

Service Manual

Repairs and maintenance

TP 30420/1 11.88

Section 2(20-23, 25-27)

Engine D 20, D 24

240 1979- 19 ..

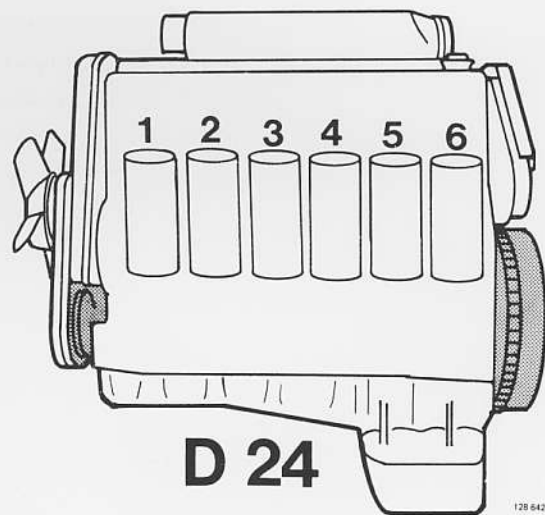
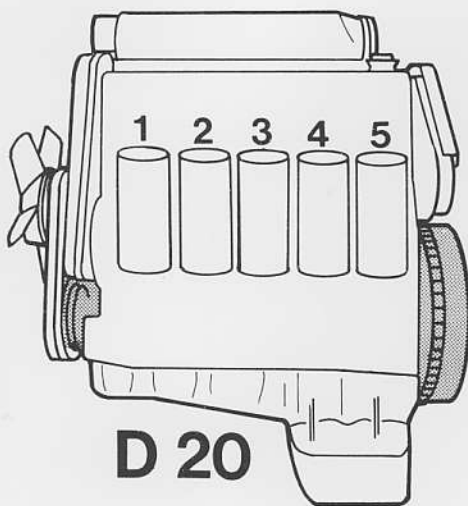
VOLVO

D 20, D 24

Both the D 20 and D 24 Diesel engines are dealt with in this manual.

The D 20 has five cylinders and the D 24 six. Otherwise the engines are similar in principle.

Note! Different flywheels and vibration dampers are fitted to the different engine types.



128 642

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

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

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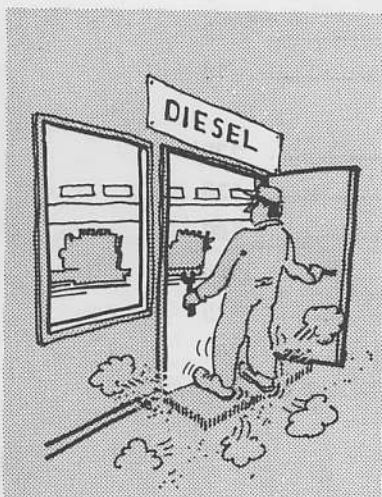
Order No.: TP 30420/1

We reserve the right to make alterations

Reprint of 1983 literature without change.

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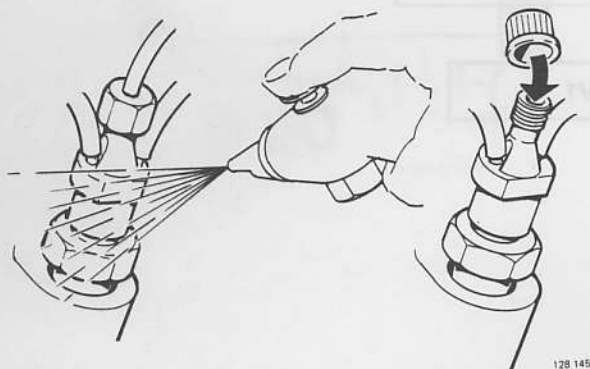
Important information



128 679

CLEANLINESS

Diesel injection systems are extremely sensitive to dirt and foreign matter. A special workplace should therefore be used for inspection of components.

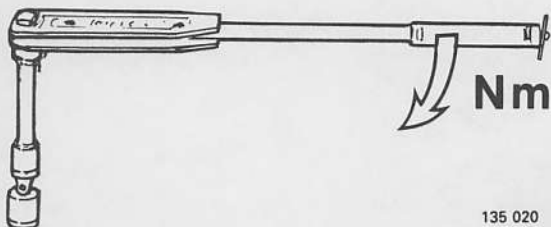


128 145

PLUGS

Clean fuel line connections thoroughly before disconnecting pipes.

Plug ends of fuel lines etc as each component is removed. Do not remove these plugs until the component is reconnected.



135 020

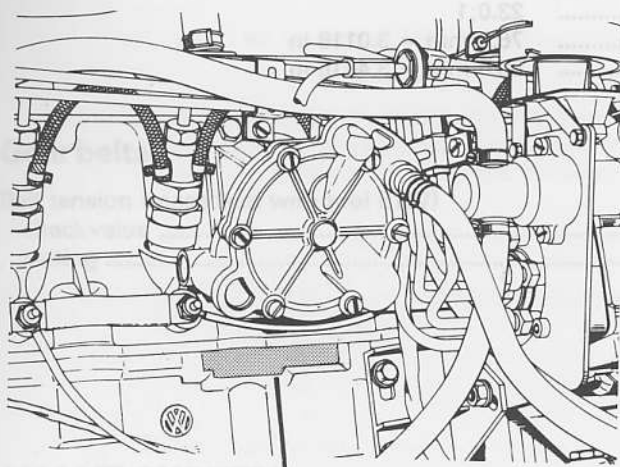
Tightening torques

Two kinds of tightening torques will be found in this manual.

1. Tighten to **40 Nm** (30 ft lbs) indicates that a torque wrench must be used for tightening.
2. Tightening torque 40 Nm (30 ft lbs) indicates a guide value. Tightening need not be done with a torque wrench.

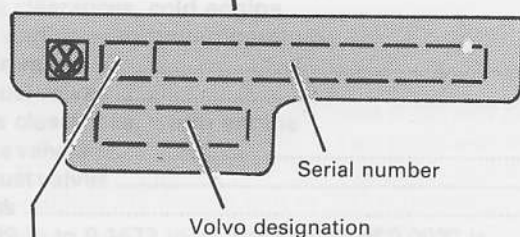
Specifications

Group 20 General



Engine type designation and serial number

Stamped on left side of engine beneath vacuum pump



VW designation

Serial number

Volvo designation

133 757

D 20 Engine

Output DIN	50 kW at 80 r/s	
	68 hp at 4,800 r/min	
Max torque DIN	120 Nm at 50 r/s	
	12.2 kpm at 3,000 r/min	
Number of cylinders	5	
Firing order	1-2-4-5-3	
Displacement	1.986 dm ³ (liter)	
Weight, approx. incl. engine mounts, alternator and starter motor	181 kg (405 lbs)	
Compression pressures:	Mpa	psi
New engine	3.2	455
Minimum	2.4	313
Max difference between cylinders	0.8	114
Compression ratio	23.0:1	
Cylinder bore	76.5 mm = 3.0118 in	
Stroke length	86.4 mm = 3.4016 in	

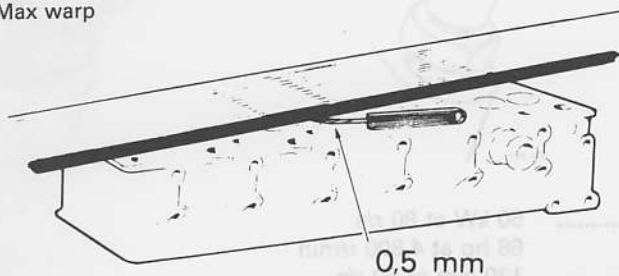
D 24 Engine

Output DIN	60 kW at 80 r/s	
	82 hp at 4,800 r/min	
Max torque DIN	140 Nm at 47 r/s	
	14.3 kpm at 2,800 r/min	
Number of cylinders	6	
Firing order	1-5-3-6-2-4	
Displacement	2.383 dm ³ (liter)	
Weight, approx. incl. engine mounts, alternator and starter motor	198 (435 lbs)	
Compression pressures:	MPa	psi
New engine	3.2	455
Minimum	2.4	313
Max difference between cylinders	0,8	114
Compression ratio	23.0:1	
Cylinder bore	76.5 mm = 3.0118 in	
Stroke length	86.4 mm = 3.4016 in	

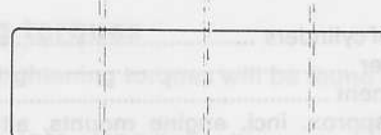
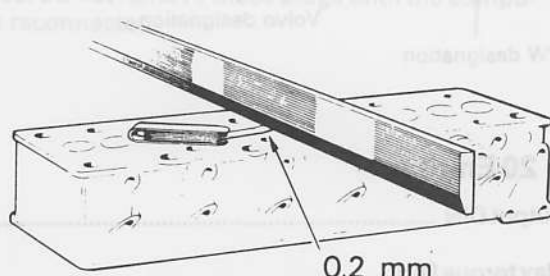
Group 21 Engine assembly

CYLINDER HEAD

Max warp



Diagonally max 0.5 mm



Square max 0.2 mm

Replace cylinder head if warp exceeds specifications.
Under no circumstances may cylinder head be machined.

CYLINDER HEAD GASKET

Three different gasket types are used depending on piston projection above cylinder block face.

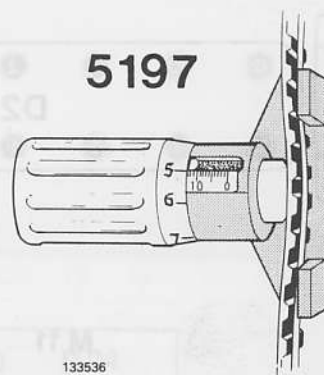


Piston projection mm (in)	Gasket notches	thickness mm (in)
0.67–0.80 (0.026–0.031)	1	1.4 (0.055)
0.81–0.90 (0.032–0.035)	2	1.5 (0.059)
0.91–1.02 (0.036–0.040)	3	1.6 (0.063)

Gear belts

Belt tension (measured with tool 5197)

check value	12–13
setting	12.5



VALVE SYSTEM

Valve clearances, cold engine

Cold engine = room temperature

intake valves

exhaust valves

Valve clearances, warm engine

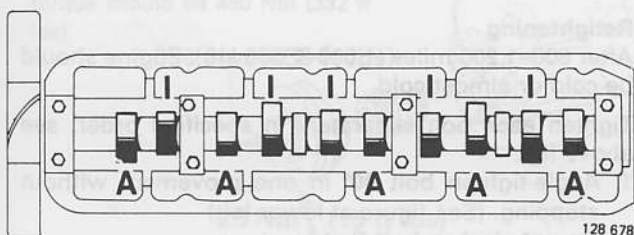
intake valves

exhaust valves

Shims

0.1299 in to 0.1673 in in increments of 0.0020 in

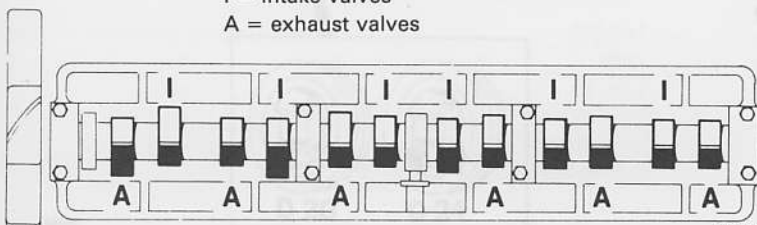
Check mm (in)	Setting mm (in)
0.15–0.25 (0.006–0.010)	0.20 (0.008)
0.35–0.45 (0.014–0.018)	0.40 (0.016)
0.20–0.30 (0.008–0.012)	0.25 (0.010)
0.40–0.50 (0.016–0.020)	0.45 (0.018)
3.00–4.25 mm in increments of 0.05 mm	



I = intake valves
A = exhaust valves

D 20

Check/adjust valves in following order:
1-2-4-5-3

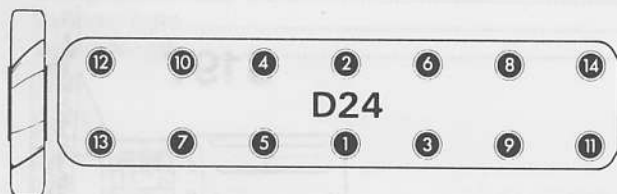
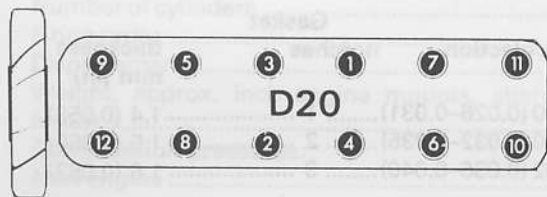


D 24

Check/adjust valves in following order:
1-5-3-6-2-4

TIGHTENING TORQUES

Tightening torques apply to oiled nuts and bolts. Degreased (washed) parts must be oiled prior to assembly.



TIGHTENING SEQUENCE FOR CYLINDER HEAD BOLTS

Important! slacken bolts in reverse order when removing cylinder head.

Remove oil and dirt from bolt holes. Oil left in holes will reduce pressure on cylinder head gasket.

Bolt threads and washers must however be oiled, otherwise frictional forces will be too great.

Two types of bolts are in use: An early type with M 11 threads and a later type with M 12 threads. (Later type is threaded along entire length.)

TIGHTENING OF CYLINDER HEAD BOLTS

M 11



Use **new washers**, convex side upwards.

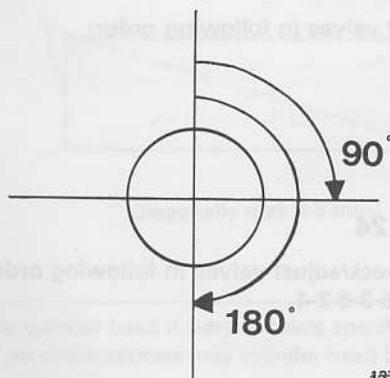
Tighten in five stages:

- 1 **50 Nm** (37 ft lbs)
- 2 **70 Nm** (50 ft lbs)
- 3 **90 Nm** (65 ft lbs)
- 4 run engine until oil temperature is at least 50°C (122 °F)
- 5 **90 Nm** (65 ft lbs)

Retightening

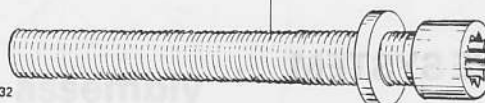
— After 600–1,200 miles (1,000–2,000 km). Engine should be cold or almost cold. Tighten each bolt separately in specified order, see above fig.:

1. Slacken bolt 30°
2. Torque to **90 Nm** (65 ft lbs)



197 158

M 12



Use **new bolts**. Not necessary to replace washers.

Tighten in six stages:

- 1 **40 Nm** (30 ft lbs)
- 2 **60 Nm** (44 ft lbs)
- 3 **75 Nm** (55 ft lbs)
- 4 angle-tighten **180°** in one movement without stopping. (See figure at lower left)
- 5 run engine until oil temperature is at least 50°C (122 °F)
- 6 angle-tighten **90°** in one movement without stopping.

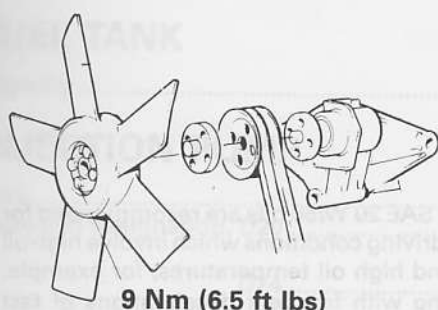
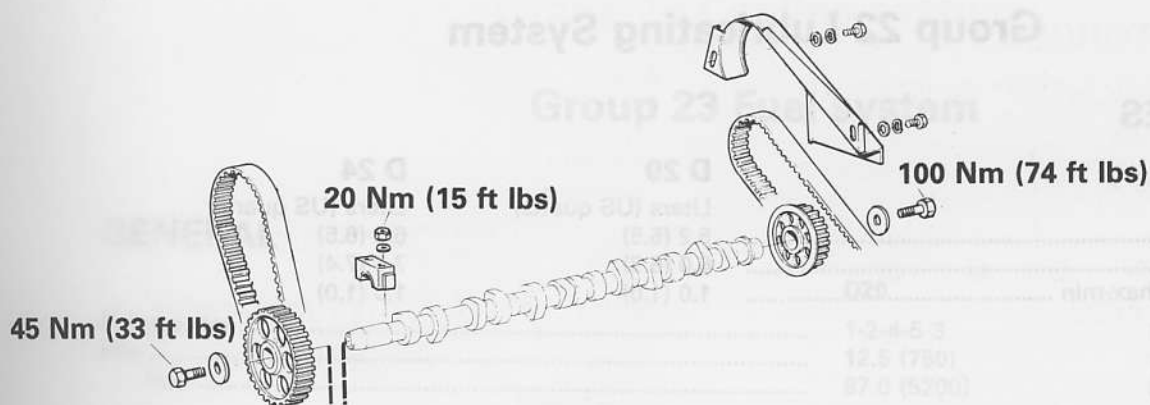
Retightening

After 600–1,200 miles (1,000–2,000 km). Engine should be cold or almost cold.

Tighten each bolt separately in specified order, see above fig.:

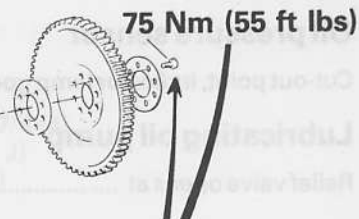
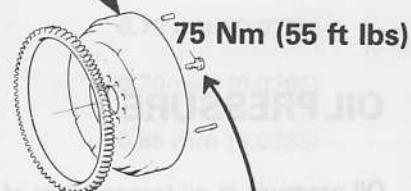
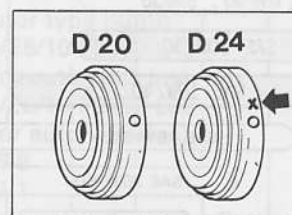
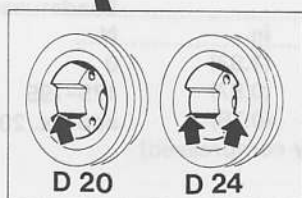
1. Angle-tighten bolt **90°** in one movement without stopping. (See figure at lower left)

Do not slacken bolt first.



Smear threads and bolt head contact surfaces with locking compound (P/N 277961-9).

Tightening torque 350 Nm (258 ft lbs) applies when using special tool 5188. If a torque wrench is used directly on the center bolt (without 5188), the tightening torque should be 450 Nm (332 ft lbs).



Use new bolts
Smear threads with locking compound P/N 277961-9.

Group 22 Lubricating System

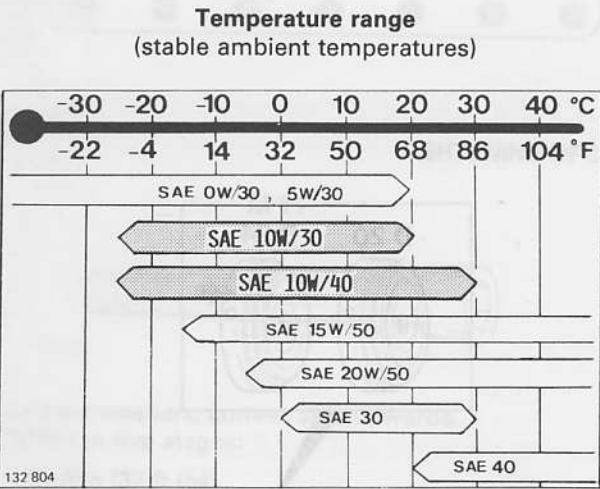
OIL CAPACITIES

	D 20	D 24
	Liters (US quarts)	Liters (US quarts)
Excl. oil filter	5.2 (5.5)	6.2 (6.5)
Incl. oil filter	6.0 (6.3)	7.0 (7.4)
Difference in volume, max-min	1.0 (1.0)	1.0 (1.0)

ENGINE OIL

Quality	min CC
According to API	Oils with designations SE/CC, SE/CD, SF/CC and SF/CD meet this requirement

Viscosity

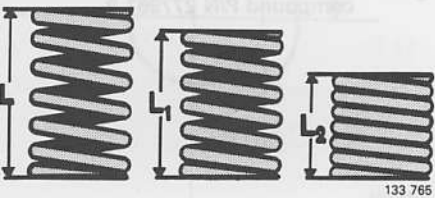


SAE 15 W/50 or SAE 20 W/50 oils are recommended for use in extreme driving conditions which involve high oil consumption and high oil temperatures, for example, mountain driving with frequent decelerations of fast motorway driving. (Note however the lower temperature limits.)

OIL PRESSURE

	kPa	psi
Oil pressure at oil temperature of 80°C (176°F) and 33.3 r/s (2000 r/min) min	200	28
Oil pressure sensor		
Cut-out point, indicator lamp goes out at	15–45	2–6.4
Lubricating oil pump		
Relief valve opens at	600–700	85–99

Relief valve spring, length at different loads



Length		Load	
mm	in.	N	lbs
L = 49	(1.93)	0	0
L ₁ = 22	(0.87)	175–195	(39–44)
L ₂ = 19.8	(0.78)	approx. 200	(45)
(completely compressed)			

Group 23 Fuel system

GENERAL

	D20	D24
Firing order	1-2-4-5-3	1-5-3-6-2-4
Idle	12.5 (750)	12.5 (750) r/s (r/min)
fast	87.0 (5200)	87.0 (5200) r/s (r/min)

FUEL

Standard	DIN 51601: CEC-ERF-DI, or ASTM-D 975-No. 2-D
Ignition response (cetane No.) min	45
Sulphur content, max. w.p.	0.5

FUEL TANK

Capacity	60 litres (15.8 US galls.)
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INJECTION PUMP

Type	Distributor type pump	
Make and designation, D20	Bosch VE5/10 F2400 L45 (L45-1 for auto vehicles)	
D24	Bosch VE6/10 F2400 L32 (L32-1 for auto vehicles)	
Volvo P/N (exchange unit) D20	5001716-9	
D24	5001715-1	
Injection timing (pump plunger stroke at TDC)	Checking mm (in)	Setting mm (in)
D20	0.75–0.83 mm (0.0295–0.0327)	0.80 mm (0.0315)
D24	0.65–0.73 mm (0.256–0.0287)	0.70 mm (0.0276)
D24 USA and Canada 1979–1981	0.65–0.73 mm (0.0256–0.0287)	0.70 mm (0.0295)
1982-	0.82–0.90 mm (0.0323–0.0354)	0.85 mm (0.0335)

NOTE! High altitude adjustments are necessary in certain parts of USA, see page 132.

INJECTORS

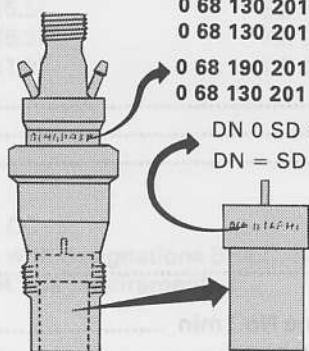
Make and designation	Bosch KCA 30SD 27/ (44)
Bosch No. USA/Canada 1982-	0 68 130 201 F (201 J)
Other markets	0 68 130 201 (201 K)
Volvo P/N USA/Canada 1982-	1328073-0
Other markets	1257144-4
Checking	
Injector opening pressure	12–13
..... MPa	1707-1849
..... psi	

Nozzles

Make	Bosch
Designation USA/Canada 1982-	DN O SD 193 0
Other markets	DN O SD 193
Volvo P/N USA/Canada 1982-	1328096-1
Other markets	1542303-1

0 68 130 201 F } USA/Canada 1982-
 0 68 130 201 J }
 0 68 190 201 } Other markets
 0 68 130 201 K }

DN O SD 193 0 = USA/Canada 1982-
 DN = SD 193 = other markets



Injector
(complete)

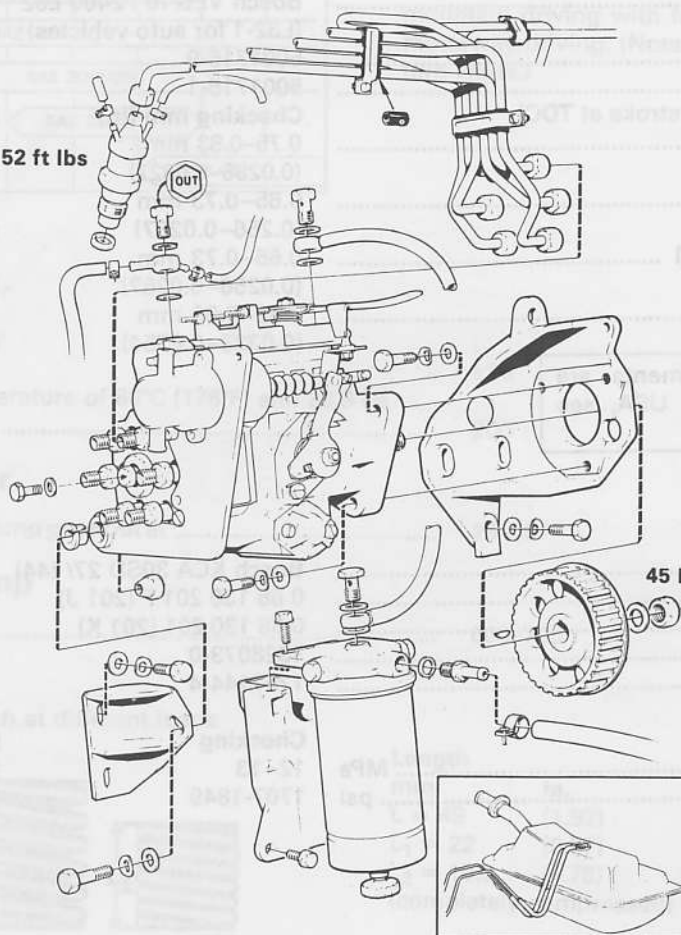
Nozzle

Identification of injectors and nozzles

TIGHTENING TORQUES

	Nm	ft. lbs
Injector, in cylinder head	70	52
upper - lower section	70	52
Injection pump, pump gear	45	33

70 Nm = 52 ft lbs

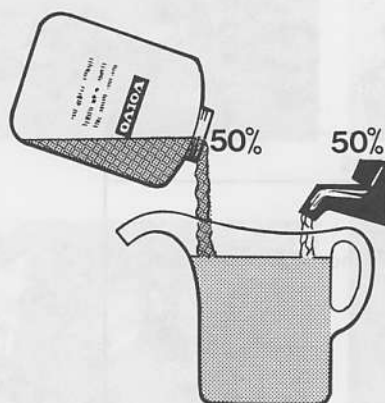


45 Nm = 33 ft lbs

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Group 26 Cooling system

GENERAL



128 187

Coolant

Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage.

Use genuine Volvo blue-green coolant type C diluted with clean water in proportions of 50/50.

This mixture helps to prevent corrosion and frost damage.

- Never fill the cooling system with water alone.
- The coolant should be changed regularly since the corrosion protective additives in the coolant lose their effect in time.

	D 20 litres (US quarts)	D 24 litres (US quarts)
Capacity, with manual gearbox	8.2 (8.7)	9.4 (9.9)
with automatic transmission	8.0 (8.4)	9.2 (9.7)

EXPANSION TANK

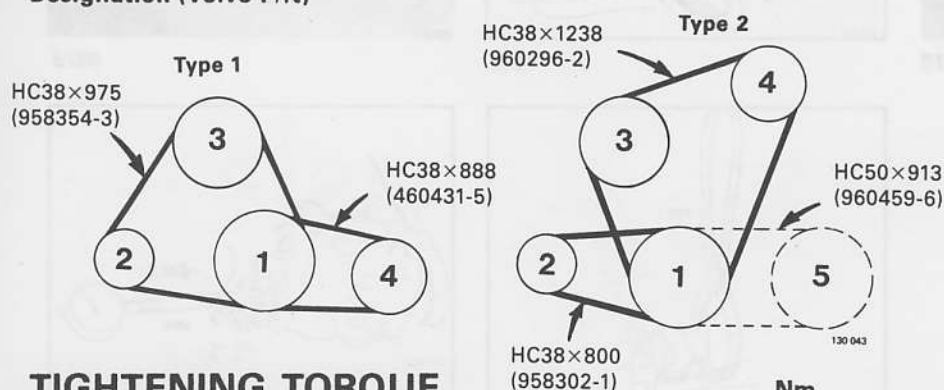
Pressure valve in cap opens at	Type 1 kPa (psi)	Type 2 kPa (psi)
overpressure	65–85 (9.2–12.1)	100 (14.2)
underpressure	7 (1.0)	7 (1.0)

THERMOSTAT

Marking	87°C
Starts to open at	87°C (189°F)
Fully open at	102°C (216°F)
Opening gap, min	8 mm (0.3 in)

DRIVE BELTS

Designation (Volvo P/N)



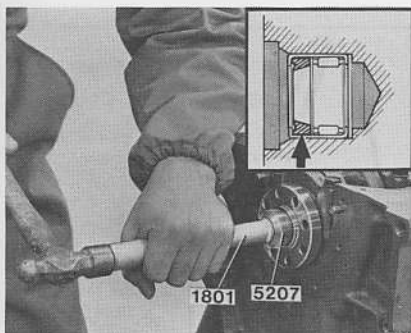
- 1 Crankshaft pulley
- 2 Alternator
- 3 Cooling fan
- 4 Power steering pump
- 5 AC compressor

TIGHTENING TORQUE

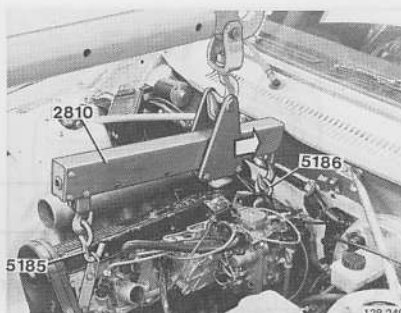
	Nm	ft. lbs.
Cooling fan	9	6.6

Special tools

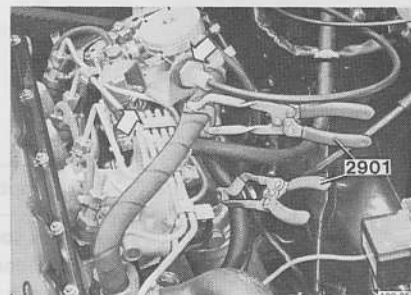
999	Description – Use
1801-3	Standard handle: used with drift 5207 and 5208
2810-3	Lift beam: removing/installing engine
2901-0	Clamping pliers (2x): clamping water hoses when removing injection pump
2903-6	Oil filter wrench
4090-0	Puller: removing pilot bearing
5006-5	Lift bracket: replacing front engine mounts
5033-9	Support (2x): for lift bracket 5006
5112-1	Locking sector: locking flywheel
5115-4	Lift hook: used with lift bracket 5006
5185-7	Lift hook, front: removing/installing engine
5186-5	Lift hook, rear: removing/installing engine
5187-3	Wrench: vibration damper
5188-1	Wrench with extension arm: for vibration damper center bolt
5190-7	Gauge: installing camshaft
5191-5	Adapter: connecting pressure gauge
5193-1	Stop: locking injection pump gear
5194-9	Holder: for dial indicator when adjusting injection pump
5195-6	Pliers: removing valve discs



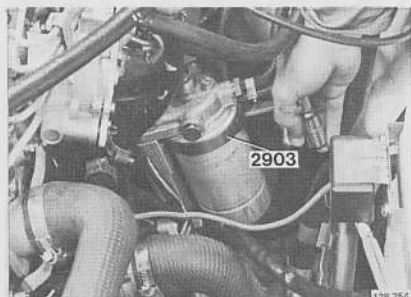
1801



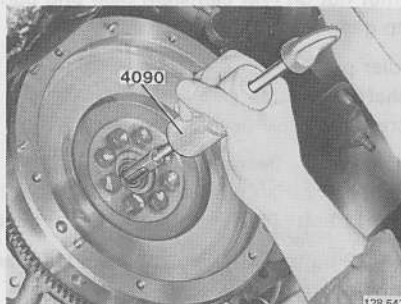
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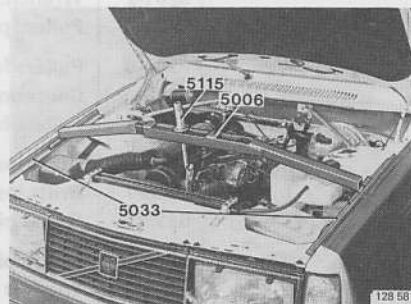
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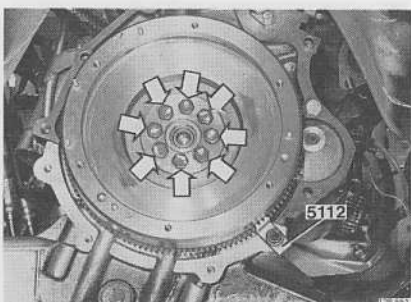
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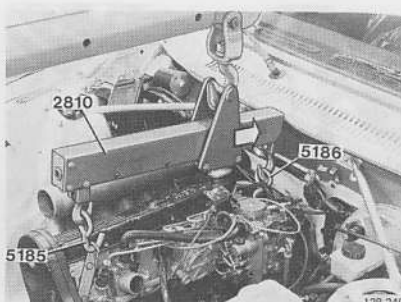
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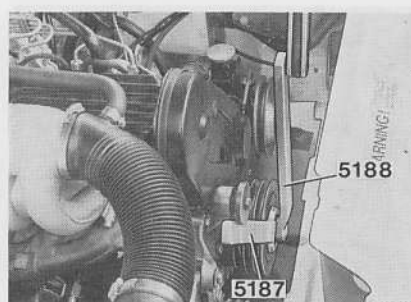
5006, 5033, 5115



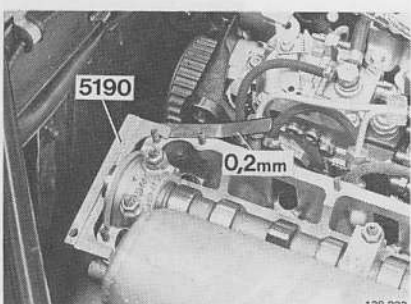
5112



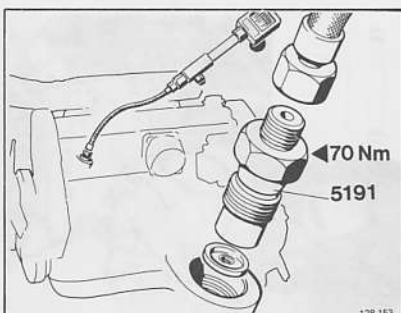
5185, 5186



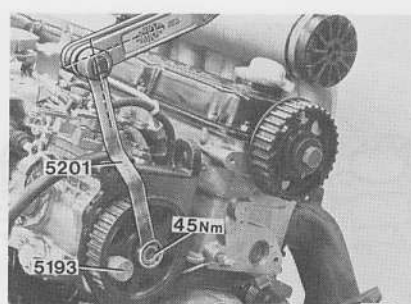
5187, 5188



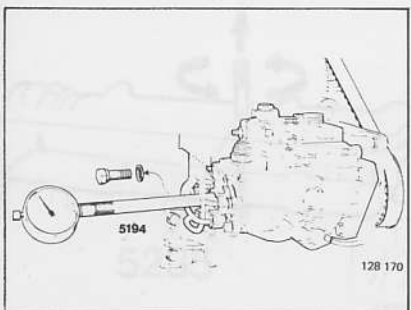
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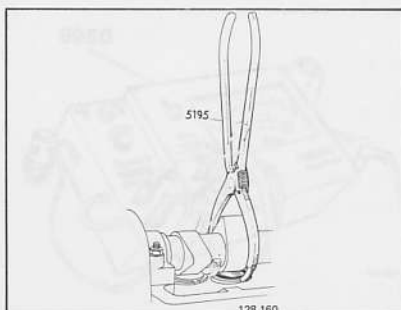
5191



5193

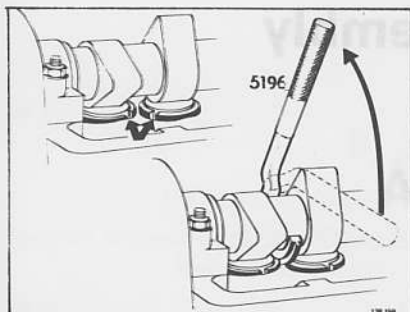


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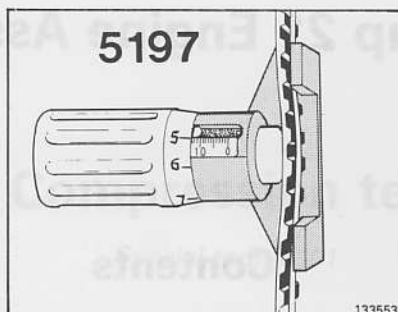


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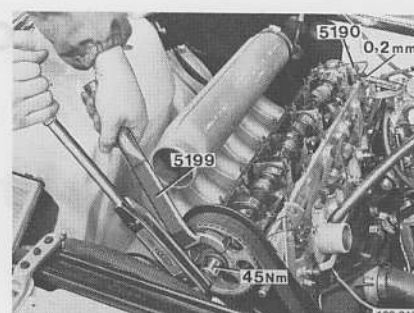
999	Description – Use
5196-4	Press tool: for valve tappets
5197-2	Belt tension gauge: timing gear belts and pump drive
5199-8	Wrench: front and rear camshaft gears
5200-4	Adapter: installing crankshaft front seal and camshaft seals
5201-2	Wrench: center nut on rear camshaft gear and pump gear
5204-6	Puller: pump gear, injection pump
5202-0	Puller: for idler pulley
5203-8	Centering shaft: for clutch disc
5205-3	Puller: for crankshaft front seal
5207-9	Drift: installing needle bearing in crankshaft
5208-7	Drift: installing crankshaft rear seal
5233-7	Guide pins, M 11 bolts (4x): installing cylinder head
5234-3	Guide pins, M 12 bolts (4x): installing cylinder head
5235-0	Tool for removing guide pins
9950-0	Adapter: engine rpm. Used with Volvo Monotester



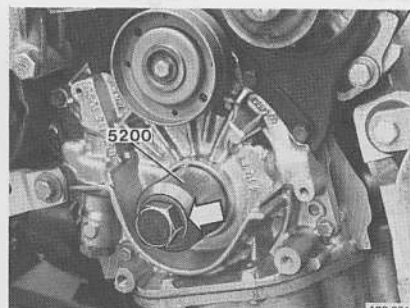
5196



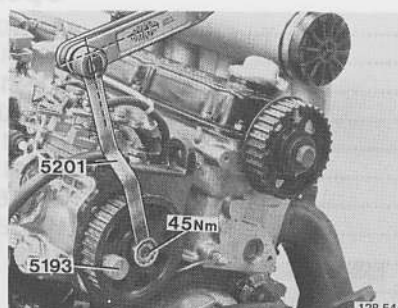
5197



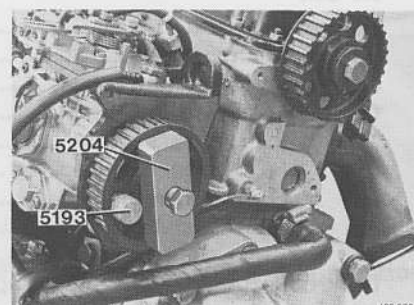
5199



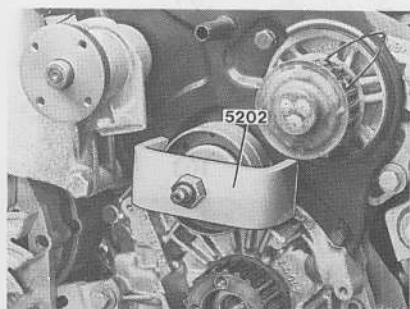
5200



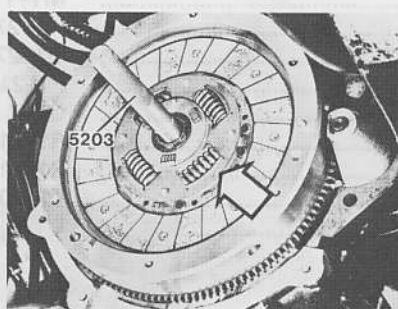
5201



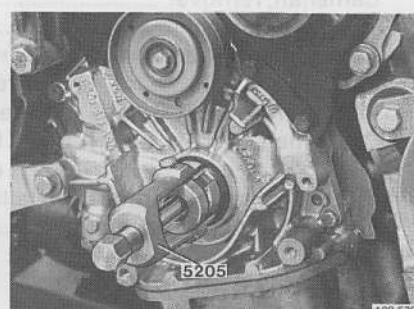
5204



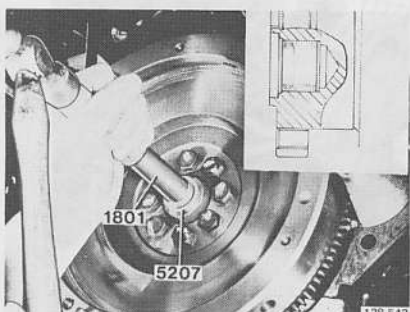
5202



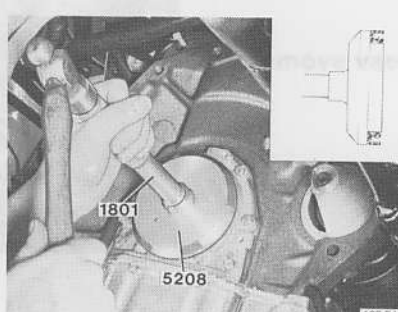
5203



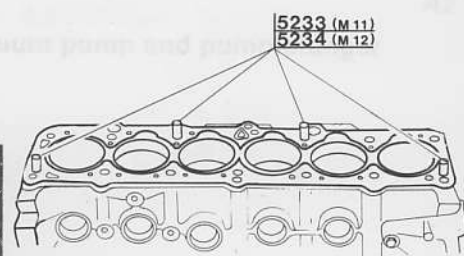
5205



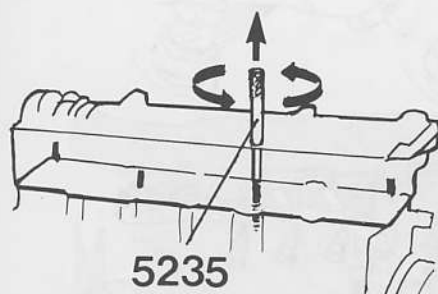
5207



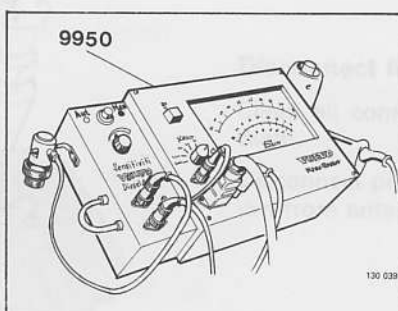
5208



5233, 5234



5235



9950

Group 21 Engine Assembly

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Replacement of engine

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A. Compression test

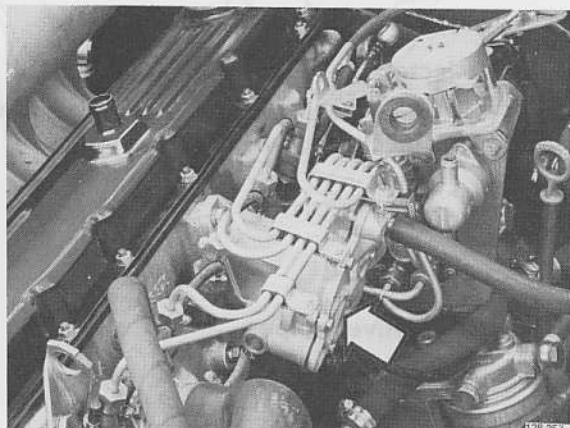
Special tool: 5191



A 1

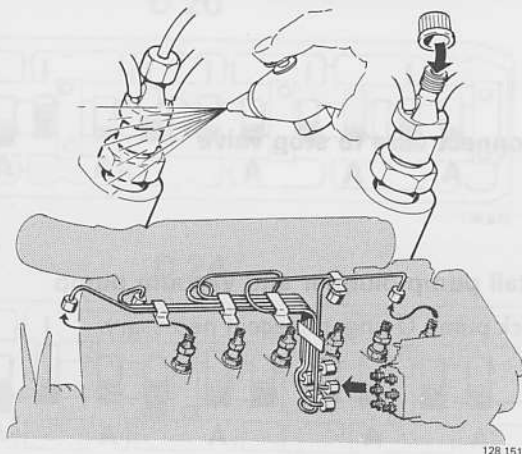
Disconnect wire from stop valve on injection pump

This stops flow of fuel and prevents unnecessary spillage.



A2

Remove vacuum pump and pump plunger

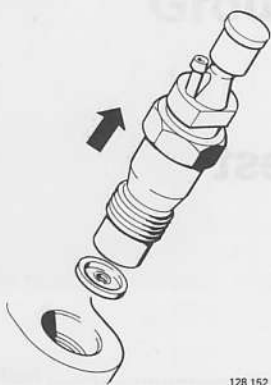


A3

Disconnect fuel delivery pipes

Clean all connections carefully before disconnecting them.

Disconnect pipes and plug all connections to prevent dirt from entering system.



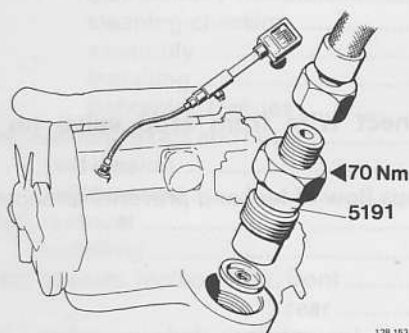
128 152

Remove injectors

Use 27 mm socket (Volvo P/N 1158146).

Lift out heat shields under injectors otherwise they will be blown out during compression test.

A4



128 153

Connect compression tester

Place a heat shield in cylinder head and screw in adapter 5191. Tighten to 70 Nm (50 ft lbs).

Connect compression tester to adapter.

A5

Run engine and record compression

Compression

New = 3.2 MPa (455 psi)

Min = 2.4 MPa (341 psi)

Max difference between cylinders = 0.8 MPa (114 psi)

A6



128 154

Install injectors

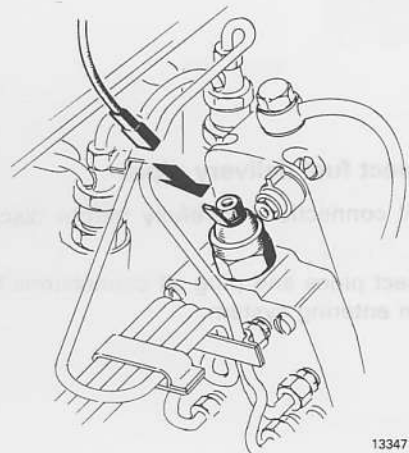
Place new heat shields in cylinder head, see fig. Install injectors. Torque to 70 Nm (50 ft. lbs).

A7

Reconnect delivery pipes

Tightening torque 25 Nm (18 ft lbs).

A8



133471

Reconnect wire to stop valve

A9

Install pump plunger and vacuum pump

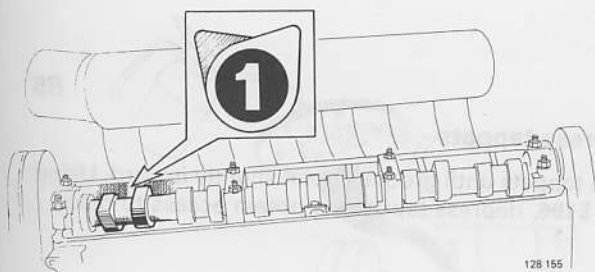
Check pump O-ring, replace if necessary.

A10

B. Valve adjustment

Special tools: 5195, 5196

Valve clearance must be checked/adjusted after completion of repairs such as grinding valves, crankshaft replacement etc., and also after 600–1,200 miles (1,000–2,000 km).



Remove valve cover

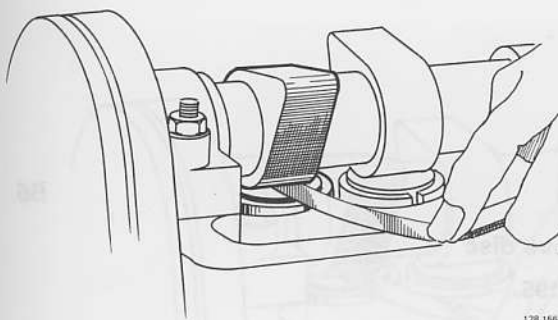
B1

B2

Turn engine until cyl. 1 is at TDC – injection

Always use the vibration damper center bolt to turn the engine. 27 mm socket or wrench 5188.

Both cylinder 1 cams should point obliquely upwards.

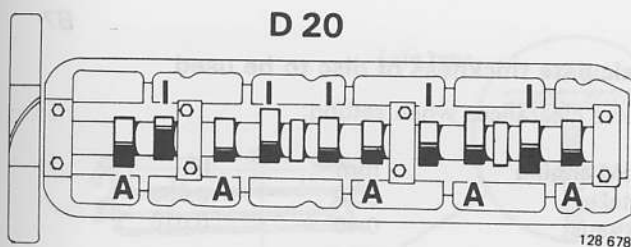


B3

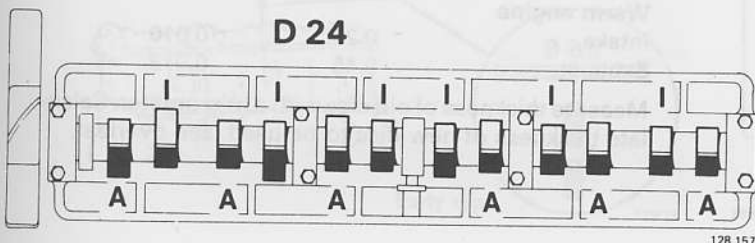
Check valve clearance for cyl. 1

Checking values

	mm	in
Cold engine		
Intake	0.15–0.25	0.006–0.010
Exhaust	0.35–0.45	0.014–0.018
Warm engine		
Intake	0.20–0.30	0.008–0.012
Exhaust	0.40–0.50	0.016–0.020



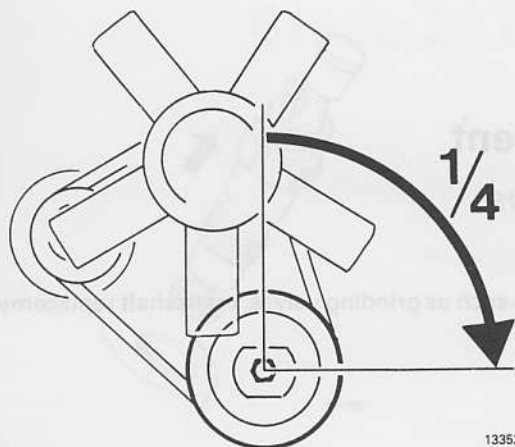
D 24



Cold engine = room temperature

I = intake valve

A = exhaust valve



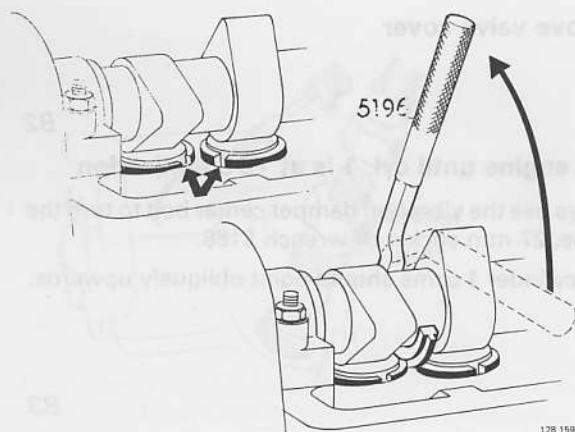
133522

Incorrect clearance (B4-B8)

B4

Turn engine approx. 1/4 turn

Piston must not be at top dead center when setting valve clearance, otherwise valves will contact piston when tappet is depressed.

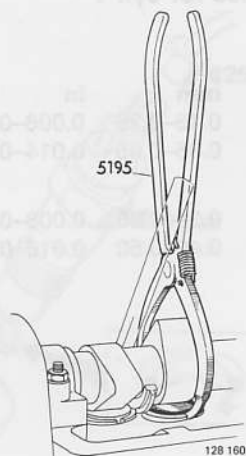


128 159

Depress tappets

Turn tappets until grooves point slightly inward. Using tool 5196, depress tappets to obtain access to discs.

B5

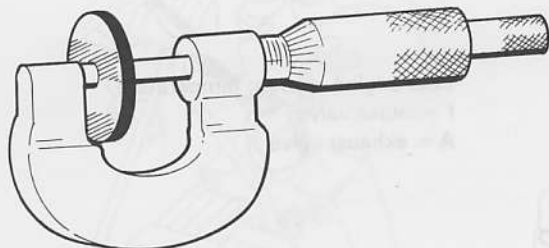


128 160

Remove disc

Use 5195.

B6



133478

Calculate thickness of disc to be used

Valve clearances when setting:

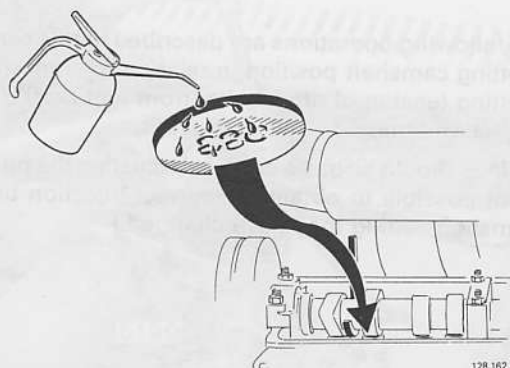
	mm	in
Cold engine		
Intake	0.20	0.008
Exhaust	0.40	0.016
Warm engine		
Intake	0.25	0.010
Exhaust	0.45	0.018

Measure thickness of old disc with a micrometer. Calculate thickness of new disc to be used, see overleaf.

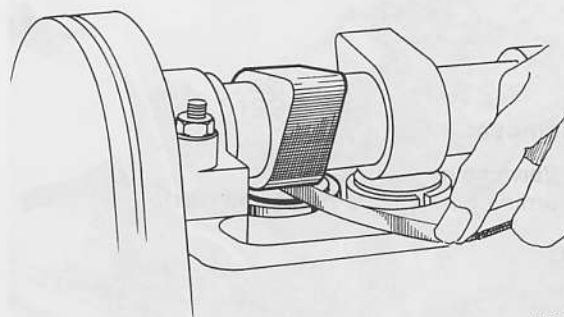
B7

3,80

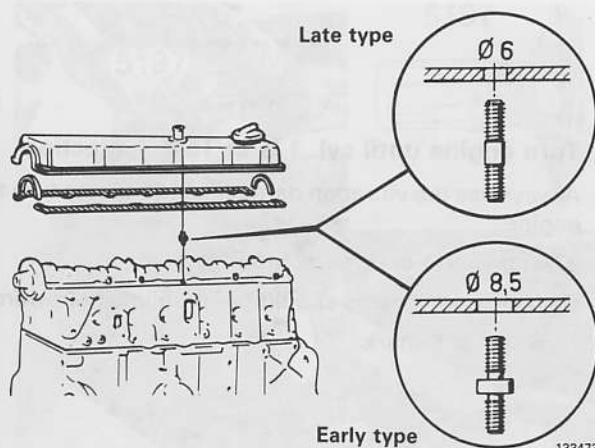
133479



128 162



128 156



133473

Example:

If clearance is 0.20 mm and specified clearance is 0.25 mm then replace existing disc with one which is 0.05 mm thinner.

Always use new discs.

Disc thicknesses available = 3.00–4.25 mm at intervals of 0.05 mm.

B8

Position new disc and remove pliers

Disc should be lubricated and installed with size marks facing down.

B9

Check/adjust valve clearance for remaining cylinders

Check/adjust in following order:

D 20, 1-2-4-5-3

D 24, 1-5-3-6-2-4

Important! Do not forget to rotate crankshaft 1/4 turn before check/adjusting valve clearance.

B10

Recheck valve clearance for all cylinders

Rotate engine several turns before rechecking.

B11

Install valve cover

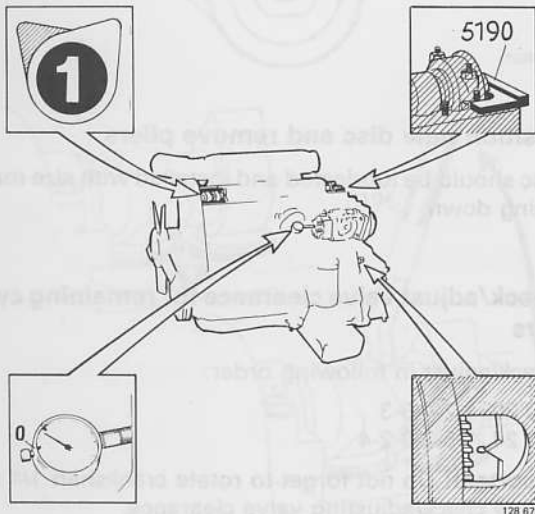
Use new gaskets if required.

Two types of pin studs are available see fig. Late types have a spacer, and hole in gasket is larger to prevent damage to gasket by overtightening.

Late and early type parts **must not** be interchanged.

C. Basic setting of engine

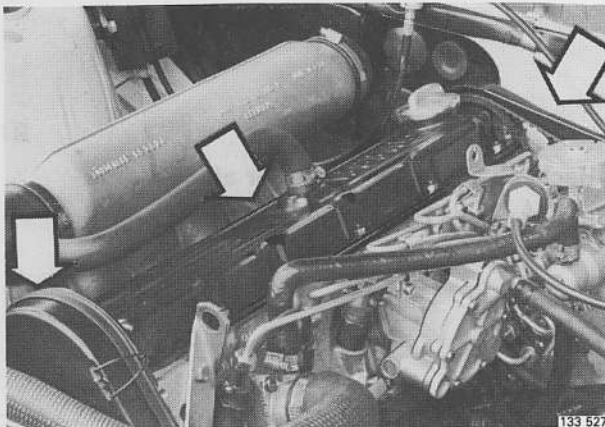
Special tools: 5190, 5193, 5194, 5197, 5199, 5201



The following operations are described in this section:

- setting camshaft position in relation to crankshaft
- setting tension of drive belts (front and rear)
- injection timing.

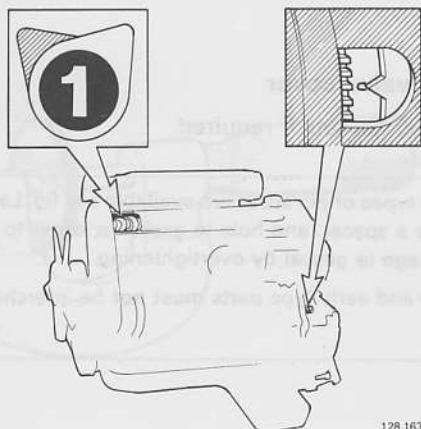
Engines should be basic-set if, by adjusting the pump, it is not possible to obtain the correct injection timing. (Camshaft setting may have changed.)



Remove:

- Valve cover
- timing gear covers (front and rear).

C1



Turn engine until cyl. 1 is at TDC – injection

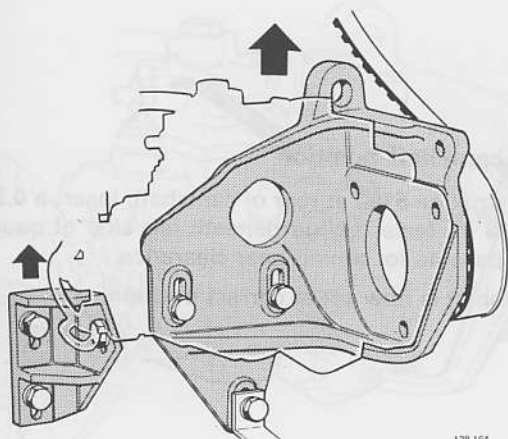
Always use the vibration damper center bolt to turn the engine.

27 mm socket or wrench 5188.

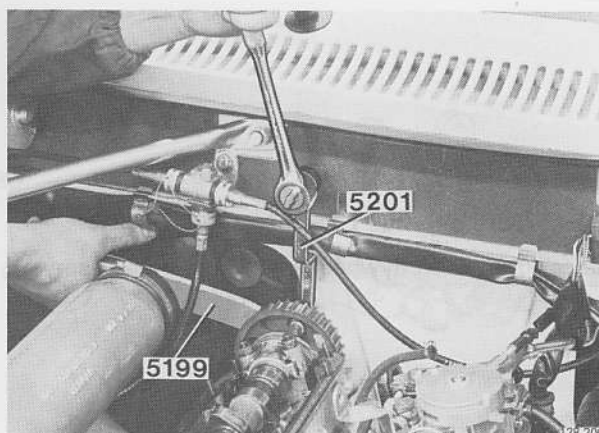
Both cylinder 1 cams should point obliquely upwards.

Flywheel at 0 mark.

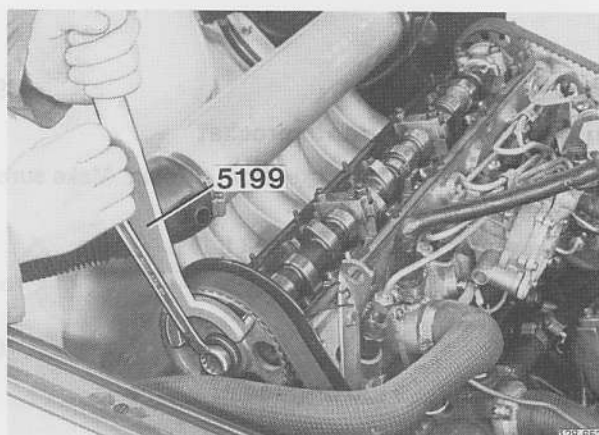
C2



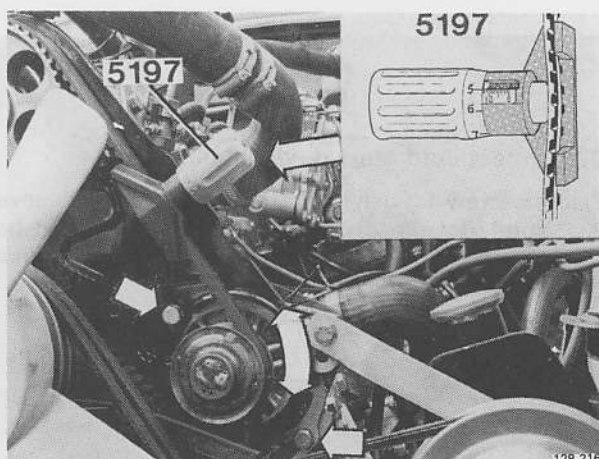
128 164



128 209



128 652



128 216

C3

Lift off pump belt

Slacken mounting bolts for injection pump bracket to release belt tension. Tighten one bolt so that pump remains in upper position.

Lift off belt.

C4

Remove camshaft rear sprocket

Hold sprocket in position with **5199** and unscrew nut with wrench **5201**. Take care not to rotate camshaft.

C5

Slacken camshaft front sprocket

Use **5199** to hold sprocket in position when loosening bolt. Make sure that camshaft does not rotate.

Tap sprocket to free it from camshaft.

C6

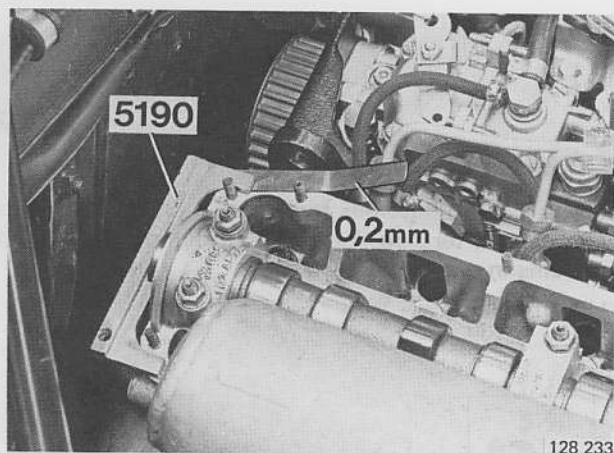
Set belt tension

Adjust tension by moving coolant pump.

Use gauge **5197** to check belt tension. Attach gauge to belt and set to **12.5** units.

Stretch belt until mark on gauge plunger is flush with sleeve.

Depress belt strongly with hand and recheck/adjust tension.

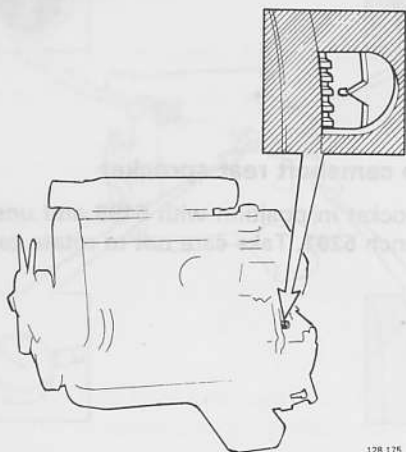


C7

Set camshaft position

Place gauge **5190** at rear of camshaft. Insert a **0.2 mm** (0.008 in) feeler gauge beneath left side of gauge to compensate for timing gear clearance.

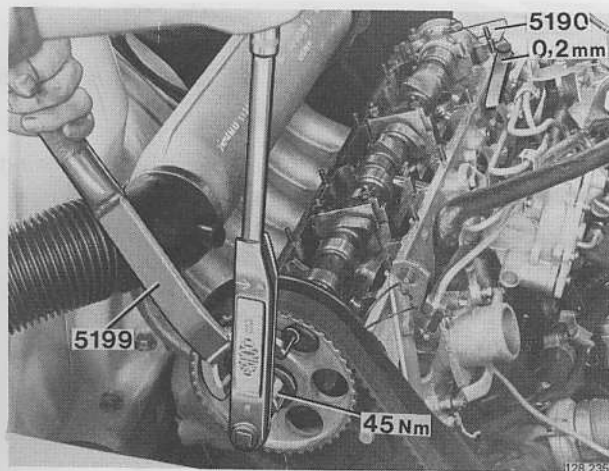
Camshaft is now set at correct position.



C8

Make sure cyl. no. 1 is at top dead center

Check 0 mark on flywheel and adjust if necessary.



C9

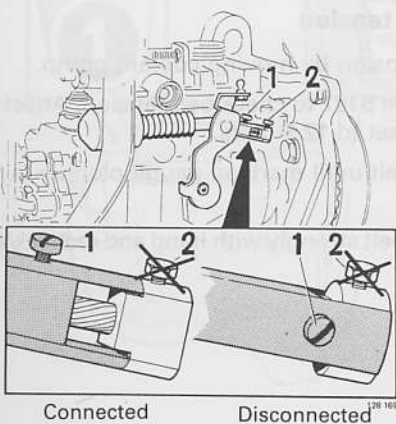
Tighten camshaft front sprocket

Use **5199** to prevent sprocket from turning. Make sure that camshaft does not turn.

Torque center bolt to **45 Nm** (33 ft lbs).

C10

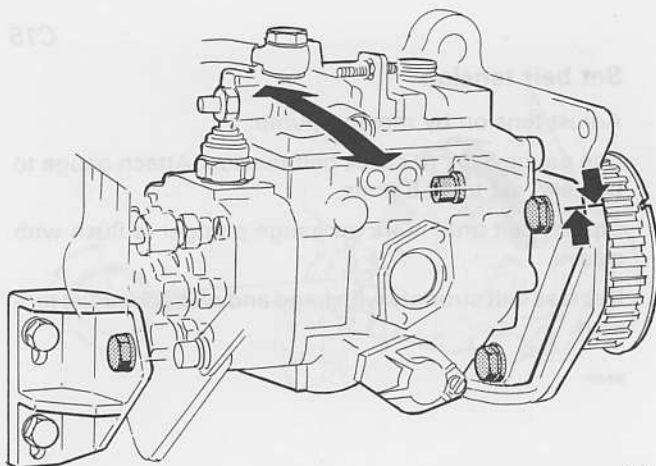
Remove gauge 5190 and feeler gauge



C11

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°. Note! Do not turn screw 2 otherwise it will be necessary to remove cold start device and reset it on a test bench.

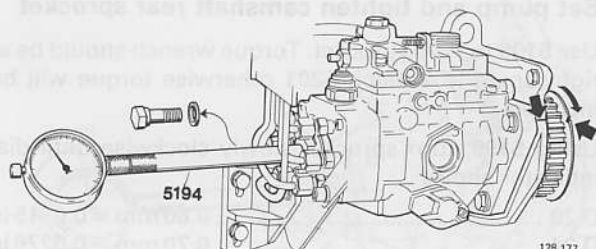


128 167

C12

Basic-set injection pump

Slacken pump mounting bolts (Allen key = 6 mm). Align marks in pump and mounting bracket by turning pump. Retighten mounting bolts.



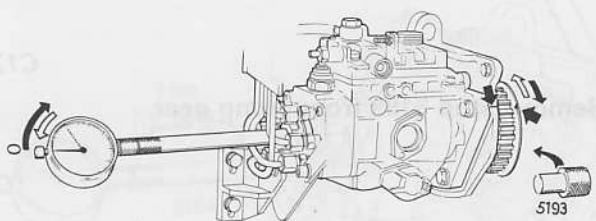
128 177

C13

Set dial indicator zero. Lock pump gear at cyl. 1 injection using stop 5193

Unscrew and remove plug from injection pump distributor. Install holder **5194** and dial indicator (range 0–3 mm). Set gauge to approx. 2 mm.

Turn pump gear clockwise until mark on gear and mounting bracket coincide.

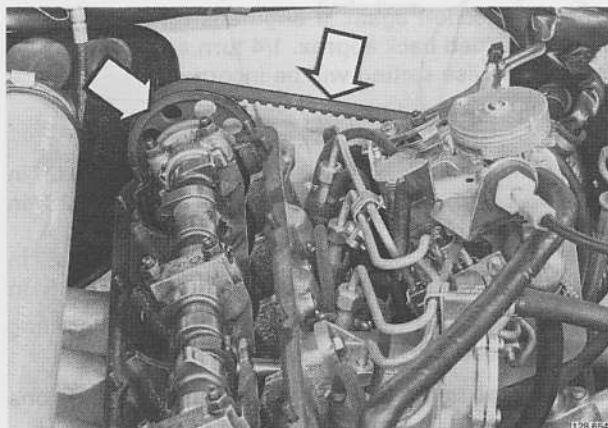


128 670

Then turn pump gear back slightly until min. reading registers on dial indicator.

Set indicator to zero.

Turn pump gear clockwise until mark on gear and pump mounting bracket coincide. Lock gear in this position with stop **5193**. (Insert stop through pump gear into mounting bracket.)

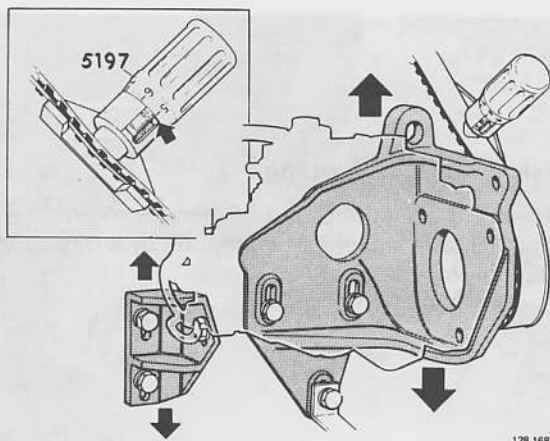


128 654

C14

Install camshaft rear sprocket and belt

Tighten center bolt by hand, but it should still be possible to turn sprocket on camshaft.



C15

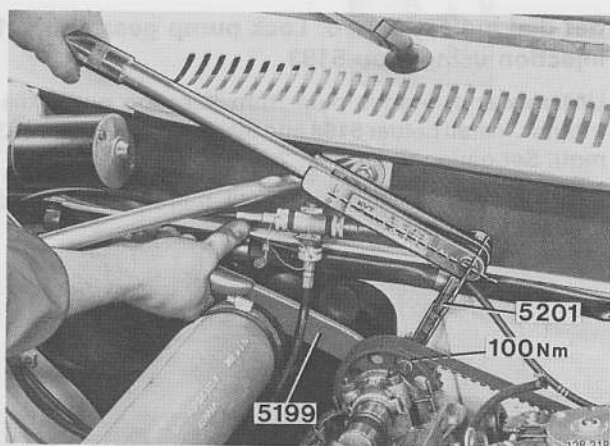
Set belt tension

Adjust tension by moving pump.

Use gauge **5197** to check belt tension. Attach gauge to belt and set to **12.5** units.

Stretch belt until mark on gauge plunger is flush with sleeve.

Depress belt strongly with hand and recheck/adjust tension.



C16

Set pump and tighten camshaft rear sprocket

Use **5199** to hold sprocket. Torque wrench should be at right angle to wrench **5201** otherwise torque will be incorrect.

Using **5199**, turn sprocket slowly clockwise until dial indicator shows:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada 1979–1981	0.70 mm = 0.0276 in
1982–	0.85 mm = 0.0335 in

Hold sprocket in this position and torque bolt to **100 Nm** (73 ft. lbs). Take care that camshaft and sprocket do not move.

C17

Remove stop 5193 from pump gear

C18

Check pump setting

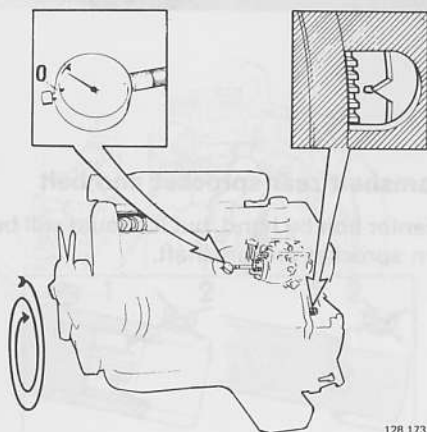
Turn engine two full turns until cyl. 1 is at top dead center – injection again. If engine is turned too far it must be turned back approx. 1/4 turn and then to zero mark otherwise setting will be incorrect.

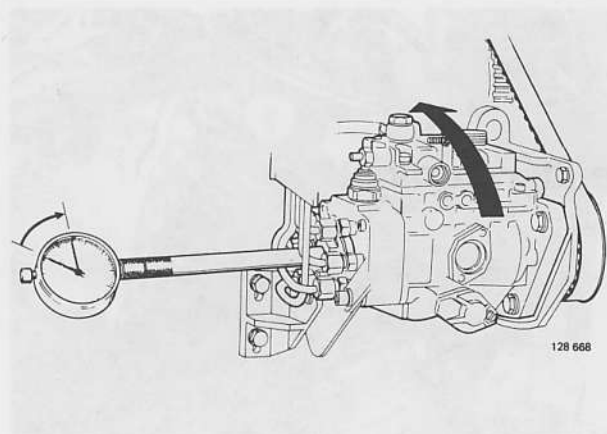
Dial indicator should show:

D 20	0.75–0.83 mm = 0.0295–0.0327 in
D 24	0.65–0.73 mm = 0.0256–0.0287 in
D 24 USA and Canada	
1979–81	0.65–0.73 mm = 0.0256–0.0287 in
1982–	0.82–0.90 mm = 0.0323–0.0354 in

Correct reading: Tighten injection pump mounting bolts. Proceed to C19.

Incorrect reading: Readjust according to instructions on next page.



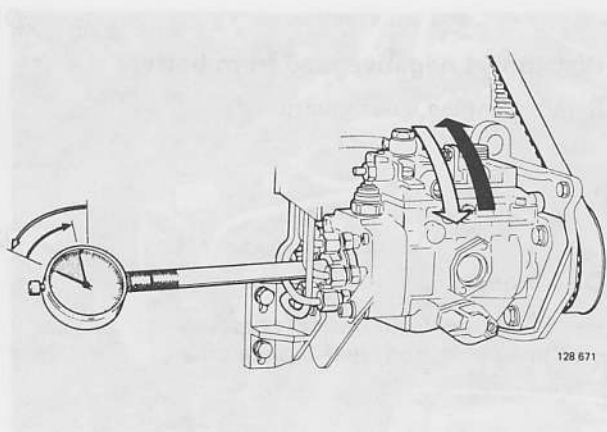
**Readjusting pump setting:**

Setting values:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA and Canada 1979-81	0.70 mm = 0.0276 in
1982-	0.85 mm = 0.0335 in

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump setting.

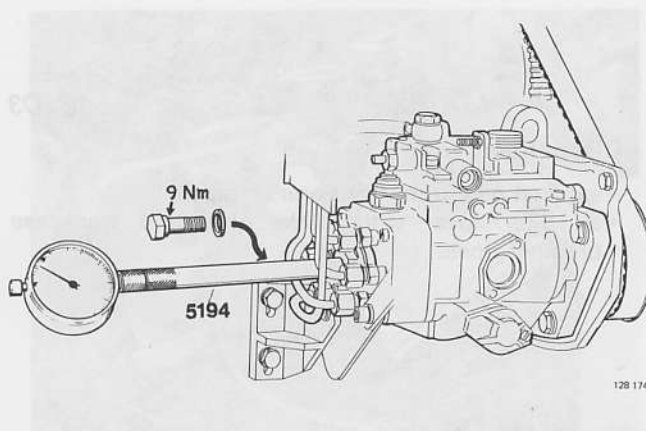
**Reading more than specified:**

Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows **approx.**

D 20	0.70 mm = 0.0276 in
D 24	0.60 mm = 0.0236 in
D 24 USA/Canada 1979-81	0.60 mm = 0.0236 in
1982-	0.75 mm = 0.0295 in

Then turn pump inwards until specified value is obtained. Tighten mounting bolts and recheck pump setting.

Note! Injection pump must not be tapped or knocked as this will alter setting.



C19

Remove dial indicator and holder 5194. Install plug with new seal

Tightening torque 9 Nm (6.5 ft lbs).

C20

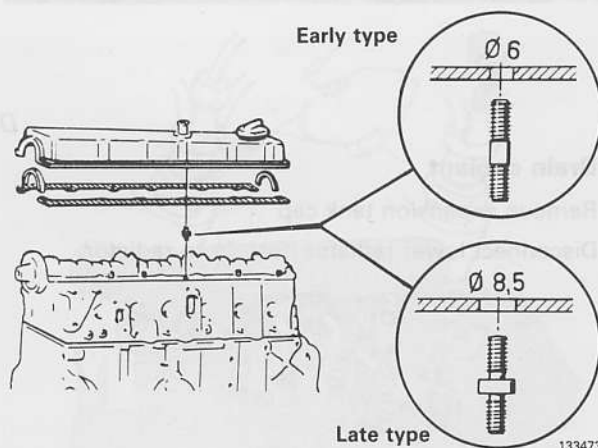
Reconnect cold start device

Press lever forwards and turn sleeve 90°. Retighten screw 1.

C21

Install valve cover and timing gear covers

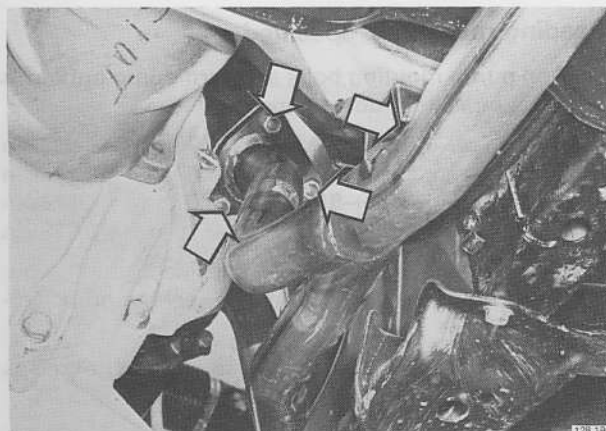
Use new gaskets if necessary.



Two types of pin studs are available, see fig. Late types have a spacer, and hole in gasket is larger to prevent damage to gasket by overtightening. Late and early type parts **must not** be interchanged.

D. Cylinder head, removal

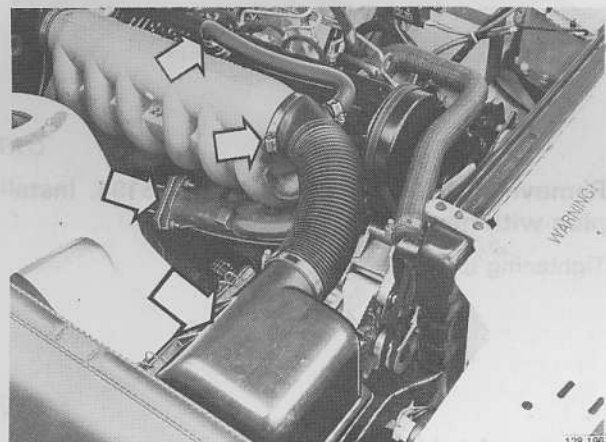
Special tools: 5199, 5201



D1

Disconnect negative lead from battery

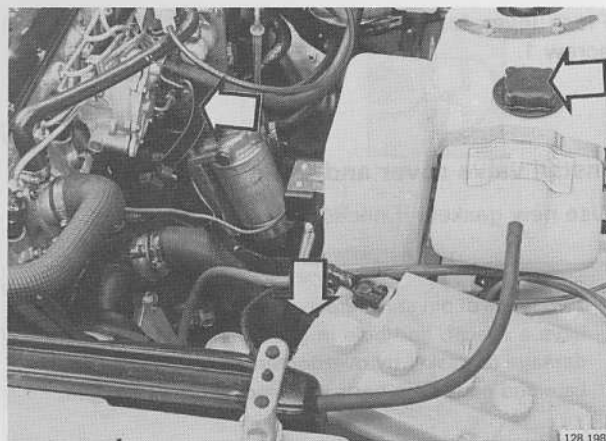
Remove engine splashguard.



D2

Disconnect:

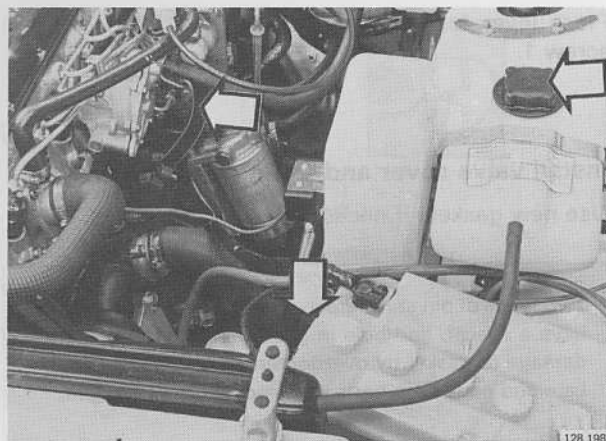
- exhaust pipe from gearbox bracket
- exhaust pipe from rear branch pipe.



D3

Disconnect:

- exhaust pipe from front branch pipe
- air filter cover with intake hose and crankcase breather hose.

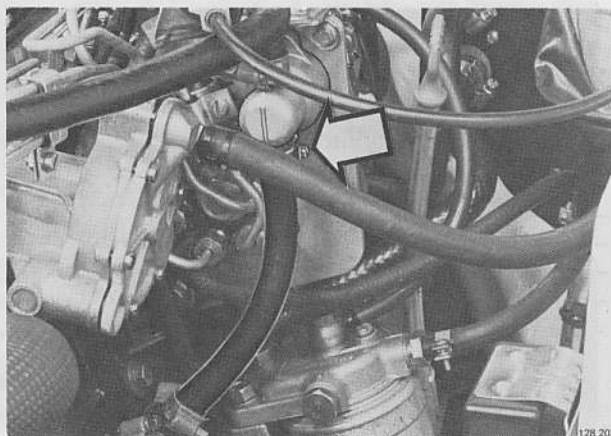


D4

Drain coolant

Remove expansion tank cap

Disconnect lower radiator hose from radiator.

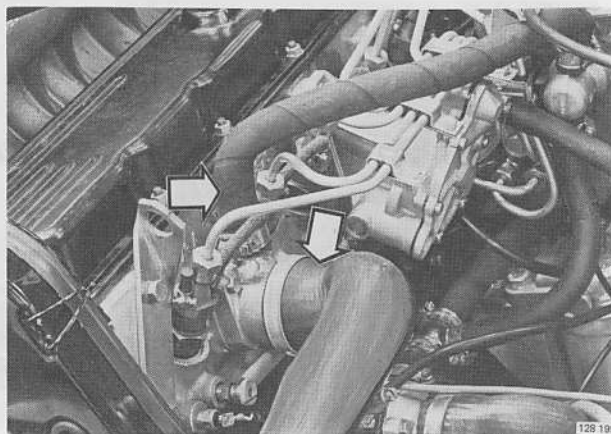


Drain coolant from engine

(Engine is without a drain cock.)

Disconnect lower hose from cold start device and drain coolant.

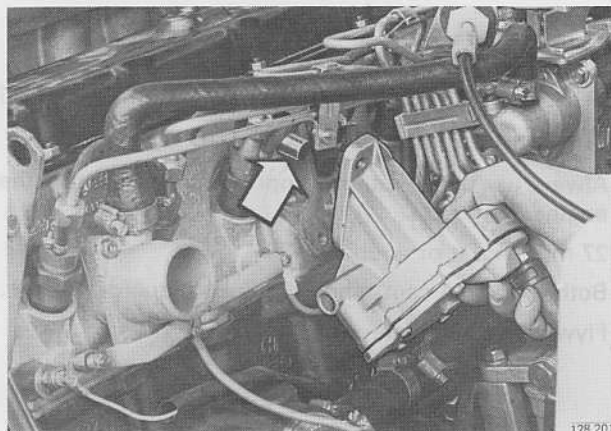
D5



Disconnect from cylinder head:

- upper radiator hose
- hose for cold start device.

D6

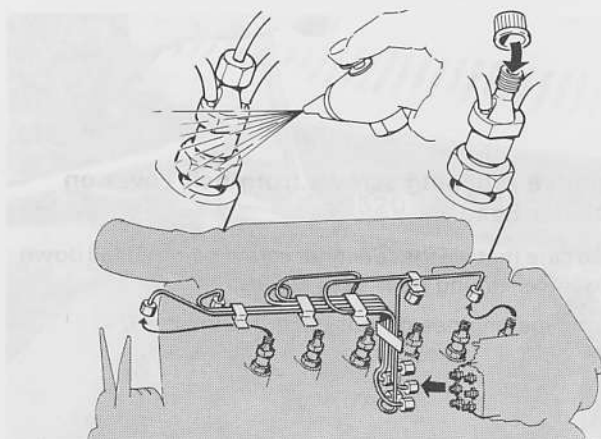


Remove vacuum pump and pump plunger

Remove pump retaining nuts and place pump on wheelarch.

Remove plunger from cylinder head.

D7

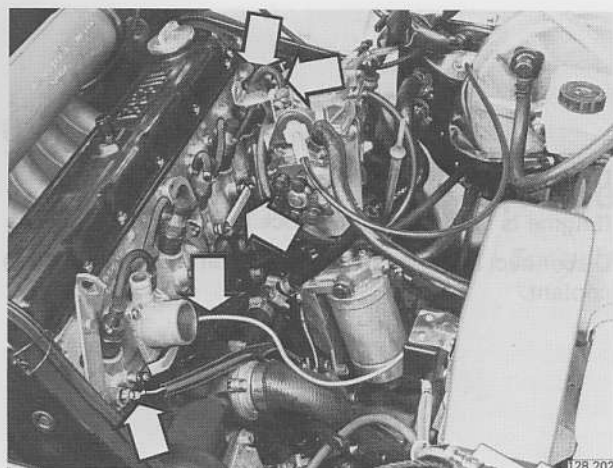


Remove fuel delivery pipe

Clean all connections thoroughly before disconnecting pipes.

Remove all pressure pipes and plug ends to prevent dirt from entering fuel system.

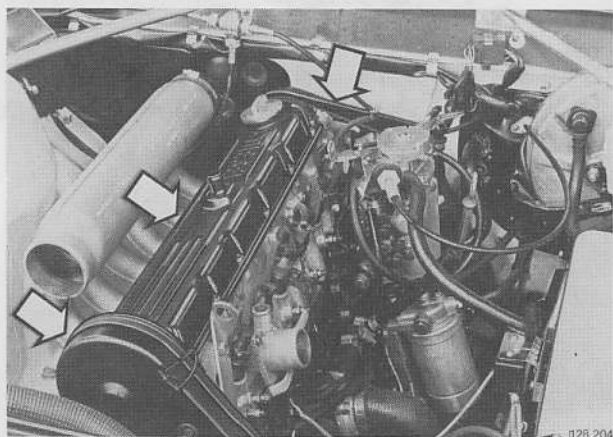
D8



D9

Disconnect from cylinder head:

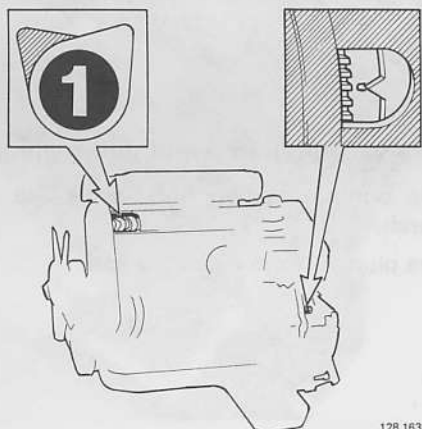
- wire for temperature gauge sender
- wire for glow plugs
- copper connecting strip for rear glow plug
- return hose from rear injector
- wire for temperature gauge sender at rear of cylinder head.



D10

Remove:

- valve cover
- timing gear covers (front + rear).



D11

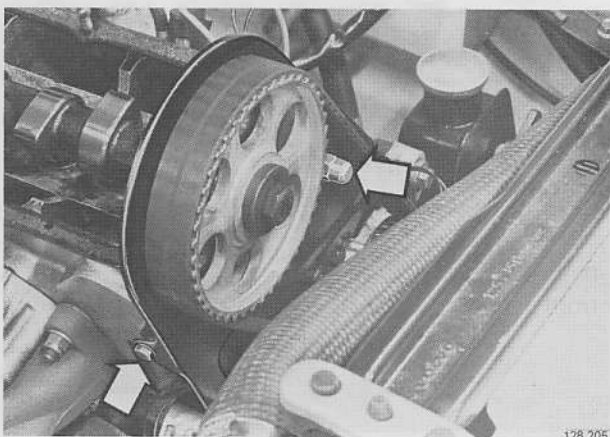
Turn engine until cyl. 1 is at TDC – injection

Always use the vibration damper center bolt to turn the engine.

27 mm socket or wrench 5188.

Both cylinder 1 cams should point obliquely upwards.

Flywheel at '0' mark.

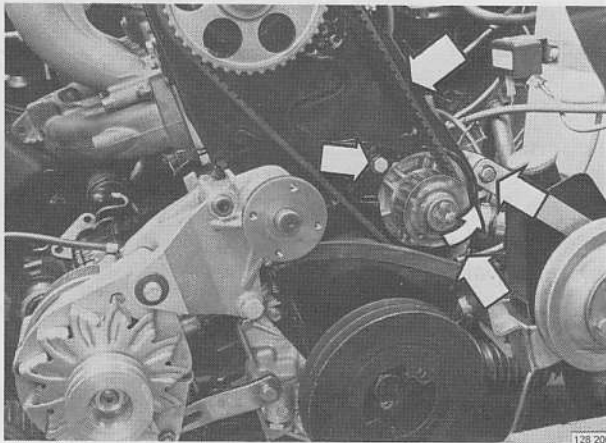


D12

Remove retaining screws from belt cover on cylinder head

Take care that washer on inner screw does not fall down into lower timing gear case cover.

(Late type engines do not have this washer).

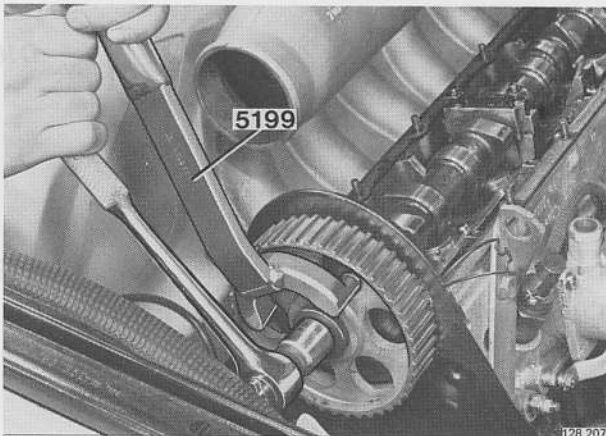


D13

Remove belt from camshaft sprocket

Slacken coolant pump mounting bolts and belt tensioner.

Remove belt from sprocket.

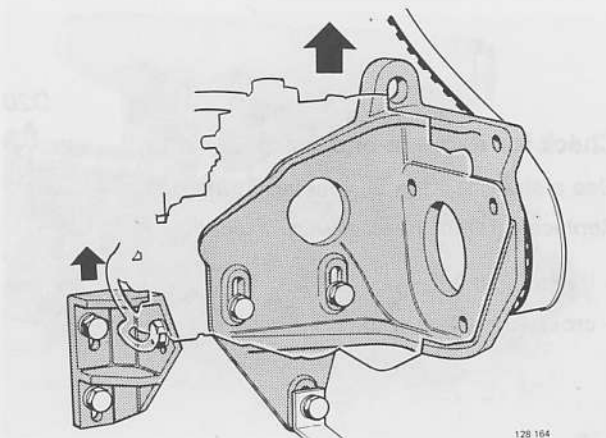


D14

Remove camshaft front sprocket

Use 5199 to hold sprocket in position when loosening bolt. Make sure that camshaft does not rotate.

Tap sprocket to free it from camshaft.

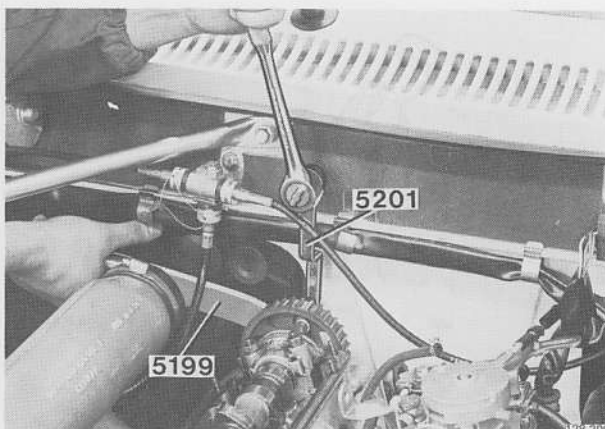


D15

Lift off pump belt

Slacken mounting bolts for injection pump bracket to release belt tension. Tighten one bolt so that pump remains in upper position.

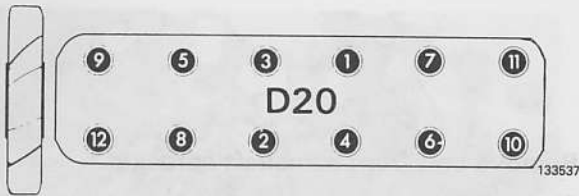
Lift off belt.



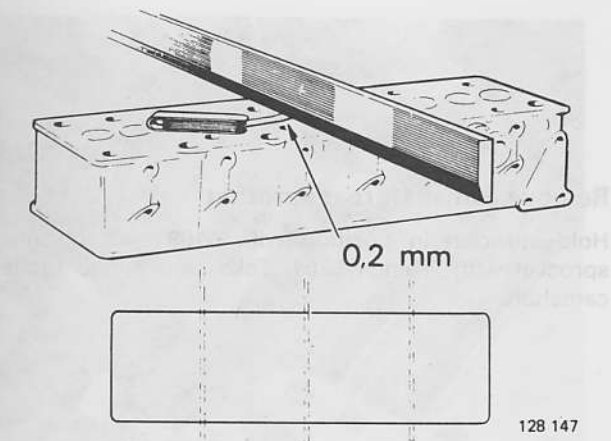
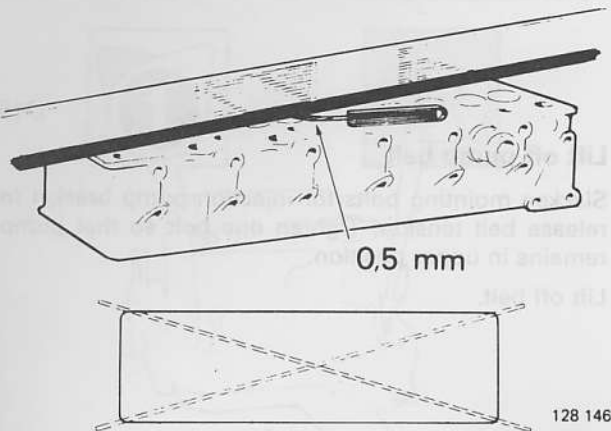
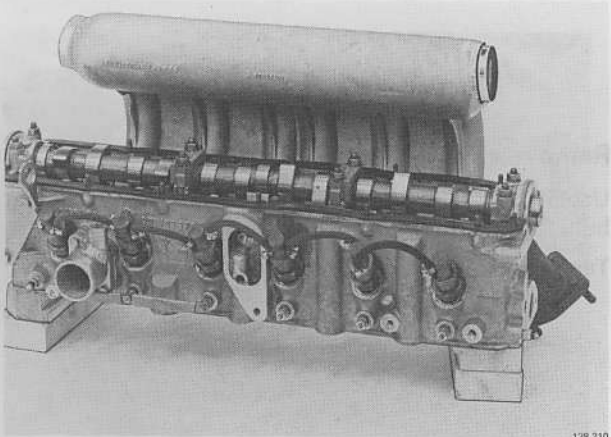
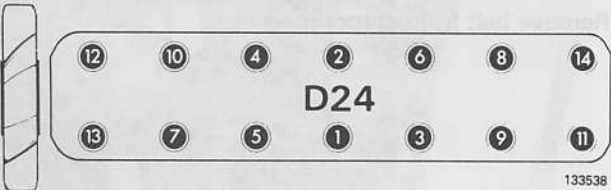
D16

Remove camshaft rear sprocket

Hold sprocket in position with 5199 and unscrew sprocket with wrench 5201. Take care not to rotate camshaft.



Tightening sequence for cylinder head bolts.
Bolts must be slackened in reverse sequence.



D17

Remove cylinder head

Important: Slacken bolts in reverse sequence to tightening. (i.e. start at 12 (or 14) and finish at 1.)

Lift away cylinder head. Check that rear glow plug clears injection pump bracket and that valves do not contact cylinder walls.

D18

Place cylinder head on wooden blocks

Do not rest cylinder head on valves.

D19

Clean gasket surfaces on cylinder head and cylinder block

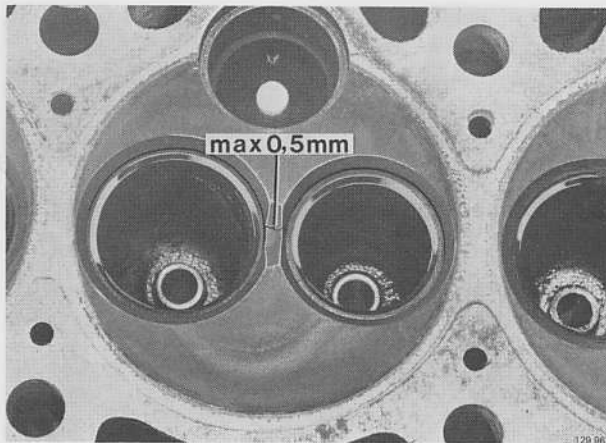
D20

Check for damage and warp

Use a straight edge and feeler gauge.

Replace cylinder head if warp exceeds:

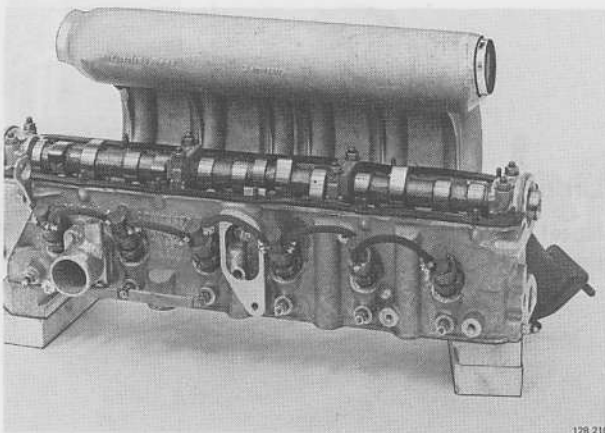
- lengthwise **0.5 mm** (0.02 in).
- crosswise **0.2 mm** (0.008 in).



Note! Small cracks (0.5 mm = 0.02 in) do not warrant replacement of cylinder head since they do not impair engine function.

For gasket replacement only see "Cylinder head installation" page 45.

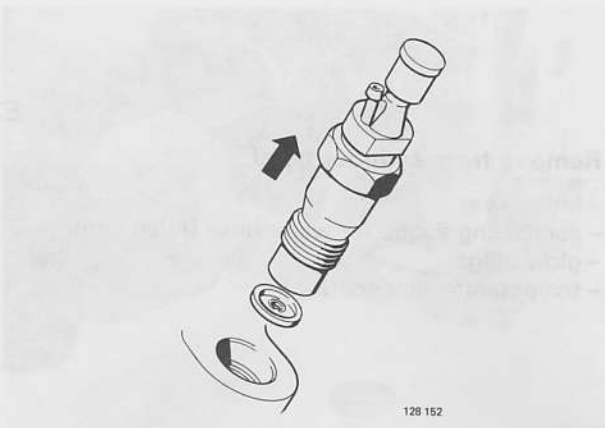
E. Cylinder head, disassembly



E1

Remove intake manifold, exhaust manifold and gasket

Allen 6 mm.



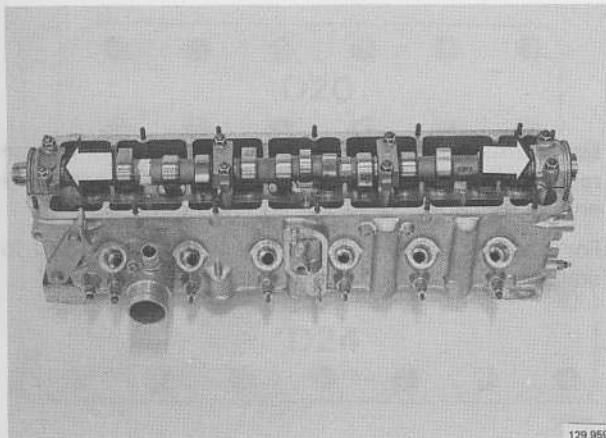
E2

Remove injectors

Remove dirt around injectors.

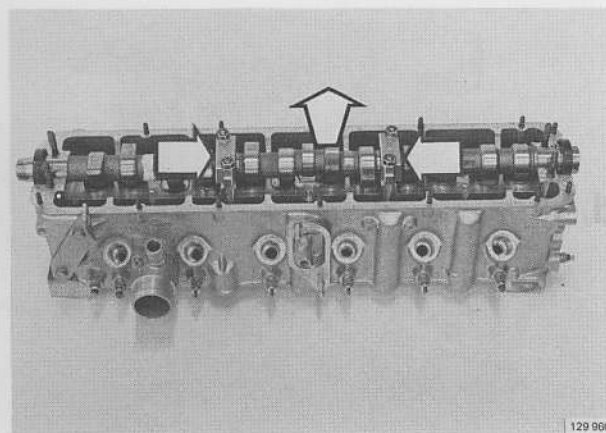
Disconnect fuel lines.

Remove injectors, 27 mm socket. Lift out heat shields from cylinder head.



Remove camshaft bearing caps 1 and 4

E3



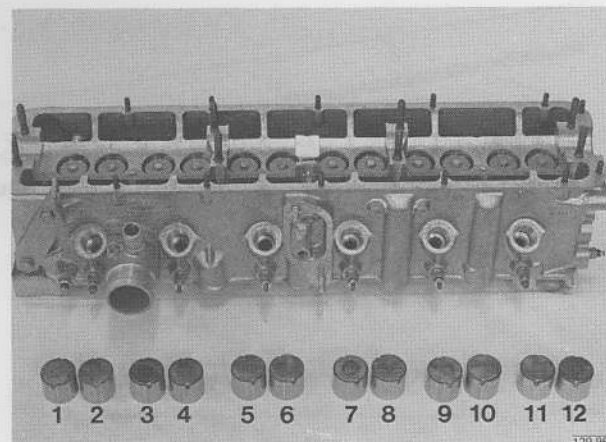
Remove camshaft bearing caps 2 and 3

Slacken nuts crosswise to avoid placing uneven load on camshaft.

E4

Lift away camshaft and remove oil seals

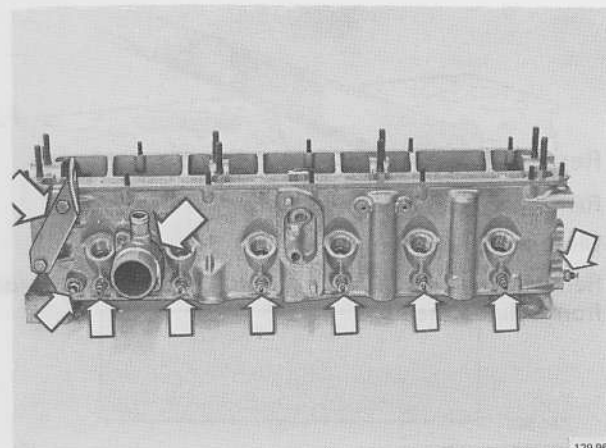
E5



Lift out tappets

Note! Do not interchange tappets. Mark tappets so that they can be installed in same position.

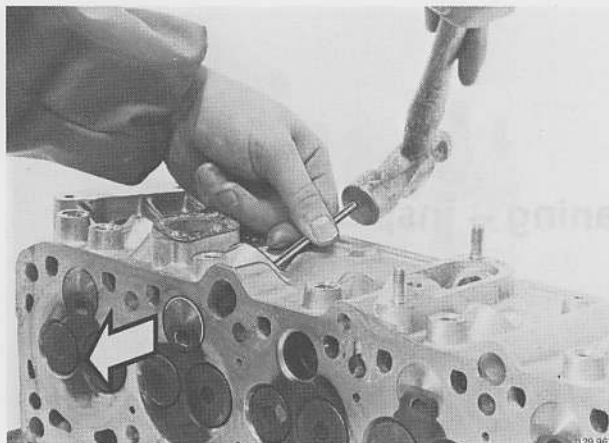
E6



Remove from cylinder head:

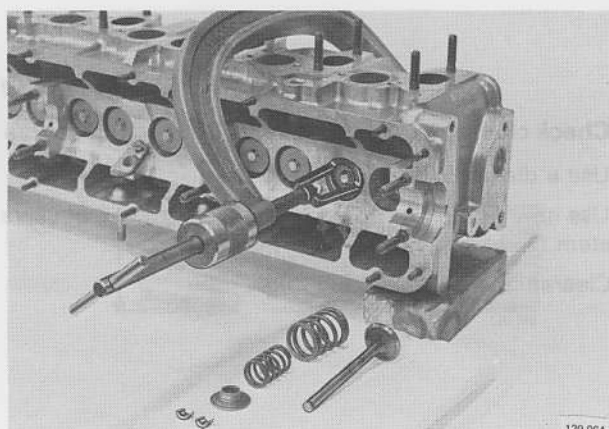
- lifting eyes
- connecting flange for water hose (Allen 5 mm)
- glow plugs
- temperature senders (2 X).

E7

**Tap out swirl chambers**

Use a long narrow punch (6 mm = 0.24 in diameter), length 150 mm (6 in).

E8

**Remove valve springs and valves**

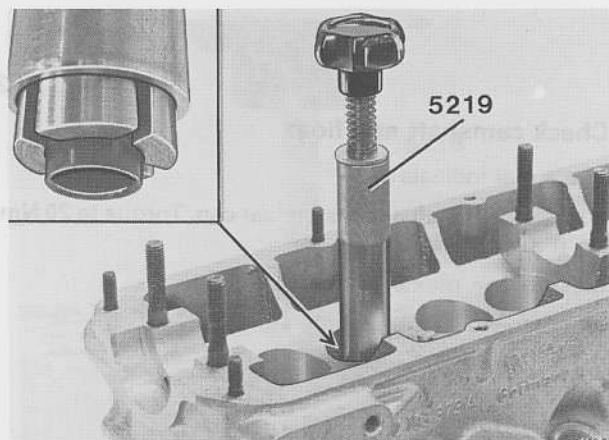
Important! Do not interchange parts.

Depress valve springs with a special compressor tool.

Remove:

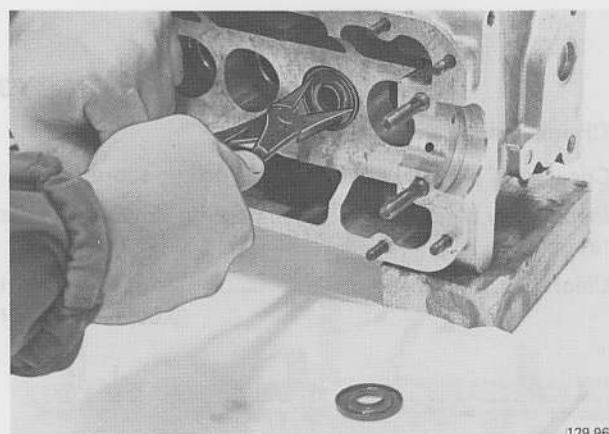
- retainer (collet)
- upper spring seat
- springs
- valve.

E9

**Remove seals from valve guides**

Use tool 5219.

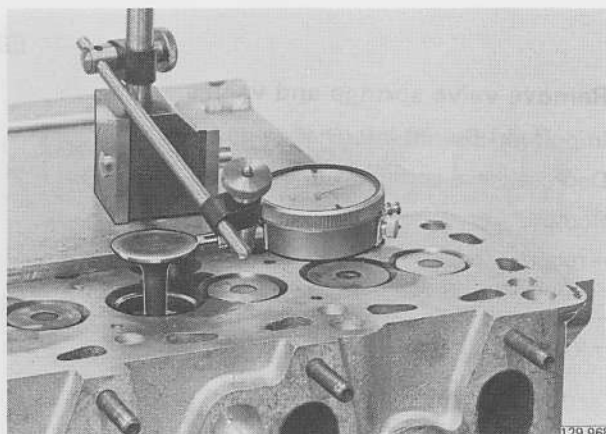
E10

**Remove lower valve spring washers**

Use a pair of external lock ring pliers with flat jaws.

E11

F. Cylinder head, cleaning – inspection



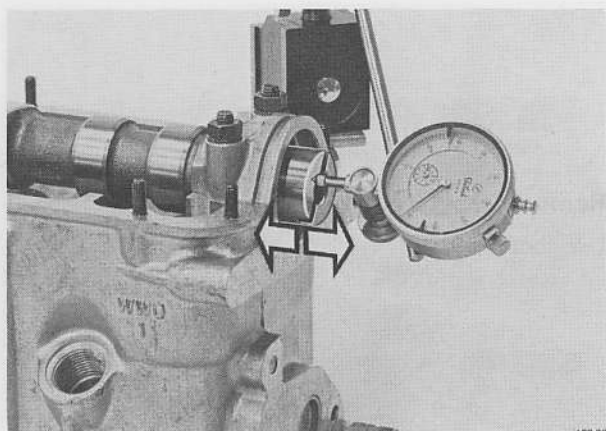
F1

Check clearance between valve guides and valves

Use a dial indicator.

Use new valves (intake and exhaust) with end of valve stem flush with valve guide.

Clearance = **1.3 mm** (0.05 in).



F2

Check camshaft end float

Use a dial indicator.

Position camshaft and install rear cap. Torque to **20 Nm** (15 ft lbs).

Clearance = max **0.15 mm** (0.006 in).

Remove cap and camshaft.



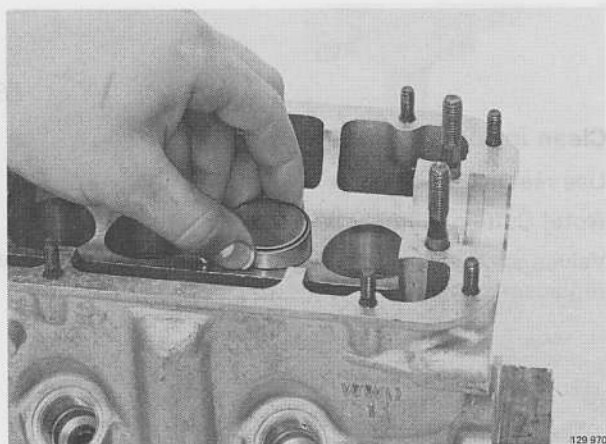
F3

Check discs

Check disc play. Replace disc if worn or scored.

Install new discs with numbers facing down, towards tappets.

Clearance, new parts 0.016–0.046 mm
(0.0006–0.0018 in)



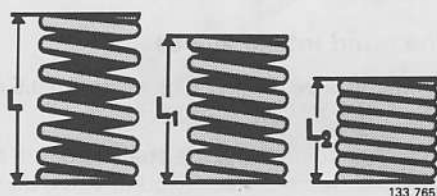
F4

Check tappets

Place tappets in cylinder head

Check fit and clearance.

Clearance, new parts 0.025–0.075 mm (0.001–0.003 in)



133 765

F5

Check valve springs**Inner springs**

Length		Load	
mm	(in)	N	(lbs)
33.9	(1.334)	0	(0)
28.6	(1.126)	67–77	(15–17.5)
18.3	(0.720)	209–231	(47–52.2)

Outer springs

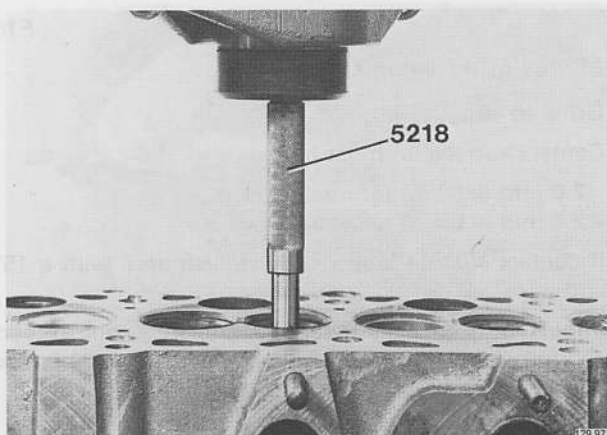
Length		Load	
mm	(in)	N	(lbs)
40.2	(1.583)	0	(0)
32.6	(1.283)	167–185	(38–42)
22.3	(0.878)	433–479	(98–108.3)

Replacing valve guides
Operations F 6–8

F6

Press out valve guide

Use drift 5218. Press from combustion chamber side.



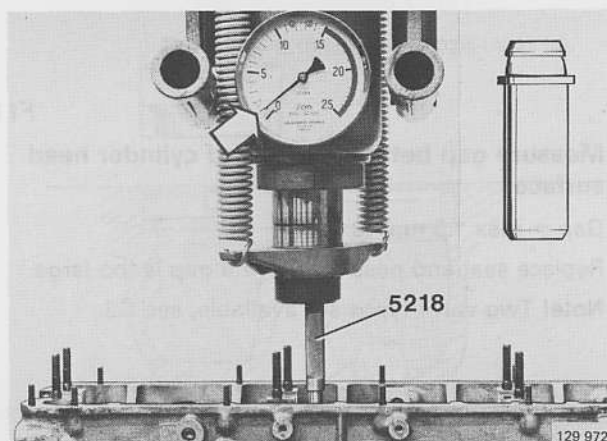
F7

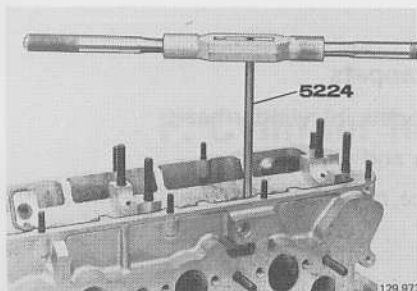
Press in new valve guide

Lubricate valve guide.

Use drift 5218. Press in from camshaft side.

Press in guide until flange on guide contacts cylinder head. In this position press force must not exceed 1 ton since flange may break off.





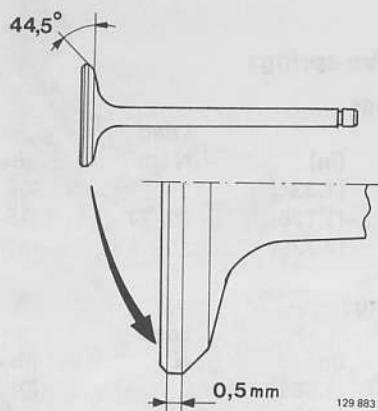
F8

Clean inside of valve guide

Use reamer 5224

Note! Cutting oil must be used when reaming.

Valves and seats must be ground-in after valve guide replacement.



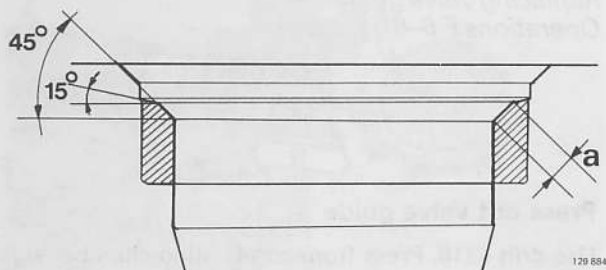
Grinding-in valves and seats Operations F 9–12

F9

Machine grind intake valves

Edge of intake valve must not be less than **0.5 mm** (0.02 in).

Important! Exhaust valves are stellite coated and must not be ground by machine. Grind-in valve on seat with grinding paste.



F10

Mill or grind valve seats

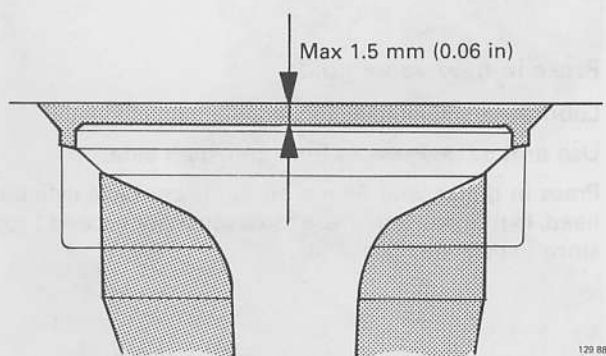
Grind to **45°**.

Contact surface (a) must be:

- **2.0 mm** (0.08 in) for intake valve
- **2.4 mm** (0.09 in) for exhaust valve.

If contact surface is too wide reduce area with a **15°** cutter.

Important! Outer diameter of cutter must not exceed **35.2 mm** (1.39 in) for intake valve seats and **33.2 mm** (1.31 in) for exhaust valve seats.



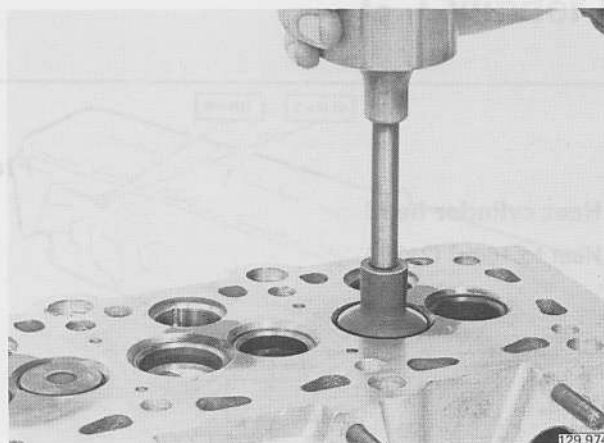
F11

Measure gap between disc and cylinder head surface

Gap = max **1.5 mm** (0.06 in).

Replace seat and possibly valve if gap is too large.

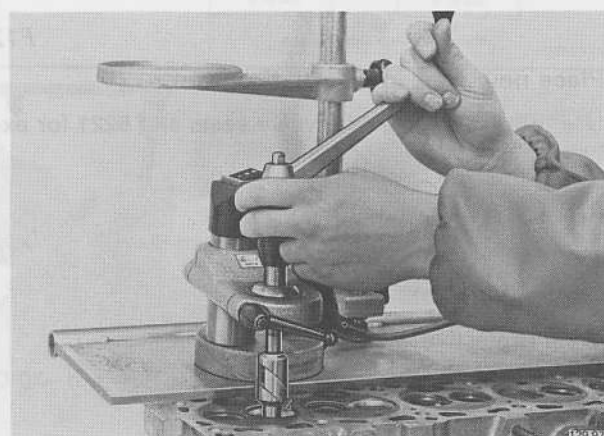
Note! Two valve types are available, see G3.



F12

Grind-in valves with paste

Clean valves thoroughly.

**Replacing valve seats**
Operations F 13–21

Valve guides must be replaced before replacing seats, see F6–8, page 37.

Clean combustion chamber

F13

Edge of seat must be clearly visible after cleaning.

Remove valve seat

F14

Mill valve seat, using cutters such as Mira (P/N 9986045). Refer to manufacturer's instructions. Make sure that seat in cylinder head is not damaged.

Clean surfaces thoroughly.

F15

Measure diameter of seat recess in cylinder head and of valve seat

Use an internal micrometer to measure seat recess.

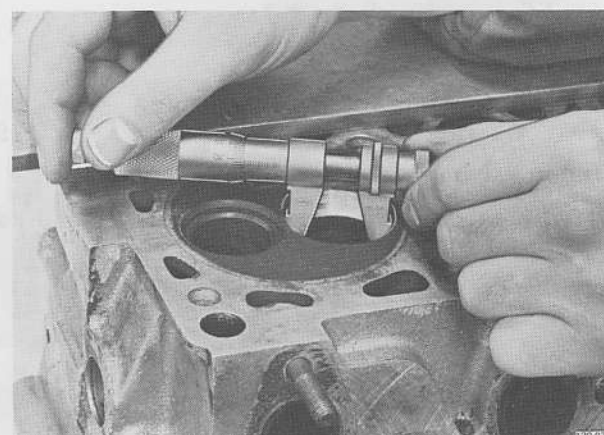
Standard
(production version)

Diameter, seat recess, mm (in)		
intake	37.000–37.016	(1.4567–1.4573)
exhaust	33.000–33.016	(1.2992–1.2998)
Diameter, seat,		
intake	37.090–37.105	(1.4602–1.4608)
exhaust	33.090–33.105	(1.3028–1.3033)

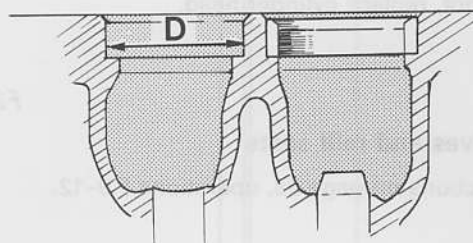
Oversize
(replacement parts version)

Diameter, seat recess, mm (in)		
intake	37.200–37.216	(1.4646–1.4652)
exhaust	33.200–33.216	(1.3071–1.3077)
Diameter, seat,		
intake	37.290–37.305	(1.4681–1.4687)
exhaust	33.290–33.305	(1.3106–1.3112)

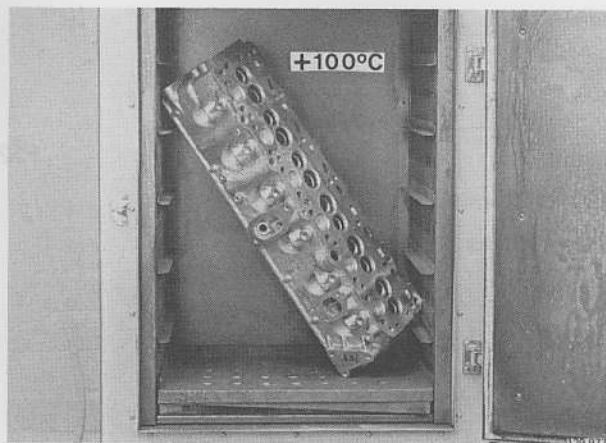
When replacing valve seats: the interference between the valve seat and its bore in the cylinder head shall be **0.074–0.105 mm** (0.0029–0.0041 in) i.e. valve seat diameter must be 0.074–0.105 mm (0.0029–0.0041 in) greater than the diameter of the bore in the cylinder head. Replace cylinder head if clearance is too small. Mill seat recess if interference is too large.



$$D + (0.074 - 0.105 \text{ mm} = 0.0029 - 0.0041 \text{ in})$$



129 844



F16

Heat cylinder head

Heat to 100°C (212°F).



F17

Place new seat in installation tool

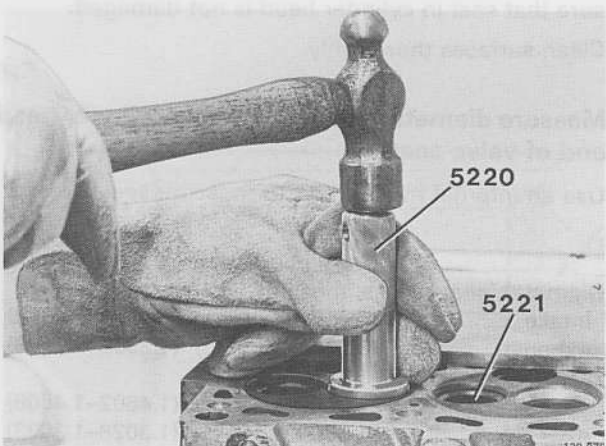
Use drift 5220 for intake valve seats and 5221 for exhaust valve seats.

F18

Cool valve seat

Wear protective gloves and safety glasses.

Use liquid carbon dioxide to cool seat down to -70°C (-94°F).



F19

Tap-in valve seat

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

F20

Check fit of valve seat

Make sure that the seat has bottomed correctly and is secure. If not, replace cylinder head.

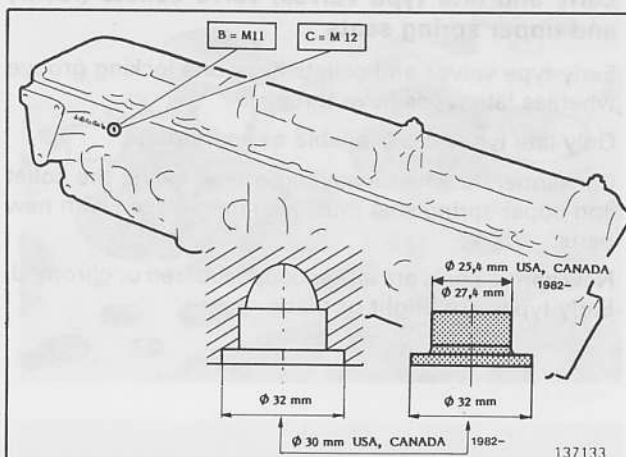
F21

Grind valves and mill seats

See instructions on page 38, operations F 9–12.

G. Cylinder head, assembly

New cylinder head



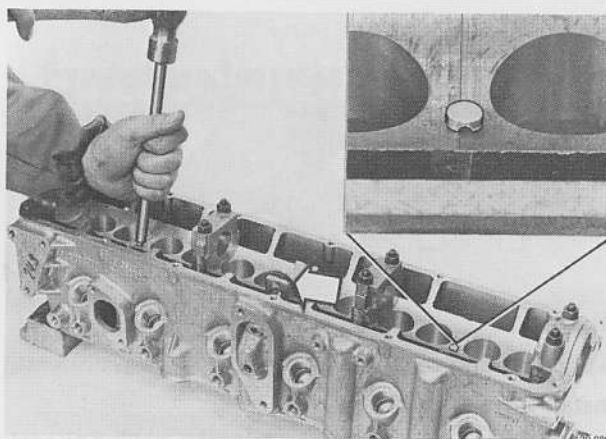
Important

- New cylinder head must be the same type as the old. Cylinder heads designed for use with M 12 bolts must not be used with M 11 bolts.

Cylinder heads can be identified as follows (see illustration at left):

- Number series followed by B = M 11
- Number series followed by C = M 12

- USA/Canada 1982- has a different type of cylinder head and swirl chamber. Swirl chamber and its bore is 2 mm (0.080 in) smaller in diameter than other types.



New cylinder head

Operation G1

G1

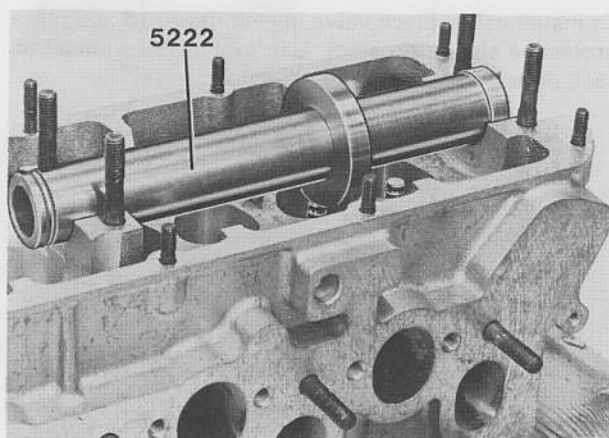
Install oil jets and pin studs in cylinder head

Carefully tap in oil jets using a brass punch.

Note! Turn out jets to point across cylinder head, see fig.

Important! Check specification and type of cylinder head. M 12 bolts must not be used with M 11 bolts.

Different type cylinder heads are used for USA/Canada.



G2

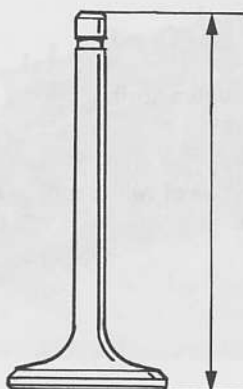
Check valve stem position in relation to camshaft

This measurement is carried out to ensure that there is sufficient adjustment latitude for valves.

Place gauge **5222** with largest diameter ring, on cylinder head. (Small ring is for B 17-B 23 engines.)

Note! Front bearing recess diameter is larger than others. Make sure that gauge is positioned correctly.

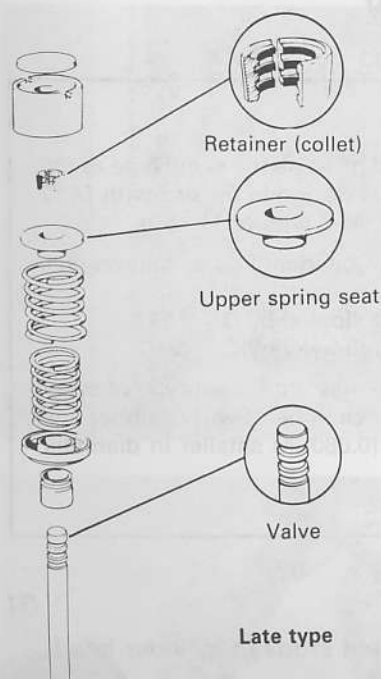
Taking each valve in turn, check that stem does not contact gauge. If this happens, grind valve stem.



129 873

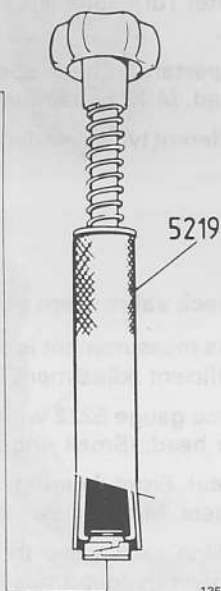
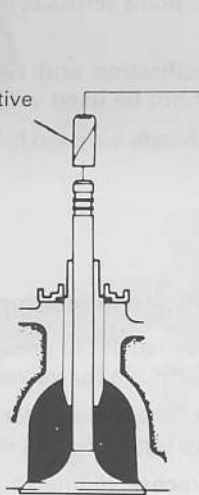
Valve length, mm (in)

	New	Min
Intake valve	104.8 (4.126)	104.3 (4.106)
Exhaust valve	104.6 (4.118)	104.1 (4.098)



135006

Protective sleeve



135569

G3

Early and late type valves, valve collets (locks) and upper spring seats

Early type valves and collets have one locking groove whereas late types have three.

Only late types are available as spare parts.

Consequently when installing a new valve, the collet and upper spring seat must also be replaced with new parts.

New spring seats are either copper coated or chromed. Early types are bright or black.

G4

Install:

– upper spring seats, flanged side up.

Install valve stem oil seal.

Protective sleeves must be used when installing oil seal.

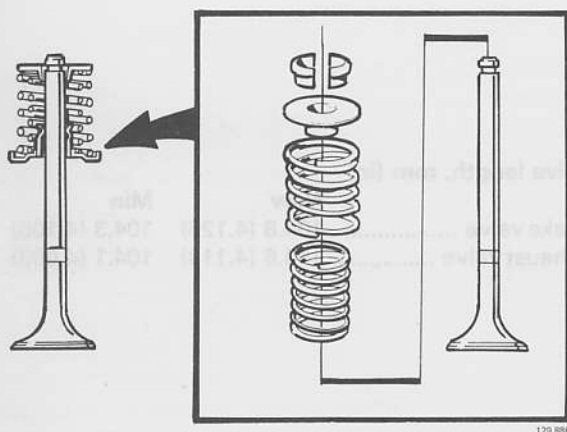
To install valve, place valve in cylinder head and place protective sleeve on stem. Use tool **5219** to install oil seal, note that tool should abut flange seal.

G5

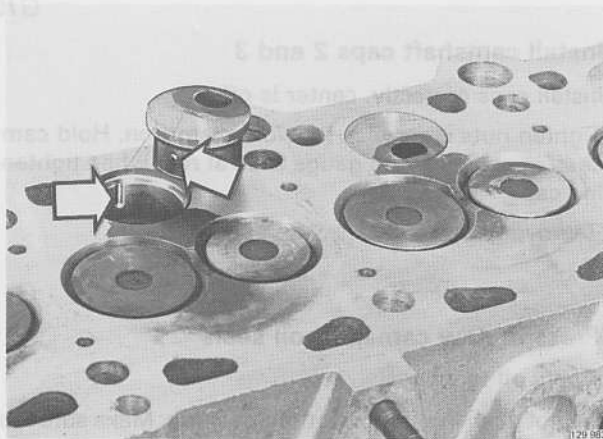
Install:

- inner and outer valve springs
- upper valve seat
- retainer (collet).

Important! Two types of valves, upper spring seats and collets are in use.



129 886



G6

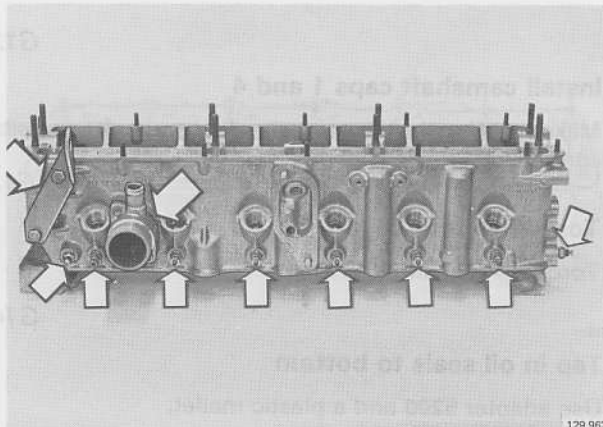
Install swirl chambers

Check that steel ball is in chamber.

If not, install new swirl chamber.

Make sure that ball fits in slot in cylinder head. Tap down swirl chambers.

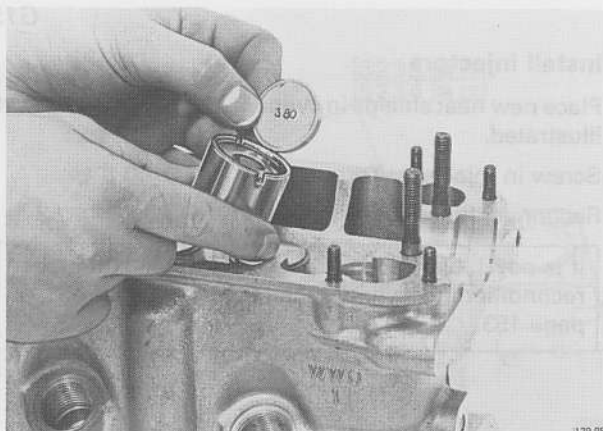
Important! Special swirl chambers (different diameter) for USA/Canada 1982-.



G7

Install:

- glow plugs. Tightening torque 40 Nm (30 ft lbs)
 - temperature senders (2X). Same type front and rear
 - connecting flange for radiator hose (Allen 5 mm).
- Install new gasket. Tightening torque 10 Nm (7 ft lbs).
- lifting eyes.



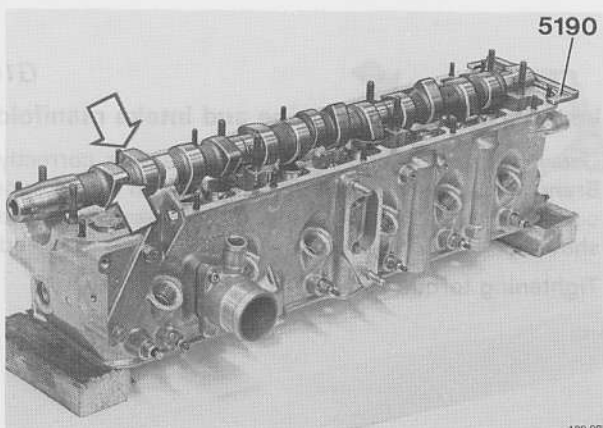
G8

Install tappets with shims

Smear tappets and shims with oil before installation.

Number on shims should face down.

Check that tappets slide easily without sticking.

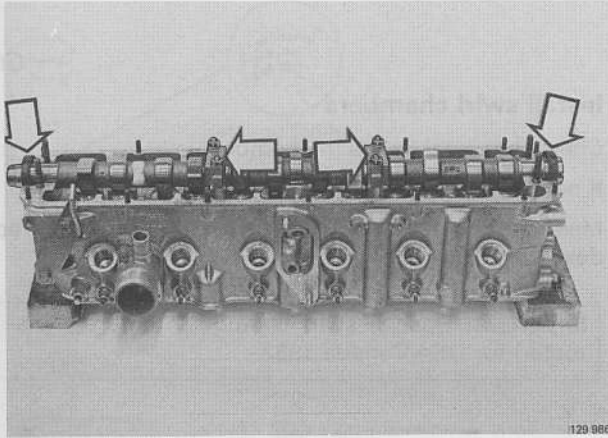


G9

Place camshaft in cylinder head

Lubricate contact surfaces of camshaft and bearings.

Place gauge **5190** at rear of camshaft. **Important!** Both cams for number 1 cylinder must point diagonally up, see fig.



G10

Install camshaft caps 2 and 3

Install caps correctly, center is off-set.

Tighten nuts crosswise to avoid distortion. Hold camshaft in position with gauge **5190** at rear when tightening caps.

Remove gauge **5190**.

G11

Press in new camshaft oil seals

Apply oil to oil seals.

Do not push in seals to bottom position. Make sure that seals are "square".

G12

Install camshaft caps 1 and 4

Make sure that the thrust washer for camshaft cap 4 sits correctly.

G13

Torque all four caps

Torque = **20 Nm** (15 ft lbs).

G14

Tap in oil seals to bottom

Use adapter **5200** and a plastic mallet.

G15

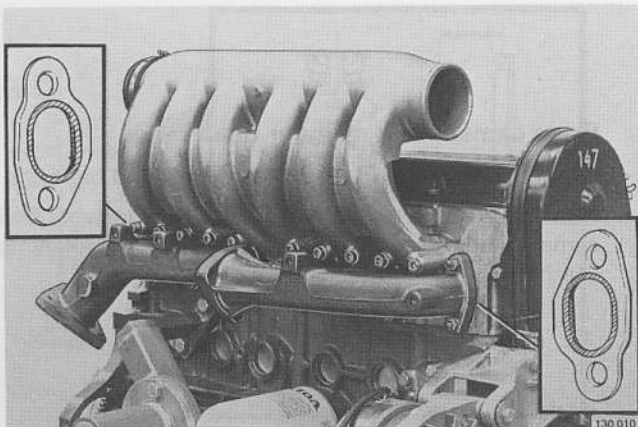
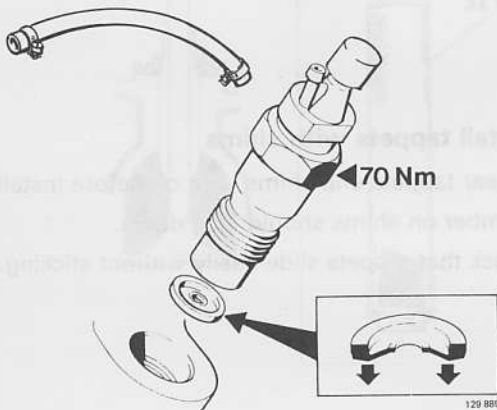
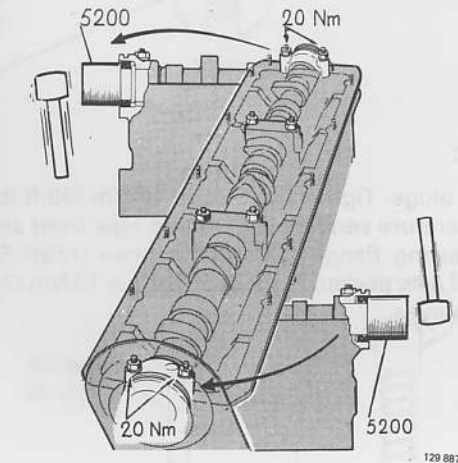
Install injectors

Place new heat shields in cylinder head. Turn shields as illustrated.

Screw in injectors. Torque to **70 Nm** (50 ft lbs).

Reconnect fuel delivery lines between injectors.

It is advisable to check condition of injectors when reconditioning cylinder head. See instructions on page 153.



G16

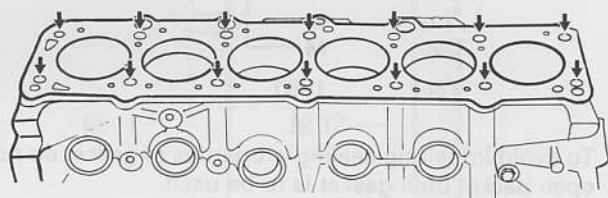
Install exhaust branch pipe and intake manifold

Use new gaskets and nuts. Install gaskets correctly. Branch pipe gasket should be turned with raised edge outwards, facing branch pipe. Intake manifold gasket should be turned with green side facing cylinder head.

Tightening torque **25 Nm** (18 ft lbs).

H. Cylinder head, installing

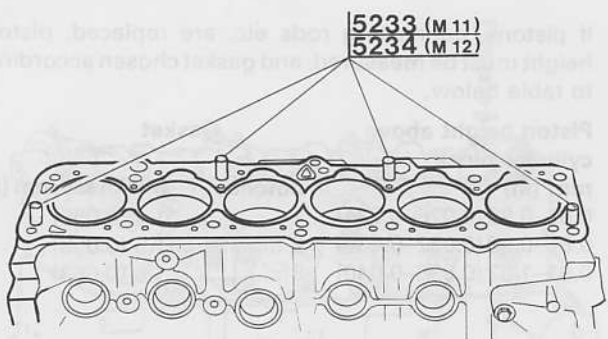
Special tools: 5190, 5193, 5194, 5197, 5199, 5201, 4 x 5233, 4 x 5234, 5235



133523

H1 Clean holes for cylinder head bolts

Oil and dirt must be removed from holes otherwise gasket may leak as a result of insufficient tightening pressure.



133524

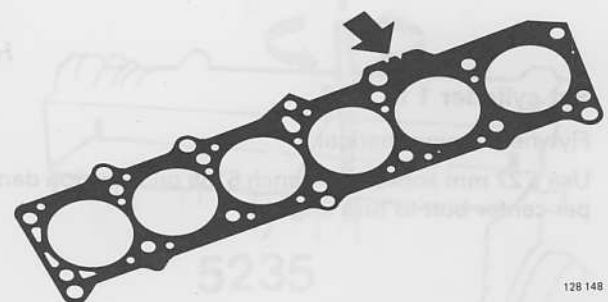
H2 Install guide pins in cylinder block

5233 for blocks with M 11 bolts.

5234 for blocks with M 12 bolts.

Two outer pins hold gasket in position. Cylinder head is prevented from sliding and damaging gasket by two inner pins.

Important! Use all four pins, located as illustrated.



128 148

H3 Install new cylinder head gasket

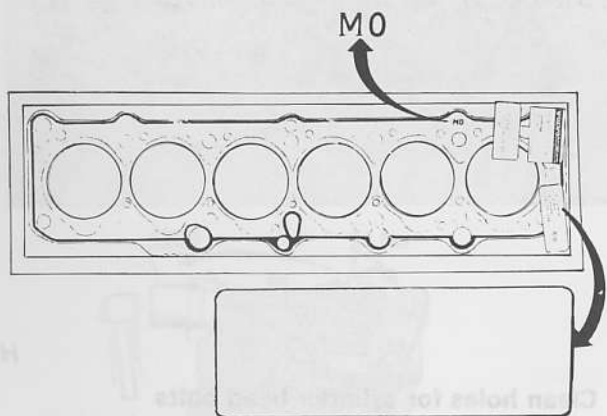
Three different types are available, and are marked with notches. Type to be fitted depends on piston height above cylinder block.

Use same gasket type (no. notches) as before, with OBEN facing up.

H1

H2

H3



132978

Observe date code on gasket and packet. Gasket must be used before this date.

Only gaskets with code **MO** or later may be used on D 24 engines.

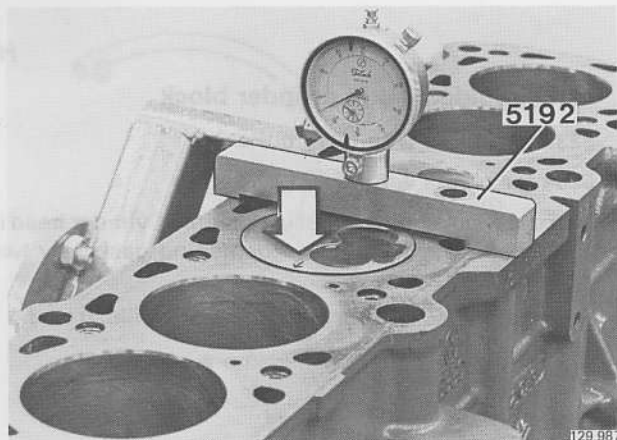
Date code

Month	Jan	A	0 = 1980
	Feb	B	1 = 1981
	Mar	C	2 = 1982
	Apr	D	etc.
	May	E	
	June	F	
	July	G	
	Aug	H	
	Sept	J	
	Oct	K	
	Nov	L	
	Dec	M	
Year		1980	

To avoid impairing sealing properties of gasket do not open packet until gasket is to be used.

Take care not to damage packet and cause damage to gasket, (teflon strip, rubber seal).

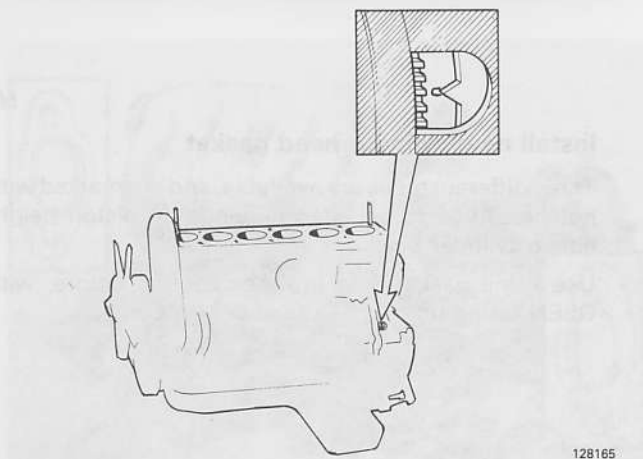
H4



1129 987

If pistons, connecting rods etc. are replaced, piston height must be measured, and gasket chosen according to table below.

Piston height above cylinder block mm (in)	Gasket notches	thickness mm (in)
0.67-0.80 (0.026-0.031)	1	1.4 (0.055)
0.81-0.90 (0.032-0.035)	2	1.5 (0.059)
0.91-1.02 (0.036-0.040)	3	1.6 (0.063)



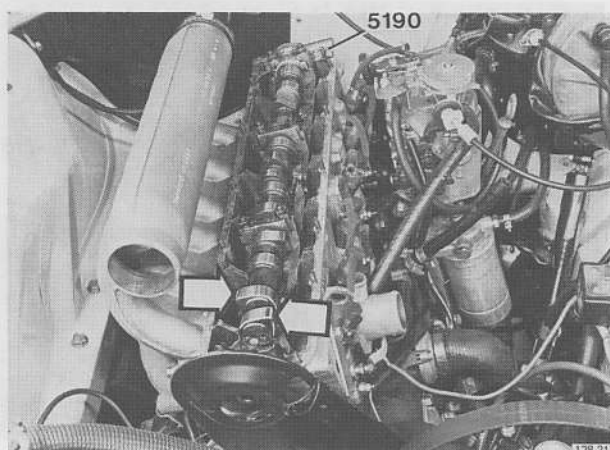
128165

H5

Set cylinder 1 to TDC

Flywheel timing mark at '0'

Use a **27 mm** socket or wrench **5188** on vibration damper center bolt to turn engine.



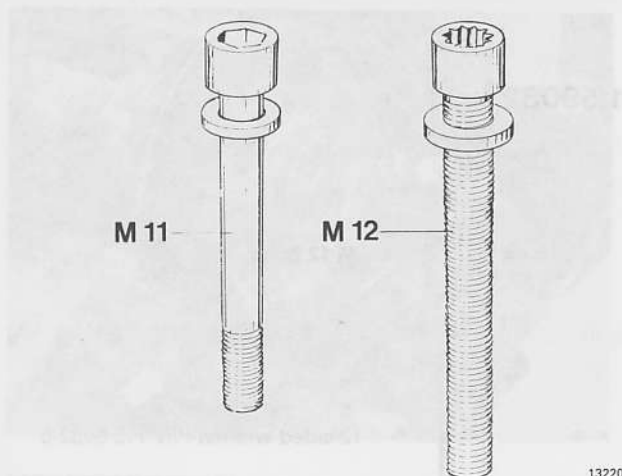
H6

Position camshaft

Set camshaft so that number 1 cylinder is at injection (both cam lobes should point diagonally upwards).

Prevent camshaft from moving with stop 5190.

Important! Camshaft must be locked otherwise valves may strike pistons.

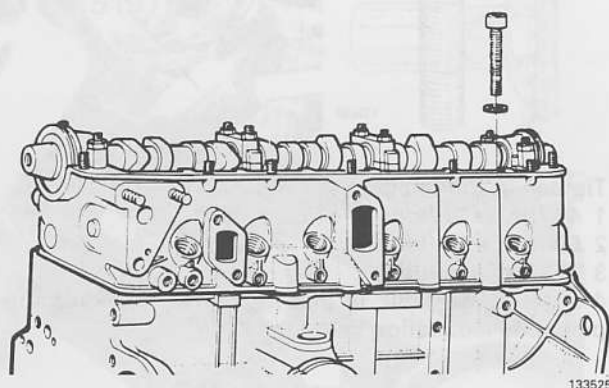


Cylinder head bolts

Two types of cylinder head bolts are in use.

Early type bolts have M 11 threads. These bolts can be reused with **new** washers. Fit washers with cup shape facing up.

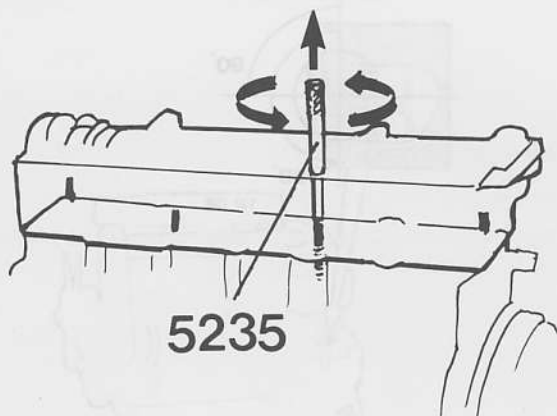
Late type bolts have M 12 threads along entire length. These bolts **must not** be reused. Washers may however be reused.



H7

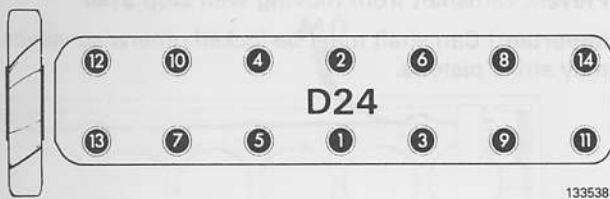
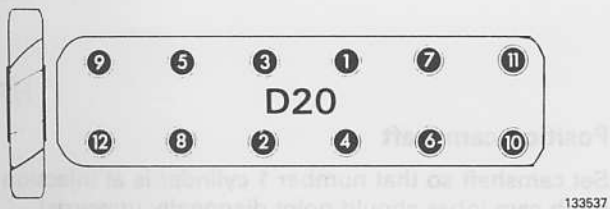
Install cylinder head bolts

Lubricate threads and sliding surface of washers. Place bolts in holes without guide pins.



Remove guide pins. Use tool 5235.

Install remaining bolts.



M 11 bolts

Allen key 10 mm

133529

Tighten in three stages:

- 1 50 Nm = 37 ft lbs
- 2 70 Nm = 51 ft lbs
- 3 90 Nm = 66 ft lbs

Torque cylinder head bolts

Tighten all bolts one at a time in order specified adjacent before proceeding with next stage.

H8



1159082



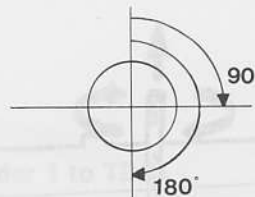
M 12 bolts

12-sided wrench P/N 115 9082-5

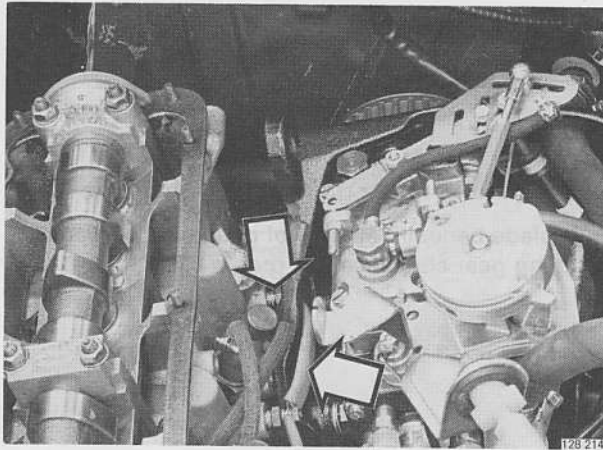
133530

Tighten in four stages:

- 1 40 Nm = 29 ft lbs
- 2 60 Nm = 44 ft lbs
- 3 75 Nm = 55 ft lbs
- 4 angle-tighten 180° in one movement without stopping. See illustration below:

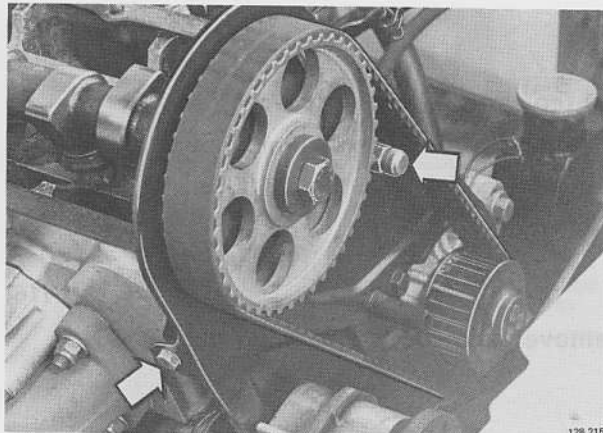


137 158



H9

Connect copper connecting strip for two rear glow plugs



H10

Install bolts for cover

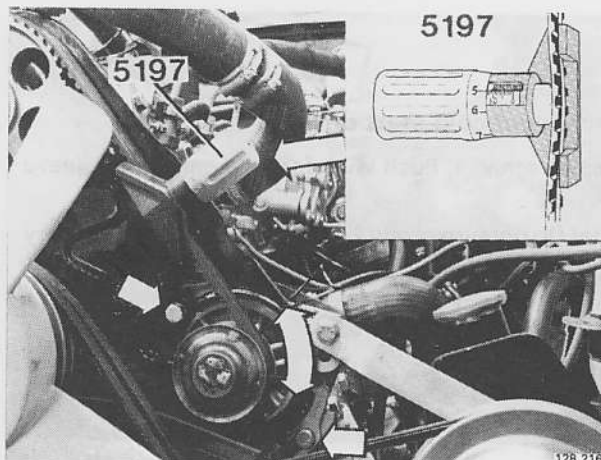
H11

Install camshaft sprocket and belt

Pull belt to ensure that it sits correctly on crankshaft gear.

Place belt over camshaft sprocket and position sprocket and belt.

Tighten center bolt by hand, but it should still be possible to turn sprocket on camshaft.



H12

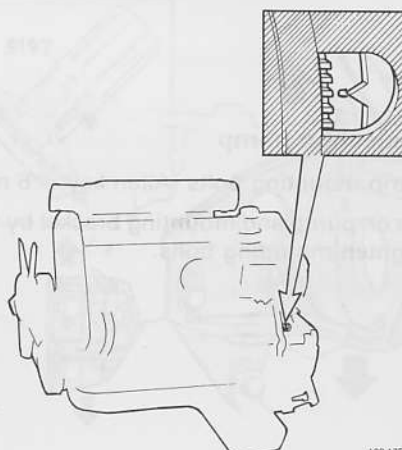
Set belt tension

Adjust tension by moving cooling pump.

Use gauge **5197** to check tension. Attach gauge to belt and set to 12.5 units.

Stretch belt until mark on gauge plunger is flush with sleeves.

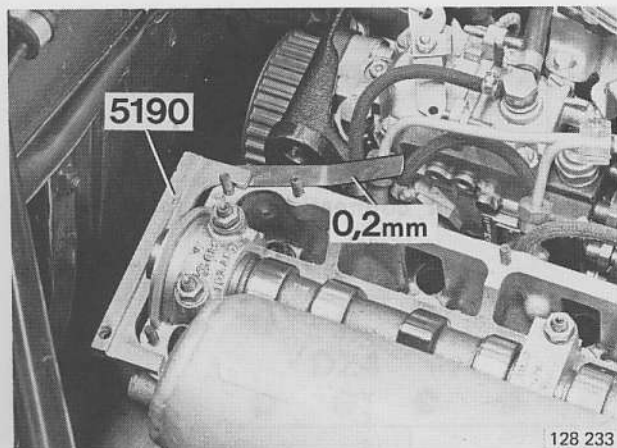
Depress belt strongly with hand and recheck/adjust tension.



H13

Make sure cyl. 1 is at top dead center

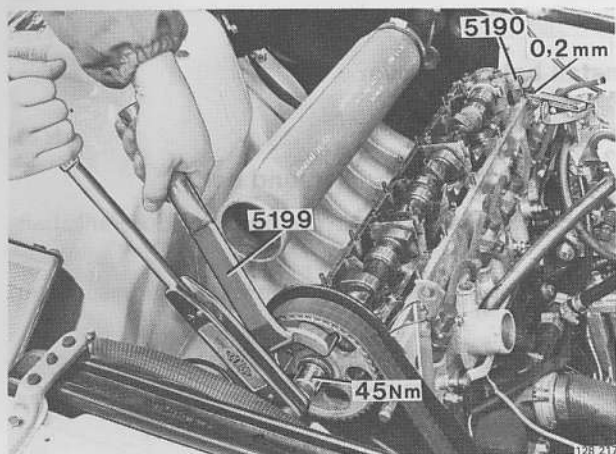
Check '0' mark on flywheel and adjust if necessary.



H14

Place a 0.2 mm feeler gauge beneath gauge 5190

Insert blade beneath left side of gauge to compensate for timing gear clearance. 0.2 mm = 0.008 in.



H15

Tighten camshaft front sprocket

Use 5199 to prevent sprocket from turning.

Torque center bolt to 45 Nm (33 ft lbs).

H16

Remove gauge 5190 and feeler gauge

H17

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2 otherwise it will be necessary to remove cold start device and reset it on a test bench.

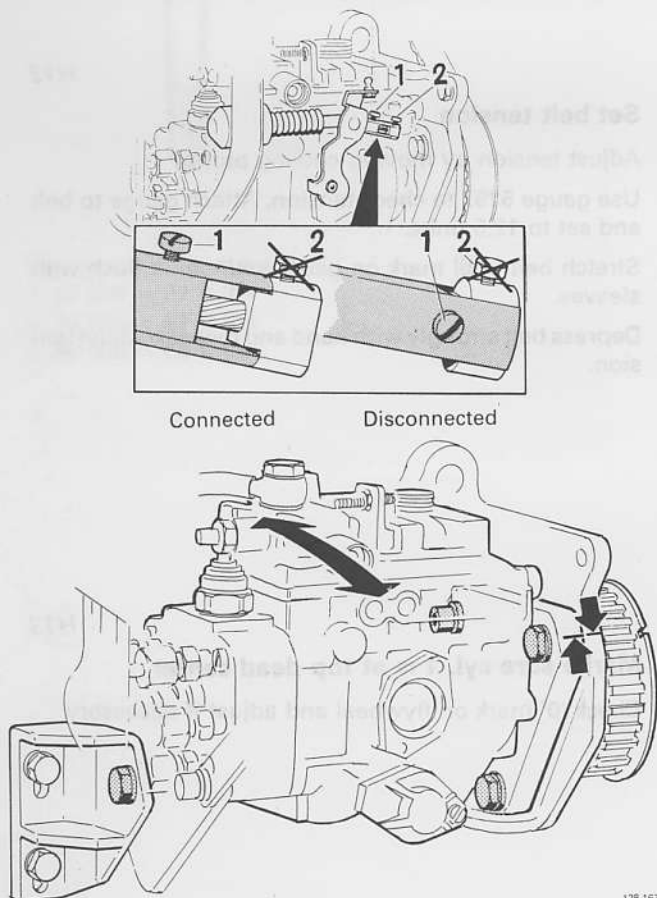
Press lever back against stop.

H18

Basic-set injection pump

Slacken pump mounting bolts (Allen key = 6 mm).

Align marks on pump and mounting bracket by turning pump. Retighten mounting bolts.



H19

Set dial indicator zero. Lock pump gear at cyl. 1 injection using stop 5193

Unscrew and remove plug from injection pump distributor.

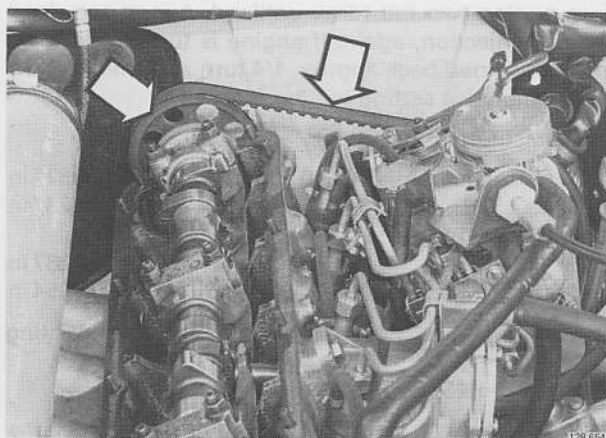
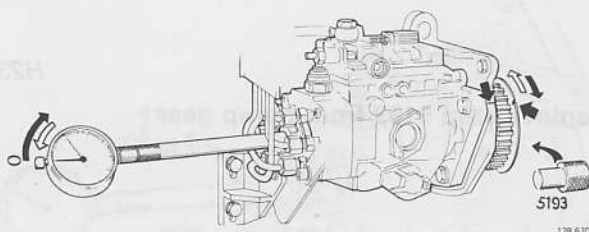
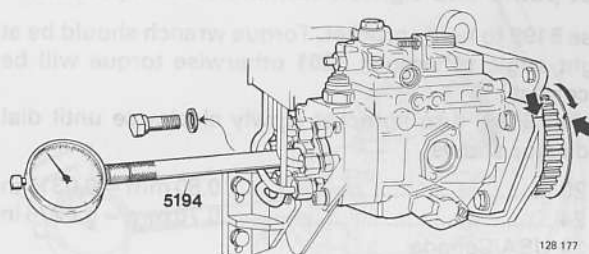
Install holder 5194 and dial indicator (range 0-3 mm). Set gauge to approx. 2 mm.

Turn pump gear clockwise until mark on gear and mounting bracket coincide.

Then turn pump gear back slightly until min reading registers on dial indicator.

Set indicator to zero.

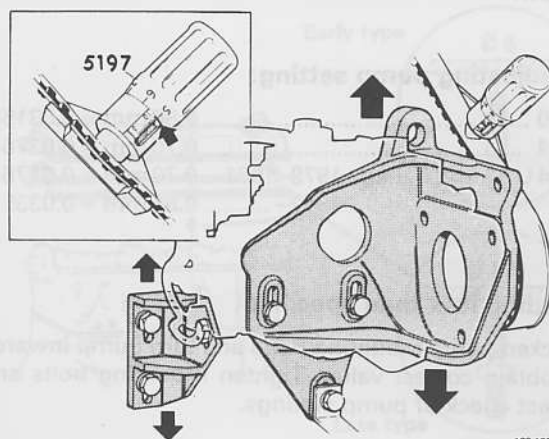
Turn pump gear clockwise until mark on gear and pump mounting bracket coincide. Lock gear in this position with stop 5193. (Insert stop through pump gear into mounting bracket.)



H20

Install camshaft rear sprocket and belt

Tighten center bolt by hand, but it should still be possible to turn sprocket on camshaft.

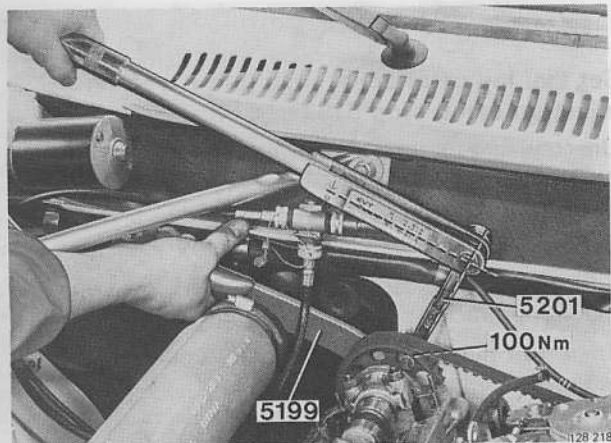


H21

Set belt tension

Adjust tension by moving pump.

Use gauge 5197 to check tension. Attach gauge to belt and set to 12.5 units. Stretch belt until mark on gauge plunger is flush with sleeve. Depress belt strongly with hand and recheck/adjust tension.



H22

Set pump and tighten camshaft rear sprocket

Use **5199** to hold sprocket. Torque wrench should be at right angle to wrench **5201** otherwise torque will be incorrect.

Using **5199**, turn sprocket slowly clockwise until dial indicator shows:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada	
1979-81	0.70 mm = 0.0276 in
1982-	0.85 mm = 0.0335 in

Hold sprocket in this position and torque bolt to **100 Nm** (73 ft lbs). Take care that camshaft and sprocket do not move.

H23

Remove stop 5193 from pump gear

H24

Check pump setting

Turn engine two full turns until cyl. 1 is at top dead center – injection, again. If engine is turned too far it must be turned back approx. 1/4 turn and then to zero mark otherwise setting will be incorrect.

Dial indicator should show:

D 20	0.75–0.83 mm = 0.0295–0.0327 in
D 24	0.65–0.73 mm = 0.0256–0.0287 in
D 24 USA and Canada	
1979–1981	0.65–0.73 mm = 0.0256–0.0287 in
1982-	0.82–0.90 mm = 0.0323–0.0354 in

Correct reading: Tighten injection pump mounting bolts.

Proceed to H25.

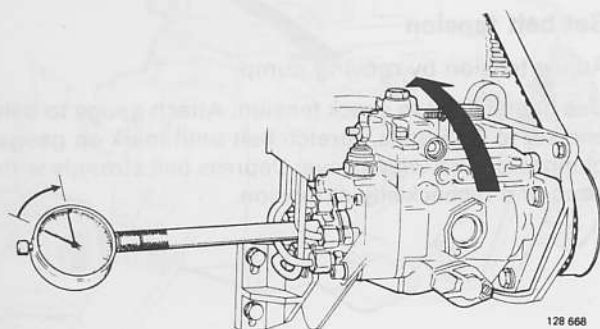
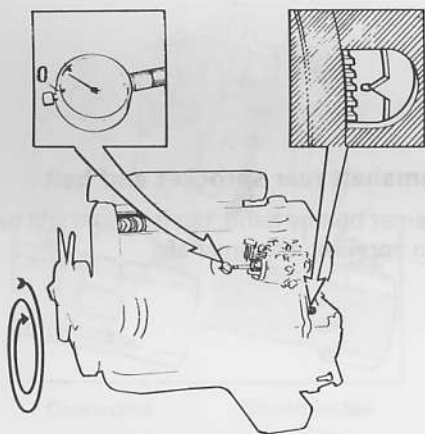
Incorrect reading: Readjust according to instructions below.

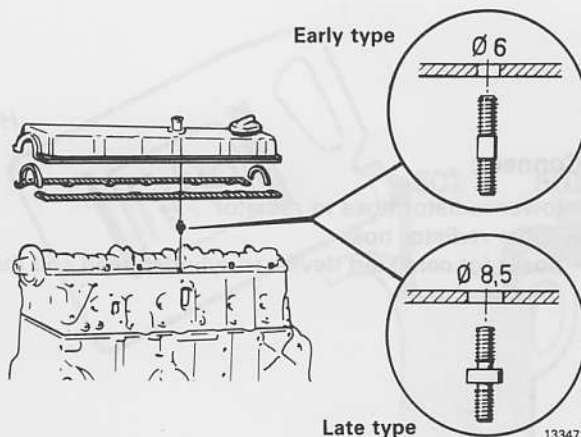
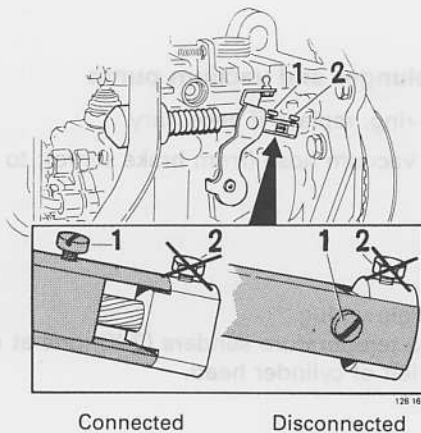
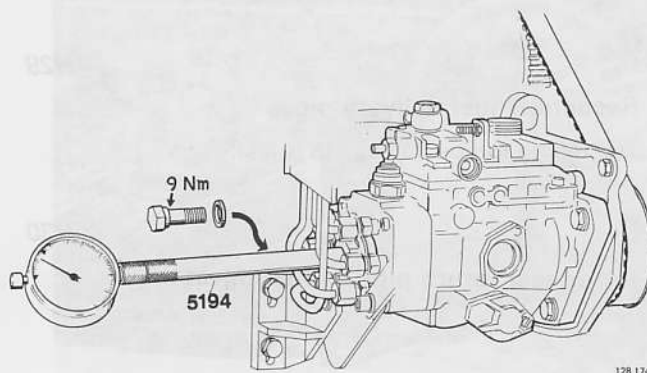
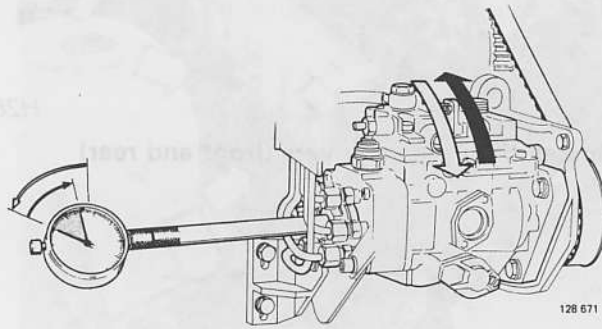
Readjusting pump setting:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA and Canada 1979–1981	0.70 mm = 0.0276 in
1982-	0.85 mm = 0.0335 in

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump settings.





Reading more than specified:

Slacken pump mounting bolts and turn pump outwards until dial indicator shows approx:

D 20	0.70 mm = 0.0276 in
D 24	0.60 mm = 0.0236 in
D 24 USA/Canada 1979–1981	0.60 mm = 0.0236 in
1982–	0.75 mm = 0.0295 in

Then turn pump inwards until specified value is obtained. Tighten mounting bolts and recheck pump setting.

Note! Injection pump must not be tapped or knocked as this will alter its setting.

H25

Remove dial indicator and holder 5194. Install plug with new seal

Tightening torque 9 Nm (6.5 ft lbs).

H26

Reconnect cold start device

Press lever forwards and turn sleeve 90°. Retighten screw 1.

Note! Do not turn screw 2 otherwise it will be necessary to reset cold start device on a test bench.

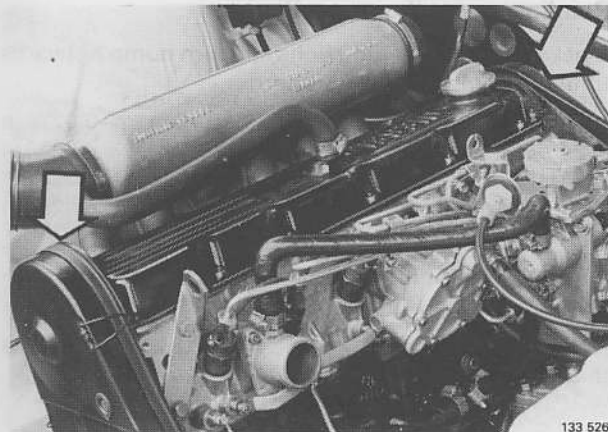
H27

Install valve cover

Use new gaskets if necessary.

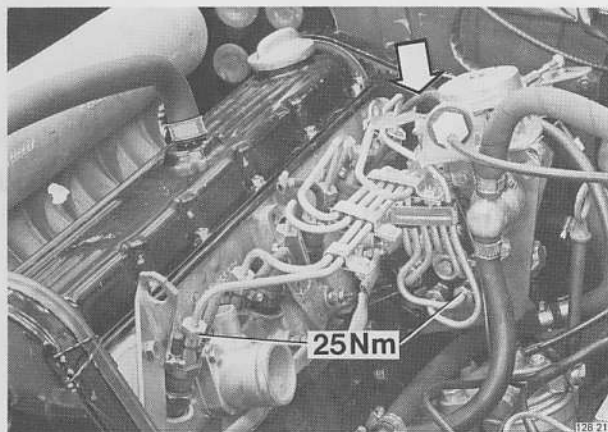
Two types of pin studs are available, see fig. Late types have a spacer, and hole in gasket is larger to prevent damage to gasket by overtightening. Late and early type parts **must not** be interchanged.

Note! Only install a few nuts since cover is to be removed later on when tightening cylinder head bolts.



Install timing gear covers (front and rear)

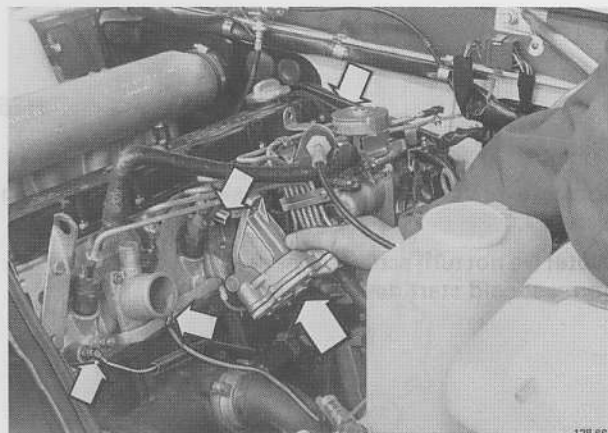
H28



Reconnect fuel delivery pipes

Tightening torque 25 Nm (18 ft lbs).

H29



Install plunger and vacuum pump

Check O-ring, replace if necessary.

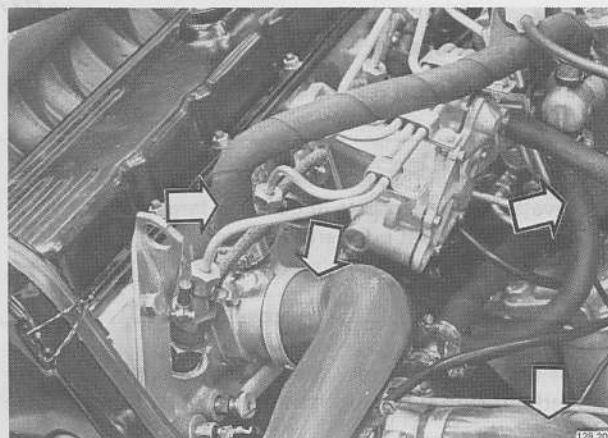
Connect vacuum hose (from brake servo); to pump.

H31

Install:

- wire to glow plug
- wires to temperature senders (2 X), one at rear and one to left of cylinder head.

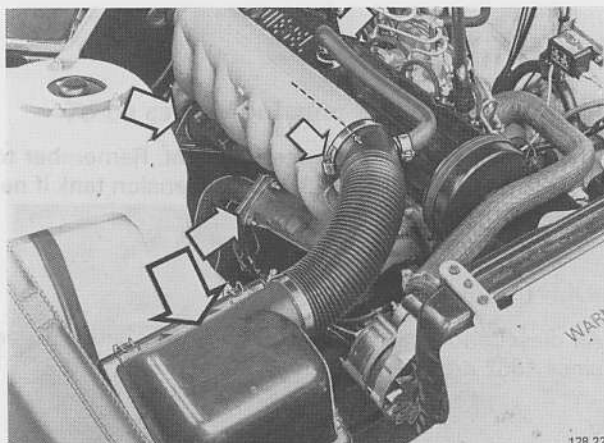
H32



Connect:

- lower radiator hose to radiator
- upper radiator hose
- hoses for cold start device to cylinder head and thermostat.

H33



H34 Install air filter and connect hoses

Arrow on inlet hose must point towards inlet manifold otherwise the crankcase breather hose may contact bonnet (hood).



H35 Connect:

- exhaust pipe to branch pipe. Use new gaskets.
- exhaust pipe to gearbox mounting
- splashguard
- battery.

H36 Bleeding of cooling system

Disconnect upper hose from cold start device. Place drip pan beneath hose and hold hose level with top edge of expansion tank.

Coolant

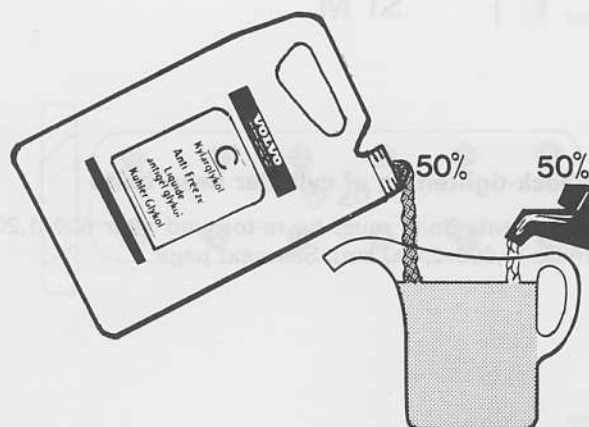
Since aluminium is used in the engines, active corrosion protection is necessary in the coolant help prevent corrosion damage.

Use genuine Volvo blue-green coolant type C, dilute with **clean** water in proportions of 50/50.

This mixture helps to prevent corrosion and frost damage.

- Never fill the cooling system with water alone.
- The coolant should be changed regularly since the corrosion protective additives in the coolant lose their effect in time.

Note! Do not run engine when level of coolant is low. High local temperatures can result which may cause the cylinder head to crack.



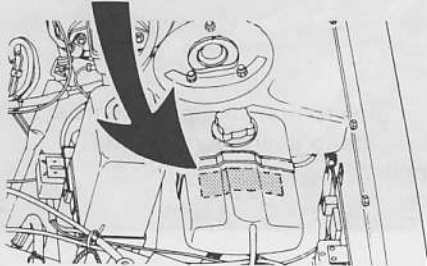
133542

VOLVO ORIGINAL KYLVATSKA TYP C ÄR PÅFYLLED. KYLSYSTEMET ÄR FROSTSKYDDAT TILL -30°C. EFTERFyll ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVATSKA TYP C.

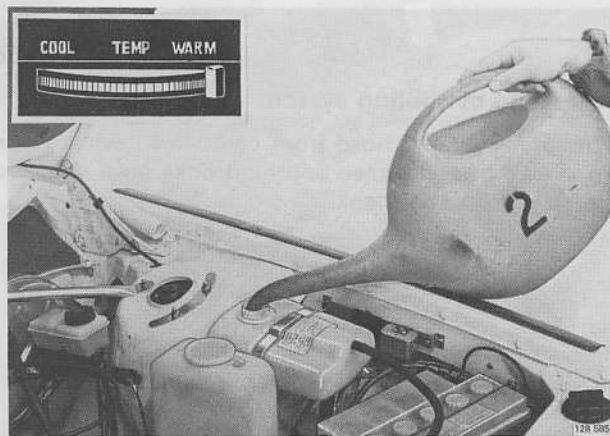
FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

REMPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

1297524



133477



128 585

Replacing coolant

Always use **type C** blue-green coolant. Remember to replace decal (P/N 1331473-7) on expansion tank if necessary.

Type C blue-green coolant

All diesel and petrol (gasoline) engines manufactured since 1982 are filled with type C coolant.

H37

Fill coolant

Capacity: D 20 = 8.1 liters (8.6 US quarts)
D 24 = 9.3 liters (9.8 US quarts).

Flush cooling system before adding new coolant, see Group 26 Cooling System.

Set dashboard heater control to max. Turn on engine and warm-up for 5 minutes. Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap.

H38

Tighten cylinder head bolts

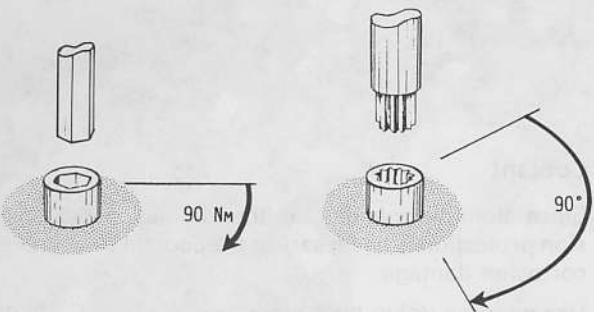
Warm-up engine until oil temperature is at least 50°C (122°F).

Remove vacuum pump with plunger and valve cover.

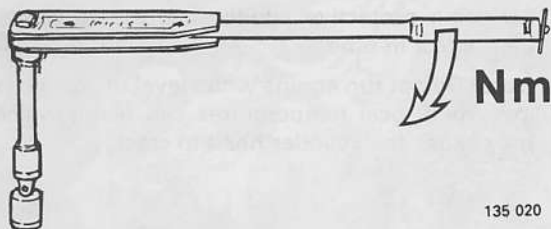
M 11 bolts: torque to 90 Nm (65 ft lbs)

M 12 bolts: angle-tighten 90° in one movement with out stopping. Install valve cover, pump plunger and vacuum pump.

133499



133499



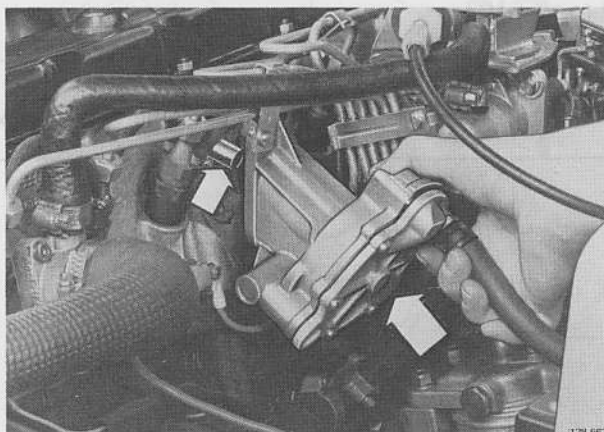
135 020

Check-tightening of cylinder head bolts

Important: Bolts must be re-torqued after 600–1,200 miles (1,000–2,000 km). See next page.

J. Cylinder head, retorquing

To be carried out after 600–1,200 miles (1,000–2,000 km) on cold or nearly cold engine.



120 663

M 11 bolts = 10 mm Allen key

M 11



133533

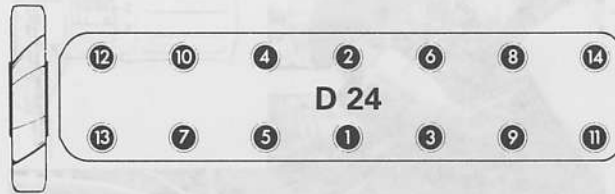
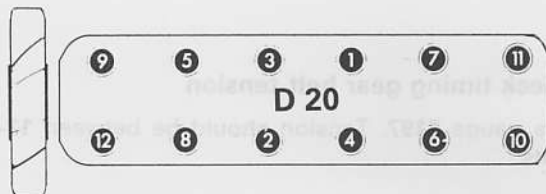
1159082

M 12 bolts = 12 sided socket
P/N 115 9082-5.

M 12



133534



133537

J1

Remove valve cover, vacuum pump and plunger

Access to one of cylinder head bolts is restricted by pump plunger.

J2

M 11 bolts:

Tighten each bolt in turn as indicated according to below:

1. Slacken bolt 30°
2. Torque to 90 Nm (65 ft lbs).

M 12 bolts:

Tighten each bolt in turn as indicated according to below:

1. Angle-tighten bolt 90° in one movement without stopping. Do not slacken bolt first. See illustration in operation H38.

J3

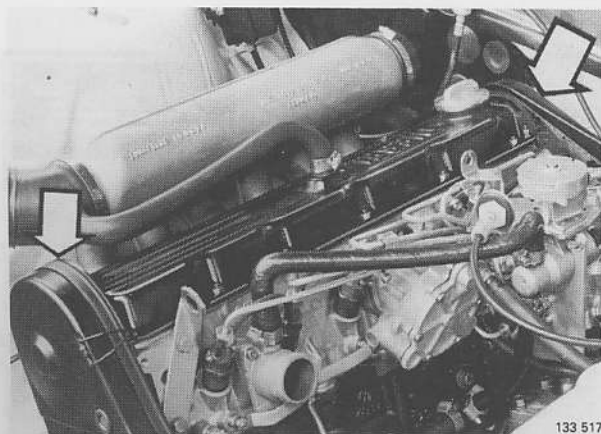
Install valve cover, plunger and vacuum pump

Check O-ring, replace if necessary.

K. Timing gear belt tension, checking/adjusting

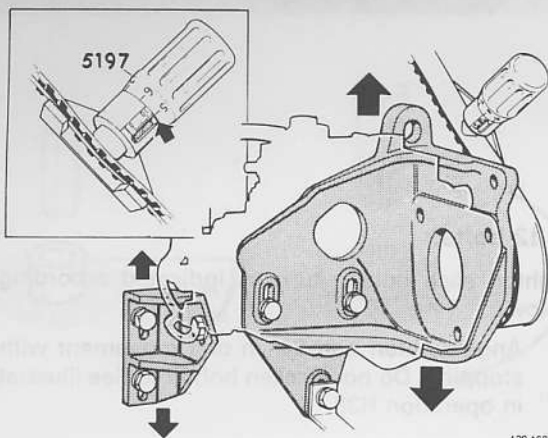
Special tool: 5197

Belt tension affects injection timing. Follow below instructions carefully. Overtight belts cause pulley to squeak.



K1

Remove timing gear covers (front and rear)



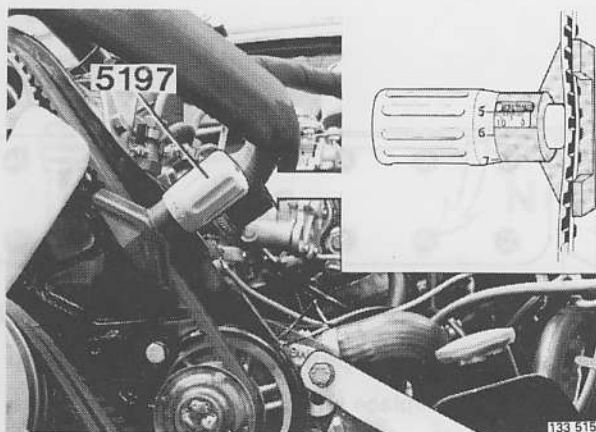
K2

Check belt tension

Use gauge **5197**. Tension should be between **12–13** units.

If incorrect:

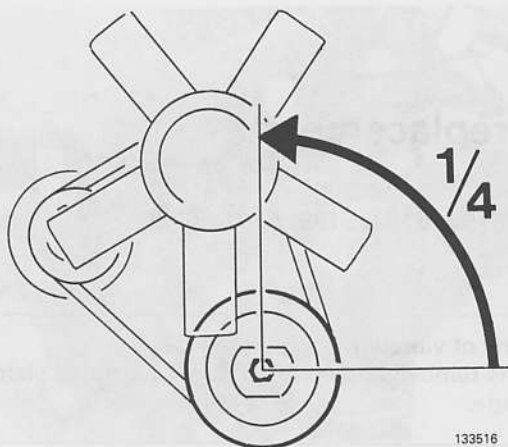
Adjust tension to **12.5** units by moving pump mounting bracket.



K3

Check timing gear belt tension

Use gauge **5197**. Tension should be between **12–13** units.

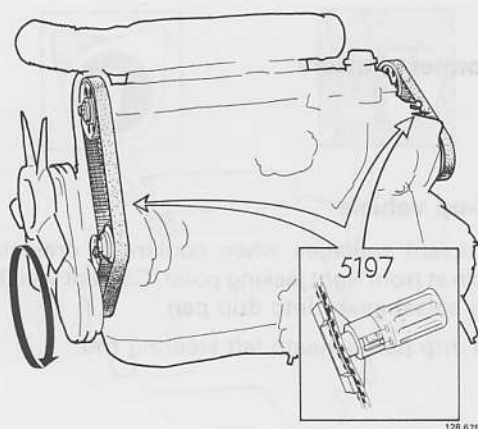
**Incorrect belt tension**

Unscrew expansion tank cap to release overpressure from cooling system.

Turn engine approx. 1/4 turn anticlockwise to obtain slack part of belt on driving side. If this is not done injection pump setting will be incorrect.

Turn crankshaft with **27 mm** socket or **5188**.

Adjust belt tension to **12.5** units on gauge **5197** by moving coolant pump mounting bracket.



K4

If gear belt tension has been adjusted

Turn engine at least one turn clockwise and check that belt tension is **12–13** units on tool **5197**. Adjust if necessary according to operations K2–3 and recheck tension.

K5

Install timing gear covers

L. Timing gear belts, replacement

Special tools: 5187, 5188, 5190, 5193, 5194, 5197, 5199, 5201, 5202

Engine may only be turned by means of vibration damper.
Do not rotate crankshaft or camshaft when timing gear belt is removed otherwise valves may strike pistons and cause damage.



Disconnect battery

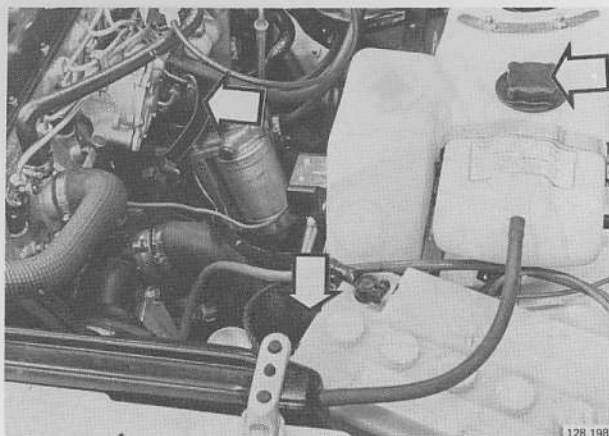
L1

Jack-up vehicle

L2

To prevent spillages when coolant is drained, raise vehicle at front right jacking point. Coolant will then run along splashguard into drip pan.

Place drip pan beneath left steering rod.



Drain coolant

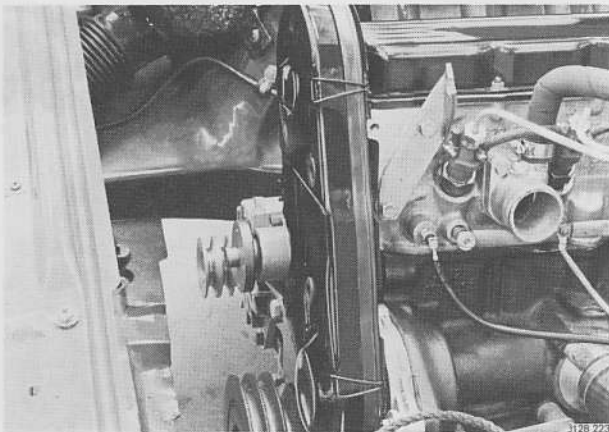
L3

Unscrew expansion tank cap.

Disconnect lower radiator hose from radiator.

Disconnect lower hose from thermostat for cold start device and drain coolant. (Engine is without drain taps).

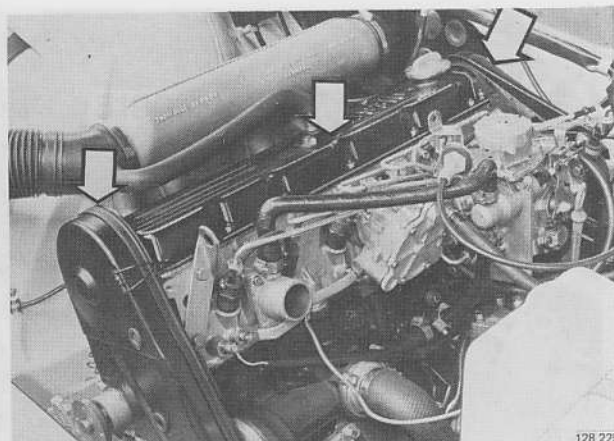
Lower vehicle.



Remove

L4

- radiator
- cooling fan with spacer and pulley
- fan belts and power steering pump belt
- splashguard.

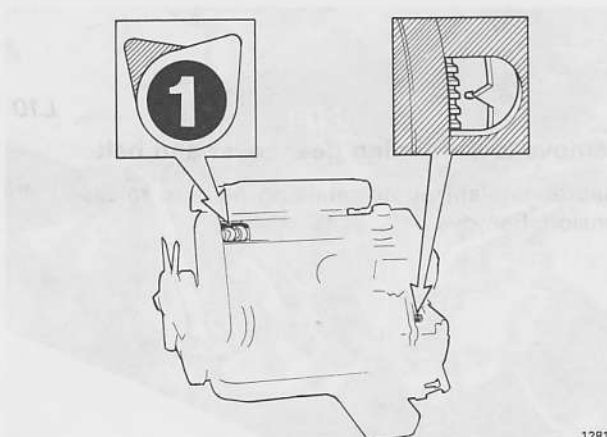


128 225

L5

Remove:

- valve cover
- timing gear covers (front and rear).



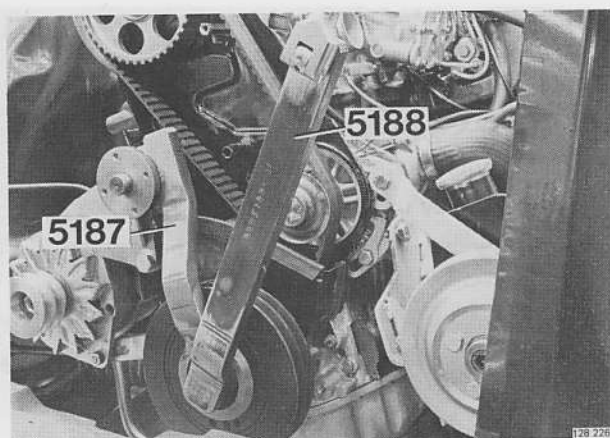
128163

L6

Turn engine until cyl. 1 is at TDC – injection

Always use vibration damper center bolt to turn engine.
27 mm socket or wrench **5188**.

Both cylinder 1 cams should point obliquely upwards.
Flywheel at '0'.



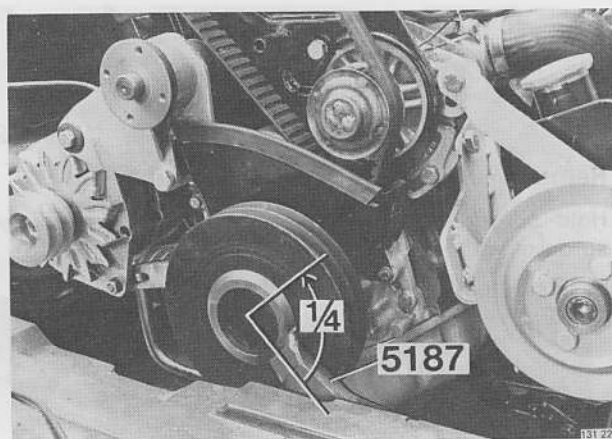
128 226

L7

Remove vibration damper center bolt

Use **5187** to prevent pulley from rotating, and socket **5188** to unscrew bolt.

It may be necessary to turn engine slightly so that **5187** rests on fan bearing.



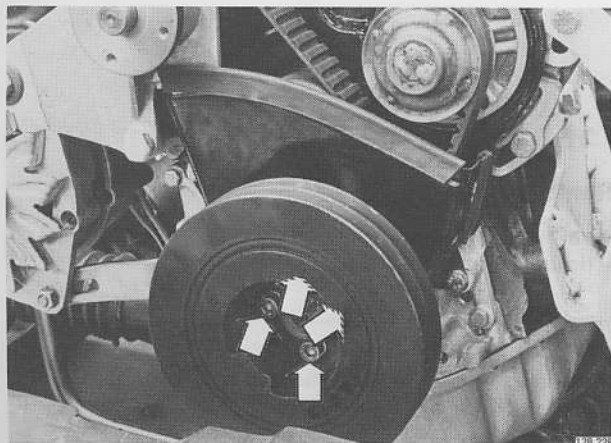
131 227

L8

Check that cyl. 1 is at TDC – injection

Check '0' mark on flywheel.

Adjust if necessary, use **5187** to turn engine.

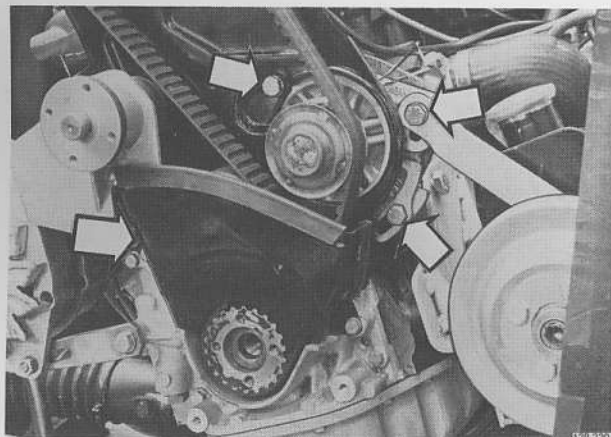


L9

Remove vibration damper

Remove four Allen screws (6 mm).

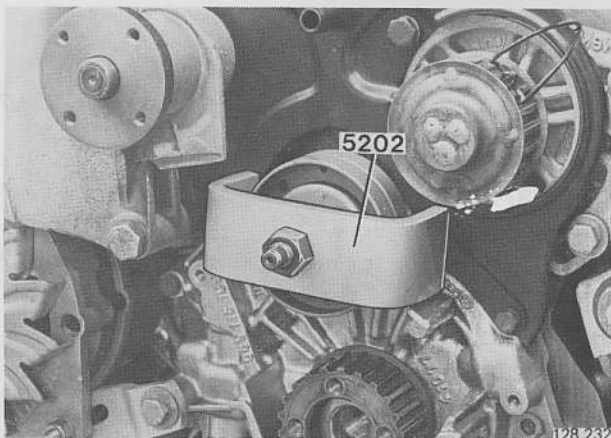
Pull off vibration damper. **Note!** Crankshaft gear may sometimes stick to vibration damper.



L10

Remove lower timing gear cover and belt

Slacken coolant pump retaining bolts to release belt tension. Remove belt.



L11

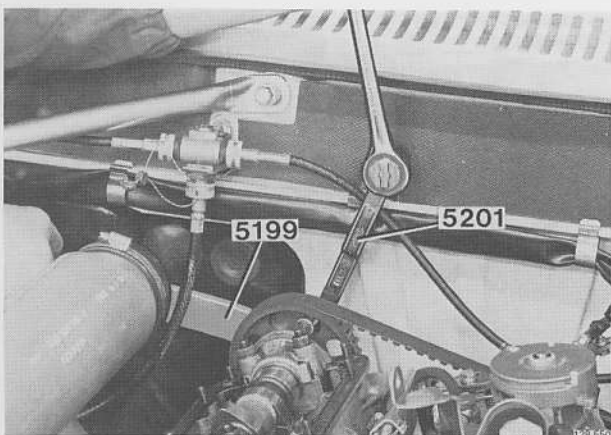
Replace idler pulley

Always replace pulley when fitting new belt.

Remove center bolt.

Withdraw pulley using 5202.

Tap on new pulley and install center bolt.

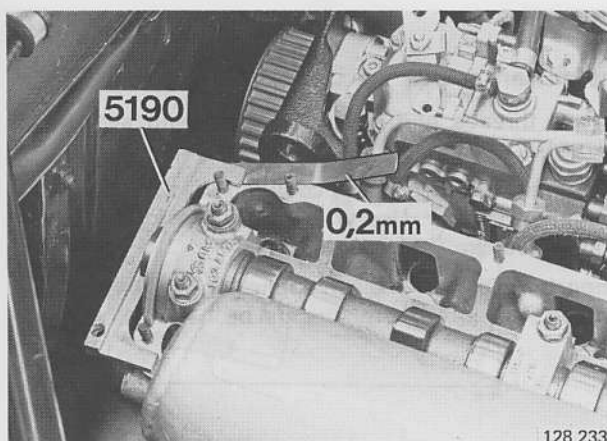


L12

Remove camshaft rear sprocket and belt

Hold sprocket in position with 5199 and unscrew sprocket with wrench 5201.

Take care not to rotate camshaft.

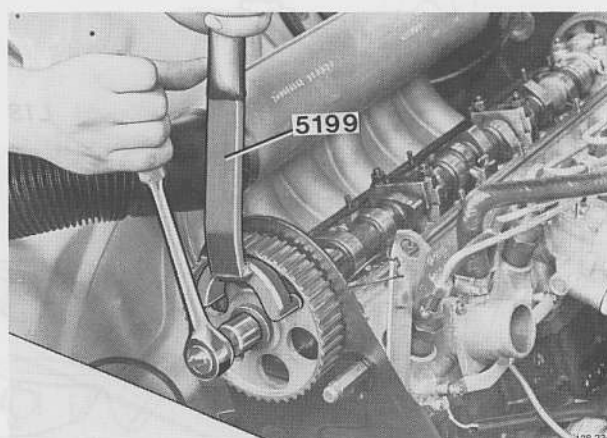
**Lock camshaft in position**

Lift valve cover gasket

Place gauge **5190** at rear of camshaft. Insert a **0.2 mm** feeler gauge beneath left side of gauge to compensate for timing gear clearance.

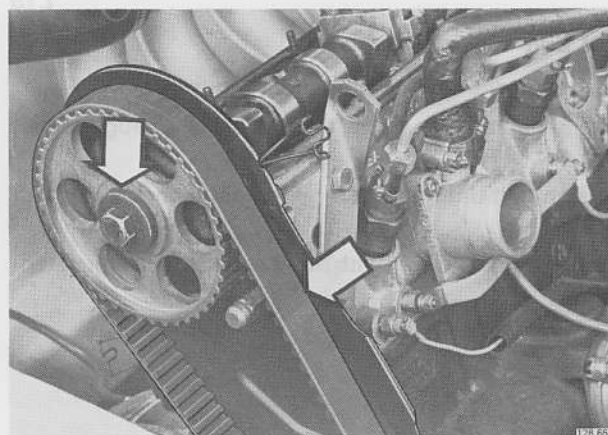
Camshaft is now set at correct position.

L13

**Remove camshaft front sprocket**

Use **5199** to hold sprocket in position when loosening bolts. Tap sprocket to free it from camshaft.

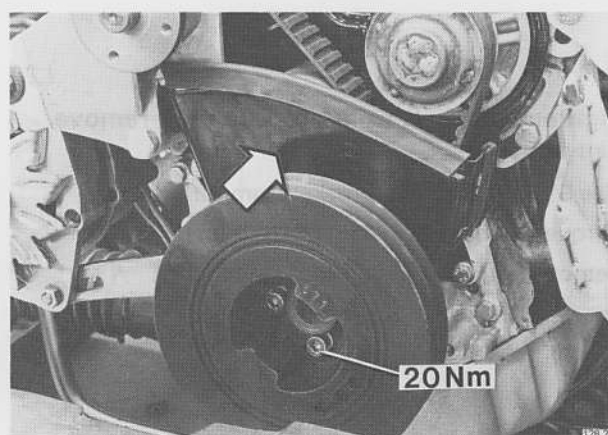
L14

**Install gear belt and camshaft front sprocket**

Make sure that belt fits securely on all gears.

Install center bolt, hand tight. It should be possible to turn sprocket on camshaft without camshaft rotating.

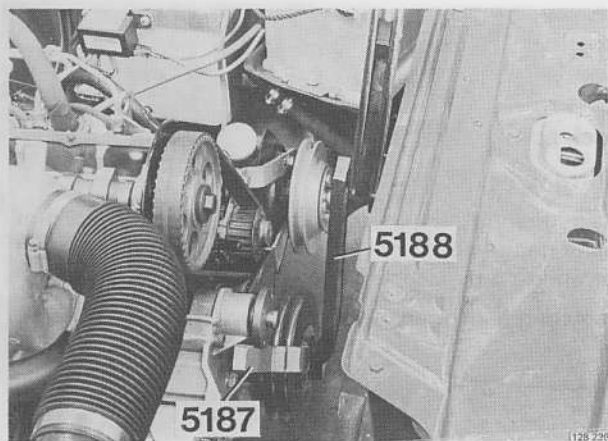
L15

**Install lower timing gear cover and vibration damper**

Damper can only be fitted in one way. Pin on crankshaft gear must fit in vibration damper.

Torque inhex bolts to **20 Nm** (15 ft lbs).

L16



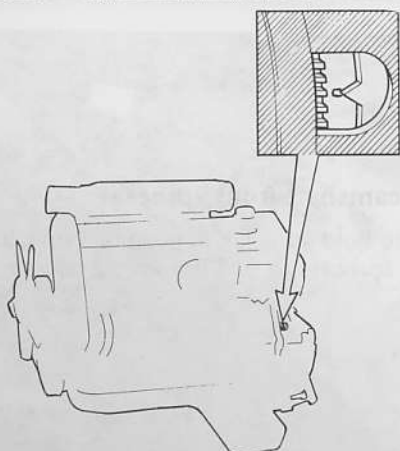
L17

Install center bolt

Smear threads and mating surface with sealer P/N 277961-9.

Use wrench **5187** (rest on cooling fan journal) to hold vibration damper. Use wrench **5188** to torque center bolt to **350 Nm** (255 ft lbs).

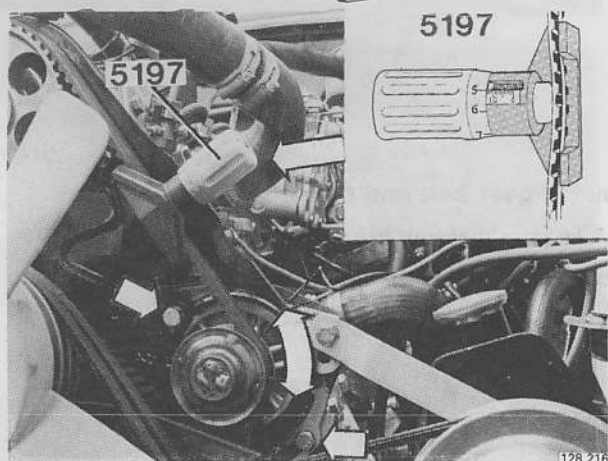
Important: Torque 350 Nm applies only if wrench 5188 is used. Also torque wrench must be in line with wrench 5188.



L18

Make sure cyl. 1 is at TDC – injection

Check '0' mark on flywheel and adjust if necessary.



L19

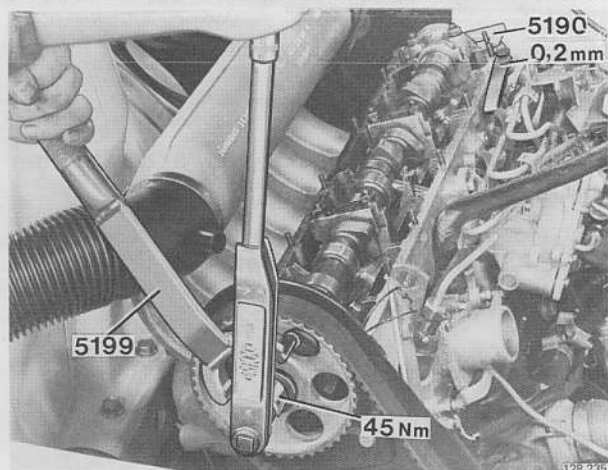
Set belt tension

Adjust tension by moving coolant pump

Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units.

Stretch belt until mark on gauge plunger is flush with sleeve.

Depress belt strongly with hand and recheck/adjust tension.



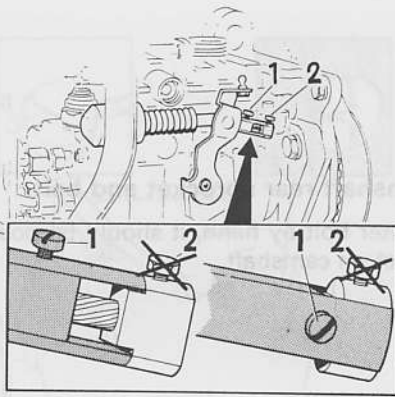
L20

Tighten camshaft front sprocket and remove gauge 5190

Use **5199** to prevent sprocket from turning.

Torque center bolt to **45 Nm** (33 ft lbs).

Remove gauge 5190 and feeler gauge.



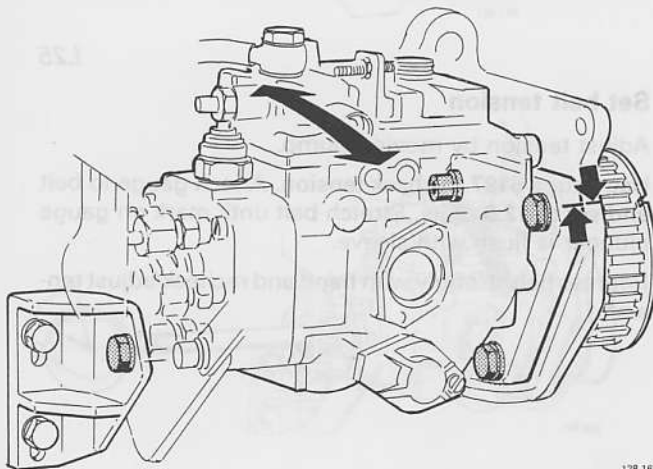
L21

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2 otherwise it will be necessary to remove cold start device and reset it on a test bench.

Press back lever against stop.

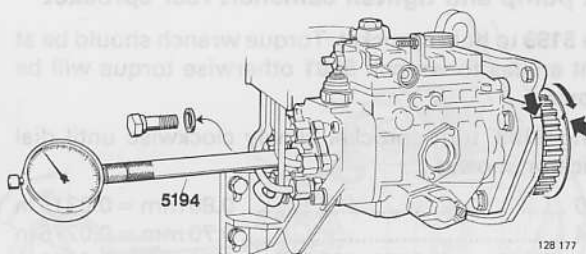


L22

Basic-set injection pump

Slacken pump mounting bolts (Allen key = 6 mm).

Align marks on pump and mounting bracket by turning pump. Retighten mounting bolts.



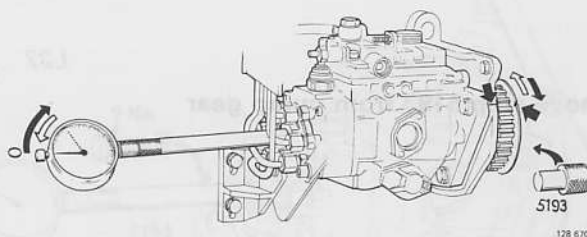
L23

Set dial indicator zero. Lock pump gear at cyl. 1 injection using stop 5193

Unscrew and remove plug from injection pump distributor.

Install holder 5194 and dial indicator (range 0–3 mm). Set gauge to approx. 2 mm.

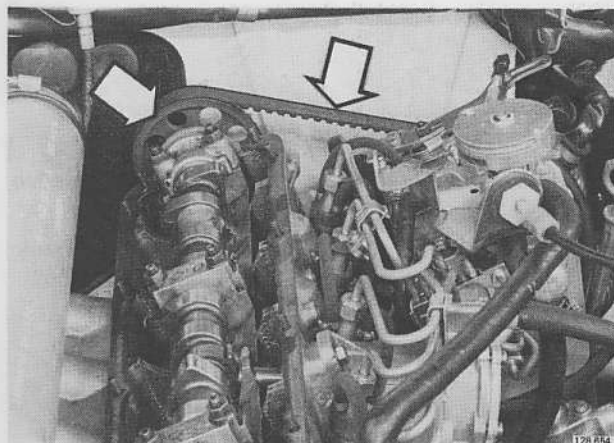
Turn pump gear clockwise until mark on gear and mounting bracket coincide.



Then turn back pump gear slightly until min reading registers on dial indicator.

Set indicator to zero.

Turn pump gear clockwise until mark on gear and pump mounting bracket coincide. Lock gear in this position with stop 5193. (Insert stop through pump gear into mounting bracket.)



Install center bolt

L24

Install camshaft rear sprocket and belt

Tighten center bolt by hand, it should be possible to turn sprocket on camshaft.

Intersect
Insert A
5198.

Set belt tension

Adjust tension by moving pump.

Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units. Stretch belt until mark on gauge plunger is flush with sleeve.

Depress belt strongly with hand and recheck/adjust tension.



Set pump and tighten camshaft rear sprocket

Use **5199** to hold sprocket. Torque wrench should be at right angles to wrench **5201** otherwise torque will be incorrect.

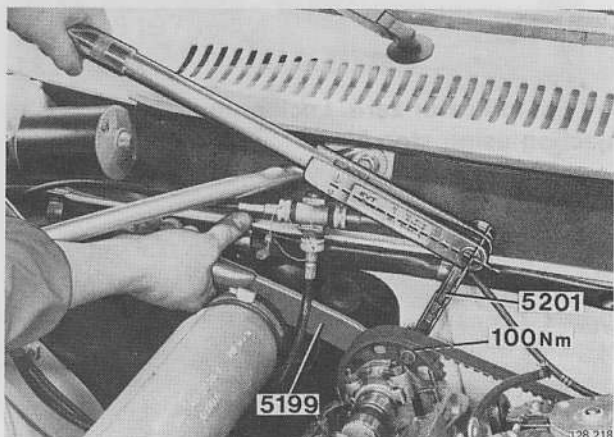
Using **5199**, turn sprocket slowly clockwise until dial indicator shows:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada 1979-1981	0.70 mm = 0.0276 in
1982-	0.85 mm = 0.0335 in

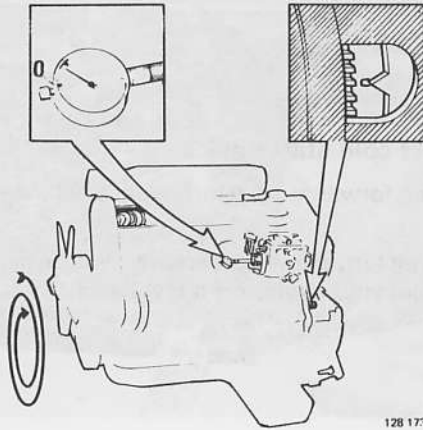
Hold sprocket in this position and torque bolt to **100 Nm** (73 ft lbs). Take care that camshaft and sprocket do not move.

Tighten camshaft front sprocket and remove gauge 5198

Remove stop 5193 from pump gear



L28



128 173

Check pump setting

Turn engine two full turns until cyl. 1 is at top dead center – injection, again. If engine is turned too far it must be turned back approx. 1/4 turn and then to zero mark otherwise setting will be incorrect.

Dial indicator should show:

D 20	0.75–0.83 mm = 0.0295–0.0327 in
D 24	0.65–0.73 mm = 0.0256–0.0287 in
D 24 USA/Canada	
1979–1981	0.65–0.73 mm = 0.0256–0.0282 in
1982–	0.82–0.90 mm = 0.0323–0.0354 in

Correct reading: Tighten injection mounting bolts. Proceed to L29.

Incorrect reading: Readjust according to instructions below.

Radjusting pump setting:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada	
1979–1981	0.70 mm = 0.0276 in
1982–	0.85 mm = 0.0335 in

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump settings.

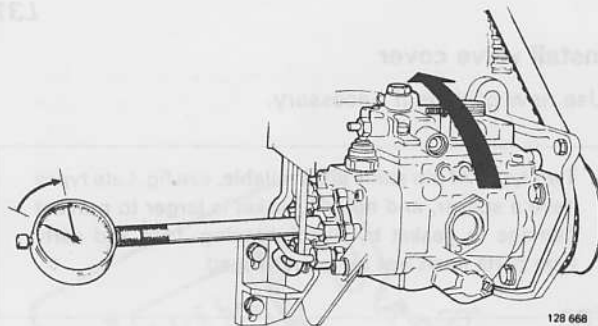
Reading more than specified:

Slacken pump mounting bolts and turn pump **outwards** until dial indictor shows approx:

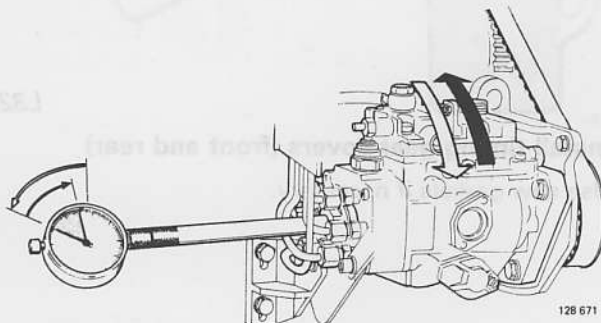
D 20	0.70 mm = 0.0276 in
D 24	0.60 mm = 0.0236 in
D 24 USA/Canada 1979–1981	0.60 mm = 0.0236 in
1982–	0.75 mm = 0.0295 in

Then turn pump inwards until specified value is obtained. Tighten mounting bolts and recheck pump setting.

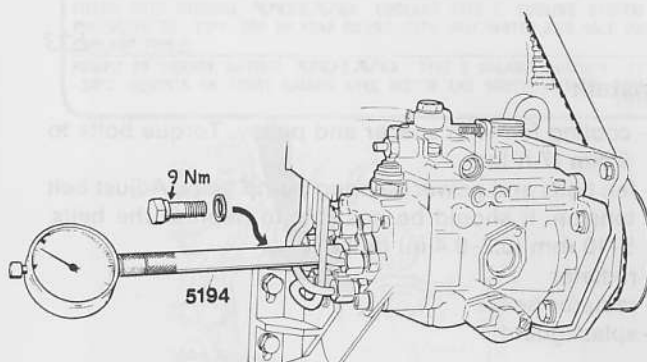
Note! Injection pump must not be tapped or knocked as this will alter its setting.



128 668



128 671

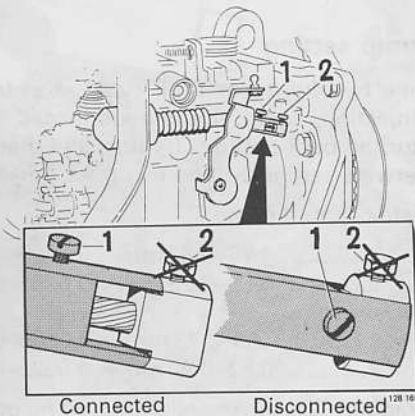


128 174

Remove dial indicator and holder 5194. Install plug with new seal

Tightening torque 9 Nm (6.5 ft lbs).

L29

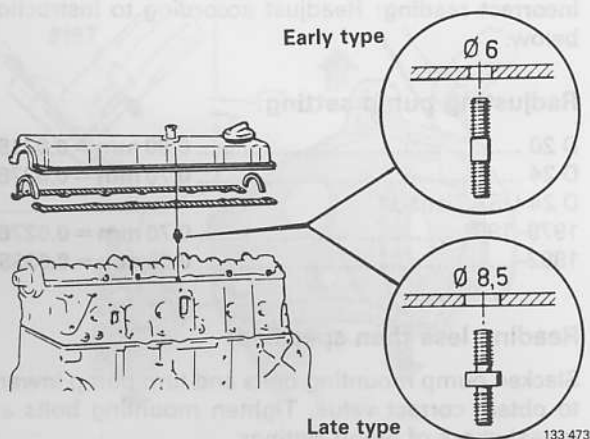


L30

Reconnect cold start device

Press lever forwards and turn sleeve 90°. Retighten screw 1.

Note! Do not turn screw 2 otherwise it will be necessary to reset cold start device on a test bench.

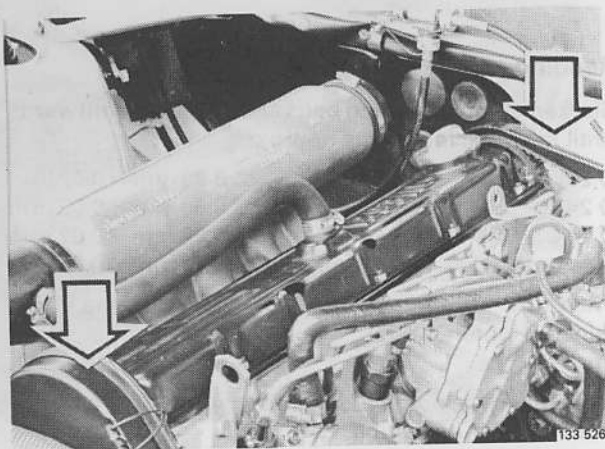


L31

Install valve cover

Use new gaskets if necessary.

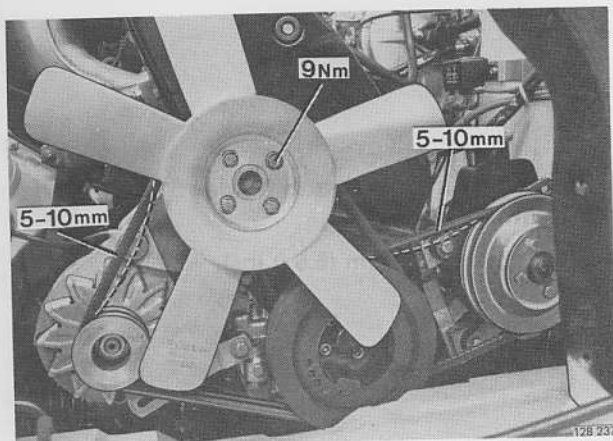
Two types of pin studs are available, see fig. Late types have a spacer, and hole in gasket is larger to prevent damage to gasket by overtightening. Late and early type parts **must not** be interchanged.



L32

Install timing gear covers (front and rear)

Use new gaskets if necessary.



L33

Install:

- cooling fan with spacer and pulley. Torque bolts to 9 Nm (7 ft lbs)
- fan belts and power steering pump belts. Adjust belt tension. It should be possible to depress the belts 5-10 mm (0.2-0.4 in) by hand.
- radiator
- radiator hoses
- splashguard.



L34

Bleeding of cooling system

Disconnect upper hose from cold start device. Place drip pan beneath hose and hold hose level with top edge of expansion tank.

Coolant

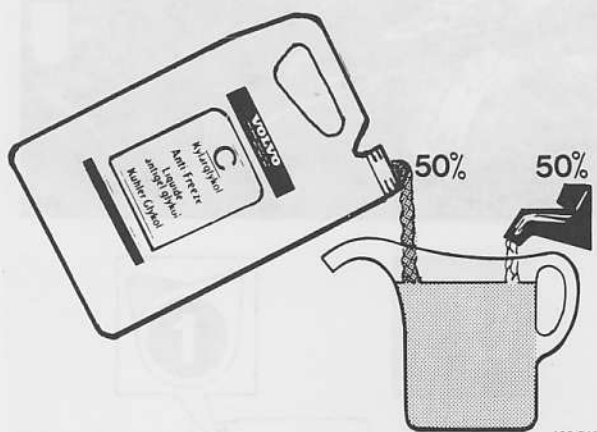
Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage.

Use genuine Volvo blue-green coolant type C, diluted with **clean** water in proportions of 50/50.

This mixture helps to prevent corrosion and frost damage.

Never fill the cooling system with water alone.

The coolant should be changed regularly since the corrosion protective additives in the coolant lose their effect in time.



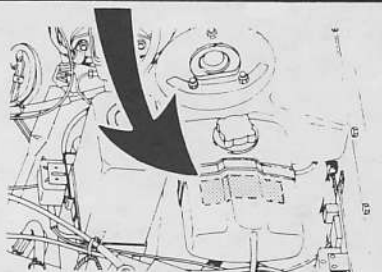
Note! Do not run engine when level of coolant is low since high local temperatures can result which may cause the cylinder head to crack.

VOLVO ORIGINAL KYLVATSKA TYP C ÄR PÅFYLLED. KYLSYSTEMET ÄR FROST-SKYDDAT TILL -30°C. EFTERFyll ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVATSKA TYP C.

FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

REPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

1297524



133 477

Replacing coolant

Always use **type C** blue-green coolant. Remember to replace decal (P/N 1331473-7) on expansion tank if necessary.

Type C blue-green coolant

All diesel and petrol (gasoline) engines manufactured since 1982 are filled with type C coolant.



Fill coolant

Capacity: D 20 = 8.1 liters (8.6 US quarts)
D 24 = 9.3 liters (9.8 US quarts).

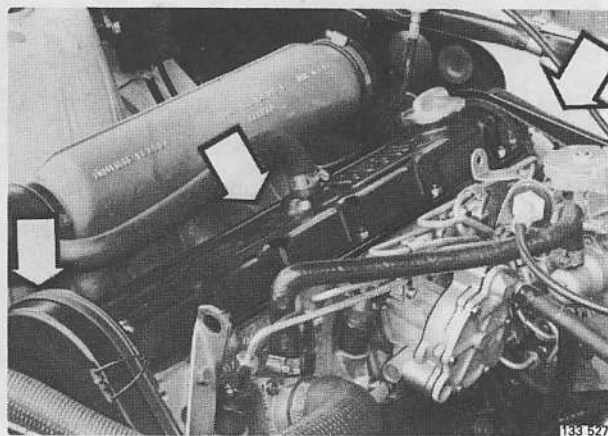
Flush cooling system before adding new coolant, see Group 26 Cooling System.

Set dashboard heater control to max. Turn on engine and warm-up for 5 minutes. Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap.

L35

M. Camshaft, removal

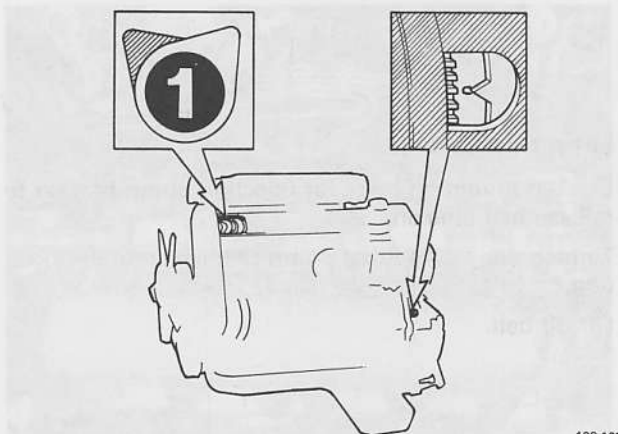
Special tools: 5199, 5201



Remove:

- valve cover
- timing gear covers (front and rear).

M1

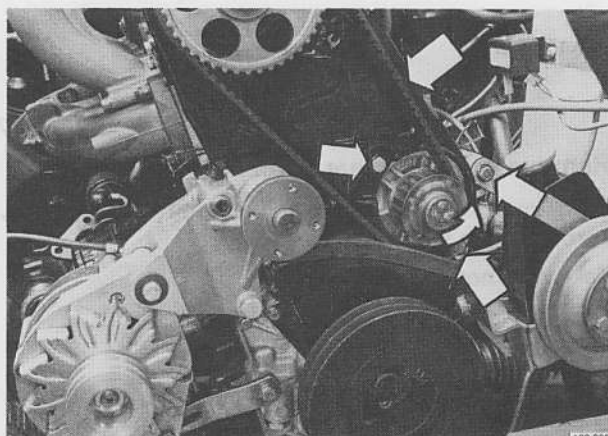


Turn engine until cyl. 1 is at TDC – injection

Always use the vibration damper center bolt to turn the engine. **27 mm** socket or wrench **5188**.

Both cylinder 1 cams should point obliquely upwards.
Flywheel at '0'.

M2



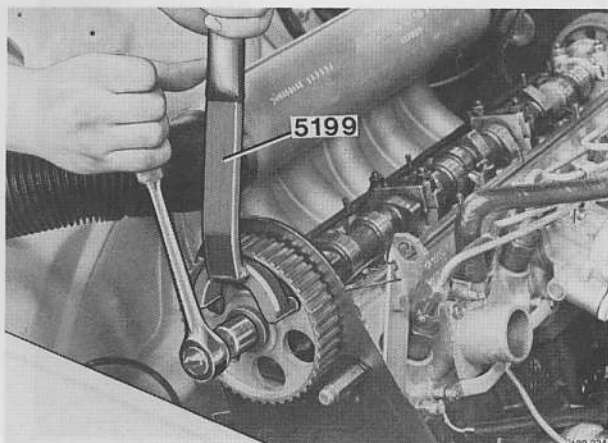
Remove belt from camshaft sprocket

Unscrew expansion tank cap to release overpressure from cooling system.

Slacken coolant pump mounting bolts and belt tensioner. Tighten two lower mounting bolts to avoid unnecessary loss of coolant.

Remove belt from camshaft sprocket.

M3

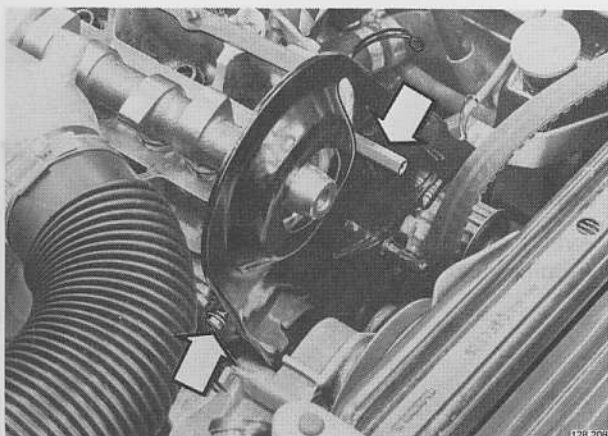


M4

Remove camshaft front sprocket

Use **5199** to hold sprocket in position when loosening bolt. Make sure that camshaft does not rotate.

Tap sprocket to free it from camshaft.



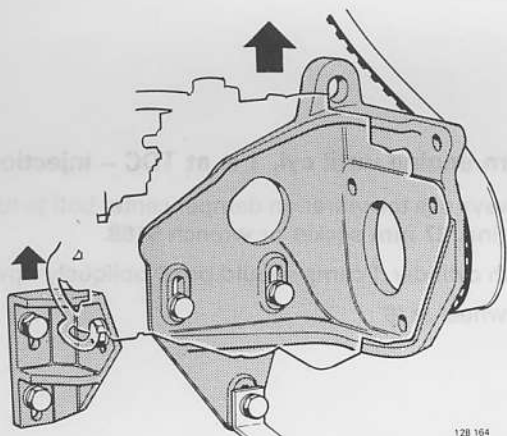
M5

Detach belt shield from cylinder head

Remove two upper retaining bolts.

Bend out shield to free it from camshaft. If necessary slacken coolant pump upper bolt.

Keep shield in outer position with a piece of wood.



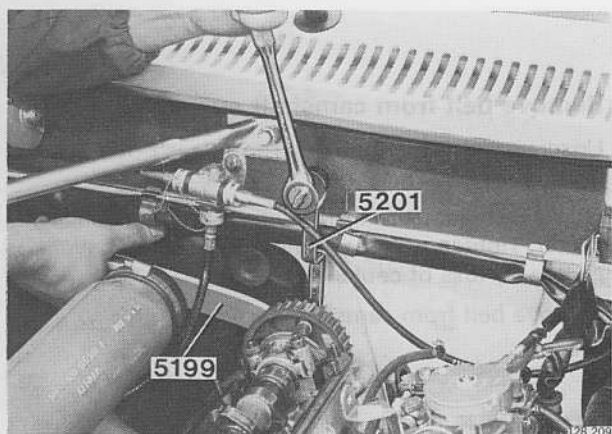
M6

Lift off pump belt

Slacken mounting bolts for injection pump bracket to release belt tension.

Tighten one bolt so that pump remains in upper position.

Lift off belt.

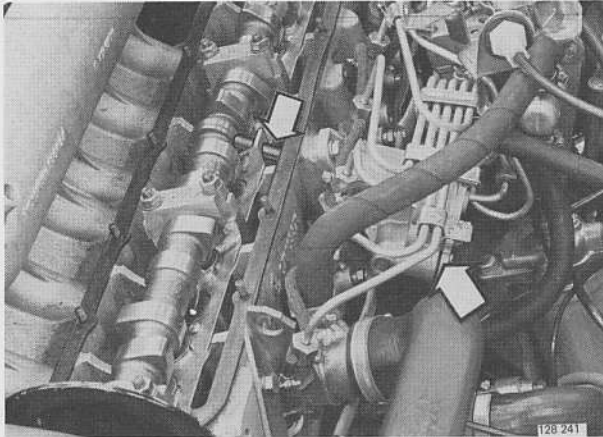


M7

Remove camshaft rear sprocket

Hold sprocket in position with **5199** and unscrew sprocket with wrench **5201**.

Take care not to rotate camshaft.

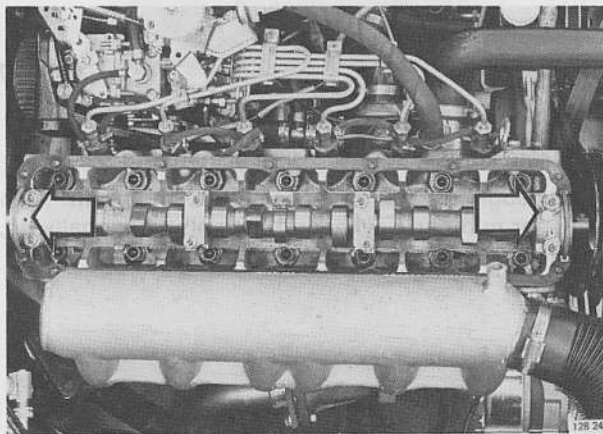


M8

Remove vacuum pump and pump plunger

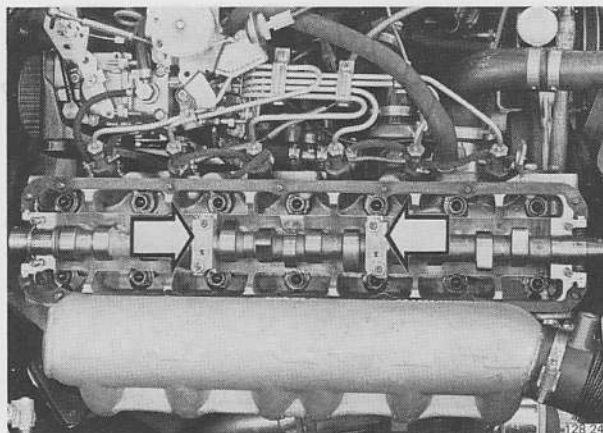
Remove pump retaining nuts and place pump on wheelarch.

Withdraw plunger from cylinder head.



M9

Remove camshaft bearing caps 1 and 4



M10

Remove camshaft bearing caps 2 and 3

Slacken nuts crosswise to avoid placing uneven load on camshaft.

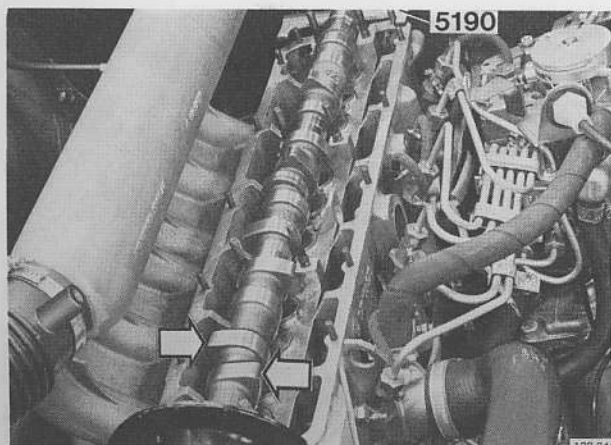


M11

Lift away camshaft and remove oil seals

N. Camshaft, installing

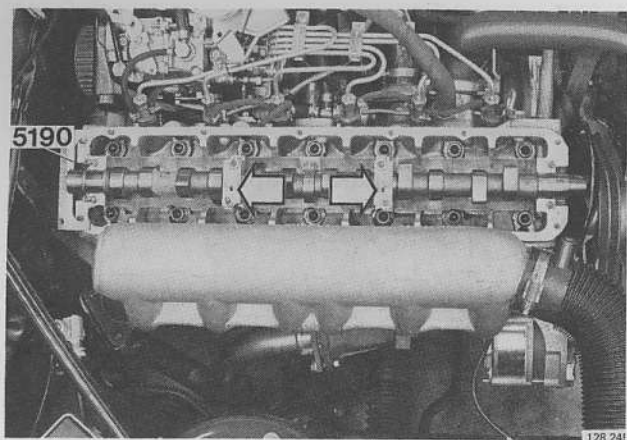
Special tools: 5190, 5193, 5194, 5195, 5196, 5197, 5199, 5200, 5201



N1

Place camshaft in cylinder head

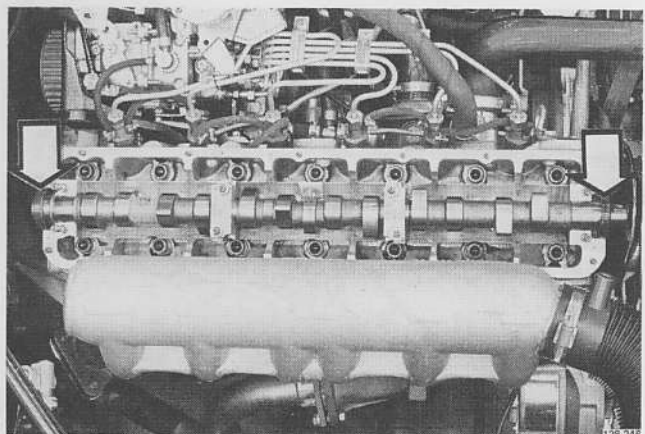
Lubricate contact surfaces of camshaft and bearings.
Place gauge **5190** at rear of camshaft. **Important!** Both cams for number 1 cylinder must point diagonally up, see fig.



N2

Install camshaft caps 2 and 3

Install caps correctly, center is off-set.
Tighten nuts crosswise to avoid warp. Keep camshaft in position with gauge **5190** at rear when tightening caps.



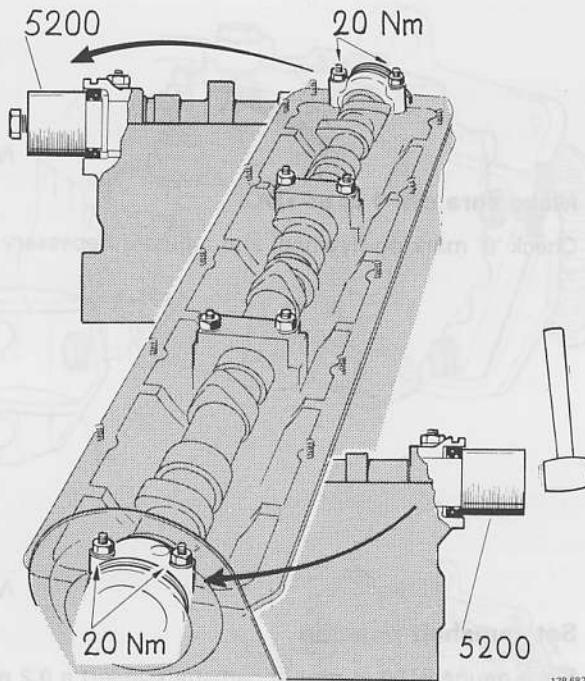
N3

Remove gauge 5190

N4

Press in new camshaft oil seals

Oil seals.
Do not push in seals to bottom position. Make sure that seals are "square".



N5

Install camshaft caps 1 and 4

Make sure that the thrust washer for camshaft cap 4 sits correctly.

N6

Torque all four caps

Torque = 20 Nm (15 ft lbs).

N7

Tap in oil seals to bottom

Rear oil seal: Use adapter 5200 and bolt for camshaft rear sprocket.

Front oil seal: Use adapter 5200 and tap seal into position.

N8

Install bolts for belt cover

N9

Install gear belt and camshaft front sprocket

Pull belt to ensure that it is seated correctly on crankshaft gear.

Place belt over camshaft sprocket and install sprocket and belt.

Install center bolt hand tight. It should be possible for sprocket to turn on camshaft without camshaft rotating.

N10

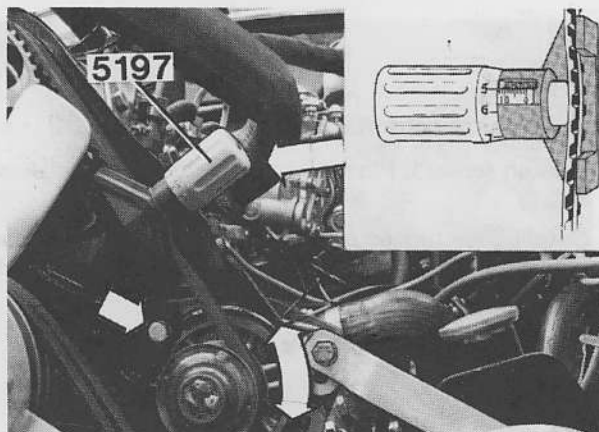
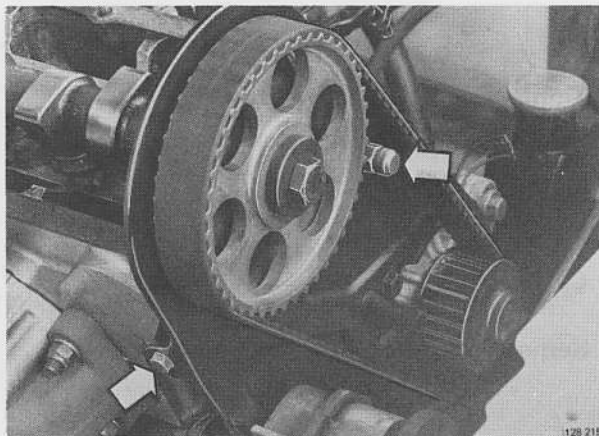
Set belt tension

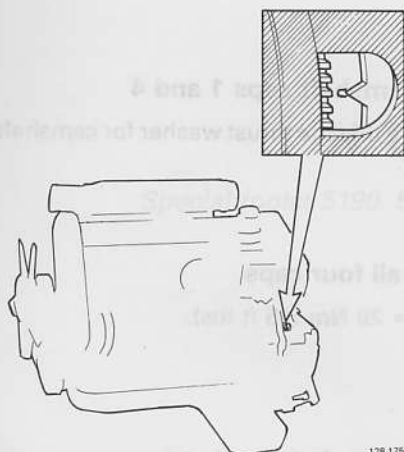
Adjust tension by moving cooling pump.

Use gauge 5197 to check tension. Attach gauge to belt and set to 12.5 units.

Stretch belt until mark on gauge plunger is flush with sleeves.

Depress belt strongly with hand and recheck/adjust tension.

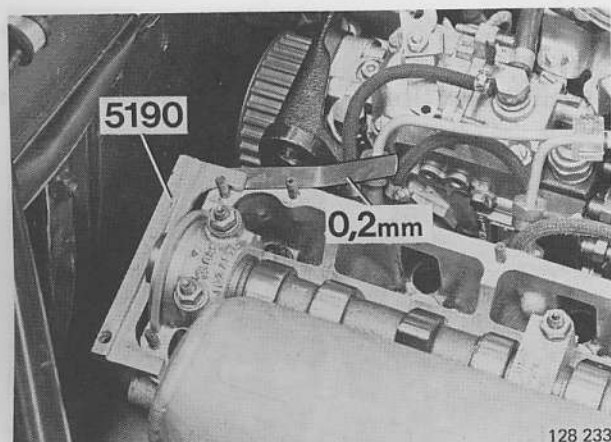




N11

Make sure cyl. 1 is at TDC

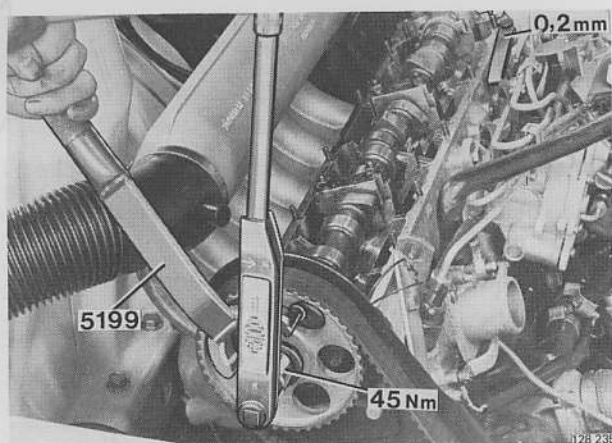
Check '0' mark on flywheel and adjust if necessary.



N12

Set camshaft position

Place gauge 5190 at rear of camshaft. Insert a 0.2 mm feeler gauge beneath left side of gauge to compensate for timing gear clearance.



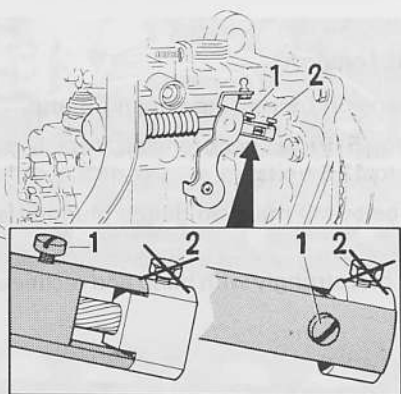
N13

Tighten camshaft front sprocket

Use 5199 to prevent sprocket from turning. Torque center bolt to 45 Nm (33 ft lbs).

N14

Remove gauge 5190 and feeler gauge



Connected

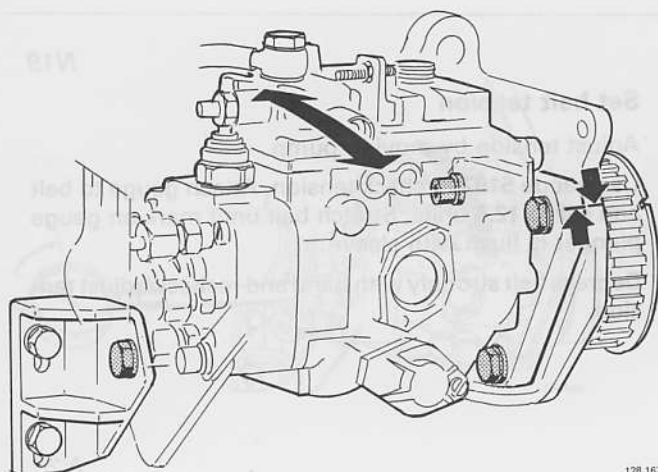
Disconnected

N15

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2 otherwise it will be necessary to remove cold start device and reset it on a test bench. Press back lever against stop.

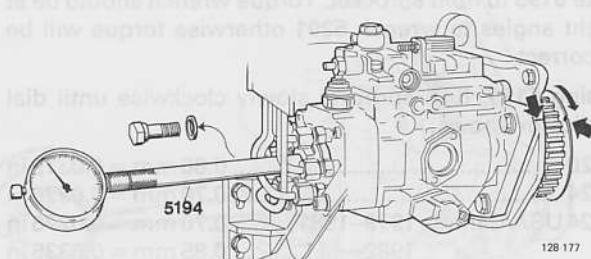


N16

Basic-set injection pump

Slacken pump mounting bolts (Allen key = 6 mm).

Align marks on pump and mounting bracket by turning pump. Retighten mounting bolts.



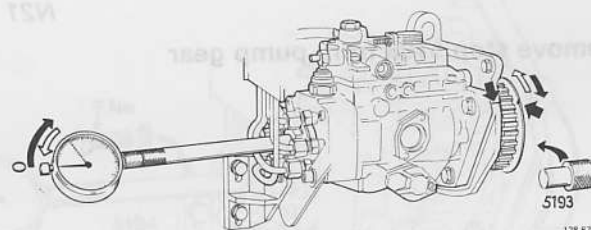
N17

Set dial indicator zero. Lock pump gear at cyl. 1 injection using stop 5193

Unscrew and remove plug from injection pump distributor.

Install holder 5194 and dial indicator (range 0–3 mm). Set gauge to approx. 2 mm.

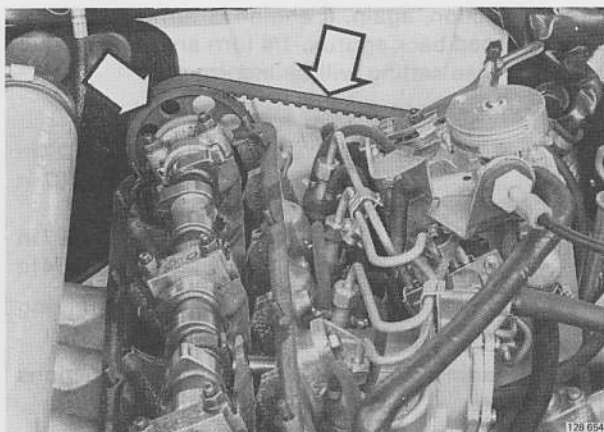
Turn pump gear clockwise until mark on gear and mounting bracket coincide.



Then turn pump gear back slightly until min reading registers on dial indicator.

Set indicator to zero.

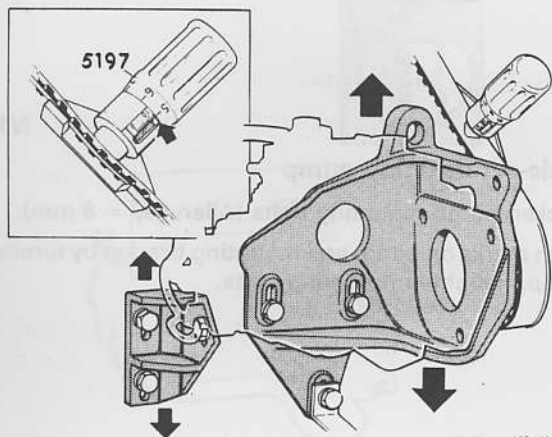
Turn pump gear clockwise until mark on gear and pump mounting bracket coincide. Lock gear in this position with stop 5193. (Insert stop through pump gear into mounting bracket.)



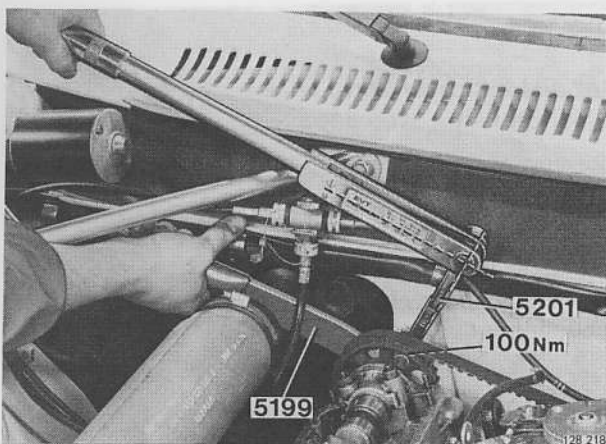
N18

Install camshaft rear sprocket and belt

Tighten center bolts by hand, it should be possible to turn sprocket on camshaft.



128 168



128 218

N19

Set belt tension

Adjust tension by moving pump.

Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units. Stretch belt until mark on gauge plunger is flush with sleeve.

Depress belt strongly with hand and recheck/adjust tension.

N20

Set pump and tighten camshaft rear sprocket

Use **5199** to hold sprocket. Torque wrench should be at right angles to wrench **5201** otherwise torque will be incorrect.

Using **5199**, turn sprocket slowly clockwise until dial indicator shows:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada 1979–1981	0.70 mm = 0.0276 in
1982–	0.85 mm = 0.0335 in

Hold sprocket in this position and torque bolt to **100 Nm** (73 ft lbs). Take care that camshaft and sprocket do not move.

N21

Remove stop 5193 from pump gear

N22

Check pump setting

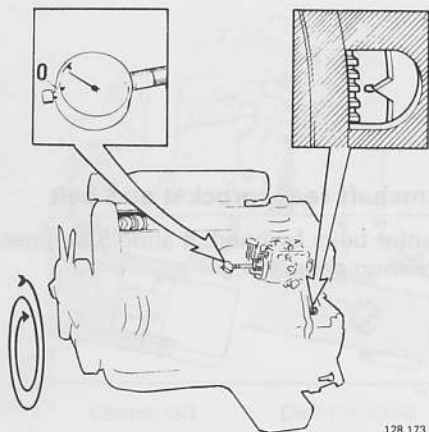
Turn engine two full turns until cyl. 1 is at top dead center – injection, again. If engine is turned too far it must be turned back approx. 1/4 turn and then to zero mark otherwise setting will be incorrect.

Dial indicator should show:

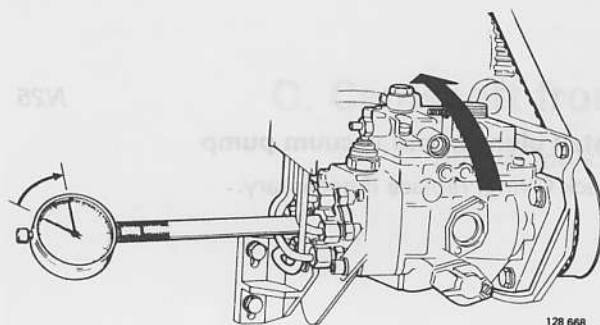
D 20	0.75–0.83 mm = 0.0295–0.0327 in
D 24	0.65–0.73 mm = 0.0256–0.0287 in
D 24 USA/Canada	
1979–1981	0.65–0.73 mm = 0.0256–0.0287 in
1982–	0.82–0.90 mm = 0.0323–0.0354 in

Correct reading: Tighten injection pump mounting bolts. Proceed to N23.

Incorrect reading: Readjust according to instructions on next page.



128 173

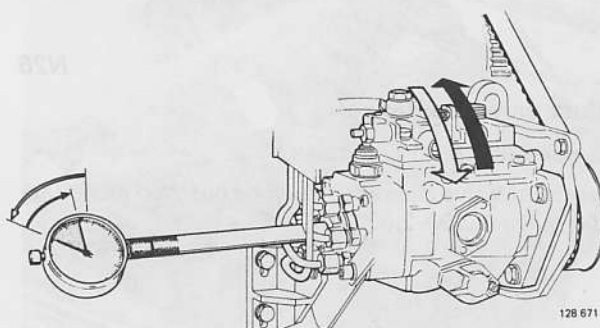


Readjusting pump setting:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada 1979–1981	0.70 mm = 0.0276 in
1982–	0.85 mm = 0.0335 in

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump settings.



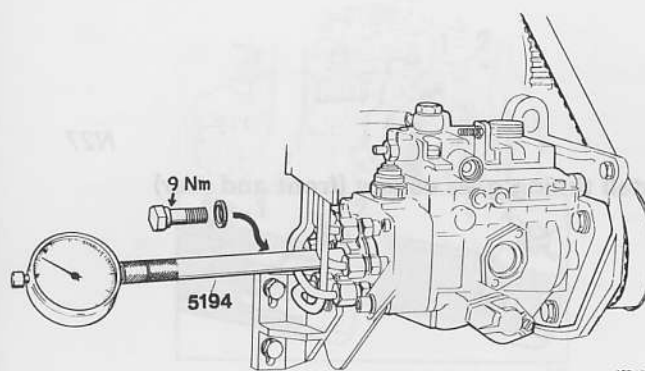
Reading less than specified:

Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows approx:

D 20	0.70 mm = 0.0276 in
D 24	0.60 mm = 0.0236 in
D 24 USA/Canada 1979–1981	0.60 mm = 0.0236 in
1982–	0.75 mm = 0.0295 in

Then turn pump **inwards** until specified value is obtained. Tighten mounting bolts and recheck pump setting.

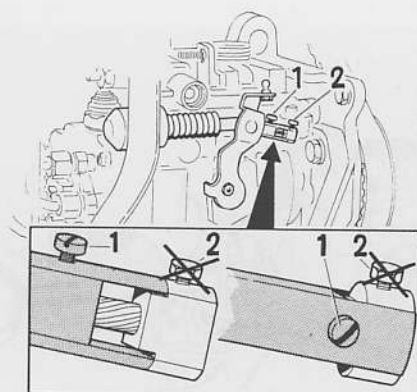
Note! Injection pump must not be tapped or knocked as this will alter its setting.



N23

Remove dial indicator and holder 5194. Install plug with new seal

Tightening torque 9 Nm (6.5 ft lbs).



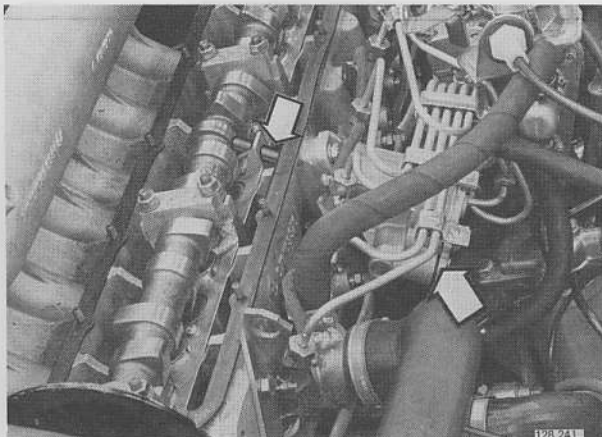
Connected Disconnected

N24

Reconnect cold start device

Press lever forwards and turn sleeve 90°. Retighten screw 1.

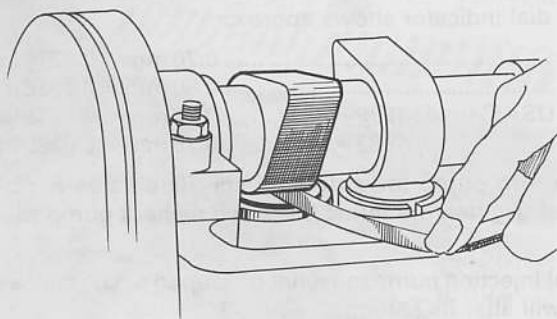
Note! Do not turn screw 2 otherwise it will be necessary to reset cold start device on a test bench.



N25

Install plunger and vacuum pump

Check O-ring, replace if necessary.

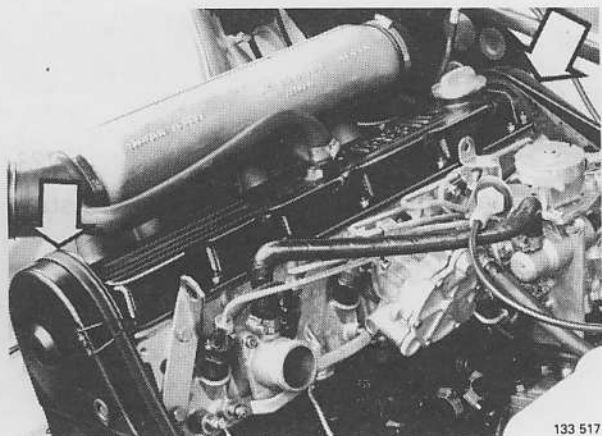


N26

Adjust valve clearance:

See operation B1-11, page 19.

Important! Valve clearance must be checked after 600–1,200 miles (1,000–2,000 km).

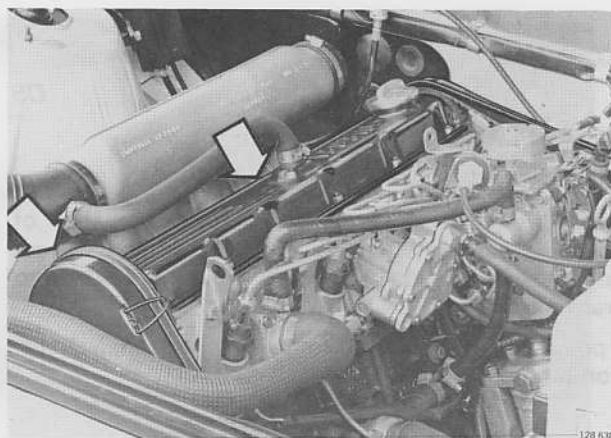


N27

Install timing gear covers (front and rear)

O. Camshaft front seal, replacement

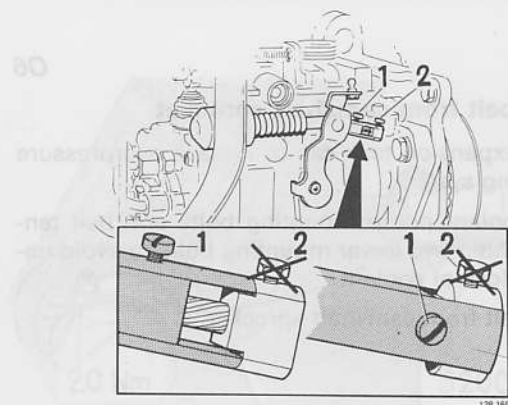
Special tools: 5194, 5197, 5199, 5200



Remove:

- valve cover
- front timing gear cover.

O1



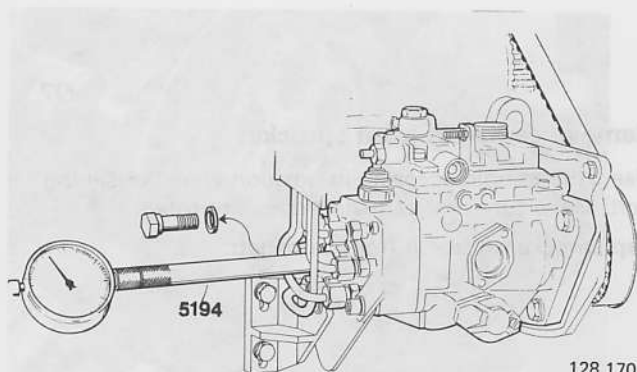
Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2 otherwise it will be necessary to remove cold start device and reset it on a test bench.

Press back lever against stop.

O2



Install dial indicator

Unscrew and remove plug from injection pump distributor.

Install holder 5194 and dial indicator (range 0-3 mm). Set gauge to approx. 2 mm.

O3

04

Turn engine until cyl. 1 is at TDC – injection

Always use the vibration damper center bolt to turn the engine. **27 mm** socket or wrench **5188**.

Both cylinder 1 cams should point obliquely upwards.

Turn engine approx. 1/4 turn clockwise past '0' and then back to '0' again, to obtain slack part of belt on driving side. If this is not done injection pump setting will be incorrect.

05

Set dial indicator zero

Important!

Gauge pointer must not move during installation of new oil seal otherwise it will be necessary to basic-set engine since camshaft will have moved in relation to crankshaft.

If pointer does not move it suffices to check/adjust injection pump setting.

06

Remove belt from camshaft sprocket

Unscrew expansion tank cap to release overpressure from cooling system.

Slacken coolant pump mounting bolts and belt tensioner. Tighten two lower mounting bolts to avoid unnecessary loss of coolant.

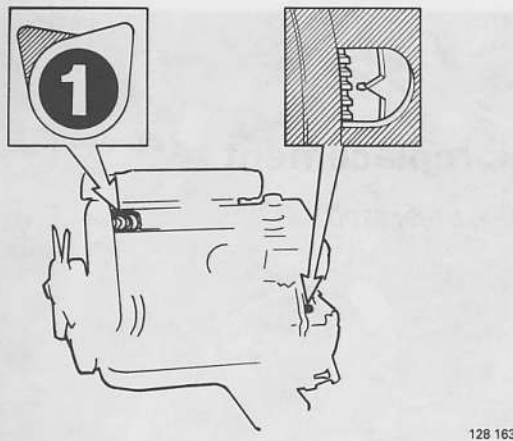
Remove belt from camshaft sprocket.

07

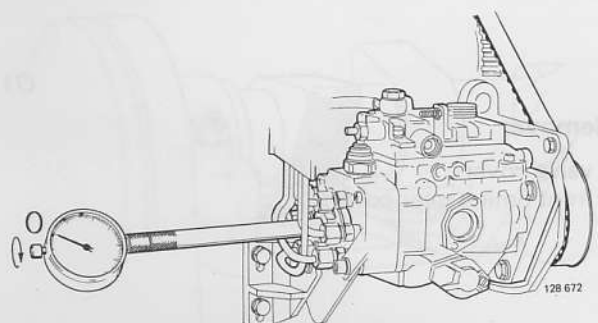
Remove camshaft front sprocket

Use **5199** to hold sprocket in position when loosening bolt. Make sure that camshaft does not rotate.

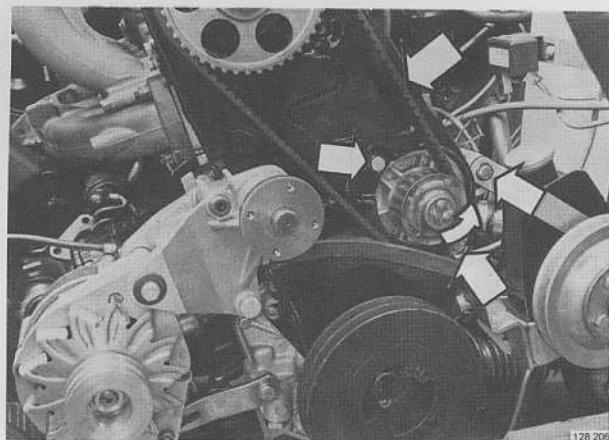
Tap sprocket to free it from camshaft.



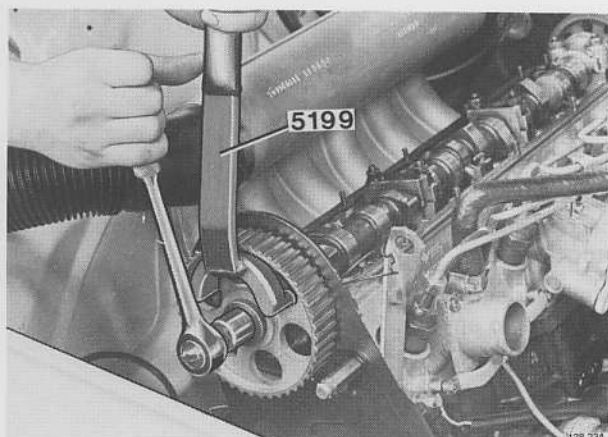
128 163



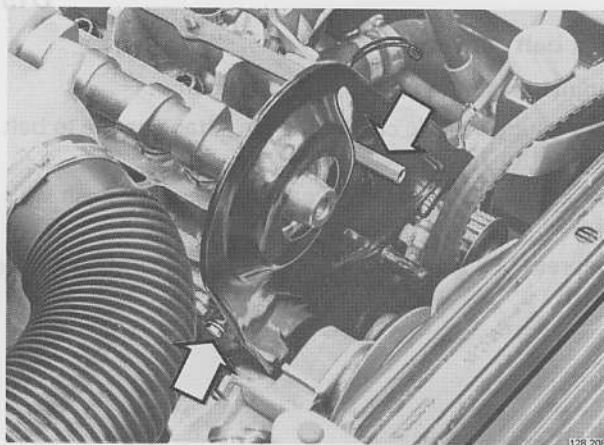
128 672



128 205



128 234



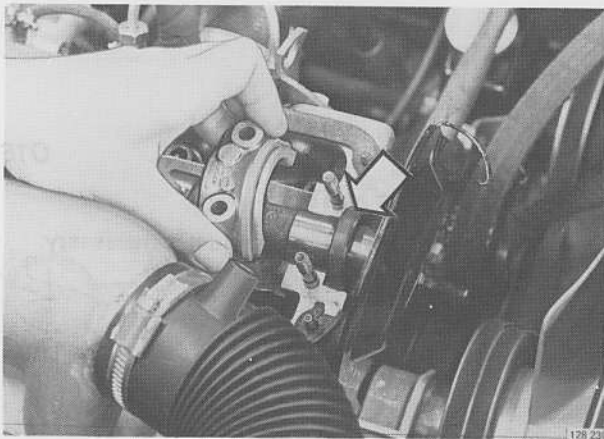
Detach belt shield from cylinder head

Remove two upper retaining bolts.

Bend out shield to free it from camshaft. If necessary slacken coolant pump upper bolt.

Keep shield in outer position with a piece of wood.

08



Remove camshaft cap 1 and oil seal

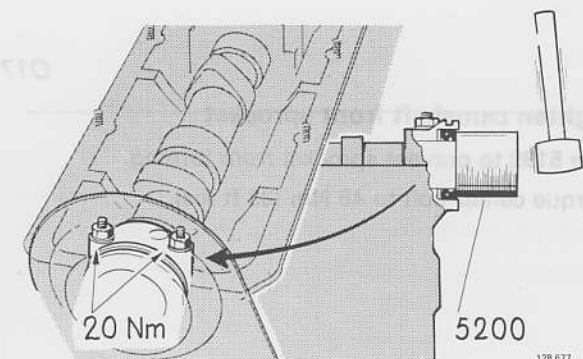
Press in new camshaft oil seal

Oil seal.

Do not push in seal to bottom position. Make sure that seal is "square".

09

010



Install camshaft cap 1

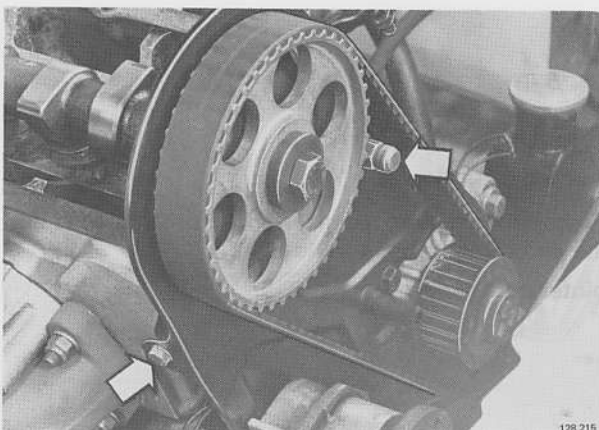
Torque to 20 Nm (15 ft lbs).

011

Press in seal to bottom position

Release cover. Use adapter 5200 to tap in oil seal.

012



Install bolts for belt cover

Install gear belt and camshaft front sprocket

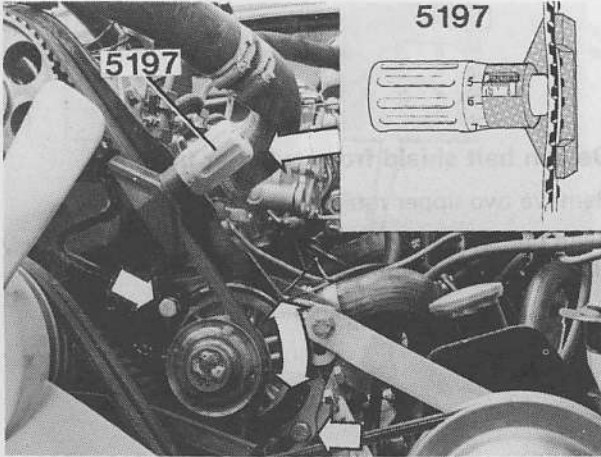
Pull belt to ensure that it is seated correctly on crankshaft gear.

Place belt over camshaft sprocket and install sprocket and belt.

Install center bolt and tighten. It should be possible for sprocket to turn on camshaft without camshaft rotating.

013

014



O15

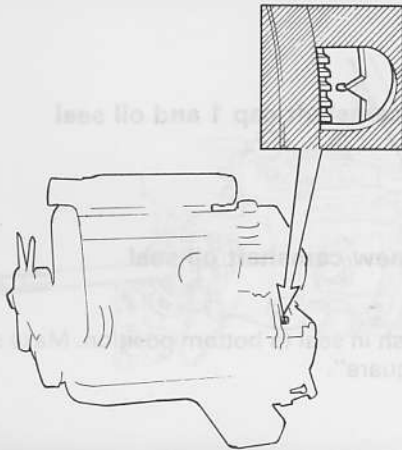
Set belt tension

Adjust tension by moving cooling pump.

Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units.

Stretch belt until mark on gauge plunger is flush with sleeve.

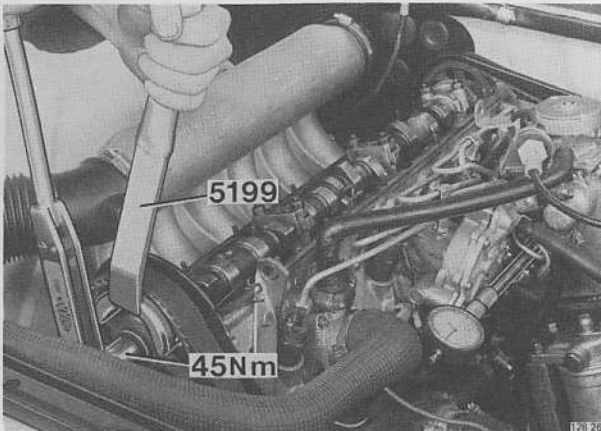
Depress belt strongly with hand and recheck/adjust tension.



O16

Make sure cyl. 1 is at TDC

Check '0' mark on flywheel and adjust if necessary.

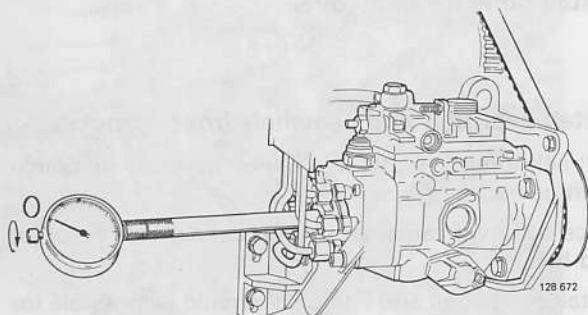


O17

Tighten camshaft front sprocket

Use **5199** to prevent sprocket from turning.

Torque center bolt to **45 Nm** (33 ft lbs).

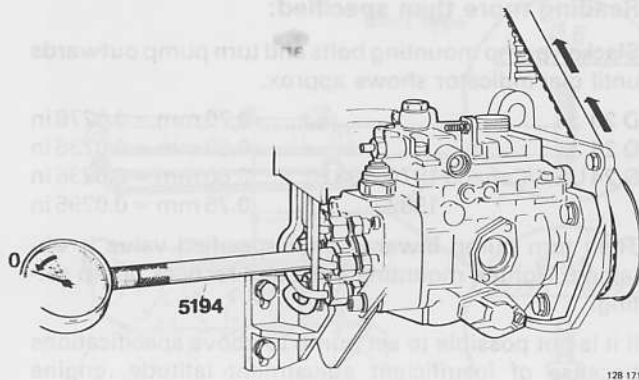


O18

Check dial indicator

If pointer has moved from zero position: basic-set engine according to operations C1-21.

Pointer at zero: Proceed to O19.

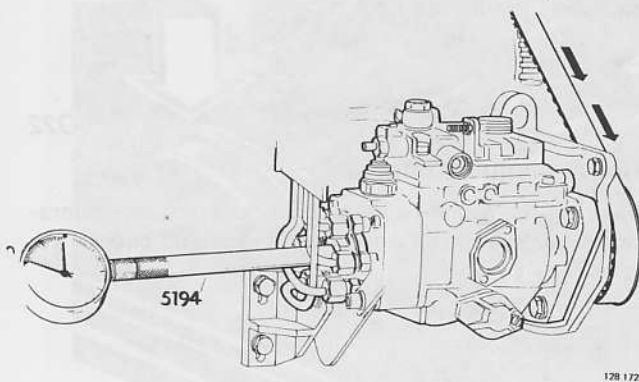


O19

Zero injection pump and dial indicator

Slowly turn engine anticlockwise until min reading is reached on dial indicator.

Set zero.



O20

Check pump setting

Slowly turn engine clockwise until flywheel reaches '0' mark.

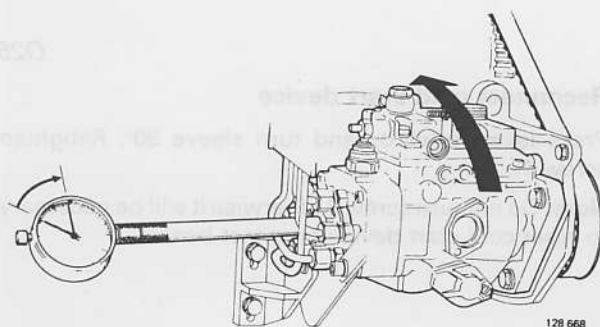
If engine is turned too far it must be turned back approx. 1/4 and then to 'o' mark otherwise setting will be incorrect.

Dial indicator should show:

D 20	0.75–0.83 mm = 0.0295–0.0327 in
D 24	0.65–0.73 mm = 0.0256–0.0287 in
D 24 USA/Canada	
1979–1981	0.65–0.73 mm = 0.0256–0.0287 in
1982–	0.82–0.90 mm = 0.0323–0.0354 in

Correct reading: Tighten injection pump mounting bolts. Proceed to O23.

Incorrect reading: Readjust according to below.



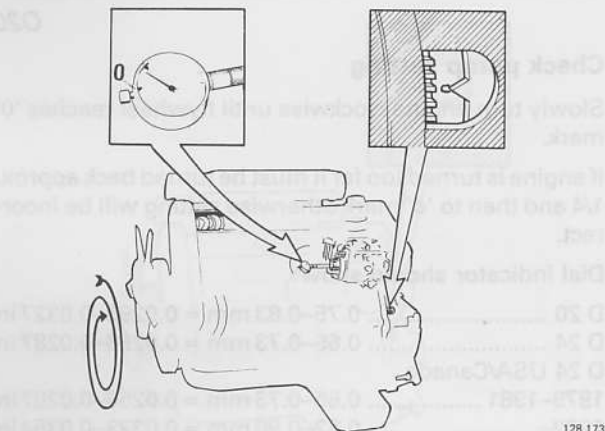
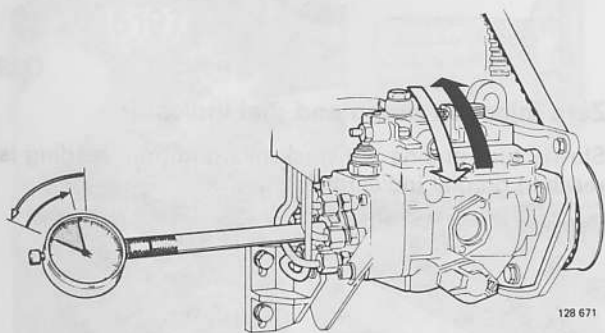
O21

Check/adjust pump setting

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada 1979–1981	0.70 mm = 0.0276 in
1982–	0.85 mm = 0.0335 in

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump setting.



Reading more than specified:

Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows approx.

D 20	0.70 mm = 0.0276 in
D 24	0.60 mm = 0.0236 in
D 24 USA/Canada 1979–1981	0.60 mm = 0.0236 in
1982–	0.75 mm = 0.0295 in

Then turn pump **inwards** until specified value is obtained. Tighten mounting bolts and recheck pump setting.

If it is not possible to set pump to above specifications because of insufficient adjustment latitude, engine must be basic-set again, since camshaft and crankshaft are probably out-of-line.

Note! Injection pump must not be tapped or knocked as this will alter its setting.

O22

Check pump setting

Turn engine round twice and check setting, see operation O20. Readjust if necessary and repeat check.

O23

Remove dial indicator and holder

O24

Install plug with new seal

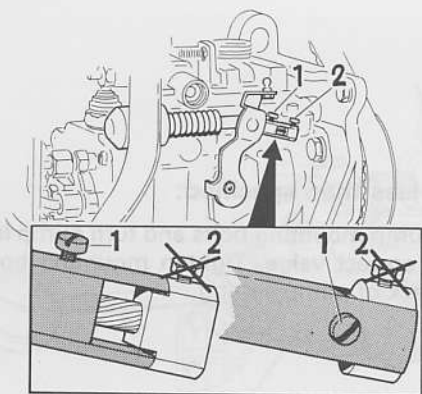
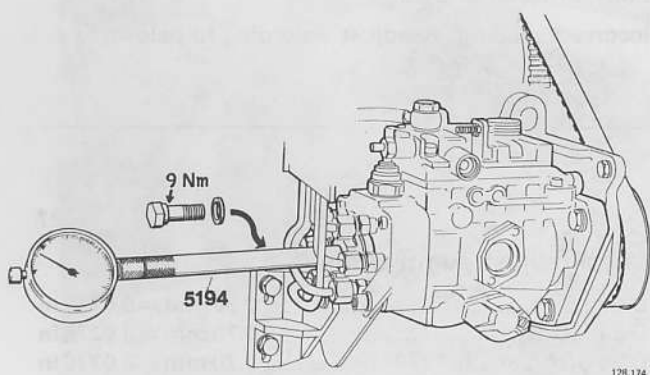
Tightening torque 9 Nm (6.5 ft lbs).

O25

Reconnect cold start device

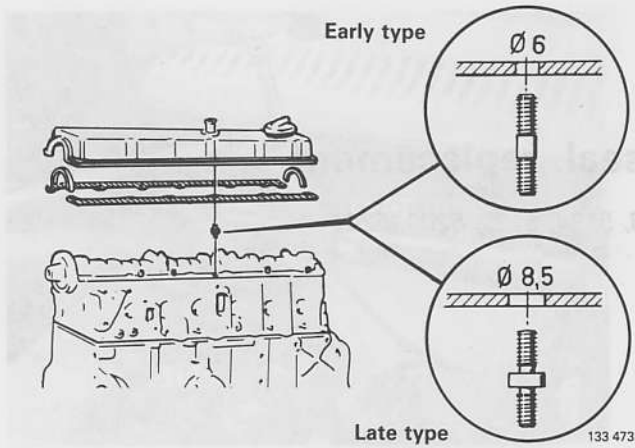
Press lever forwards and turn sleeve 90°. Retighten screw 1.

Note! Do not turn screw 2 otherwise it will be necessary to reset cold start device on a test bench.



Connected

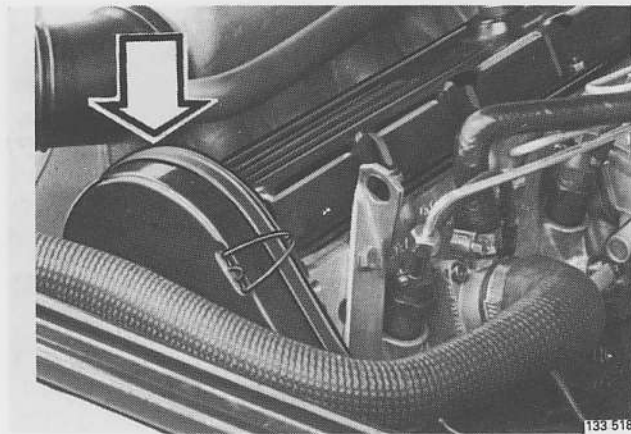
Disconnected



install valve cover

Use new gaskets if necessary.

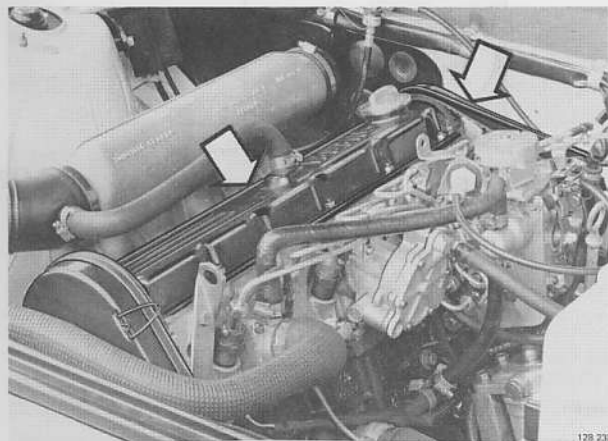
Two types of pin studs are available, see fig. Late types have a spacer, and hole in gasket is larger to prevent damage to gasket by overtightening.
Late and early type parts **must not** be interchanged.



Install front timing gear cover

P. Camshaft rear seal, replacement

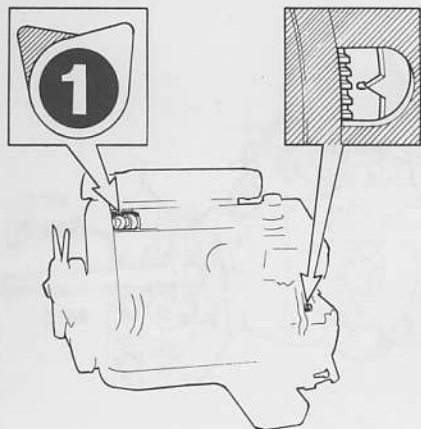
Special tools: 5190, 5193, 5194, 5199, 5200, 5201



Remove:

- valve cover
- rear timing gear cover.

P1



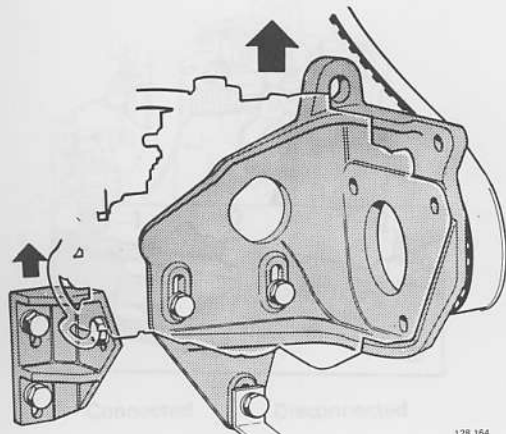
P2

Turn engine until cyl. 1 is at TDC – injection

Always use the vibration damper center bolt to turn the engine.

Use a 27 mm socket.

Both cylinder 1 cams should point obliquely upwards.



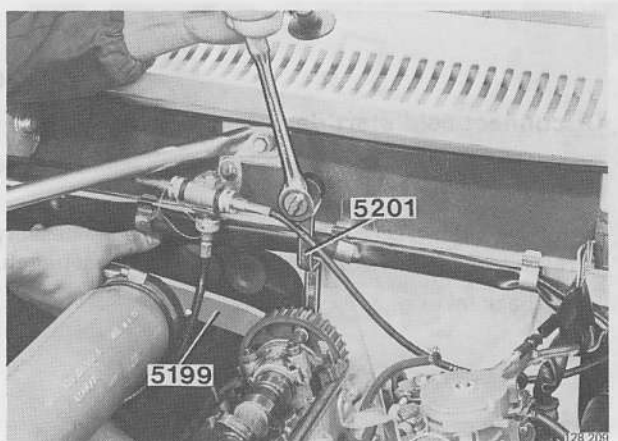
P3

Lift off pump belt

Slacken mounting bolts for injection pump bracket to release belt tension.

Tighten one bolt so that pump remains in upper position.

Lift off belt.

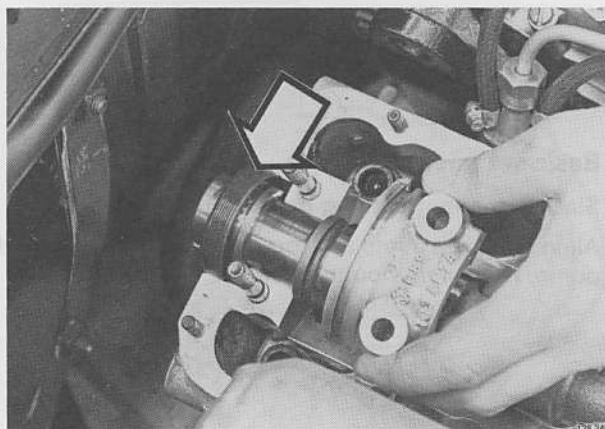


P4

Remove camshaft rear sprocket

Hold sprocket in position with **5199** and unscrew sprocket with wrench **5201**.

Note! Take care not to rotate camshaft.



P5

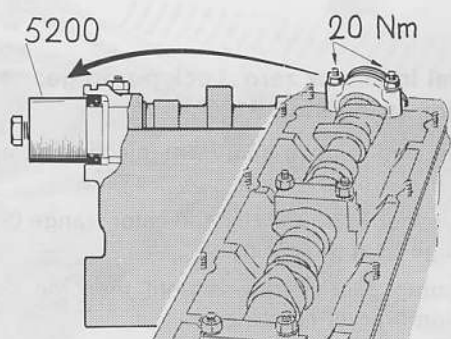
Remove camshaft cap 4 and old oil seal

P6

Press in new oil seal

Oil seal.

Do not push in seal to bottom position. make sure that seal is "square".



P7

Install camshaft caps 1 and 4

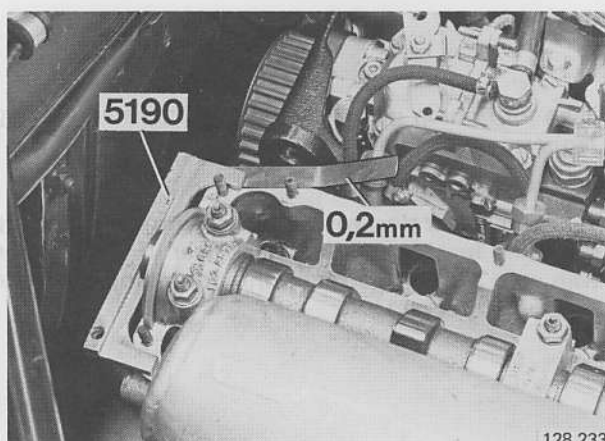
Make sure that thrust washer for camshaft cap 4 sits correctly.

Tightening torque **20 Nm** (15 ft lbs).

P8

Tap in oil seal to bottom

Use adapter **5200** and bolt for rear camshaft sprocket.

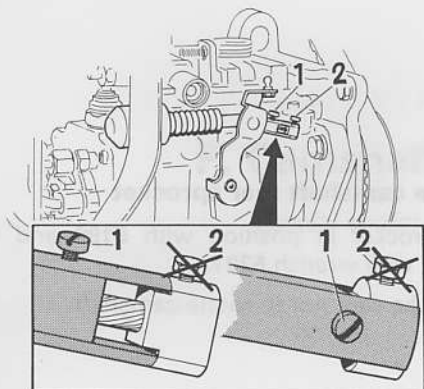


P9

Check camshaft setting

Check with gauge **5190** that camshaft is correctly set in relation to crankshaft.

Gauge should fit in groove in back end of crankshaft. If not, engine must be basic-set according to operations C1-21.



Connected

Disconnected

128 169

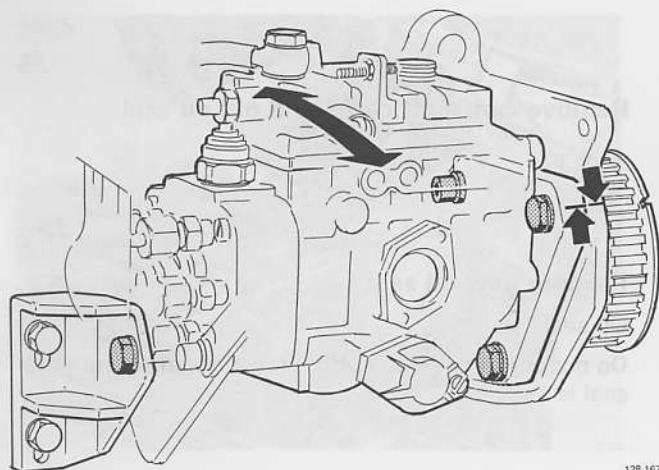
P10

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2 otherwise it will be necessary to remove cold start device and reset it on a test bench.

Press back lever against stop.



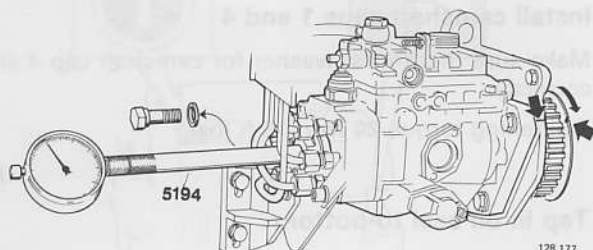
128 167

P11

Basic-set injection pump

Slacken pump mounting bolts (Allen key = 6 mm).

Align marks on pump and mounting bracket by turning pump. Retighten mounting bolts.



128 177

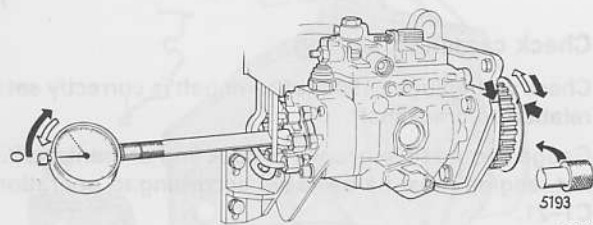
P12

Set dial indicator zero. Lock pump gear at cyl. 1 injection using stop 5193

Unscrew and remove plug from injection pump distributor.

Install holder 5194 and dial indicator (range 0–3 mm). Set gauge to approx. 2 mm.

Turn pump gear clockwise until mark on gear and mounting bracket coincide.

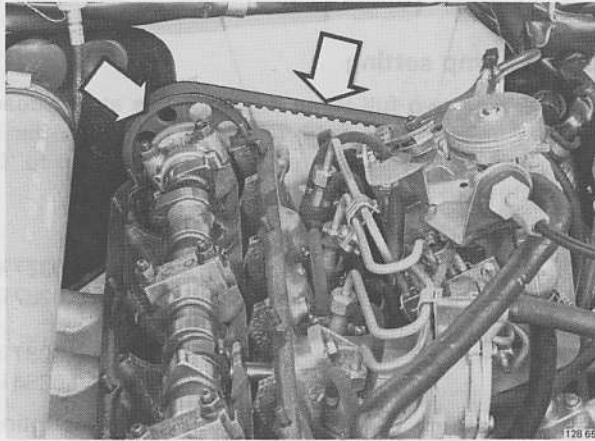


128 670

Then turn pump gear back slightly until min reading registers on dial indicator.

Set indicator to zero.

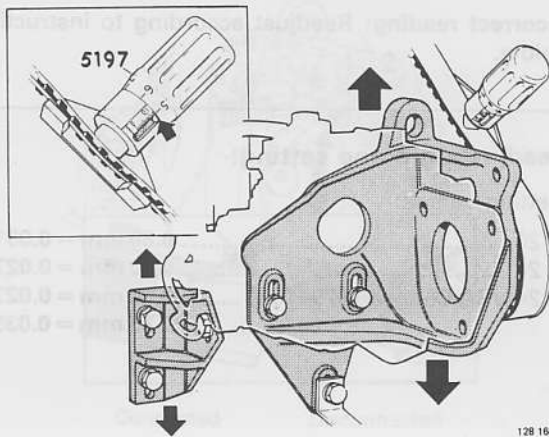
Turn pump gear clockwise until mark on gear and pump mounting bracket coincide. Lock gear in this position with stop 5193. (Insert stop through pump gear into mounting bracket.)



P13

Install camshaft rear sprocket and belt

Tighten center bolt by hand, it should be possible to turn sprocket on camshaft.



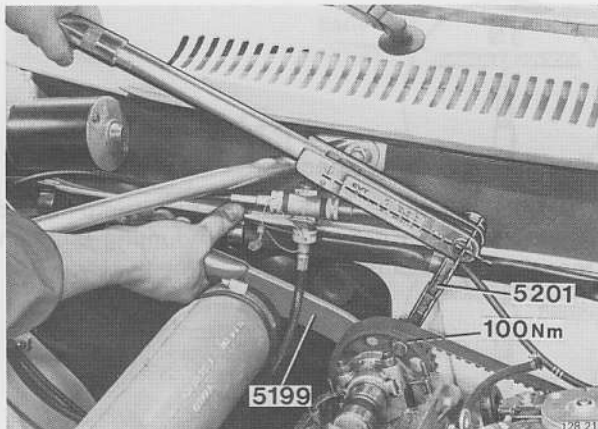
P14

Set belt tension

Adjust tension by moving pump.

Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units. Stretch belt until mark on gauge plunger is flush with sleeve.

Depress belt strongly with hand and recheck/adjust tension.



P15

Set pump and tighten camshaft rear sprocket

Use **5199** to hold sprocket. Torque wrench should be at right angles to wrench **5201** otherwise torque will be incorrect.

Using **5199**, turn sprocket slowly until dial indicator shows:

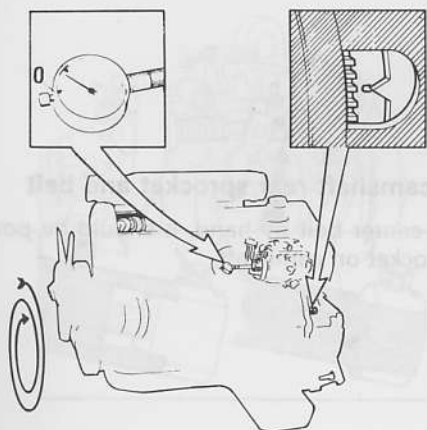
D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada 1979–1981	0.70 mm = 0.0276 in
1982–	0.85 mm = 0.0335 in

Hold sprocket in this position and torque to **100 Nm** (73 ft lbs). Take care that camshaft and sprocket do not move.

P16

Remove stop 5193 from pump gear

P17



128 173

Check pump setting

Turn engine two full turns until cyl. 1 is at top dead center – injection, again. If engine is turned too far it must be turned back approx. 1/4 turn and then to '0' mark otherwise setting will be incorrect.

Dial indicator should show:

D 20	0.75–0.83 mm = 0.0295–0.0327 in
D 24	0.65–0.73 mm = 0.0256–0.0287 in
D 24 USA/Canada	
1979–1981	0.65–0.73 mm = 0.0256–0.0287 in
1982–	0.82–0.90 mm = 0.0323–0.0354 in

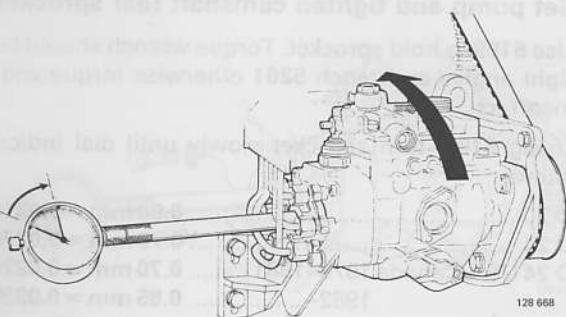
Correct reading: Tighten injection pump mounting bolts. Proceed to P18.

Incorrect reading: Readjust according to instructions below.

Readjusting pump setting:

Setting values:

D 20	0.80 mm = 0.0315 in
D 24	0.70 mm = 0.0276 in
D 24 USA/Canada 1979–1981	0.70 mm = 0.0276 in
1982–	0.85 mm = 0.035 in



128 668

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump setting.

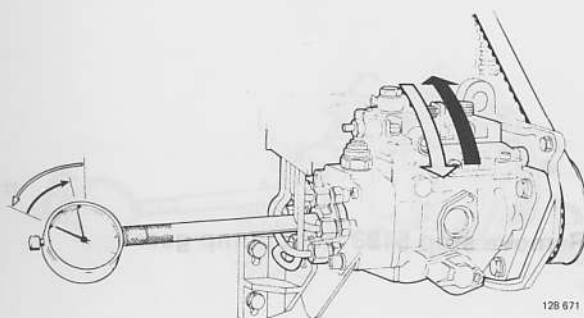
Reading more than specified:

Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows approx.

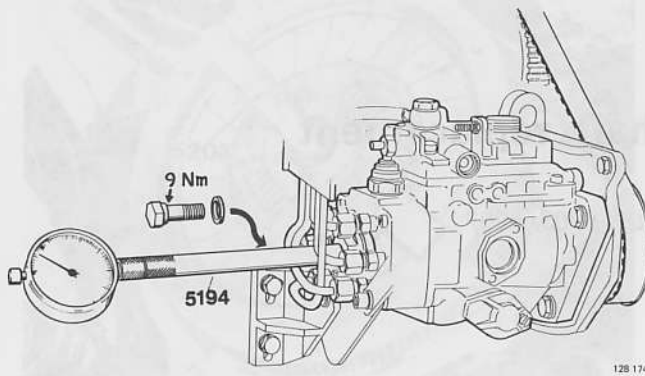
D 20	0.70 mm = 0.0276 in
D 24	0.60 mm = 0.0236 in
D 24 USA/Canada 1979–1981	0.60 mm = 0.0236 in
1982–	0.75 mm = 0.0295 in

Then turn pump **inwards** until specified value is obtained. Tighten mounting bolts and recheck pump setting.

Note! Injection pump must not be tapped or knocked as this will alter its setting.

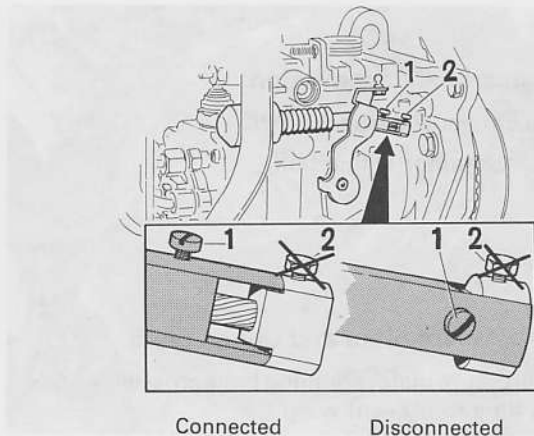


128 671



P18
Remove dial indicator and holder 5194. Install plug with new seal

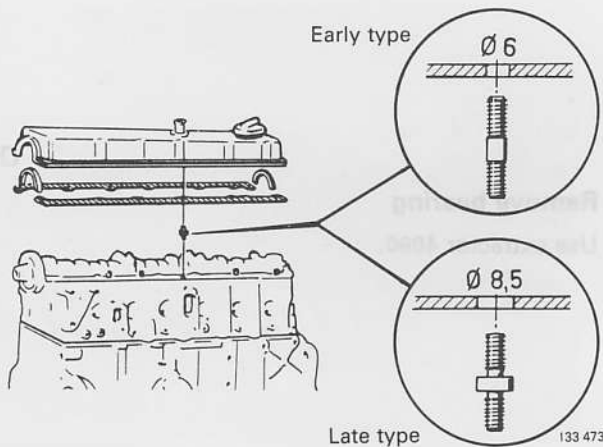
Tightening torque 9 Nm (6.5 ft lbs).



P19
Reconnect cold start device

Press lever forwards and turn sleeve 90°. Retighten screw 1.

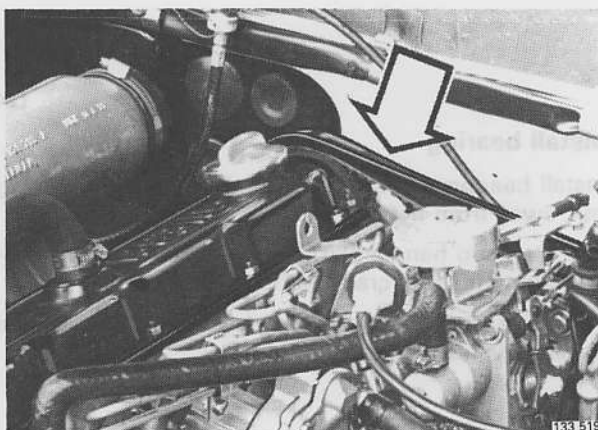
Note! Do not turn screw 2 otherwise it will be necessary to reset cold start device on a test bench.



P20
Install valve cover

Use new gaskets if necessary.

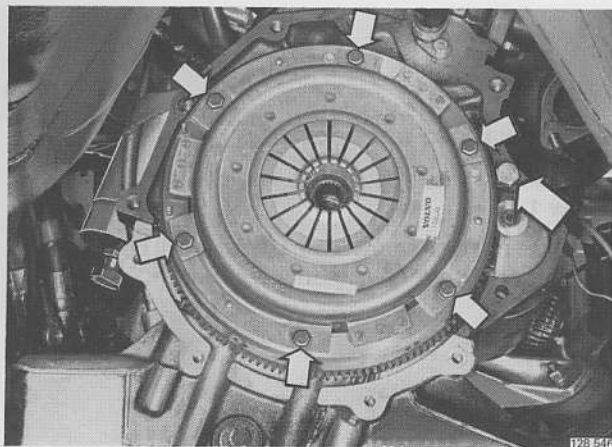
Two types of pin studs are available, see fig. Late types have a spacer, and hole in gasket is larger to prevent damage to gasket by overtightening. Late and early type parts **must not** be interchanged.



P21
Install rear timing gear cover

Q. Pilot bearing in crankshaft, replacement

Special tools: 1801, 4090, 5203, 5207



Remove gearbox/transmission

See Service manual section 4 (43).

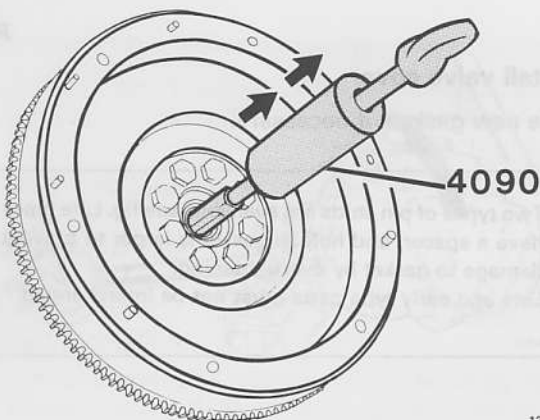
Secure starter motor with a bolt.

Q1

Remove pressure plate and driven plate

Unscrew pressure plate mounting bolts crosswise a few turns at a time to prevent warp.

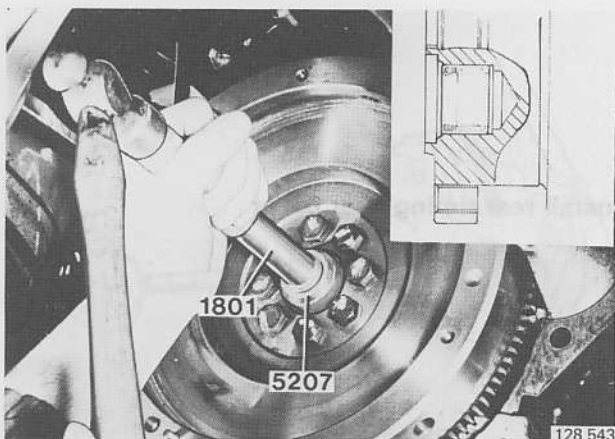
Q2



Remove bearing

Use extractor 4090.

Q3



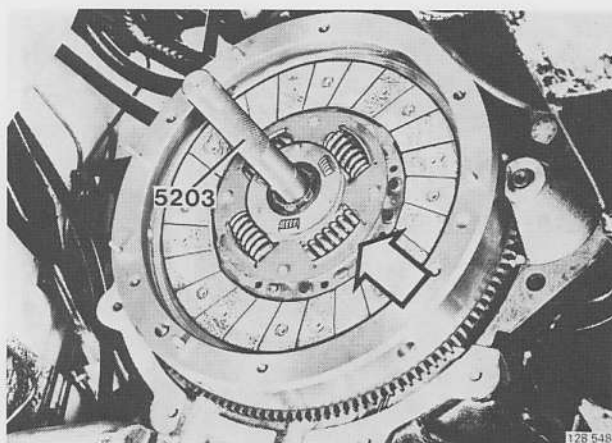
Install bearing

Install bearing and seal with text on outer ring facing out, away from flywheel.

Use standard handle 1801 and drift 5207 to tap in bearing until it abuts crankshaft.

Press in a small amount of grease (1.3–1.5 gram) in the space beyond the bearing.

Q4

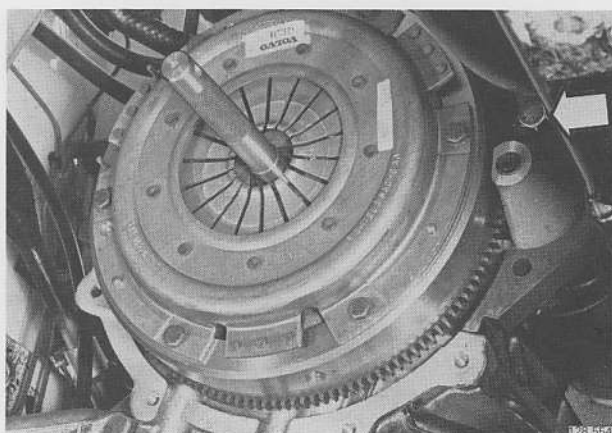


Q5

Install driven plate

Use centering shaft 5203.

Turn driven plate with hub facing out, away from fly-wheel.



Q6

Install pressure plate

Tighten bolts crosswise a few turns at a time to avoid warp.

Q7

Install gearbox

Do not forget to remove bolts securing starter motor.

R. Crankshaft front seal, replacement

Special tools: 5187, 5188, 5197, 5200, 5205



Disconnect battery

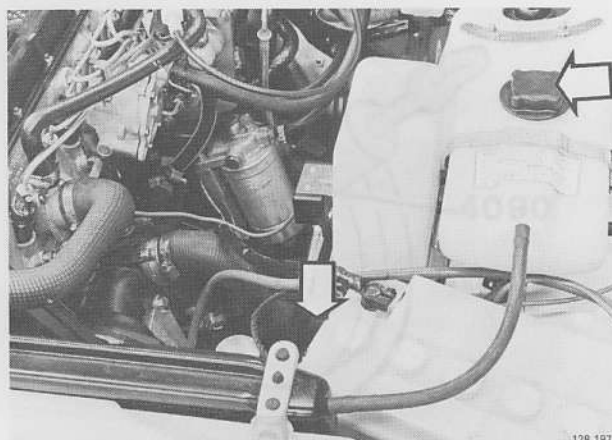
R1

Jack-up vehicle

To prevent spillages when coolant is drained, raise vehicle at front right jacking point. Coolant will then run along splashguard into drip pan.

Place drip pan beneath left steering rod.

R2



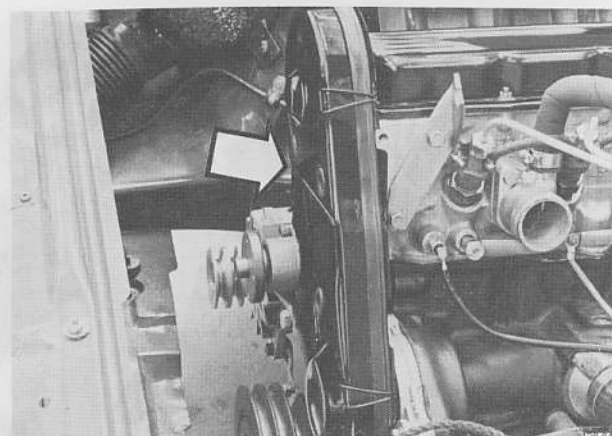
Drain coolant

R3

Unscrew expansion tank cap.

Disconnect lower radiator hose from radiator and drain coolant. (Engine is without drain taps).

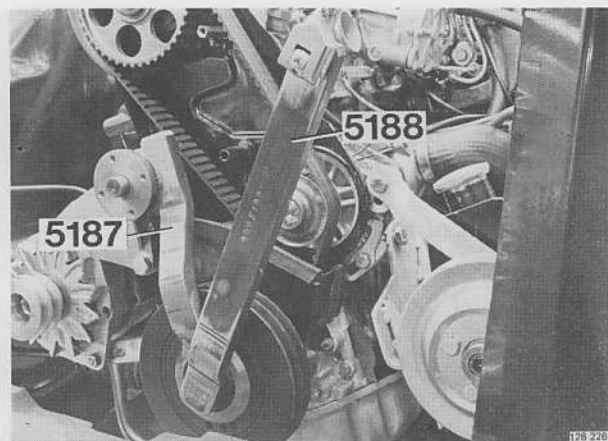
Lower vehicle.



Remove:

- radiator
- cooling fan with spacer and pulley
- fan belts and power steering pump belt
- front timing gear cover.

R4

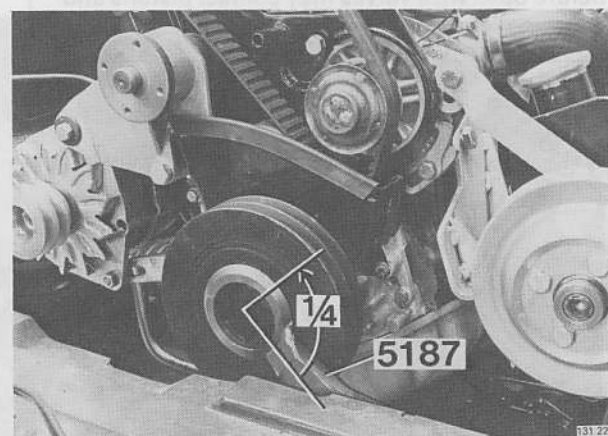


R5

Remove vibration damper center bolt

Use **5187** to prevent pulley from rotating, and socket **5188** to unscrew bolt.

It may be necessary to turn engine slightly so that **5187** rests on fan bearing.

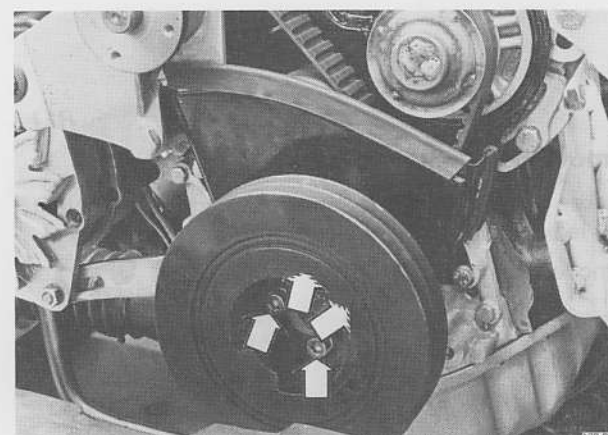


R6

Turn engine approx. 1/4 turn anticlockwise

Use wrench **5187**.

By turning engine anticlockwise, slack in belt will move to driving side, making it easier to remove and install belt.



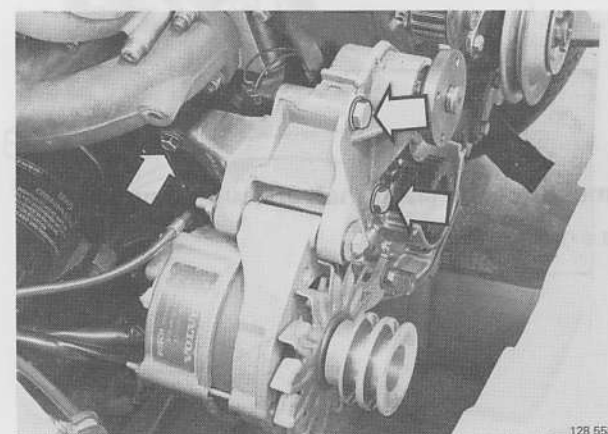
R7

Remove vibration damper

Remove four in-hex bolts (6 mm).

Pull off vibration damper. **Note!** Crankshaft gear may sometimes stick to vibration damper.

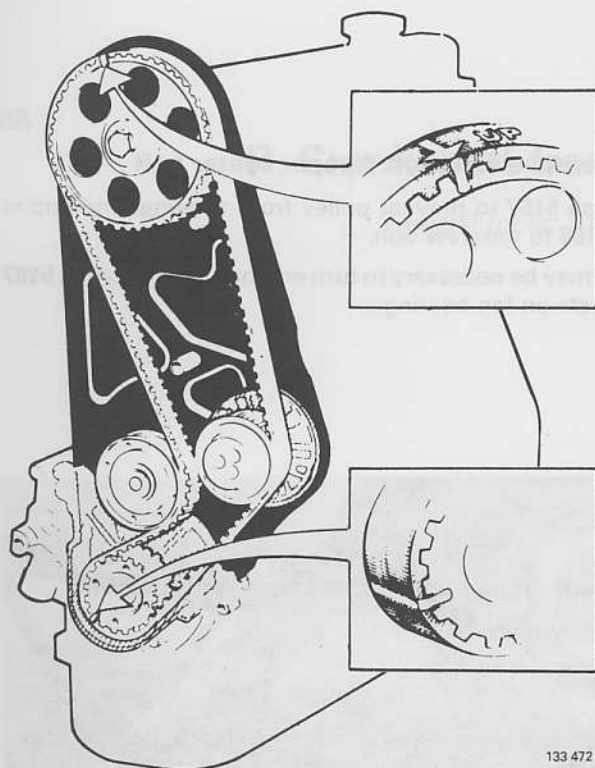
R8

Remove lower timing gear cover

R9

Detach cooling fan mounting bracket and alternator and place on one side

Remove mounting bolts (arrowed) and press bracket outward.



R10

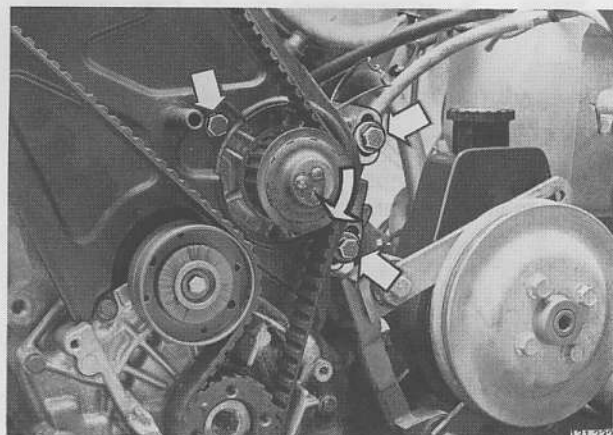
Mark position of timing gear belt

Mark belt, camshaft sprocket and crankshaft gear. Mark in front of a cog.

Also identify outside and topside of gear belt.

Important

Belt must be fitted in **exactly** same position as before otherwise valves may contact pistons and cause serious damage.

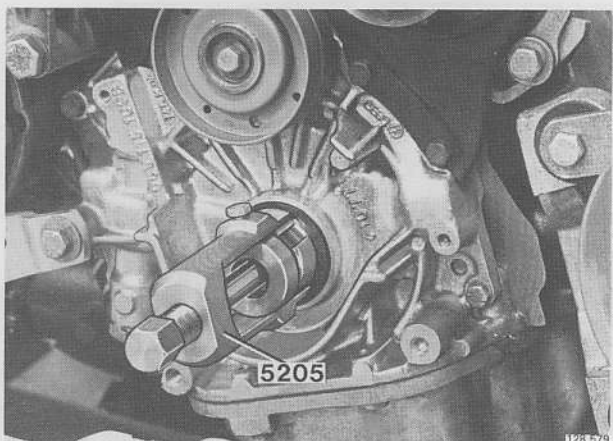


R11

Remove gear belt

Slacken coolant pump mounting bolts and belt. Coolant may leak when bolts are slackened.

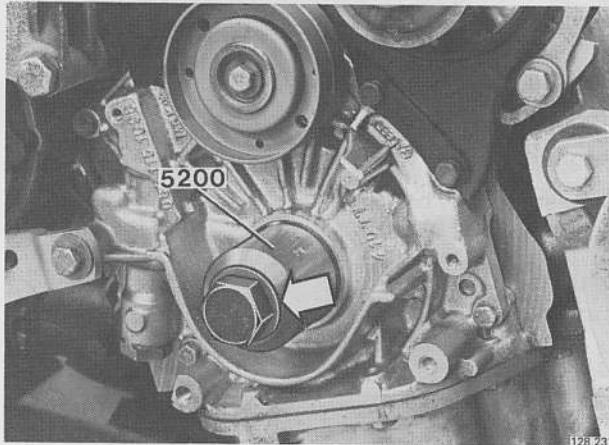
Remove belt.



R12

Remove gear on crankshaft and withdraw oil seal

Use extractor 5205.



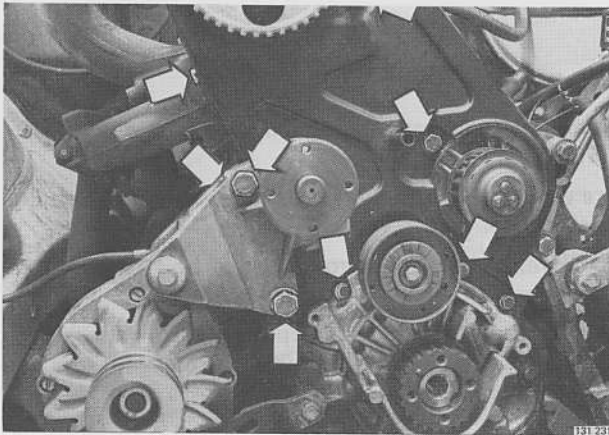
R13

Install new oil seal and gear on crankshaft

Pack space between sealing lips with grease.

Press in new seal. Use adapter **5200**, vibration damper center bolt and a thick washer.

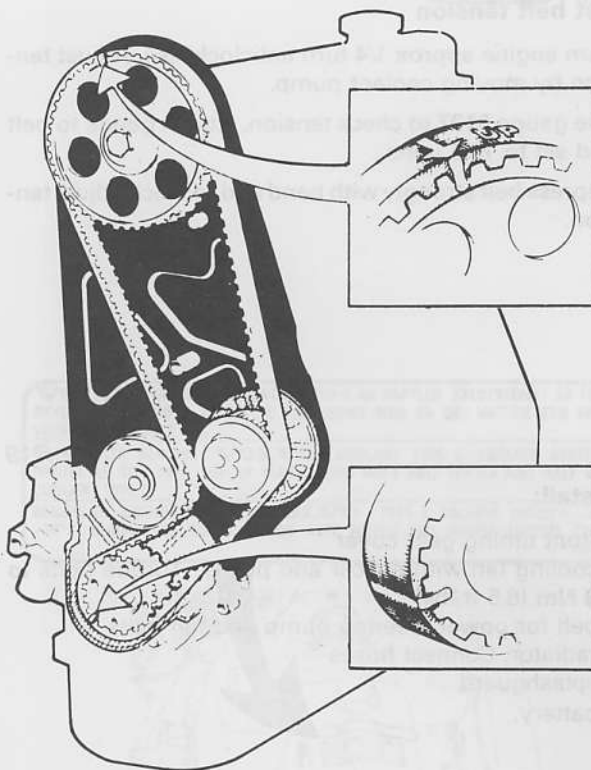
Install gear on crankshaft.



R14

Install:

- retaining bolts for cover
- mounting bracket for cooling fan/alternator.



R15

Install camshaft gear belt

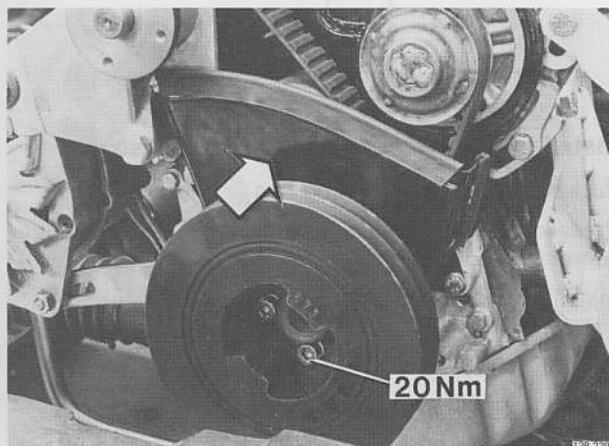
Make sure that belt is fitted in **exactly same position as before**.

Align identification marks on belt, camshaft sprocket and crankshaft gear.

It is extremely important that belt is fitted in exactly same position as before.

Tension belt by moving coolant pump (by hand).

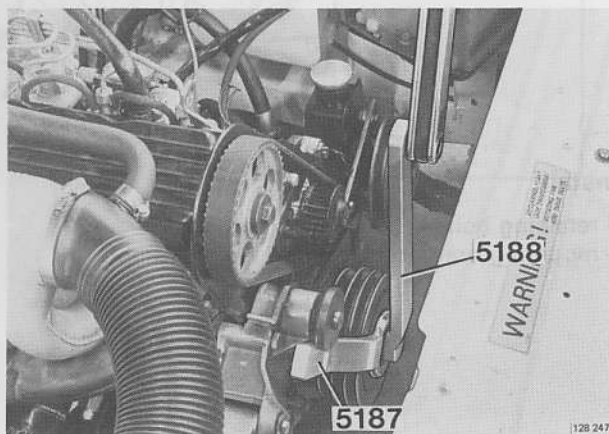
Tighten pump mounting bolts.



R16 Install lower timing gear cover and vibration damper

Damper can only be fitted in one way. Pin on crankshaft gear must fit in vibration damper.

Torque inhex bolts to **20 Nm** (15 ft lbs).



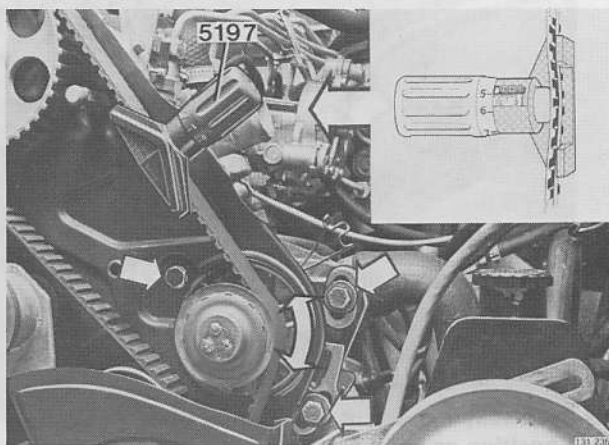
R17 Install center bolt

Smear threads and mating surface with sealer P/N 277961-9.

Use wrench **5187** (rest on cooling fan bearing) to hold vibration damper.

Use wrench **5188** to torque center bolt to 350 Nm (255 ft lbs).

Important: Torque 350 Nm applies only if wrench 5188 is used. Also torque wrench must be in line with wrench 5188.

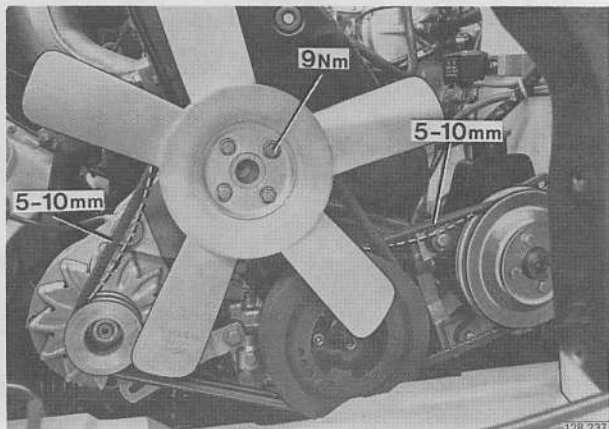


R18 Set belt tension

Turn engine approx 1/4 turn anticlockwise. Adjust tension by moving coolant pump.

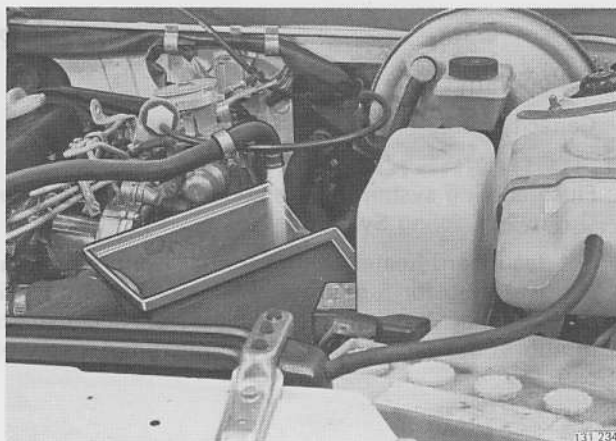
Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units.

Depress belt strongly with hand and recheck/adjust tension.



R19 Install:

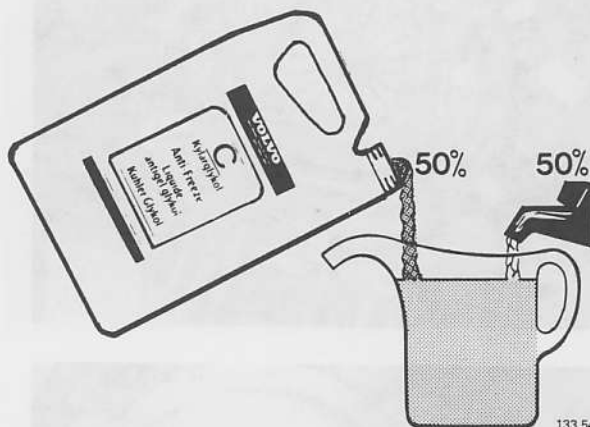
- front timing gear cover
- cooling fan with spacer and pulley: Torque bolts to **9 Nm** (6.5 ft lbs)
- belt for power steering pump and fan belts
- radiator. Connect hoses
- splashguard
- battery.



R20

Bleeding of cooling system

Disconnect upper hose from cold start device. Place drip pan beneath hose and hold hose level with top edge of expansion tank.



133 542

Coolant

Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage.

Use genuine Volvo blue-green coolant type C, diluted with clean water in proportions of 50/50.

This mixture helps to prevent corrosion and frost damage.

Never fill the cooling system with water alone.

The coolant should be changed regularly since the corrosion protective additives in the coolant lose their effect in time.

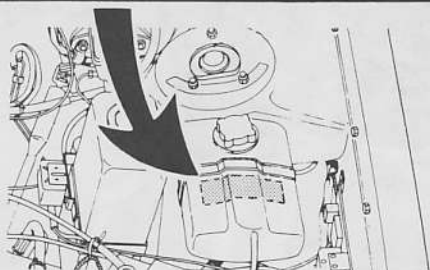
Note! Do not run engine when level of coolant is low, since high local temperatures can result which may cause the cylinder head to crack.

VOLVO ORIGINAL KYLVATSKA TYP C ÄR PÅFYLLED. KYLSYSTEMET ÄR FROST-SKYDDAT TILL -30°C. EFTERFYLL ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVATSKA TYP C.

FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

REPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

1297524



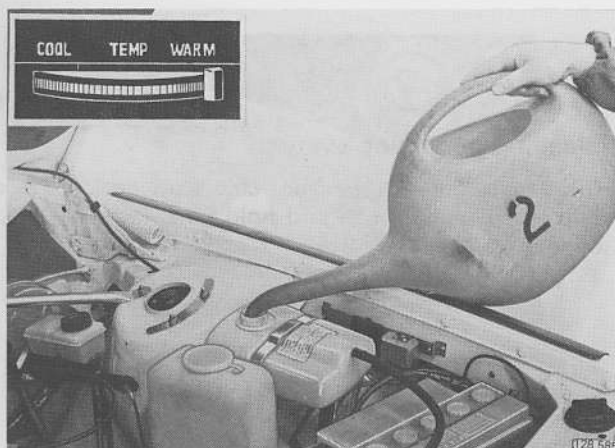
133 477

Replacing coolant

Always use **type C** blue-green coolant. Remember to replace decal (P/N 1331473-7) on expansion tank if necessary.

Type C blue-green coolant

All diesel and petrol (gasoline) engines manufactured since 1982 are filled with type C coolant.



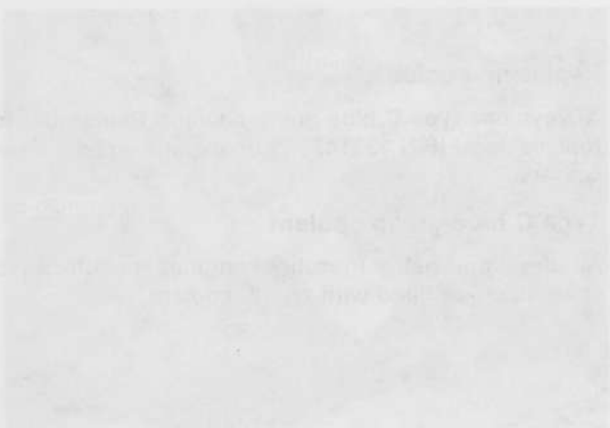
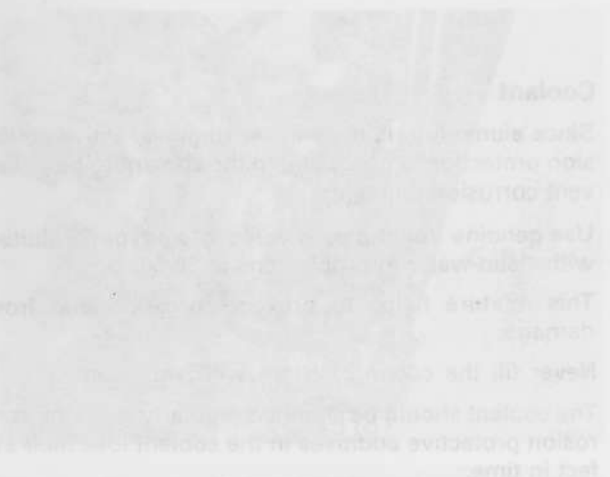
R21

Fill coolant

Capacity: D 20 = 8.1 liters (8.6 US quarts)
D 24 = 9.1 liters (9.8 US quarts)

Flush cooling system before adding new coolant, see Group 26 Cooling System.

Set dashboard heater control to max. Turn on engine and warm-up for 5 minutes. Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap.



Install water filter

Remove the old water filter and install the new one. The new filter is located in the engine compartment.

Use wrench 5187 to remove the old water filter. The new filter is located in the engine compartment.

Use wrench 5187 to install the new water filter. The new filter is located in the engine compartment.

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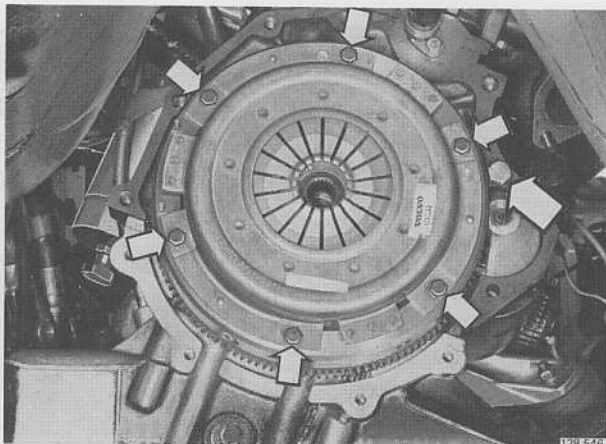
Use wrench 5187 to install the new water filter. The new filter is located in the engine compartment.

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S. Crankshaft rear seal, replacement

Special tools: 1801, 5112, 5203, 5208



Remove gearbox/transmission

See Service manual section 4 (43).

Secure starter motor with a bolt.

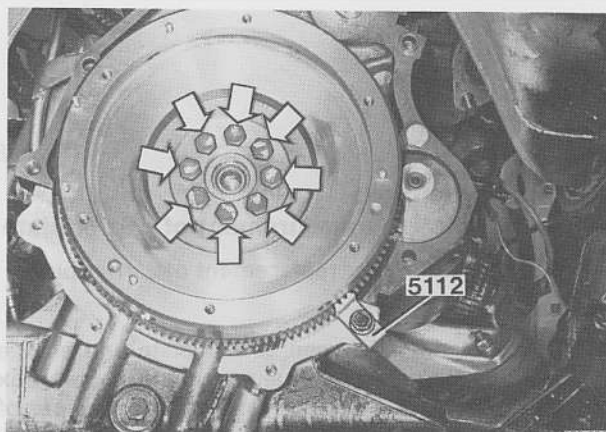
S1

Manual gearbox:

S2

Remove pressure plate and driven plate

Unscrew pressure plate mounting bolts crosswise a few turns at a time to prevent warp.



Manual gearbox:

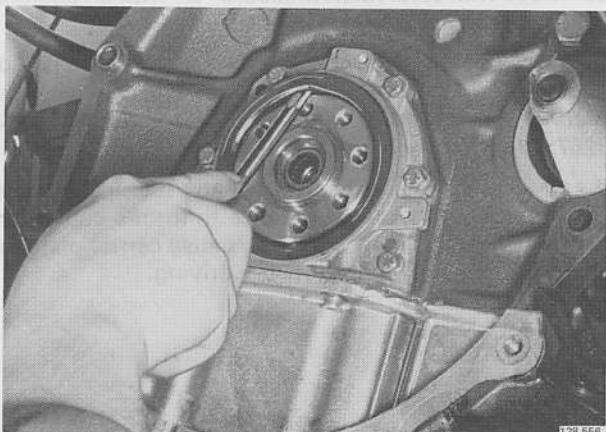
S3

Remove flywheel

Automatic gearbox:

Remove carrier plate

Use locking sector 5112 to prevent flywheel from moving.



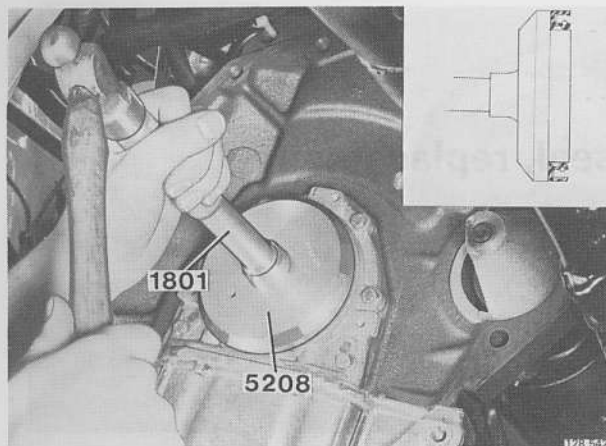
Remove crankshaft rear oil seal

Lift out oil seal with a screwdriver as indicated.

S4

Clean and inspect sealing surfaces.

S5



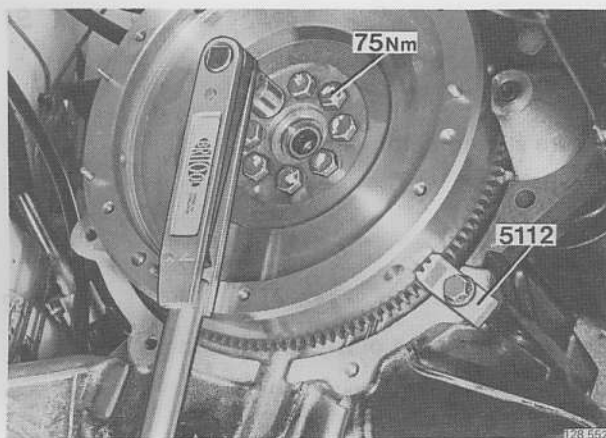
S6

Install new oil seal

Assemble standard handle **1801** and drift **5208**.

Smear oil onto sealing surfaces and lips on seal.

Place seal on drift and tap in until drift abuts crankshaft.



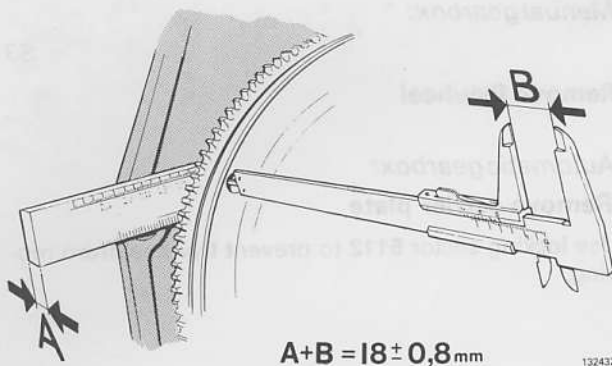
S7

Install flywheel/carrier plate

Flywheel (manual) and carrier plate (auto) can only be fitted in one way.

Use new bolts, smeared with sealer P/N 277961-9.

Torque bolts to **75 Nm** (55 ft lbs). Use locking sector **5112** to hold flywheel in position.



S8

Automatic gearbox:

Check installation measurement of carrier plate

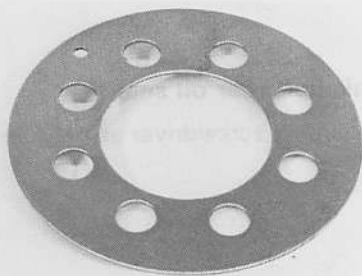
(To be carried out after replacement of carrier plate.)

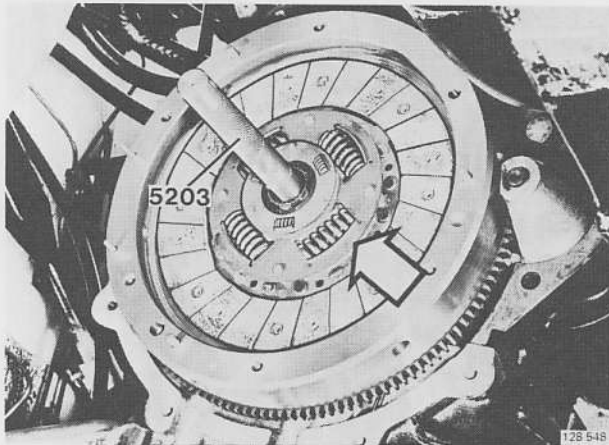
To measure

Place a steel ruler between carrier plate and engine block. Ruler should rest against engine to gearbox mounting flange and should rest against both sides of flange. Turn crankshaft until one of holes in carrier plate coincides with steel ruler. Measure "B" with an outside caliper equipped for depth measurement.

Measured value "B" + thickness of steel ruler should equal 17.2–18.8 mm = 0.667–0.740 in. If distance is less than 17.2 mm = 0.677 in use a spacer washer (P/N 1257377-0) between crankshaft and carrier plate.

If carrier plate is installed incorrectly (i.e. installation measurement is wrong), distance to torque converter carrier will be too long. This may cause carrier plate to crack and possibly a noise when driving.





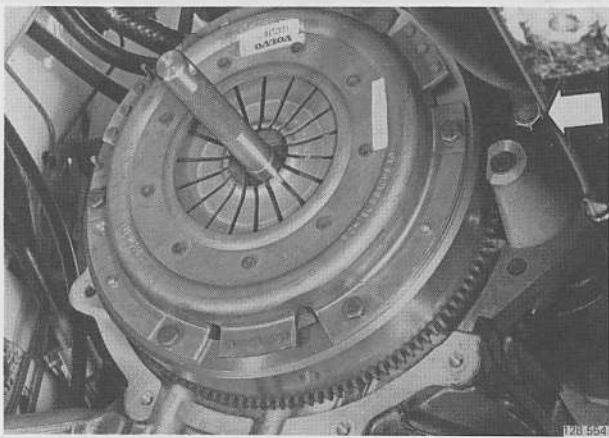
Manual gearbox:

S9

Install driven plate

Use centering shaft **5203**.

Turn disc with hub facing out, away from flywheel.



Manual gearbox

S10

Install pressure plate

Tighten bolts crosswise a few turns at a time to avoid warp.

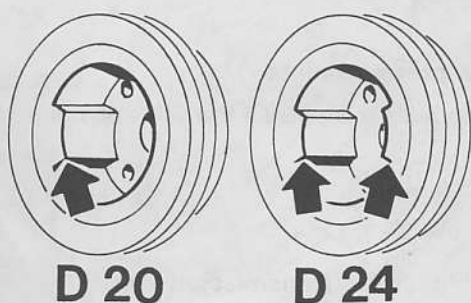
S11

Install gearbox/transmission

Do not forget to remove bolt securing starter motor.

T. Vibration damper, removing/installing

Special tools: 5187, 5188



Note! Different vibration dampers for D 20 and D 24 engines.



Disconnect battery

T1

Jack-up vehicle

T2

To prevent spillages when coolant is drained, raise vehicle at front right jacking point. Coolant will then run along splashguard into drip pan.

Place drip pan beneath left steering rod.

Drain coolant

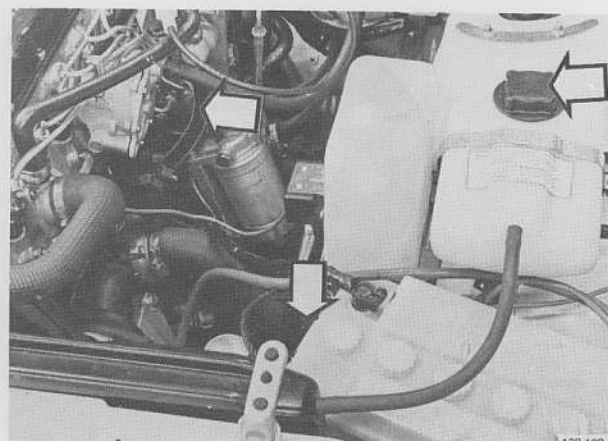
T3

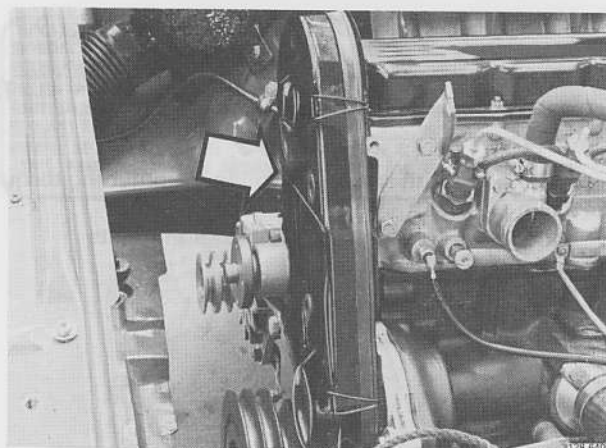
Unscrew expansion tank cap.

Disconnect lower radiator hose from radiator and drain coolant.

(Engine is without drain taps).

Lower vehicle.

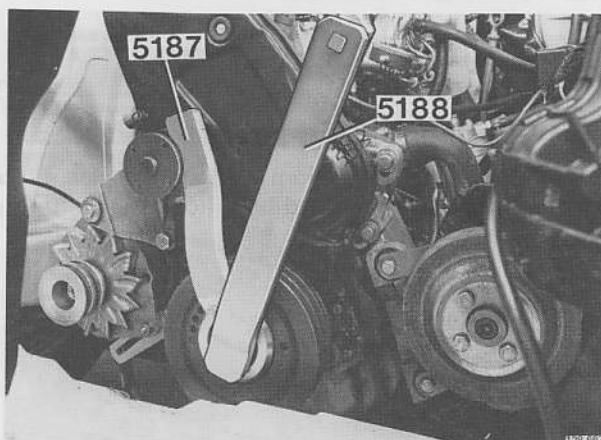




T4

Disconnect:

- radiator
- cooling fan with spacer and pulley
- fan belt and power steering pump belt.



T5

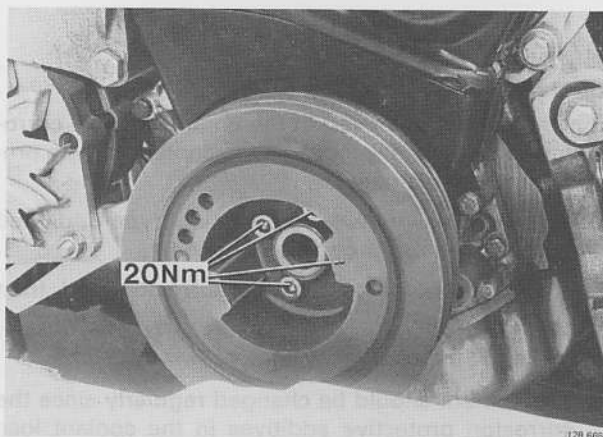
Remove vibration damper

Remove center bolt. Use **5187** to prevent pulley from rotating, and socket **5188** to unscrew bolts.

It may be necessary to turn engine slightly so that **5187** rests on fan bearing.

Remove four inhex bolts (6 mm).

Pull off vibration damper. **Note!** Crankshaft gear may sometimes stick to vibration damper.

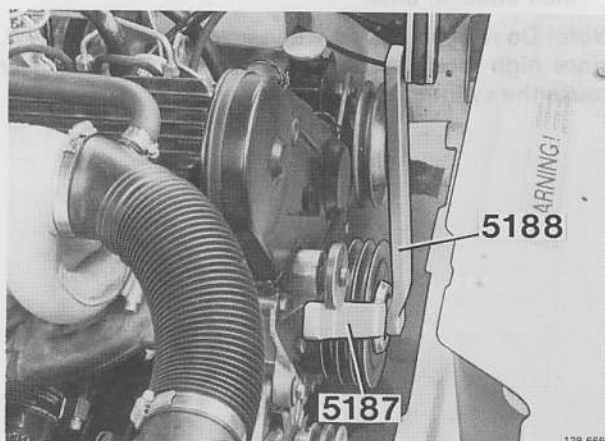


T6

Install vibration damper

Damper can only be fitted in one way. Pin on crankshaft gear must fit in vibration damper.

Torque bolts to **20 Nm** (15 ft lbs).



T7

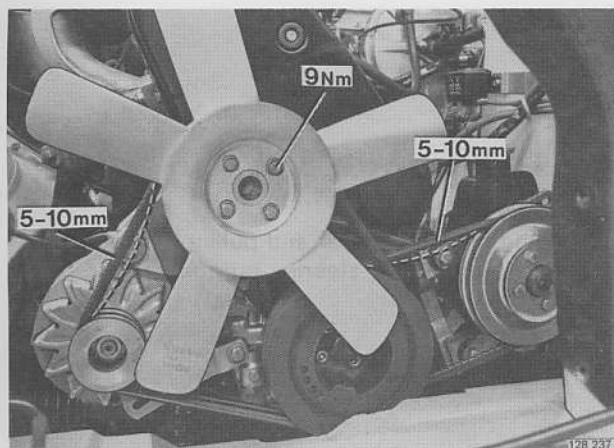
Install center bolt

Smear threads and mating surface with sealer P/N 277961-9.

Use wrench **5187** (rest on cooling fan bearing) to hold vibration damper.

Use wrench **5188** to torque center bolt to **350 Nm** (255 ft lbs).

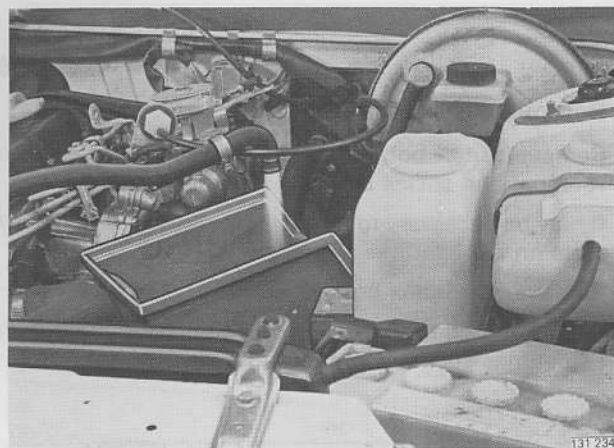
Important: Torque 350 Nm applies only if wrench 5188 is used. Also torque wrench must be in line with wrench 5188.



T8

Install:

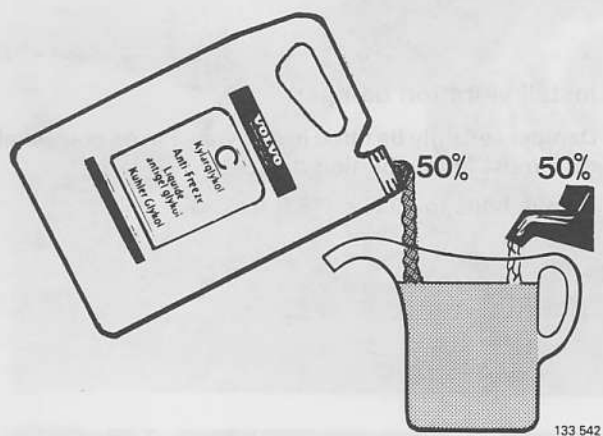
- cooling fan with spacer and pulley. Tightening torque **9 Nm** (7 ft lbs)
- belt for power steering pump and fan belts
- radiator. Connect hoses
- battery.



T9

Bleeding of cooling system

Disconnect upper hose from cold start device. Place drip pan beneath hose and hold hose level with top edge of expansion tank.



Coolant

Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage.

Use genuine Volvo blue-green coolant type C, diluted with **clean** water in proportions of 50/50.

This mixture helps to prevent corrosion and frost damage.

- Never fill the cooling system with water alone.
- The coolant should be changed regularly since the corrosion protective additives in the coolant lose their effect in time.

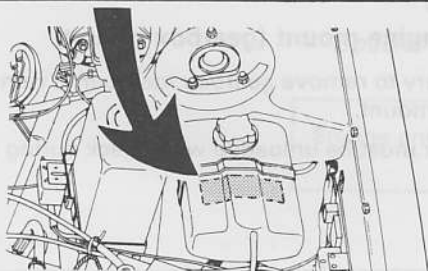
Note! Do not run engine when level of coolant is low, since high local temperatures can result which may cause the cylinder head to crack.

VOLVO ORIGINAL KYLVATSKA TYP C ÄR PÅFYLLED. KYLSYSTEMET ÄR FROST-SKYDDAT TILL -30°C. EFTERFyll ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVATSKA TYP C.

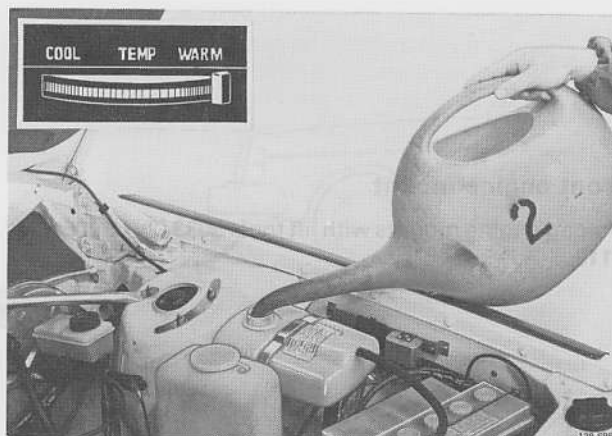
FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

REPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

1297524



133 477



128 585

Replacing coolant

Always use **type C** blue-green coolant. Remember to replace decal (P/N 1331473-7) on expansion tank if necessary.

Type C blue-green coolant

All diesel and petrol (gasoline) engines manufactured since 1982 are filled with type C coolant.

T10

Fill coolant

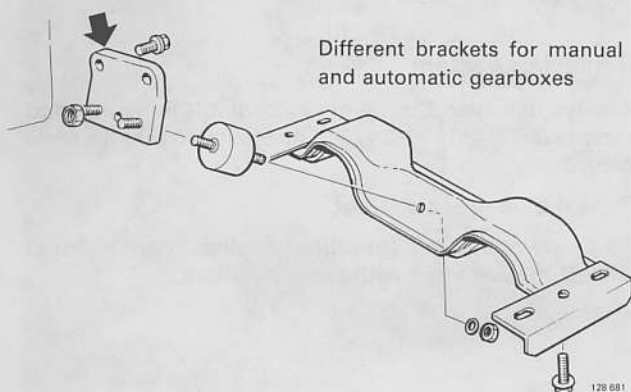
Capacity: D 20 = 8.1 liters (8.6 US quarts)

D 24 = 9.3 liters (9.8 US quarts)

Flush cooling system before adding new coolant, see Group 26 Cooling System.

Set dashboard heater control to max. Turn on engine and warm-up for 5 minutes. Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap.

U. Engine mounts, replacement

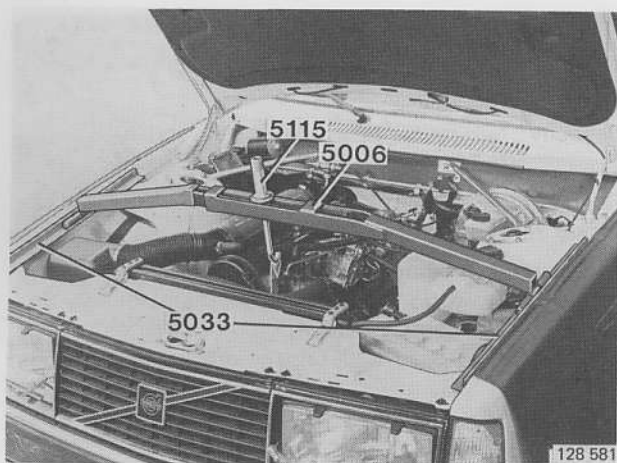


U1

Rear engine mount (gearbox mount)

Necessary to remove gearbox member to remove rear engine mount.

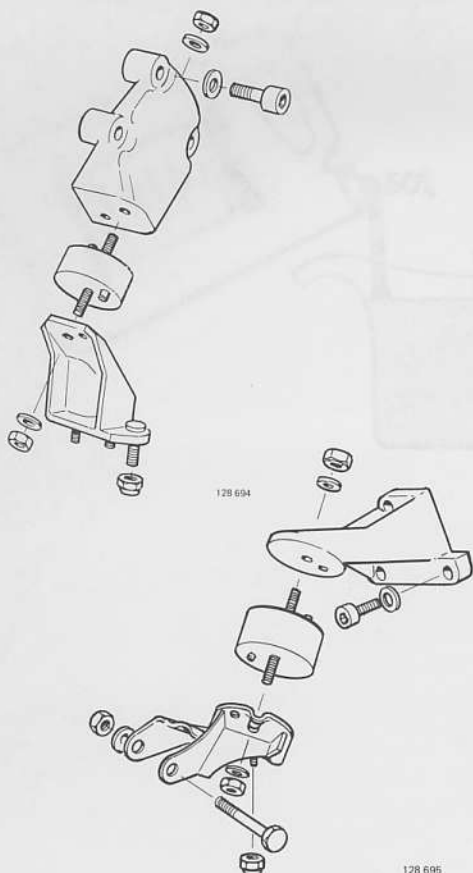
Gearbox must be unloaded with a jack during replacement.



U2

Front engine mount

Unload engine mounts with lift tools 5033 (2x), 5006 and 5115.



U3

Left side

To replace rubber pad: remove engine mount with upper and lower brackets.

U4

Right side

To replace rubber pad: remove upper bracket and rubber pad together, do not remove lower bracket.

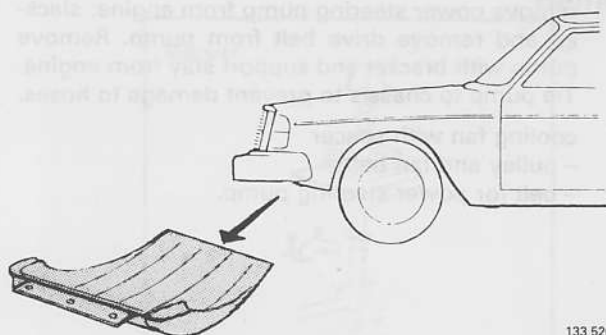
Do not tighten upper nut for rubber pad until engine mount is positioned.

V. Removing engine

Operations V1-7

Special tools: 2810, 5185, 5186

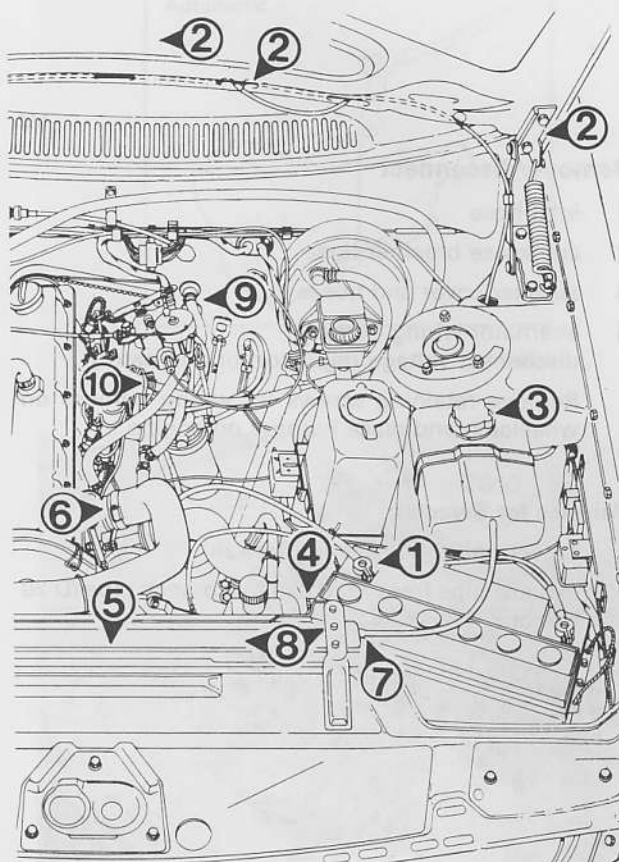
Engine and gearbox removed as a unit



133 520

V1

Remove engine splashguard and drain coolant



133 474

V2

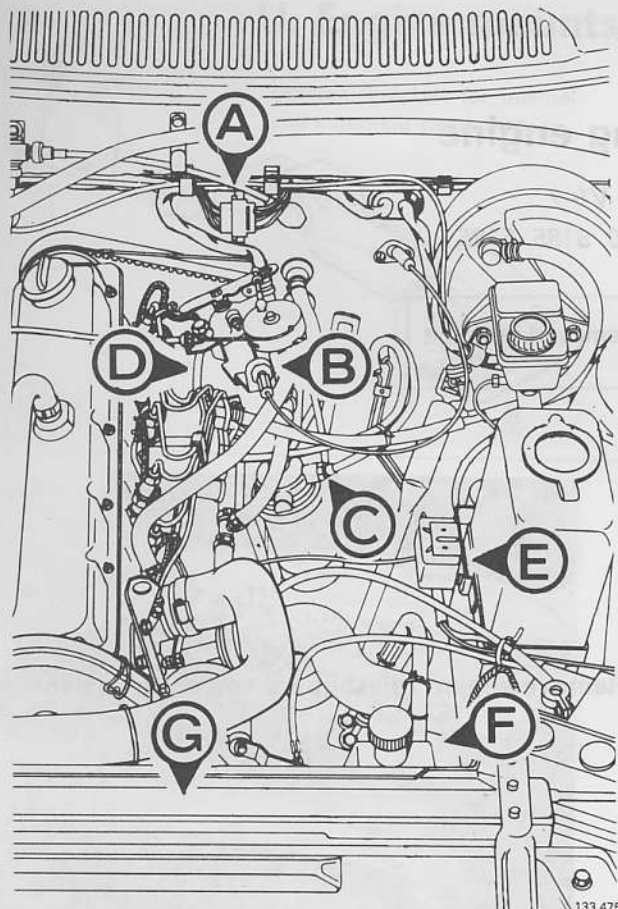
Remove/disconnect:

- 1 positive lead from battery
- 2 bonnet (hood)
- 3 expansion tank cap
- 4 lower radiator hose from radiator

Auto (operation 5):

- 5 oil pipe from oil cooler. Hold connectors on oil cooler with a wrench. If accidentally slackened, torque to **6 Nm** (4.5 ft lbs)
- 6 upper radiator hose from engine
- 7 hoses to expansion tank at radiator
- 8 radiator
- 9 hoses from heater control valve
- 10 hose from vacuum pump.

V3



Remove/disconnect

- A connector from clip on bulkhead (firewall)
- B throttle cable from pulley and bracket

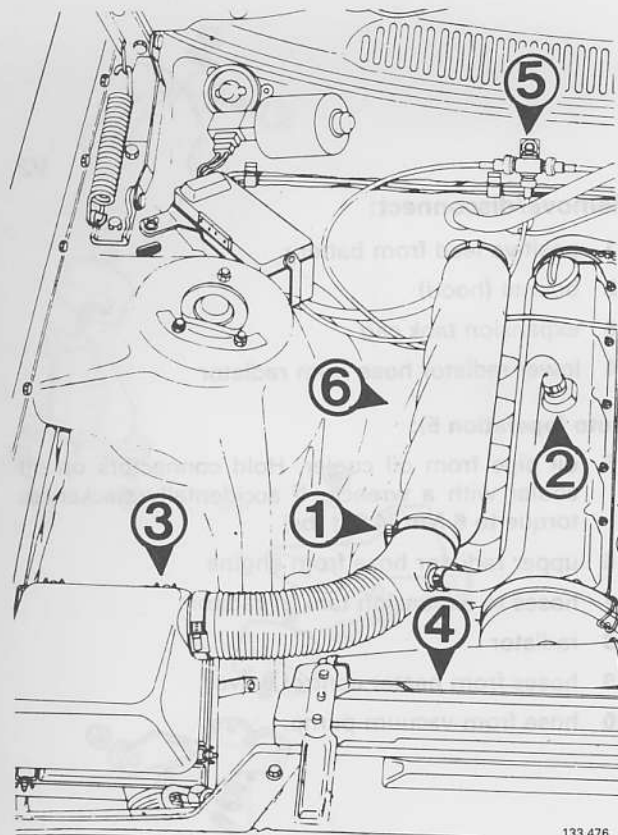
Fuel line connections

(C–E below):

Blow-clean, disconnect and plug ends to prevent dirt entering fuel system

- C supply line from fuel filter – return line from injection pump (at clamp)
- E place relay for pre-heating system on engine: Disconnect wire from junction box. Disconnect black wire and small red wire from relay. Unscrew retaining screws from relay.
- F remove power steering pump from engine: slacken and remove drive belt from pump. Remove pump with bracket and support stay from engine. Tie pump to chassis to prevent damage to hoses.
- G cooling fan with spacer
– pulley and fan belts
– belt for power steering pump.

V4



Remove/disconnect

- 1 inlet hose
- 2 crankcase breather hose
- 3 air filter cover and hoses
- 4 alternator wiring harness: disconnect voltage regulator (or alternator). Remove retaining screws for wiring harness on wheelarch and place harness on engine.

Vehicles for Sweden:

- 5 T-gear unit on bulkhead (firewall)
- 6 exhaust pipe from front exhaust branch pipe (D 20 has only 1 manifold).

V5

Drain engine oil

Install plug and washer after draining oil.

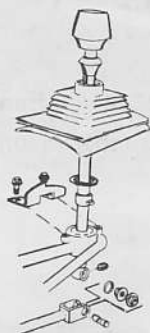
Remove:

- engine mount retaining bolts from front axle cross-member.
- Left engine mount: remove nuts from front axle cross-member.
- Right engine mount: remove lower nut from rubber pad.

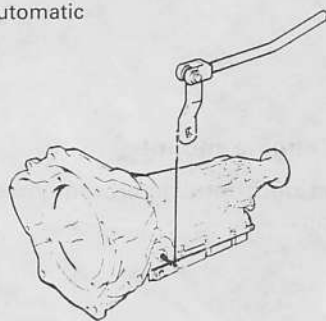
Removing engine

V6

Manual



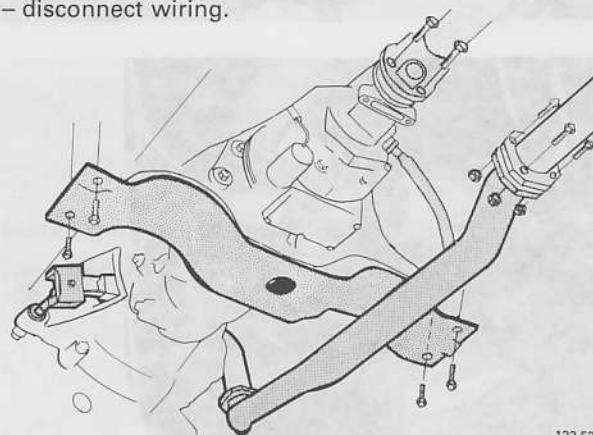
Automatic



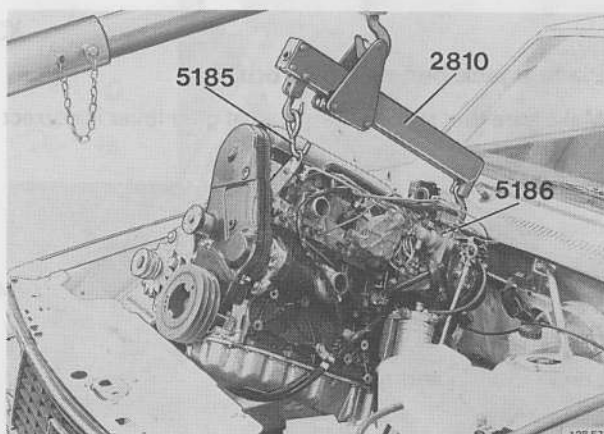
135 050

Remove/disconnect

- front exhaust pipe clamps
- disconnect exhaust pipe coupling. Remove front exhaust pipe
- (manual) clutch cable and gear lever
- (auto) selector control from gearbox/transmission
- speedometer cable
- propeller shaft
- gearbox crossmember. Position a jack beneath gearbox as support
- disconnect wiring.



133 535



128 578

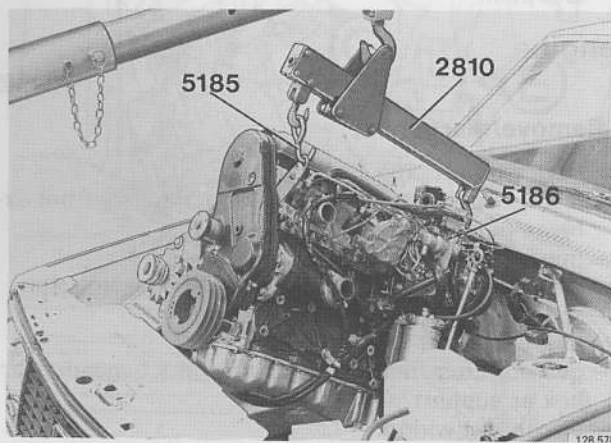
V7

Use lifting tools **2801**, **5185** (at front) and **5186** (at rear).
Lift engine enough to unload left engine mount.
Remove engine mount.
Remove jack beneath gearbox, slide pulley unit forwards and lift out engine.

X. Removing engine

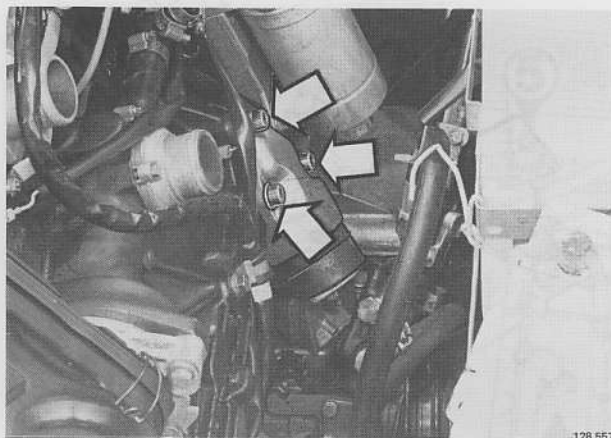
Operations X1-3
Special tools: 2810, 5185, 5186

Engine and gearbox installed as a unit



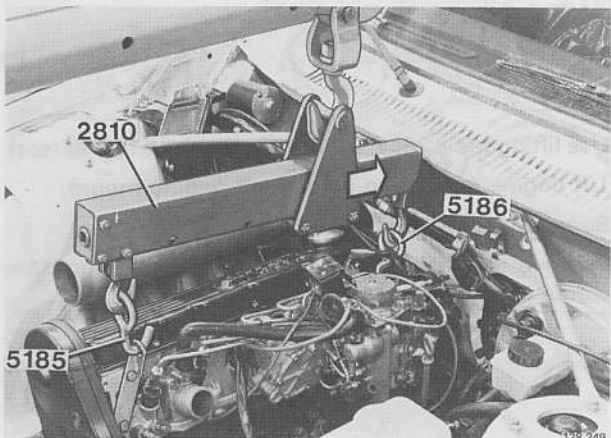
Position engine

Use lift tools **2810**, **5185** (at front) and **5186** (at rear).
Position right side rubber mount on lower bracket.



Install left engine mount

Place mount on front axle crossmember and tighten retaining bolts.

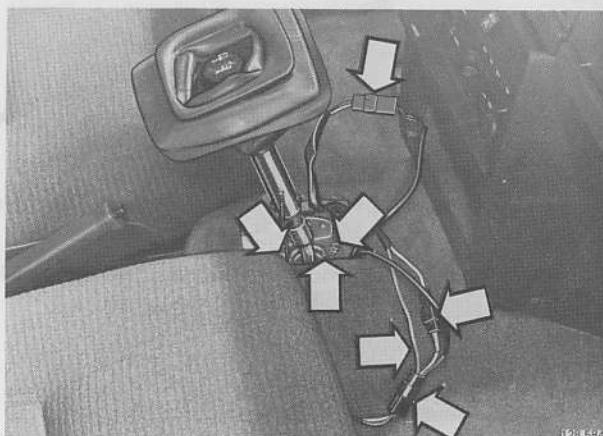


Place a jack beneath gearbox

Make sure that rubber foam pad at gear lever is correctly positioned.
Insert wiring into passenger compartment.
Jack-up gearbox until level.

Remove lifting tools

Lower engine and remove tools.



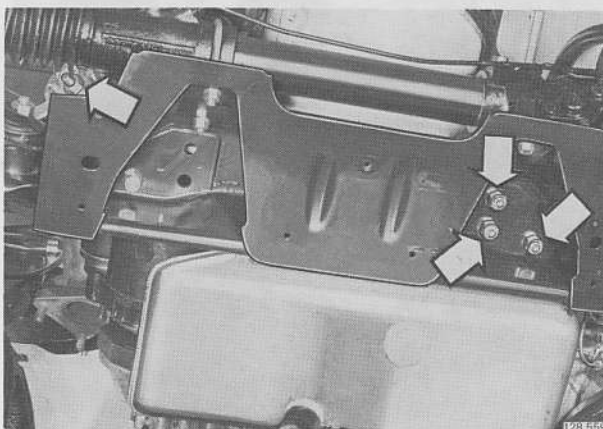
X5

Install gear lever

Place gear lever in housing.

Press plastic collar and rubber ring into position. Install lock ring. Reconnect wiring.

Install bracket for reverse gear detent. Do not tighten screws at this stage since bracket must be adjusted at a later stage.



X6

Install nuts for engine mounts

Left mount: nuts in front axle crossmember.

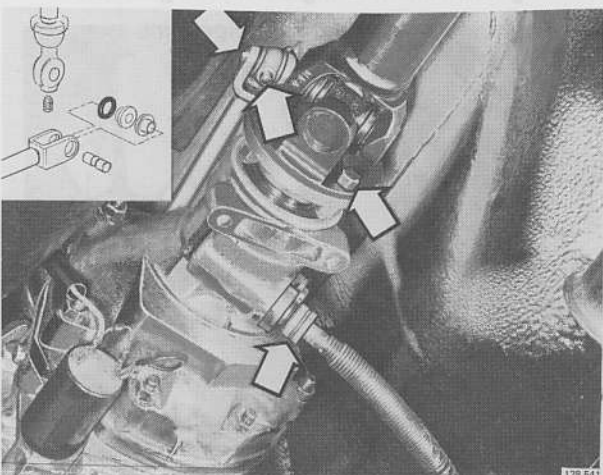
Right mount: lower nut on rubber pad.



X7

Install gearbox crossmember

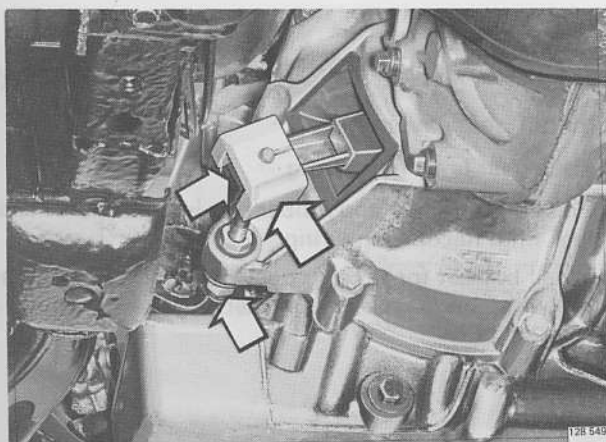
Remove jack.



X8

Install on gearbox:

- gear lever. Make sure that bushings and O-ring are correctly installed. Insert gear level in yoke, fit pin and tighten screw (Allen key 4 mm), see inset
- propeller shaft. Always use new nuts and bolts
- speedometer cable. Sweden: wire must be sealed at gearbox to conform to tax regulations (kilometer taxation).



X9

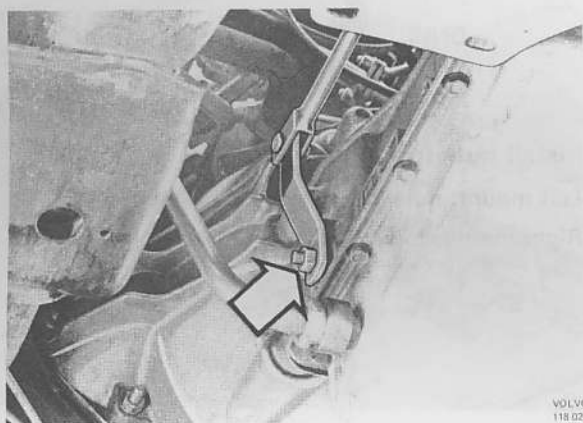
Connect clutch cable and install return spring

Insert cable through flywheel casing and connect to lever.

Install rubber buffer and vibration damper on cable, making sure that buffer is facing right way.

Connect return spring.

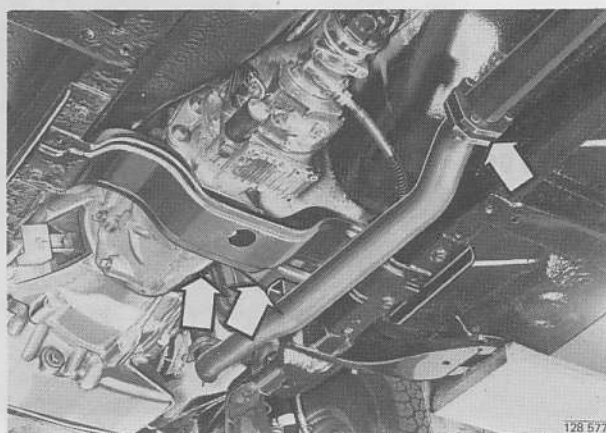
Adjust play = 1–3 mm. (0.04–0.12 in).



Automatic gearbox

X10

Attach gear selector to gearbox

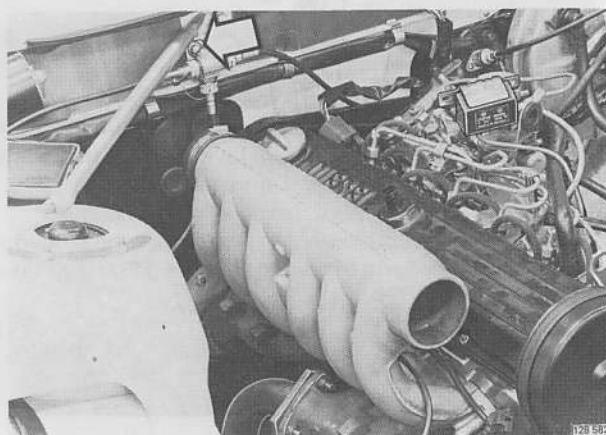


X11

Install front exhaust pipe

For strain-free installation, instructions must be followed carefully:

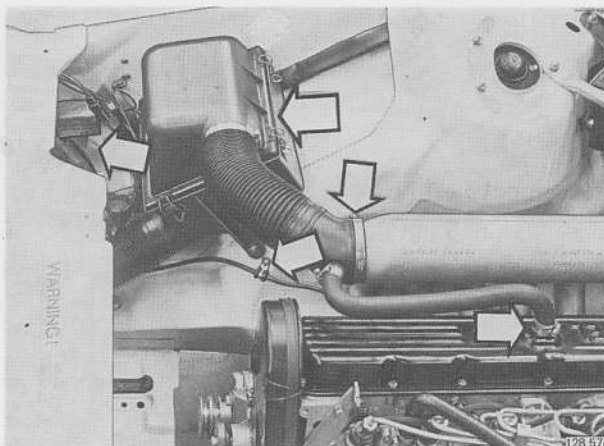
- 1 Slacken two retaining bolts holding bracket to gearbox/transmission
- 2 Attach front exhaust pipe finger tight. Use new gaskets
- 3 Tighten nuts and bolts holding exhaust pipe to branch pipe
- 4 Tighten bolt holding front pipe to bracket
- 5 Tighten bolts holding bracket to gearbox
- 6 Tighten clamp at exhaust pipe joint.



Cars for Sweden

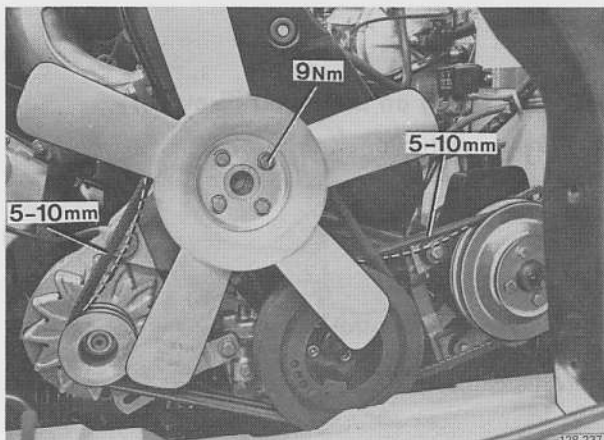
X12

Attach T-gear unit to bulkhead (firewall)



X13 Connect alternator wiring harness

Reconnect voltage regulator.
Attach clamp on wheelarch.

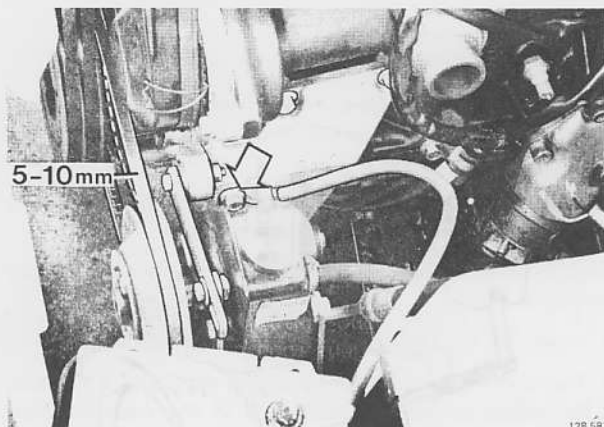


X14 Install air filter cover

Reconnect air inlet hose and breather hose to valve cover.
Note that arrow on inlet hose must point towards manifold as indicated, otherwise hose may be compressed by bonnet/hood.

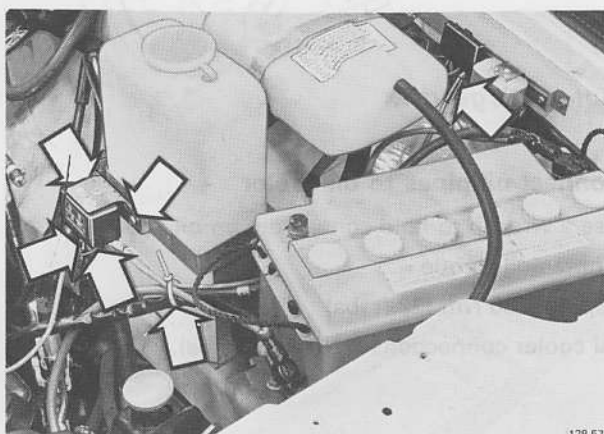
Place power steering pump belt on vibration damper.
Install fan belts and pulley.
Install cooling fan with spacer. Torque to 9 Nm (6.5 ft lbs).

Tension fan belts. It should be possible to depress belt 5-10 mm on run between fan and alternator, see fig.



X15 Install drive belts and cooling fan

Negative lead from battery should be connected to lower front retaining bolt for pump mounting bracket.
Tension fan belts. It should be possible to depress belt 5-10 mm (0.2-0.4 in) in center of run between fan and vibration damper.



X16 Install power steering pump and belt

Connect black wire to terminal 86 on relay and red wire to terminal 85.

Attach relay to washer reservoir mounting bracket.
Reconnect wiring to junction box.
Secure wires with clamps and reconnect battery.

Connect relay for preheating system

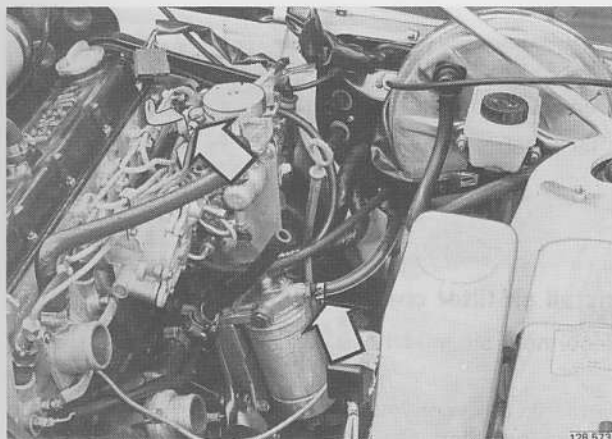
X13

X14

X15

X16

X17

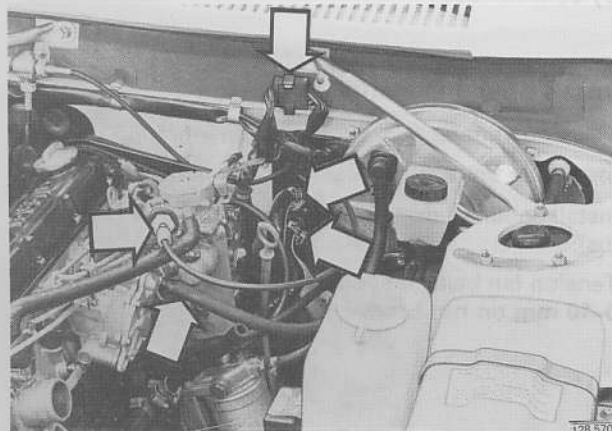


126 573

X18

Reconnect fuel lines

Make sure that dirt does not enter fuel system.



126 570

X19

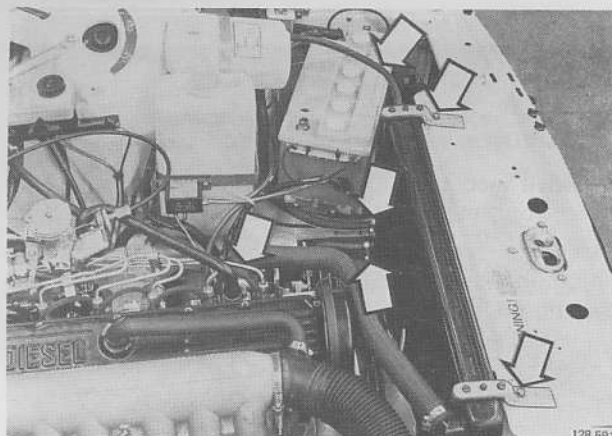
Reconnect plug on bulkhead (firewall)

Secure plug with clip.

X20

Reconnect:

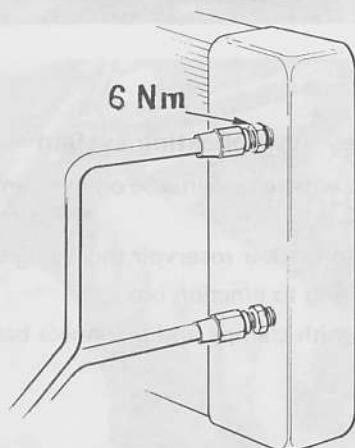
- hoses to heater control valve
- hose to vacuum pump
- throttle cable.



126 591

X21

Install radiator and connect hoses



126 683

X22

Automatic gearbox

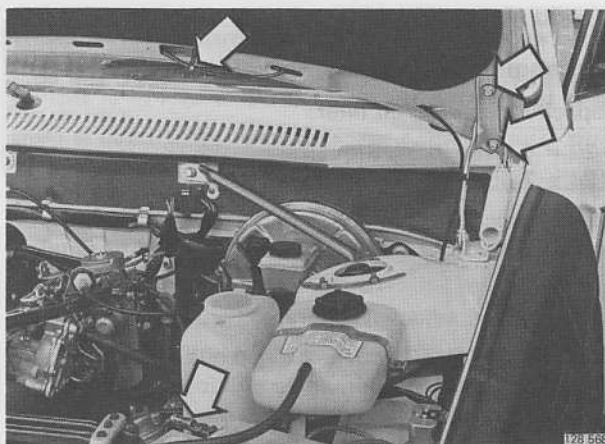
Connect oil pipes to oil cooler

Use a wrench to hold connectors on oil cooler.

Tightening torque

Cap nuts 30 Nm (22 ft lbs)

Oil cooler connections 6 Nm (4.5 ft lbs).



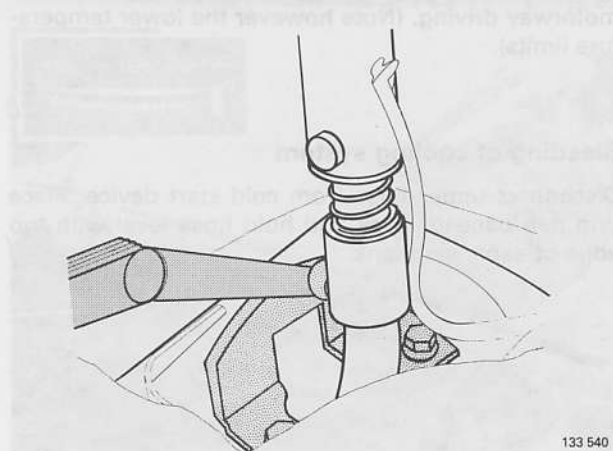
X23

Install bonnet/hood

Connect washer hose.

X24

Reconnect battery



Manual gearbox

X25

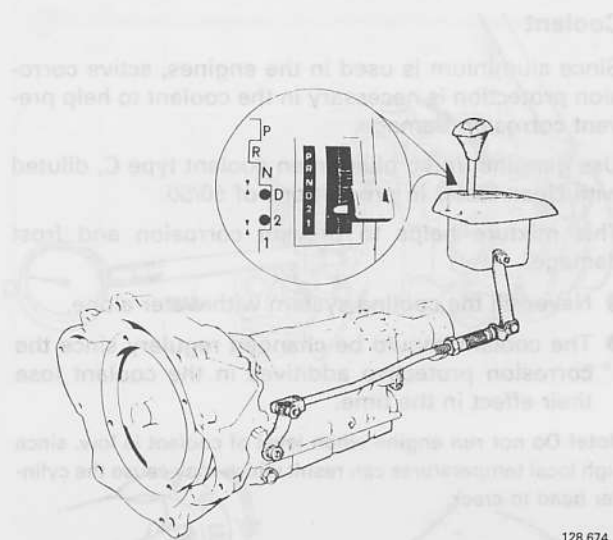
Adjust bracket for reverse gear detent. Install rubber gaiter

Engage first gear. Adjust clearance between gear lever and detent bracket to **0.5–1.5 mm** (0.020–0.060 in). Use a feeler gauge.

Tighten retaining bolts.

Recheck clearance in second gear.

Install rubber gaiter/boot.



Automatic gearbox

X26

Check/adjust gear selector

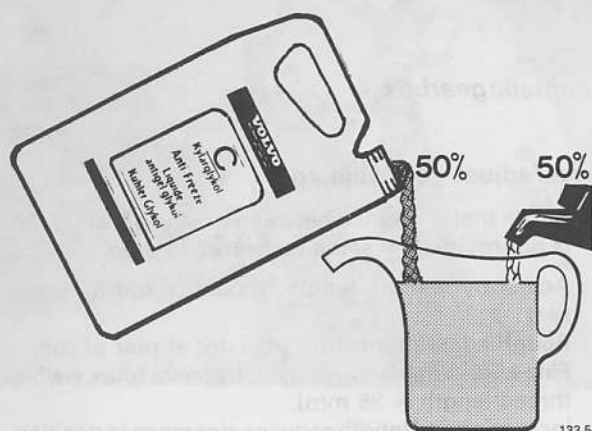
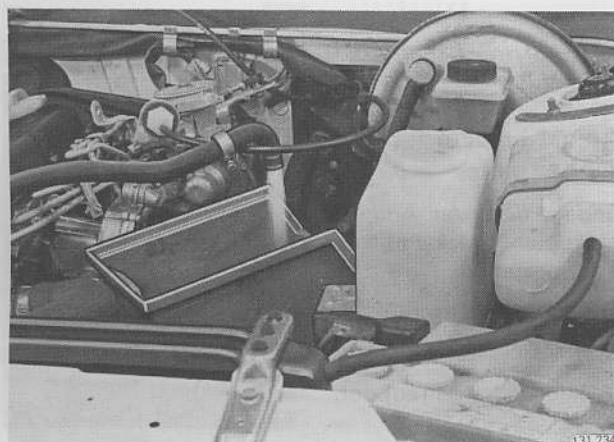
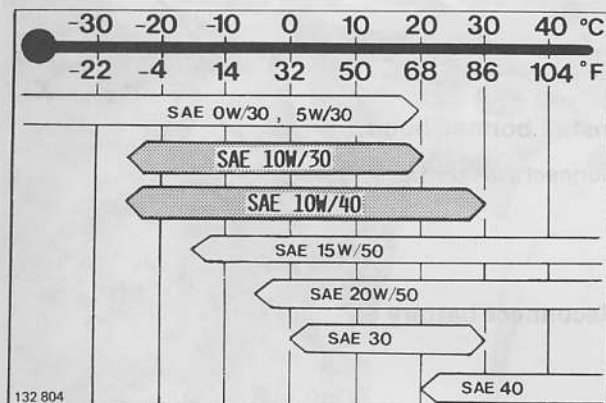
1. Check that clearance between position D and stop is approximately same as from 2 to stop.
2. Adjust by altering length of control rod if necessary.

Rough adjustment: turn adjuster at rear of rod

Fine adjustment: turn serrated sleeve (max visible thread length = 35 mm).

Increasing rod length reduces clearance in position D, and increases clearance in position 2.

After adjustment: move lever to position 1 and then to position P. Repeat check according to stage 1.



X27

Add engine oil

Capacity including oil filter:

D 20 = 6 litres (6.3 US quarts)

D 24 = 7 litres (7.4 US quarts)

Quality: according to API, min CC (oils with designations SE/CC, SC/CD, SF/CC and SF/CD fulfil this requirement).

Viscosity, see adjacent diagram.

Note! SAE 15 W 50 or SAE 20W 50 oils are recommended for use in extreme driving conditions which involve high oil consumption and high oil temperatures e.g. mountain driving with frequent decelerations or fast motorway driving. (Note however the lower temperature limits).

X28

Bleeding of cooling system

Disconnect upper hose from cold start device. Place drip pan beneath hose and hold hose level with top edge of expansion tank.

Coolant

Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage.

Use genuine Volvo blue-green coolant type C, diluted with clean water in proportions of 50/50.

This mixture helps to prevent corrosion and frost damage.

- Never fill the cooling system with water alone.
- The coolant should be changed regularly since the corrosion protective additives in the coolant lose their effect in the time.

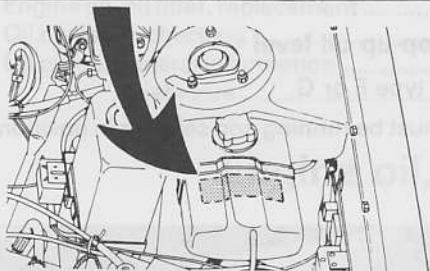
Note! Do not run engine when level of coolant is low, since high local temperatures can result which may cause the cylinder head to crack.

VOLVO ORIGINAL KYLVATSKA TYP C ÄR PÅFYLLD. KYLSYSTEMET ÄR FROST-SKYDDAT TILL -30°C. EFTERFYLL ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVATSKA TYP C.

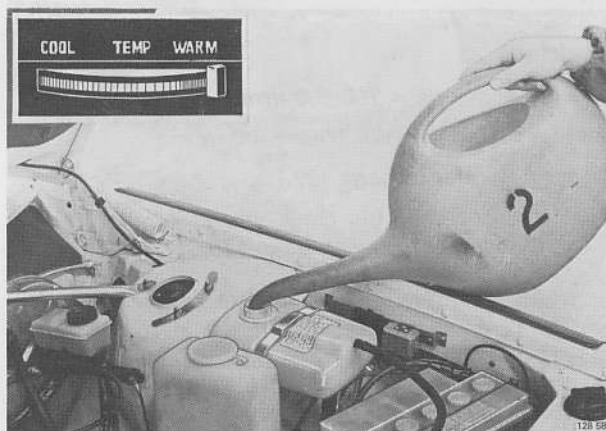
FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

REPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

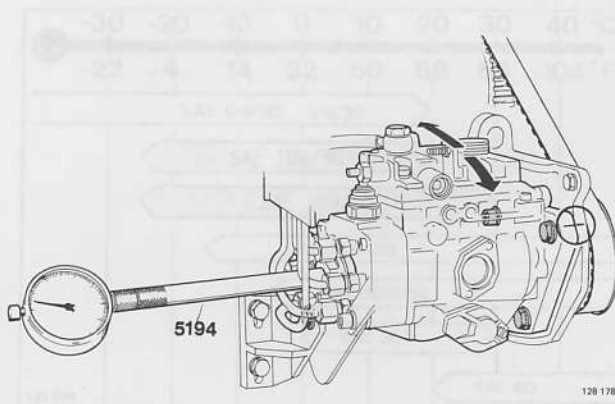
1297524



133 477

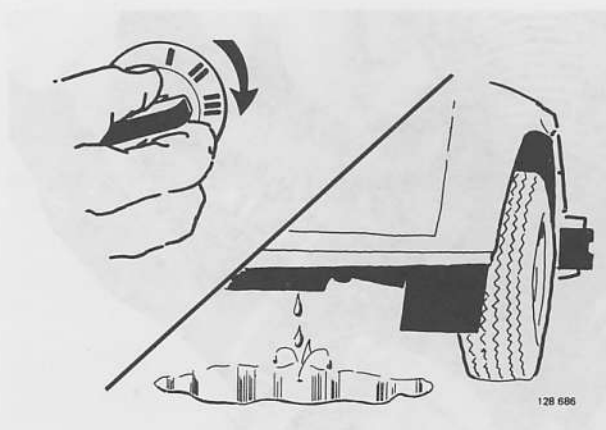


128 585



5194

128 178



128 686

Replacing coolant

Always use type C blue-green coolant. Remember to replace decal (P/N 1331473-7) on expansion tank if necessary.

Type C blue-green coolant

All diesel and petrol (gasoline) engines manufactured since 1982 are filled with type C coolant.

X29

Fill coolant

Capacity: D 20 = 8.1 litres (8.6 US quarts)

D 24 = 9.3 litres (9.8 US quarts)

Flush cooling system before adding new coolant, see Group 26 Cooling System.

Set dashboard heater control to max. Turn on engine and warm-up for 5 minutes. Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap.

X30

Check/adjust injection timing

See instructions on page 24, C11-20.

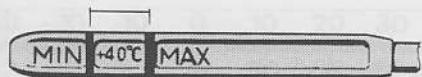
X31

Check operation

Turn on engine and warm-up.

Check for oil and coolant leakages. Top-up if necessary.

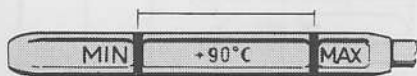
Install engine splashguard.



Cold gearbox oil – oil temperatures 40°C (104°F).

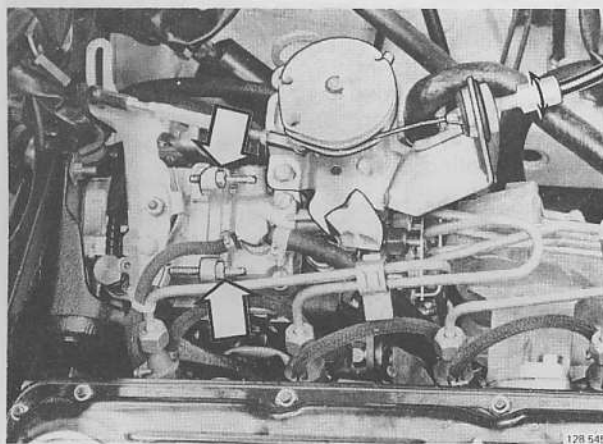
This temperature is reached after approx. 10 minutes idling.

At oil temperatures below 40°C level may be below MIN.



Hot gearbox oil – oil temperature 90°C (194°F)

133 541



128 54E

Automatic gearboxes:

X32

Check-top-up oil level

Use ATF type F or G.

Engine must be running and selector in position N or P.

X33

Check/adjust

Idle = 12.5 ± 0.8 r/s = 750 ± 50 r/min

Fast idle = 87 ± 1.7 r/s = 5200 ± 100 r/min

If necessary refer to page 129.

Engine controls (throttle cable and kick-down cable) (Auto). If necessary refer to page 176.

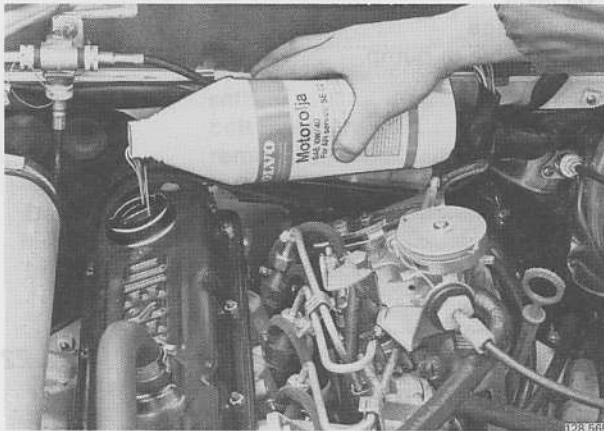
Important: If engine has been disassembled cylinder head bolts must be check-tightened after 600–1,200 miles (1,000–2,000 km).

Group 22 Lubricating System

Contents

	Operation	Page
Engine oil, oil filter, replacement	Y1-2	123
Oil pressure, checking	Z1	124
Oil pump, general information	Z1	124
relief valve	Z2	124

Engine oil, oil filter, replacement



Y1

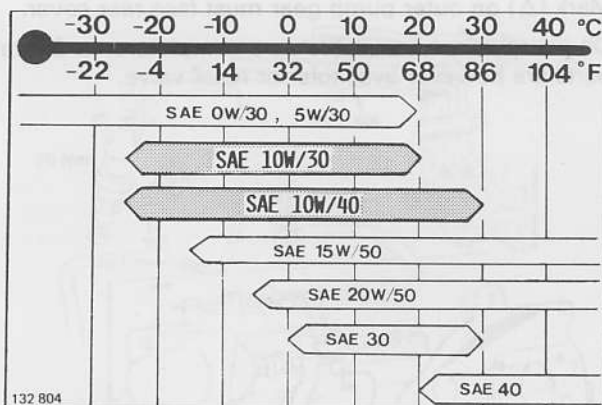
Oil capacity litres (US quarts)

	D 20	D 24
Excl. oil filter	5.2 (5.5)	6.2 (6.5)
Incl. oil filter	6.0 (6.3)	7.0 (7.4)
Max-Min	1.0 (1.0)	1.0 (1.0)

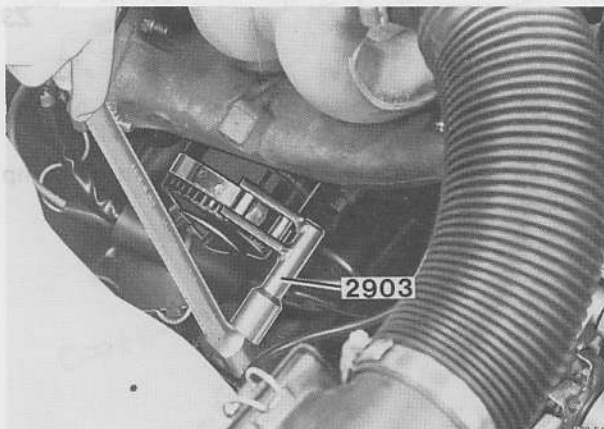
Quality

According to API MIN CC
Oils with designations SE/CC, SE/CD, SF/CC and SF/CD fulfil this requirement.

Temperature range
(stable ambient temperatures)



Note SAE 15W 50 or SAE 20W 50 oils are recommended for use in extreme driving conditions which involve high oil consumption and high oil temperatures e.g. mountain driving with frequent decelerations of fast motorway driving. (Note however the lower temperature limits.)



Y2

Oil filter

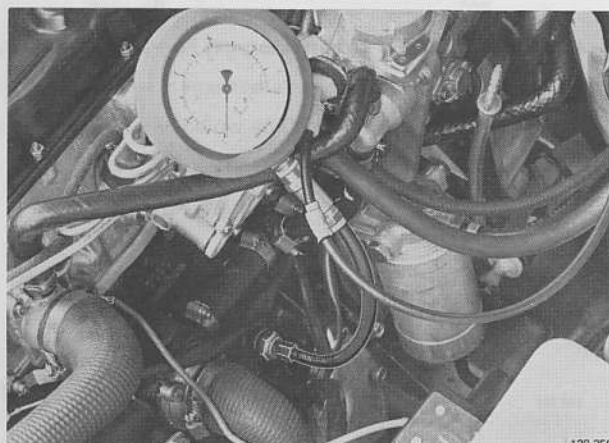
Use oil filter wrench **2903** to remove filter.

To install filter, see instructions on filter.

If only filter is replaced (i.e. not engine oil), add 0.8 litres (0.8 US quarts) of oil.

Oil pressure, checking

Z1



Connect oil pressure gauge to connection for oil pressure sender

Oil pressure must be at least **200 kPa (28 psi)** at 33 r/s (2,000 r/min) and 80°C (176°F) oil temperature.

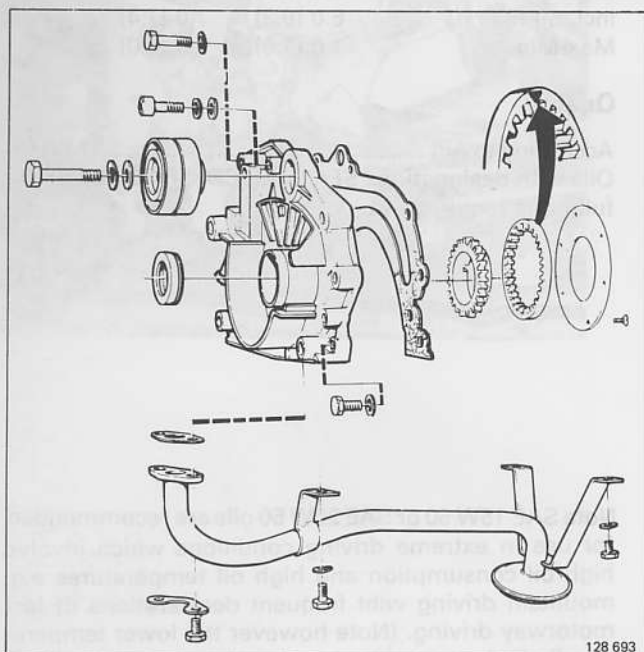
Relief valve in pump should open at 600–700 kPa (85–99 psi).

If incorrect check:

- oil level
- for leakage
- relief valve in pump.

Oil pump

Z2

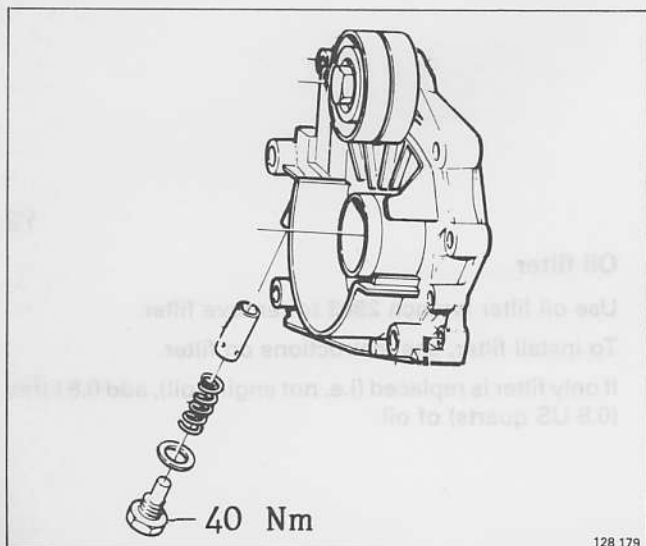


General information

Oil pan cannot be removed from installed engine. Consequently it is necessary to remove engine to replace oil pump.

Mark (Δ) on outer pump gear must face rear cover.

Oil pump is only available as a complete unit. Spare parts are however available for relief valve.



Z3

Relief valve

If oil pressure is not as specified check that plunger moves freely and that spring is in good condition.

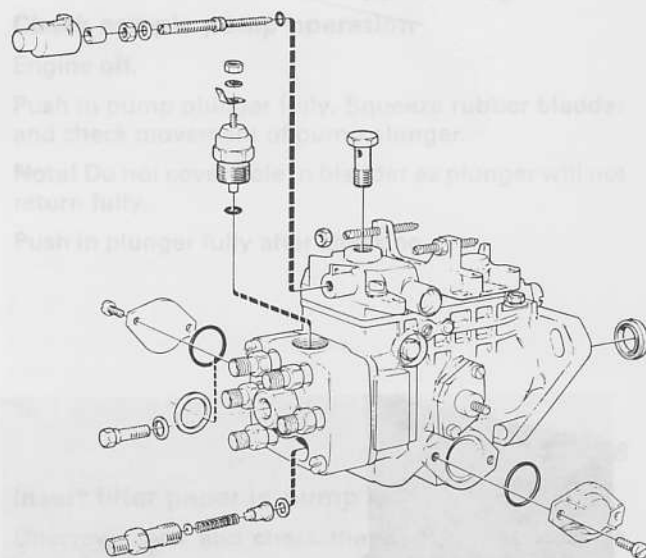
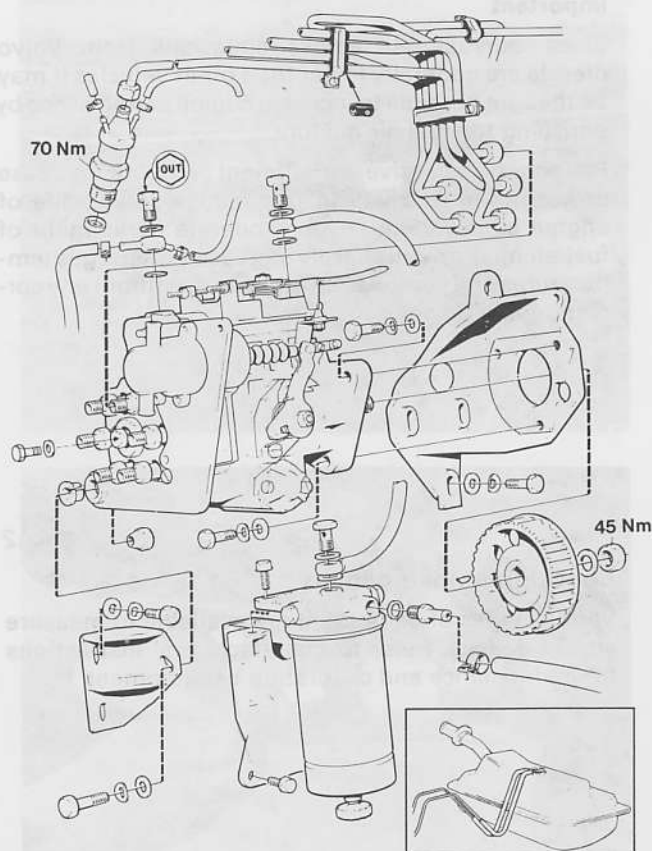
Relief valve is accessible from below with oil pump installed.

Tightening torque 40 Nm (30 ft lbs).

Group 23 Fuel system

Contents

	Operation	Page
Exhaust gas smoke density, general	AA1	126
checking	AA2-10	126
Idle + fast idle	AB1-6	129
Fuel filter, draining water	AC1	130
replacement	AC2	130
Injection pump, general	AE1-14	131
altitude adjustment, USA	AD2	132
setting	AD3-14	133
belt replacement	AE1-14	136
removal	AF1-11	140
installation	AG1-17	143
Delivery pipes, removal/installation	AH1-3	148
replacement	AJ1-10	149
Injectors, malfunctions/checking	AK1-2	151
removal	AK3-6	151
installation	AK7-9	152
overhaul (incl. testing)	AL1-10	153
Cold start device	AM1-2	155
Preheating system (glow plugs), wiring diagram 1979-80	AN1	156
1981-	AO1	158



AA. Exhaust gas density

AA1

General

Exhaust gas smoke density gives a good indication of the condition of an engine and whether the injection pump is correctly adjusted.

Swedish regulations stipulate that smoke density must not exceed 3.5 Bosch units for passenger cars at time of registration and 4.5 Bosch units at the annual inspection.

Important

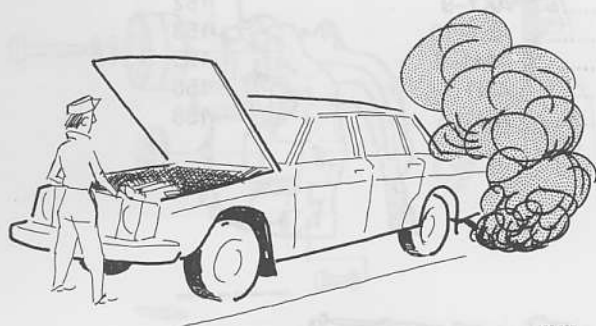
Since exhaust gas smoke emissions from Volvo diesels are generally lower than other vehicles it may be thought possible to increase engine performance by enriching the fuel air mixture.

Prolonged excessive enrichment will not increase power output but will in fact reduce service life of engine considerably. Even moderate enrichment of fuel-air mixture will sharply increase exhaust gas temperatures and combustion pressures, without any corresponding power gain.

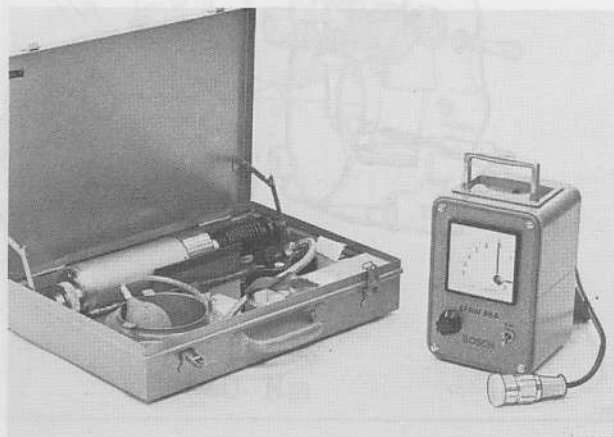
AA2

Checking smoke density

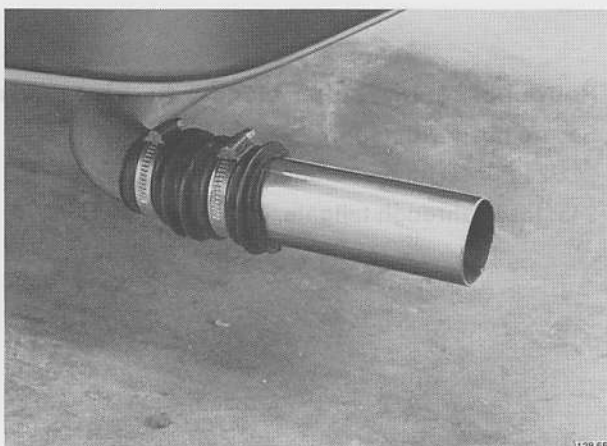
Various types of equipment are available to measure smoke density. Refer to manufacturers' instructions for maintenance and calibration of equipment.



128 687



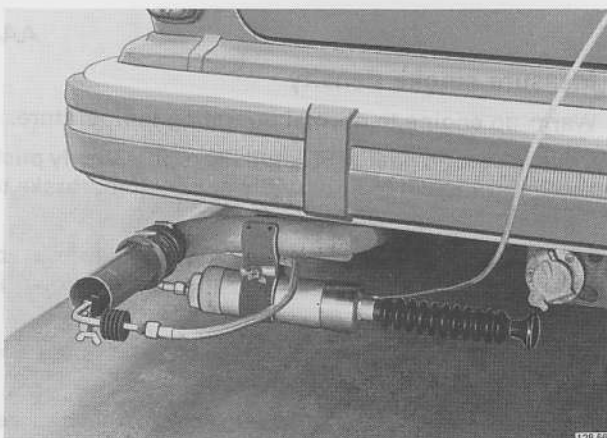
128 560



AA3

Connect extension piece to exhaust pipe

This reduces the risk of ambient air affecting instrument probe. Pipe dimensions: length = 200 mm (8in) internal diameter = 50 mm (2in). Secure extension piece with rubber hose and clamps.



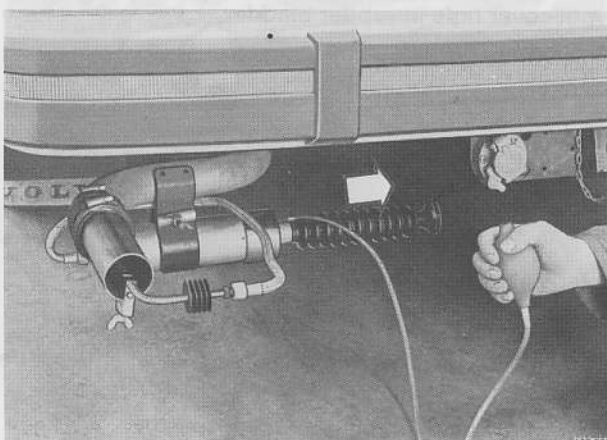
AA4

Install sample pump

Insert probe into exhaust pipe. Probe must be in center and inserted to a depth of not less than 200 mm (8in), otherwise readings will be incorrect.

Hang flexible hose from clamp as illustrated.

Connect hose from rubber bladder to sample pump.



AA5

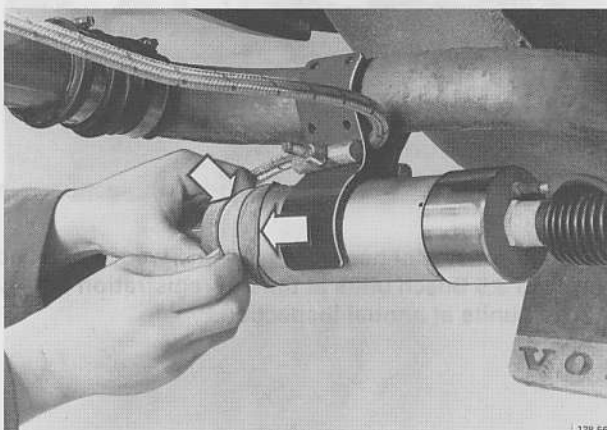
Check sample pump operation

Engine off.

Push in pump plunger fully. Squeeze rubber bladder and check movement of pump plunger.

Note! Do not cover hole in bladder as plunger will not return fully.

Push in plunger fully after checking.



AA6

Insert filter paper in pump

Unscrew cover and check that contact surfaces are clean.

Place filter paper in opening and tighten cover hand tight.

Position rubber seal over cover (to prevent dirt and moisture from affecting test).

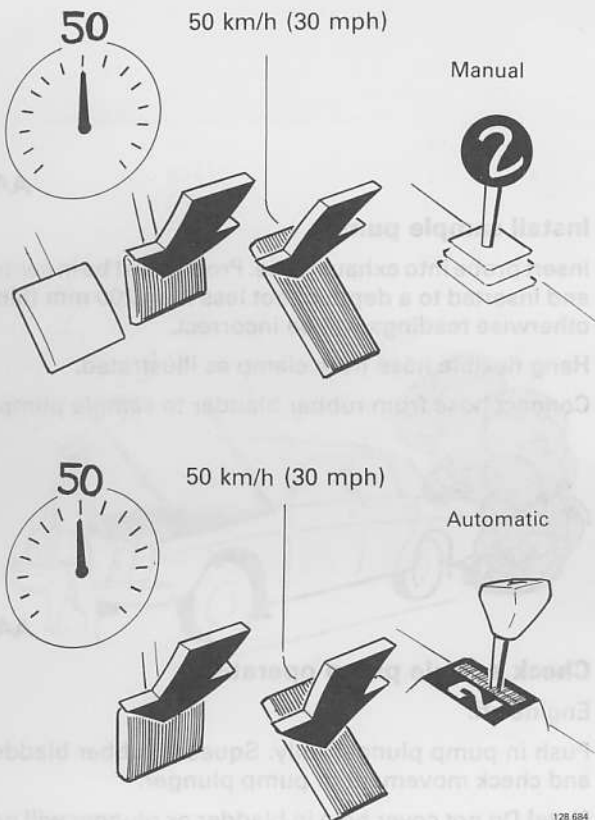
AA7

Route hose with rubber bladder to drivers seat

Secure hose with tape.

242/244: Insert hose through rear side window.

245: Insert through tailgate.



AA8

Measure smoke density

Warm-up engine to normal operating temperature.

Drive in second gear at 50 km/h (30 mph). Slowly push accelerator pedal to floor while applying footbrake to maintain constant 50 km/h.

Note! Automatic transmission: Do not depress accelerator pedal to such an extent that kick-down is engaged.

Maintain constant speed for a few seconds and squeeze rubber bladder to operate pump.

Note! Squeeze rubber bladder hard for several seconds to ensure that sample pump has been filled. Do not cover hole in rubber bladder.

AA9

Repeat measurements

Remove filter paper from pump.

Depress pump plunger fully and place a new filter paper in pump. Reposition rubber cover.

Repeat measurements according to AA8.

AA10

Evaluate result

Calibrate equipment according to manufacturers instructions.

Smoke density for passenger cars in Sweden must not exceed 3.5 Bosch units at time of registration and 4.5 Bosch units at annual inspection.



AB. Idle + fast idle

Special tool: 9950

AB1

Connect tachometer

Use Volvo Monotester and adapter 9950.

If Volvo Monotester is not available use photoelectric rev counter (999 9795-9).

AB2

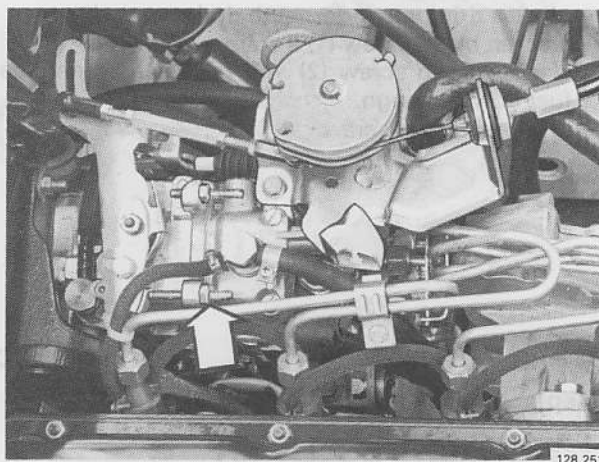
Warm-up engine

AB3

Check/adjust idle

12.5 r/s (750 r/min).

Seal adjustment screw and lock nut with paint after adjustment.



128 251

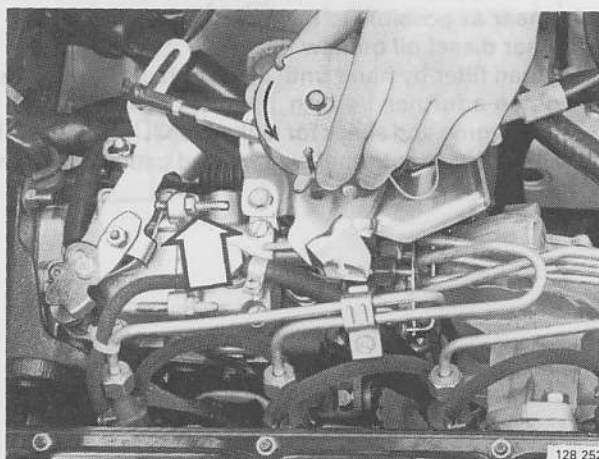
AB4

Check/adjust fast idle

87 r/s (5200 r/min).

Seal adjustment screw and lock nut with paint after adjustment.

Do not race engine longer than necessary.



128 252

AB5

Disconnect tachometer.

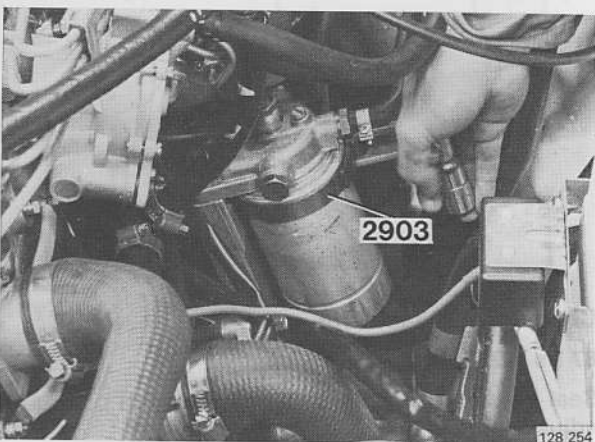
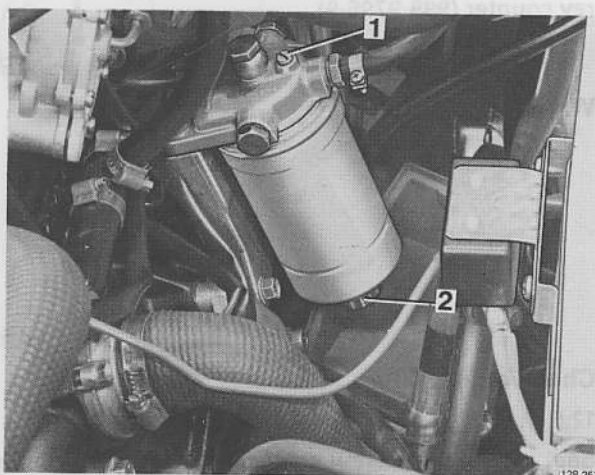
AB6

Check/adjust engine controls

Always check/adjust engine controls after adjusting idle speed.

See instructions on page 176, operations AX1-AX9.

AC. Fuel filter



AC1

Drain water from fuel filter

- place a drip pan underneath drain screw (2)
- slacken bleed screw (1) a couple of turns
- slacken drain screw (2) and retighten when clean fuel flows through.
- retighten bleed screw.

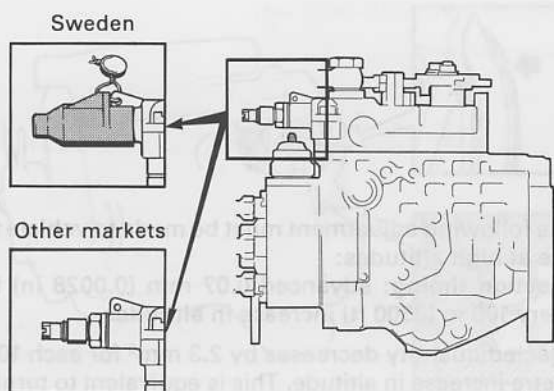
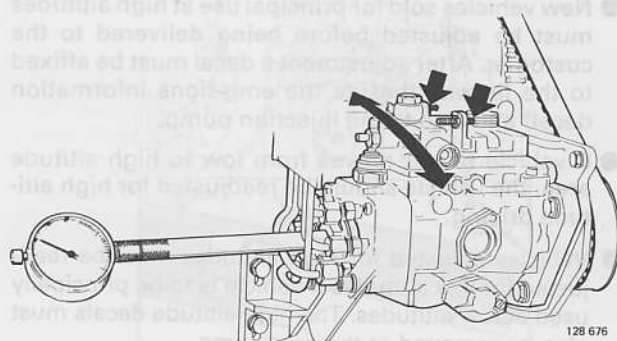
AC2

Replacement

Special tool: 2903

- Use strap wrench 2903 to remove filter. Place strap as near as possible to base of filter, see fig.
- smear diesel oil on new filter seal
- tighten filter by hand until seal contacts body. Then tighten a further 1/4 turn
- start engine and check for leaks. If seal is not tight air will be drawn into fuel system and cause poor running.

AD. Injection pump, general



AD1

Adjustments which can be carried out on an installed injection pump are limited to the following:

- adjusting idle and fast idle
- adjusting injection timing

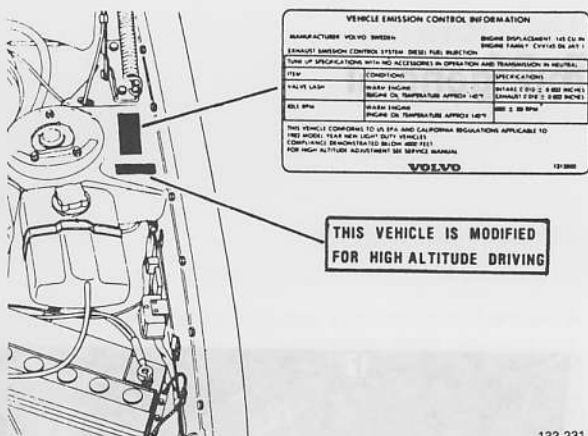
For more detailed repairs and adjustments the pump must be removed and tested by specially trained personnel, on a special test bench.

Smoke density regulations for Sweden

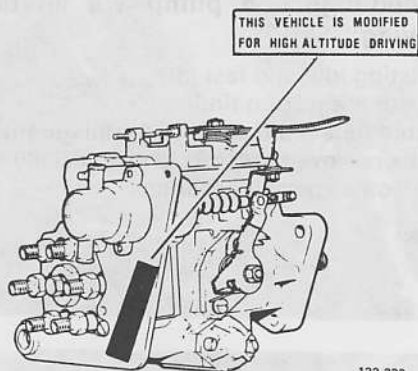
Fuel regulating screw is sealed at factory.

Note! Fuel supply may only be checked/adjusted on a test bench by trained personnel.

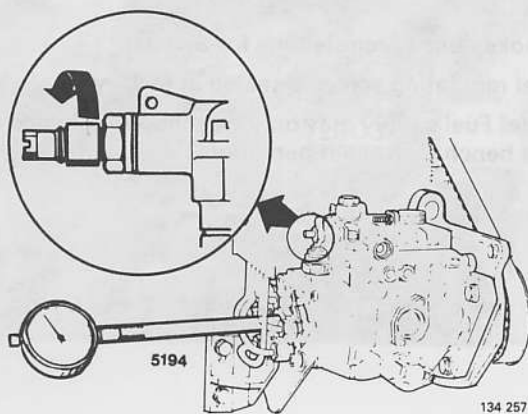
High altitude adjustment (Legal requirement)



133 231



133 232



134 257

Injection timing

Example: If altitude is 2000 metres above sea level the following calculations can be made:

0.85 mm is normal setting (for 1982-models)

$$0.85 + \left(\frac{2000}{1000} \times 0.07 \right) = 0.99 \text{ mm}$$

High altitude setting is 0.99 mm

Injected quantity

Example: If altitude is 2000 metres above sea level the following calculations can be made:

$$\frac{2000}{1000} \times 35^\circ = 70^\circ$$

Turn adjustment screw 70° counterclockwise.

AD2

Environmental Protection Agency (EPA) defines:

- high altitude as an elevation exceeding 1219 metres (4000 ft)
- low altitude as an elevation lower than or equal to 1219 metres (4000 ft).

- On delivery from factory all vehicles are adjusted for low altitudes.
- New vehicles sold for principal use at high altitudes must be adjusted before being delivered to the customer. After adjustment a decal must be affixed to the firewall (beside the emissions information decal) and also to the injection pump.
- If vehicle owner moves from low to high altitude area, the vehicle should be readjusted for high altitude driving.
- Vehicles adjusted for high altitudes must be readjusted for low altitudes if vehicle is to be principally used at low altitudes. The high altitude decals must also be removed at the same time.

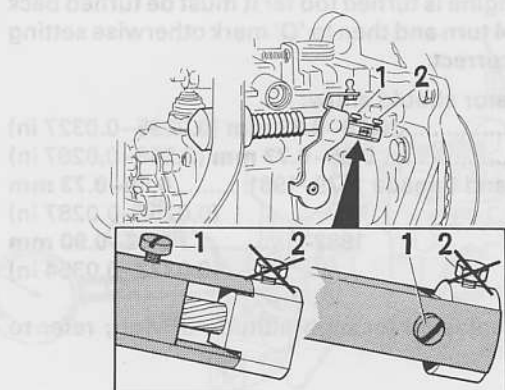
The following adjustment must be made to vehicle for use at high altitudes:

Injection timing: advanced 0.07 mm (0.0028 in) for every 100 m (3300 ft) increase in altitudes.

Injected quantity decreases by 2.3 mm³ for each 1000 metre increase in altitude. This is equivalent to turning adjustment screw 35° counterclockwise.

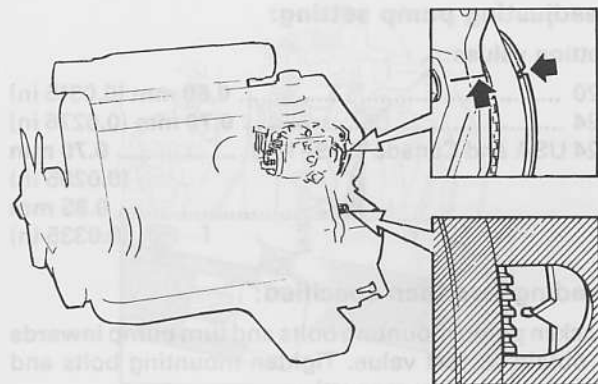
AD. Injection pump, setting

Special tool: 5194

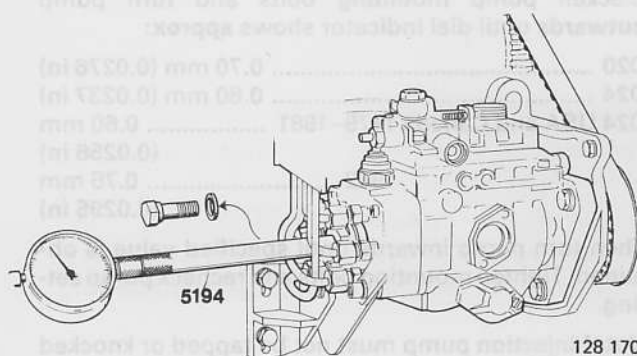


Connected

Disconnected



128 176



128 170

AD3

Remove rear timing gear cover

AD4

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2 otherwise it will be necessary to remove cold start device and reset it on a test bench.

Push lever back against stop.

AD5

Turn engine until cyl. 1 is at TDC-injection

Always use the vibration damper centre bolt to turn the engine.

Use a 27 mm socket.

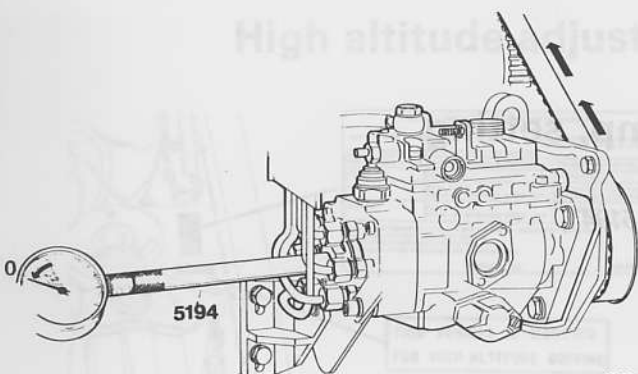
Mark in pump gear should be opposite mark in mounting bracket. Flywheel at "O" mark.

AD6

Place dial indicator in injection pump

Unscrew and remove plug from injection pump distributor.

Install holder 5194 and dial indicator (measuring range 0–3 mm). Set gauge to approx. 2 mm.



128 171

AD7

Set indicator to zero

Turn pump gear back slightly until min. reading registers on dial indicator.

Set indicator to zero.

AD8

Check pump setting

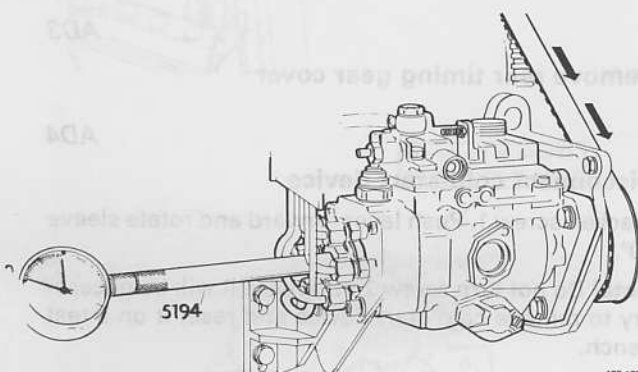
Turn engine slowly clockwise until flywheel is at 'O' mark.

Note! If engine is turned too far it must be turned back approx. 1/4 turn and then to 'O' mark otherwise setting will be incorrect.

Dial indicator should show:

D 20	0.75–0.83 mm (0.0295–0.0327 in)
D24	0.65–0.73 mm (0.256–0.0287 in)
D24 USA and Canada 1979–1981	0.65–0.73 mm (0.0256–0.0287 in)
1982-	0.82–0.90 mm (0.0323–0.0354 in)

(Vehicles adjusted for high altitude driving; refer to page 14)



128 172

AD9

Readjusting pump setting:

Setting values:

D20	0.80 mm (0.0315 in)
D24	0.70 mm (0.0276 in)
D24 USA and Canada 1979–1981	0.70 mm (0.0295 in)
1982-	0.85 mm (0.0335 in)

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump setting.

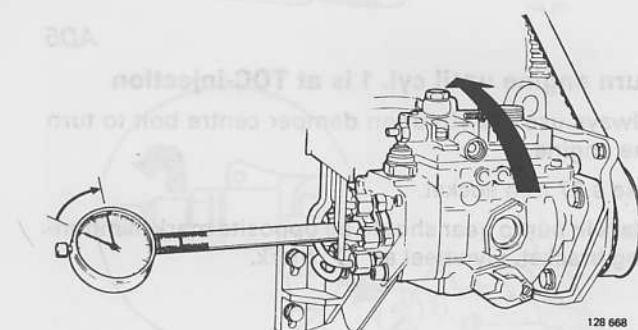
Reading more than specified:

Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows **approx:**

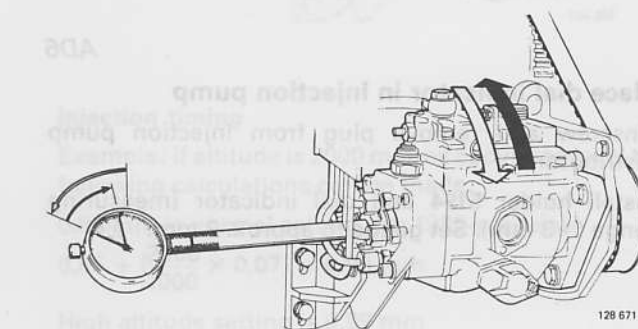
D20	0.70 mm (0.0276 in)
D24	0.60 mm (0.0237 in)
D24 USA and Canada 1979–1981	0.60 mm (0.0256 in)
1982-	0.75 mm (0.0295 in)

Then turn pump inwards until specified value is obtained. Tighten mounting bolts and recheck pump setting.

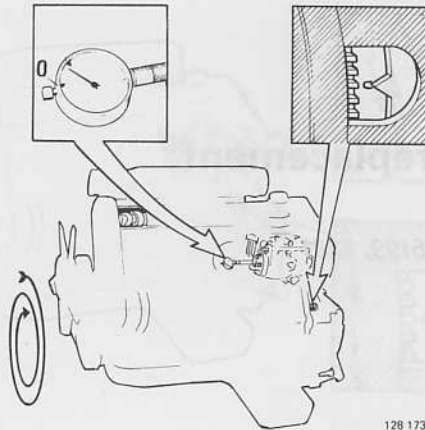
Note! Injection pump must not be tapped or knocked as this will alter its setting.



128 668



128 671

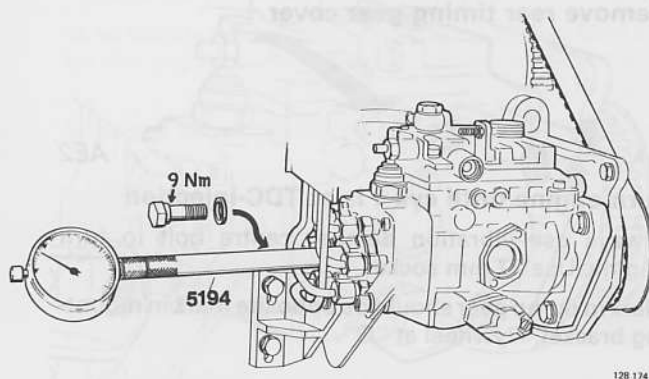


AD10

Check pump setting

Turn engine two turns and check setting.

Adjust if necessary according to operation D8 and recheck.



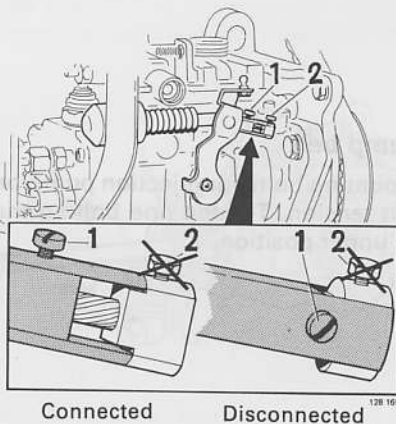
AD11

Remove dial indicator and holder

AD12

Install plug with new seal

Tightening torque 9 Nm (6.5 ft lbs).



AD13

Install rear timing gear cover

AD14

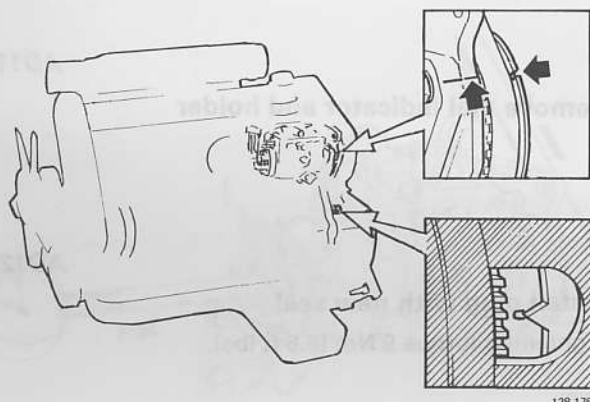
Reconnect cold start device

Press lever forwards and turn sleeve 90°. Retighten screw 1.

Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.

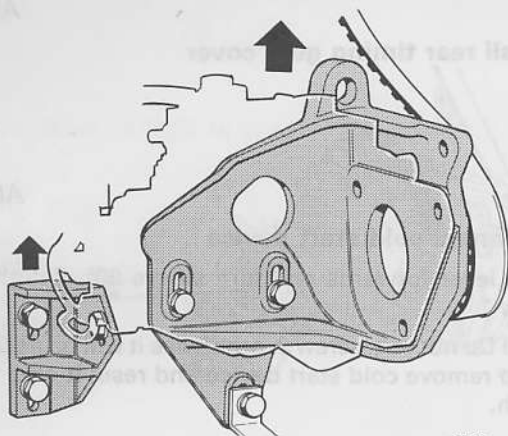
AE. Injection pump belt, replacement

Special tools: 5193, 5194, 5197, 5199, 5201

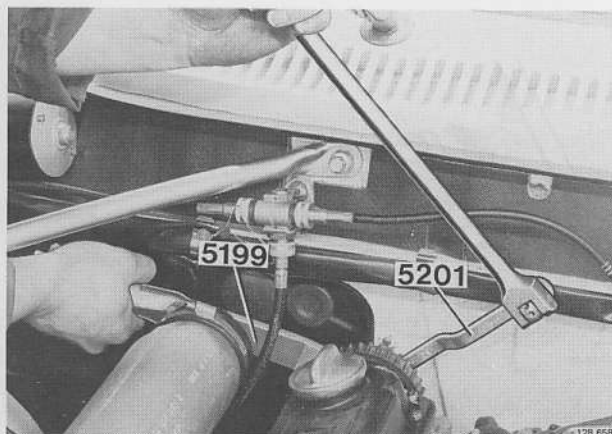


AE1
Remove rear timing gear cover

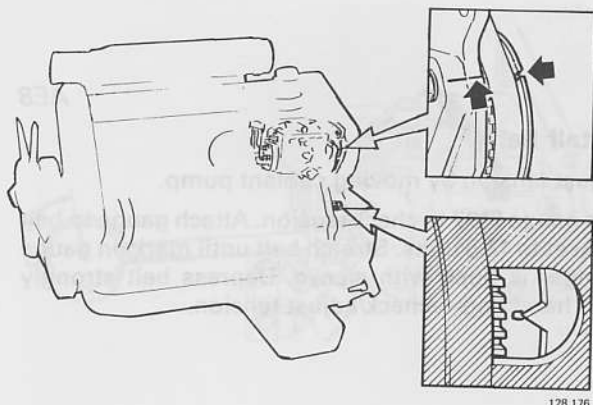
AE2
Turn engine until cyl. 1 is at TDC-injection
Always use vibration damper centre bolt to turn engine. Use **27 mm** socket.
Mark in pump gear should be opposite mark in mounting bracket. Flywheel at "O".



AE3
Lift off pump belt
Slacken mounting bolts for injection pump bracket to release belt tension. Tighten one bolt so that pump remains in upper position.
Lift off belt.



AE4
Remove camshaft rear sprocket
Hold sprocket in position with **5199** and unscrew sprocket with wrench **5201**.
Take care not to rotate camshaft.
Install center bolt, hand tight. It should be possible to turn sprocket on camshaft without camshaft rotating.



128 176

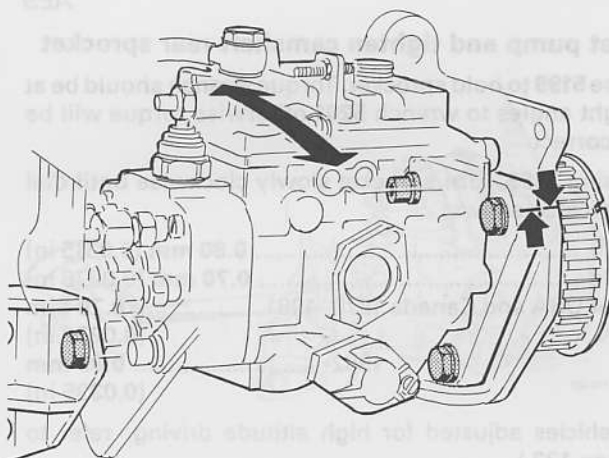
AE5

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.

Press lever back against stop.



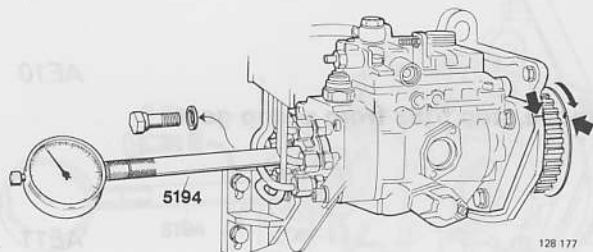
128 167

AE6

Basic-set injection pump

Slacken pump mounting bolts (Allen key = 6 mm).

Align marks on pump and mounting bracket by turning pump. Retighten mounting bolts.



128 177

AE7

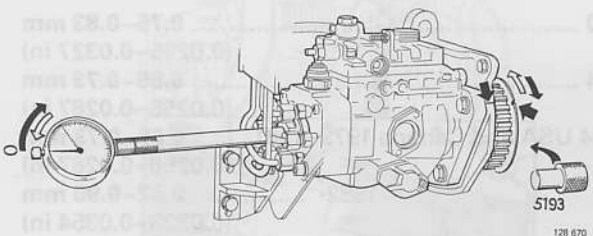
Set dial indicator zero.

Lock pump gear at cyl. 1 injection using stop 5193

Unscrew and remove plug from injection pump distributor.

Install holder 5194 and dial indicator (measuring range 0–3 mm). Set gauge to approx. 2 mm.

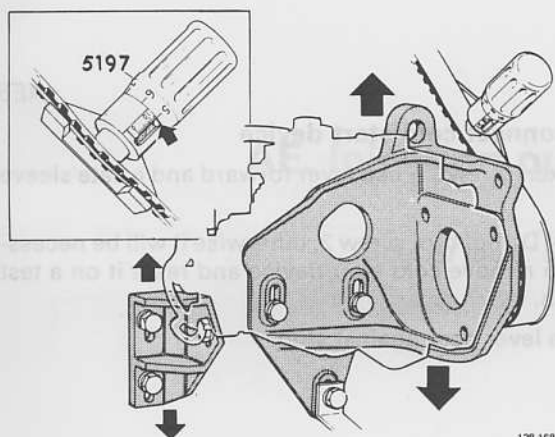
Turn pump gear clockwise until mark on gear and mounting bracket coincide.



128 670

Then turn pump gear back slightly until min reading registers on dial indicator. Set indicator to zero.

Turn pump gear clockwise until mark on gear and pump mounting bracket coincide. Lock gear in this position with stop 5193. (Insert stop through pump gear into mounting bracket.)



128 158

AE8

Install belt

Adjust tension by moving coolant pump.

Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units. Stretch belt until mark on gauge plunger is flush with sleeve. Depress belt strongly with hand and recheck/adjust tension.

AE9

Set pump and tighten camshaft rear sprocket

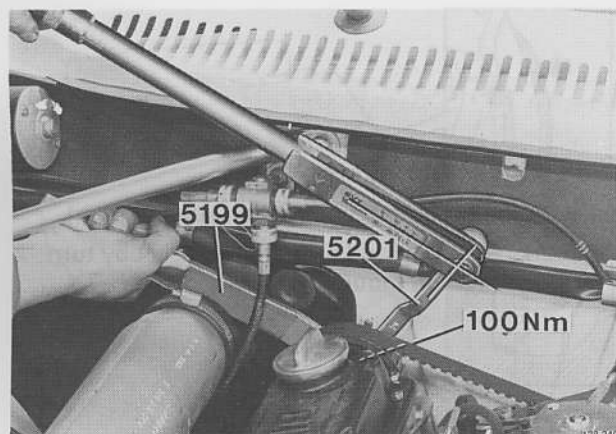
Use **5199** to hold sprocket. Torque wrench should be at right angles to wrench **5201** otherwise torque will be incorrect.

Using **5199**, turn sprocket slowly clockwise until dial indicator shows:

D20	0.80 mm (0.0315 in)
D24	0.70 mm (0.0276 in)
D24 USA and Canada 1979-1981	0.70 mm (0.0276 in)
1982-	0.85 mm (0.0335 in)

(Vehicles adjusted for high altitude driving; refer to page 132.)

Hold sprocket in this position and torque bolt to **100 Nm** (73 ft lbs). Take care that camshaft and sprocket do not move.



128 240

AE10

Remove stop 5193 from pump gear

AE11

Check pump setting

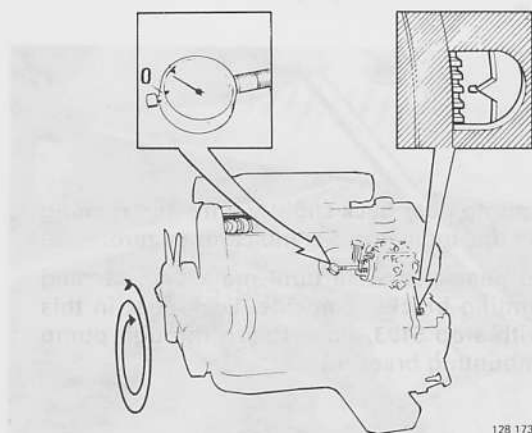
Turn engine two full turns until cyl. 1 is at TDC-injection again. If engine is turned too far it must be turned back approx. 1/4 turn and then to zero mark otherwise setting will be incorrect.

Dial indicator should show:

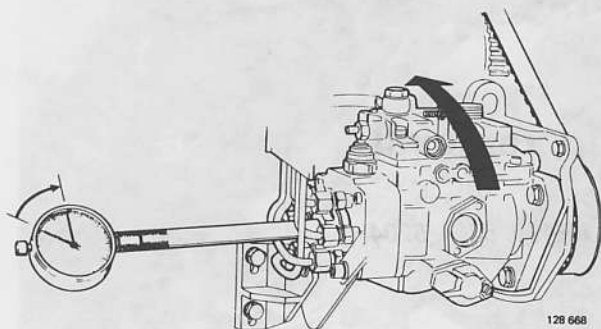
D20	0.75-0.83 mm (0.0295-0.0327 in)
D24	0.65-0.73 mm (0.0256-0.0287 in)
D 24 USA and Canada 1979-1981	0.65-0.73 mm (0.0256-0.0287 in)
1982-	0.82-0.90 mm (0.0323-0.0354 in)

Correct reading: Tighten injection pump mounting bolts. Proceed to E12.

Incorrect reading: Readjust according to instructions on next page.



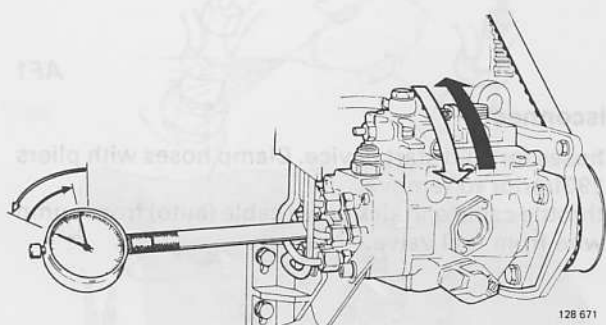
128 173

**Readjusting pump setting:**

D20	0.80 mm (0.0315 in)
D24	0.70 mm (0.0276 in)
D24 USA and Canada 1979–1981	0.70 mm (0.0276 in)
1982-	0.85 mm (0.0335 in)

Reading less than specified:

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump setting.

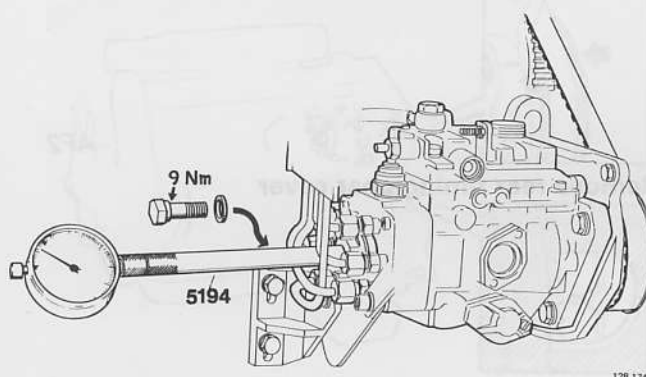
**Reading more than specified:**

Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows **approx**:

D20	0.70 mm (0.0276 in)
D24	0.60 mm (0.0237 in)
D24 USA and Canada 1979–1981	0.60 mm (0.0237 in)
1982-	0.75 mm (0.0295 in)

Then turn pump inwards until specified value is obtained. Tighten mounting bolts and recheck pump setting.

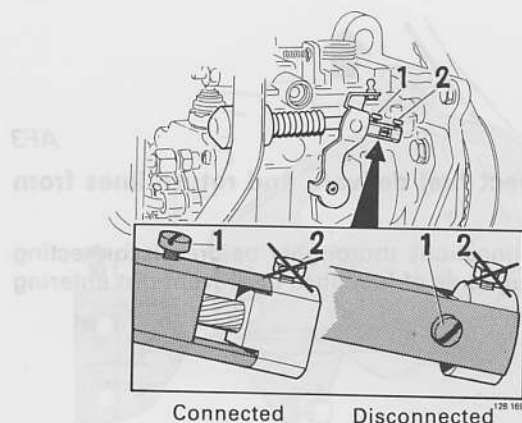
Important! Injection pump must not be tapped or knocked as this will alter its setting.



AE12

Remove dial indicator and holder 5194. Install plug with new seal.

Tightening torque 9 Nm (6.5 ft lbs).



AE13

Press lever forward and turn sleeve 90°. Retighten screw 1.

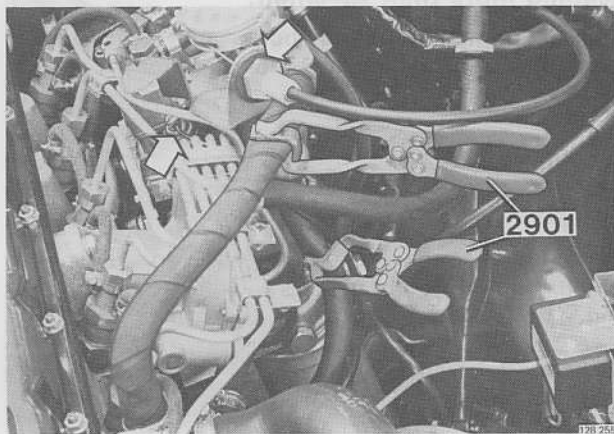
Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.

AE14

Install rear timing gear cover

AF. Injection pump, removal

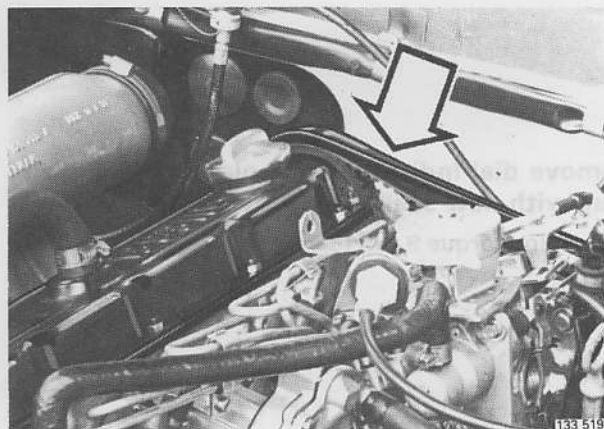
Special tools: 2 × 2901, 5193, 5199, 5201, 5204



AF1

Disconnect:

- hoses for cold start device. Clamp hoses with pliers 2901 prior to removal
- throttle cable and kick down cable (auto) from pump
- wire from fuel valve.



AF2

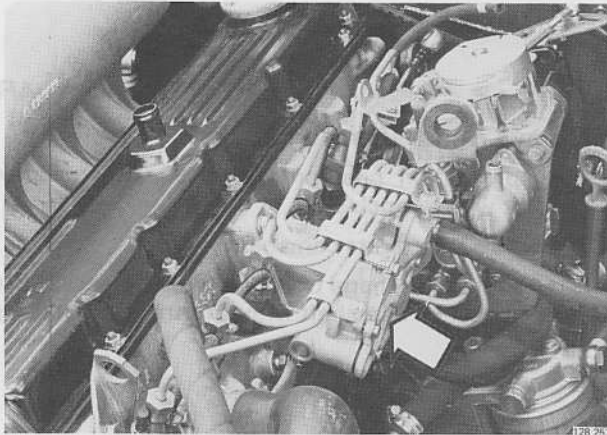
Remove rear timing gear cover



AF3

Disconnect fuel delivery and return lines from pump

Clean connections thoroughly before disconnecting them. Plug ends of fuel lines to prevent dirt entering fuel system.

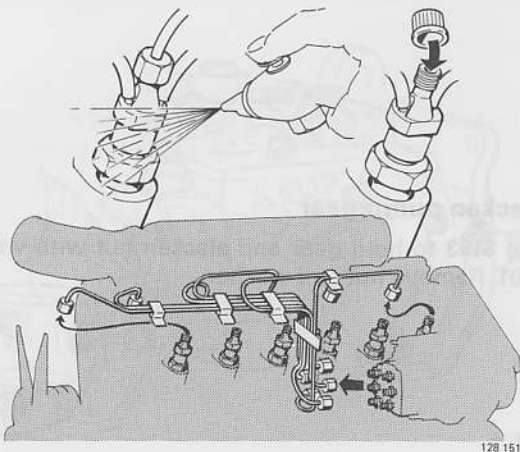


AF4

Remove vacuum pump and pump plunger

Remove pump retaining nuts and place pump on wheelarch.

Remove plunger from cylinder head.

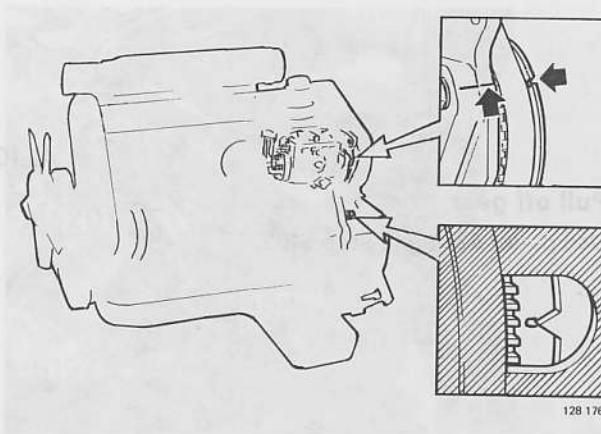


AF5

Remove fuel delivery pipes

Clean all connections thoroughly before disconnecting pipes.

Remove all delivery pipes and plug ends to prevent dirt from entering fuel system.

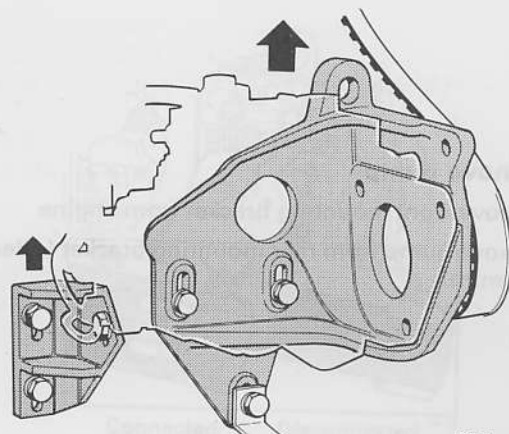


AF6

Turn engine until cyl. 1 is at TDC-injection

Always use vibration damper center bolt to turn engine. Use 27 mm socket.

Mark in pump gear should be opposite mark in mounting bracket. Flywheel at "O".

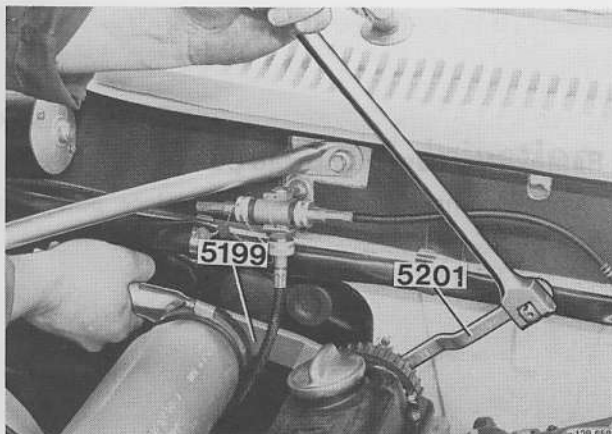


AF7

Lift off pump belt

Slacken mounting bolts for injection pump bracket to release belt tension. Tighten one bolt so that pump remains in upper position.

Lift off belt.



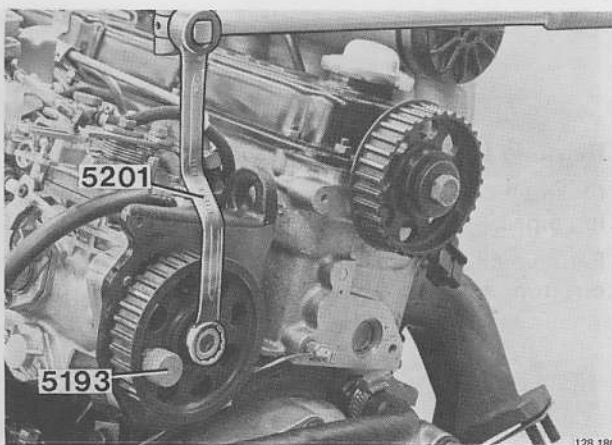
AF8

Remove camshaft rear sprocket

Hold sprocket in position with **5199** and unscrew sprocket with wrench **5201**.

Take care not to rotate camshaft.

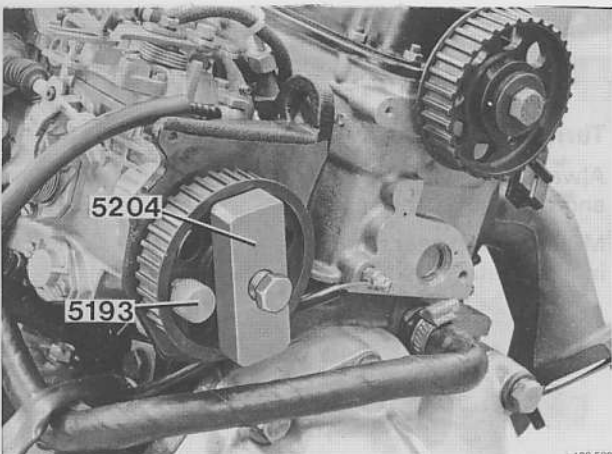
Install center bolt, hand tight. It should be possible to turn sprocket on camshaft without camshaft rotating.



AF9

Slacken pump gear

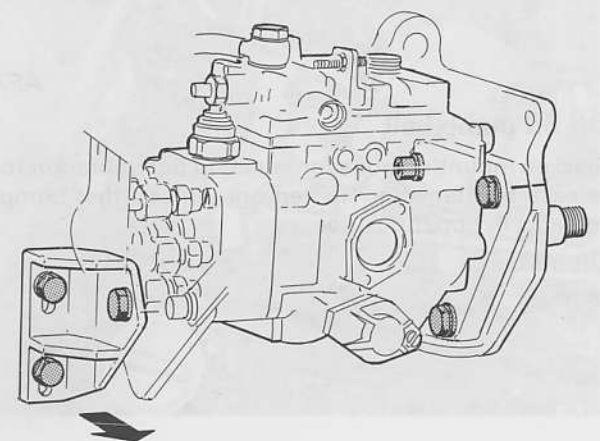
Use **5193** to hold gear and slacken nut with wrench **5201**. Remove nut and washer.



AF10

Pull off gear

Use puller **5204** and stop **5193**.



AF11

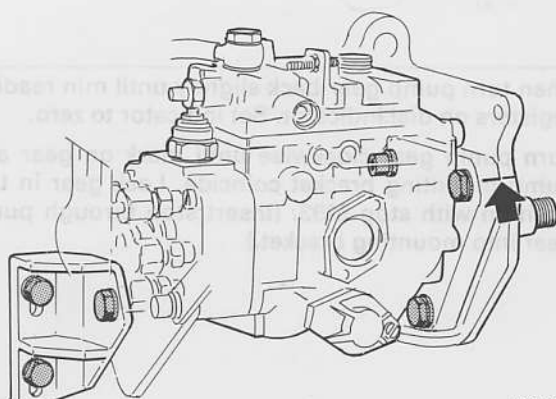
Remove pump

Remove front mounting bracket from engine

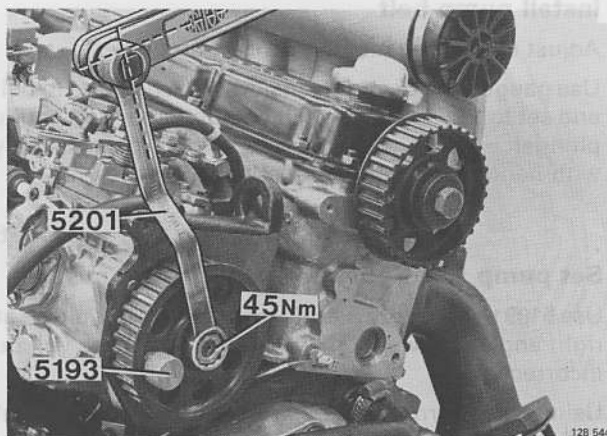
Remove pump from rear mounting bracket (Allen key = 6 mm).

AG. Injection pump, installation

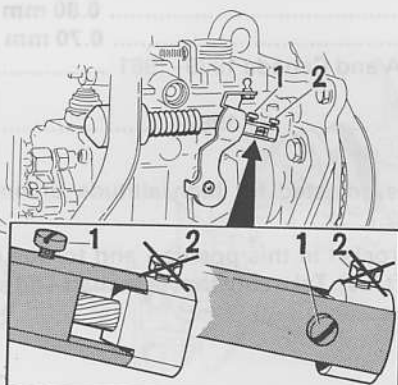
Special tools: 5193, 5194, 5197, 5199, 5201



128 182



128 544



Connected Disconnected

AG1

Position injection pump

Mount pump on engine and secure it with retaining bolts and front mounting bracket. Do not tighten bolts fully at this stage.

Align mark in pump with mark in mounting bracket. Then tighten retaining bolts for pump – mounting bracket.

AG2

Install pump gear

Do not forget to place key in pump axle. Install gear, washer and nut.

Torque nut to **45 Nm** (33 ft lbs).

Use **5193** to hold sprocket and **5201** to tighten nut. Torque wrench should be at right angles to wrench 5201, otherwise torque will be incorrect.

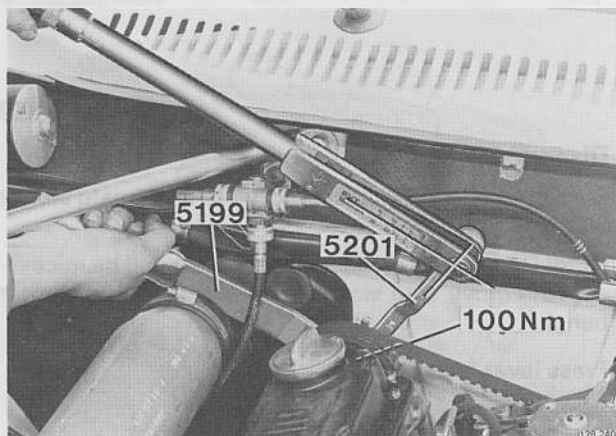
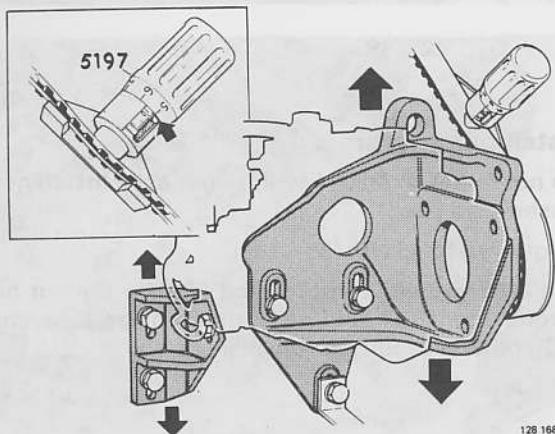
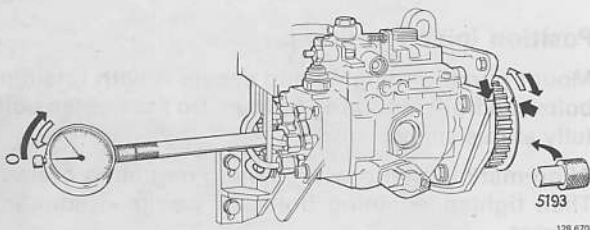
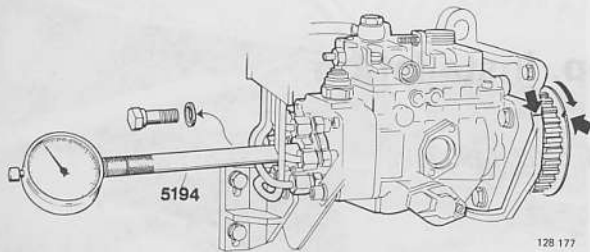
AG3

Disconnect cold start device

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.

Press lever back against stop.



AG4

Set dial indicator zero. Lock pump gear at cyl. 1 injection using stop 5193

Unscrew and remove plug from injection pump distributor.

Install holder **5194** and dial indicator (measuring range 0–3 mm). Set gauge to approx. 2 mm.

Turn pump gear clockwise until mark on gear and mounting bracket coincide.

Then turn pump gear back slightly until min reading registers on dial indicator. Set indicator to zero.

Turn pump gear clockwise until mark on gear and pump mounting bracket coincide. Lock gear in this position with stop 5193. (Insert stop through pump gear into mounting bracket.)

AG5

Install pump belt

Adjust tension by moving coolant pump.

Use gauge **5197** to check tension. Attach gauge to belt and set to **12.5** units. Stretch belt until mark on gauge plunger is flush with sleeve. Depress belt strongly with hand and recheck/adjust tension.

AG6

Set pump and tighten camshaft rear sprocket

Use **5199** to hold sprocket. Torque wrench should be at right angles to wrench **5201** otherwise torque will be incorrect.

Using **5199**, turn sprocket slowly clockwise until dial indicator shows:

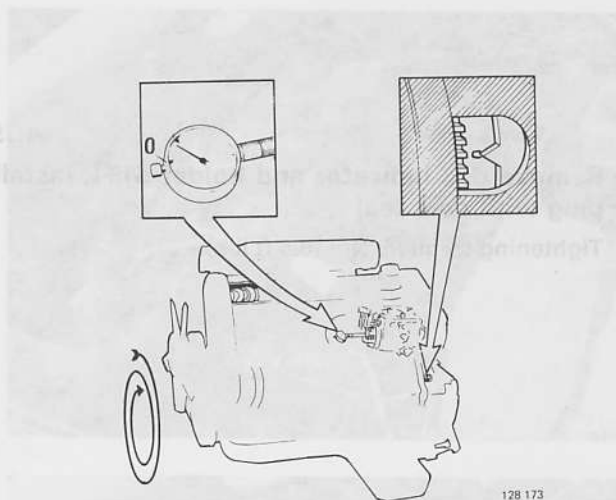
D20	0.80 mm (0.0315 in)
D24	0.70 mm (0.0276 in)
D24 USA and Canada 1979–1981	0.70 mm (0.0276 in)
1982-	0.85 mm (0.0335 in)

(Vehicles adjusted for high altitude driving: refer to page 132.)

Hold sprocket in this position and torque bolt to **100 Nm** (73 ft lbs). Take care that camshaft and sprocket do not move.

AG7

Remove stop 5193 from pump gear

**Check pump setting**

Turn engine two full turns until cyl. 1 is at TDC-injection, again. If engine is turned too far it must be turned back approx. 1/4 turn and then to 'O' mark otherwise setting will be incorrect.

Dial indicator should show:

D20	0.75–0.83 mm (0.0295–0.0327 in)
D24	0.65–0.73 mm (0.0256–0.0287 in)
D24 USA and Canada 1979–1981	0.65–0.73 mm (0.0256–0.0287 in)
1982-	0.82–0.90 mm (0.0323–0.0354 in)

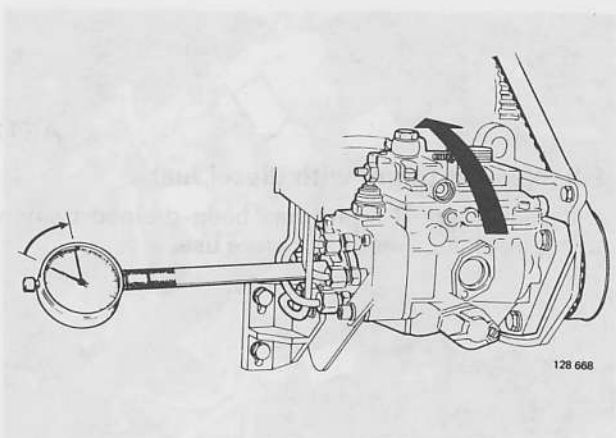
Correct reading: Tighten injection pump mounting bolts. Proceed to AG9.

Incorrect reading: Readjust according to instructions below.

Readjusting pump setting:

Setting values:

D20	0.80 mm (0.0315 in)
D24	0.70 mm (0.0276 in)
D24 USA and Canada 1979–1981	0.70 mm (0.0276 in)
1982-	0.85 mm (0.0335 in)

**Reading less than specified:**

Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump setting.

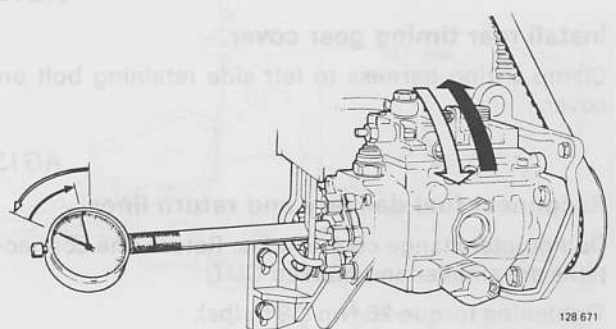
Reading more than specified:

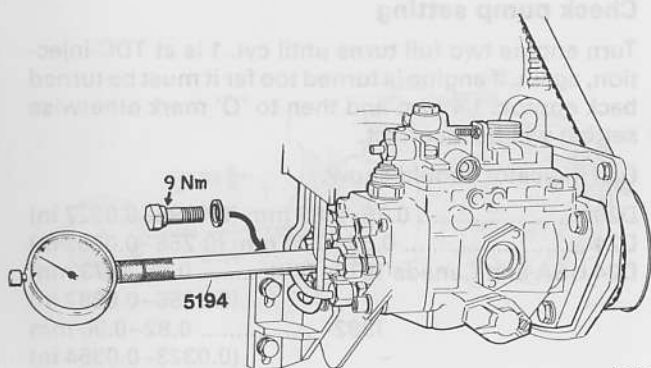
Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows **approx**:

D20	0.70 mm (0.0276 in)
D24	0.60 mm (0.0237 in)
D24 USA and Canada 1979–1981	0.60 mm (0.0237 in)
1982-	0.75 mm (0.0295 in)

Then turn pump inwards until specified value is obtained. Tighten mounting bolts and recheck pump setting.

Important! Injection pump must not be tapped or knocked as this will alter its setting.



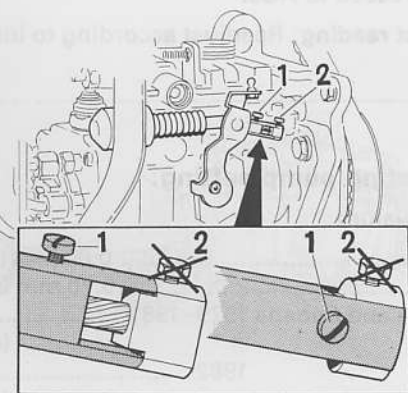


128 174

AG9

Remove dial indicator and holder 5194. Install plug with new seal

Tightening torque 9 Nm (6.5 ft lbs).



Connected

Disconnected

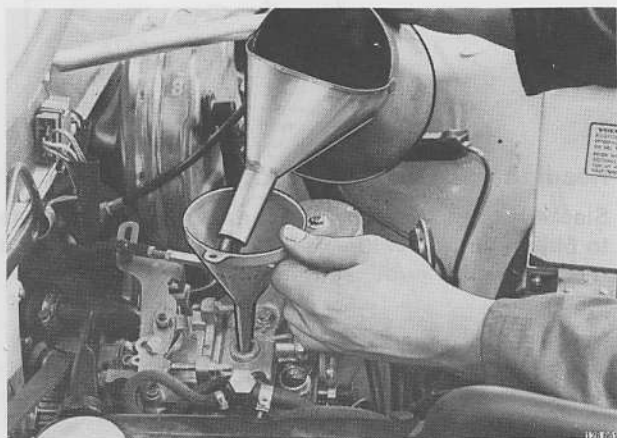
128 169

AG10

Connect cold start device

Press lever forward and turn sleeve 90°. Retighten screw 1.

Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.

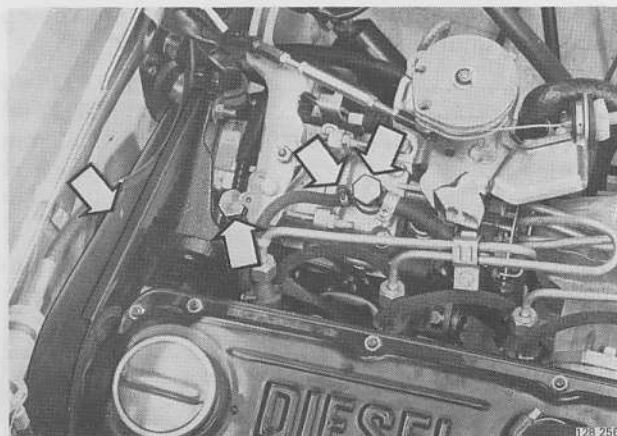


128 165

AG11

Fill injection pump with diesel fuel

Only necessary if pump has been drained or new pump installed. Filter fuel before use.



128 256

AG12

Install rear timing gear cover

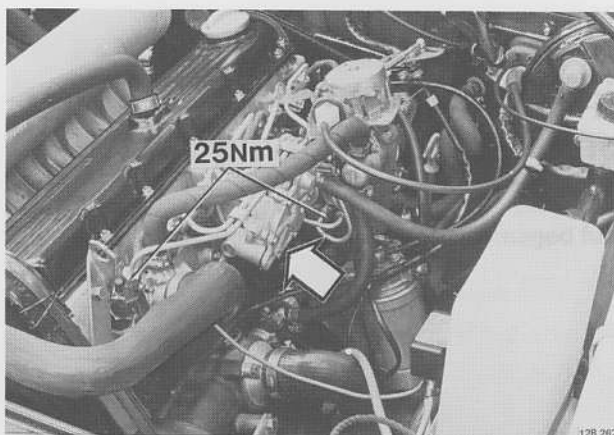
Clamp wiring harness to left side retaining bolt on cover.

AG13

Reconnect fuel delivery and return lines

Do not interchange connections. Return line connections are smaller and marked OUT.

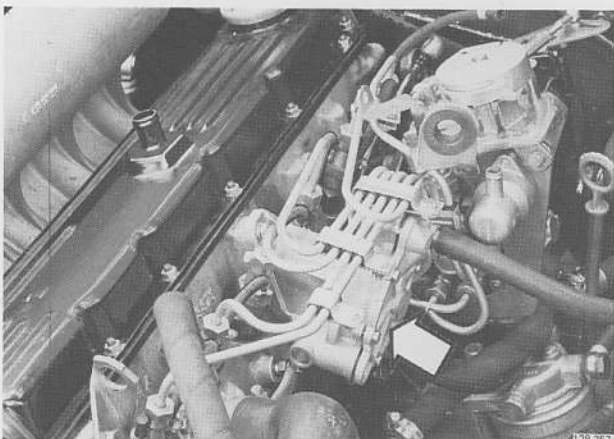
Tightening torque 25 Nm (18 ft. lbs).



Reconnect fuel delivery pipes

Tightening torque 25 Nm (18 ft lbs).

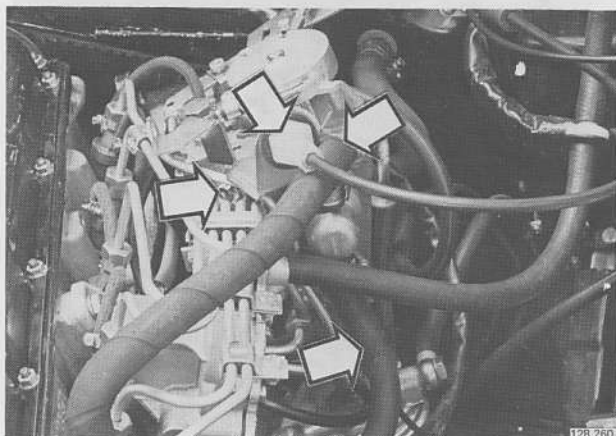
AG14



Install plunger and vacuum pump

Check O-ring, replace if necessary.

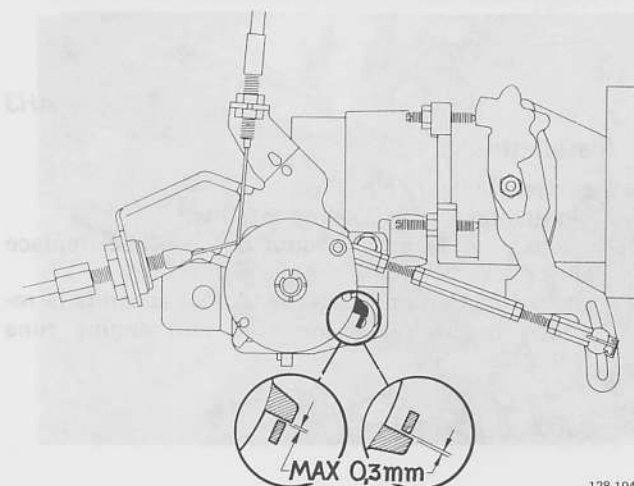
AG15



Connect:

- hoses to cold start device. Remove clamping pliers
- wire to fuel valve
- throttle cable and kick-down cable (auto)

AG16

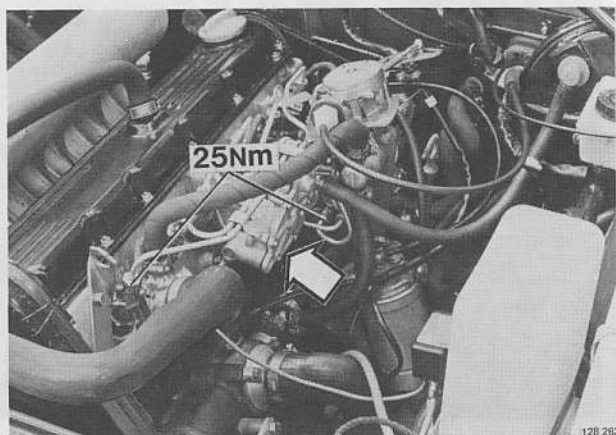
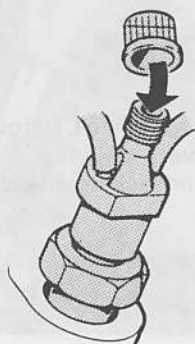
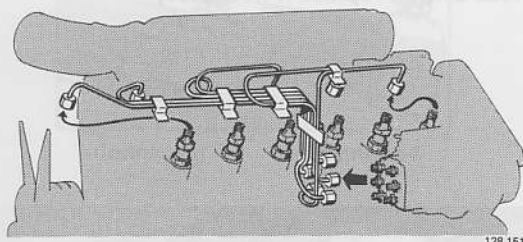
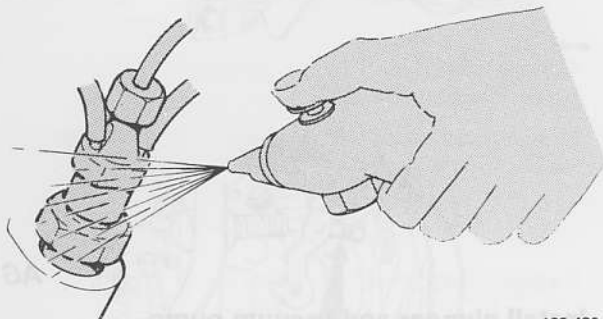


Set throttle control

See instruction on page 176, operations AX1-AX9.

AG17

AH. Fuel delivery pipes, replacement



AH1

Clean all connections thoroughly

AH2

Remove

- vacuum pump and pump plunger
- delivery pipes.

Important

Blank off ports and pipes to prevent entry of dirt.

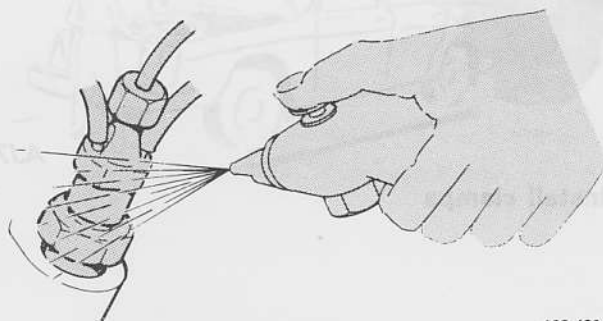
AH3

Installation

- connect delivery pipes.
Tightening torque 25 Nm (18 ft. lbs.)
- pump plunger and vacuum pump. Check/replace O-ring.
- check function and security. A few seconds is required before pipes are bled and engine runs smoothly.

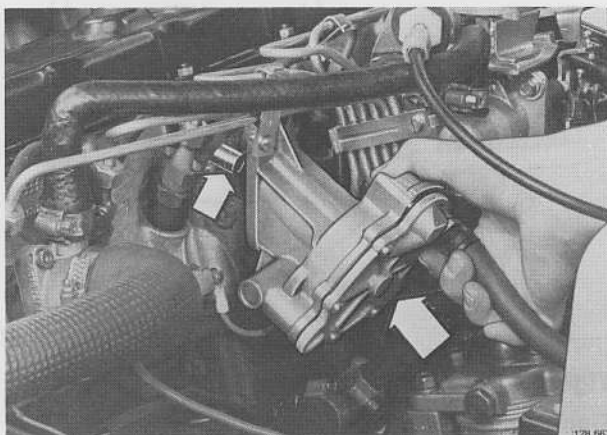
AJ. Delivery pipes, replacement of one or more pipes

(Do not attempt to weld or repair damaged fuel delivery pipes. Damaged pipes must be replaced.)



133 480

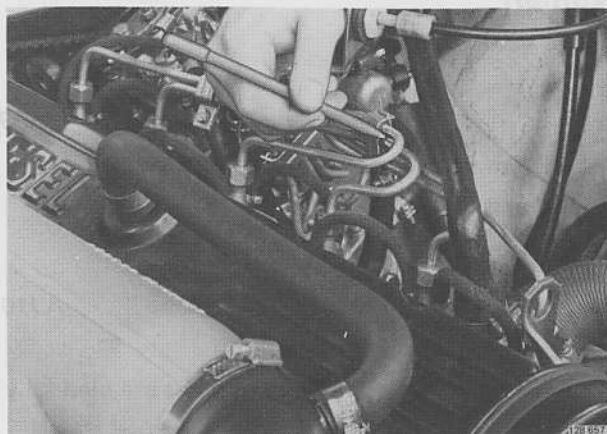
Clean all connections carefully. Blow-dry pipes



128 663

Remove vacuum pump and pump plunger

Remove pump retaining bolts. Place pump on wheelarch and withdraw plunger from cylinder head.



128 657

Mark position of clamps on pipes

Location of clamps is important. Incorrectly located clamps can cause vibrations and fuel supply problems may result.

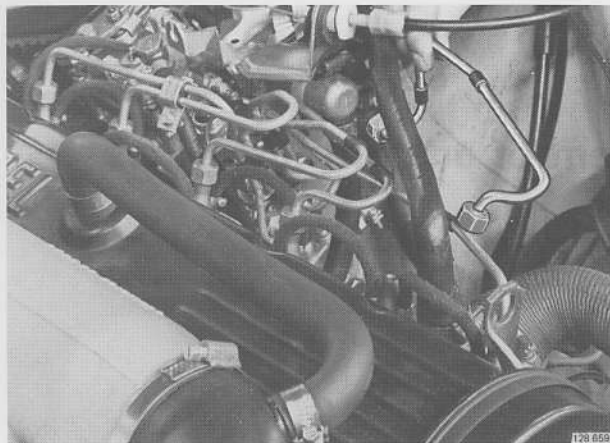
Disconnect all pipes

AJ1

AJ2

AJ3

AJ4



AJ5

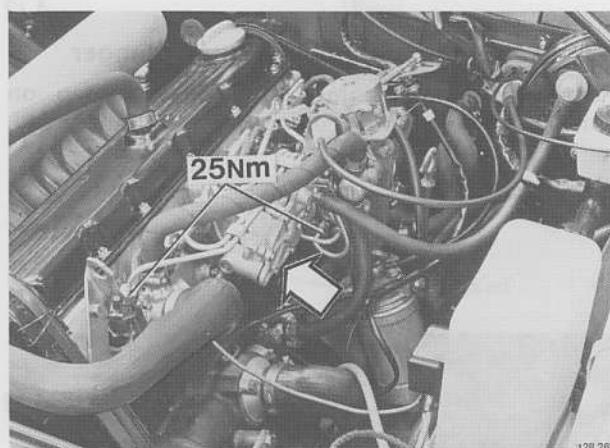
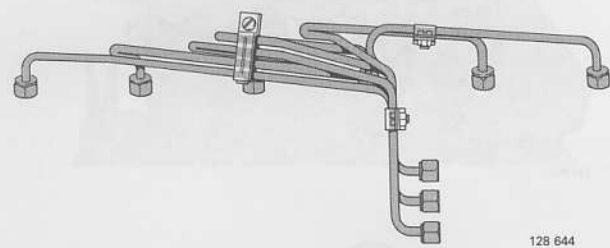
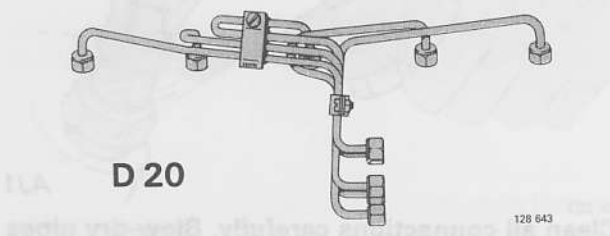
Remove clamps securing pipe(s) to be replaced

AJ6

Replace pipe

Do not tighten connections at this stage.

Check position of rubber sleeve on pipe.



AJ7

Install clamps

AJ8

Tighten pipe connections

Tightening torque 25 Nm (18 ft. lbs.)

AJ9

Install pump plunger and vacuum pump

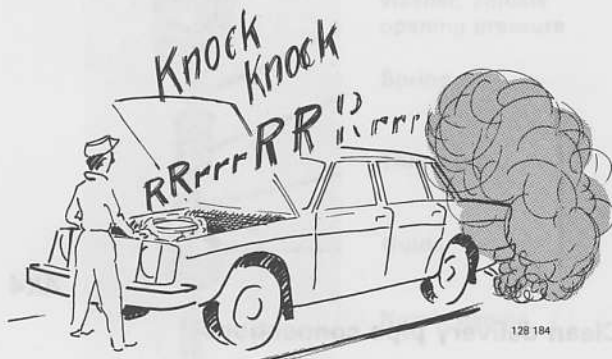
Check/replace O-rings.

AJ10

Check operation and leakage

A few seconds is required before pipes are bled fully and engine runs smoothly.

AK. Injectors

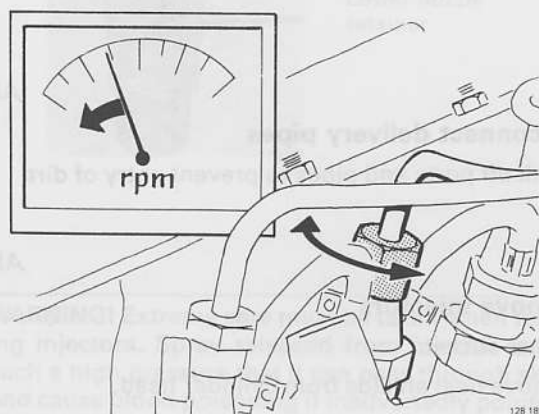


AK1

Malfunctions

Listed below are malfunctions which can occur if one or more of the injectors is defective.

- one or more of cylinders knock.
- Note!** Do not confuse this with bearing clatter. Check injector operation.
- overheating
- power loss
- uneven idle
- black exhaust smoke
- excessive fuel consumption.



AK2

Checking injection operation

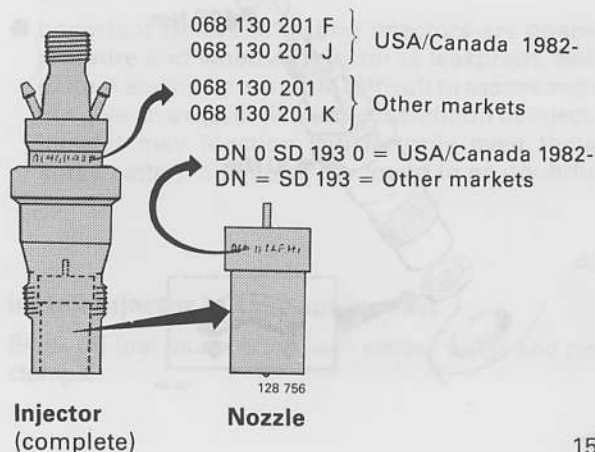
1. Run engine at above idle speed
2. Loosen cap nuts on injectors one at a time. Wrap absorbing paper around injectors to prevent spillage.

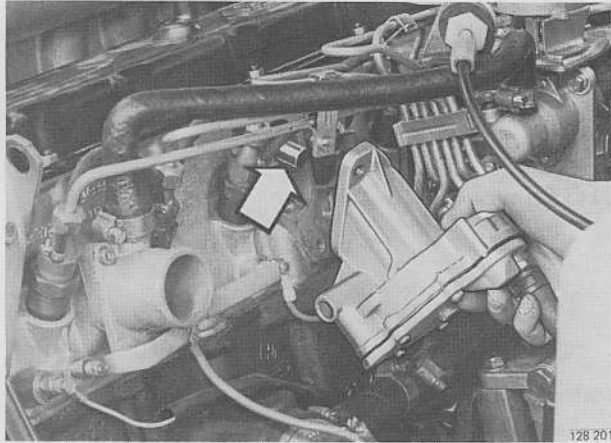
If engine speed remains constant or if knocking disappears, fault may be:

- defective injector
- defective heat shield
- leaking delivery pipe.

Removing injectors

See specifications for identification of injector type.





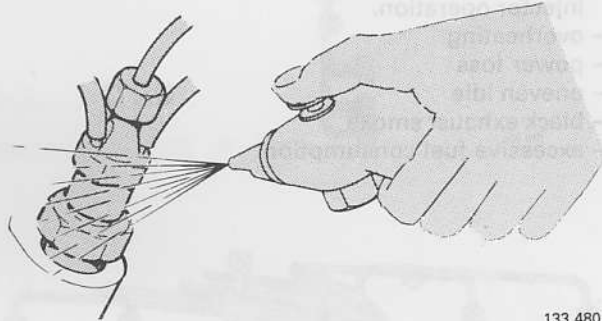
128 201

AK3

Remove vacuum pump and pump plunger

Remove pump retaining nuts and place pump on wheelarch.

Withdraw plunger from cylinder head.

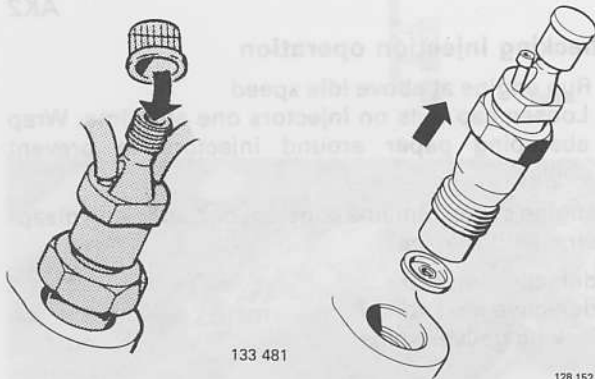


133 480

AK4

Clean delivery pipe connections

Clean all connections thoroughly before disconnecting pipes.



133 481

128 152

AK5

Disconnect delivery pipes

Blank off ports and pipes to prevent entry of dirt.

AK6

Remove injectors

27 mm socket.

Remove heat shields from cylinder head.

Installing injectors

AK7

Position injectors

Remove soot etc. from sealing surfaces.

Place new heat shields in cylinder head, see fig. Torque injectors to 70 Nm (50 ft. lbs.).

AK8

Reconnect delivery pipes

Tightening torque 25 Nm (18 ft. lbs.).

AK9

Install pump plunger and vacuum pump

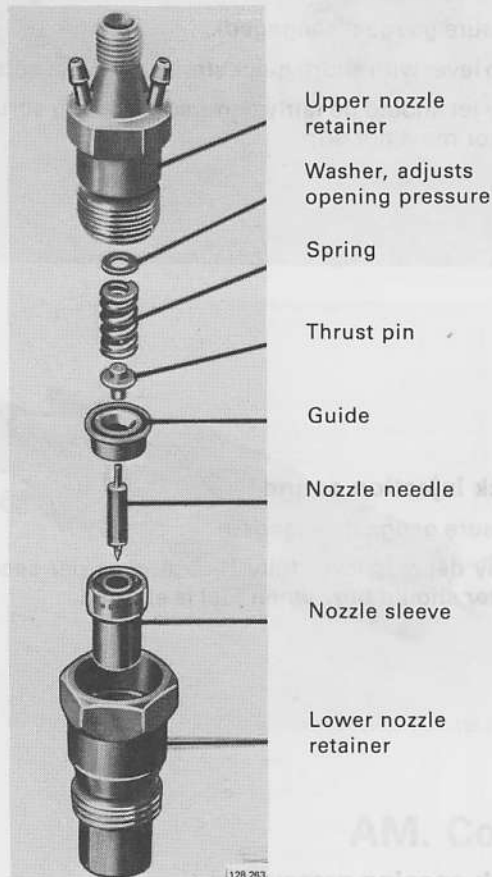
Check/replace O-ring.



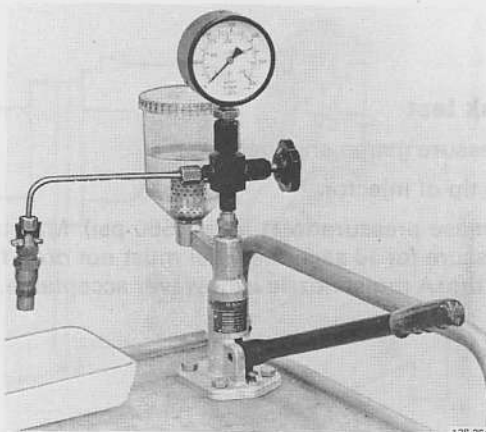
128 154

AL. Reconditioning injectors

Utmost cleanliness must be observed when working with injectors.



WARNING! Extreme care must be taken when testing injectors. Spray released from injector is at such a high pressure that it can pass through skin and cause blood poisoning if inadvertently pointed at body.



Disassembly

- clean outer surface of injector
- disassemble injector. Care must be taken to ensure that parts do not fall onto bench or floor. If nozzle needle is dropped it must not be reused
- immerse parts in clean diesel fuel as soon as they are removed
- do not interchange parts

AL1

Cleaning, checking

- clean all parts with clean diesel fuel
- use nozzle cleaner equipment to clean nozzle needle and sleeve
- replace damaged parts. Nozzle needle and sleeve are matched and must be replaced together.

AL2

Assembly

- wash off rustproofing compound from new parts with clean petrol/gasoline
- immerse parts in clean diesel fuel
- assemble injector. Torque to **70 Nm** (50 ft. lbs.).
- test injectors

AL3

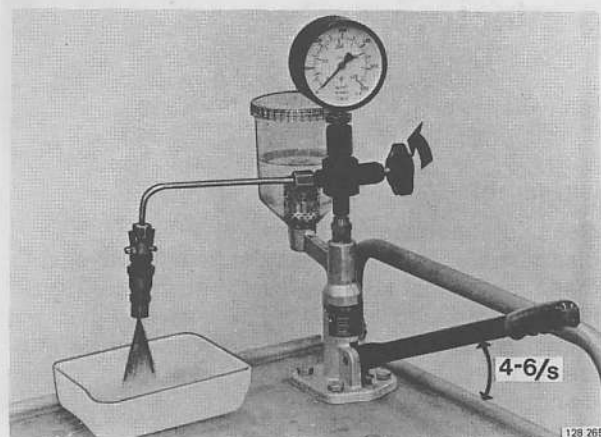
Testing

- Injectors should be tested with clean test oil or filtered diesel fuel. Under no circumstances may petrol/gasoline be used because of the risk of explosion.
- The use of suitable evacuation equipment to remove diesel fumes is law in certain countries (incl. Sweden).
- Important factors in testing injectors are opening pressure and whether injector is leakproof. Spray pattern and noise are more difficult to assess and do not give an exact indication of condition of injector. Injector may function satisfactorily even though spray pattern and noise are found to be doubtful.

AL4

Install injector in test equipment

Blank off fuel return pipes with rubber plugs and hose clamps.



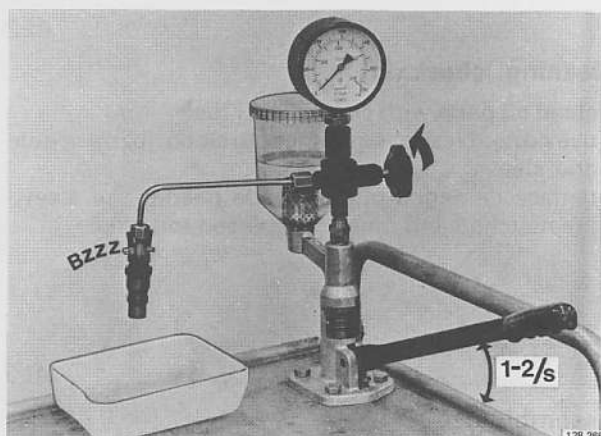
AL5

Check spray pattern

(Pressure gauge disengaged).

Pump lever with short, quick strokes (4–6 per second).

Spray jet should be fairly compact and stop abruptly. Injector must not drip.

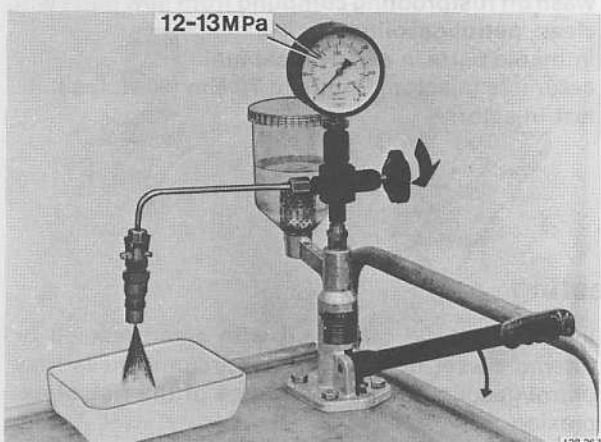


AL6

Check injection sound

(Pressure gauge disengaged).

Slowly depress lever fully (1–2 strokes per second). Injector should buzz when fuel is emitted.



AL7

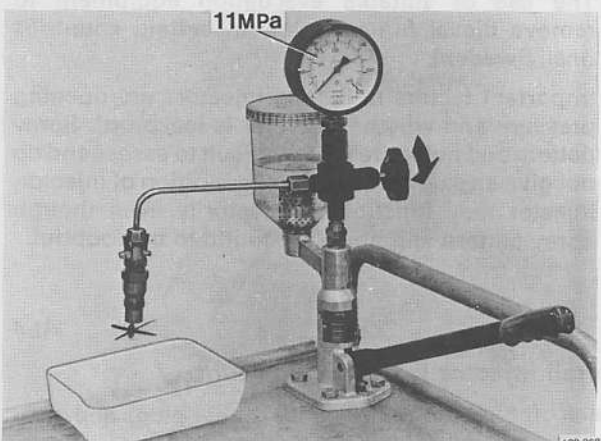
Check opening pressure

(Pressure gauge engaged.)

Slowly depress lever and check opening pressure.

Opening pressure check value: **12–13 MPa** (1700–1850 psi).

If incorrect, leak test before adjusting pressure.



AL8

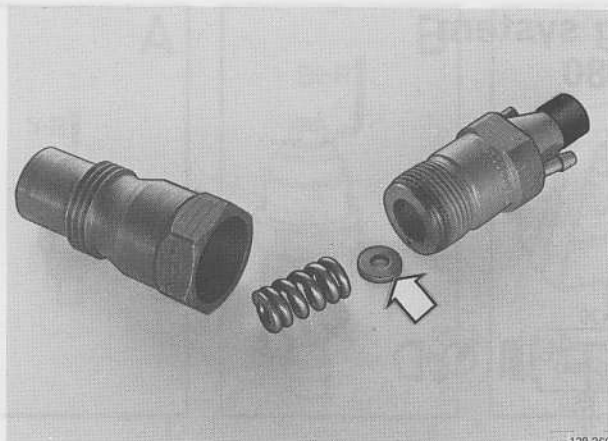
Leak test

(Pressure gauge engaged)

Dry tip of injector.

Increase pressure to **11 MPa** (1560 psi). Maintain this pressure for 10 seconds. Fuel must not drop from injectors. A moist nozzle is however acceptable.

L9



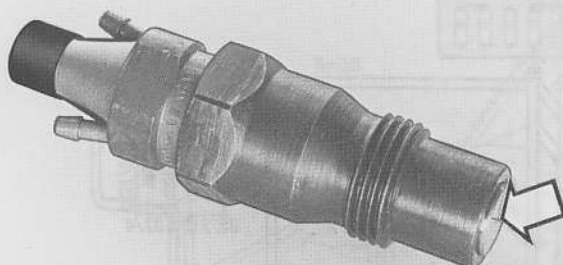
Adjusting opening pressure

Setting value = **12.5–13.5 MPa** (1780–1920 psi).

Remove injector from test equipment. Disassemble injector and adjust opening pressure by replacing washer (shim).

- to **increase** opening pressure = fit a **thicker** washer.
- to **decrease** opening pressure = fit a **thinner** washer.
- **0.05 mm** change in thickness is equivalent to approx. **5 kPa** (7 psi).
- shims are available in following sizes: 1.00–1.95 mm at 0.05 mm increments.

Reassemble injector. Torque to **70 Nm** (50 ft. lbs.). Retest injector.



AL10

Remove injector from test equipment

Cover end with protective cap.

Take care not to damage nozzle when installing injector.

AM. Cold start device

AM1

General

Cold start device may only be adjusted on a special test bench, when connected to injection pump.

However a service check can be carried out on an installed injection pump.

Note! If cold start device does not function the following will occur

- cold starting difficulties
- blue-white exhaust smoke
- engine will not start at temperatures below -10°C (-14°F).

AM2

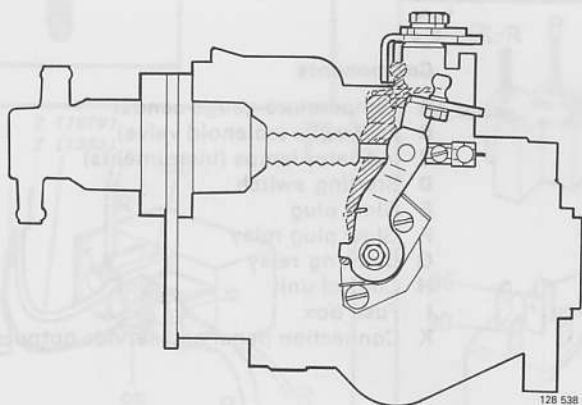
Operation check

Measure idle speed when engine is cold and hot.

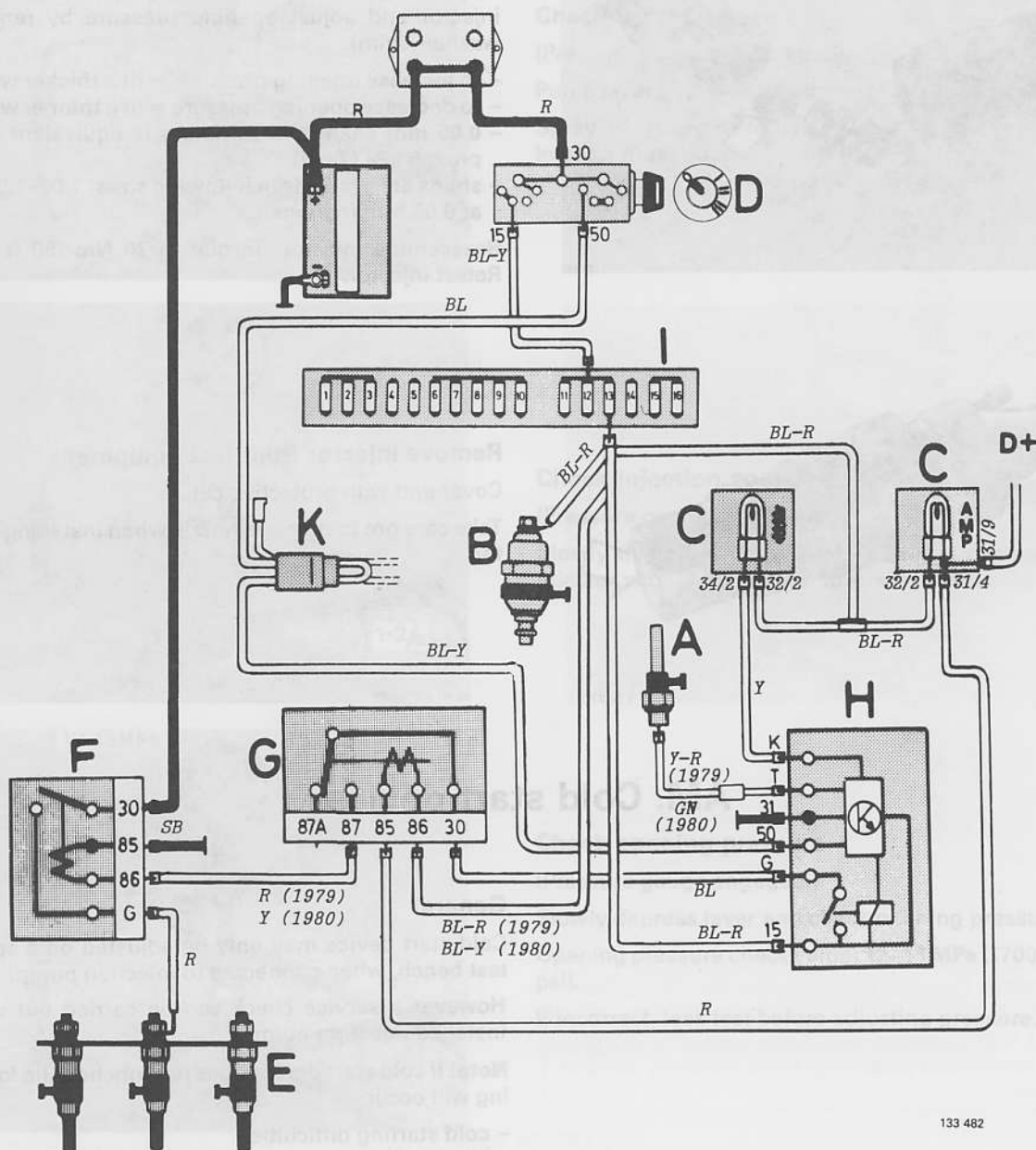
Cold engine (below 20°C = 68°F) = approx. 3.3 r/s (200 r/min) more than warm engine idle.

With warm engine, lever on cold start device should not contact lever on injection pump.

Idle speed (warm engine) = 12.5 r/s (750 r/min).



AN. Preheating system 1979–1980



133 482

Fuse No. 13

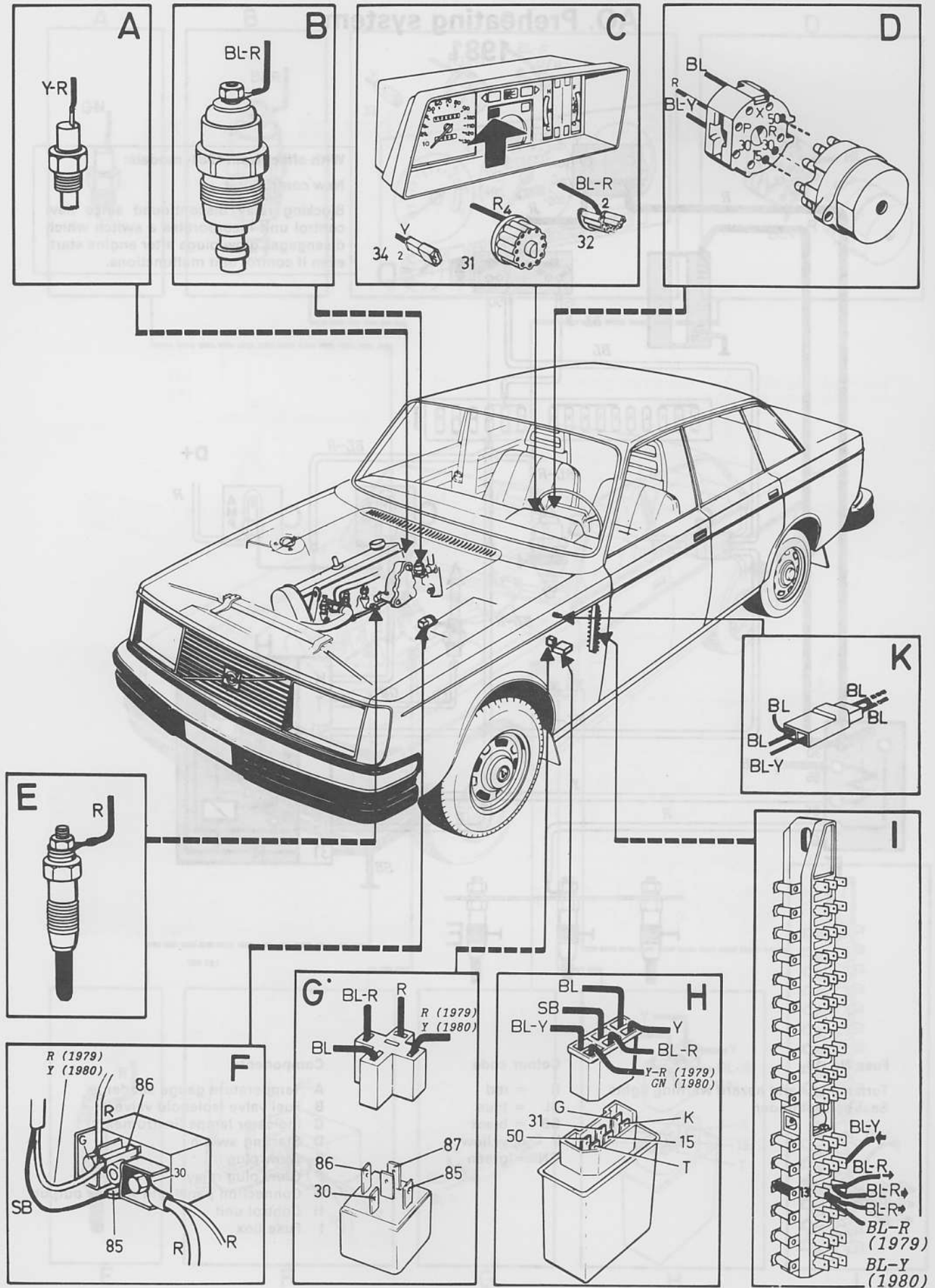
Preheating system
Fuel valve (solenoid valve)
Indicator lamps for instruments

Colour code

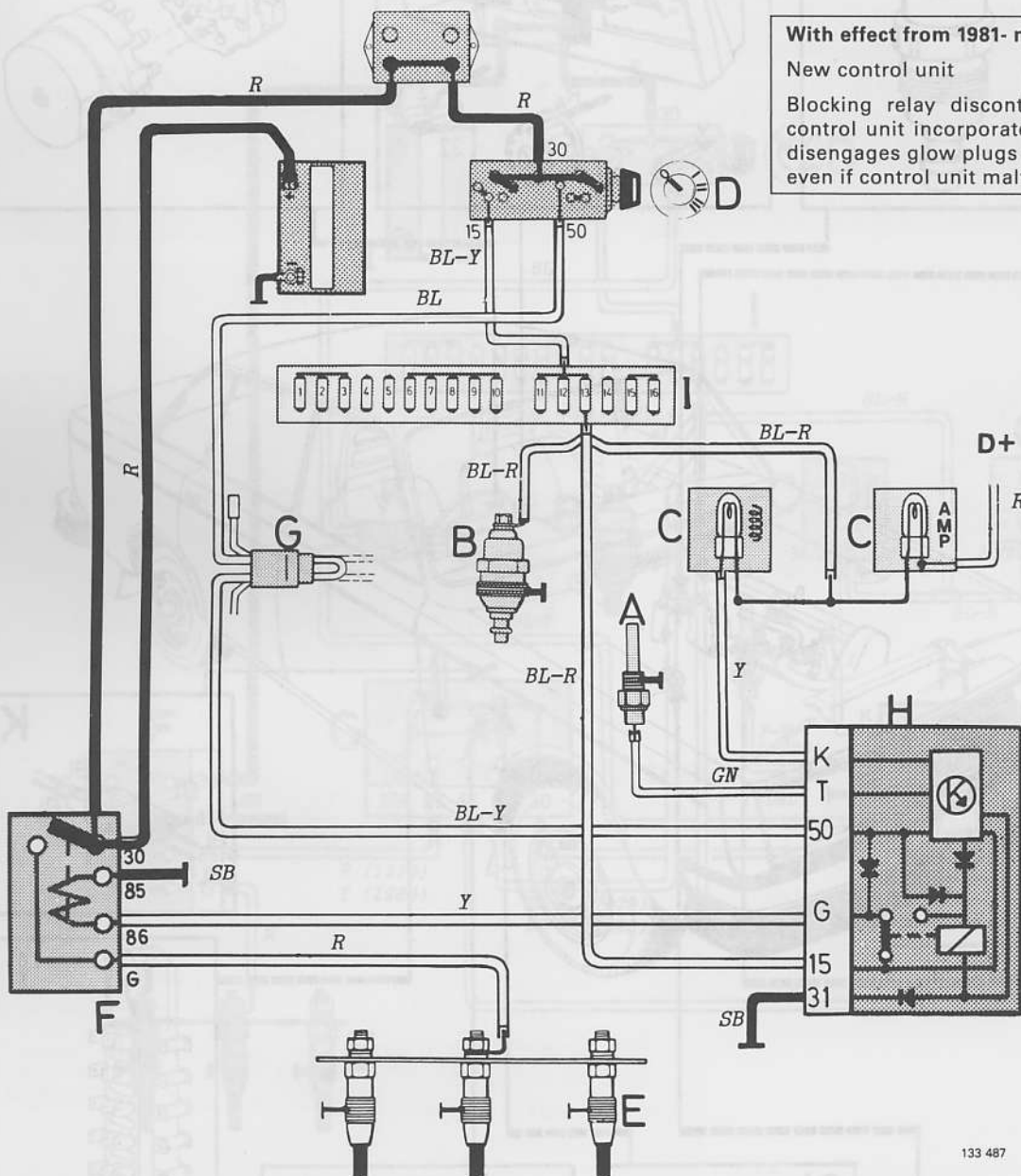
R = red
BL = blue
SB = black
Y = yellow
GN = green

Components

A Temperature gauge sender
B Fuel valve (solenoid valve)
C Indicator lamps (instruments)
D Starting switch
E Glow plug
F Glow plug relay
G Blocking relay
H Control unit
I Fuse box
K Connection panel and service output



AO. Preheating system 1981



With effect from 1981- models:

New control unit

Blocking relay discontinued since new control unit incorporates a switch which disengages glow plugs after engine start, even if control unit malfunctions.

Fuse No. 13

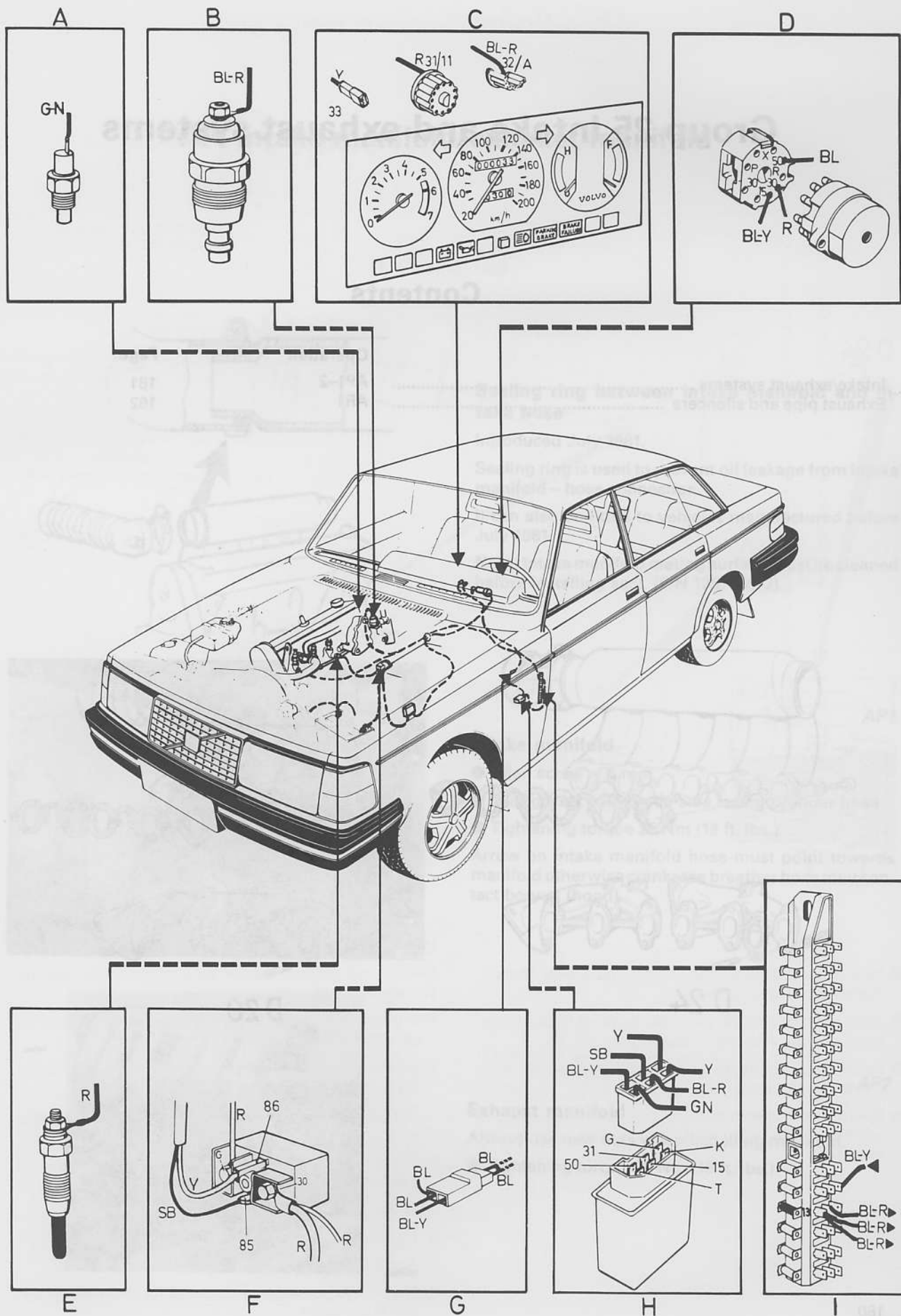
Turn signals and hazard warning lights
Seat belt reminder

Colour code

R = red
BL = blue
SB = black
Y = yellow
GN = green

Components

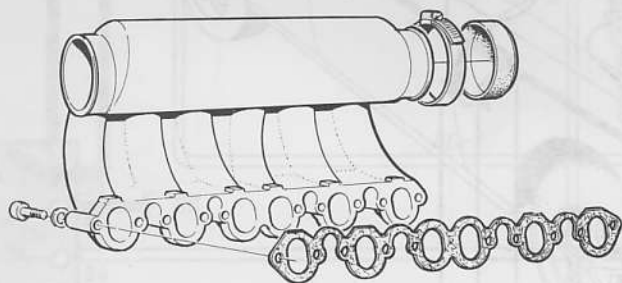
A Temperature gauge sender
B Fuel valve (solenoid valve)
C Indicator lamps (instruments)
D Starting switch
E Glow plug
F Glow plug relay
G Connection panel and service output
H Control unit
I Fuse box



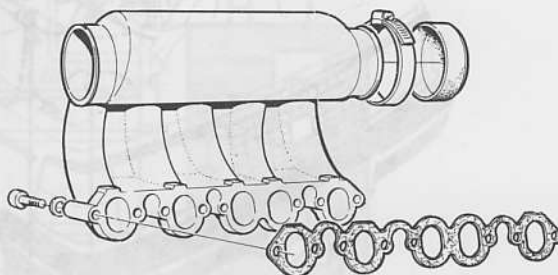
Group 25 Intake and exhaust systems

Contents

	Operation	Page
Intake/exhaust systems	AP1-2	161
Exhaust pipe and silencers	AR1	162

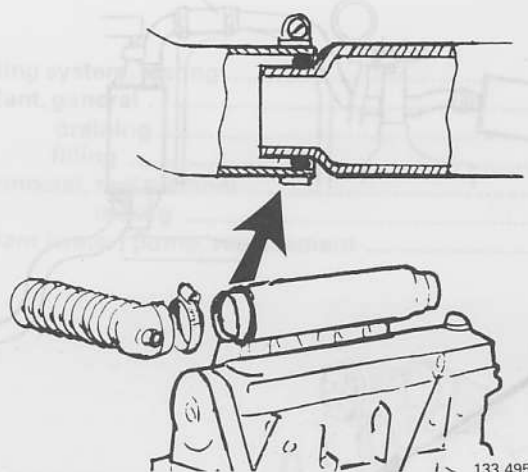


D 24



D 20

AP. Intake manifold/exhaust manifold



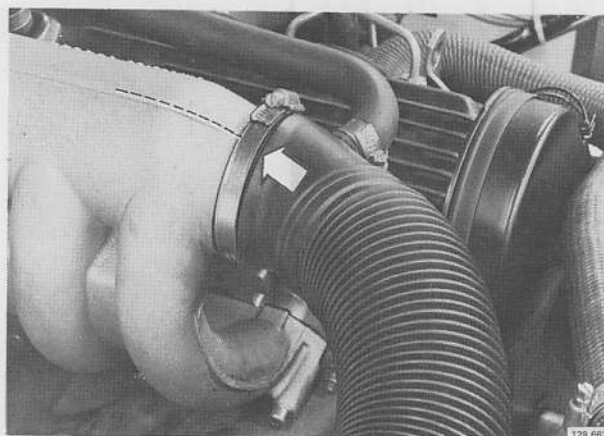
Sealing ring between intake manifold and intake hose

Introduced July 1981.

Sealing ring is used to prevent oil leakage from intake manifold – hose connection.

It can also be fitted to vehicles manufactured before July 1981.

Note! Intake manifold mating surface must be cleaned before installing seal. (P/N 1257809-2).

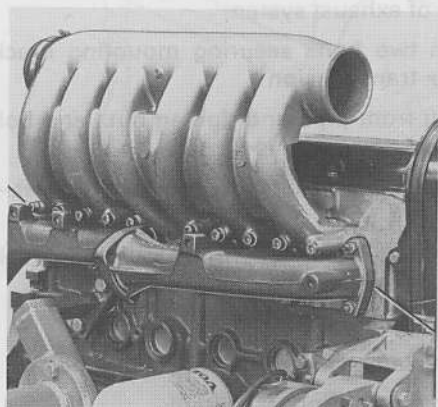


Intake manifold

- Allen screw = 6 mm
- Turn gasket with green side facing cylinder head
- Tightening torque 25 Nm (18 ft. lbs.)

Arrow on intake manifold hose must point towards manifold otherwise crankcase breather hose may contact bonnet (hood).

AP1



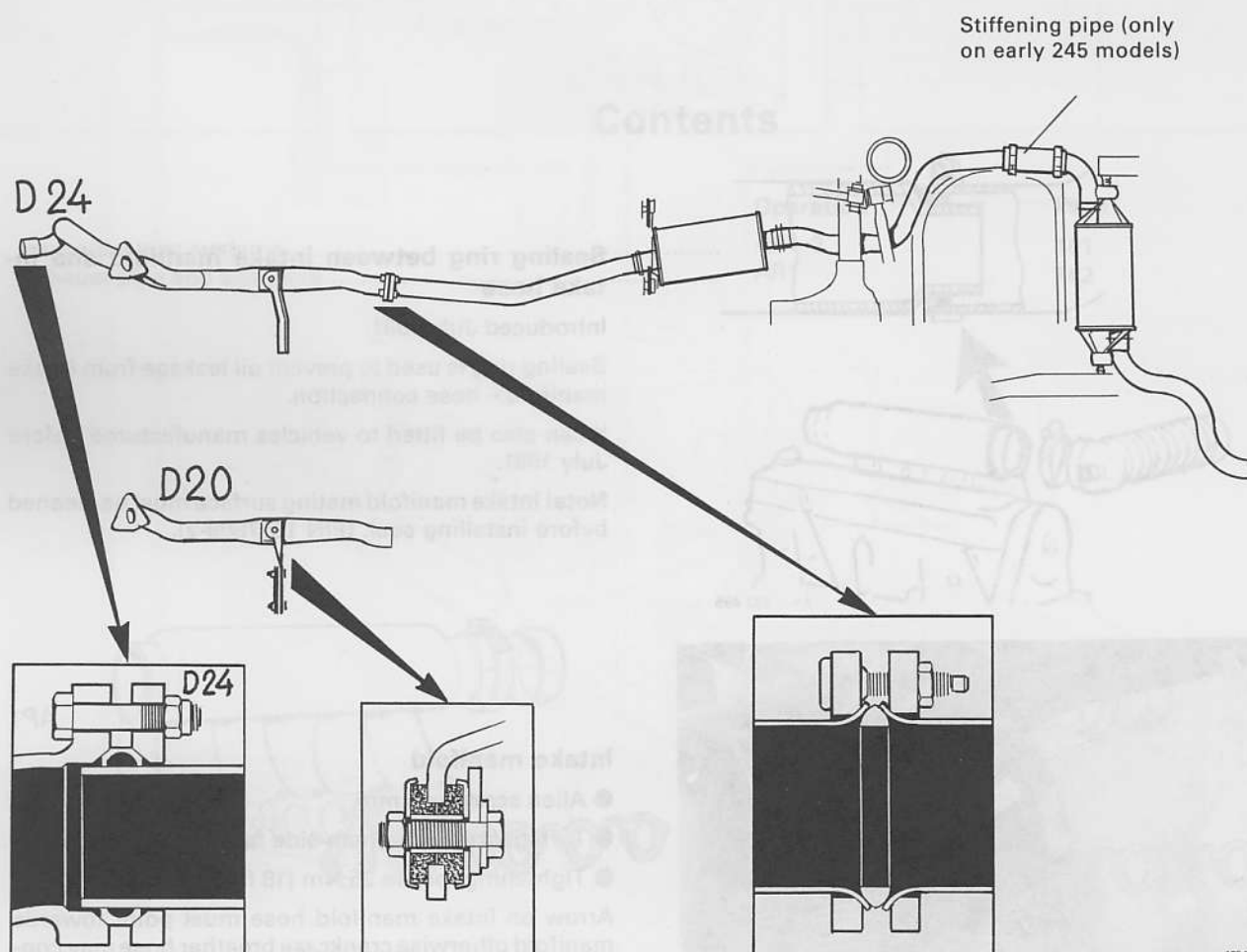
Exhaust manifold

Always use new nuts when installing manifold.

- Tightening torque 25 Nm (18 ft. lbs.)

AP2

AR. Exhaust system



128 688

AR1

- New seals should be used throughout when installing new exhaust systems.
- Steel seals in flexible joint and exhaust branch pipe need only be replaced if damaged.
- Exhaust pipes must be inserted approx. 40 mm (1.6 in) in silencers
- Clearance between exhaust pipe and body should not be less than 20 mm (0.8 in). Rear silencer is marked "IN".

Installing complete exhaust system

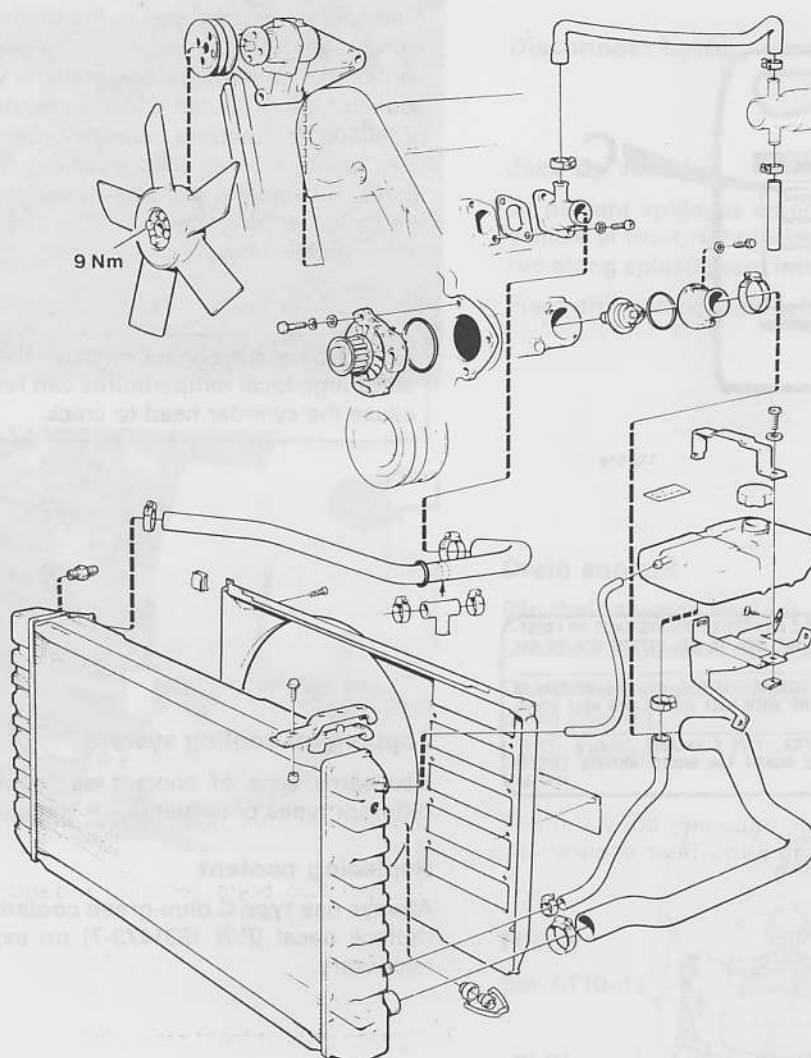
Follow instructions below to ensure stress-free installation of exhaust system

1. Slacken two bolts securing mounting bracket to gearbox transmission.
2. Position front pipe and tighten nuts and bolts for front pipe – branch pipe.
3. Tighten retaining bolts for mounting bracket – front pipe.
4. Tighten two bolts securing mounting bracket to gearbox transmission.
5. Align complete exhaust system.
6. Tighten clamps joining silencers to pipes.
7. Tighten nuts at front pipe joint.
8. Ensure that exhaust system cannot strike body, adjust if necessary.

Group 26 Cooling system

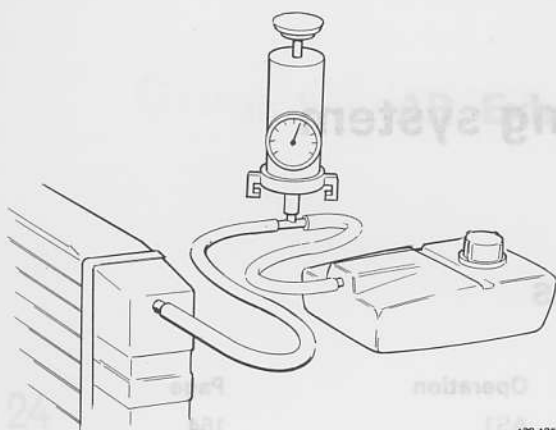
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Coolant, general	AT1	164
draining	AT2-9	165
filling	AT10-12	167
Thermostat, replacement	AU1	168
testing	AU2	168
Coolant (water) pump, replacement	AV1-23	169



133 494

AS. Cooling system testing



128 186

AS1

Connect test pump between radiator and expansion tank as shown adjacent.

Increase pressure and check opening pressure of expansion tank cap. Also check for leakage.

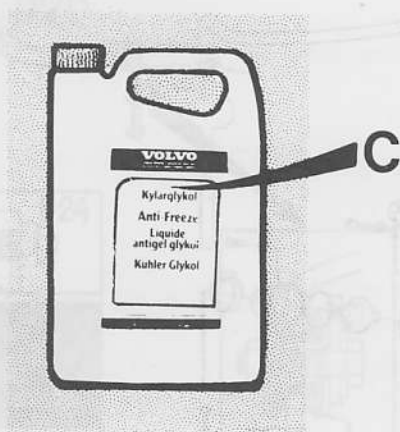
Opening pressure: Type 1: 65–85 kPa (9–12 psi). Type 2 (introduced spring 1982): 100 kPa (14 psi).

Pressure should remain constant for at least 30 seconds.

AT. Coolant

AT1

Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage. Use genuine Volvo blue-green coolant type C, diluted with clean water in proportions of 50/50. This mixture helps to prevent corrosion and frost damage. Never fill the cooling system with water alone. The coolant should be changed regularly since the corrosion protective additives in the coolant lose their effect in time.



132 519

Note! Do not run engine when level of coolant is low since high local temperatures can result which may cause the cylinder head to crack.

VOLVO ORIGINAL KYLVATSKA TYP C ÄR PÅFYLLED KYLSYSTEMET ÄR FROSTSKYDDAT TILL -30°C. EFTERFYLL ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVATSKA TYP C.

FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

REPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

1297524

Topping-up cooling system

Use same type of coolant as before. Do not mix different types of coolants.

Replacing coolant

Always use **type C** blue-green coolant. Remember to replace decal (P/N 1331473-7) on expansion tank if necessary.



133 477

Replacing coolant

Cooling system need not be flushed when replacing type B coolant (blue) with type C (blue-green), since these coolants can be mixed.

However, since type A (red) and type C (blue-green) are not mixable it is necessary to flush cooling system prior to filling type C coolant.

Described below are two different methods for draining coolant, (1) with flushing and (2) without flushing, prior to filling type C coolant.

(1) Draining coolant without flushing cooling system

AT2

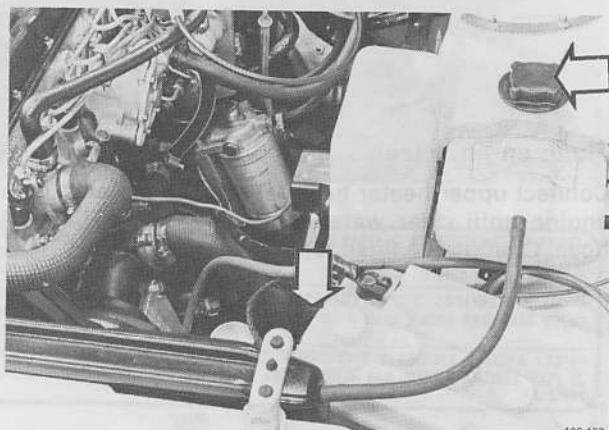
Disconnect battery ground lead

AT3

Jack-up vehicle

To prevent spillages when coolant is drained, raise vehicle at front right jacking point. Coolant will then run along splashguard into drip pan.

Place drip pan beneath left steering rod.



AT4

Drain coolant

(No drain taps on engine)

Unscrew expansion tank cap.

Disconnect lower radiator hose from radiator and drain coolant.

Lower vehicle.

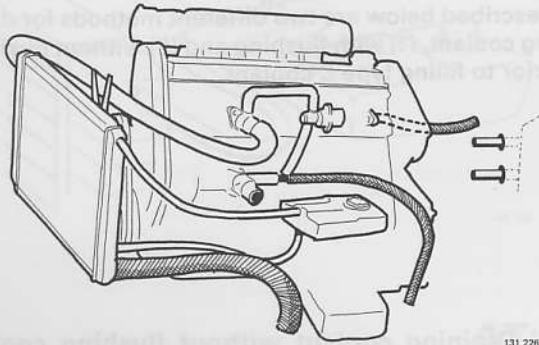
Filling

See AT10-12.

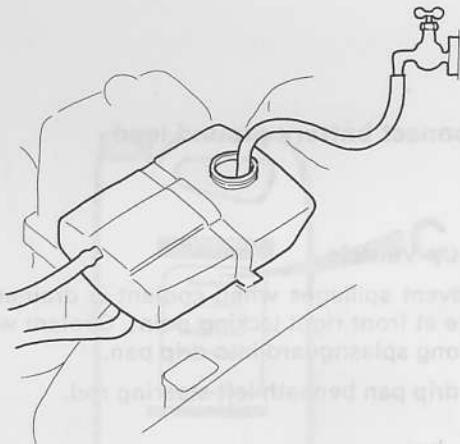
AS. Cooling system testing

Replacing coolant

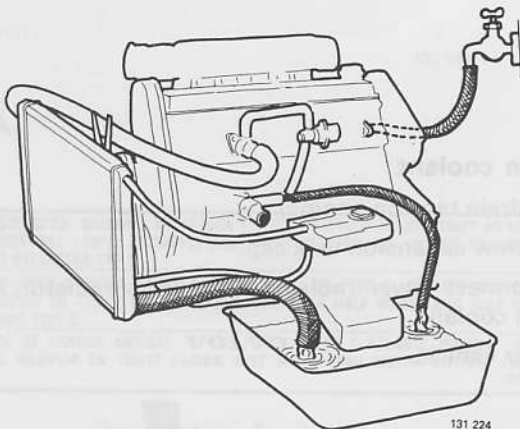
Cooling system must not be flushed when replacing. Type B coolant (blue) with type C (blue-green) or type C (blue-green) coolant can be mixed. However, type A (red) and type C (blue-green) are not mixable. It is necessary to flush cooling system prior to filling type C coolant.



131 226



131 225



131 224

Coolant, replacement

Draining and flushing cooling system

AT5

Drain cooling system

Place drip pan beneath left side of engine behind splashguard.

Disconnect lower radiator hose from thermostat housing.

Disconnect hoses from heater control valve (on firewall). Point lower hose down.

Flushing

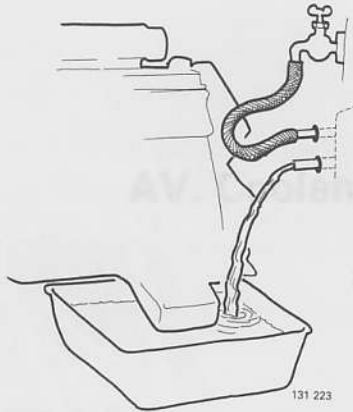
AT6

Flush expansion tank clean

AT7

Flush engine clean

Connect upper heater hose (at rear) to tap and flush engine until clear water appears at lower (heater) hose. Continue to flush for a further 2 minutes.



AT8

Flush heater clean

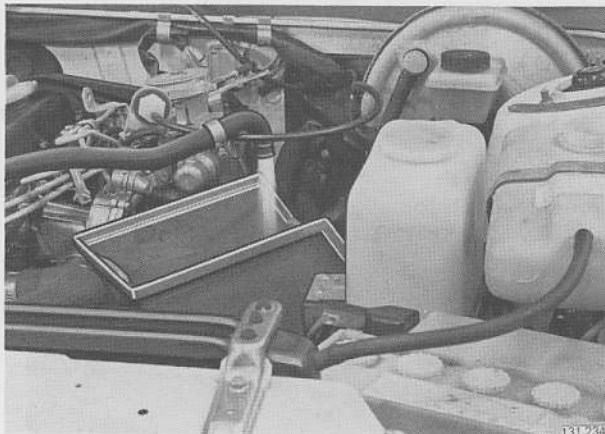
Set heater controls to MAX heat.

Connect upper pipe to tap and flush until clear water appears from lower pipe.

AT9

Reconnect all hoses

Water hose from thermostat housing is connected to lower pipe on heater control valve.



Filling

AT10

Bleeding of cooling system

Disconnect upper hose from cold start device. Place drip pan beneath hose and hold hose level with top level of expansion tank.



AT11

Fill coolant

Capacity: D 20 = 8.1 litres (8.6 US quarts)
D 24 = 9.3 litres (9.8 US quarts).

Set dashboard heater control to MAX. Add coolant through expansion tank cap.

Only **type C (blue-green)** coolant is to be used.

Turn on engine and warm-up for 5 minutes. (Expansion tank cap removed). Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap again.

VOLVO ORIGINAL KYLVATSKA TYP C ÄR PÅFYLLD. KYLSYSTEMET ÄR FROST-SKYDDAT TILL -30°C. EFTERFYLL ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVATSKA TYP C.

FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

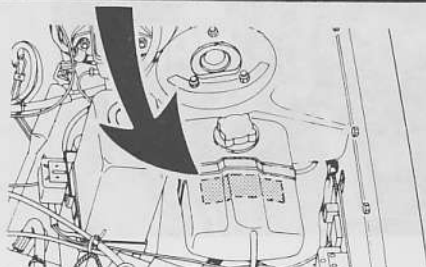
REPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

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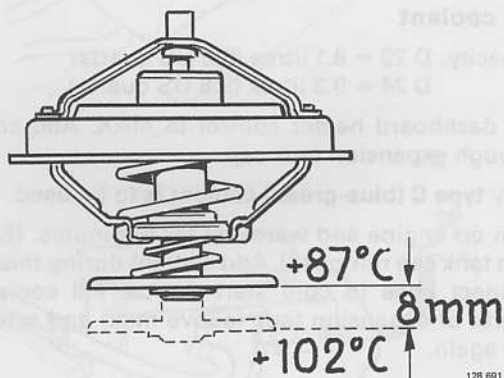
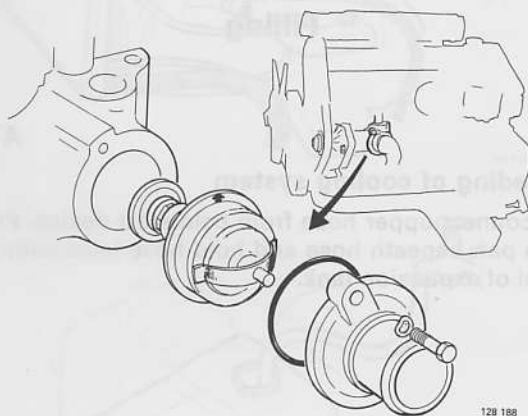
AT12

Replace decal

Attach new type C decal to expansion tank.



AU. Thermostat



Replacement

- replace thermostat and seal
- arrow on thermostat must point up

Testing

If necessary test thermostat in hot water.
Thermostat should:

- start to open at 87°C (188°F)
- be fully open at 102°C (216°F). Min opening gap = 8 mm (0.3 in).

AV. Coolant (water) pump, replacement

Special tools: 5187, 5188, 5197



AV1

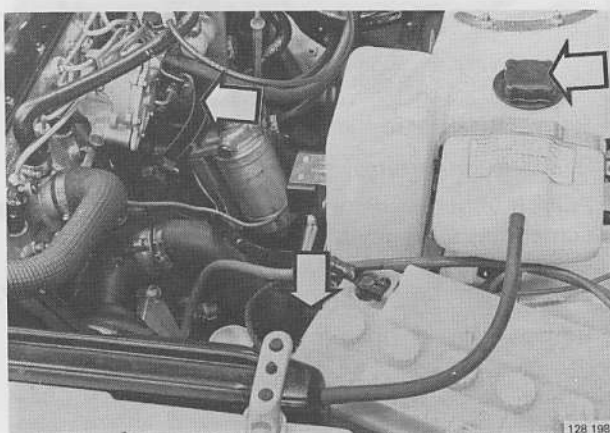
Disconnect battery ground lead

AV2

Jack-up vehicle

To prevent spillages when coolant is drained, raise vehicle at front right jacking point. Coolant will then run along splashguard into drip pan.

Place drip pan beneath left steering rod.



AV3

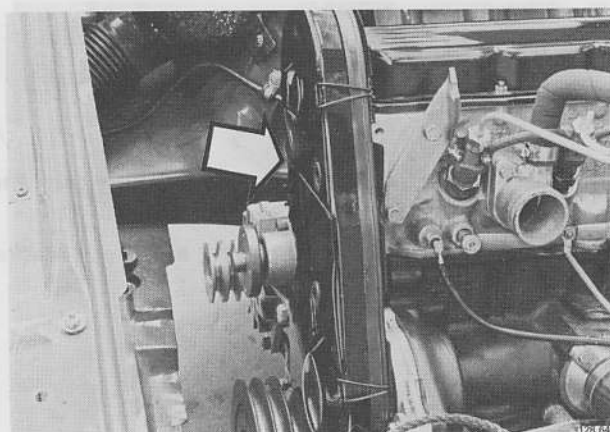
Drain coolant

(No drain taps on engine)

Unscrew expansion tank cap.

Disconnect lower radiator hose from radiator. Disconnect lower hose from thermostat for cold start device and drain coolant.

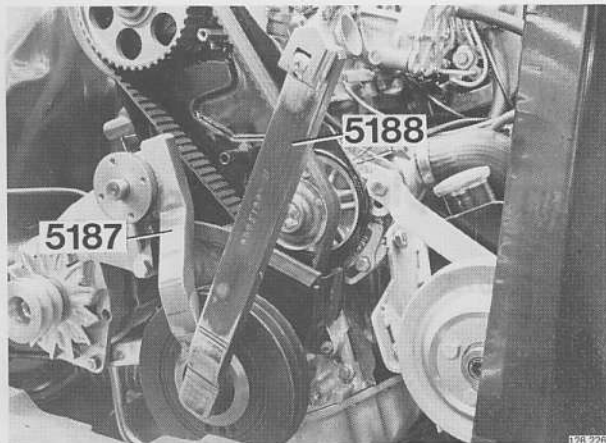
Lower vehicle.



AV4

Remove

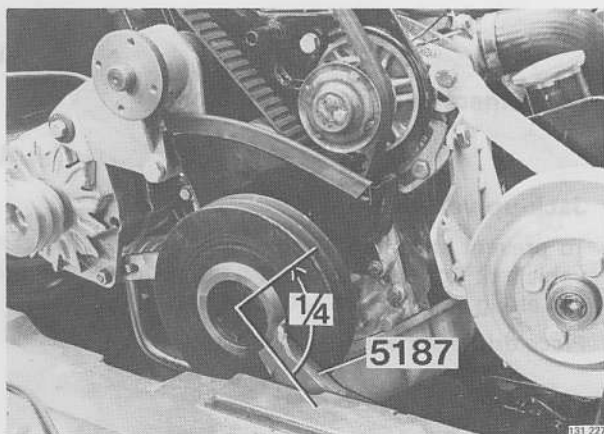
- radiator
- cooling fan with spacer and pulley
- fan belts and power steering pump belt
- front timing gear cover.



AV5

Remove vibration damper center bolt

Use 5187 to prevent pulley from rotating, and wrench 5188 to unscrew bolt. It may be necessary to turn engine slightly so that 5187 rests on fan bearing.

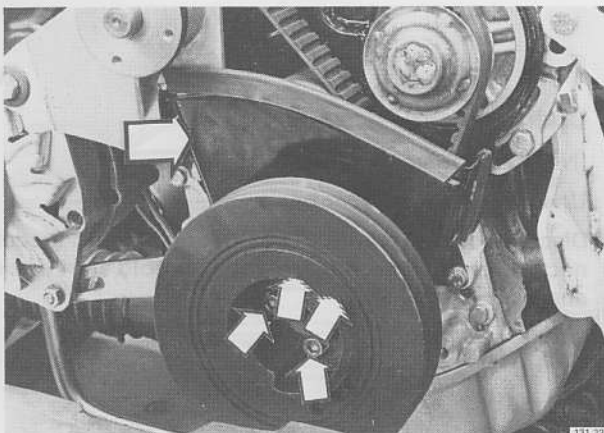


AV6

Turn engine approx. 1/4 turn anticlockwise

Use wrench 5187.

By turning engine anticlockwise, slack in belt will move to driving side, making it easier to remove and install belt.



AV7

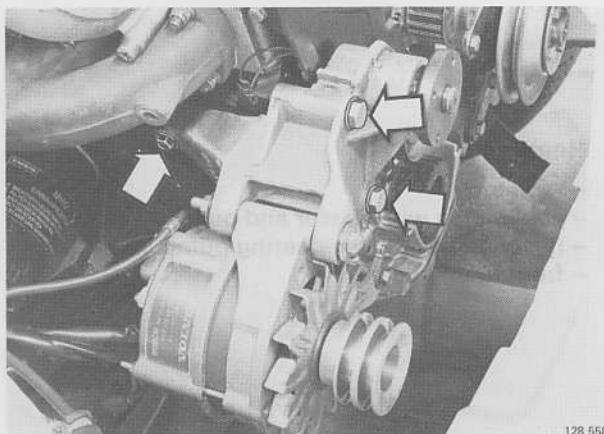
Remove vibration damper

Remove 4 bolts (arrowed). Allen key 6 mm.

Pull off vibration damper. Note crankshaft gear may sometimes stick to vibration damper.

AV8

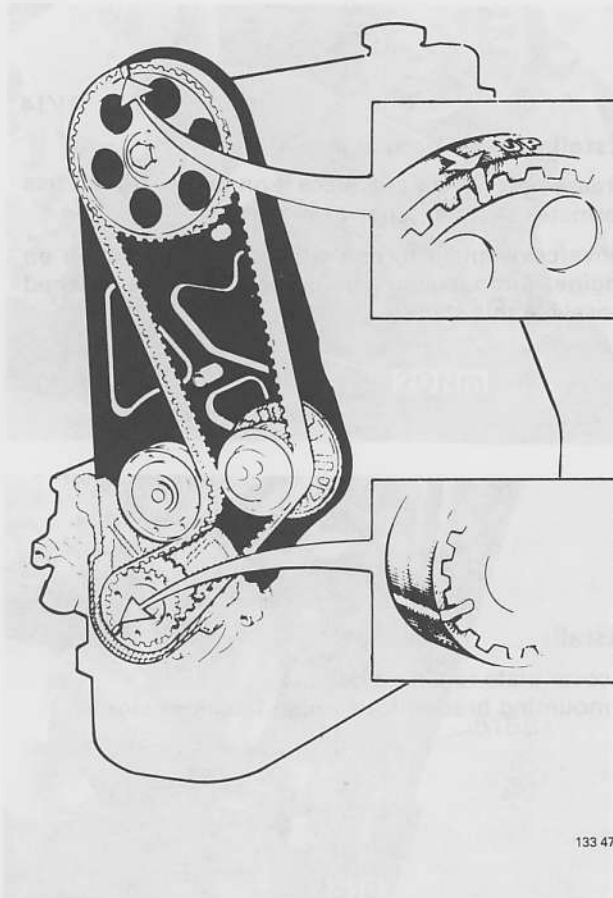
Remove lower timing gear cover



AV9

Detach mounting bracket for cooling fan and alternator and place on one side

Remove mounting bolts (arrowed) and press bracket outwards.



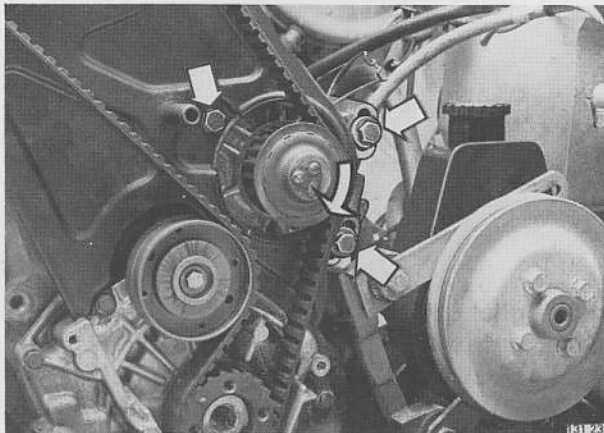
AV10

Mark position of timing gear belt

Mark belt, camshaft sprocket and crankshaft gear. Mark in front of a cog. Also identify outside and top-side of gear belt.

Important

Belt must be fitted in exactly same position as found otherwise valves may contact pistons and cause serious engine damage.

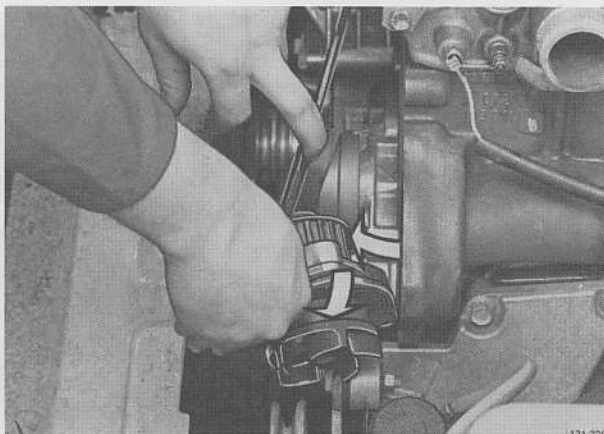


AV11

Remove gear belt

Slacken coolant pump mounting bolts and belt. Coolant may leak when bolts are slackened.

Lift off belt.



AV12

Remove coolant pump

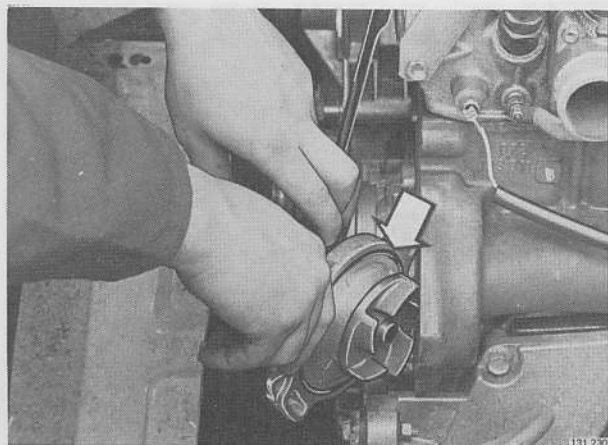
Remove cover panel and retaining bolts for coolant pump.

Move panel to one side and remove pump. Take care not to crack panel.

AV13

Clean

Clean contact surface for pump on cylinder block. Dry off coolant from cylinder block, gear etc.

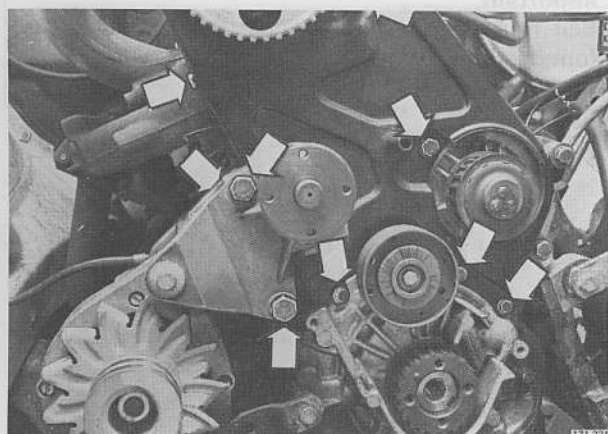


AV14

Install new coolant pump

Grease new O-ring and place it on pump. **Do not** use permatex or other types of sealers.

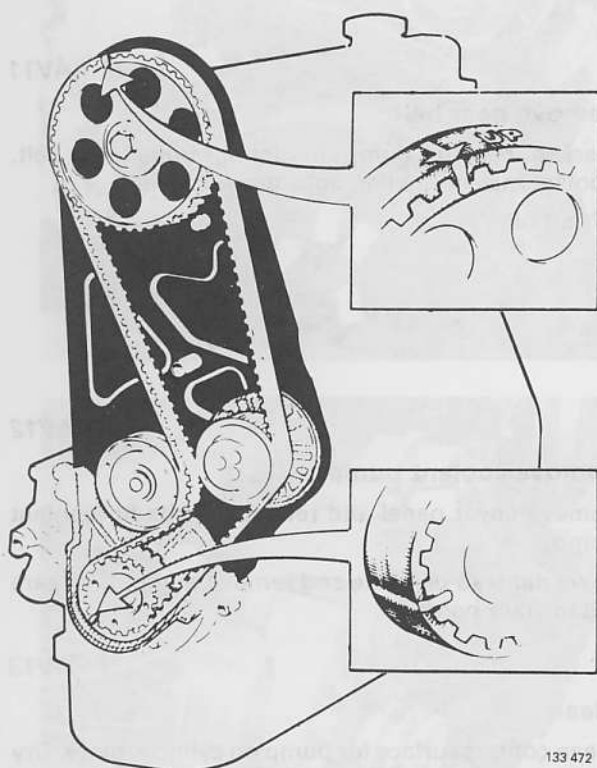
Move cover plate to one side and mount pump on engine. Pump retaining bolts should only be attached loosely at this stage.



AV15

Install:

- cover plate retaining bolts.
- mounting bracket for cooling fan/alternator.



AV16

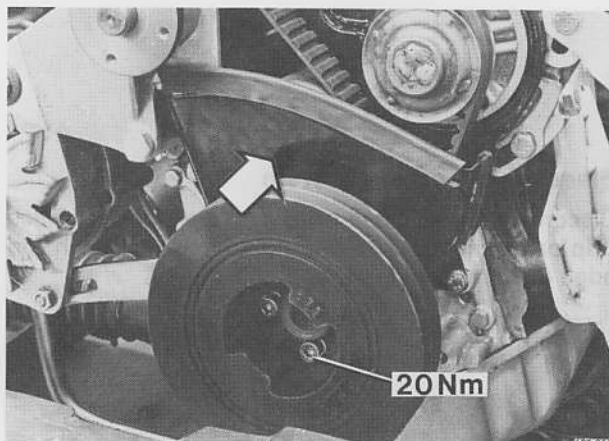
Install gear belt

Make sure that belt is fitted in exactly same position as before

Align identification marks on belt, camshaft sprocket and crankshaft gear.

It is extremely important that belt is fitted in exactly same position as before.

Tension belt by moving coolant pump (by hand). Tighten pump mounting bolts.

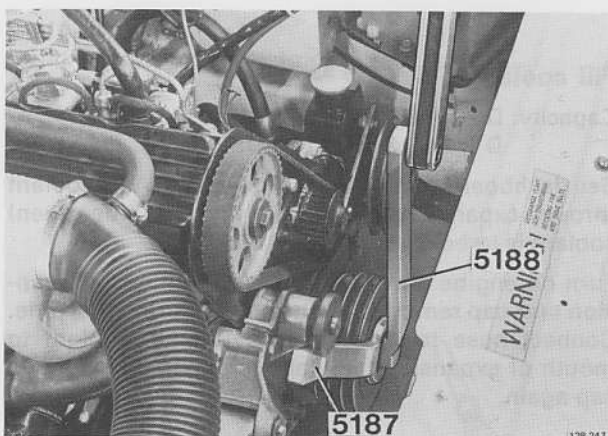


AV17

Install lower timing gear cover and vibration damper

Damper can only be fitted in one way. Pin on crankshaft gear must fit in vibration damper.

Torque inhex bolts to **20 Nm** (15 ft lbs).



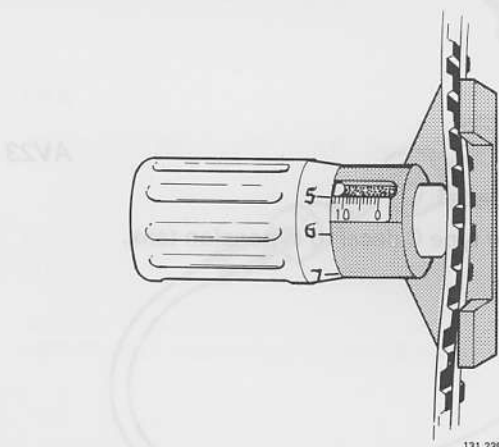
AV18

Install center bolts

Smear threads and mating surface with sealer P/N 277961-9.

Use wrench **5187** (rest on cooling fan journal) to hold vibration damper. Use wrench **5188** to torque centre bolt to **350 Nm** (255 ft lbs).

Important! Torque **350 Nm** applies only if wrench **5188** is used. Also torque wrench must be in line with wrench **5188**.

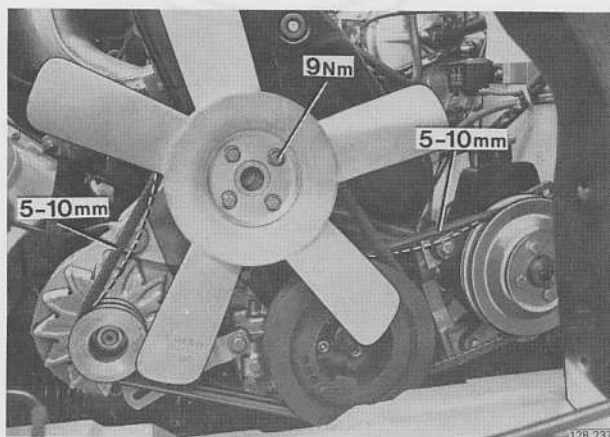


AV19

Set belt tension

Turn engine approx. 1/4 turn anticlockwise. Adjust tension by moving coolant pump. Use gauge **5197** to check tension. Attach gauge to belt and set to 12.5 units. Stretch belt until mark on gauge plunger is flush with sleeve.

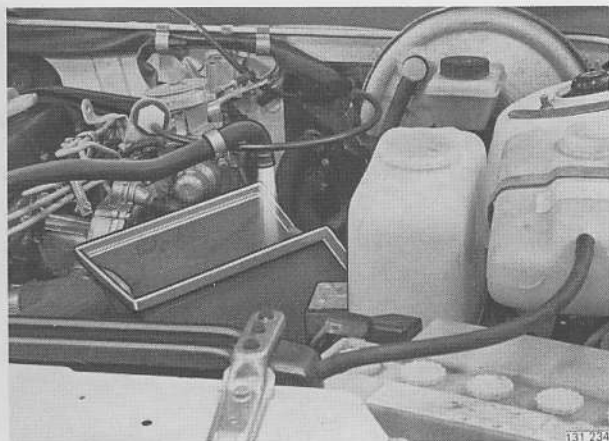
Depress belt strongly with hand and recheck/adjust tension.



AV20

Install:

- front timing gear cover
- cooling fan with spacer and pulley. Torque bolts to **9 Nm** (7 ft lbs).
- belt for power steering pump and fan belts
- radiator. Connect hoses (also hose to cold start device)
- battery.



AV21

Bleeding of cooling system

Disconnect upper hose from cold start device. Place drip pan beneath hose and hold hose level with top edge of expansion tank.



AV22

Fill coolant

Capacity: D 20 = 8.1 litres (8.6 US quarts)
D 24 = 9.3 litres (9.8 US quarts).

Set dashboard heater control to MAX. Add coolant through expansion tank cap. Only type C (blue-green) coolant is to be used.

Turn on engine and warm-up for 5 minutes. (Expansion tank cap removed). Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap again.



VOLVO ORIGINAL KYLVÄTSKA TYP C ÄR PÅFYLLED. KYLSYSTEMET ÄR FROSTSKYDDAT TILL -30°C. EFTERFÖLL ÅRET RUNT MED EN DEL VATTEN OCH EN DEL VOLVO KYLVÄTSKA TYP C.

FILLED WITH GENUINE **VOLVO** COOLANT TYPE C. COOLING SYSTEM IS PROTECTED TO -22°F. TOP UP YEAR ROUND WITH HALF WATER AND HALF VOLVO COOLANT TYPE C.

REMPLI DE LIQUIDE ANTIGEL **VOLVO** TYPE C VALABLE JUSQU'À -22°F/-30°C. REMPLIR EN TOUTE SAISON AVEC MOITIÉ EAU MOITIÉ ANTIGEL TYPE C.

1297524

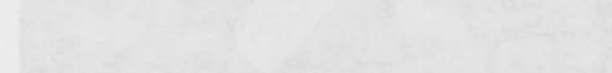
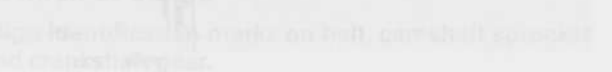


133 477

AV23

Replace decal

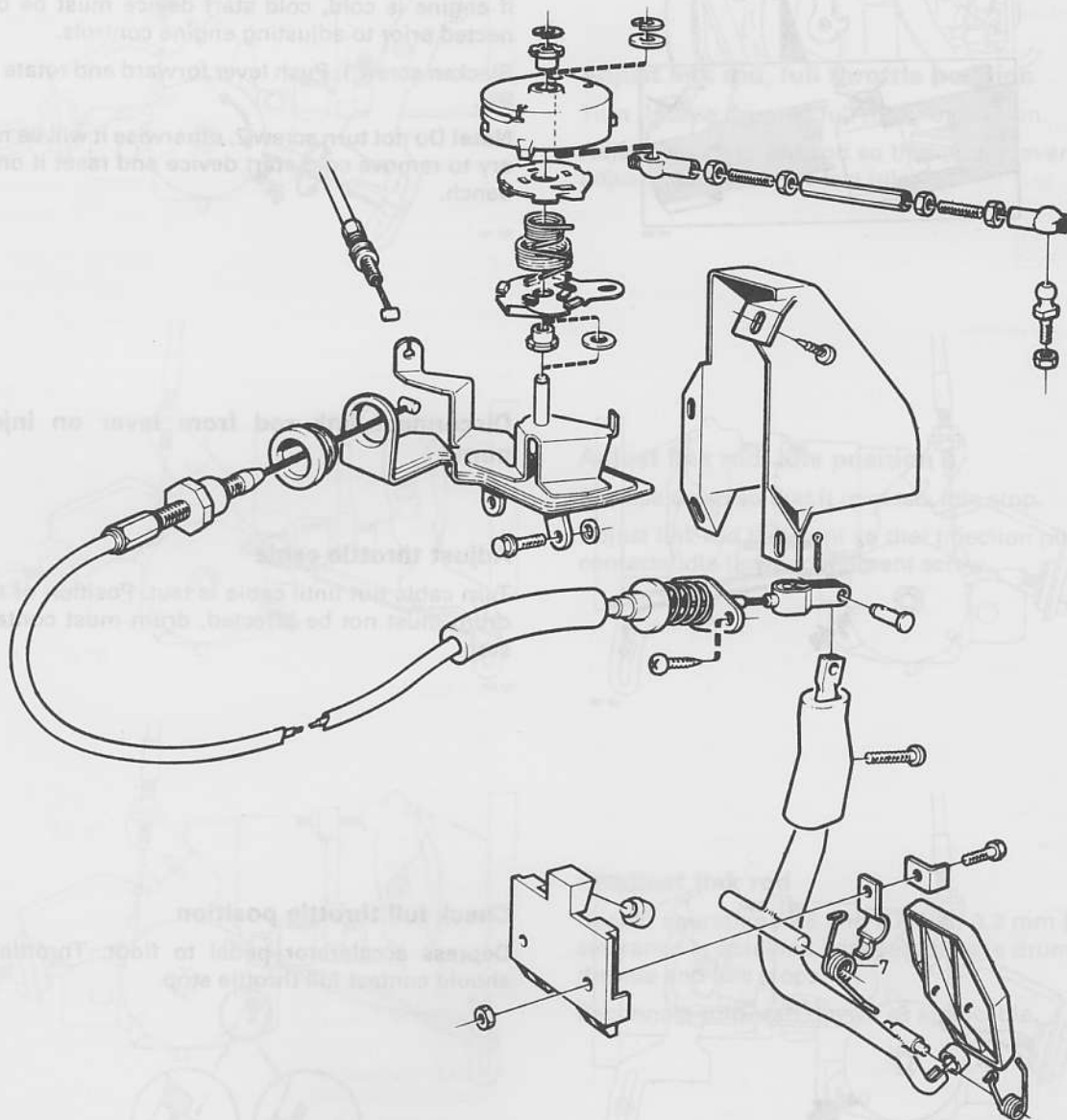
Attach new type C decal to expansion tank.



Group 27 Engine controls

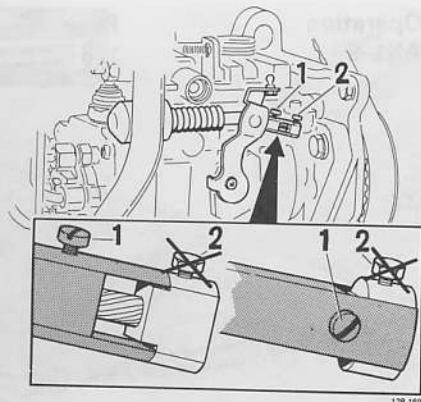
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Engine controls, adjustment	AX1-9	176



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AX. Engine controls, adjustment



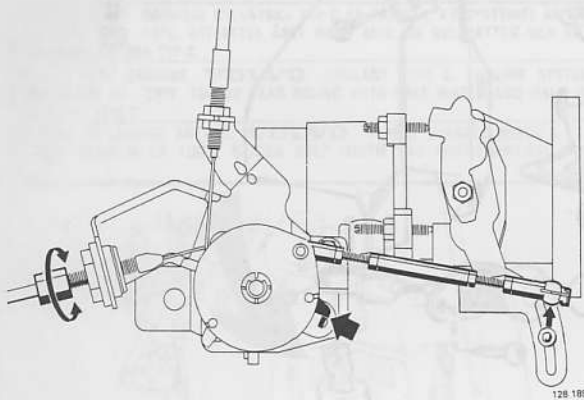
AX1

Disconnect cold start device

If engine is cold, cold start device must be disconnected prior to adjusting engine controls.

Slacken screw 1. Push lever forward and rotate sleeve 90°.

Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.



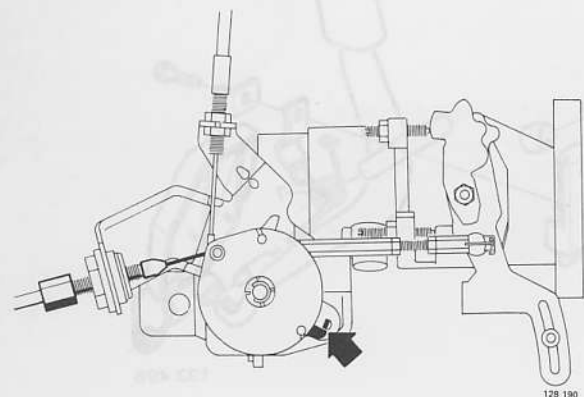
AX2

Disconnect link rod from lever on injection pump

AX3

Adjust throttle cable

Turn cable nut until cable is taut. Position of throttle drum must not be affected, drum must contact idle stop.

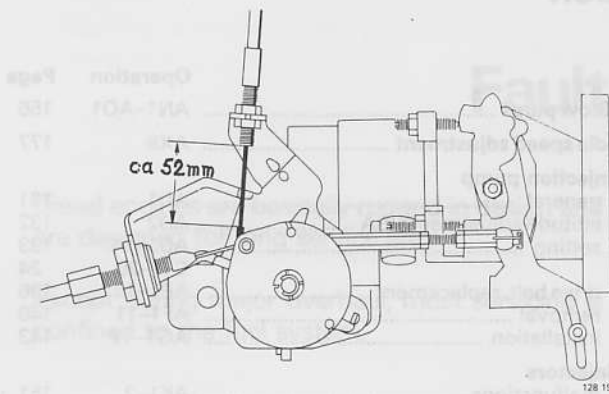


AX4

Check full throttle position

Depress accelerator pedal to floor. Throttle drum should contact full throttle stop.

AX5



**Automatic transmission.
Adjust kick-down cable**

Depress accelerator pedal to floor. Cable should move approx. 52 mm (2.05 in) between idle and full throttle positions.

Cable should be taut in idle position. Distance between clip on cable and nut should be 0.25–1.0 mm (0.01–0.04 in).

AX6

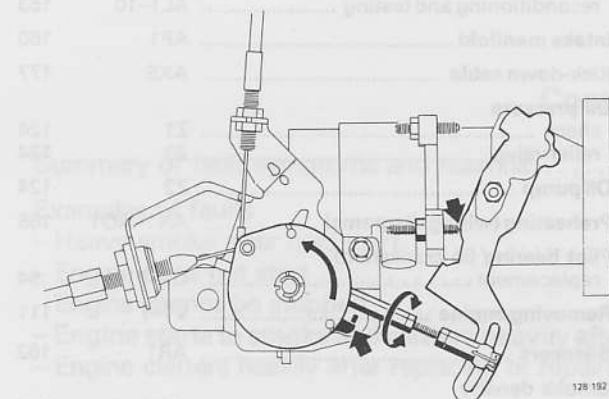
Reconnect link rod to lever

AX7

Adjust link rod, full throttle position

Turn throttle drum to full throttle position.

Adjust length of link rod so that pump lever contacts adjustment screw for fast idle.

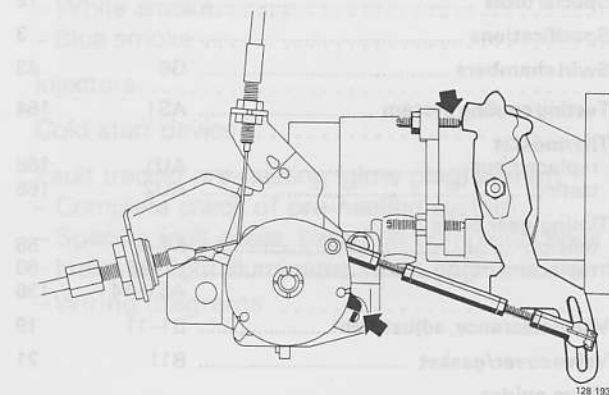


AX8

Adjust link rod, idle position

Release drum so that it contacts idle stop.

Adjust link rod ball joint so that injection pump lever contacts idle (low) adjustment screw.

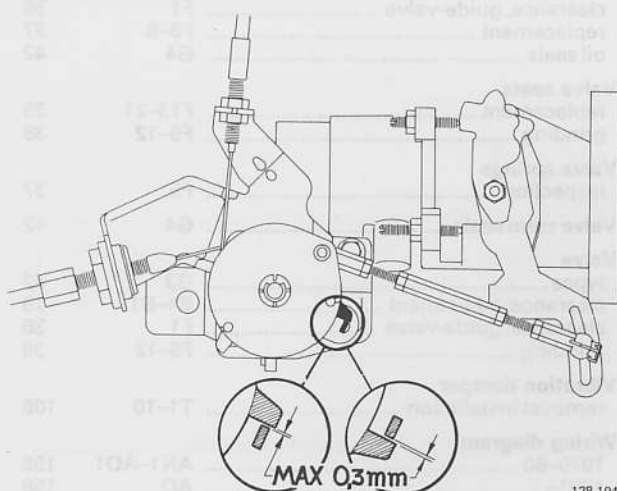


AX9

Readjust link rod

Repeat operations X6 and X7 until 0.3 mm (0.012 in) clearance is obtained between throttle drum and full throttle and idle stops.

Reconnect cold start device as applicable.



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Fault Tracing

Diesel engines are basically rugged in design and are designed for long service life.

Analysis of exhaust smoke will provide useful information on determining fuel related problems.

Except during major overhaul, most servicing is confined to the fuel system.

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Summary of fault symptoms and reasons

The fault symptoms are listed numerically according to:
—likely occurrence, ease in checking and logical sequence.

EXAMPLE: Under each symptom are a group of numbers. No. 1 would be the first item to check, then No. 2 and so on, until the fault has been resolved.

Symptoms

NOTE: Starting system (Battery, starter, etc.) is assumed to be in good condition.

Symptoms								Reasons for faults	
Engine does not start	Cold engine difficult to start	Warm engine difficult to start	Uneven idling	Engine stalls during driving	Low output, low speed	High fuel consumption	Wrong speed, low or high idle		
1			1					Fuel system	
2	6	2	5	4	9			Fuel valve (stopping valve) in the injection pump	
8	5	1	4	3	1	1		Injection pump sucks air (leakage between fuel tank and pump)	
								Fuel leakage (leakage between pump and delivery pipes or other external fuel leaks)	
3	3		5	7				Ice or paraffin in fuel lines or fuel filter (wintertime)	
7	9	5	8	6	3		5	Injection timing incorrect	
10	2							Pre-heating system (see wiring diagrams).	
6	1						2	Cold-start device	
12	13	9	11	9	15	9	8	10 Faulty injection pump	
4	7	3	6	6	4		6	Fuel filter blocked (drain condensation water)	
9	8	4	7	7	10		7	Fuel lines blocked	
11	10	6	8	12	6		8	Faulty injectors	
			1	2	5	1	4	Mix-up of hollow screws in pump for feed and return lines	
			2				9	Incorrectly adjusted for high altitude	
								Injection pump bracket loose/damaged	
							4	Incorrect low idle setting	
				8			5	Incorrect high idle setting	
					4			Return line blocked	
			3					Other faults	
				2	2	6	1	Engine mounts loose/damaged	
				11	5	7		Air cleaner blocked	
				3		3		Exhaust system blocked	
								Incorrect accelerator control setting	
5	4							Engine mechanical faults	
	11	7	9	13	7			Incorrect oil viscosity for cold temperatures	
	12	8	10	14	8			Compression low/uneven	
								Incorrect valve clearance	
							3	Water leakage	
							2	High oil consumption	

Examples of faults

Heavy smoke after cold start

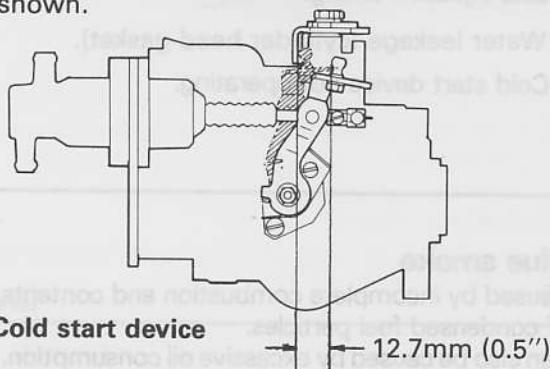
Poor fuel quality.

Check the cold start device by checking idle speed.

Idle speed should be approx. 200 rpm higher with cold engine. Idle speed at normal operating temperature should be 800 rpm.

At normal operating temperature, the cold start lever should not touch the lever on the injection pump.

After setting low idle speed, the automatic idle increase device must be checked and adjusted if necessary. The gap between control lever and ball stud should be 12.7mm (0.5") as shown.

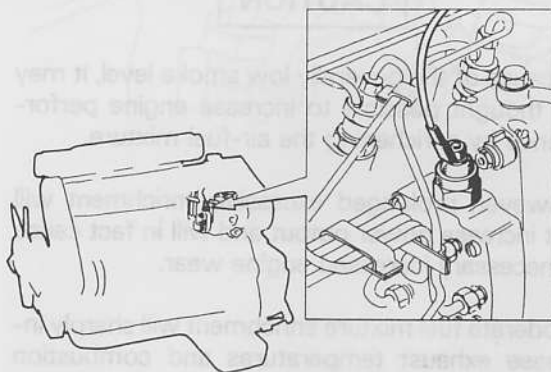


128538

Engine does not start

Check the fuel valve (stopping valve) in the injection pump. No fuel will reach the injectors if the valve does not open (listen for audible click).

The voltage at the fuel valve solenoid must be at least 10 volts to open the valve, and minimum 8 volts to remain open (starter motor engaged).



128536

Engine cannot be stopped

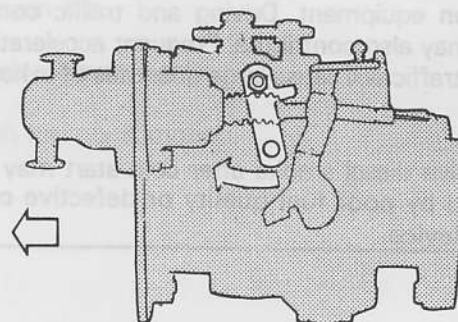
The fuel valve (stopping valve) in the injection pump does not close. It is a solenoid valve. Increase momentarily to high engine speed and try again to switch off the start key. If this does not help:

—Vehicles with manual transmission:

Engage 3rd or 4th gear, depress the brake pedal and release the clutch pedal.

—Vehicles with automatic transmission:

Use the emergency stop lever on the injection pump, see ill. below.



Emergency stop lever

128535

Engine starts to smoke and clatter heavily after replacing fuel injection pump

The injection pump might be incorrectly timed or assembled (distributor plunger 180° reversed).

Check basic injection timing. If correct, try another injection pump.

Engine clatters heavily (sounds like bearing failure) after replacing/repairing injectors or fuel delivery pipes

An injector might have jammed open. The combustion is out of control when accelerating.

Loosen the cap nuts to one injector at a time. The compression pressure will reveal visible bubbles at the cap nut of a stuck injector.

Note: Clean cap nuts before loosening

Excessive smoke



128184

Excessive diesel smoke is usually caused by incomplete combustion. Reasons may be engine condition, fuel or fuel injection equipment. Driving and traffic conditions may also contribute. Frequent acceleration in city traffic will cause large quantities of exhaust gases.

Excessive diesel smoke after cold start may be caused by poor fuel quality or defective cold start device.

Black smoke

Caused by too much fuel. The carbon content in the exhaust gases becomes noticeable. Causes may be:

- Poor fuel quality.
- Dirty air cleaner (insufficient air supply).
- Excessive injection.
- Worn injectors.
- Incorrect fuel.
- Low compression pressure.
- Considerable backpressure in exhaust system (clogging).

White smoke

Occurs mainly during cold starter and is caused by insufficient fuel supply. The smoke consists of condensed fuel particles. The combustion speed is low and the fuel particles have longer time to condense.

(cont.)

White exhaust smoke (cont.)

NOTE:

White exhaust smoke can also be caused by water leaks into the exhaust system or cylinder head.

Possible causes for white smoke:

- Pre-heating system (glow plugs) not operating.
- Low compression pressure.
- Low operating temperature.
- Defective injectors.
- Late injection timing.
- Water leakage (cylinder head gasket).
- Cold start device not operating.

Blue smoke

Caused by incomplete combustion and contents of condensed fuel particles.

Can also be caused by excessive oil consumption.

Possible causes for blue smoke:

- Late injection timing.
- Defective injectors.
- Heat shield under injector damaged or missing.
- High fuel consumption.
- Low operating temperature.

CAUTION

Because of the generally low smoke level, it may be thought possible to increase engine performance by enrichening the air-fuel mixture.

However, prolonged excessive enrichment will not increase power output and will in fact cause unnecessary increased engine wear.

Moderate fuel mixture enrichment will sharply increase exhaust temperatures and combustion pressures without any corresponding power gain.

Injectors

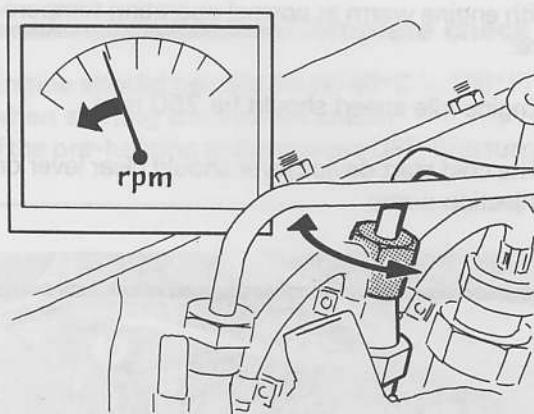


Malfunctions

One or several of the following malfunctions can occur:

- One or several cylinders knock.
NOTE: Do not confuse with bearing clatter. Check injector operation.
- Overheated engine.
- Reduced power output.
- Uneven idle.
- Black exhaust smoke.
- High fuel consumption.

128184



Checking injector operation

1.
Run the engine at increased idle speed.
2.
Loosen the cap nuts at the injectors, one at a time. Wrap absorbing paper round the injectors to prevent fuel spill.

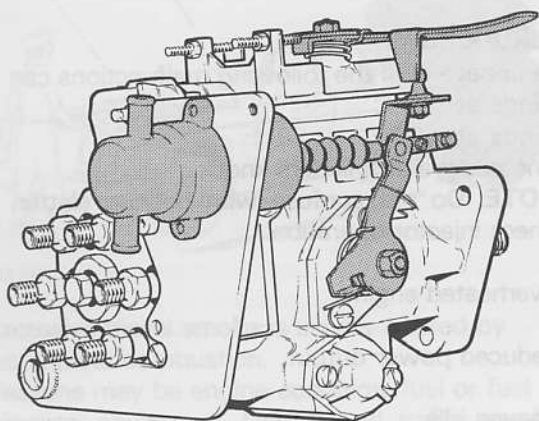
If the idle speed remains stable or if knocking disappears, the fault might be:

- defective injector
- defective heat shield
- leaking delivery pipe

For further test, remove the injectors and test in a test machine.

128185

Cold start device



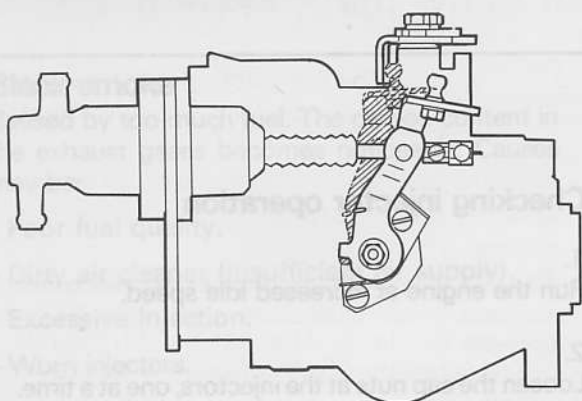
The cold start device can only be tested on a test bench together with the injection pump.

A simple operation test can be performed without removing the cold start device from the engine.

Signs of cold start device malfunction:

- Cold engine hard to start.
- Engine does not start at temperatures below $-10^{\circ}\text{C} = 14^{\circ}\text{F}$.
- Blue-white exhaust gases.

129578



Operation check

Check idle speed cold and at normal operating temperature.

1. With cold engine, below $20^{\circ}\text{C} = 70^{\circ}\text{F}$, engine idle speed should be approx. 950 rpm (200 rpm more than warm).
2. With engine warm at normal operating temperature:
 - Engine idle speed should be 750 rpm.
 - The cold start device lever should clear lever on injection pump.

128538

Pre-heating system

Basic operation of system:

- The system is switched on when the start key is turned to driving position II). The pre-heating time depends on coolant temperatures. The dashboard indicator light will stay on approx.:

1980 MODELS

45 seconds at $-20^{\circ}\text{C} = 4^{\circ}\text{F}$.
25 seconds at $0^{\circ}\text{C} = 32^{\circ}\text{F}$.
15 seconds at $+20^{\circ}\text{C} = 68^{\circ}\text{F}$.
0 seconds at $+50^{\circ}\text{C} = 112^{\circ}\text{F}$.

1981 & ON

9 seconds at $-20^{\circ}\text{C} = 4^{\circ}\text{F}$.
6 seconds at $0^{\circ}\text{C} = 32^{\circ}\text{F}$.
4 seconds at $+20^{\circ}\text{C} = 68^{\circ}\text{F}$.
0 seconds at $+50^{\circ}\text{C} = 112^{\circ}\text{F}$.

- The glow plugs remain ON approx. 20 seconds after the indicator light has gone out for 1980 models and approx. 7 seconds for 1981 and on.
- The glow plugs are ON when the starter motor operates. The glow plugs are cut out when the engine starts and the start key is turned back to position II.
- To repeat a starting attempt, the start key must be turned back to position I to switch on the pre-heating system.
- The system also comprises a blocking relay on 1980 models, on 1981 and on this function is part of the control unit. It will interrupt the electrical circuit between the control unit and the relay for the glow plugs when the alternator starts charging.

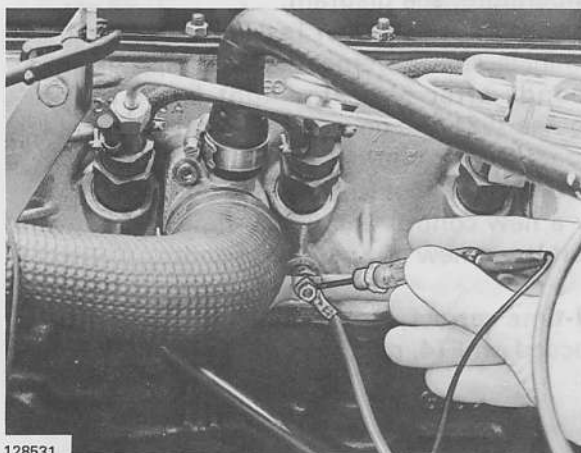
Fault tracing pre-heating (glow plug) system

Refer to the wiring diagrams at rear of manual during fault tracing. The pre-heating system is an electrical system and the wiring diagrams are necessary to understand and correctly trouble-shoot the pre-heating system.

Complete check of pre-heating system

Engine should be cold (max. $40^{\circ}\text{C} = 100^{\circ}\text{F}$) when starting the system check.
If the pre-heating system shuts OFF, first turn

start key to intermediate position (I), then to driving position (II) to obtain a new cut-in period.



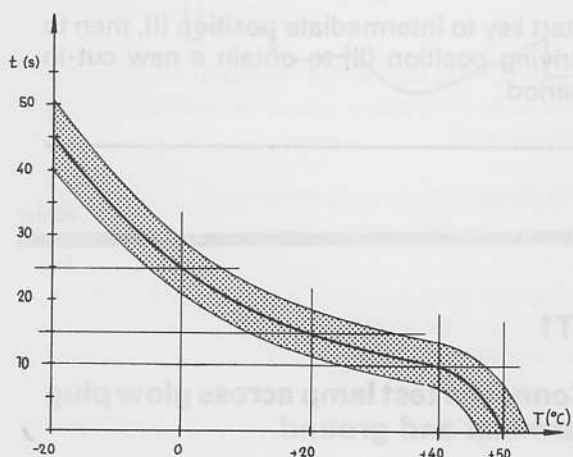
128531

FT1

Connect a test lamp across glow plug terminal and ground.



128635



128537

FT2

Check function of test lamp and indicator light (on instrument panel in vehicle)

CASE A

Indicator light OUT.

Test light OUT.

—Indicates failure at the control unit. See FT6.

CASE B

Indicator light ON.

Test light OUT.

—Indicates failure at the glow plug relay. See FT8.

CASE C

Indicator light OUT.

Test light ON.

—Indicates failure at temperature sender or control unit. See FT13.

Indicator light ON.

Test light ON.

—Proceed on FT3, next.

FT3

Check ON-time for indicator light and test light.

Turn start key to intermediate position (I) and then to driving position (II). ON-time for **indicator light** should be according to coolant temperature, see diagram.

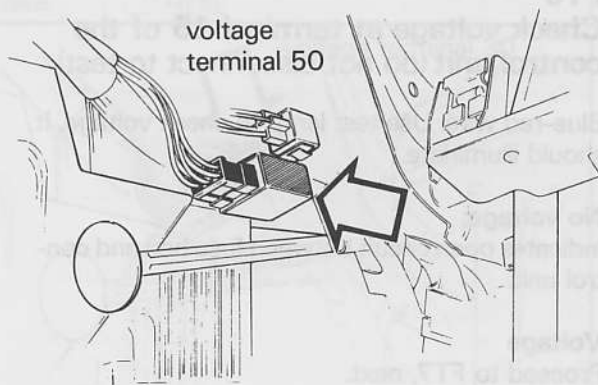
For engines prior to 1981 Test light at glow plug terminals should remain ON for approx. 20 seconds **after** indicator light is OUT. For engines 1981 and onward the test light should remain ON for approx. 7 seconds.

ON-time incorrect (too short):

Try a new control unit. If ON-time still is too short, try a new temperature sender.

ON-time correct:

Proceed on FT4, next.



128530

FT4

Check operation with starter motor operating

Test light should illuminate, indicating voltage at the glow plugs.

Test light OUT:

Starter motor engaged, use the test lamp to check voltage at terminal 50 (blue-yellow wire) of the control unit.

Voltage:

Indicates a faulty control unit.

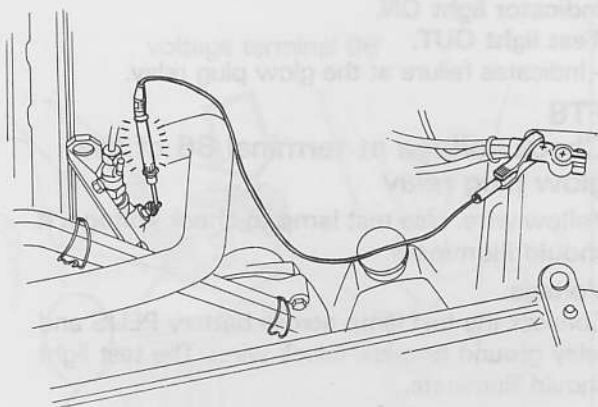
No voltage:

Indicates open circuit between connector and control unit.

(Connector located under carpet next to control panel left support).

Test light ON:

Proceed on FT5, next.



128533

FT5

Check glow plugs, one by one

Start key in position 0.

Remove the bar between the glow plug terminals. Connect the test light across battery PLUS and one glow plug at a time to check that current passes through the glow plugs.

Light OUT at one or more glow plugs:

Indicates faulty glow plug.

Light ON

System checked OK.

End of complete system check

FT2, case A

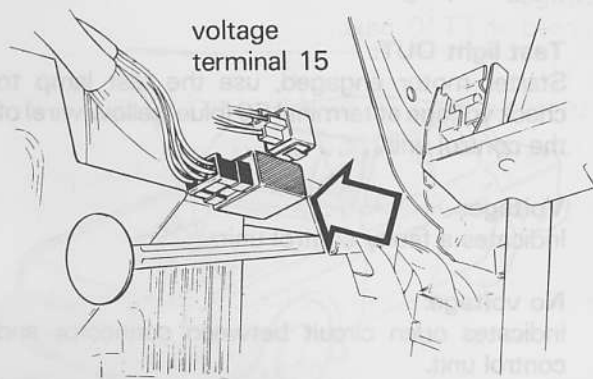
Test light and indicator light should illuminate.

Indicator light OUT.

Test light OUT.

– Indicates failure at the control unit.

First check that cut-in period has not expired or that coolant temperature is too high.



128530

FT6

Check voltage at terminal 15 of the control unit (do not disconnect to test).

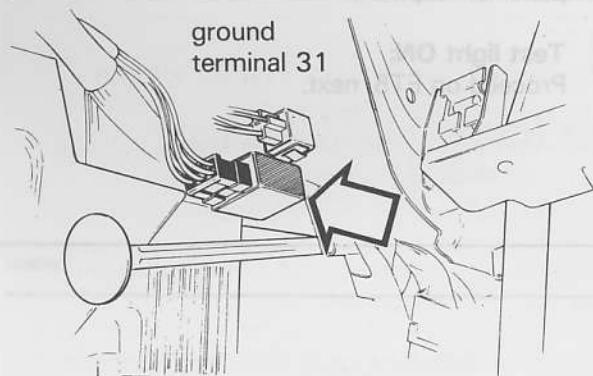
Blue-red wire. Use test lamp to check voltage. It should illuminate.

No voltage:

Indicates open circuit between fuse box and control unit.

Voltage

Proceed to FT7, next.



128530

FT7

Check ground terminal 31 of the control unit

Black wire. Connect test lamp across battery PLUS (or fuse box PLUS terminal) and terminal 31 of the control unit.

Test light should illuminate.

No voltage:

Indicates fault in ground connection.

Voltage:

Indicates control unit failure.

FT2, case B

voltage terminal 86



128534

Indicator light ON.

Test light OUT.

– Indicates failure at the glow plug relay.

FT8

Check voltage at terminal 86 of the glow plug relay

Yellow wire. Use test lamp to check voltage. It should illuminate.

Voltage:

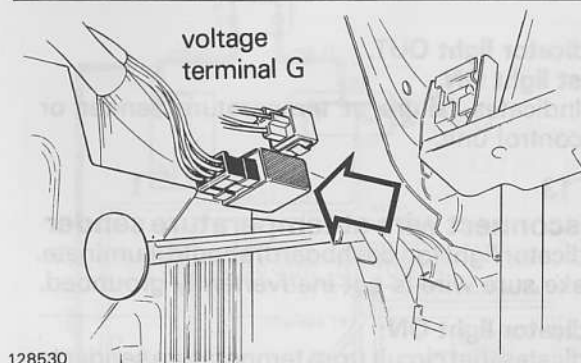
Connect the test lamp across battery PLUS and relay ground terminal (black wire). The test light should illuminate.

Voltage: Indicates faulty glow plug relay.

No voltage: Indicates incorrect ground connection.

No voltage

Proceed to FT9, next.



FT9

Check voltage at terminal G of the control unit

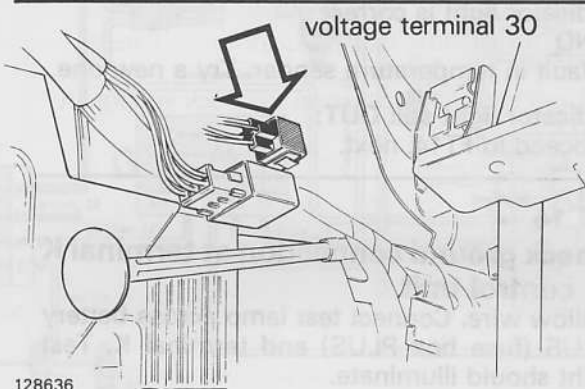
Blue wire. Use test lamp to check voltage. Test light should illuminate.

No voltage:

Indicates a faulty control unit.

Voltage

Proceed on FT10, next.



FT10

Check voltage at terminal 30 of the blocking relay (1980 only)

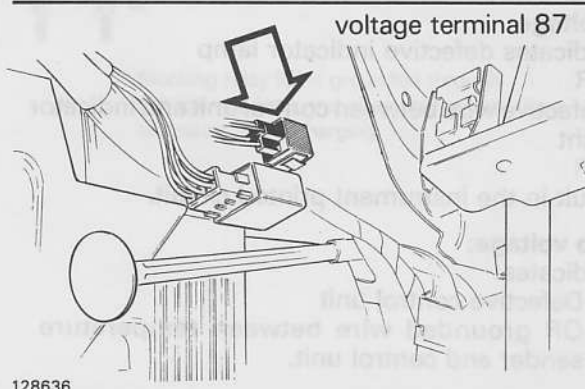
Blue wire. Use test lamp to check for voltage. Test light should illuminate.

No voltage

Indicates open circuit in wire between control unit and blocking relay.

Voltage:

Proceed on FT11, next.



FT11

Check voltage at terminal 87 of the blocking relay (1980 only)

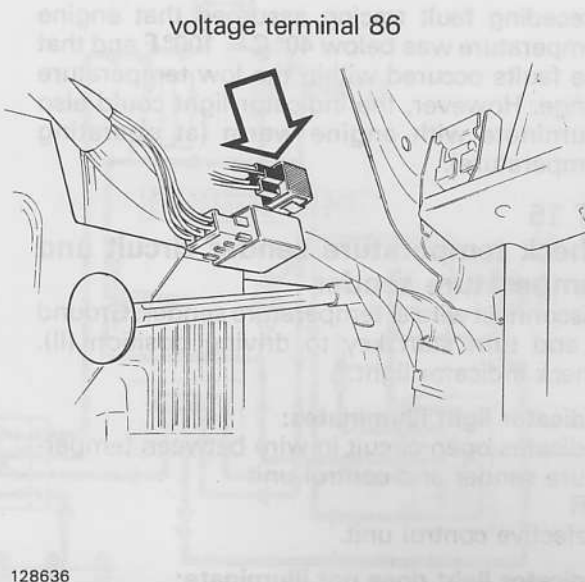
Yellow wire. Use test lamp to check voltage. Test light should illuminate.

Voltage:

Indicates open circuit in wire between blocking relay and glow plug relay.

No voltage (blocking relay does not operate):

Proceed on FT12, next.



FT12

Check voltage at terminal 86 of the blocking relay (1980 only)

Blue-yellow wire. Use test lamp to check voltage. Test light should illuminate.

No voltage:

Open circuit in wire between fuse box and blocking relay.

Voltage:

Connect test lamp across battery PLUS (fuse box PLUS) and ground terminal 85 of the blocking relay. Test light should illuminate.

Voltage:

Indicates faulty blocking relay.

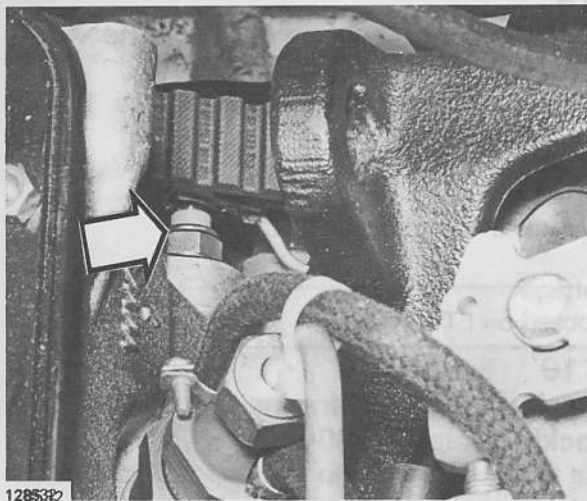
No voltage:

Indicates open circuit in wire between blocking relay and instrument panel,

OR

fault in the instrument printed circuit.

FT2, case C



Indicator light OUT.

Test light ON.

—Indicates failure at temperature sender or control unit.

FT13

Disconnect wire at temperature sender

Indicator light (on dashboard) should illuminate. Make sure wire is not inadvertently grounded.

Indicator light ON:

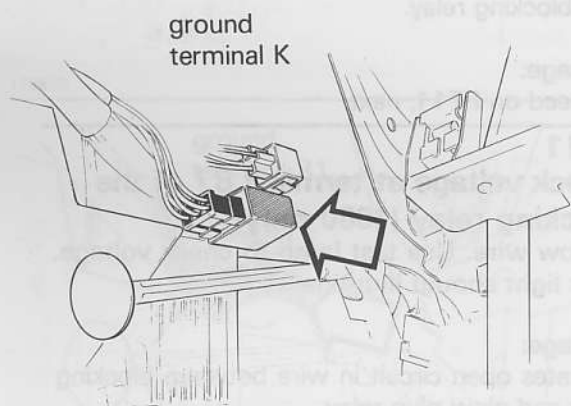
Indicates that circuit from temperature sender to indicator light is correct

AND

a fault in temperature sender. Try a new one.

Indicator light still OUT:

Proceed to FT14, next.



FT 14

Check ground connection at terminal K of control unit

Yellow wire. Connect test lamp across battery PLUS (fuse box PLUS) and terminal K. Test light should illuminate.

Voltage:

Indicates defective indicator lamp

OR

defective wire between control unit and indicator light

OR

fault in the instrument printed circuit.

No voltage:

Indicates:

—Defective control unit

—OR grounded wire between temperature sender and control unit.

Indicator light illuminates when engine is warm



Preceding fault tracing assumed that engine temperature was below 40° C = 100° F and that the faults occurred within the low temperature range. However, the indicator light could also illuminate with engine warm (at operating temperature).

FT 15

Check temperature sender circuit and temperature sender

Disconnect wire at temperature sender. Ground it and turn start key to driving position (II). Check indicator light.

Indicator light illuminates:

Indicates open circuit in wire between temperature sender and control unit

OR

defective control unit.

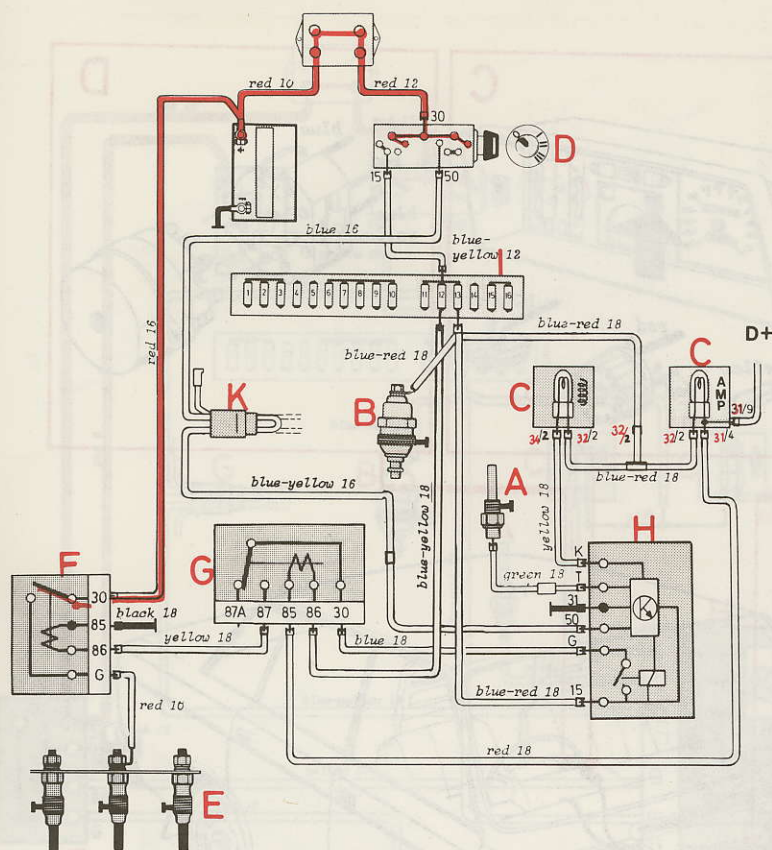
Indicator light does not illuminate:

Indicates faulty temperature sender.

Glow plug system Diesel 1980 —

Legend:

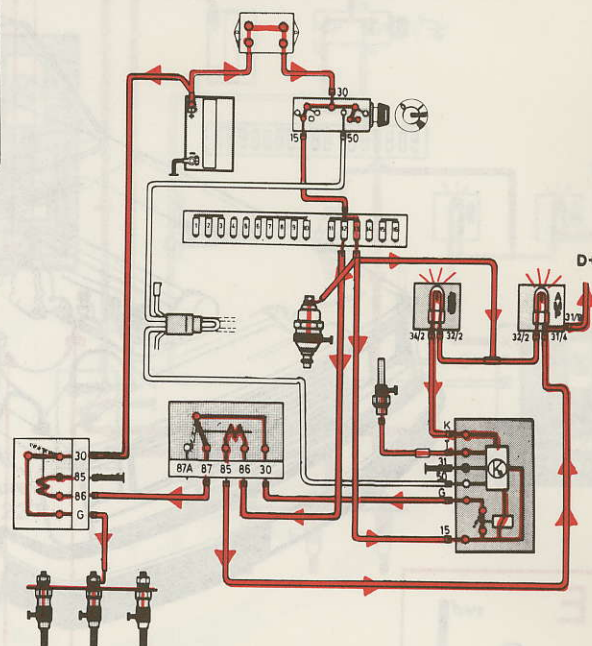
- A Temperature sensor
- B Stop valve
- C Indicator light
- D Start switch
- E Glow plug
- F Glow plug relay
- G Blocking relay
- H Control unit
- I Fuse box
- K Remote starter pick-up point



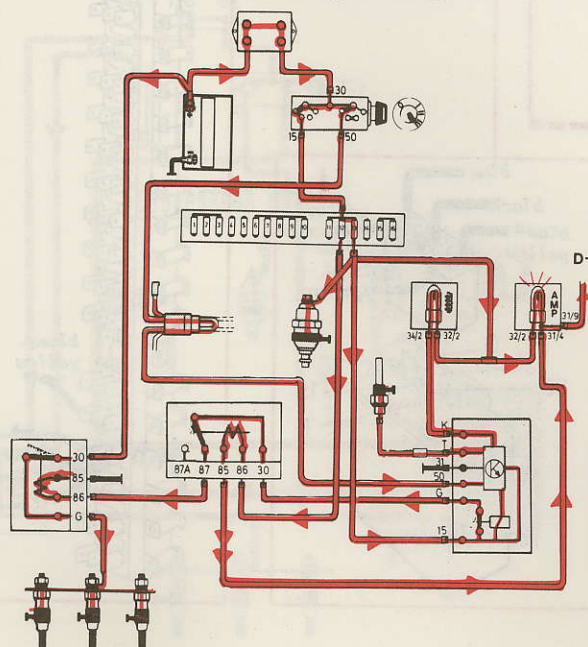
Blocking relay (G) is grounded through voltage regulator and alternator circuit when alternator is not charging.

Start key ON

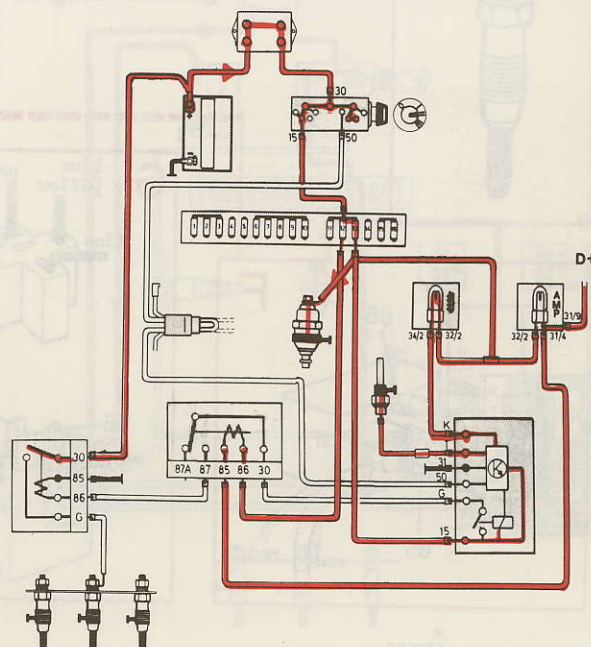
Coolant temperature below +50° C = 122° F



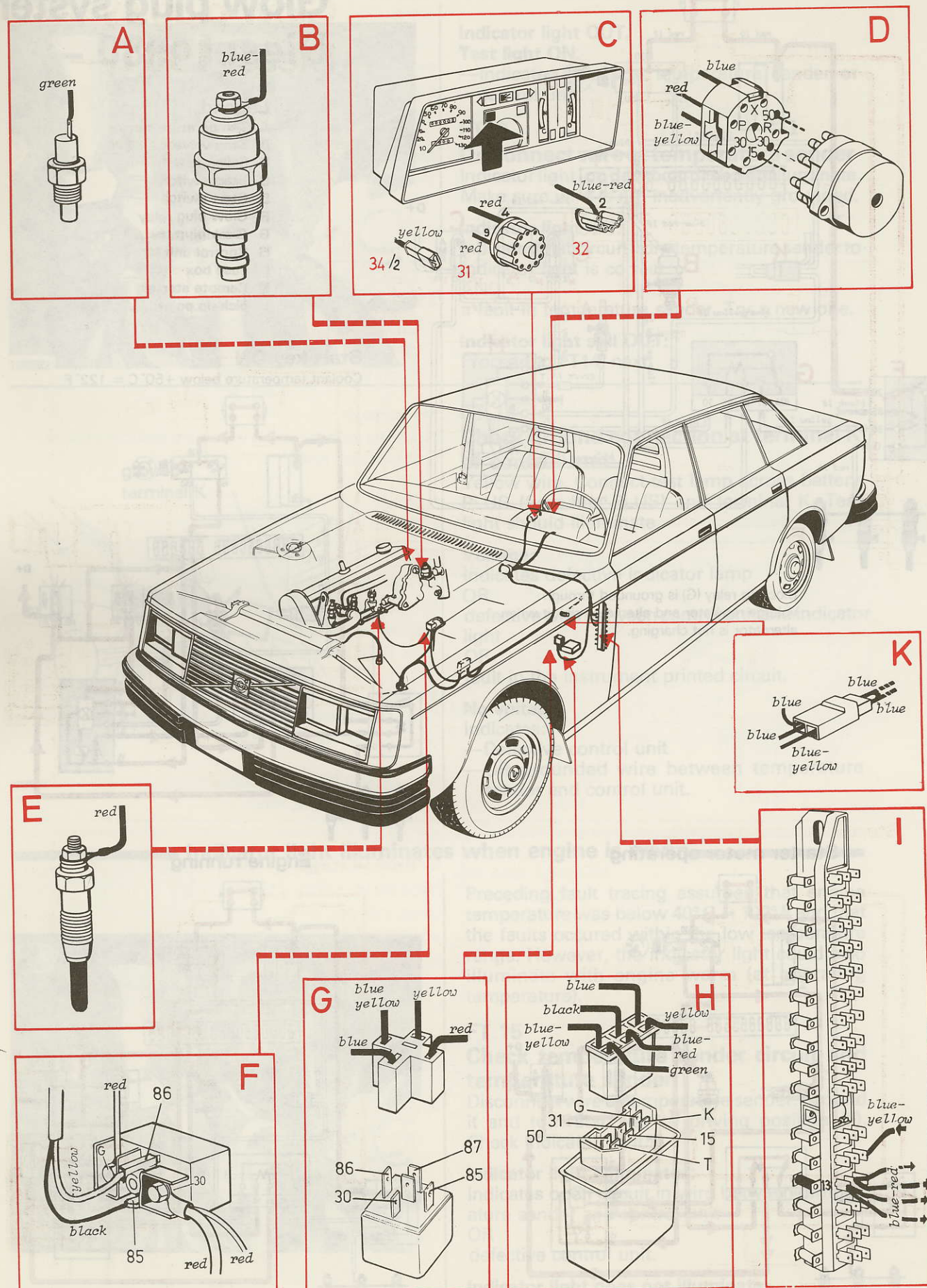
Starter motor operating



Engine running



Glow plug system
Diesel 1980

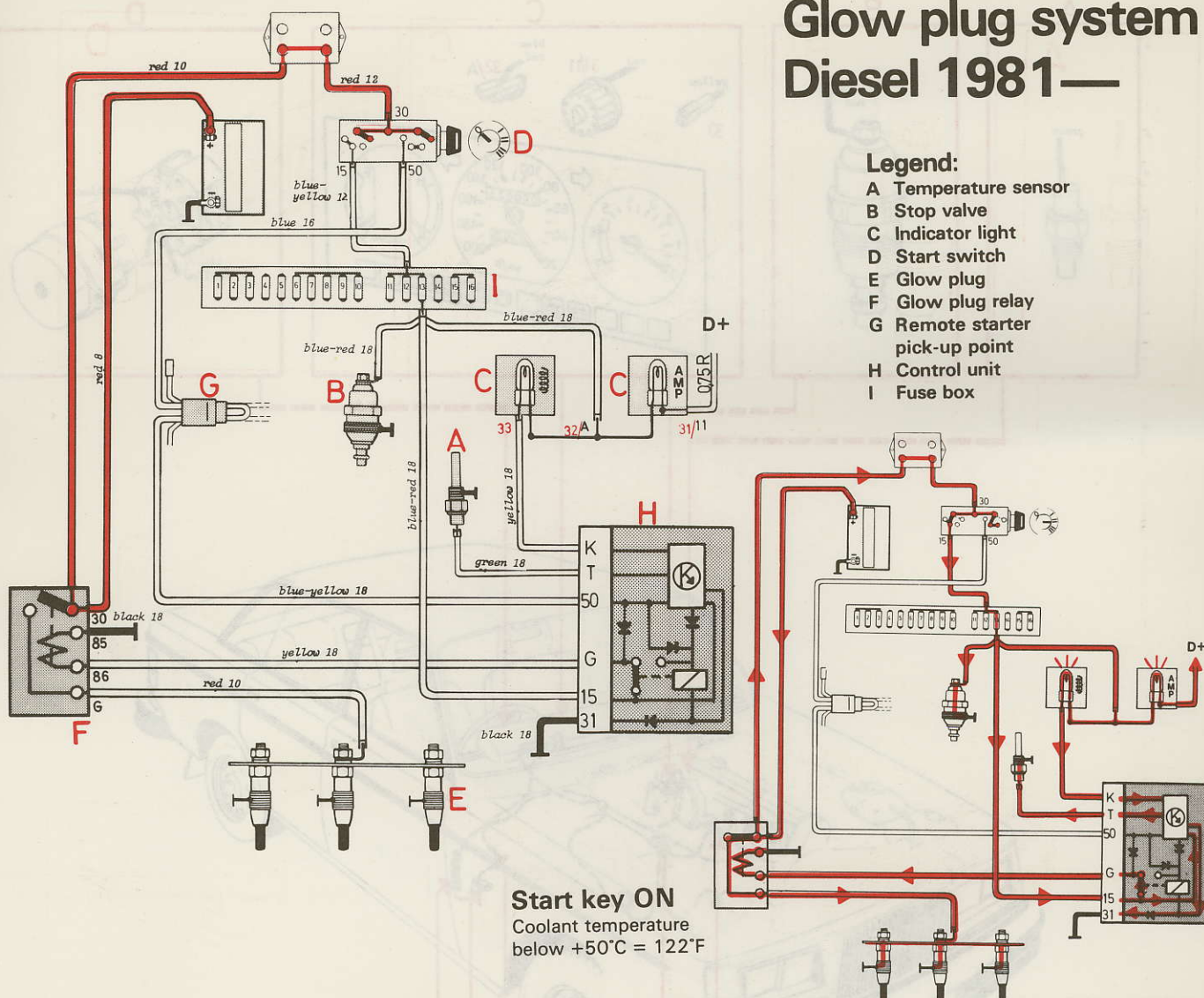


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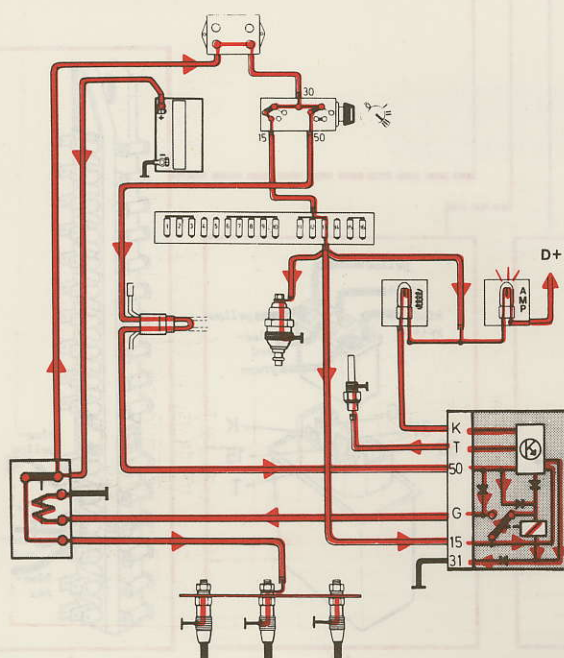
Glow plug system Diesel 1981 —

Legend:

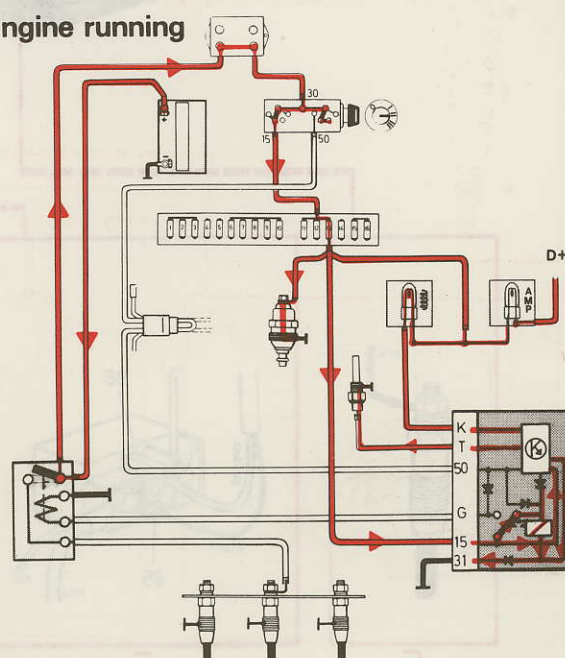
- A Temperature sensor
- B Stop valve
- C Indicator light
- D Start switch
- E Glow plug
- F Glow plug relay
- G Remote starter pick-up point
- H Control unit
- I Fuse box



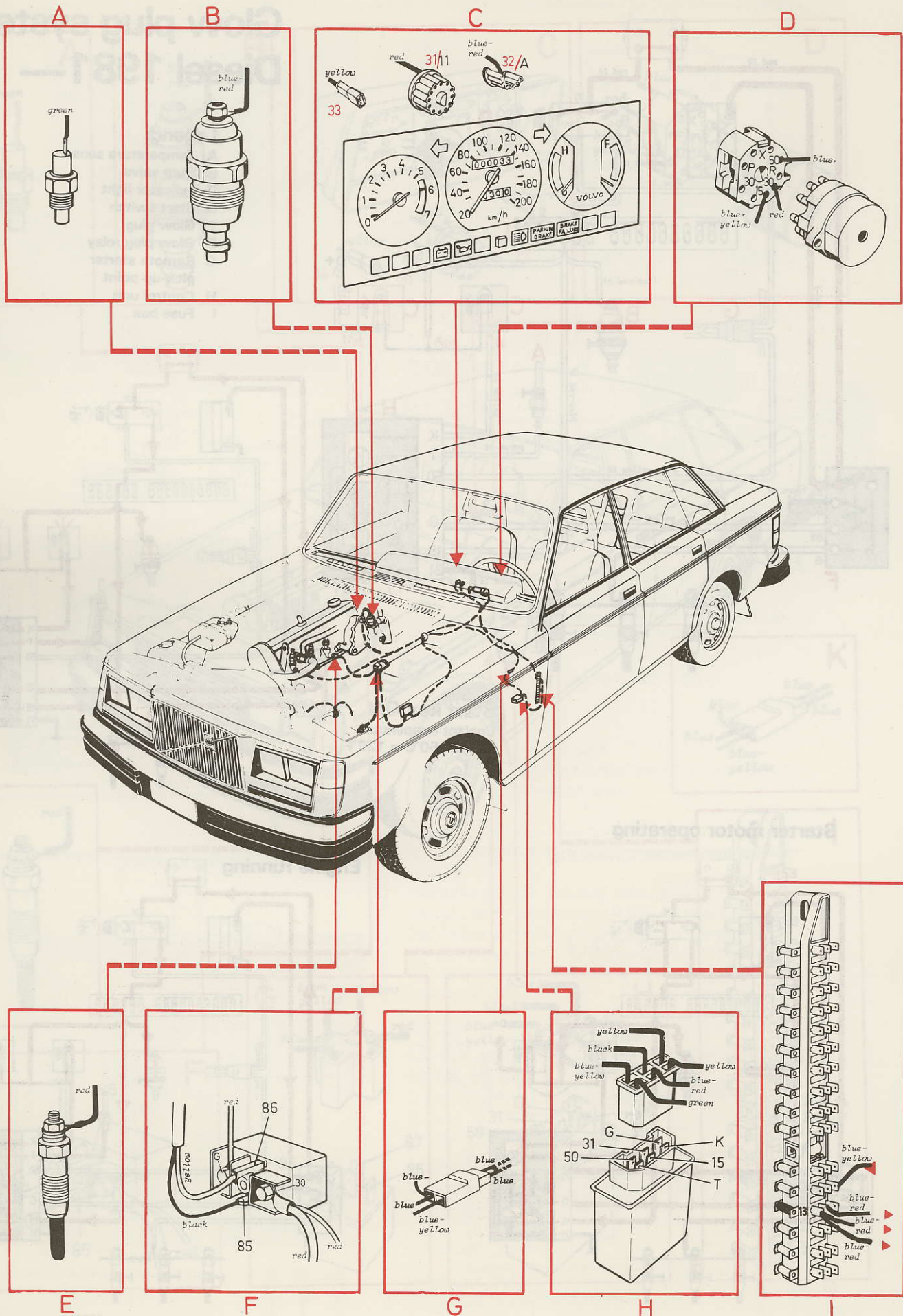
Starter motor operating



Engine running



Glow plug system
Diesel 1981-



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ASE VOLUNTARY
CLASSIFICATION
SYSTEM





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F

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