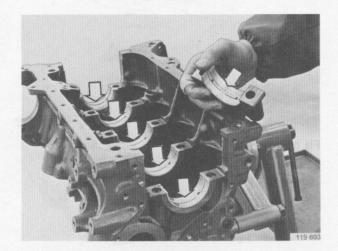
D. Engine, assembly

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



CRANKSHAFT

D1

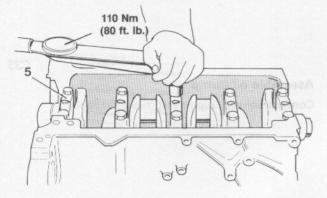
D2

D3

Install main bearing shells in block and caps

Lubricate shells.

Make sure that matched pairs are installed together. Bearing cap at flywheel end is marked 5.



Install crankshaft and main bearing caps

Lubricate bearings and studs.

Note that drop-shaped symbol on caps should point towards front of block.

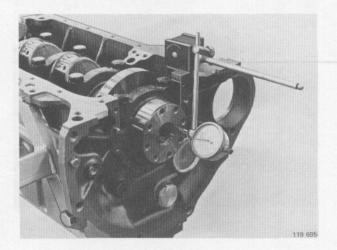
Cap No. 5 (thrust bearing) should be next to flywheel. Torque bolts to **110 Nm** (80 ft.lbs).



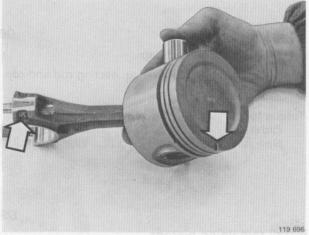
Check end float.

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

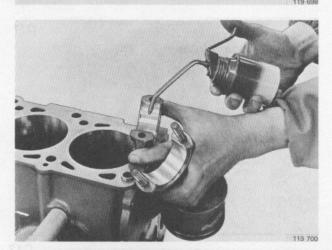
End float = \max . **0.25 mm** (0.0099 in)

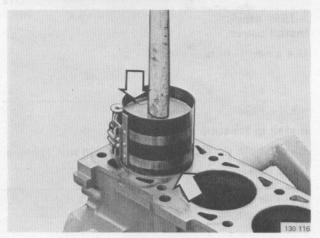


Assembly









PISTONS, CONNECTING RODS

D4

Assemble pistons to connecting rods

Mark on piston crown should face forwards.

Connecting rod mark should face towards oil filter.

Check that pistons and connecting rods are not interchanged.

D5

Install piston rings

Turn rings so that gaps are 120° apart.



D6

Install bearing shells in connecting rods and caps Oil cylinder liners, pistons and shells.

D7

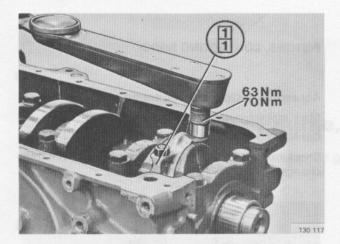
Place No. 1 liner in cylinder

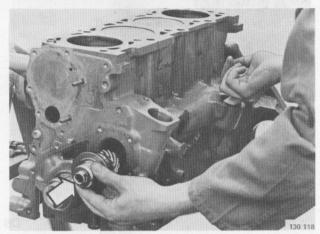
Turn crankshaft so that No. 1 crank points directly down.

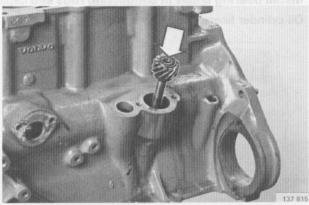
Insert piston using a ring compressor tool.

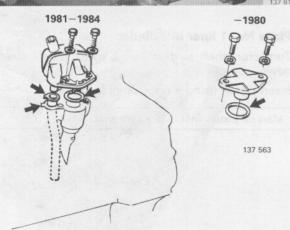
Mark on piston should face forwards.

Assembly









D8

Install connecting rod cap

Check identification mark on connecting rod and cap.
Oil studs and use new nuts.

Torque to:

 Old studs
 63 Nm (46 ft.lbs)

 New studs
 70 Nm (51 ft.lbs)

D9

Install remaining pistons

Check after installing each cap that crankshaft can be turned.

D10

Install intermediate shaft.

Oil bearing and gear.

Place finger in oil pump opening and guide shaft into position.

D11

Install oil pump pinion

D12

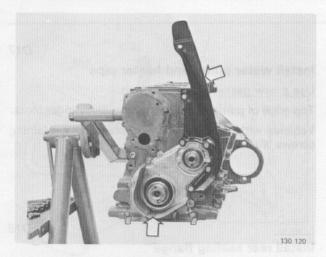
-1980 models Install cover

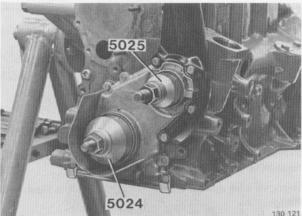
Use a new O-ring.

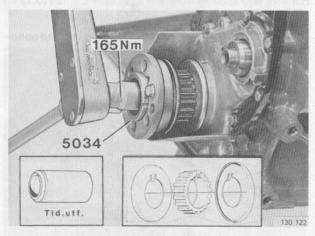
1981-1984

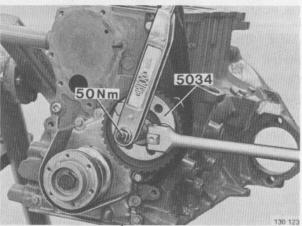
Install drain tube and oil trap

Press tube in as far as possible and align with opening. Use a new oil trap O-ring.









OIL SEALS, TIMING GEARS

D13

Install front sealing flange and rear belt cover

Sealing flange should be installed without seals.

Use a new gasket.

Trim edges of gasket.

Note: Do not forget two cable harness clips.

D14

Lubricate and install front oil seals

Use press tool **5025** for intermediate shaft seals and **5024** for crankshaft seals.

Check that seals are not damaged or twisted.

D15

Install:

- (early types) spacer sleeve on crankshaft. Bevelled edge of sleeve should face forwards.
- key (early types)
- guide plates (edge facing away from pulley)
- pulley. (Later types: install pulley with key bevel facing cylinder block)
- hub
- centre bolt

Torque center bolt to 165 Nm (120 ft. lbs.) using 5034.

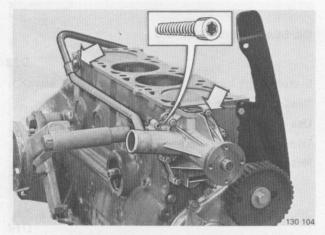
D16

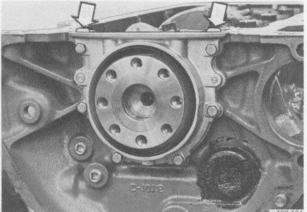
Install intermediate shaft pulley

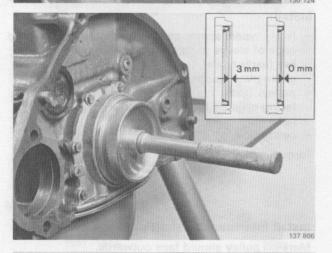
Mark on pulley should face outwards.

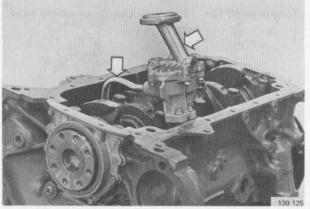
Torque to 50 Nm (36 ft.lbs). Use counterhold 5034.

Assembly









D17

Install water pump and heater pipe

Use a new gasket and new O-ring.

Top edge of pump should be flush with cylinder block. Vehicles with Pulsair system: replace tube retaining screws with inhex type.

D18

Install rear sealing flange

Use a new gasket. Trim edges of gasket.

D19

Insert oil seal in rear sealing flange

Assemble special tool 1801 and drift 5276.

Oil contact faces and place seal in drift.

If end of crankshaft shows signs of wear press seal further in than before.

Remove **one** spacer from drift if old seal is flush with flange.

Remove two spacers from drift if old seal is 3 mm (0.12 in) from flange.

Leave both spacers in drift if crankshaft is in good condition.

Tap in seal until drift seats against crankshaft.

OIL PUMP, SUMP

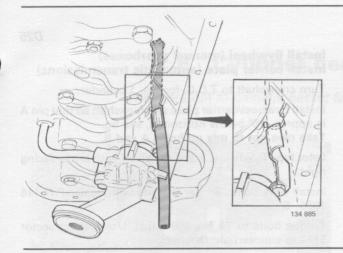
D20

Install oil pump and pipe

Check that pump shaft fits into drive gear.

Do not forget to install O-rings in pipe.

1981-84: Secure bracket for oil trap hose to oil pump retaining screws. See next page.



1981-1984

D21

Secure oil trap drain hose

Secure bracket for drain hose to oil pump retaining screw.

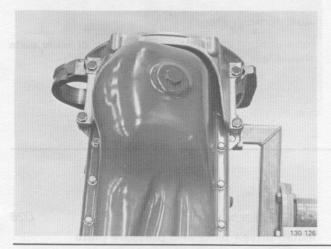
Make sure that hose is clamped behind lug on oil pump.

Important: Do not shorten hose. It is important that hose is of exact length.

D22

Install:

- oil sump gasket. Turn mark on gasket to face starter motor mount.
- oil sump
- support bracket. Do not tighten bolts at this stage.



1426

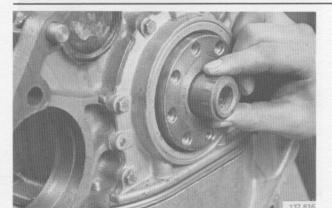
FLYWHEEL, CLUTCH, CARRIER PLATE

Manual gearboxes

D23

Install

- pilot bearing in crankshaft using drift 1426
- lock ring.



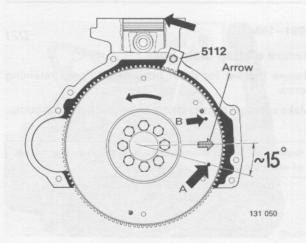
Automatic transmissions

D24

Install:

- guide sleeve with bevelled end facing outward.

Assembly



Install flywheel (manual gearboxes) Install carrier plate (automatic transmissions)

Turn crankshaft to T.D.C. for No. 1 cylinder.

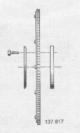
Install flywheel/carrier plate on crankshaft so that pin A is approx. 15° below horizontal, see fig.

Take care not to mix up holes A and B.

Later type flywheels: Install flywheel with arrow facing right.

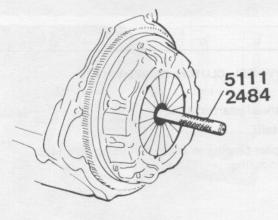
Install **new** bolts. Smear threads with sealer P/N 116 1056-5.

Torque bolts to **70 Nm** (50 ft.lbs). Use locking sector **5112** to counterhold flywheel.



Automatic gearboxes:

Note position of support plates. Edge of outer plate should face outwards.



Manual gearboxes

D26

D25

Install driven plate and pressure plate

Early type: Use centering drift 2484.

Late types (evolute teeth): Use centering drift 5111.

Torque bolts crosswise a few turns at a time to avoid distorting clutch.

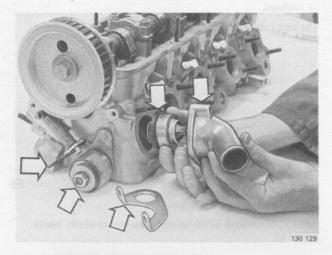
D27

Remove locking sector 5112

130 351

E. Cylinder head, disassembly

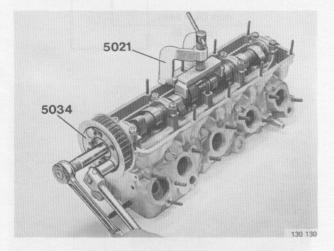
Take care not to damage gasket face when dismantling cylinder head.



Remove

- belt tensioner. Unhook spring with a 3 mm (0.1 in) drill

- lifting eye, thermostat housing and thermostat.



Remove camshaft pulley

Counterhold pulley with 5034.

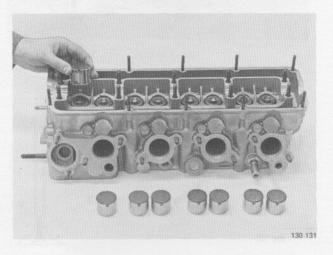
Remove camshaft

Remove center cap.

Position press tool 5021 and press camshaft into its bearings.

Remove remaining bearing caps.

Remove press tool, camshaft and oil seals.



Remove:

- tappets and shims

- rubber seals from valves.

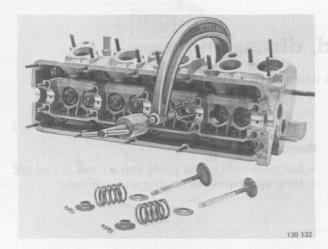
Note: Do not interchange tappets.

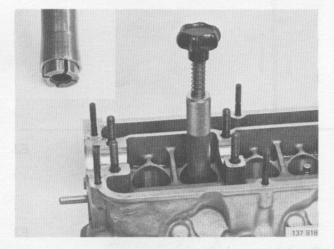
E1

E2

E3

E4





Remove:

- valve cotters
- upper spring seats
- valve springs
- lower spring seats
- valves.

Do not interchange parts.

E6

E5

Remove valve stem seals

Use special tool 5219 to remove valve stem seals.

E7

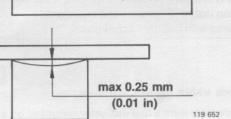
E8

E9

Cylinder head, cleaning, inspection

Clean cylinder head and gasket face

max 0.5 mm (0.02 in)



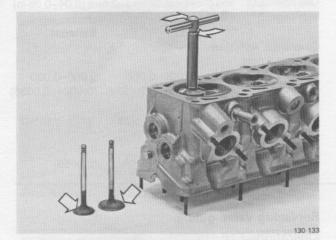
Check cylinder head for distortion

Use a steel ruler and feeler gauge.

Distortion must not exceed 0.5 mm (0.02 in) longitudinally and 0.25 mm (0.01 in) across cylinder head.

Important: If distortion is greater than 1.0 mm (0.04 in) longitudinally or 0.5 mm (0.02 in) crosswise cylinder head must be replaced.

Cylinder head height, new 146.1 mm (5.7563 in) min (after machining) 145.6 mm (5.7366 in)



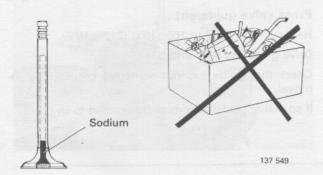
Clean/inspect valves and valve seats

Clean valve seats with a cutter.

Remove carbon from combustion chambers and valves.

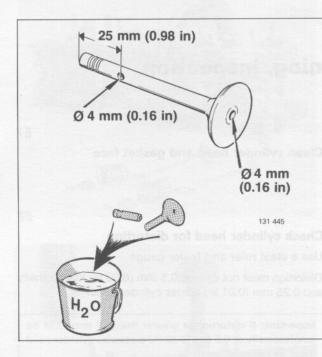
If valve seats are fractured or show signs of excessive wear they must be replaced.

Clean and check spark plug threads for damage.



Turbocharged engines have sodium-filled exhaust valves. Scrapped valves must not be mixed with ordinary scrap iron before first removing the sodium.

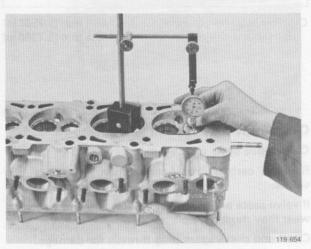
See instructions on next page.



Scrapping sodium-filled exhaust valves

Caution: Sodium in contact with water is explosive. Consequently when drilling, cutting or performing any form of work which involves separating sodium, ensure the sodium does not come in contact with water.

- Drill a hole (4.0 mm or 0.16 in) in the valve crown as illustrated.
- 2. Drill a hole (4.0 mm or 0.16 in) in the valve stem, or cut the stem approximately 25 mm (0.98 in) from the end.
- 3. Throw the valve into a bucket of water. A powerful reaction of an explosive nature will occur and you are advised to stand at least 3 meters (10 feet) from the bucket. The reaction lasts 1–2 minutes and afterwards the valve can be mixed with ordinary scrap metal.

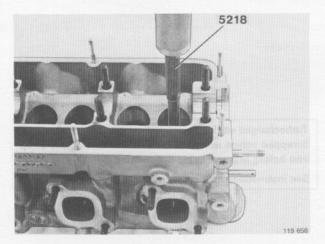


Check valve guides for wear

Check wear with a dial indicator mounted on a magnetic stand.

Use new valves and press valves up 1-2 mm (0.04–0.08 in) with finger.

	Inlet	Exhaust
Clearance, with new valve and new		
guide mm (in)	0.030-0.060 (0.0012-0.0024)	0.060-0.090 (0.0024-0.0035)
Max. clearance measured with new valve and old		
guide mm (in)	0.15 (0.0059)	0.15 (0.0059)



Replacing valve guides

Operations E12-16

E12

E11

E10

Press valve guide out

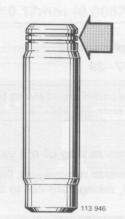
Heat cylinder head to 100±10°C (212°±18°F).

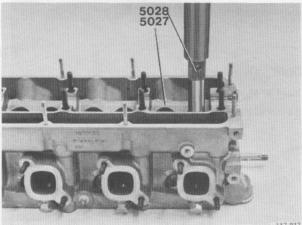
Drive guide out with drift 5218.

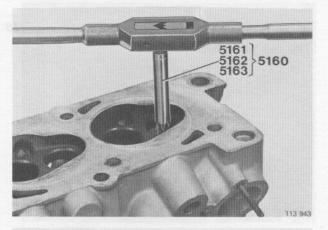
Check that guide has not damaged bore during removal.

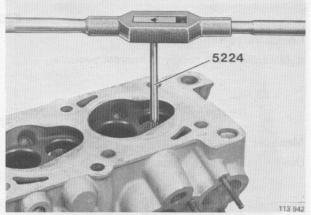
If so, valve guide bore must be reamed to oversize.

Cylinder head, cleaning, inspection









Identification of valve guides

Valve guides are marked with grooves to indicate oversize. Use new guide of same number of grooves as previous guide.

No.of grooves	Size
0	Standard
1	Oversize 1
2	Oversize 2
3	Oversize 3

E14

E13

Press in new valve guide

Cylinder head should be at room temperature

Use drift 5027 for inlet valves and 5028 for exhaust valves.

Press guide until drift contacts cylinder head to give valve correct protrusion.

Important: Force used for pressing valve guide into position must be at least 9000 N (900 kp). If this force is not reached the guide must be removed again and valve seat reamed to next oversize and appropriate guide installed.

E15

Reamer part number

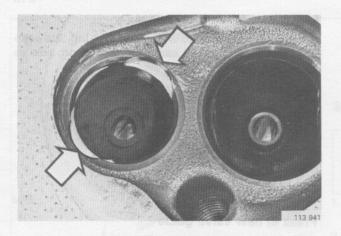
Oversize	Reamer
1	5161
2	5162
3	5163

E16

Clean valve guide

Use reamer 5224 or 5164.

Valve and seat must be ground in after replacing valve guide.



Valve seat, replacement

Operations E17-28

Important: Valve guides should always be replaced before replacing valve seats. See E12-16.

E17

Cut two notches in ring of old valve seat

This makes it easier to remove seat. Grind an additional notch for chisel, taking care not to damage cylinder

E18

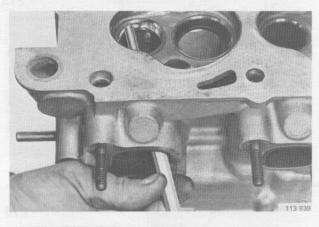


Split seat with a chisel.

Be careful not to damage cylinder head.



Use a long drift as illustrated.



E20

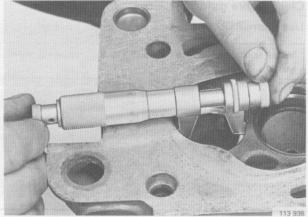
Check valve seat recess

If damaged, ream recess to nearest oversize.

E21

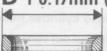
Measure diameter

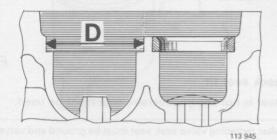
Use an inside micrometer.

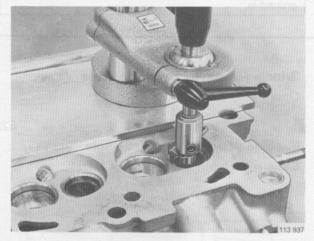


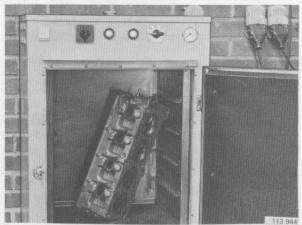
Cylinder head, cleaning, inspection

D+0.17mm (0.0067 in)











Measuring new valve seat

Size of new valve seat is not marked but must be measured. Two oversizes are available.

Valve seat insert should be **0.17 mm** (0.0067 in) larger than recess in cylinder head.

E23

E22

If less than 0.17 mm (0.0067 in):

Recut valve seat to oversize. Use a valve cutter e.g. Mira P/N 998 6045-5 and follow manufacturers instructions.

Valve seat diameter	Inlet	Exhaust
Standardmm	46.00	38.00
(in)	(1.8124)	(1.4972)
Oversize 1	46.25	38.25
	(1.8223)	
Oversize 2	46.50	38.50
(in)	(1.8321)	(1.5169)

E24

Heat cylinder head

Heat to 100 ° C (212°F).

E25

Fit new seat insert on drift

Drift 5029 = inlet valves

Drift 5220 = exhaust valves.

E26

Cool seat insert to -70°C (-94°F)

Use carbon dioxide.

Wear protective gloves for safety.

Cylinder head, cleaning, inspection

5029 5220

E27

Tap valve seat insert into cylinder head

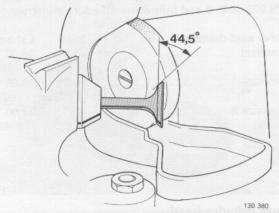
This operation must be carried out very quickly, within 3–4 seconds to avoid temperature loss.

E28

Check seat fit

If seat is not secure, oversize seat must be used.

After replacing valve seat, seat must be ground and valves ground-in.



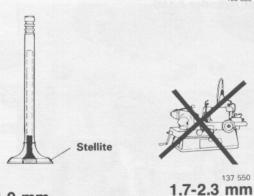
Grinding-in valves and valve seats

Operations E29-31

E29

Machine valves to specified angle

Same angle for inlet and exhaust valves.



Important:

Exhaust valves in turbo engines are stellite coated and must not be machined. They can only be ground-in with lapping paste against valve seat. If stellite coating is removed valves will lose heat resistance.

1.3-1.9 mm (0.0512-0.0749 in) (0.0670-0.0906 in)

45°

Inlet Exhaust

119 661

Mill or grind valve seats

Same angle for inlet and exhaust valves.

Valve diameter

Inlet 1.3-1.9 mm (0.0512-0.0749) Exhaust 1.7-2.3 mm (0.0670-0.0906)

E31

E30

Check valve fit

Grind-in valves if necessary with lapping paste.

E32

Check tappets for damage, scoring etc

E33

Test valve springs in a spring tester

Two different types are in use.

Type 2 springs are used on

- B 21 F LH-Jetronic, late types (introduced from 1983 models)
- B23F
- B 19 ET, B 21 ET and B 21 FT late types (introduced from 1984 models)

Type 2 springs can also be used on B 21 F LH-Jetronic early types and B 19 ET, B 21 ET and B 21 FT early types.

Type 1 springs are used on all other engine types.

Important: Do not interchange adjusting shims and springs in same engine types.

Туре	1	1 Type 2	
Length mm (in)	Load N (lb.)	Length mm (in)	Load N (lb.)
45.0 (1.77)	0	45.5 (1.79)	0
38.0 (1.50)	280-320 (62-70)	38.0 (1.50)	280-320 (62-70)
27.0 (1.06)	710-790 (156-174)	27.5 (1.08)	702-782 (154-172)

E34

Check camshaft end float

Place camshaft in cylinder head.

Fit rear bearing cap.

Slide camshaft to and fro and measure end float.

End float = 0.1-0.4 mm (0.0039-0.0158 in)

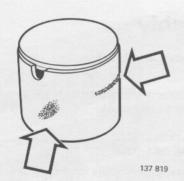
If end float is too large, replace rear bearing cap.

E35

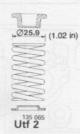
Check belt tensioner

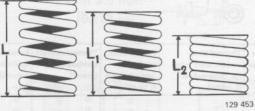
Check roller for excessive wear.

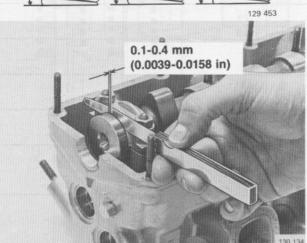
Running face of roller must not be damaged. If surface is grooved both roller and belt must be replaced.

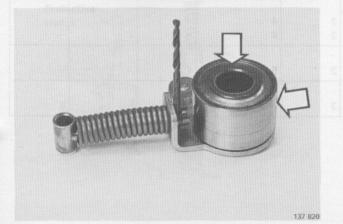












Location of senders/contacts on cylinder head and block

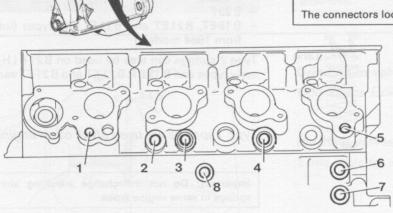
E36

All senders/contacts are located on the left-hand side of the cylinder head and block.

F engines USA 1981-1984

Make sure that the connectors for the start injector, CIS system temperature sender and LH-Jetronic temperature sender are correctly connected.

The connectors look alike and can easily be interchanged.



Engine type	Temperature sender CIS (blue & red)	Thermostat valve EGR (black hoses)	Thermostat valve accelera- tion enrichment (black hoses)	Temperature sender gauge (yellow)	Thermal time- switch, start injec- tor (blue-yellow & white)	Temperature sender LH- Jetronic (blue & black)	Thermal contact, Lambda-sond (green)	Knock sensor ignition (brown)
B 17, 19, 21, 23 A 1975-1984	9 0000 T 33	2 ³⁾	(m) min (m) 7 (7 (7 (7 (7 (7 (7 (7 (7 (7 (7 (7 (7 (3	-1 -1	-	-	-
B 19 K 1984	38.0	088-088 (-(07-58)	38.0 (1.10)	3	- (ci 83rd	era A.O. I. (0). (>0000.0)	-	_
B 19, 21, 23 E 1975-1984	-	2 ³⁾	-	3	5	-	_	-
B 19, 21 E-Turbo 1981–1984	malika	2 ⁵⁾	-	3	4	-	-	-
B 21 F-5 ¹⁾ 1976-1984 1981 USA	_ 1 ⁴⁾	2 ³⁾	2	3	5 5	_	-	_
B 21 F-9 ²⁾ 1981 1982	1	dondyouther Les day pr au bos-actif	2 2	3	5 5	_	- 7	_
B 21 F-Turbo 1981 1982-1984	6	egisi oot	2 2	3	4 4	- 43-11 - 13-11	- 7	- - -
B 21 F LH-Jetronic 1982	1	Tisnolena	Check bills	3	5	4	_	-
B 23 F LH-Jetronic 1983-1984	Jasyvy	of faller -	Check roller 6	3	_	4	_	8

 $^{^{1)}\,\}mathrm{B}$ 21 F-5 = CI system and Bosch ignition system

²⁾ B 21 F-9 = CI system and Chrysler ignition system

³⁾ Only certain year models and markets

⁴⁾ Only California

⁵⁾ Only B 21 ET Scandinavia and Switzerland 1984–48

E37

Check valve stem position in relation to camshaft

This measurement should be carried out to ensure that there is sufficient space for valve adjustment.

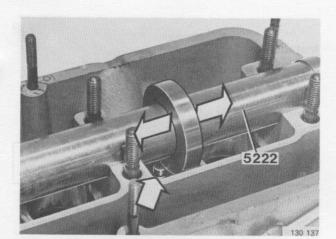
Place valves in cylinder head.

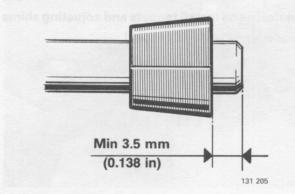
Remove measuring rings for D 20/D 24 (largest ring) from gauge 5222 and place gauge in cylinder head. Slide measuring ring for B 17—B 23 over valve and press valve against seat with a finger.

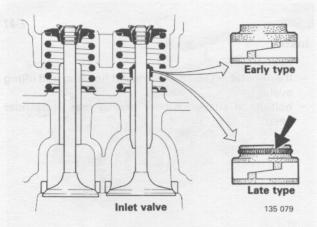
Ring must not touch valve. If valve touches ring the stem must be ground down.

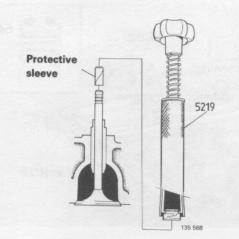
Max grinding = 0.5 mm (0.02 in)

Min 3.5 mm (0.138 in) between valve cotter and end of valve stem.









Fit new valve stem seals

Seals are only required on inlet valves.

Use only late type seals.

Always use the protective sleeve supplied with new parts.

To install seal:

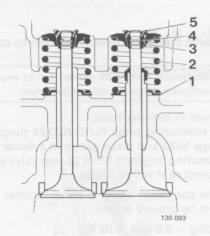
Oil and place valve in position.

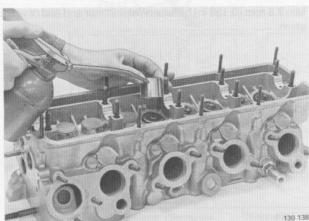
Place protective sleeve on valve stem.

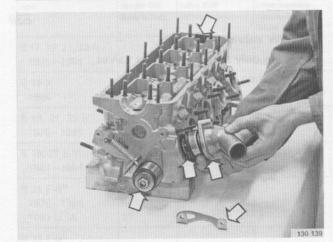
Fit seal using tool 5219. The tool should abut seal flange.

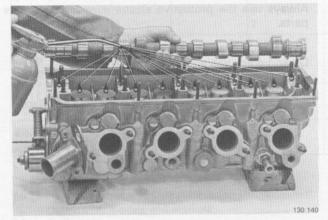
Remove protective sleeve.

E38









Install:

- lower spring seat (1)
- spring (2)
- upper spring seat (3)
- valve cotter (4)
- rubber seal (5)

Important:

Two different types of springs and seats are in use, see E 33.

E40

E39

Lubricate and install tappets and adjusting shims

Place in same position as found.

E41

Install:

- belt tensioner
- thermostat + O-ring, thermostat housing and lifting eyelet
- half-moon shaped rubber seal at rear of cylinder head

E42

Lubricate:

- bearing shells
- cams
- tappets and adjusting shims

E43



5021

Place camshaft and rear bearing cap on cylinder head. Guide pin (arrowed) for pulley should face up.

Press camshaft into cyliner head with press tool 5021. (Use rear bearing cap as guide).

Do not tighten nuts on rear bearing cap fully at this stage.

Smear front bearing cap sealing face with sealer P/N $1161\ 027-6$.

Lubricate and fit remaining bearing caps. Do not tighten nuts fully at this stage.

Remove press tool 5021.

Lubricate and fit center bearing cap.

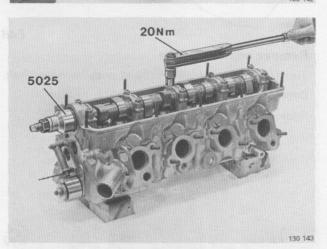
Torque bearing cap nuts to 20 Nm (14 ft.lbs).

E44

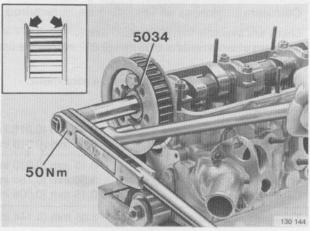
Install front oil seal

Use sleeve 5025.

Grease oil seal and shaft. Check that edges of seal are not damaged.



5021

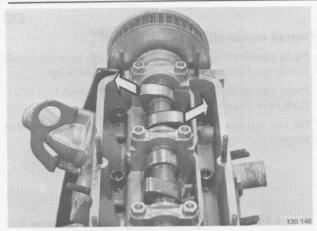


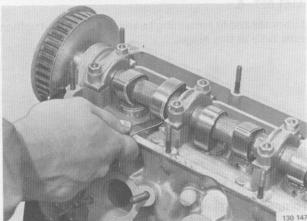
Install guide plates and pulley

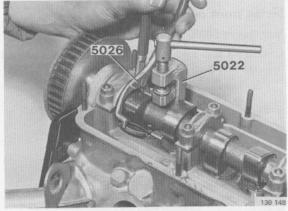
Turn plates so that edges point away from pulley. Torque to **50 Nm** (36 ft.lbs). Use counterhold 5034.

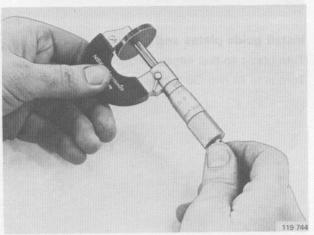
E45











Valve adjustment

Operations E46-54

E46

Turn camshaft to position corresponding to T.D.C. for No. 1 cylinder

Turn pulley until cams above No. 1 cylinder point diagonally upwards.

E47

Measure valve clearance

0.35-0.40 mm (0.0138-0.0158 in).

E48

Remove adjusting shim

Turn tappets so that grooves point away from camshaft. Depress tappets with press tool 5022.

Remove adjusting shim with pliers 5026.

E49

Calculate thickness of adjusting shim required

Shims are available from 3.30–4.50 mm (0.130–0.177 in) thickness at increments of 0.05 mm (0.002 in). Always use new shims.

Measure thickness of fitted shim with a micrometer.

Example:

Correct valve clearance	0.40 mm (0.016 in)
Measured clearance	0.25 mm (0.010 in)
Difference	0.15 mm (0.010 in)
Thickness of fitted adjusting shim	3.80 mm (0.150 in)
Difference	0.15 mm (0.006 in)

Thickness of adjusting shim required 3.65 mm (0.144 in)

E50

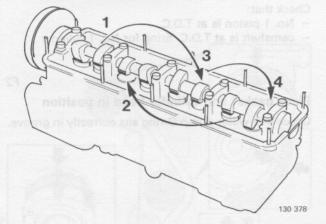


Lubricate and install new adjusting shim
Shim must be fitted with mark facing downwards.

E51

Remove special tool 5022

E52



Check valve clearance for remaining cylinders
Check valve clearance in following sequence:
Cyl 3, Cyl 4 and Cyl 2.

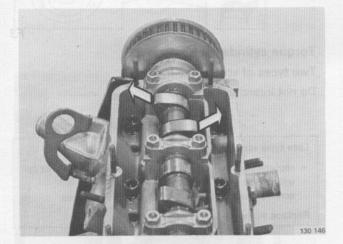
E53

Turn camshaft a few turns and recheck clearance of all valves

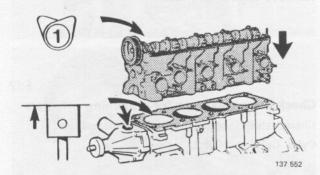
E54

Set camshaft to T.D.C. firing for No. 1 cyl.

Both cams above No. 1 cylinder should point diagonally upwards.



Assembling, engine



Check position of crankshaft and camshaft

Check that:

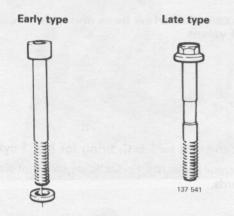
- No. 1 piston is at T.D.C.

- camshaft is at T.D.C. firing for No. 1 cylinder

Place gasket and cylinder head in position
Check that water pump O-ring sits correctly in groove.

F2

F3



7 3 1 5 9 0 0 0 0 0 0 0 0 8 4 2 6 10

Torque cylinder head screws

Two types of screws are in use.

Do not interchange different types.

Late type screws:

- replace screws if they show signs of distortion. This can usually be seen at centre of screw.
- screws must not be reused more than 5 times.

Replace screws if in doubt.

Oil screws.

Place screws in cylinder head and tighten each screw in sequence according to following stages.

Early type

1 = 60 Nm (43 ft.lbs)

2 = 110 Nm (80 ft.lbs)

Note: Retorque early type screws, see F8 page 56

Late type

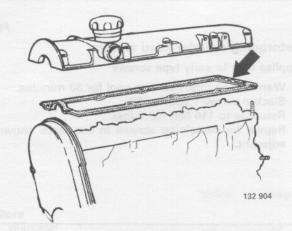
1 = 20 Nm (14 ft.lbs)

2 = 60 Nm (43 ft.lbs)

3 = Angle-tighten 90°

Colour P/N

F4



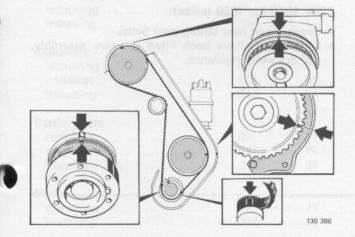
Install gasket and rocker cover

Check that half moon-shaped seal at rear of cylinder head is in position.

Use a new gasket.

Turbo engines require a harder type of gasket. Part number and colour of gasket are shown below.

	ooloui	
Turbo	Light biege	1326640-8
Other models	Blue	463999-3



Install timing gear belt

Important: Do not turn crankshaft or camshaft as pistons can strike valves and cause damage.

 Check that camshaft, intermediate shaft and crankshaft are aligned as shown adjacent.

 Place belt around crankshaft and intermediate shaft pulleys so that two lines on belt align with timing mark on crankshaft.

Stretch belt and place over camshaft and belt tensioner.

Check position of belt. Recheck position of pulleys.

F6

F5

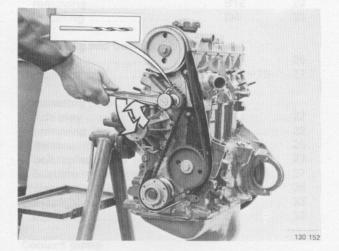


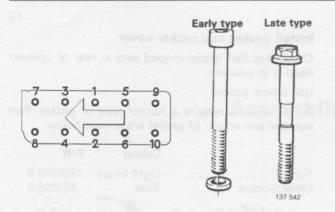
Slacken belt tensioner nut. Spring will now tension belt.
Remove drill from belt tensioner (See E1).
Retighten nut.

F7

Install:

- timing gear case
- crankshaft pulley

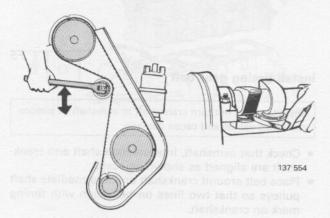




Retorquing cylinder head screws

Applies only to early type screws

- 1. Warm-up engine. Leave to cool for 30 minutes.
- Slacken screw 1 approx. 30°. Retorque to 110 Nm (80 ft.lbs).
- 3. Repeat for remaining screws in sequence shown adjacent.



After 1000 km (600 miles):

· Check/adjust new timing gear belts.

 If new parts have been fitted to valve assembly, recheck valve clearance.

F9

F8

(E)

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