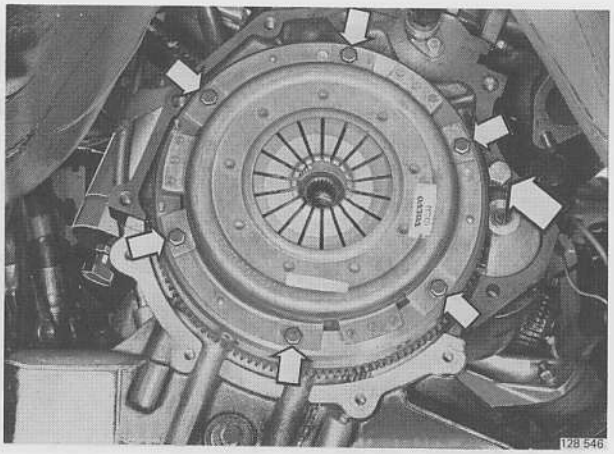
S. Crankshaft rear seal, replacement

Special tools: 1801, 5112, 5203, 5208



S1

Remove gearbox/transmission

See Service manual section 4 (43).

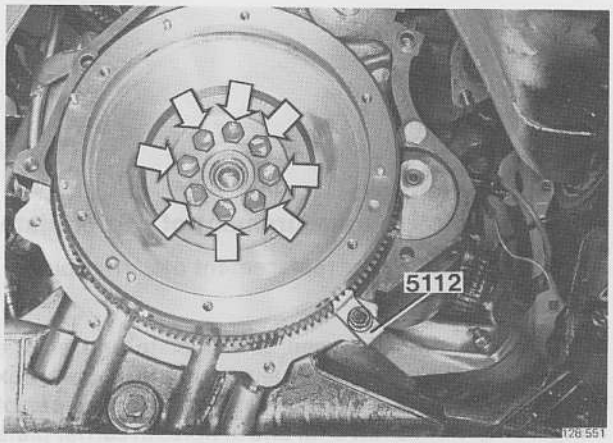
Secure starter motor with a bolt.

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:

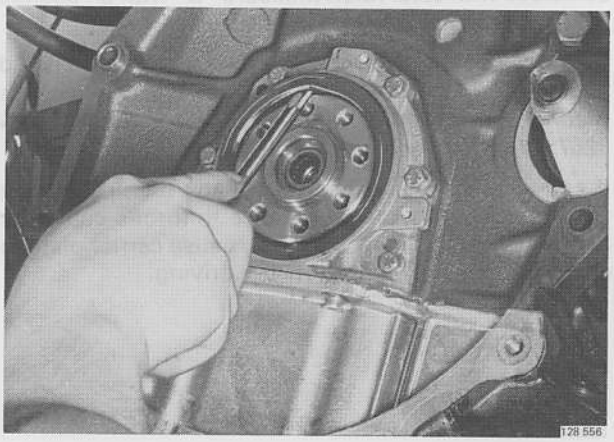
S3

Remove flywheel

Automatic gearbox:

Remove carrier plate

Use locking sector **5112** to prevent flywheel from moving.



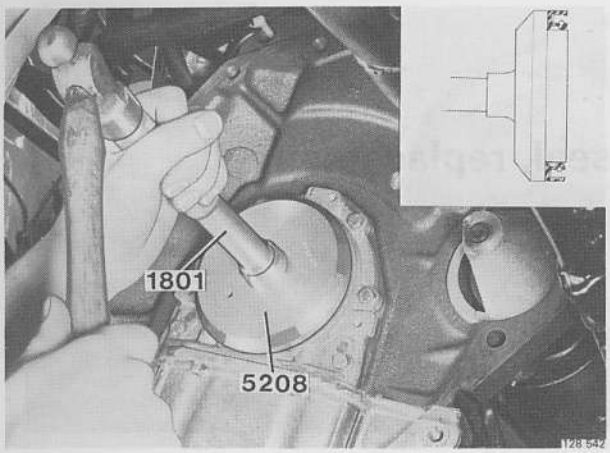
S4

Remove crankshaft rear oil seal

Lift out oil seal with a screwdriver as indicated.

S5

Clean and inspect sealing surfaces.



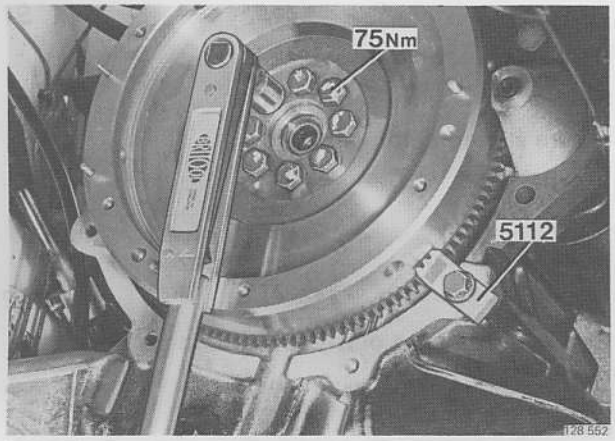
S6

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.



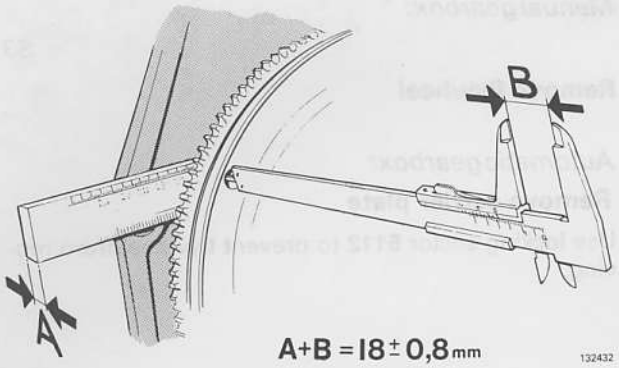
S7

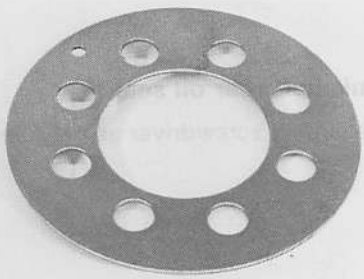
Install flywheel/carrier plate

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

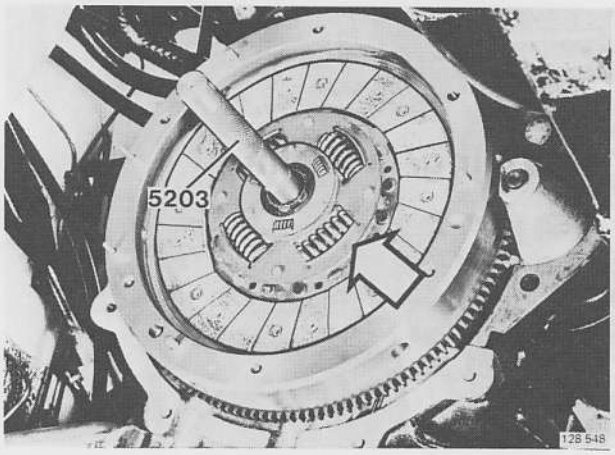
(To be carried out after replacement of carrier plate.)

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.



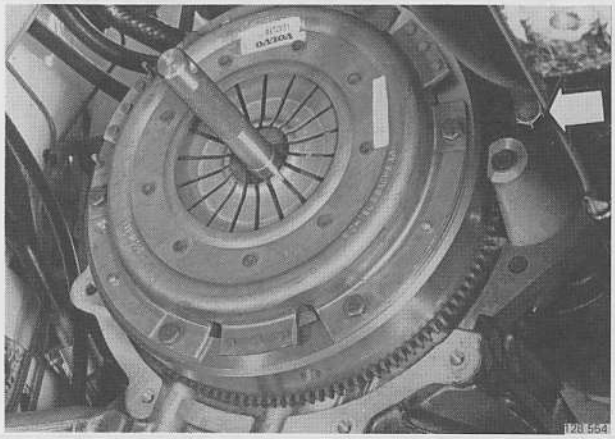
Manual gearbox:

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.

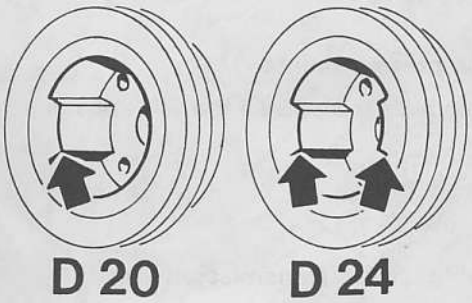
S11

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.

T1

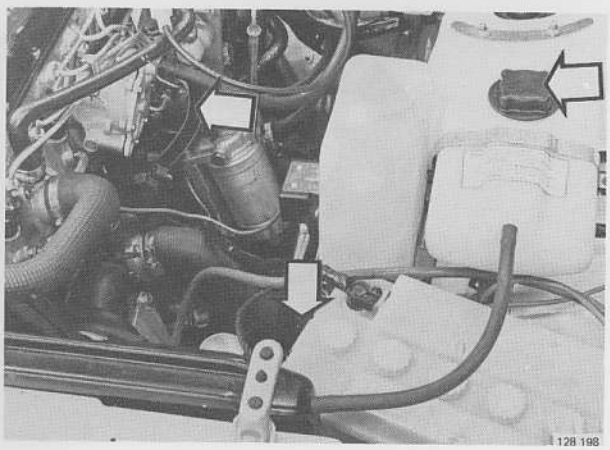
Disconnect battery

T2

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.



T3

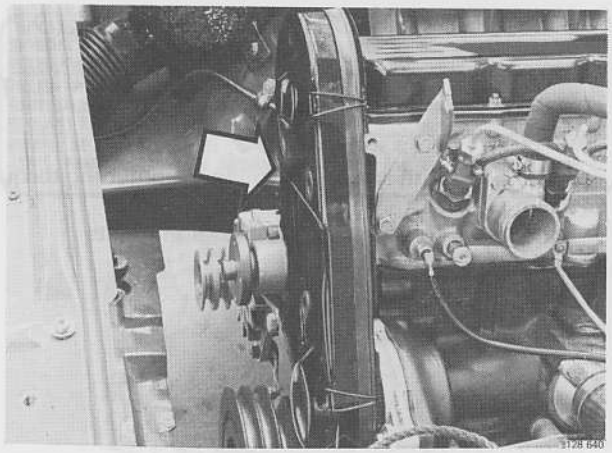
Drain coolant

Unscrew expansion tank cap.

Disconnect lower radiator hose from radiator and drain coolant.

(Engine is without drain taps).

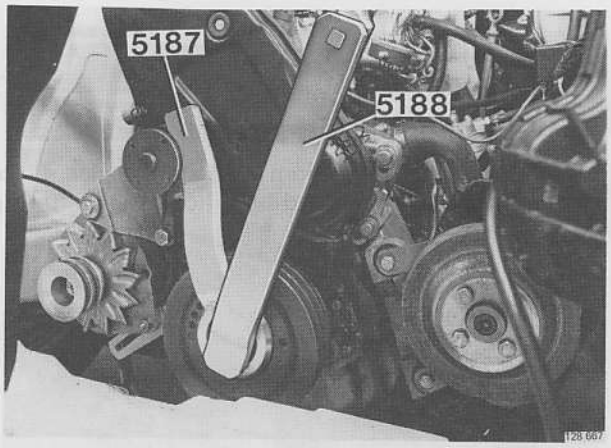
Lower vehicle.



T4

Disconnect:

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



T5

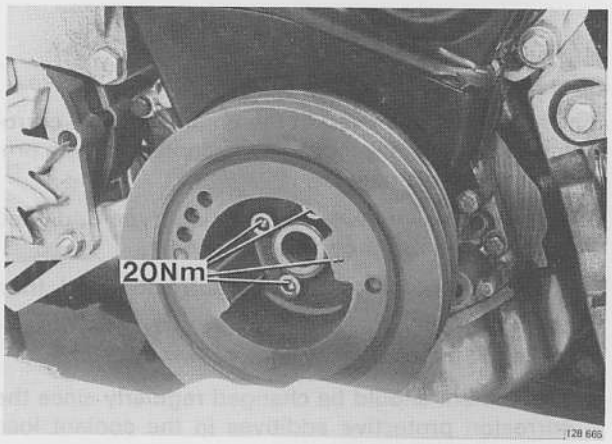
Remove vibration damper

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.

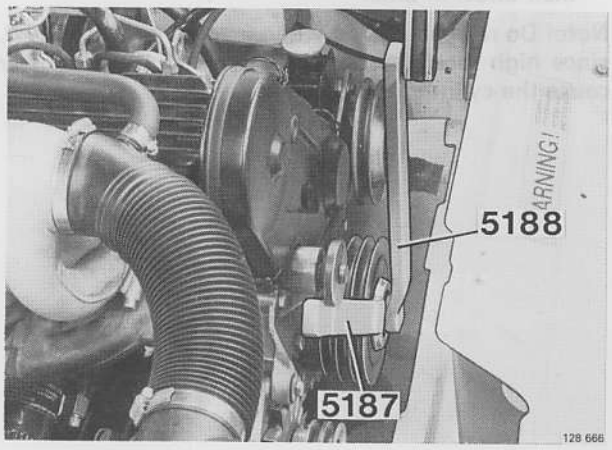


T6

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

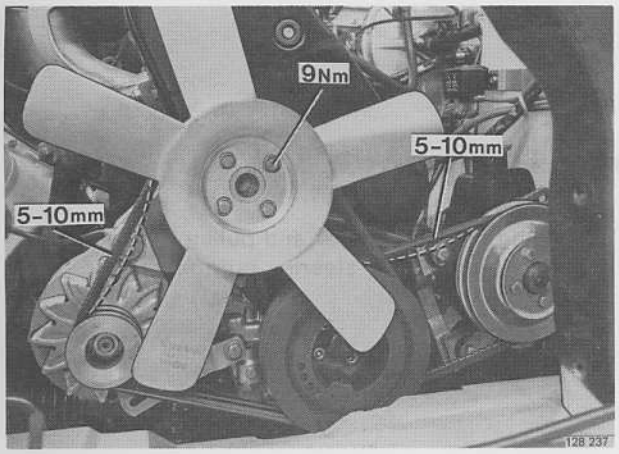
Install center bolt

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).

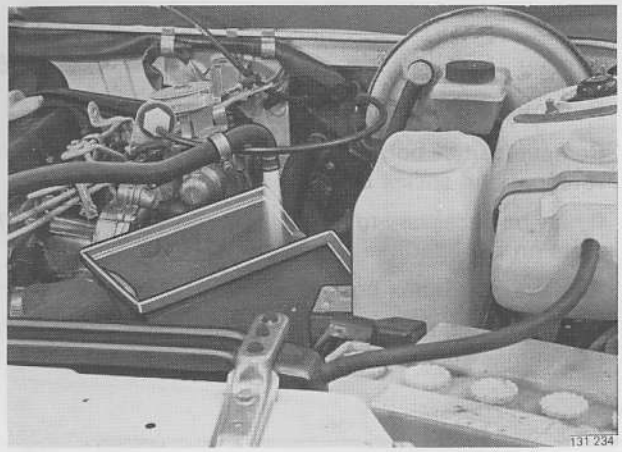
Important: Torque 350 Nm applies only if wrench 5188 is used. Also torque wrench must be in line with wrench 5188.



T8

Install:

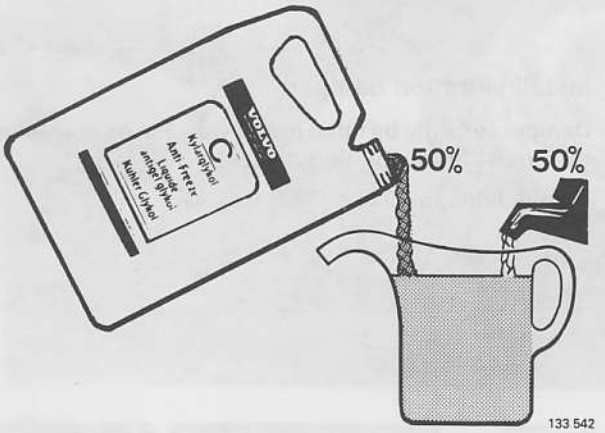
– cooling fan with spacer and pulley. Tightening torque **9 Nm** (7 ft lbs)
– belt for power steering pump and fan belts
– radiator. Connect hoses
– battery.



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

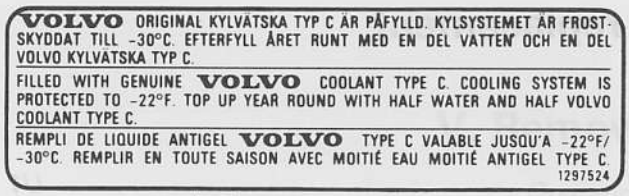
Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage.

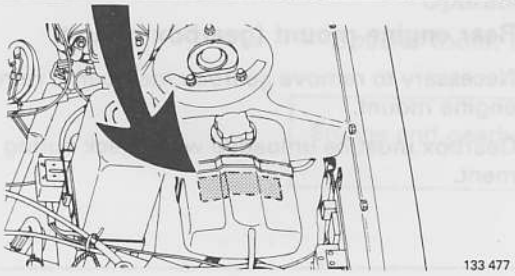
Use genuine Volvo blue-green coolant type C, diluted with **clean** water in proportions of 50/50.

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.



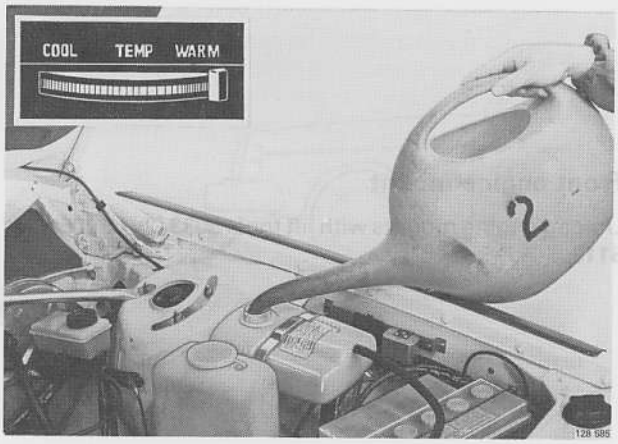


Replacing coolant

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

Type C blue-green coolant

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



T10

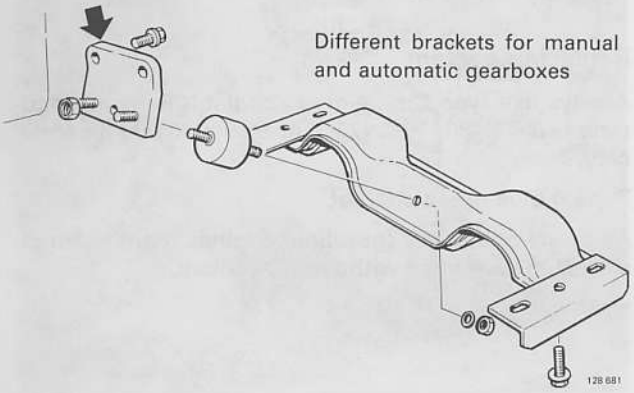
Fill coolant

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



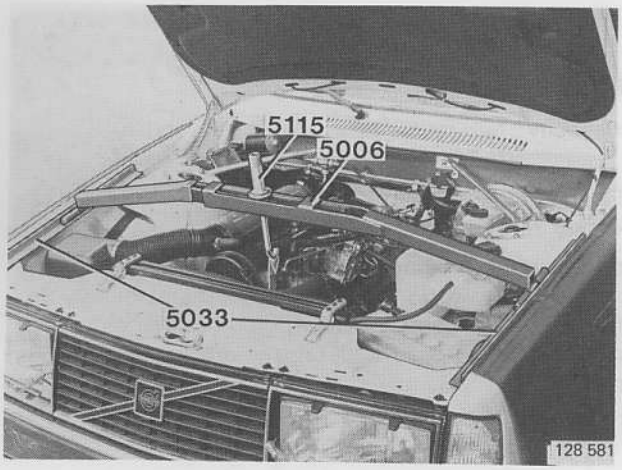
Different brackets for manual and automatic gearboxes

U1

Rear engine mount (gearbox mount)

Necessary to remove gearbox member to remove rear engine mount.

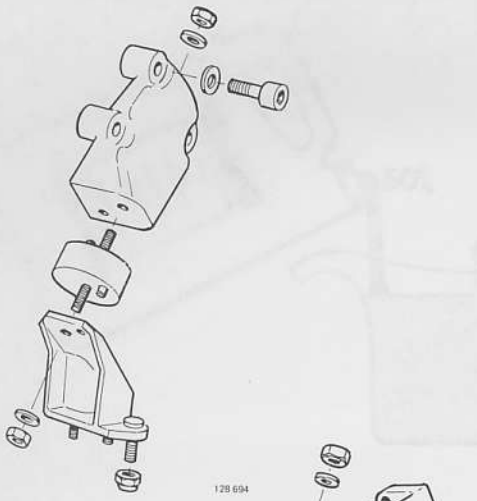
Gearbox must be unloaded with a jack during replacement.



U2

Front engine mount

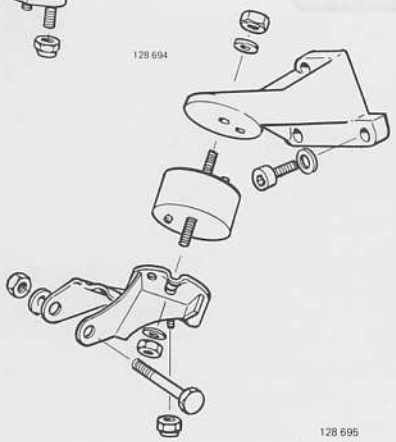
Unload engine mounts with lift tools **5033** (2x), **5006** and **5115.**



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.

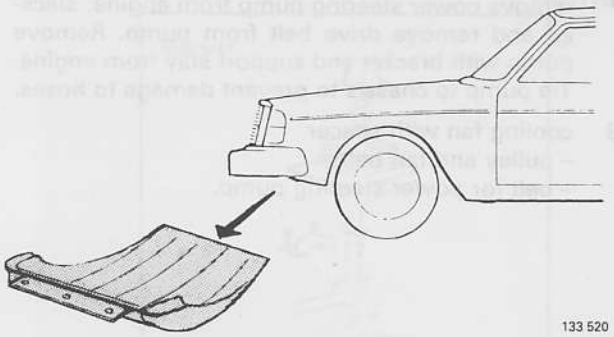
Do not tighten upper nut for rubber pad until engine mount is positioned.

V. Removing engine

Operations V1–7

Special tools: 2810, 5185, 5186

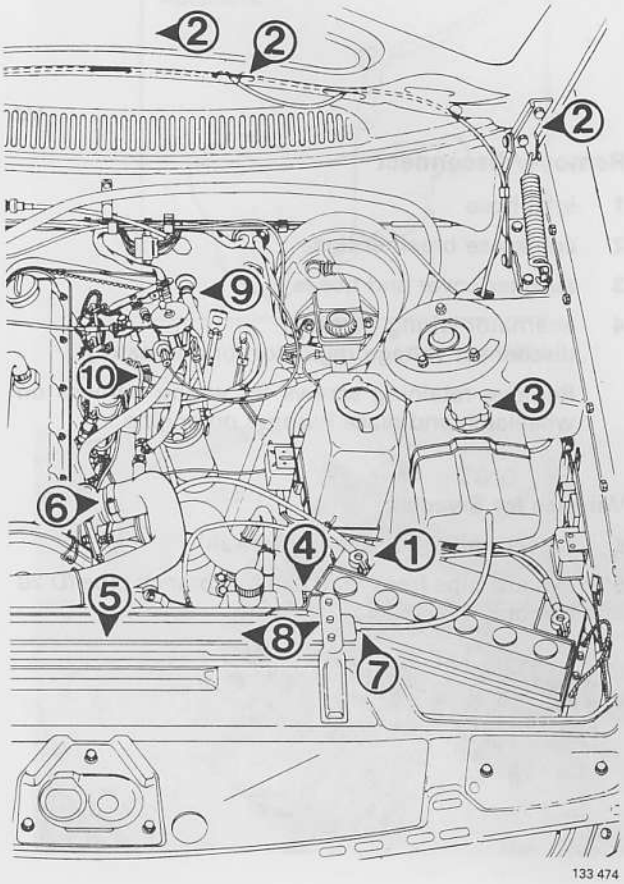
Engine and gearbox removed as a unit



133 520

V1

Remove engine splashguard and drain coolant



133 474

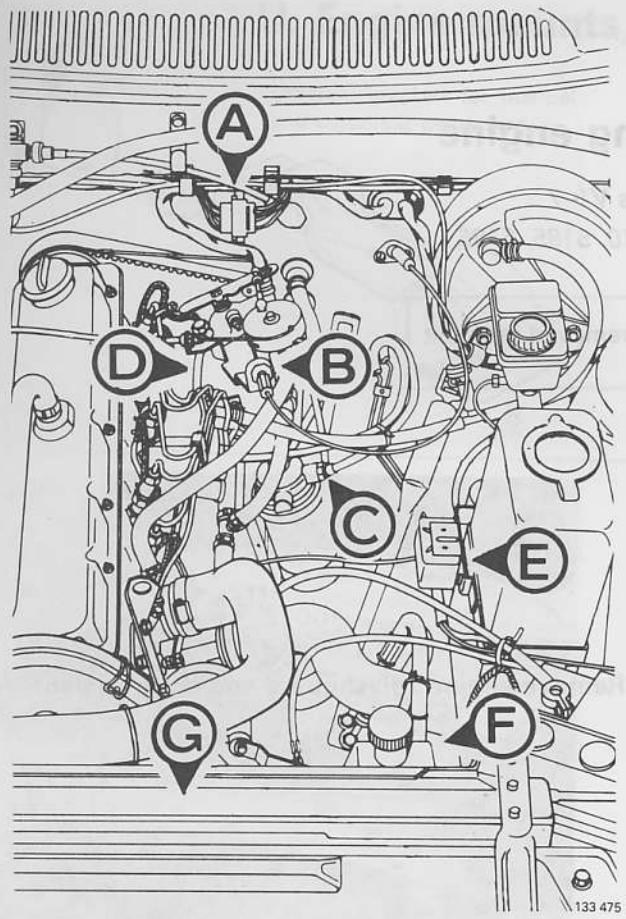
V2

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 raditor
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):

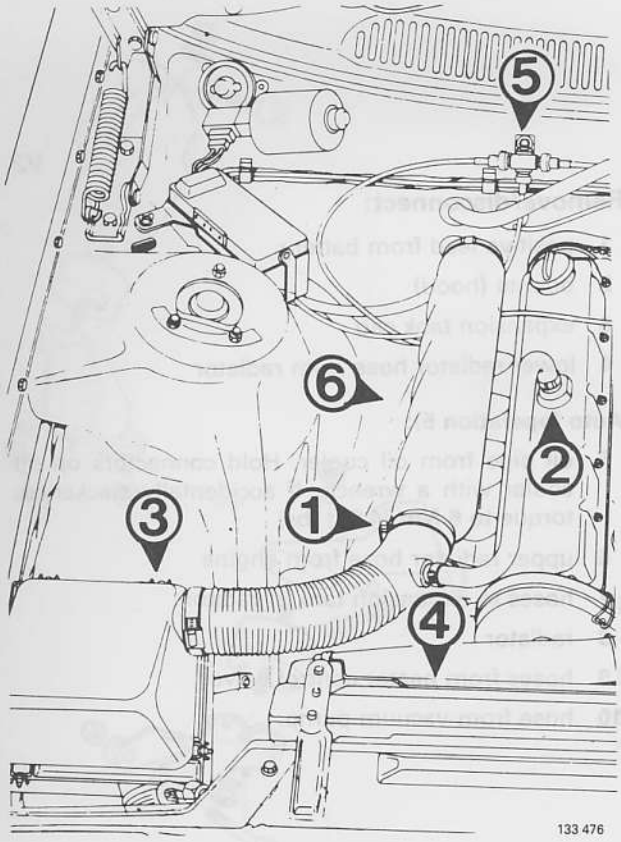
Blow-clean, disconnect and plug ends to prevent dirt entering fuel system

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 crossmember.
Left engine mount: remove nuts from front axle crossmember.

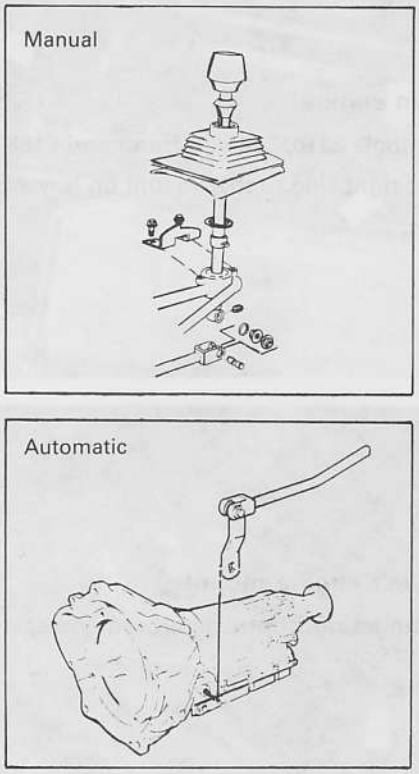
Right engine mount: remove lower nut from rubber pad.

Removing engine

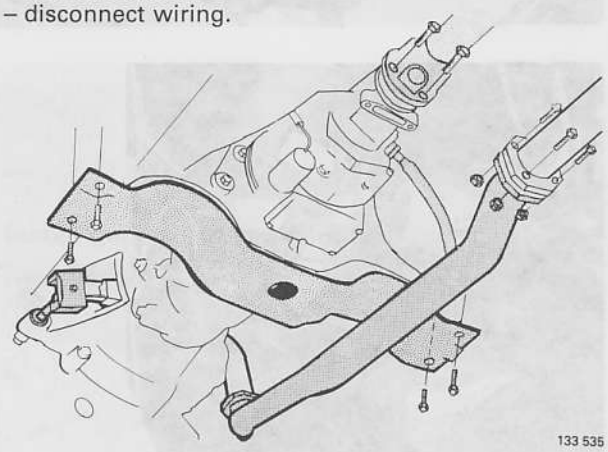
V6

Remove/disconnect

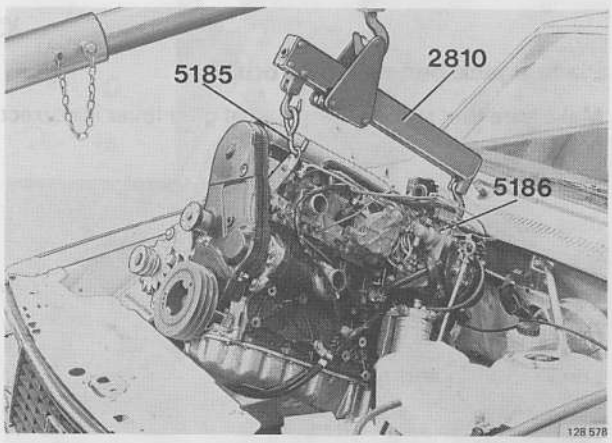
– front exhaust pipe clamps
– disconnect exhaust pipe coupling. Remove front exhaust pipe
– (manual) clutch cable and gear lever
– (auto) selector control from gearbox/transmission
– speedometer cable
– propeller shaft
– gearbox crossmember. Position a jack beneath gearbox as support
– disconnect wiring.



135 050



133 535



128 578

V7

Use lifting tools **2801, 5185** (at front) and **5186** (at rear).

Lift engine enough to unload left engine mount.

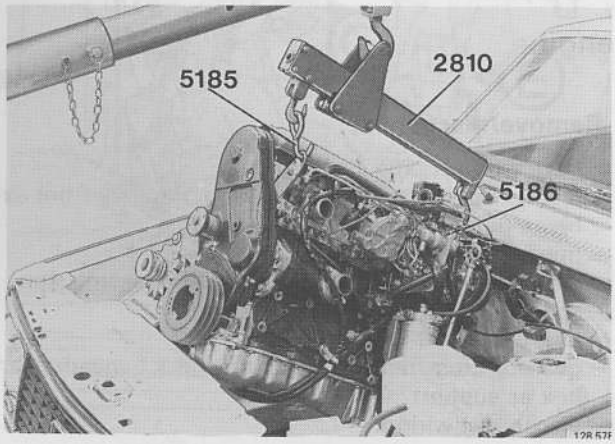
Remove engine mount.

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

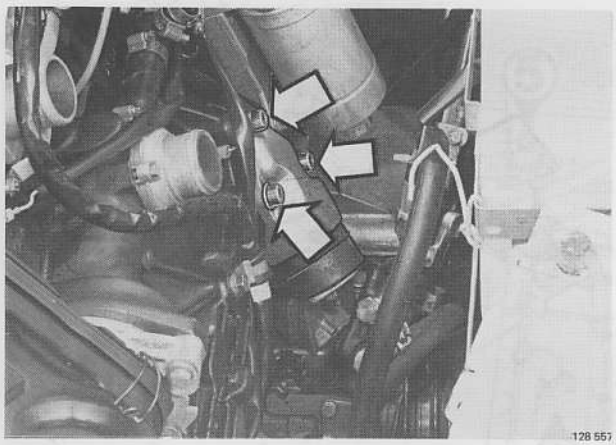


X1

Position engine

Use lift tools **2810, 5185** (at front) and **5186** (at rear).

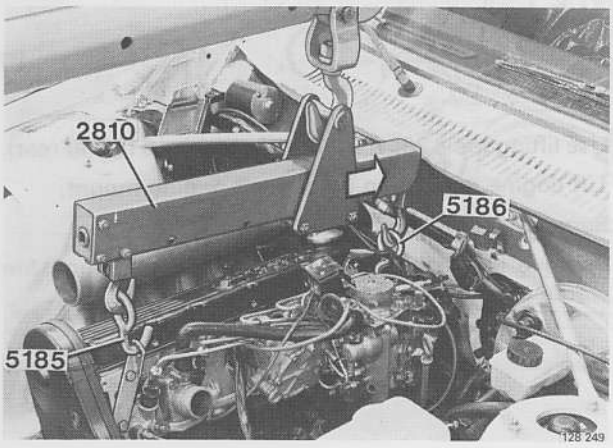
Position right side rubber mount on lower bracket.



X2

Install left engine mount

Place mount on front axle crossmember and tighten retaining bolts.



X3

Place a jack beneath gearbox

Make sure that rubber foam pad at gear lever is correctly positioned.

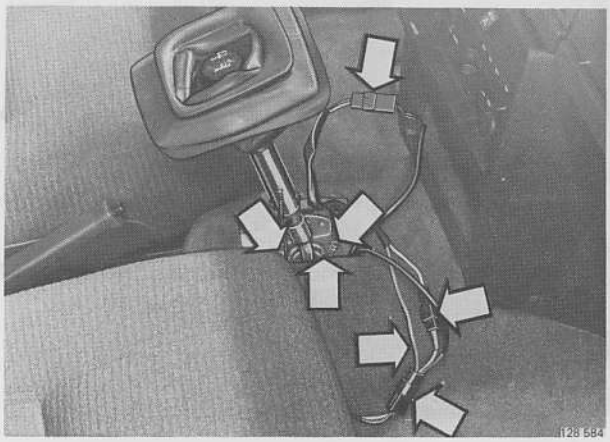
Insert wiring into passenger compartment.

Jack-up gearbox until level.

X4

Remove lifting tools

Lower engine and remove tools.



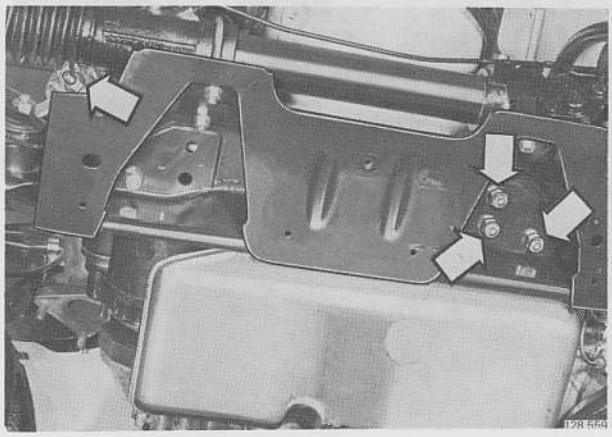
X5

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.

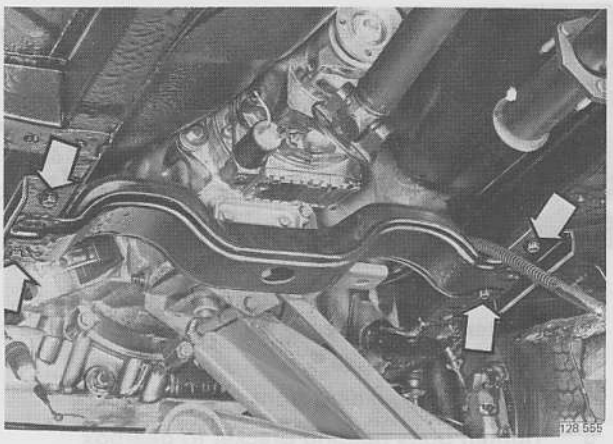


X6

Install nuts for engine mounts

Left mount: nuts in front axle crossmember.

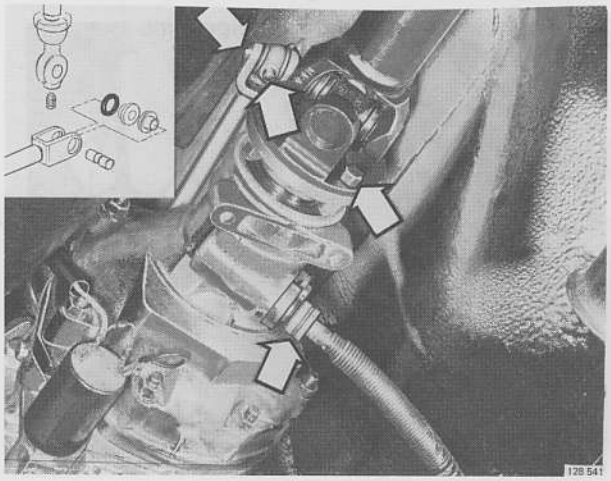
Right mount: lower nut on rubber pad.



X7

Install gearbox crossmember

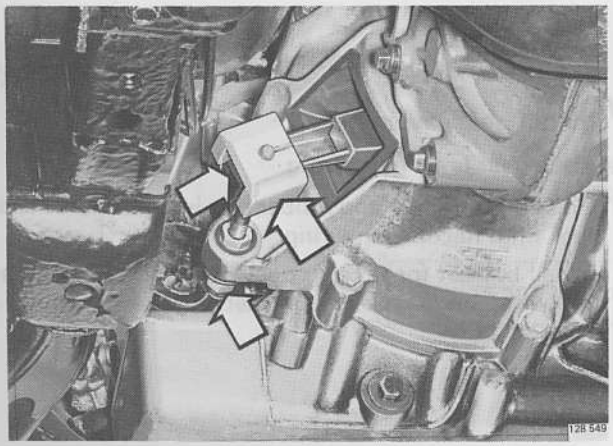
Remove jack.



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

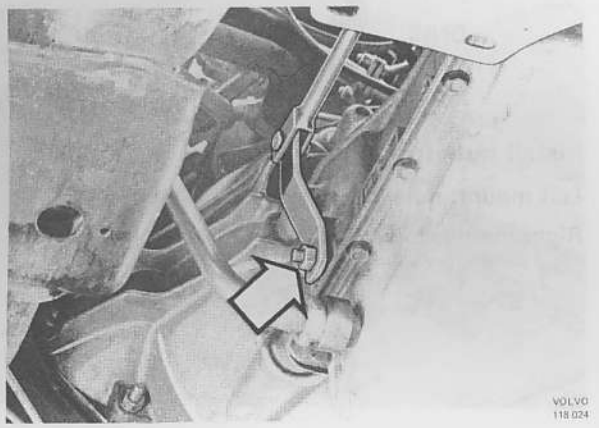
Connect clutch cable and install return spring

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.

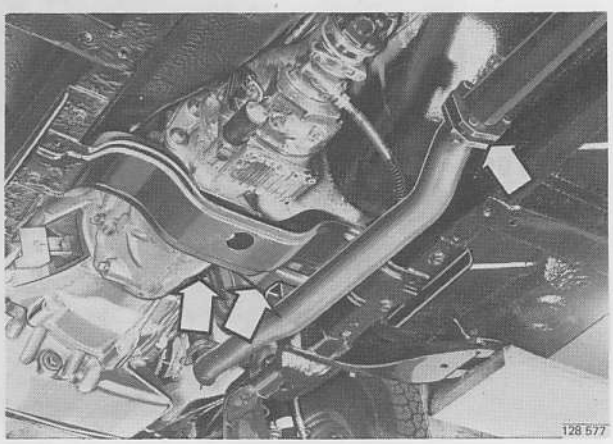
Adjust play = 1–3 mm. (0.04–0.12 in).



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

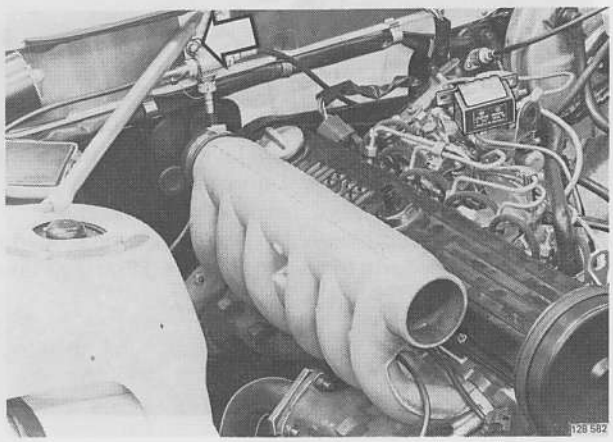
2 Attach front exhaust pipe finger tight. Use new gaskets

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

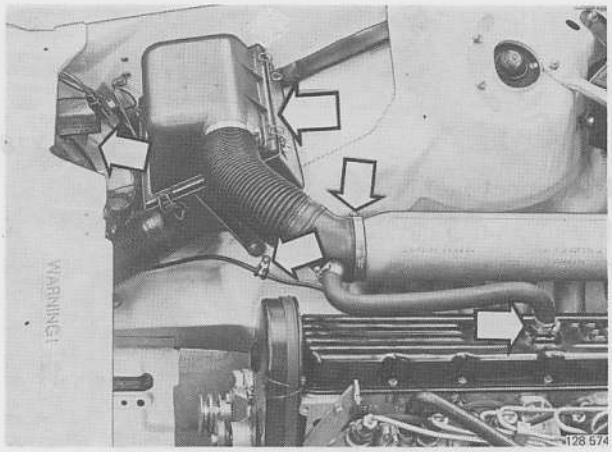
6 Tighten clamp at exhaust pipe joint.



Cars for Sweden

X12

Attach T-gear unit to bulkhead (firewall)



X13

Connect alternator wiring harness

Reconnect voltage regulator.

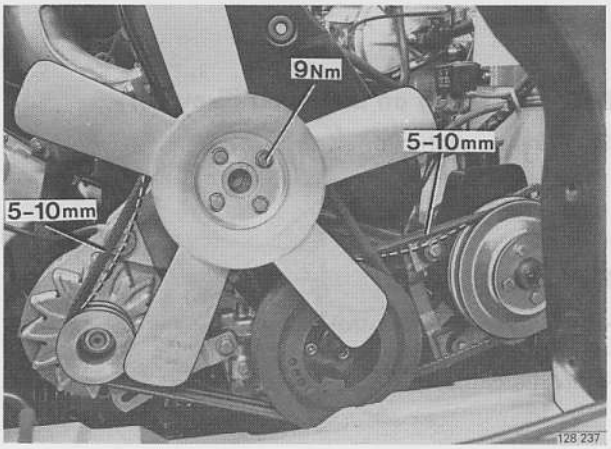
Attach clamp on wheelarch.

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.



X15

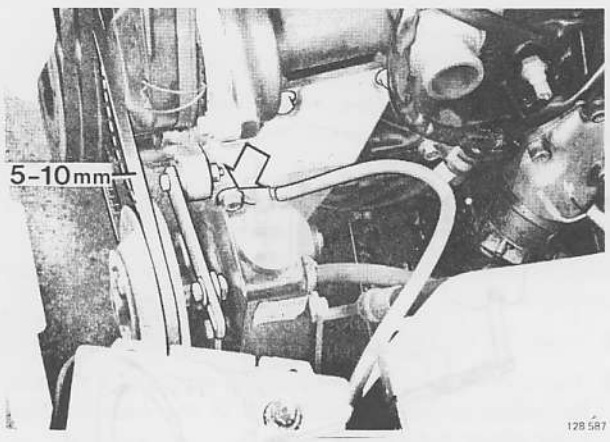
Install drive belts and cooling fan

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.

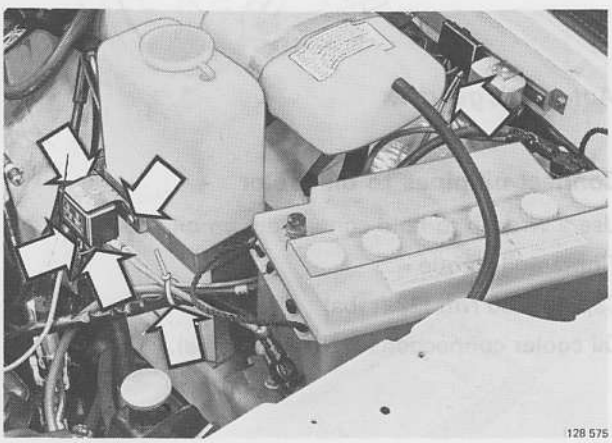


X16

Install power steering pump and belt

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.



X17

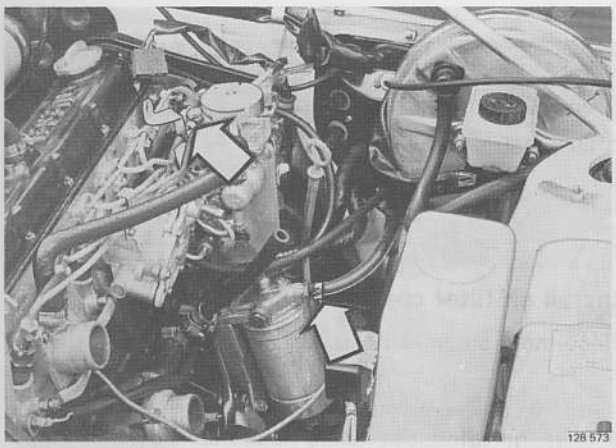
Connect relay for preheating system

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.

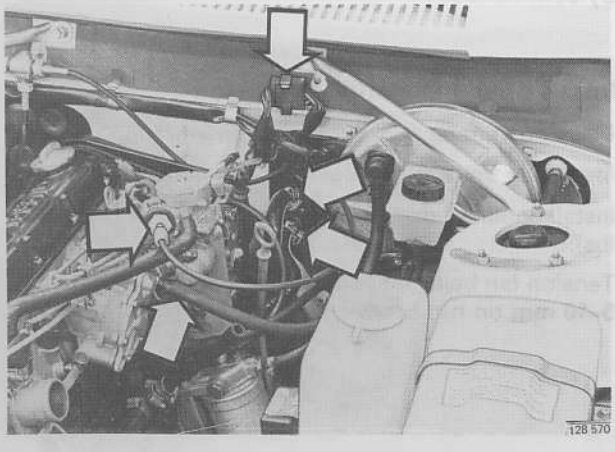
Secure wires with clamps and reconnect battery.



X18

Reconnect fuel lines

Make sure that dirt does not enter fuel system.



X19

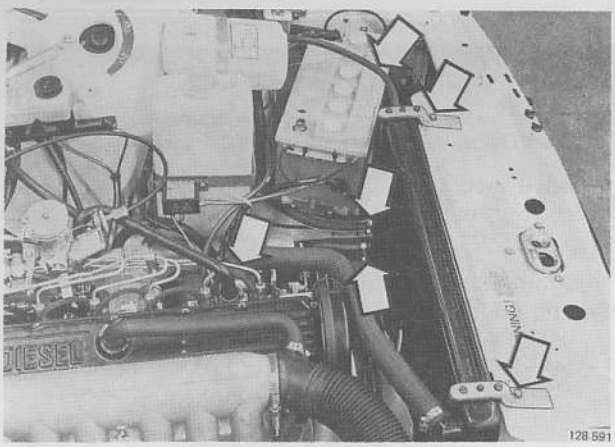
Reconnect plug on bulkhead (firewall)

Secure plug with clip.

X20

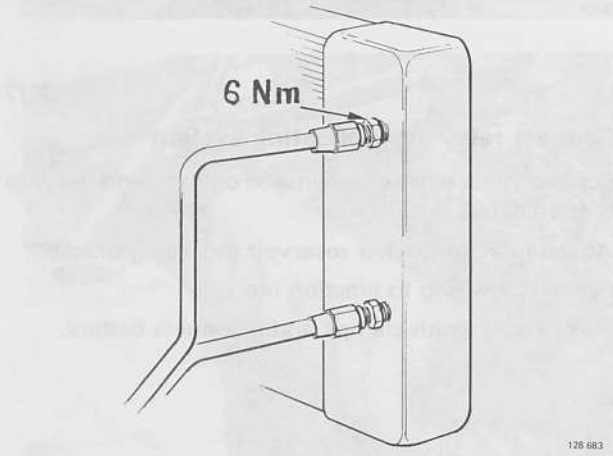
Reconnect:

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



X21

Install radiator and connect hoses



Automatic gearbox

X22

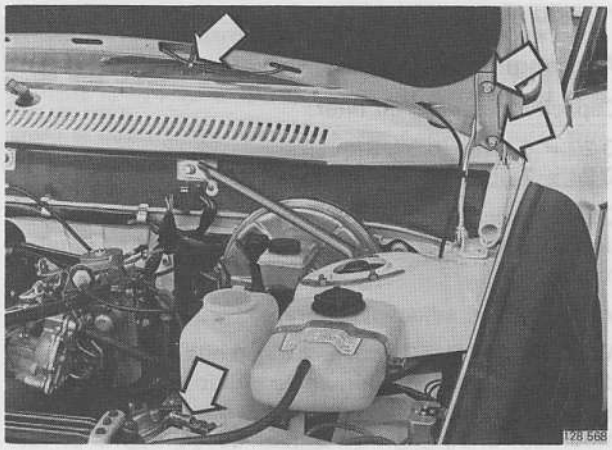
Connect oil pipes to oil cooler

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).



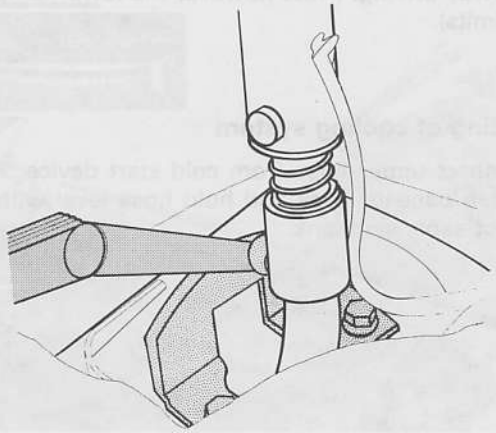
X23

Install bonnet/hood

Connect washer hose.

X24

Reconnect battery



Manual gearbox

X25

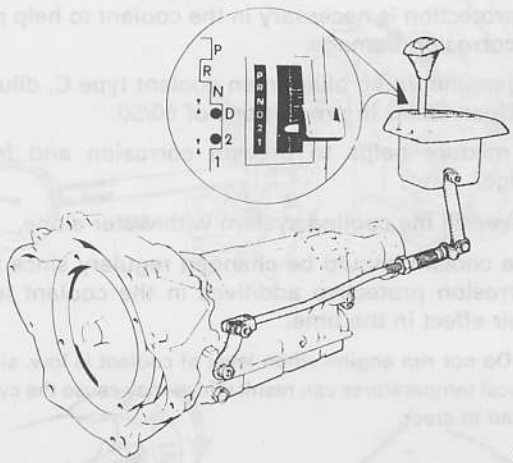
Adjust bracket for reverse gear detent. Install rubber gaiter

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.

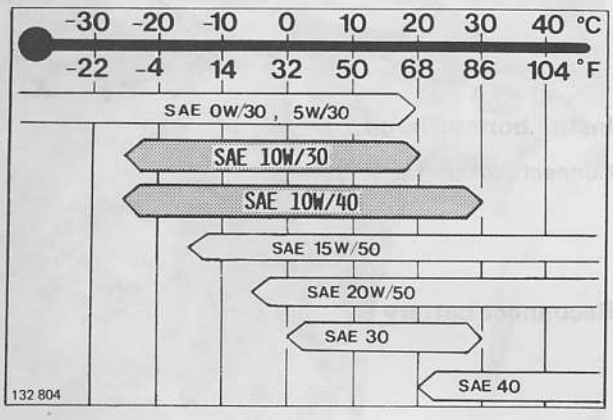


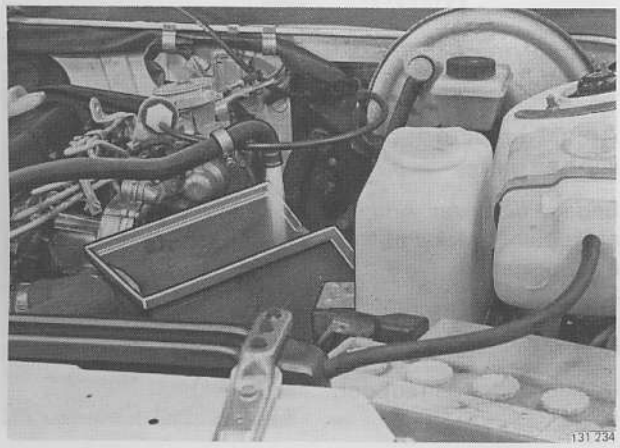
Automatic gearbox

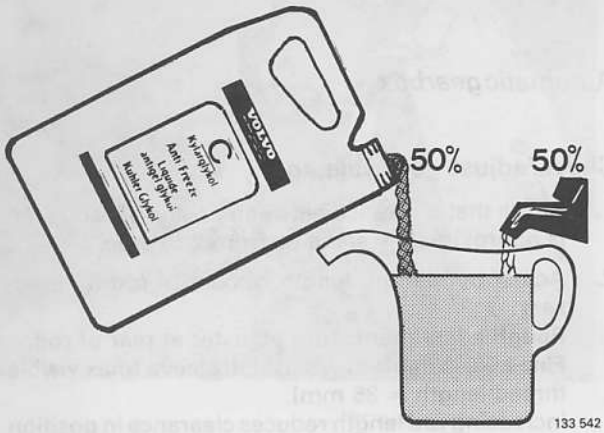
X26

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

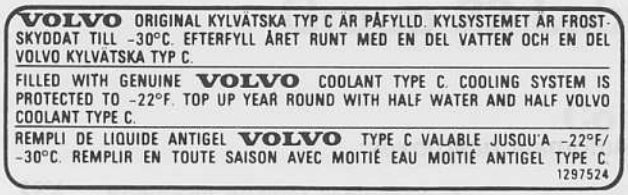
Since aluminium is used in the engines, active corrosion protection is necessary in the coolant to help prevent corrosion damage.

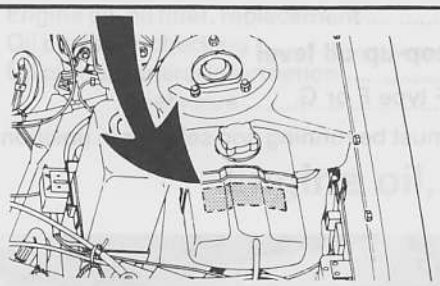
Use genuine Volvo blue-green coolant type C, diluted with clean water in proportions of 50/50.

This mixture helps to prevent corrosion and frost damage.

- Never fill the cooling system with water alone.
- The coolant should be changed regulary 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.





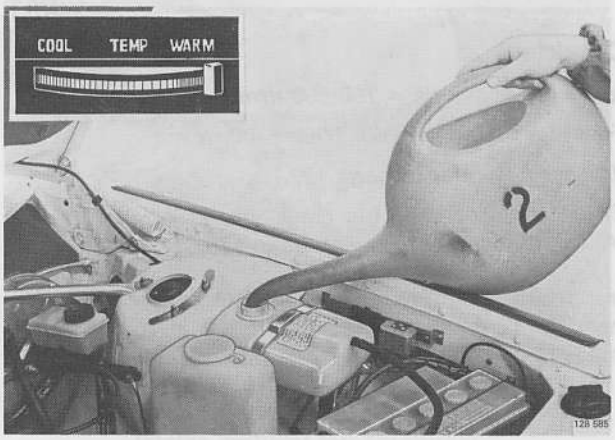
Replacing coolant

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

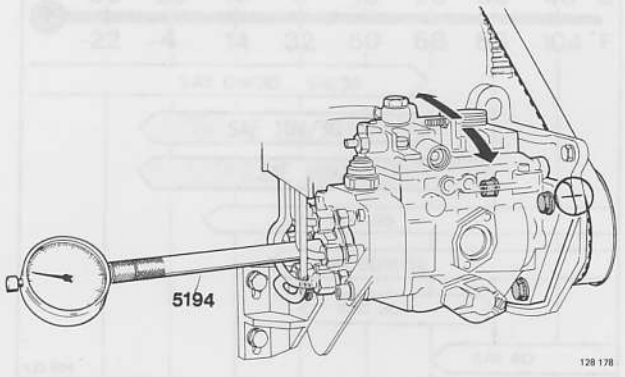


Fill coolant

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.

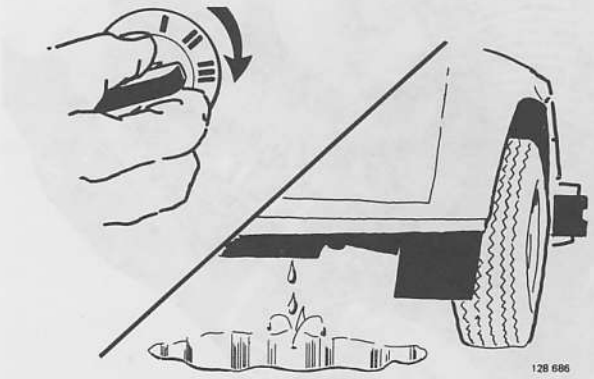
Set dashboard heater control to max. Turn on engine and warm-up for 5 minutes. Add coolant during this time. Connect hose to cold start device. Fill coolant to mouth of expansion tank (above max) and screw on cap.



X30

Check/adjust injection timing

See instructions on page 24, C11–20.



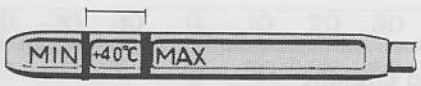
X31

Check operation

Turn on engine and warm-up.

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

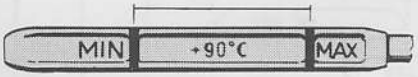
Install engine splashguard.



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

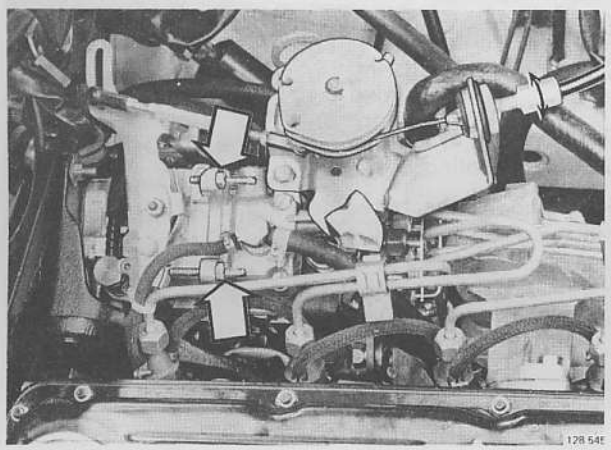
This temperature is reached after approx. 10 minutes idling.

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

Engine oil, oil filter, replacement

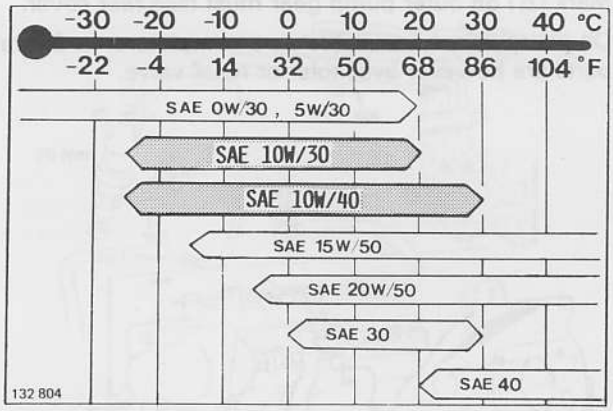
Y1

	D 20	D 24
Oil capacity litres (US quarts)		
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)

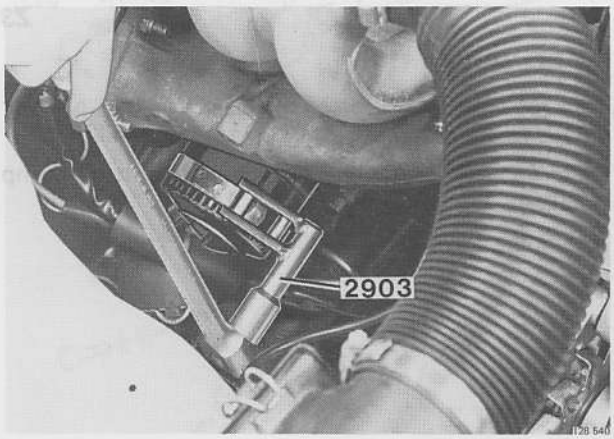
Quality

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 wiht frequent decelerations of fast motorway driving. (Note however the lower temperature limits.)



Y2

Oil filter

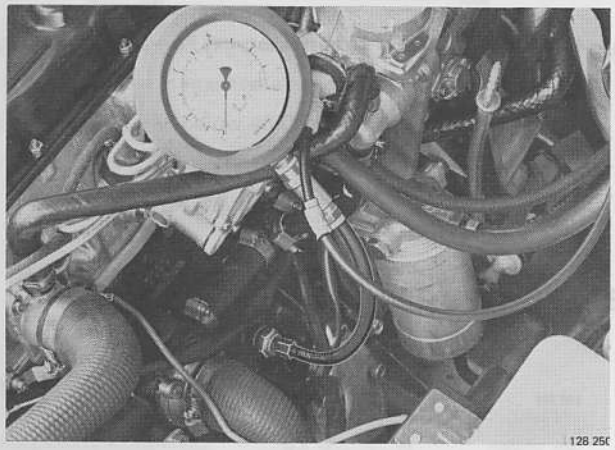
Use oil filter wrench **2903** to remove filter.

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

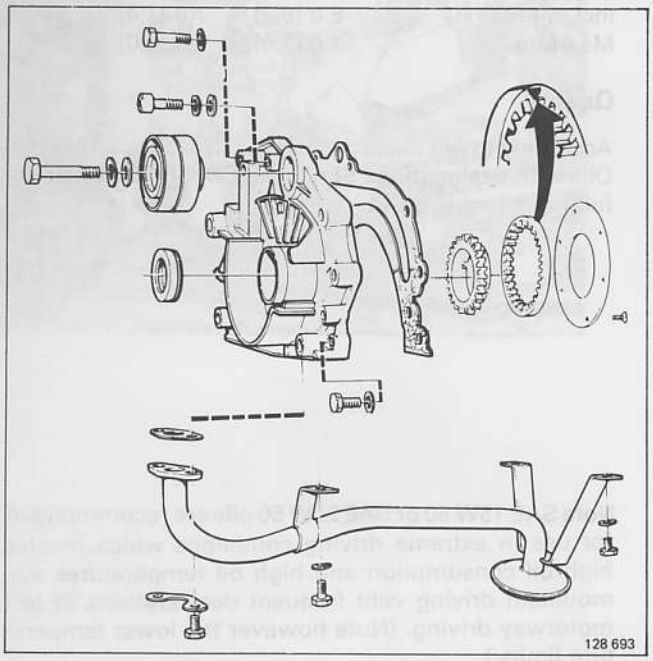
Oil pressure must be at least **200 kPa** (28 psi) at 33 r/s (2,000 r/min) and 80°C (176°F) oil temperature.

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



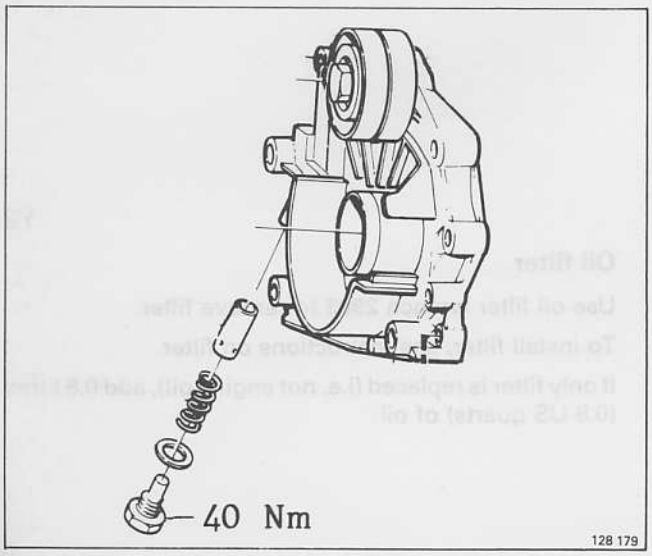
Z2

General information

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

Mark (△) 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

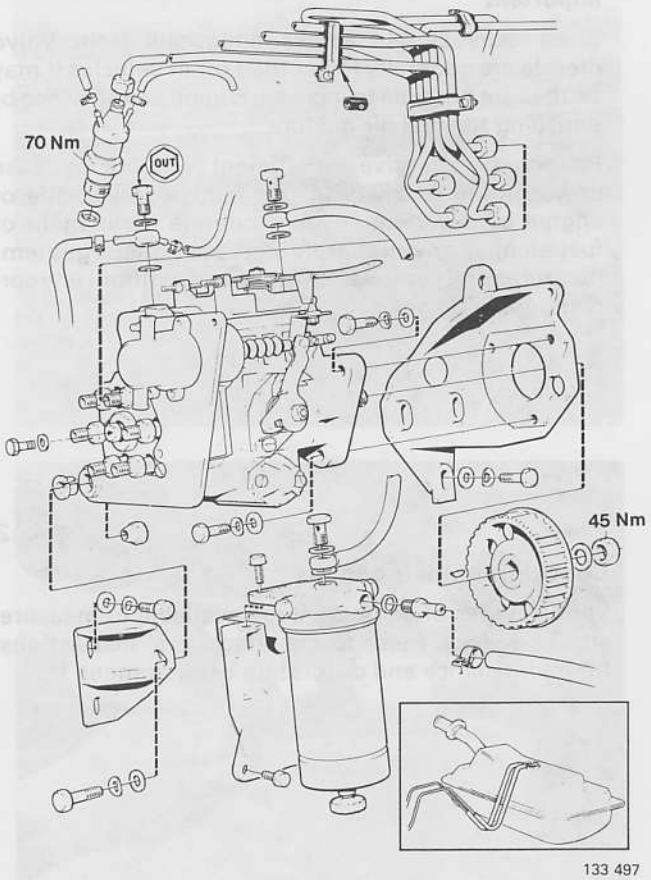
If oil pressure is not as specified check that plunger moves freely and that spring is in good condition.

Relief valve is accessible from below with oil pump installed.

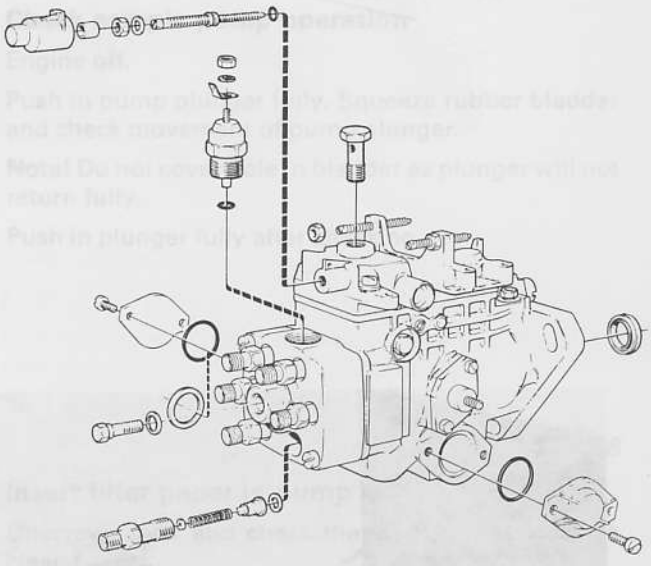
Tightening torque 40 Nm (30 ft lbs).

Group 23 Fuel system

Contents

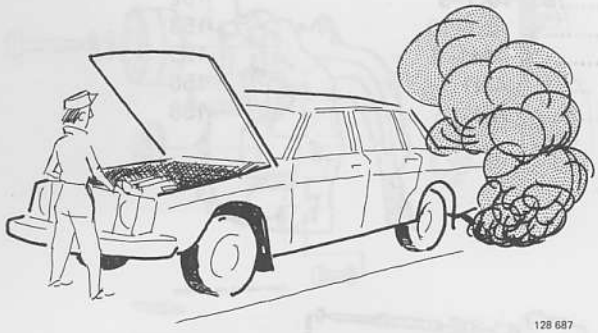


133 497



133 498

AA. Exhaust gas density



128 687

AA1

General

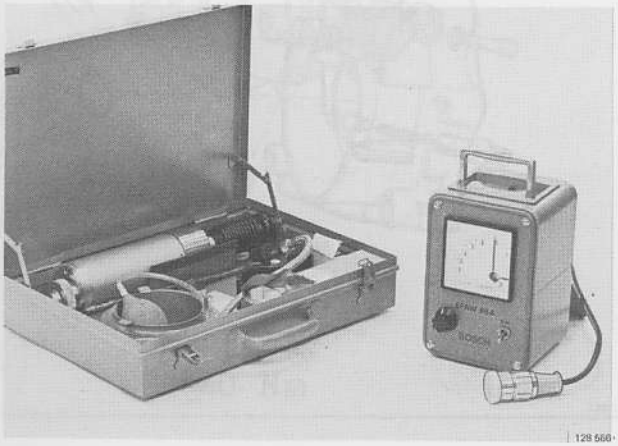
Exhaust gas smoke density gives a good indication of the condition of an engine and whether the injection pump is correctly adjusted.

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.

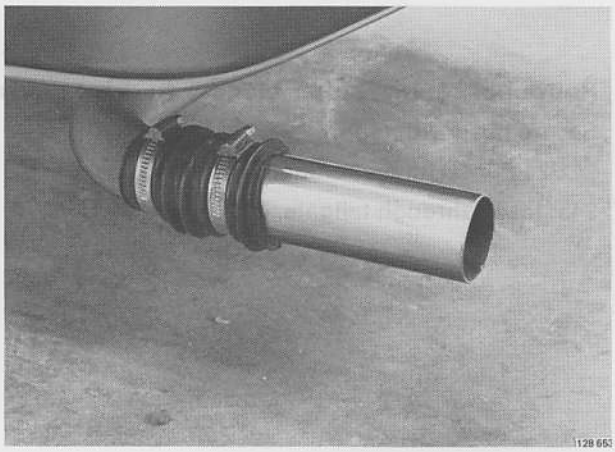


128 566

AA2

Checking smoke density

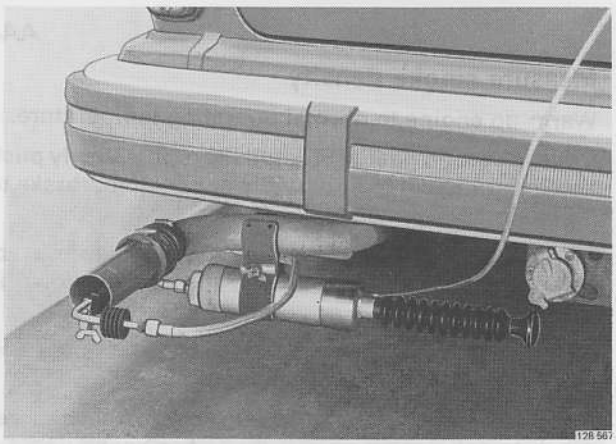
Various types of equipment are available to measure smoke density. Refer to manufacturers' instructions for maintenance and calibration of equipment.



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 extention piece with rubber hose and clamps.



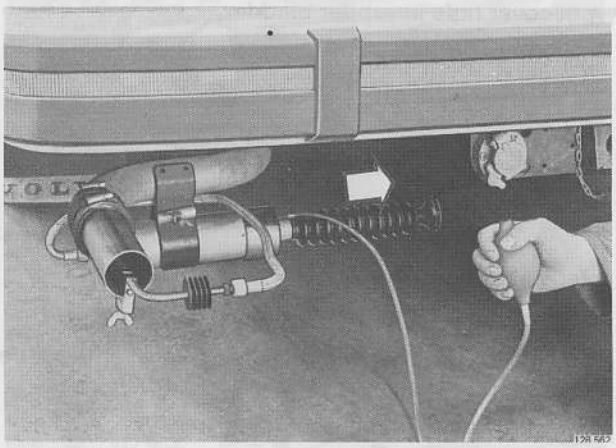
AA4

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

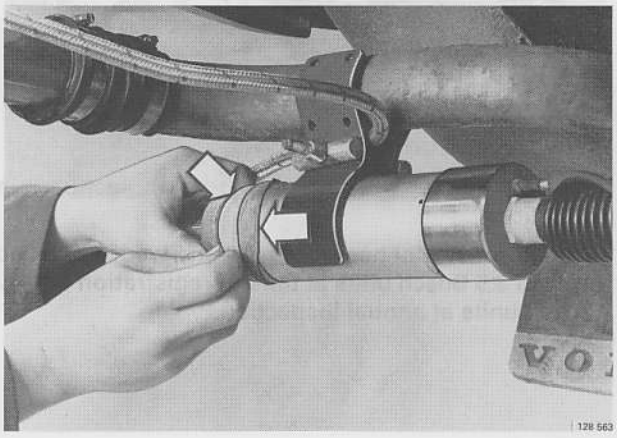
Check sample pump operation

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).

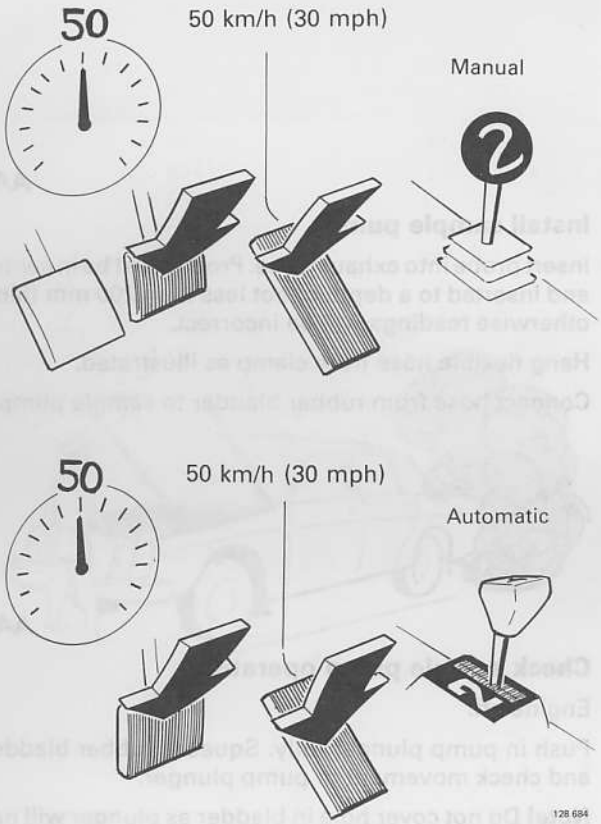
AA7

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.

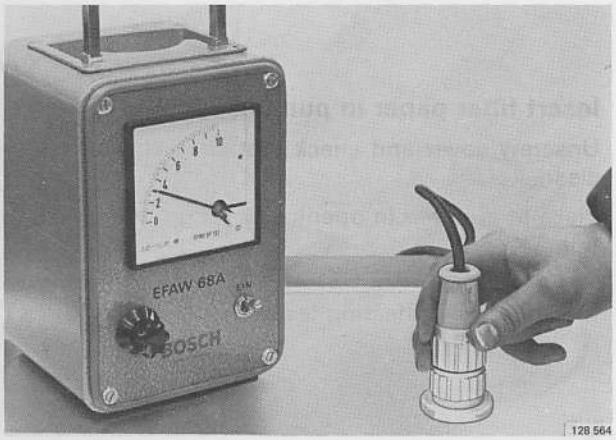
AA9

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

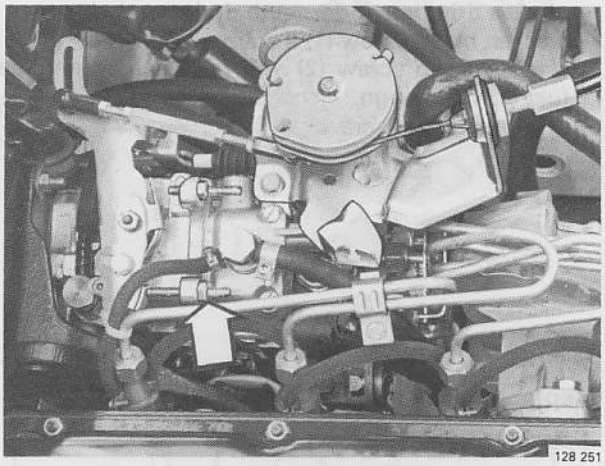
Evaluate result

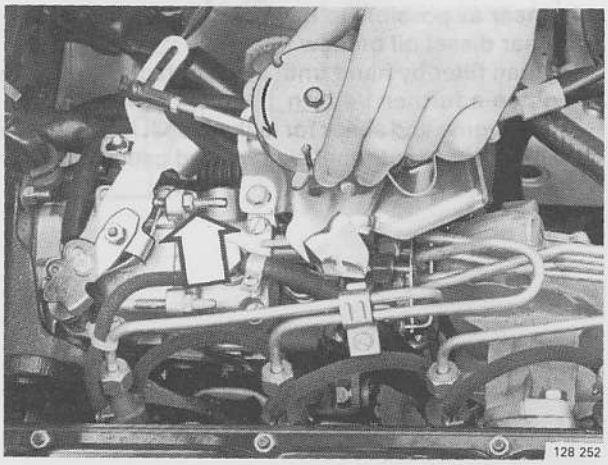
Calibrate equipment according to manufacturers instructions.

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


128 251


128 252

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.

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.

AB5

Disconnect tachometer.

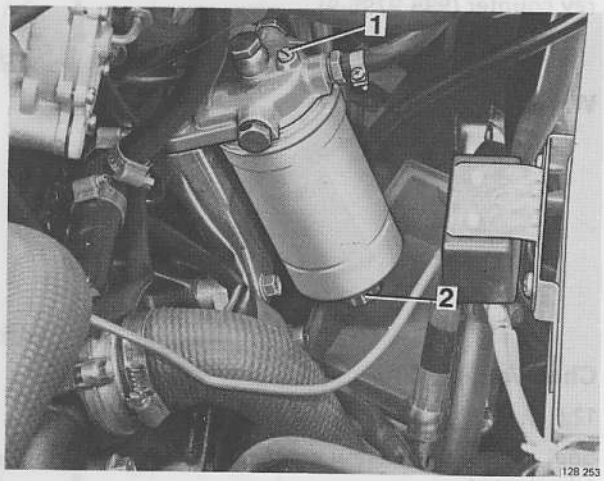
AB6

Check/adjust engine controls

Always check/adjust engine controls after adjusting idle speed.

See instructions on page 176, operations AX1–AX9.

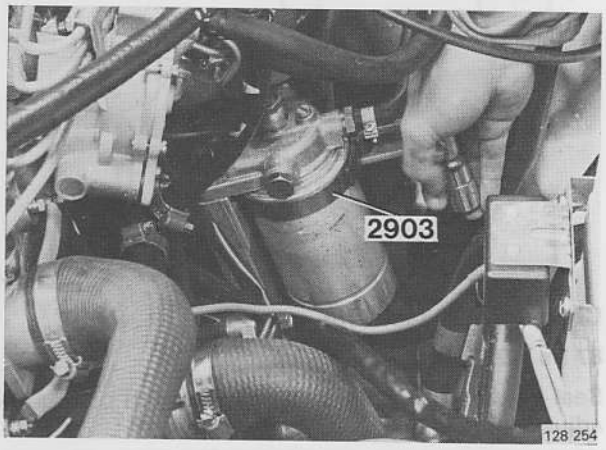
AC. Fuel filter



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.



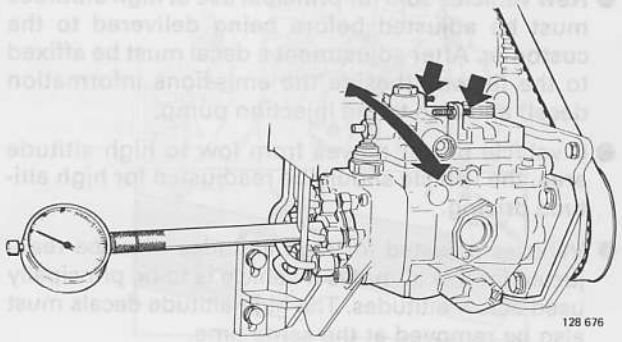
AC2

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

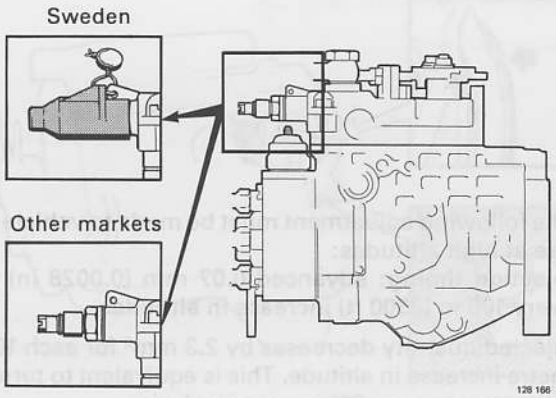


AD1

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.

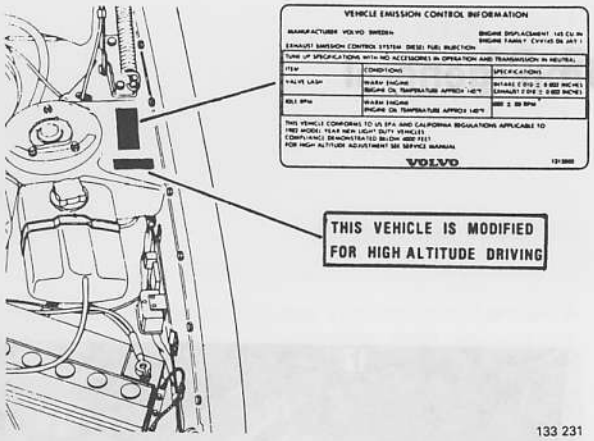


Smoke density regulations for Sweden

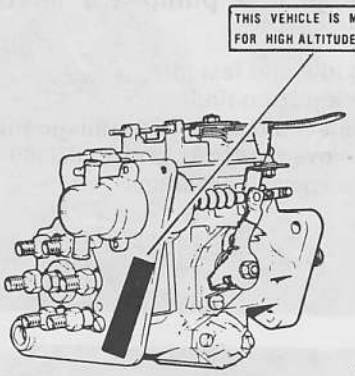
Fuel regulating screw is sealed at factory.

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

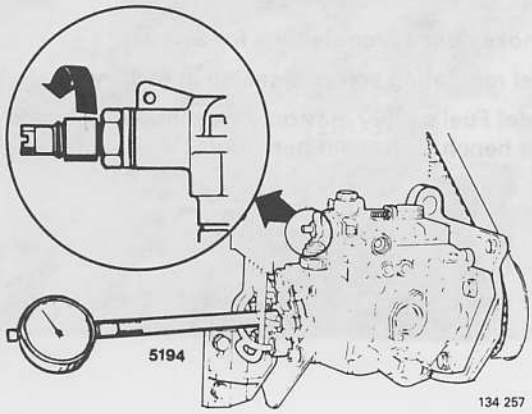
High altitude adjustment (Legal requirement)



133 231



133 232



134 257

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 mm^3 for each 1000 metre increase in altitude. This is equivalent to turning adjustment screw 35° counterclockwise.

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)

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

High altitude setting is 0.99 mm

Injected quantity

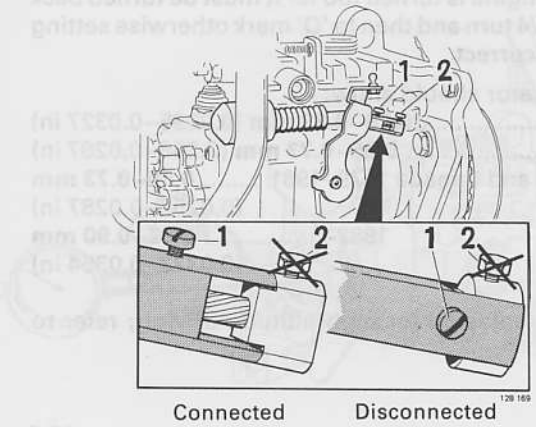
Example: If altitude is 2000 metres above sea level the following calculations can be made:

$\frac{2000}{1000} \times 35° = 70°$

Turn adjustment screw 70° counterclockwise.

AD. Injection pump, setting

Special tool: 5194



Connected Disconnected

AD3

Remove rear timing gear cover

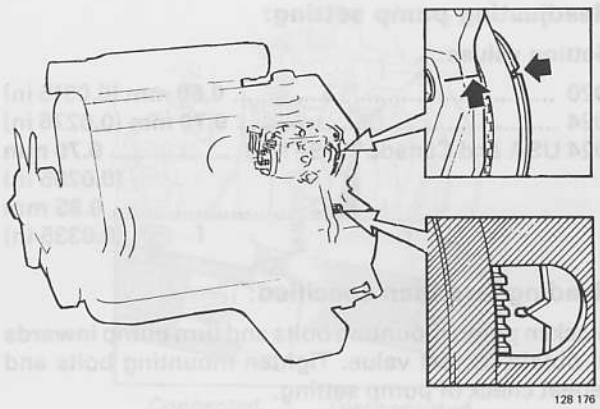
AD4

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.



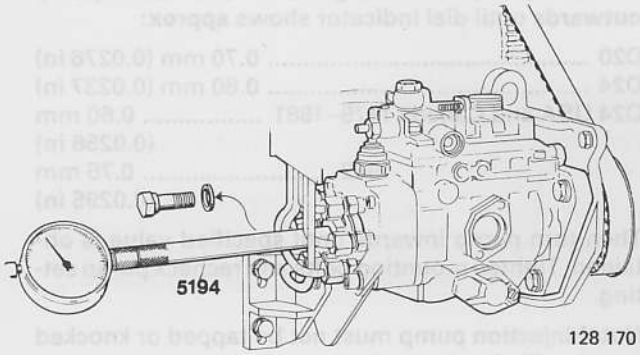
AD5

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.

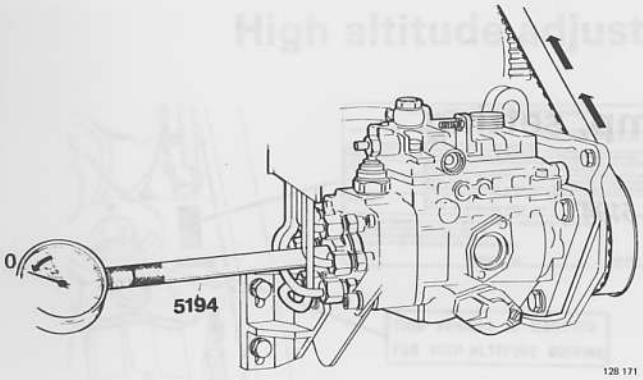


AD6

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.

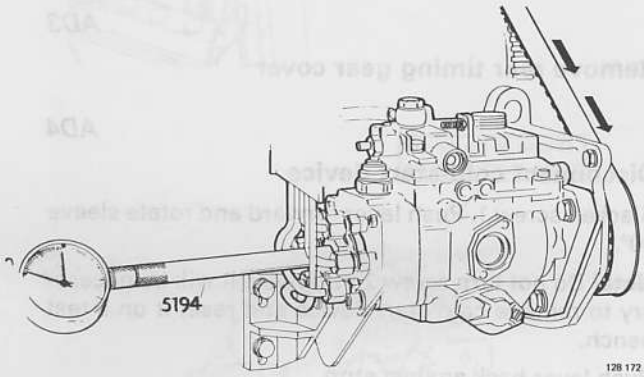


AD7

Set indicator to zero

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

Set indicator to zero.



AD8

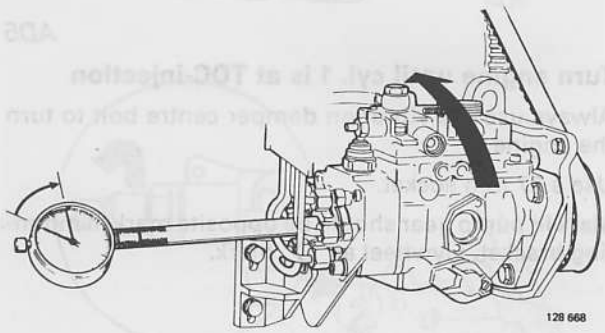
Check pump setting

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)



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:

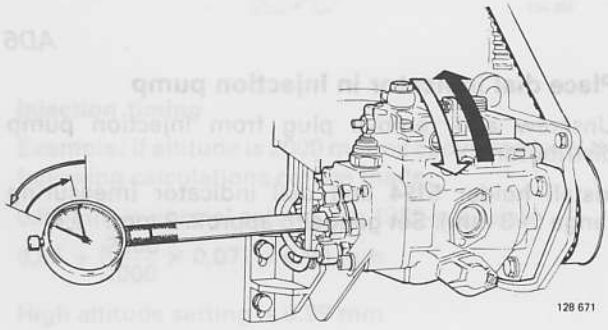
Slacken pump mounting bolts and turn pump **inwards** to obtain correct value. Tighten mounting bolts and repeat check of pump setting.

Reading more than specified:

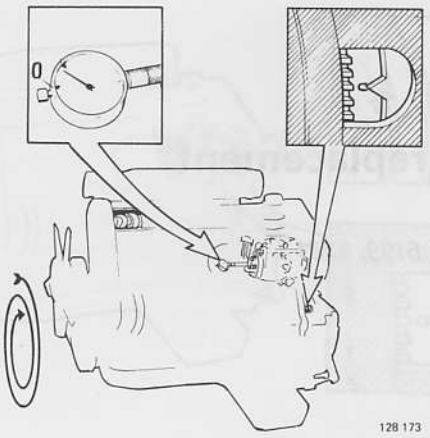
Slacken pump mounting bolts and turn pump **outwards** until dial indicator shows **approx:**

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.

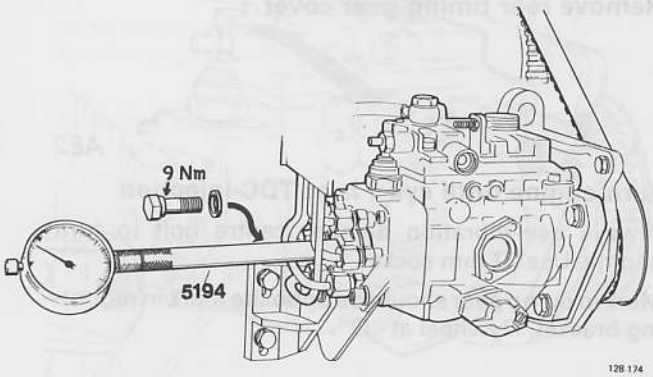


AD10

Check pump setting

Turn engine two turns and check setting.

Adjust if necessary according to operation D8 and recheck.



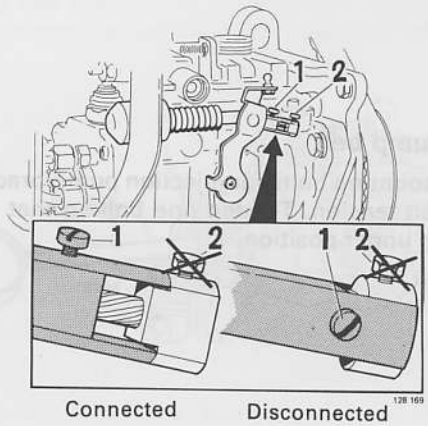
AD11

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

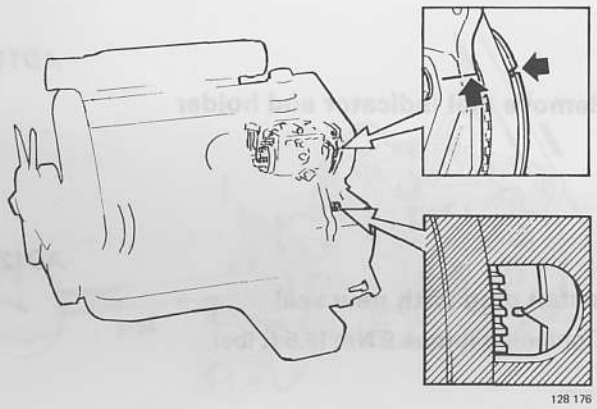
Reconnect cold start device

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

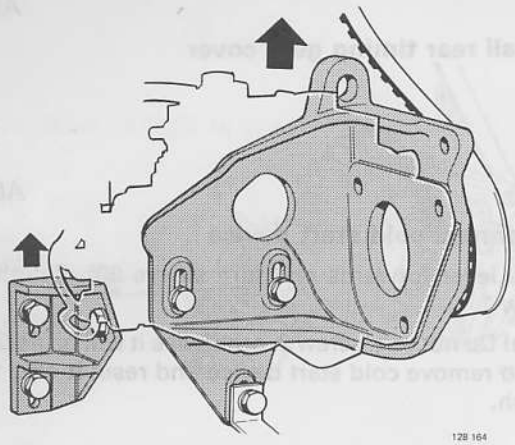
Remove rear timing gear cover

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".

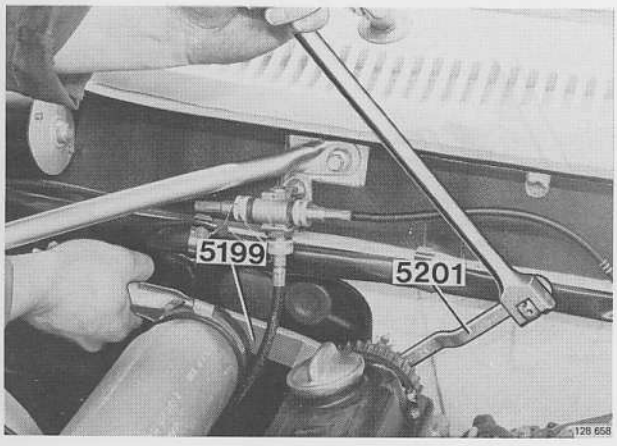


AE3

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.



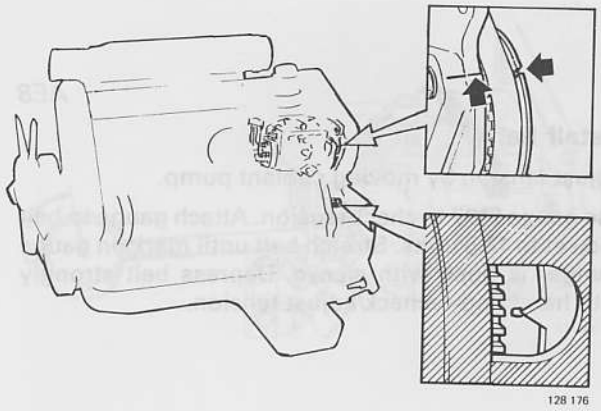
AE4

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.



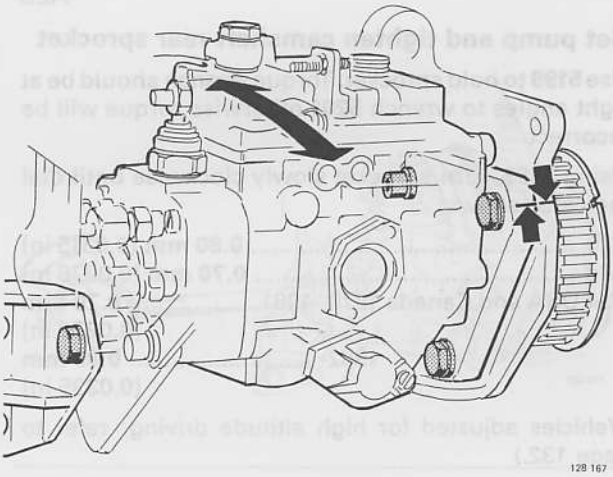
AE5

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.

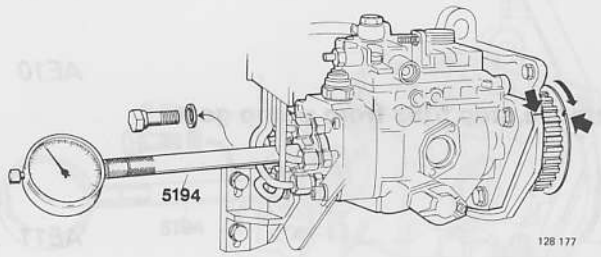


AE6

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.



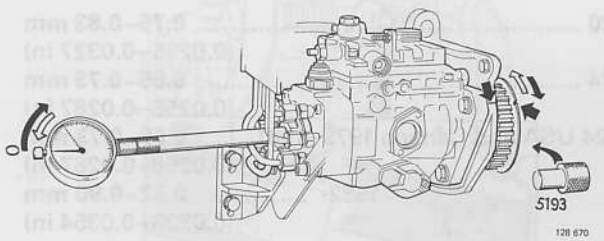
AE7

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

Unscrew and remove plug from injection pump distributor.

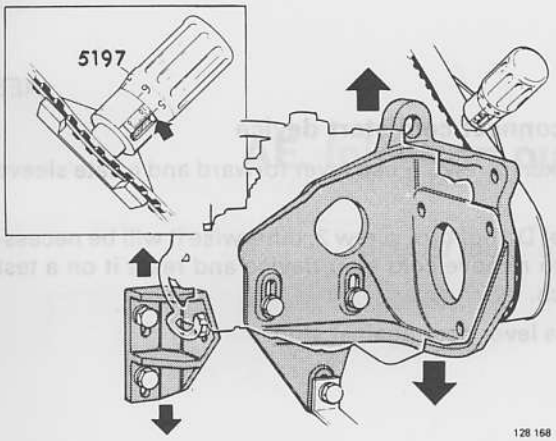
Install holder **5194** and dial indicator (measuring range 0–3 mm). Set gauge to approx. 2 mm.

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



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.)

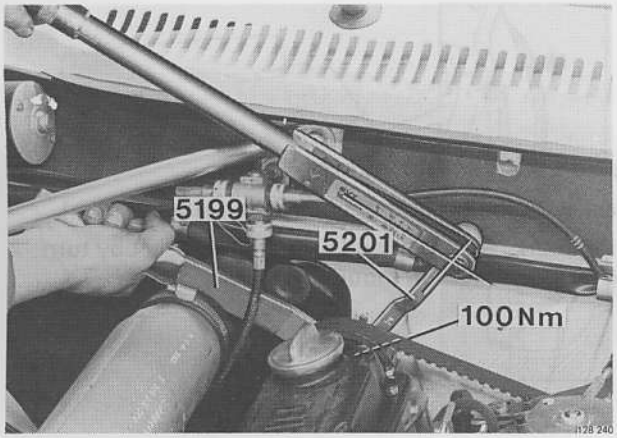


AE8

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.

AE10

Remove stop 5193 from pump gear

AE11

Check pump setting

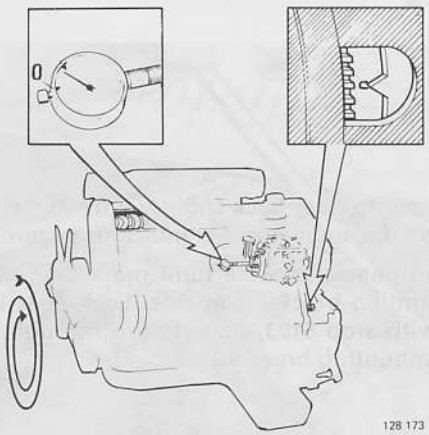
Turn engine two full turns until cyl. 1 is at TDC-injection again. If engine is turned too far it must be turned back approx. 1/4 turn and then to zero mark otherwise setting will be incorrect.

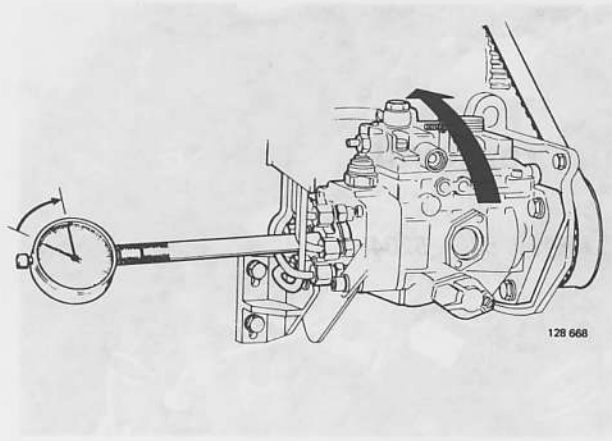
Dial indicator should show:

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.



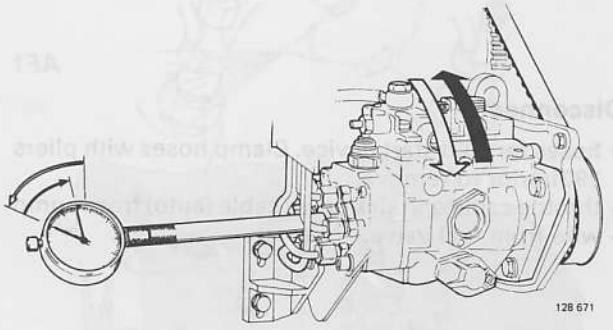


Readjusting pump setting:

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.



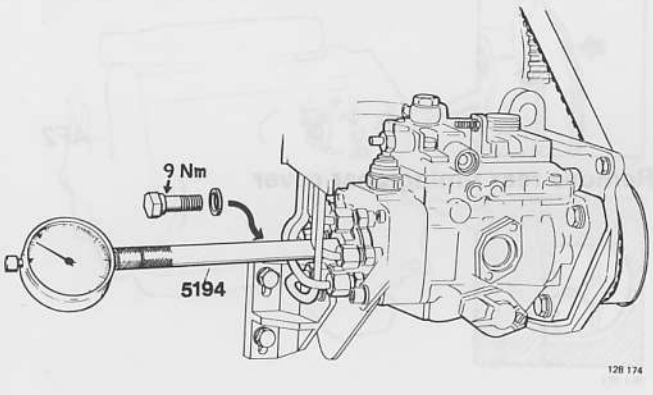
Reading more than specified:

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.

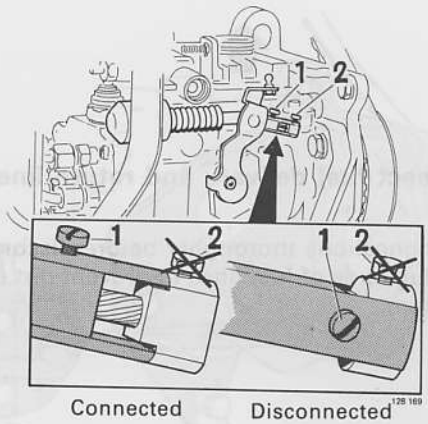
Important! Injection pump must not be tapped or knocked as this will alter its setting.



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.

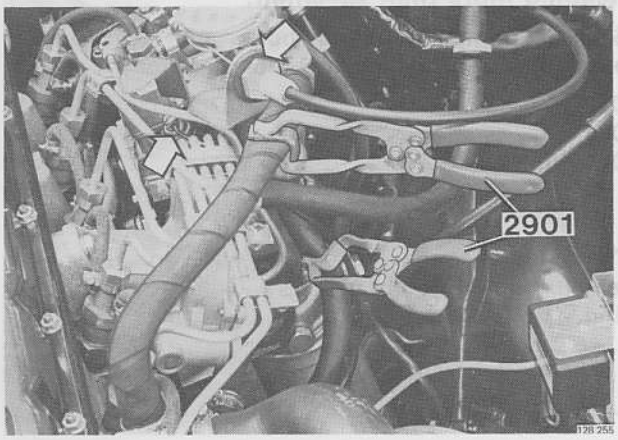
Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.

AE14

Install rear timing gear cover

AF. Injection pump, removal

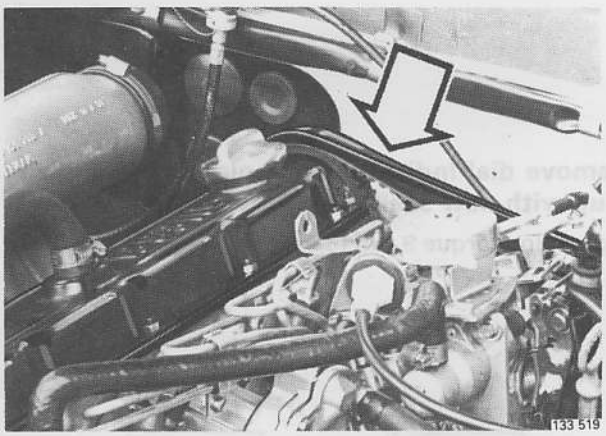
Special tools: 2 × 2901, 5193, 5199, 5201, 5204



AF1

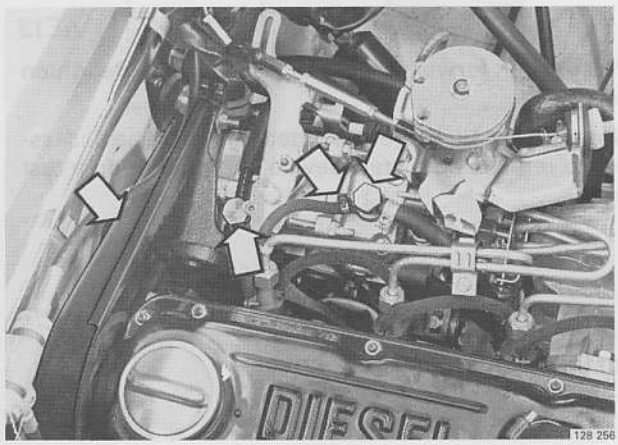
Disconnect:

- 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

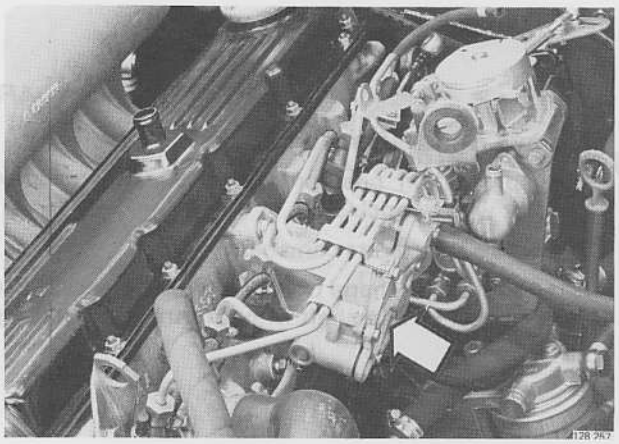
Remove rear timing gear cover



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.

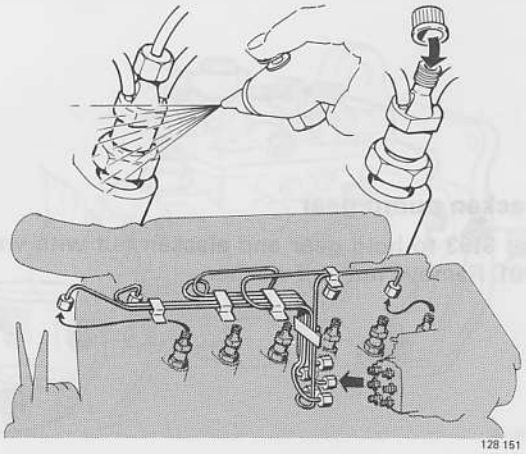


AF4

Remove vacuum pump and pump plunger

Remove pump retaining nuts and place pump on wheelarch.

Remove plunger from cylinder head.

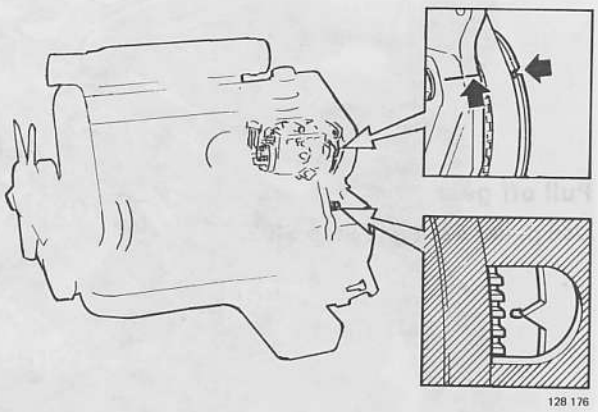


AF5

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.

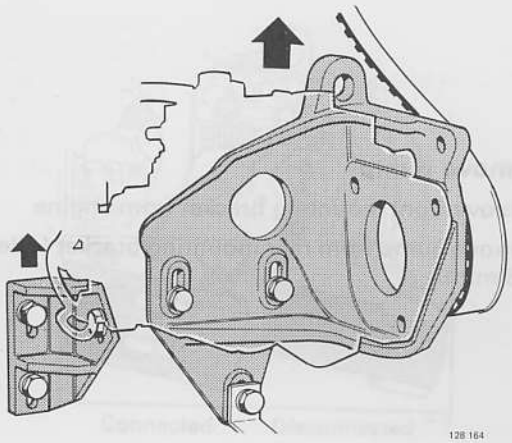


AF6

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".

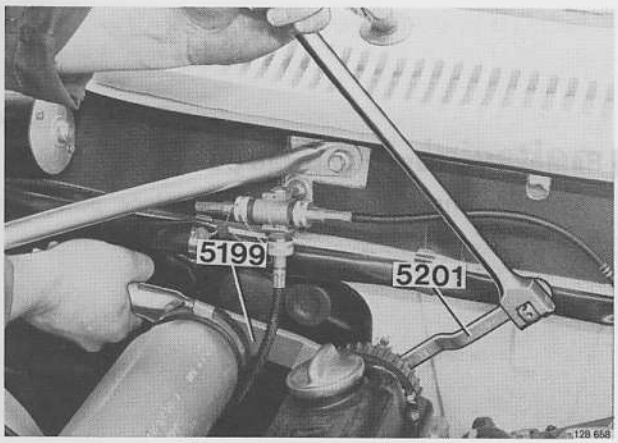


AF7

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.**

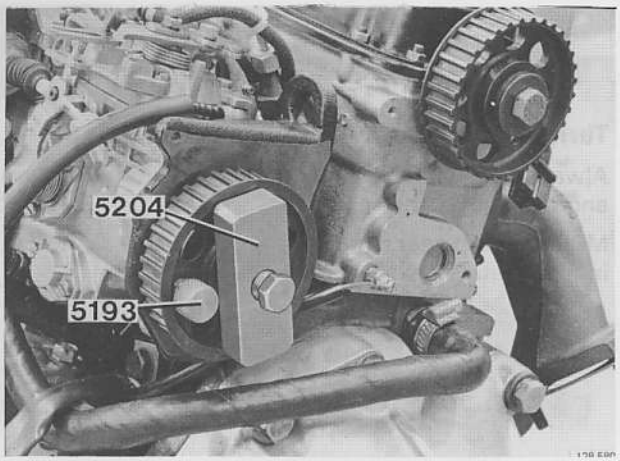
Take care not to rotate camshaft.

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

AF9

Slacken pump gear

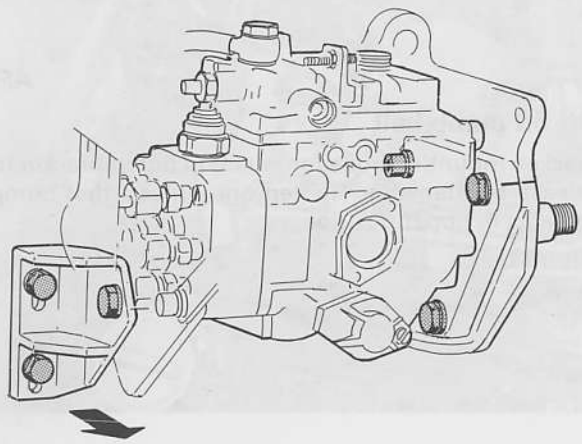
Use **5193** to hold gear and slacken nut with wrench 5201. Remove nut and washer.



AF10

Pull off gear

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



AF11

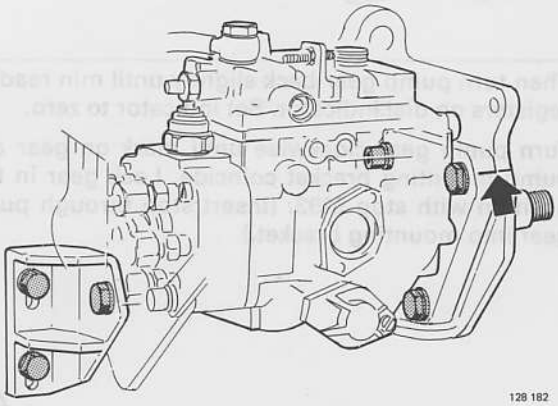
Remove pump

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

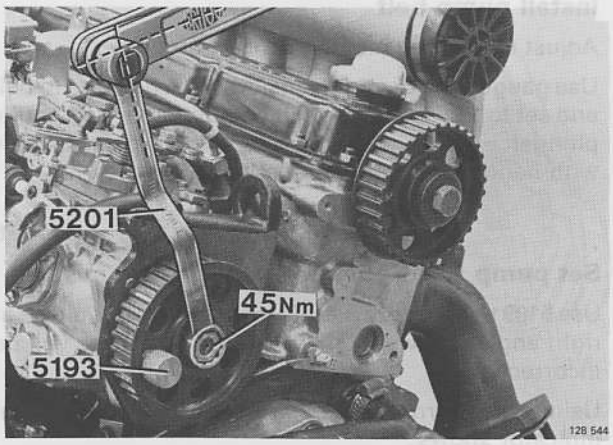


AG1

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.



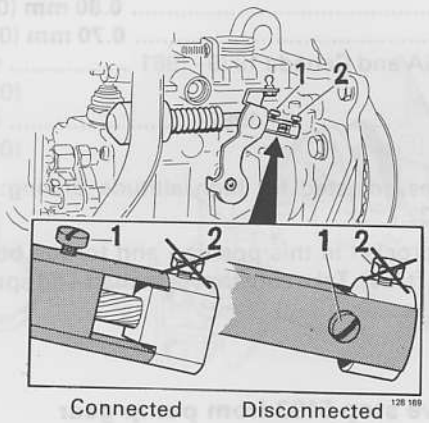
AG2

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.



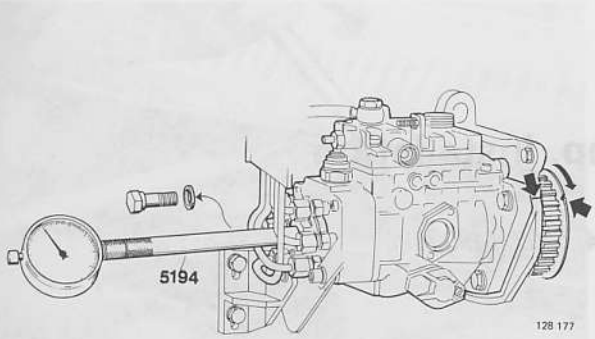
AG3

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.



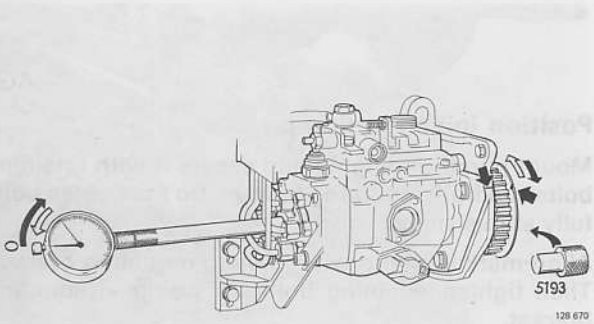
AG4

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

Unscrew and remove plug from injection pump distributor.

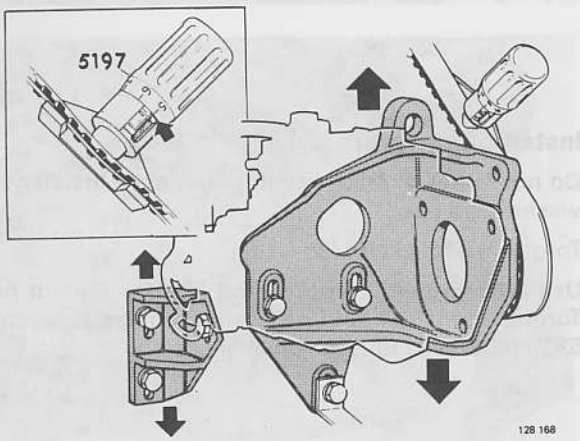
Install holder **5194** and dial indicator (measuring range 0–3 mm). Set gauge to approx. 2 mm.

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.)

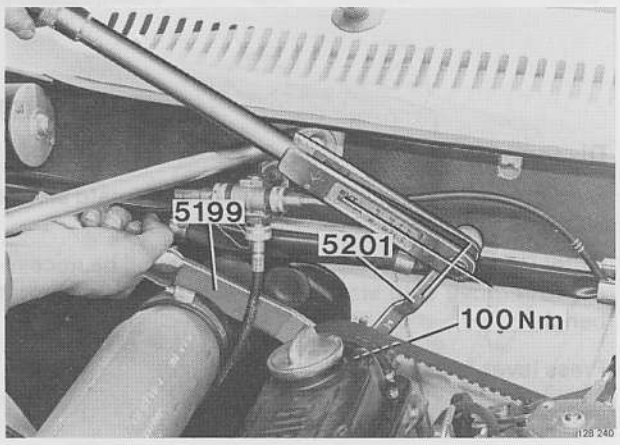


AG5

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)

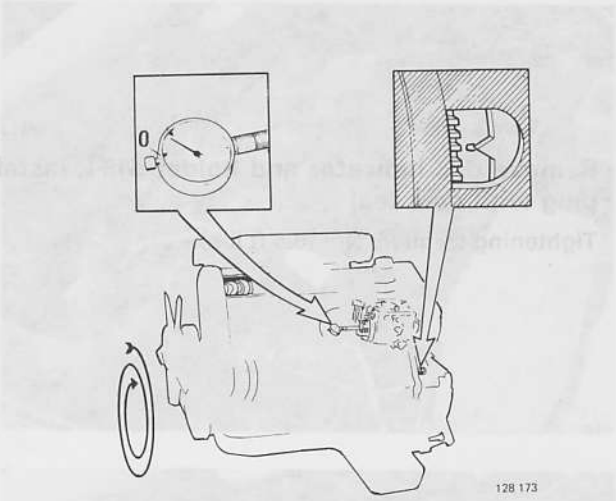
(Vehicles adjusted for high altitude driving: refer to page 132.)

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

AG8



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 (0.256–0.0287 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)

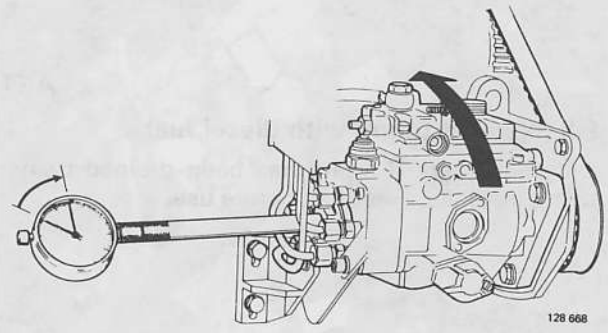
Correct reading: Tighten injection pump mounting bolts. Proceed to AG9.

Incorrect reading: Readjust according to instructions below.

Readjusting pump setting:

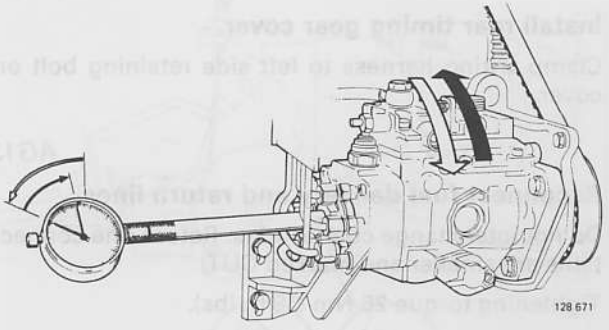
Setting values:

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.



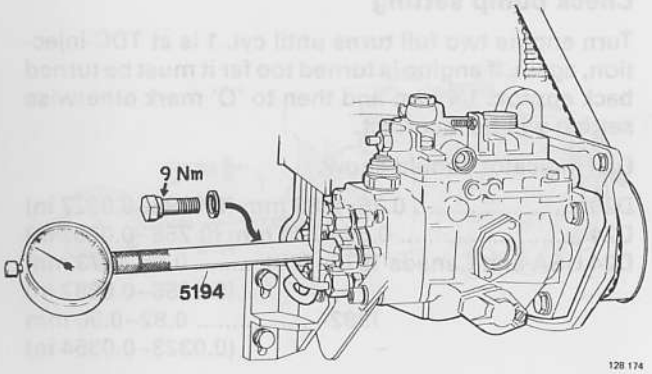
Reading more than specified:

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.

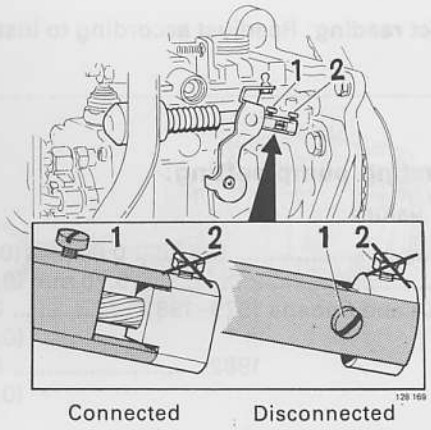
Important! Injection pump must not be tapped or knocked as this will alter its setting.



AG9

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

Tightening torque 9 Nm (6.5 ft lbs).



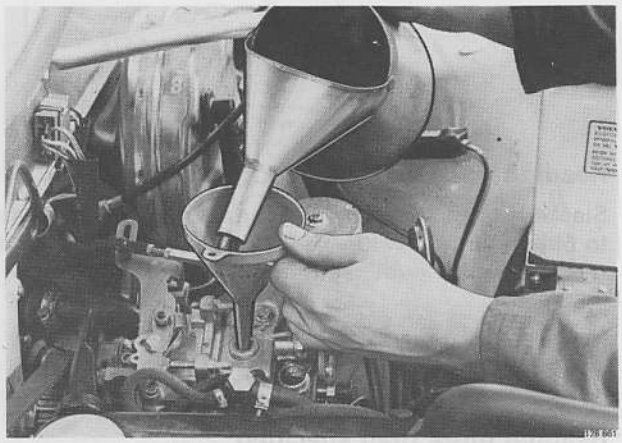
Connected Disconnected

AG10

Connect cold start device

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

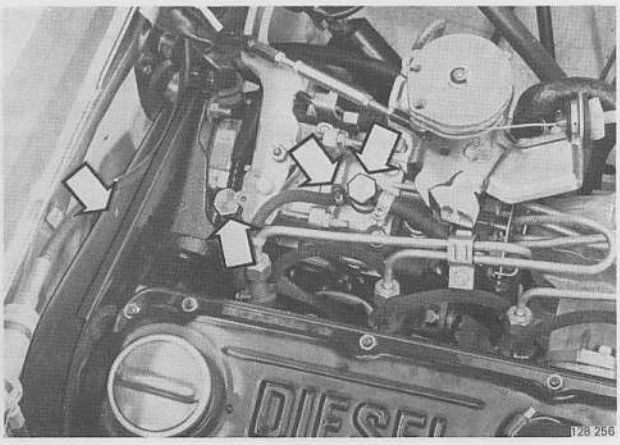
Note! Do not turn screw 2, otherwise it will be necessary to remove cold start device and reset it on a test bench.



AG11

Fill injection pump with diesel fuel

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



AG12

Install rear timing gear cover

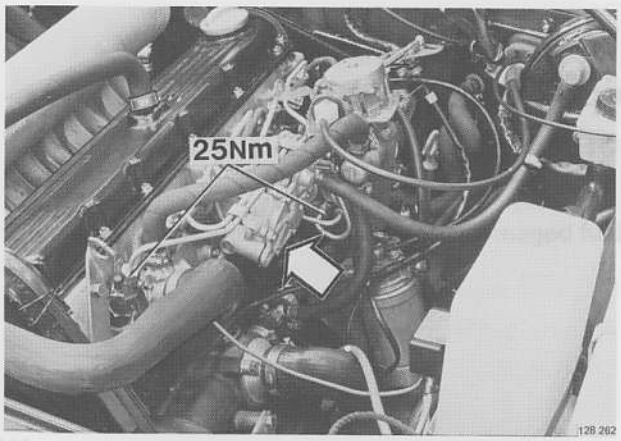
Clamp wiring harness to left side retaining bolt on cover.

AG13

Reconnect fuel delivery and return lines

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

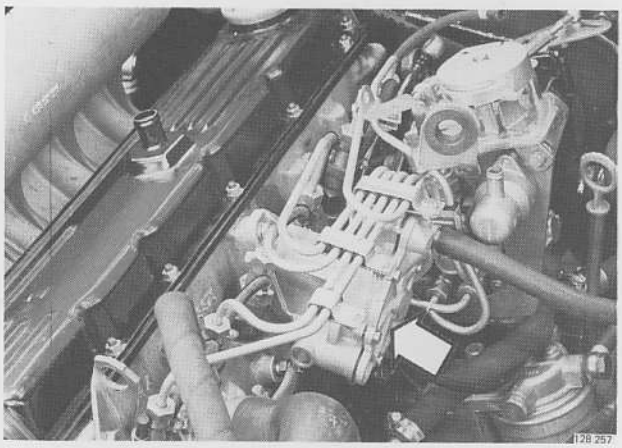
Tightening torque 25 Nm (18 ft. lbs).



AG14

Reconnect fuel delivery pipes

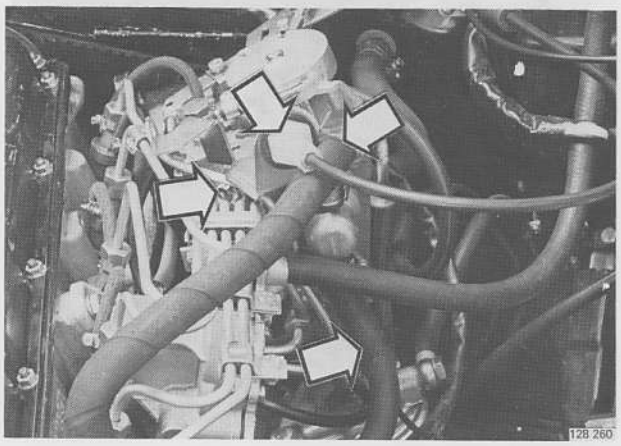
Tightening torque 25 Nm (18 ft lbs).



AG15

Install plunger and vacuum pump

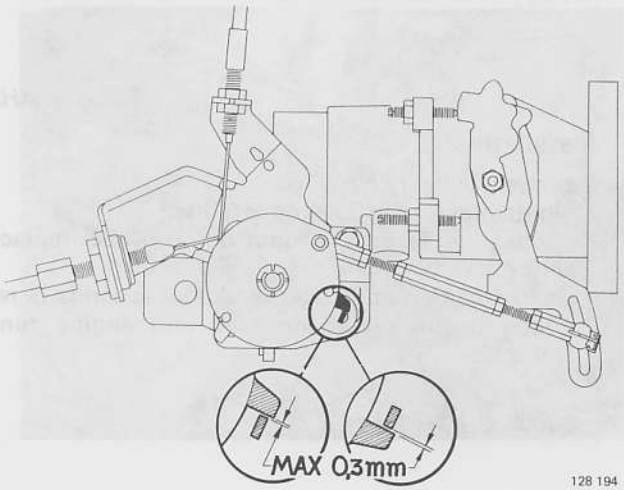
Check O-ring, replace if necessary.



AG16

Connect:

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

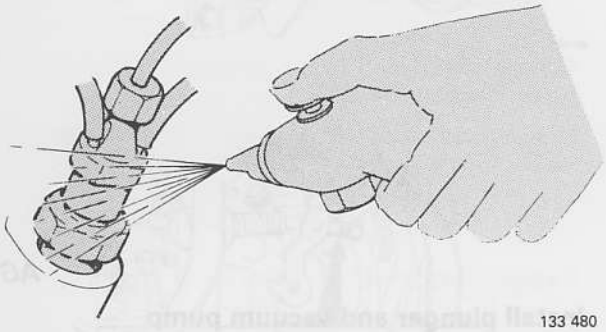


AG17

Set throttle control

See instruction on page 176, operations AX1–AX9.

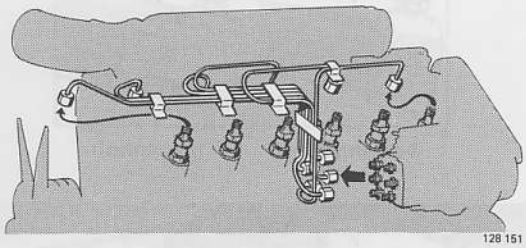
AH. Fuel delivery pipes, replacement



133 480

AH1

Clean all connections thoroughly

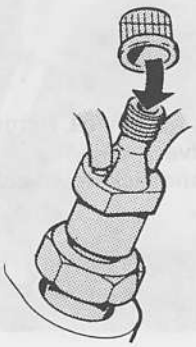


128 151

AH2

Remove

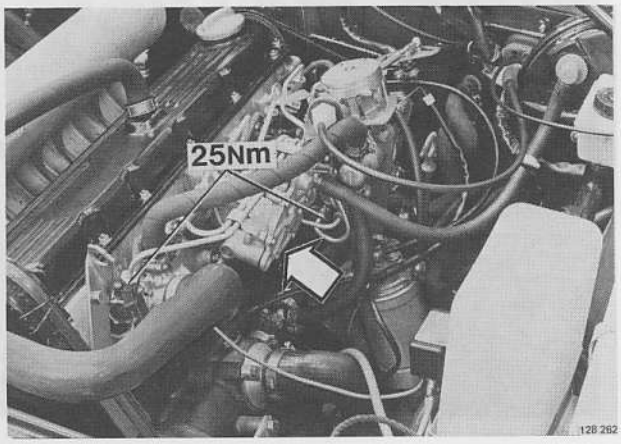
- vacuum pump and pump plunger
- delivery pipes.



133 481

Important

Blank off ports and pipes to prevent entry of dirt.



128 262

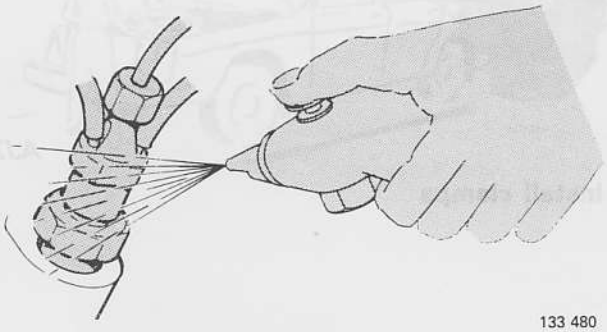
AH3

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

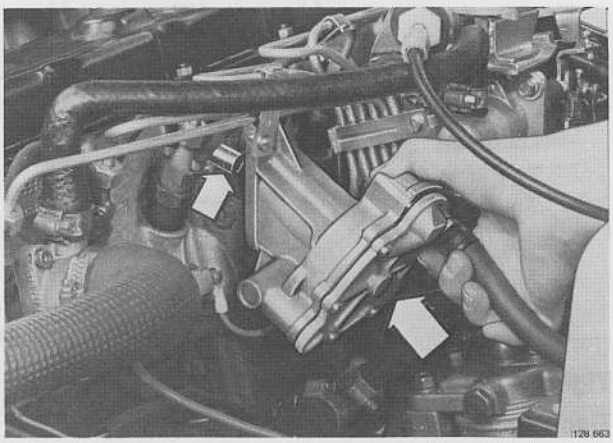
(Do not attempt to weld or repair damaged fuel delivery pipes. Damaged pipes must be replaced.)



133 480

AJ1

Clean all connections carefully. Blow-dry pipes

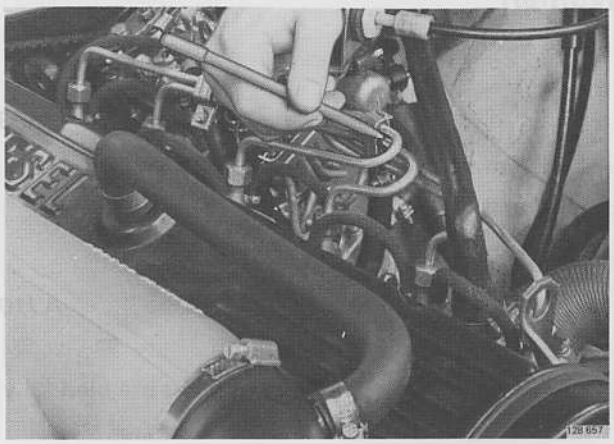


128 663

AJ2

Remove vacuum pump and pump plunger

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



128 657

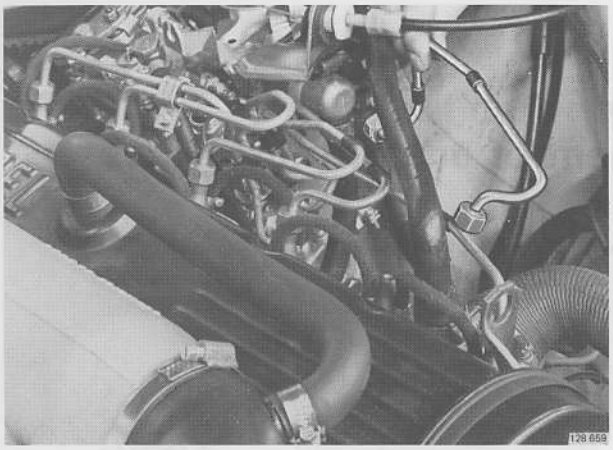
AJ3

Mark position of clamps on pipes

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

AJ4

Disconnect all pipes



AJ5

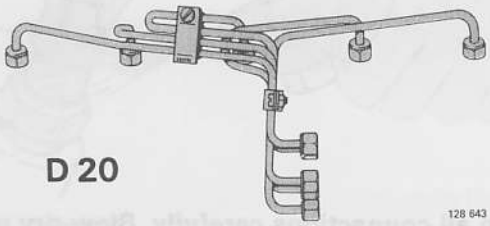
Remove clamps securing pipe(s) to be replaced

AJ6

Replace pipe

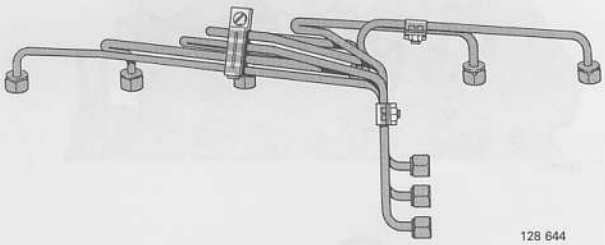
Do not tighten connections at this stage.

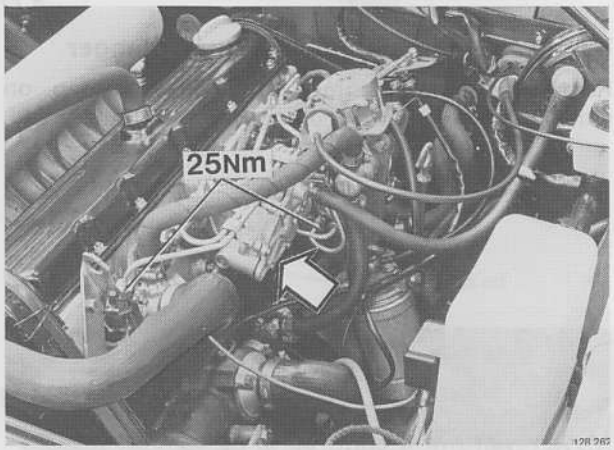
Check position of rubber sleeve on pipe.



AJ7

Install clamps





AJ8

Tighten pipe connections

Tightening torque 25 Nm (18 ft. lbs.)

AJ9

Install pump plunger and vacuum pump

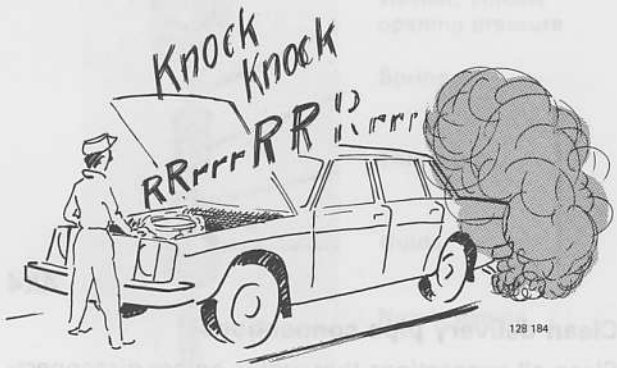
Check/replace O-rings.

AJ10

Check operation and leakage

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

AK. Injectors

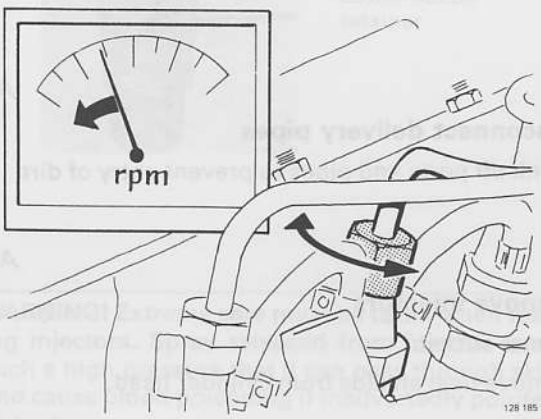


AK1

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

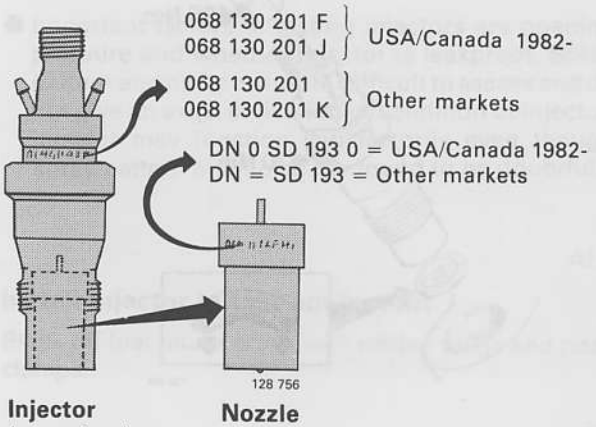
1. Run engine at above idle speed
2. Loosen cap nuts on injectors one at a time. Wrap absorping paper around injectors to prevent spillage.

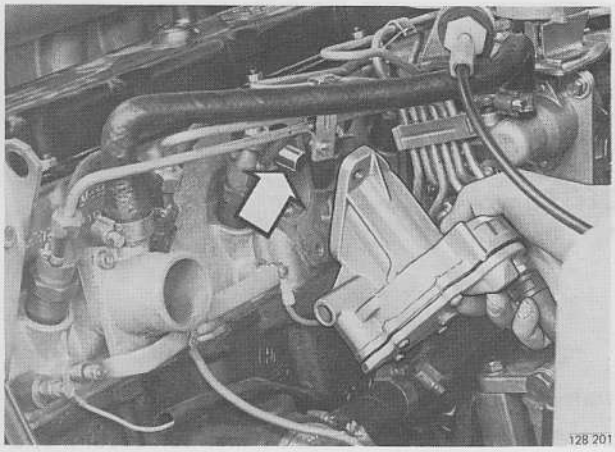
If engine speed remains constant or if knocking disappears, fault may be:

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

Removing injectors

See specifications for identification of injector type.



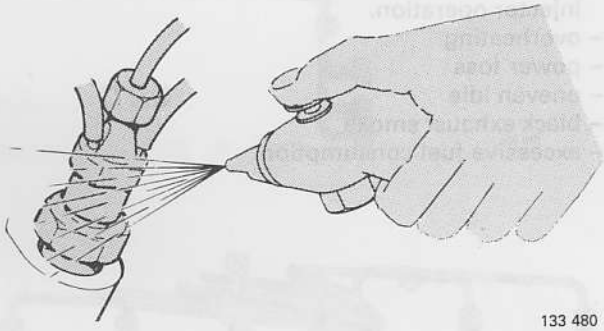


AK3

Remove vacuum pump and pump plunger

Remove pump retaining nuts and place pump on wheelarch.

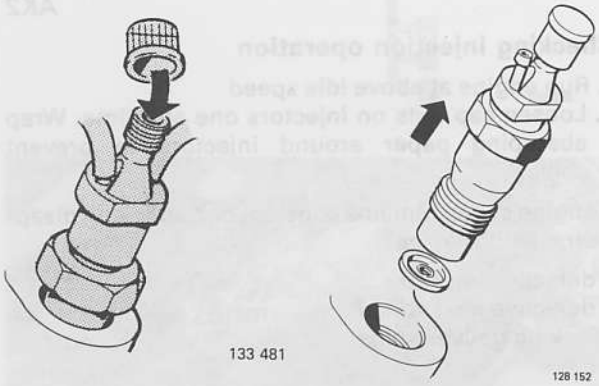
Withdraw plunger from cylinder head.



AK4

Clean delivery pipe connections

Clean all connections thoroughly before disconnecting pipes.



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).

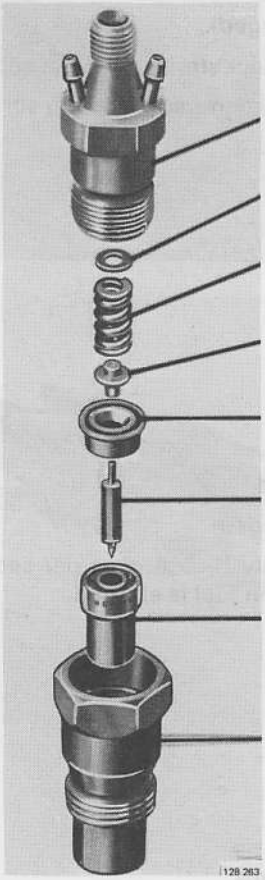
AK9

Install pump plunger and vacuum pump

Check/replace O-ring.

AL. Reconditioning injectors

Utmost cleanliness must be observed when working with injectors.



AL1

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

AL2

Cleaning, checking

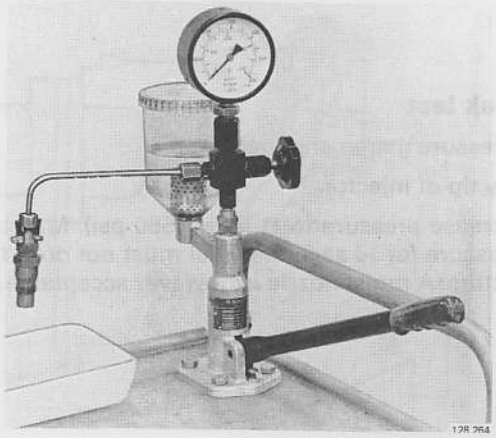
- clean all parts with clean diesel fuel
- use nozzle cleaner equipment to clean nozzle needle and sleeve
- replace damaged parts. Nozzle needle and sleeve are matched and must be replaced together.

AL3

Assembly

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



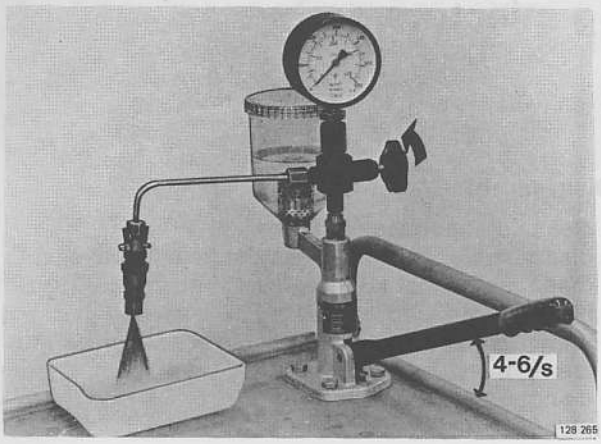
Testing

- 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.



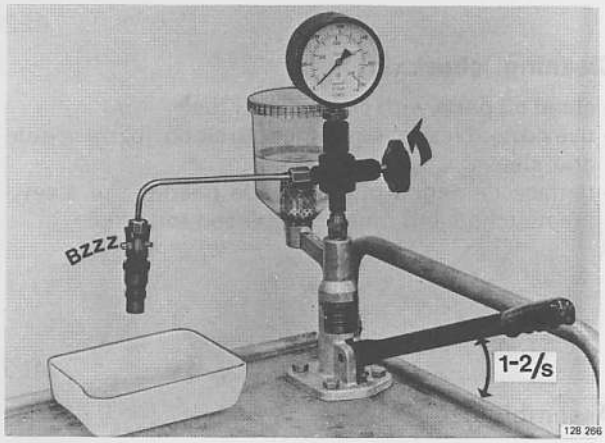
AL5

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.

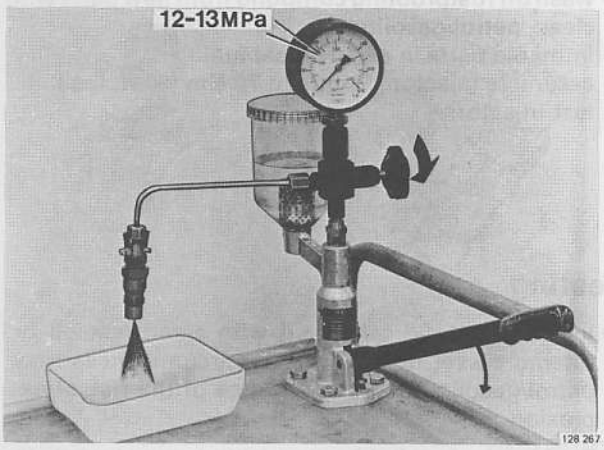


AL6

Check injection sound

(Pressure gauge disengaged).

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



AL7

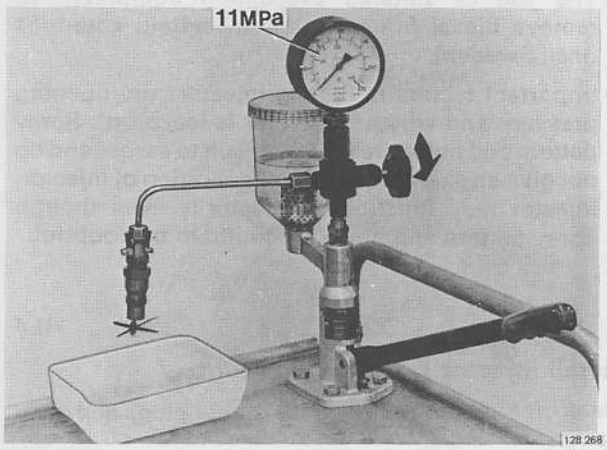
Check opening pressure

(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.



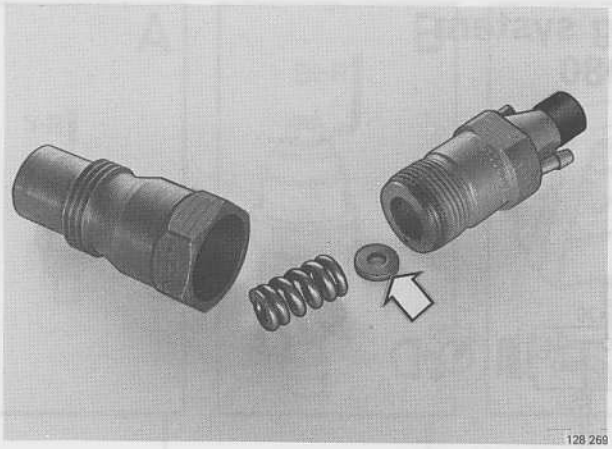
AL8

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.


128 269

L9

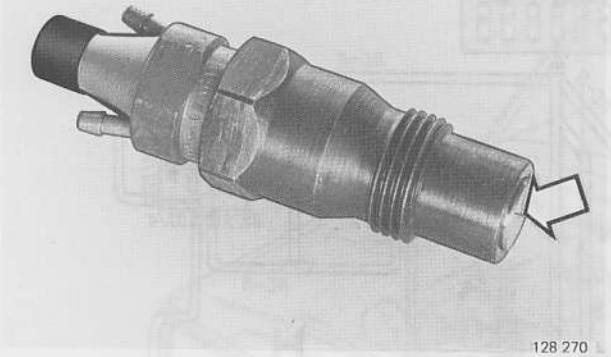
Adjusting opening pressure

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.


128 270

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

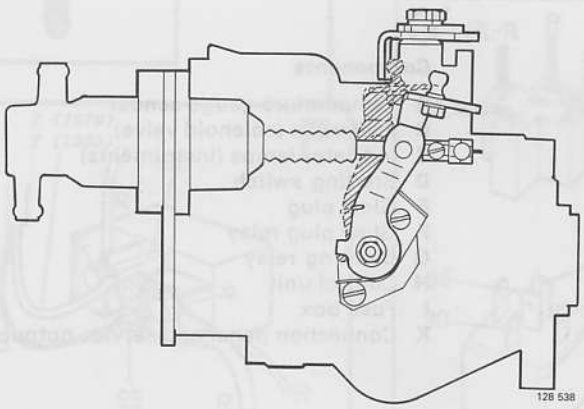
General

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).


128 538

AM2

Operation check

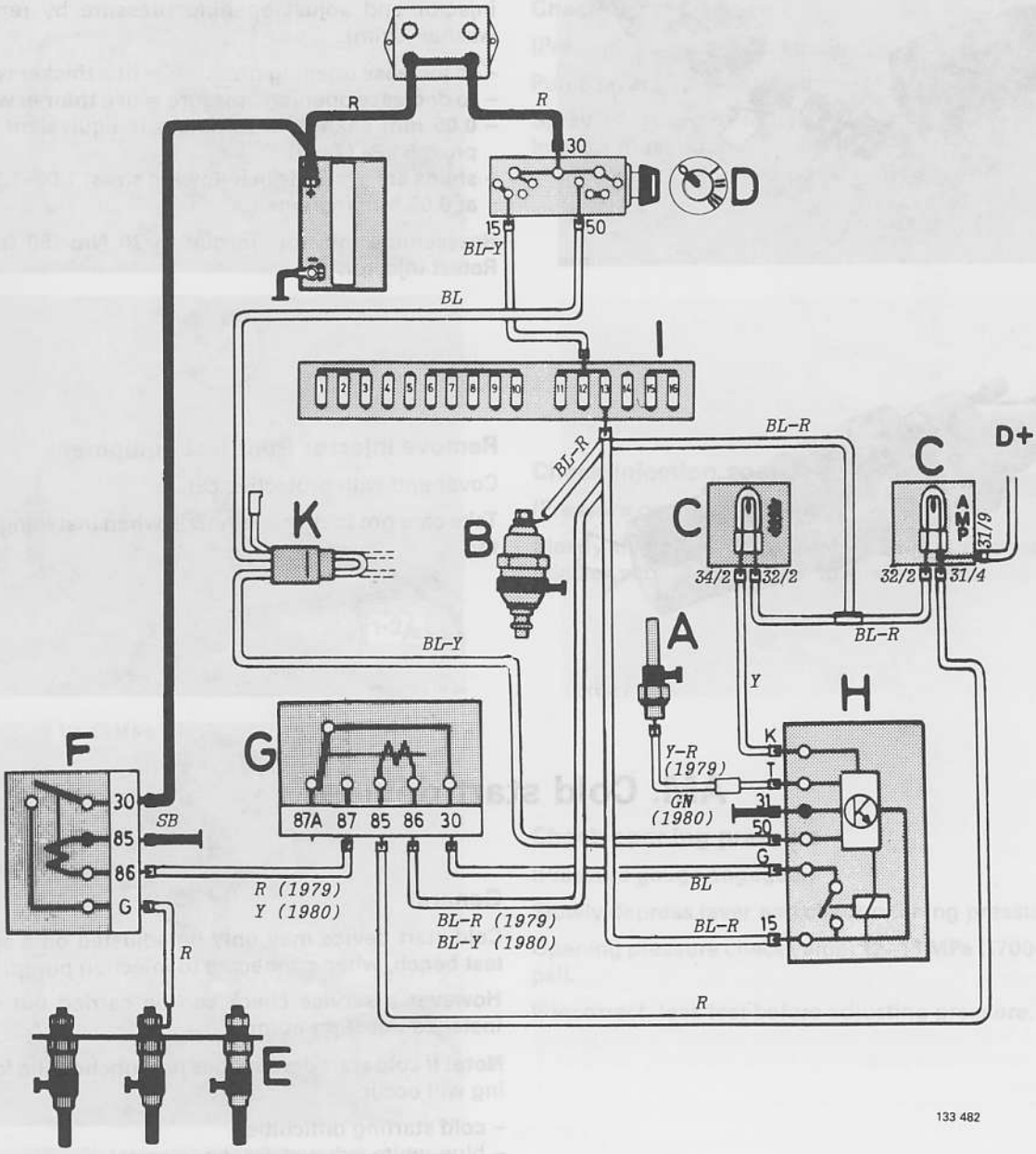
Measure idle speed when engine is cold and hot.

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



Fuse No. 13

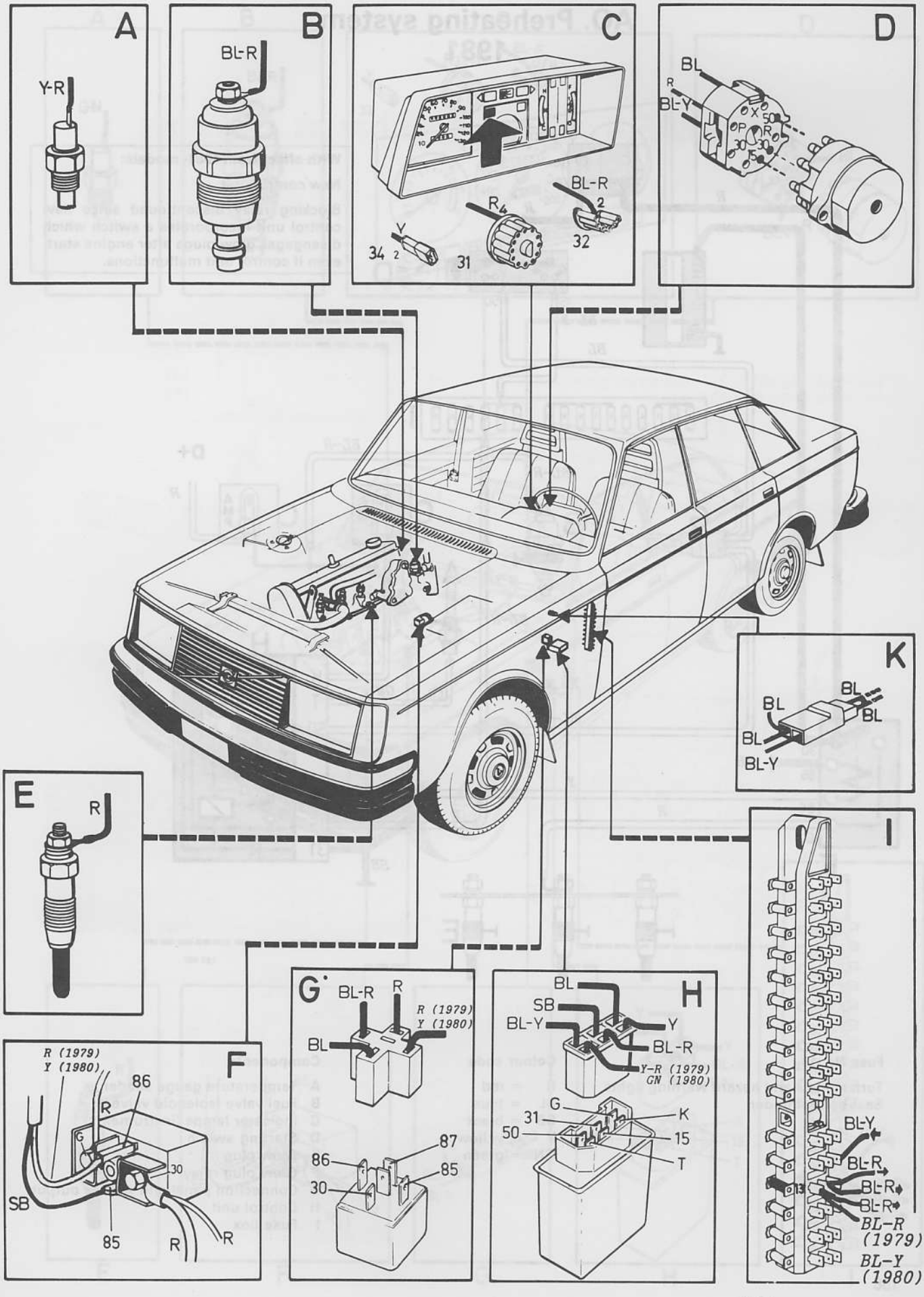
Preheating system
Fuel valve (solenoid valve)
Indicator lamps for instruments

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


A
Y-R
B
BL-R
C
BL-R
R
Y
34
2
31
2
32
D
BL
R
BL-Y
X
50
P
R
30
15
K
BL
BL
BL
BL
BL-Y
E
R
F
R (1979)
Y (1980)
86
R
G
30
SB
85
R
R
G
BL-R
R
R (1979)
Y (1980)
BL
87
86
85
30
H
BL
SB
BL-Y
Y
BL-R
Y-R (1979)
GN (1980)
G
31
K
50
15
T
I
BL-Y
BL-R
BL-R
BL-R
BL-R (1979)
BL-Y (1980)

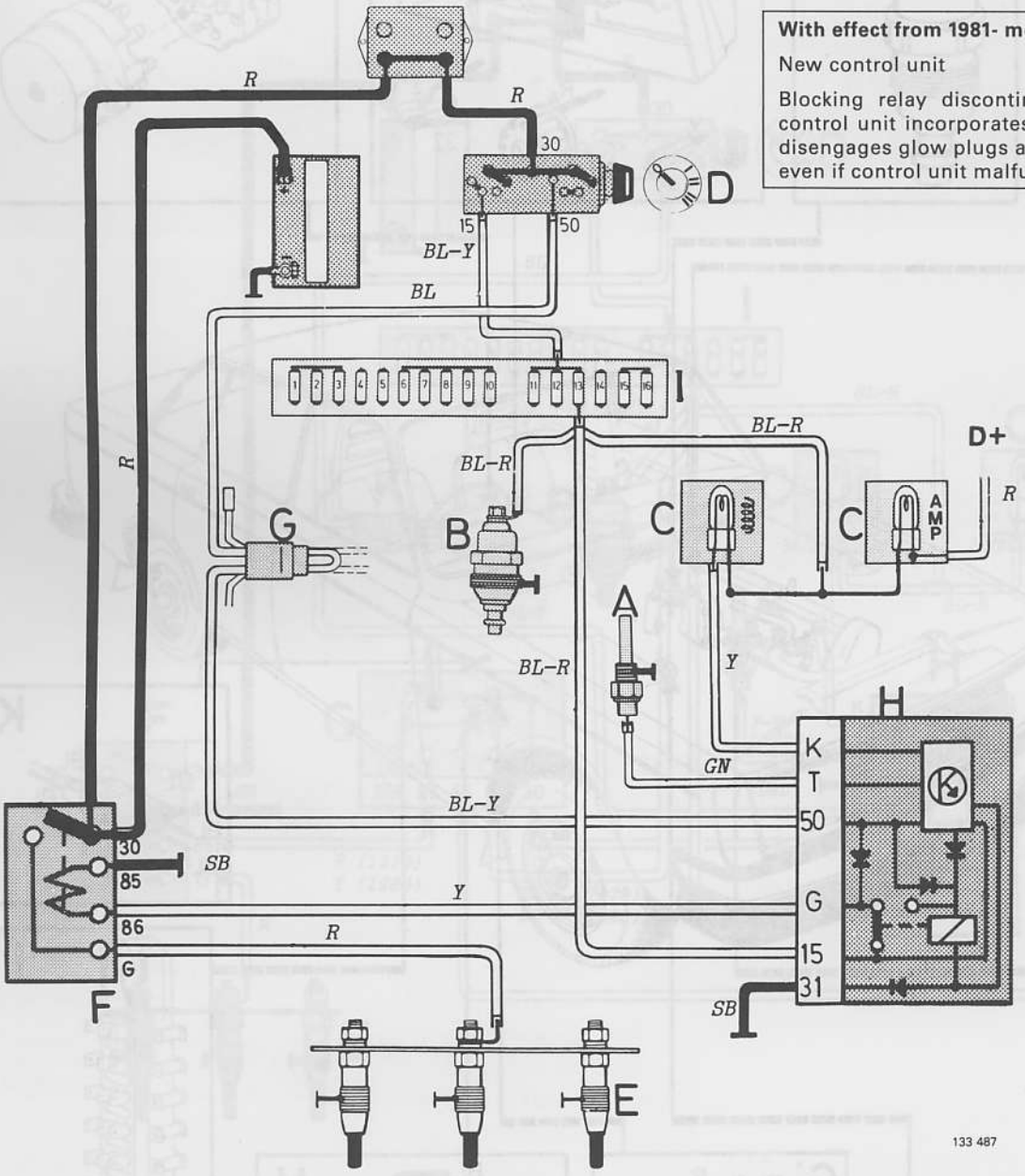
133 483

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

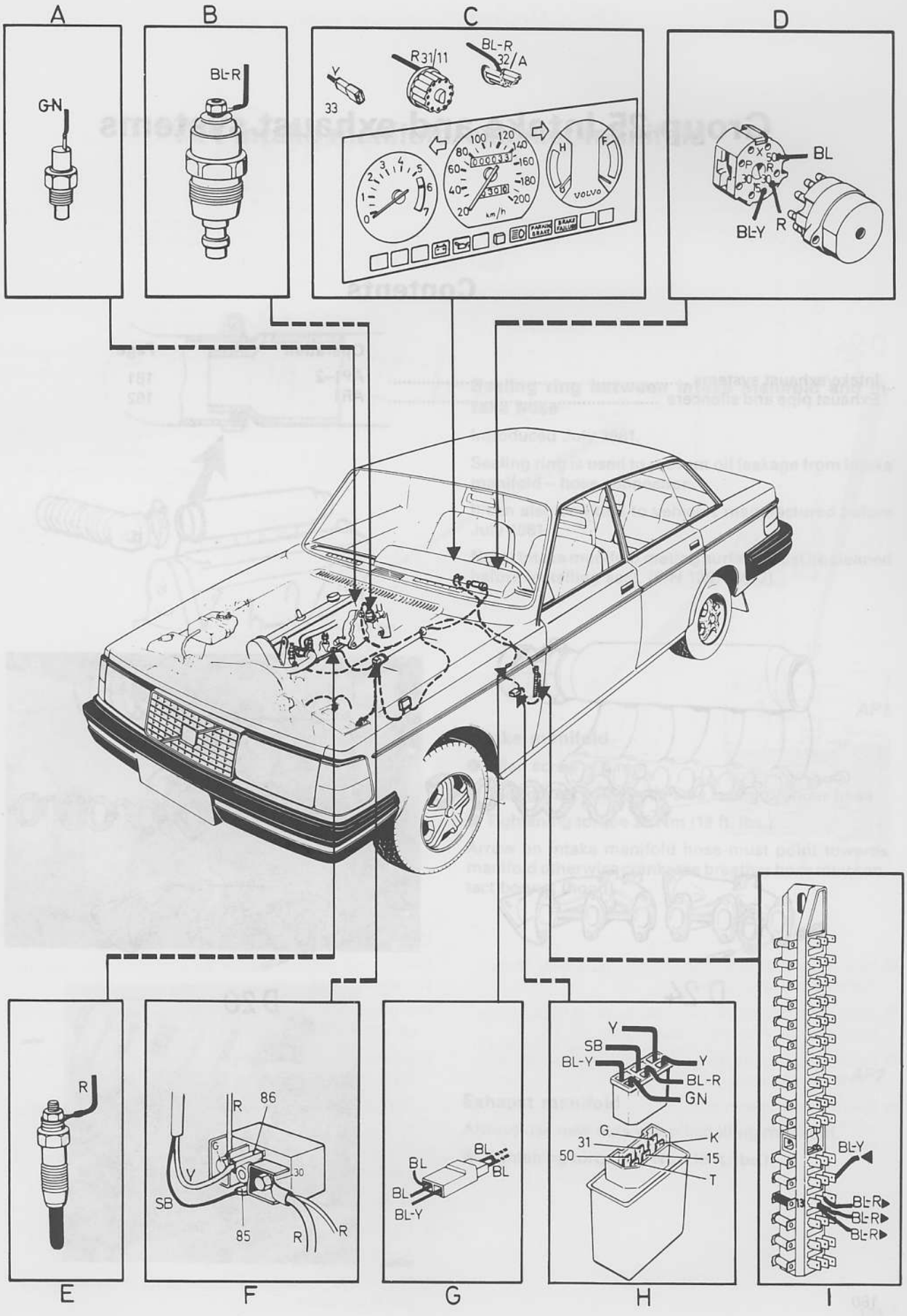
Turn signals and hazard warning lights
Seat belt reminder

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


A
GN
B
BL-R
C
R31/11
BL-R
32/A
Y
33
D
BL
BL-Y
R
E
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R
86
G
Y
30
SB
85
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BL-Y
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BL-R
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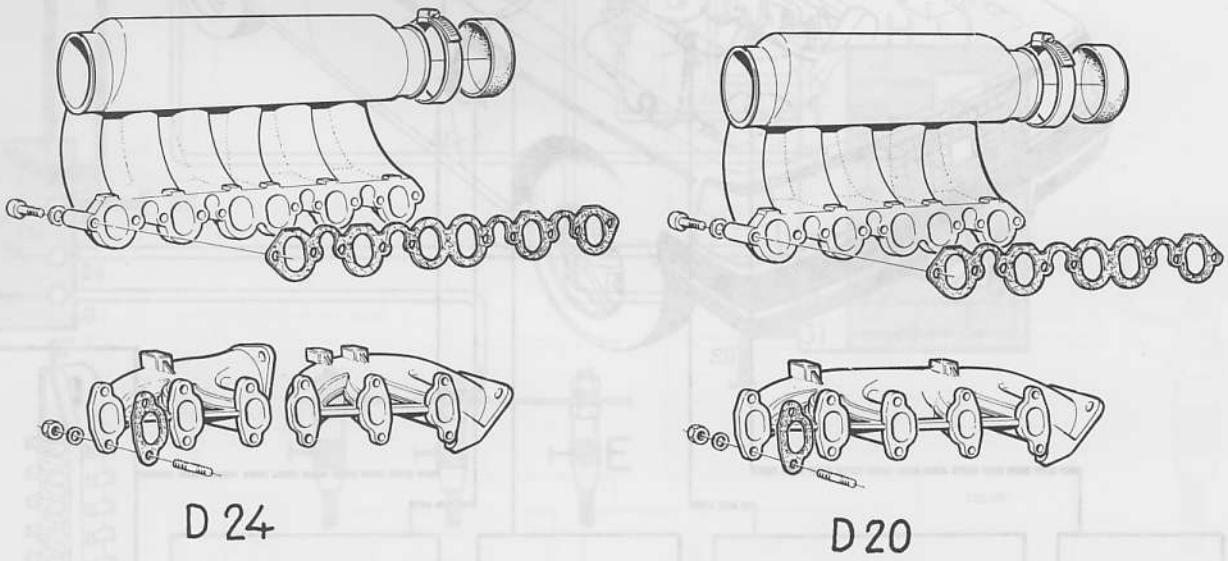
BL-R

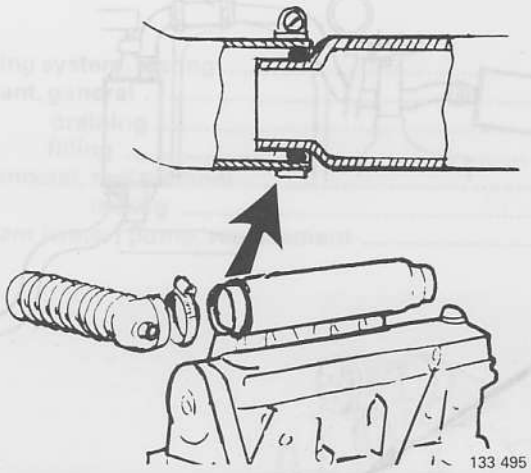
133 488

Group 25 Intake and exhaust systems

Contents



AP. Intake manifold/exhaust manifold



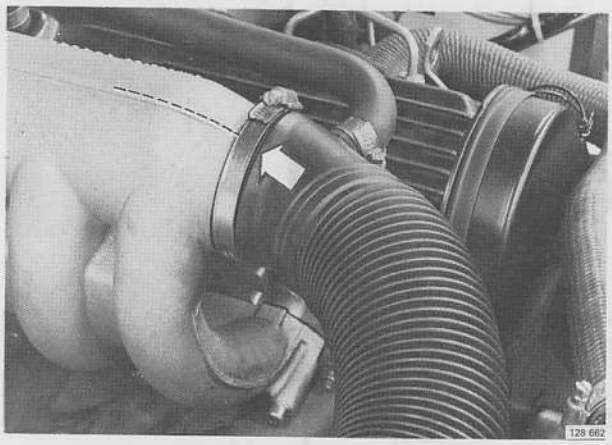
Sealing ring between intake manifold and intake hose

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).

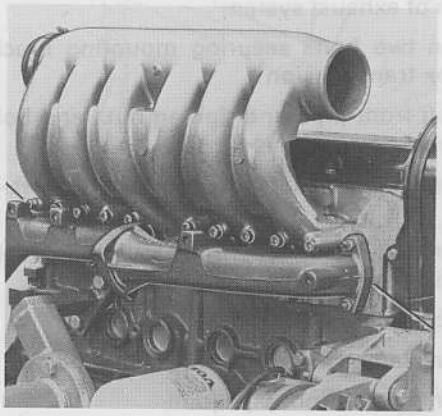


AP1

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).



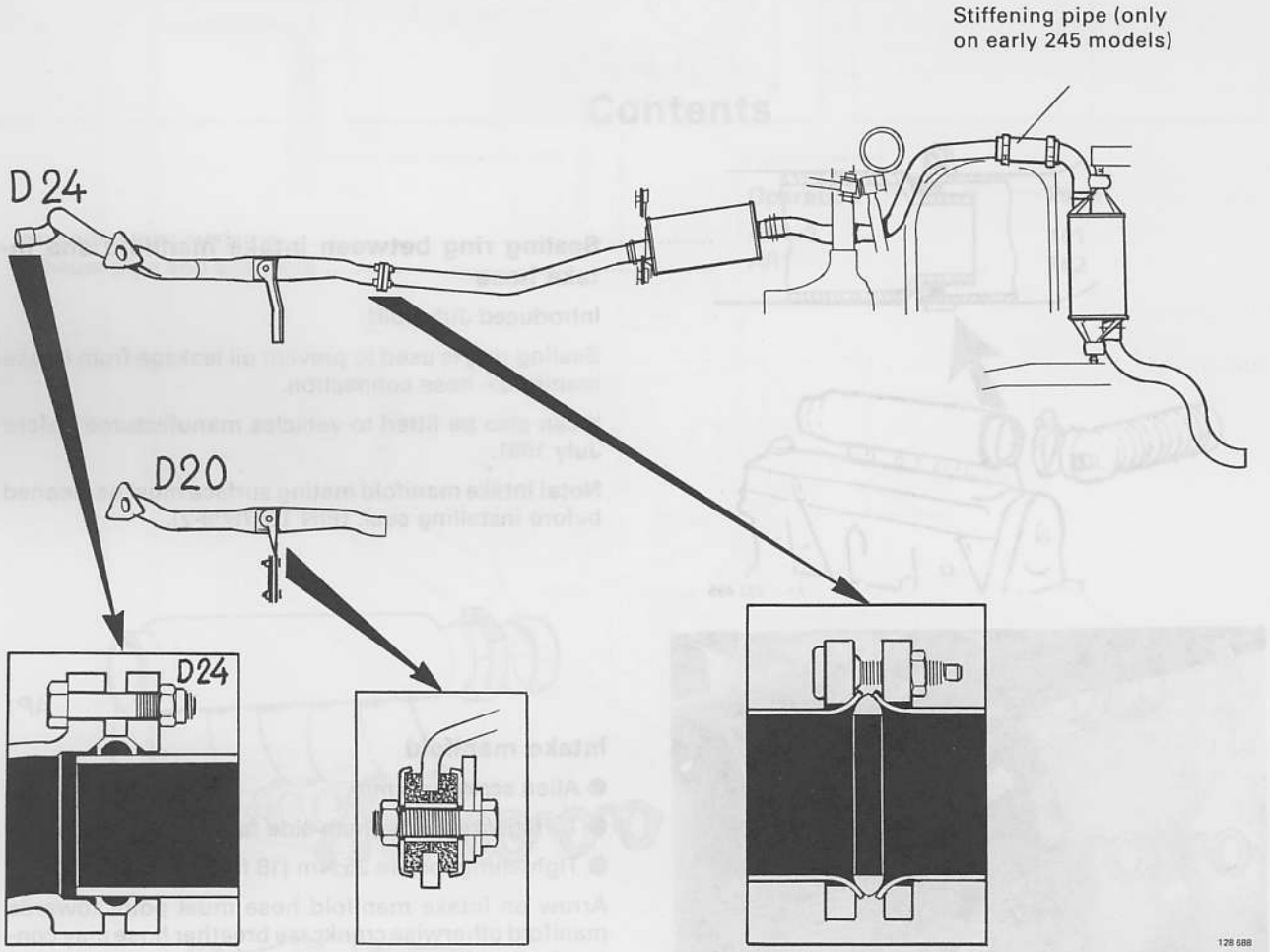
AP2

Exhaust manifold

Always use new nuts when installing manifold.

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

AR. Exhaust system



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".

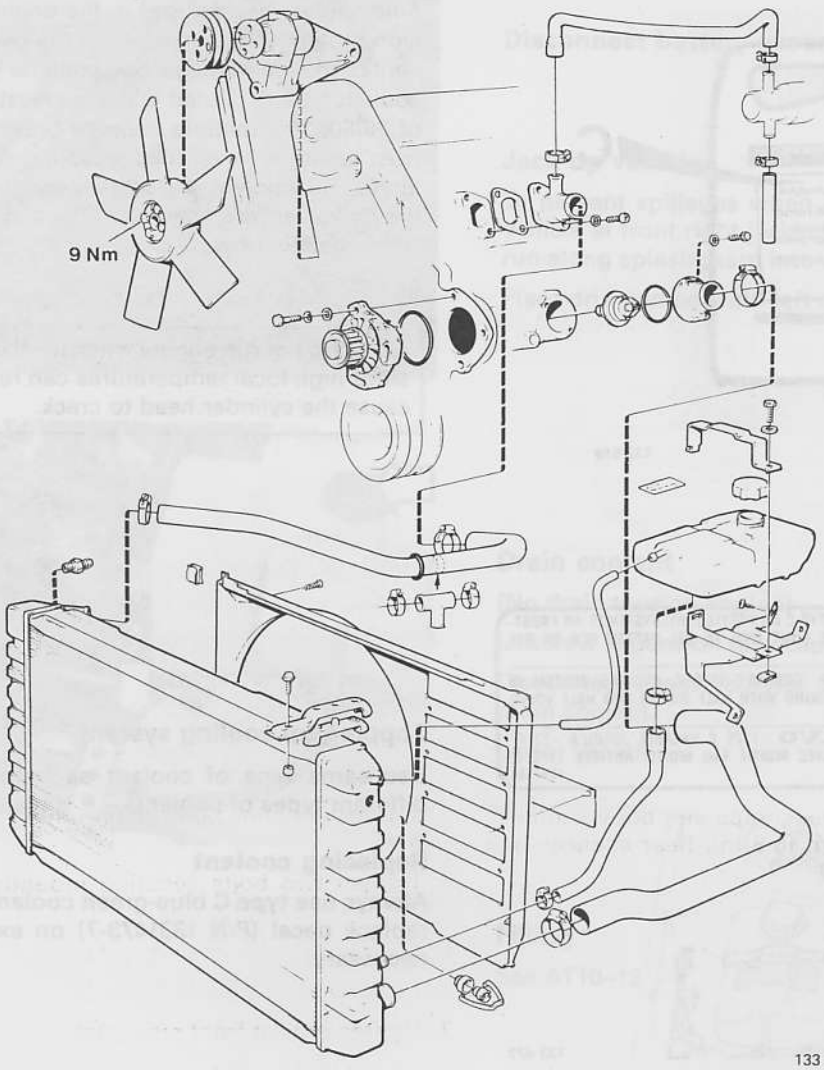
Installing complete exhaust system

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.

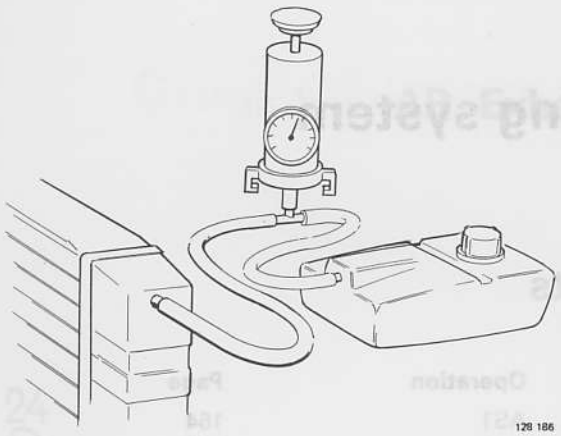
Group 26 Cooling system

Contents



133 494

AS. Cooling system testing



128 186

AS1

Connect test pump between radiator and expansion tank as shown adjacent.

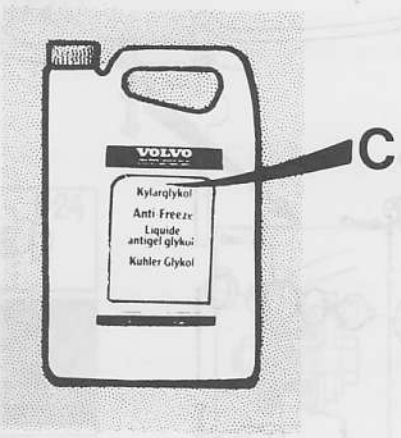
Increase pressure and check opening pressure of expansion tank cap. Also check for leakage.

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

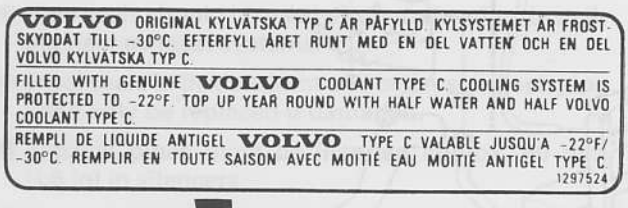
AT1



132 519

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.



133 477

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.

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

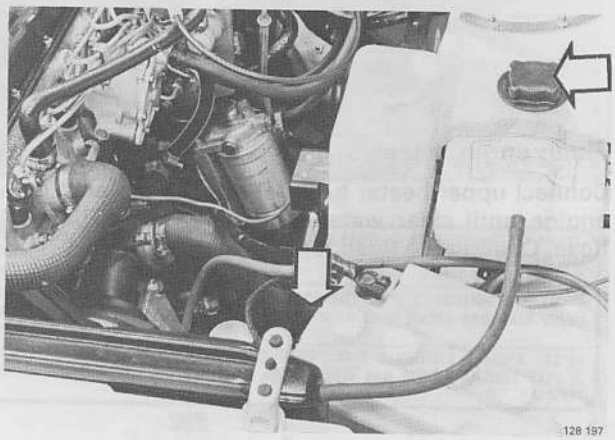
Disconnect battery ground lead

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.

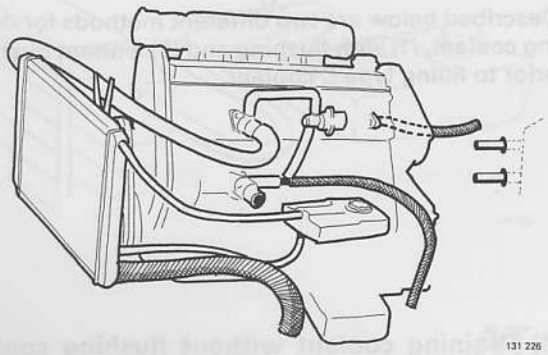
Disconnect lower radiator hose from radiator and drain coolant.

Lower vehicle.

Filling

See AT10–12.

Coolant, replacement
Draining and flushing cooling system



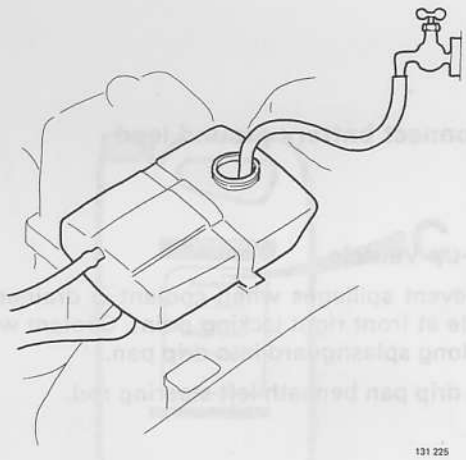
AT5

Drain cooling system

Place drip pan beneath left side of engine behind splashguard.

Disconnect lower radiator hose from thermostat housing.

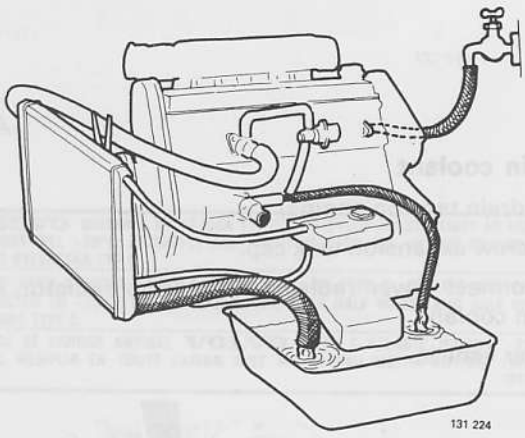
Disconnect hoses from heater control valve (on firewall). Point lower hose down.



Flushing

AT6

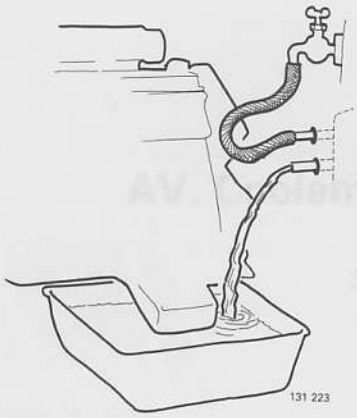
Flush expansion tank clean



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.

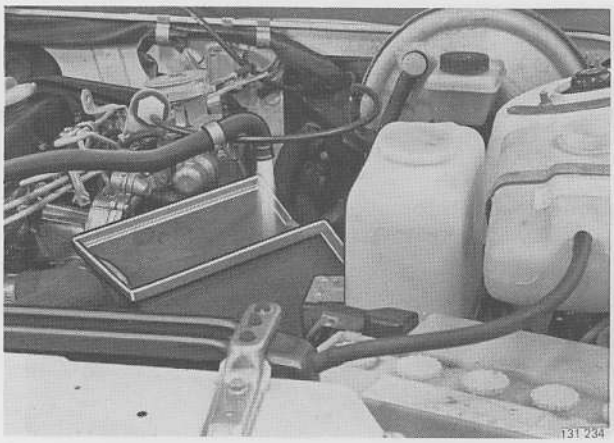
Connect upper pipe to tap and flush until clear water appears from lower pipe.

AT9

Reconnect all hoses

Water hose from thermostat housing is connected to lower pipe on heater control valve.

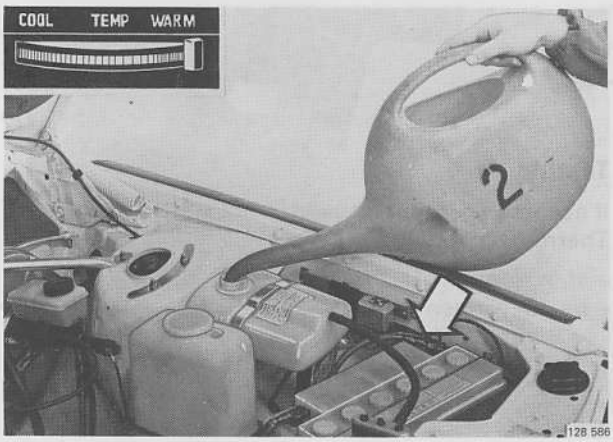
Filling



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

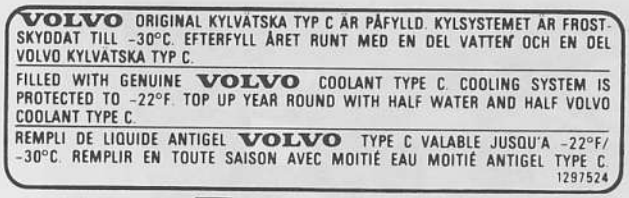
Fill coolant

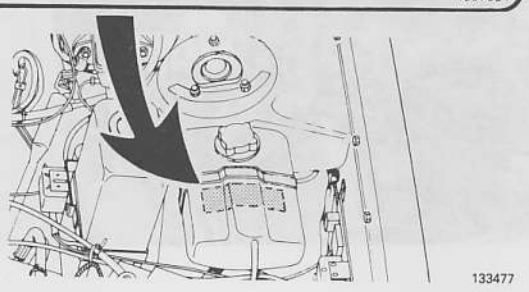
Capacity: D 20 = 8.1 litres (8.6 US quarts)
D 24 = 9.3 litres (9.8 US quarts).

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.



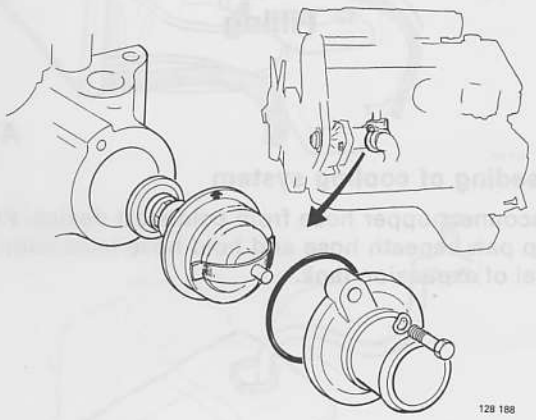


AT12

Replace decal

Attach new type C decal to expansion tank.

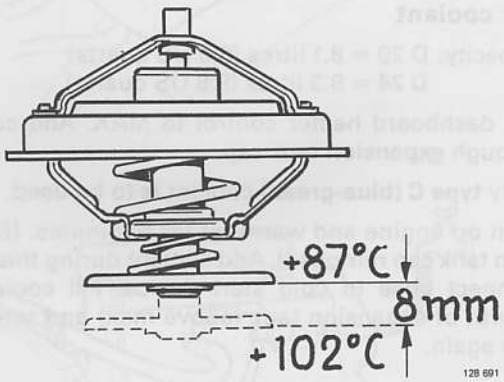
AU. Thermostat



AU1

Replacement

- replace thermostat and seal
- arrow on thermostat must point up



AU2

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

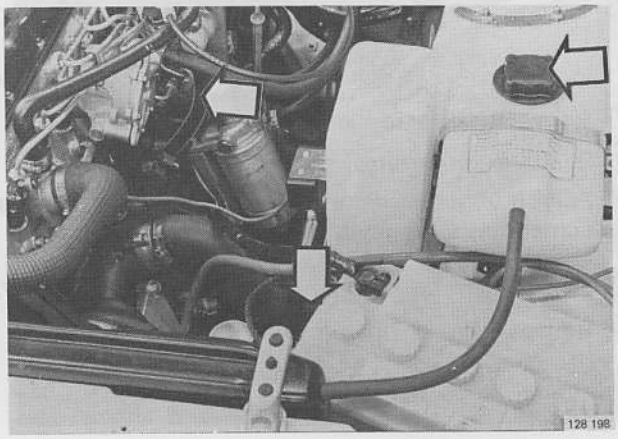
Disconnect battery ground lead

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

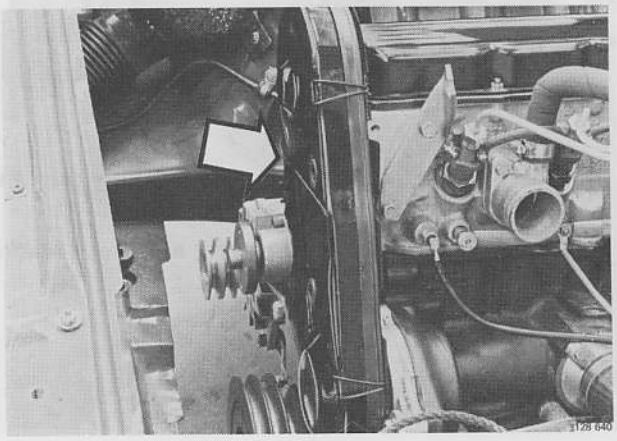
Drain coolant

(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.

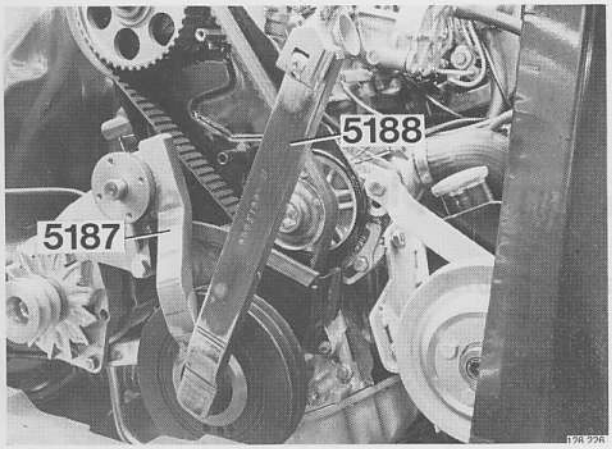
Lower vehicle.



AV4

Remove

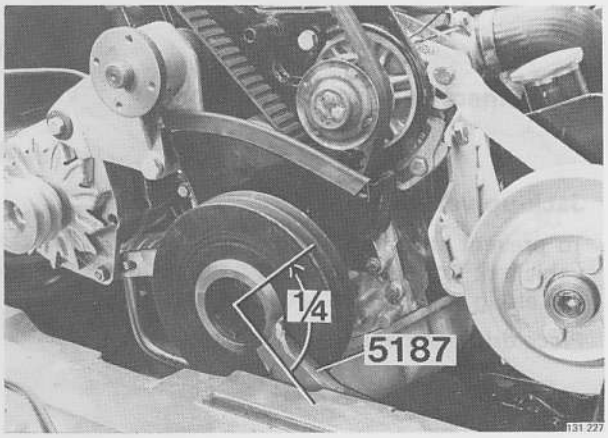
- radiator
- cooling fan with spacer and pulley
- fan belts and power steering pump belt
- front timing gear cover.



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.

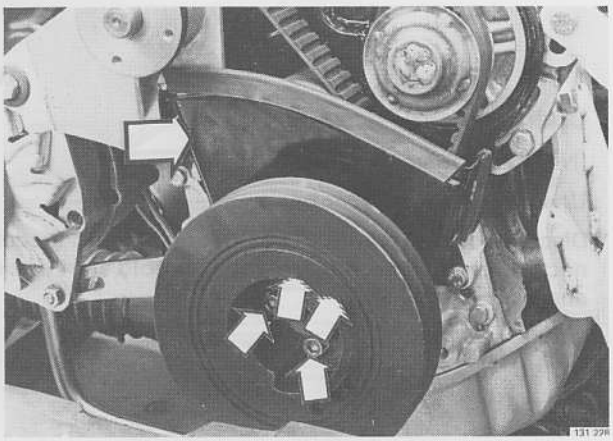


AV6

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

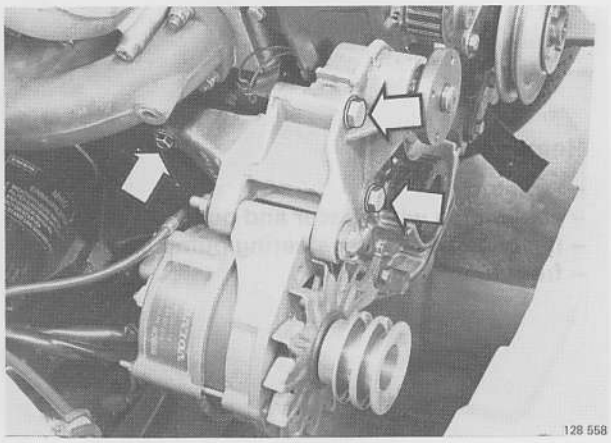
Remove vibration damper

Remove 4 bolts (arrowed). Allen key 6 mm.

Pull off vibration damper. Note crankshaft gear may sometimes stick to vibration damper.

AV8

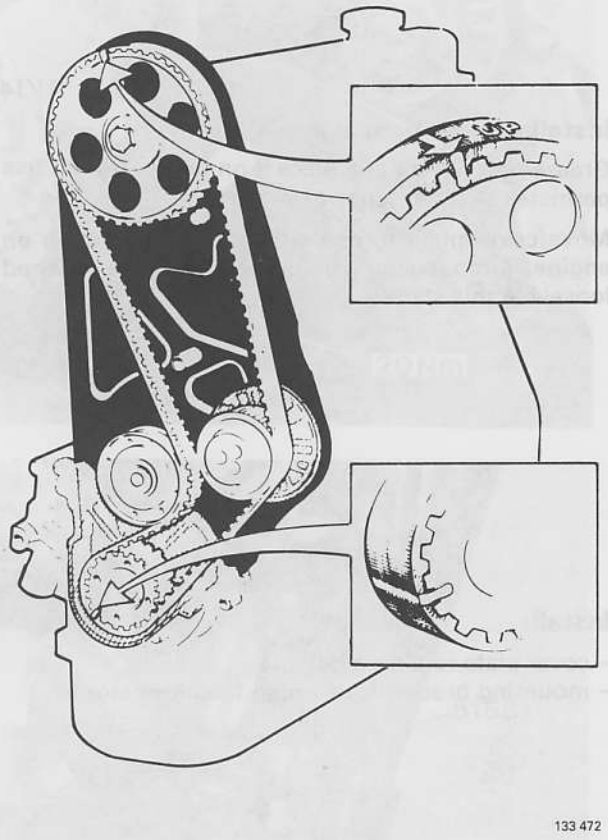
Remove lower timing gear cover



AV9

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

Remove mounting bolts (arrowed) and press bracket outwards.



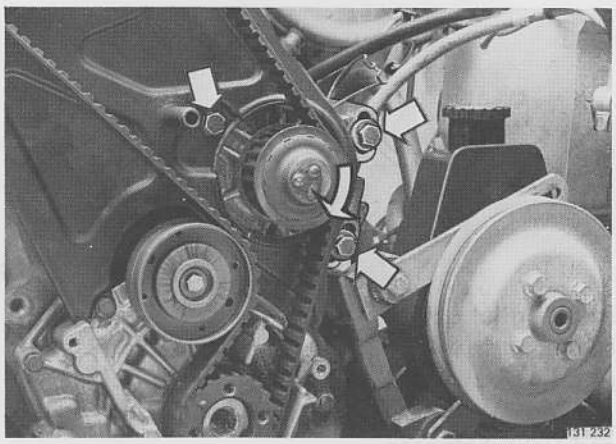
133 472

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.



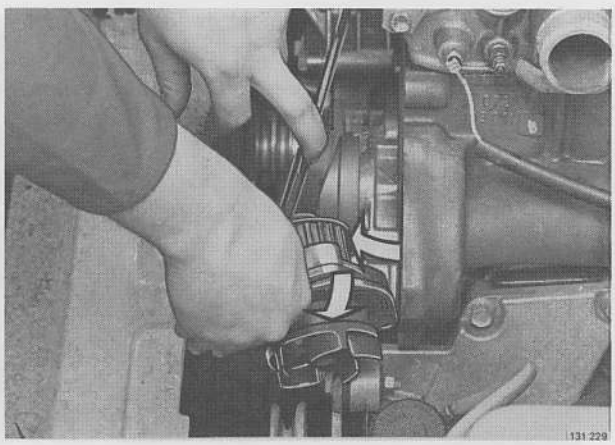
131 232

AV11

Remove gear belt

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

Lift off belt.



131 229

AV12

Remove coolant pump

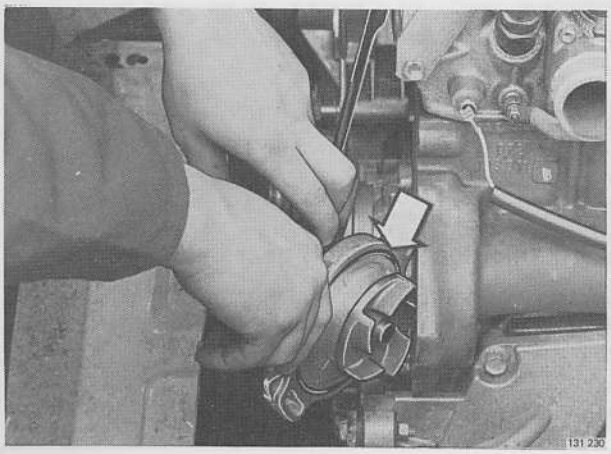
Remove cover panel and retaining bolts for coolant pump.

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.

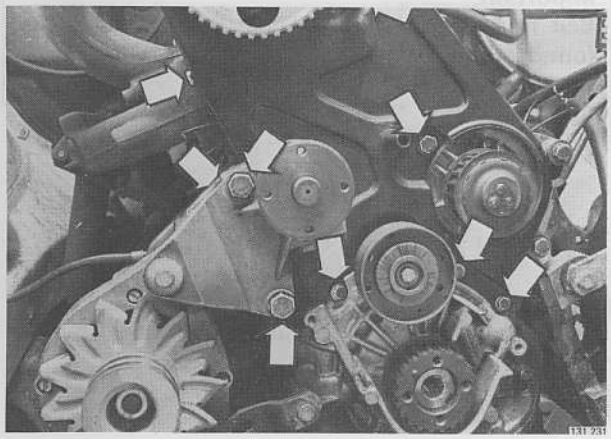


AV14

Install new coolant pump

Grease new O-ring and place it on pump. **Do not** use permatex or other types of sealers.

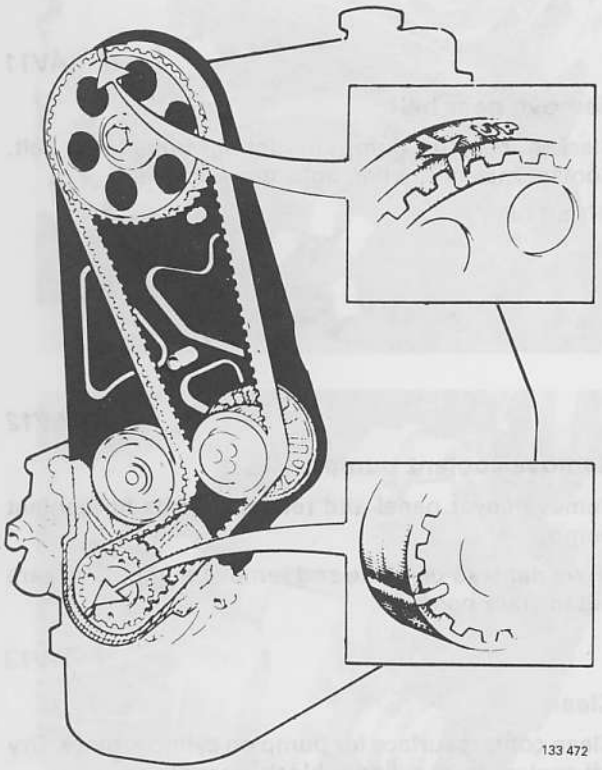
Move cover plate to one side and mount pump on engine. Pump retaining bolts should only be attached loosely at this stage.



AV15

Install:

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



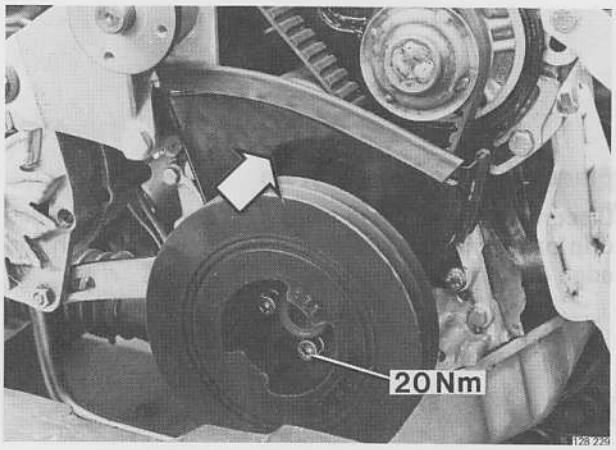
AV16

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.

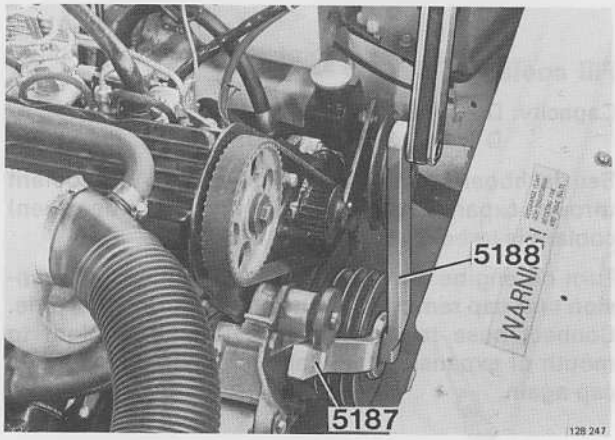


AV17

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).



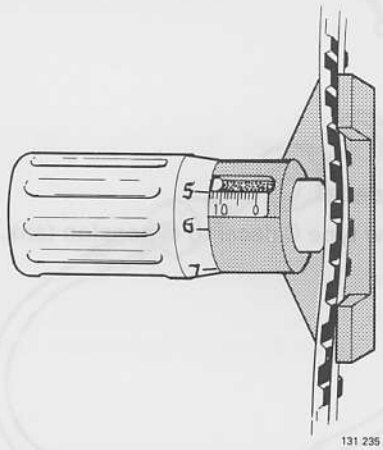
AV18

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.**

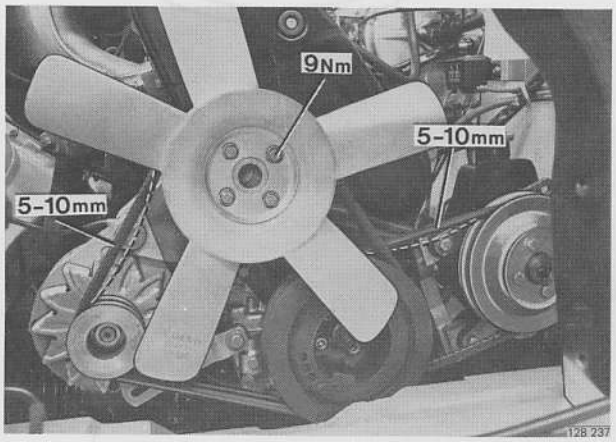


AV19

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

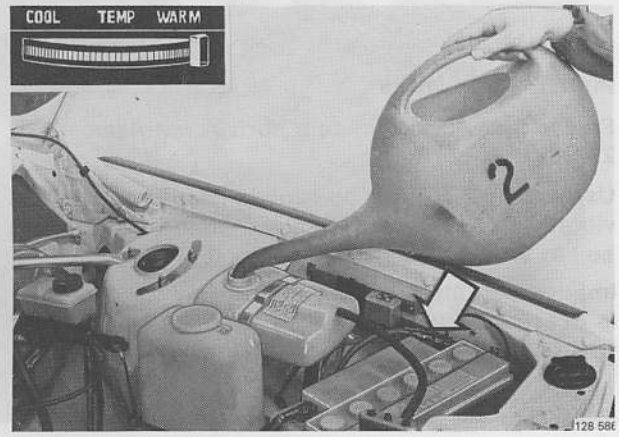
Install:

- 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.



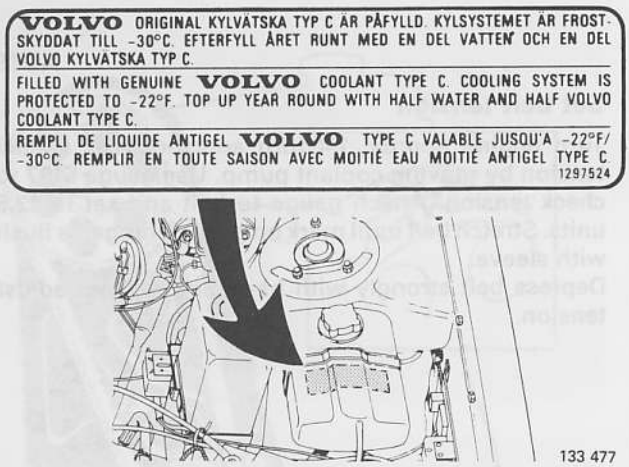
AV22

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.



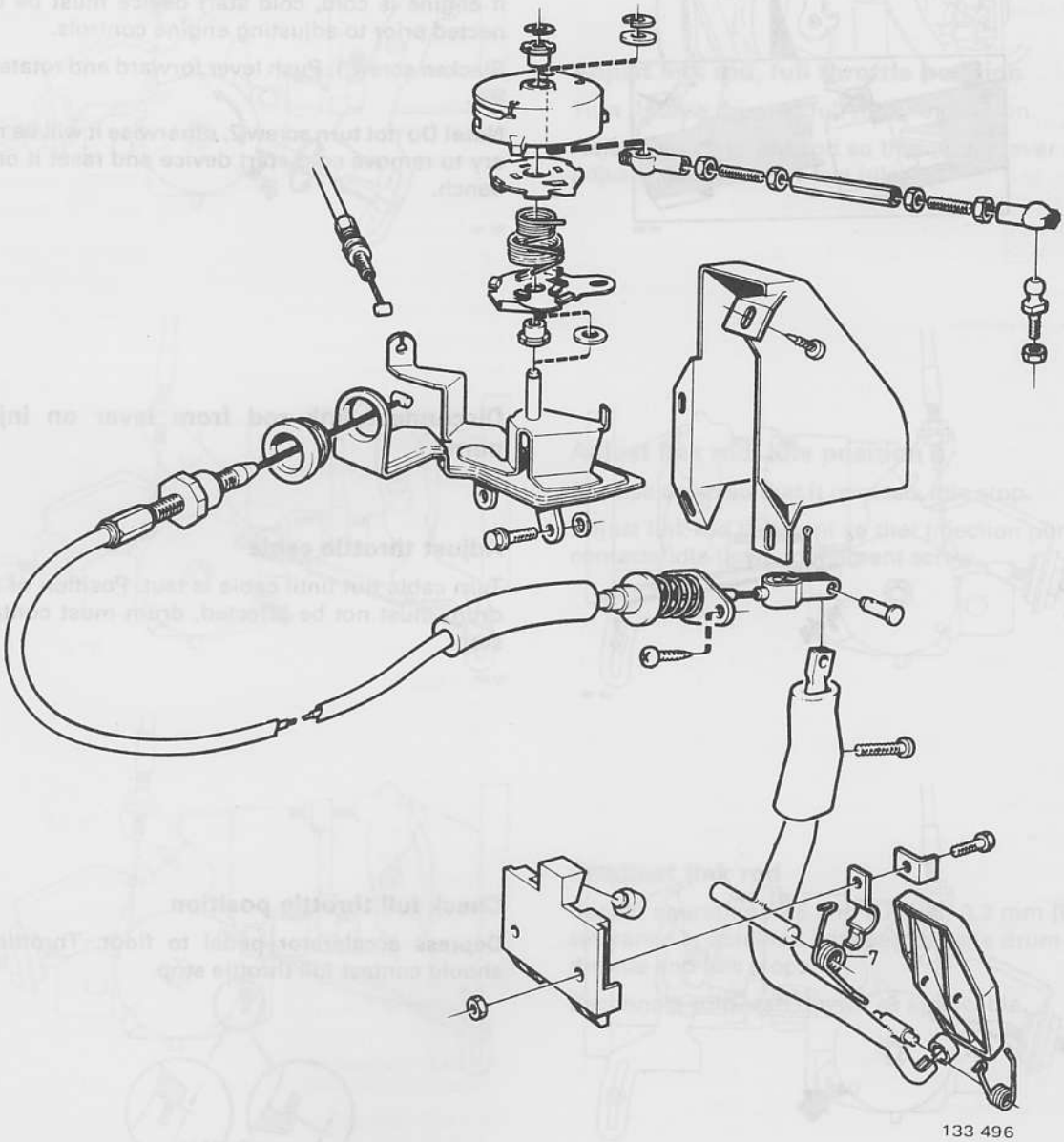
AV23

Replace decal

Attach new type C decal to expansion tank.

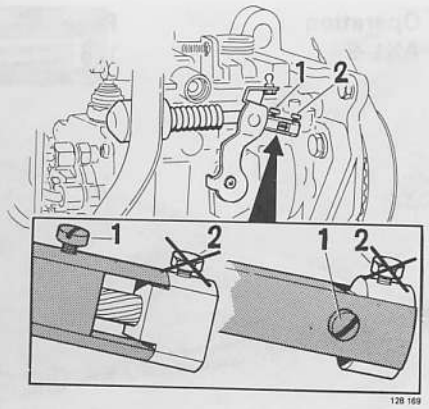
Group 27 Engine controls

Contents



133 496

AX. Engine controls, adjustment



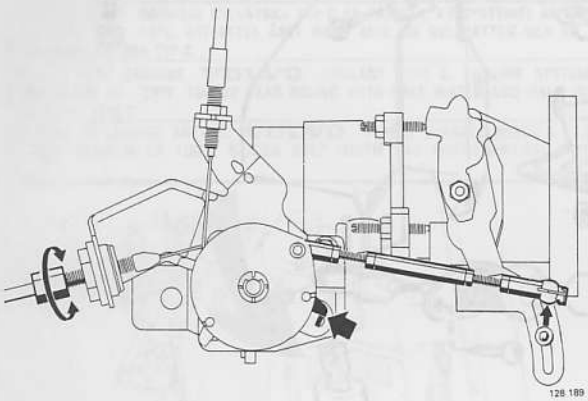
AX1

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.



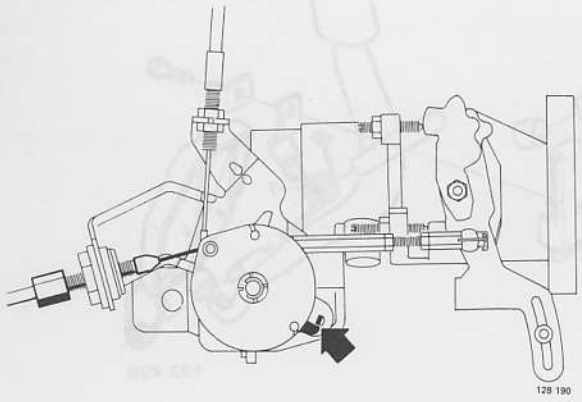
AX2

Disconnect link rod from lever on injection pump

AX3

Adjust throttle cable

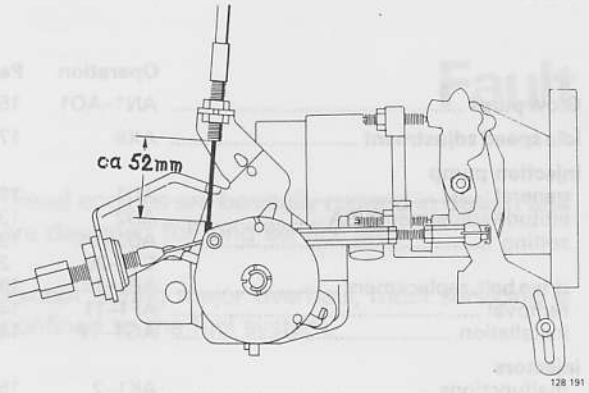
Turn cable nut until cable is taut. Position of throttle drum must not be affected, drum must contact idle stop.



AX4

Check full throttle position

Depress accelerator pedal to floor. Throttle drum should contact full throttle stop.

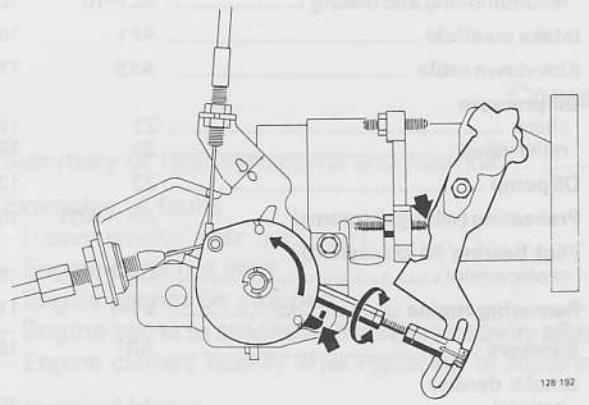


AX5

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

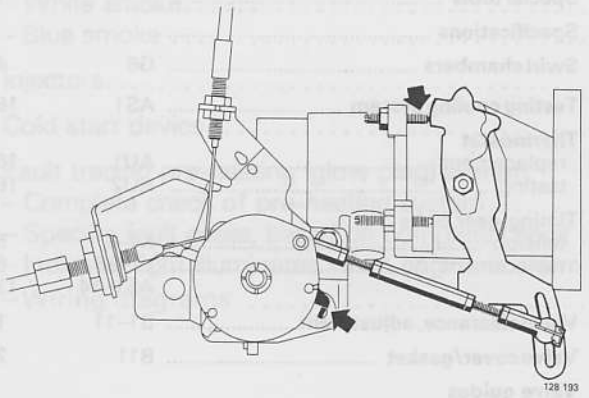
Reconnect link rod to lever

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.

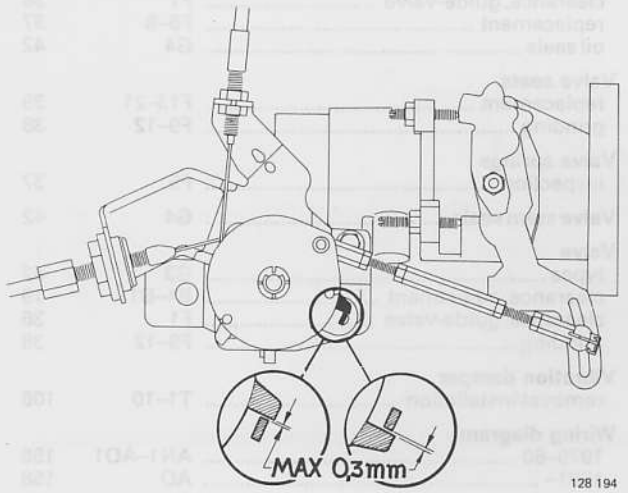


AX8

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.

Index

Fault Tracing

Diesel engines are basically rugged in design and are designed for long service life.

Except during major overhaul, most servicing is confined to the fuel system.

Analysis of exhaust smoke will provide useful information on determining fuel related problems.

Contents

Summary of fault symptoms and reasons

The fault symptoms are listed numerically according to:
—likely occurance, 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.

NOTE: Starting system (Battery, starter, etc.) is assumed to be in good condition.

Symptoms: 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	Black, white or blue exhaust gases	Reasons for faults
									Fuel system
1			1						Fuel valve (stopping valve) in the injection pump
2	6	2	5	4	9				Injection pump sucks air (leakage between fuel tank and pump)
8	5	1	4	3	1	1			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
								9	Incorrectly adjusted for high altitude
			2						Injection pump bracket loose/damaged
							4		Incorrect low idle setting
					8		5		Incorrect high idle setting
						4			Return line blocked
									Other faults
			3						Engine mounts loose/damaged
					2	2	6	1	Air cleaner blocked
					11	5	7		Exhaust system blocked
					3		3		Incorrect accelerator control setting
									Engine mechanical faults
5	4								Incorrect oil viscosity for cold temperatures
	11	7	9		13	7			Compression low/uneven
	12	8	10		14	8			Incorrect valve clearance
								3	Water leakage
								2	High oil consumption

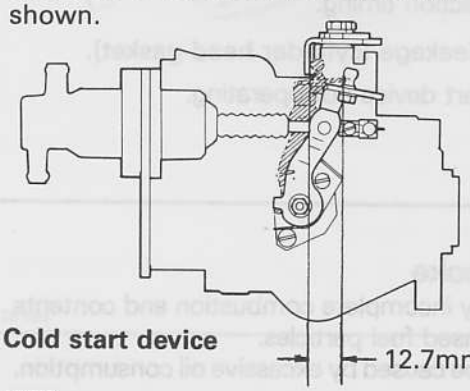
Examples of faults

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.



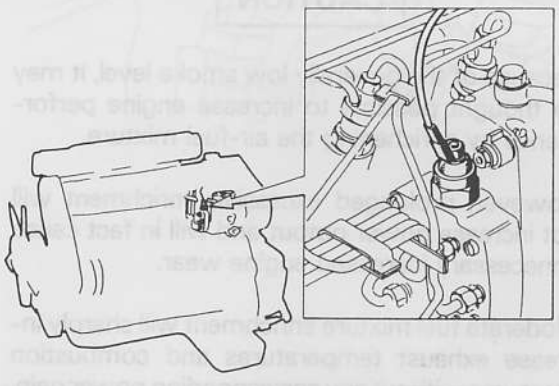
Cold start device

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).



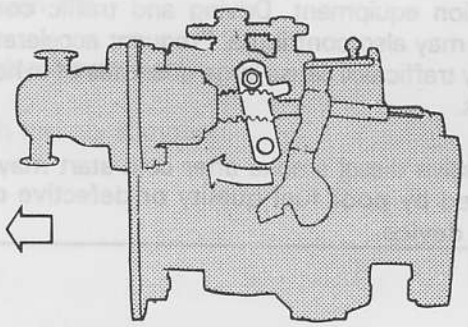
128536

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 quantites 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

128184

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.

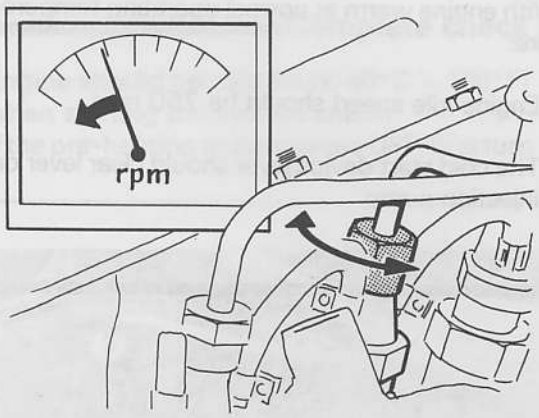
– Overheated engine.

– Reduced power output.

– Uneven idle.

– Black exhaust smoke.

– High fuel consumption.



128185

Checking injector operation

1.
Run the engine at increased idle speed.

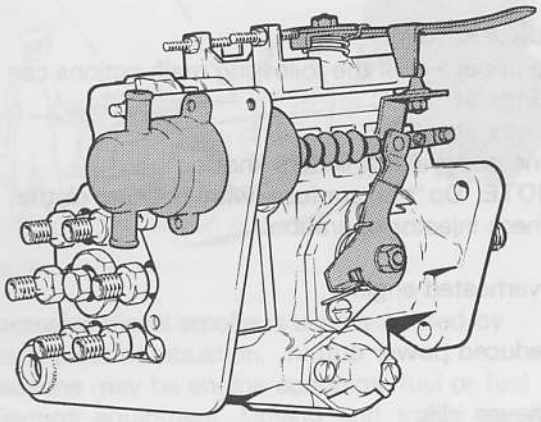
2.
Loosen the cap nuts at the injectors, one at a time. Wrap absorbing paper round the injectors to prevent fuel spill.

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.

Cold start device



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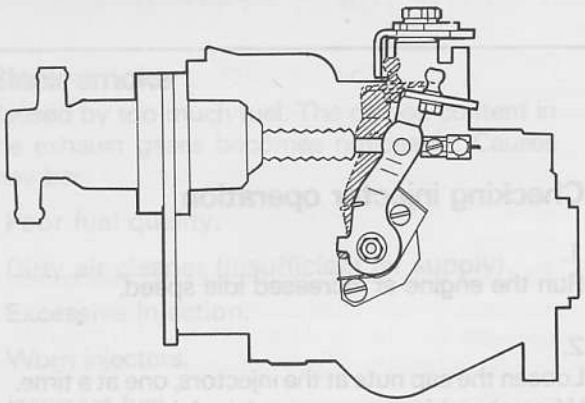
The cold start device can only be tested on a test bench together with the injection pump.

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° C = 14°F.
- Blue-white exhaust gases.



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Operation check

Check idle speed cold and at normal operating temperature.

1.
With cold engine, below 20° C = 70° 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.

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	1981 & ON
45 seconds at −20° C = 4° F.	9 seconds at −20° C = 4° F.
25 seconds at 0° C = 32° F.	6 seconds at 0° C = 32° F.
15 seconds at +20° C = 68° F.	4 seconds at +20° C = 68° F.
0 seconds at +50° C = 112° F.	0 seconds at +50° C = 112° 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.

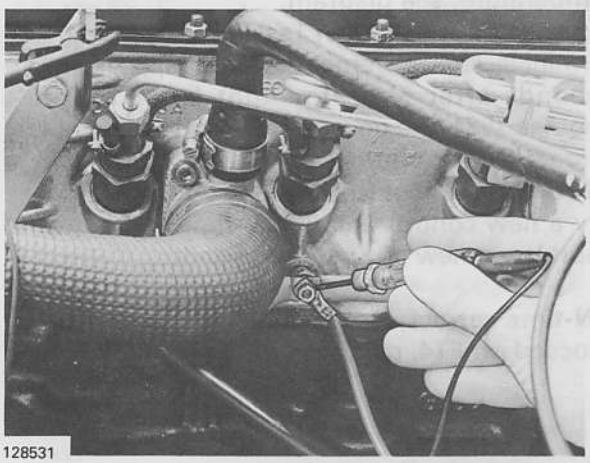
—The system also comprises a blocking relay on 1980 models, on 1981 and on this function is part of the control unit. It will interrupt the electrical circuit between the control unit and the relay for the glow plugs when the alternator starts charging.

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° C = 100° 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

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.

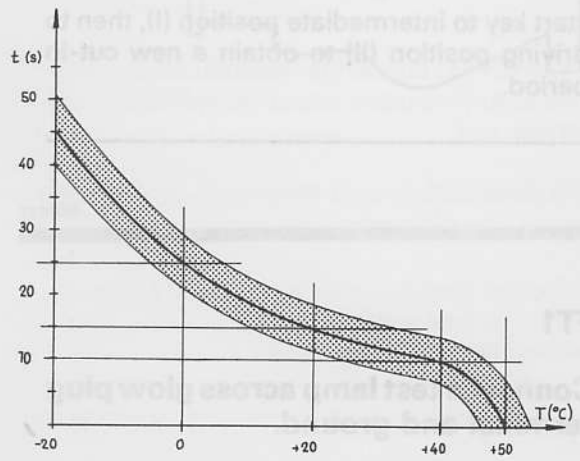
CASE B

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.



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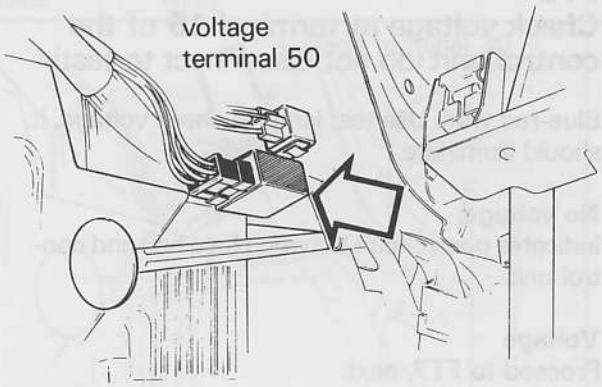
FT3

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

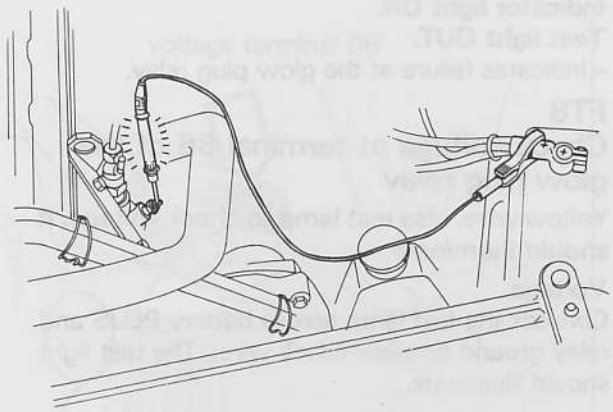
Test light should illuminate, indicating voltage at the glow plugs.

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.

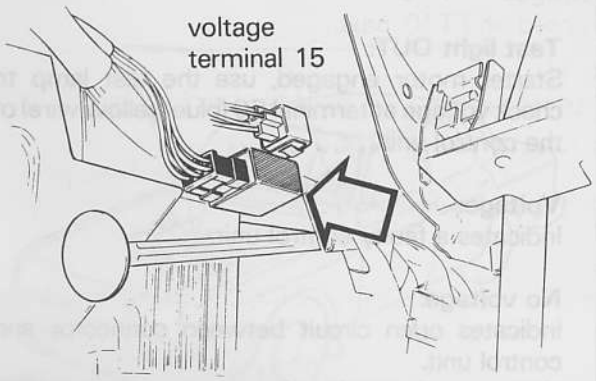
End of complete system check

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.



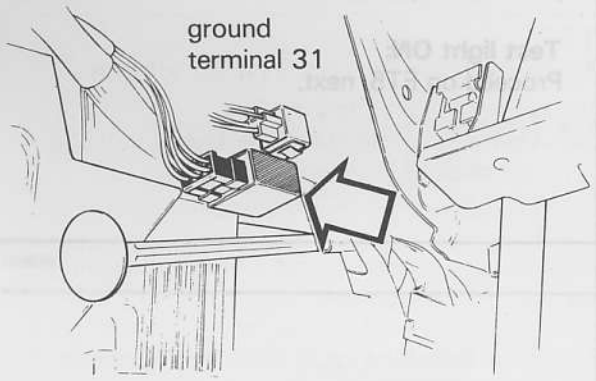
128530

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

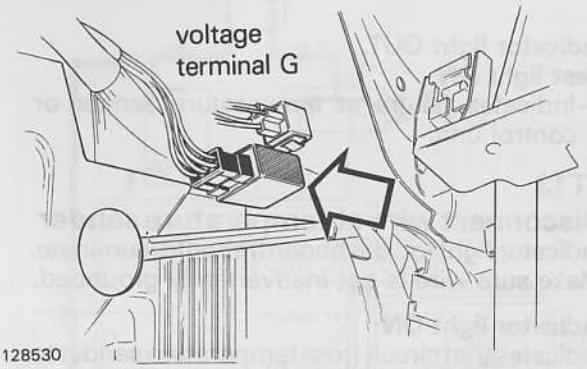
Yellow wire. Use test lamp to check voltage. It should illuminate.

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.



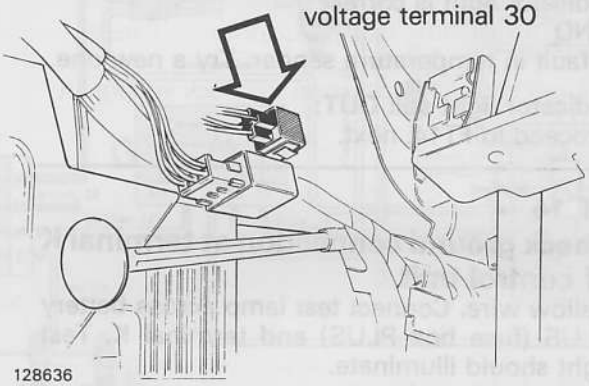
128530

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.



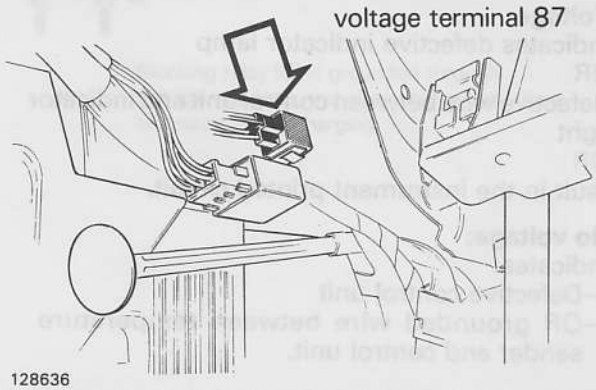
128636

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.



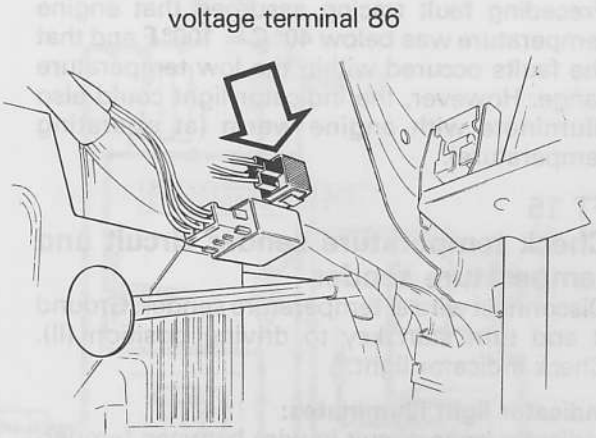
128636

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.



128636

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.

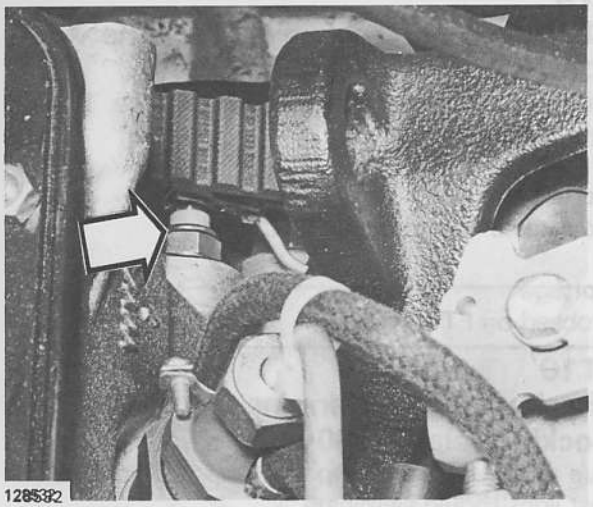
No voltage:
Open circuit in wire between fuse box and blocking relay.

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



128532

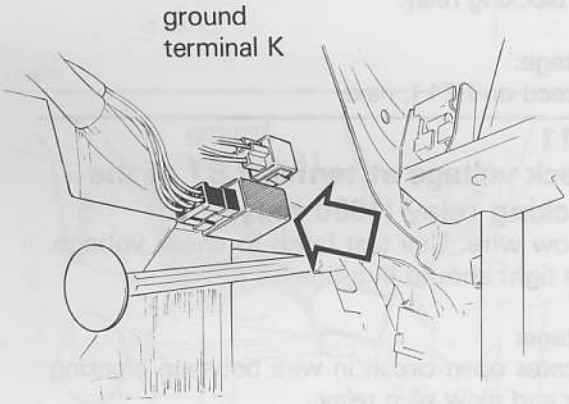
Indicator light OUT.
Test light ON.
—Indicates failure at temperature sender or control unit.

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.



128530

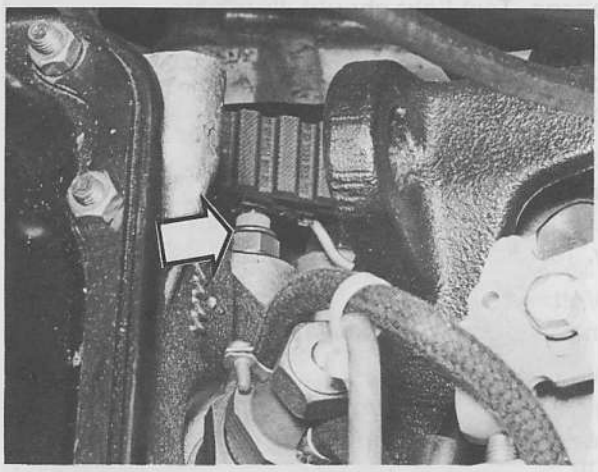
FT 14
Check ground connection at terminal K of control unit

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



128532

Preceding fault tracing assumed that engine temperature was below 40° C = 100° F and that the faults occured 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.

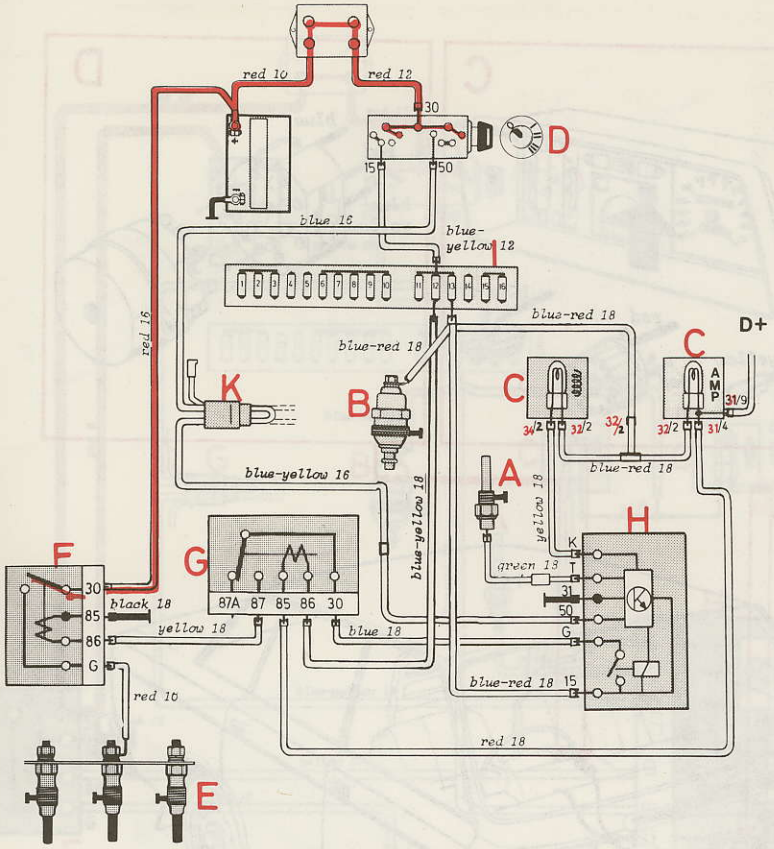
Indicator light illuminates:
Indicates open circuit in wire between temperature sender and control unit
OR
defective control unit.

Indicator light does not illuminate:
Indicates faulty temperature sender.

Glow plug system Diesel 1980 —

Legend:

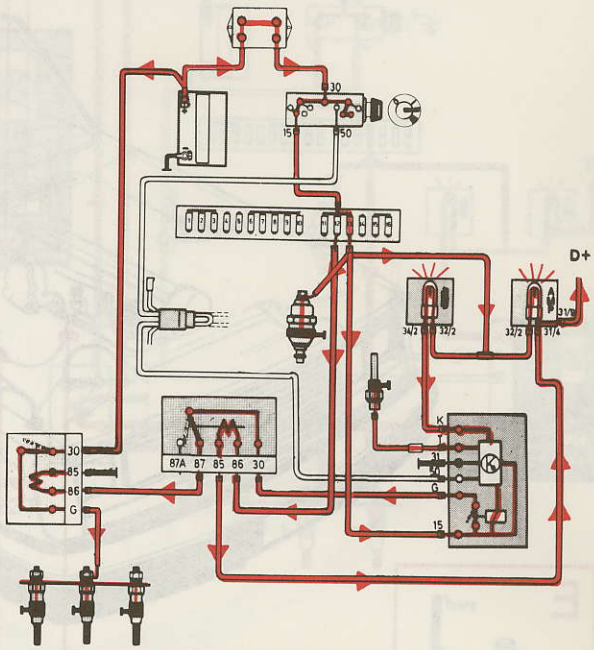
- A Temperature sensor
- B Stop valve
- C Indicator light
- D Start switch
- E Glow plug
- F Glow plug relay
- G Blocking relay
- H Control unit
- I Fuse box
- K Remote starter pick-up point



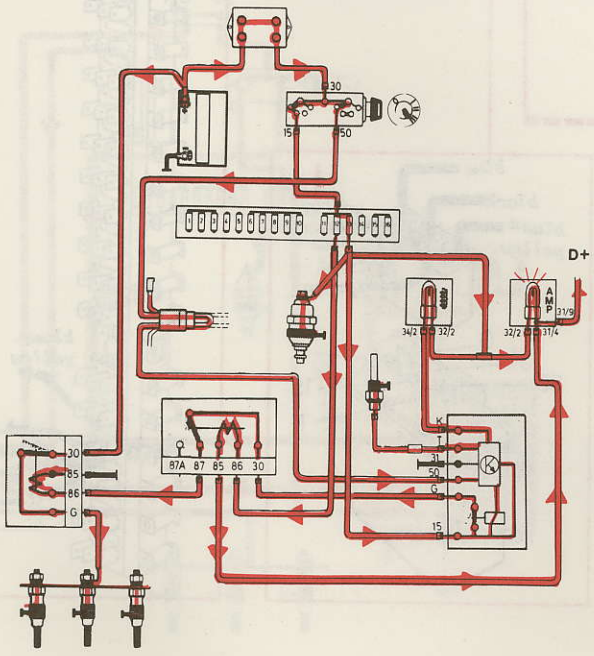
Blocking relay (G) is grounded through voltage regulator and alternator circuit when alternator is not charging.

Start key ON

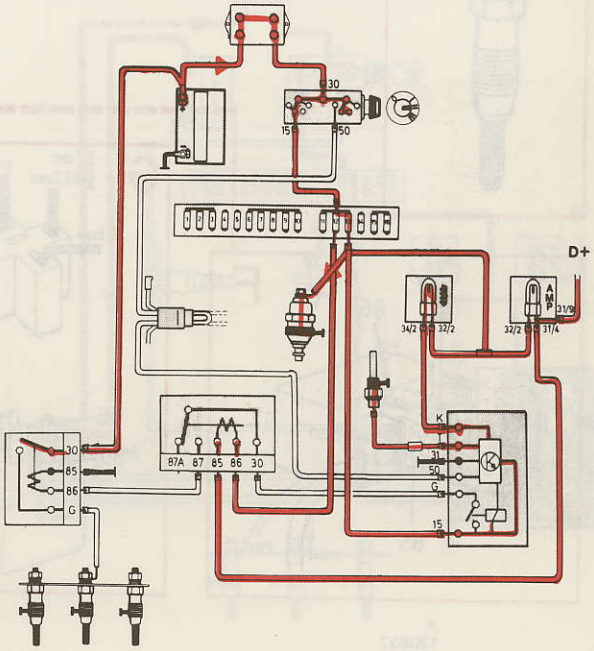
Coolant temperature below +50° C = 122° F



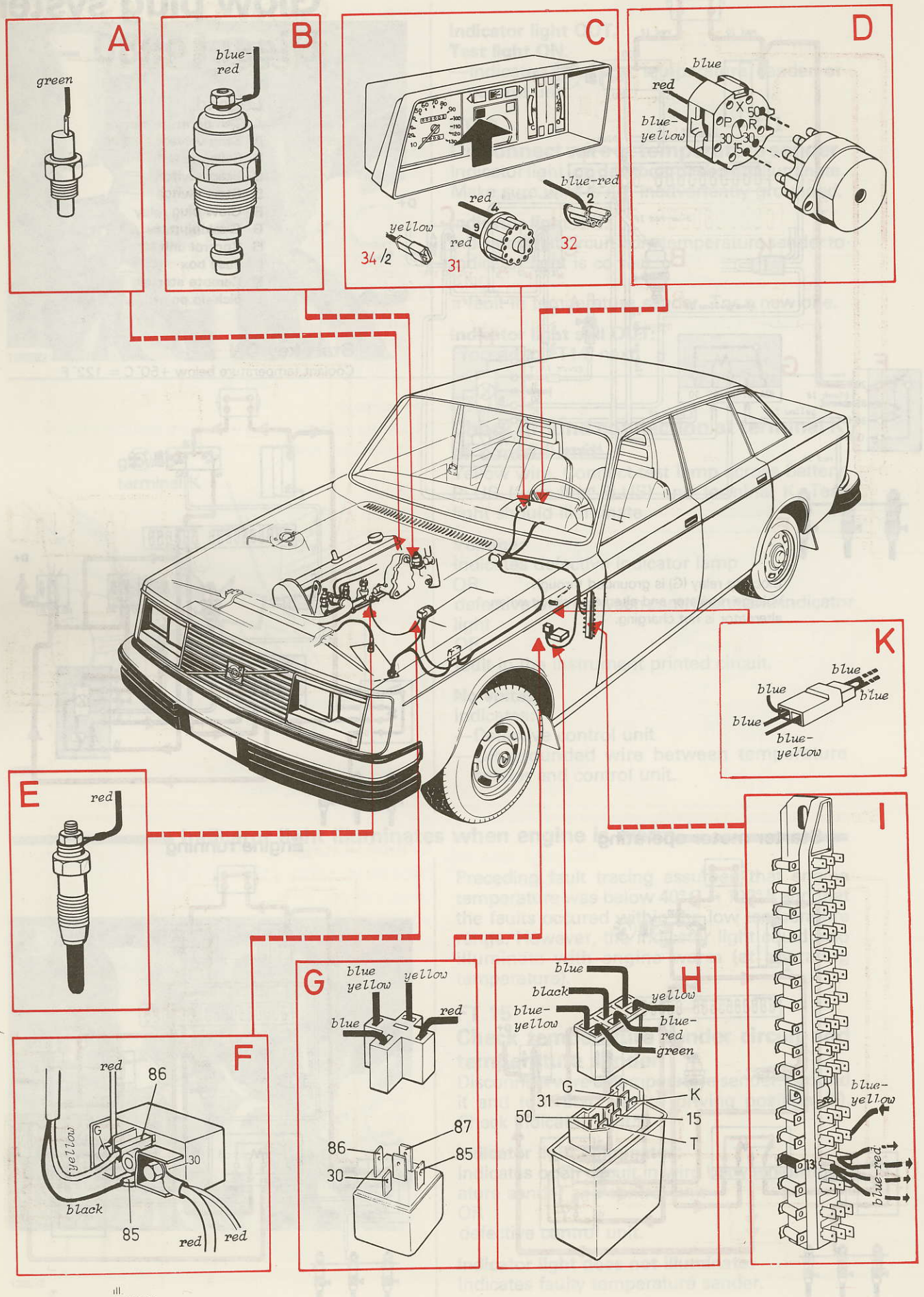
Starter motor operating



Engine running



ill. 130836


A
green
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red
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34/2
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9
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31
blue-red
2
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D
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red
blue-
yellow
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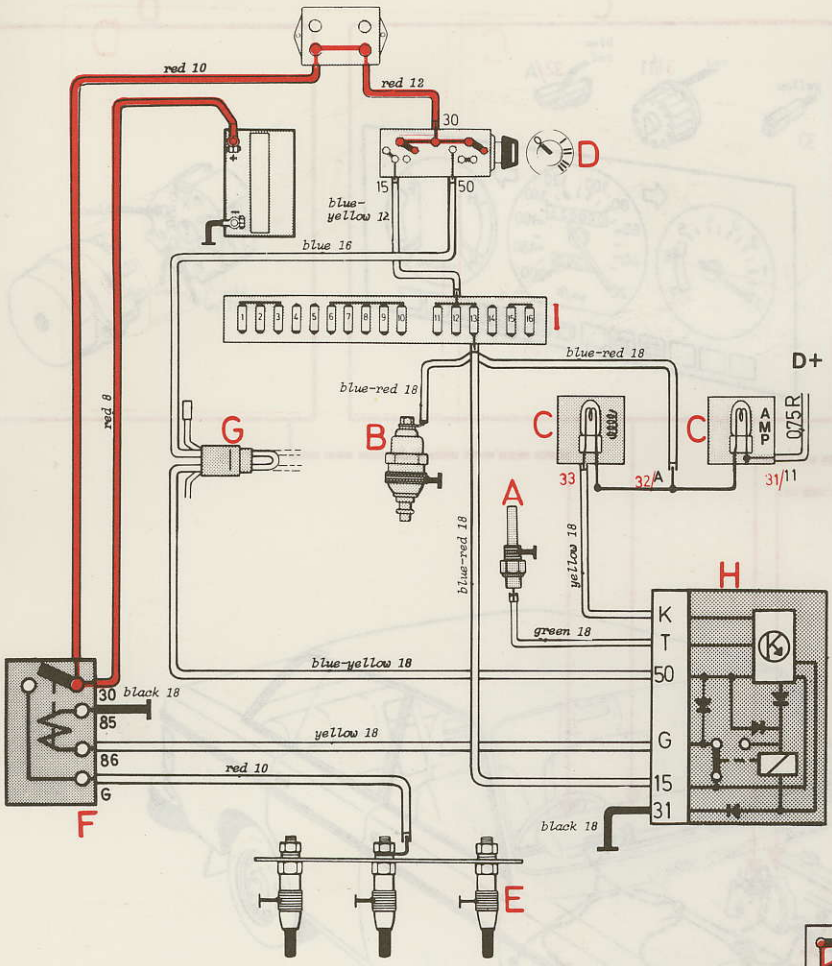
blue

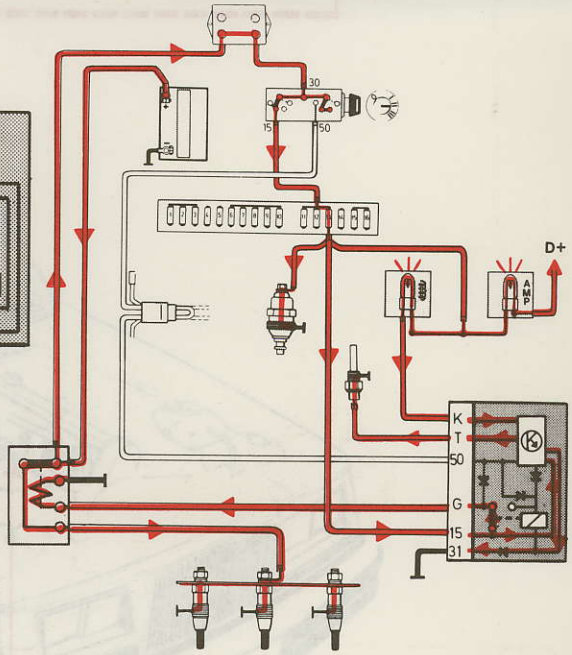
130837

Glow plug system Diesel 1981—

Legend:

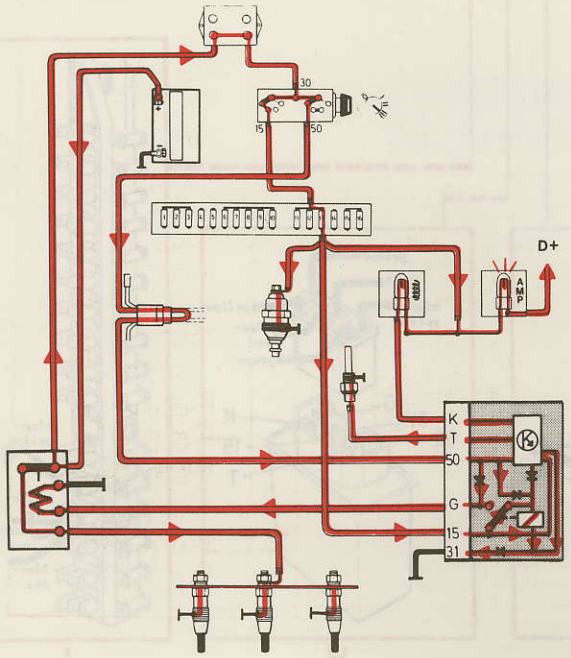
- A Temperature sensor
- B Stop valve
- C Indicator light
- D Start switch
- E Glow plug
- F Glow plug relay
- G Remote starter pick-up point
- H Control unit
- I Fuse box



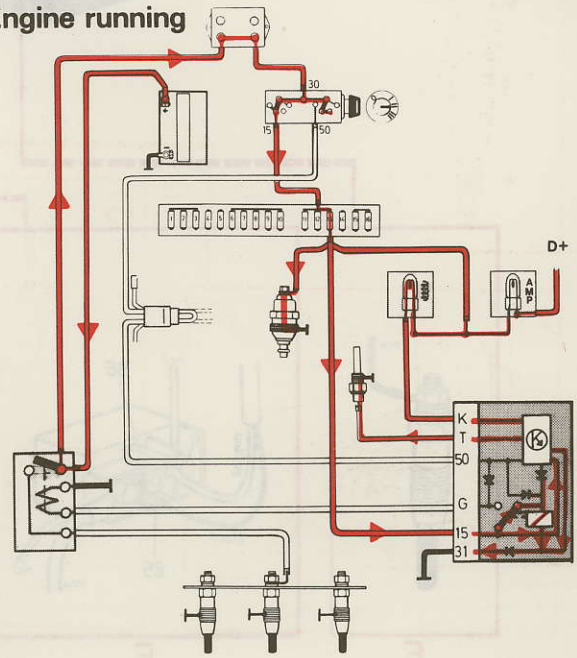


Start key ON
Coolant temperature
below +50°C = 122°F

Starter motor operating



Engine running



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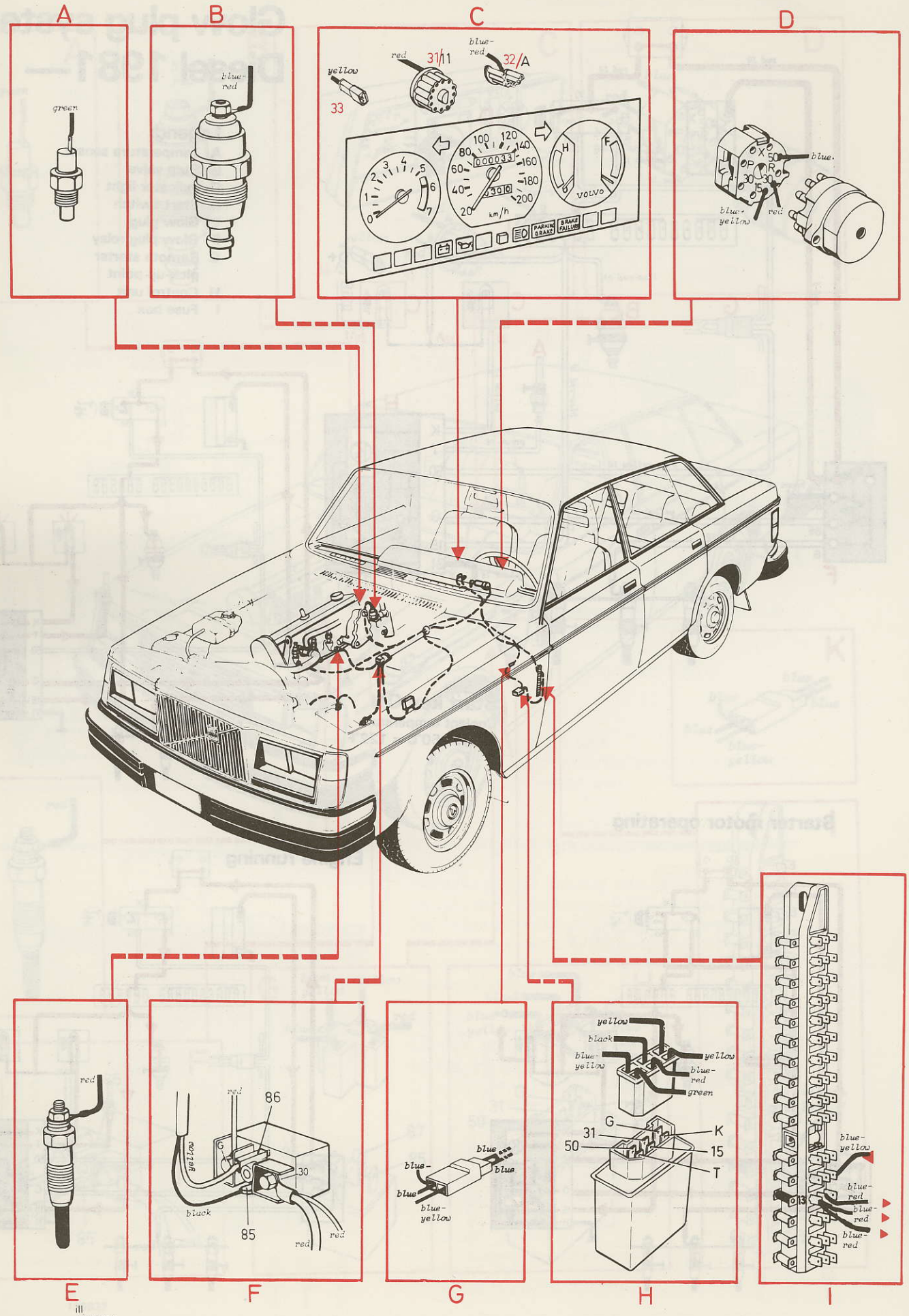
A
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blue-red
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yellow
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