

# Service Manual

## Repairs and maintenance

Section 2 (21)

Reconditioning  
engine  
B 27, B 28

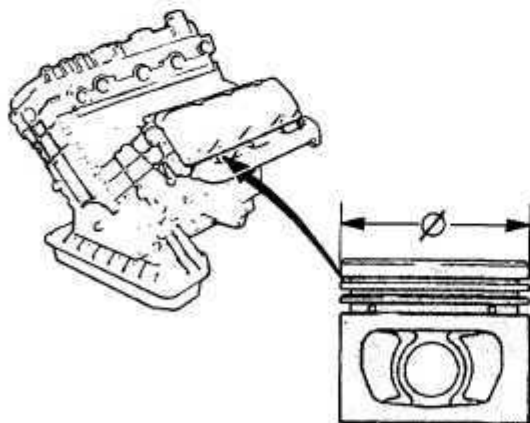
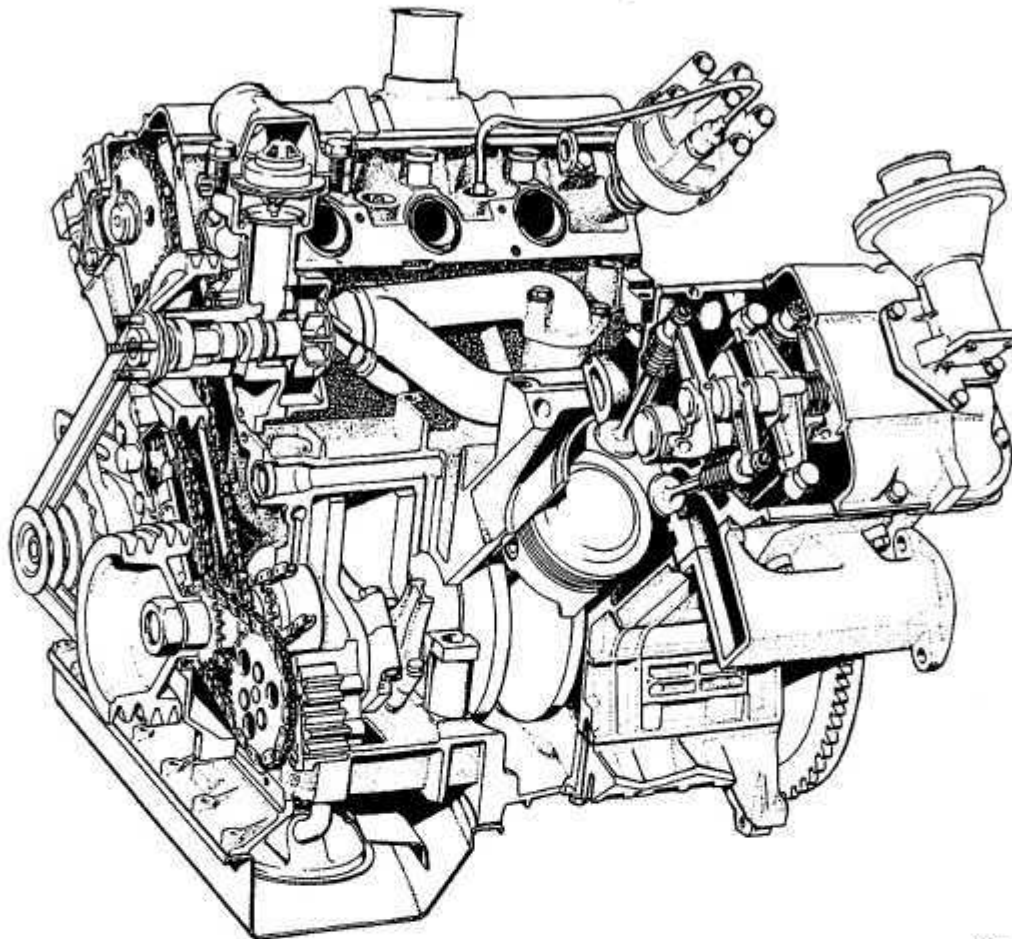
260 1975-1983

# VOLVO



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**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.

## Contents

	Page
<b>Important information</b> .....	2
<b>Specifications</b> .....	2
<b>Special tools</b> .....	11
	<b>Operation</b>
<b>Thread repairs</b> .....	A 1-14 14
<b>Reconditioning engine</b>	
Disassembly.....	B 1-19 20
Cleaning and inspection.....	C 1-41 26
Assembly.....	D 1-35 38
Cylinder head, reconditioning.....	E 1-26 46
Assembly (cont.).....	F 1-33 52

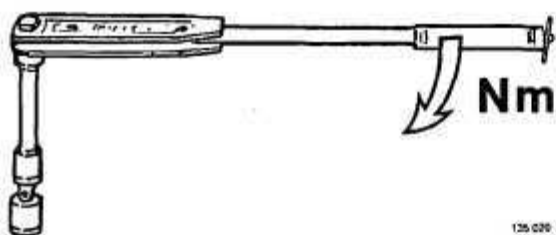
Index page 62

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



135 020

### 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.

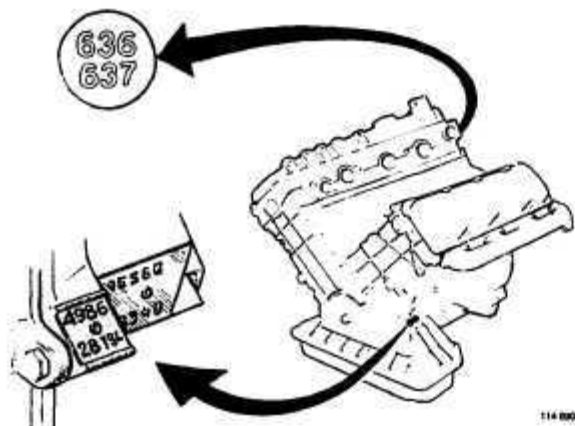
Two types of tightening torques are used in this manual:

- 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.

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## Specifications

### Group 20 General



114 000

### Engine serial number and part number

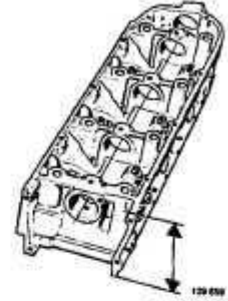
Located on a plate in front of the oil filter.

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

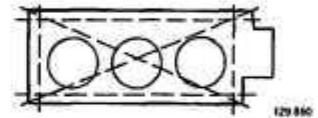
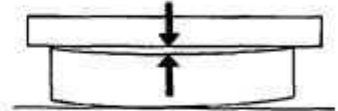
### CYLINDER HEAD

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>B 27</b> 88.00–88.01 mm (3.4646–3.4650 in)	<b>B 27</b> 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

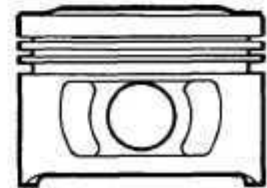
#### Pistons for B 27

Pistons and liners are matched sets.

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



Demolin



Mahle

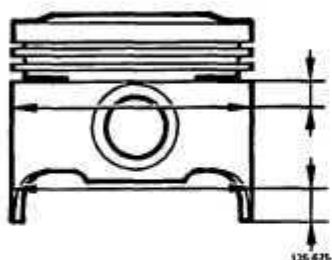
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Group 21 Reconditioning engine

Specifications

**DEMOLIN PISTONS (B 27)**

	<b>B 27 A</b>	1976-1979	
	<b>B 27 E</b>	1975-1978	
	<b>B 27 F</b>	1979	<b>1976-1978</b>
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)	



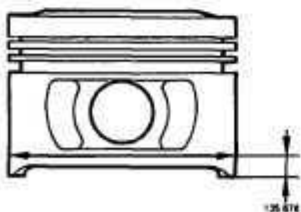
Piston diameter is measured at right angles to gudgeon pin bore and:  
**11 mm (0.43 in)** from lower edge of piston for B 27 F 1976-1978  
**8.5 mm (0.33 in)** from lower edge of oil scraper ring for other engines.

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>B 27 A</b>	1976-1979	
	<b>B 27 E</b>	1975-1978	<b>1979-1980</b>
	<b>B 27 F</b>	1979	<b>1976-1978</b>
Height, overall		63,4 mm	62.2 mm
from gudgeon pin centre to piston crown		(2.4960 in)	(2.4488 in)
		39.4 mm	38.2 mm
		(1.5521 in)	(1.5039 in)
			65.3 mm
			(2.5709 in)
			41.3 mm
			(1.6260 in)
Weight		445±3 gram	
Max weight difference between pistons in same engine		6 gram	
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.

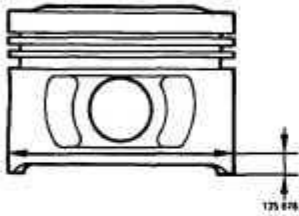
Diameter, gudgeon pin bore:

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.

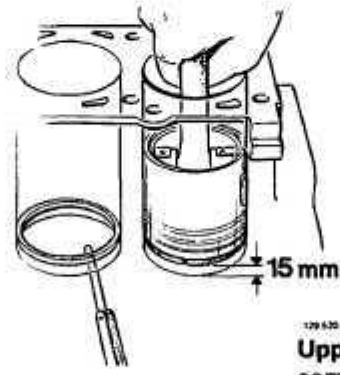
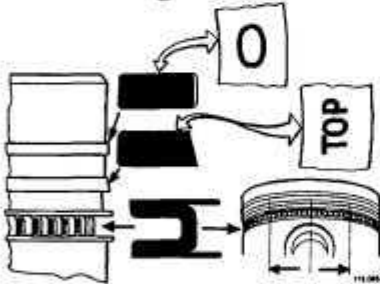
Weight.....	455±3 grams
Max weight difference between pistons in same engine.....	6 grams
Height, overall A- and F-engines.....	62.8 mm (2.4724 in)
E-engine.....	65.3 mm (2.5709 in)
from gudgeon pin centre to piston crown	
A- and F-engines.....	38.8 mm (1.5276 in)
E-engine.....	41.3 mm (1.6260 in)
Piston 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:		
<b>Marking, piston</b>	<b>Marking, gudgeon pin</b>	
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

		129 620		
Height.....	mm	Upper compression ring	Lower compression ring	Oil ring
	in	1.478–1.490	1.978–1.990	2.629–2.731
Side clearance (measured with ring on piston).....	mm	9.0582–0.0587	0.0779–0.0783	0.1035–0.1075
	in	0.045–0.074	0.025–0.054	0.009–0.233
Ring gap when checked in 91 mm (3.5826 in) cylinder (B 28),				
88 mm (3.4646 in) (B 27), see fig.....	mm	0.0017–0.0029	0.0009–0.0212	0.0003–0.0091
	in	0.40–0.60	0.40–0.60	0.38–1.45
		0.0157–0.0236	0.0157–0.0236	0.0150–0.0570

**Gudgeon (piston) pins**

Diameter		
<b>Marking, gudgeon pin</b>	<b>Marking, piston</b>	
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)

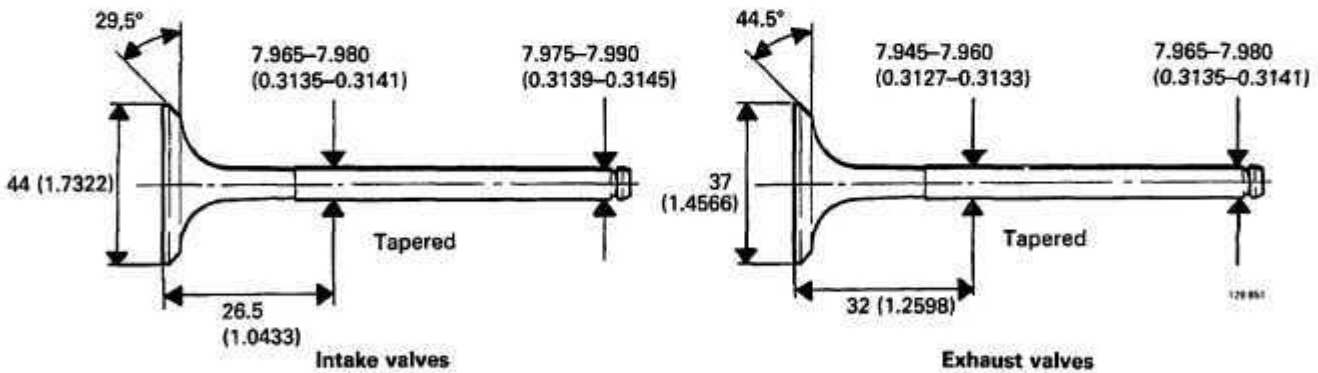
Specifications

**VALVE SYSTEM**

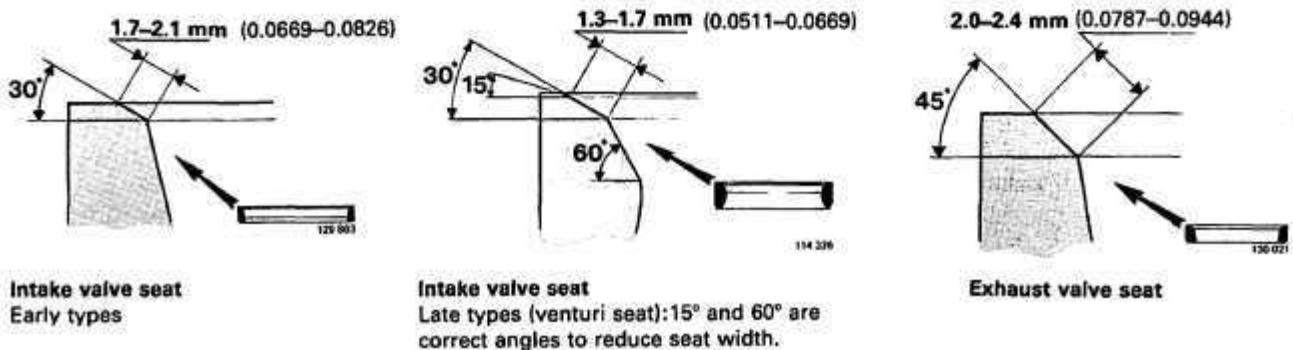
**Valve clearances** (varies with engine type)

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)
<b>Engine type – model year</b>		
<b>B 27 A 1976–1979</b> .....	X	
<b>B 28 A 1980</b> .....		X
1981–1982.....	X	
<b>B 27 E 1975–1978</b> .....	X	
1979–1980 Sweden + Australia.....	X	
1979–1980 Other markets.....		X
<b>B 28 E 1981–1983</b> .....	X	
<b>B 27 F 1976–1979</b> .....	X	
<b>B 28 F 1980</b> .....		X
1981–1982.....	X	

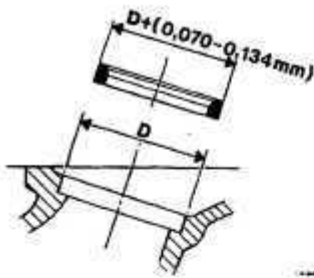
**Valves** mm (in)



**Valve seats** mm (in)





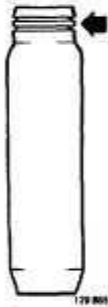


**Note!** When replacing valve seats: the interference between the valve seat and its bore in the cylinder head must be 0.070–0.134 mm, (0.0027–0.0052 in), i.e. the valve seat diameter must be 0.070–0.134 mm greater than the diameter of the bore in the cylinder head.

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	–
Oversize 1	1 groove	5166
2	2 grooves	5167
3	3 grooves	5168

**Valve springs**

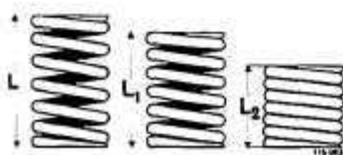
Two types of valve springs are in use. The springs are colour coded as follows:

**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)
<b>Check of camshaft setting (cold engine):</b> Adjust valve clearance on 1st and 6th intake valves to 0.7 mm (0,027 in), the intake valves should then open at,			
1st .....	9°±3°	9°±3°	8°±3°
6th .....	7°±3°	9°±3°	8°±3°
<b>Engine type</b>			
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)

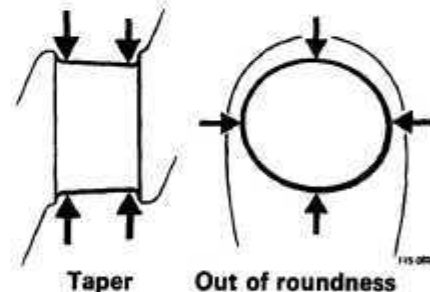
## CRANK MECHANISM

### 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

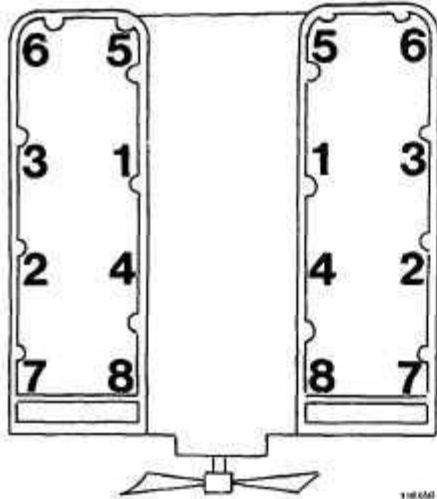
Axial throw, max . . . . .	0.05 mm	(0.0019 in)
Radial throw, max (measured at diameter 282.4 mm) . . . . .	0.15 mm	(0.0059 in)

Specifications

**TIGHTENING TORQUES**

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

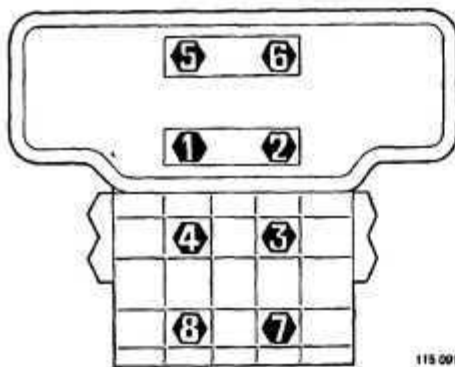
Degreased (washed) parts must be oiled prior to assembly.



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.



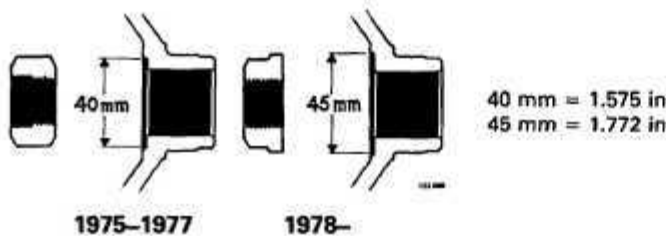
Tightening sequence for main bearings (via lower crankcase)

**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.

	Nm	ft. lbs.
Cylinder head (see below)		
Connecting rod bearings	45–50	33–37
Crankshaft front end, 1975–1977	160–180	118–133
1978–	240–280	177–207



	Nm	ft. lbs.
Camshaft sprocket	70–90	52–66
Flywheel (always use new bolts)	45–50	33–37
Spark plugs (do not oil)	12±2	9±1.5
Valve cover	15	11

## Group 22 Lubricating system

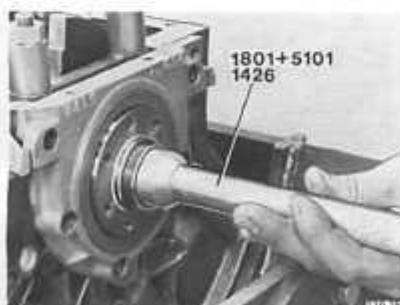
### OIL PUMP

End float .....	0.025–0.084 mm (0.0009–0.0033 in)
Radial play between cog tip and pump housing wall (excl. bearing play) .....	0.110–0.185 mm (0.0043–0.0072 in)
Backlash (excl. bearing play) .....	0.17–0.27 mm (0.0066–0.0106 in)
Bearing play, drive shaft .....	0.015–0.053 mm (0.0006–0.0021 in)
idler shaft .....	0.015–0.051 mm (0.0059–0.0020 in)
Relief valve spring, length at various loads:	
unloaded .....	89.5 mm (3.52 in)
loaded to 88.3 N (8.83 kp = 20 lbs) .....	56.5–60.5 mm (2.22–2.33 in)

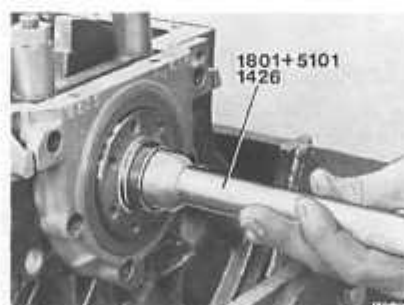
## Special tools

999	Description – use
1426-9	Drift: fitting pilot bearing in crankshaft (late type)
1801-3	Standard handle: used with 5101 and 5953
2484-7	Centering drift: clutch, M45/46 gearboxes (early type)
2520-8	Stand: used with fixture 5099
4090-0	Extractor: pilot bearing
5029-7	Drift: fitting intake valve seat

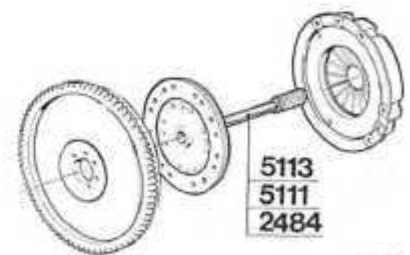
Continued on page 12.



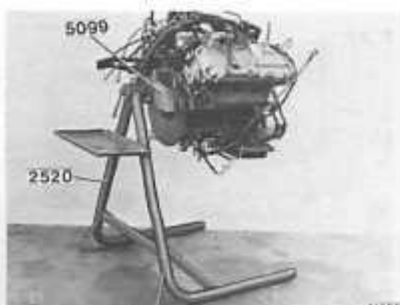
1426



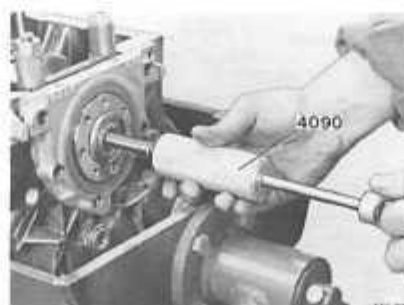
1801



2484



2520



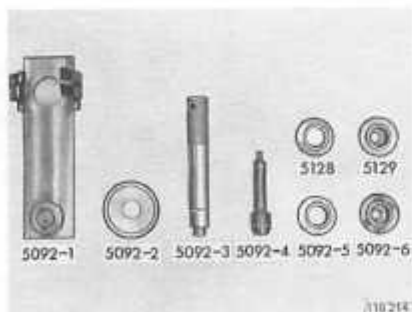
4090



5029

Special tools

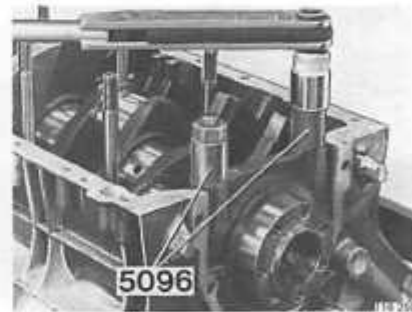
999	Description – use
5092-5	<b>Combined tools:</b> (6 parts) removing – fitting gudgeon (piston) pins 5128 and 5129 also required for Mahle pistons.
5093-3	<b>Retainer:</b> (4 x) for cylinder liners
5096-6	<b>Spacer sleeve:</b> main bearings
5098-2	<b>Protractor:</b> for angle-tightening cylinder head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



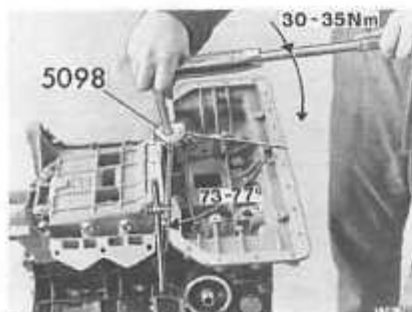
5092



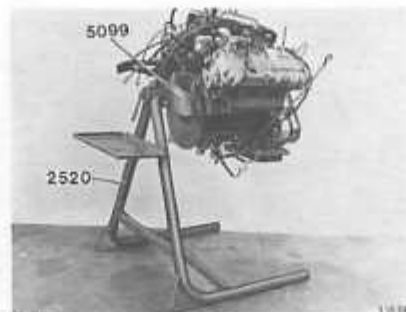
5093



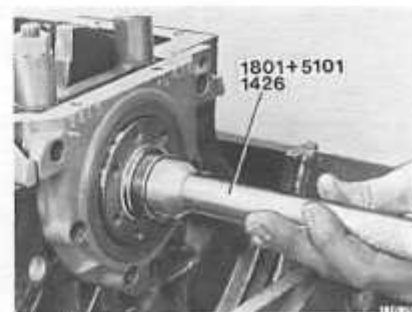
5096



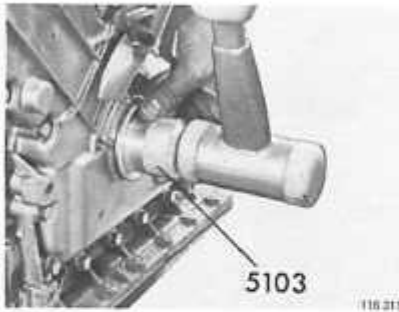
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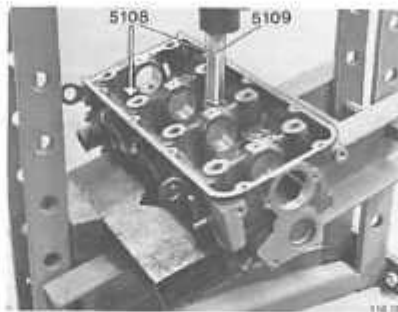
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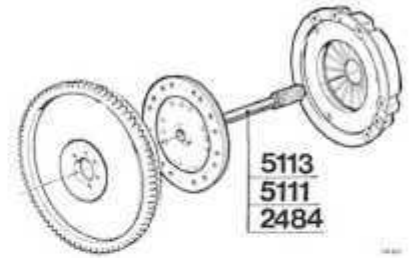
5101



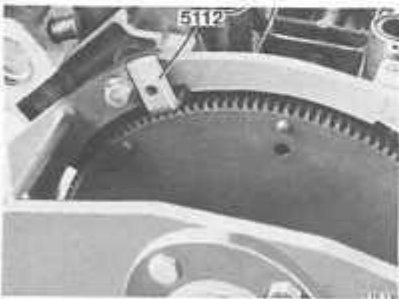
5103



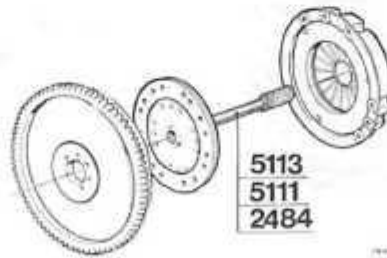
5108, 5109



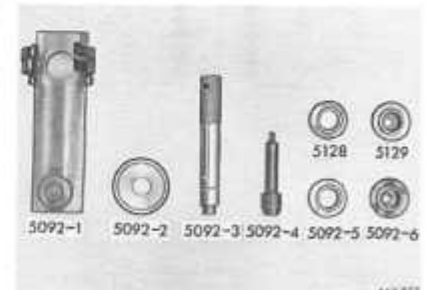
5111



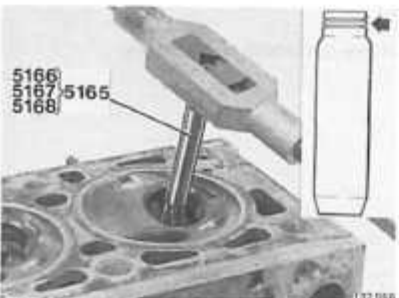
5112



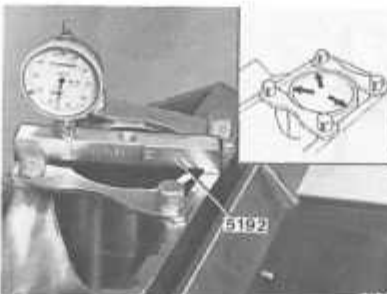
5113



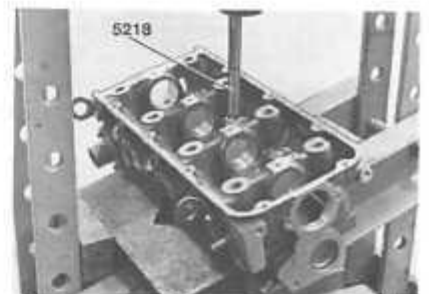
5128, 5129



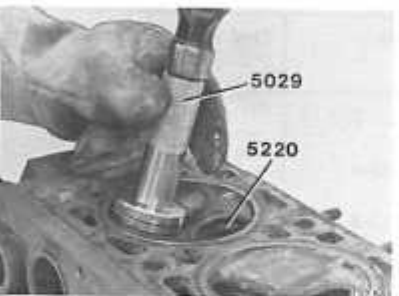
5165 (5166, 5167, 5168)



5192



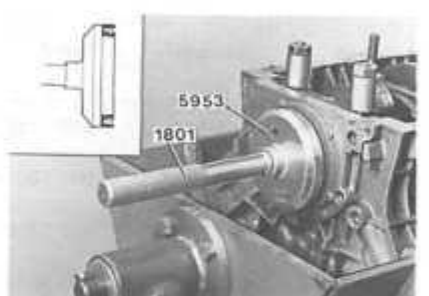
5218



5220

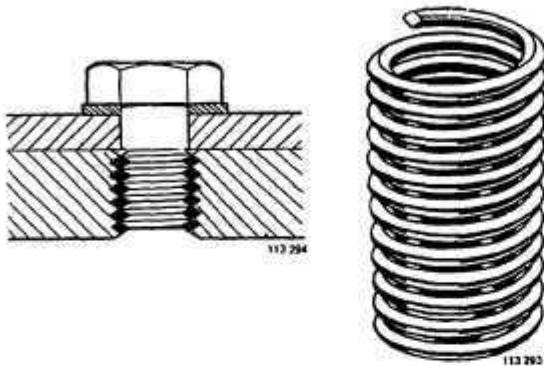


5224



5953

## A. Thread repairs

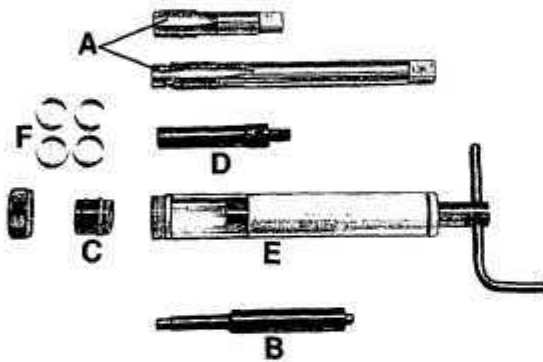


A1

### 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

### 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.

130 394

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 <sup>1)</sup>	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

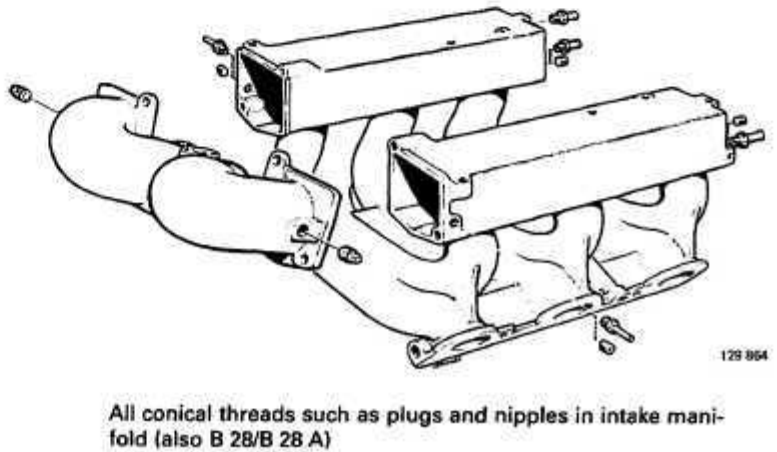
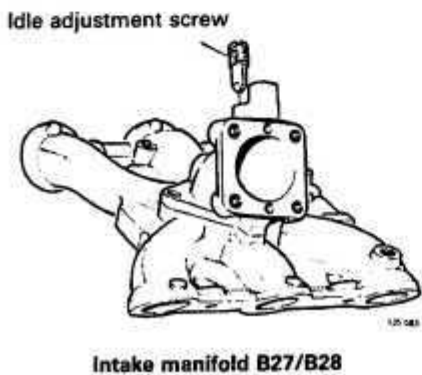
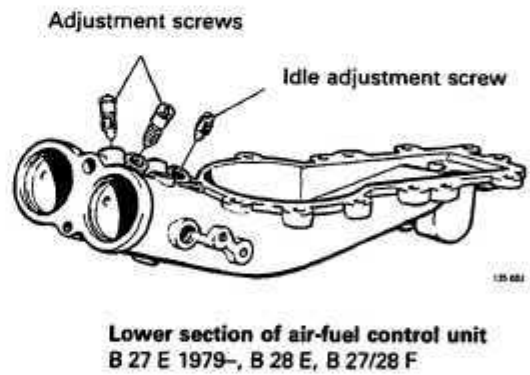
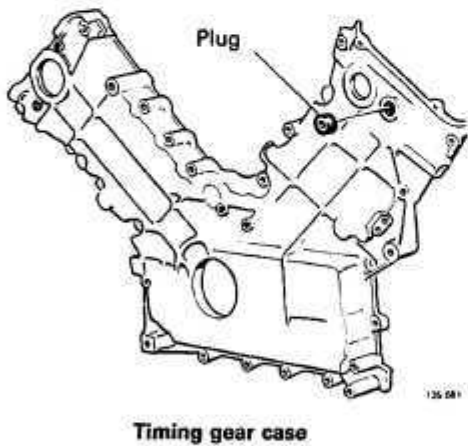
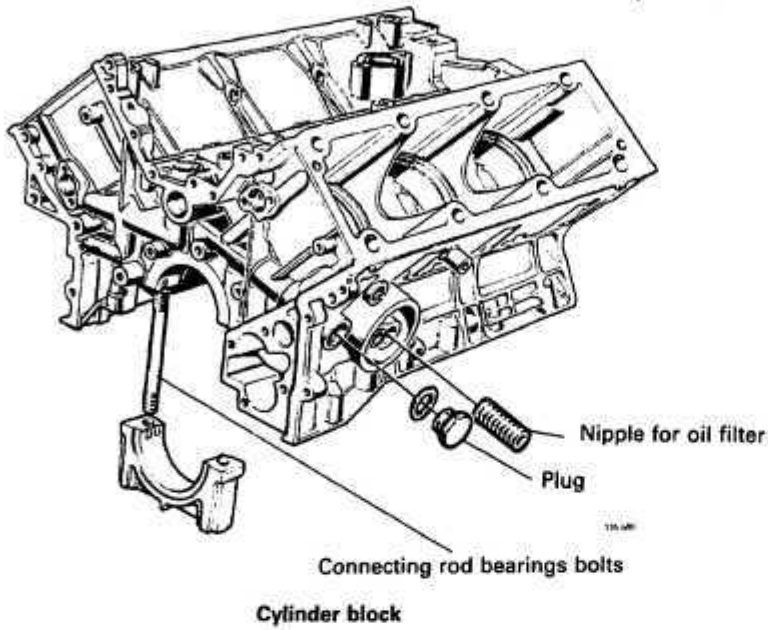
**Notes:**

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

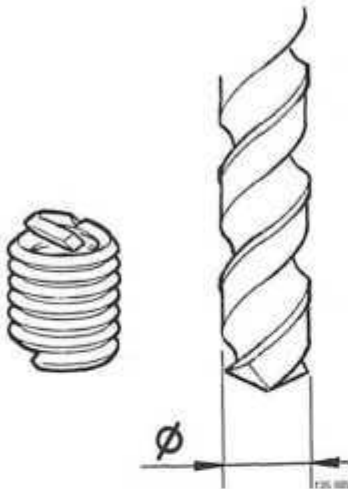


**Do not repair these threads**

(Threads shown below cannot or must not be repaired)



**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
5/88"x18UNF	8.0	948755-4	16.4

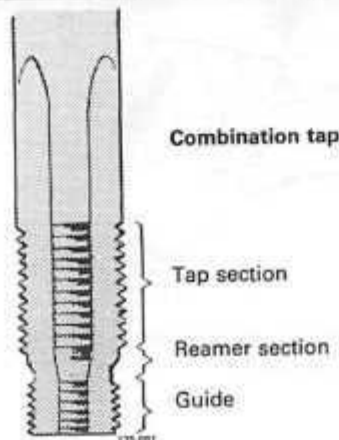
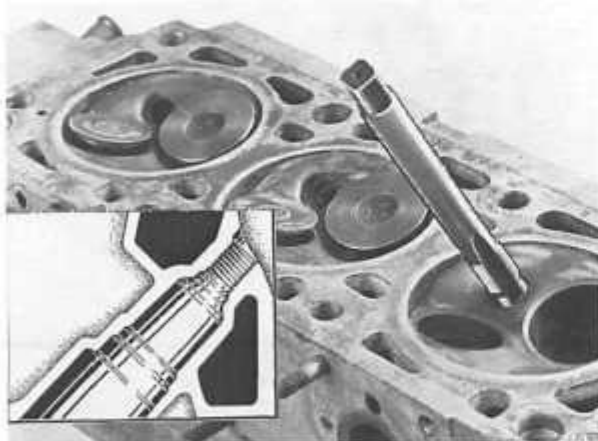
**Repairing spark plug threads**

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).

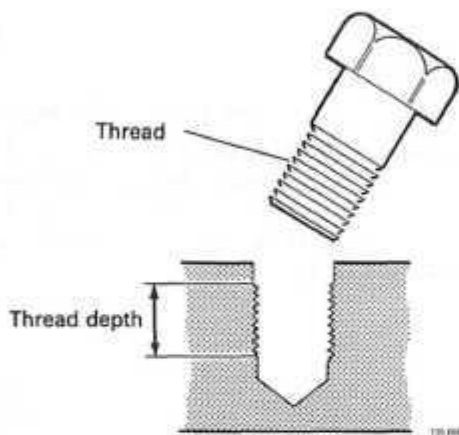


### Installing thread inserts

A6

#### Select drill size, tap and insert

Measure length and thread of old hole.



A7

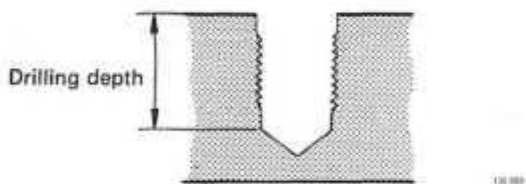
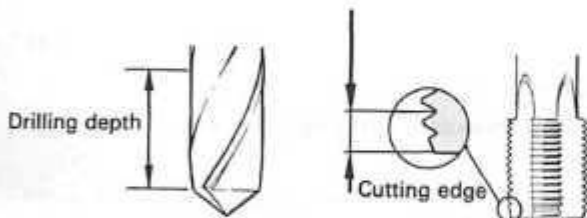
#### Tap hole

**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

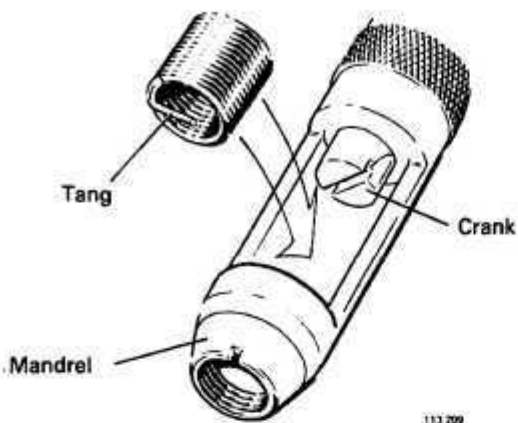
#### Assemble installation tool

**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



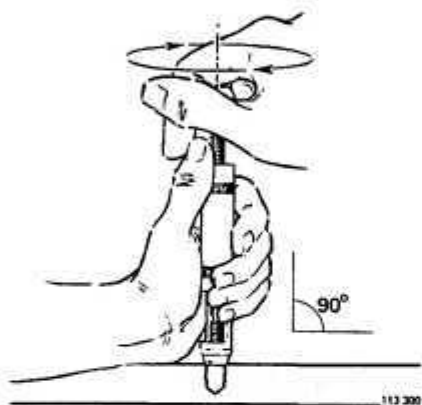
**Fit thread insert in installation tool**

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

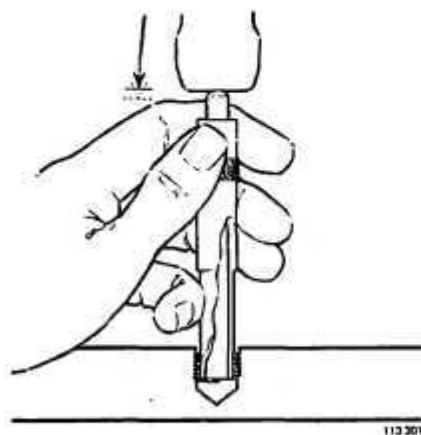


**Install thread insert**

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



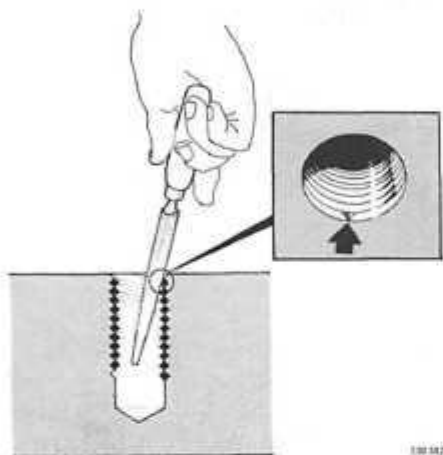
**Break off tang**

**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.

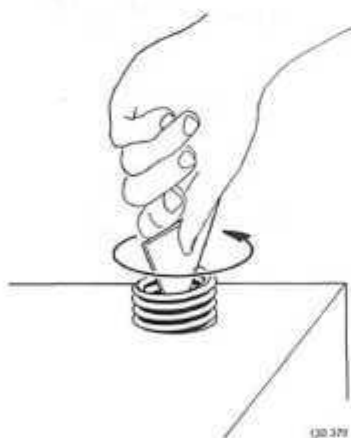
## Removing thread repair inserts



A12

### File groove in thread insert

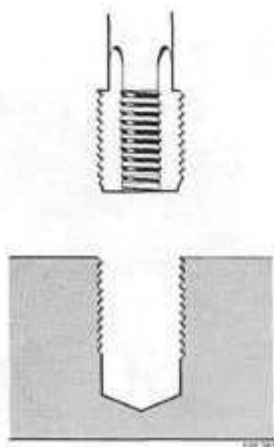
Using a triangular file make a groove in the top thread of the insert, approx. 1/4 of a thread from the end. Take care not to damage the thread holding the insert.



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

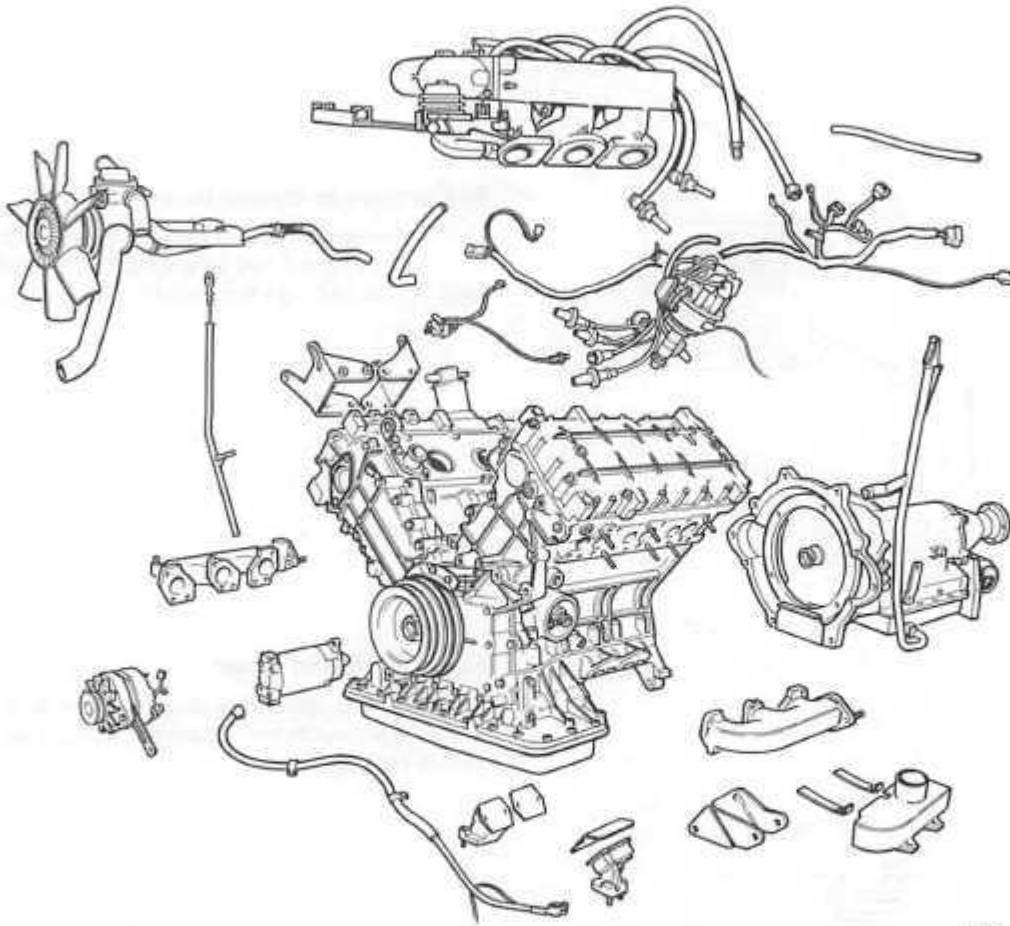
### Fit new thread insert

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

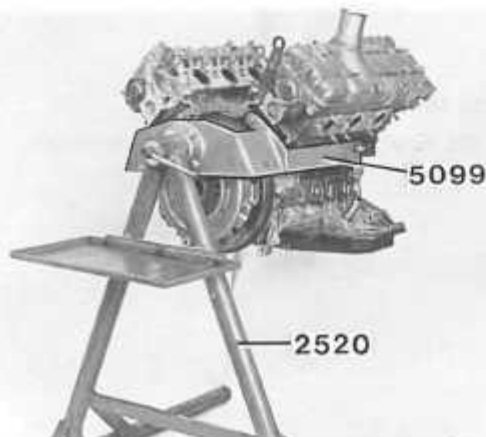
## Reconditioning engine

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

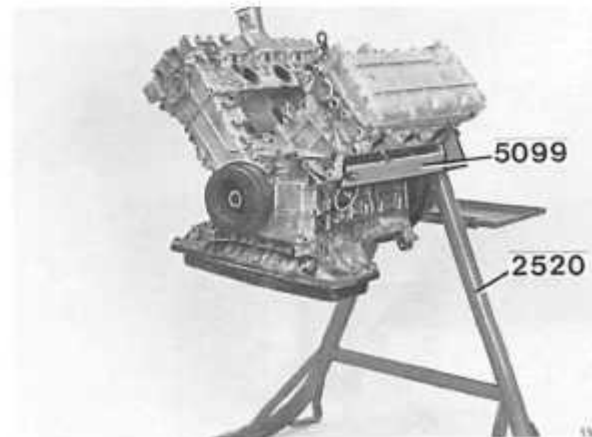
For the overhaul of the engine it is presumed that the components shown in the illustration below have already been removed. Also that the engine is mounted on universal stand 2520 with support 5099.



138 001



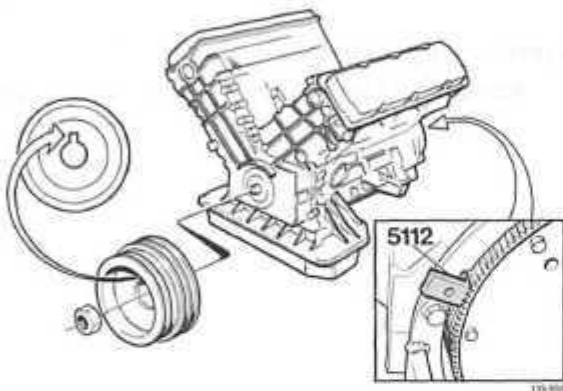
139 000



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

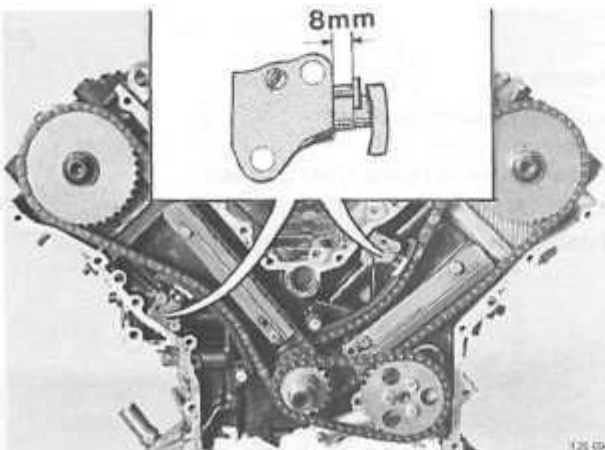


#### Remove:

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

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

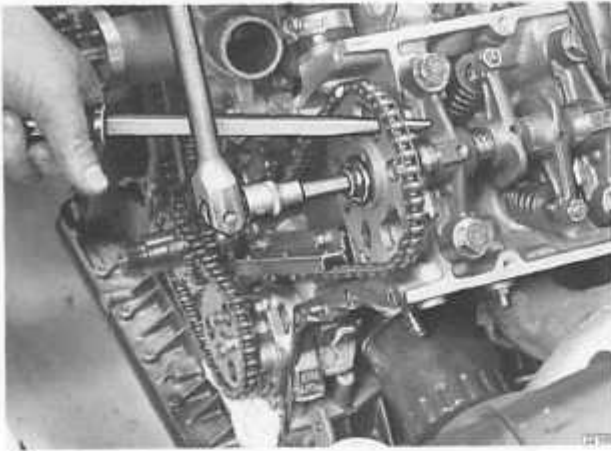
B3



#### 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.

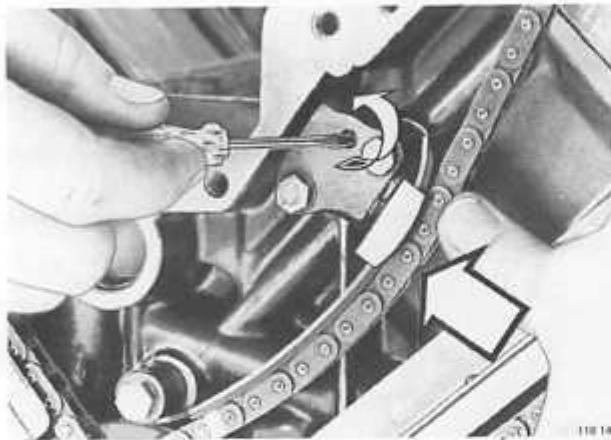


B4

**Slacken camshafts centre bolts**

Allen key 10 mm.

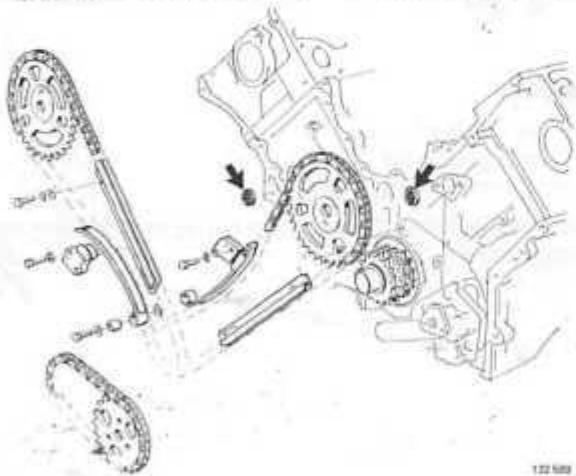
If necessary prevent sprocket from rotating with a screwdriver.



B5

**Slacken timing gear chains**

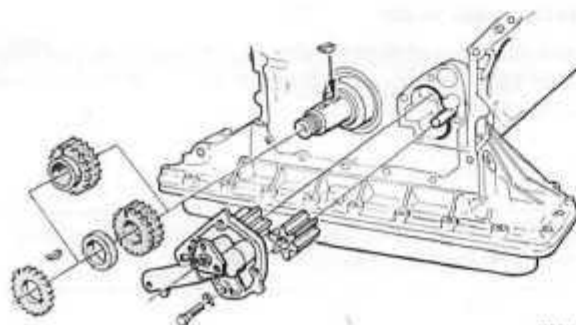
Turn each lock 1/4 turn anti-clockwise and push in piston.



B6

**Remove:**

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



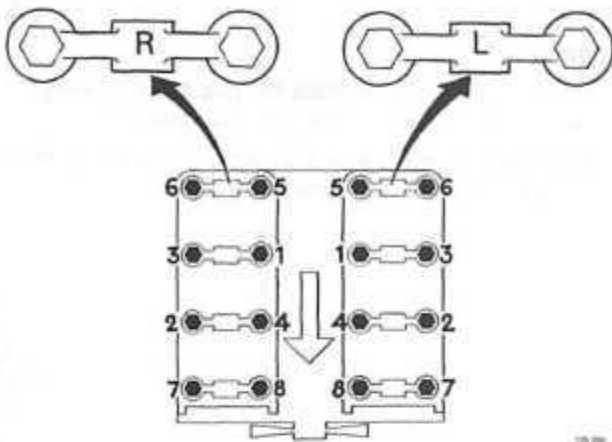
B7

**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.





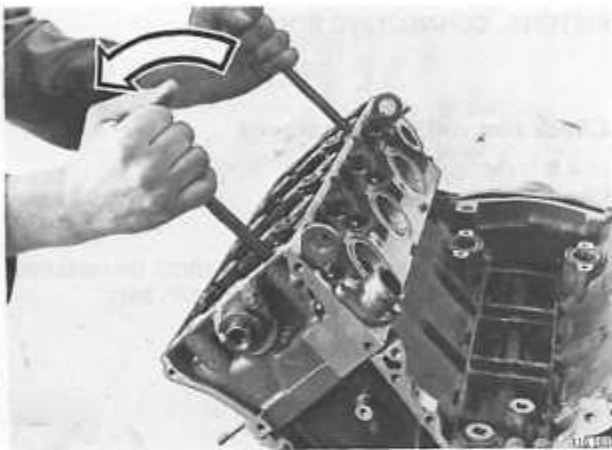
**CYLINDER HEAD**

B8

**Remove rocker arms**

Mark left and right rocker arms.

Slacken bolts in sequence shown adjacent.



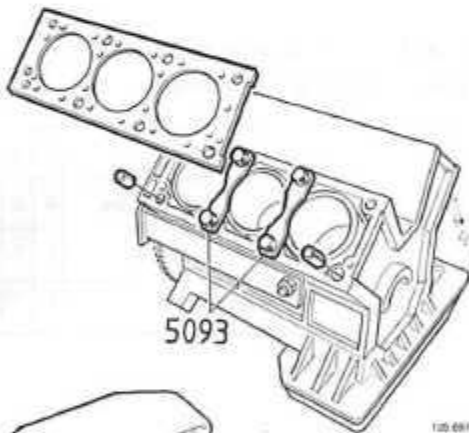
B9

**Remove cylinder heads**

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

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

Place cylinder heads on wooden blocks to prevent damage.



B10

**Remove:**

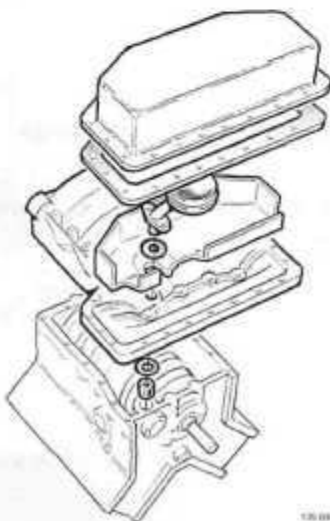
- cylinder head gaskets
- guide sleeves, use a pair of pliers.

B11

**Fit liner holders 5093**

Two per side.

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



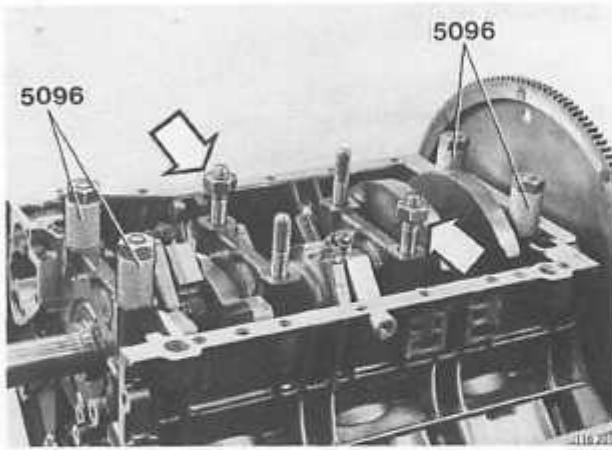
**OIL SUMP, LOWER CRANKCASE**

B12

**Remove:**

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

Disassembly

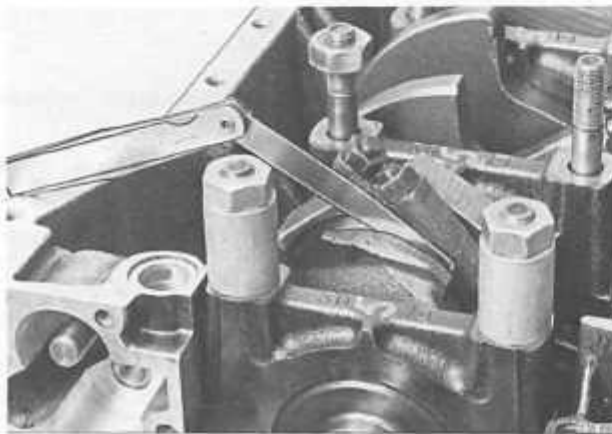


B13

**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**

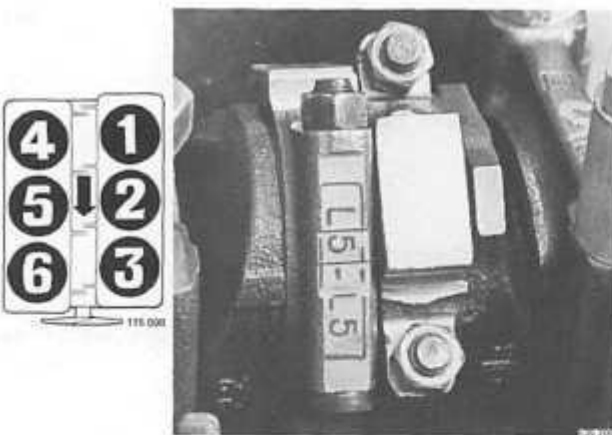
B14

**Check on 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:

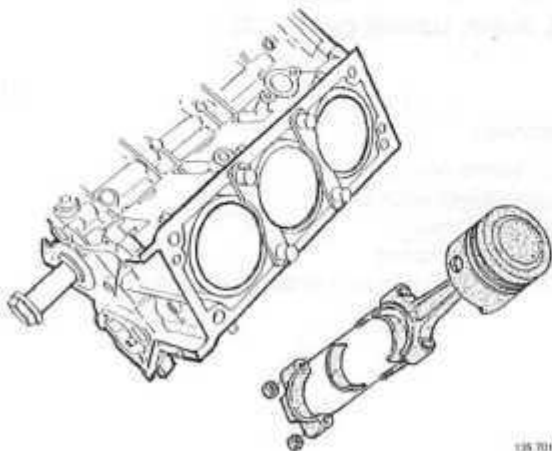
Cylinder	1	4	2	5	3	6
Marking of con rod and cap	early type					
	A	B	C	D	E	F
	late type					
	1	2	3	4	5	6
Crank webs (from rear)	1		2		3	

B16

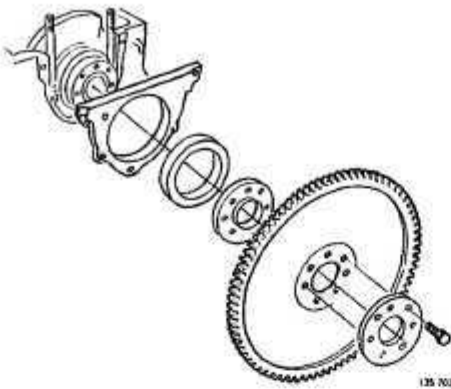
**Remove pistons with con rods and bearings**

Clean cylinder liners.

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

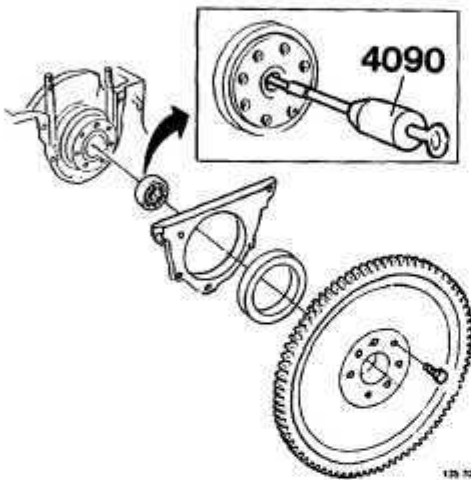


135 701



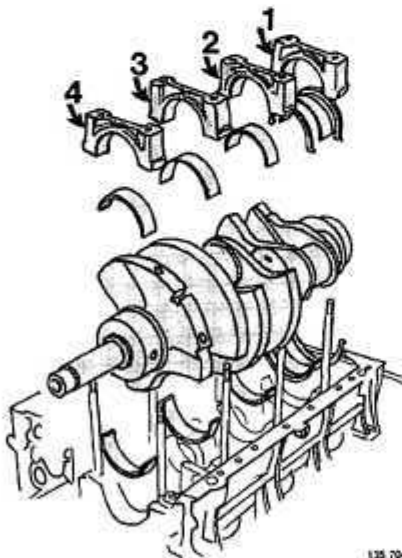
125 702

Automatic



125 723

Manual



125 704

### 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

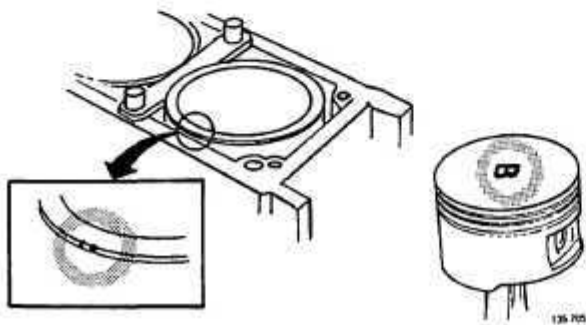
### Remove crankshaft, main bearings and thrust bearings

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

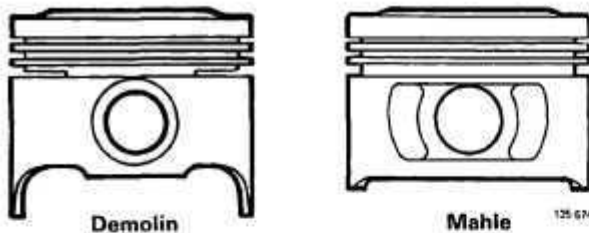


### Check type of piston and cylinder liner

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

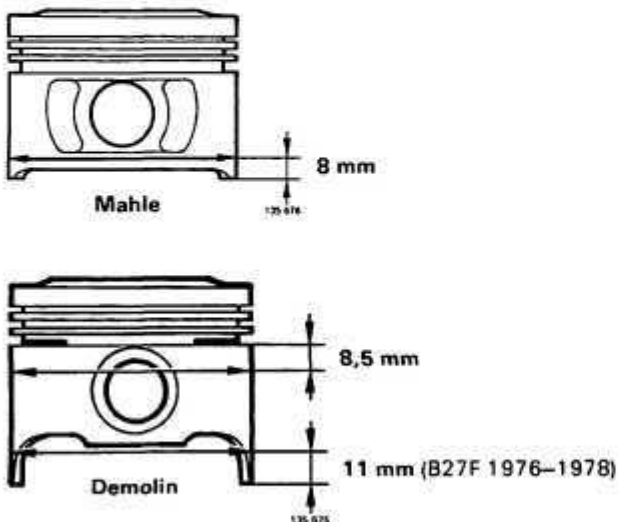
C2



### Check make of pistons

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

C3



### Measure piston diameter

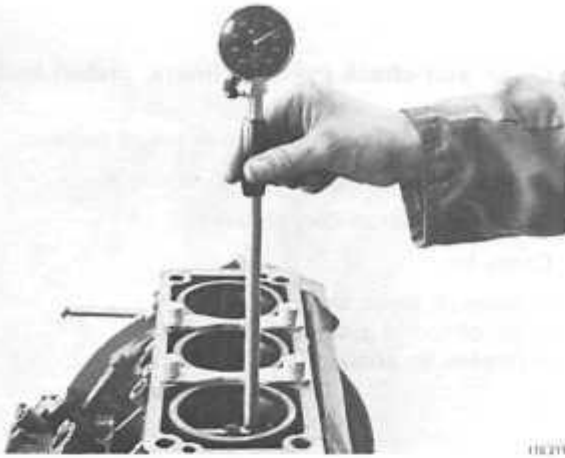
Measure at right angles to gudgeon (piston) pin bore.

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.

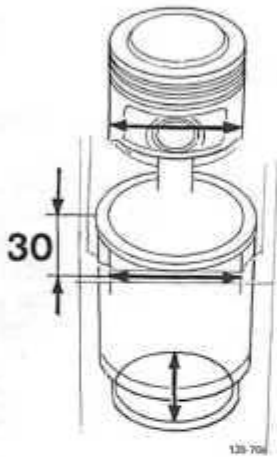
See specifications on pages 4-5 for diameters of new parts.

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>B 27 Demolin piston</b> .....	<b>0.090–0.110 mm</b> (0.0035–0.0043 in)
Mahle piston.....	<b>0.020–0.040 mm</b> (0.0008–0.0016 in)
<b>B 28 Mahle piston</b> .....	<b>0.020–0.040 mm</b> (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



C5

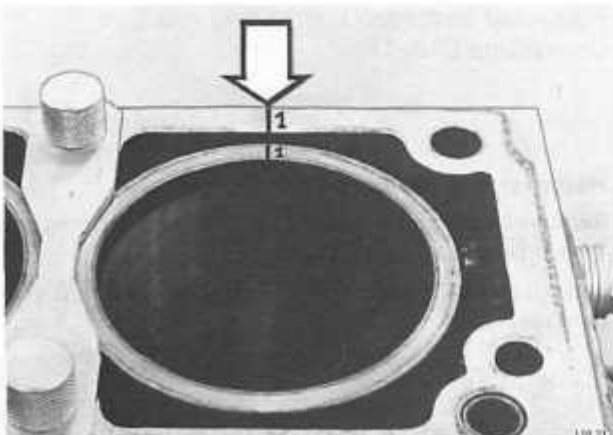
**Clean mating surface on cylinder block and liner**

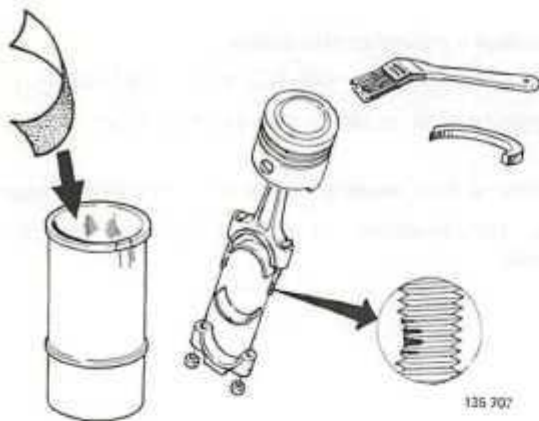
Use a plastic putty knife to avoid damage.

C6

**Mark position of cylinder liner before removing liner**

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





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.



136 706

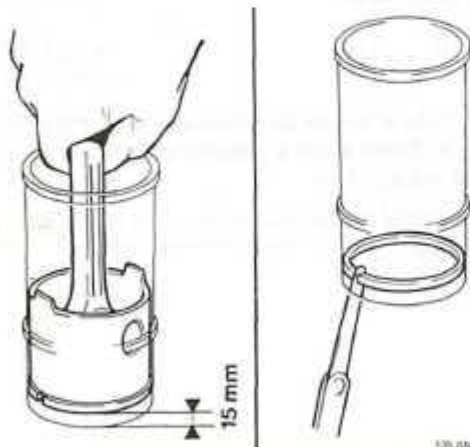
C8

**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)



136 708

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)



136 710

**Replacing damaged connecting rod bolt**  
Operations C10–11

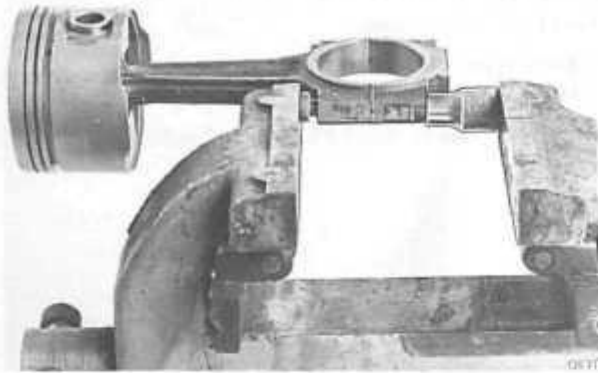
C10

**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.

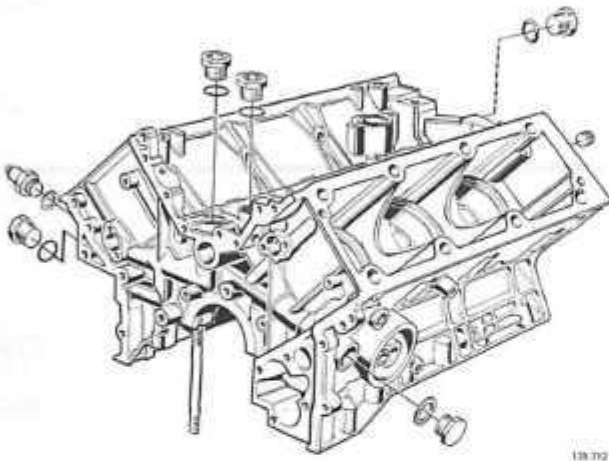
C11



**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.)

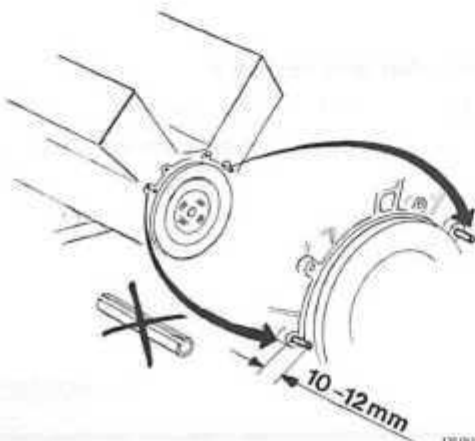
C13

**Check guide pins for gearbox**

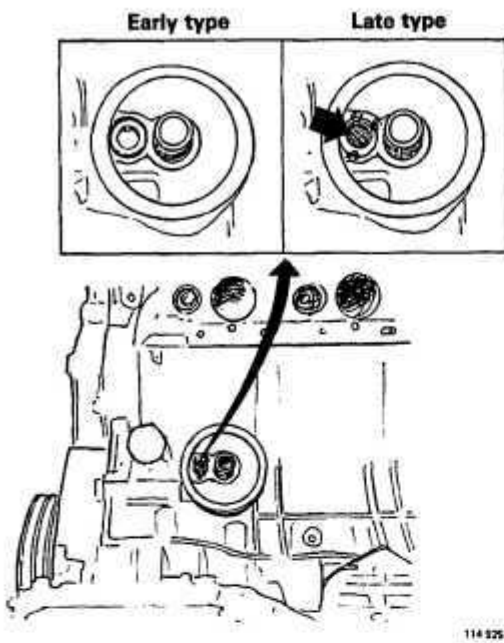
Guide pins must protrude **10–12 mm** (0.39–0.47 in) from cylinder block.

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

Secure pins with locking fluid.



Cleaning, checking



C14

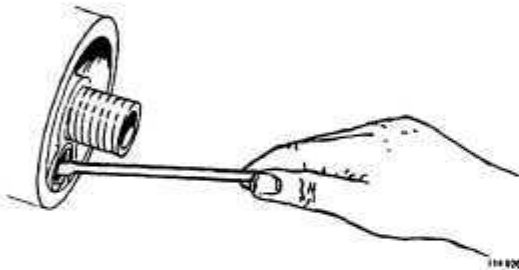
**Check overflow valve in cylinder block**

Two types are in use:

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

Early type valves must be replaced with new type.

*Overflow valve, replacement  
Operations C15-17*

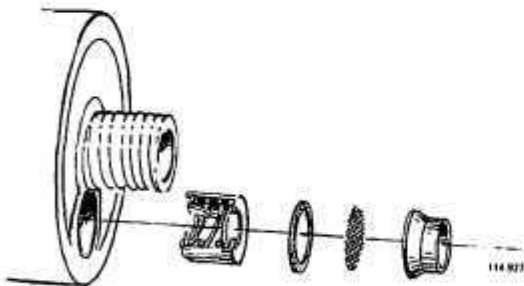


C15

**Remove old valve and clean seat**

Use a screwdriver.

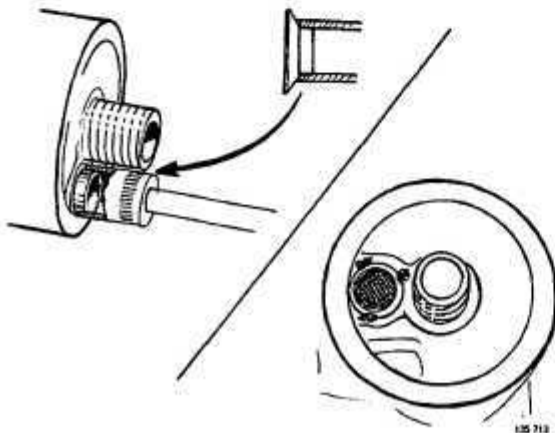
**Important!** Take care not to damage the oil filter mating surfaces and make sure that dirt does not enter the oilways.



C16

**Install new parts**

Install valve with spring facing inwards.



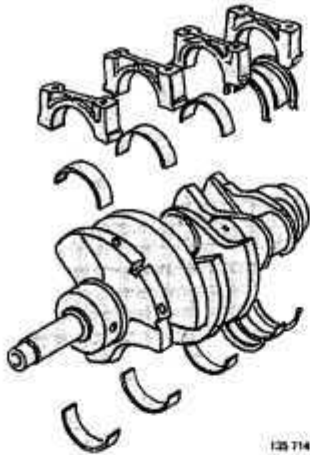
C17

**Tap in washer and secure it**

Use an 11 mm (inner diameter) socket.

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





138 714

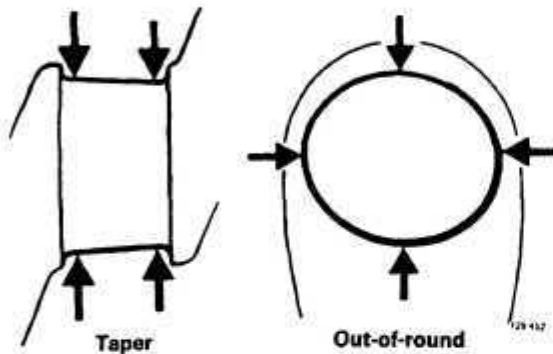
**C18**

**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.



139 412

**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")

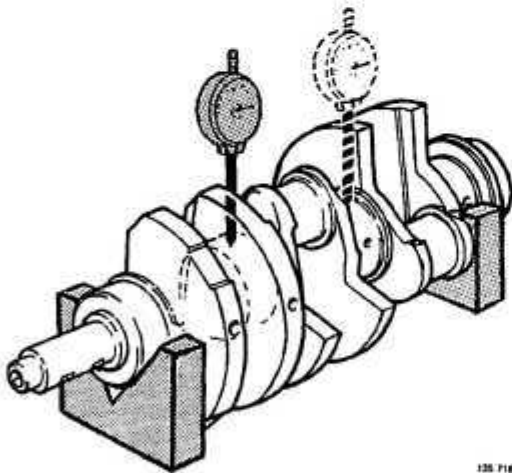
Crank pins can be ground to a smaller size, see specifications on page 9.

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

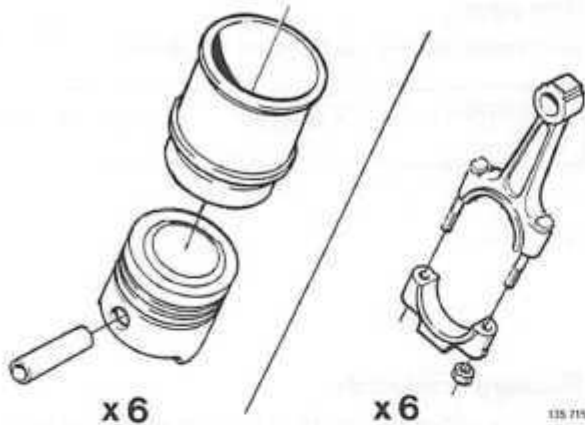
Support crankshaft by two outer main bearings on a V-block.

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.



138 716



**Replacing piston or connecting rod  
Operations C20-29**

C20

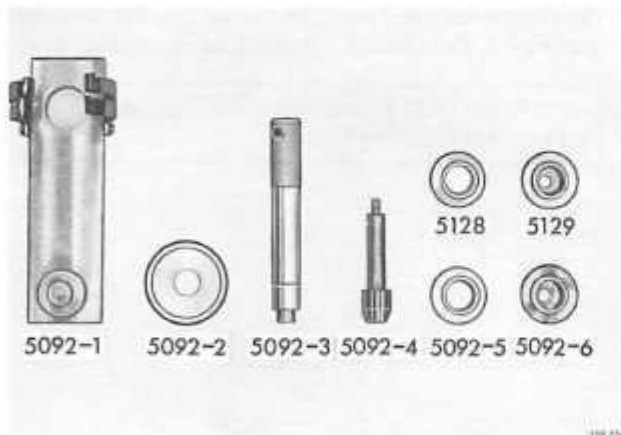
**General**

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.



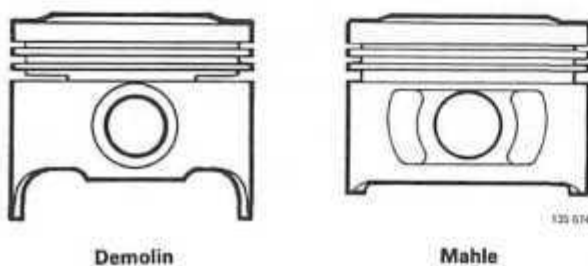
C21

**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

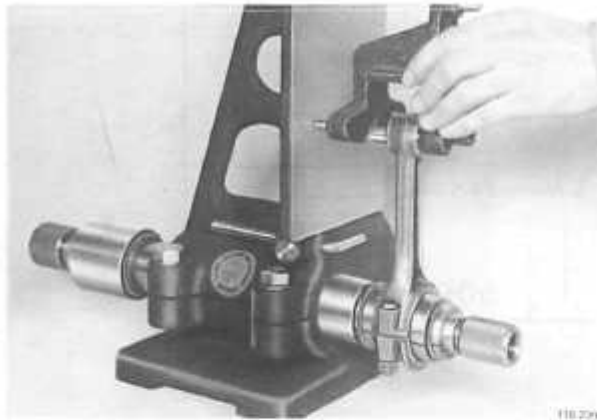
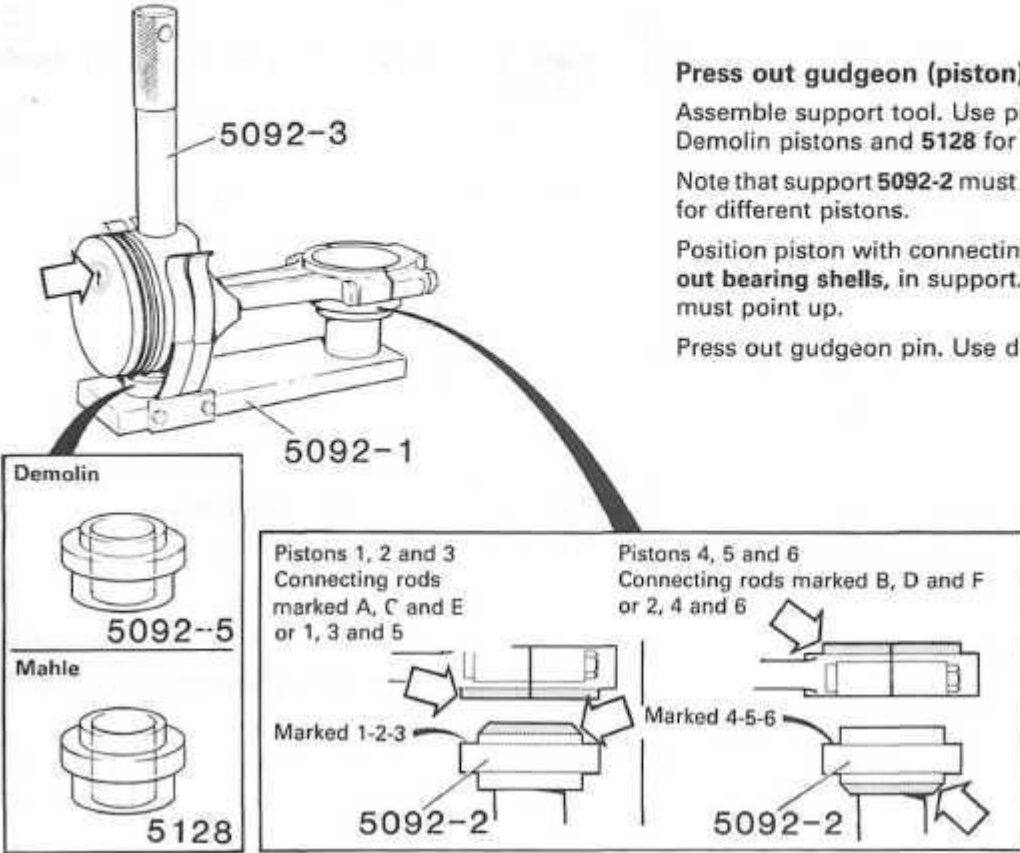
**Press out gudgeon (piston) pin**

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**.



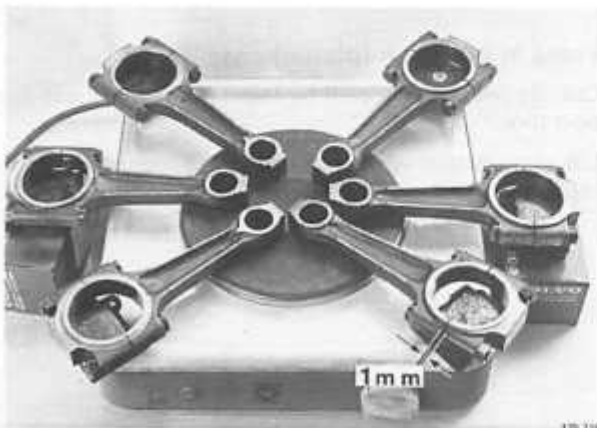
C24

**Check connecting rods**

Use an alignment gauge.

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

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

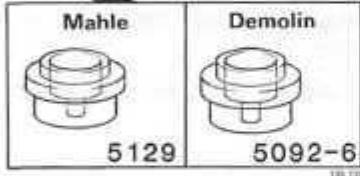
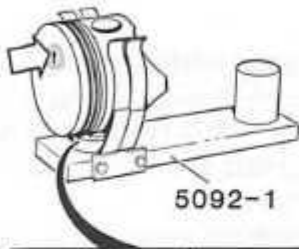


C25

**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).

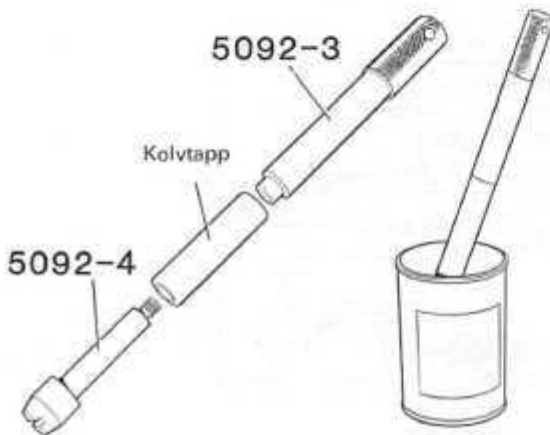


C26

**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**

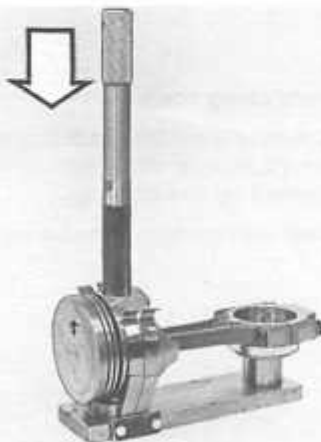
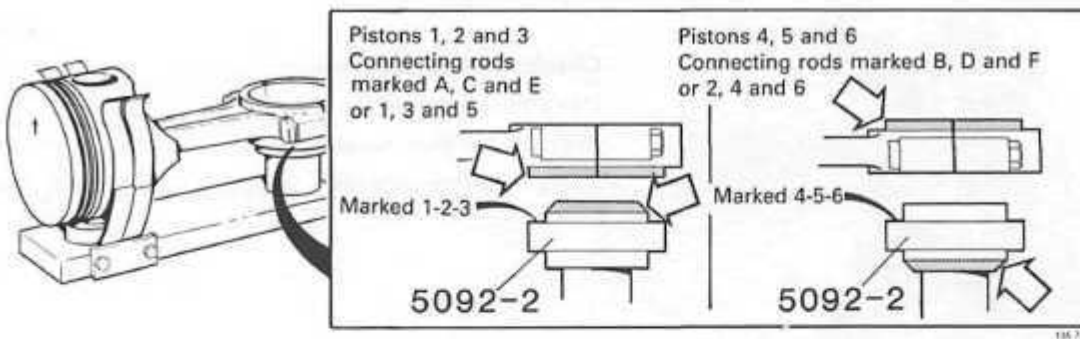
**Immerse in oil**

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.



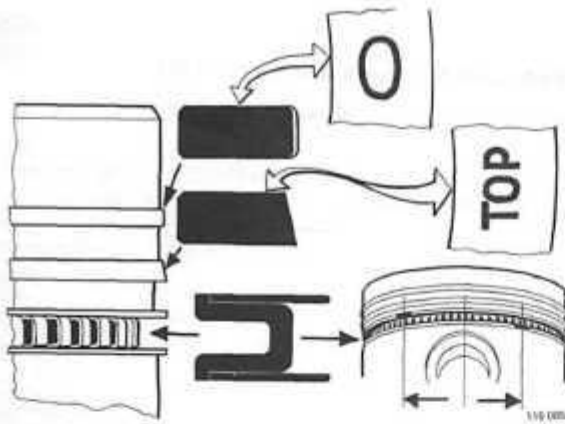
C29

**Press in gudgeon (piston) pin**

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

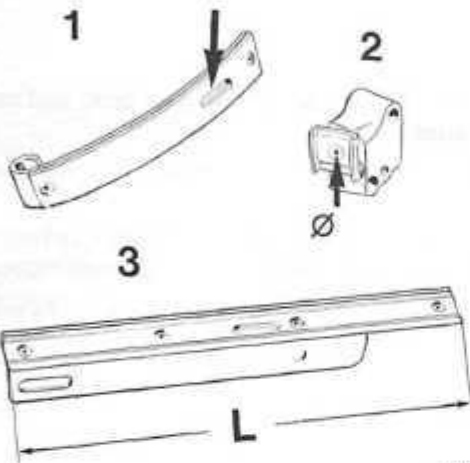
Lift away piston with connecting rod from holder. Remove drift and guide pin from gudgeon pin.

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.

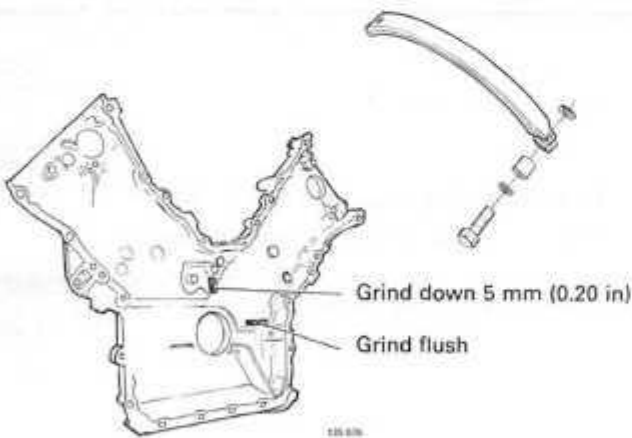
**IMPORTANT!** Late type chain tensioners may only be used with late type chain dampers.

	Early type	Late type
1 bent chain damper	without oilway	with oilway
2 chain tensioner.....	Ø = 0.4 mm (0.016")	Ø = 1.2 mm (0.047")
3 straight chain damper.....	L = 174 mm (6.85")	L = 220 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.

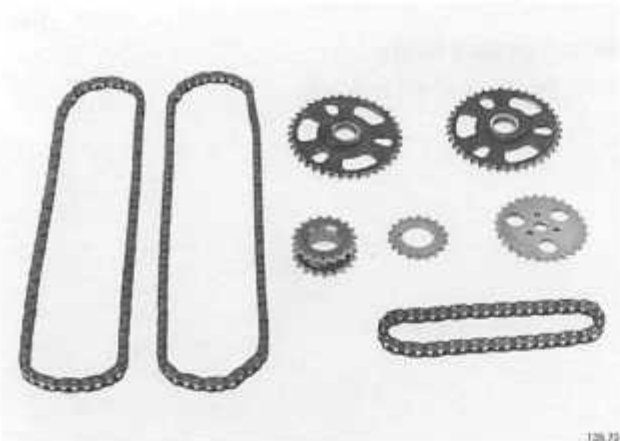
Check that oilways in chain tensioners do not leak.

Check dampers for damage and wear.

Replace parts as necessary.



C33



128 754

**Clean, check chains and sprockets**

Check for damage and wear.

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

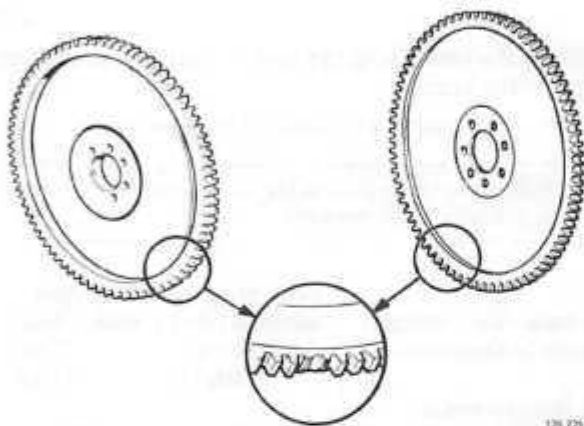
C34

**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.



128 723

*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.

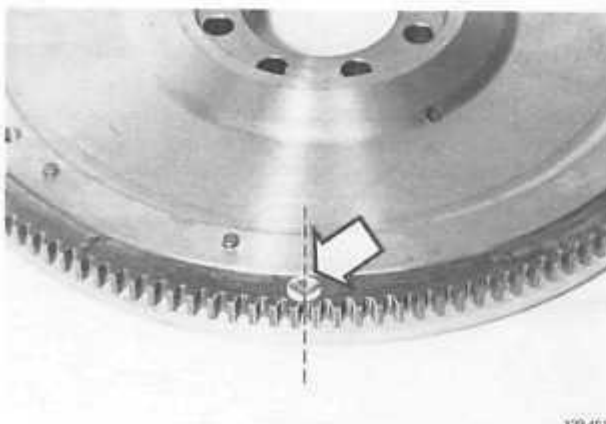
C36

**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.



129 461

C37

**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.



C38

**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).

C39

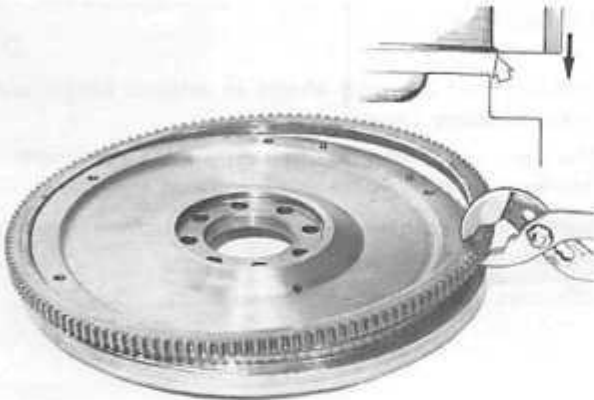
**Install new ring gear**

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.

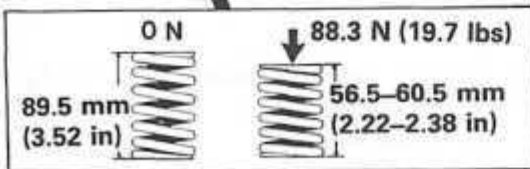
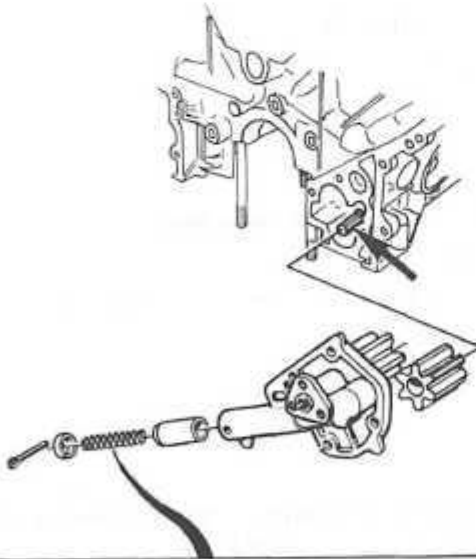


120 489

C40

**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.



118 716

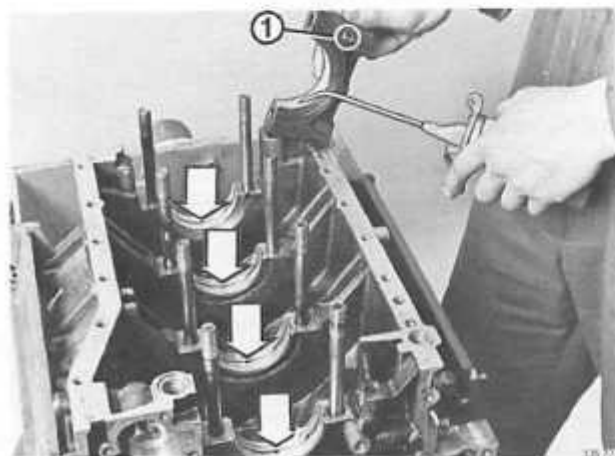
C41

**Clean and check parts**

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

## D. Engine assembly

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



### CRANKSHAFT

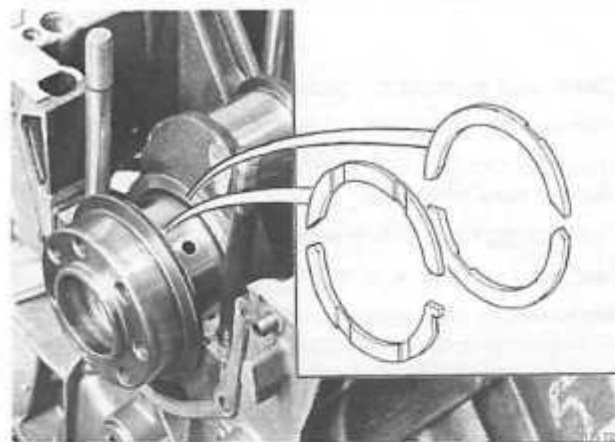
D1

#### 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

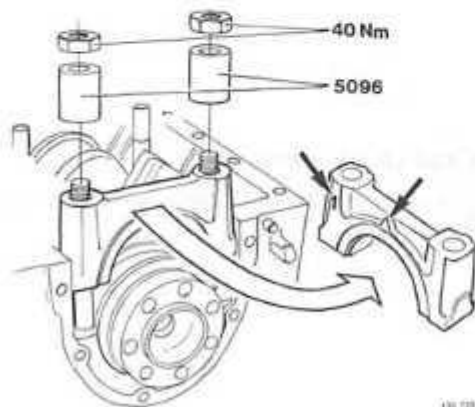
Lubricate bearings.

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

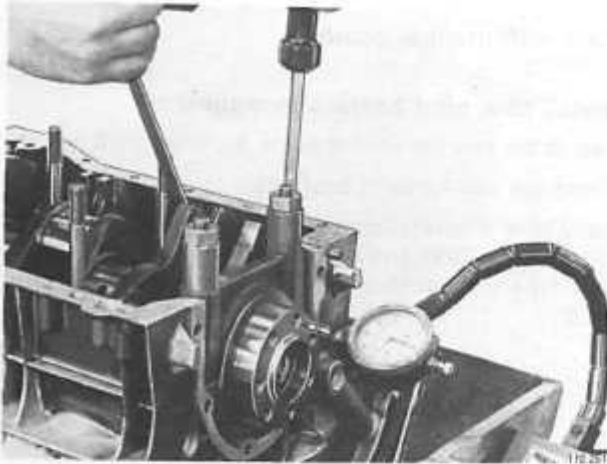
Rear cap is marked 1.

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

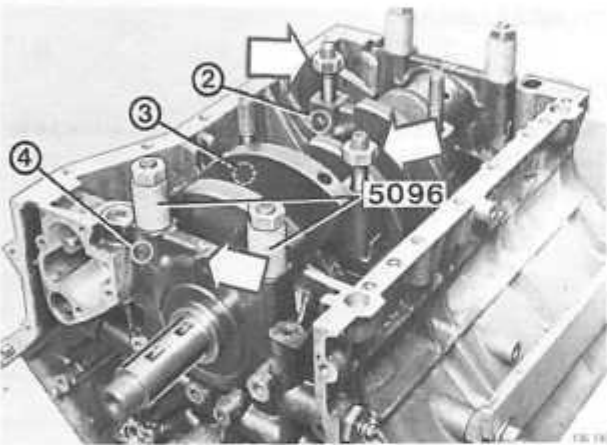
**Check crankshaft end float**

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)

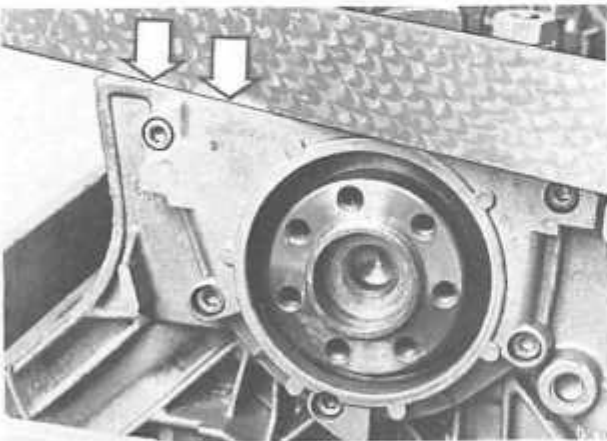


D6

**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.



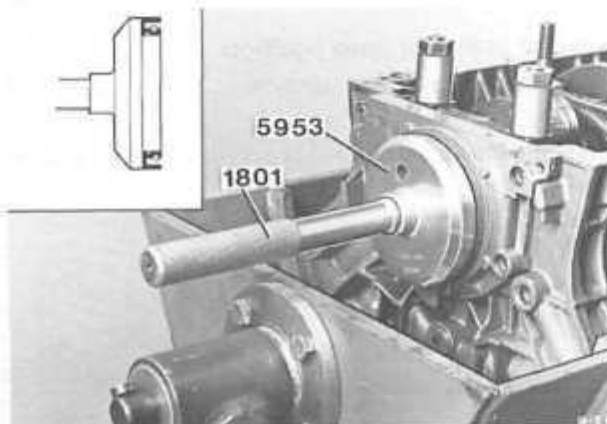
**CRANKSHAFT REAR SEAL, PILOT BEARING**

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**

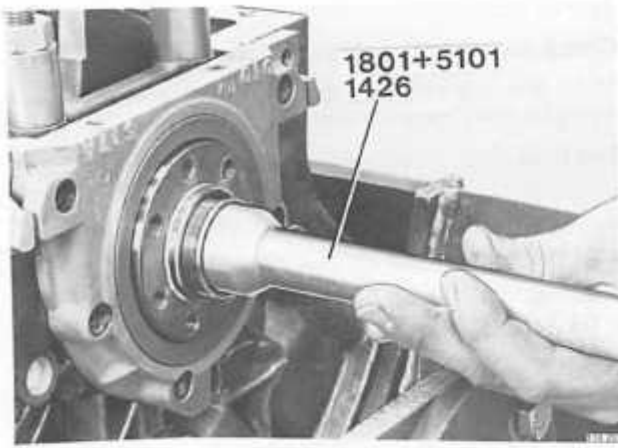
Assemble standard handle 1801 and drift 5953.

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.

Assembly



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**.

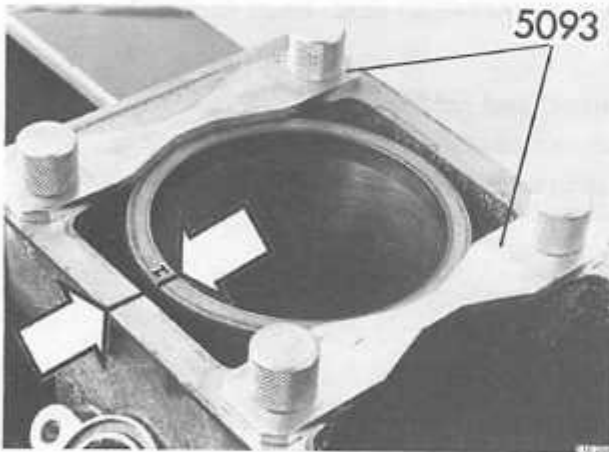
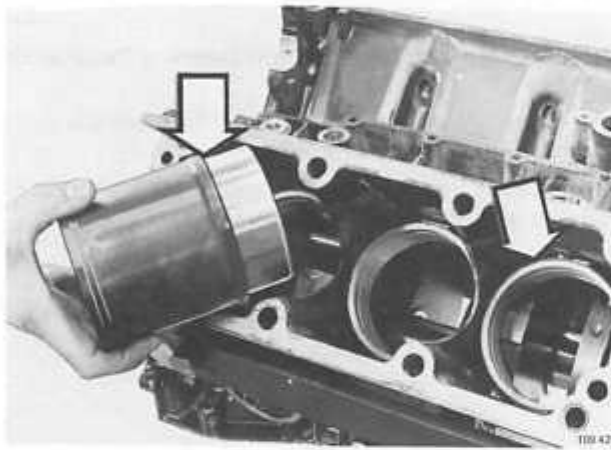
Late type = inner diameter 15 mm (0.590"). Use drift **1426**.

**CYLINDER LINERS**

D10

**Check mating surfaces for shims**

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

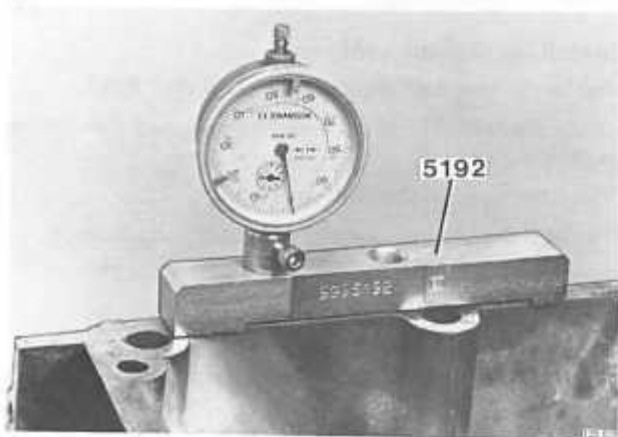


D11

**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.

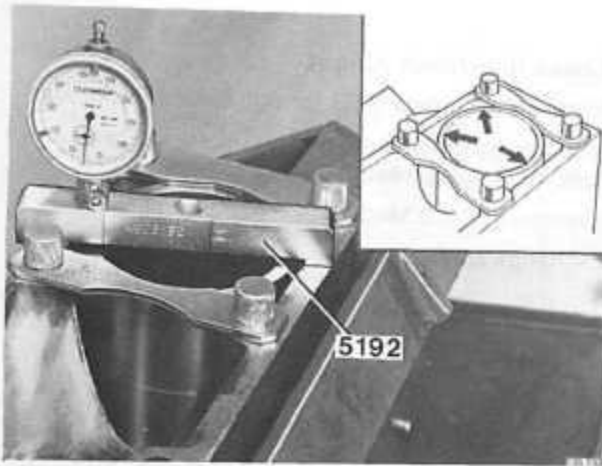
D13

**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

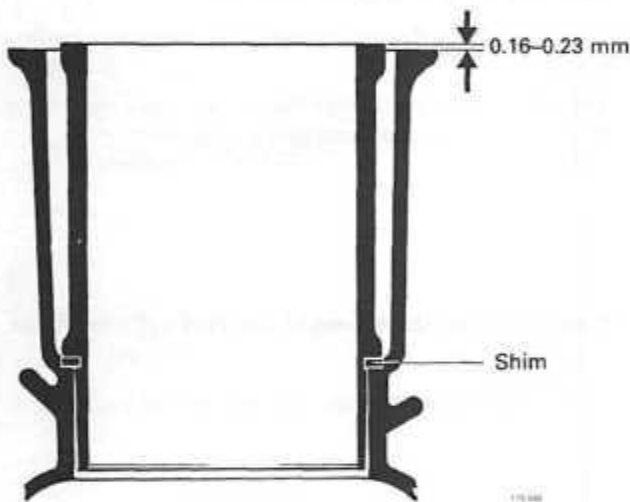
**Select correct size shim**

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



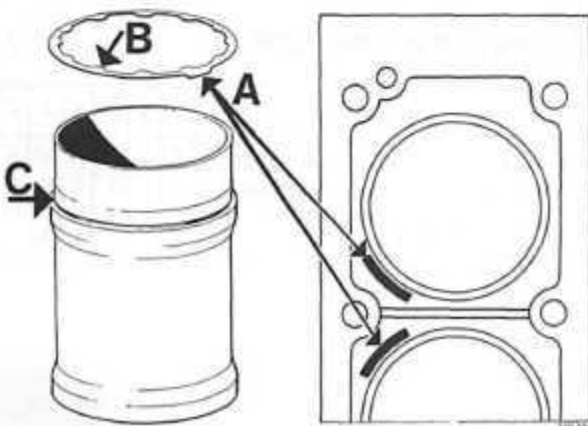
Example:	
Max. specified gap .....	0.23 mm
Measured gap (without shim) .....	0.11 mm
<hr/>	
Difference .....	0.12 mm
Select a white shim.	

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).

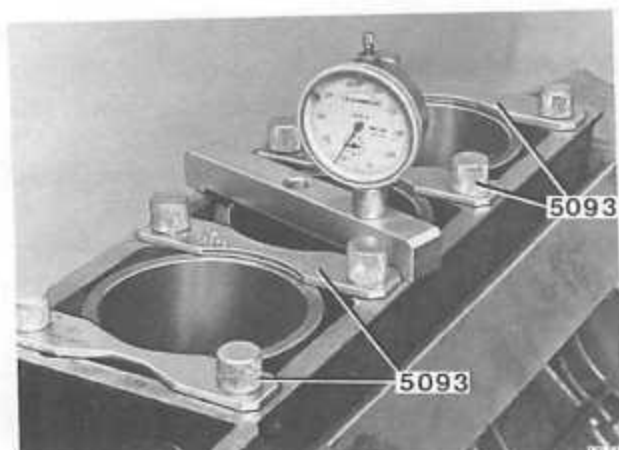


D16

**Install liner in block**

Observe liner identification marks as applicable.

D17



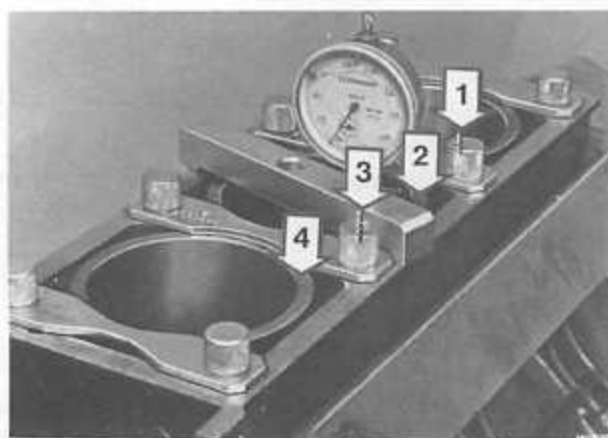
**Check liner/deck height**

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.

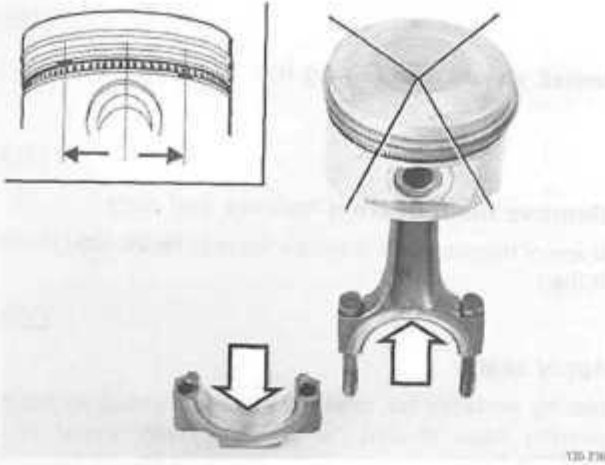


**PISTONS, CONNECTING RODS**

Cylinder	1	4	2	5	3	6	
Marking of connecting rod and cap	early type	A	B	C	D	E	F
	late type	1	2	3	4	5	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.

D22

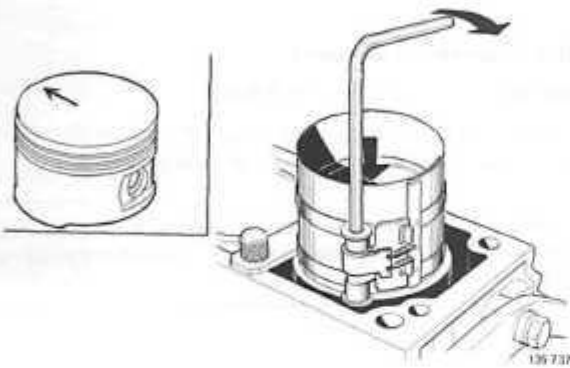
**Lubricate:**

- bearing shells
- cylinder bores
- pistons

D23

**Install piston**

Use a piston ring compressor tool.



**IMPORTANT!** Arrow on top of piston must point forwards.

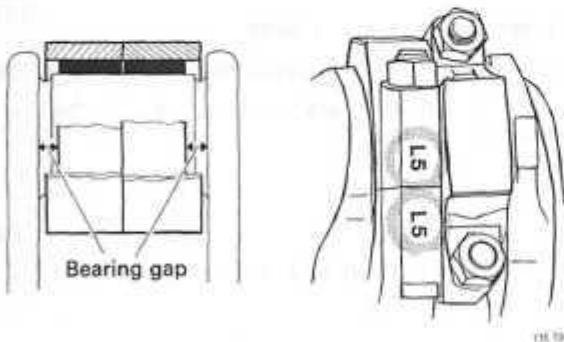
D24

**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.

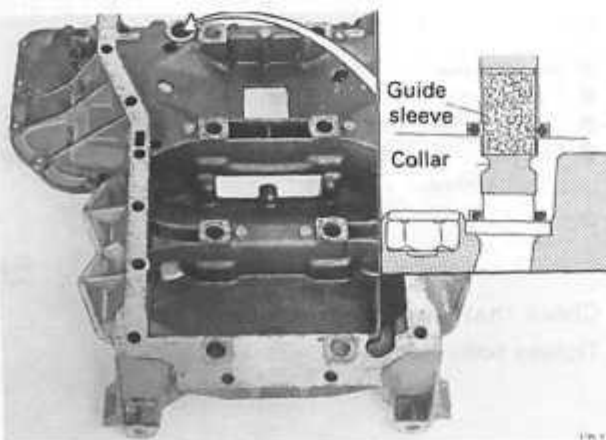
**LOWER CRANKCASE, SUMP**

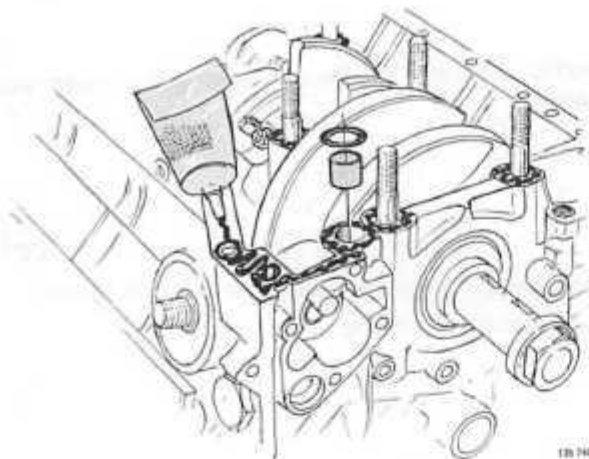
D25

**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 Loctite.





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.

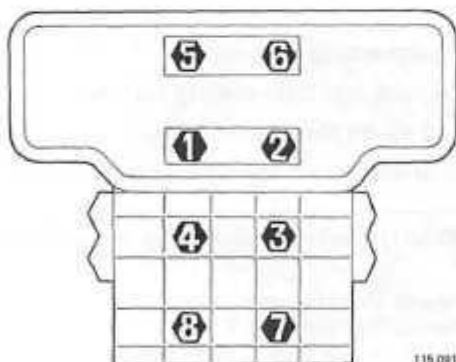
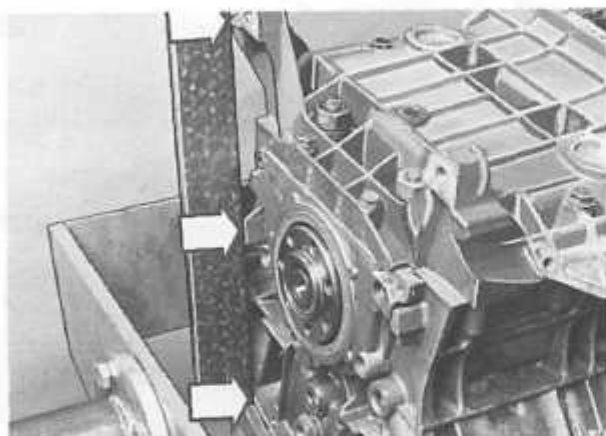
D29

**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.



115 091

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.

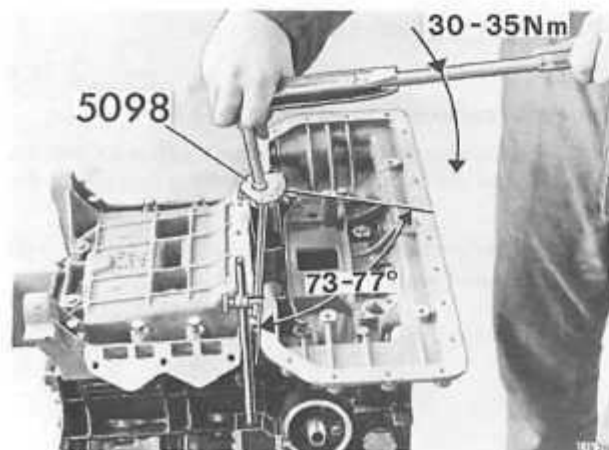
A measuring stand can be used to align the protractor. The magnetic base of the stand should be placed on fixture 5099 and the arm pointed towards the protractor.

- 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.

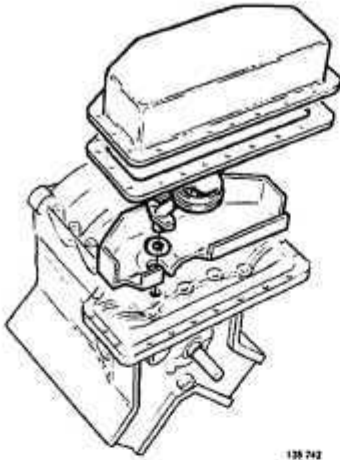
D32

**Check that crankshaft rotates.**

**Tighten bolts for lower crankcase**



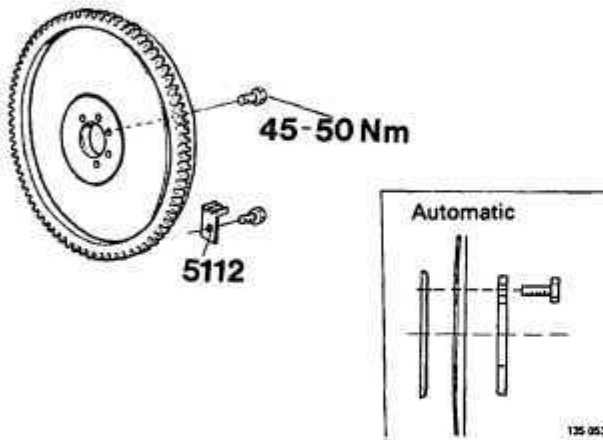
D33



125 742

**Install:**

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



125 053

**FLYWHEEL, CLUTCH, CARRIER PLATE**

D34

**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

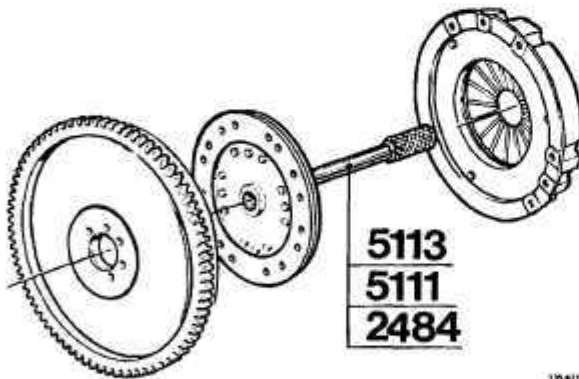
**Install clutch driven plate and pressure plate**

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

Different centering drifts for different types of gearboxes:

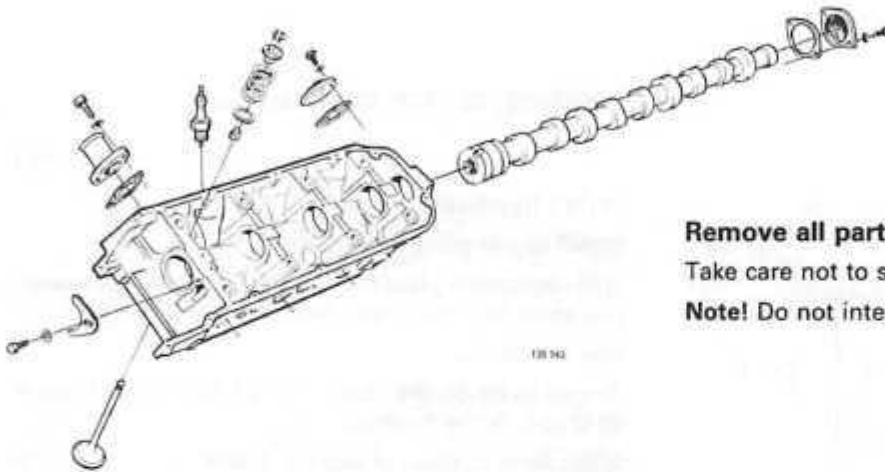
- M50/51 = drift 5113
- M45/46 early type = drift 2484
- M45/46 late type = drift 5111

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



125 817

## E. Cylinder head, reconditioning

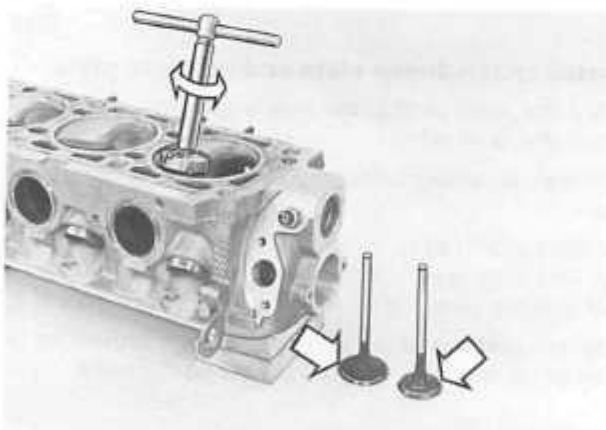


E1

### 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.

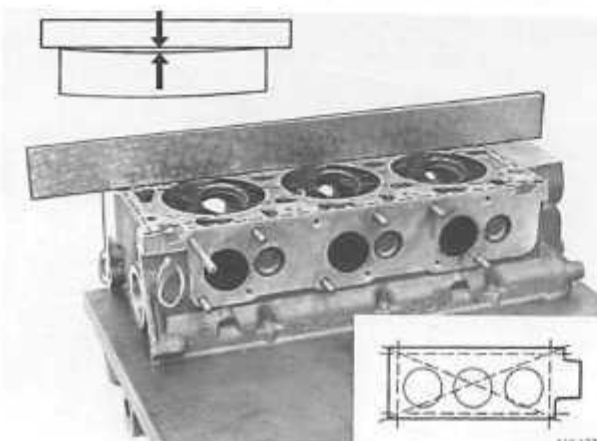
E4

### Check cylinder head for warp

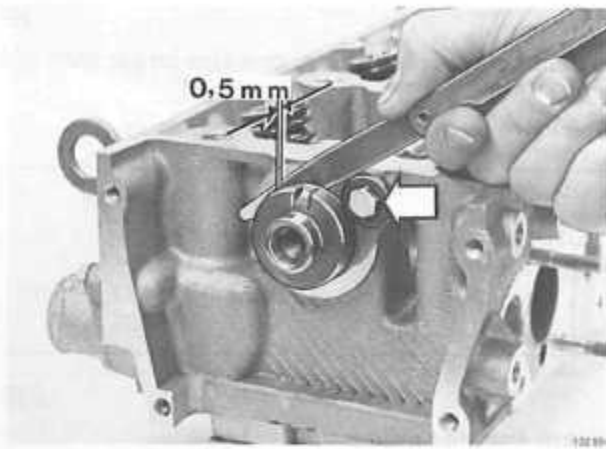
Use a straight edge and feeler gauge.

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.







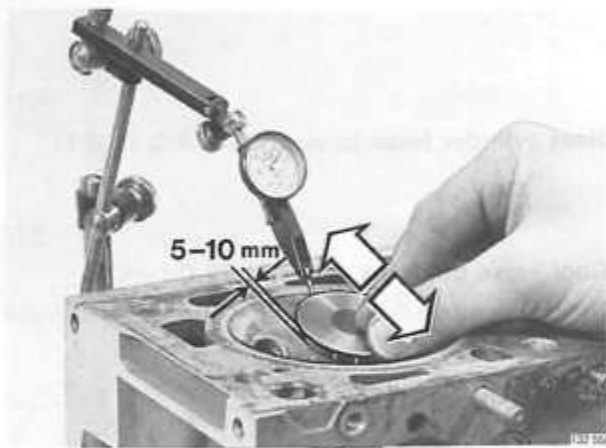
E5

**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.



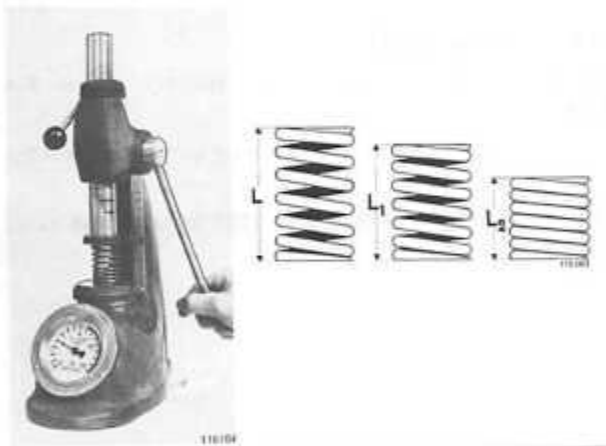
E6

**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)**.

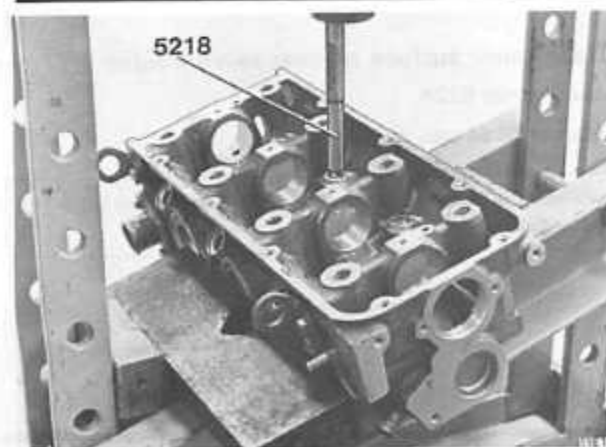


E7

**Check valve springs**

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

Colour code	Lenth, 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)



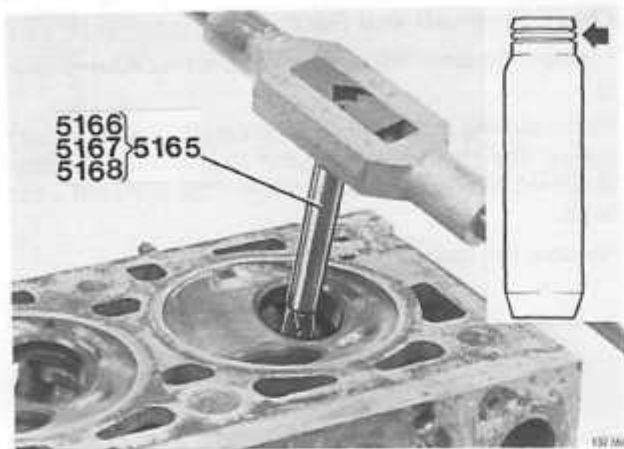
**Valve guide replacement**  
Operatons E8–14

E8

**Press out valve guides**

Use drift 5218.

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



E9

**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	

E10

**Ream seat for guide**

See above table.

E11

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

E12

**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.

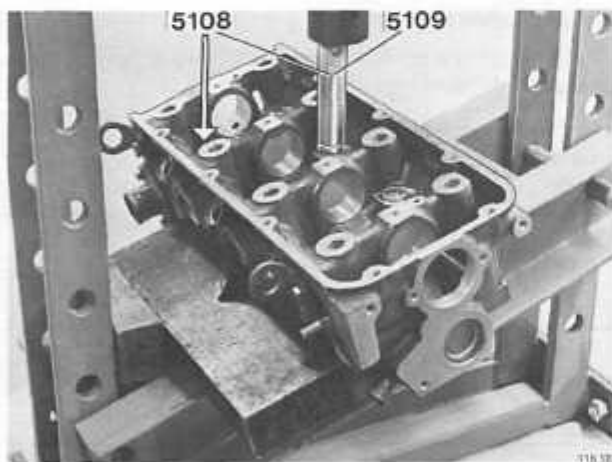
E13

**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.



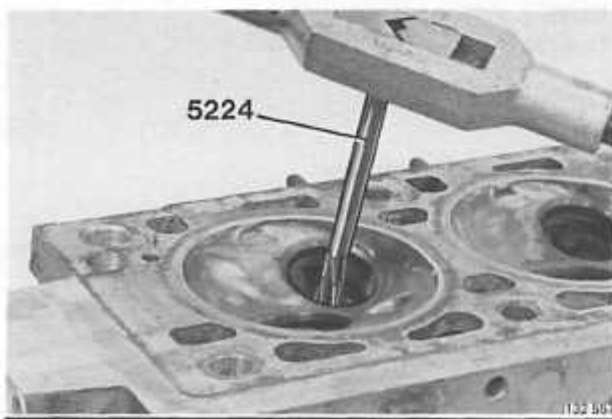
E14

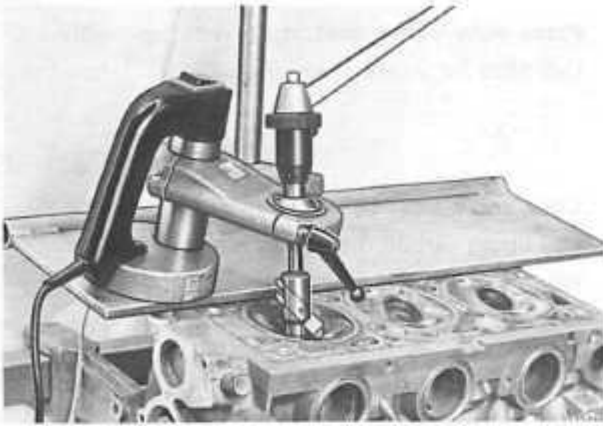
**Clean inner surface of new valve guides**

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**

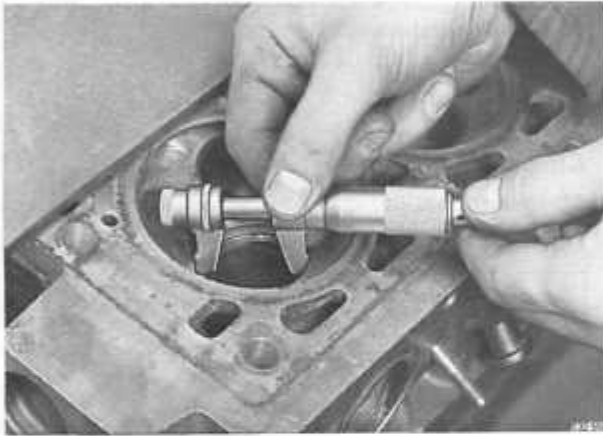
Clean the surfaces until the edge of the inserted seat is clearly visible.

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

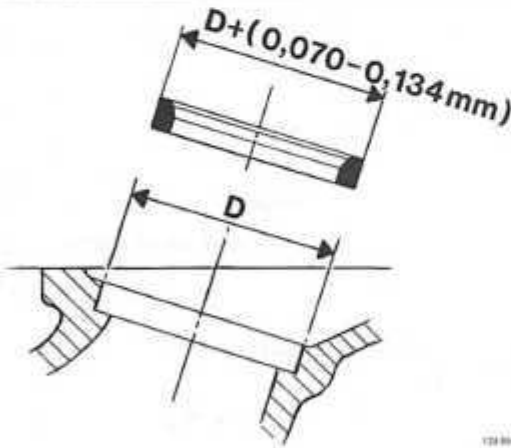
**Measure valve seat diameter in cylinder head and select a new seat of correct size**

Use an internal micrometer.

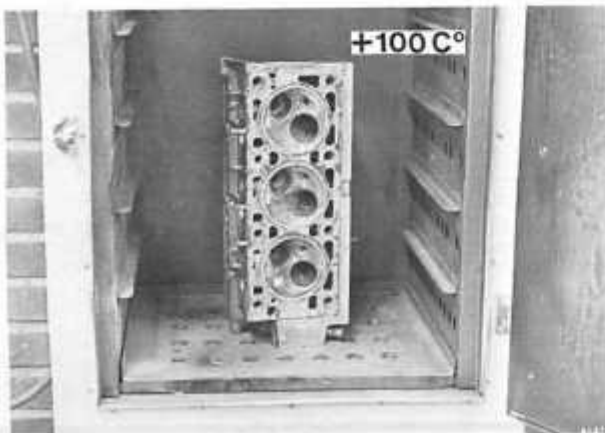
Valve seats are available in three oversizes.

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.



129 894



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.

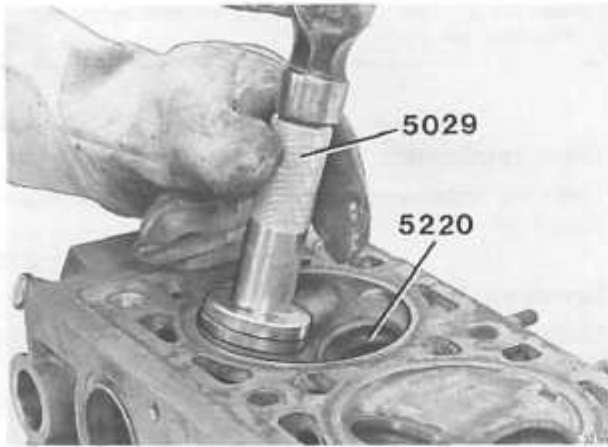
E21

**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.



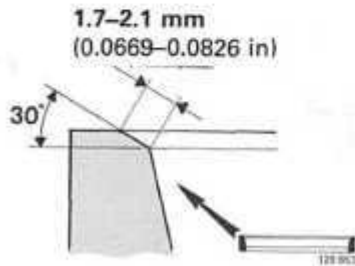
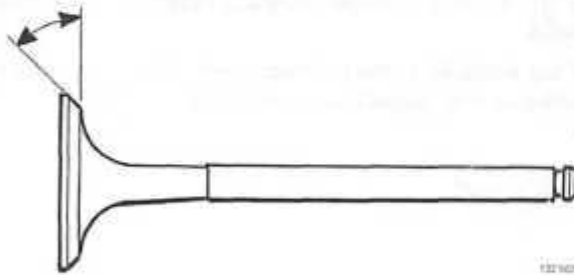
*Grinding of valves and valve seats*  
*Operations E23-24*

E23

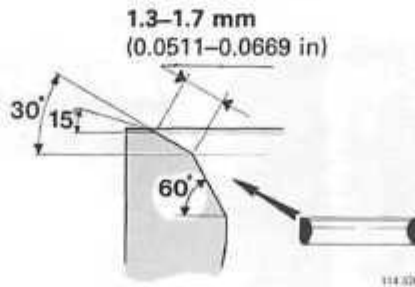
**Machine grind valves**  
Intake valves ..... 29.5°  
Exhaust valves ..... 44.5°  
Also grind flush the end of the valve stem.

E24

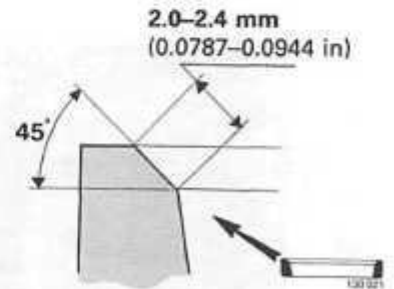
**Mill or grind valve seats**  
**Check valve fit**  
If necessary grind-in valves with grinding paste.



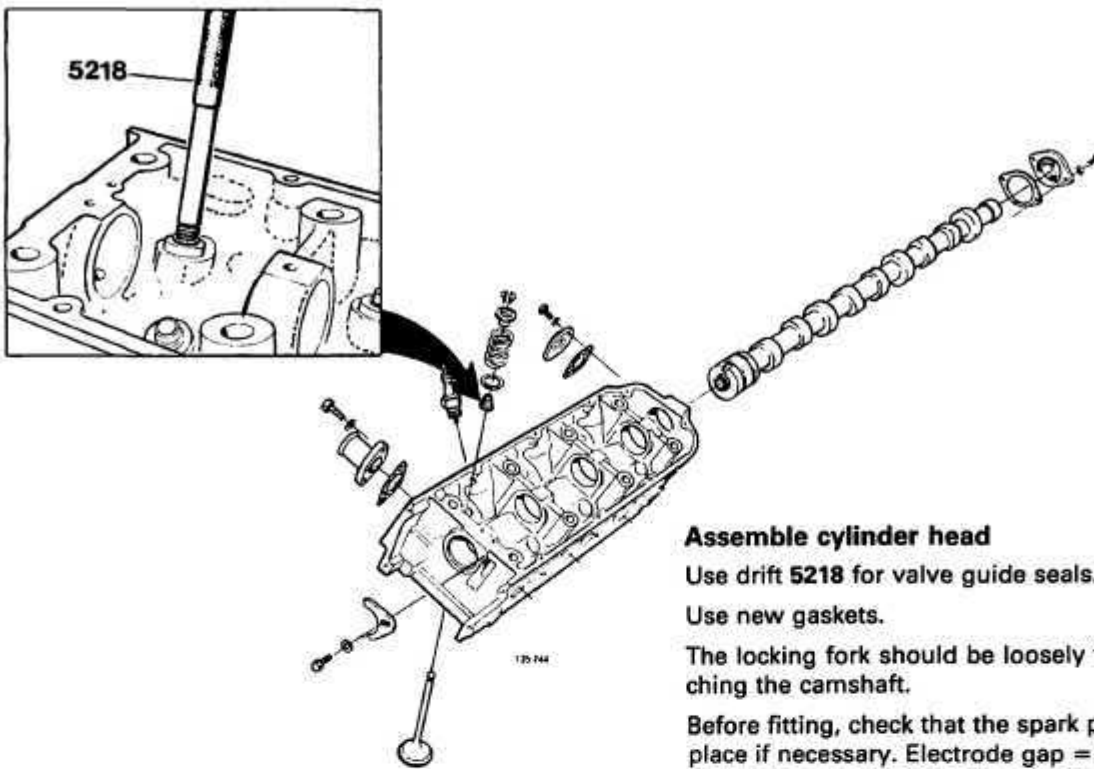
**Intake valve seat**  
Early types



**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.).

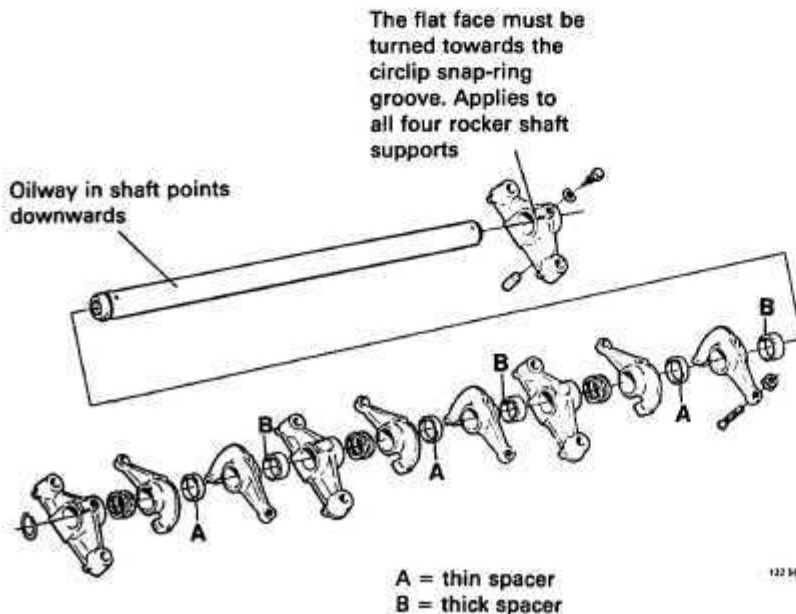
E26

**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).

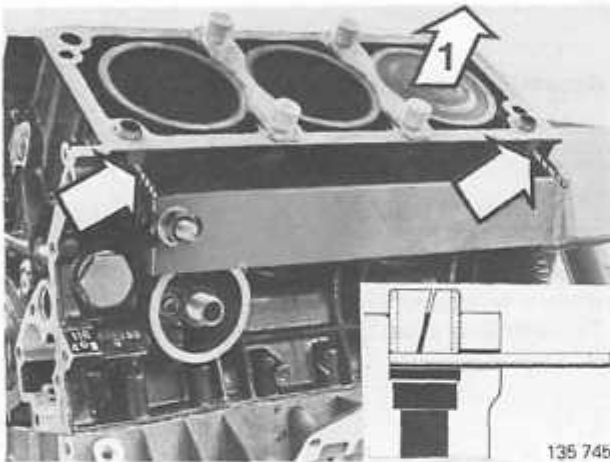
**IMPORTANT!** The rocker arm contact surface on the camshaft is face-hardened and must not be ground.



A = thin spacer  
B = thick spacer

122 394

## 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

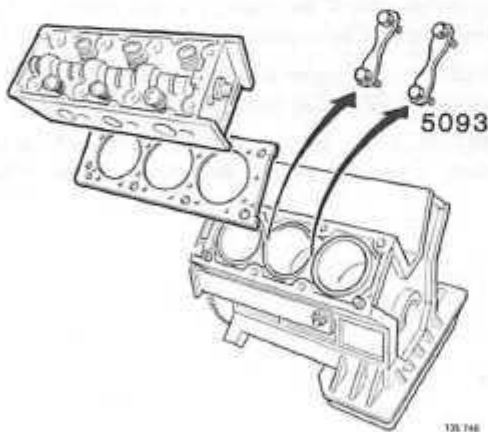
Secure the sleeves with e.g. a 3 mm drill. This prevents the sleeves from being forced down when the cylinder head is fitted.

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

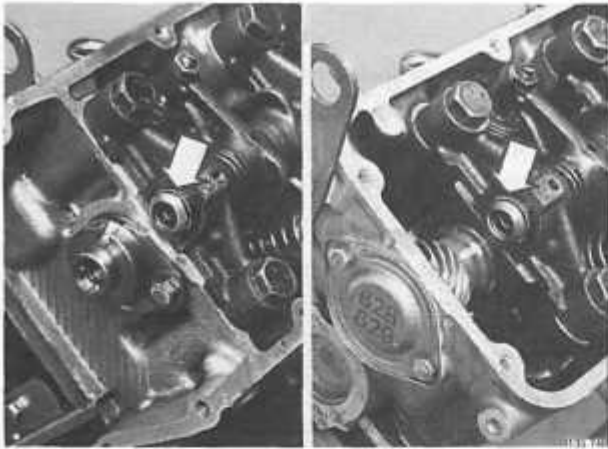
Set camshaft

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.

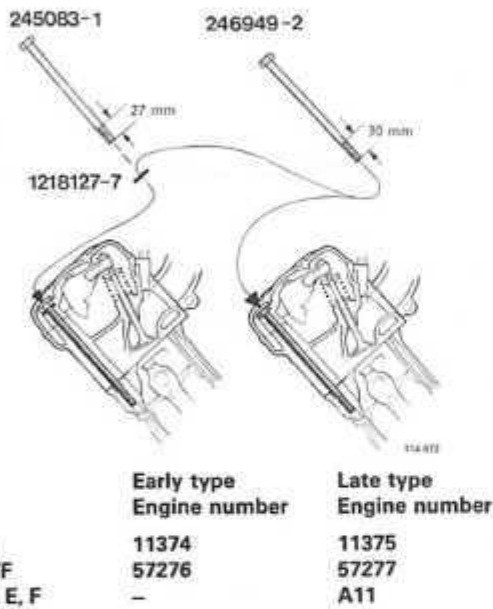
- left side circlip must face forwards and
- right side circlip must face rearwards.

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

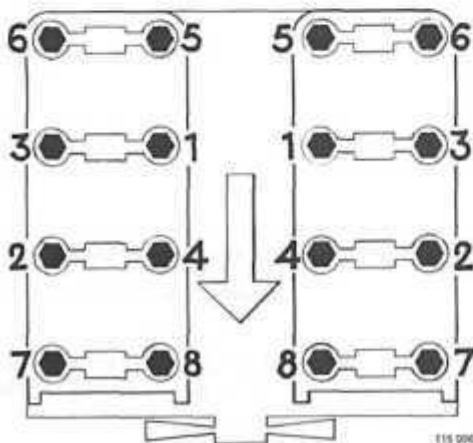
**Tighten cylinder head bolts**

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.)

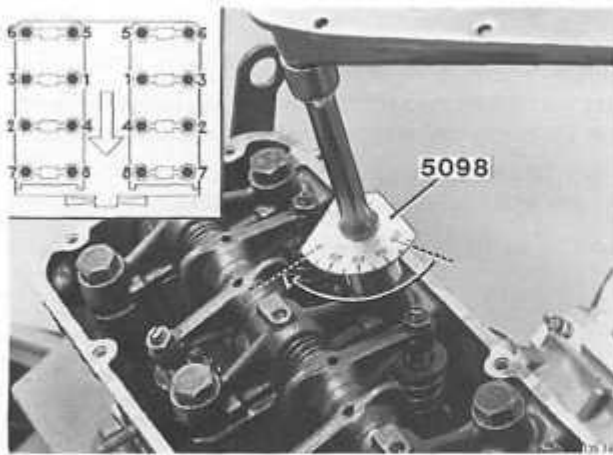


F8

**Install other cylinder head**

Install according to C53-65.

Assembly



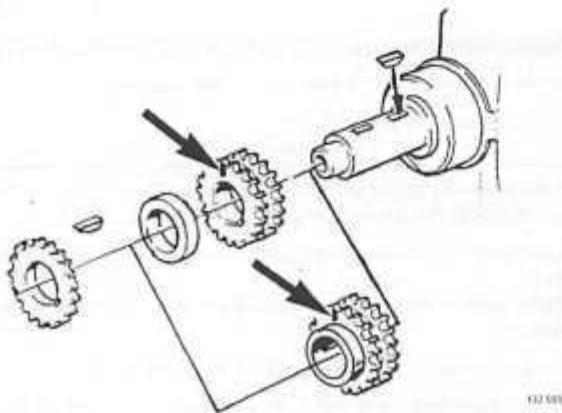
F9

**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

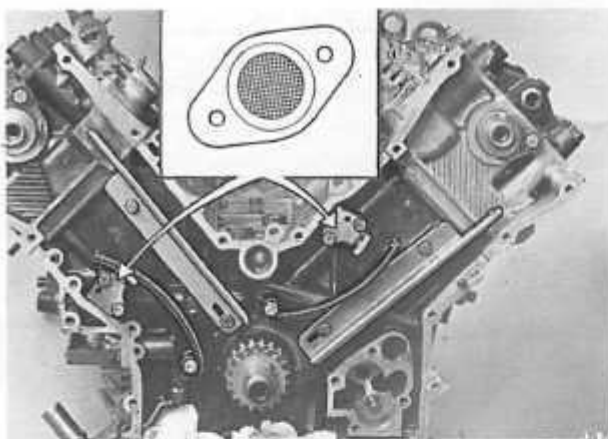
**Install crankshaft gears and keys**

Block holes in crankcase to prevent keys from falling in.

Lubricate parts.

The mark on the inner gear must face out.

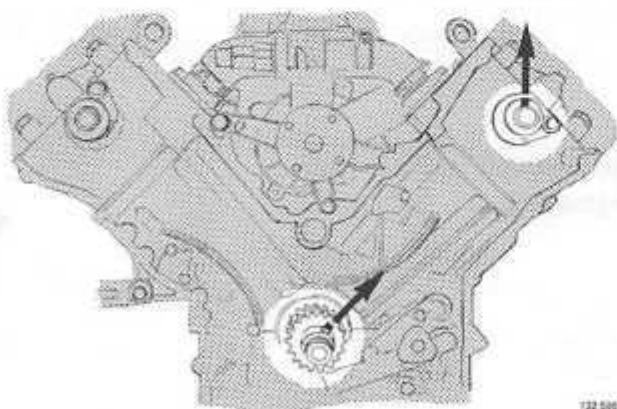
Note! On late types, gear and spacer are manufactured in one unit.



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**

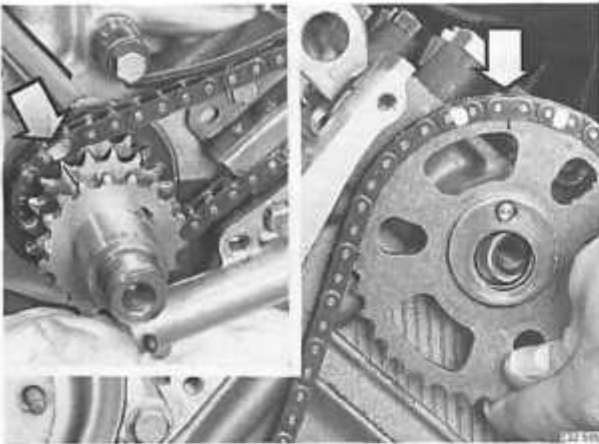
Place the chain on the camshaft sprocket, with the mark on the sprocket between the two marks on the chain.

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.

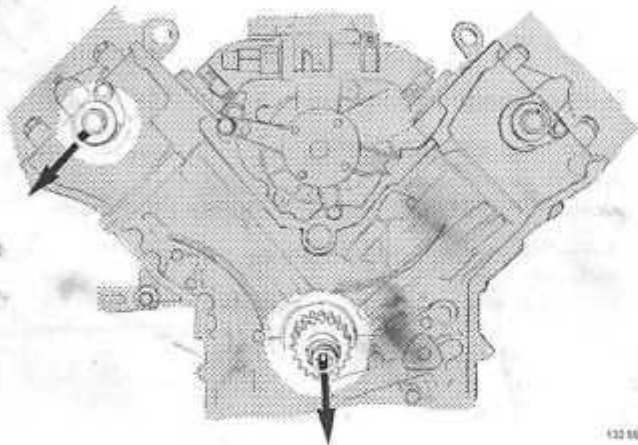


F14

**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**

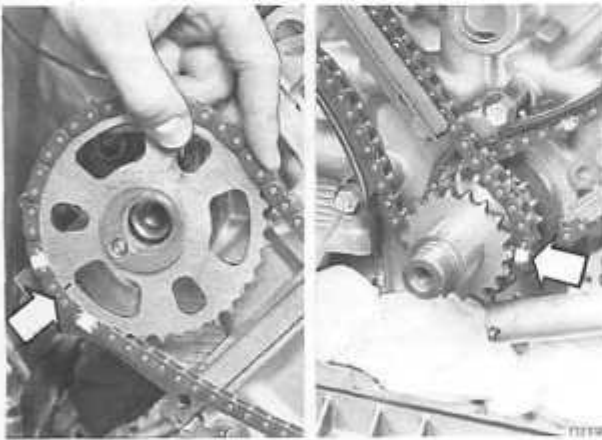
Place the chain on the camshaft sprocket, with the mark on the sprocket between the two marks on the chain.

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.

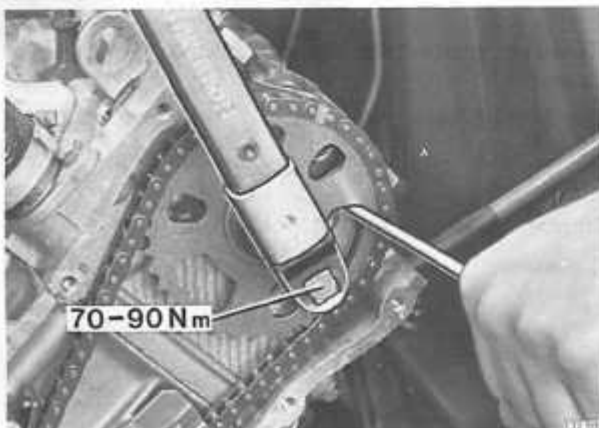
Install the centre bolt.

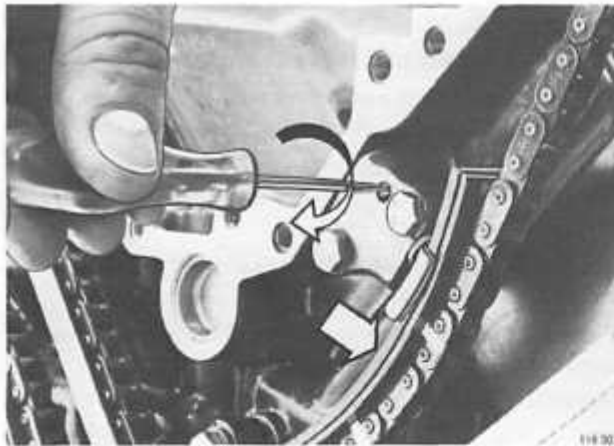


F16

**Tighten both camshaft centre bolts**

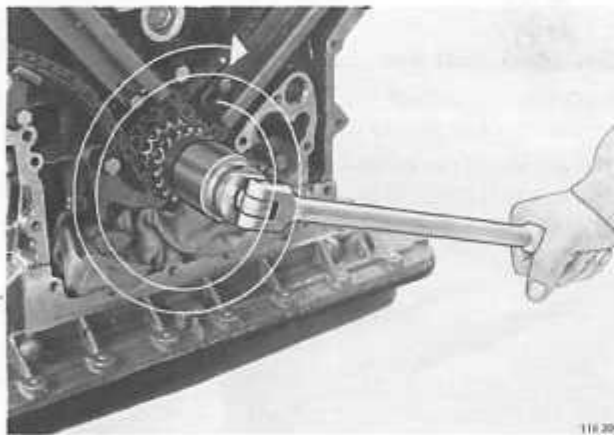
Tighten to a torque of **70–90 Nm** (52–66 ft.lbs.) Use a screwdriver as a counterhold, placing it between two cogs on the sprocket without holes.





F17

Turn locks 1/4 turn clockwise



F18

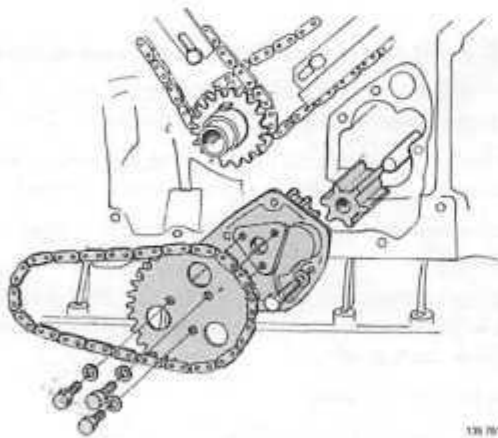
**Set chain tension**

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.

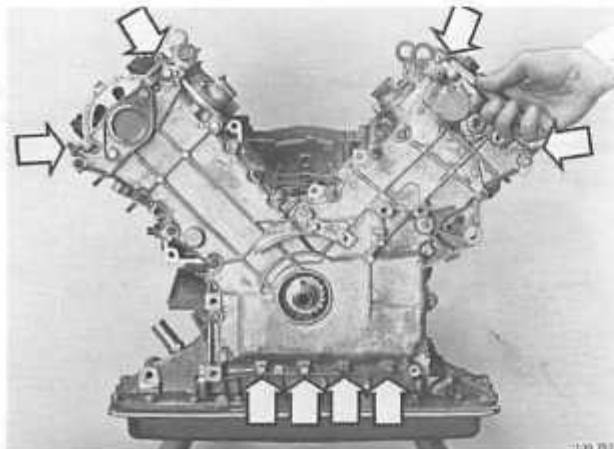


F19

**Install:**

- oil pump with sprocket
- chain and gear.

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



F20

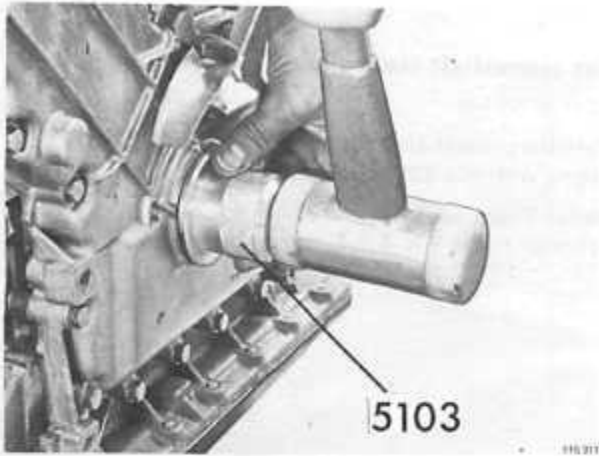
**Remove protective paper. Install timing gear case**

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.



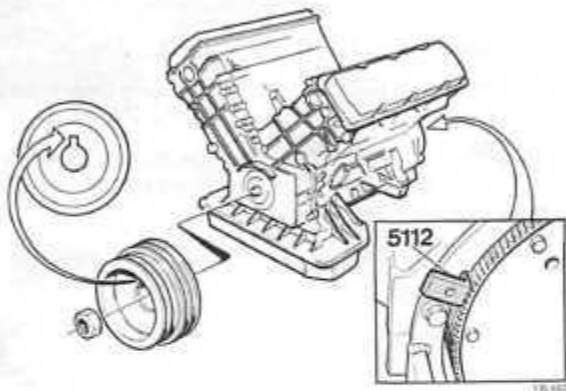
**CRANKSHAFT FRONT OIL SEAL, PULLEY**

F21

**Install new seal in timing gear case**

Grease the seal.

Use drift 5103.



F22

**Install crankshaft pulley**

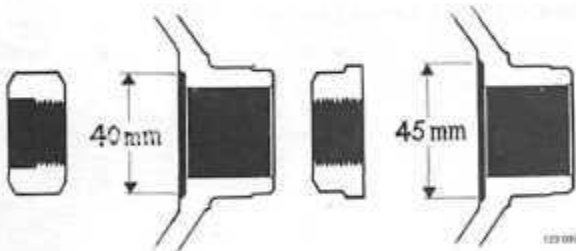
Fit locking sector 5112 to the flywheel casing at the lower bolt (RHD-vehicles = upper bolt.)

Make sure that key in crankshaft does not fall out.

Tighten nut to correct torque, see left.

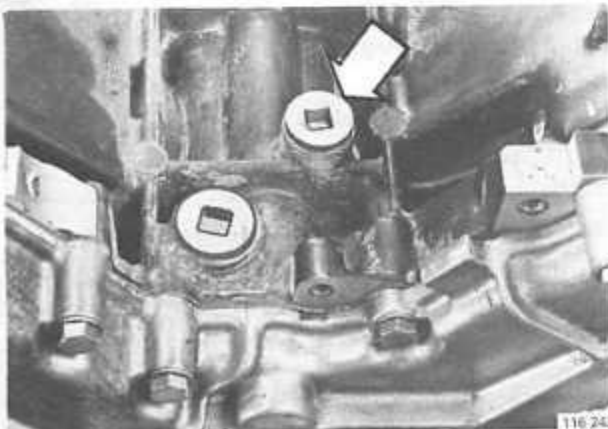
36 mm socket.

**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**

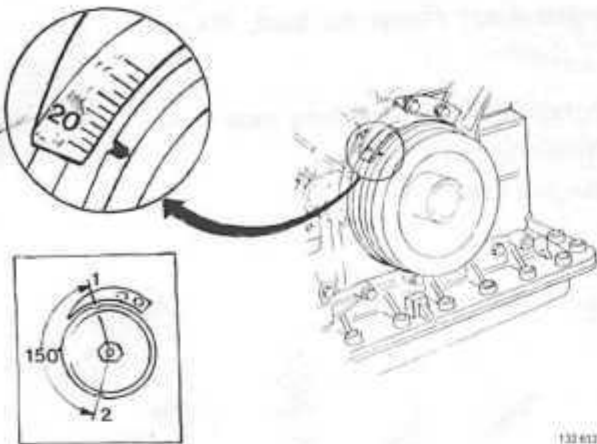
F24

**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

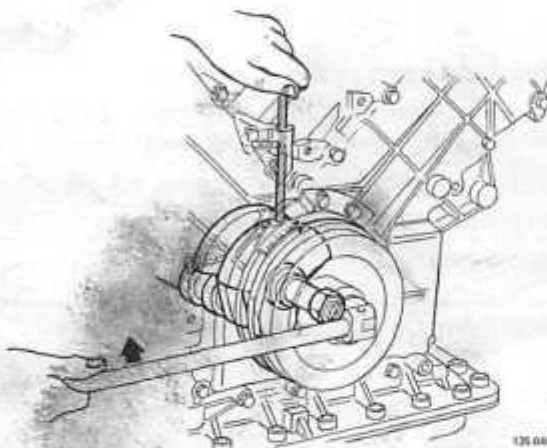
F25

**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.

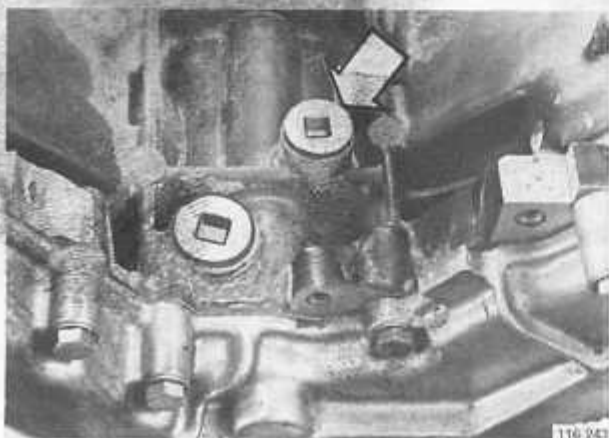
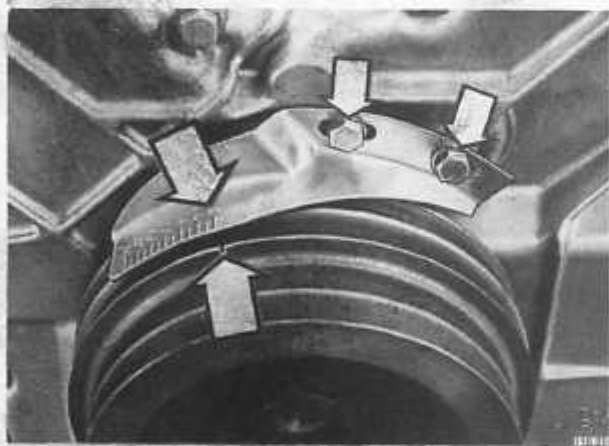


135 046

F26

**Check/adjust timing scale**

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



116 243

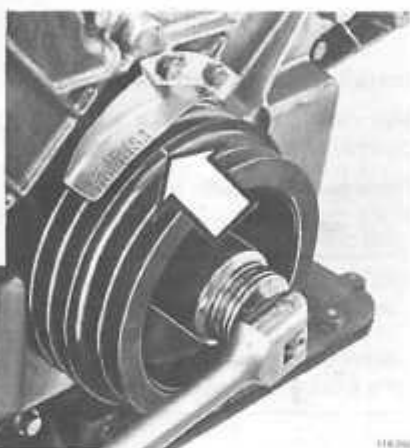
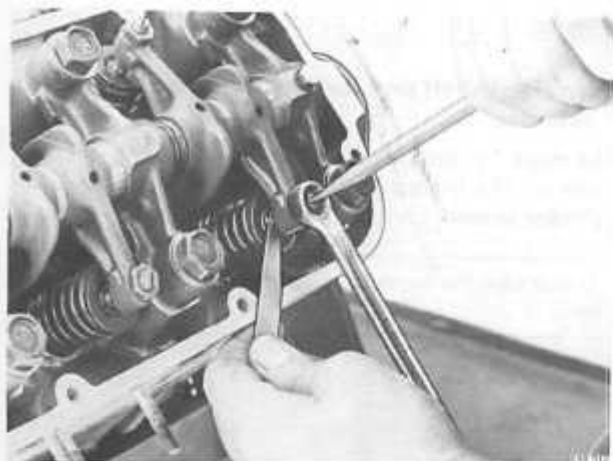
F27

**Install blocking plug**

Use a new seal.

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

**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>B 27 A</b> 1976-1979 .....	X	
<b>B 28 A</b> 1980 .....		X
1981-1982 .....	X	
<b>B 27 E</b> 1975-1978 .....	X	
1979-1980 Sweden and Aus- tralia .....	X	
1979-1980 Other markets .....		X
<b>B 28 E</b> 1981-1983 .....	X	
<b>B27 F</b> 1976-1979 .....	X	
<b>B 27 F</b> 1980 .....		X
<b>B 27 F</b> 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**

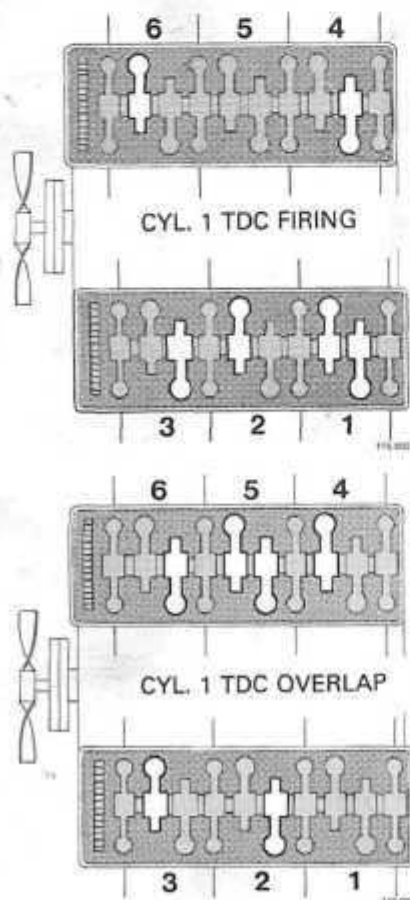
The mark "1" on the pulley should align with the zero mark on the scale. **There should be no clearance between the rocker arms and valve stem tops for No. 1 cylinder.**

F31

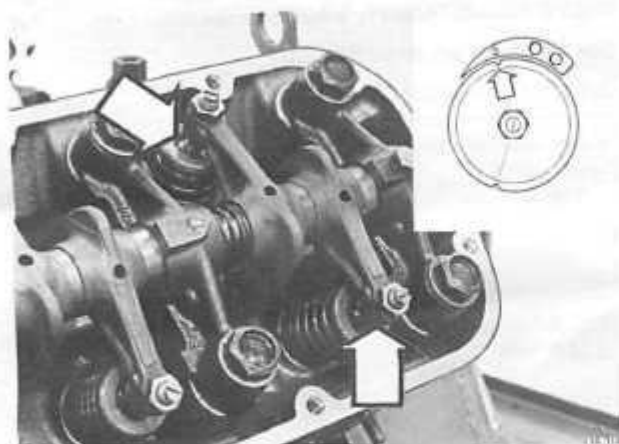
**Check/adjust valve clearances**

Check the following valves in the set position.

- Intake:** cylinders 3, 5 and 6
- Exhaust:** cylinders 2, 4 and 5



Assembly

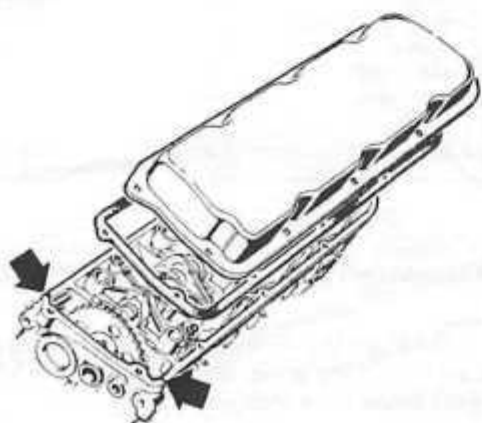


F32

**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.

## Index

	Opera- tion	Page		Opera- tion	Page
<b>Camshaft</b>			<b>Cylinder liner</b>		
removal .....	E1	46	classes .....	C1	26
endfloat .....	E5	47	diameter .....	C4	27
installation .....	E25	51	removal .....	C5-6	27
<b>Carrier plate (Auto)</b>			inspection .....	C7	28
removal .....	B17	25	liner height .....	D10-13	40
inspection .....	C34	36	installation .....	D14-19	41
installation .....	D34	45	<b>Cylinder head gasket</b>		
<b>Chain dampers, tensioners</b>			installation .....	F3	52
removal .....	B5-6	22	<b>Cylinder head</b>		
different types .....	C31	35	removal .....	B8-11	23
inspection .....	C32	35	disassembly .....	E1	46
installation .....	F11	54	cleaning-checking .....	E2-3	46
<b>Clutch</b>			warp .....	E4	46
removal .....	B18	25	assembly .....	E25	51
installation .....	D35	45	bolts, different types .....	F6	53
<b>Connecting rod bearings</b>			installation .....	F1-9	52
removal .....	B15-16	24	bolts, tightening .....	F7-9	53
installation .....	D20-24	43	<b>Flywheel</b>		
<b>Connecting rods</b>			removal .....	B18	25
side clearance .....	B14	24	inspection .....	C34	36
removal .....	B15-16	24	ring gear replacement .....	C35-39	36
bolts, replacement .....	C10-11	28	installation .....	D34	45
inspection .....	C7	23, 28, 33	<b>Gudgeon pins</b>		
replacement .....	C20-29	32	checking .....	C7	28
different types .....	C20	32	removal .....	C23	33
installation .....	D20-24	43	installation .....	C25-29	33
<b>Crankshaft oil seal</b>			<b>Lower crankcase</b>		
rear, removal .....	B17-18	25	removal .....	B12	23
installation .....	D7-8	39	installation .....	D25-32	43
front, removal .....	B2	21	<b>Main bearings</b>		
installation .....	F21	57	removal .....	B19	25
<b>Crankshaft pulley</b>			installation .....	D1-6	38
removal .....	B1	21	end float .....	D4-5	38
installation .....	F22	57	nuts, tightening .....	D29-31	44
<b>Crankshaft</b>			<b>Oil pump</b>		
removal .....	B19	25	removal .....	B7	22
inspection .....	C18-19	31	cleaning-checking .....	C40	37
different types .....	C20	32	installation .....	F19	56
installation .....	D1-6	38	<b>Oil strainer</b>		
end clearance .....	D4-5	38	removal .....	B12	23
<b>Cylinder block</b>			installation .....	D33	45
cleaning-checking .....	C12	29			

	Opera- tion	Page		Opera- tion	Page
<b>Overflow (relief) valve</b> (in cylinder block)			<b>Timing gear chains, sprockets</b>		
checking, different types .....	C14	30	wear check .....	B3	21
replacement .....	C15-17	30	removal .....	B4-7	22
<b>Pilot bearing (manual)</b>			inspection .....	C33	36
removal .....	B18	25	installation .....	F10-19	54
installation .....	D9	40	<b>Timing gear cover</b>		
<b>Piston pins</b>			removal .....	B2	21
see Gudgeon pins			installation .....	F20	56
<b>Piston rings</b>			<b>Timing scale</b>		
removal .....	C7	26	checking-adjusting .....	F23-27	57
axial play .....	C8	28	<b>Valve covers</b>		
ring gap .....	C9	28	removal .....	B2	21
installation .....	C30	35	installation .....	F33	60
<b>Pistons</b>			<b>Valve guides</b>		
removal .....	B15-16	24	clearance .....	E6	47
types, manufacturer .....	C1-2	26	replacement .....	E8-14	47
diameter .....	C3	26	oil seals, removal .....	E1	46
clearance .....	C4	27	oil seals, installation .....	E25	51
inspection .....	C7	28	<b>Valve seats</b>		
replacement .....	C20-29	32	grinding .....	E24	50
installation .....	D20-24	43	replacement .....	E15-22	49
<b>Pressure plate</b>			<b>Valve springs</b>		
removal .....	B18	25	removal .....	E1	46
installation .....	D35	45	inspection .....	E7	47
<b>Ring gear</b>			installation .....	E25	51
replacement .....	C35-39	36	<b>Valves</b>		
<b>Rocker arms</b>			removal .....	E1	46
removal .....	B8	23	grinding .....	E23	50
cleaning-inspection .....	E26	51	installation .....	E25	51
installation .....	F5	53	adjustment .....	F28-32	59
<b>Sump</b>			<b>Vibration damper</b>		
removal .....	B12	23	see Crankshaft pulley		
installation .....	D33	45			
<b>Thread inserts</b>					
general information .....	A1	14			
installation .....	A2	14			
non repairable threads .....	A3	15			
thread inserts .....	A4	16			
drill sizes .....	A4	16			
spark plug threads .....	A5	16			
installation .....	A6-11	17			
removal .....	A12-14	19			





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