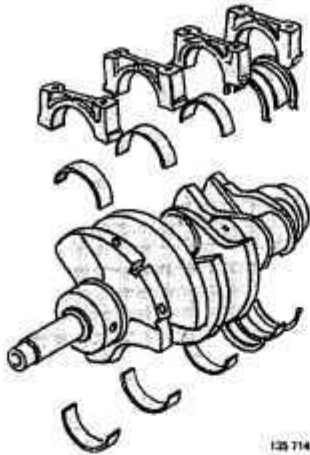
125 713

C17

Tap in washer and secure it

Use an 11 mm (inner diameter) socket.

Secure washer by making three notches in block with a drift.



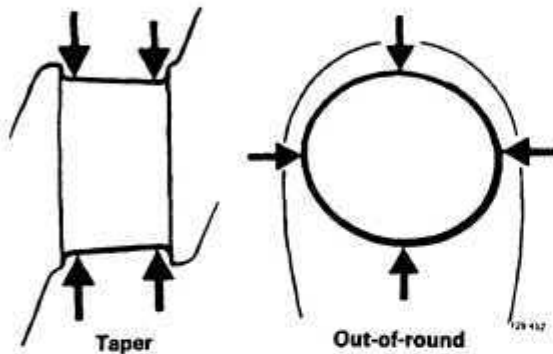
C18

Clean and check crankshaft, main bearing caps and main bearings

Clean oilways in crankshaft with a piece of wire and blow clean.

Also check sealing surfaces on crankshaft.

IMPORTANT! Do not interchange bearing caps and shells.



C19

Measure crankshaft

Measure out-of-roundness and taper of crank pins. Use a micrometer and take measurements at several different positions.

Max. out-of-round **0.007 mm** (0.0003")

Max. taper **0.01 mm** (0.0004")

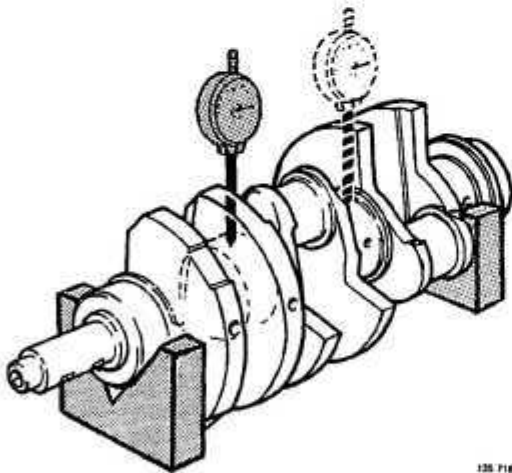
Crank pins can be ground to a smaller size, see specifications on page 9.

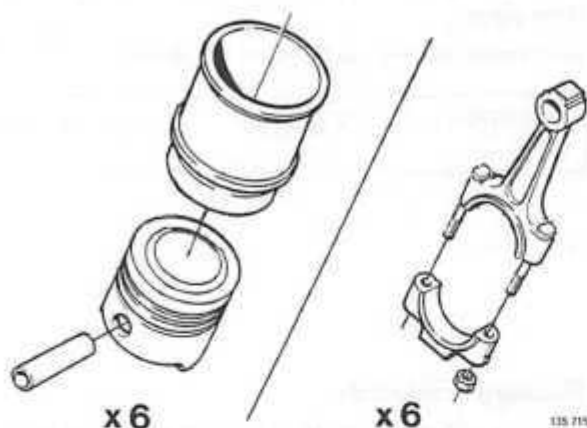
If crankshaft is thought to be out-of-true check with a dial indicator.

Support crankshaft by two outer main bearings on a V-block.

Rotate one turn and measure out-of-true for two centre crank pins. Out-of-true = max. **0.02 mm** (0.0008 in).

IMPORTANT! B 27 E 1975 models may be fitted with early type crankshafts, see C20.





Replacing piston or connecting rod Operations C20-29

C20

General

Pistons – connecting rods should only be disassembled when replacing pistons/liners. Once a piston has been removed it may not be used again. This is because the piston is deformed when the gudgeon (piston) pin is removed.

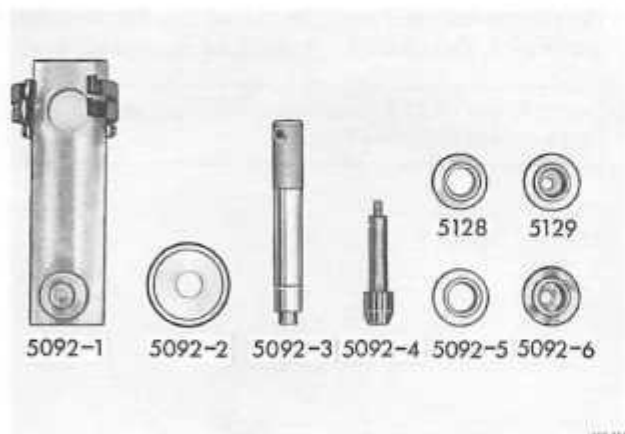
If a connecting rod is to be removed, it is not necessary to disassemble the piston-connecting rod since new connecting rods and pistons must be used.

Liner – piston – gudgeon pin are supplied in matched sets (six).
Connecting rods are supplied in kits of six. Note that all six connecting rods must be replaced at the same time.

IMPORTANT B 27 E 1975

Engine types 498354 and 498356 up to and incl. engine no. 7630.
Exchange engine 1218098.

The above engines may be equipped with early type crankshafts and connecting rods. Only parts of the same type may be used together.



C21

Tools required to replace piston or connecting rod

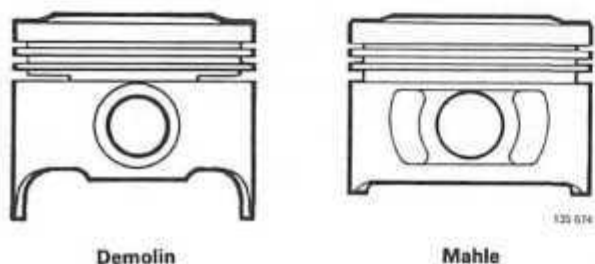
- 5092-1 Holder
- 5092-2 Connecting rod support for big end
- 5092-3 Drift to press out gudgeon pin, also used as handle to press in pin
- 5092-4 Guide pin, used to press in gudgeon pin

Additional tools required for Demolin pistons:

- 5092-5 Piston support, used when pressing out gudgeon pin (with large bore)
- 5092-6 Piston support, used when pressing in gudgeon pin.

Additional tools required for Mahle pistons:

- 5128 Piston support, used when pressing out gudgeon pin (with large bore)
- 5129 Piston support, used when pressing in gudgeon pin.



C22

Make sure correct piston is installed

B 27 engines = Demolin or Mahle pistons.
B 28 engines = Mahle pistons.

C23

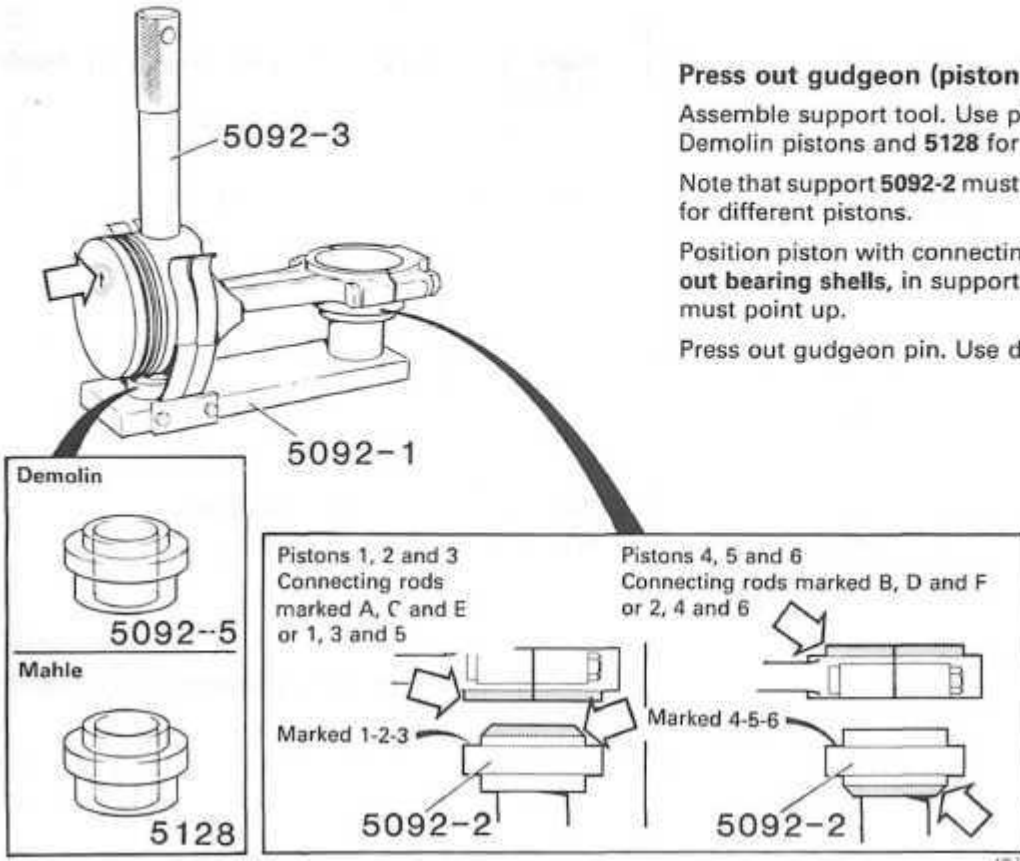
Press out gudgeon (piston) pin

Assemble support tool. Use piston support **5092-5** for Demolin pistons and **5128** for Mahle pistons.

Note that support **5092-2** must be turned different ways for different pistons.

Position piston with connecting rod and cap, but **without bearing shells**, in support. Arrow on top of piston must point up.

Press out gudgeon pin. Use drift **5092-3**.



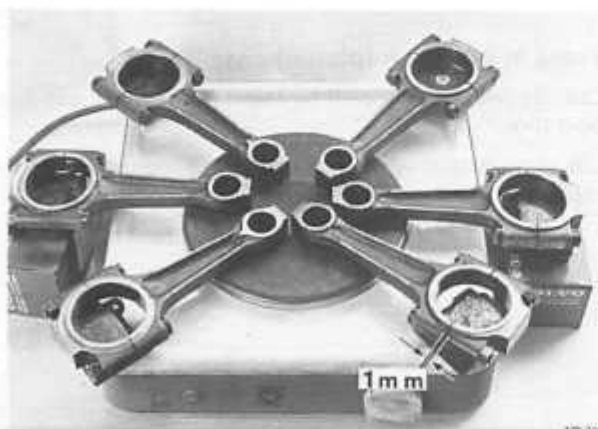
C24

Check connecting rods

Use an alignment gauge.

Check out-of-true, twist, S-form.

Check bolt threads and replace if necessary, see C10-11.

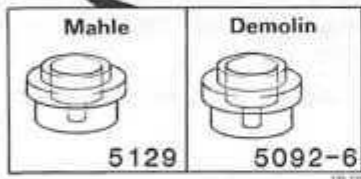
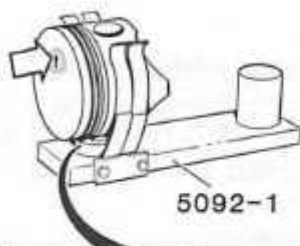


C25

Heat connecting rods

Install caps on connecting rods but **not bearing shells**. There should be approx. 1 mm (0.04") clearance between connecting rod and cap.

Place small end on heater and heat to approx. 250°C (480°F).



C26

Place piston support and piston in holder 5092-1

Use 5092-6 for Demolin pistons and 5129 for Mahle pistons.

Arrow on top of piston must point up.



C27

Place gudgeon (piston) pin in tool

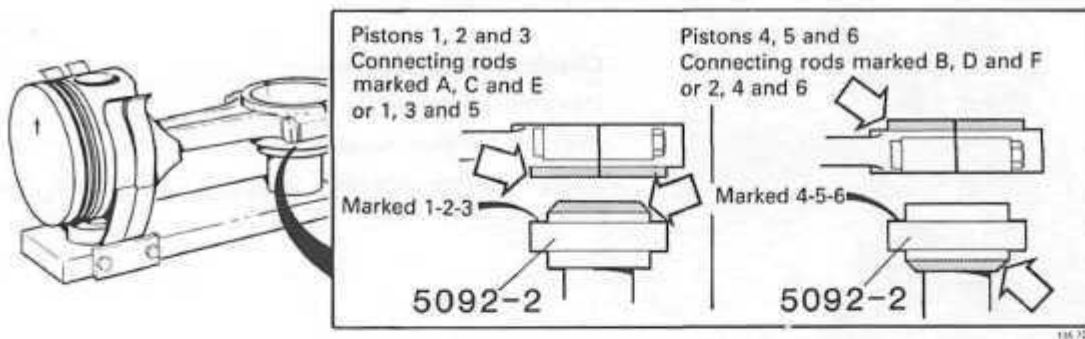
Immerse in oil

C28

Place connecting rod support and connecting rod in holder

IMPORTANT! Connecting rod support and connecting rod must be turned in different directions for different pistons – connecting rods.

Gudgeon pin must be pressed in **immediately** (Operation C29) otherwise it may jam halfway.



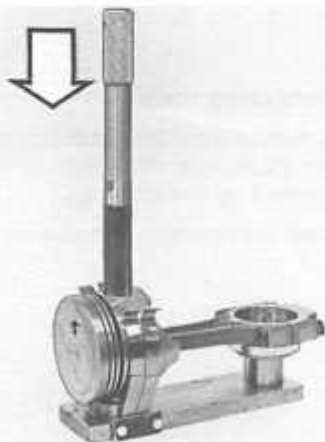
136 727

C29

Press in gudgeon (piston) pin

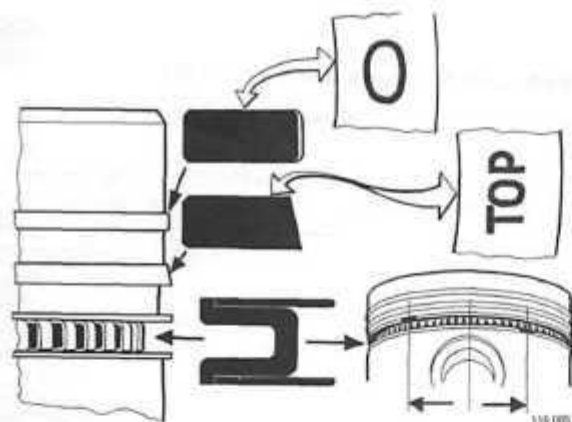
Quickly press down drift by hand until it contacts support tool.

Lift away piston with connecting rod from holder. Remove drift and guide pin from gudgeon pin.

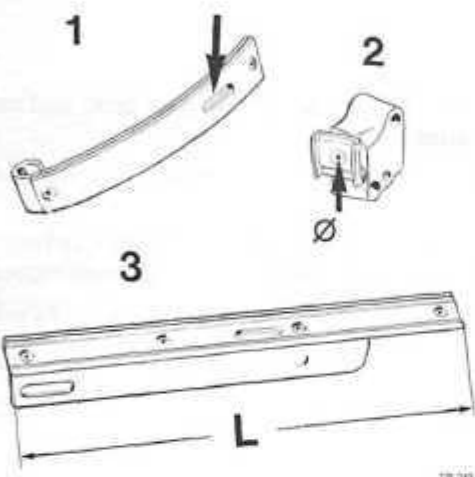


136 736

C30

**Install piston rings**

Note position of oil ring gap.



C31

Check if chain dampers and tensioners are of early or late type

Early types must be replaced with new ones.

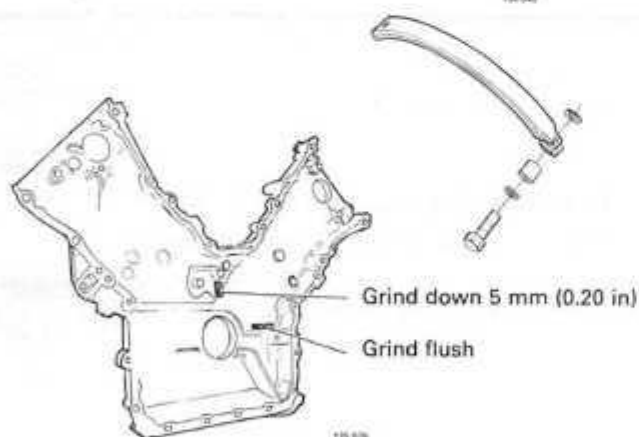
IMPORTANT! Late type chain tensioners may only be used with late type chain dampers.

	Early type	Late type
1 bent chain damper	without oilway	with oilway
2 chain tensioner.....	$\varnothing = 0.4 \text{ mm}$ (0.016")	$\varnothing = 1.2 \text{ mm}$ (0.047")
3 straight chain damper	$L = 174 \text{ mm}$ (6.85")	$L = 220 \text{ mm}$ (8.66")

IMPORTANT! On B 27 engines manufactured up to approx. middle of 1976 a bent chain damper with a small mounting is fitted.

When replacing this type with a late type chain damper, late type screws, washers and spacers must be fitted.

In addition two faces on the timing gear case must be ground to make space for the new wider dampers. One face must be ground down by 5 mm and the other flush.



C32

Clean, check chain tensioners and chain dampers

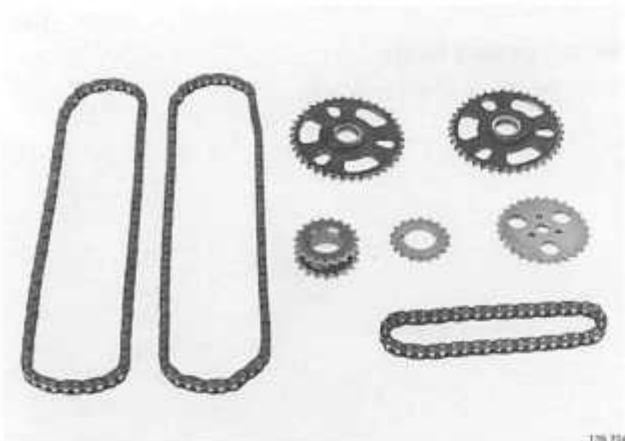
Important! Do not disassemble tensioners. If locking pin falls out, complete tensioner must be replaced.

Check that oilways in chain tensioners do not leak.

Check dampers for damage and wear.

Replace parts as necessary.





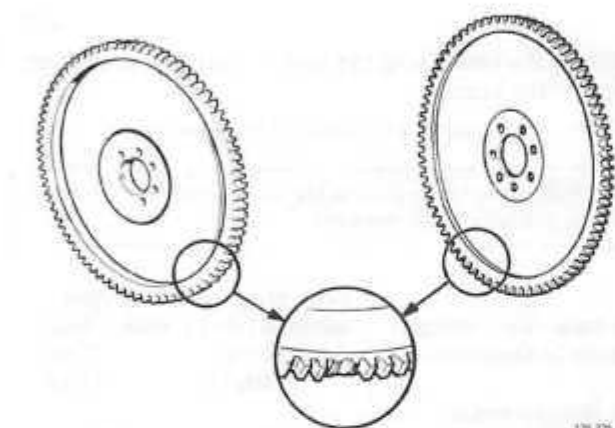
126.734

C33

Clean, check chains and sprockets

Check for damage and wear.

IMPORTANT! If damaged, replace chains and sprockets together. Also replace oil strainers behind tensioners.



126.725

C34

Clean, check flywheel (man. gearbox) and carrier plate (auto.)

Carrier plate with ring gear must be replaced as one unit.

Damaged or worn flywheel must be replaced with ring gear attached. Ring gears can be replaced separately.

New flywheels are rustproofed and should be washed (degreased) prior to assembly.

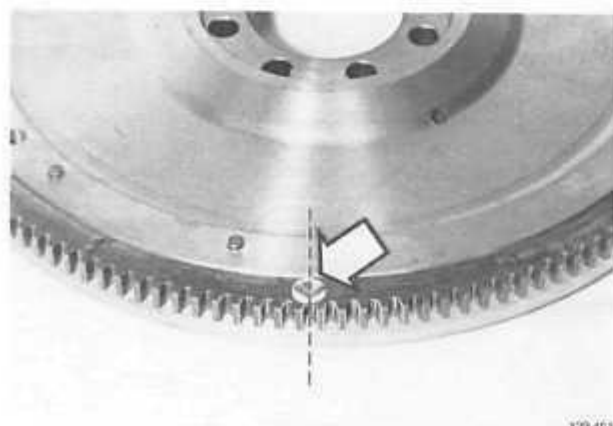
Replacing ring gear Operations C35–39

C35

Heat new ring gear to +230°C (446°F)

Heat in an oven or by oxyacetylene flame.

If oven is to be used begin heating now. With oxyacetylene, heat just before installation.



129.461

C36

Drill hole between two cogs

Use a 10 mm (0.4 in) drill.

Hole depth = 9 mm (0.35 in).

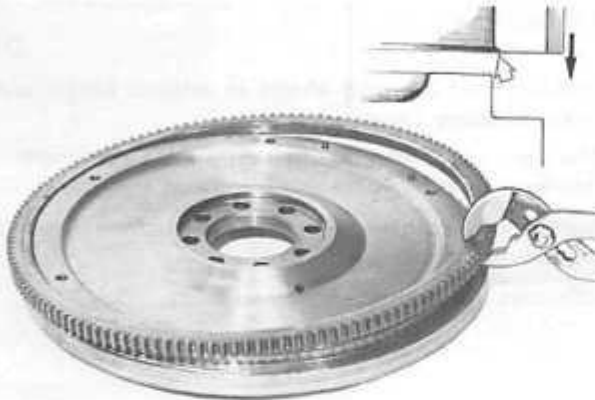
IMPORTANT! Do not drill into flywheel since it may become out-of-balance.



Remove ring gear

Mount the flywheel in a vice protected by soft jaws.
Lever off ring gear with a screwdriver. It may be necessary to split the ring gear above the drilled hole.
Clean mating surfaces on flywheel.

C37



Heat new ring gear to approx. 230°C (446°F)

Check temperature with solder (40% tin, 60% lead). Solder melts at 220–230°C (428–446°F).

C38

Install new ring gear

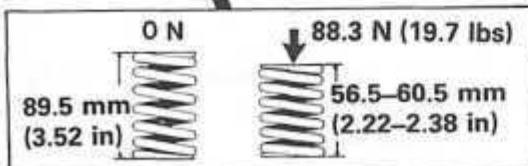
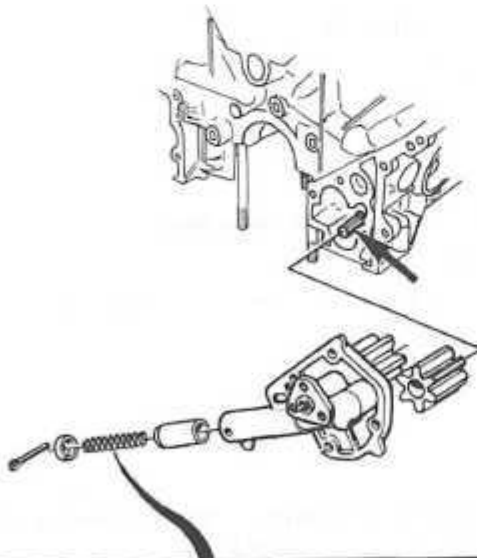
Position ring gear.

IMPORTANT! Bevelled side of ring gear must face flywheel.

If necessary tap ring gear until flush. Use a brass drift.

Leave to cool.

C39



Clean and inspect oil pump

Disassemble and clean oil pump.

Check for damage and wear and also that relief valve plunger runs smoothly.

Check that axle is firmly secured to cylinder block.

Test relief valve in a spring tester.

Replacement oil pumps are only available as complete units (pump body cover, gears and relief valve). Spare parts for the relief valve are, however, available.

Re-assemble pump.

C40

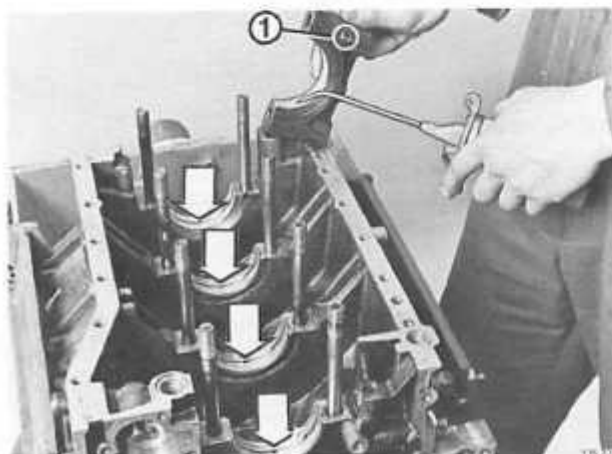
Clean and check parts

Oil strainer, sump, lower crankcase, valve covers and timing gear case.

C41

D. Engine assembly

Always use new seals, O-rings and gaskets when assembling the engine.



CRANKSHAFT

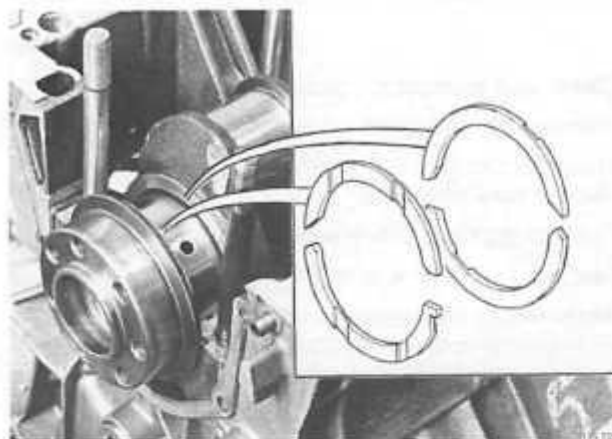
D1

Install main bearing shells in engine block and main bearing cap

Make sure that matched pairs are installed together. Bearing cap at flywheel end is marked 1.

Note! The holes in the bearing shells must coincide with the oilways in the engine block.

Lubricate the bearing shells and studs.



D2

Locate crankshaft

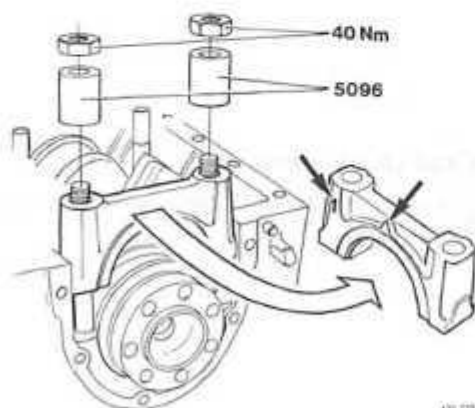
Lubricate bearings.

D3

Install thrust washer segments

Lubricate washers.

Note the oilways in the two lower segments.



D4

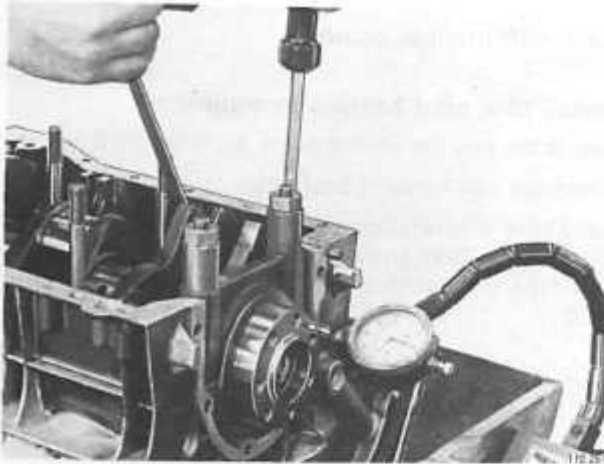
Install rear main bearing cap with shells and holder 5096 for main bearing

Rear cap is marked 1.

Identification number and casting lug on the bearing cap should face forwards.

Install cap, holder and nuts.

Torque to 40 Nm (30 ft.lbs.)



D5

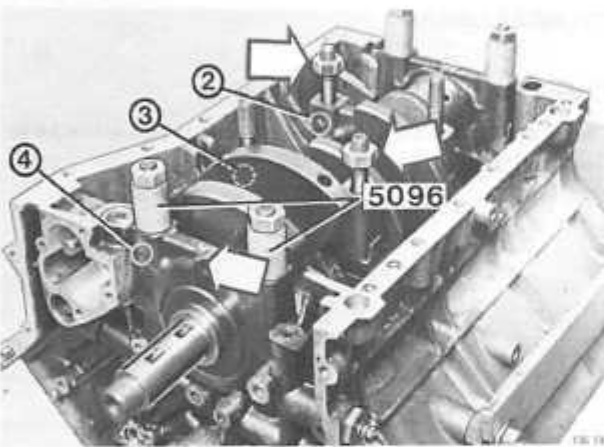
Check crankshaft end float

Move the crankshaft lengthwise back and forth and measure the clearance with a dial indicator.

End float. **0.070–0.270 mm**
(0.0027–0.0106")

Replace thrust washers if necessary. Washers are available in the following sizes:

standard.....	2.30–2.35 mm (0.0905–0.0925 in)
OS 1.....	2.40–2.45 mm (0.0944–0.0964 in)
OS 2.....	2.45–2.50 mm (0.0964–0.0984 in)
OS 3.....	2.50–2.55 mm (0.0984–0.1003 in)

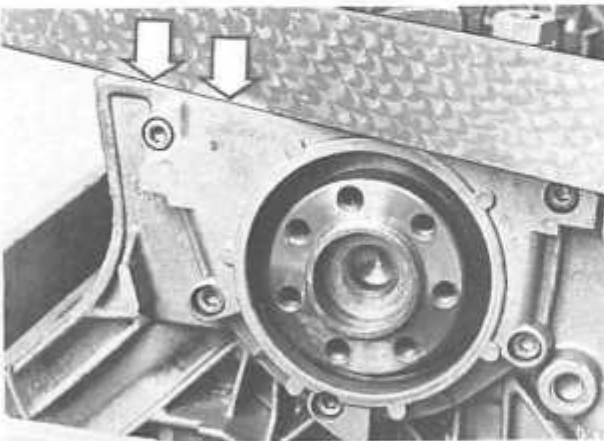


D6

Install three remaining main bearing caps with shells

Identification numbers 2, 3 and 4 and the casting lugs on the caps must face forwards.

Secure front bearing cap with holder **5096** and install nuts on each of the two centre caps.



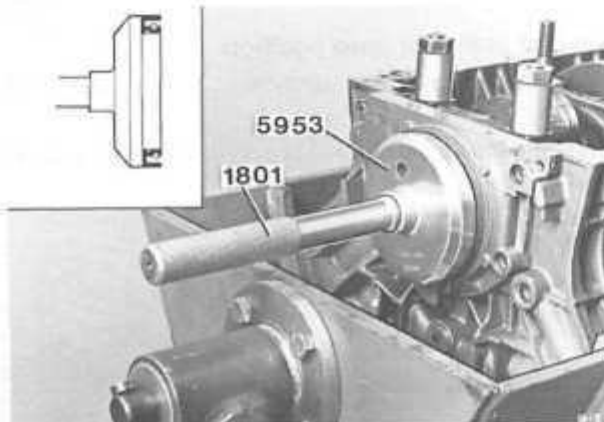
CRANKSHAFT REAR SEAL, PILOT BEARING

D7

Install seal holder

Use a new seal.

Using a straight edge, make sure that the holder is flush with the cylinder block.



D8

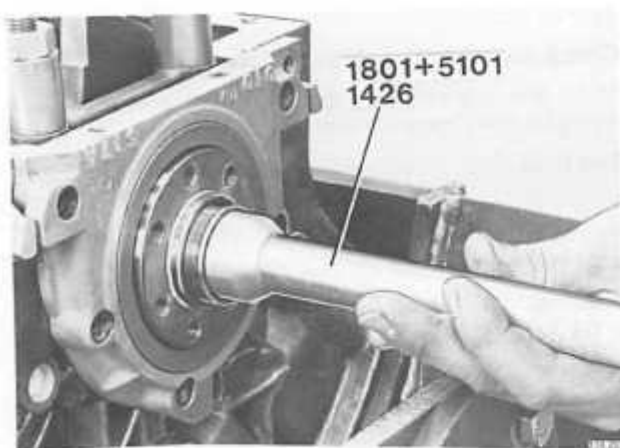
Install crankshaft seal

Assemble standard handle **1801** and drift **5953**.

Lubricate the seal and groove. Pack grease between the sealing lips.

Place the seal on the drift, see fig.

Tap in the seal until the drift abuts the crankshaft.



Cars with manual gearbox

D9

Install new pilot bearing in crankshaft

Tap in the bearing until it abuts the crankshaft.

There are two types of bearings:

Early type = inner diameter 17 mm (0.669"). Use standard handle **1801** and drift **5101**.

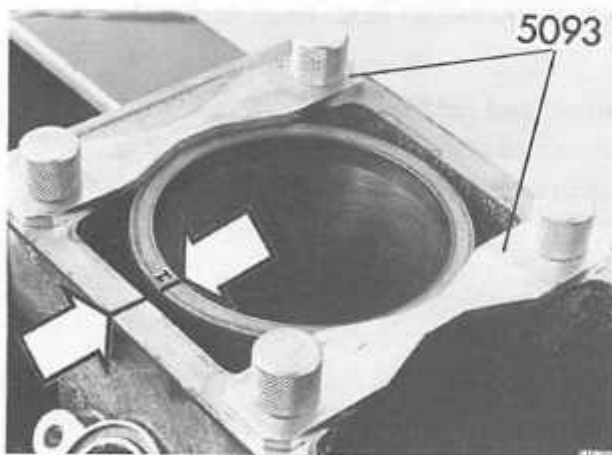
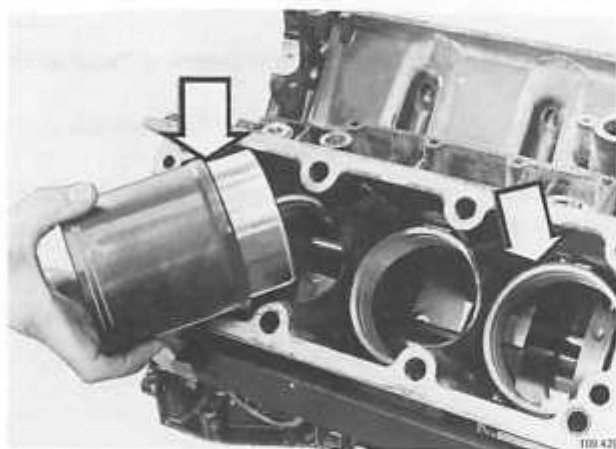
Late type = inner diameter 15 mm (0.590"). Use drift **1426**.

CYLINDER LINERS

D10

Check mating surfaces for shims

Check that surfaces in liner and block are clean and free from defects.

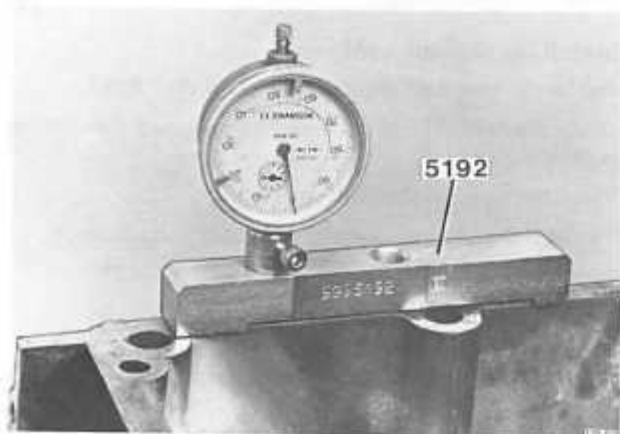


D11

Install no 1 liner without shim

Check line-up marks and number.

Install two holder **5093**, hand tight.



D12

Set dial indicator zero position

Place dial indicator in outer hole in holder **5192** (**5094** can also be used).

Rest holder on a flat surface (e.g. cylinder block) and set zero.

D13

Measure liner height

Measure at three different positions, as shown adjacent.

Difference between the three measurements must **not exceed 0.05 mm** if greater, check for dirt, etc.

Use the highest measurements for the calculation.

Example: 1st measurement	0.11 mm
2nd measurement	0.08 mm
3rd measurement	0.09 mm
Difference between measurements does not exceed 0.05 mm and highest measurement is 0.11 mm.	

D14

Select correct size shim

Distance between top of liner and block should be **0.16–0.23 mm**. Gap should be as near as possible to 0.23 mm.

Select a shim which is the same or just under the calculated thickness.

Shims are available as follows:

Colour	Thickness
Blue	0.070–0.105 mm
White	0.085–0.120 mm
Red	0.105–0.140 mm
Yellow	0.130–0.165 mm

Example:	
Max. specified gap	0.23 mm
Measured gap (without shim)	0.11 mm
Difference	0.12 mm
Select a white shim.	

D15

Install same size shim on all liners

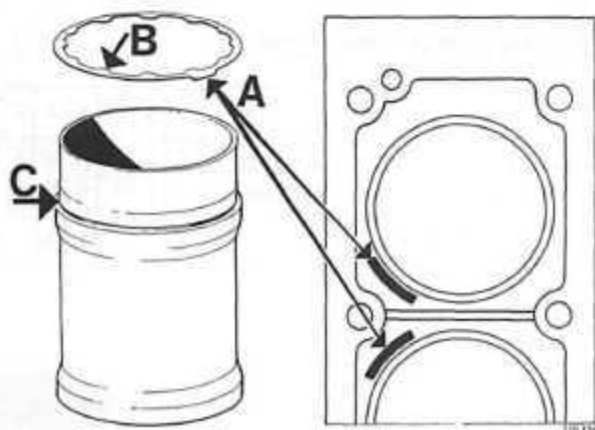
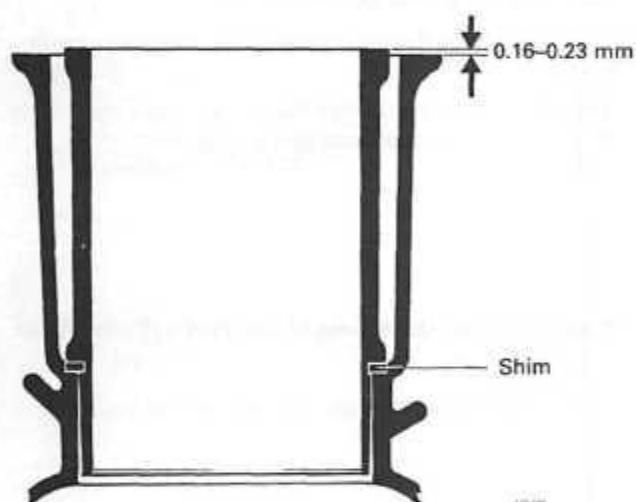
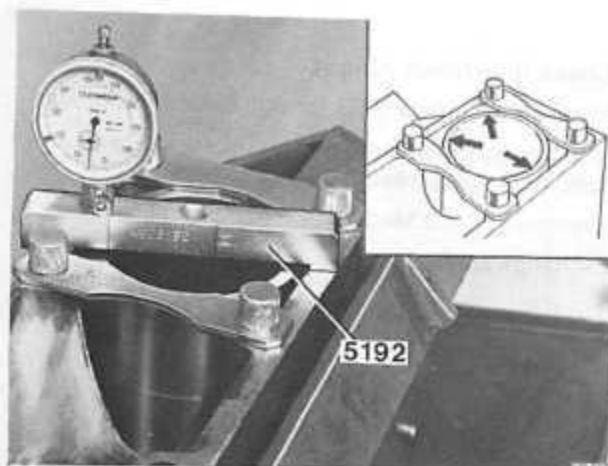
Colour marking should face upwards and be visible when liner is installed.

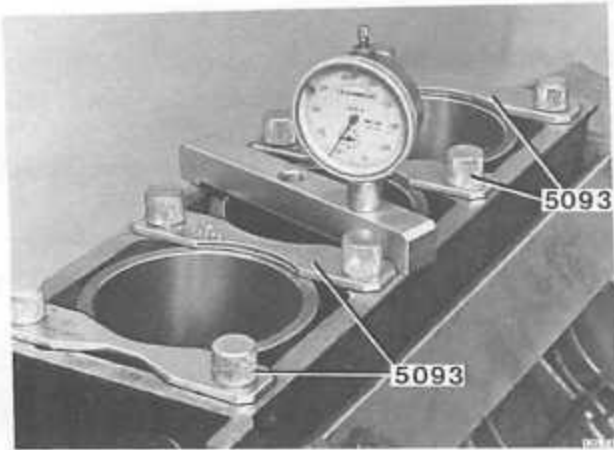
The tongues (B) on the inside of the shim should fit into the groove in the liner (C).

D16

Install liner in block

Observe liner identification marks as applicable.

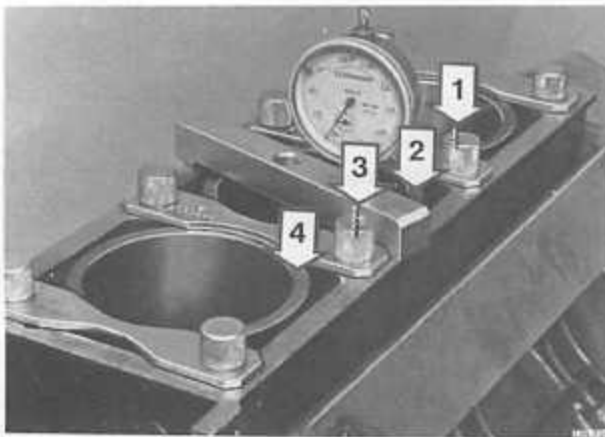




D17

Check liner/deck height

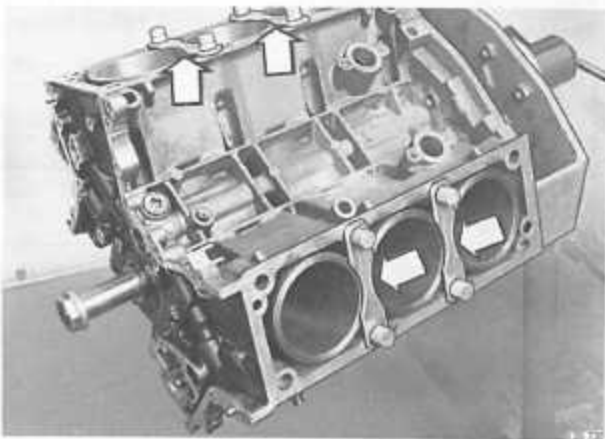
Install four holders 5093 for one bank of cylinders.
Measure height at three places. Difference between values must **not exceed 0.05 mm** (0.0020").
Liner height = **0.16–0.23 mm** (0.0063–0.0091").
Exchange shims if necessary.



D18

Measure difference in height between next liner

Measure at points 1, 2, 3 and 4 as illustrated.
Difference between 1 and 2, and 3 and 4 must not exceed **max. 0.04 mm** (0.0016").
Exchange shims if necessary and re-measure according to D17.
If new liners are used and difference is too large, rotate liners or change positions and re-measure.



D19

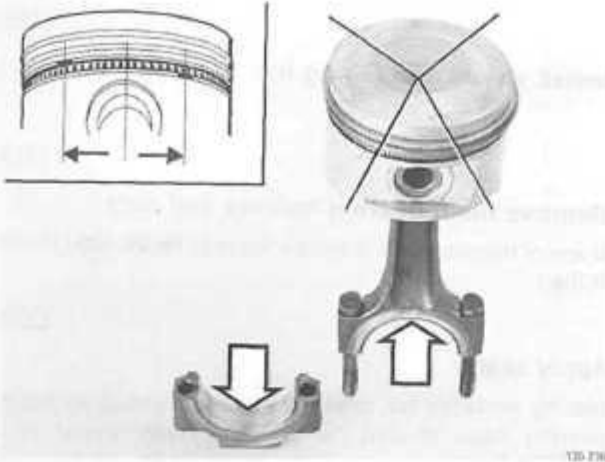
Measure liner/deck height for 2nd cylinder bank

Follow D17–18.
Then transfer the two outer holders to the 1st cylinder bank.



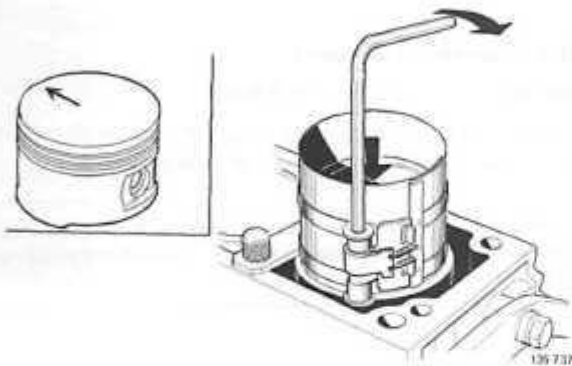
PISTONS, CONNECTING RODS

Cylinder	1	4	2	5	3	6
Marking of connecting rod and cap	early type late type	A 1	B 2	C 3	D 4	E 5 F 6
Crank webs, from rear	1		2		3	



D20
Install bearing shells in connecting rods and caps

D21
Turn piston rings so that gaps are not in line
Note position of oil ring gap.



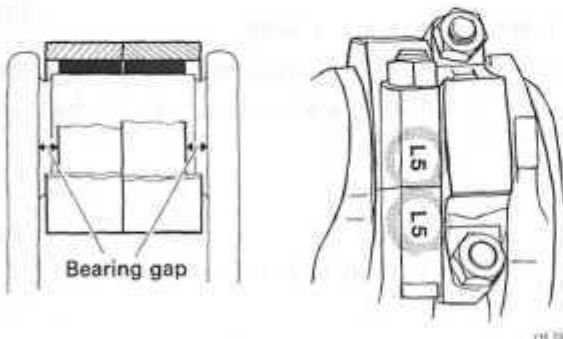
Lubricate:

- bearing shells
- cylinder bores
- pistons

D23
Install piston

Use a piston ring compressor tool.

IMPORTANT! Arrow on top of piston must point forwards.



D24
Install connecting rod cap

Use new nuts, lubricate mating surface.

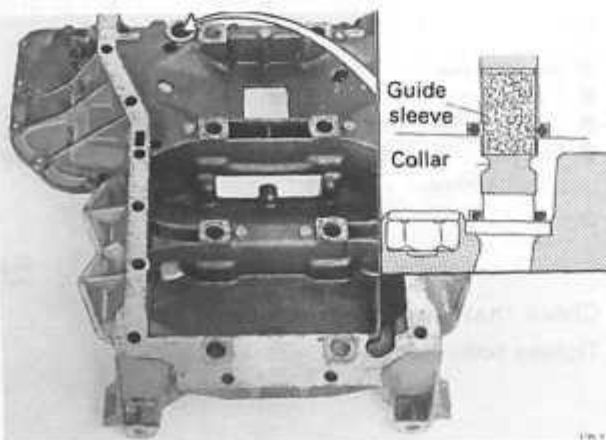
Torque to 45–50 Nm (33–37 ft.lbs.).

Check that crankshaft can be rotated.

IMPORTANT! Marks on connecting rod and cap must match.

Bearing gap should point:

- rearwards for cylinder 1, 2 and 3
- forwards for cylinders 3, 5 and 6.

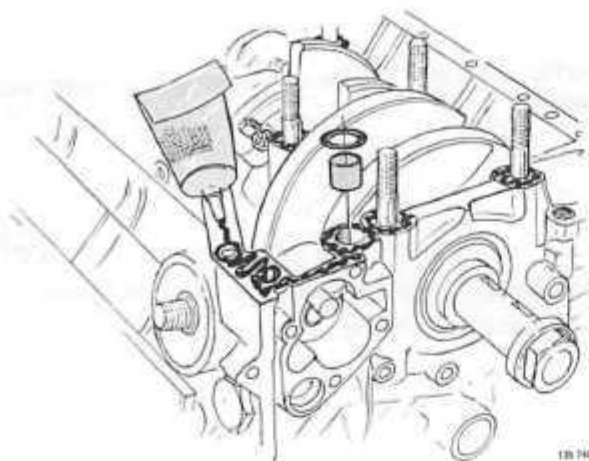


LOWER CRANKCASE, SUMP

D25
Check if crankcase is early or late type

Late type crankcases are fitted with a collar to prevent the sleeve in the oil channel from falling down into the sump.

For early type crankcases, install a new sleeve (P/N 1161057-3) and secure with Locktite.



D26

Install sleeve and O-ring in oil channel

D27

Remove main bearing holders and nuts

If any of the pin studs is slack torque to **15–20 Nm (11–15 ft.lbs.)**.

D28

Apply sealer

Mating surfaces for lower crankcase as well as main bearing caps should be smeared with sealer P/N 1161058-1.

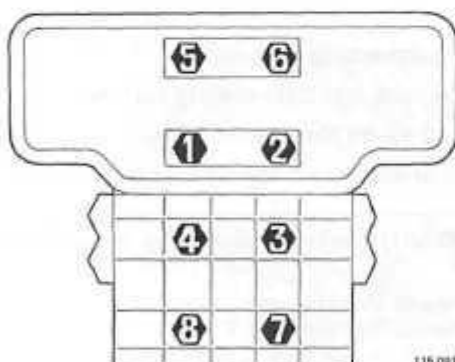
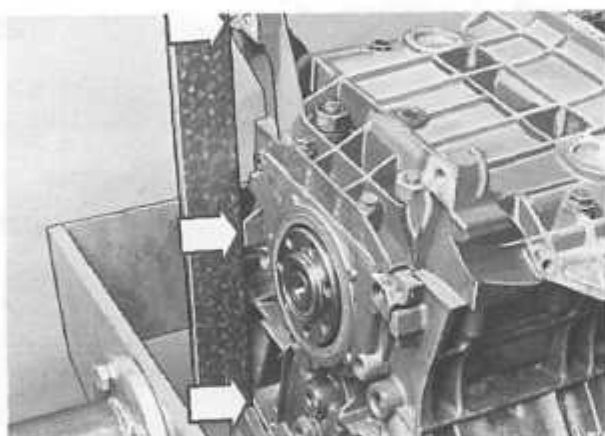
D29

Install lower crankcase

Tighten nuts and bolts by hand.

Align crankcase so that rear edge is flush with cylinder block rear. Use a straight edge. Check both sides.

IMPORTANT! Crankcase and cylinder block must be flush otherwise distortions may result and cause noise or damage.



D30

Tighten main bearing nuts

Tighten in order shown adjacent to **30 Nm (15 ft.lbs.)**.

Re-check that lower crankcase lies flush with the rear of cylinder block, see D29.

D31

Angle-tighten main bearing nuts

Use protractor 5098.

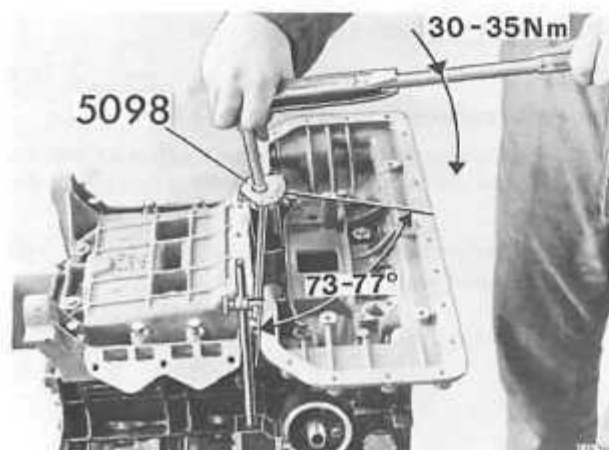
A measuring stand can be used to align the protractor. The magnetic base of the stand should be placed on fixture 5099 and the arm pointed towards the protractor.

- Slacken nut 1
- Tighten nut 1 to **30–35 Nm (15–27 ft.lbs.)**.
- Angle-tighten nut 1 to **73–77°**
- Slacken and re-tighten remaining nuts in order specified above.

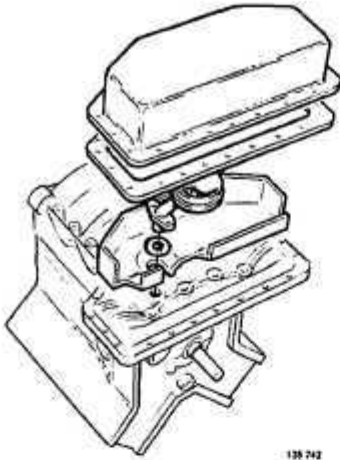
D32

Check that crankshaft rotates.

Tighten bolts for lower crankcase



D33



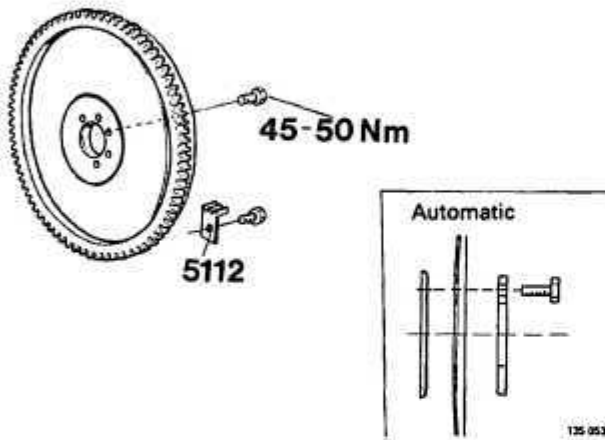
135 742

Install:

- splash panel
- oil strainer with O-ring
- oil sump with gasket.

FLYWHEEL, CLUTCH, CARRIER PLATE

D34



135 953

Install flywheel (manual)

Install carrier plate (automatic)

Flywheel/carrier plate can only be installed in one position since bolt holes are asymmetrically located.

Use **new** bolts.

Torque to **45-50 Nm (33-37 ft.lbs.)**. Use locking sector **5112** to lock the flywheel.

Auto: Note position of support plates. Inner plate should be turned with bevel forwards.

D35

Install clutch driven plate and pressure plate

Turn the plate so that the hub faces outwards, away from the flywheel.

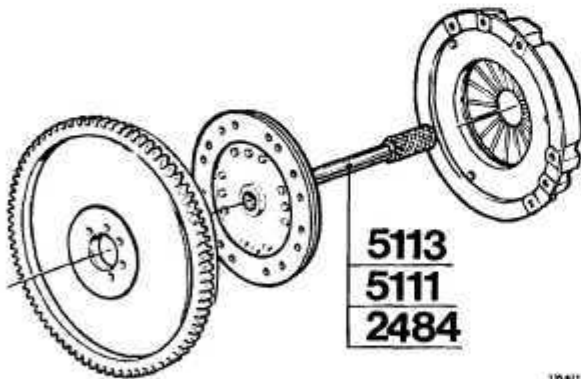
Different centering drifts for different types of gearboxes:

M50/51 = drift **5113**

M45/46 early type = drift **2484**

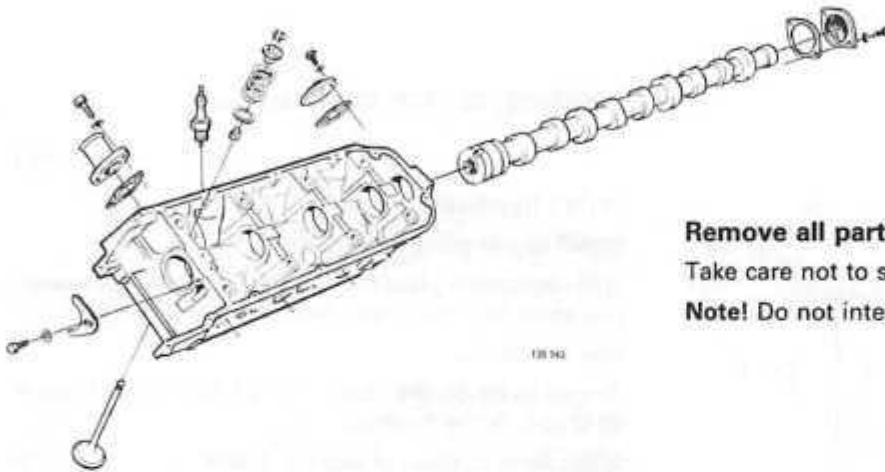
M45/46 late type = drift **5111**

Tighten pressure plate retaining screws crosswise, a few turns at a time to avoid distorting the plate.



135 617

E. Cylinder head, reconditioning

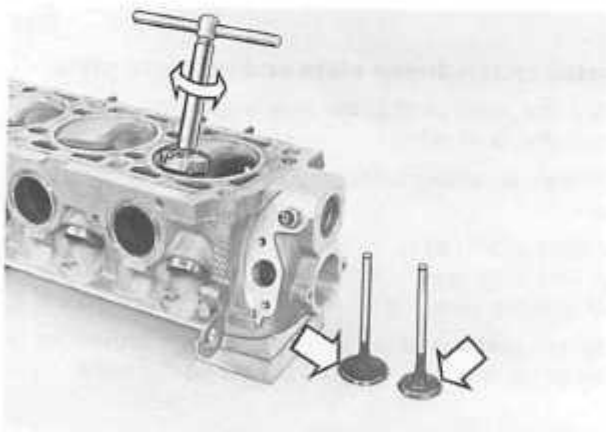


E1

Remove all parts from cylinder head

Take care not to score/damage the mating surfaces.

Note! Do not interchange valve parts.



E2

Clean cylinder head and parts

Remove carbon deposits from the combustion chambers and valves.

Clean valve seats with a grinder (to be able to see cracks, damage, etc.).

Clean gasket mating surfaces.

Use a plastic scraper and if necessary a fine grade wet abrasive paper.

E3

Check all parts

Visible damage, wear, etc.

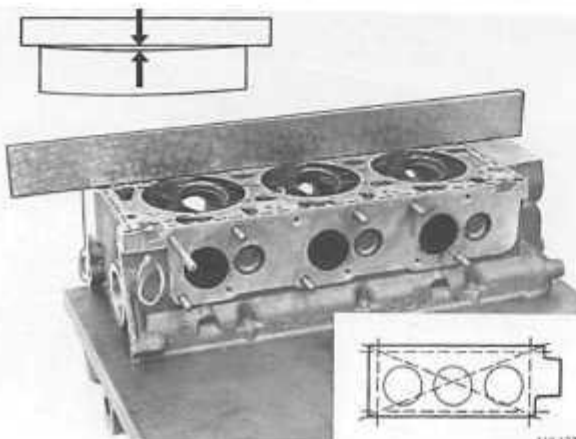
E4

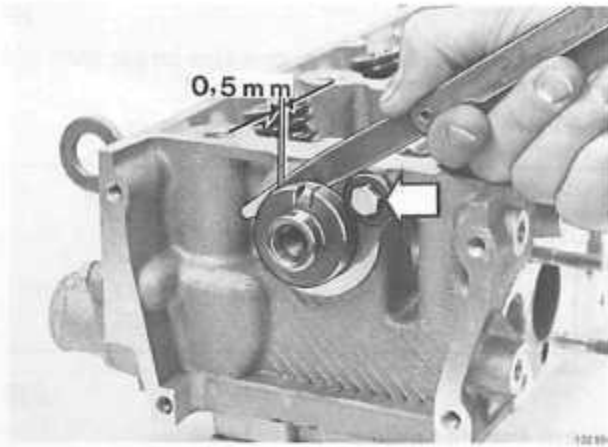
Check cylinder head for warp

Use a straight edge and feeler gauge.

Warp = max. **0.05 mm (0.002 in)** per 100 mm (3.94 in).

The cylinder head must not be machined but instead replaced if the warp is too great.





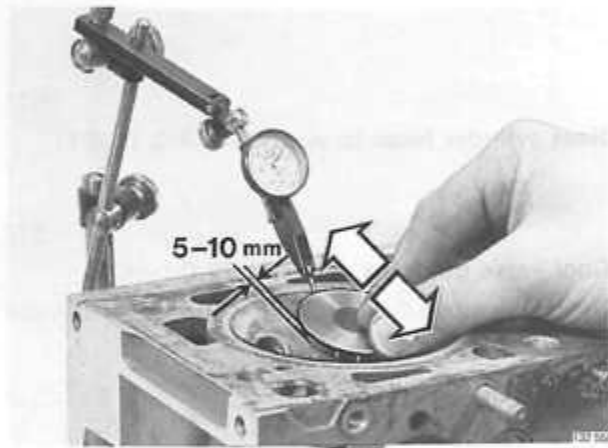
E5

Check camshaft end float

Position the camshaft and make sure that it turns easily.

Fit the locking fork. Measure the end float with a feeler gauge. The clearance must not exceed max. **0.5 mm (0.020 in)**. Replace the locking fork if the end float is too large.

Remove the locking fork and camshaft.



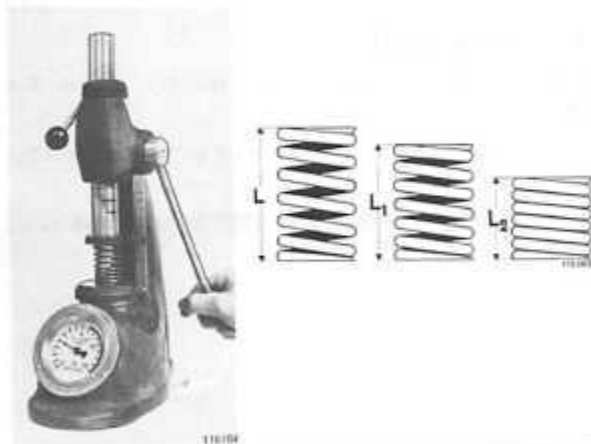
E6

Check valve guide – valve clearances

Use a dial indicator.

Use new valves and press up **5–10 mm (0.2–0.4 in)** with finger when measuring.

The clearance must not exceed max. **0.15 mm (0.0059 in)**.

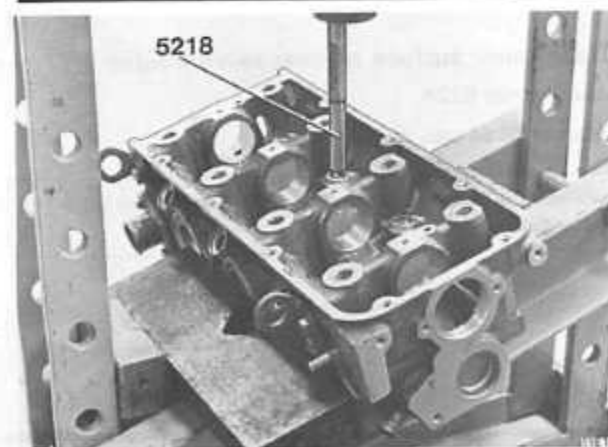


E7

Check valve springs

The springs are colour coded, and two different types are used depending on engine type.

Colour code	Length, mm (in)	Load N (lbs.)
GREY	47.2 (1.86)	0 0
	40.0 (1.57)	233–268 (52–60)
	32.2 (1.27)	521–585 (116–131)
GREEN	47.1 (1.85)	0 0
	40.0 (1.57)	230–266 (51–59)
	30.0 (1.18)	613–689 (137–154)



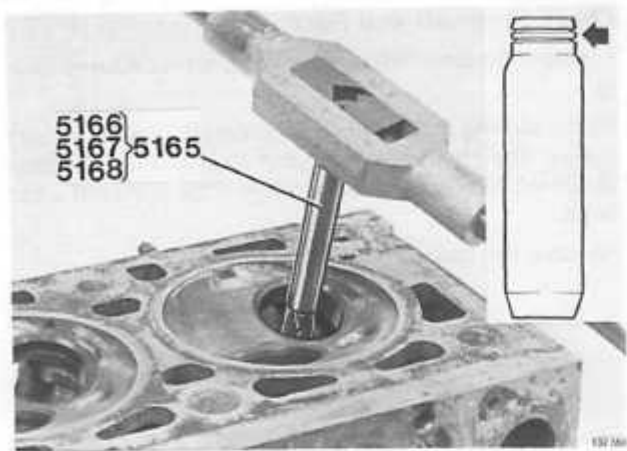
Valve guide replacement Operations E8–14

E8

Press out valve guides

Use drift 5218.

Place the cylinder head on a sloping surface so that the valve guides are vertical.



Select a new valve guide, one size larger than old one

The valve guides are marked with grooves.

Valve guide	Mark	Reamer	
Standard +	no groove	—	
Oversize 1	1 groove	5166	
2	2 grooves	5167	5165
3	3 grooves	5168	

Ream seat for guide

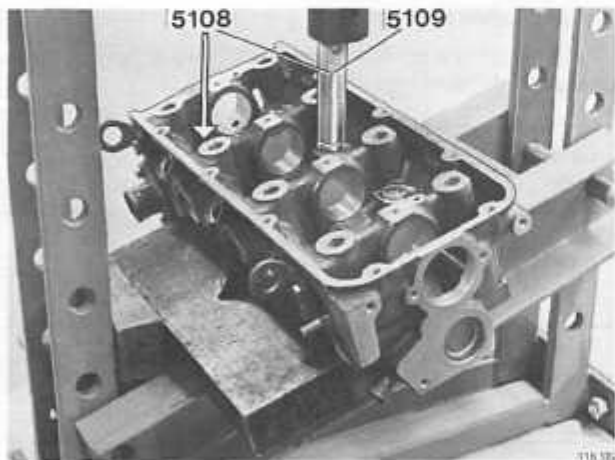
See above table.

Heat cylinder head to approx. 150°C. (300°F)

Cool valve guide to approx. -70°C (-95°F)

Use liquid carbon dioxide or equivalent to cool the valve guides.

Wear protective gloves and safety glasses.

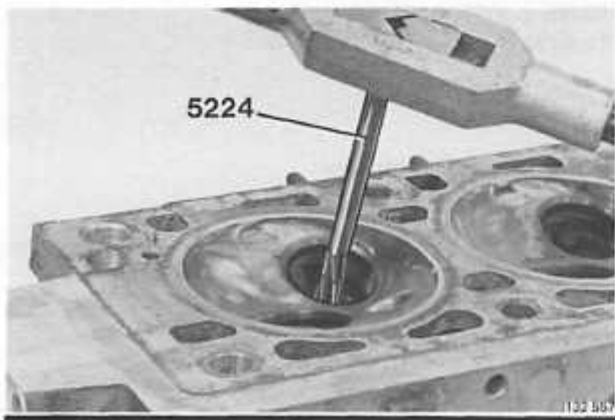


Press in new guide

Note! This must be done very quickly, within 3–4 secs.

Place the cylinder head on a sloping surface so that the valve guides are vertical.

Use drift 5108 for intake and 5109 for exhaust valve guides.

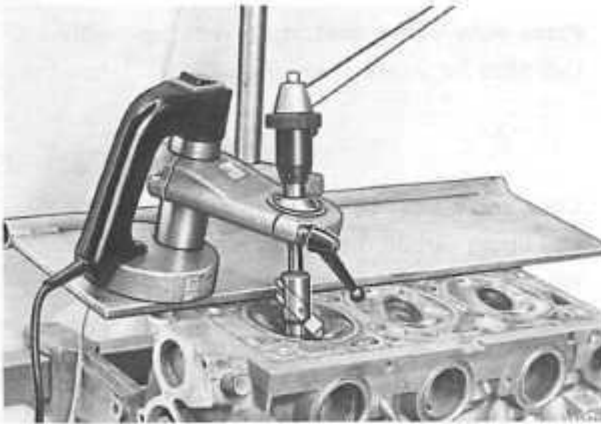


Clean inner surface of new valve guides

Use reamer 5224.

Reamer 5164 can also be used.

Valves and valve seats must be ground-in if guide has been replaced.



Valve seat replacement Operations E15–22

Note! Valve guides must always be renewed before replacing seats, see E8–14.

E15

Clean combustion chambers

Clean the surfaces until the edge of the inserted seat is clearly visible.

E16

Remove valve seat

Machine the valve seat. Use Mira valve cutter P/N 998 6045-5. Follow the manufacturer's instructions.

Make sure that the cylinder head is not damaged. Clean carefully.



E17

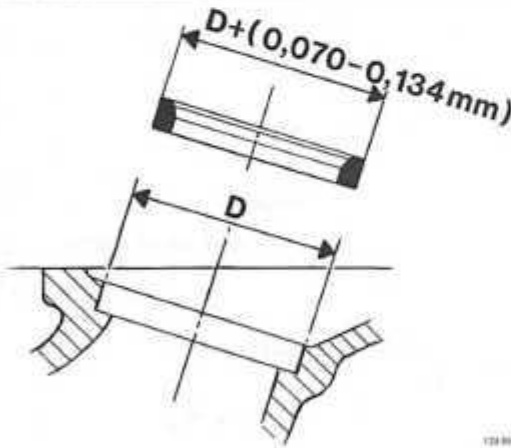
Measure valve seat diameter in cylinder head and select a new seat of correct size

Use an internal micrometer.

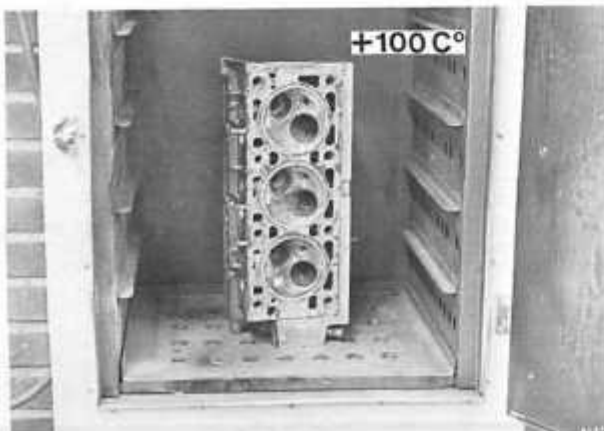
Valve seats are available in three oversizes.

The interference between the valve seat and recess in the cylinder head must be **0.070–0.134 mm** (0.0027–0.0052 in). I. e. the valve seat must be 0.070–0.134 mm larger than the recess in the cylinder head.

If too small, fit a new cylinder head. If too large, mill the valve seat to correct size. Use a valve cutter.



129 804



E18

Heat up cylinder head

Approx. 100°C. (212°F).

E19

Place new valve seat in correct assembly tool

Use 5029 for intake seats and 5220 for exhaust seats.

E20

Cool valve seat to -70°C (-95°F)

Use liquid carbon dioxide or equivalent.

Wear protective gloves and safety glasses.

E21

Tap in valve seat

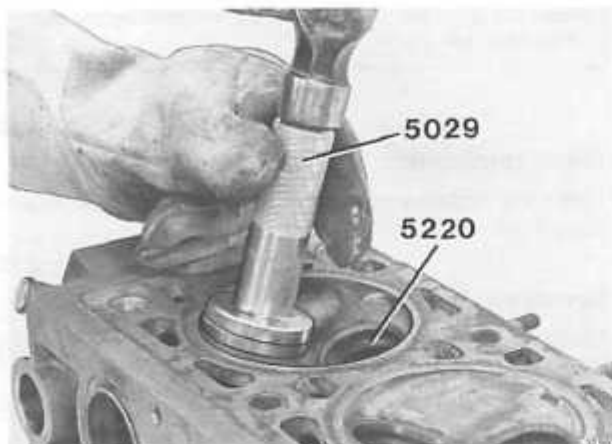
Note! This must be done quickly, within 3–4 seconds to avoid temperature loss.

E22

Check fit of valve seat

Make sure that the seat has bottomed correctly and is secure. If not, fit a larger size.

After valve seat replacement, valve seats must be milled and valves ground.



Grinding of valves and valve seats Operations E23–24

E23

Machine grind valves

Intake valves 29.5°

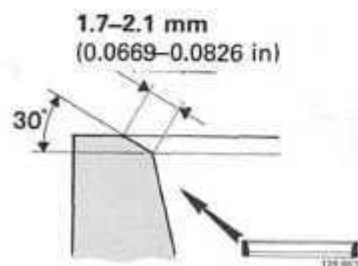
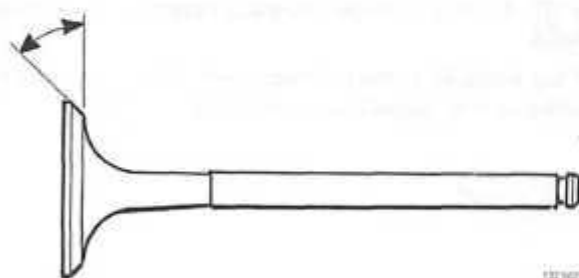
Exhaust valves 44.5°

Also grind flush the end of the valve stem.

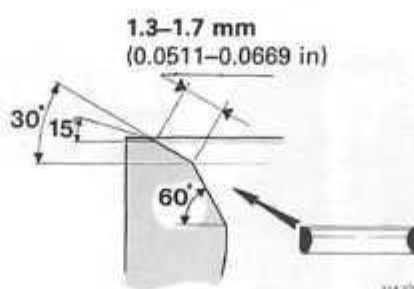
E24

Mill or grind valve seats Check valve fit

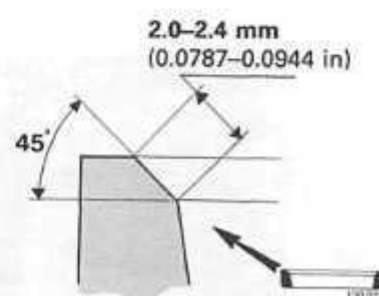
If necessary grind-in valves with grinding paste.



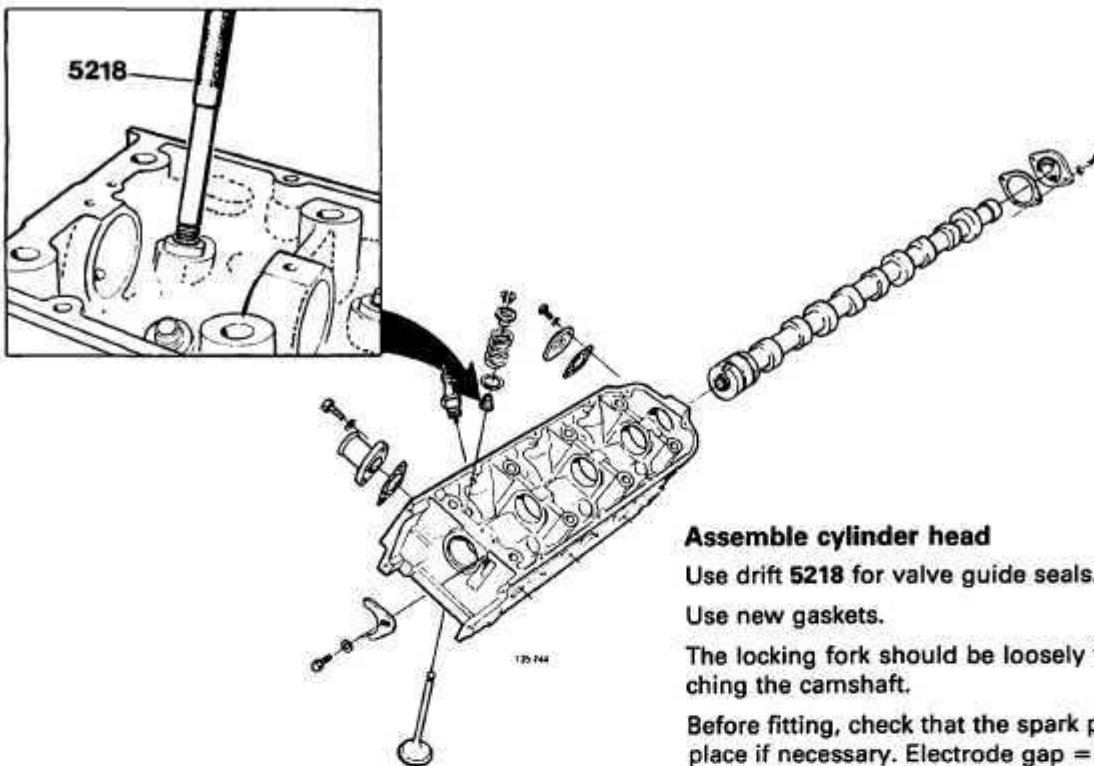
Intake valve seat
Early types



Intake valve seat
Late types (venturi seat):
 15° and 60° are correct angles
to reduce seat width.



Exhaust valve seat



E25

Assemble cylinder head

Use drift 5218 for valve guide seals.

Use new gaskets.

The locking fork should be loosely fitted and not touching the camshaft.

Before fitting, check that the spark plugs are clean, replace if necessary. Electrode gap = 0.6 mm (0.024 in). Tightening torque 12 ± 2 Nm (9 ± 1.5 ft.lbs.).

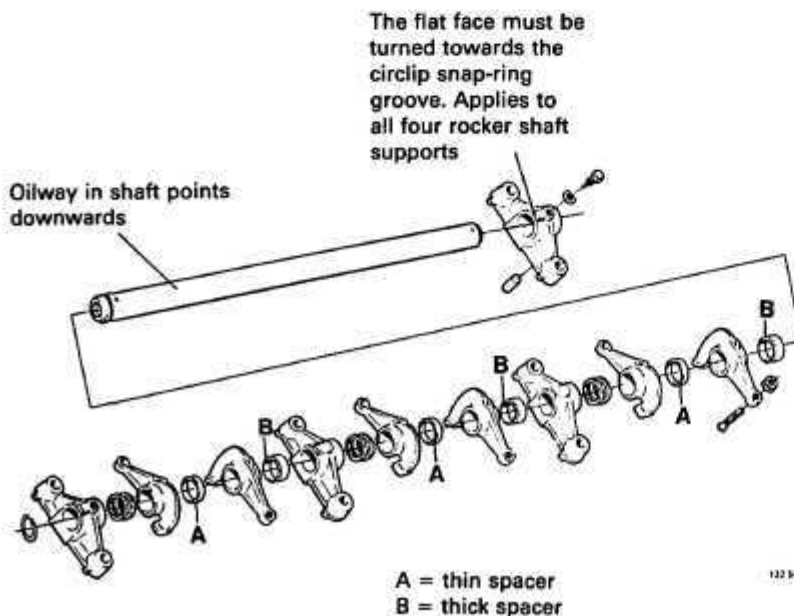
E26

Clean and check rocker arm shaft

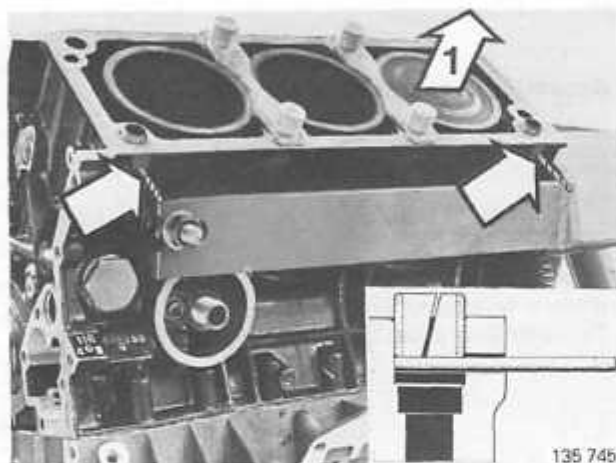
Disassemble only if necessary. (Place parts in order, so that they can be re-assembled in the same position.)

The clearance between the rocker arm and shaft is for new parts 0.012–0.054 mm. (0.0005–0.0021 in).

IMPORTANT! The rocker arm contact surface on the camshaft is face-hardened and must not be ground.



F. Engine, assembly



CYLINDER HEAD

Install cylinder heads one at a time i.e. perform operations F1–7 separately for each cylinder head.

F1

Turn crankshaft to TDC for cyl. 1.

F2

Install guide sleeves in cylinder block

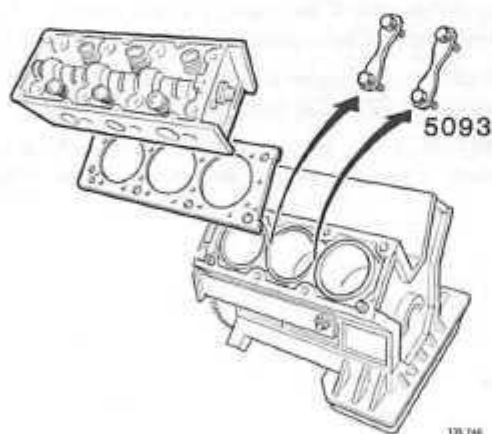
Secure the sleeves with e.g. a 3 mm drill. This prevents the sleeves from being forced down when the cylinder head is fitted.

F3

Install cylinder head gasket and cylinder head

First remove liner holder 5093 and then the protective paper in the water passages.

Note! Different gaskets for right and left cylinder heads.



F4

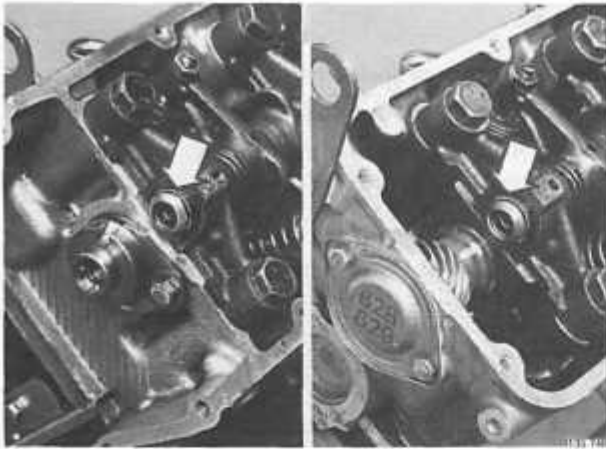
Set camshaft

Left side: groove in camshaft must point up and No. 1 rocker arms should have clearance.

Right side: groove in camshaft must point out and down.



F5

**Install rocker arm assembly**

Use the correct bridge on the right and left sides. Bridges are the same but must face different directions.

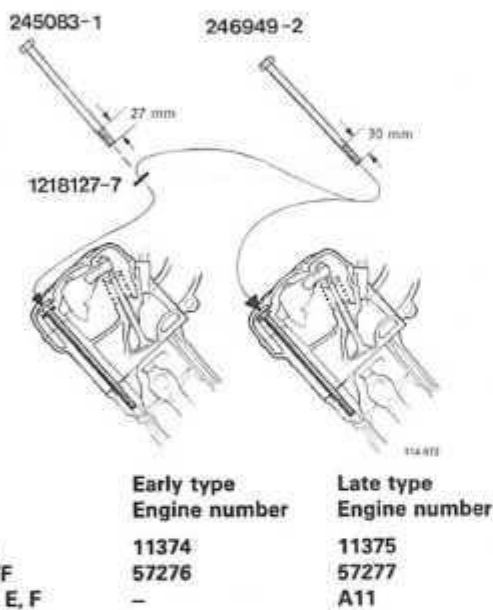
- left side circlip must face forwards and
- right side circlip must face rearwards.

F6

Clean, lubricate and install cylinder head bolts

(Remove 3 mm drill beneath guide sleeves.)

Tighten bolts by hand.



Two different types of cylinder head bolts are in use, depending on the thread length in the cylinder block.

Late type = bolt thread length 27 mm (1.063 in) with washer

Early type = bolt thread length 30 mm (1.181 in) without washer

Only late type bolts are available as spare parts.

If late type bolts are used on early type cylinder heads, washers must be used (the same washers as used for late type bolts).

F7

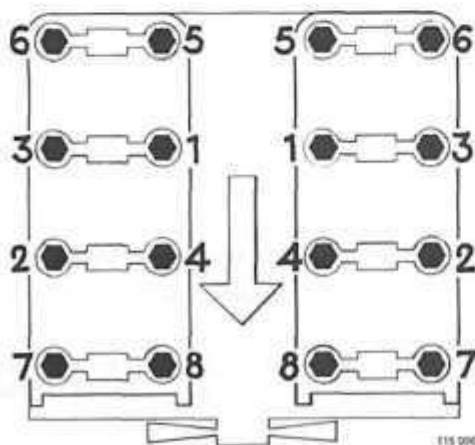
Tighten cylinder head bolts

Tighten to the correct torque in three stages.

1 = 10 Nm (7 ft.lbs.)

2 = 30 Nm (22 ft.lbs.)

3 = 60 Nm (44 ft.lbs.)

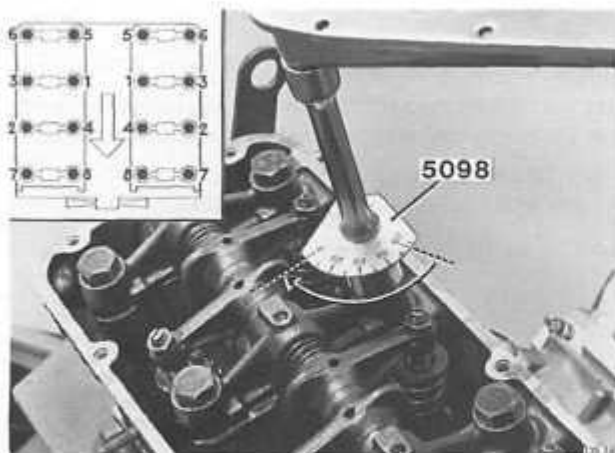


F8

Install other cylinder head

Install according to C53–65.

Assembly



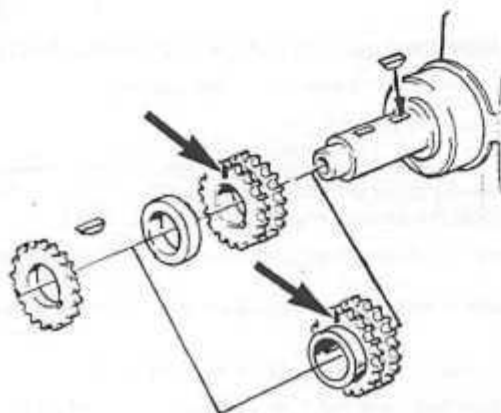
F9

Angle-tighten cylinder head bolts

At the earliest, 10–15 minutes after F7.

- 1 = Slacken all bolts in order shown adjacent
- 2 = Tighten to a torque of 15–20 Nm (11–15 ft.lbs.) in order shown
- 3 = Angle-tighten 113–117° in order shown adjacent. Use protractor 5098. The rocker arm bridge can be used as a line of sight.

IMPORTANT! Bolts must be retightened after engine has cooled.



TIMING GEARS

F10

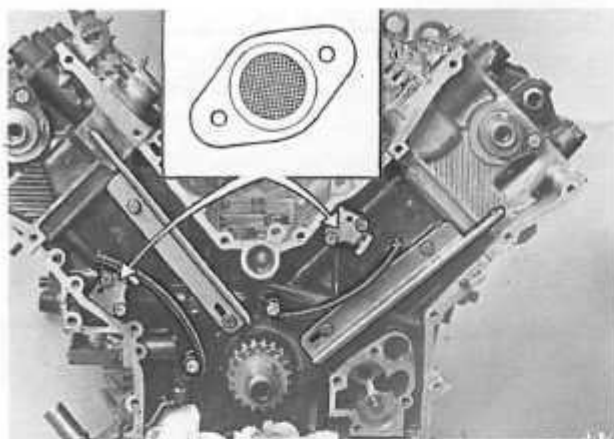
Install crankshaft gears and keys

Block holes in crankcase to prevent keys from falling in.

Lubricate parts.

The mark on the inner gear must face out.

Note! On late types, gear and spacer are manufactured in one unit.



F11

Install:

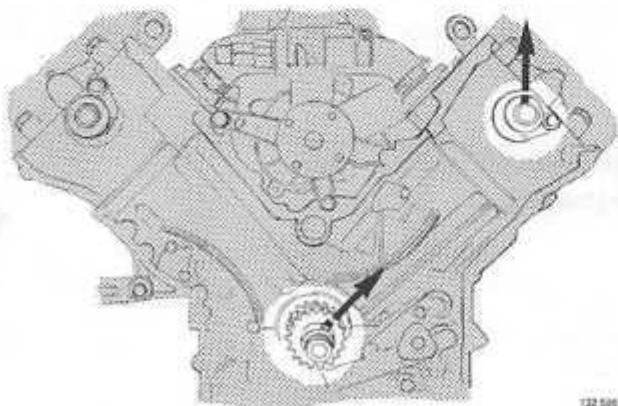
- new strainers in cylinder block
- chain tensioners
- straight chain dampers
- bent chain dampers. Apply locking fluid (P/N 116 1053-2) to bolts.

F12

Set crankshaft and left-hand camshaft

The key in the crankshaft should point towards the left-hand camshaft.

The groove in the camshaft should point upwards and there should be no clearance between the rocker arms and valve stem tops for No. 1 cylinder.



F13

Install left-hand camshaft chain and sprocket

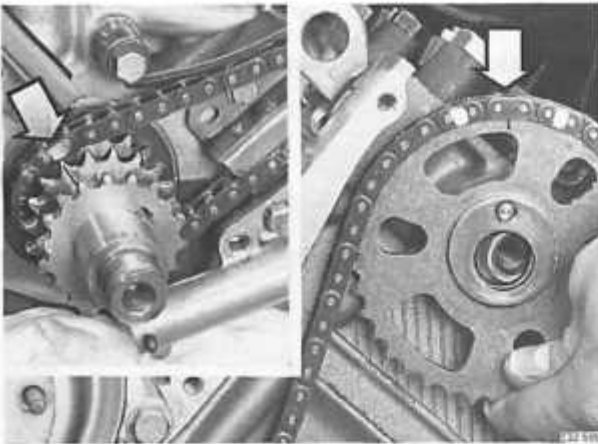
Place the chain on the camshaft sprocket, with the mark on the sprocket between the two marks on the chain.

Place the chain on the inner crankshaft sprocket, with the mark on the chain opposite the mark on the sprocket.

Stretch the chain on the pulling side (the side against the straight chain damper).

Position the camshaft sprocket. Make sure that the sprocket fits in the groove in the camshaft.

Install the centre bolt.

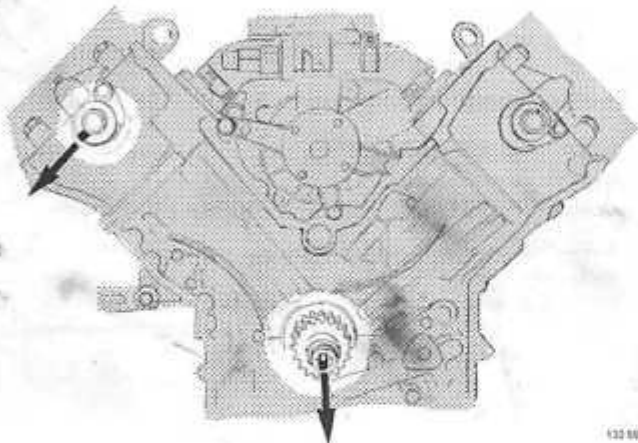


F14

Set crankshaft and right-hand camshaft

Install the crankshaft nut. Turn the crankshaft clockwise so that the key points directly downwards.

The groove in the camshaft should point outwards, see fig., and there should be no clearance between the rocker arms and valve stem tops for No. 6 cylinder.



F15

Install right-hand camshaft chain and sprocket

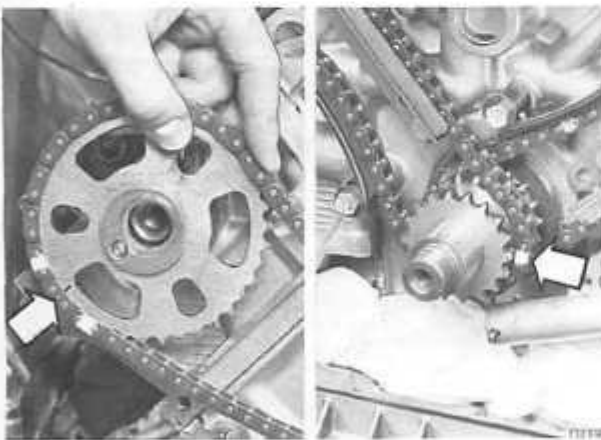
Place the chain on the camshaft sprocket, with the mark on the sprocket between the two marks on the chain.

Place the chain on the camshaft sprocket, with the mark on the chain opposite the mark on the sprocket.

Stretch the chain on the pulling (the side against the straight chain damper.)

Install the camshaft sprocket. Make sure that the sprocket fits in the groove in the camshaft. If necessary rotate the crankshaft slightly.

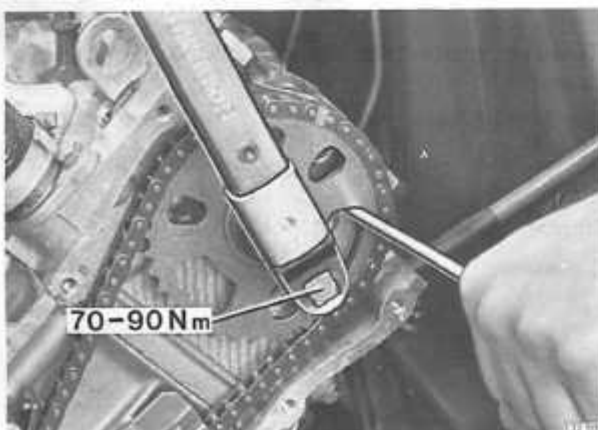
Install the centre bolt.

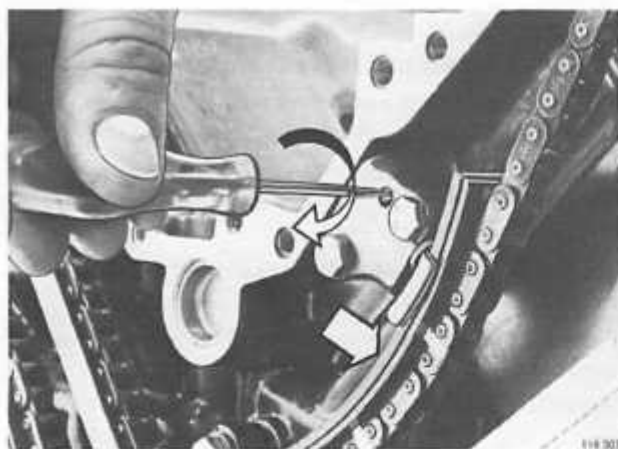


F16

Tighten both camshaft centre bolts

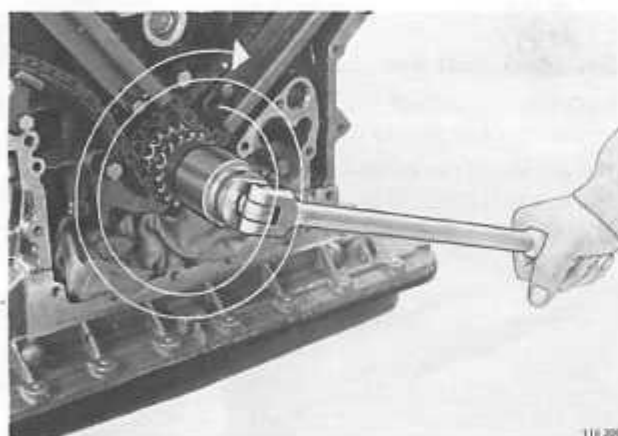
Tighten to a torque of 70–90 Nm (52–66 ft.lbs.) Use a screwdriver as a counterhold, placing it between two cogs on the sprocket without holes.





F17

Turn locks 1/4 turn clockwise



F18

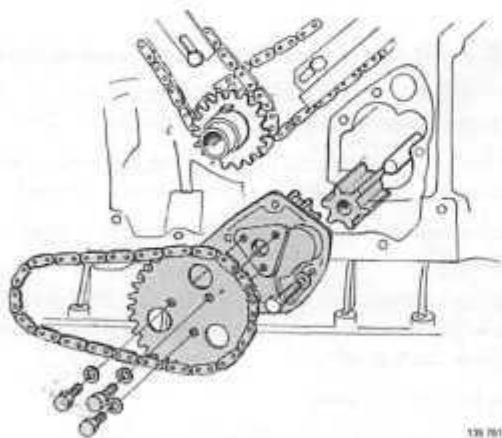
Set chain tension

Turn the crankshaft round twice.

Remove the crankshaft nut.

Note! The key in the crankshaft should point upwards to prevent it from falling out of its groove.

When the crankshaft has been rotated the marks for the chains and sprockets do not coincide. It is necessary to rotate the crankshaft a large number of turns to obtain the correct position.

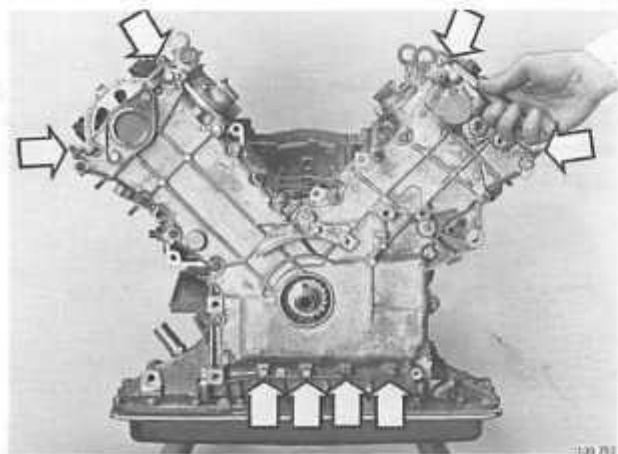


F19

Install:

- oil pump with sprocket
- chain and gear.

Apply locking fluid (P/N 116 1053-2) to the bolts.



F20

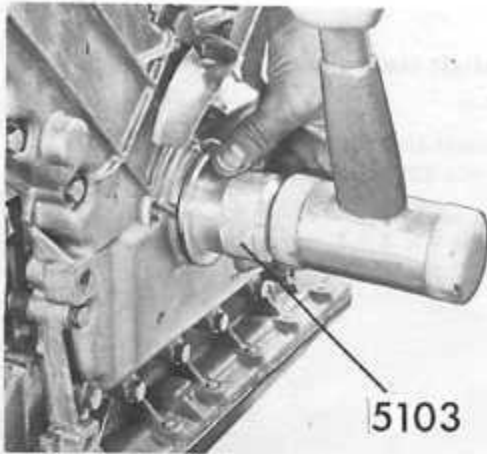
Remove protective paper. Install timing gear case

Use new gaskets.

Smear the four lower bolts with locking fluid P/N 116 1056-5.

Tightening torque 10–15 Nm (7–11 ft.lbs.).

Cut sides of gaskets flush with cylinder heads.



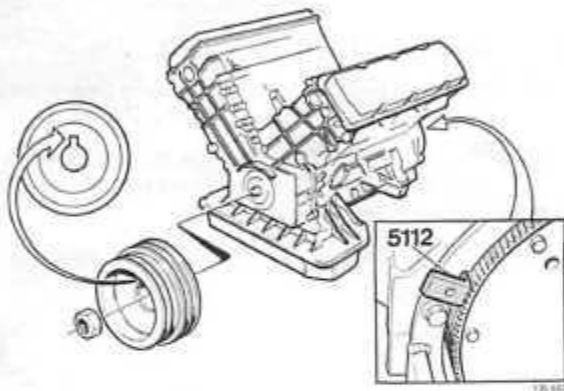
CRANKSHAFT FRONT OIL SEAL, PULLEY

F21

Install new seal in timing gear case

Grease the seal.

Use drift 5103.



F22

Install crankshaft pulley

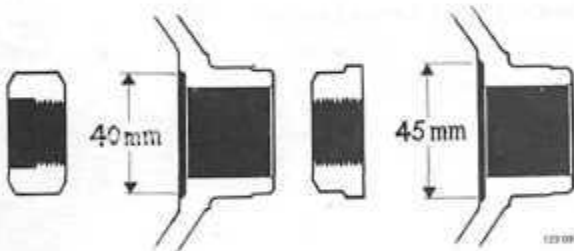
Fit locking sector 5112 to the flywheel casing at the lower bolt (RHD-vehicles = upper bolt.)

Make sure that key in crankshaft does not fall out.

Tighten nut to correct torque, see left.

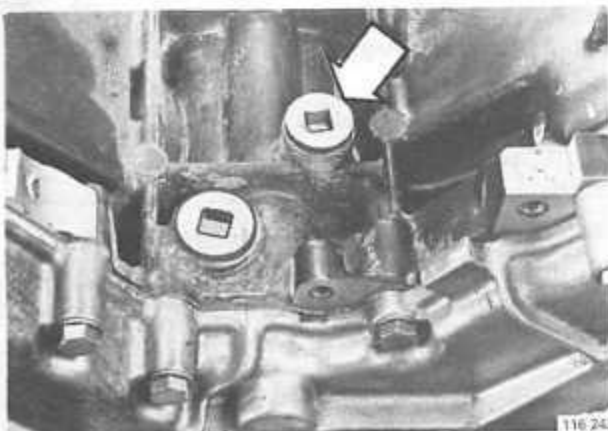
36 mm socket.

IMPORTANT! There are two different types of nuts.



160–180 Nm
(118–133 ft.lbs.)

240–280 Nm
(177–206 ft.lbs.)



TIMING SCALE

Check/adjust only if necessary, eg if plate is removed or replaced.

F23

Remove rear plug in cylinder block

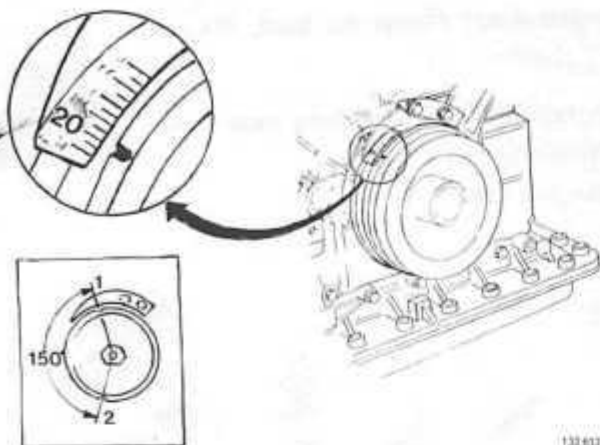
F24

Set crankshaft statically

36 mm socket.

Turn the crankshaft so that the mark for T.D.C. cylinder 1 aligns with the 20° mark on the timing scale.

Note! There are two marks on the pulley, 1 = T.D.C. cylinder 1 and 2 = T.D.C. cylinder 6.



133 613

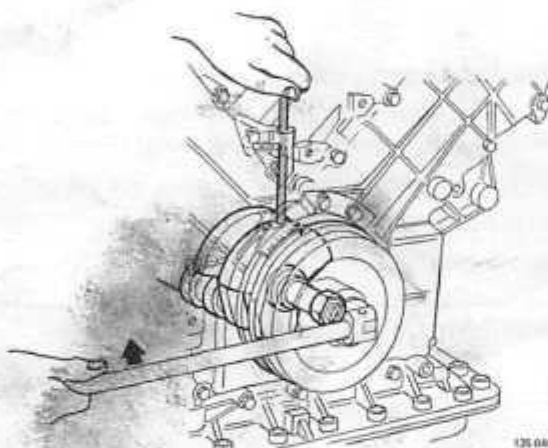
F25

Set crankshaft at T.D.C. cylinder 1

Insert a 8 mm drill (0.315 in) in the blanking plug hole so that it rests on the crankshaft counterweight.

Press lightly on the drill and turn the crankshaft slowly in the normal direction of rotation until the drill fits into the hole in the counterweight.

The engine is now set at exactly T.D.C. for cylinder 1.



135 048

F26

Check/adjust timing scale

The zero-mark on the scale must align exactly with the mark on the pulley.

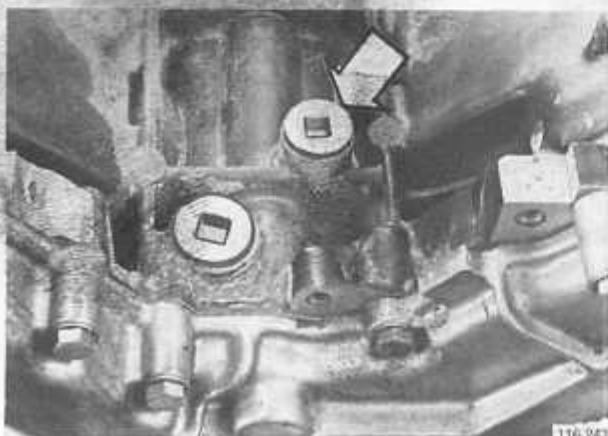


F27

Install blocking plug

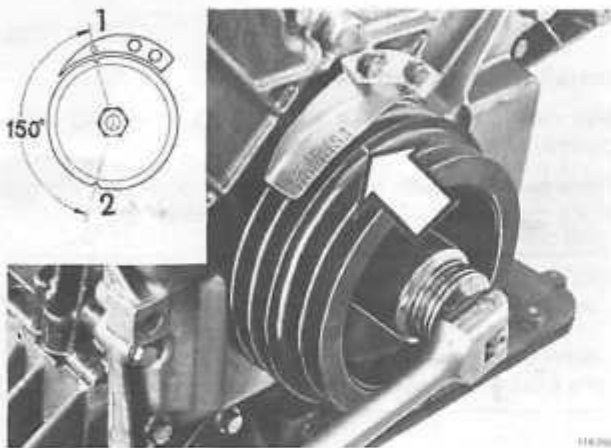
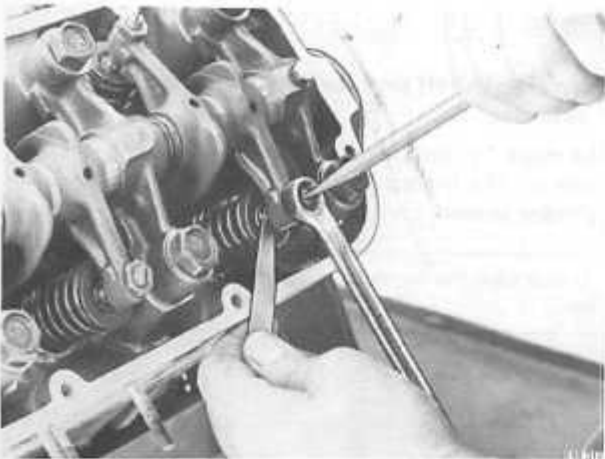
Use a new seal.

Tightening torque 35–40 Nm (26–30 ft.lbs.).



116 243

Before proceeding with valve clearance check:
Camshaft setting must be checked. See specifications on page 8.

**VALVE ADJUSTMENT, VALVE COVERS**

See footnote on page 58.

Different clearances for different engine types

Valve clearance mm (in), cold engine	Type 1	Type 2
intake	0.10–0.15 (0.004–0.006 in)	0.20–0.25 (0.008–0.010 in)
exhaust	0.25–0.30 (0.010–0.012 in)	0.30–0.35 (0.012–0.014 in)
B 27 A 1976–1979	X	
B 28 A 1980		X
1981–1982	X	
B 27 E 1975–1978	X	
1979–1980		
Sweden and Australia	X	
1979–1980 Other markets		X
B 28 E 1981–1983	X	
B 27 F 1976–1979	X	
B 27 F 1980		X
B 27 F 1981–1982	X	

F28

Turn crankshaft to firing position for No. 1 cylinder

The mark "1" on the pulley should align with the zero mark on the timing scale. **Both** rocker arms for No. 1 cylinder should have clearance.

F29

Check/adjust valve clearances

Check the following valves in the set position.

Intake: cylinders 1, 2 and 4

Exhaust: cylinders 1, 3 and 6

F30

Turn crankshaft one turn in normal direction to overlap position for No. 1 cylinder

The mark "1" on the pulley should align with the zero mark on the scale. **There should be no clearance between the rocker arms and valve stem tops for No. 1 cylinder.**

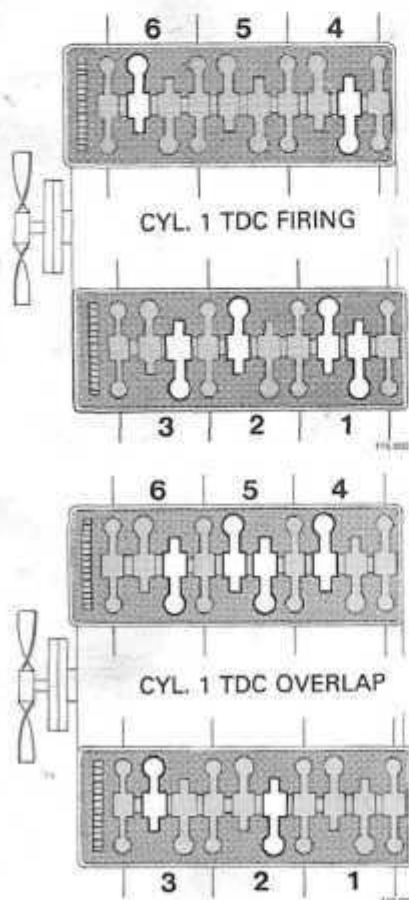
F31

Check/adjust valve clearances

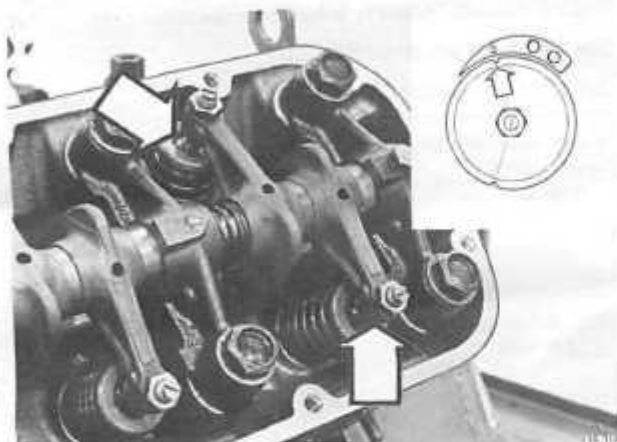
Check the following valves in the set position.

Intake: cylinders 3, 5 and 6

Exhaust: cylinders 2, 4 and 5



Assembly

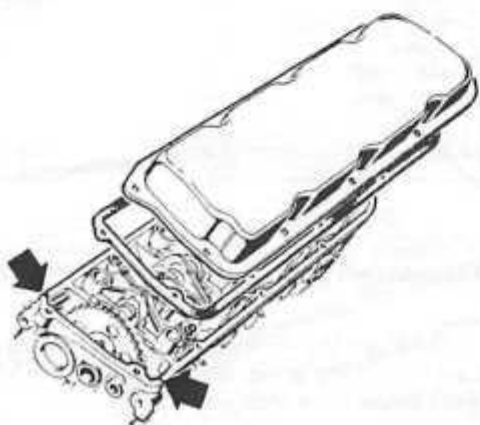


F32

Turn crankshaft one turn to firing position for No. 1 cylinder

The mark "1" on the pulley should align with the zero-mark on the timing scale. The rocker arms for No. 1 cylinder should have clearance.

This is now the correct setting for installing the distributor.



F33

Install gaskets and valve covers

Use new gaskets. Apply a few spots of sealing compound. (P/N 116 1026-8).

Place only four bolts in each valve cover. Do not tighten since the covers are to be removed later on.

To ensure that the junction between the valve cover, cylinder block and timing gear case is fully leak-proof, a thin coat of silicone (P/N 116 1048-2) can be applied to the joint. **Note!** Do not use too much silicone otherwise it may enter the lubrication system and block the oil channels.

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