

SAAB

900

**SERVICE
MANUAL**

2:1 Basic engine

M 1981-86-



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SERVICE MANUAL

Units

The basic units as well as the derived units used throughout the Service Manual are in accordance with the SI system.

As a supplement to these, a number of other units are specified within brackets.

The following symbols for the various units have been used in this issue:

SI unit	Supplementary unit	Also equivalent to
mm	in	-
kg	lbs	lb
N	lbs	lbf
Nm	ft.lbs	lbf-ft
bar	PSI	lbf/in ²
l	qts (US)	-
°C	°F	-

Conversion factors

1 in = 25,4 mm	1 mm = 0.039 in
1 lbs = 4,45 N	1 N = 0,23 lbs
1 ft.lbs = 1,36 Nm	1 Nm = 0,74 ft.lbs
1 PSI = 0,07 bar	1 bar = 14,5 PSI
1 qts = 0,95 l	1 l = 1,05 qts

Technical data



Engine number (1981 - 1983 models)

	B	20	S	M	UC	01	B	0000001
Position 1 <u>Engine type</u>	B = Petrol engine							
Positions 2-3 <u>Swept volume</u>	20 = 2 dm ³ (2.0 l)							
Position 4 <u>Engine version</u>	C = Single-carburettor T = Twin-carburettor I = Fuel injection S = Turbo							
Position 5 <u>Transmission type</u>	A = Automatic M = Manual							
Positions 6-7 <u>Exhaust emission control specification</u>	EU = Europe SW = Sweden UC = USA							
Positions 8-9 <u>Equipment specification</u>								
Position 10 <u>Model year</u>	B = 1981 C = 1982 D = 1983							
Positions 11-16 <u>Serial number</u>	Consecutive number within the model year							

Engine number (as from 1984 models)

	B	20	1	2	T	0	1	M	E	000001
*Position 1 <u>Engine type</u>	B = Petrol engine F = Petrol engine modified to run on paraffin									
*Position 2-3 <u>Swept volume</u>	20 = 2 dm ³ (2.0 l)									
*Position 4 <u>Cylinder head</u>	1 = Overhead camshaft 2 = Twin overhead camshafts									
Position 5 <u>Model</u>	1 = Saab 99 2 = Saab 900									
*Position 6 <u>Version</u>	C = Single-carburettor D = Fuel injection (B202) T = Twin-carburettor I = Fuel injection S = Turbo L = Turbo with intercooler									
Position 7 <u>APC code</u>	0 = Without APC 1 = With APC									
Position 8 <u>Exhaust emission control specification</u>	0 = No market specification 1 = Europe specification 2 = Sweden specification 3 = USA specification									
*Position 9 <u>Transmission type</u>	A = Automatic M = Manual									
Position 10 <u>Model year</u>	E = 1984 F = 1985									
Positions 11-16 <u>Serial number</u>										

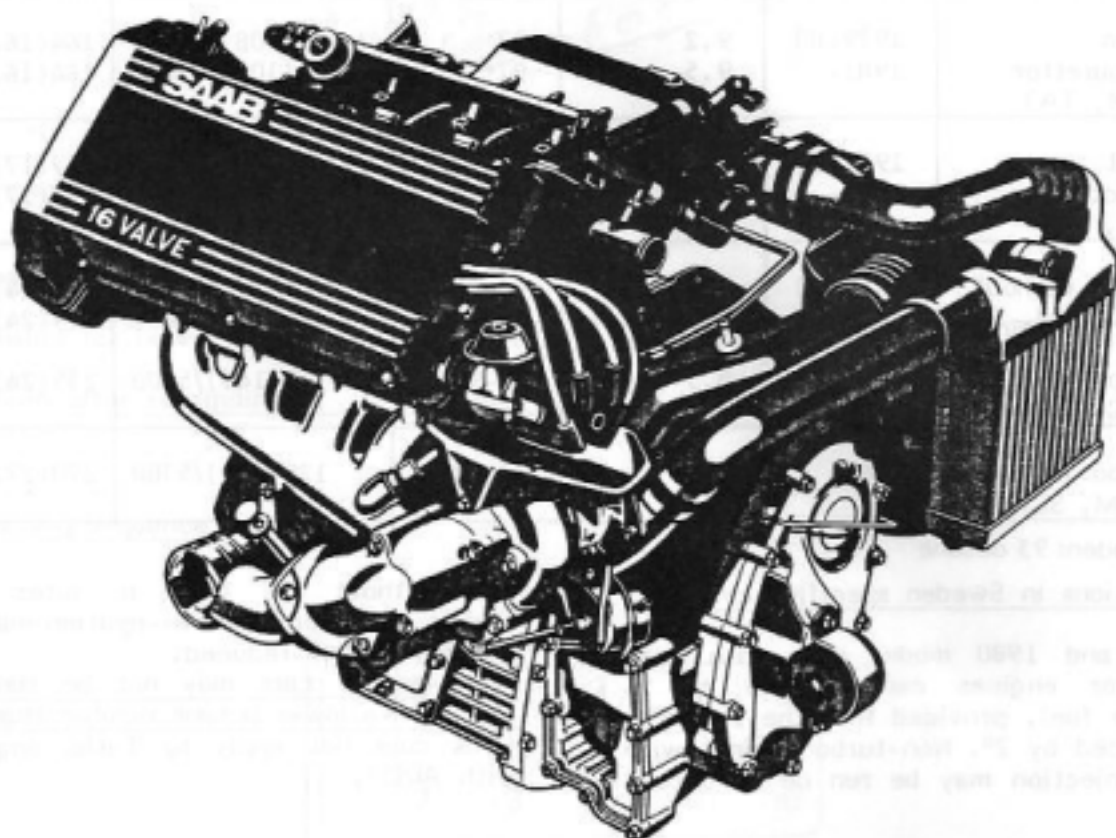
*These codes are used to distinguish the different engine versions.

Example

B202 SLM = 16-valve Turbo with APC, intercooler and manual transmission.

CA = Single-carburettor engine with automatic transmission.

General data



Type B201

B202

Cylinder bore

mm (in)

4-cylinder, 4-stroke engine with overhead camshaft

Stroke

mm (in)

4-cylinder, 4-stroke engine with twin overhead camshafts

Swept volume

cm³(in³)

90 (3.543)

78 (3.071)

1985 (307.7)

Firing order

1-3-4-2

(No.1 cylinder at rear)

Approximate weight, B201

kg (lb)

140 (309)

B202

kg (lb)

150 (331)

Performance, compression ratio, fuel octane number, etc.

Engine version	Model year	Compression ratio	Octane number,	Rating (DIN), kW at r/min	Torque (DIN), (kgf m) at RON r/min
Single carburettor (CM, CA)	1979-80	9.2	97	73(100)/5200	162(16.5)/3500
	1981-	9.5	97*	73(100)/5200	162(16.5)/3500
Twin carburettor (TM, TA)	1979-80	9.2	97	79(108)/5200	164(16.7)/3300
	1981-	9.5	97*	79(108)/5200	164(16.7)/3300
Fuel injection (IM, IA)	1979-80	9.2	97	87(118)/5500	167(17)/3700
	1981-	9.5	97*	87(118)/5500	167(17)/3700
Turbo without APC (SM, SA)	1979-80	7.2	97	107(145)/5000	235(24)/3000
	1981-82	7.2	98	107(148)/5000	235(24)/3000
Turbo with APC (SAM, SAA)	1982-	8.5	92-98	107(145)/5000	235(24)/3000
Turbo 16 (SLM, SLA)	1984-	9.0	92-98	129(175)/5300	270(27.8)/3000

* Sweden: 93 octane

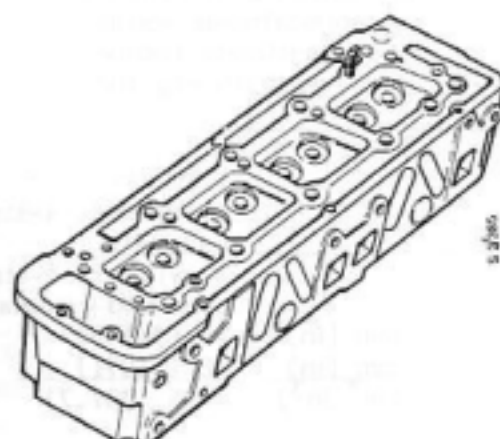
Deviations in Sweden specification

1979 and 1980 model cars with carburettor engines can be run on 96 octane fuel, provided that the timing is advanced by 2°. Non-turbo engines with fuel injection may be run on 93 octane

fuel without the need to alter the timing. However, the pre-ignition margin will be slightly reduced.

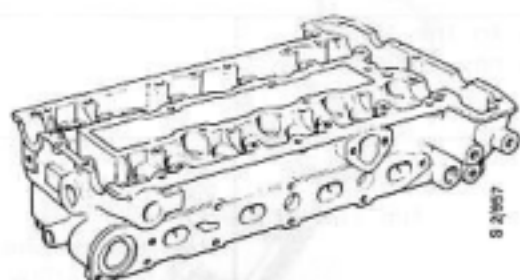
Turbo-engine cars may not be run on fuel with a lower octane number than 97 (this does not apply to Turbo engines with APC).

Engine body



Cylinder head (B201)

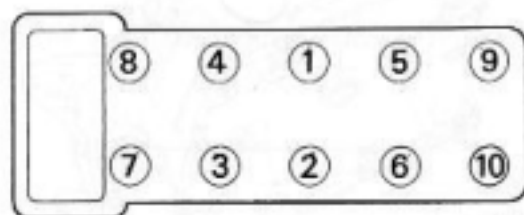
Dimension for new cylinder head:	mm (in)	92.75 ± 0.05 (3.6516 ± 0.0020)
Minimum after regrinding:	mm (in)	92.75 ± 0.05 (3.6358 ± 0.0020)
For cylinder heads that have been reground, a head gasket, 0.3 mm (0.0118 in) thicker, is available for H engines (1981 models onwards).		



Cylinder head (B202)

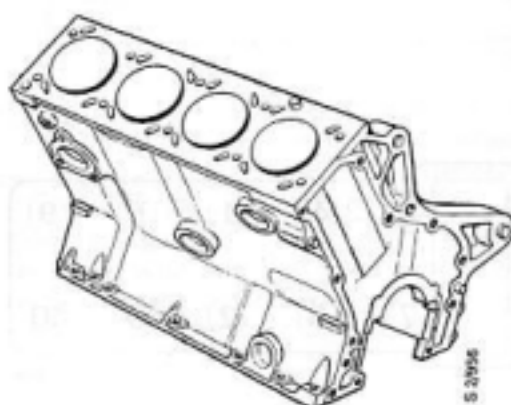
Dimension for new cylinder head:	mm (in)	140.5 ± 0.1 (5.5325 ± 0.0029)
Minimum after regrinding:	mm (in)	140.1 ± 0.1 (5.5157 ± 0.0039)

Tightening sequence



Tightening torques for M15 head bolts and TORX M12 bolts

The specified torques apply to the following bolts after fitting a new cylinder head gasket.		
Stage I	Nm (lbf ft)	60 (44.5)
Stage II	Nm (lbf ft)	90 (67)
Stage III		Run the engine to normal temperature and then allow it to cool for 30 minutes
Stage IV	Nm (lbf ft)	Slacken and then retighten each bolt to 80 (59)
Stage V		Tighten through a further 90°



Cylinder block

Cylinder bore:		
Standard (A)	mm (in)	90.000 - 90.010 (3.5433 - 3.5437)
Standard (B)	mm (in)	90.010 - 90.020 (3.5437 - 3.5441)
First oversize	mm (in)	90.500 (3.5630)
Second oversize	mm (in)	91.000 (3.5827)



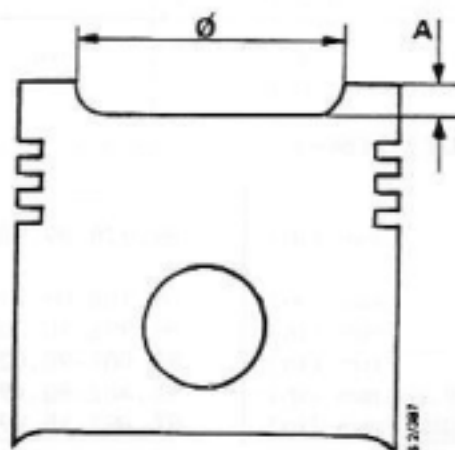
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Pistons

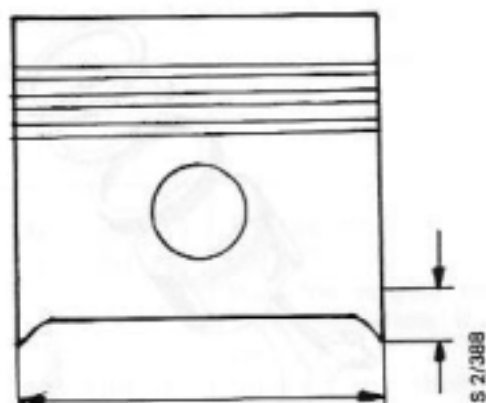
Make	MAHLE, KARL SCHMIDT, or HEPOLITE Pistons of different makes must not be fitted in the same engine.	
Piston speed (average) at 5000 r/min.	m/sek. (ft/s)	13 (39.7)

Piston type

The type of piston used varies with the compression ratio of the engine.



Engine	Model year	Piston dia, mm (in)	A, mm (in)	Piston weight, g (oz)
Carburettor	1981-	58 (2.284)	0.4 (0.016)	480-492 (17.2-17.7)
Fuel injection	1981-	58 (2.284)	0.4 (0.016)	480-492 (17.2-17.7)
Turbo	-1981	70 (2.756)	6.6 (0.260)	-
Turbo APC	1982-	70 (2.756)	2.65 (0.104)	497-506 (17.8-18.2)
Turbo 16	1984-	64 (2.520)	4.7 (0.185)	-
Turbo 16	1986	64 (2.520)	3.85 (0.152)	-



Turbo -1982 Turbo APC

Standard A (not spare part)	mm (in)	89.960-89.970 (3.5417-3.5421)
Standard AB	mm (in)	89.970-89.978 (3.5421-3.5424)*
Standard B	mm (in)	89.978-89.986 (3.5424-3.5428)*
Standard C	mm (in)	89.986-90.002 (3.5428-3.5434)
First oversize (0.5 mm)	mm (in)	90.460-90.475 (3.5614-3.5620)
Second oversize (1.0 mm)	mm (in)	90.960-90.975 (3.5811-3.5817)

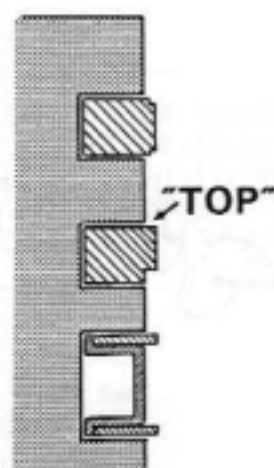
*Turbo -1982: -89.976/89.976- mm

Other engines (Mahle/SCHMIDT) 1984-

Standard A (not spare part)	mm (in)	89.978-89.988 (3.5424-3.5428)
Standard AB	mm (in)	89.988-89.996 (3.5428-3.5431)
Standard B	mm (in)	89.996-90.004 (3.5431-3.5435)
Standard C	mm (in)	90.004-90.020 (3.5435-3.5441)
First oversize (0.5 mm)	mm (in)	90.482-90.497 (3.5623-3.5629)
Second oversize (1.0 mm)	mm (in)	90.892-90.997 (3.5820-3.5826)

Piston clearance

Turbo -1982	mm (in)	0.02-0.05 (0.0008-0.0020)
Turbo APC	mm (in)	0.02-0.05 (0.0008-0.0020)
Other variants 1984-	mm (in)	0.01-0.04 (0.0004-0.0016)



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Piston rings

		Top compression ring	Second compression ring	Scraper ring
Width (thickness),	mm (in)	1.73-1.75 (0.0681-0.0689)	1.98-1.99 (0.0780-0.0783)	2.63-2.73* (0.1035-0.1075)
Side clearance in groove	mm (in)	0.050-0.082 (0.0020-0.0032)	0.040-0.072 (0.0016-0.0028)	
Working gap in new cylinder,	mm (in)	0.35-0.55 (0.0138-0.0217)	0.30-0.45 (0.0118-0.0177)	0.38-1.40** (0.0150-0.0551)

* Segment width (thickness): 0.58-0.64 mm (0.0028-0.0252 in)

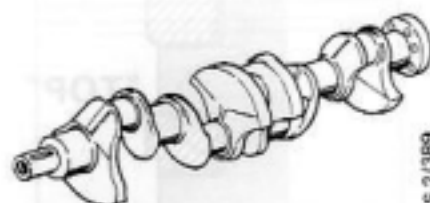
** Applies to segment

Gudgeon pins

Diameter:	mm (in)	23.996-24.000 (0.9447-0.9449)
Fit	mm (in)	0.005-0.014 (0.0002-0.0006) (sliding fit under gentle thumb pressure)

Connecting rods

Diameter of big-end	mm (in)	56.000-56.019 (2.2047-2.2055)
Diameter of small-end bush (fitted)	mm (in)	24.005-24.010 (0.9451-0.9453)
Maximum permissible weight variation per set	g (oz)	6 (0.215)



Crankshaft

Maximum variation in straightness	mm (in)	0.10 (0.0039)
End float	mm (in)	0.08-0.28 (0.0031-0.0110)
Maximum ovality of journals	mm (in)	0.05 (0.0020)
Maximum taper of journals	mm (in)	0.05 (0.0020)
Radius of main journal fillet	mm (in)	2.2-2.5 (0.0866-0.0984)
Main bearing clearance	mm (in)	0.020-0.062 (0.0008-0.0024)
Big-end bearing clearance	mm (in)	0.026-0.061 (0.0010-0.0024)

Colour markings of main bearing and big-end bearing shells:

	Thin	Thick
Standard	Red	Blue
First undersize	Yellow	Green
Second undersize	White	Brown

Crank pin diameter:

Standard	mm (in)	51.981-52.000 (2.0465-2.0472)
First undersize	mm (in)	51.731-51.750 (2.0367-2.0374)
Second undersize	mm (in)	51.481-51.500 (2.0268-2.0276)
Third undersize	mm (in)	51.237-51.250 (2.0172-2.0177)
Fourth undersize	mm (in)	50.987-51.000 (2.0074-2.0079)

Main journal diameter:

Standard	mm (in)	57.981-58.000 (2.2827-2.2835)
First undersize	mm (in)	57.731-57.750 (2.2729-2.2736)
Second undersize	mm (in)	57.481-57.500 (2.2630-2.2638)
Third undersize	mm (in)	57.237-57.250 (2.2534-2.2539)
Fourth undersize	mm (in)	56.987-57.000 (2.2436-2.2441)

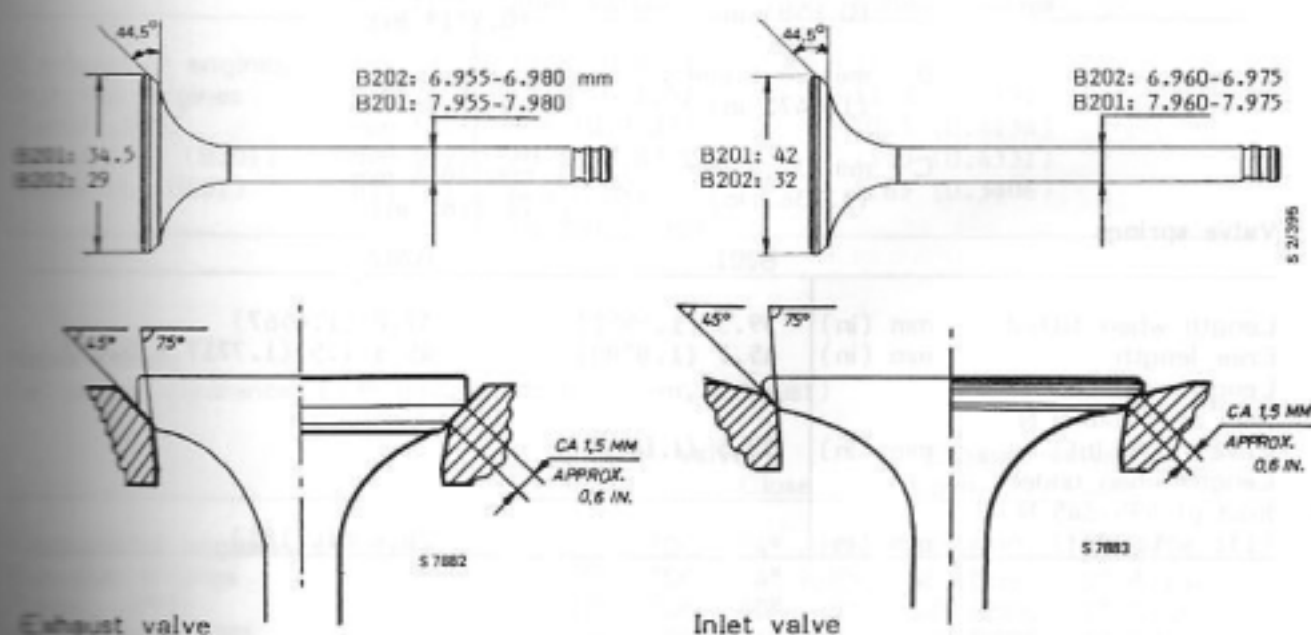
Valve mechanism

Valve clearance, mm, in engine having stood for 30 min after running at normal temperature

Note: B201 engines only.

B201 engines		Turbo	Other engines
On checking:	inlet	0.15-0.30	0.15-0.30
	exhaust	0.40-0.50	0.35-0.50
On adjusting:	inlet	0.20-0.25	0.20-0.25
	exhaust	0.45-0.50	0.40-0.45

Shims available in intervals of 0.05 mm between 1.77 and 2.89 mm

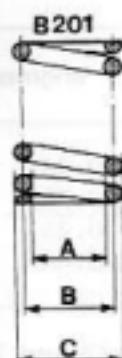


NOTE

The exhaust valves have a stellite coating and should therefore not be machined. Grinding using valve grinding paste is the only recommended method. The exhaust valves in engines with fuel injection are sodium filled and the sodium must therefore be removed before the valves are scrapped.

Valve guides

		B201	B202
Length	mm (in)	46.65 (1.8366)	49.0 (1.9291)
Outer diameter	mm (in)	13.040-13.051 (0.5134-0.5138)	12.039-12.050 (0.4740-0.4744)
Bore for valve guides in cylinder head	mm (in)	13.000-13.018 (0.5118-0.5125)	12.000-12.018 (0.4724-0.4731)
Maximum clearance between valve stem and valve guide	mm (in)	0.5 (0.0197) measured on valve head raised 3 (0.1181) above seat	



- A min 21.8 mm
(0.8583 in)
- B min 26.6 mm
(1.0472 in)
- C min 31.4 mm
(1.2362 in)



- A min 19.6 mm
(0.7717 in)
- B min 24 mm
(0.9449 in)
- C min 28.4 mm
(1.1181 in)

Valve springs

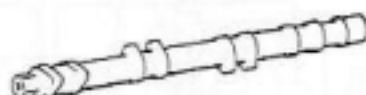
		B201	B202
Length when fitted	mm (in)	39.5 (1.5551)	37.0 (1.4567)
Free length	mm (in)	45.7 (1.8780)	45 ± 1.5 (1.7717 ± 0.05)
Length when under load of 740-800 N (162 - 174 lbf)	mm (in)	29.5 (1.1614)	
Length when under load of 595-645 N (131 - 141 lbf)	mm (in)		28.4 (1.1181)

Cam followers

		B201	B202
Diameter	mm (in)	37.87-38.98 (1.4909-1.4953)	32.959 - 32.975 (1.2976-1.2982)
Height	mm (in)	33 (1.2992)	26 (1.0236)
Bore for cam followers in cylinder head (camshaft bearing assembly)	mm (in)	38.000-38.016 (1.4961-1.4967)	33.000 - 33.016 (1.2992-1.2998)

Shims for valve adjustment (B201 engines only)

Diameter	mm (in)	15.5 (0.6102)
Thickness	mm (in)	1.77-2.89 (0.0697-0.1138)
23 shims available within the range, at intervals of 0.05 mm (0.002 in)		



Camshaft

		B201	B202
No. of bearings		5	5
Bearing diameter	mm (in)	28.94 (1.1394)	28.922-28.935 (1.1387-1.1392)
End float	mm (in)	0.08-0.25 (0.0031-0.0098)	0.08 - 0.35 (0.0031-0.0138)

Cam lift at 0 valve clearance

		Inlet valves	Exhaust valves
Carburettor engines	mm (in)	10.8 (0.4252)	11.0 (0.4331)
Injection engines	mm (in)	10.8 (0.4252)	11.0 (0.4331)
Turbo -1982	mm (in)	9.1 (0.3583)	10.5 (0.4134)
Turbo APC (B201)	mm (in)	10.8 (0.4252)	11.0 (0.4331)
Turbo 16 (B202)	mm (in)	8.65/6.65 (0.3406/0.2618)	8.65 (0.3406)

Valve timing

(at design clearance: 0.35 mm, inlet; 0.55 mm, exhaust)

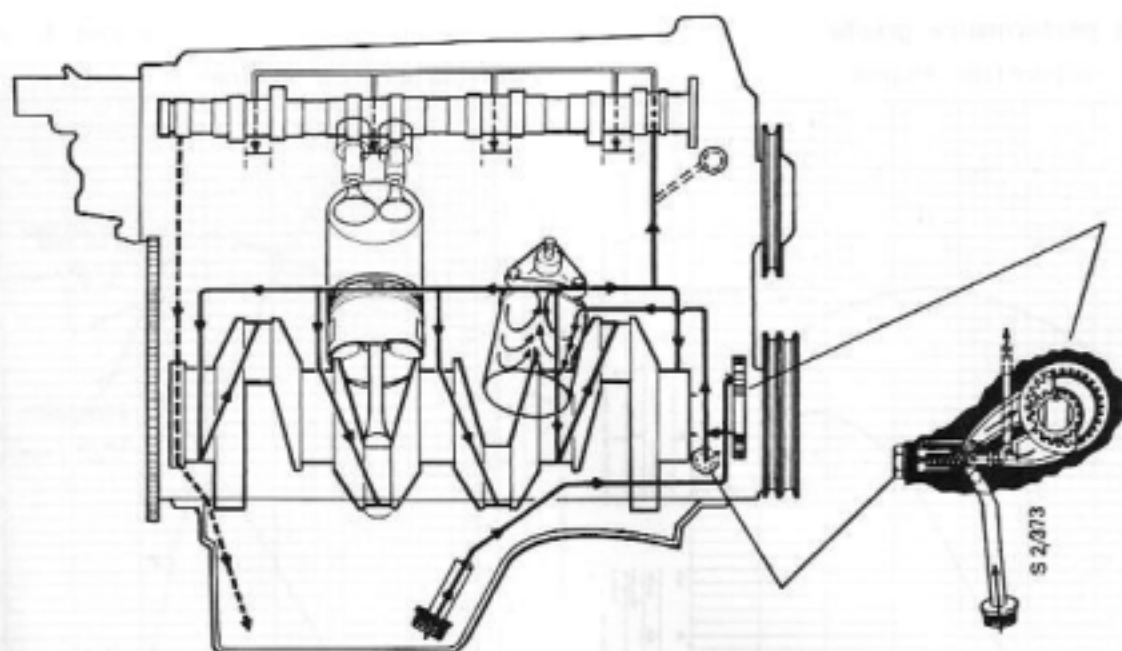
	Inlet valves		Exhaust valves	
	Open	Close	Open	Close
Carburettor engines, 1981 onwards	10° BTDC	54° ABDC	46° BBDC	18° ATDC
Injection engines	10° BTDC	54° ABDC	46° BBDC	18° ATDC
Turbo, -1982	12° BTDC	40° ABDC	62° BBDC	2° ATDC
Turbo APC, B201	10° BTDC	54° ABDC	46° BBDC	18° ATDC
B202 -1985	10° BTDC	56° ABDC	56° BBDC	16° ATDC
B202 1986	16° BTDC	56° ABDC	61° BBDC	13° ATDC

Tightening torques

	Torque, Nm	Torque, ft. lb	Dimension
Main bearings	110	81.4	M 12
Big-end bearings	55	40.7	M 10
Camshaft bearing caps, B201	18	13.3	M 8
B202	15	11.1	M 8
Valve cover B201	5	3.7	M 6
B202	15	11.1	M 8
Crankshaft pulley	190	140.6	M 16
Rear engine plate (flywheel end)	20	14.8	M 8
Flywheel	60	44.4	M 10
Oil pump	8	5.9	M 6
Spark plugs	28	20.7	M 14x1.25
Chain tensioner, B201	12	8.9	M 6
Chain guide, B201	12	8.9	M 6
Chain tensioner, B202	63	46.6	M 10
Camshaft sprocket, B201	20	14.8	M 8
Camshaft sprocket, B202	63	46.6	M 10
Inlet manifold	18	13.3	M 8
Thermostat housing	18	13.3	M 8
Throttle housing	18	13.3	M 8
Exhaust manifold, Turbo	25	18.5	M 8
all other models	20	14.8	M 8
Timing cover	20	14.8	M 8
Distributor, B201	5	3.7	M 6
B 202	20	14.8	M 8
Oil filter	10	7.4	3/4"-16UNF
Oil pressure switch	10	7.4	1/4"-18NPTF
EGR valve	15	11.1	M 14x1.5
Engine block heater plug	55	40.7	R 3/8"
Drain plug, coolant	30	22.2	M 14x1.5
Knock detector, up to and incl. 1982 models	8	5.9	-
1983 models onwards	20±5	14.8±3.7	-

All other bolts should be tightened as follows:

Dimension	Tightening torque	
	Nm	ft. lb
M 5	5	3.6
M 6	10	7.2
M 8	20	14.4
M 10	40	23.8



Lubricating system

Oil capacity, including oil cleaner, B201	liter	3.8
B202	liter	4.0
		Turbo: The oil cooler holds an additional 0.5 liter
Volume between MAX and MIN marks on dipstick	liter	1.0
Recommended oil, Turbo		Saab Turbo Motoroil or oil to API Service SF/CD or SF/CC
Others		API-Service SF/CC
Viscosity:		10W-30, 10W-40 or 5W-30. In markets where these viscosities are not available, 15W-40 or 15W-50 oil may be used.

Oil pressure

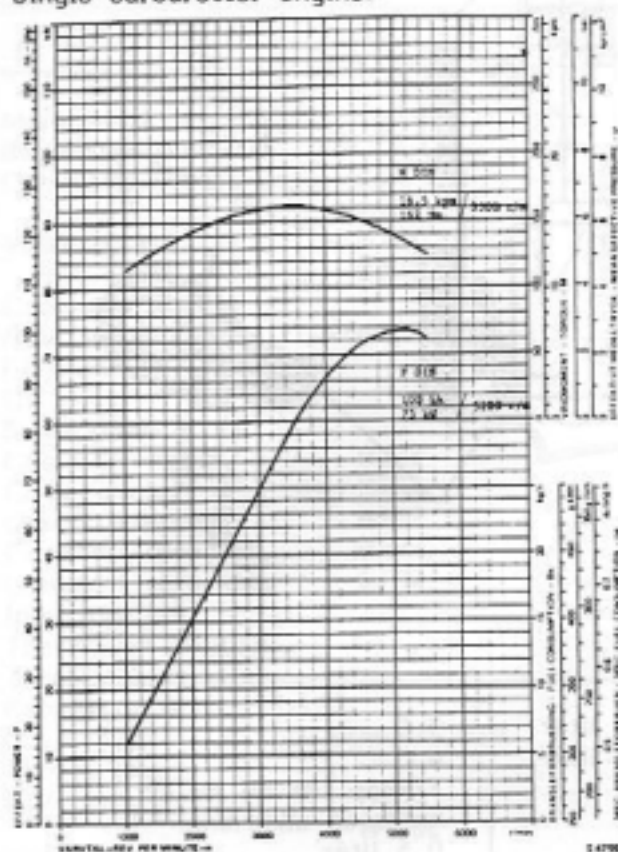
Oil pump pressure-reducing valve opens at: B201	bar(Psi)	4.5-5.0 (65-72)
B202	bar(Psi)	3.6-5.2 (52-75)
Warning light lights up at	bar(Psi)	0.3-0.5 (4.4-7.2)
Oil pressure at 2000 r/min, engine temperature of 80 C and 10W-40 oil	bar(Psi)	Minimum of 3.0 (43)

Oil pump

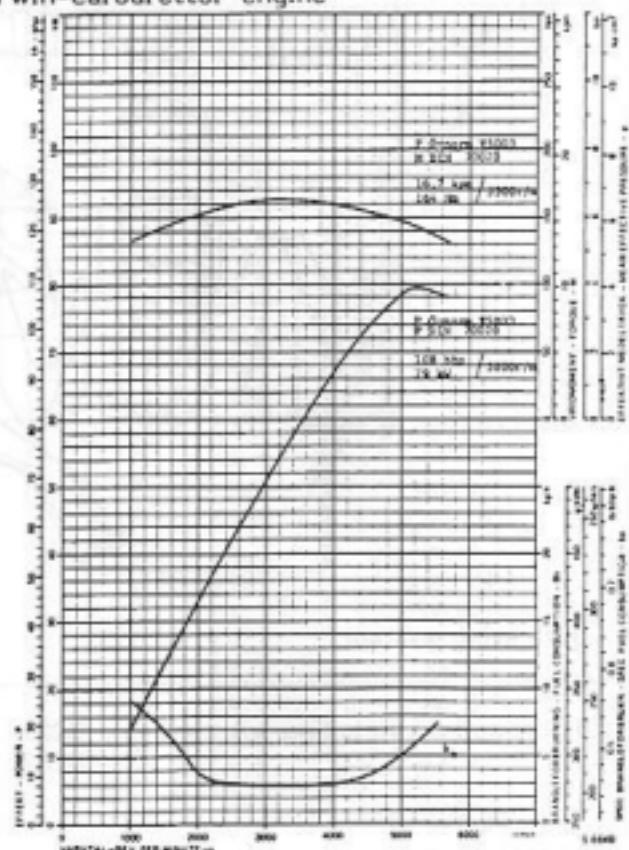
End float between rotor and housing	mm (in)	0.03-0.08 (0.0012-0.0031)
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Engine performance graphs

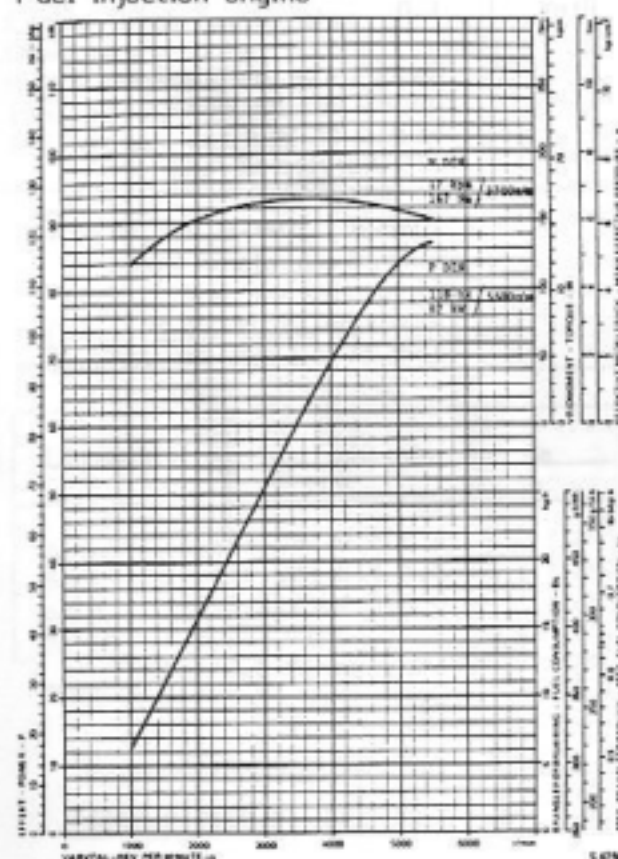
Single carburettor engine



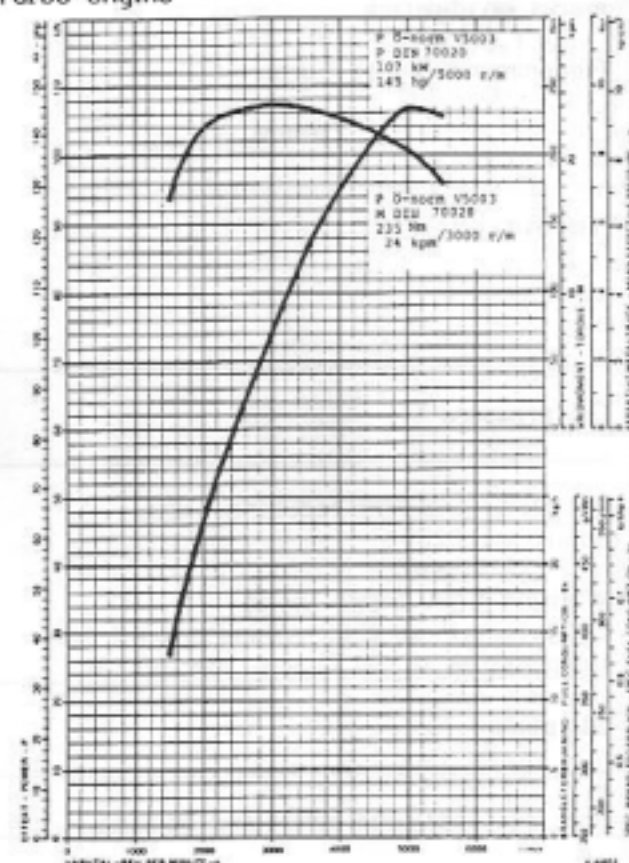
Twin-carburettor engine



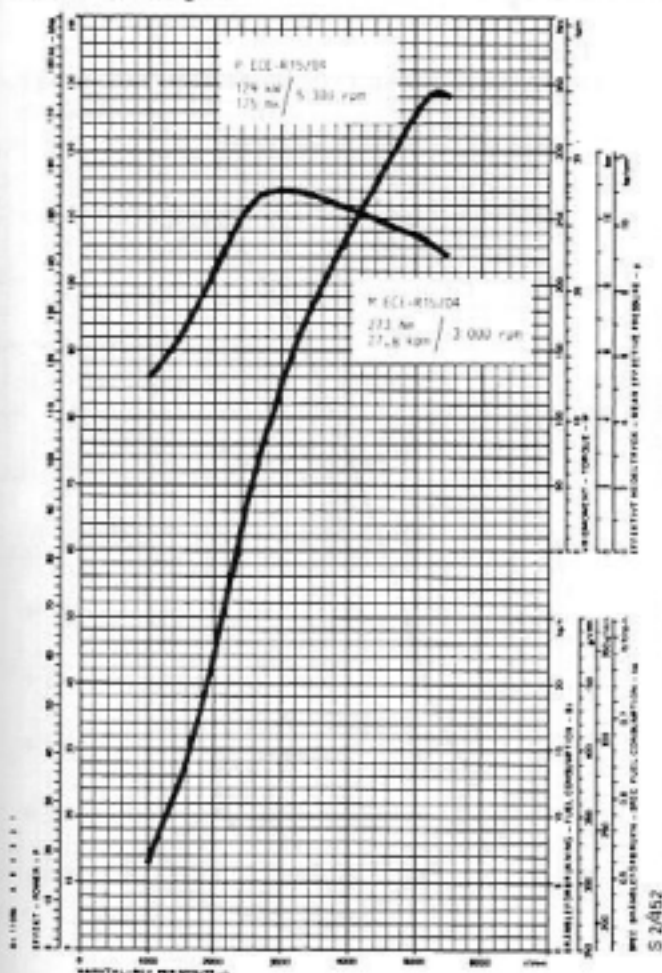
Fuel injection engine



Turbo engine



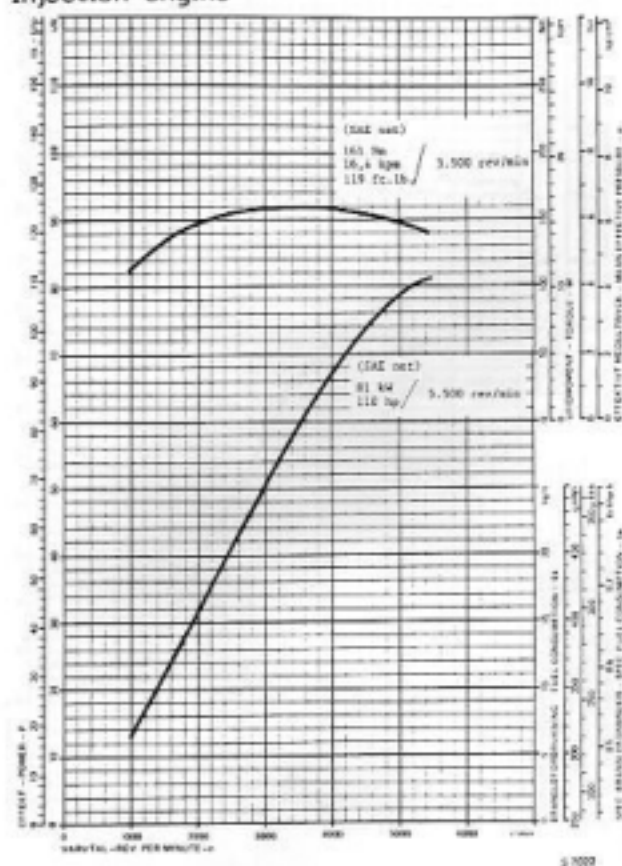
Turbo 16 engine



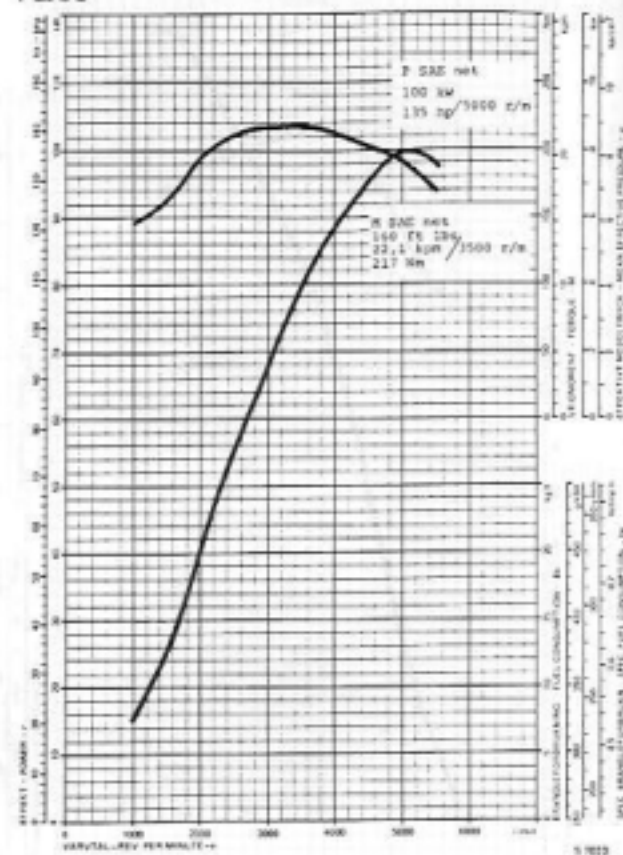
Engine performance graphs

Cars equipped with catalytic converters

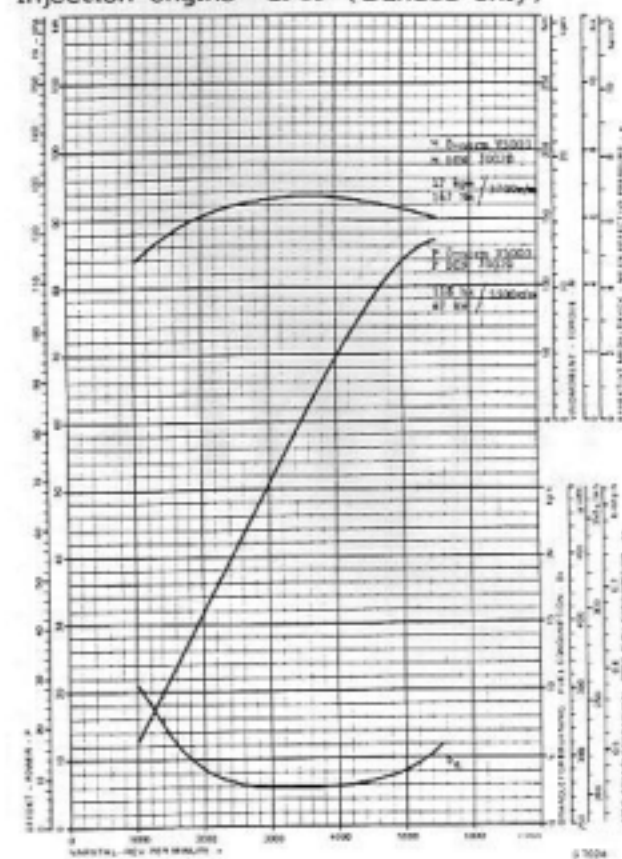
Injection engine



Turbo

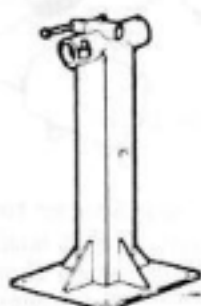


Injection engine -1983 (Canada only)



Special tools

Some tools can also be used in other groups.



78 60 794

Floor stand for stationary installation



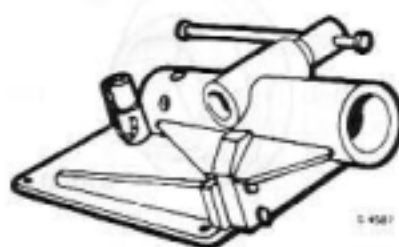
S 2 940

83 92 169

Holder for engine floor stand

83 93 951

Holder as from model 1985



S 4507

78 60 877

Bench stand

78 60 885

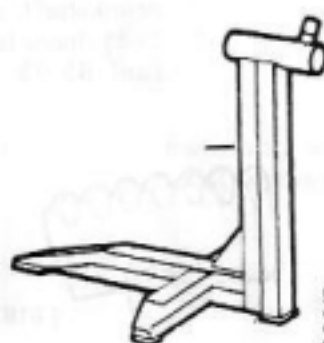
Vice stand



S 2 849

78 60 802

Oil pan, for floor stand



S 2 947

78 61 479

Movable stand (alternative for 78 60 794)

83 90 478

Axle for stand



S 2 950

83 92 409

Lifting yoke, power unit



S 2 951

78 62 014

Strap wrench oil
filter standard
filter

83 93 332

Strap wrench oil
filter (removal
of factory installed
filter at 1200 mile
service)



83 91 849

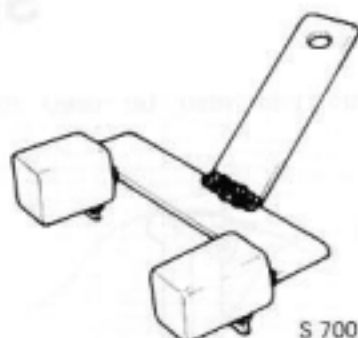
Dolly, removal
of chain wheel



S 2 945

83 92 540

Installing tool,
crankshaft seal,
flywheel end



S 7003

83 93 209

Spacer tool, unloading
front suspension
when removing
the power unit



S 8130

83 93 340

Tool for fitting
timing-chain-end
crankshaft seal.

83 94 215

Tool for fitting
timing-chain-end
crankshaft seal as from
1985 models. Supersedes
tool 83 93 340.



S 6183

83 92 987

Locking segment for
locking of crankshaft



83 92 961

Ring spanner, pulley bolt

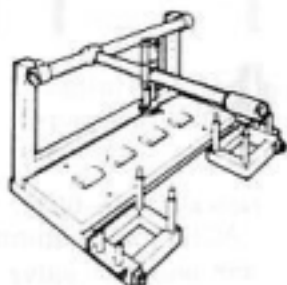
83 93 639

Socket for pulley bolt (as from 1984 models)



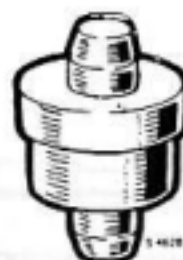
83 92 300

Spring depressor (for use in car or on removed cylinder head)



83 93 050

Installing and removing tool, valves



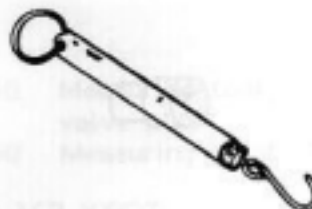
83 91 997

Drift, flywheel bearing



78 62 287

Piston installing tool



S 2/021

83 90 130

Spring balance, checking of piston clearance



S 2 933

83 91 401

Magnetic tool,
removal of cam
followers



83 92 326

Air nipple, spark
plug hole



83 93 910

TORX E16 socket, 1/2"
drive



S 2 051

- 83 92 193 Valve cutter assy.
- 83 92 201 Cutter 75°
- 83 92 219 Cutter 11° -45°
- 78 61 057 Guide spindle
- 78 61 065 T-key

The remaining tools in the set are
for other Saab-models



S 2 065

- 83 93 928 Neway type 008m 150-7 (AGB) guide spindle for 45° and 60° valve grinding tool. Suitable for valve guides of inside diameter of 7 mm (H7).
- 83 93 936 Neway type 8-270 60° (AGB) valve seat grinding tool for use with 45° and 60° valve grinding tools.
- 83 93 944 Valve guide reamer, 7 mm dia., for stiff H7 fit (6.97 mm dia. valve stem).



83 92 268 Reamer, valve
guide \varnothing 8 mm H8



83 92 631 Valve guide tool (for
removal and installa-
tion in a press)



83 94 140 Adaptor for checking of
expansion tank pressure
cap.



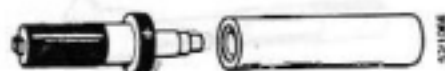
83 91 450 Measuring tool,
valve play
83 92 250 Measuring point



83 92 326 Compressed-air
adaptor for spark
plug drilling



83 94 157 Tool for removal
of valve seals



83 94 181

Sleeve.

83 94 207

Tool for fitting of valve collets.



S 8131

83 93 357

Tool, chain tensioner



83 93 746

Protective sleeve for cylindrical guide for cam follower (set of 16).



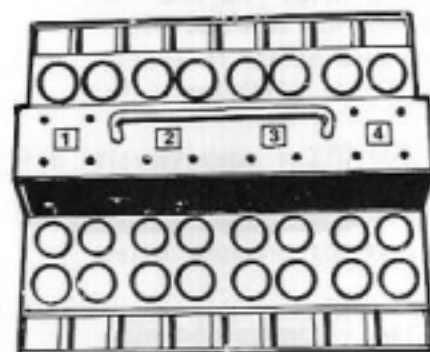
78 40 622

Dial indicator



83 92 185

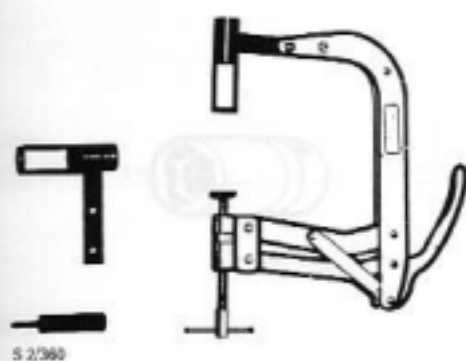
Spanner, crankshaft bolt (turning the crankshaft to adjust valves)



83 93 787

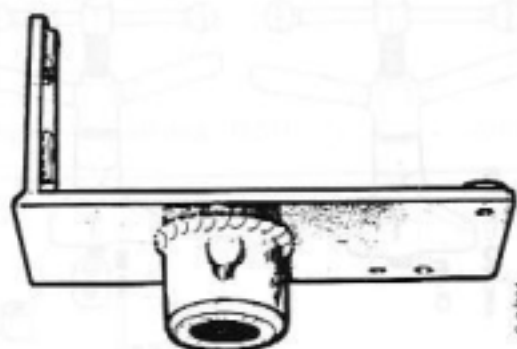
Valve stand.

Technical description

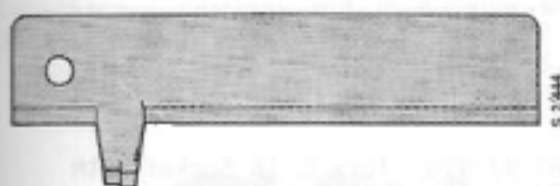


83 93 761 KD-tools type 308 valve spring compressor for use with special anvil 83 93 779.

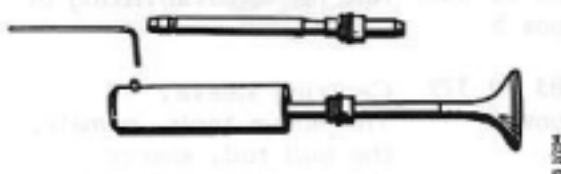
83 93 779 Special anvil for use with valve spring compressor 83 93 761.



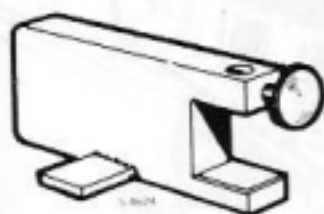
83 93 795 Cylinder head bracket for use with floor stand 78 60 794.



83 93 753 Measuring head for valve clearance.



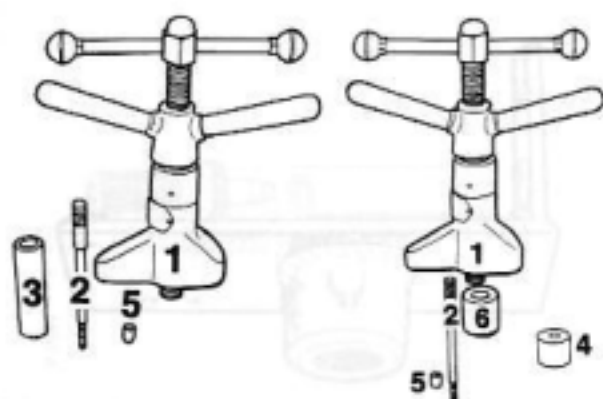
83 93 803 Tool for fitting valve guide seal.



83 91 633 Measuring plate, checking of adjusting pallets



83 93 589 Centring tool. Used for centring oil pumps without guide pins or in the case of unwanted noise in the oil pump on H-engines.



Removal

Fitting

- 83 93 811 Pull rod for removal/fitting of valve guide. pos 2
- 83 93 829 Sleeve for removal of valve guide. pos 3
- 83 93 837 Stop for fitting of valve guide. pos 4
- 83 93 845 Nut for removal/fitting of valve guide. pos 5
- 83 90 379 Centring sleeve. pos 6
The above tools, namely, the pull rod, spacer sleeve, stop, nut and centring sleeve are used with the valve guide press (jack-screw).



- 83 93 571 Spanner 13 mm, removal and fitting of slave cylinder pressure line



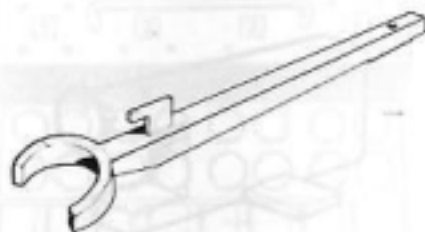
S 2/368

- 83 93 902 NV 16 Spark plug socket with 3/8-inch drive (AB Memento).



S 2/369

- 83 93 910 Torx E 16 Socket with 1/2-inch drive (AB Memento) for removal/fitting of cylinder head bolts.



- 83 93 175 Tool, removal of clutch shaft

Technical description

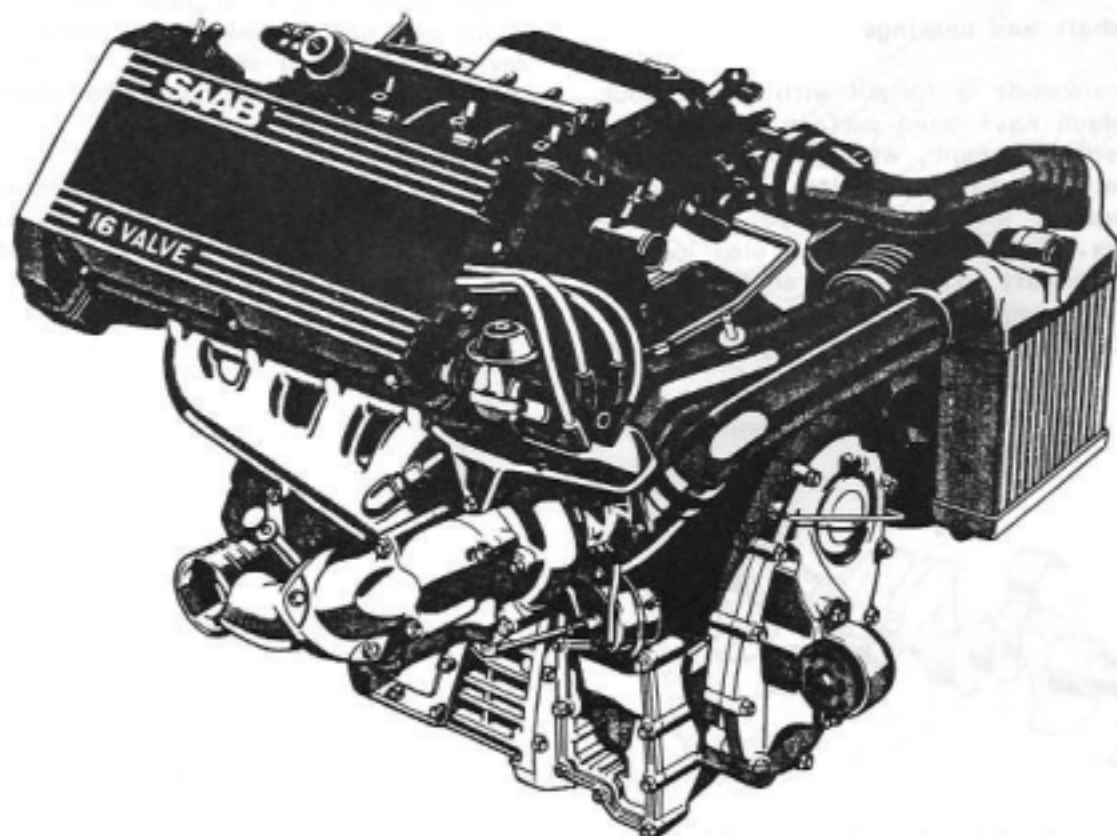
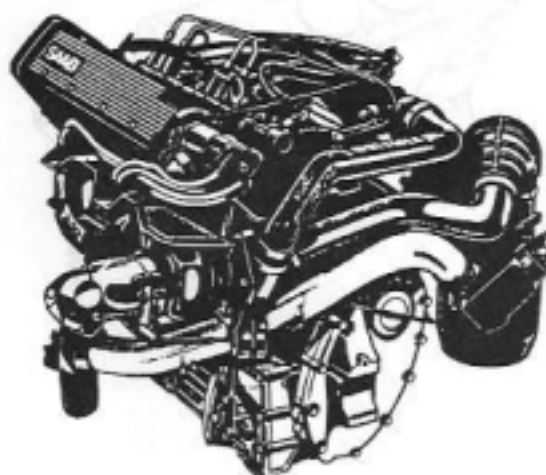
Engine 200-1
Lubricating system 200-5

Engine mountings B201 200-7

Engine

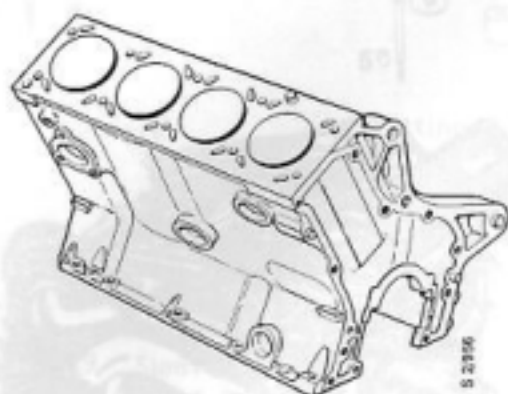
General

The water cooled engine is a four-in-line with overhead camshaft. The crankcase ventilation is totally enclosed. The cylinder block is inclined at an angle of 45° to the right and the cylinder head is of the cross-flow type, i.e. with the inlet ports on one side and the exhaust ports on the other. The engine is mounted with the clutch towards the front of the car and with the timing chain and the no. 1 cylinder towards the rear. The engine is available in carburettor, fuel injection and turbocharged versions and in 8-valve and 16-valve variants.

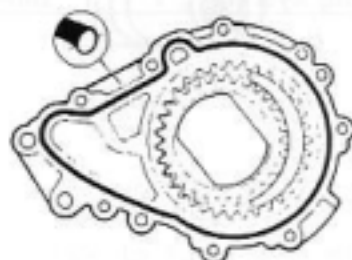


Cylinder block

The cylinder block is made of special cast iron, cast in one piece. The cylinder bores, surrounded by cooling jackets, are drilled straight out of the block. The block also contains oilways for the lubricating system.



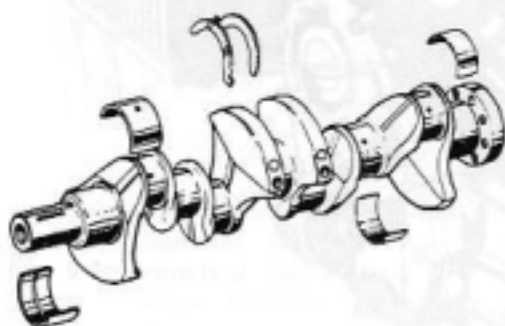
crankshaft drives the oil pump via a driving plate on the transmission sprocket,



and the water pump and alternator via a belt drive. The power steering servo pump and the AC compressor are also belt-driven from pulleys on the crankshaft.

Crankshaft and bearings

The crankshaft is forged with ground journals which have been surface-hardened by "Tenifer" treatment, which provides a hard non-metallic surface giving good protection against wear. There are five main bearings. The centre bearing also locates the crankshaft axially. The shaft contains drilled passages for lubricating oil. All main bearing shells can be replaced. The



Pistons and piston rings

The pistons are made of light alloy and are provided with grooves for two compression rings and one oil scraper ring. The top compression ring is flat with a chromed finish. The second compression ring has oil-scraping characteristics and is somewhat wider than the top ring. The actual oil scraper is a three-piece ring.



Cylinder head

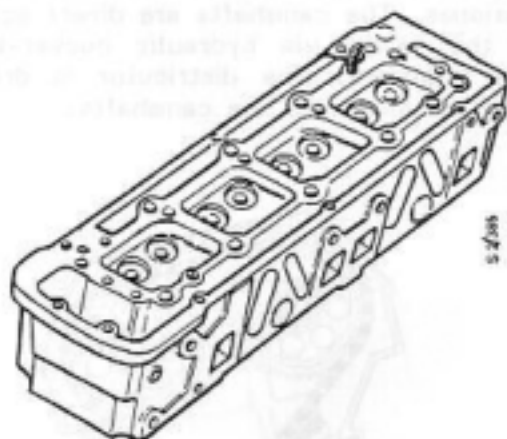
The cylinder head is a precision, light-alloy casting. It is secured to the block by means of Torx-type bolts. The valves are made of steel with chromium-plated stems.

The inlet valves have induction-hardened heads. The exhaust valve heads are stellited.

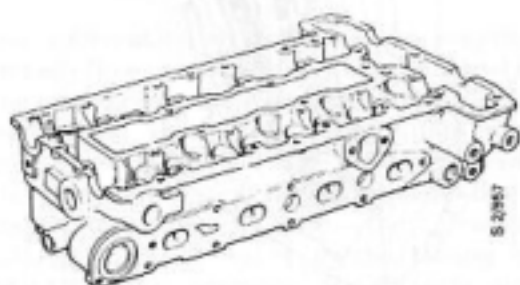
Connecting rods

The connecting rods are forged and fitted with small-end bushes in which the gudgeon pins run. The small-end bushes and big-end bearing shells can be replaced.

The gudgeon pins have a floating fit in the pistons and connecting rods. The pins are located by a circlip at each end of the gudgeon pin hole.

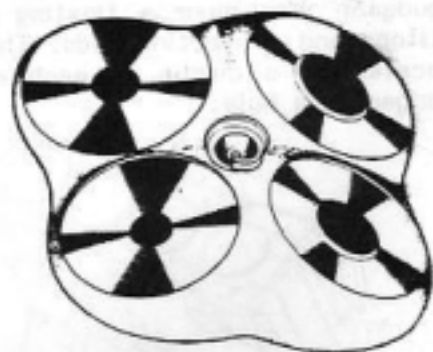


Cylinder head, 8-valve variant

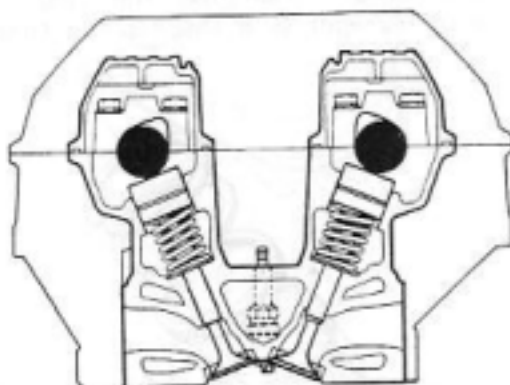


Cylinder head, 16-valve variant

The combustion chambers are hemispherical and each cylinder has four valves with the spark plug located centrally.

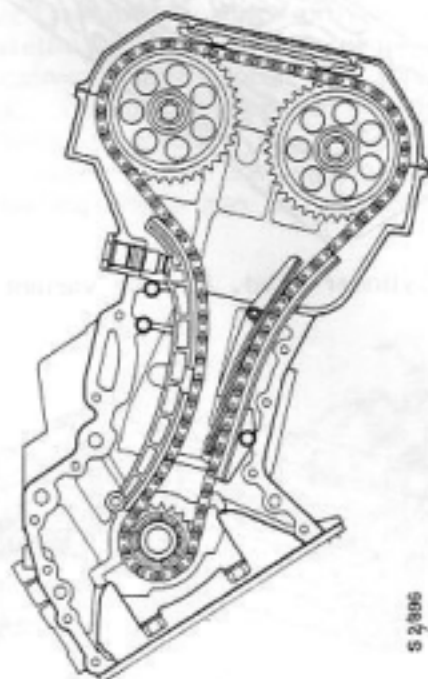


The hydraulic cam followers adjust automatically to differences in valve clearance caused by variations in temperature. The main advantage of the hydraulic cam followers is that they operate silently and are extremely reliable.

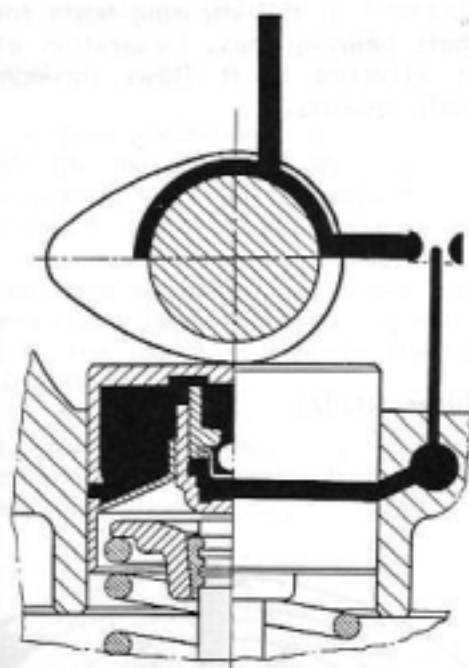


Camshafts and cam followers

The engine has twin overhead camshafts, each of which is mounted in five bearings. The cams have a wide base circle, which provides a large amount of lift but with little stress. The camshafts are driven by a chain with an effective automatic chain tensioner. The camshafts are direct acting on the valves via hydraulic bucket-type cam followers. The distributor is driven direct from one of the camshafts.



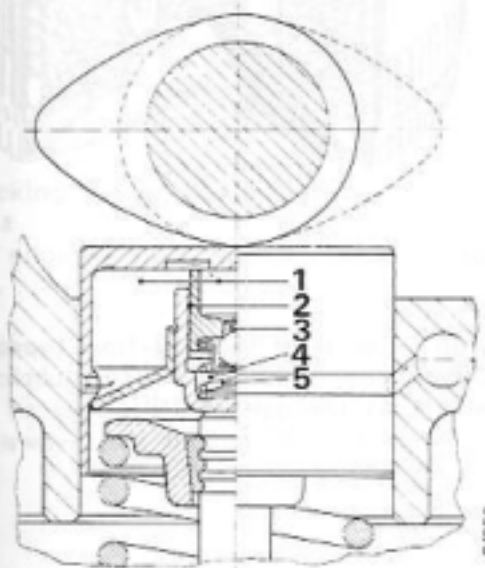
52306



S 2/439

Oil flow through the cam follower

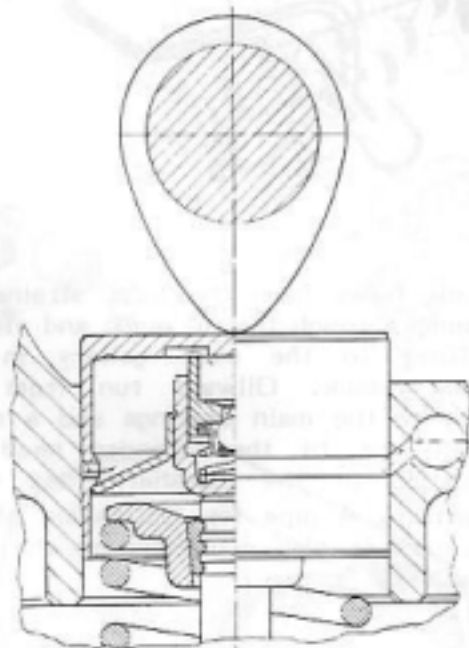
Each cam follower has two storage chambers and one high-pressure chamber. A spring-loaded ball valve seals the orifice between the high-pressure chamber and the adjacent storage chamber. A return spring in the high-pressure chamber acts on the



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- | | |
|--------------------|--------------------------|
| 1. Storage chamber | 4. High-pressure chamber |
| 2. Leakage orifice | 5. Spring |
| 3. Check valve | |

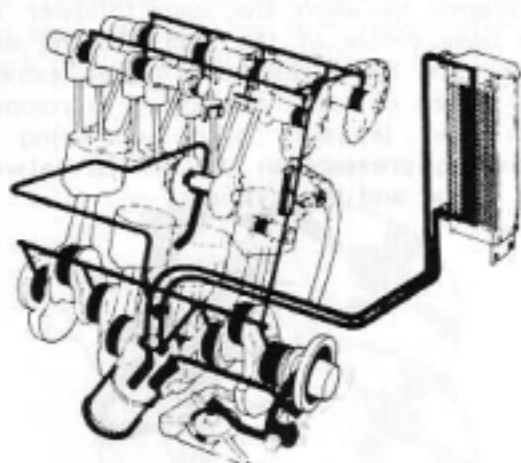
sliding piston, to maintain a constant clearance between the cam follower and the base circle of the cam. At the same time, the high-pressure chamber expands and makes up the oil volume, to compensate for leakage losses occurring at actuating pressure in the orifice between the piston and the cylinder.



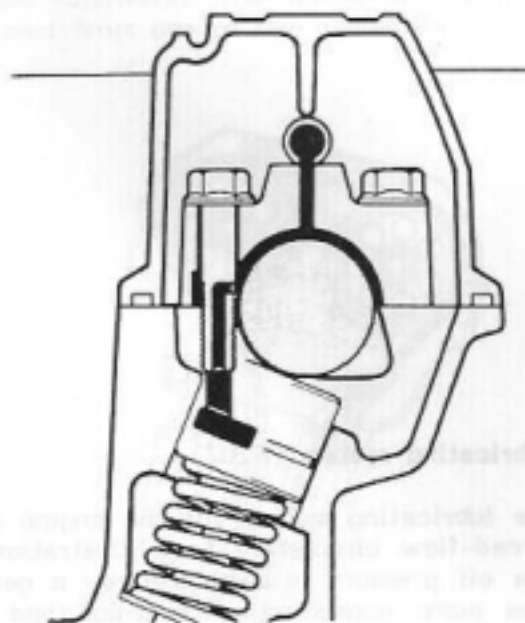
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Lubricating system (B202)

The lubricating system for the engine has forced-flow circulation (see illustration). The oil pressure is generated by a gear-type pump consisting of a pinion and an eccentric ring gear. The pump is driven by the crankshaft and is interposed between the timing cover and the crankshaft pulley. A relief valve in the timing cover limits the oil pressure and diverts surplus oil to the inlet side of the pump.



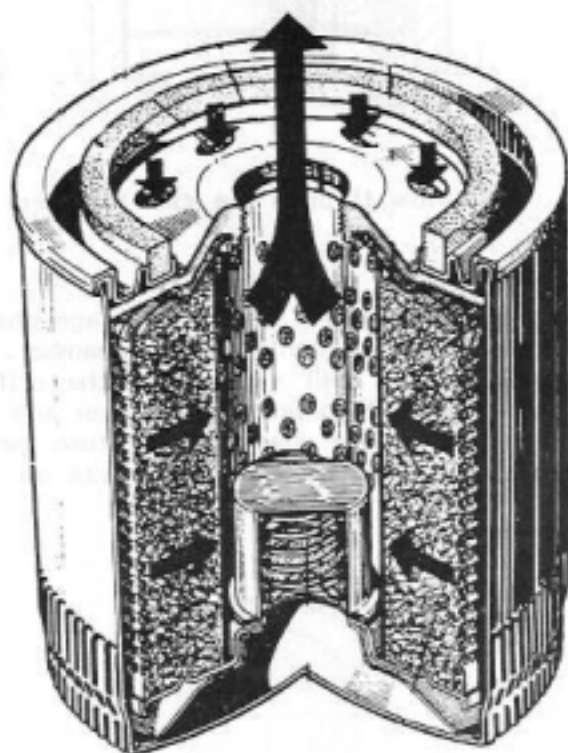
The oil flows from the inlet strainer in the sump through the oil pump and via the oil filter to the main gallery in the cylinder block. Oilways run from the gallery to the main bearings and a rising oilway runs to the cylinder head for lubrication of the camshafts and valve mechanism. A pipe for lubrication of the turbo unit is also connected to the main oil gallery.



The hydraulic cam followers operate in an oil bath, with oil supplied via oilways

incorporated in the securing bolts for the camshaft bearing caps. Deaeration of the oil is effected as it flows through the camshaft bearing.

Oil filter (B202)



S 1154

The oil filter is of the full-flow type: i.e. all of the oil circulated to the lubrication points flows through the filter.

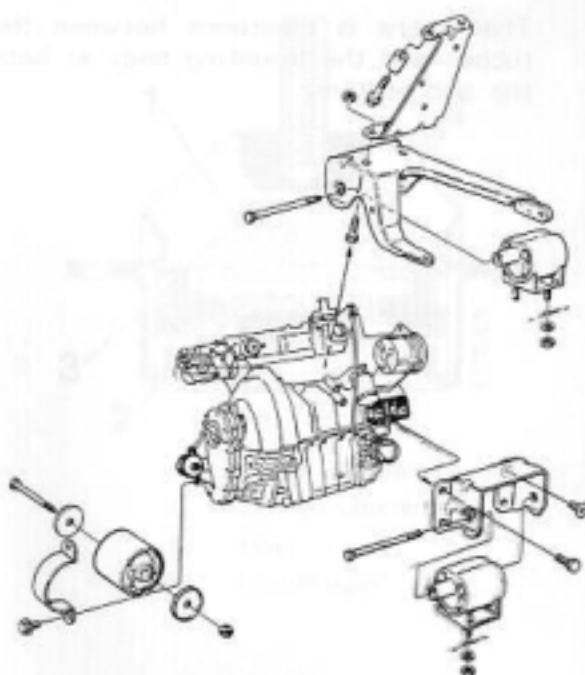
Engine mountings (B201)

General

The engine mountings are designed to absorb the movement of the engine while it is running and also to protect the body from engine vibration and noise.

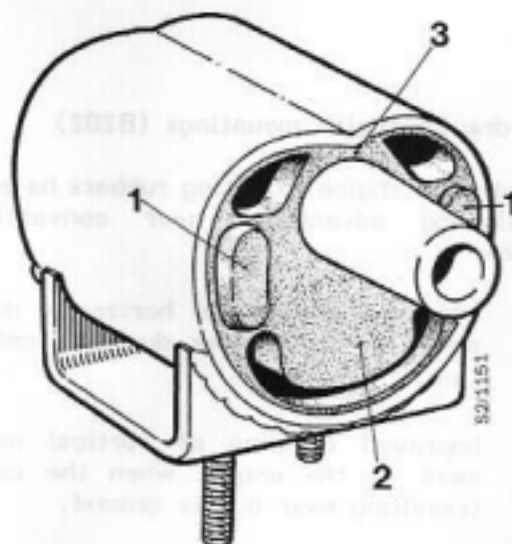
The damping action of the engine mounting rubbers is progressive - the greater the load on the mounting rubbers the greater the resistance.

Thus, the engine mountings protect the surrounding components from excessive movement of the engine.



Engine mounting rubbers

The engine mounting rubbers have two primary modes of operation: under normal driving conditions, only the No. 1 sections of the mountings are operative, providing low damping resistance. However, when the car is accelerating or braking hard, sections 2 and 3 also come into play, providing a considerably greater damping effect.

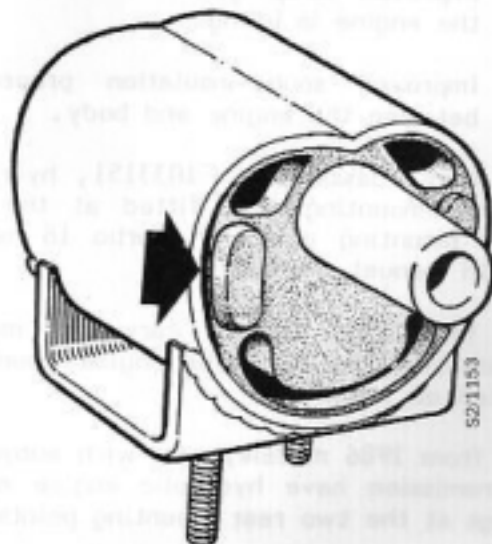


Checking the engine mountings

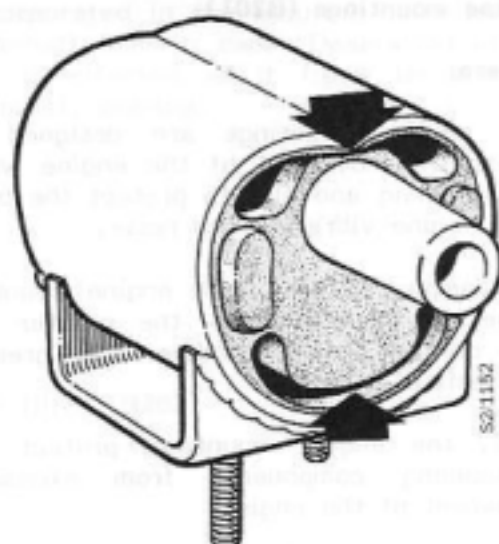
The engine mountings can be inspected in situ.

Check:

To see if the rubber bonding has come away from the mounting body.



That there is clearance between the rubber and the mounting body at both top and bottom.



Hydraulic engine mountings (B202)

Hydraulic engine mounting rubbers have the following advantages over conventional ones:

- Improved damping of horizontal movement of the engine during acceleration.

- Improved damping of vertical movement of the engine when the car is travelling over bumpy ground.

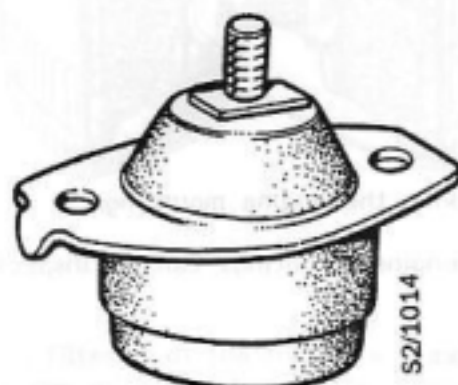
- Improved damping of vibrations when the engine is idling.

- Improved sound-insulation properties between the engine and body.

As from chassis No. F1033151, hydraulic engine mountings are fitted at the two rear mounting points in Turbo 16 models (with manual gearbox).

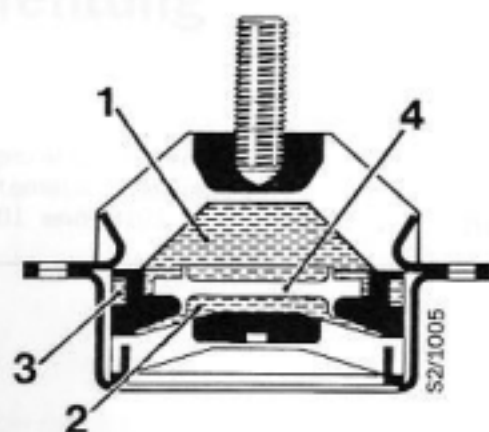
As from 1986 models, cars with manual gearboxes have hydraulic engine mountings fitted all round.

As from 1986 models, cars with automatic transmission have hydraulic engine mountings at the two rear mounting points.



The hydraulic engine mounting has two chambers containing a special damping fluid. Linking the two chambers is a port, and the length and cross-section area of this port govern the damping properties of the mounting. The chambers are also separated by a diaphragm which takes up the forces generated by the small movements of the engine occurring under normal conditions.

The capacity of the diaphragm is not sufficient to damp large engine movements; under these conditions, fluid is forced from the upper to the lower chamber, equalizing the pressures. The damping action of the hydraulic mounting is therefore progressive, with the resistance to movement increasing with load.



1. Upper chamber
2. Lower chamber
3. Port
4. Diaphragm

Removal and refitting

Removal and refitting, B201 . .	201-1
Removal and refitting, B202 . .	201-10
Separation of engine and manual gearbox, B201 and B202 .	201-22

Separation of engine and automatic transmission, B201 and B202	201-24
--------------------------------------------------------------------------------	--------

Removal and refitting B201

Removal of power train

For major work on the engine and transmission, the entire power train should be lifted out of the car. Removal of the engine by itself is not recommended.

1. Disconnect the positive battery lead.
2. Drain the coolant through the radiator drain cock and drain plug in the engine block.
3. Remove the hood:
 - Disconnect the windshield washer hose
 - Undo the hood hinge links
 - With the aid of assistant, lift off the hood.



4. Undo and remove the following connections (see illustration)

- a. Starter motor connections.
- b. Upper radiator hose.
- c. The earthing braid.
- d. Temperature transmitter.
- e. Ignition coil.
- f. Oxygen (Lambda) sensor connectors (certain markets only)
- g. Clutch hydraulic lines.
- h. Lower radiator hose.
- i. Air cleaner and connections.
- j. Fuel lines.
- k. Choke cable.
- l. Throttle cable.
- m. Expansion tank hose.
- n. Oil pressure transmitter.
- o. Rear cable harness, engine.
- p. Heating system hoses.
- q. Vacuum hoses.

Injection engines.

- r. Electric connections, injection system
- s. Fuel lines, injection system.

NOTE

Clean the area around the connections before disconnecting. Plug and seal all openings.

-
- t. Fuel distributor and air cleaner with connections.

APC-System

- u. Electric connection to solenoid valve.
- v. Solenoid valve.
- x. Connector, knock detector.

Cars with power-assisted steering

- z. Disconnect the two hydraulic lines from the servo pump and plug the openings.

Cars with air-conditioning (AC)

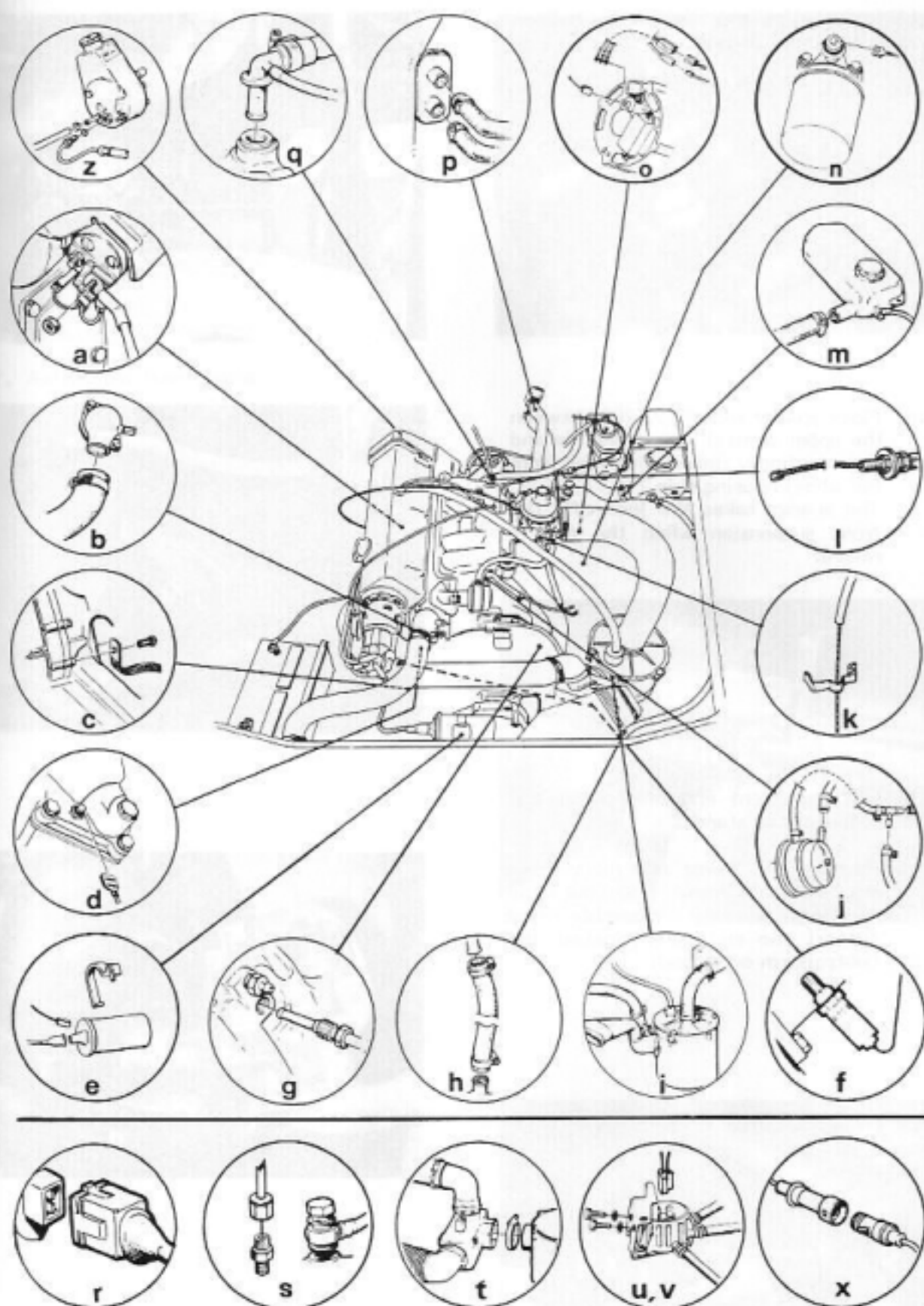
Remove the compressor, rest it on the RH wheel-arch and disconnect the electrical leads.

Remove the auxiliary fan.

hold

lines
the

the
the



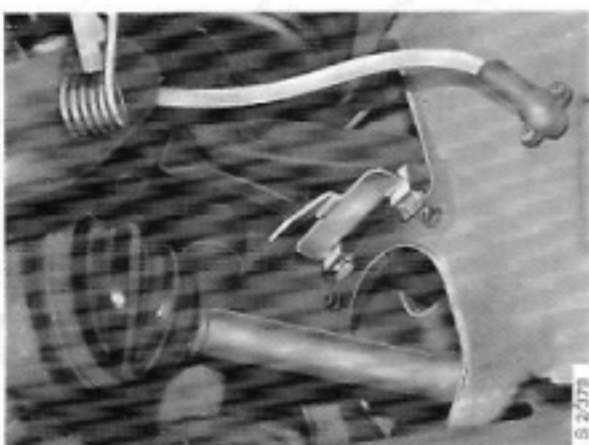
S2/1098

5. Undo the clips and remove the bellows from the inner drivers.



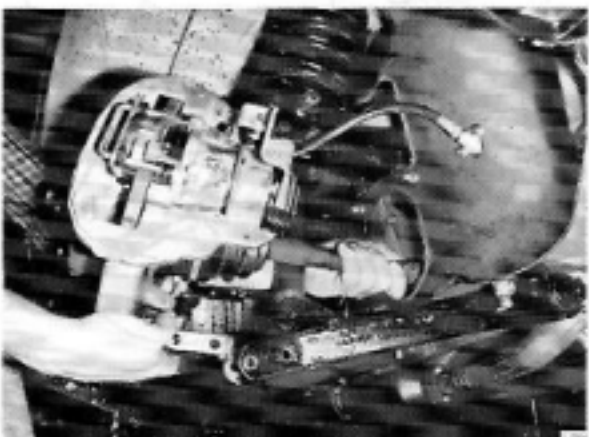
- 6.a. Place spacer tool 83 93 209 between the upper control arm underside and the car body. (Insert the tool from the wheel housing side.)

The spacer takes the load off the front suspension when the car is raised.



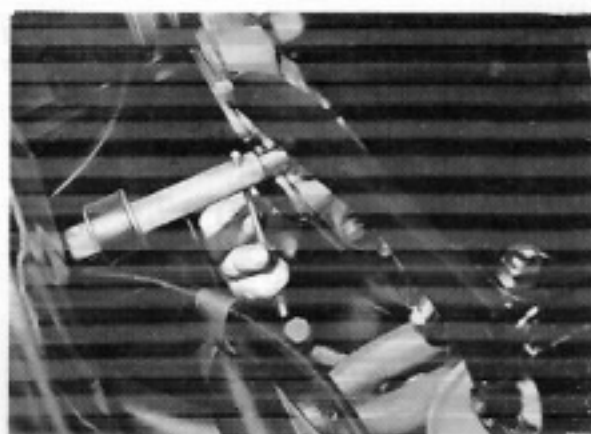
- b. Lift the front end of the car and support it on stands.

- c. Remove the lower end piece from the control arm. Pull out the steering knuckle assembly and support the end piece against the control arm outer end.



7. Manual transmission:

Put the gear lever in neutral. Remove the nut and tap out the taper pin in the gear shift rod joint. Separate the joint from the gear shift rod.



7. Automatic transmission:

- a. Remove the retaining screw for the gear selector cable at the transmission.
- b. Withdraw the cable with the gear selector rod in its extreme forward position (P).
- c. Slide back the spring-loaded sleeve on the gear shift rod and unhook the end of the cable.

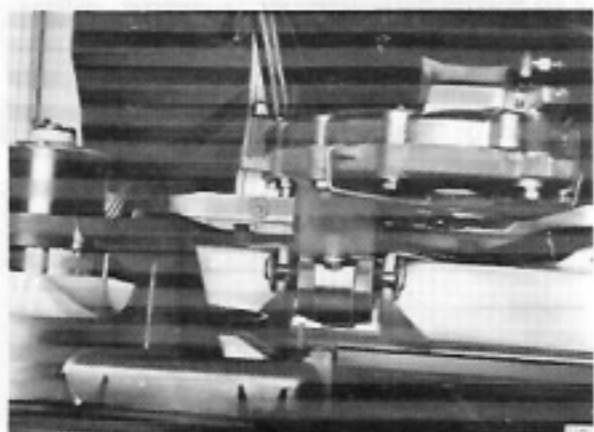


8. Unbolt the exhaust pipe from the exhaust manifold.
9. Disconnect the speedometer cable from the transmission.
10. a. Remove the rear engine mounting bolts.



- b. Slacken the front engine mounting nut so that the mounting can be lifted out of the bracket.

There is no need to remove the nut.



11. Attach lifting gear to the two lugs on the engine and slightly raise the unit. Move the power unit to one side and free the two universal joints.

Lift the power unit out of the car.



Fitting the power unit

1. a. Check that the inner universal joints are packed with grease.
b. Fit new gaskets to the exhaust pipe flanges.
c. Hook the clips onto the inner drivers.
2. Lower the engine into the engine compartment and adjust the lifting sling to tilt the engine forward, so that the front mounting locates in its bracket before the rear mountings, and then continue to lower the rear of the engine until it is approximately 50-60 mm (2-2.5 in) above the rear mounting points.



3. a. Engage the LH drive shaft joint by simultaneously moving the engine to the left.



Fitting LH drive shaft joint

3. b. Lower the engine carefully onto its mountings and, at the same time, guide the RH drive shaft joint into the driver cup, and align the exhaust pipe flanges.

Check that the gaskets are properly seated.

3. c. Fit the RH end piece to the control arm, and fit the two bolts and locknuts.



Inserting the LH drive-shaft joint

4. Fit the rear engine mounting bolts and tighten all engine mountings.
5. Fit the exhaust pipe flanges.
6. Connect the speedometer cable.



7. Manual transmission:

Connect the gear shift rod joint and fit the taper pin.

8. Automatic transmission:

Connect the cable to the gear selector rod and secure the cable sheath to the transmission.

Check the gear positions and adjust if necessary.

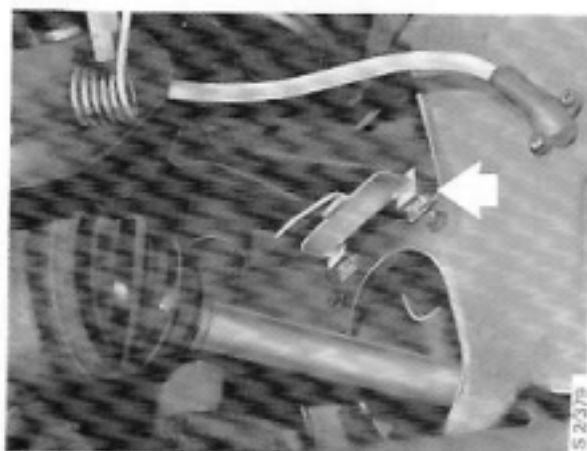


9. Fit the bellows and clips at the inner universal joints.



10. Remove the spacer tool 83 93 209

11. Re-fit the hoses as shown in the illustration on page 201-2.



NOTE

When installing the air cleaner assembly and the mixture control unit ensure that there is at least 10 mm (0.3937 in) clearance round the throttle controls.

12. Replace the hood and connect the windshield wiper hose.
13. Fill up with coolant and bleed the cooling system by means of the bleeder nipple on the thermostat housing.
14. Reconnect the positive battery lead.
15. Test drive the car. Check the coolant level after driving.

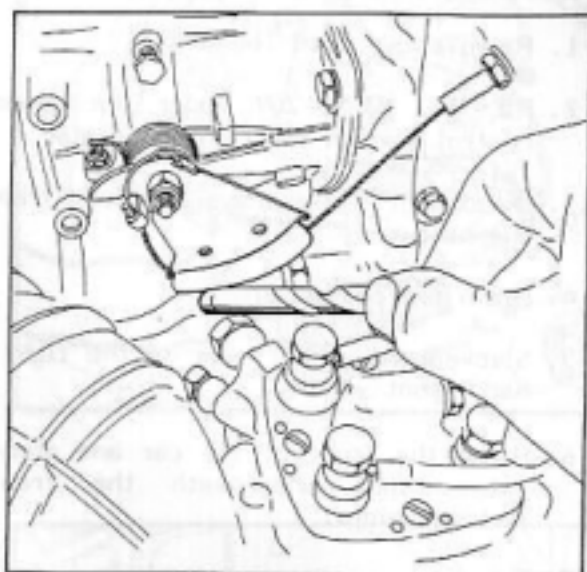
Deviations, cars with power steering

- Connect the two hydraulic lines to the servo pump.

Tightening torque:
Servo pump coupling
20-34 Nm (14.8-25.2 ft lbs)

NOTE

Do not over-tighten the couplings as this can damage the seals.

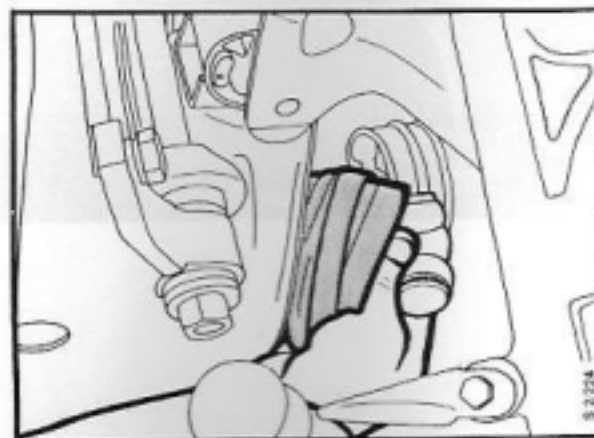
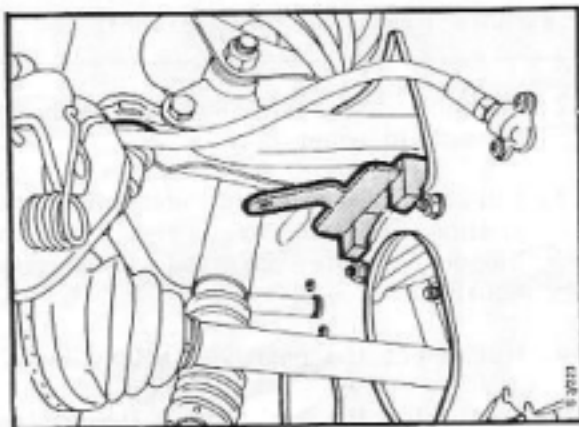


min 10 mm

Removal and refitting B202

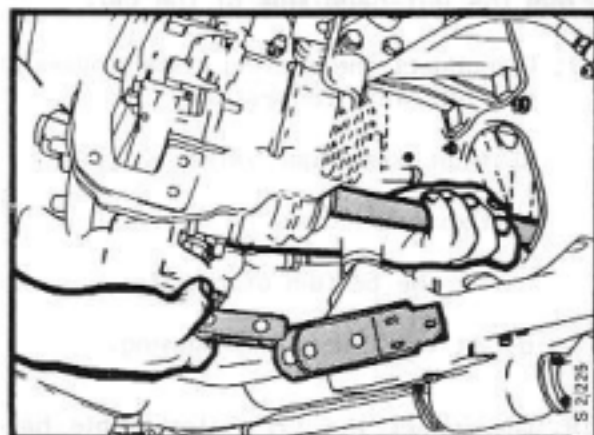
Removal of power train

1. Remove the hood (bonnet).
2. Fit tool 83 93 209 under the upper control arm on the right-hand side.
3. Disconnect the positive (+) lead from the battery.
4. Drain the coolant.
5. Slacken the wheel nuts on the right-hand front wheel.
6. Raise the front of the car and place axle stands underneath the front jacking points.
7. Engage reverse gear.
8. Carry out the following from underneath the car:
 - a. Remove the taper pin from the gear shift rod joint.
 - b. Disconnect the speedometer cable.
 - c. Remove the bolt securing the exhaust pipe to the clamp bracket on the transmission.
 - d. Slacken the clips round the rubber boots on the inner universal joints and slide the rubber boots clear (this operation can also be done from above).

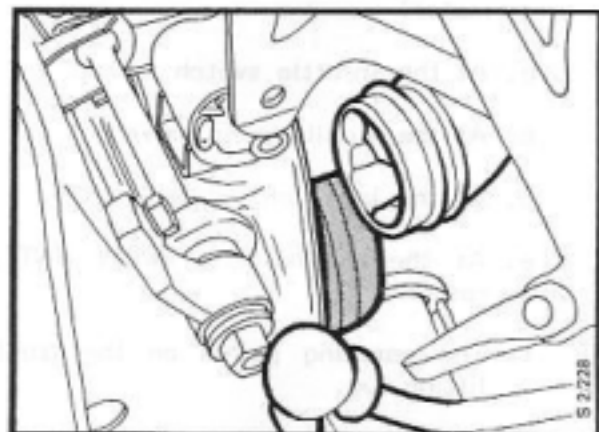


On the right-hand side of the car:

9. Remove the front wheel.
10. Separate the end piece from the lower control arm.

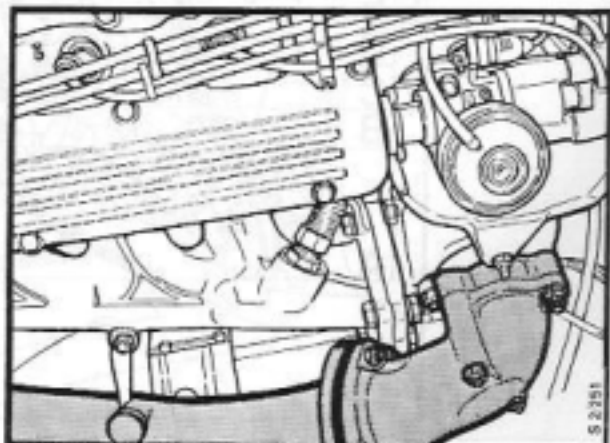


11. Separate the universal joint and position the fork (knuckle) in front of the driver. Support the end piece against the outer end of the control arm.



12. Disconnect the positive (+) lead from the battery and free it from the clips holding it to the body. Disconnect the earth braid from the transmission.
13. Disconnect the starter motor leads.
14. Unbolt the exhaust pipe from the exhaust manifold.

15. Disconnect the pressure pipe from the steering servo pump and have a plug handy to prevent oil escaping from the pipe. Take care not to drip oil onto the engine mounting and control arm rubbers.



16. Remove the AC compressor drive belt.

From the left-hand side of the car:

17. Disconnect the cooling system hoses at the following connections:

- a. Heat exchanger valve
- b. Expansion tank
- c. At the bottom of radiator
- d. At the thermostat housing.

18. Disconnect the LH system cable harness as follows:

- a. At the LH sensor (air mass meter)
- b. At the throttle switch
- c. At the auxiliary air valve
- d. At the injection valves
- e. At the thermostatic switch (NTC resistor)
- f. The earthing points on the front lifting lug.

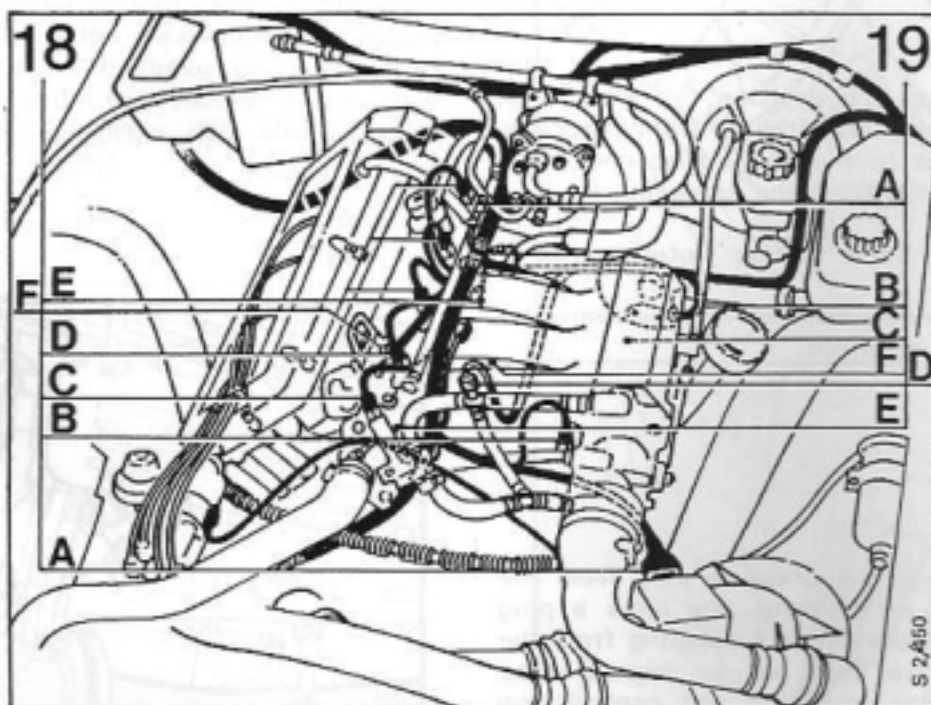
NOTE

Use a small screwdriver to release the tension in the springs on the terminal blocks.

19. Disconnect the other cable harness connections as follows:

- a. At the AC compressor. Terminal block and plug connector (earth lead).
- b. At the alternator, and the green/white cable to the positive (+) terminal on the regulator. Earth (black) cable.
- c. Blue cable from oil pressure switch.
- d. The black, yellow and red leads to the idling-increase valve.
- e. Yellow/white cable from temperature transmitter.
- f. Grey cable from knockdetector.

Release the cable harness from the clip on the fuel injection manifold, from the rear of the engine and from the coolant hose between the engine and the expansion tank.

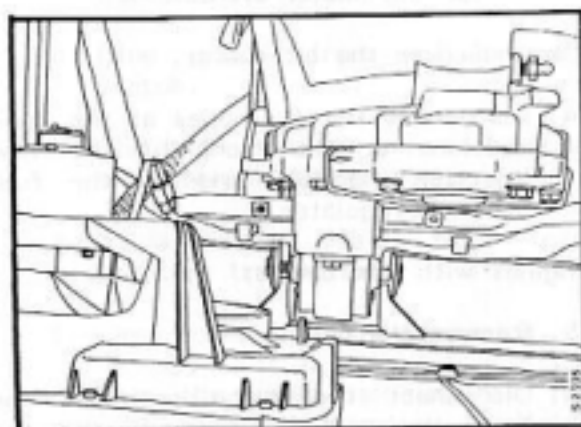
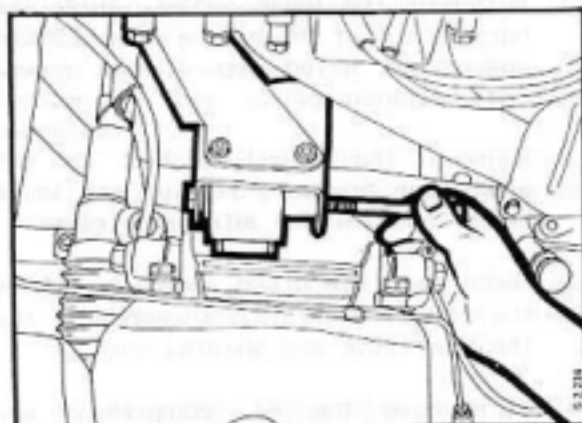


20. Withdraw the loose cables, guide the harness out of the engine compartment and place it on top of the power distribution unit.
21. Remove the adjusting bolt in the alternator bracket, remove the drive belts, and lift the alternator clear.
22. Disconnect the brake servo hose from the inlet manifold. Disconnect the throttle cable and sheath.
23. a. Remove the AC compressor and bracket from the block. Place them on the filter housing for the heater system.
b. Secure the alternator.
24. Disconnect the fuel lines at the connections at the front of the fuel injection manifold and on the fuel pressure regulator.

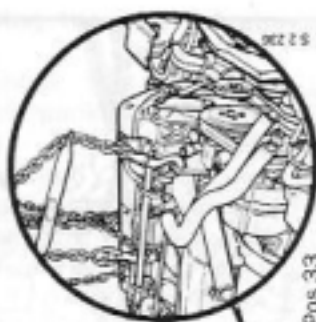
Engines with intercooler:

25. Remove the coil.
26. Disconnect the turbo pressure line from the turbo compressor and the intercooler/throttle housing.
27. Remove the auxiliary fan.
28. Remove the air mass meter together with the suction pipe for the turbo unit. Disconnect the hoses at the solenoid valve, and the crankcase ventilation at the suction pipe.
29. Disconnect the cables from the Hall transmitter and coil in the distributor. Free the Hall transmitter cable from the clips on the clutch cover.
30. Disconnect the solenoid valve hoses from the connections on the turbo unit and charging pressure regulator.
31. Disconnect the hydraulic hose from the slave cylinder. Plug the hose to stop fluid escaping.

32. Remove the engine mounting bolts.



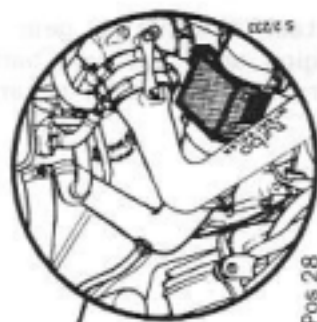
33. The AC bracket (on engines with air conditioning) incorporates a recess for attachment of a lifting hook. Rather than use this recess, attach lifting lug 93 13 222 to the water pump cover, using the existing bolts.



Pos 33



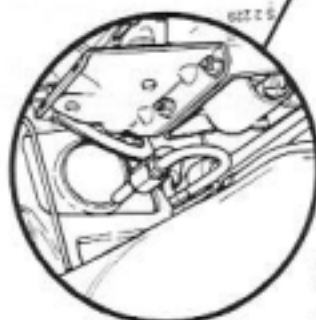
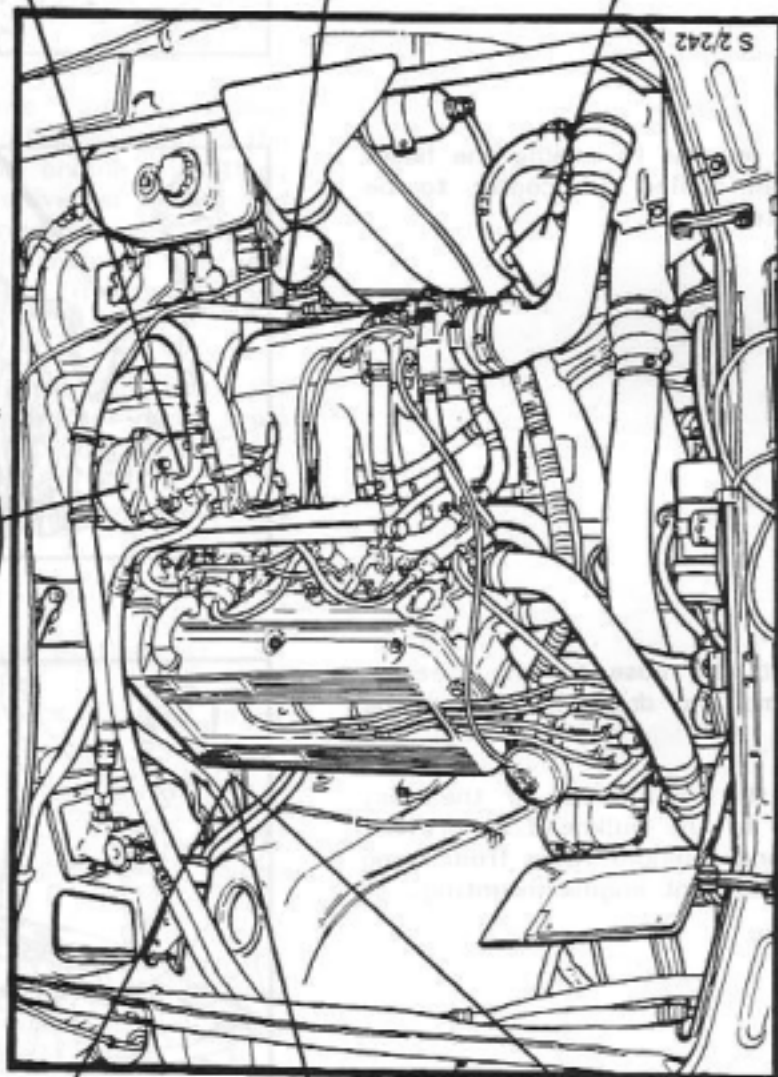
Pos 35



Pos 28



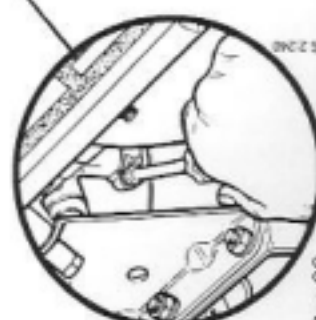
Pos 23



Pos 15



Pos 15



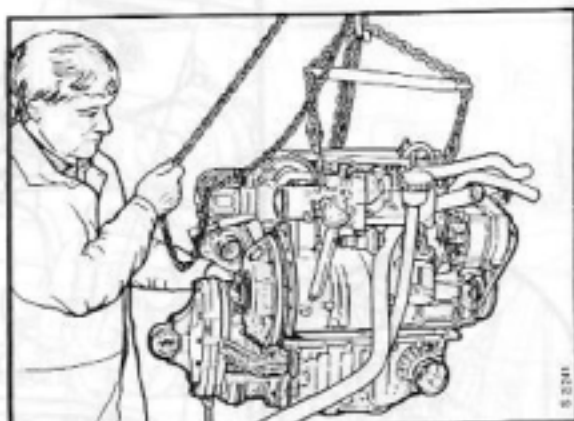
Pos 36

Items that must be removed or disconnected before the engine can be removed. The item number under each picture refers to the corresponding item in the text.

34. Attach the lifting gear and raise the engine until the left-hand, inner universal joint can be separated.

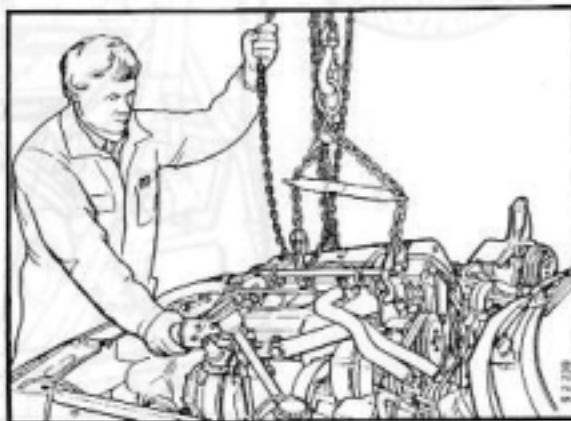


35. Raise the engine to enable the hoses on the air-cooled oil cooler to be disconnected.



36. Disconnect the hose to the steering servo pump and drain the oil in the system.

When lifting the engine out of the car, keep it close to the bulkhead to prevent the radiator and solenoid valve from being damaged by the front engine mounting.



Refitting the power train

1. Check that the inner universal joints are packed with grease.
2. Suspend the engine from the lifting gear. Adjust the lifting gear so that the front engine mounting is slightly lower than the rear mountings.
3. Lower the engine into the engine compartment until the hoses to the air-cooled oil cleaner and servo pump can be connected.
4. Guide the engine into position, attending to the following items in the order given: front engine mounting, left-hand inner universal joint and right-hand inner universal joint. Lower the engine until it rests on the rear engine mountings and fit the mounting bolts.
5. Unhook the lifting gear and unbolt the lifting lug from the water pump (cars equipped with an AC compressor).
6. Fit the AC compressor and its mounting.

From the right-hand side of the car:

7. a. Fit the end piece to the lower control arm.
b. Fit the wheel.
c. Fit the exhaust pipe loosely to the exhaust manifold.
d. Rest the battery lead on the starter motor and clip the lead to the body. Connect the earth braid to the transmission casing.
8. Connect the pressure pipe to the steering servo pump.
9. Fit the drive belt for the AC compressor and tighten it.

10. From underneath the car, refit
/reconnect the following

- a. The rubber boots and clips on the left-hand and right-hand universal joints.
 - b. The bolt in the exhaust pipe clamp bracket.
 - c. The speedometer cable.
 - d. The taper pin in the gear shift rod joint.
11. Lift the front of the car, remove the axle stands and lower the car to the ground.
12. a. Tighten the nuts on the right front wheel to the correct torque and remove tool 83 93 209 from under the right-hand upper control arm.
- b. Tighten the bolts securing the exhaust pipe to the exhaust manifold.
13. From the left-hand side of the car:
Fit the alternator belts and the alternator adjusting bolt. Adjust the tension of the alternator belts and tighten the locknut.
14. Reconnect the coolant hoses at the following connections:
- a. Heat exchanger valve
 - b. Expansion tank
 - c. Bottom connector on radiator
 - d. Thermostat housing

Engines with intercooler:

15. Fit the auxiliary fan.
16. Refit the air mass meter together with the suction pipe for the turbo unit. Reconnect the hoses to the solenoid valve and the crankcase ventilation.
17. Connect the turbo pressure line to the turbo compressor, intercooler and throttle housing.

18. Refit the coil.

19. Reconnect the cable harness for the LH system (see illustration). Run the wiring loom along the top of the engine, securing it by means of two clips to the fuel injection manifold, with the marker tape under the front clip. Connect the respective connector blocks (each block is marked for identification). Continue the run of the loom towards the front of the engine, passing it under the upper hose to the auxiliary air valve and connecting the 3-pole connector to the throttle switch and the 6-pole connector to the air mass meter.

Run the wiring loom with the marker tape along the back of the engine and secure it to the two brackets by means of the two clips, in such a way that the marker tape comes just under the lower clip.

Run the leads to the alternator and the power distribution unit along the rear edge of the fuel injection manifold, underneath the coolant hose between the engine and the expansion tank, and secure by means of three clips.

The APC lead follows the loom from the engine via the coolant hose.

20. Connect the following components:

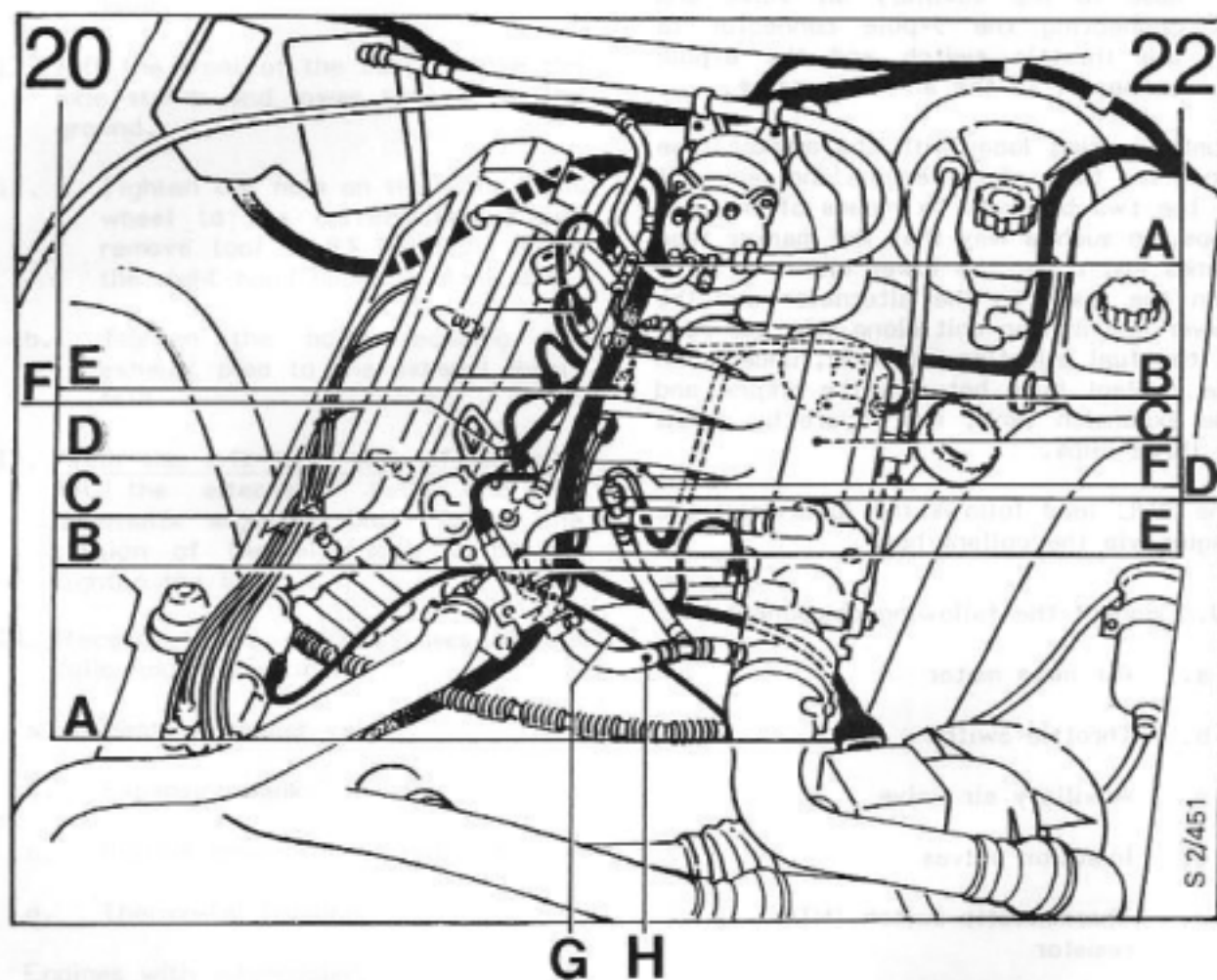
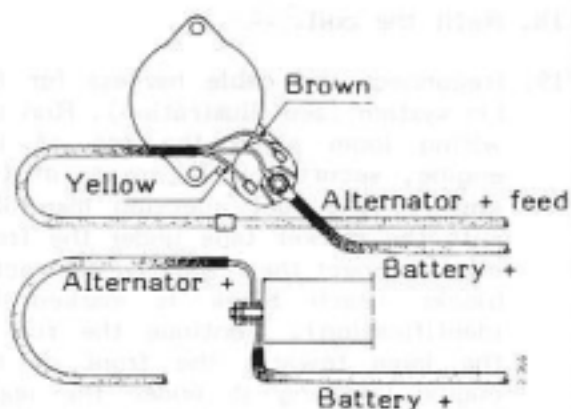
- a. Air mass meter
- b. Throttle switch
- c. Auxiliary air valve
- d. Injection valves
- e. Thermostatic switch (NTC resistor)
- f. Earthing points at the front lifting lug.

21. Reconnect the distributor leads. Run wiring loom G from the Hall transmitter along the edge of the clutch cover, behind the auxiliary air valve and over the thermostat housing to the connection on the distributor. Secure the cables in clips in two places on the clutch cover, underneath the rubber hose at H and at the thermostat housing.

22. Connect the cables to the distributor in the order shown in the diagram. The positive cable from the battery should be connected via a fuse to the ignition switch.



22. Connect the cables to the solenoid on the starter motor as shown in the diagram. The positive (+) lead from the battery should be connected closest to the solenoid, as shown in the diagram.



- Connect the AC compressor.
- Reconnect the leads to the alternator and the following components:
 - Oil pressure switch (blue cable).
 - Idling-increase valve (black, yellow and red leads).
 - Temperature transmitter (yellow/white).

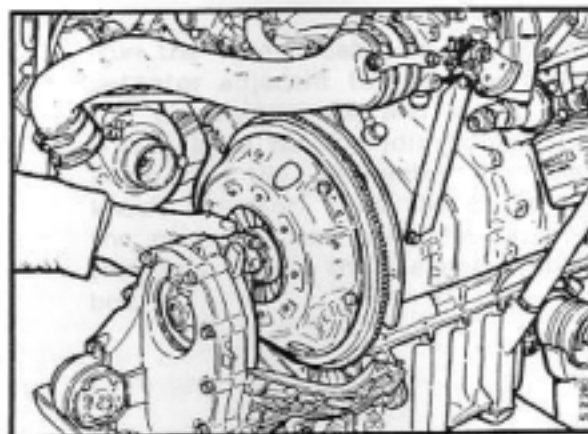
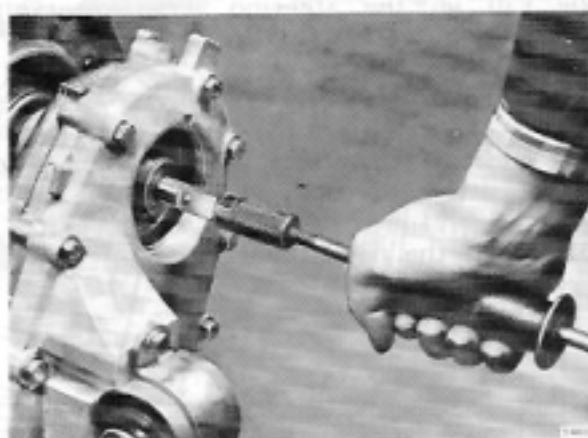
- Run the (grey) cable to the knock detector adjacent to the hose from the expansion tank and along the wiring loom for the idling-increase valve to the connector on the knock detector. Clip the cable to the coolant hoses from the expansion tank and to the preheatter valve body.

23. Reconnect the throttle cable.
24. Reconnect the brake servo hose.
25. Connect the fuel lines. Clip together the fuel hoses and oil cooler hoses behind the stay on the inlet manifold.
26. Connect the hydraulic hose to the clutch slave cylinder and bleed the system.
27. Connect the solenoid valve hoses to the turbo unit and the charging pressure regulator.
28. Fill up the steering servo reservoir with hydraulic fluid.
29. Refill the cooling system.
30. Refit the battery and connect the positive (+) lead.
31. Refit the hood (bonnet).

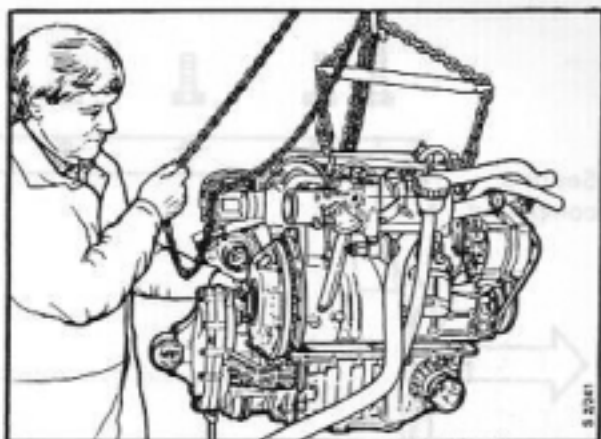


Separating the engine from the transmission (manual transmission) B201 and B202

1. Clean the external surfaces of the engine and transmission.
2. Drain the engine oil. Remove the EGR pipe.
3. Remove the clutch cover, the oil dipstick pipe and the oil return pipe from the turbo compressor.
4. Remove the stay plate from the transmission.
5. Withdraw the clutch shaft using sliding hammer 83 90 270 and joint 87 90 529.
6. Remove the three socket screws from the slave cylinder.



7. Undo all bolts in the mating flanges between the engine and transmission. Release the clip for the oil filler pipe at the throttle control on the inlet manifold.
8. Lift the engine carefully off the transmission (see illustration), removing the release bearing guide sleeve at the same time.

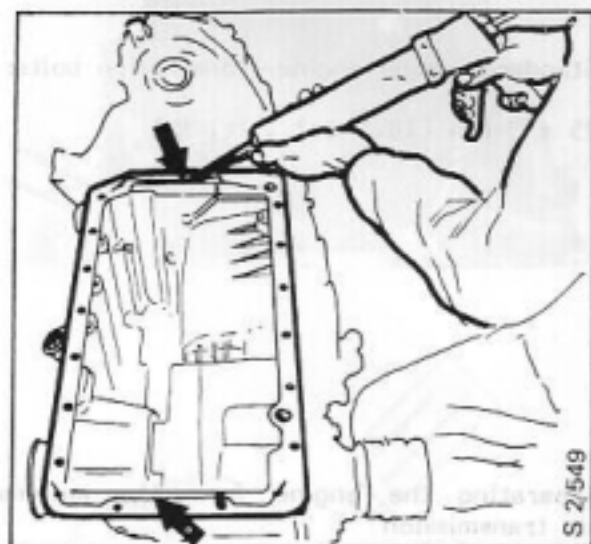


Caution

If the engine and transmission fail to separate, make no attempt to prise them apart without first checking that all the bolts have been removed.

Before fitting together the engine and transmission:

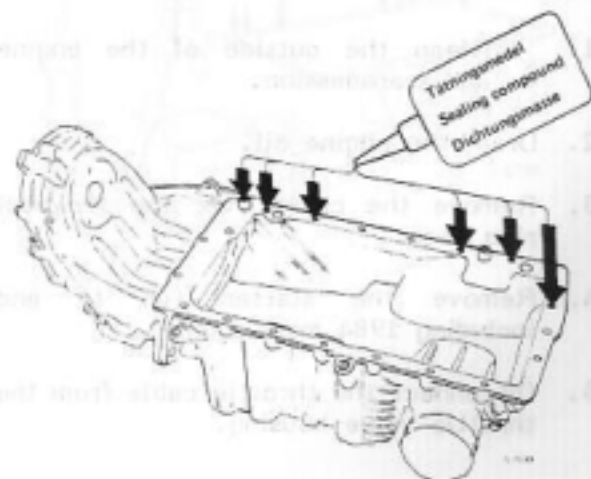
- Ensure that the mating flanges between the engine and transmission are scrupulously clean.
- Check that the two guide sleeves are fitted in the transmission.
- Fit a new gasket on the transmission flange. Apply sealing compound to the cuttings in the gasket ends indicated in the illustration.
- Apply thread sealing compound to the six bolts to be fitted in the holes indicated in the illustration.

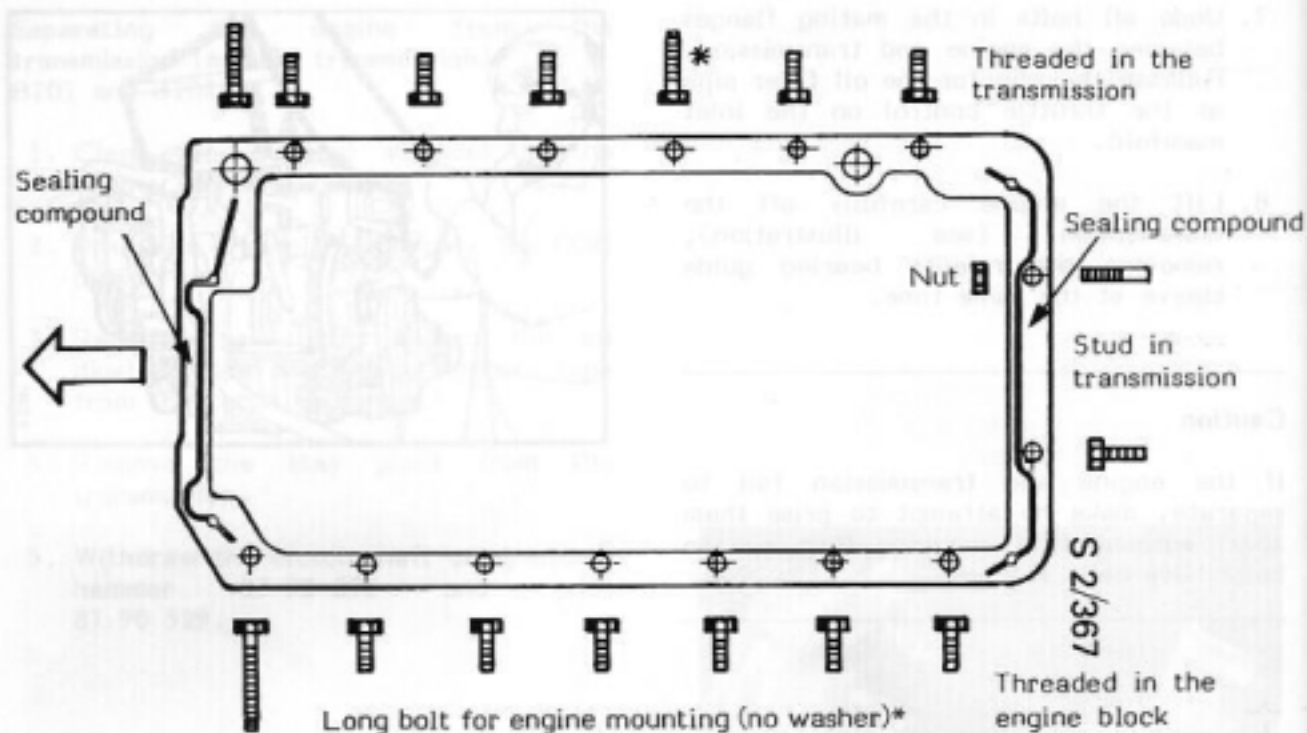


Refit in the reverse order.

NOTE

The guide sleeve and release bearing must be held in position against the clutch as the engine is lowered onto the transmission flange.





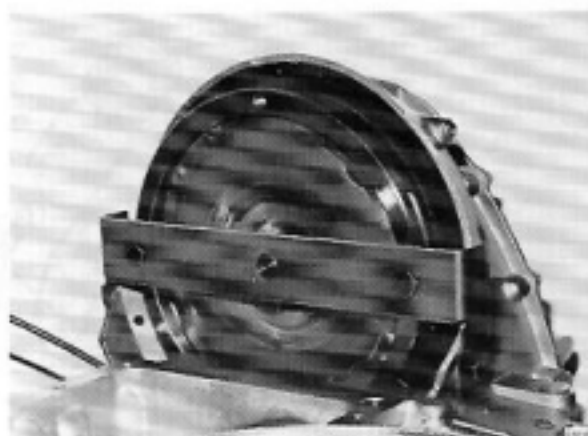
Standard torque engine-transmission bolts:

$25 \pm 3 \text{ Nm}$ ($18.5 \pm 2.2 \text{ ft. lb}$)

Separating the engine from the automatic transmission B201 and B202

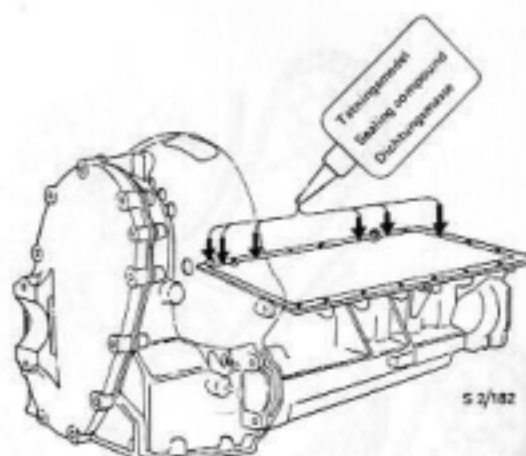
1. Clean the outside of the engine and transmission.
2. Drain the engine oil.
3. Remove the cover over the flywheel ring gear.
4. Remove the starter (up to and including 1984 models only).
5. Disconnect the throttle cable from the throttle valve housing.

6. Remove all bolts in the mating flanges of engine and transmission.
7. Remove the bolts securing the flywheel ring gear to the torque converter.
8. Turn the driver disc, so that the plate angles will be horizontal. Lift the engine carefully off the transmission.
9. Fit the torque converter support (special tool 87 90 255).



Before fitting together the engine and automatic transmission:

- Ensure that the mating flanges between the engine and transmission are scrupulously clean.
- Check that the two guide sleeves are fitted in the transmission.
- Fit a new gasket on the transmission flange. Apply sealing compound to both sides of the gasket as indicated by the arrows in the illustration.
- Apply thread sealing compound to the six bolts to be fitted in the holes indicated in the lower illustration.
- Be careful not to damage the centre stub of the torque converter when lifting the engine into position over the transmission.

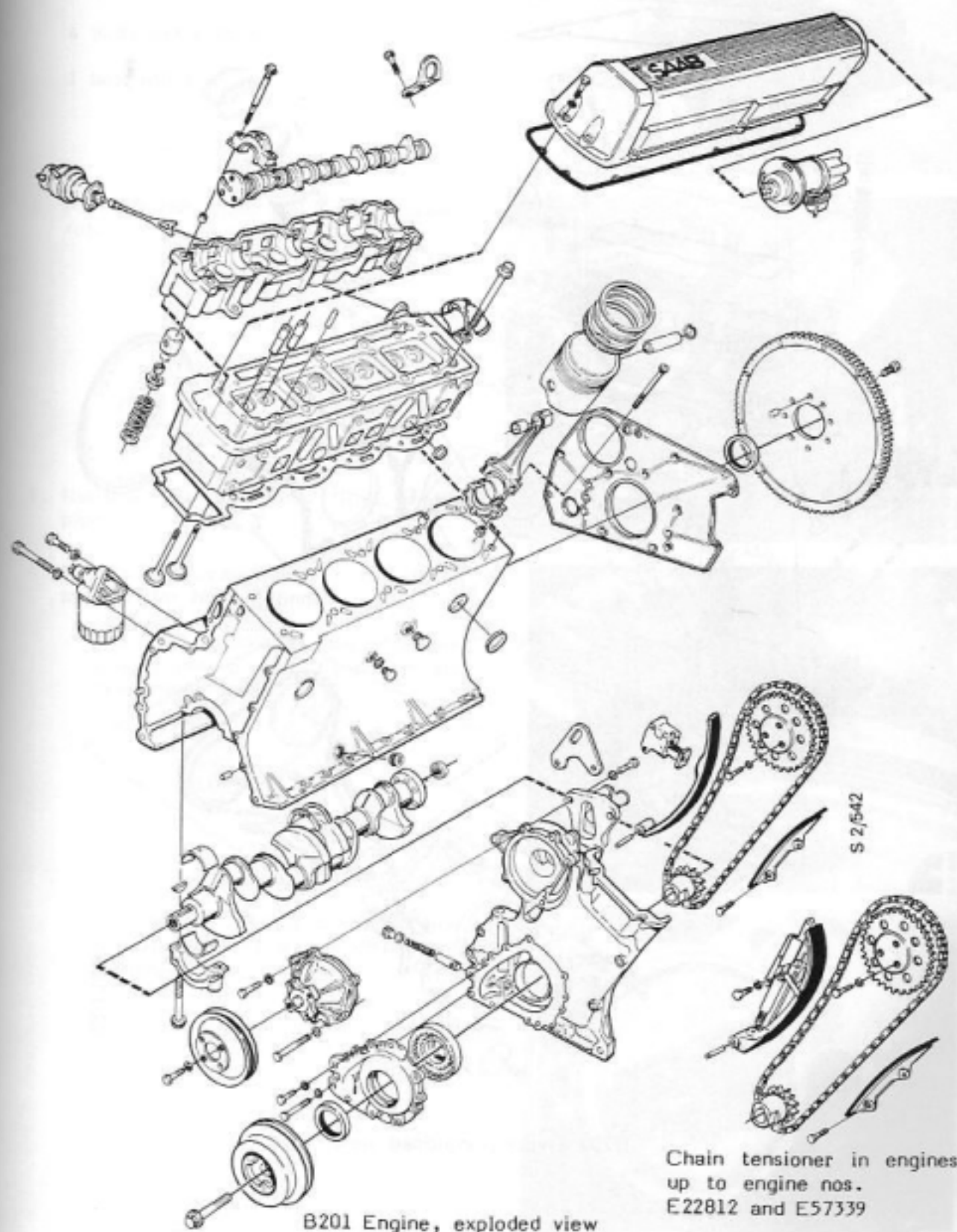


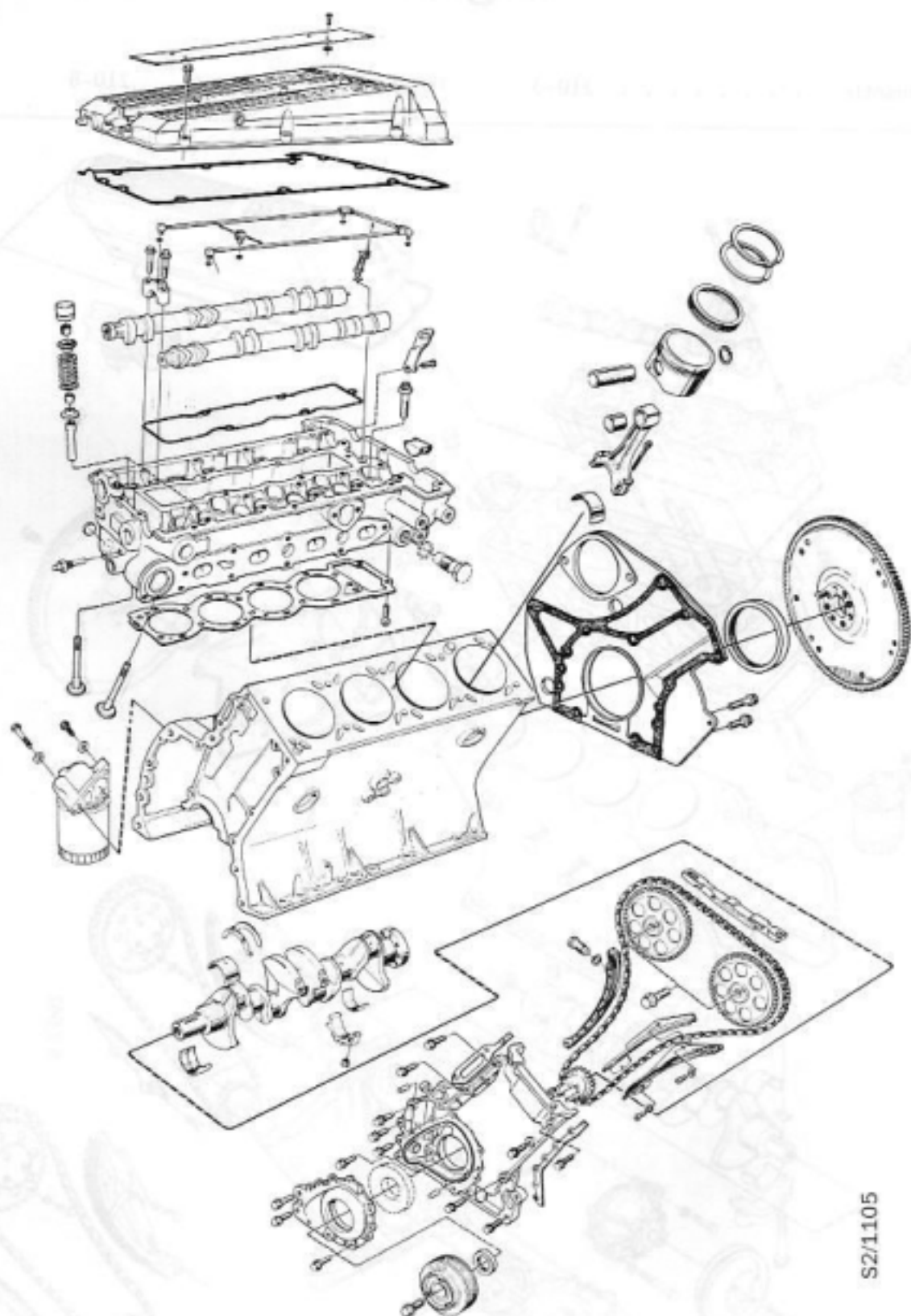
Refit in the reverse order

Engine

To dismantle 210-3

To assemble 210-8





B202 Engine, exploded view

S2/1105

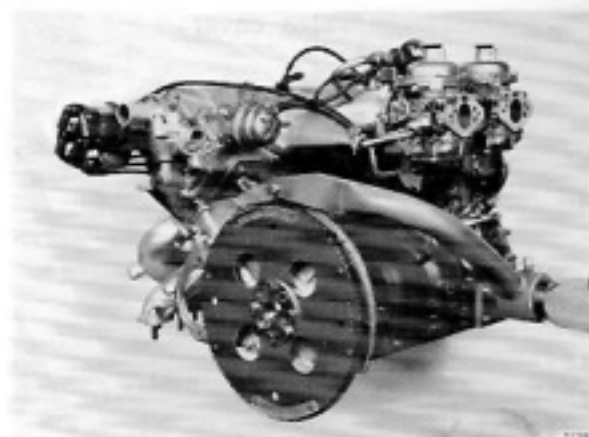
To dismantle

1. Remove the engine mountings and the oil filter and mount the engine in a stand.

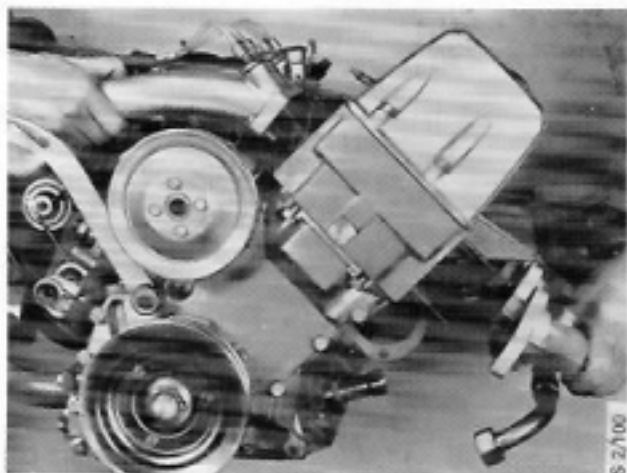
Holder 83 92 169

4 bolts M8 x 30 mm

1 bolt M8 x 40 mm



2. Remove the inlet and exhaust manifolds.



3. Remove the oil pump filter intake pipe.

4. Rotate the crankshaft to the firing position for No 1 cylinder.

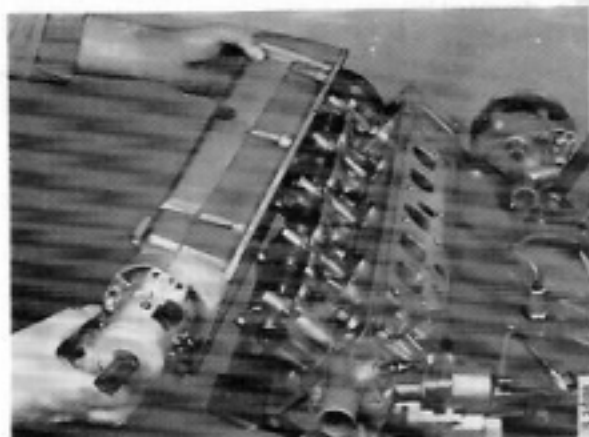
- The "0" mark on the flywheel should line up with the line on the rear engine plate.



- The mark on the rotor should line up with the line on the distributor housing.

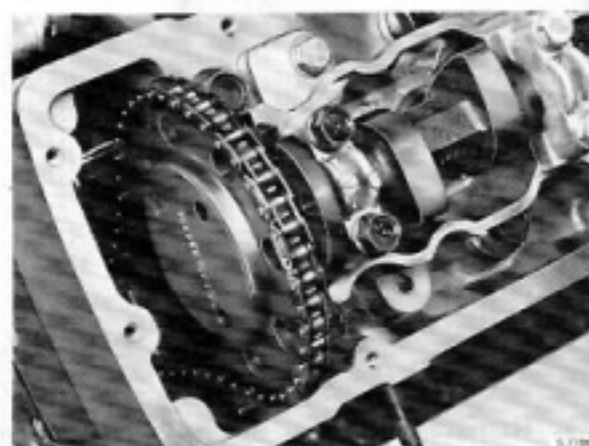


5. Remove the valve cover.



6. a. Chain tensioners up to and incl. engine Nos. E22812 and E57339:

Remove the sprocket from the camshaft. Tighten the chain by moving it onto the next tooth. Rest the sprocket between the chain guides.



6. b. Chain tensioners as from engine Nos. E22813 and E57340:

Remove the sprocket from the camshaft and rest it on the chain tensioner and the chain guide.



7. Remove the cylinder head bolts (10 + 2 in in the end plate) and lift off the cylinder head. Remove the cylinder head gasket.

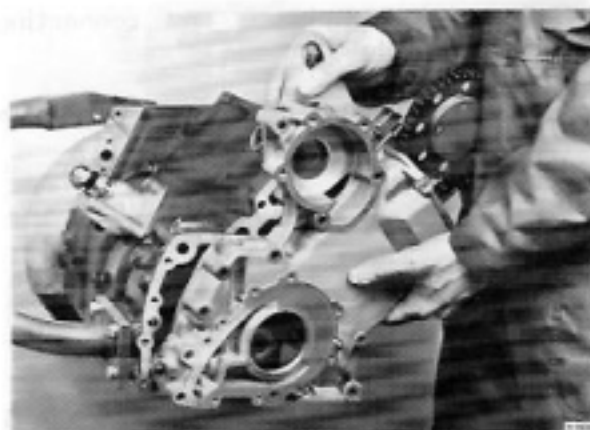
8. Remove the crankshaft pulley and oil pump.



9. Remove the water pump pulley and the water pump.

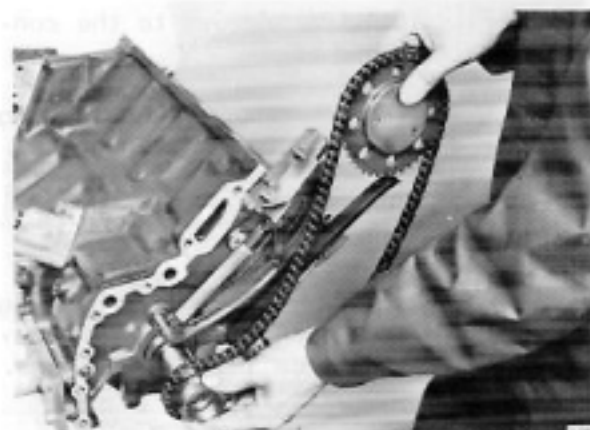


10. Remove the timing cover.



11. Remove the curved chain guide.

Remove the timing chain and sprocket. (Up to and including engine Nos. E22812 and E57339).



12. Remove the chain tensioner and the straight chain guide.

Remove the chain tensioner, chain guide and chain tensioner retaining plate. (Up to and including engine Nos. E22812 and E57339.)

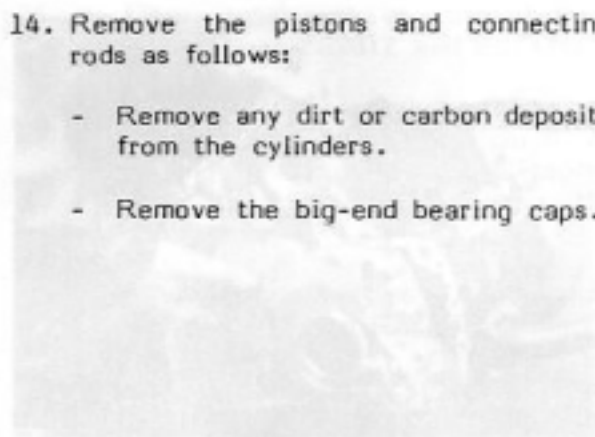


13. Remove the oil filter adaptor.

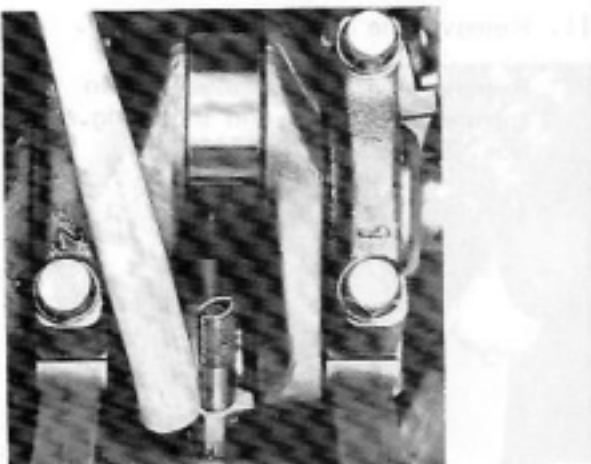
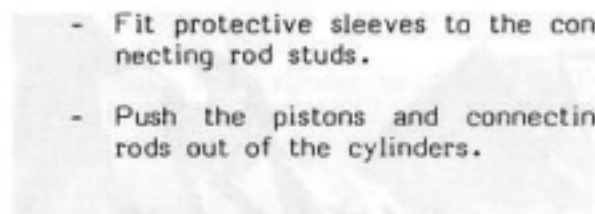


14. Remove the pistons and connecting rods as follows:

- Remove any dirt or carbon deposits from the cylinders.
- Remove the big-end bearing caps.



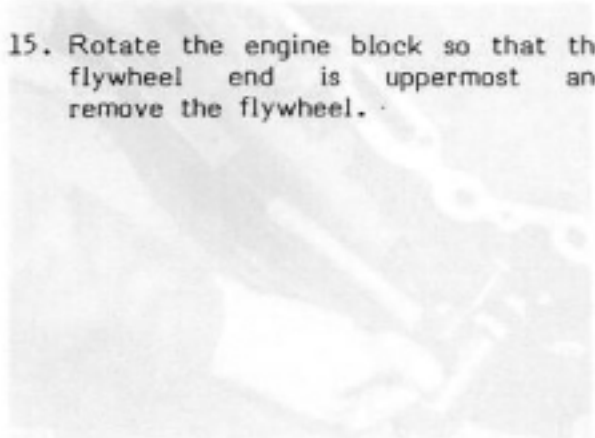
- Fit protective sleeves to the connecting rod studs.
- Push the pistons and connecting rods out of the cylinders.



NOTE

the marks on the pistons and connecting rods. Keep the bearing shells so that they can be refitted in their original positions.

15. Rotate the engine block so that the flywheel end is uppermost and remove the flywheel.



16. Remove the rear engine plate.
Remove the bolt for the engine
holder.

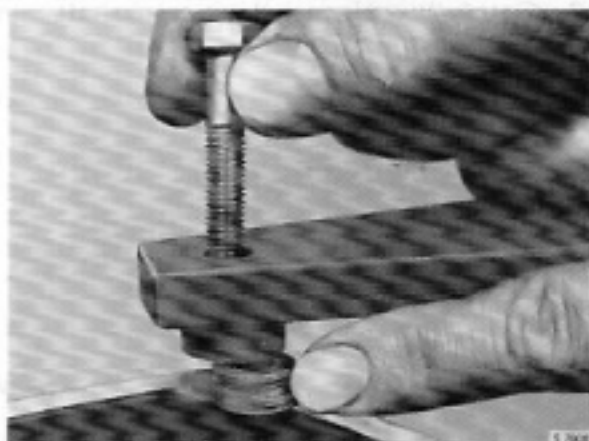
Pack the space between the engine block
and the engine holder with washers and
refit the bolts.

17. Remove the main bearing retaining
bolts and the main bearing caps.

NOTE THE MARKINGS

18. Lift out the crankshaft. Keep the
bearing shells and the thrust washers
so that they can be replaced in their
original positions.

CLEAN AND INSPECT ALL PARTS.
REMOVE ALL TRACES OF OLD SEALING
COMPOUND FROM MATING SURFACES.
FOR MEASURING AND FITTING PISTONS
AND PISTON RINGS see Section 212. For
measuring and selecting MAIN BEARINGS
and BIG-END BEARINGS see Section 216.

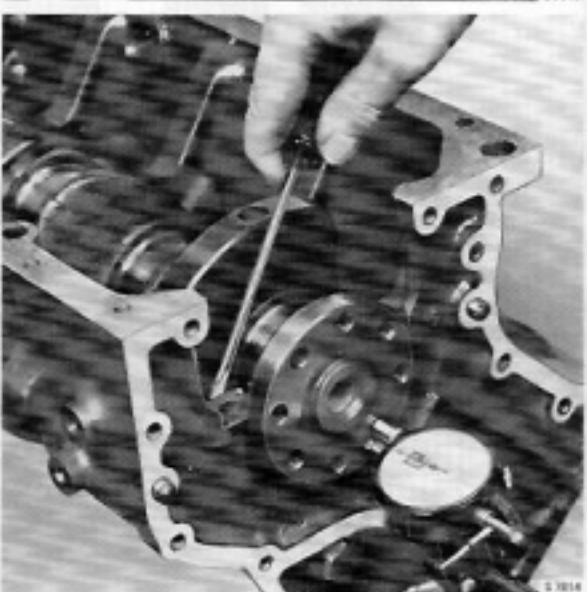
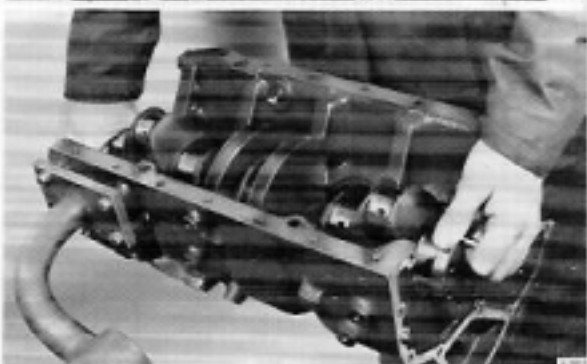


To assemble

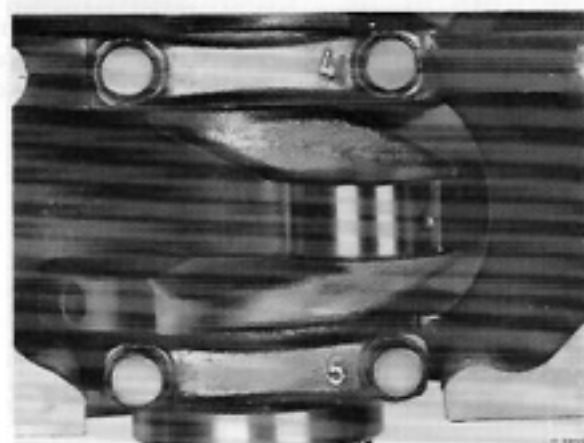
1. Place the shells in the top half of the bearings and coat them with engine oil.

2. Carefully place the crankshaft in position.

3. Install the thrust washers and check the end float.



4. Oil the bearing shells in the main bearing caps and refit. (Note the markings.)



Tightening torque, Main bearings
108 Nm (79.9 ft. lb)



5. Refit the rear engine plate as follows:

- Rotate the engine so that the flywheel end is uppermost and remove the bolt in the engine holder.
- Apply dabs of grease to the mating surfaces on the engine block (to hold the gasket in place during assembly) and fit a new gasket.

NOTE

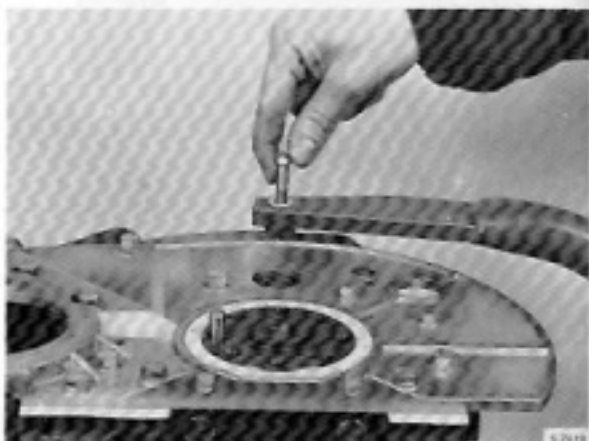
Do not use cement or other adhesive as this tends to melt when the engine is hot, disturbing the gasket and reducing the torque of the bolts. Grease is not affected in this way.



- Place the guide ring for tool 83 92 540 on the flywheel flange and refit the rear engine plate and bolts.



- Refit the bolts for the engine holder.



- Trim off excess gasket material from the mating surface with the transmission casing.

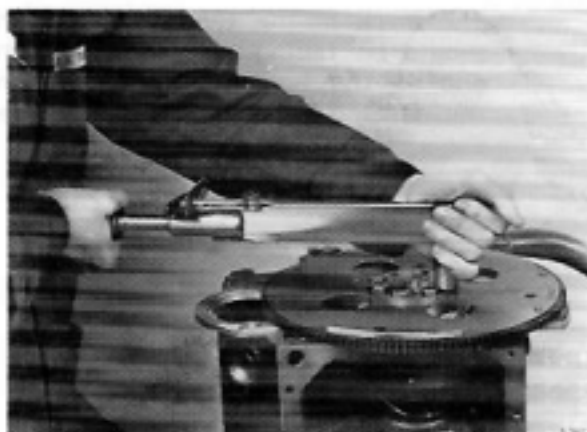


6. Refit the flywheel

If the old bolts are to be refitted, remove all traces of old sealing compound from the threads and then apply new sealant to them. Alternatively, fit new bolts, pre-coated with sealant.



Tightening torque, Flywheel
59 Nm (43.7 ft. lb)

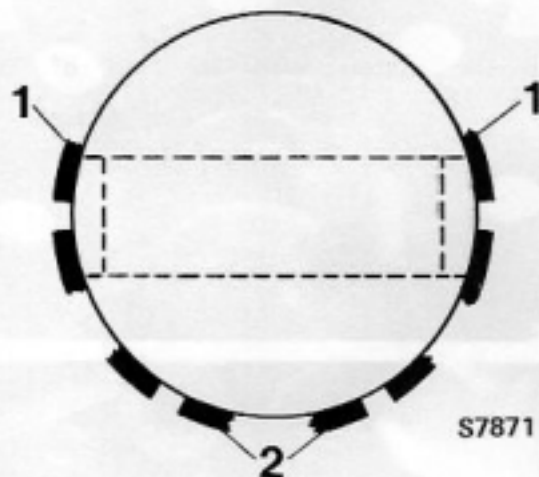


7. Refit the pistons and connecting rods as follows:

- Position the piston ring openings as shown in the illustration.

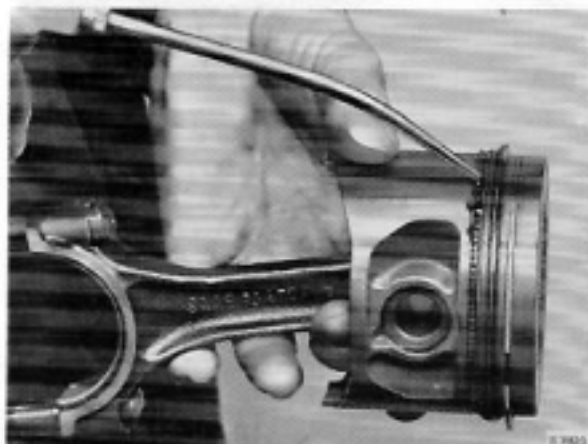
Rotate the gaps of the compression rings 180° and position them in line with the gudgeon pin holes.

Rotate the oil scraper ring so that the gaps do not line up.

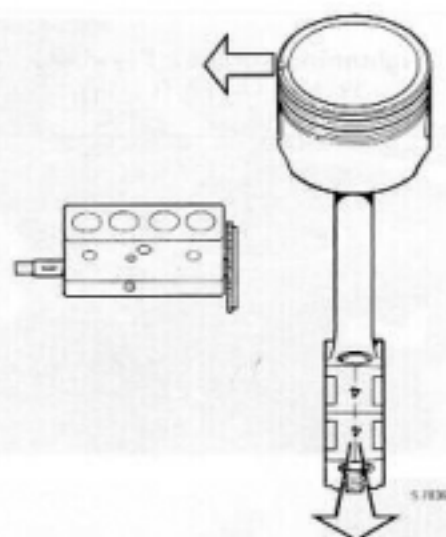


1. Compression rings
2. Scraper ring

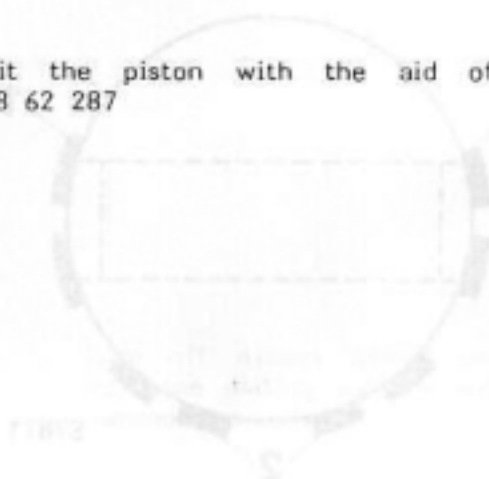
- Put the bearing shells in place in the connecting rod and cap.
- Lubricate the piston rings and bearings.



- The mark in the top of the piston should be facing the timing chain end of the engine. The marks on the connecting rods should face the exhaust side.



Fit the piston with the aid of tool 78 62 287



Make sure that the identifying numbers line up and the big-end bearing nuts are fitted with the flanges towards the bearing caps.



Tightening torque, Big-end bearings
54 Nm (40 ft. lb)

8. Clean the holes for the chain tensioner securing bolts.
Refit the chain tensioner and guide.

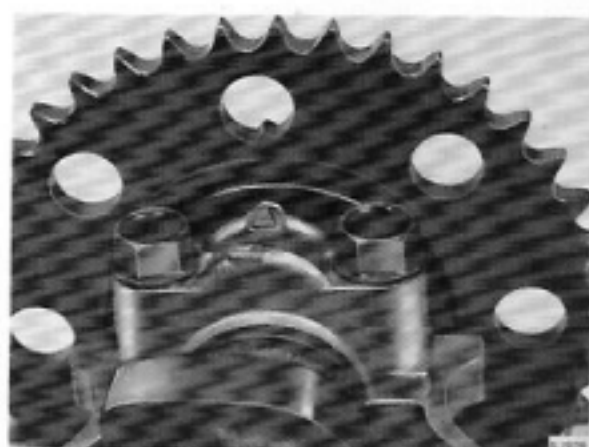
Fit flat washers between the bolt heads and the chain guide, and apply Loctite to the threads.

Tightening torque
12 Nm (8.9 ft lb)

9. Prepare the cylinder head for refitting by rotating the camshaft to the firing position for No 1 cylinder, i.e. the mark on the camshaft chainwheel should line up with the arrow on the bearing cap. (Camshaft sprocket temporarily installed.)
10. Rotate the crankshaft to the firing position for No 1 cylinder.
11. Refit the sprocket and the chain to crankshaft and temporarily suspend the chain and the camshaft sprocket between the chain guide and tensioner. Apply grease to the flange and fit the gasket.



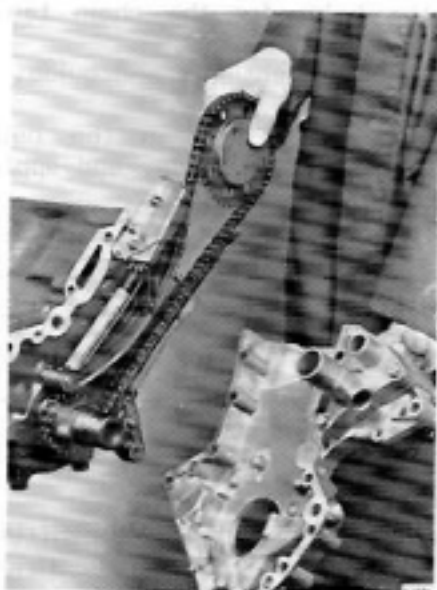
Chain tensioner, as from engine Nos. E22813 and E57340



12. Refit the timing cover. Pull up the chain when the cover is being fitted to prevent it being trapped.



- Trim off excess gasket material from the mating surface with the timing cover.



13. a. Refit the water pump with a new gasket.

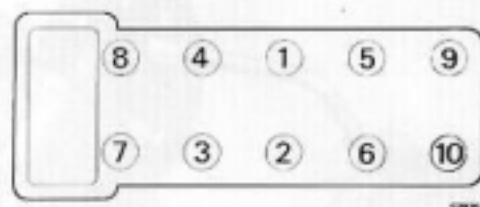
b. Fit the water pump pulley.



14. Refit the cylinder head with a new cylinder head gasket.

Caution A fully open valve can come into contact with a piston at top dead centre. Position the camshaft and crankshaft in the firing position for cylinder No 1 when refitting engine parts. Do not rotate the shafts before installing the timing gear

- Tighten the bolts to the correct torque in two stages. For tightening order see the illustration.



Tightening torques, Cylinder head bolts:

(Hex.bolts, 15 mm width across flats or TORX bolts*. See page 211-4 for hex. bolts, 17 mm width across flats.)

Stage I: 60 Nm (44.4 ft lb)

Stage II: 80 Nm (59 ft lb)

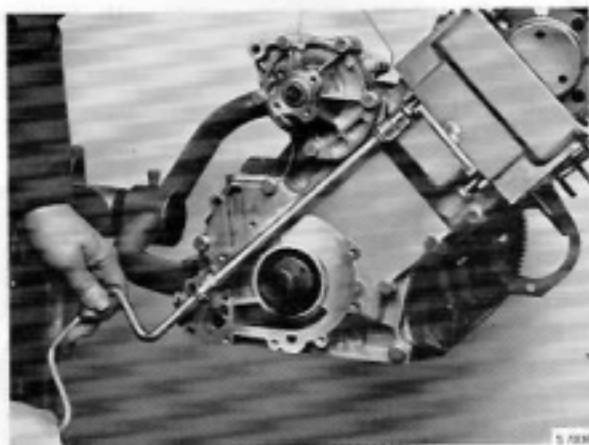
* NOTE

TORX type cylinder head bolts are pre-coated with lubricant and need no further lubricating when being refitted for the first time (but see page 211-4).



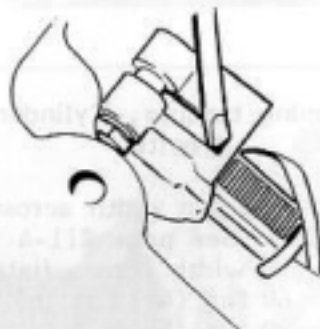
- Refit the two bolts in the timing cover.

The engine should be run until warm and allowed to cool for 30 min approx. before retightening the bolts. See the section on retightening of the cylinder head bolts.



As from engine number E22813 and E57340:

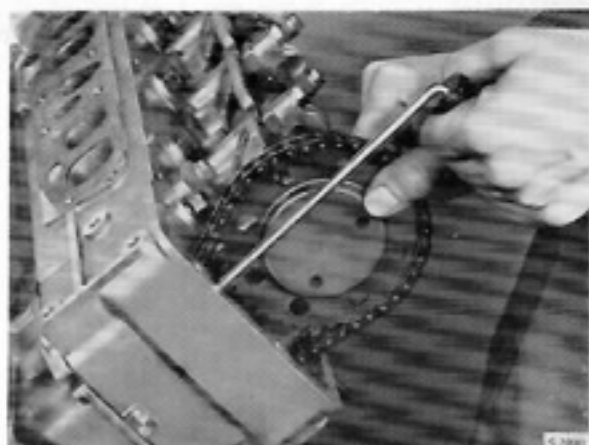
Press down the outside of the ratchet tooth on the chain tensioner to render it inoperative. Depress the tensioning device by pressing on the chain guide. Hold the chain guide in this position, fit the chain transmission and then release the guide, whereupon it will return to its position against the chain.



15. Insert hook 83 93 357 in the chain tensioner and pull upwards, to disengage the tensioner from the chain. Refit the sprocket on the camshaft. Reseat the chain on the sprocket until the marks on the sprocket and the bearing cap coincide.

NOTE

The crankshaft should be in the "0" position.



16. Refit the sprocket bolts with plain washers.

Caution

Washers must be fitted to prevent the bolts from butting against the camshaft bearing assembly.



Tightening torque
Camshaft sprocket
20 Nm (14.8 lb ft)

17. Refit the oil pump as follows:

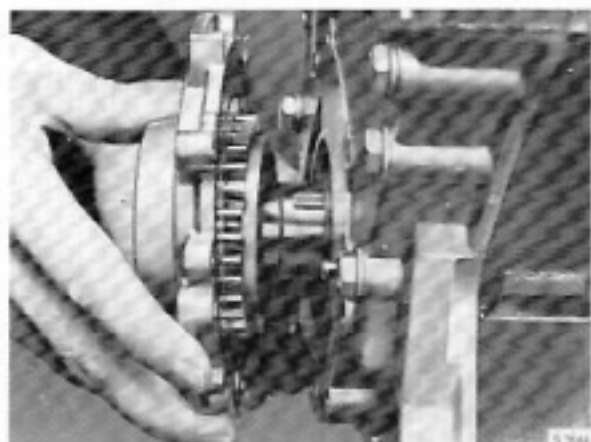
- Refit the ring gear so that the mark is visible.



- Fit a new sealing ring in the groove in the pump housing.



- Oil the pump wheels to make installation easier. Push out the pump wheel a bit so to make the installation easier. Use centring tool 83 93 589 to fit pumps not equipped with locating pins (see section 221, "Oil pump").



- Fill the oilway between the oil pump and the oil filter adaptor with engine oil.



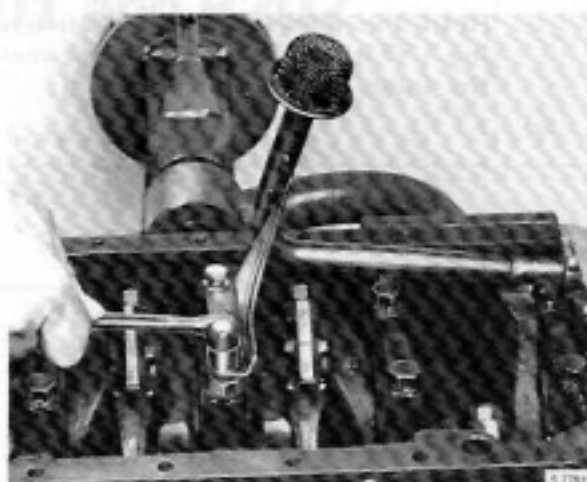
18. Refit the adaptor casting for the oil filter with a new gasket.

19. Refit the pulley on the crankshaft.

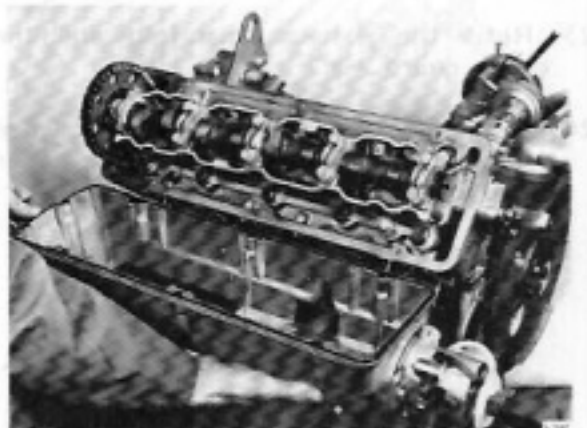
Tightening torque
Pulley 190 Nm (141 ft. lb)



20. Refit the oil pump filter intake pipe with O ring.



21. Fit the rubber sealing ring in the valve cover groove.



- Refit the valve cover. Line up the distributor rotor arm with the line on the distributor housing so that the distributor driving dog locates in the slot in the end of the camshaft.

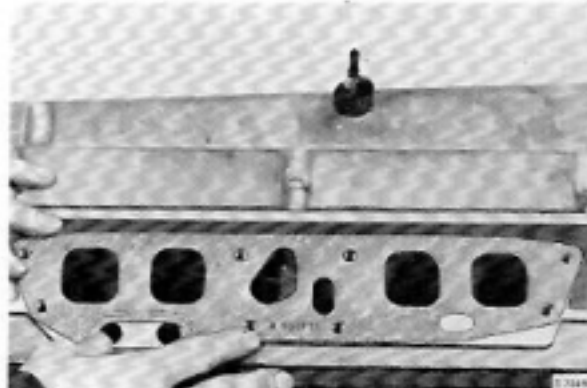


Tightening torque
Valve cover 4.9 Nm (3.6 ft. lb)

22. Fit a new inlet manifold gasket.

Caution

Do not confuse the "H" engine inlet manifold gasket with the "B20" engine gasket. If an incorrect gasket is used then the water will enter the cylinder head through the EGR-channel. Carburettor and fuel injection engines have different gaskets.



- Refit the inlet manifold and lifting lug. (Fit plain washers between the inlet manifold and the lug.

Tightening torque

Inlet Manifold 18 Nm (13.3 ft. lb)



- 23. Refit the exhaust manifold and the heat guard.
- 24. Suspend the engine by the lifting yoke and fit the engine mountings and a new oil filter.



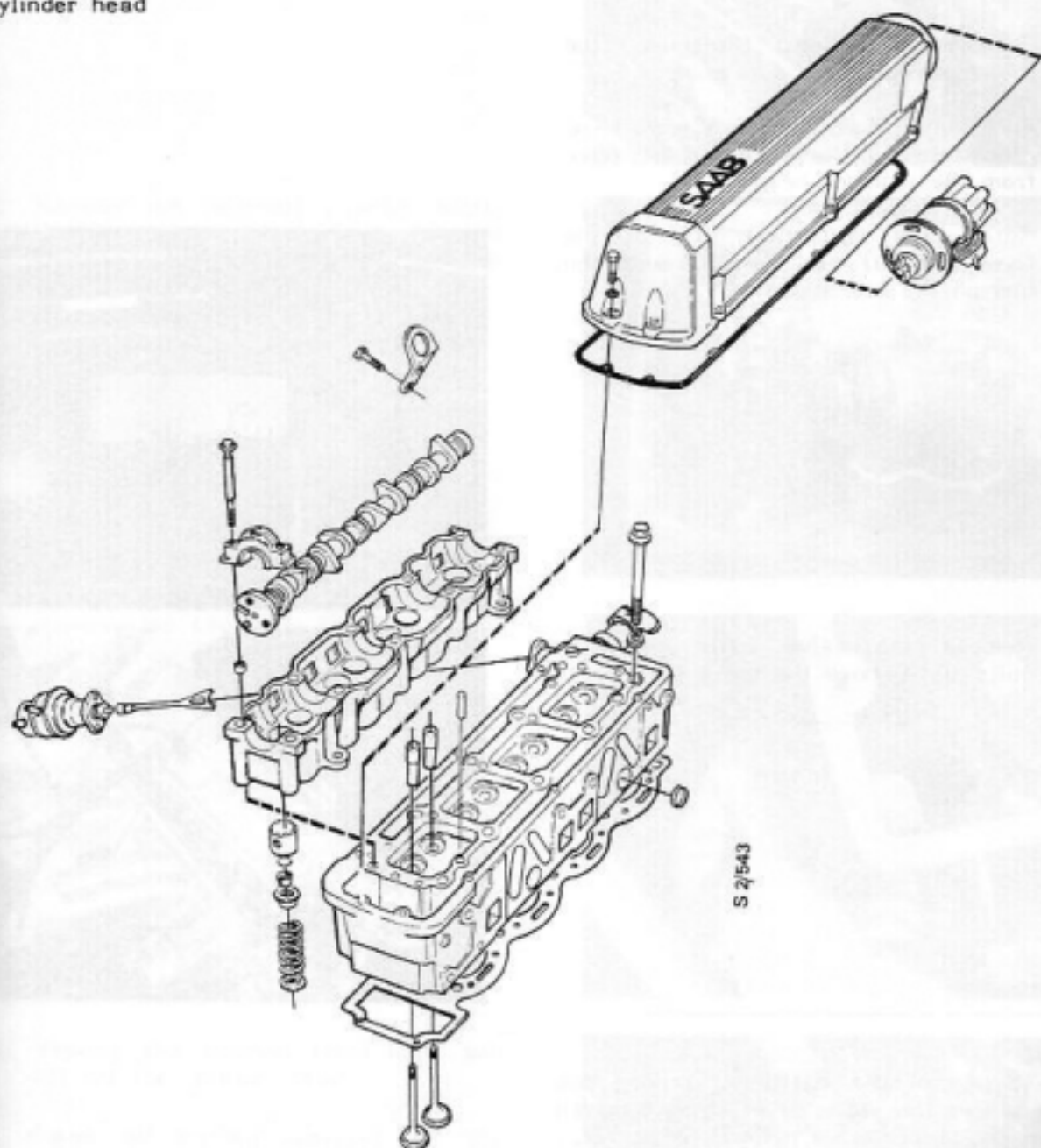
Up to and including 1985 models

Cylinder head, B201 and B202

Cylinder head, B201 211-1

Cylinder head, B202 211-9

Cylinder head



To remove

1. Disconnect the positive lead from the battery.
2. Drain the coolant through the drain cock on the radiator and the drain plug in the engine block.

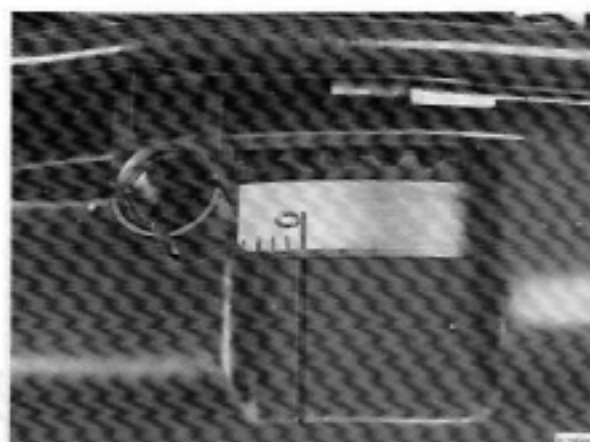
3. Remove the upper radiator hose.
4. Disconnect the crankcase ventilation hoses from the valve cover.
5. Disconnect the wiring from the distributor and the temperature transmitter.
6. Carburettor engines: Disconnect the fuel pipes from the fuel pump.
7. Injection engines: Remove the warm-up regulator and the auxiliary air valve from the cylinder head.
8. Rotate the crankshaft so that the flywheel's (0) mark lines up with the line on the clutch cover.

9. Remove the valve cover retaining bolts and remove the valve cover.

NOTE

The design of the distributor driving dog only allows the valve cover to be removed when No. 1 or No. 4 cylinder is at TDC.

10. Place a jack under the transmission case. Detach the stay between the right engine mounting and the cylinder head and rotate it to one side. Jack up the power unit slightly and support it on a piece of wood placed between the cross member and the transmission case.

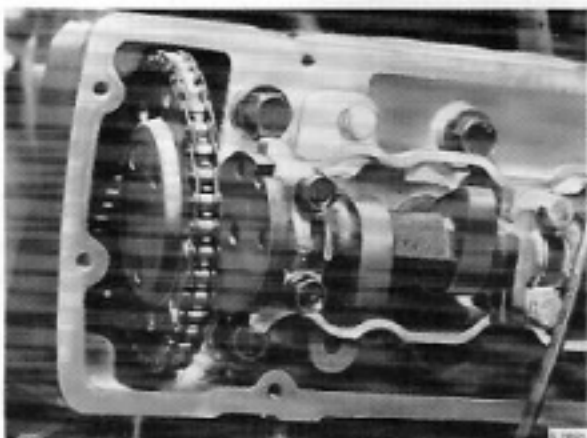


11. Detach the exhaust manifold from the cylinder head (supporting it in a suitable manner).

Detach the inlet manifold from the cylinder head. (Support it in a suitable manner.)



12. Remove the camshaft sprocket bolts. Remove the sprocket from the cam shaft but keep the chain hanging on the sprocket. Place the sprocket between the chain guide and tensioner.



13. Remove the two bolts from the timing cover.

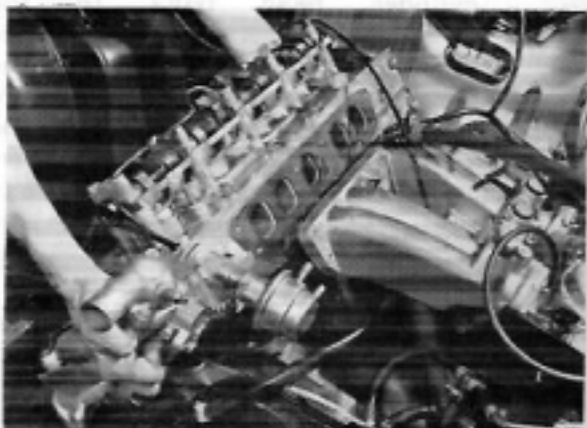


14. Remove the cylinder head bolts and lift off the cylinder head.

Clean all mating surfaces on the cylinder head, engine block, inlet and exhaust manifolds.

Carefully scrape away remains of the gaskets and sealing compound. Do not use emery cloth.

Check that the mating surfaces are flat.



To refit

1. Place the new cylinder head gasket on the engine block.
2. a. Rotate the crankshaft to the "0" position.

- b. Temporarily refit the camshaft sprocket on the camshaft and rotate the camshaft to TDC on the combustion stroke for No. 1 cylinder.

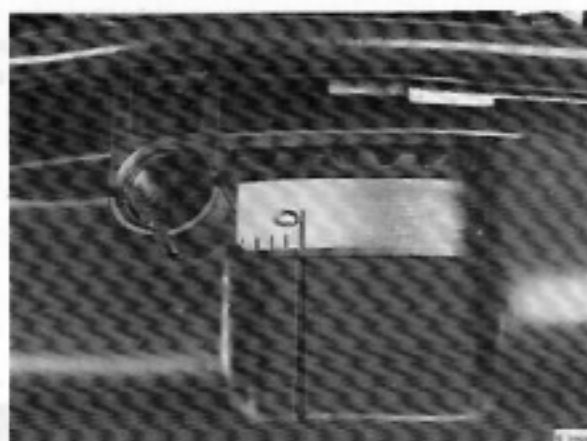
Caution

Do not move any of the shafts before refitting the timing chain.

A fully open valve can come into contact with the piston in the top dead centre position.

3. Position the chain on the camshaft sprocket and place the chain between the chain guide and tensioner.

4. a. Fit the cylinder head and the cylinder head bolts. Tighten the cylinder head bolts to the prescribed torque, in the sequence shown in the illustration. Fit the bolts in the timing cover. Before retightening the bolts, run the engine to normal operating temperature and then allow it to cool for 30 minutes. Slacken the bolts and retighten them to 80 Nm (59 ft lb).



- b. Retighten the cylinder head bolts when the car has clocked up a further 1200 miles (2000 km).

Tightening torques for cylinder head bolts
(Hex. bolts, 15 mm width across flats, or TORX M12 bolts* as from 1984 models, engine nos. E42621-46906 and E53614.)

Stage I: 60 Nm (44.4 ft.lb)

Stage II: 80 Nm (59 ft. lb)

***NOTE**

The TORX type bolts are precoated with lubricant and will therefore not normally require further lubrication when being refitted for the first time. The bolts may be refitted no more than five times, as the lubricant coating by this time will have worn off. The bolts may still be re-used, but they must first be thoroughly cleaned, with all traces of lubricant removed. Apply Molycote 1000 to the bolts after they have been cleaned before refitting them.

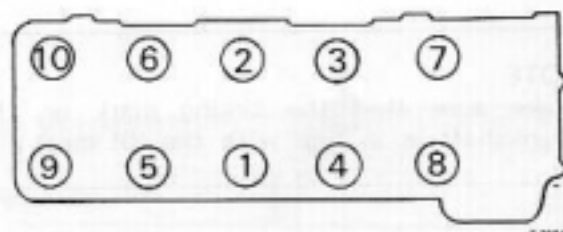
5. As from engine numbers E22813 and E57340, fit the timing chain as follows:

Press down the outside of the ratchet tooth on the chain tensioner to render it inoperative. Depress the tensioning device by pressing the chain guide.

Hold the chain guide in this position, fit the timing chain and release the chain guide, whereupon it will return to its position against the chain.

As from engine numbers E 22812 and E57339 refit the timing chain and sprocket as follows:

- a. Hook tool 83 93 357 onto the chain and lift it to reduce the tension on the chain. Fit the sprocket onto the camshaft. Rotate the sprocket until the mark on the sprocket coincides with the one on the bearing cap.



NOTE

Make sure that the timing mark on the crankshaft is in line with the '0' mark.

- b. Refit the three camshaft sprocket retaining bolts with flat washers.



6. Insert the gasket in the groove running round the valve cover and refit the cover.

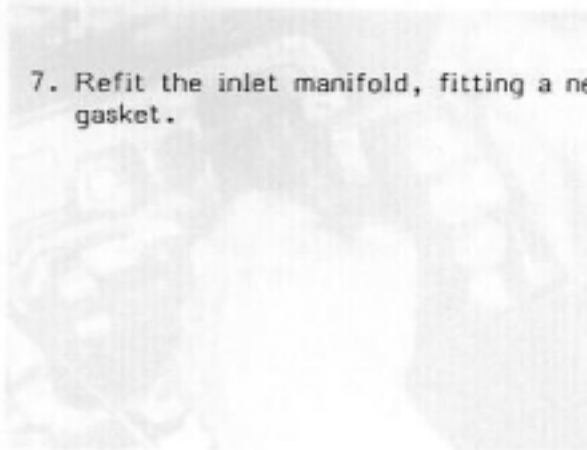
(If the distributor is mounted, the rotor arm should be positioned facing the line on the edge of the distributor housing.)



Tightening torque

Camshaft cover 4.9 Nm (3.6 ft. lb)

7. Refit the inlet manifold, fitting a new gasket.

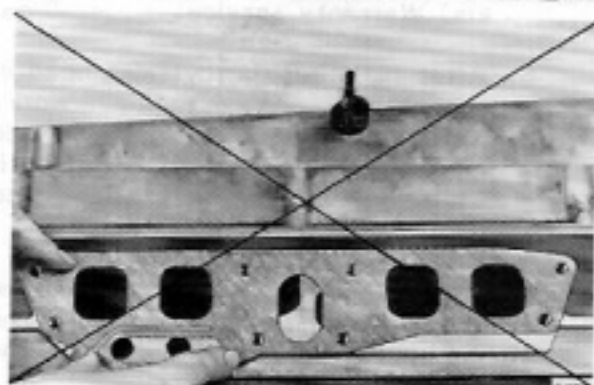
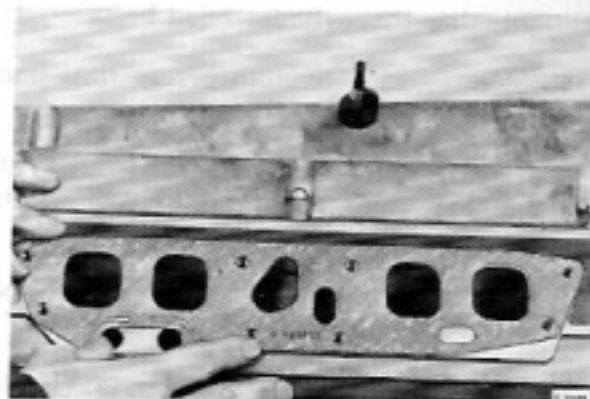


Caution

Do not confuse the "H" engine inlet manifold gasket with the "B 20" engine gasket. If the incorrect gasket is used then water will enter the cylinder head through the EGR channel.

Different gaskets are fitted to carburettor engines and injection engines.

Tightening torque
Inlet Manifold
18 Nm (13.3 ft. lb)



8. Carburettor engines: Refit the fuel pipes to the fuel pump.
Injection engines: Refit the warm-up regulator and the auxiliary air valve.
9. Jack up the engine under the transmission case and refit the exhaust manifold and heat shield/gasket.
10. Refit the stay between the right engine mounting and the cylinder head. Remove the wooden block from beneath the engine.
11. Refit the radiator hose.
12. Reconnect the wiring to the temperature transmitter and the distributor.
13. Close the drain cock and the plug and refill the system with coolant.
14. Reconnect the crankcase ventilation hoses.
15. Reconnect the battery.
16. Start the engine, preparatory to retightening the head as detailed below.



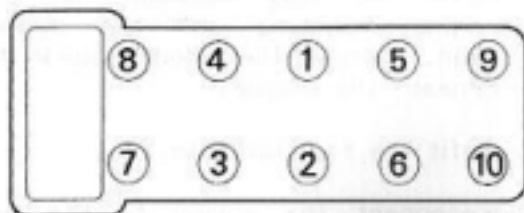
Retightening the cylinder head bolts

(Hex. bolts, 15 mm width across flats and TORX M12 bolts)

Refer to page 211-4 for details of retightening bolts having a 17 mm width across flats.

The cylinder head bolts should be retightened on the following occasions:

- a. As part of the 1,200 mile (1,000 km) Warranty service.
 - b. After refitting the cylinder head in connection with repair work. Retightening is then performed once the engine has been run until warm and subsequently allowed to cool for 30 min.
1. Slacken off each bolt slightly and then retighten to 80 Nm (59 ft. lb). The tightening sequence is shown in the adjacent figure.



57925

2. Then tighten each bolt a further quarter-turn (through 90 deg.)

Stage I: Tightening torque
80 Nm (59 ft. lb)

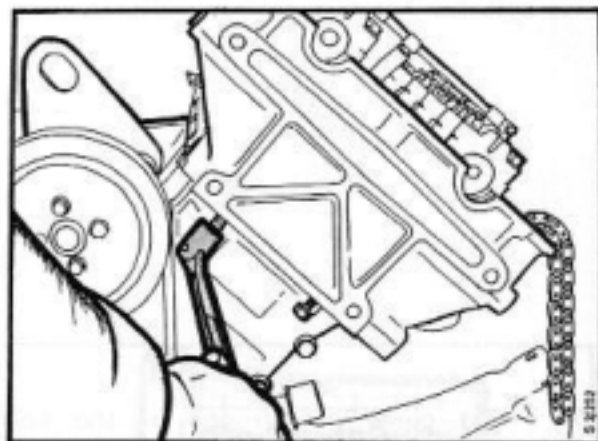
Stage II: Further tightening
a quarter-turn (90°)



Cylinder head, B202

To remove

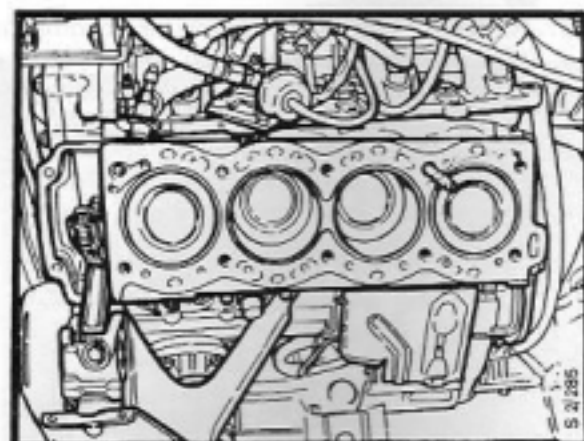
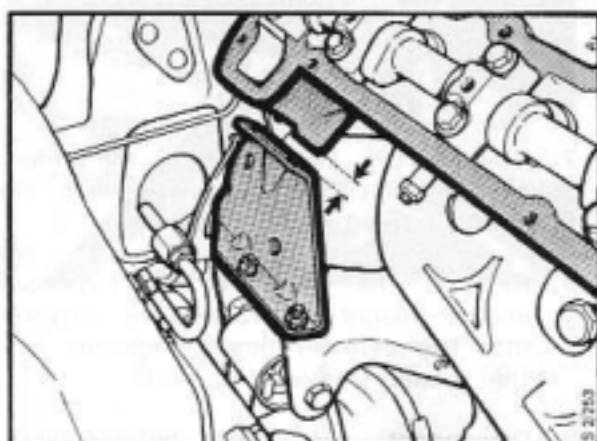
1. Remove the hood (bonnet).
2. Remove the battery.
3. Drain the coolant from the radiator and block.
4. Remove the exhaust manifold and turbo unit (see separate section on page 211-8).
5. Remove the tensioning pulley and drive belt for the AC compressor.
6. Slacken the securing bolts for the steering servo pump bracket, remove the drive belt and push the pump out of the way.
 - a. Undo the wiring loom clips on the cylinder head. If the cylinder is to be mounted on the floor stand, remove the clips completely.
7. Remove the two bolts in the timing cover, which are screwed into the cylinder head from underneath.
8. Remove the bolts in the righthand engine mounting which are screwed into the cylinder head, together with the spacer sleeves.
9. Disconnect the hose between the thermostat housing and radiator at the thermostat housing.
10. Remove the fuel pressure regulator and disconnect the earth leads for the LH system.
11. Remove the auxiliary air valve. Remove the bracket for the AC compressor from the cylinder head.



12. Remove the inlet manifold complete with injection valves and fuel injection manifold.
13. Disconnect the lead from the temperature transmitter.
14. a. Remove the lid on the valve cover and the ignition cables together with the distributor cap.
b. Remove the valve cover. Disconnect the crankcase ventilation hose and remove the semi-circular rubber plug halves from the cylinder head.
15. Line up the timing marks on the crankshaft and camshafts as described in the section 214, "Setting the valve and crankshaft mechanisms".
16. Remove the chain tensioner (see item 3, page 211-3).
17. Remove the camshaft sprockets.
18. Block up the engine to lift the cylinder head off the engine steady plate. Remove the cylinder head bolts. Siphon off the oil from the cylinder head.



19. Fit a guide pin in one of the bolt holes (see illustration) and lift off



the cylinder head, taking care to ensure that the pivoting and fixed guides for the timing chain are not damaged. Refit the drain plug in the block and close the drain valve on the radiator.

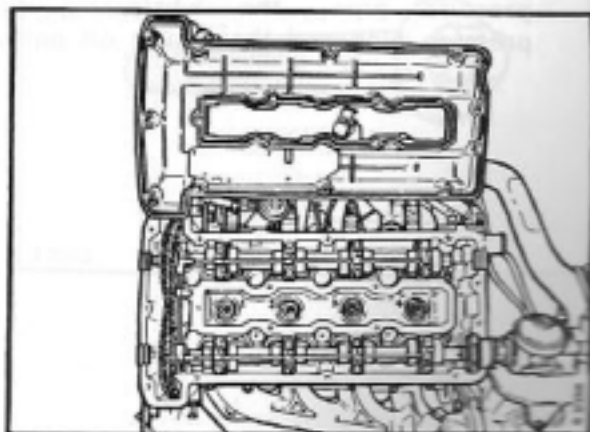
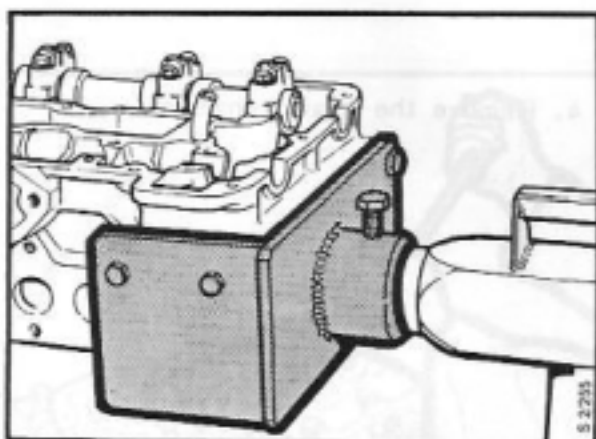
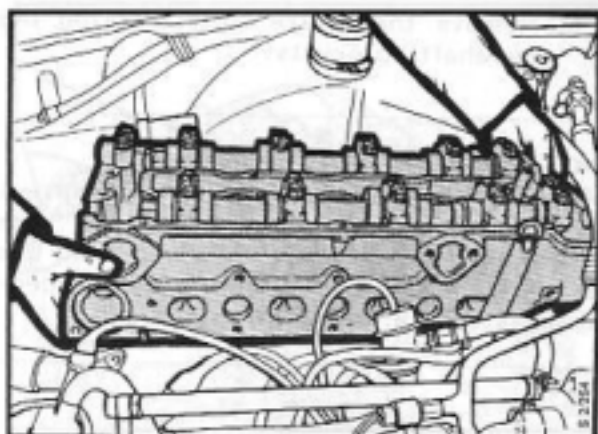
When work is to be done on the cylinder head, use of the bracket (available as a special tool) for mounting the cylinder head on the engine stand is recommended.

NOTE

Never stand the cylinder head on its flanges as, when open, the valves will protrude. Stand the cylinder head on wooden blocks.

Dismantling the cylinder head (engine removed from car)

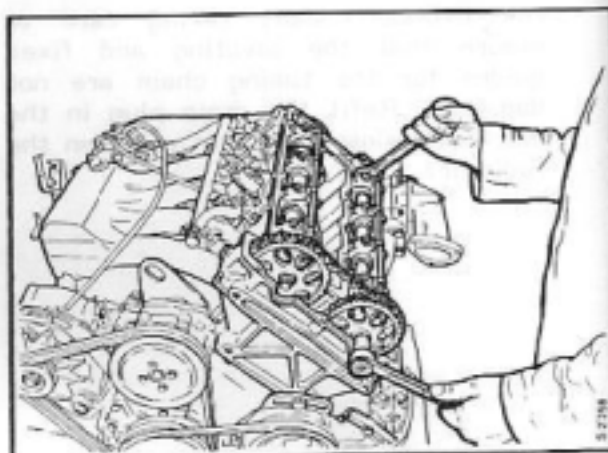
1. Remove the lid on the valve cover. Disconnect the ignition leads and vacuum hose from the distributor and remove the distributor cap.
2. Remove the valve cover and position the crankshaft for top dead centre (the '0' mark on the flywheel in line with the timing mark on the end plate).



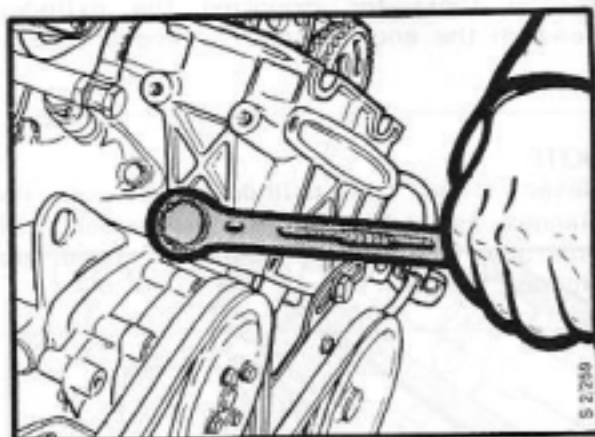
3. Remove the centre bolts securing the camshaft sprockets.

NOTE

Always keep the camshafts in the correct basic setting. If the setting of the crankshaft or camshafts is altered at this stage (any of the shafts rotated independently) the valves can be damaged.

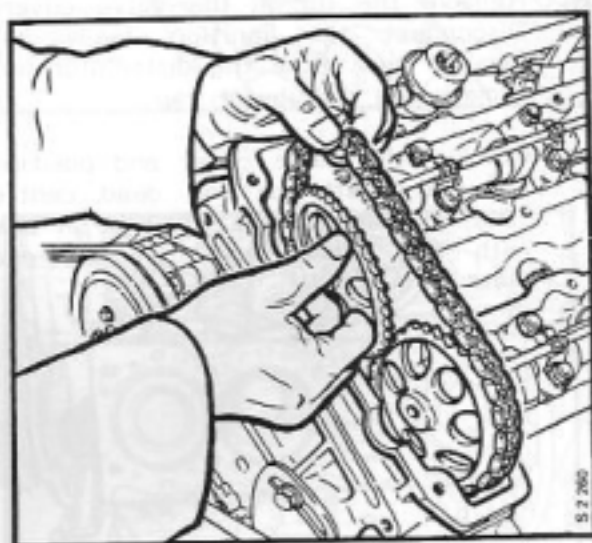


4. Remove the chain tensioner.

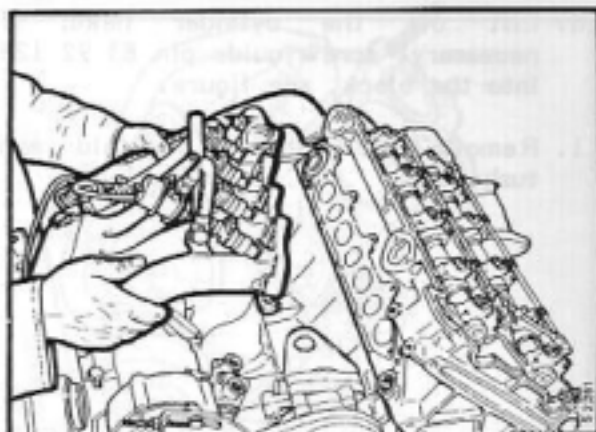


5. Remove the camshaft sprockets.

6. Remove the EGR pipe, the turbo pressure pipe, the lubricating oil pressure pipe and the return oil pipe.



7. Remove the inlet manifold (pressure regulator) and the auxiliary air valve.

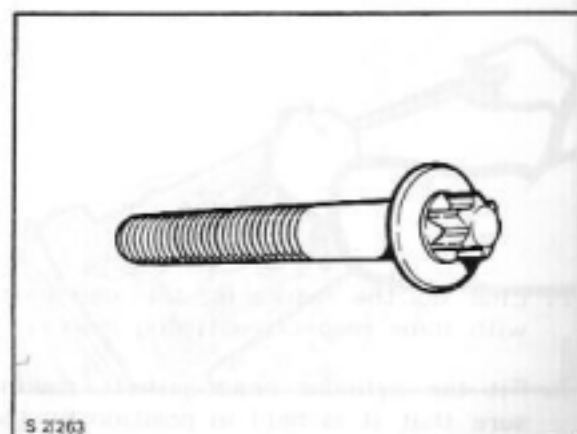


8. Remove the cylinder head bolts.



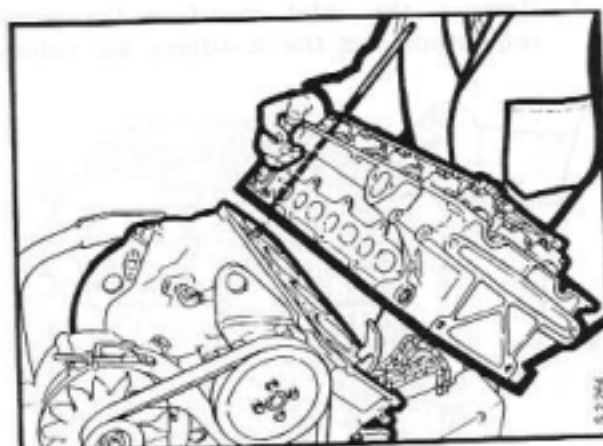
NOTE

The cylinder head bolts are of type TORX M12 (bolt head E16).



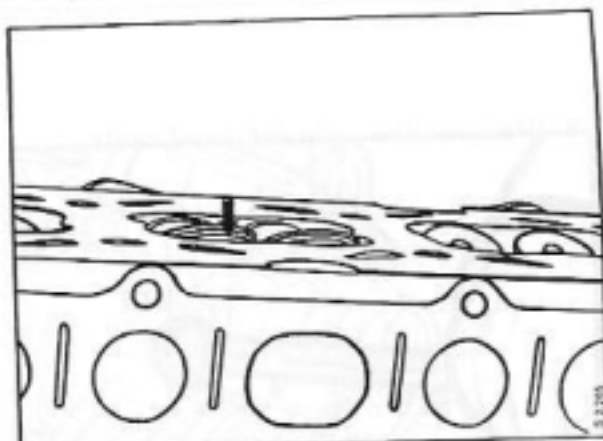
9. Arrange the timing chain and the chain guide to allow the cylinder head to be lifted off.

10. Lift off the cylinder head; if necessary, screw guide pin 83 92 128 into the block, see figure.
11. Remove the exhaust manifold and turbo unit.



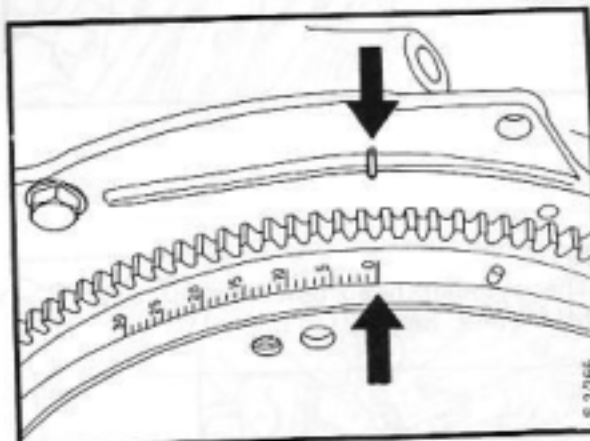
NOTE

Do not stand the cylinder head on its flanges, as, when open, the valves project above the surface.

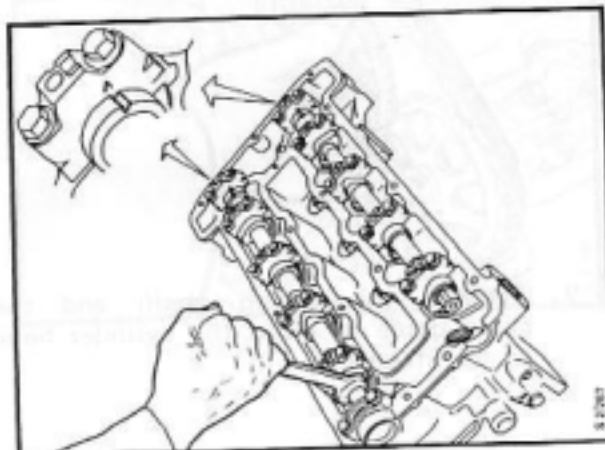


Refitting the cylinder head

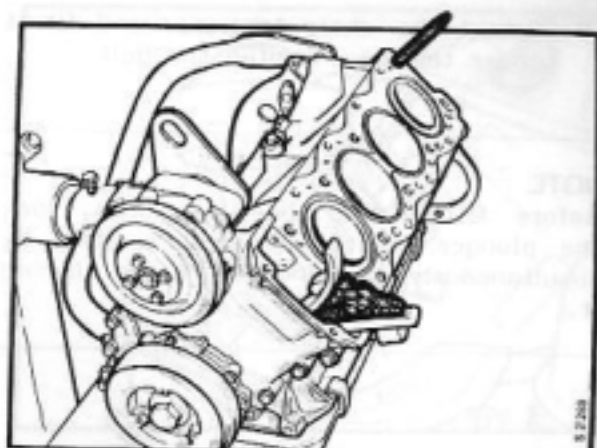
1. Align the "0" mark on the flywheel (crankshaft) with the timing mark on the end plate.



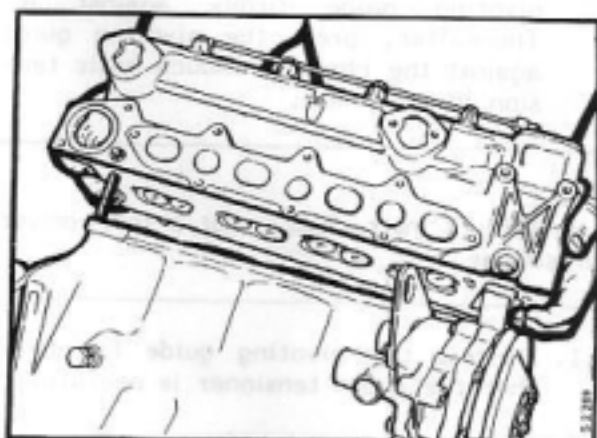
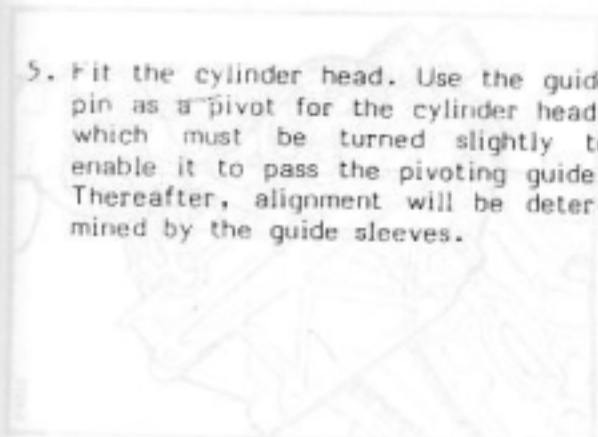
2. Line up the marks on the camshafts with their respective timing marks.
3. Fit the cylinder head gasket, making sure that it is held in position by the guide sleeves in the cylinder head flange.



4. Fit guide pin 83 92 128 and position the timing chain and pivoting guide as illustrated.

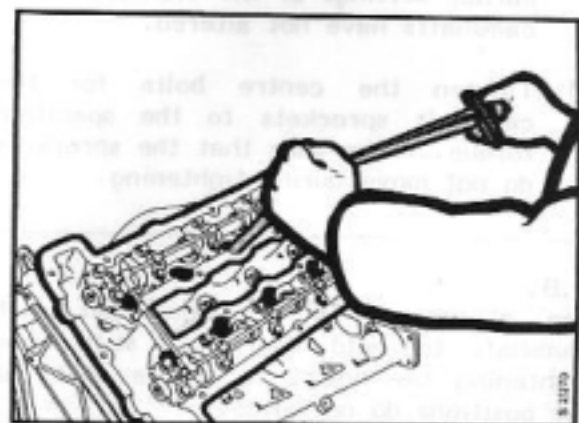


5. Fit the cylinder head. Use the guide pin as a pivot for the cylinder head, which must be turned slightly to enable it to pass the pivoting guide. Thereafter, alignment will be determined by the guide sleeves.



6. Fit the cylinder head bolts and tighten them to the specified torque (refer to "Specifications"). Remember to fit the two M8 bolts in the underside of the cylinder head.

7. Fit the camshaft sprockets, fitting the sprocket for the exhaust-valve camshaft first. Make sure that the chain between the crankshaft sprocket and the camshaft sprocket is kept tight and properly located in the guide channel. Next fit the sprocket on the inlet-valve camshaft. Keep the chain tight between the sprockets.

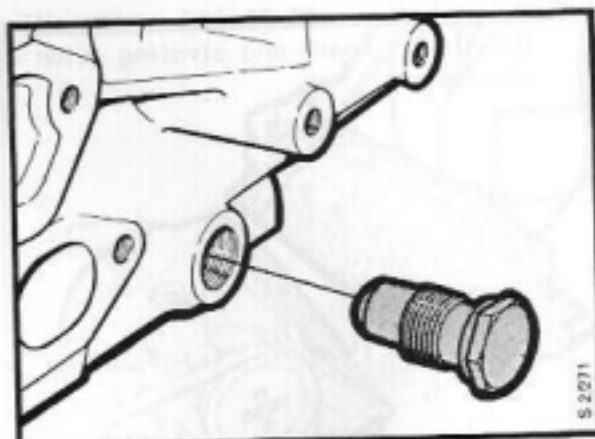


8. Lightly tighten the centre bolts securing the camshaft sprockets.

9. Adjust the chain tensioner and fit it under tension. Tighten the bolt.

NOTE

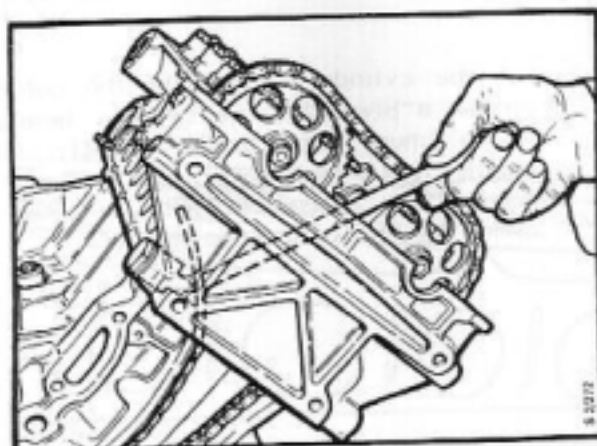
Before fitting the chain tensioner, lock the plunger in its innermost position by simultaneously pressing it in and turning it.



10. Release the tensioner by pressing the pivoting guide firmly against it. Thereafter, press the pivoting guide against the chain to induce basic tension in the chain.

NOTE

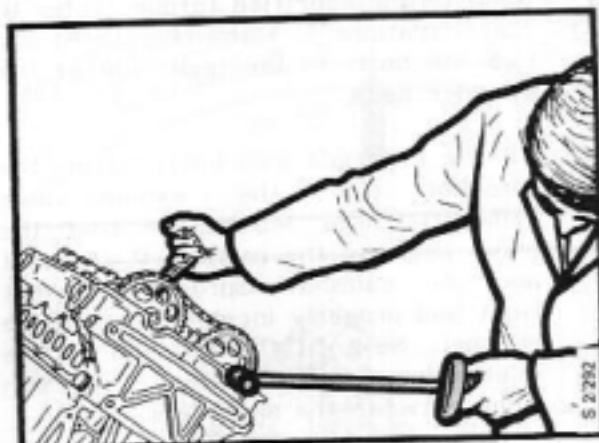
Use a blunt instrument - not a screwdriver or similar.



11. Depress the pivoting guide to check that the chain tensioner is operating.
12. Rotate the crankshaft two complete turns clockwise, viewed from the transmission end. Check that the earlier settings of the crankshaft and camshafts have not altered.
13. Tighten the centre bolts for the camshaft sprockets to the specified torque. Make sure that the sprockets do not move during tightening.

N.B.

Use a spanner on the flats on each camshaft to hold the shaft still when tightening the bolts, to ensure that the set positions do not alter.



Tightening torque: 63 NM (46.6 ft. lb)

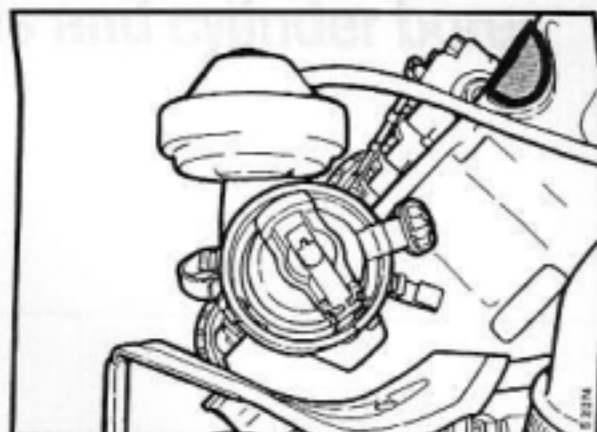
14. Refit the valve cover. Make sure that the gaskets and split rubber plugs are properly seated in their grooves.

15. a. Fit the distributor cap and reconnect the ignition leads and vacuum hose.

b. Fit the lid on the valve cover.

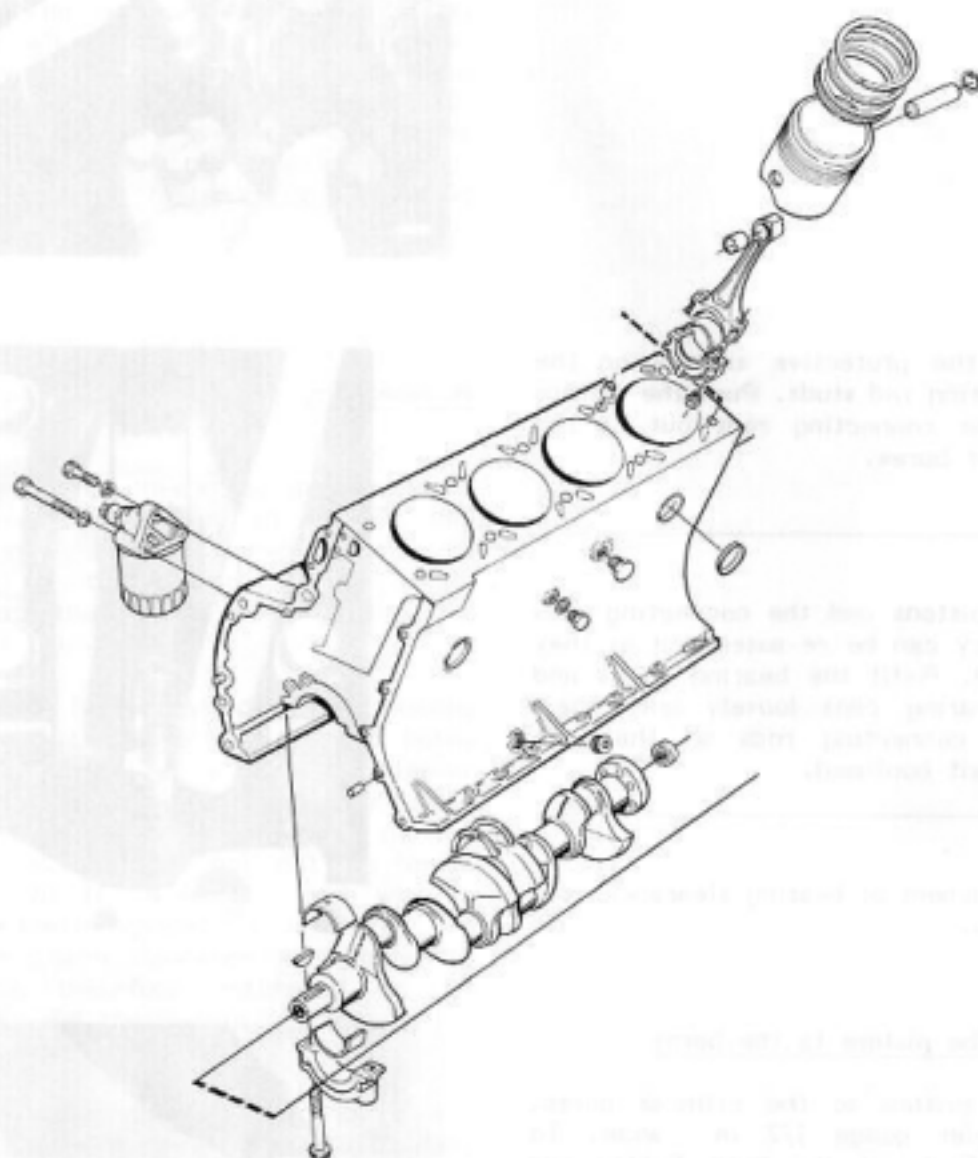
16. Fit the exhaust manifold and turbo unit, and connect the EGR pipe, the turbo pressure pipe, the lubricating oil pressure pipe and the return oil pipe.

17. Fit the inlet manifold, the auxiliary air valve, the pressure regulator and the lifting lug. Connect the vacuum hose to the distributor.



Pistons, connecting rods and cylinder bores B201 and B202

To replace pistons, piston rings
and big-end bearings 212-1



To renew pistons, piston rings and
big-end bearings

(Engine mounted in workstand, cylinder
head removed)

To remove

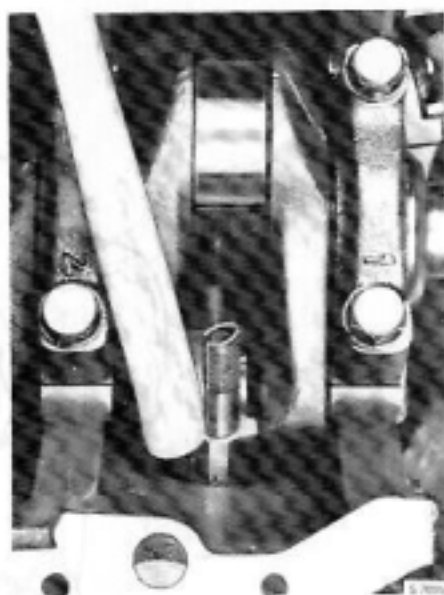
1. Remove any crusts and deposits of carbon from the top ends of the cylinders.
2. Remove the big-end bearing caps.



3. Place the protective sleeves on the connecting rod studs. Push the pistons and the connecting rods out of the cylinder bores.

NOTE

Mark the pistons and the connecting rods so that they can be re-assembled as they were found. Refit the bearing shells and big-end bearing caps loosely onto their respective connecting rods so that the parts are not confused.



For measurement of bearing clearance, see section 216.

Matching the pistons to the bores

To match pistons to the cylinder bores, use a feeler gauge $1/2$ in wide. To measure, first oil the bore lightly and insert the piston without rings in the cylinder in the position in which it will ultimately be working. Attach the feeler gauge to a spring balance and place it between the piston and cylinder bore at right angles to the axis of the gudgeon pin (see illustration). At a tractive force of 8-12 N (1.7 - 2.6 lbf), the mean value of the clearance equals the thickness of the feeler gauge. Repeat the test with



the piston at several different depths. Spare pistons are stocked in both standard and oversize diameters. Where the latter are used, the cylinder bore must be honed or rebored to obtain the correct piston clearance. For piston clearance, refer to the Technical data at the beginning of the group.

Carry out the matching as follows:

Using a feeler gauge and spring balance, determine which piston or pistons has an abnormally large clearance. Replace the piston (or pistons) with a piston (or pistons) of the next oversize. Check the piston clearance of the new piston (or pistons), using the feeler gauge and spring balance.

Example of class A cylinder and class A piston

When the piston clearances are measured in the engine by means of a 0.05 mm feeler gauge, no measurable force is recorded on the spring balance when withdrawing the feeler gauge from no. 2 and no. 3 cylinders.

In no. 1 and No. 4 cylinders, the pistons cannot be fitted into the cylinder bores with a 0.05 mm or a 0.04 mm feeler gauge. When the piston is inserted into the bore with a 0.03 mm feeler gauge, the force necessary to pull out the feeler gauge is 20 N (4.4 lbf) and with a 0.02 mm feeler gauge, it is 6 N (1.3 lbf). The piston clearance in cylinders 1 and 2 is therefore estimated to be 0.032 mm, and the pistons in these cylinders need not be replaced.

Since the piston clearance in no. 2 and no. 3 cylinders is greater than 0.05 mm, it is estimated that the maximum tolerance in these cylinders is 90.010 mm, and since the engine has been run in a certain extent, which should give +0.003 mm, the bore can be assumed to be 90.013 mm.

Assume a standard B piston.

The theoretical piston clearance will then be 0.009-0.017 mm. An estimated running-in clearance of 0.02 mm will result in a maximum clearance of 0.037 mm, which should be sufficient to eliminate unacceptable piston slap. Choose standard B pistons for these cylinders and check with a feeler gauge and spring balance that the correct piston clearance is obtained.

NOTE

Pistons of different makes must not be used in the same engine. The name of the piston manufacturer is cast-in on the inside of the piston. Pistons of the following makes are fitted in production:

Mahle

Karl Schmidt

Hepolite as from 1985 models

The weight difference between the various piston classes is negligible.

Classification of Pistons and cylinder bores

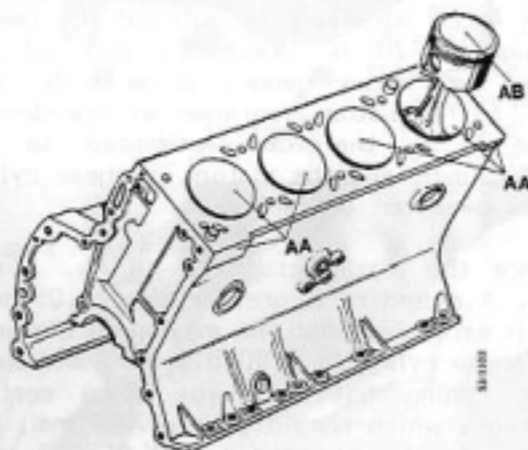
The piston class is stamped on the piston crown. The piston classes for service are:

AB

B

C

The cylinder class is stamped on the cylinder plane and is specified for each cylinder. The cylinder class may be A or B, and both classes may occur in any cylinder block.



Piston classification

Earlier classification

	Turbo (Mahle)	Others (Schmidt)
Standard A (not spare part)	89.960-89.970	89.972-89.980
Standard AB	89.970-89.976	89.980-89.986
Standard B	89.976-89.986	89.986-89.994
Standard C	89.986-90.002	89.994-90.010
First oversize (0.5 mm)	90.460-90.475	90.472-90.487
Second oversize (1.0 mm)	90.960-90.975	90.972-90.987
<u>Piston clearance</u>	0.024-0.050	0.014-0.040

New Classification

	Turbo	Carburettor/ Injection (Mahle, Schmidt) 1984-	Injection (Hepolite) 1985-
Standard A (not carried as spare)	89.960-89.970	89.978-89.988	89.977-89.985
Standard AB	89.970-89.978	89.988-89.996	89.985-89.991
Standard B	89.978-89.986	89.996-90.004	89.991-89.999
Standard C	89.986-90.002	90.004-90.020	89.999-90.015
First oversize (0.5 mm)	90.460-90.475	90.482-90.497	90.477-90.492
Second oversize (1.0 mm)	90.960-90.975	90.982-90.997	90.977-90.992
<u>Piston clearance</u>	0.022-0.050	0.004-0.032	0.009-0.035

Cylinder block

Cylinder bore	Standard (A)	90.000-90.010 mm
	Standard (B)	90.010-90.020 mm
	First oversize	90.500 mm
	Second oversize	91.000 mm

Resulting piston clearance

Earlier classification			New classification			
Piston/cyl. comb.	Clearance limits, 1/1000 mm		Piston/cyl. comb.	Clearance limits, 1/1000 mm		
Piston make	Non-Turbo Schmidt	Turbo Not APC	Piston make	Non-Turbo Mahle	Turbo Hepolite	Non-Turbo Hepolite
A/A	20-38	30-50	A/A	12-32	30-50	15-33
AB/A	14-30	24-40	AB/A	4-22	22-40	9-25
AB/B	24-40	35-50	AB/A	14-32	32-50	19-35
B/A	6-24	14-34	B/A	-	14-32	1-19
B/B	16-34	24-44	B/B	6-24	24-42	11-29
C/B	-	8-34	C/B	-	8-34	-

Matching piston rings to a new or rebored cylinder

1. Push the piston rings down into the cylinder one at a time, using an inverted piston head to position them correctly.
2. Measure the ring gap with a feeler gauge (see illustration). Correct gap sizes are given under 'Technical Data'. If necessary, widen the gap with a special file.
3. Try the piston rings in their respective grooves by rolling. Measure the clearance at a few points too.

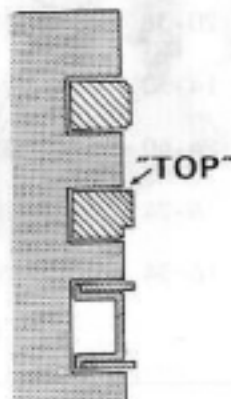
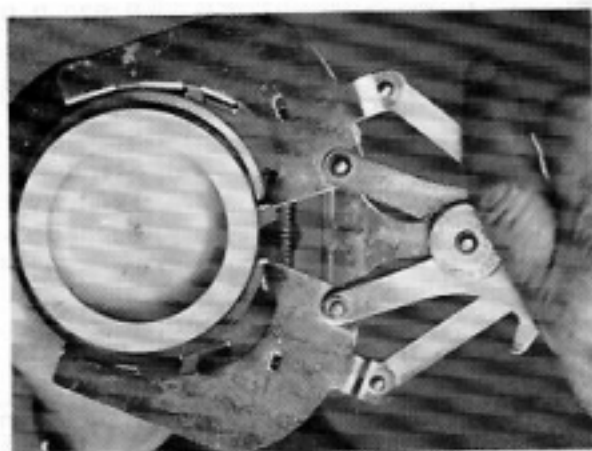


Fitting piston rings in worn cylinder

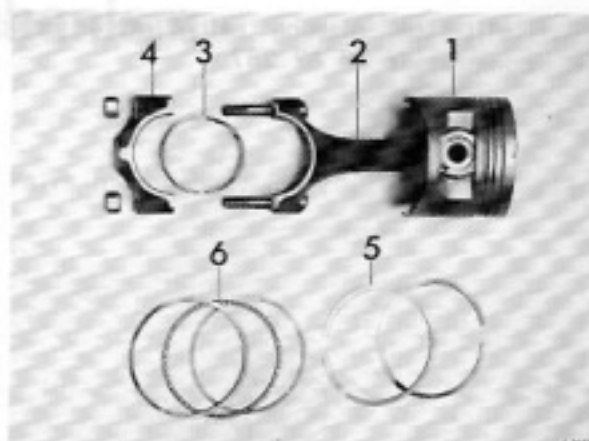
Rings to be fitted in a worn cylinder must be tried at the lower limit of travel of the piston, as the bore will be narrowest at this point.

To fit piston rings to pistons

Use the piston ring tool to fit the rings as illustrated. The lower compression ring should be fitted with the side marked "top" uppermost.



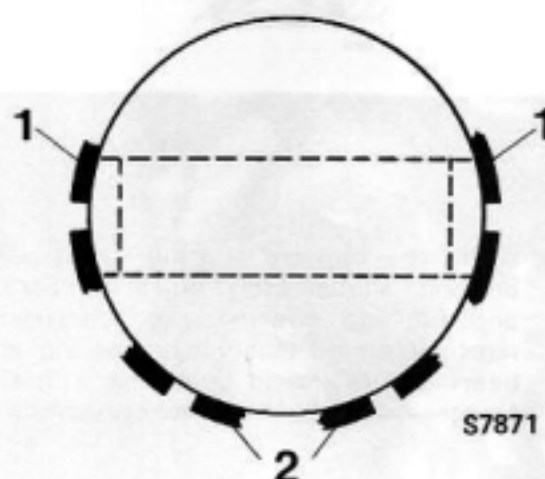
Oil the piston and rings before assembly.



Piston and connecting rod with bearings and piston rings

1. Piston
2. Connecting rod
3. Bearing
4. Bearing cap
5. Compression rings
6. Oil scraper ring

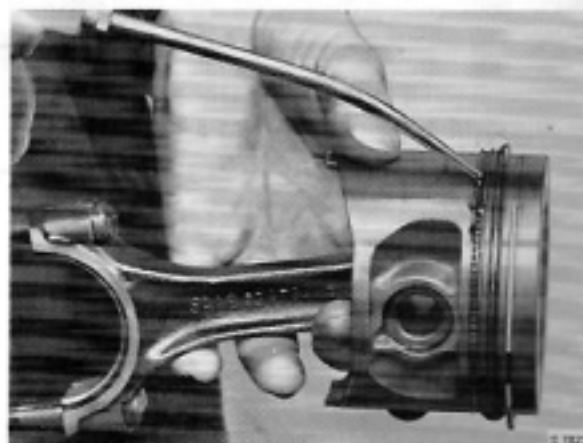
Position the compression rings so that the gaps are at approx. 180° to each other, each positioned above one of the gudgeon pin holes. Make sure, that the gaps in the oil scraper ring are equally spaced out round the piston, and not in line with one another.



1. Compression rings
2. Scraper ring

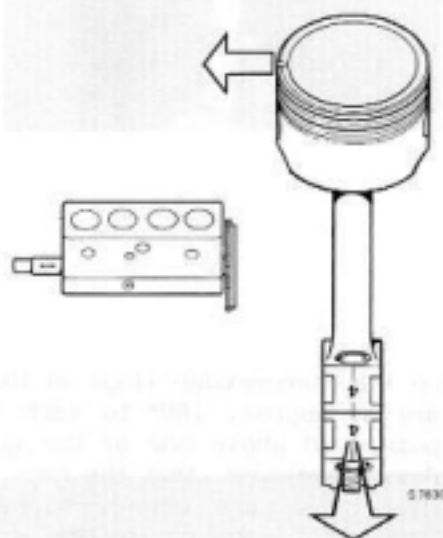
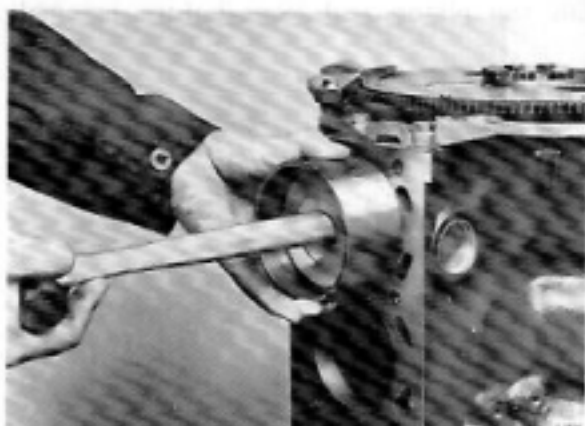
To fit the pistons in the cylinders

1. Place the bearing shells in position in the connecting rods and fit the protective sleeves to the connecting rod studs.
2. Oil the piston rings and bearings.

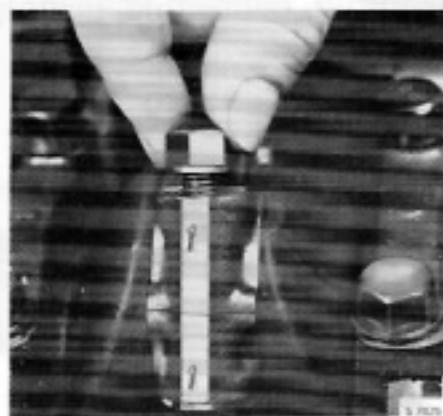


3. Refit the pistons using piston ring compressor 78 62 287

Ensure that the piston crown markings are pointing towards the timing cover and that the connecting rod figures face the exhaust side.



4. Refit the big-end bearing caps with bearing shells (the big-end bearing and big-end bearing cap identifying numbers should coincide). The big-end bearing nuts should be fitted with the flanges towards the connecting rods.



Tightening torque
Big-end bearings 54 Nm (40 ft. lb)



Valve mechanism

Valve mechanism, B201 214-1

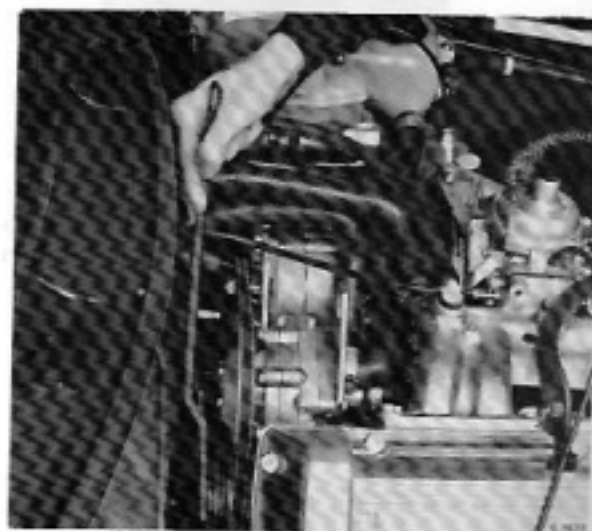
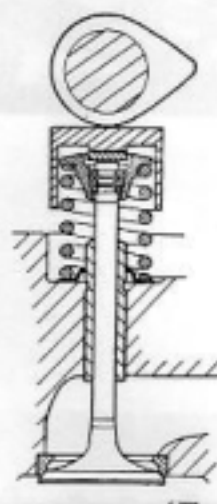
Valve mechanism, B202 214-16

Valve mechanism, B201

To remove the camshaft cover

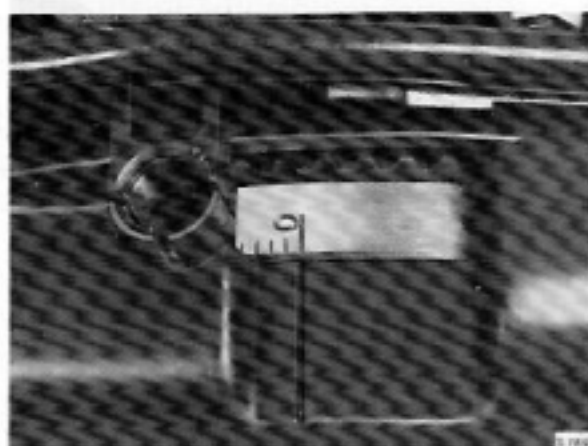
1. Rotate the crankshaft to the "0" mark
(top dead centre for No. 4 cylinder)

2. Disconnect the crankcase ventilation hoses.
3. Disconnect the HT leads from the spark plugs.
4. Remove the bolts and lift off the cover.

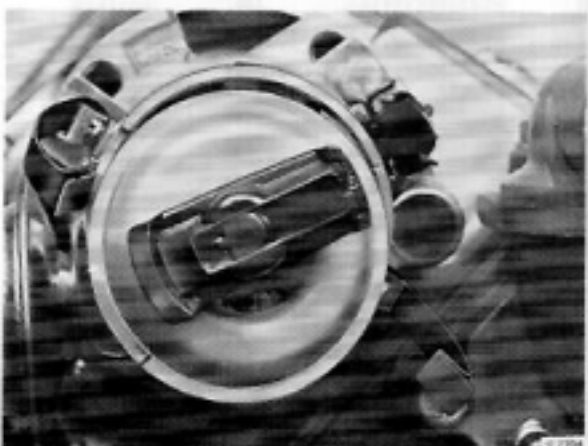


To refit

1. a. Ensure that the camshaft and the crankshaft are at top dead centre for No. 1 cylinder.



- b. Remove the distributor cap and lineup the distributor arm with the mark on the distributor housing.



2. Insert the gasket in the groove running round the cover.
3. Refit the camshaft cover.

Tightening torque
Camshaft cover 4.9 Nm (3.6 lb ft)

4. Refit the distributor cap and HT leads.
5. Refit the crankcase ventilation hoses.

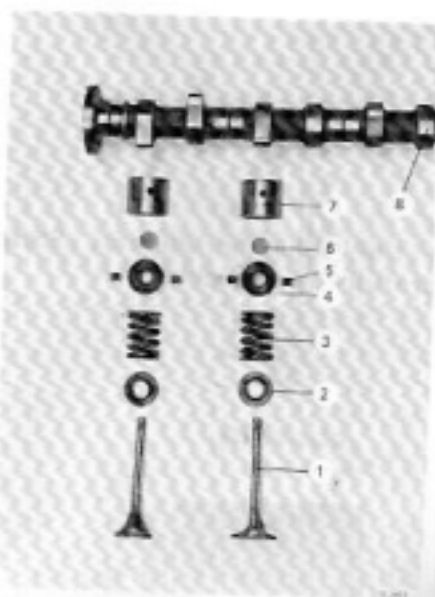


Valves

To remove

(Cylinder head removed from cylinder block)

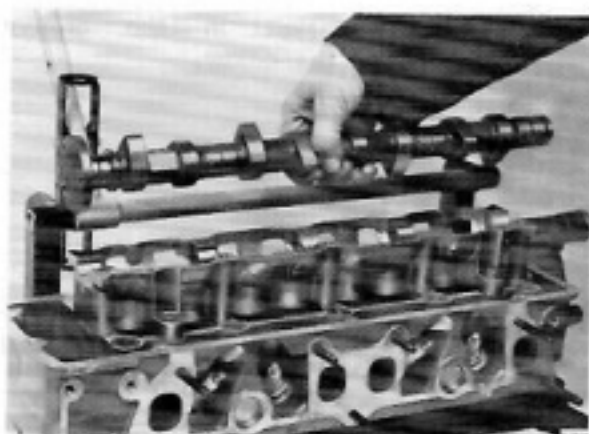
1. Remove the camshaft bearing caps.



Valve mechanism

1. Valve
2. Valve spring seat
3. Valve spring
4. Retainer
5. Collet
6. Adjusting pallet.
7. Valve depressor.
8. Camshaft

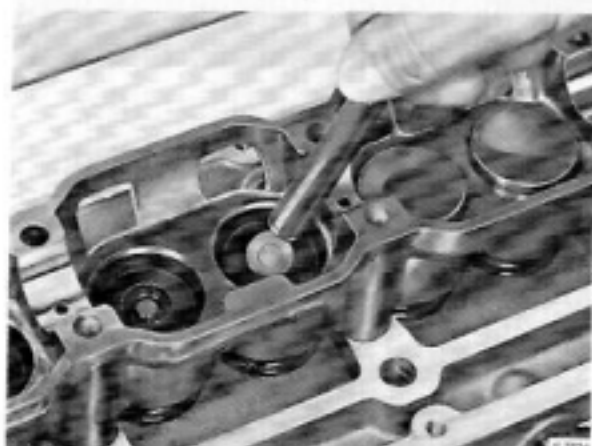
2. Lift off the camshaft.



3. Use the magnetic tool to extract the valve depressors and store them in the correct sequence.



4. Remove the adjusting pallets. Store them carefully in sequence.



5. Remove the camshaft bearing assembly.



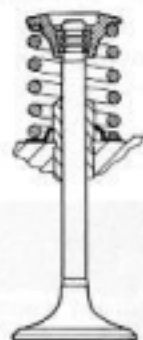
Place the cylinder head in the valve spring compressor 83 93 050.



6. a. Compress the valve springs.
b. Remove the collets release the spring and remove the tool.
7. Remove the valve spring retainer, valve spring and valve spring seat.
8. Withdraw the valve.

To refit

1. Oil the valve stems and refit the valves.
2. Refit the valve spring seats.
3. Refit the valve springs and the valve spring retainers.
4. Compress the valve springs using the valve spring compressor and refit the collets release the valve spring compressor and check that the collets are correctly positioned round the valve stem. Remove the tool.



5. Refit the camshaft bearing assembly.

NOTE

Ensure that the feeler gauge apertures face the inlet side. Incorrect installation of the camshaft bearing assembly cuts off lubrication to the valve gear.

6. Refit the adjusting pallets in their original positions.
7. Apply a thin coat of engine oil to the valve depressors and refit them. Fit the bearing assembly so that the lubrication line and the hole in the cylinder head are connected.

Caution

Do not move the cylinder head from its vertical position once the valve depressors are refitted. Moving the head can cause the valve depressors and adjusting pallets to fall out.

8. Refit the camshaft.

9. Refit the bearing caps.

(Note. Line up the marks).

Tightening torque
Camshaft bearing caps
18 Nm (13.3 ft. lb)

Scrapping sodium-filled exhaust valves

Caution

Discarded sodium-filled valves should never under any circumstances be mixed with normal scrap as they are liable to explode when melted down.

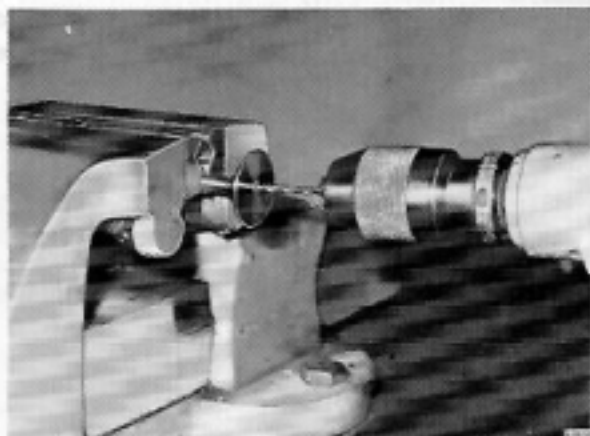


Fit the bearing assembly so that the oilway and the hole in the cylinder head are connected.

Sodium-filled exhaust valves are fitted in injection engines.

Before scrapping, the valves should be treated as follows:

1. Drill a hole in the centre of the valve head until contact is made with the sodium filling.

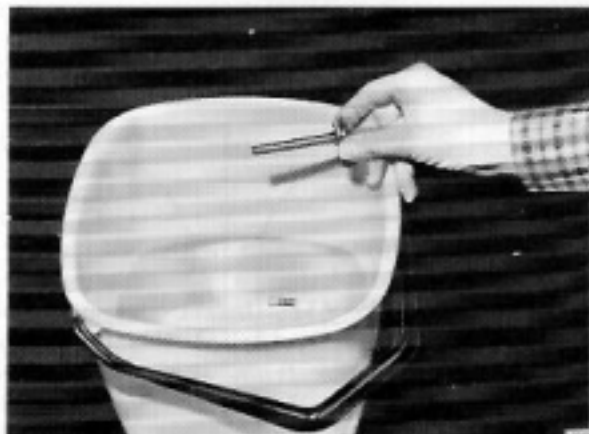


2. Drill a second hole in the valve stem or cut off approx. 25 mm (one inch) from the end of the stem.

Warning

When drilling, cutting or in any way releasing the sodium filling, keep away from water to avoid explosions.

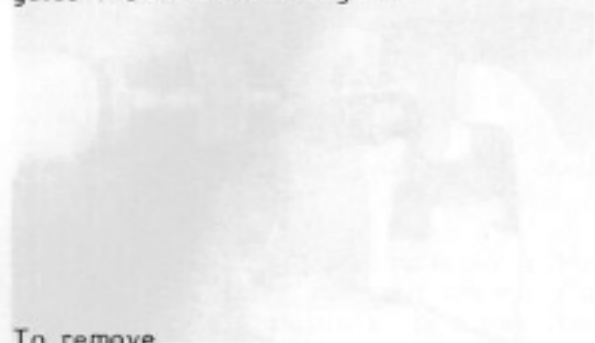
3. Throw the valve into a bucket of water. On contact with water a powerful explosive reaction will occur. The manufacturer recommends 3.5 yards (3 metres) as the minimum safety distance. After 1 - 2 minutes the reaction will die down and the valve may now be scrapped in the normal way.



Valve guides

To check for wear

Pull up the valve 0.12 in (3 mm) from its seat and check the radial play by rocking the valve head. If the play at the head exceeds 0.02 in (0.05 mm) the valve guide should be exchanged.



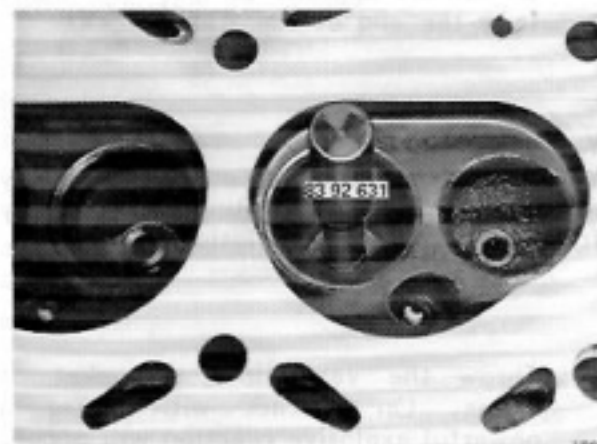
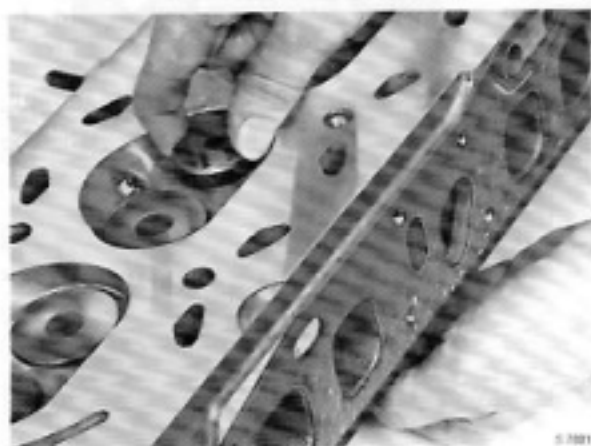
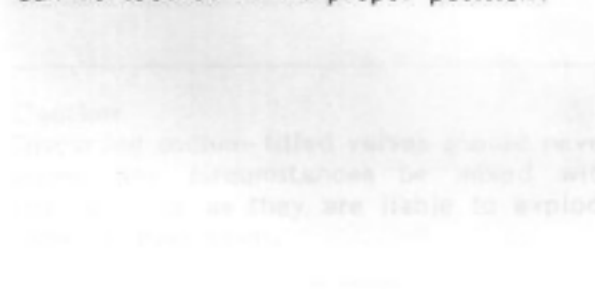
To remove

Before removing the valve guide, flush the cylinder head with hot water. Press out the guide using a drift and tool 83 92 631



To replace

Flush the cylinder head with hot water. Insert the guide using a press and valve guide tool 83 92 631. Insert the centring drift from the underside of the head and press in the guide from above using the drift. In the final stages the valve guide tool moves to one side and the valve guide can be located in its proper position.



Milling valve seats

Clean all parts and remove all traces of carbon and dirt from the valves and ports.

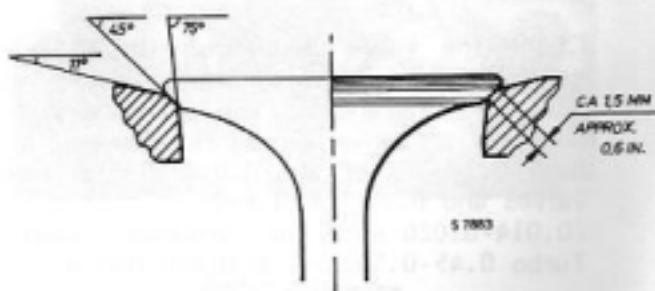
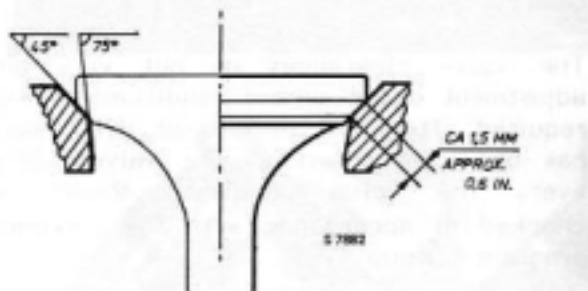
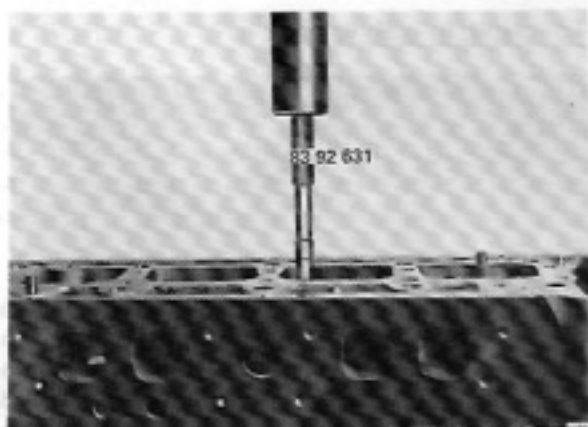
Insert the cutter pilot in the valve guide and tighten the bolt until the pilot is secured in the guide. The valve seats in the cylinder head should be recut with a 45° cutter. It may be necessary to use an emery cloth first to remove the hard deposits on the surface of the exhaust valve seats.

After recutting, the width of the valve seat is often excessive and must be reduced.

The exhaust valve seats should only be reduced from the bottom by means of a 75° cutter. The contact surface should extend to the periphery of the valve head.

The width of the inlet valve seats should be reduced so that the contact surface lies in the middle of the ground surface of the valve head. Reduce from the bottom by means of a 75° cutter and from the top using an $11^\circ - 12^\circ$ cutter. In carburettor engines, valve seats incorporating a restriction cannot be milled, as the cutter will come into contact with the restriction.

Engineers' marking can be used to check the finished seat width which should be 1,5 mm (0.06 in.) approx. for both inlet and exhaust valve seats.



To grind in valves

If, on examination of the valves, it appears unlikely that they will clean up satisfactorily with ordinary grinding in, they must be refaced or replaced. The valve faces should be at an angle of 44.5° .

Place a small amount of valve grinding paste evenly round the valve seat and place on its seating by means of the grinding tool. Rotate the valve from side to side through a few degrees only, using light pressure. Remove the valve, clean the seat and check for a good seal with engineers' marking.

Continue grinding in if necessary and recut the valve seats if required.

NOTE

The exhaust valve seats are stellite and are therefore not suitable for machine grinding. Grinding other than with the use of grinding paste is therefore not recommended.

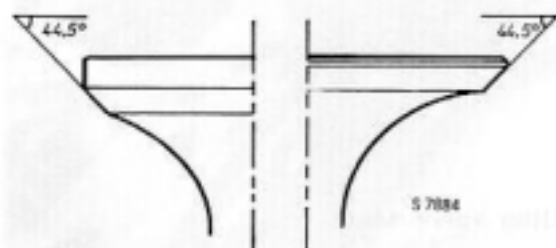
Valve clearance

General

The valve clearances do not vary and adjustment under normal conditions is only required after long periods or when work has been performed on the valves. However, the valve clearance should be checked in accordance with the servicing program (Group 110).

Checking

Check the valve clearance with a feeler gauge, comparing with the maximum and minimum tolerances. The tolerances for purposes of valve clearance checking are 0.15-0.30 mm (0.006-0.012 in) for inlet valves and 0.35-0.050 mm (0.014-0.020 in) for exhaust valves. Turbo 0.45-0.50 mm (0.018-0.020 in)



The procedure is as follows:

1. Rotate the crankshaft to the "0" position. Use spanner 83 92 185 on the pulley bolt, or rotate the wheel as described before.
2. Remove the valve cover.

NOTE

The distributor drive design only allows the camshaft to be removed with either cylinder 1 or No. 4 at top dead centre.

3. a. Rotate the crankshaft using spanner 83 92 185 until the cam lobe of the valve to be measured is opposite the valve depressor.

- b. Check the valve clearance with the feeler gauge. If it does not fall within the limits then the clearance should be measured and adjusted.

4. Rotate the crankshaft to TDC on the compression stroke for No. 1 cylinder and fit the valve cover. (See Section 214.)



Andy's VW Service
R.R. 1, Box 500A
Machias, Maine 04654

To measure and adjust

The clearance of all valve should be checked if one is found to fall outside the prescribed limits.

Adjustment of valve clearance is to be based on actual measurement. Measurements are made using tool 83 91 450 and a dial indicator.

Adjustments in valve clearances are made by fitting adjusting pallets of different thicknesses. Measurement and adjustment are performed as follows:

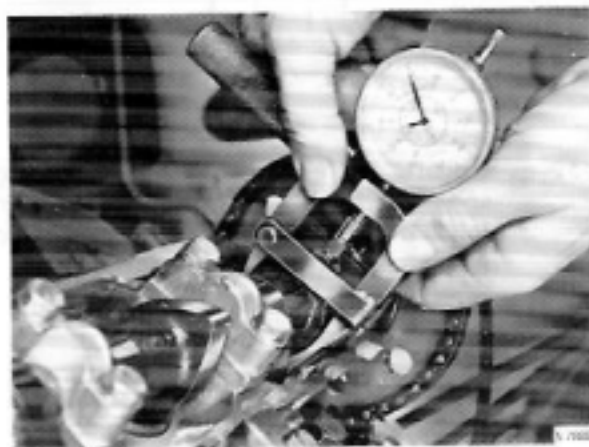
1. Position the cam lobe opposite the valve depressor.
2. Assemble measuring tool 83 91 450, and the dial indicator and clamp the three jaws onto the valve depressor. Position the point of the plunger on the top of the cam lobe. Set the dial to zero.

3. Using the measuring tool, lift the valve depressor and read off the valve clearance on the dial.

Note the reading.

4. Measure and note the clearances of all valves in the same manner. Adjust the clearance of any valves which does not lie within the following limits:

Inlet valves	0.20-0.25 mm (0.008-0.010 in)
Exhaust valves	0.40-0.45 mm (0.0157-0.0177 in)
Exhaust valves:	
Turbo:	0.45-0.50 mm (0.018-0.020 in)



5. Remove the camshaft and the valve depressors and adjusting pallets of the valves requiring adjustment.

6. Measure and note the thickness of the pallets using tool 83 91 633 or a micrometer. This thickness plus the valve clearance equals the total distance between the valve depressor and the cam.

Example:

Valve clearance
measured 0.13mm(0.005 in)

Pallet thickness
measured 2.54mm(0.100 in)

Total distance 2.67mm(0.105 in)

The thickness of the adjusting pallet required equals the total distance measured between the valve depressor and the cam, less the valve clearance specified for the inlet or exhaust valve.

Example:

Total distance 2.57mm(0.105 in)

Less specified
inlet valve
clearance 0.20-0.25mm
(0.008-0.010 in)

Pallet thickness
required 2.44mm(0.097 in)

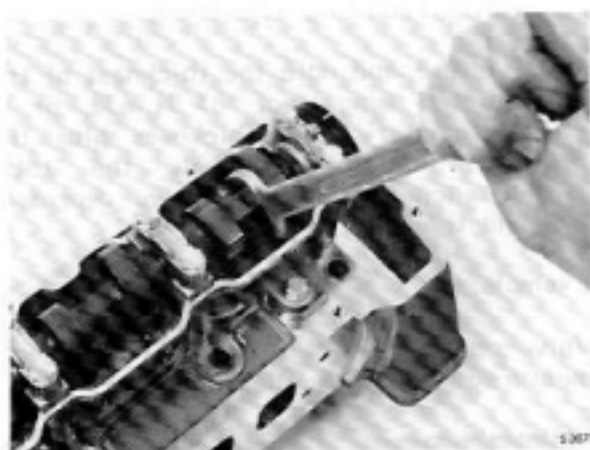
Select an adjusting
pallet 2.43mm(0.096 in)

7. Fit the new adjusting pallet and refit the valve depressor and the camshaft.

8. Repeat the measurement procedure to check that the clearances are now correct.

**To measure and adjust valve clearance
after work on valves**

1. Fit the thinnest adjusting pallets (1.77mm or 0.0697in).
2. Refit the valve depressors and camshaft.
3. Measure the clearances for each valve and calculate the total distance between the cam and the valve depressor.
4. Calculate the thickness of the adjusting pallets required to give the correct clearances.
5. Remove the camshaft and valve depressors, extract the adjusting pallets (1.77mm or 0.0697 in) and install the new pallets.
6. Refit the valve depressors and camshaft.
7. Use the dial indicator to check the valve clearance. Use the table elsewhere in this section to simplify calculating the thickness of the adjusting pallets.



Pallet thickness measured	Valve clearance measured with dial indicator (mm)																		
	Inlet, mm																		
	0.00	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.20	0.22	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.45	0.47
Exhaust (standard) mm	2.64	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88	1.82
Exhaust (Turbo) mm	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88
Valve clearance measured with dial indicator (mm)																			
0.00	2.64	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88	1.82
0.02	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88	1.82	1.77
0.05	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88	1.82	1.77
0.07	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88	1.82
0.10	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88	1.82
0.12	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88
0.15	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.93	1.88
0.17	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.82
0.20	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.98	1.82
0.22	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.25	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.27	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.30	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.32	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.35	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.37	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.40	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.42	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.45	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.47	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.50	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.52	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.55	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.57	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.60	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.62	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.65	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.68	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.70	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88
0.72	2.89	2.84	2.79	2.74	2.69	2.64	2.59	2.54	2.48	2.43	2.38	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.88

Valve adjustment table - instruction for use

The following example illustrates how the table is used:

The inlet valve clearance is 0.13 mm and therefore needs adjusting. The pallet thickness measured for this pallet is 2.54 mm.

Take the figure 0.12 on the vertical axis

(the closest in the table to the clearance recorded) and follow it across the table to the 2.54 mm inlet pallet thickness column. The pallet thickness required, 2.43 mm, can be read off from the intersection of the vertical line and the horizontal column.

General

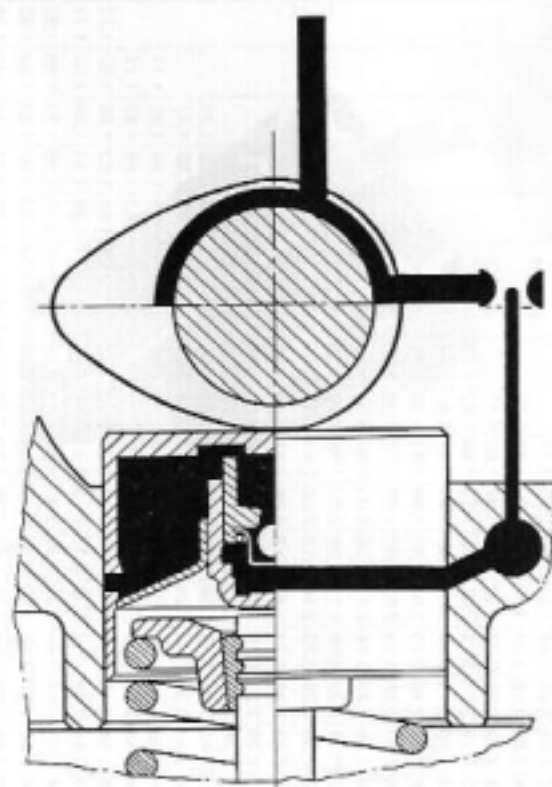
Hydraulic cam followers

The valve mechanism incorporates hydraulic cam followers, which keep the valve clearance within a limited working range of 2.05 mm (0.0807 in). This range lies between 18.75 and 20.8 mm (0.7382 - 0.8189 in) from the camshaft to the end of the valve stem.

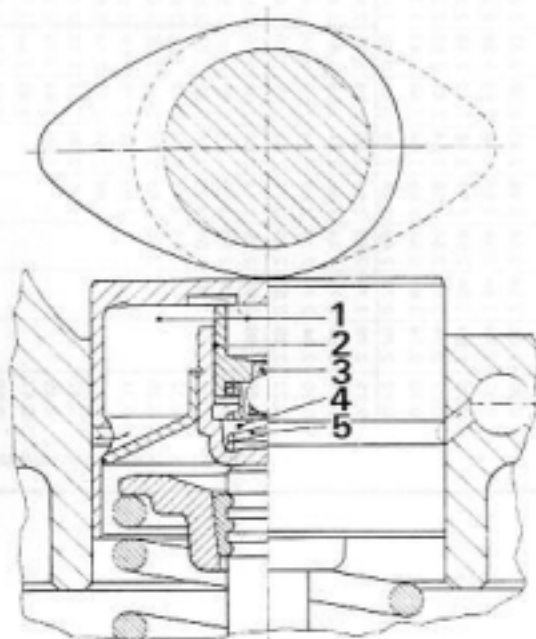
Each cam follower has two storage chambers and one high-pressure chamber. The opening of the port between the high-pressure chamber acts on the sliding piston, to eliminate any clearance between the cam follower and the cam. At the same time, the high-pressure chamber expands and makes up the oil volume, to compensate for leakage losses occurring at actuating pressure in the passage between the piston and the cylinder.

The hydraulic cam followers constitute a replacement unit; consequently, if defective, they cannot be repaired but must be replaced. Under various conditions, the hydraulic cam followers may give rise to noise, detectable as a tapping or rattling sound of varying intensity. In most cases, the noise will be short-lived and no remedial action will therefore need to be taken. The following is a list of the commonest conditions under which noise occurs, the likely causes of the noise and preliminary action that may be taken to get rid of the noise.

1. Rattling noise from the valves on starting the engine after an oil change.
If the noise from the valves did not occur before the oil change, the noise will automatically disappear as soon as the oil in the engine has reached normal working pressure.



Oil flow through the cam follower



1. Storage chamber
2. Leakage passage
3. Check valve
4. High-pressure chamber
5. Spring

2. Temporary noise on starting a cold engine.

This noise is perfectly normal and will disappear automatically as soon as the oil in the engine has reached normal working pressure.

3. Rattling noise from the valves on starting after work on the car that has involved cranking the engine by hand or on the starter motor.

The noise is due to one or more of the cam followers having been drained of oil and will therefore disappear after the engine has been running for a while. At worst, it may take fifteen minutes at between 2000 and 3000 r/min for the noise to disappear. At lower engine speeds, it will obviously take considerably longer to expel the air. Do not run the engine at a speed greater than 3000 r/min as this may damage the cam followers.

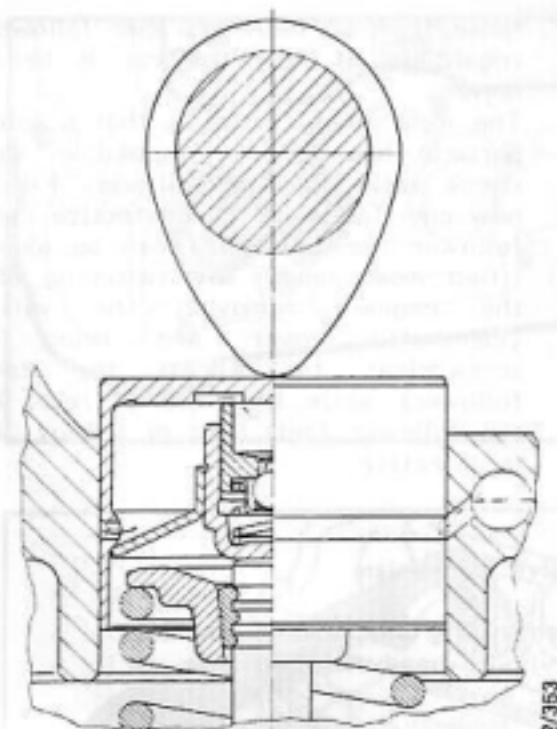
4. Noise after fitting new cam followers. The cause and remedy are the same as under item 3 above.

5. Noise occurring after a short period of idling with a hot engine (hot oil). With the engine running at 1500 r/min or more, the noise disappears after a while.

The noise is due to low oil pressure in the hydraulic cam followers when the engine is idling. Check the oil feed pipe, connectors and O-rings for leaks.

6. Noise occurring at high engine speeds and disappearing after the engine has been at idling speed for either a short or prolonged period.

This noise is due to an excessive amount of air in the oil at high engine speeds. The ingress of air is caused by leakage on the suction side of the oil pump, a poorly sealing O-ring in the suction pipe or a leak in the suction pipe caused, for instance, by a porous weld.



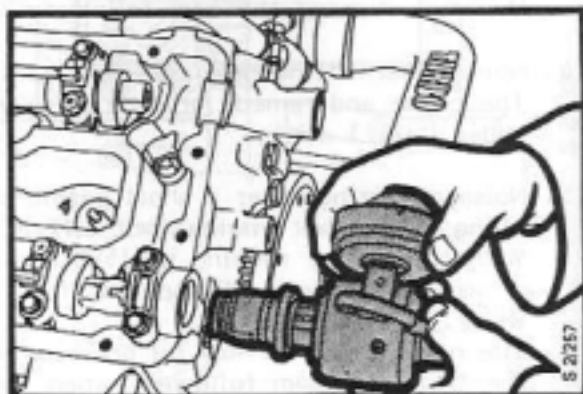
7. Noise from an individual cam follower regardless of how the car is being driven.

The most likely cause is that a solid particle has become trapped in the check valve for the follower. Fit a new cam follower. The defective cam follower (or followers) can be identified most readily by switching off the engine, removing the valve (camshaft) cover and using a screwdriver to depress the cam followers while they are at rest. If the follower feels light or spongy, it is defective.

Valve mechanism

Dismantling the valve mechanism (cylinder head removed from car)

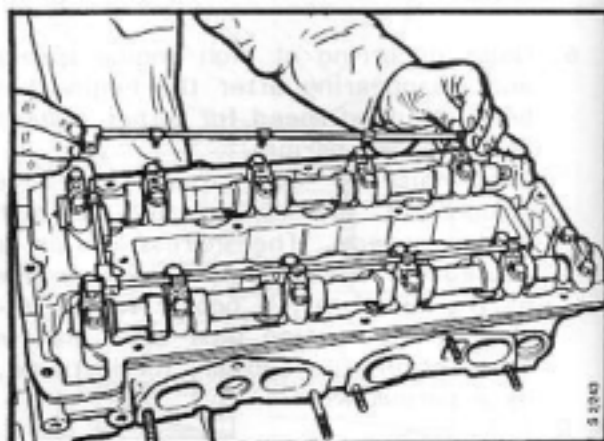
1. Remove the distributor.



2. Remove the oil pipes and the camshaft bearing caps and lift out the camshafts.

NOTE

Do not twist the pipes when removing them as this is liable to damage the mating surfaces between the pipes and couplings.

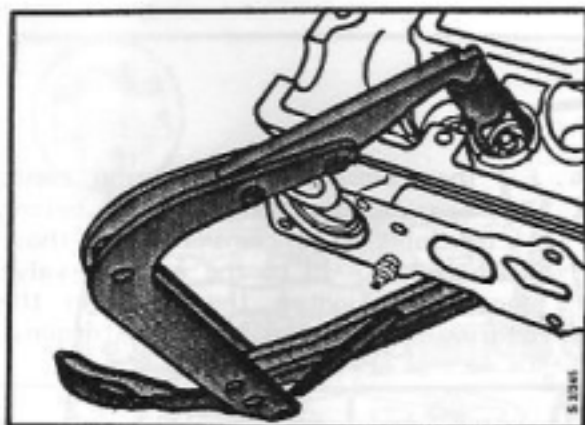
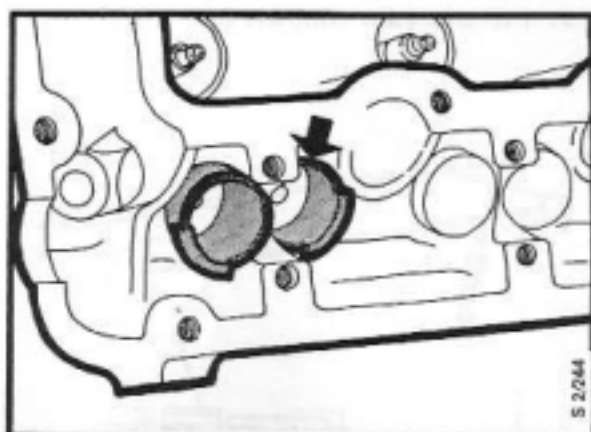


3. Remove the cam followers and place them in stand 83 93 787 to ensure they will not be confused when refitted.

4. Remove the valves. Place the valves in stand 83 93 787 to ensure they will not be confused when refitted.

NOTE

The cylindrical tappet guides around the valve springs constitute the sealing surfaces for the cam followers. These surfaces must not be scratched or scored, so use a plastic sleeve to protect the guides. Use the special valve spring compressor, 83 93 761, and special anvil 83 93 779. Withdraw the plastic sleeve by inserting the special angled tool under the reinforced edge.



Assembling the valve mechanism

Prior to assembly, thoroughly lubricate all the parts.

1. Fit the valves and springs. Use plastic sleeves to protect the cam followers guides.

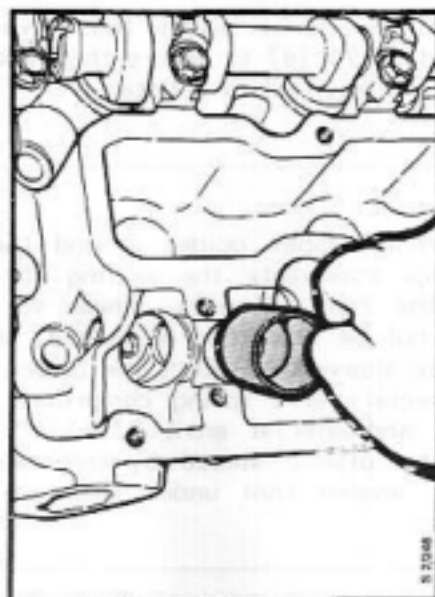
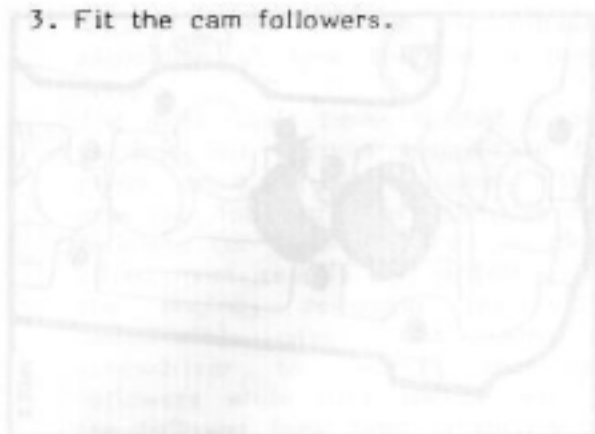
NOTE

Replace any defective valve stem seals before fitting the valves.

2. Check the valve adjustment, following the procedure described in this section.



3. Fit the cam followers.

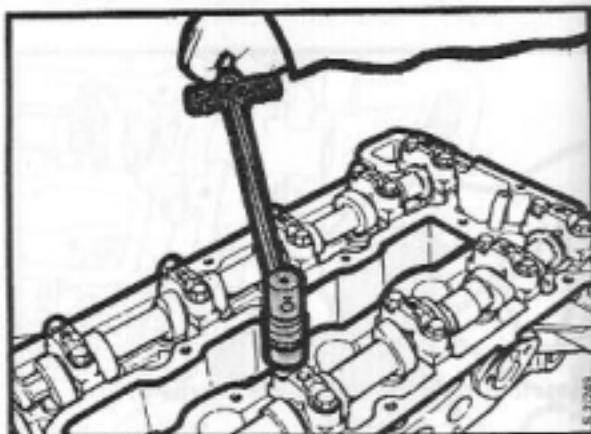


4. Fit the camshafts and bearing caps. The bearing caps marked 1 - 5 belong to the inlet-valve camshaft, and those numbered 6 - 10 to the exhaust-valve camshaft. Tighten the bolts in the bearing caps to the specified torque.

Tightening torque
15 Nm (11.1 ft. lb)

NOTE

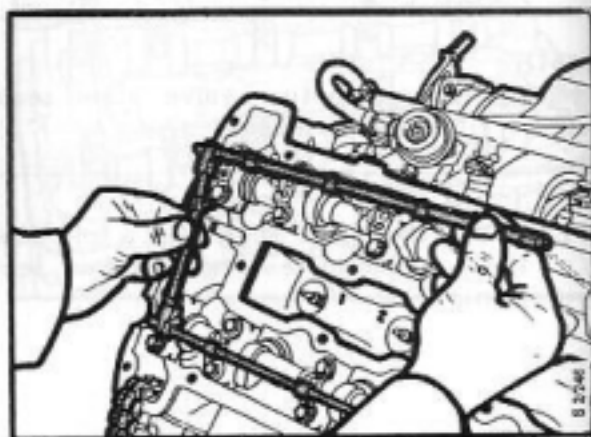
Make sure that the cylinder head is blocked up, so that the valves will not be bent when the camshafts are tightened down.



5. Refit the distributor and the lubricating oil pipes. Check the condition of the 'O' rings in the couplings on refitting the oil pipes.

NOTE

Make sure when refitting the pipes that the outlet holes face the right way. The longer pipes locate in the straight couplings and the shorter ones in the elbows.

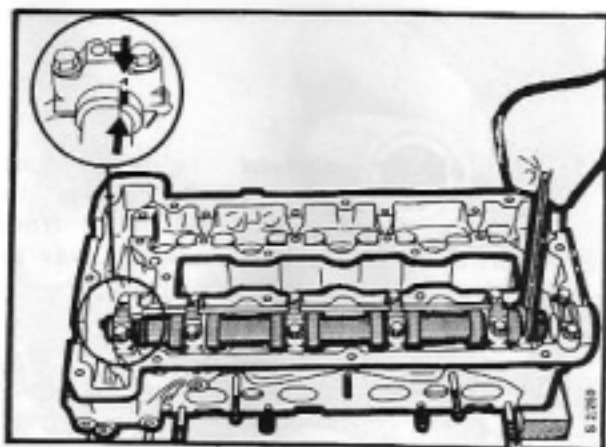
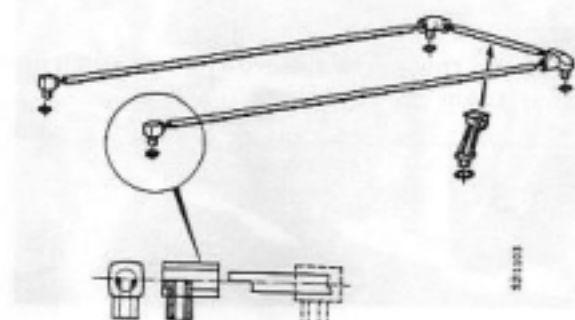


After reassembling the pipes, reconnect the pipework to the oilways in the bearing caps and cylinder head.

NOTE

Do not twist the pipes as this is liable to damage the mating surfaces between the pipes and the couplings.

6. Line up the marks on the camshafts with the respective timing marks.



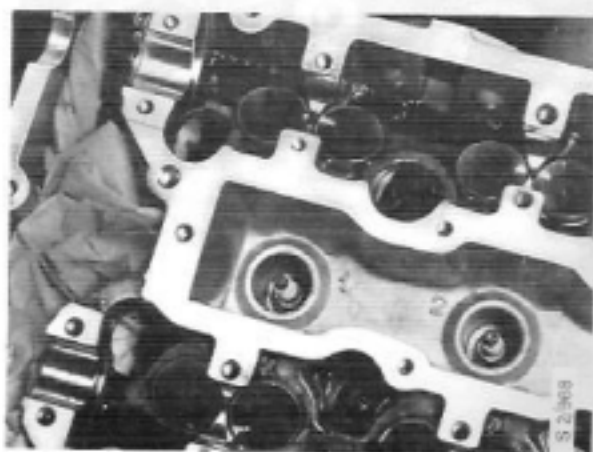
Valve stem oil seals

To change (in situ)

The same procedure should be followed in conjunction with the replacement of valve springs, valve heads or collets.

To remove

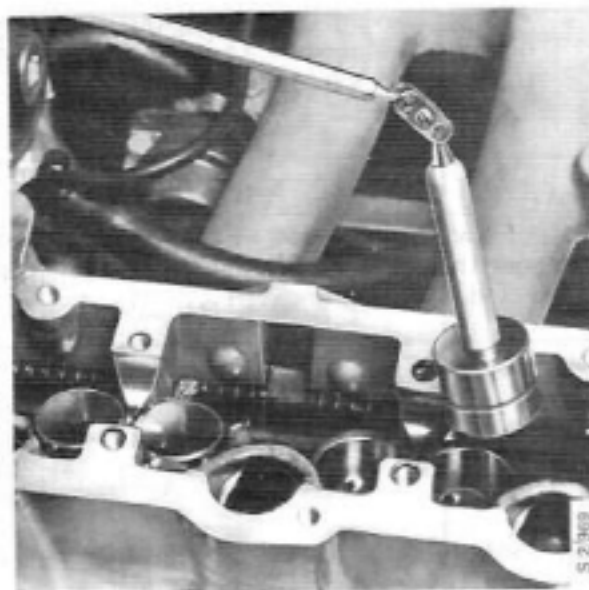
1. Rotate the crankshaft and line up the 'O' mark (top dead-centre for no. 1 and no. 4 cylinders) and remove the camshafts (all valves are closed in this position). Place a cover over the timing cover to prevent collets or seals falling inside.



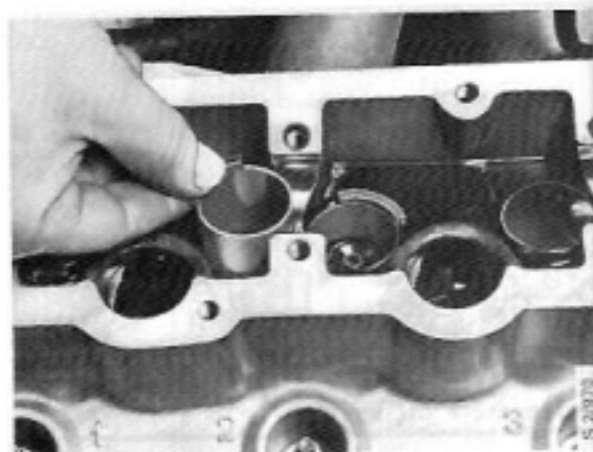
2. Using magnetic tool 83 91 401, lift out the cam followers.

NOTE

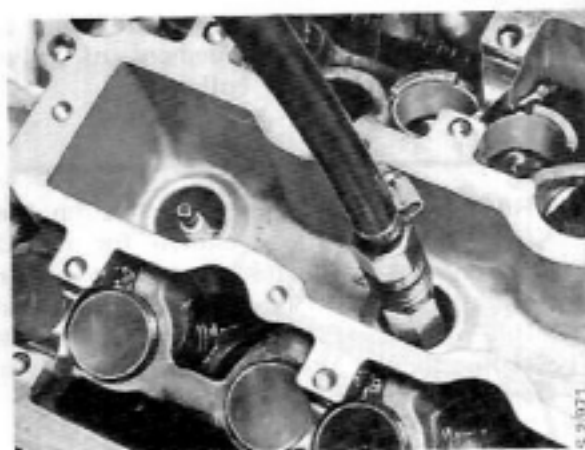
Set aside the parts carefully to avoid confusing them on refitting.



3. Fit plastic sleeves (special tool 83 93 746) to the valve springs to prevent the tappet-guide bores from scoring or scratching. Note the way in which the sleeves are oriented.



4. Unscrew the spark plug for the cylinder concerned and fit compressed-air adaptor 83 92 326. Connect the adaptor to an air line and raise the pressure on the piston and valves.



5. Position tool 83 94 181 on the valve head, directly in line with the valve stem. Using a hammer, tap the tool firmly once, whereupon the collets should come free from the valve and follow the tool out.



6. Lift out the spring cap and valve spring.

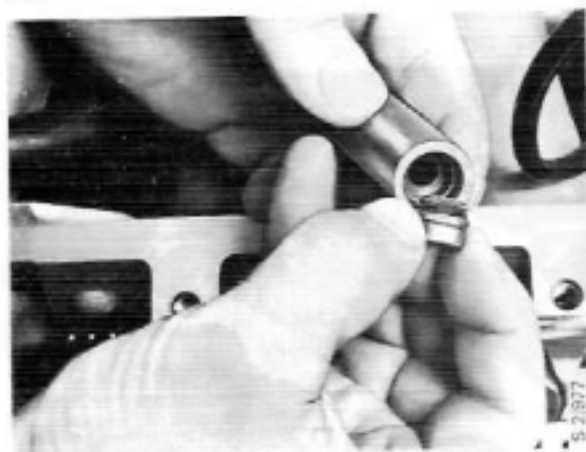
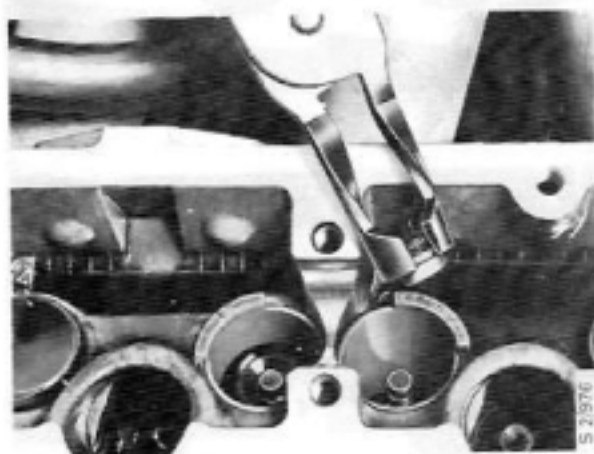


7. Remove the valve seal using tool 83 94 157.



To refit

1. Remove the shank from tool 83 93 803 and fit the valve seal in the tool with the taper facing inwards (away from the valve head).



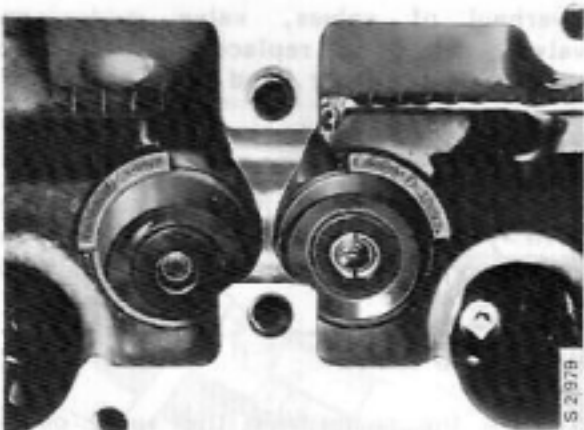
2. Fit the seal on the valve stem. Use a plastic-faced mallet to tap the seal carefully into position.



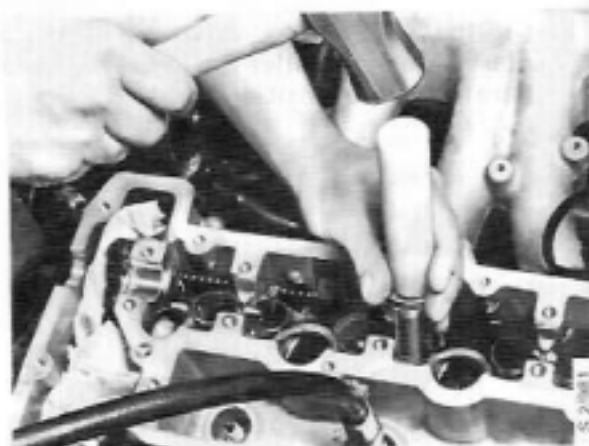
3. Fit the spring and spring cap.



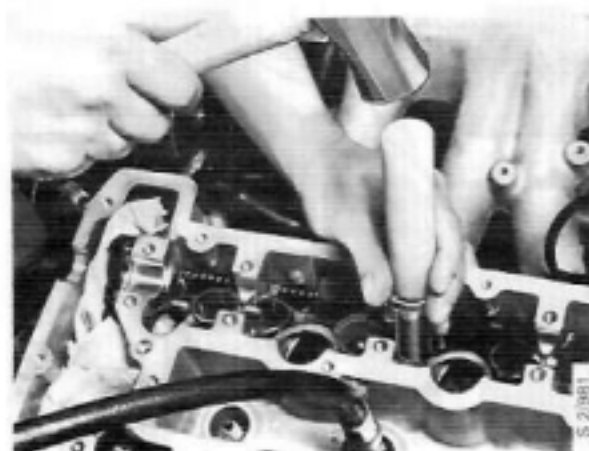
4. Position the collets in the groove in the spring cap as shown.



5. Using tool 83 94 181 with sleeve 83 94 207 and a hammer, carefully tap the collets home.



6. Remove the plastic sleeves and fit the cam followers.



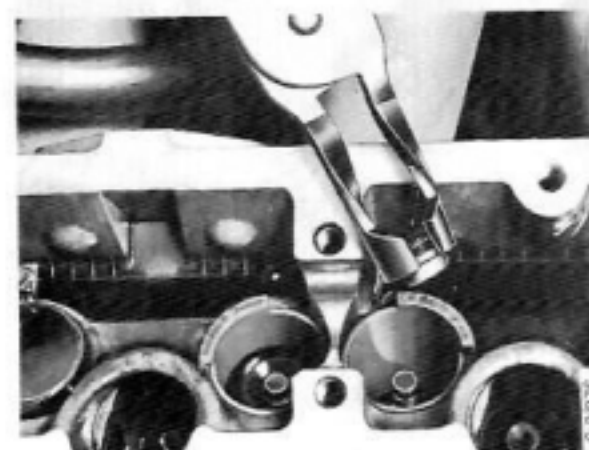
Overhaul of valves, valve guides and valve seats and replacement of valve stem seals (cylinder head removed)

Removal

The work is carried out after the valves have been removed. Refer to the beginning of this section for details of valve removal.

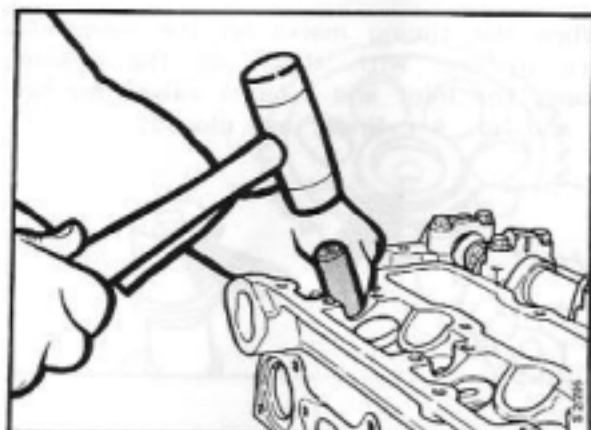
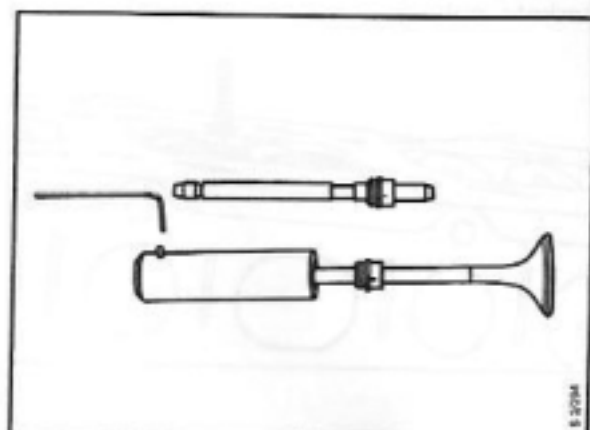
Valve stem seals

Remove the seals from the valve guides using tool 83 94 157. If the guides are to be replaced, remove the guides and seals together.



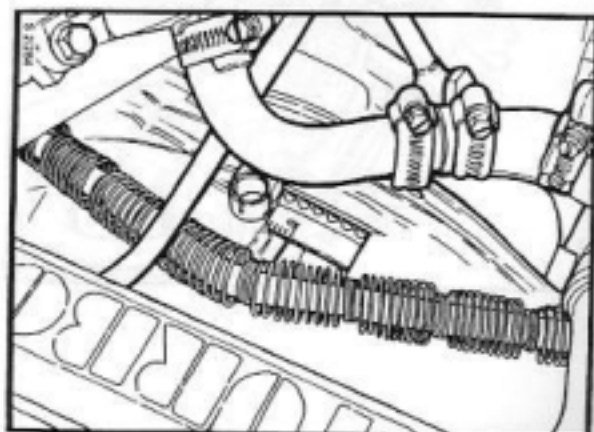
To refit

Refit the seals using special tool 83 93 803. Place the seal in the tool and then allow the tool to be guided by the valve guide. If the valve is fitted, use the stem as a guide. Tap the seal into position using a plastic-headed mallet.



Setting the valve and crankshaft mechanisms

When the pistons in No. 1 and No. 4 cylinders are at top dead centre, the crankshaft, ie. the '0' mark on the flywheel, must be in line with the mark on the clutch cover - or end plate if the clutch cover has been removed.

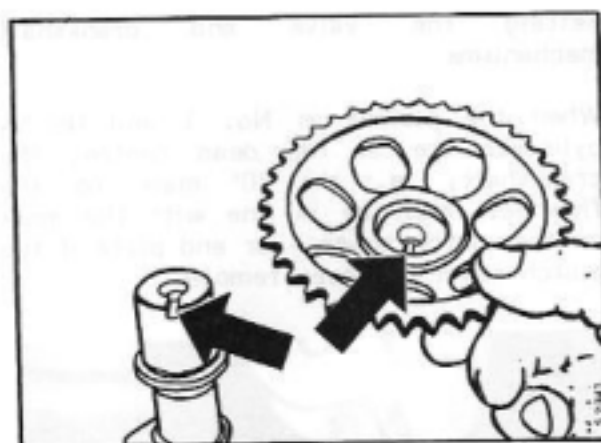
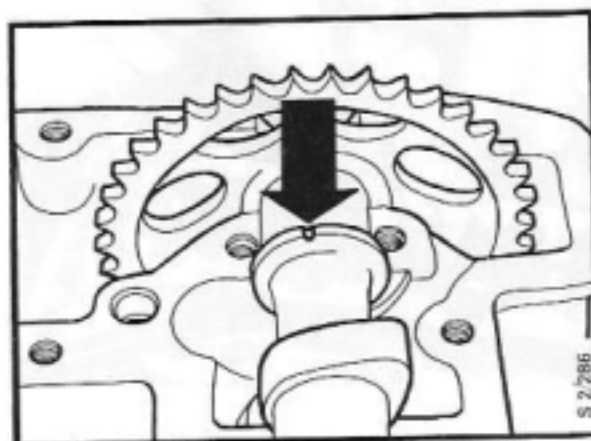
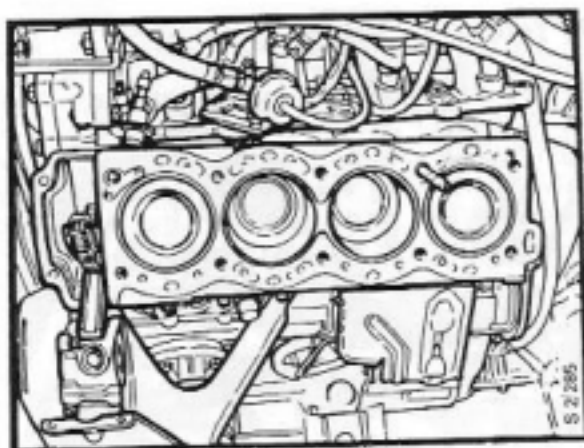


(EGR pipe shown in the picture is fitted to cars with specifications for certain markets only.)

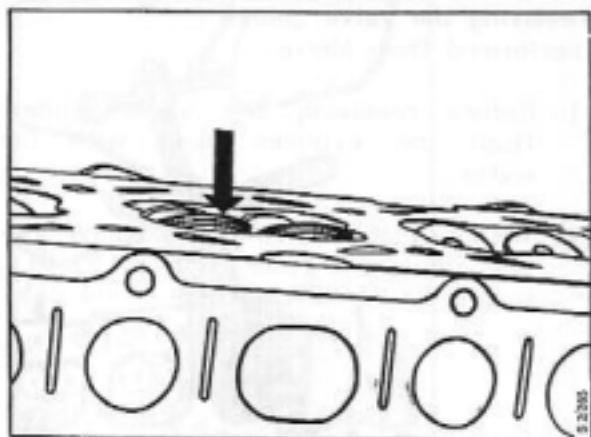


Valve mechanism

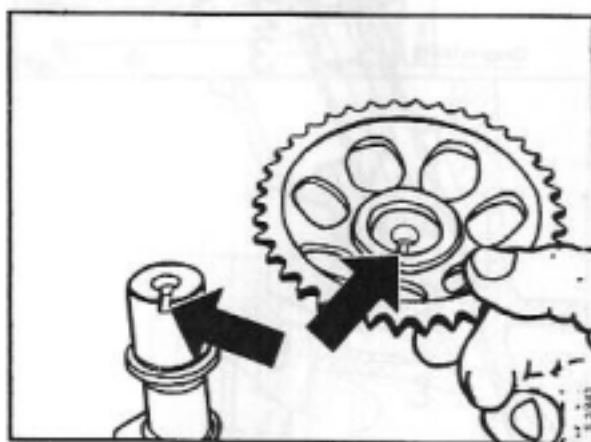
When the timing marks on the camshafts are in line with those on the bearing caps, the inlet and exhaust valves for No. 1 and No. 4 cylinder are closed.



As the valves open, they extend beyond the cylinder head and into the zone in which the pistons move (combustion chamber). Consequently, an alteration in the setting of the crank mechanism and valve mechanism may result in the valves and other vital components in the engine being damaged.



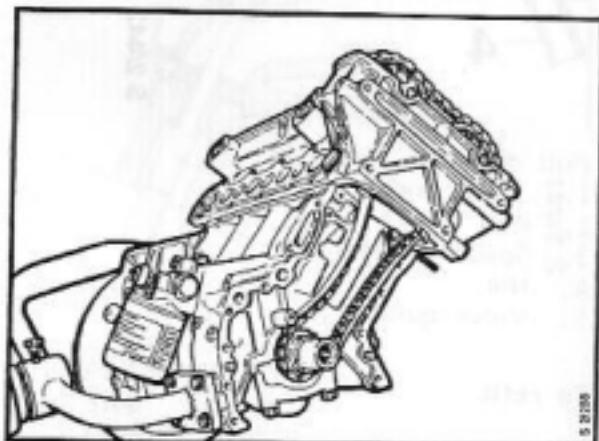
The camshaft timing mechanism comprises a sprocket and a chain. The chain has two guides, one fixed and one pivoting. The pivoting guide maintains the tension in the chain, assisted by an hydraulic chain tensioner.



The camshaft sprocket is guided by means of a lug on the shaft. Each sprocket has 38 teeth and is secured to the camshaft by a centre bolt.

The crankshaft sprocket incorporates a keyway to locate it on the crankshaft. The sprocket, which has 19 teeth, is secured by the centre nut for the crankshaft pulley.

The chain is an endless, single chain comprising 126 links. The diameter of the rollers is 6.35 mm (0.25 in).



Removing the valve guides (performed from above)

1. Before removing the valve guides, flush the cylinder head with hot water.
2. Withdraw the valve guides using special tool and pull rod 83 93 811, spacer 83 93 829 and nut 83 93 845.

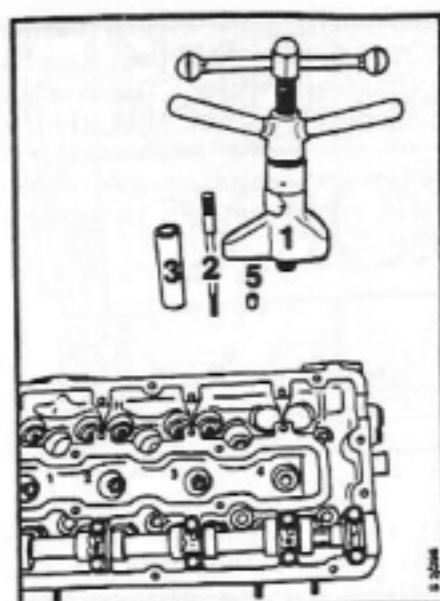


Pull direction

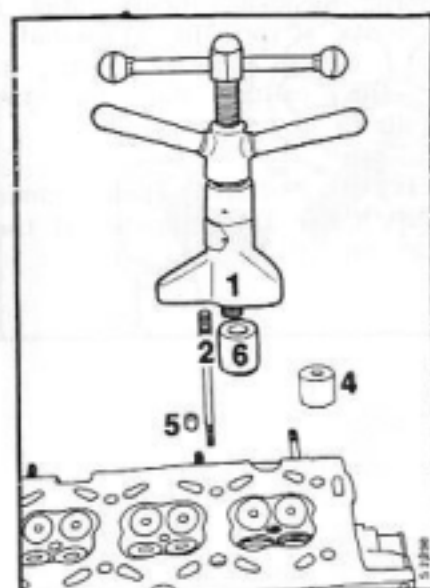
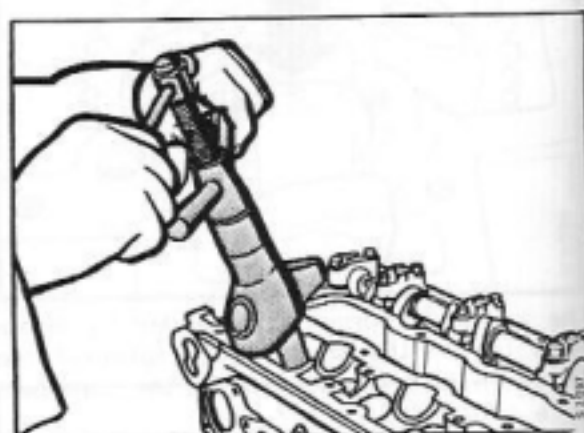
1. Jackscrew
2. Pull rod
3. Spacer sleeve
4. Nut
5. Valve guide

To refit

1. Insert the valve guide from above and apply the tool from below.
2. Before fitting the guides, flush the cylinder head with hot water and cool the guides by immersing them in cold water.
3. Fit the guides using special tool and pull rod 83 93 811, stop 83 93 837, centring sleeve 83 90 379 and nut 83 93 845.

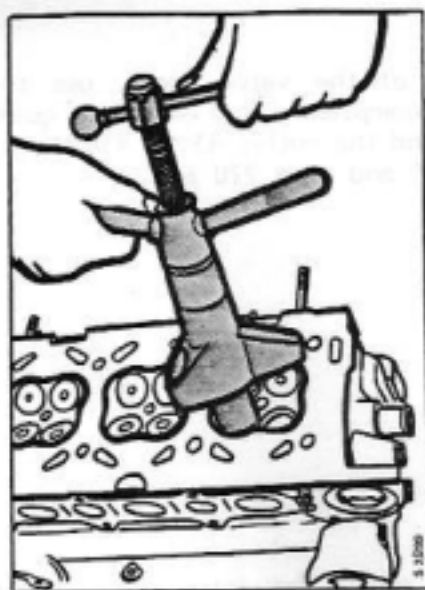


1. Jackscrew
2. Pull rod
3. Spacer sleeve
5. Nut



1. Jackscrew
2. Pull rod
4. Stop
5. Nut
6. Valve guide

Centre the tool in the valve seat and, using the tool, draw the guide into its correct position (see illustration).



Direction of pull

1. Jackscrew
2. Pull rod
3. Stop
4. Centring sleeve
5. Nut
6. Valve guide

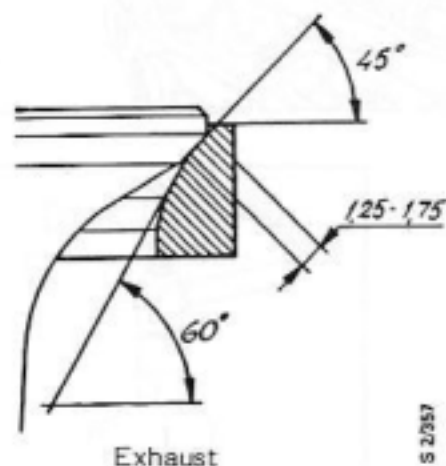
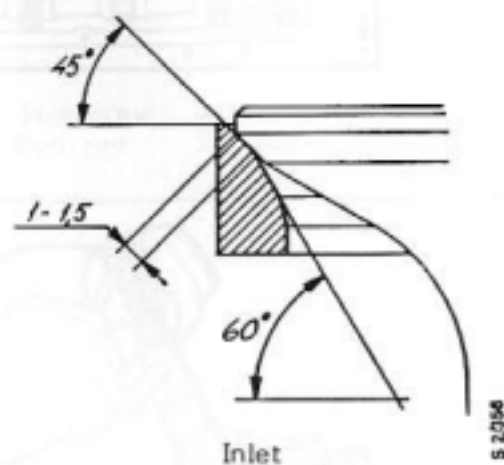
3. a. Run the 7.0 mm undersize reamer, 83 93 944, through the guide.
- b. Follow up with the 7.0 mm H7 valve guide reamer.

S 2/441

Valve seats

For milling of the valve seats, use the milling kit comprising a T-wrench, guide 83 93 928 and the cutter 83 93 936 Neway type 286 45° and type 270 60°.

Valve seat angles for inlet and exhaust valve seats: 45°.
Remilling angle: 60°.
Width of inlet valve seat: 1 - 1.5 mm.
Width of exhaust valve seat: 1.25 - 1.75 mm.
(See drawing).



Valves

Inlet valve seat angle: 44.5°
Valve head diameter: $32 \text{ mm} \pm 0.1 \text{ mm}$.

Exhaust valve seat angle: 44.5° (the contact surface of the valve has a 0.006 mm layer of stellite.)
Valve head diameter: $29 \text{ mm} \pm 0.1 \text{ mm}$.

NOTE

Only a limited amount of material can be removed from exhaust valve seats, since the stellite coating must be preserved as far as possible. Consequently, if the valve seat is badly pitted, the valve should be replaced.

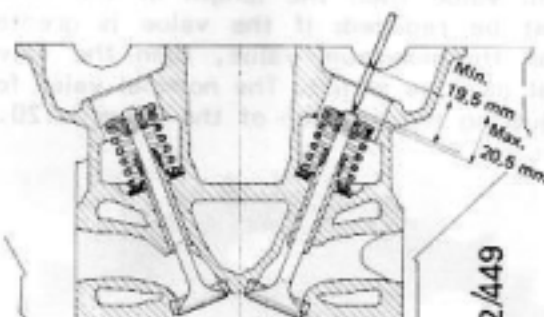
Checking the valve adjustment and basic settings (Cylinder head removed)

The valve adjustment is effected by checking and adjustment of the working range of the cam follower.

The checking values for the valve adjustment are $19.5 \pm 0.5 \text{ mm}$ min. and $20.5 \pm 0.05 \text{ mm}$ max.

The setting values are 20.0 mm min. and 20.4 mm max., and the nominal value 20.2 mm .

The valve adjustment is equivalent to the distance between the end of the valve stem and the camshaft bearing seat. The valve adjustment is checked using tool 83 93 753 (measuring head).



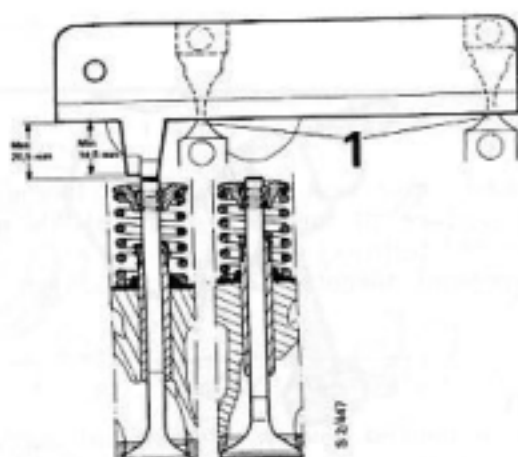
Working range of the cam follower

Before the valve adjustment can be checked, the camshafts and cam followers must be removed (refer to the section "Dismantling the valve mechanism").

Check the valve adjustment using tool 83 93 753 as follows. Place the measuring head in two of the camshaft bearing seats. Line up the instrument to read the depth to the end of the valve stem. Check that when the instrument is displaying the maximum depth reading of 20.5 mm it actually reaches the end of the valve stem, which will be confirmed by the fact that the measuring head does not make contact with the bottom of the bearing seat closest to the instrument. Thereafter, check that the contact point of the instrument does not touch the end of the valve stem when showing the minimum depth reading of 19.5 mm.

The valve adjustment is correct when the reading obtained is between the minimum and maximum values.

If the valve adjustment deviates from the specified checking values, adjustment must be made to the valve stem or the valve seat: if the value is lower than the minimum value then the length of the valve must be reduced; if the value is greater than the maximum value, then the valve seat must be milled. The nominal value for adjusting the position of the valve is 20.2 mm.



Timing chain

Timing chain, B201 1984- 215-1
Timing chain, B201 -1984 215-3

Timing chain, B202 215-5

Timing chain, B201

1984 models onwards:

As from CM CA Engine No. E22813
IM IA " " E57340
SM SA " " E57340

Timing chain

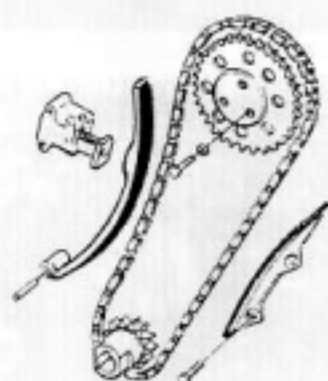
The camshaft is driven by a single chain with a mechanical chain tensioner, a pivoting guide and a fixed chain guide.

NOTE

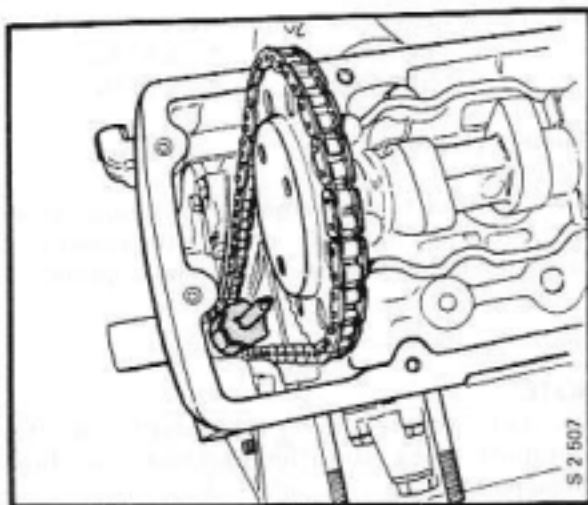
Do not rotate the crankshaft or the camshaft once the timing chain has been detached.

A fully open valve can come into contact with a piston at top dead centre

Remove and refit the timing chain with the camshaft and crankshaft at TDC on the compression stroke for No. 1 cylinder.



Before removing or refitting the camshaft sprocket, release the pressure of the chain tensioner by inserting the handle of a suitable screwdriver between the pivoting guide and the fixed guide.



Adjusting the chain tensioner

1. Press down the outside of the ratchet tooth on the chain tensioner to render it inoperative. Depress the tensioning device by pressing the chain guide.
2. Hold the chain guide in this position, fit the timing chain and release the chain guide, whereupon it will return to its position against the chain.

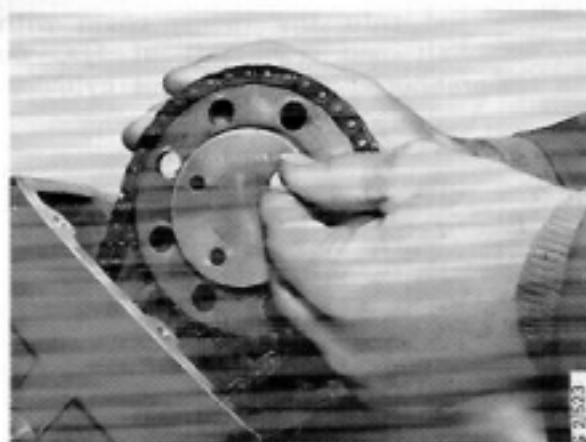


To replace the chain tensioner

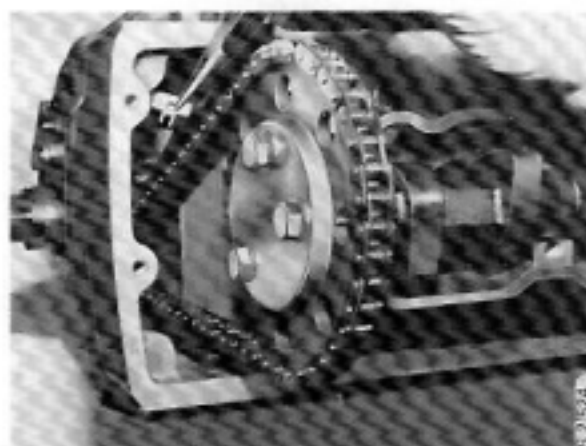
1. Fit the new chain tensioner without removing the transit lock.



2. Fit the camshaft sprocket and the timing chain.



3. Remove the transit lock from the tensioner, whereupon the tensioning device will be triggered.



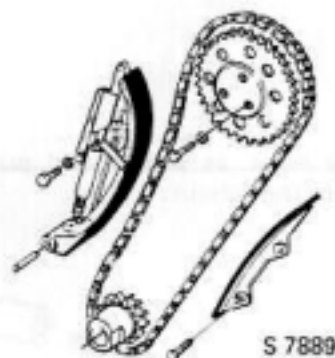
Timing chain, B201

Up to and including 1984 models:

CM CA	up to and incl. engine nos.	E22812
IM IA	" " " " " "	E57339
SM SA	" " " " " "	E57339

General

The camshaft is driven by a single chain with a mechanical chain tensioner and a straight chain guide.



NOTE

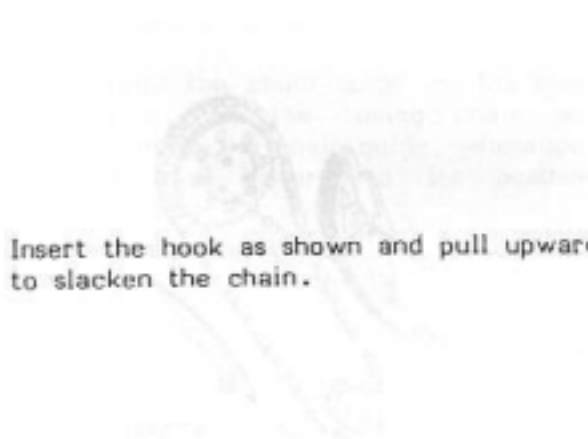
Do not rotate the crankshaft or the camshaft once the timing chain has been detached.

A fully open valve can come into contact with a piston at top dead centre.

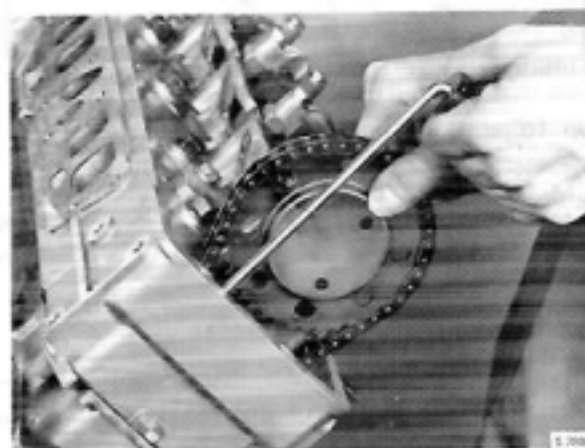
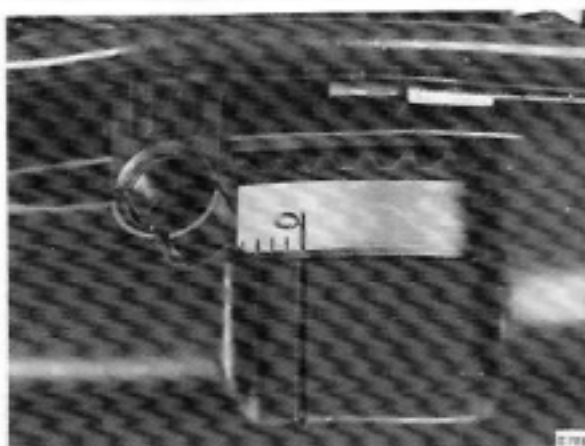
Remove and refit the timing chain with the camshaft and crankshaft at TDC on the compression stroke for No. 1 cylinder.



Tool 83 93 357 should be used to take the tension off the chain tensioner when removing and refitting the sprocket.



Insert the hook as shown and pull upwards to slacken the chain.



To fit the chain tensioner

Once fitted, the tensioner is released by introducing the tool into the catch as shown.

Turn the catch so that it slides in over the latch arm.

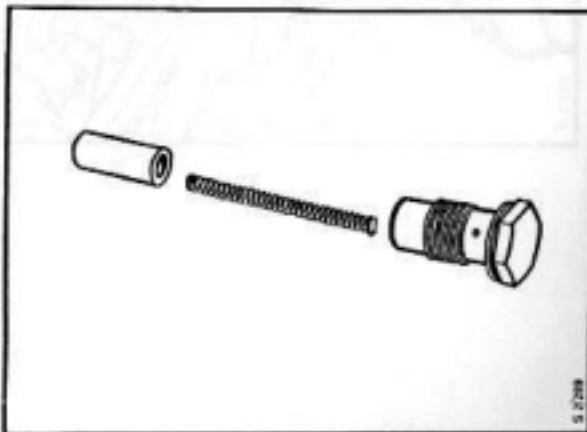


Timing chain, B202

General

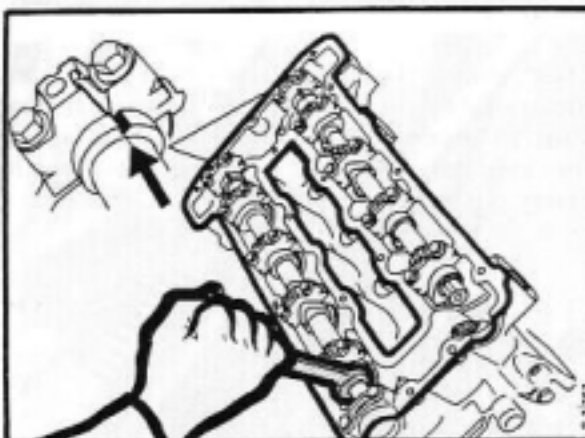
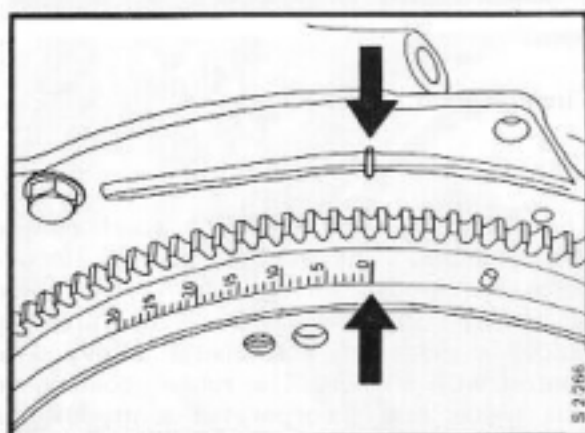
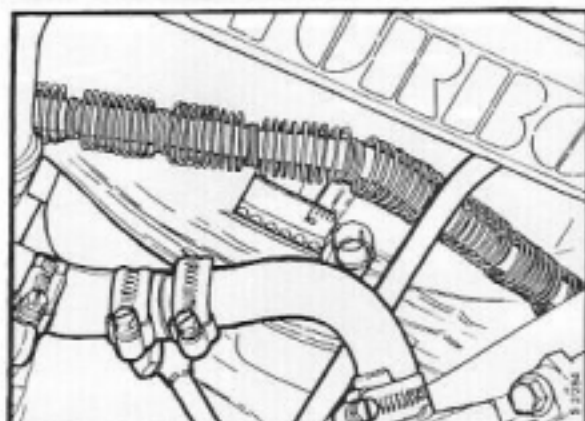
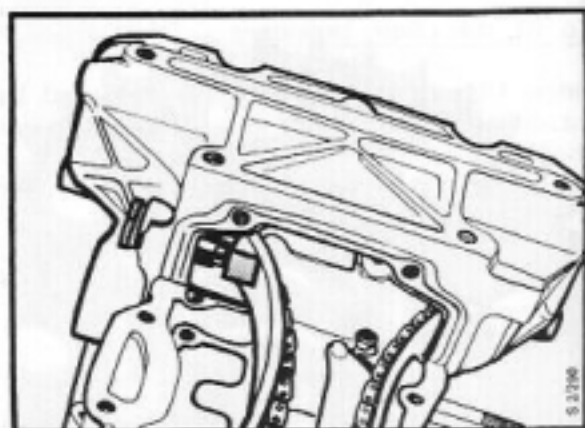
The fixed guide is made of steel coated with rubber. The rubber coating incorporates a groove for the chain. The guide is secured by two bolts. The pivoting guide is made of light-metal alloy, also coated with rubber. The rubber coating on this guide also incorporates a groove for the chain. The guide is pivoted at the bottom.

The chain tensioner is hydraulic and incorporates a spring and a basic-setting stop. The chain tensioner is fitted inside the cylinder head and acts on the pivoting chain guide.



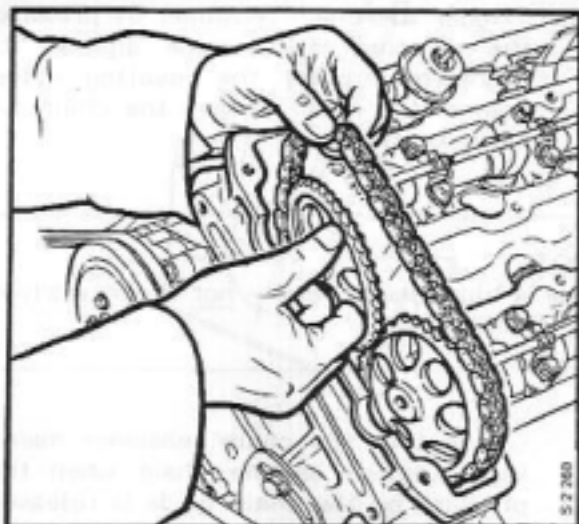
Removal and refitting of the timing chain

Before starting work to remove the timing chain, the 'O' mark on the flywheel must be turned to line up with the timing mark on the flywheel cover or endplate. The basic settings of the crankshaft and valve mechanism must not be altered before the camshafts or the cylinder head have been removed. Similarly, before the cylinder head is fitted, the crankshaft and valve mechanism must be set to their respective timing marks.

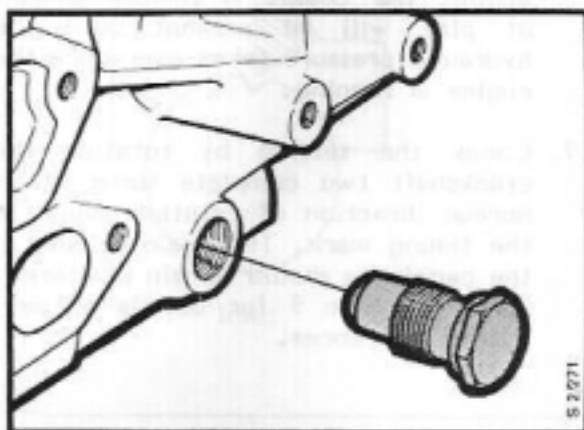


To refit

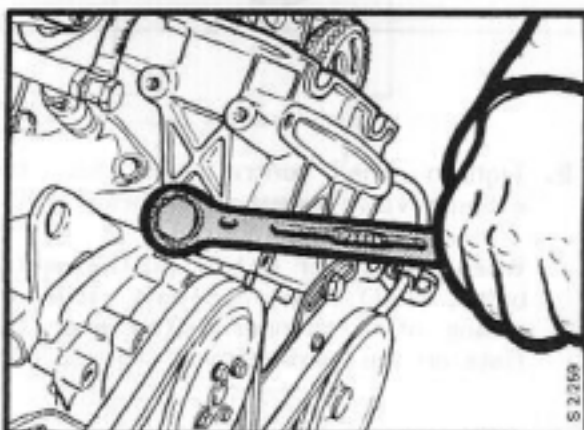
1. Place the chain around the crankshaft sprocket.
2. Fit the chain and sprocket on the exhaust-valve camshaft. Make sure the chain is taut between the crankshaft and the camshaft sprockets. Tighten the bolts.
3. Fit the chain and sprocket to the inlet-valve camshaft. Keep the chain taut between the sprockets while it is being fitted. Tighten the bolts. Refer to item 9 below for permitted tolerances in the basic timing setting.



4. Tension the chain tensioner by fully depressing the piston and then rotating it to the locked position.



5. Fit the chain tensioner with the piston under tension. Make sure that the copper gasket is in good condition and that the sealing surface is clean and free from burrs.



6. Trigger the chain tensioner by pressing the pivoting chain guide against it; thereafter, press the pivoting guide against the chain to give the chain its basic tension.

NOTE

Use a blunt instrument - not a screwdriver or similar.

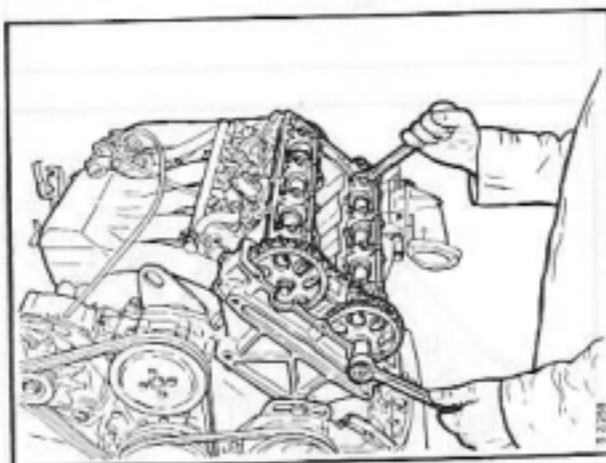
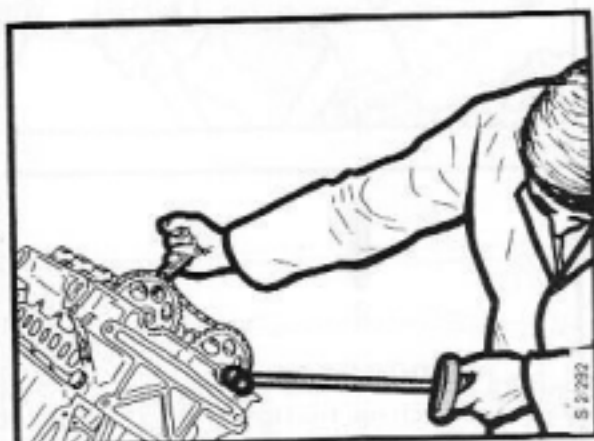
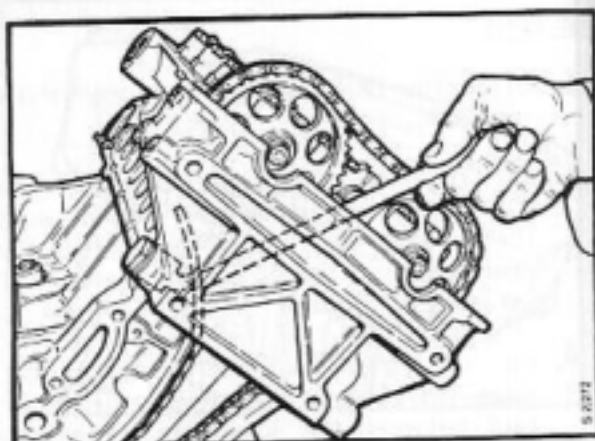
Check that the chain tensioner maintains tension on the chain when the pressure on the chain guide is released and that the basic-setting stop for the tensioner holds the chain guide tight against the chain. A limited amount of play will be present until the hydraulic pressure takes over once the engine is running.

7. Check the setting by rotating the crankshaft two complete turns in its normal direction of rotation round to the timing mark. The basic setting of the camshafts should remain unaltered. Refer to item 9 for details of permitted tolerances.

Tightening torque:
63 Nm (46.6 ft. lb)

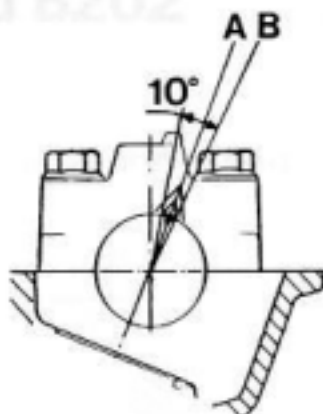
8. Tighten the centre bolt for the exhaust-valve camshaft sprocket.

When undoing or tightening the centre bolts, hold the camshaft still by means of a spanner fitted over the flats on the camshaft.

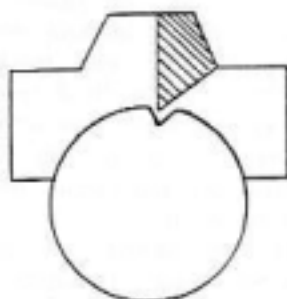


9. The adjusting accuracy will depend on the condition of the chain.

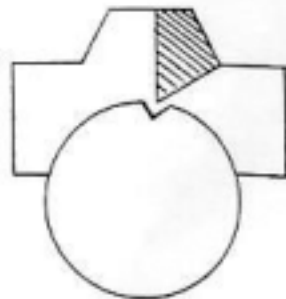
Moving the timing chain one tooth will rotate the camshaft through 10° , corresponding to approx. 3.0 mm (0.118 in), which is the width of the camshaft timing mark.



Camshaft setting

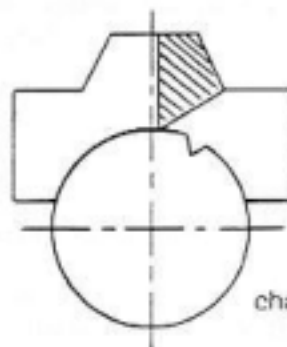


Exhaust

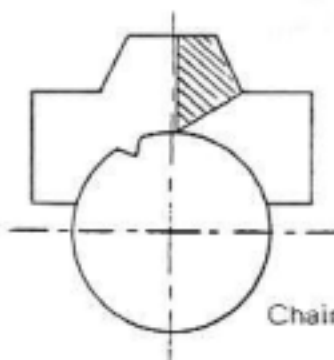
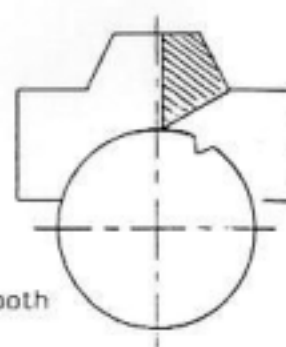


Inlet

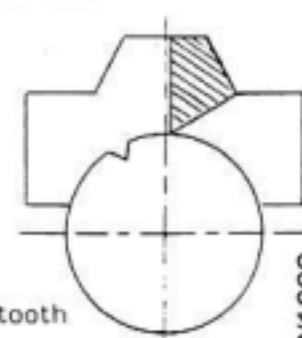
Correct



Worn chain
or
chain retarded one tooth



Chain advanced one tooth



S2/1099

Crankshaft B201 and B202

To measure the crankshaft 216-1
To measure bearing clearances . . . 216-1
To choose bearing shells for
main and big-end bearings 216-3

To change crankshaft seals . . . 216-4

To measure the crankshaft

Clean the crankshaft and measure the journals using a micrometer gauge. Measurements should be taken at several points round the journal. The ovality of the main bearing and big-end journals should not exceed 0.05 mm (0.002 in). If the measurements are close to or exceed the stated limit the crankshaft should be ground down to undersize as specified. The journals can be ground down one undersize without re-hardening. Grinding to further undersizes will necessitate "Tenifer" re-hardening. Check that the crankshaft is true to within 0.05 mm (0.0002 in) using a dial indicator. Mount the crankshaft in two V-blocks, place the indicator plunger against the centre journal and rotate the shaft.

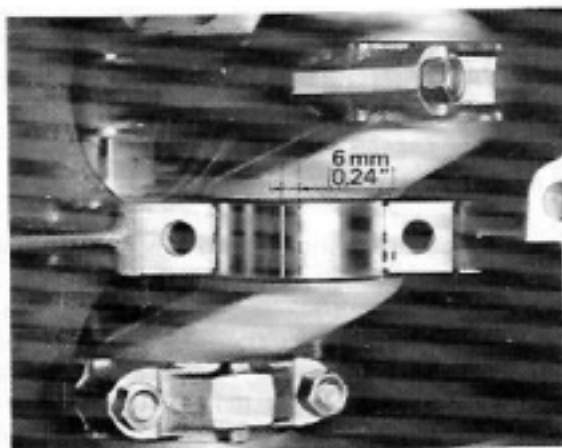
To measure bearing clearance

Before measuring the bearing clearance when fitting new bearings, check the ovality and conicity of the journals. Measurements are made using a "Plastigage", which is obtainable under spare parts no. (45) 30 06 558 and is available in three thicknesses. Type PG-1 (green) should be used.

Main bearings

"Plastigage" can be used to measure both ovality and clearance.

1. Position the engine upside-down so that the weight of the crankshaft will not affect the measurements.
2. Ensure that the parts to be measured are free from oil and dirt. Put a strip of "Plastigage" about 6 mm (0.2362 in) to one side of the longitudinal centre of the journal.
3. Refit the bearing cap and tighten to a torque of 108 Nm (80 lbf ft). The crankshaft must remain stationary while the measurement is taken.
4. Remove the bearing cap. The strip of "Plastigage" should now adhere to the bearing shell or crankshaft journal.
5. Measure the width of the "Plastigage" strip using the scale printed on the package and read off the clearance. One side of the package is calibrated in mm, the other side in thousandths of an inch. Measure the strip at its widest point but do not touch it with your fingers.

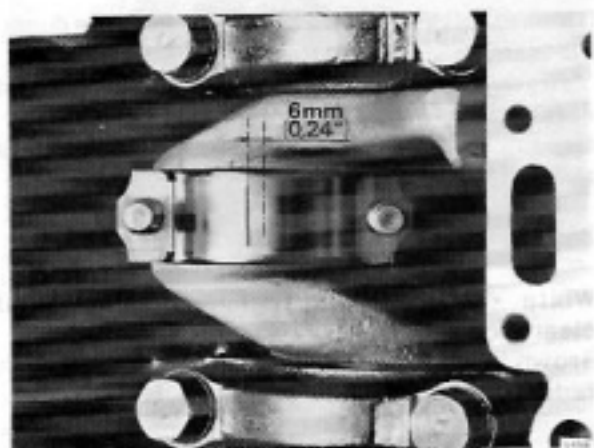


Big-end bearings

Plastigage strips cannot be used to measure the ovality of big-end bearings with the pistons fitted in the block. A micrometer should be used instead.

When fitting new bearings the big-end bearing clearance should be checked as follows.

1. Rotate the crank to be measured to about 60° BTDC.
2. Ensure that the parts to be measured are dry and free from oil and dirt. Place a strip of 6 mm (0.2362 in) "Plastigage" to one side of the journal.



3. Refit the bearing cap and tighten to a torque of 54 Nm (40 lbf ft). The crankshaft must remain stationary while the measurement is taken.
4. Remove the bearing cap. The strip of "Plastigage" should now adhere to the bearing shell or crankshaft journal.
5. Measure the width of the "Plastigage" strip using the scale printed on the package and read off the clearance. One side of the package is calibrated in mm, the other side in thousandths of an inch. Measure the strip at its widest point but do not touch it with your fingers.



Main bearing clearance:
0.020-0.062 mm (0.0008-0.0024 in)

Big-end bearing clearance
0.026-0.062 mm (0.0010-0.0024 in)

To choose bearing shells for main and big-end bearings

Bearing shells are available in two different thicknesses for standard size, 1st undersize and 2nd undersize. The two different thicknesses can be combined to obtain the correct clearance. Bearing shells for 3rd and 4th undersizes are only available in one thickness.

The different thicknesses of bearing shells are colour-coded as follows:

Standard size:

Red - thin bearing half, gives increased clearance

Blue - thicker bearing half, gives reduced clearance.

Yellow - thin bearing half, gives increased clearance.

Green - thicker bearing half, gives reduced clearance.

2nd undersize:

White - thin bearing half, gives increased clearance.

Brown - thicker bearing half, gives reduced clearance.

Example:

Try to obtain the correct clearance by fitting two thin bearing shells. If the clearance is excessive reduce it by fitting one thin and one thick or two thick shells.

If the clearance is excessive even after two thick bearing shells have been fitted, the crankshaft must be ground down to the next undersize and the appropriate undersized bearing shells fitted. See Section 0.

NOTE

The journals can be ground down one undersize 0.25 mm (0.098 in) without requiring re-hardening. Grinding to further undersize will necessitate "Tenifer" re-hardening.

To replace the crankshaft seal at the flywheel end

The seal can be replaced with the engine in situ or removed from the car, but the clutch and flywheel must always be removed first.

1. Use a screwdriver to remove the old seal.
2. Fit the new seal with the spring ring towards the crankshaft. Oil the mating surfaces before fitting. Use tool 83 92 540 to fit the seal.



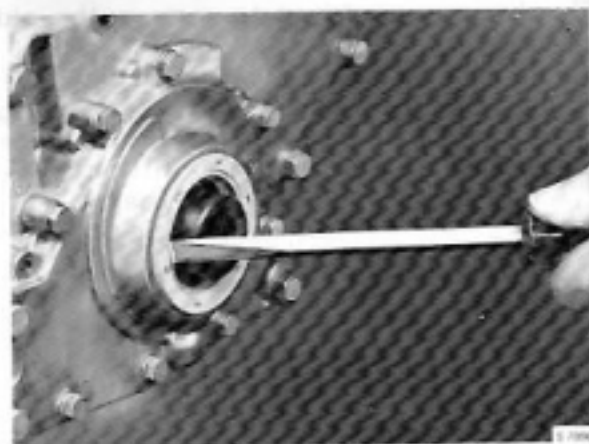
To replace the crankshaft seal at the timing chain end

The seal can be replaced with the engine in or out of the car.

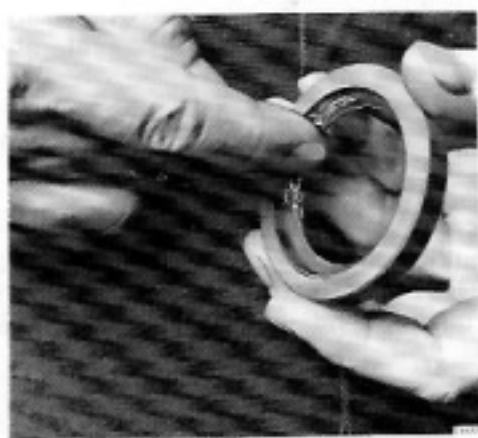
1. Remove the V-belt(s), remove the pulley retaining bolt (use clamp 83 92 987 to hold the crankshaft stationary) and remove the belt pulley.



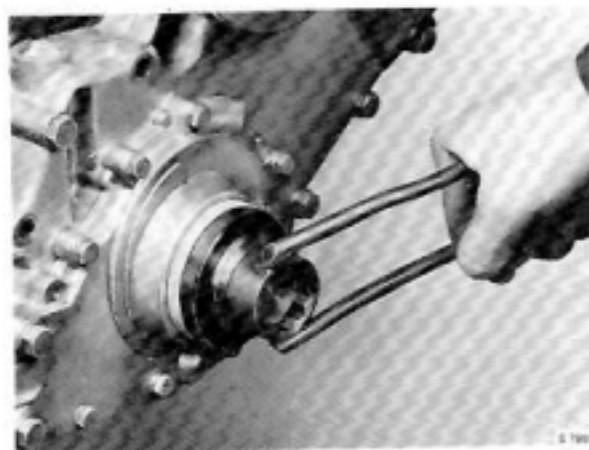
2. Remove the sealing ring by means of a screwdriver.



3. Apply a generous coating of grease to sealing lips of the sealing ring.



4. Press the sealing ring into place using sleeve 83 93 349, which is drawn in by means of the pulley retaining bolt.

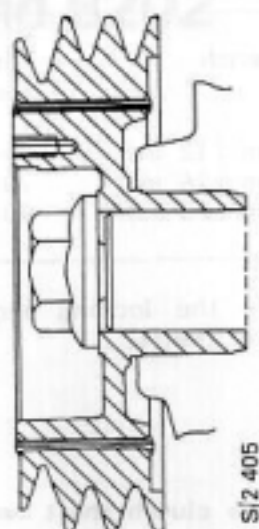


5. Install the pulley and tighten the screw to the specified torque.

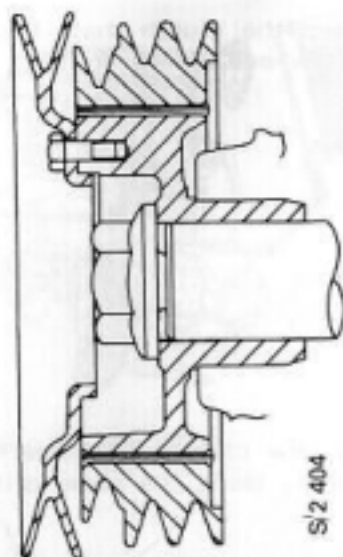
Pulley tightening torque:
190 Nm (140 lbf ft)

As from 1984 models, the pulley incorporates three grooves; cars with air conditioning have an auxiliary bolted-on pulley.

Use tools 83 92 961 and 83 93 639 to remove the pulley from the engine in situ.



S/2 405



S/2 404

Use special spanner 83 92 961 and a torque wrench when fitting with engine in situ.

To obtain the correct torque at the bolt, the tightening torque must be adapted to the length of the torque wrench.

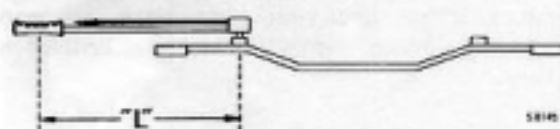


Torque wrench
length

Tightening
torque

"L"=300 mm (12 in)	55 Nm (40 lbf)
"L"=400 mm (16 in)	70 Nm (52 lbf)
"L"=500 mm (20 in)	80 Nm (59 lbf)

6. Remove the locking segment and fit the belt (belts).



Changing the clutch shaft bearing

1. Remove the flywheel.
2. Remove the clutch shaft bearing from the flywheel, using drift 83 91 997.
3. Fit a new clutch shaft bearing in the flywheel, using the same drift.



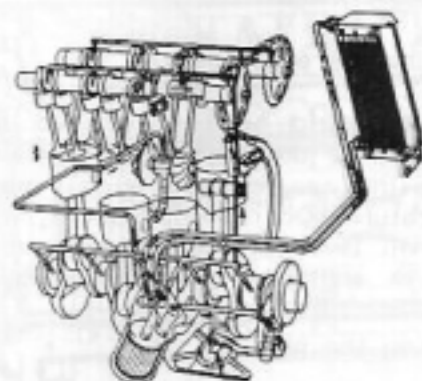
Lubricating system B201 and B202

Lubrication system, B201 and B202

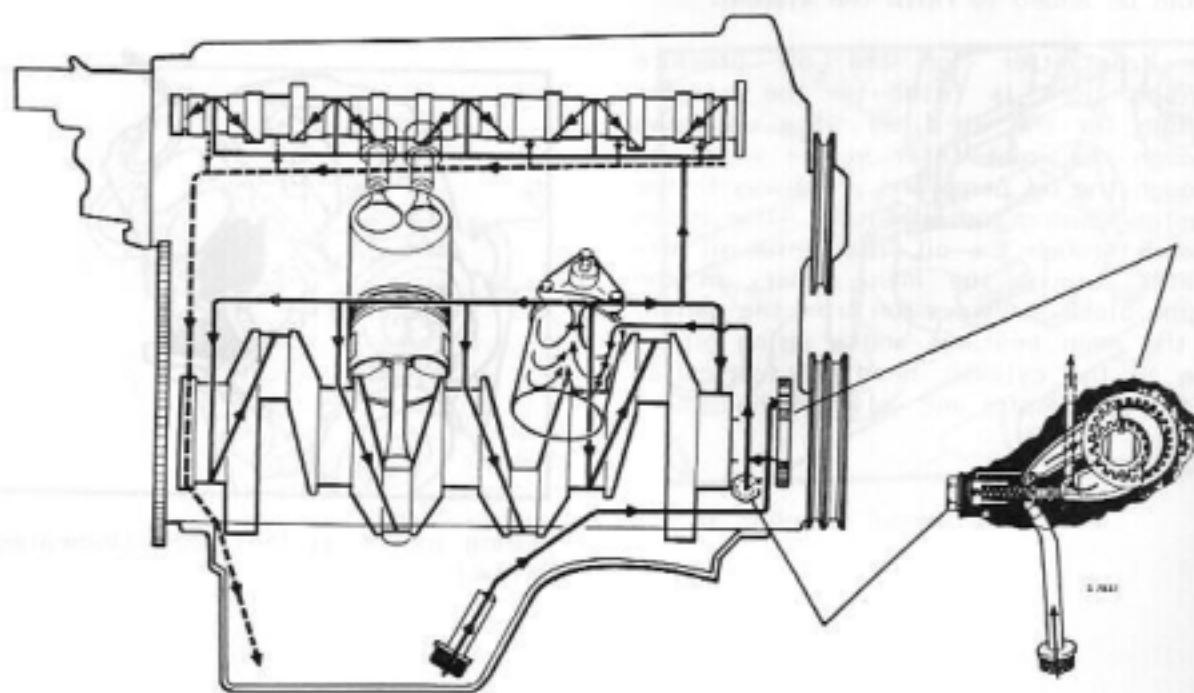
The engine has a forced lubrication system (see fig. below). Oil pressure is generated by a gear-type pump consisting of a gear wheel and an eccentric ring gear. The pump is driven by the crankshaft and is positioned between the timing cover and crankshaft pulley. A reduction valve in the timing cover limits the oil pressure by directing excess oil to the intake side of the pump.

The oil pan is a part of the transmission housing and is totally separated from the transmission lubrication system. The oil filter is of the full-flow type, i.e. all the oil force-fed to the lubrication points passes through the filter.

On the dipstick are marks for the minimum and maximum levels of oil in the sump. The marks represent oil quantities of 2.7 l (0.59 gal) and 3.7 l (0.81 gal), respectively. The total capacity of oil contained in the filter is 4.25 l (0.94 gal) or, with an engine oil cooler fitted, 4.3 l (0.95 gal).



Lubricating system B202



Lubricating system B201

Circulating oil quantity

When the engine is running, 1.2 l (0.26 gal) of oil is used to fill the oilways in the engine. This will result in the oil in the sump dropping to a level mid-way between the marks on the dipstick.

After the engine has been switched off, the oil in the engine oilways starts to drain back to the sump. The time taken for the oil to drain back into the sump will depend on the temperature of the engine. If the engine has reached its normal operating temperature, it will take about an hour for the oil to drain back. However, most of the oil will have drained back to the sump within the first ten minutes.

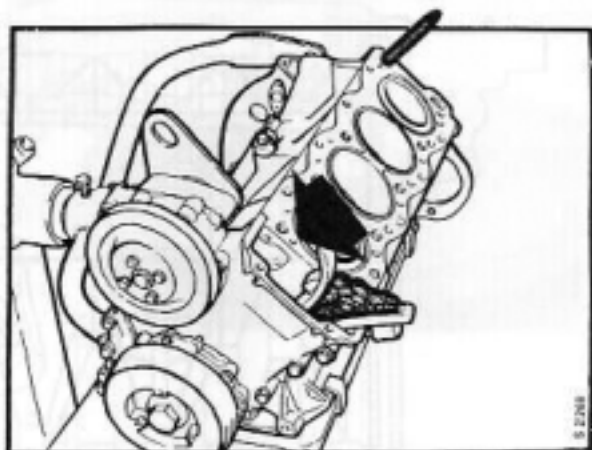
Checking the oil level

The oil should be checked two or five minutes after the engine has been switched off having reached its normal operating temperature. Do not top up the oil unless the level is lower than mid-way between the MAX and MIN marks on the dipstick.

Changing the oil

The oil and oil filter should be changed at the regular servicing intervals. When changing the oil, 4.0 l (0.88 gal) of oil should be added to refill the system.

The transmitter for the oil pressure warning light is fitted on the adaptor housing for the oil filter. The oil flows through the inlet filter in the sump, on through the oil pump and an oilway to the adaptor housing and oil filter. After it has passed through the oil filter, the oil circulates through the main gallery in the engine block. Oilways run from the gallery to the main bearings and a rising oilway runs to the cylinder head for lubrication of the camshafts and valve mechanism.

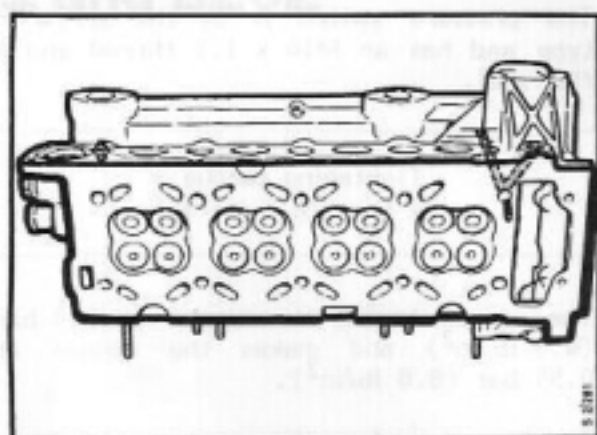


Rising oilway in the block (indicated by arrow)

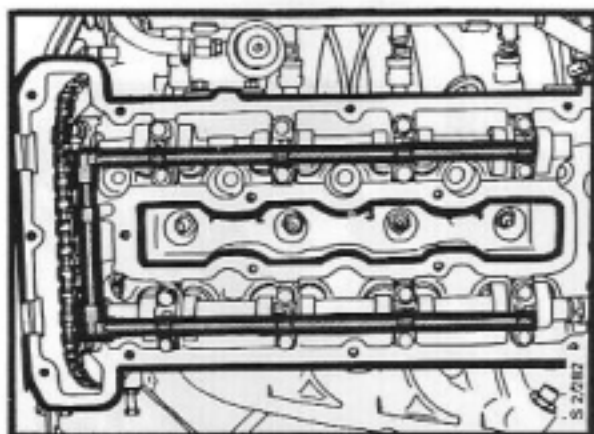
B202 engine

In the cylinder head, the oil flows through pipes to the camshaft bearings and the hydraulic cam followers. The hydraulic chain tensioner is connected to the rising oilway by a drilled passage in the cylinder head. Also connected to the main oil gallery is an oil line for lubrication of the turbo unit. On Turbo engines, the oil cooler is connected by means of a special adaptor for the oil filter, which also incorporates the oil thermostat and connectors for the oil cooler.

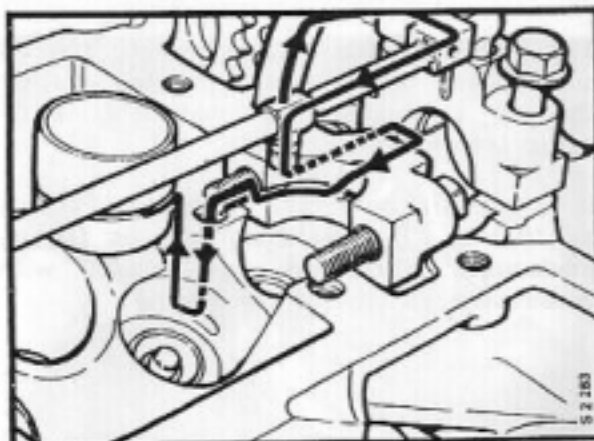
Oil is filled through the dipstick pipe.



Rising oilway in the cylinder head



Pipe system in the cylinder head



Cam follower lubrication

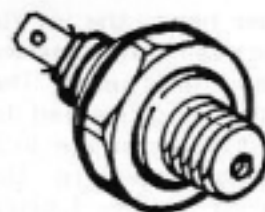
Pressure switch and adaptor

The pressure switch is of the screw-in type and has an M14 x 1.5 thread and a flat seal.

Tightening torque
25 Nm (18.5 lbf ft)

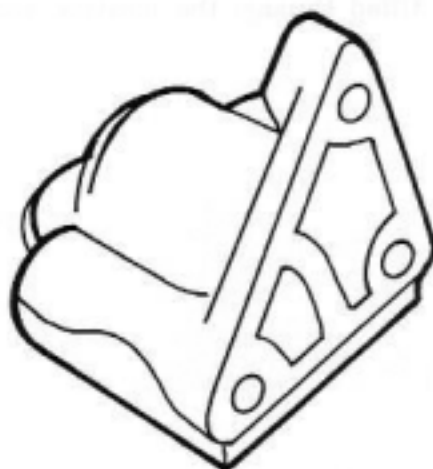
The switch breaks the circuit at 0.3 bar (4.3 lb/in²) and makes the circuit at 0.55 bar (8.0 lb/in²).

The adaptor for the engine oil filter matches the thread on the pressure switch and also the seal.



S2/1003

Pressure switch



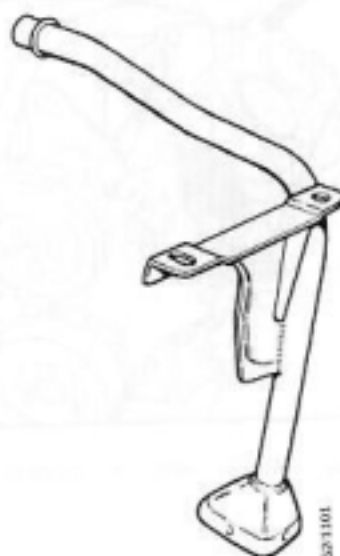
S2/1003

Adaptor

Oil pump filter intake pipes of different lengths in manual and automatic transmission variants.

The length of the intake pipe to the oil pump filter differs according to whether the car is equipped with manual or automatic transmission.

It is essential that the correct intake pipe be fitted. If the wrong pipe is fitted, inadequate lubrication can result, with consequent damage to the engine.



S2/1101

Oil pump-, B201 and B202

Oil pump, B201 and B202

The oil pump is a gear type with one gear wheel and an eccentric ring gear. The pump is mounted on the timing cover and is driven by a driving plate mounted on the crankshaft.

The oil pump reduction valve is situated in the timing cover and returns excess oil to the intake side of the pump.

To remove

The oil pump can be removed with the engine in the car.

1. Clean the area round the oil pump.
2. Remove the crankshaft pulley retaining bolt and detach the pulley from the crankshaft. Immobilize the crankshaft by attaching locking device 83 92 987 to the flywheel ring gear.



3. Remove the oil pump retaining bolts and extract the pump.



To check

Use a straightedge and feeler gauge to check the end float between the pump body and the gear wheel.

Permissible end float: 0.03 - 0.08 mm
(0.0012 - 0.0031 in)



To refit

1. Oil the gear wheels.
2. Refit the ring gear so that the mark on its face is visible.



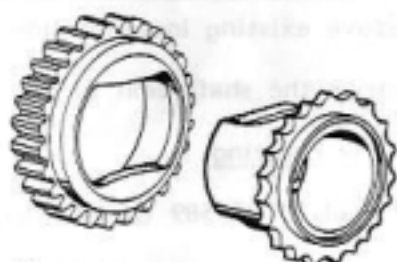
3. Fit a new sealing ring in the groove in the pump body and check that the dowel is fitted.



4. Refit the pump. Extract the pump gear slightly to facilitate locating it on the driving plate.



A



B



S 2/172

5. Remove the oil filter adaptor casting and fill the oilway to the oil pump pressure side with engine oil.

Caution

The oil pump must be primed with oil prior to fitting.

6. Refit the oil filter adaptor casting.



Centring of the oil pump

Should noise emanate from an otherwise serviceable oil pump, or if a pump not equipped with locating pins is to be fitted, tool 83 93 589 should be used to fit the pump. This obviates the need to use locating pins.

Removal

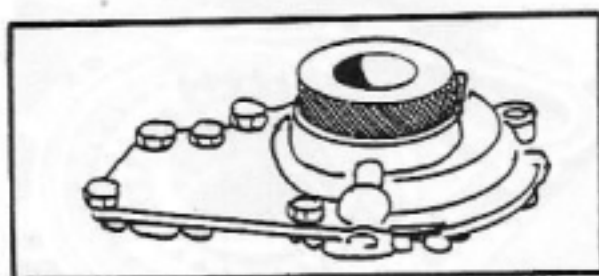
1. Remove the pulley from the crankshaft.
2. Remove the pump.
3. Remove existing locating pins.
4. Remove the shaft seal in the pump.

Fitting and centring

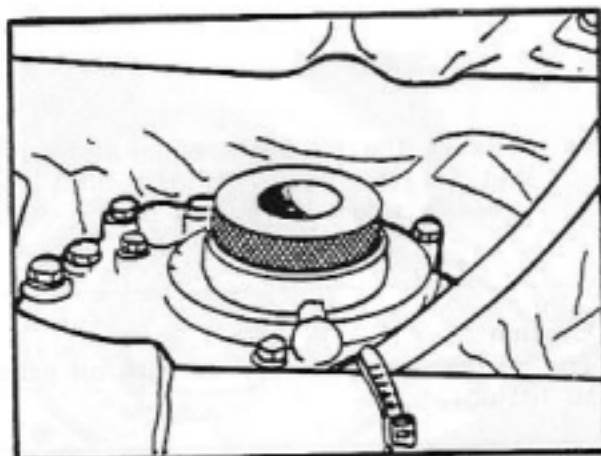
1. Fit tool 83 93 589 to the pump.

Check the condition of the O ring at the mating flange of the pump and replace if defective.

2. Fit the pump complete with the special tool.

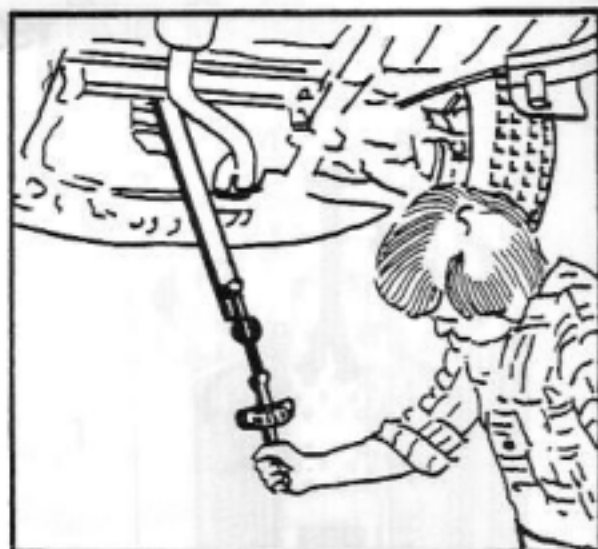


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3. Fit the pulley retaining bolt and tighten the special tool to a torque of 27 Nm (2.7 kgm; 20 lb ft) using a 400 mm (15.75 in) long torque wrench.



S 2/176

4. Secure the pump (8 + 2 bolts).
5. Remove tool 83 93 589, using strap wrench 83 93 332 or a large pair of polygrip or water-pump pliers.
6. Fit a new shaft seal on the pump.
7. Fit the pulley.

Tightening torque
190 Nm (140 lbf ft)

Oil filter

The oil filter is of the full-flow type, i.e. all the oil from the oil pump passes through the filter.

In production a smaller filter (75 mm dia.) is fitted which should be replaced with a larger model at the 1200 mile (2000 km) service.

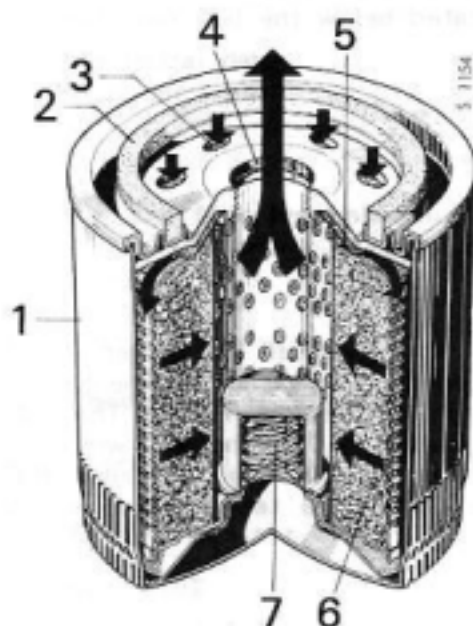
NOTE

Only the larger diameter filter should subsequently be used (90 mm dia).

Changing the filter cartridge

1. Use the strap wrench to unscrew the filter cartridge.
 - Wrench for removing factory-fitted filter (at the 1200-mile (2000-km service): 83 93 332
 - Wrench for removing ordinary filter: 78 62 014.
2. Smear the rubber seal at the bottom of the new filter with engine oil and screw it into position until it just touches the adaptor casting. Then tighten the filter a further half-a-turn.

Overtightening of the filter cartridge is liable to deform the seal, with oil leakage as the result.



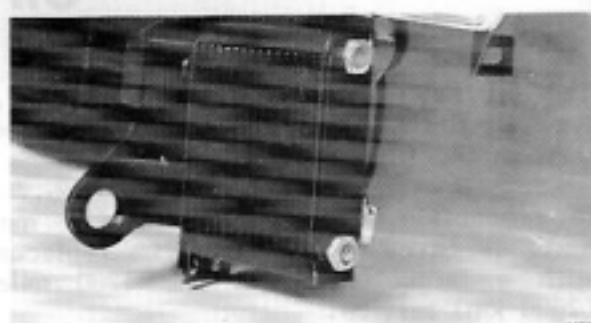
Oil filter

1. Filter housing
2. Rubber seal
3. Oil inlet
4. Oil outlet
5. Check valve
6. Filter
7. Overflow valve



Oil cooler

An air-cooled oil cooler for the engine oil is fitted to all Turbo cars. The oil cooler is located below the left-hand headlight.



When an air-cooled oil cooler is fitted, the radiator hoses are connected to an adaptor at the oil filter. The adaptor incorporates a thermostat which opens (initiates circulation through the oil cooler) when the temperature rises above 75°C (167°F).



Oil pressure transmitter

The oil pressure transmitter is located on the oil filter adaptor casing.

To remove

1. Disconnect the cable.
2. Unscrew the oil pressure transmitter (7/16 in spanner).

To refit

NOTE

Apply sealing compound to the thread before refitting.

1. Screw in the oil pressure transmitter and tighten to a torque of 12-15 Nm (8.9-11.2 lbf ft).
2. Reconnect the cable.



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Alphabetical section guide

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Saab-Scania AB
Saab Car Division
Nyköping, Sweden

(US) American edition. Ordering No. 331025. Printed in Sweden by Graphic Systems AB, Göteborg 1985.

