



Workshop Manual

2.4 litre Diesel Engine

January 1982 Edition

LT

THE LT WORKSHOP MANUAL CONSISTS OF THE FOLLOWING BOOKLETS

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	2.0 LITRE-PETROL ENGINE	RUNNING GEAR LT 28/31/35
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	4 CYLINDER DIESEL ENGINE	RUNNING GEAR LT 40/45
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Workshop Manual

LT

2.4 Litre Diesel Engine

January 1982 Edition
Supersedes November 1978 Edition

The manual is divided into separate booklets which can be ordered individually and allocated on the shop floor as required.

This booklet is valid for the 2.4 litre Diesel engine from the start of production (November 1978). It describes all the operations which require special instructions to ensure satisfactory work.

Layout of booklets

The technical data is followed by a description of the repair operations. Where practical, each operation is preceded by an exploded view which also contains all the main repair instructions. This is supplemented, where necessary, by photographs – which are referred to in the exploded view – giving details of the fitting positions of parts or showing special tools in use.

If a definite sequence has to be followed when dismantling and assembling a component, the exploded view is followed by a description of the main steps of the work sequence. Any adjustments required are also explained.

Workshop Bulletins

Workshop bulletins will be allocated to the individual booklets and should be filed at the back of the booklet concerned. To remind you that bulletins have been published, the manual pages should be marked by hand with the bulletin number as explained in the bulletin heading.

Fault finding

General fault finding instructions are given in the workshop manual.

Instructions on the elimination of current defects are given in the "Service HANDBOOK".

Technical information should always be made available to all foremen and mechanics because compliance with the instructions given is essential to ensure vehicle roadworthiness and safety. In addition, the normal safety precautions to be observed when working on motor vehicles are also applicable.

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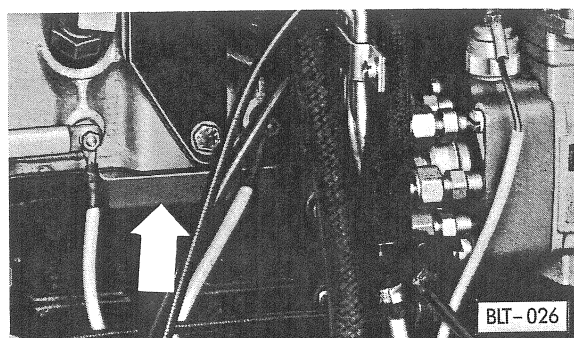
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TECHNICAL DATA

Code letters		CP
Engine data		
Manufactured	from to	11.78
Cylinders	Number	6
Capacity	litres	2.4
Output	kW/rpm	55/4500
Torque	Nm/rpm	142/3000
Bore	mm	76.5
Stroke	mm	84.4
Compression		23
Valve timing at 1 mm lift	Inlet opens after TDC	5°
	Inlet closes after BDC	21°
	Exhaust opens before BDC	27°
	Exhaust closes before TDC	5°
CN	min.	45
Firing order		1-5-3-6-2-4

Engine number



- The engine number is on the lefthand side of the cylinder block near the injection pump.

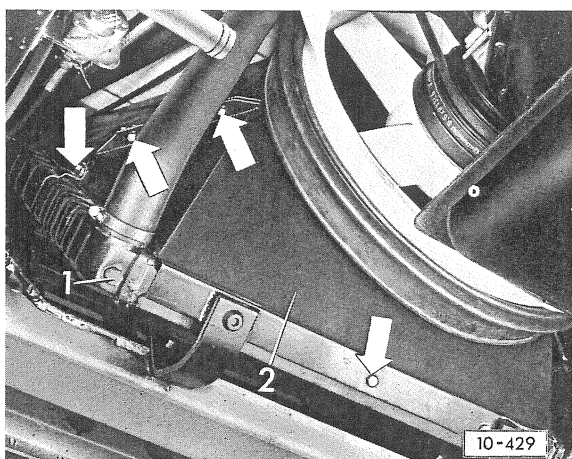
10 Removing and installing engine

REMOVING AND INSTALLING ENGINE

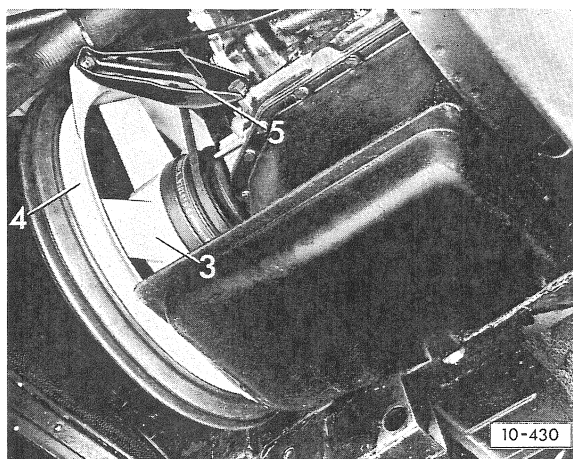
The engine is taken out upwards to the left hand side of the cab. The gearbox must be removed.

Removing

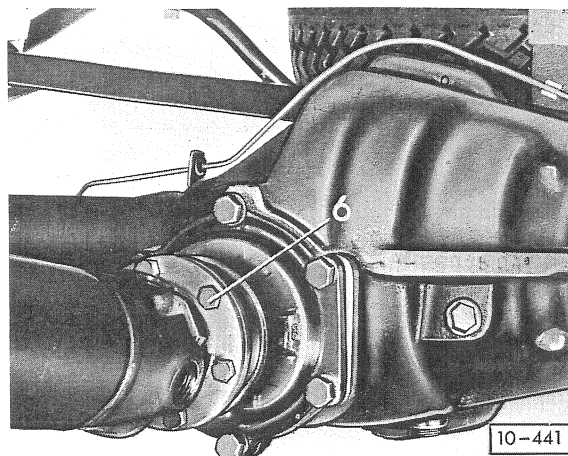
- Take out seats and engine bonnet.
- Disconnect battery earth strap.
- Open cap on expansion tank (to release pressure).



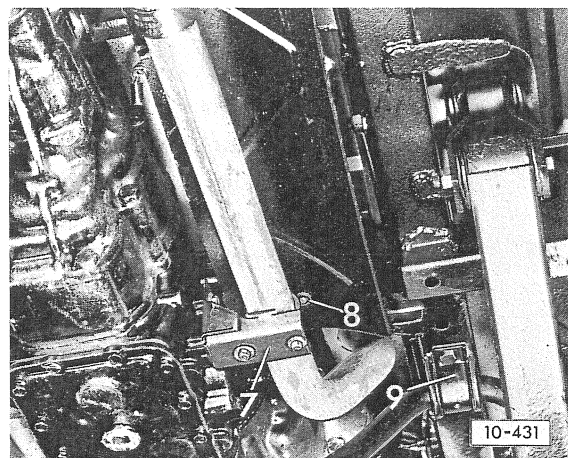
- Drain coolant via drain plug – 1 – and catch in a clean container.
- Remove lower air duct – 2 – (remove screws at side and underneath – arrow – and take air duct out.)
- Detach lower coolant hose from expansion tank and close tank. Pull coolant hose downwards and allow remaining coolant to drain from cylinder block.



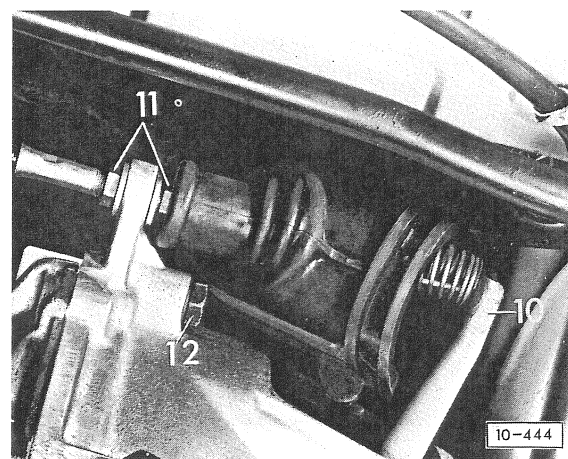
- Remove fan – 3 –.
- Remove fan cowl – 4 –.
- Remove left fan cowl mounting – 5 –.



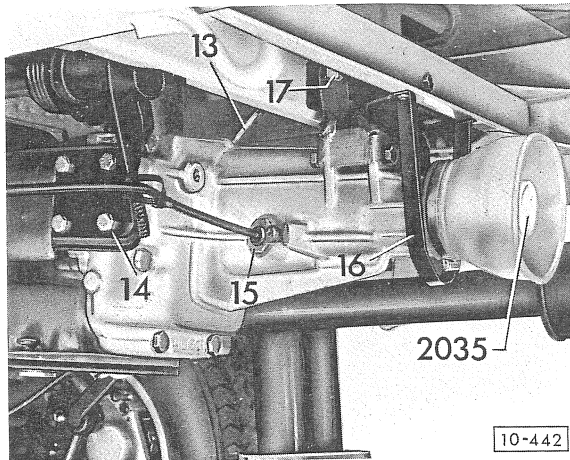
- Detach prop shaft – 6 – from rear axle and body, pull it out of gearbox and close gearbox with sleeve 2035.



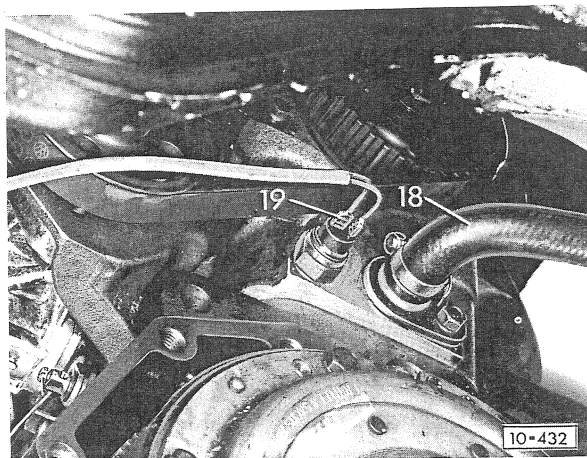
- Remove exhaust pipe bracket – 7 – complete.
- Remove deflector plate – 8 –.
- Detach anti-roll bar – 9 – from body and press it downwards.



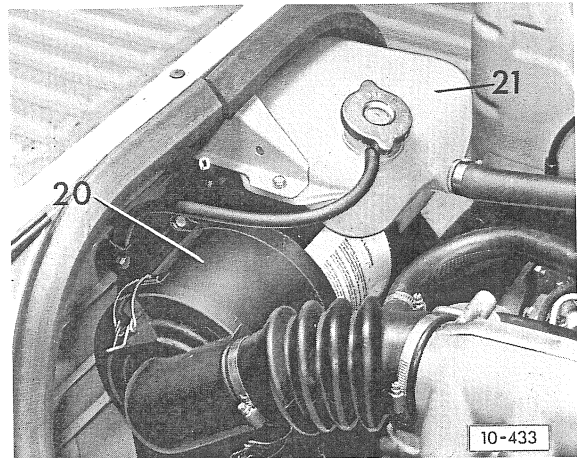
- Disconnect clutch cable at release lever – 10 – and take off cap and return spring. Detach clutch cable at gearbox support – 11 –.
- Remove all engine-gearbox bolts – 12 –.



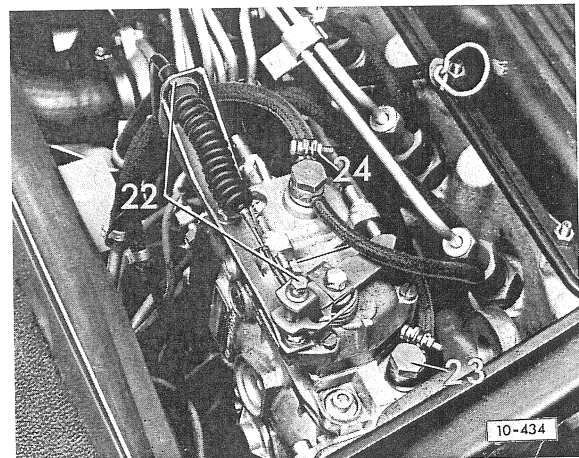
- Detach earth strap – 13 – from body.
- Detach gear lever bracket – 14 –.
- Remove speedometer drive cable – 15 – and seal opening with a rubber cap so that oil does not leak out when gearbox is removed.
- Detach retaining strap – 16 –.
- Detach rear gearbox mounting – 17 – from bonded rubber mounting (1 bolt).
- Press gearbox off dowel bushes, pull it to the rear and lift it out. :



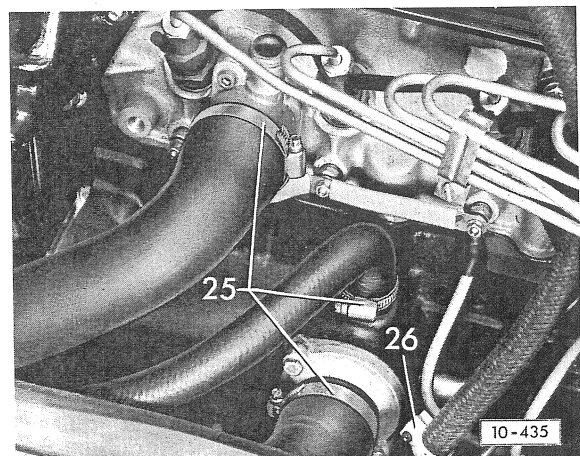
- Disconnect coolant hose – 18 –.
- Disconnect wire from temperature sender – 19 –.



- Remove air cleaner – 20 – with intake pipe and connecting elbow (remove cover and filter element beforehand).
- Remove expansion tank – 21 – complete with hoses.

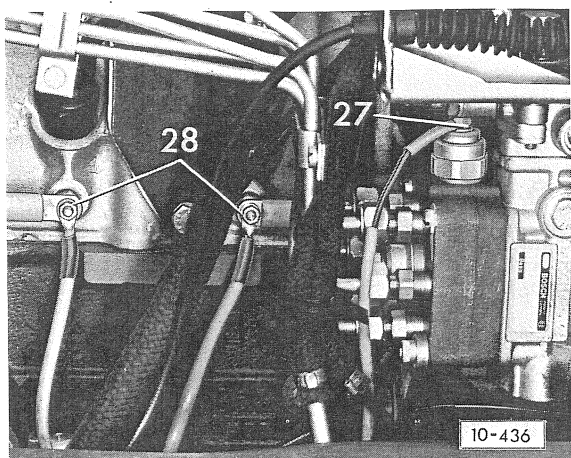


- Disconnect accelerator cable – 22 – from injection pump lever and bracket.
- Disconnect fuel line – 23 – (union).
- Disconnect fuel return line – 24 –.

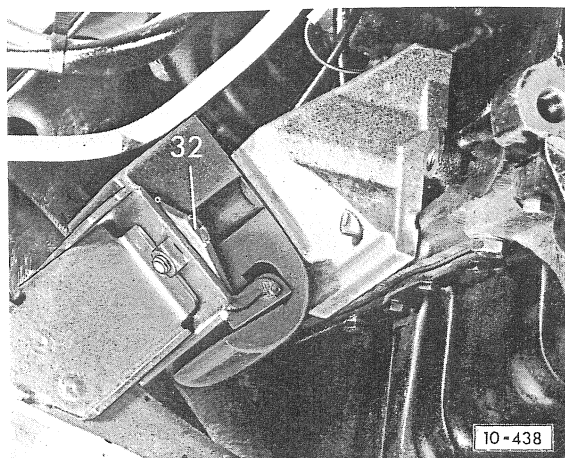


- Disconnect coolant hoses – 25 –.
- Disconnect vacuum hose from exhauster – 26 –.

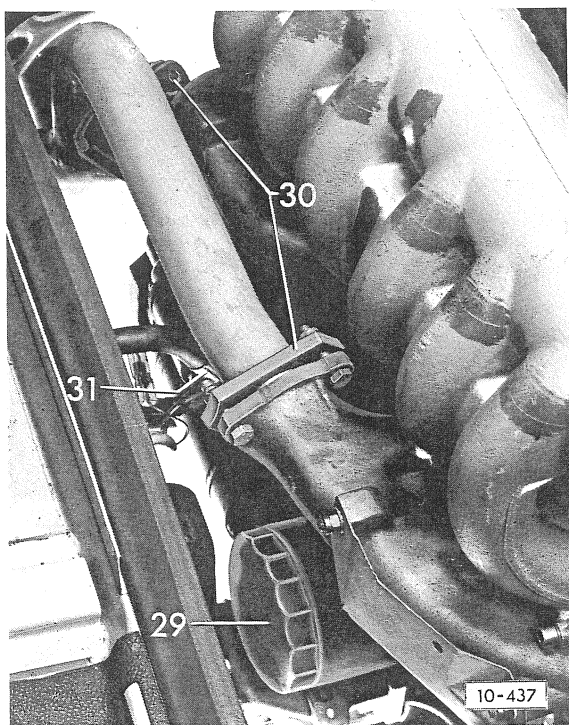
10 Removing and installing engine



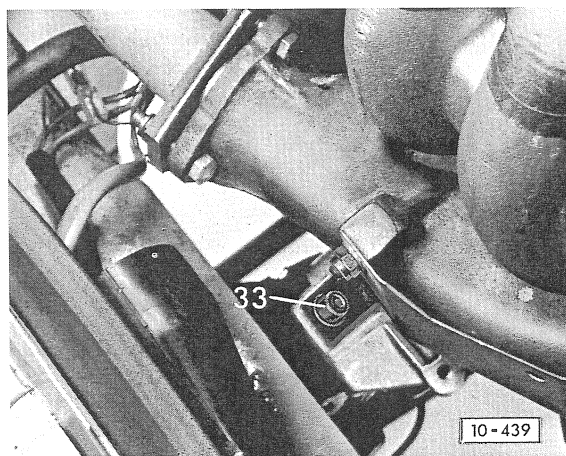
- Disconnect electric wiring from stop control – 27 –, glow plugs – 28 – and oil pressure switch.



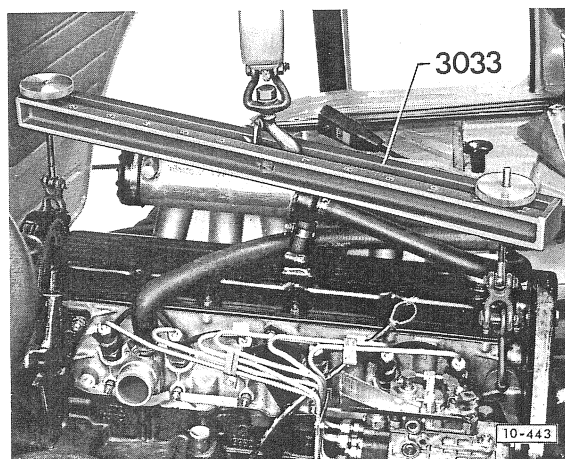
- Detach left engine carrier – 32 – from body (2 screws).



- Detach oil filter – 29 – and take it out downwards.
- Detach exhaust pipe – 30 – from both elbows.
- Disconnect wiring at starter – 31 –.

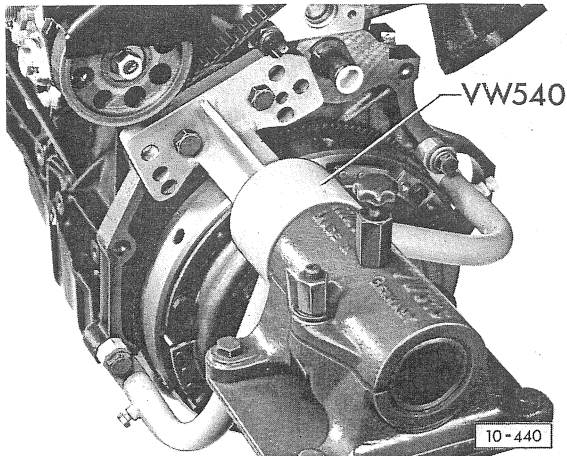


- Detach right engine carrier – 33 – from bonded rubber mounting.



- Attach lifting tackle as follows and lift engine out carefully.
 Pulley end: Set the spindle in position 2.
 Flywheel end: Set the spindle in position 10.
 Then adjust the spindle length so that the appliance is horizontal and not resting on the intake manifold.

SECURING ENGINE TO REPAIR STAND



If work is to be carried out on the engine it should be mounted in repair stand using adapter VW 540.

Installing

Note the following when installing:

- Lower engine carefully and position left engine carrier on the studs on the body.
- Align right engine carrier with suitable punch (drift) and insert securing bolts.

Note:

Engine carrier should not be tightened until gearbox has been installed.

Adjust clutch play:

The clutch should be adjusted so that there is 20 mm play at the pedal. Adjustment is made at the pedal.

Putting coolant in – page 38

Adjusting accelerator cable – page 46

Tightening torques

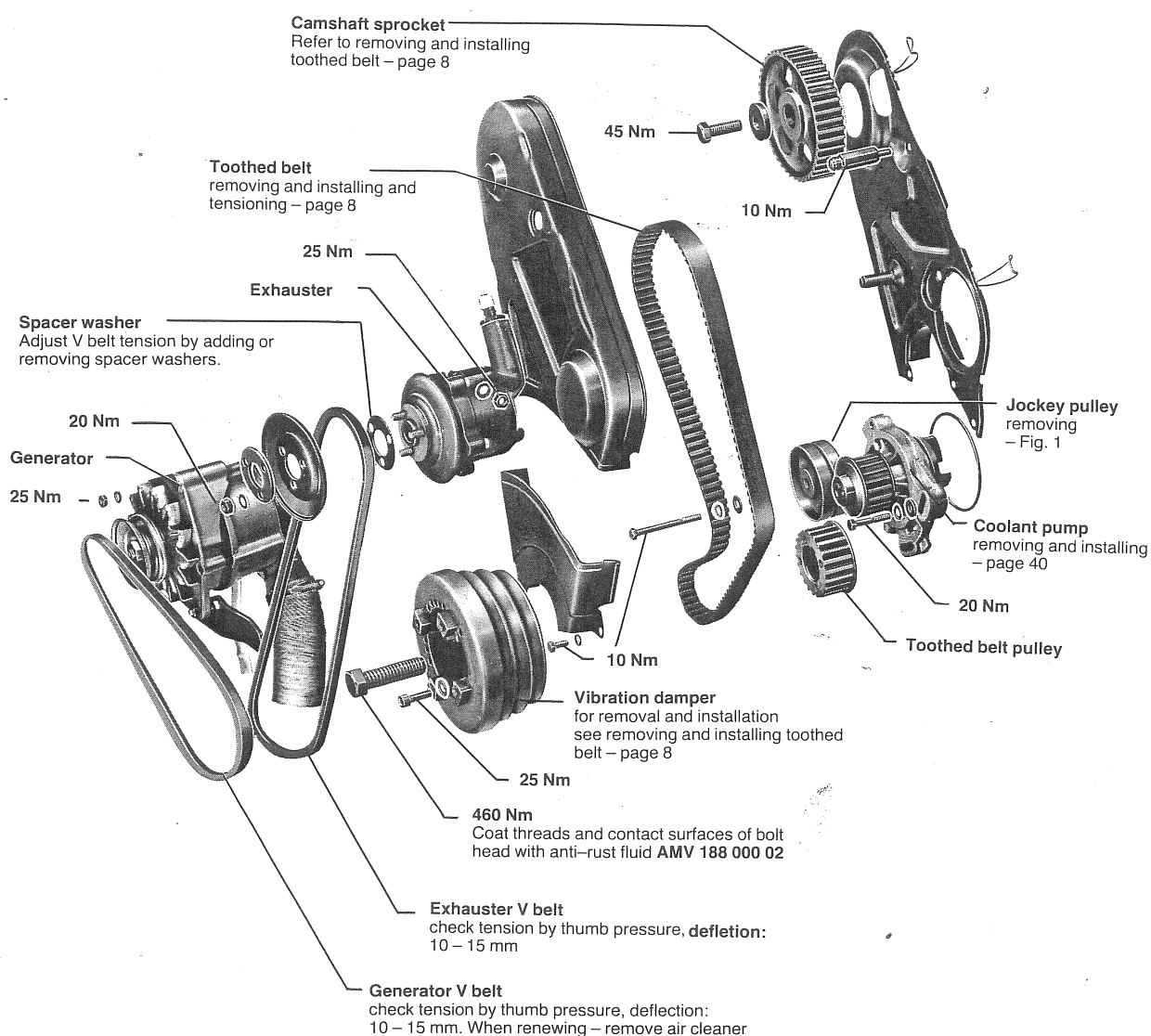
Engine to gearbox	M 12 : 60 Nm M 10 : 45 Nm M 8 : 25 Nm
Left engine carrier to body	25 Nm
Right engine carrier to bonded rubber mounting	45 Nm
Fan to vibration damper	25 Nm
Prop shaft to rear axle and body	25 Nm

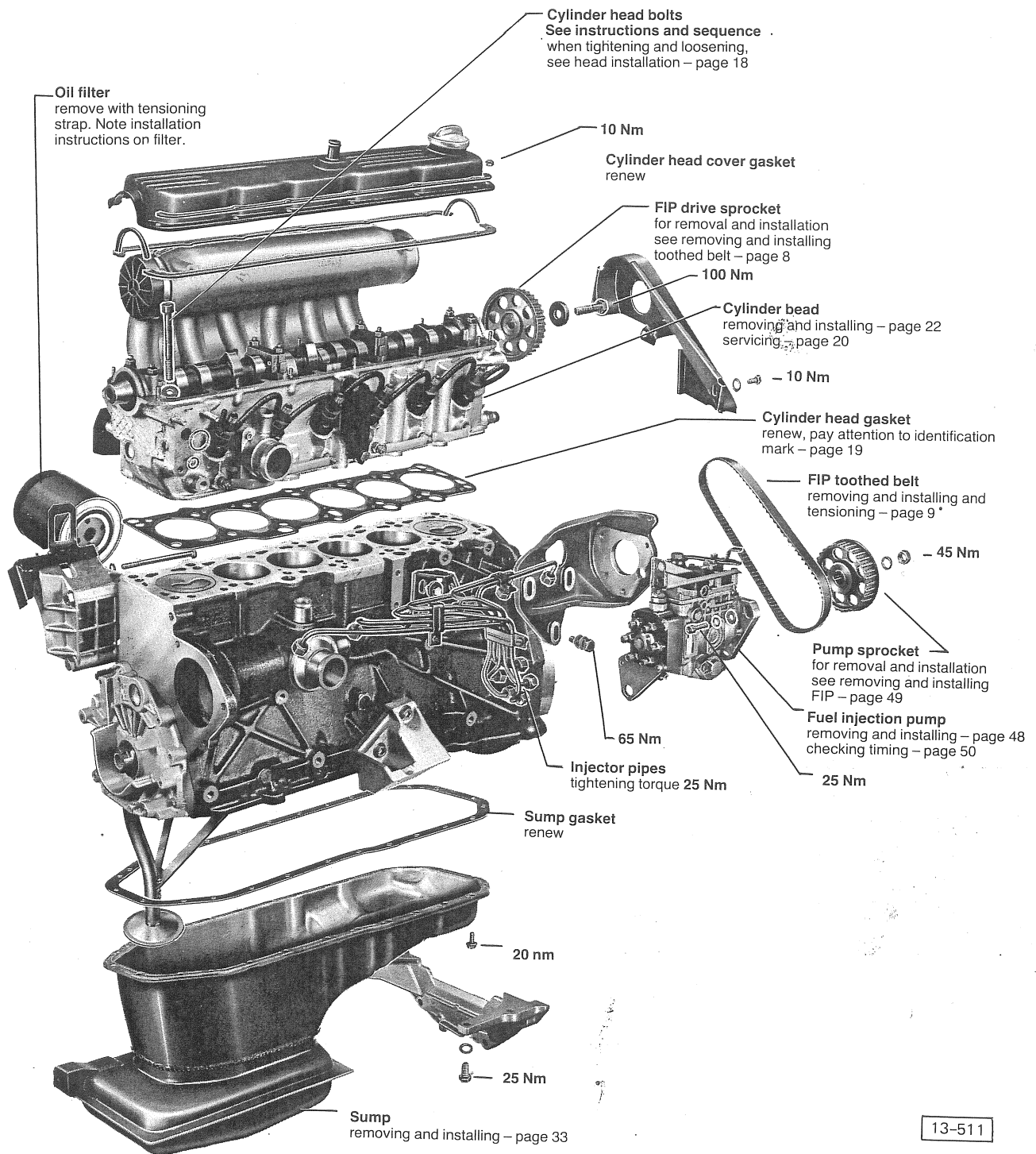
13 Crankshaft Group

DISMANTLING AND ASSEMBLING ENGINE

Note:

Defective injectors can cause loud knocking in the engine giving the impression of bearing damage. In such cases, run the engine at idling speed and slacken off the injector pipe unions one after the other. If the knocking ceases, when a union nut is slackened off, this indicates the injector which is defective. See page 54 for instructions on servicing injectors.





13 Crankshaft Group

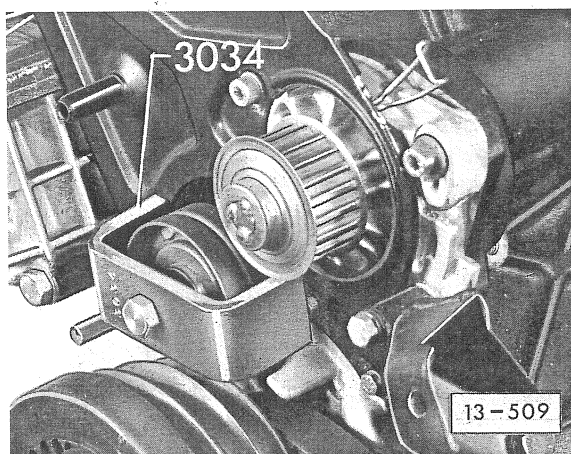
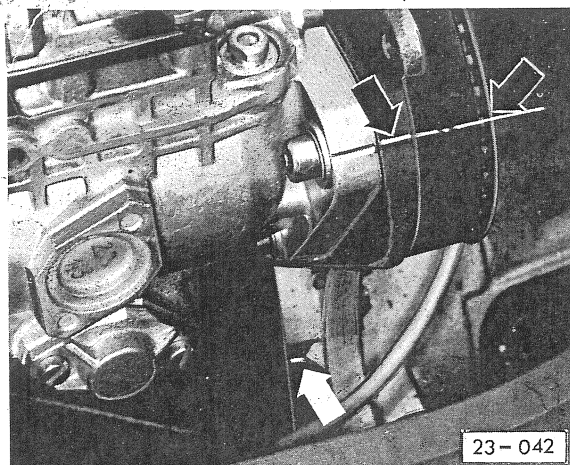


Fig. 1 Removing jockey pulley

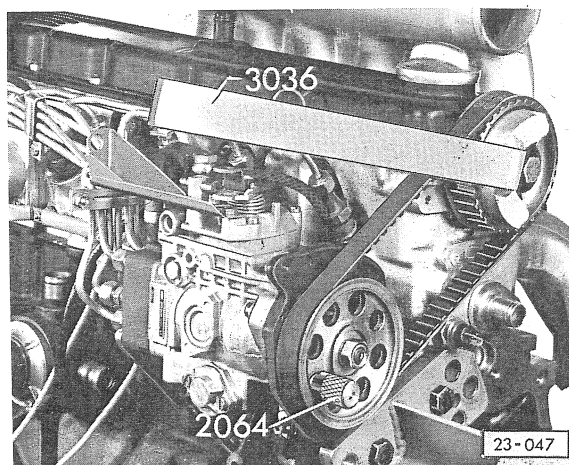
REMOVING AND INSTALLING CAMSHAFT TOOTHED BELT

Removing

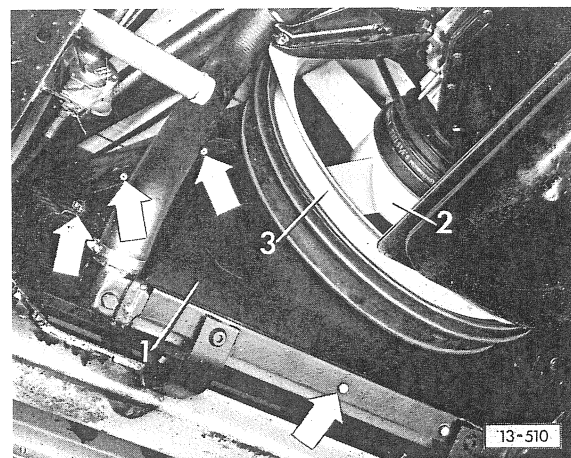
- Remove exhaust drive belt (remove front half of pulley)
- Take off both toothed belt guards and cylinder head cover.
- Detach expansion tank and place to one side with hoses connected.
- Remove air cleaner.



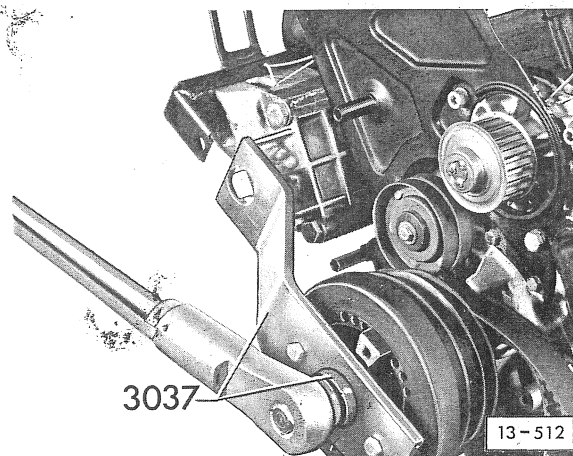
- Turn crankshaft to TDC on No. 1 cylinder: Marks on flywheel/clutch housing – white arrow – and injection pump gear/console – black arrow – must be aligned.



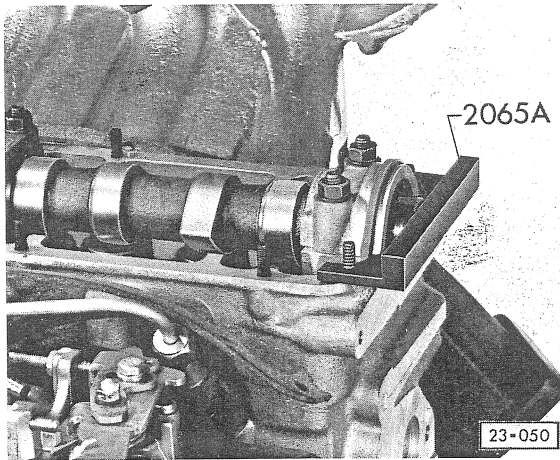
- Fix injection pump gear in position with pin 2064.
- Hold injection pump gear with bar, remove securing screw and take gear off with toothed belt.



- Remove lower air duct – 1 – (take out securing screws at side and bottom – arrow – and remove air duct).
- Remove fan – 2 –.
- Remove fan cowl – 3 –.
- Take off generator drive belt.



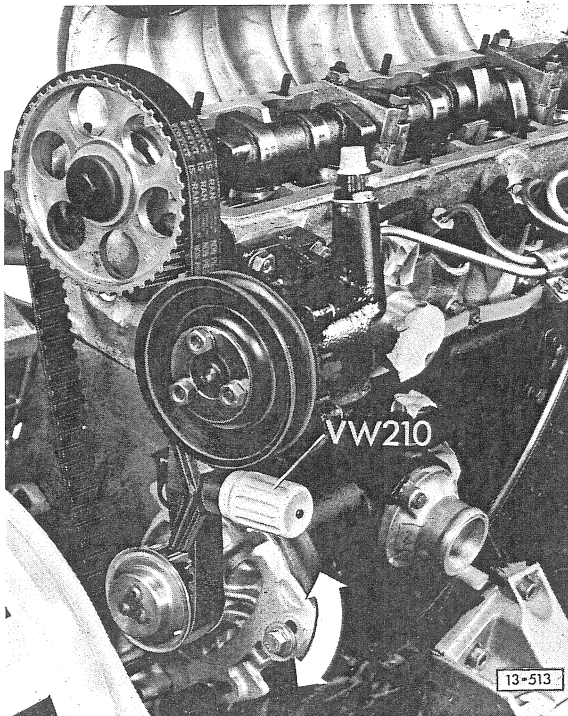
- Remove central screw in vibration damper.



- Set crankshaft to TDC on No. 1 cylinder again and fix camshaft with setting bar.
- Slacken toothed belt tension (by loosening coolant pump).
- Take off vibration damper with toothed belt gear and toothed belt.

Installing

- Install vibration damper together with belt for camshaft drive and tighten bolt to **460 Nm**.
- Loosen camshaft securing bolt about 1 turn and loosen camshaft gear on taper by tapping with drift through hole in cover plate.



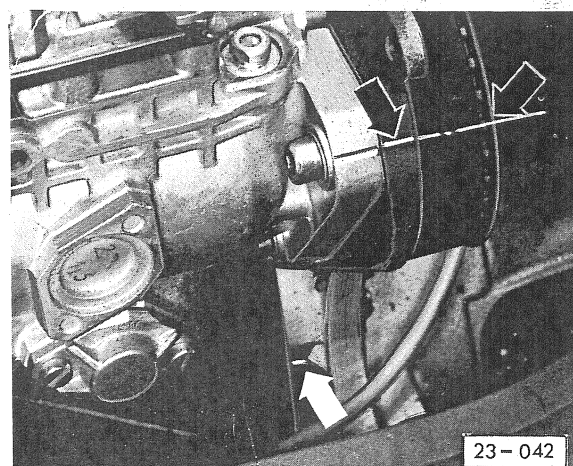
- Install camshaft toothed belt and tension by turning coolant pump.
- Scale value: 12 ... 13 (tester VW 210).

- Check if crankshaft is still at No. 1 cylinder TDC and correct if necessary.
- Tighten camshaft gear securing screw to **45 Nm** and remove setting bar.
- Fit belts for generator and exhauster and tension (thumb test 10 – 15 mm deflection).
- Install fan cowl, fan and lower air duct.
- Install injection pump drive gear and toothed belt. Tighten drive gear securing screw until it is just possible to turn the drive gear by hand.
- Check toothed belt tension and adjust if necessary by moving the injection pump on the console and support on cylinder block to give a scale reading of 12 ... 13 (tester VW 210), see page 10 Fig. 13-507
- Check that crankshaft is still at TDC on No. 1 cylinder and correct if necessary.
- Hold injection pump drive gear with bar and tighten bolt to **100 Nm**.
- Remove pin 2064.
- Check commencement of injection – page 50.
- Install toothed belt guards and cylinder head cover.

REMOVING AND INSTALLING INJECTION PUMP TOOTHED BELT

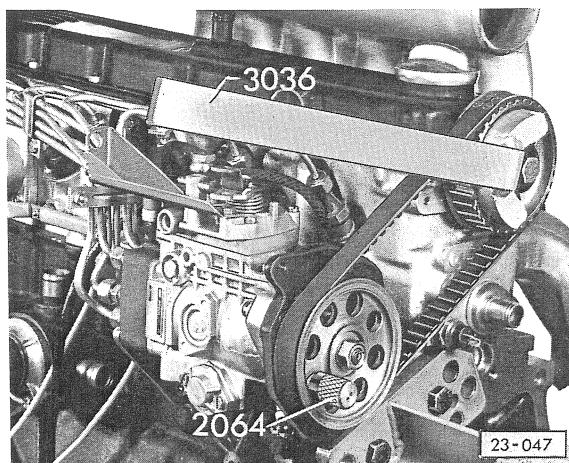
Removing

- Remove guard for injection pump drive belt.
- Detach expansion tank and place on one side complete with hoses.
- Remove air cleaner.



- Set crankshaft to TDC on No. 1 cylinder: Marks on flywheel/clutch housing – white arrow – and injection pump gear/console – black arrow – must be aligned.

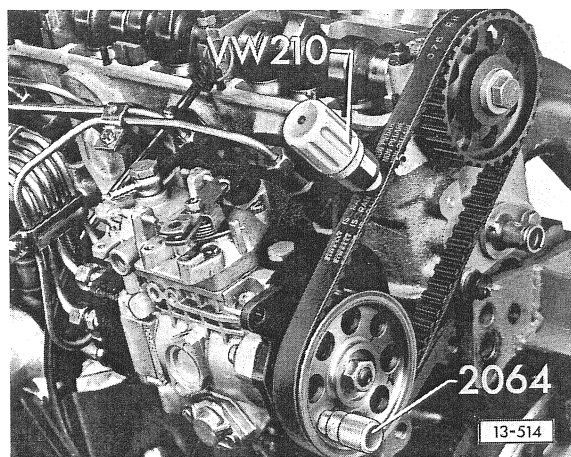
13 Crankshaft Group



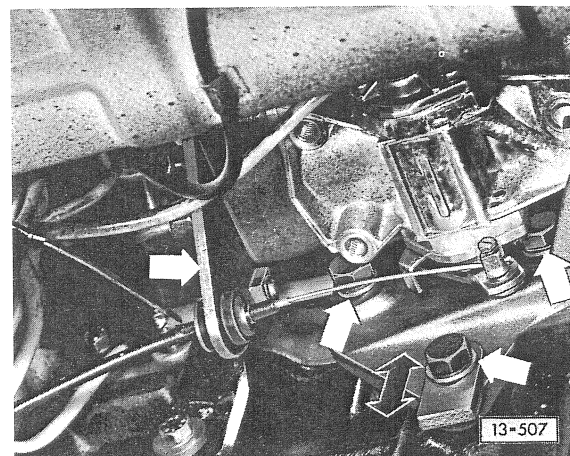
- Fix injection pump gear in position with pin 2064.
- Hold injection pump drive gear with bar, remove securing screw and take off drive gear with toothed belt.

Installing

- Install toothed belt and injection pump drive gear, and tighten securing screw for drive gear until drive gear can just be turned by hand.



- Check toothed belt tension
Scale value on tester : 12 ... 13 (VW 210).

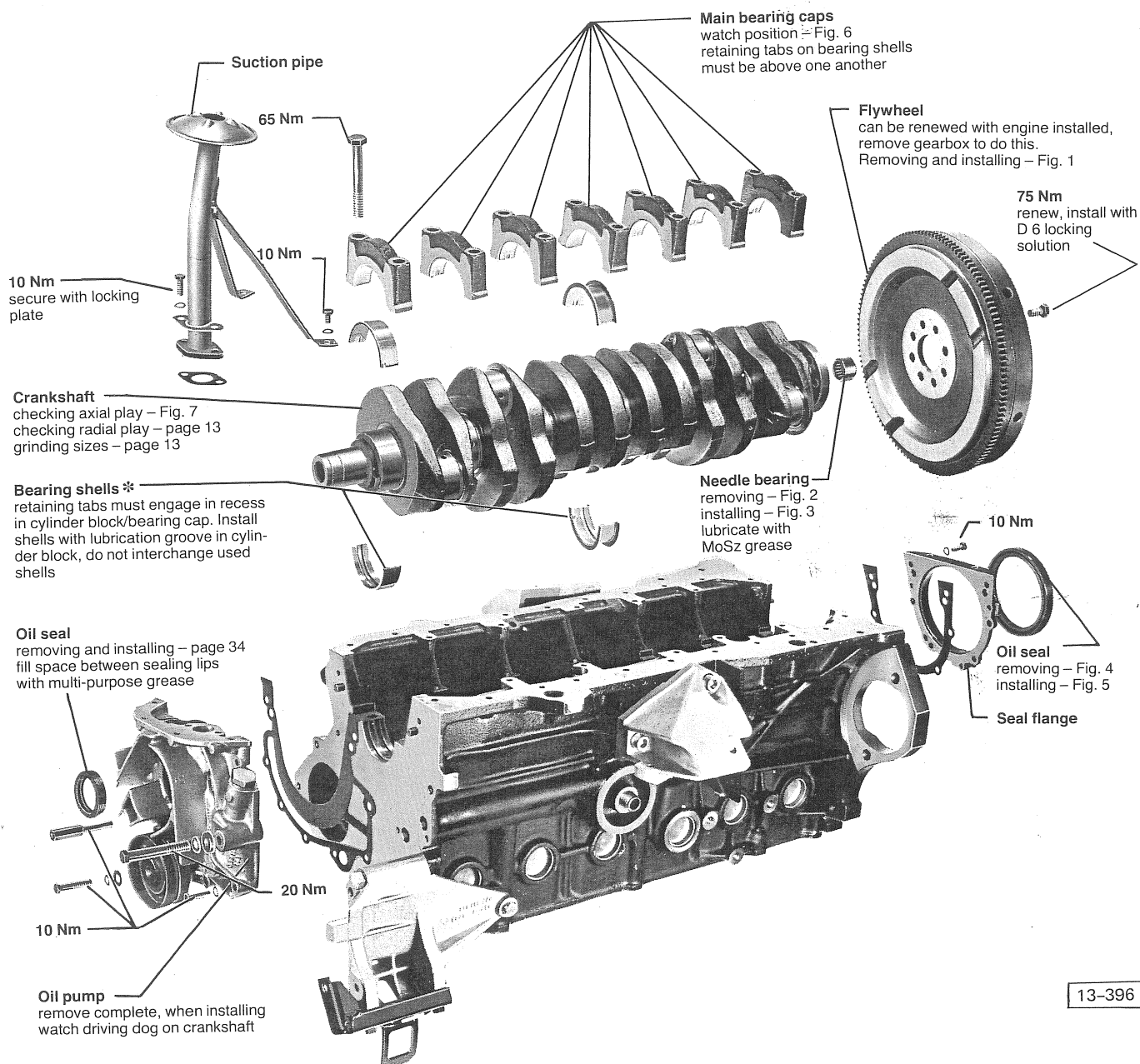


- If necessary adjust tension of toothed belt by loosening securing screws – white arrow – and moving console with pump – black arrow – to give correct reading.
- Check if TDC mark on flywheel is aligned with reference mark and adjust if necessary.
- Hold injection pump drive gear with bar and tighten securing screw to **100 Nm**.
- Take setting pin out of injection pump gear.
- Check commencement of injection again – page 50.
- Fit toothed belt guard.

DISMANTLING AND ASSEMBLING CYLINDER BLOCK, CRANKSHAFT, FLYWHEEL

Note:

Do not interchange flywheels for 5 and 6 cylinder engines.
 5 cyl. engine: No identification mark
 6 cyl. engine: X stamped on approx. 50 mm from TDC mark.



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* From 6.81 thrust washers are fitted at No. 4 bearing.
 Service bearing shells still have shoulder.

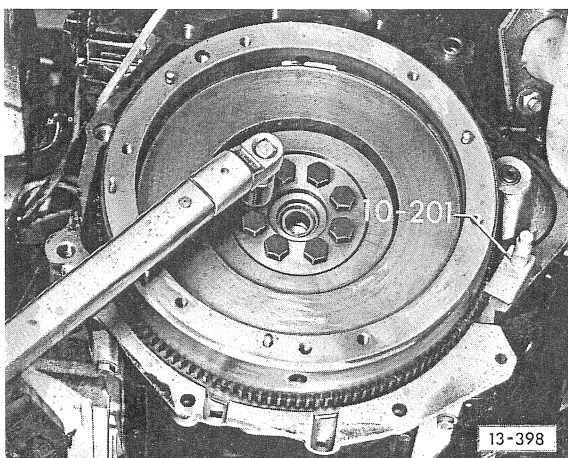


Fig. 1 Removing and installing flywheel
Change holder over when installing

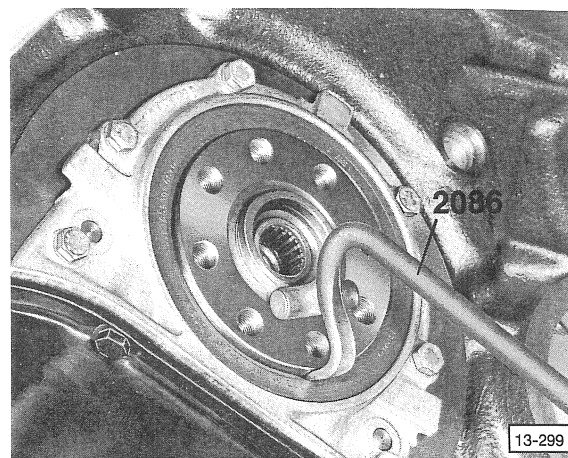


Fig. 4 Removing oil seal, flywheel end

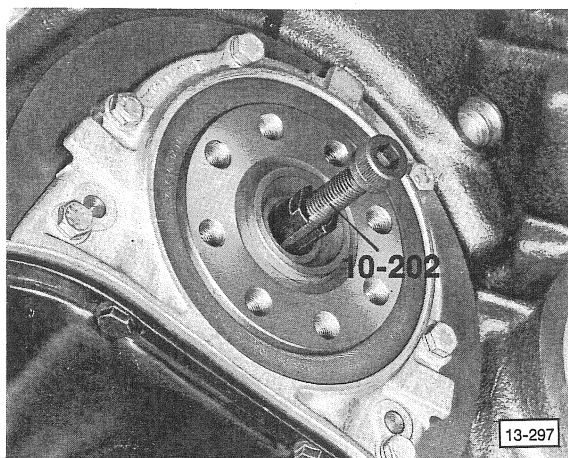


Fig. 2 Removing needle bearing

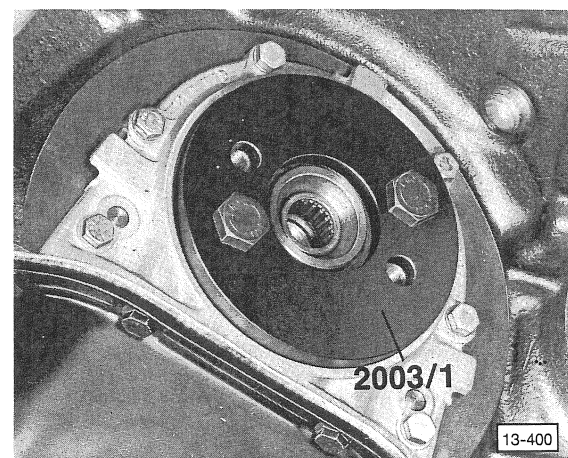


Fig. 5 Installing oil seal, flywheel end

- Lightly oil sealing lips and outer edge of oil seal before installing.

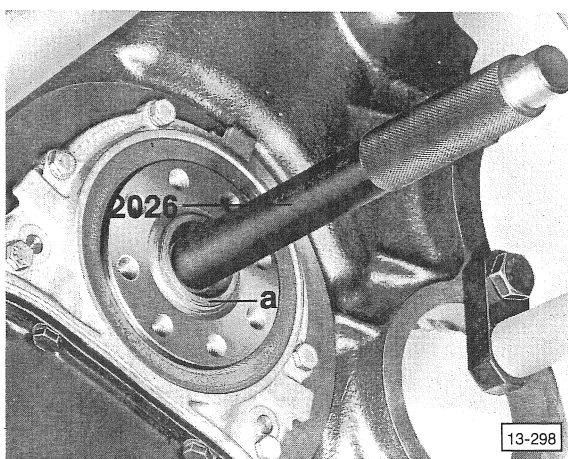


Fig. 3 Installing needle bearing

- The lettered side of bearing must be visible when installed.
- Installing depth (from edge – a – to needle bearing) 5.5 mm.

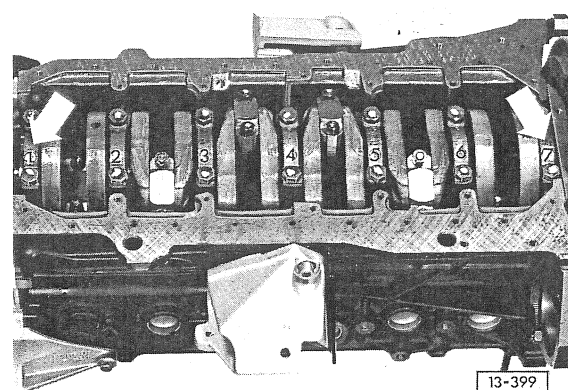


Fig. 6 Location of main bearing caps

- Bearing – 1 – pulley end.
- Bearing – 7 – flywheel end.

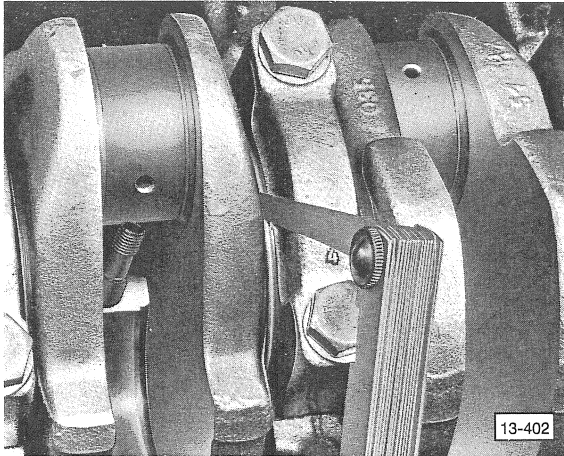


Fig. 7 Checking crankshaft end float

- End float is measured at bearing 4
- End float when new 0.07–0.18 mm
- Wear limit 0.25 mm

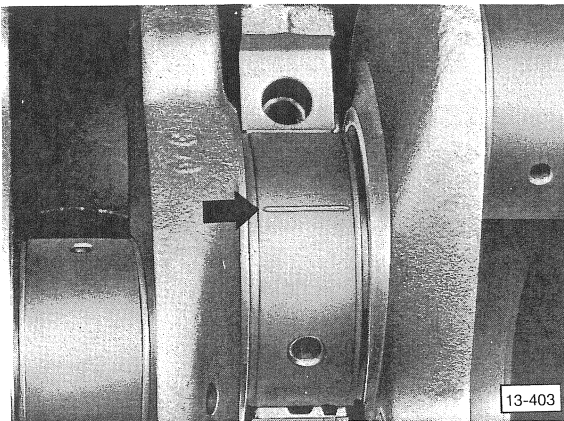
CHECKING CRANKSHAFT RADIAL PLAY (with Plastigage)

Note:

The radial play can be measured with engine in situ using Plastigage.

Measuring range	Colour	Type
0.025-0.076 mm	green	PG-1
0.050-0.150 mm	red	PR-1
0.100-0.230 mm	blue	PB-1

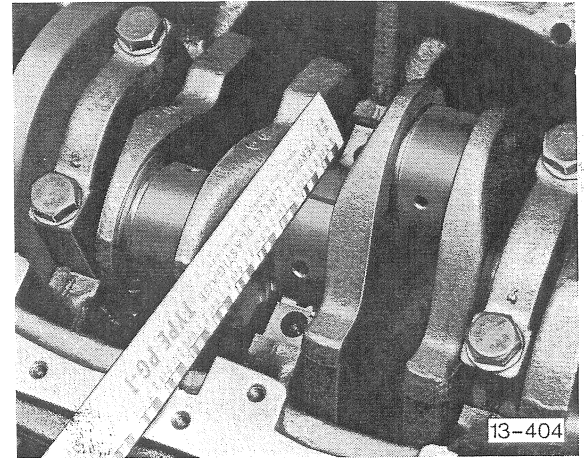
- Remove crankshaft bearing caps.
- Clean bearing shells and crankshaft journal.



- place strip of Plastigage on journal or in cap in an axial direction.
- Fit crankshaft bearing cap with shell and tighten to

65 Nm

Caution!
Do not rotate crankshaft.



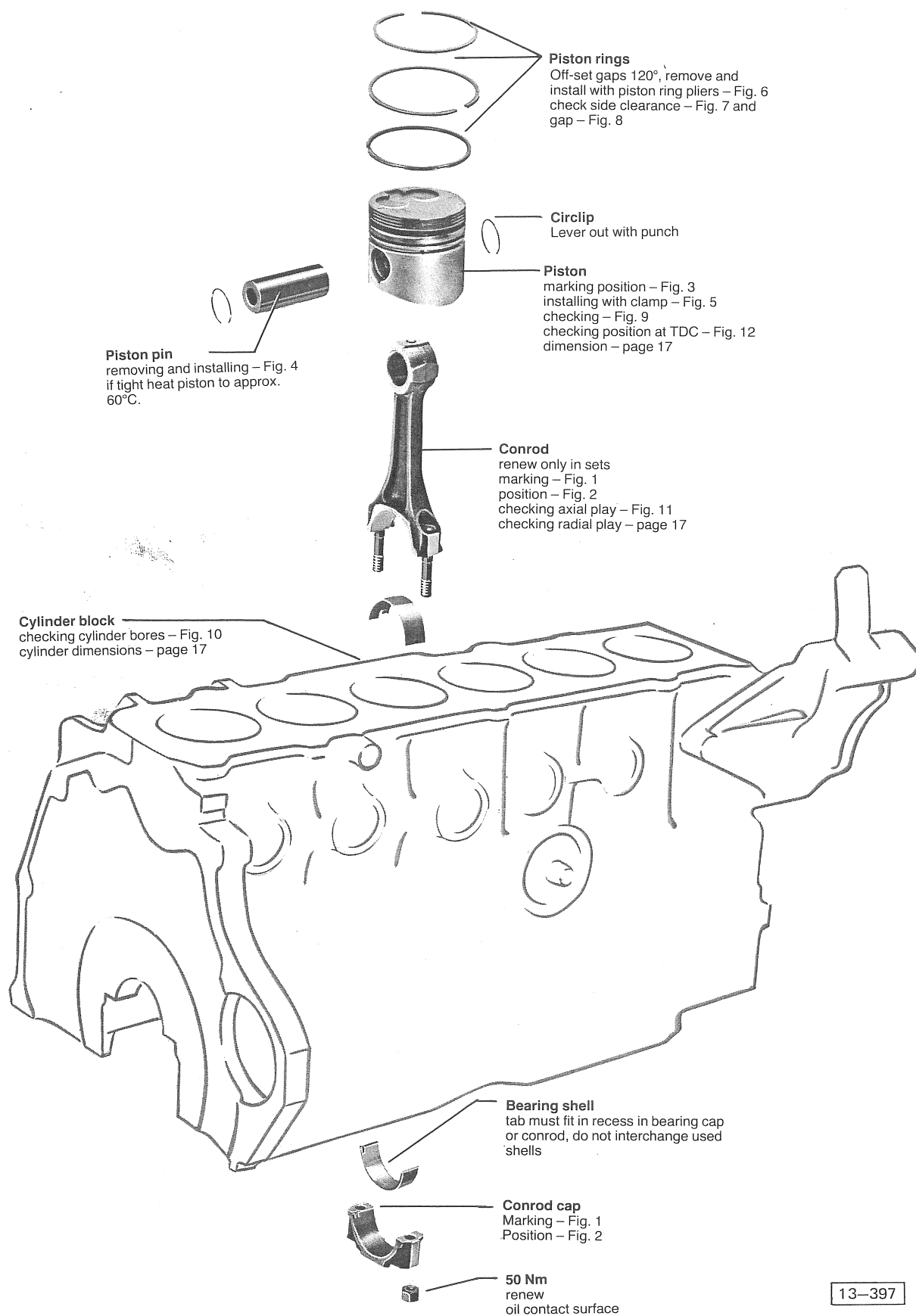
- Remove bearing cap.
 - Compare width of strip with measuring scale
- | | |
|------------|----------------|
| New | 0.016–0.075 mm |
| Wear limit | 0.15 mm |

Crankshaft grinding dimensions (in mm)

	Crankshaft journals		Crank pins	
Original size	58.00	–0.022	47.80	–0.022
		–0.042		–0.042
1st undersize	57.75	–0.022	47.55	–0.022
		–0.042		–0.042
2nd undersize	57.50	–0.022	47.30	–0.022
		–0.042		–0.042
3rd undersize	57.25	–0.022	47.05	–0.022
		–0.042		–0.042

13 Crankshaft Group

REMOVING AND INSTALLING PISTONS AND CONRODS



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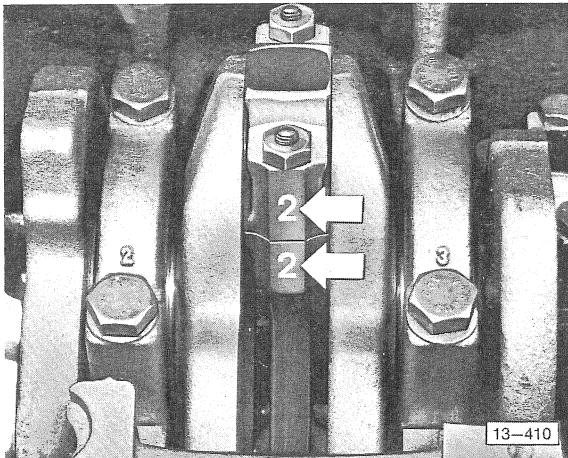


Fig. 1 Mark connecting rod and cap with cylinder No.

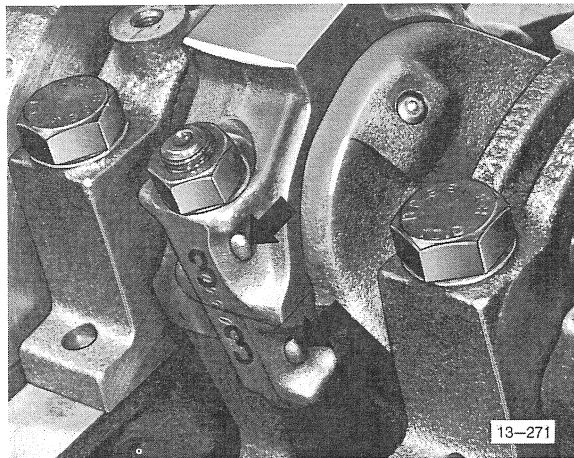


Fig. 2 Fitting position for conrods

Cast spots must face towards belt pulley and be above one another.

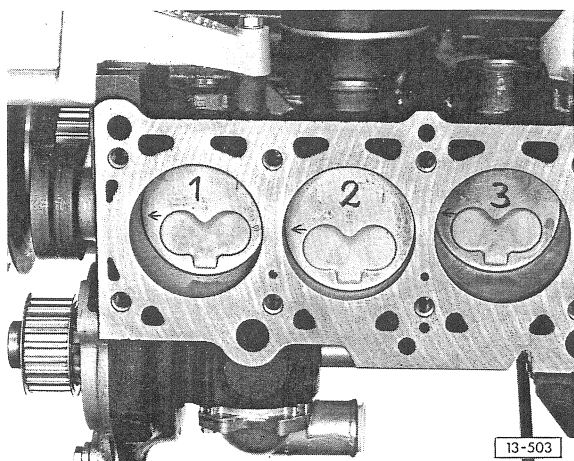


Fig. 3 Marking pistons

Arrow points towards belt pulley. Mark cylinder No. on piston.

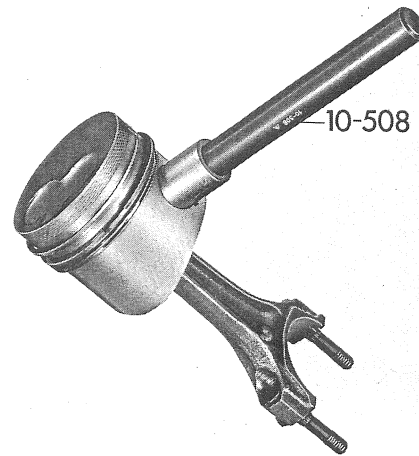


Fig. 4 Removing and install piston pins

If pin is tight, heat piston to approx. 60°C.

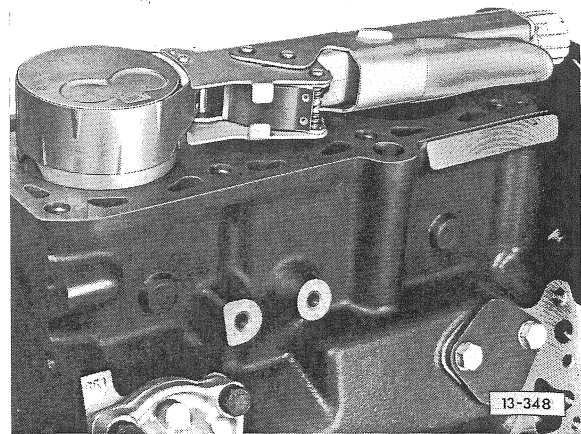


Fig. 5 Installing pistons



Fig. 6 Removing and installing piston rings

Watch "top" marks

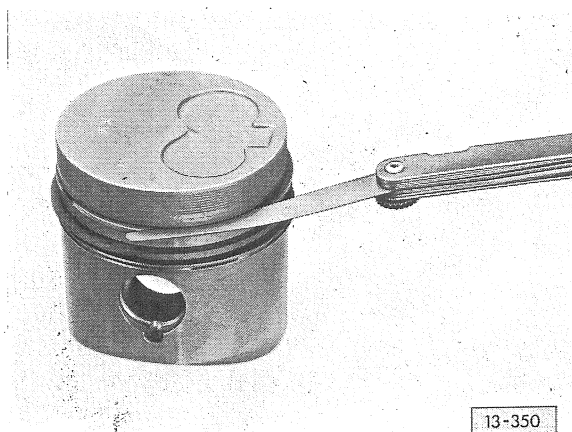


Fig. 7 Checking side clearance

	Clearance (mm)	Wear limit (mm)
Upper ring	0.06–0.09	0.2
Lower ring	0.05–0.08	0.2
Oil scraper ring	0.03–0.06	0.15

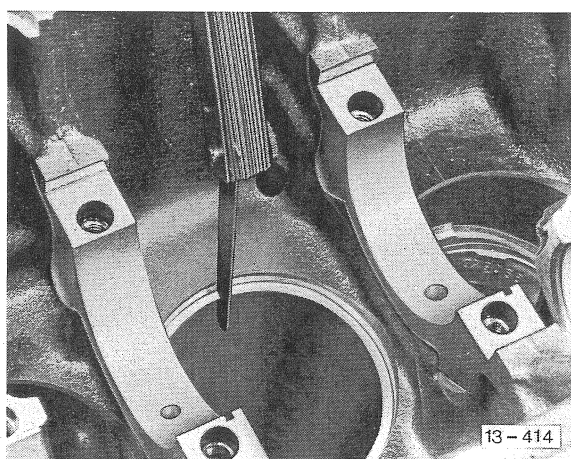


Fig. 8 Checking gap

Push ring down squarely into cylinder until it is about 15 mm from lower edge.

	Gap (mm)	Wear limit (mm)
Upper ring	0.3–0.5	1.0
Lower ring	0.3–0.5	1.0
Oil scraper ring	0.25–0.40	1.0

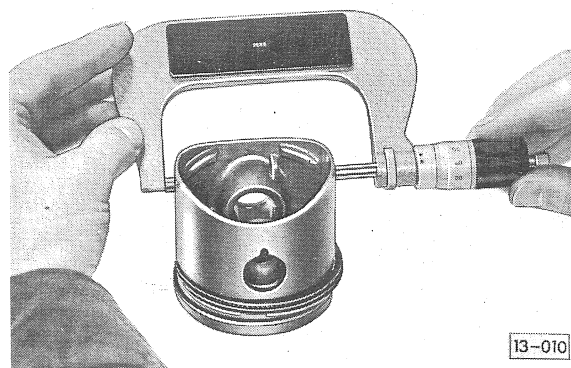


Fig. 9 Measure piston about 15 mm from bottom of skirt at 90° to piston pin axis.

Maximum deviation: 0.04 mm (see table).

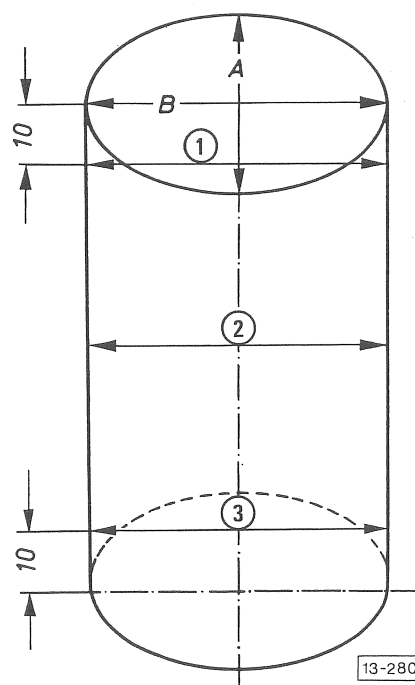


Fig. 10 Measure cylinder bores in two directions "A" and "B" and at three points

Maximum deviation: 0.08 mm (see table).

Note:

Use inside measuring instrument 50–100 mm. Do not measure when block is mounted in repair stand with adapter VW 540 as measurements may be incorrect due to distortion.

PISTON AND CYLINDER DIMENSIONS

	Mark (Honing Group)	Piston Dia. mm	Bore mm
Basic	651	76.48	76.51
	652	76.49	76.52
	653	76.50	76.53
1st oversize	676	76.73	76.76
	677	76.74	76.77
	678	76.75	76.78
2nd oversize	701	76.98	77.01
	702	76.99	77.02
	703	77.00	77.03
3rd oversize	751	77.48	77.51
	752	77.49	77.52
	753	77.50	77.53

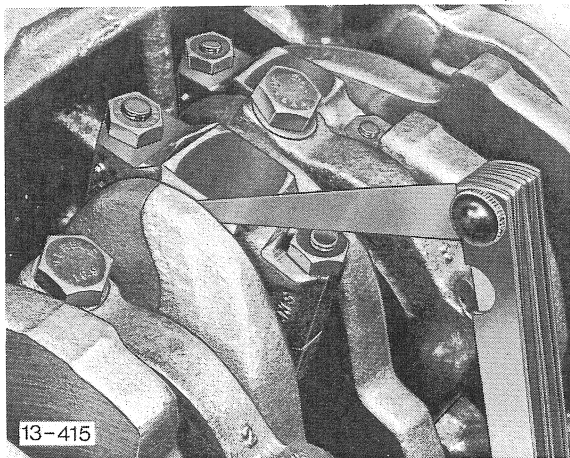


Fig. 11 Checking conrod axial clearance

Wear limit: 0,4 mm

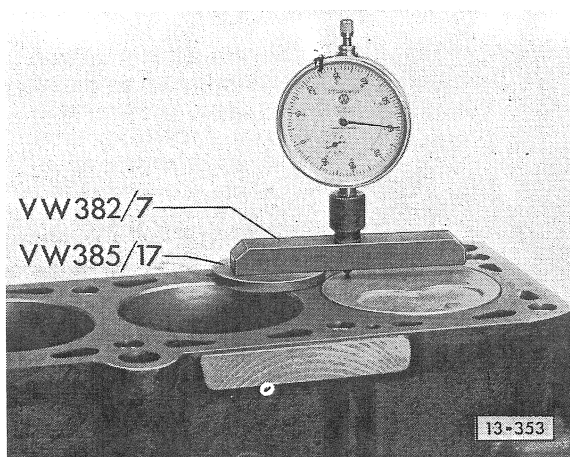


Fig. 12 Checking piston at TDC

The piston projection must be measured when fitting new pistons or short engines. The head gasket is then selected according to the measurement.

Piston projection	Identification Notches
0,67–0,80	1
0,81–0,90	2
0,91–1,02	3

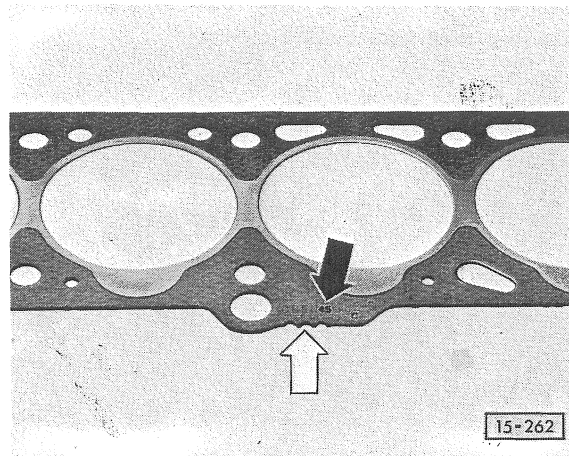


Fig. 13 Cylinder head gasket – Identification

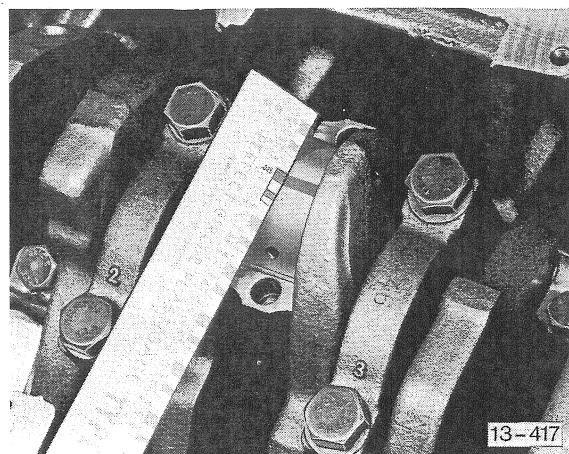
Part No. – black arrow (see Parts list)
Notches – white arrow

MEASURING CONROD RADIAL CLEARANCE

- Take conrod caps off.
- Clean bearing shell and crankpin.
- Place “Plastigage” on crankpin in axial direction.
- Fit cap and tighten to 45 Nm

Note

Do not turn crankshaft.



- Compare width of strip with measuring scale. The figure on the scale gives the bearing clearance.

New	0.015–0.062 mm
Wear limit	0.12 mm

Dismantling and assembling pistons and conrods

Piston and cylinder dimensions
Checking conrod axial and radial clearance
Checking piston at TDC

15 Cylinder head, valve gear

REMOVING AND INSTALLING CYLINDER HEAD

Note:

The head can be removed and installed with engine in situ.

Removing and installing toothed belts for camshaft and injection pump drive – page 6.

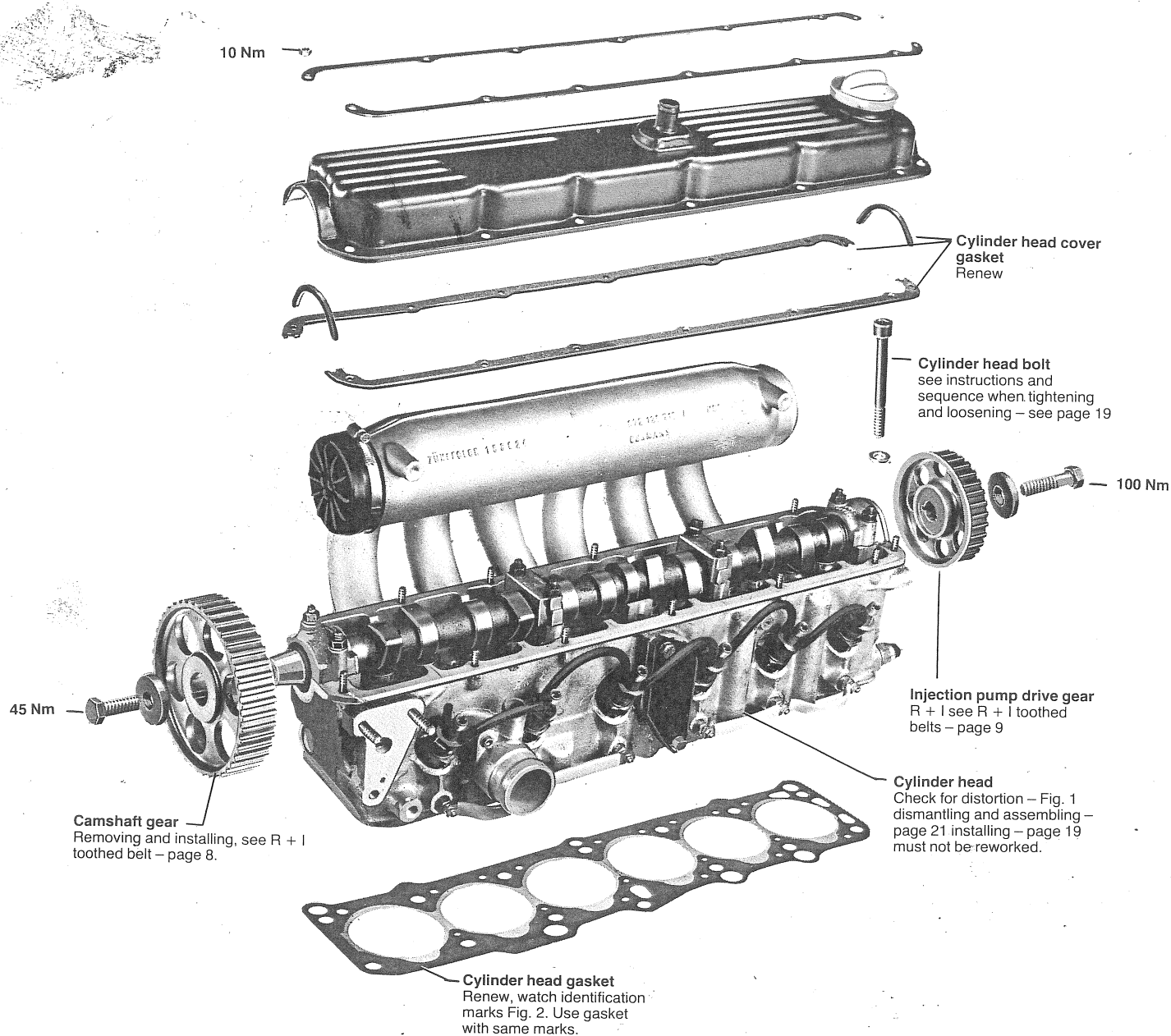
The valve clearance does not need adjusting when an exchange head with camshaft has been fitted.

The contact surfaces between valve adjusting disc and cam must be oiled when head has been installed.

The plastic valve protection caps must not be removed until immediately before head is put on.

Checking compression pressures: page 21

Specified	34.0 bar
Wear limit	28.0 bar
max. permissible pressure difference	5.0 bar



15-401

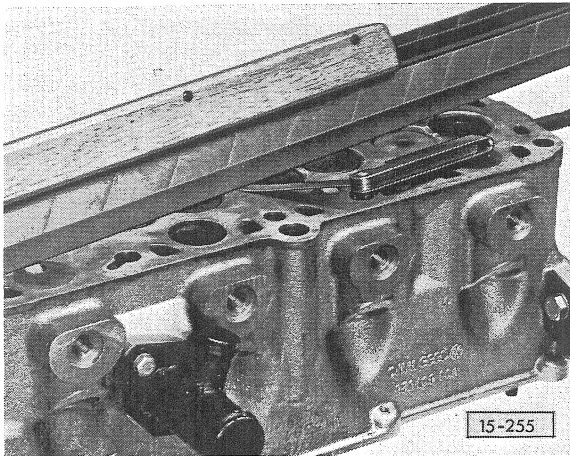


Fig. 1 Checking head for distortion

max. 0.2 mm

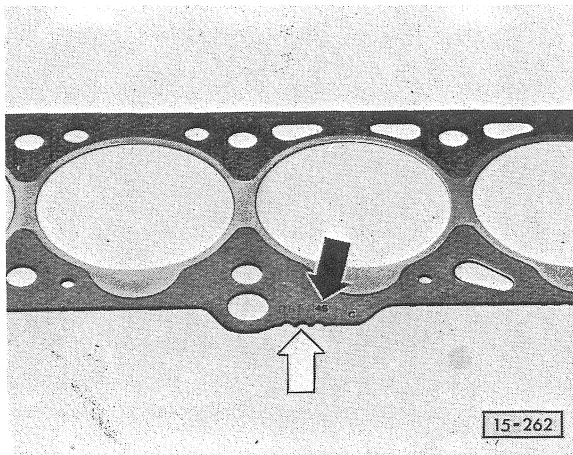


Fig. 2 Cylinder head gasket marks

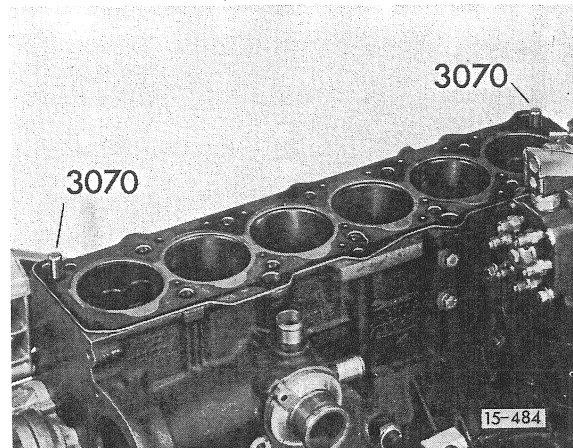
Part No. = black arrow (see Parts list)
Notches = white arrow

According to the amount the piston projects above the top surface of block, there are three gaskets of different thicknesses.
When removing the gasket, check the identification marks and install gasket with the same marks.

Installing cylinder head

Note:

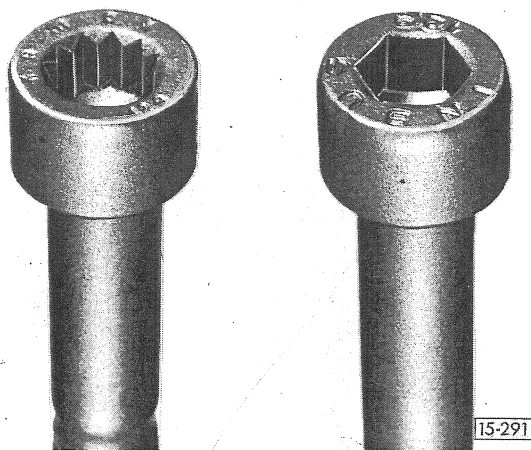
Before installing head, turn crankshaft to TDC on No. 1 cylinder.
Then turn crankshaft back 1/4 turn and install head.
Fix camshaft with setting bar 2065 A.
Install toothed belt – see page 8.



- To locate head, insert guide pins from 3070 in outer holes on intake manifold side
- Remove glow plug from cylinder No. 6
- Install head, insert remaining 12 bolts and tighten by hand.
- Remove guide pins with tool from 3070 and tighten all bolts as follows.

15 Cylinder head, valve gear

Tightening cylinder head bolts



– Bolt identification

New:

12 point socket head

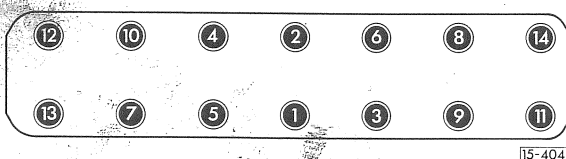
Old:

Hexagon socket head

Caution

Note different methods of tightening.

Hexagon socket head M 11



15-404

– Tightening sequence – reverse when loosening.

– Tighten all bolts in 3 stages (engine cold):

Stage 1 = 50 Nm
Stage 2 = 70 Nm
Stage 3 = 90 Nm

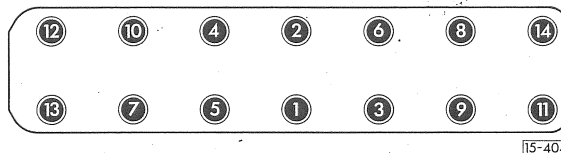
– Then run engine until warm (oil temperature above 50°C) and tighten bolts in correct sequence to 90 Nm without loosening first.

– About 1000 km after engine repair the bolts must be tightened again. This is done by loosening each bolt individually 30° in the tightening sequence and then tightening straightaway to 90 Nm (engine warm or cold).

12 point socket head M 12

Note

M 12 12 point socket head bolts must always be renewed.



15-404

– Tightening sequence – reverse when loosening.

– Tighten all bolts in 3 stages (engine cold).

Stage 1 = 40 Nm
Stage 2 = 60 Nm
Stage 3 = 75 Nm

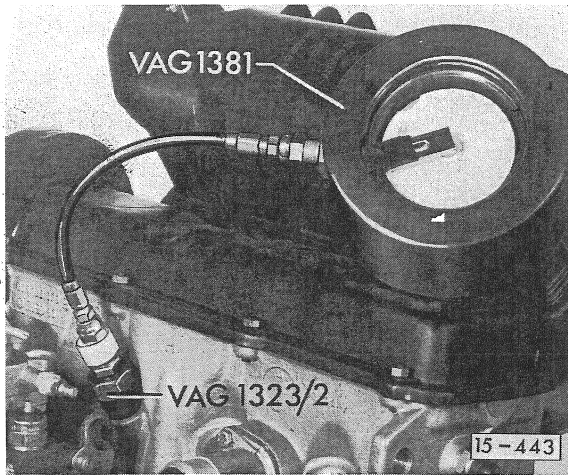
– Then tighten all bolts 1/2 (180°) turn further with a normal spanner. (2 x 90° turns are permissible).

– Run engine until warm (oil temperature above 50°C) and tighten bolts 1/4 turn (90°) further with a normal spanner in **one movement and without loosening them first** (watch sequence).

– About 1000 km after engine repair the bolts must be tightened again. This is done by tightening the bolts 1/4 turn (90°) further with a normal spanner **in one movement and without loosening them first** (watch sequence, engine cold or warm).

CHECKING COMPRESSION

- Min. engine oil temperature 30°C.
- Disconnect wire from stop control and insulate it.
- Remove injector pipes with slotted ring spanner
 - 3035.
- Take all injectors and heat shields out.



- Screw in adapter VW 1323/2 in place of injectors. Place old heat shield between adapter and head.
- Screw tester V.A.G 1381 into adapter by hand.

Note:

See instructions on use of tester.

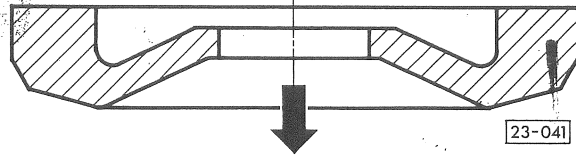
- Operate starter until tester shows no further pressure increase.

Compression pressure for V.A.G 1381 and VW 1323

New = 34 bar
 Wear limit = 28 bar
 Permissible difference between individual cylinders – 5 bar.

Note

Always fit new heat shields between cylinder head and injectors.



- Fitting position for heat shield:
 Arrow points to cylinder head.
- Tightening torques:

Injector pipes	= 25 Nm
Injectors	= 70 Nm

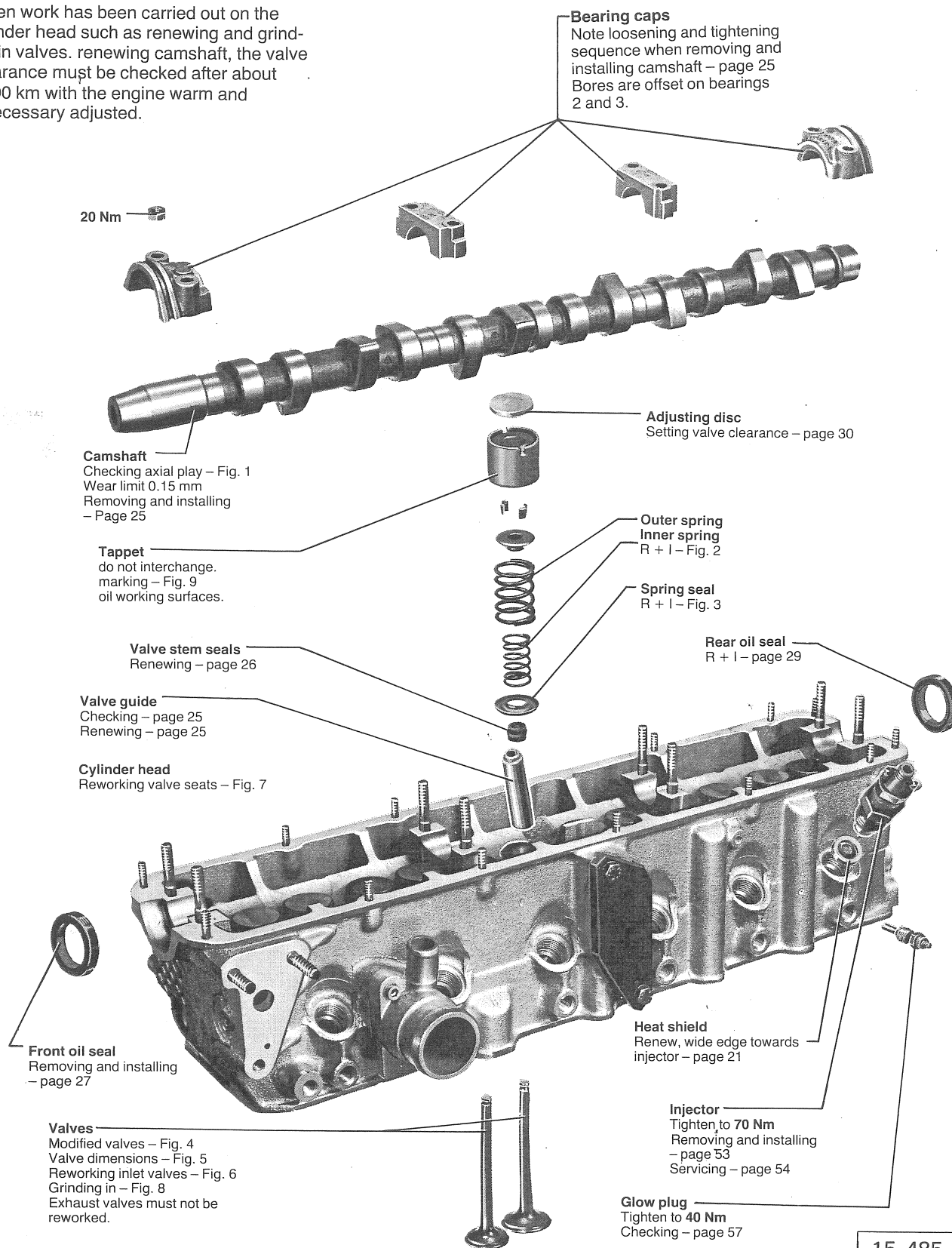
15 Cylinder head, valve gear

REPAIRING VALVE GEAR

Note:

Cylinder heads with cracks between the valve seats can be used without reducing engine life as long as the cracks are small and not over 0.5 mm wide.

When work has been carried out on the cylinder head such as renewing and grinding in valves, renewing camshaft, the valve clearance must be checked after about 1000 km with the engine warm and if necessary adjusted.



15-485

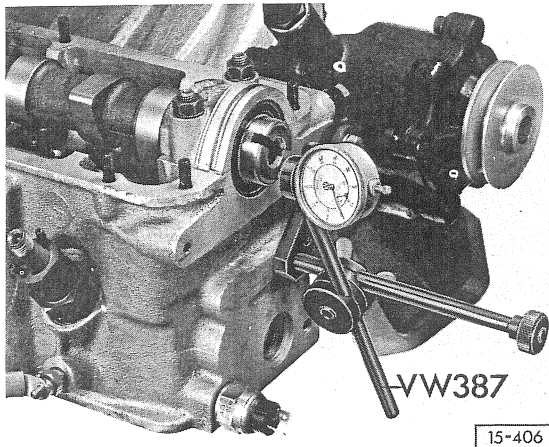


Fig. 1 Checking camshaft axial play

Wear limit 0.15 mm

Note:

Remove tappets beforehand, camshaft must be free of strain.

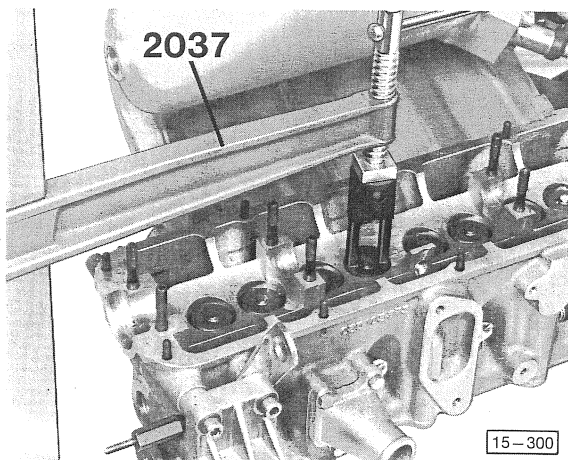


Fig. 2 Removing and installing valve springs

Loosen tight cotters by tapping lightly on the spindle of the fitting appliance.

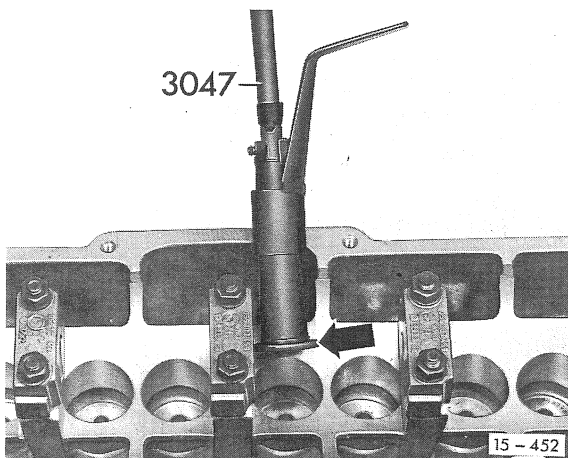


Fig. 3 Removing and installing spring seats

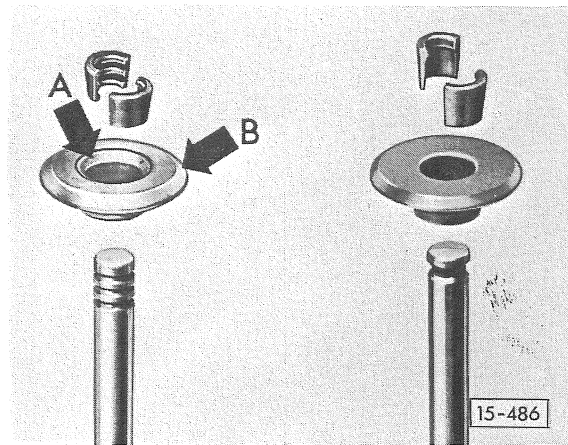


Fig. 4 Modified inlet and exhaust valves

Differences

- Valve with 3 grooves on stem (previously 1 groove)
- Cotter with 3 ridges (previously 1 ridge)
- Spring seat
 - Copper plated or yellow chromated (previously steel grey)
 - with approx. 1.5 mm chamfer – arrow A – (previously no chamfer) on inside and wider chamfer – arrow B – outside.

1 and 3 groove valves can be mixed when carrying out repairs but ensure that the correct cotters and spring seats are used.

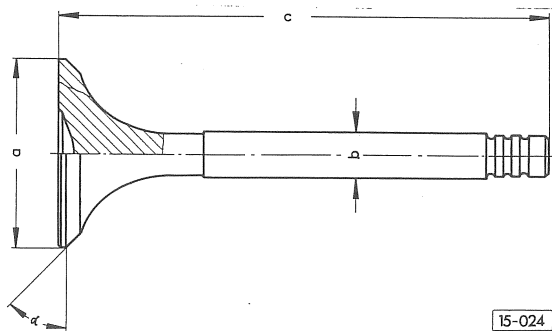


Fig. 5 Valve dimensions

Inlet valve

a = 36.00 mm dia.
b = 7.97 mm dia.
c = 104.8 mm
 $\alpha = 45^\circ$

Exhaust valve

31.00 mm dia.
7.95 mm dia.
104.6 mm
 45°

15 Cylinder head, valve gear

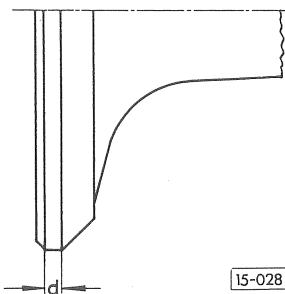


Fig. 6 Reworking inlet valves

Dimension d must not be less than 0.5 mm.

Caution!

Do not rework exhaust valves.
Grind them in only.

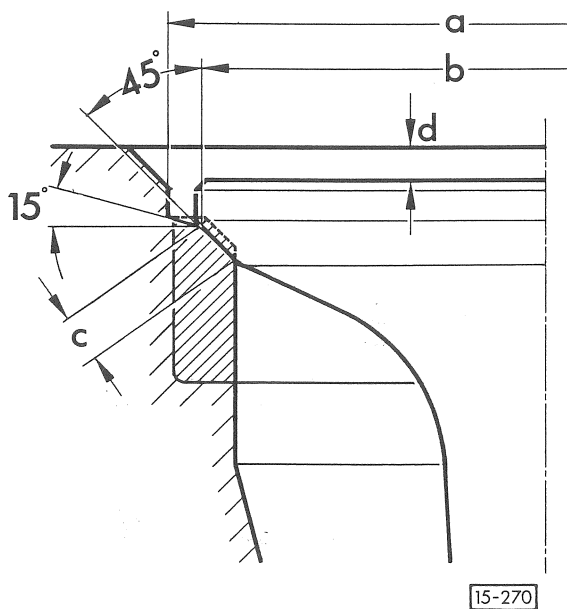


Fig. 7 Reworking valve seats

Exhaust valve

a = 33.2 mm dia. max.¹⁾

b = 30.4 mm dia.

c = 2.20 mm

d = 1.5 mm max.

45° = valve seat angle

15° = correction angle

Inlet valve

35.2 mm dia. max.¹⁾

32.8 mm dia.

2.00 mm

1.5 mm max.

When reworking valves and seats, ensure that dimension "d" is not more than 1.5 mm

¹⁾ Outside diameter of correction cutter.

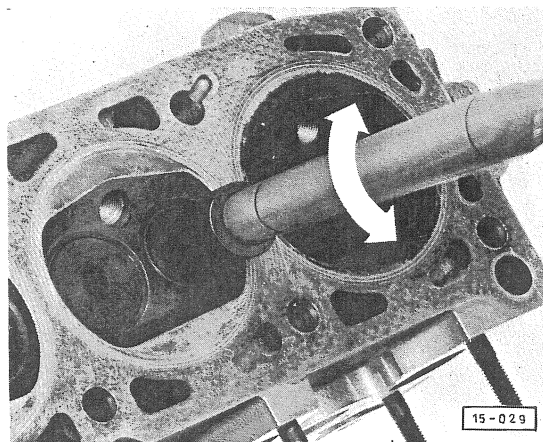


Fig. 8 Grinding valves in

Lift and turn regularly to get a smooth finish.

Note!

After grinding valves in, carefully remove all traces of grinding paste.

When fitting new valves into properly reworked seats it may not be necessary to grind the valves in.

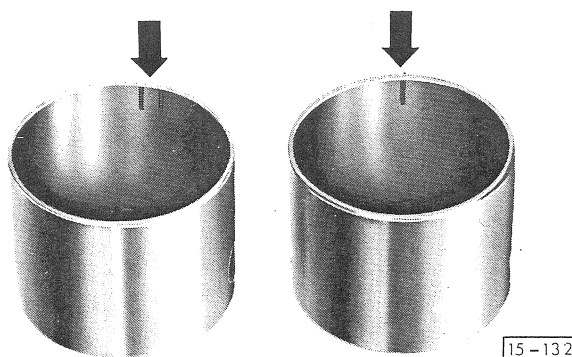


Fig. 9 Mark tappets on removal

Caution!

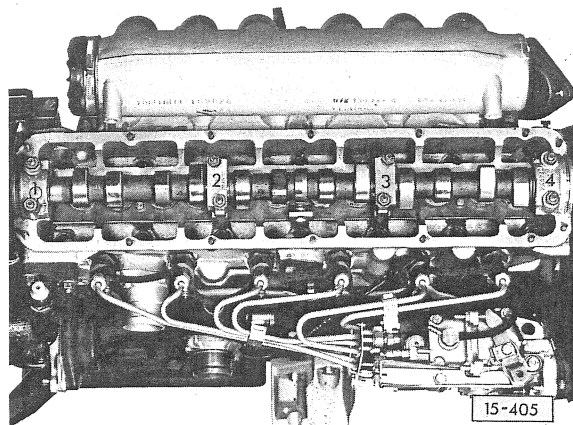
Do not interchange tappets.

Oil working surfaces before installing.

REMOVING AND INSTALLING CAMSHAFT

Removing

- When cylinder head is on engine, turn engine to cylinder No. 1
- Removing and installing toothed belts for camshaft and injection pump – page 6.



- Remove bearing caps 1 and 4 first. Loosen nuts of caps 2 and 3 alternately and diagonally.

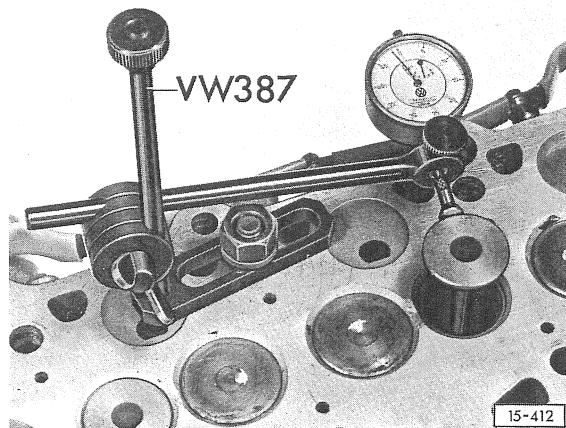
Installing:

- Cams for cylinder No. 1 must be pointing upwards uniformly. Oil working surfaces.
- Install bearing caps 2 and 3, watching offset and tighten alternately and diagonally.
- Install bearing caps 1 and 4.

CHECKING VALVE GUIDES

When repairing engines with leaking valves it is not sufficient to rework or renew valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important on engines which have done a considerable mileage.

- Remove carbon deposits with a suitable tool
- Insert new valve in guide so that end of stem is flush with end of guide.
As the stem diameters of the valves differ slightly ensure that an inlet valve is used in an inlet guide and an exhaust valve in an exhaust guide.

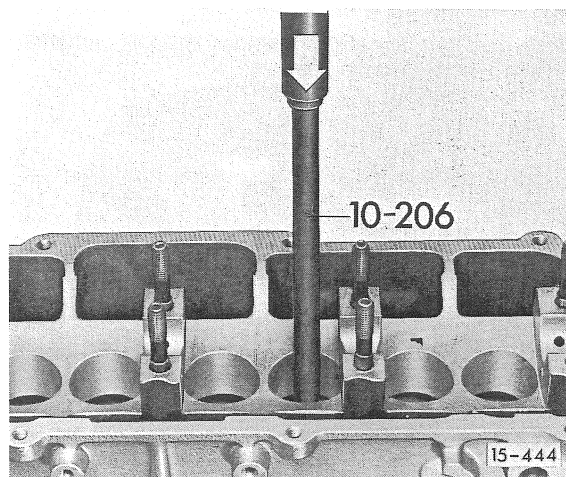


- Measure rock.

Wear limit: Inlet valve guide = 1.3 mm
Exhaust valve guide = 1.3 mm

RENEWING VALVE GUIDES

- Clean and examine head. Guides should not be renewed in heads in which the valve seats can no longer be reworked.

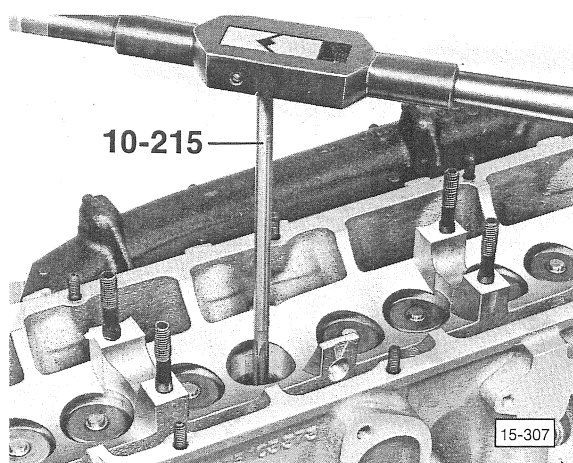


- Press worn guides out from camshaft side.
- Coat new guides with oil and press into cold head from the camshaft side.

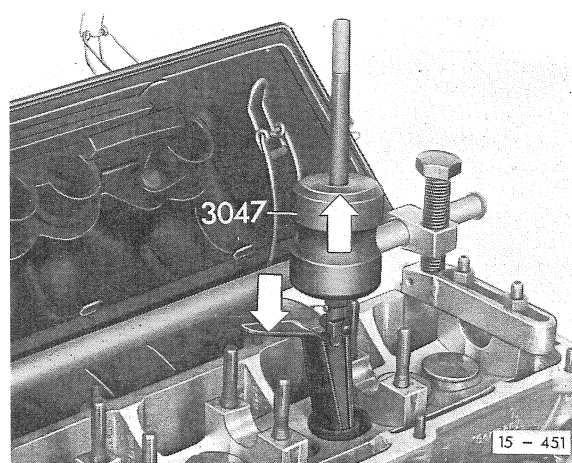
Caution

When shoulder has made contact, do not increase pressure to over 1 ton as otherwise the shoulder may be broken off.

15 Cylinder head, valve gear



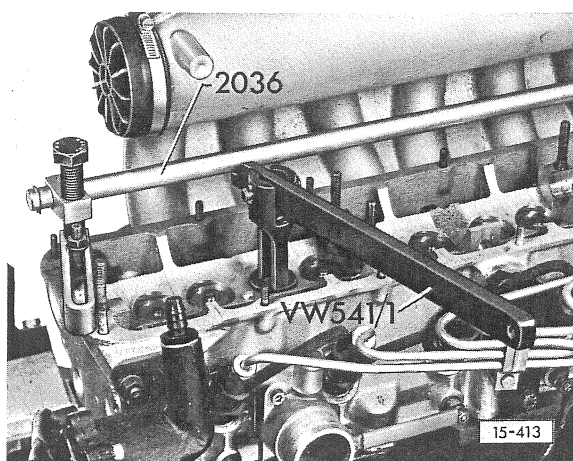
- Ream guides out with hand reamer using plenty of cutting coolant.
- Rework the valve seats.



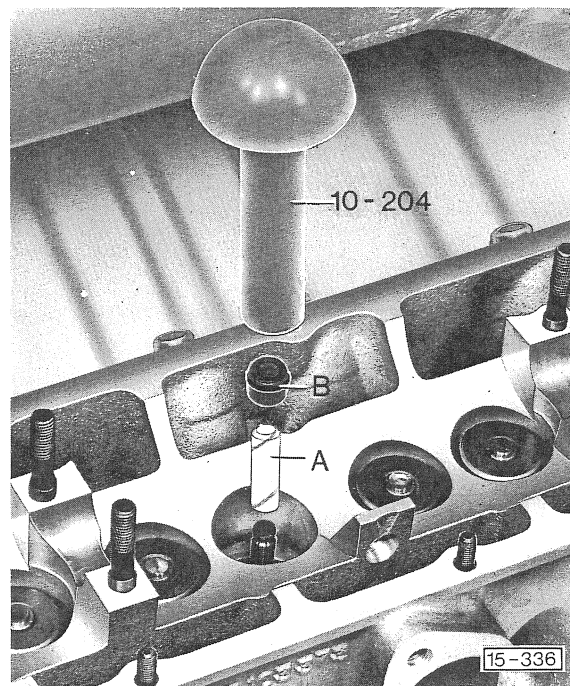
- Pulling valve stem seals off.

RENEWING VALVE STEM SEALS (With head on)

- Removing and installing toothed belts for camshaft and injection pump – page 6.
- Remove camshaft and tappets.
- Move piston of cylinder concerned to top dead centre.



- Remove valve springs.
The valves then rest on the piston crown.



- Installing stem seals. Install plastic sleeve –A– on valve stem, lubricate seal –B–, place it in the special tool and push it carefully onto the valve guide.

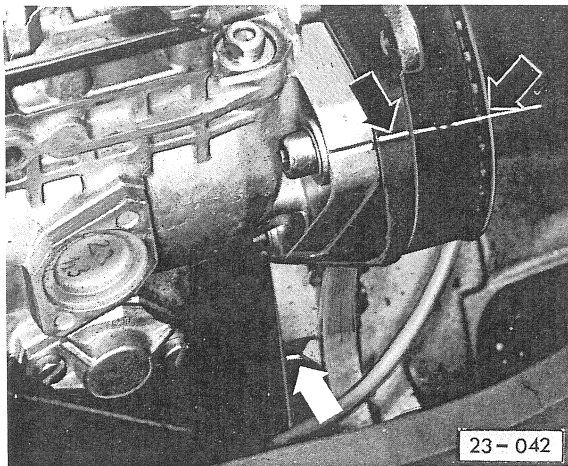
Note!

If the seals are fitted without using the plastic sleeve –A– they will be damaged.

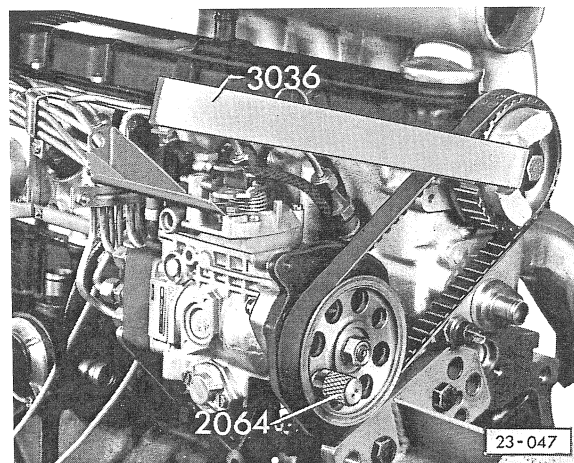
REMOVING AND INSTALLING CAMSHAFT FRONT OIL SEAL

Removing

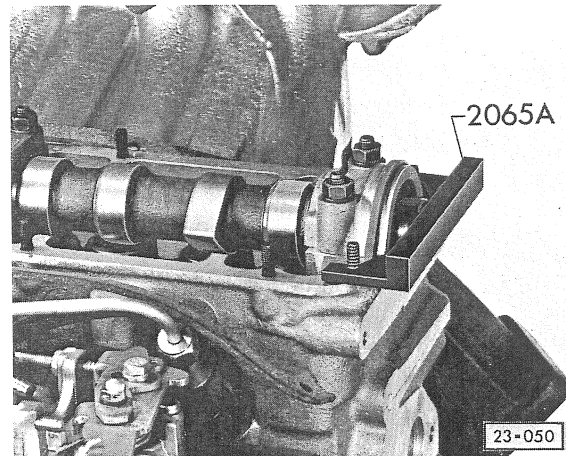
- Take off exhauster belt (loosen front pulley)
- Take off guards for both toothed belts and cylinder head cover
- Detach expansion tank and place it to one side with hoses connected.
- Remove air cleaner.



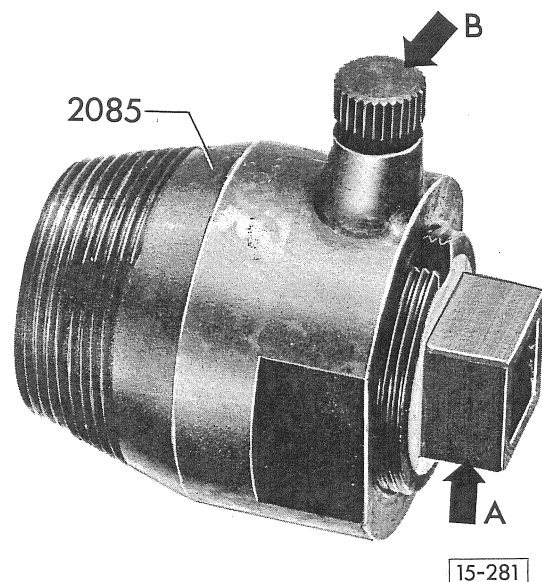
- Set crankshaft to TDC on No. 1 cylinder: marks on flywheel/clutch housing – white arrow – and injection pump/console – black arrow – must be aligned.



- Fix injection pump gear in position with pin 2064.
- Hold injection pump gear with bar, remove retaining screw and take off gear together with toothed belt.

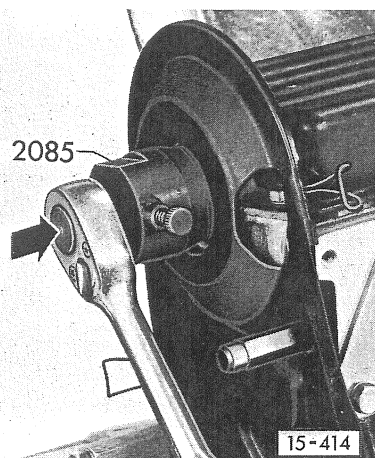


- Turn crankshaft to TDC on No. 1 cylinder again and fix camshaft in position with setting bar.
- Slacken toothed belt tension (loosen coolant pump and turn it).
- Loosen camshaft gear screw one turn.
- Loosen camshaft gear on camshaft taper by tapping with a drift through the opening in the cover plate and take gear off



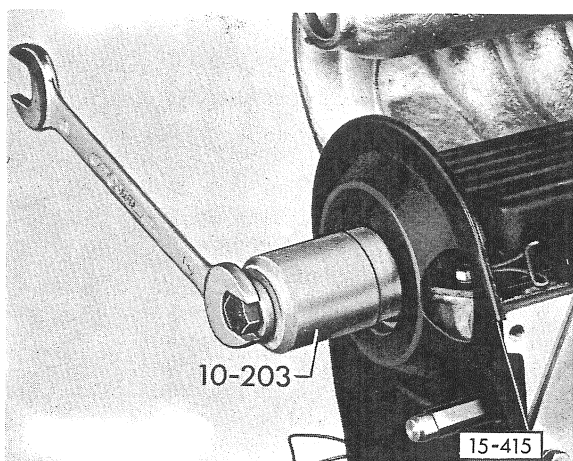
- Use oil seal extractor as follows: Screw inner part –arrow A– out of outer part about 2 turns (approx. 3 mm) and secure it with knurled screw –arrow B–.
- To guide the oil seal extractor screw camshaft gear screw in until it projects about 20 mm.

15 Cylinder head, valve gear



- Oil head of oil seal extractor and screw it firmly into oil seal.
- Loosen knurled screw and turn inner part against the camshaft until the oil seal is pulled out.
- Clamp extractor in the vice on the flats and pull oil seal off pliers.

Installing



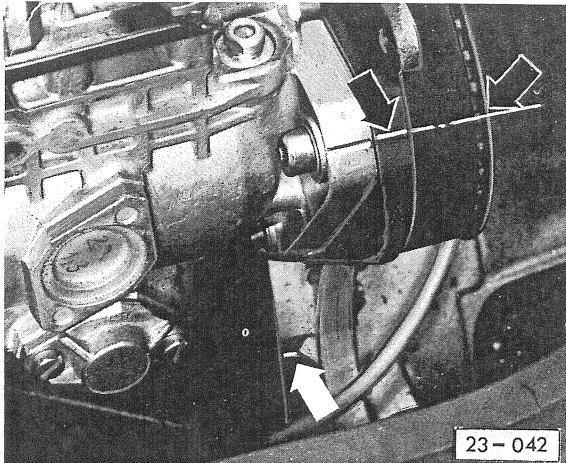
- Oil sealing lip and outer edge of oil seal lightly and press it in as far as it will go.

- Install camshaft gear together with toothed belt.
- Tension toothed belt with coolant pump to a scale value of 12 ... 13 (tester VW 210).
- Check that crankshaft is still at TDC on No. 1 cylinder and correct if necessary.
- Tighten camshaft screw to **45 Nm** and remove setting bar.
- Fit belts for generator and exhauster and tension (thumb test –10–15 mm deflection).
- Install toothed belt and injection pump drive gear. Tighten injection pump drive gear securing screw until the gear can just be turned by hand.
- Check toothed belt tension and adjust if necessary by moving the injection pump on the console and support on engine to give the required setting of scale value: 12 ... 13 (tester VW 210). See page 10 Fig. 13-507. Check if crankshaft is still at TDC on No. 1 cylinder and adjust if necessary.
- Hold injection pump gear with bar and tighten securing screw to **100 Nm**.
- Take setting pin 2064 out of injection pump gear.
- Check commencement of injection – page 50
- Install toothed belt guard and cylinder head cover.

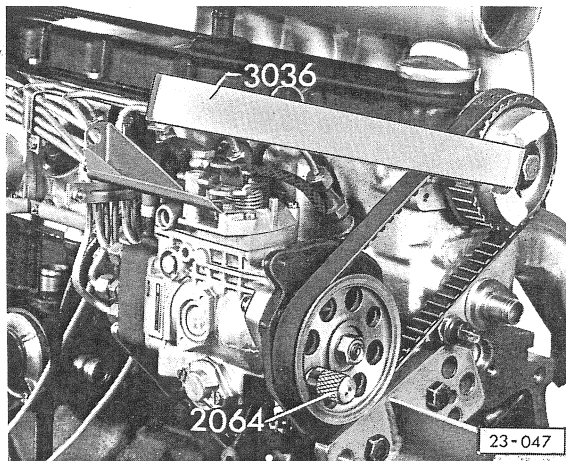
REMOVING AND INSTALLING CAMSHAFT REAR OIL SEAL

Removing

- Take off toothed belt guard for injection pump.
- Detach expansion tank and lay it on one side with hoses connected.
- Remove air cleaner,



- Set crankshaft to TDC on No. 1 cylinder:
Marks on flywheel/clutch housing – white arrow – and injection pump gear/console – black arrow – must be aligned.

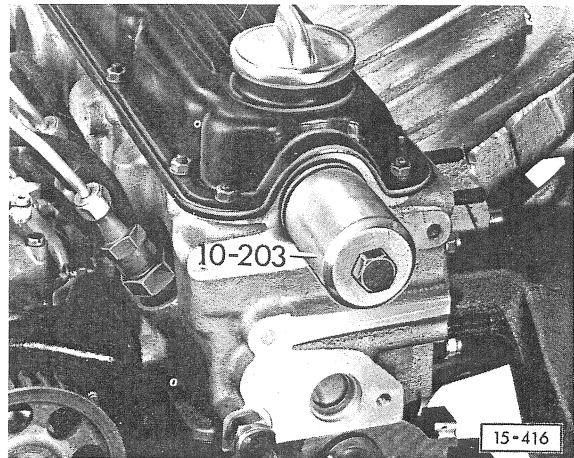


- Fix injection pump gear with pin 2064
- Hold injection pump drive gear with bar, remove retaining screw and take off gear together with toothed belt.
- Use oil seal extractor to remove oil seal as explained for front oil seal.

Note:

It is not necessary to use the screw to guide the extractor.

Installing



- Oil lip and outer edge of seal lightly and press it fully home
- Install toothed belt and injection pump drive gear. Tighten injection pump drive gear securing screw until the gear can just be turned by hand.
- Check toothed belt tension and adjust if necessary by moving the injection pump on the console and support on engine to give the required setting, see page 10 Fig. 13-507

Specified scale value: 12 ... 13 (tester VW 210).

Check if TDC mark on flywheel is aligned with reference mark and adjust if necessary.

- Hold injection pump gear with bar and tighten securing screw to **100 Nm**.
- Take setting pin out of injection pump gear.
- Check commencement of injection – page 50.
- Install toothed belt guard.

15 Cylinder head, valve gear

Checking and adjusting valves

The valve clearance should be checked and adjusted with engine warm (coolant above 35°C – head warm)

Clearance warm:

Inlet 0.20–0.30 mm
Exhaust 0.40–0.50 mm

When the cylinder head has been repaired, the valves can be set with the engine cold.

Clearance cold:

Inlet 0.15–0.25 mm
Exhaust 0.35–0.45 mm

Note

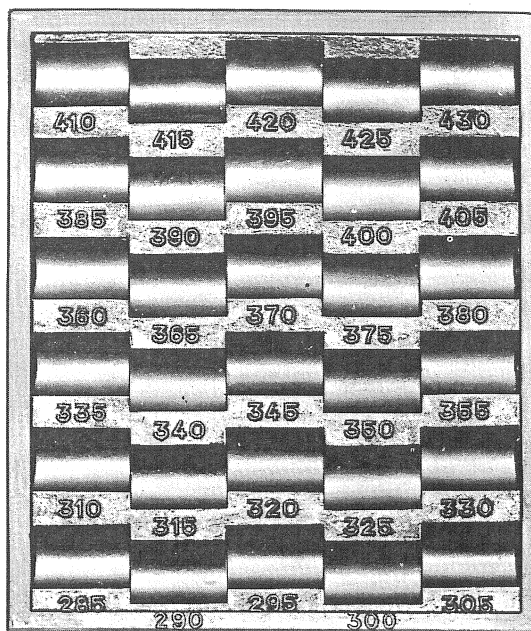
When repairs have been carried out on the head such as renewing and grinding in valves, renewing camshaft, the valve clearance must be checked and adjusted after 1000 km with engine warm.

The following adjusting discs are available:

Thickness	Part No.	Thickness	Part No.
3.00	056 109 555	3.65	056 109 568
3.05	056 109 556	3.70	056 109 569
3.10	056 109 557	3.75	056 109 570
3.15	056 109 558	3.80	056 109 571
3.20	056 109 559	3.85	056 109 572
3.25	056 109 560	3.90	056 109 573
3.30	056 109 561	3.95	056 109 574
3.35	056 019 562	4.00	056 109 575
3.40	056 109 563	4.05	056 109 576
3.45	056 109 564	4.10	056 109 577
3.50	056 109 565	4.15	056 109 578
3.55	056 109 566	4.20	056 109 579
3.60	056 109 567	4.25	056 109 580

The thickness of the discs is etched on the under-side. When installing the discs, ensure that the marks are downwards towards the tappet.

Used discs can be installed again if they are free of mechanical damage.

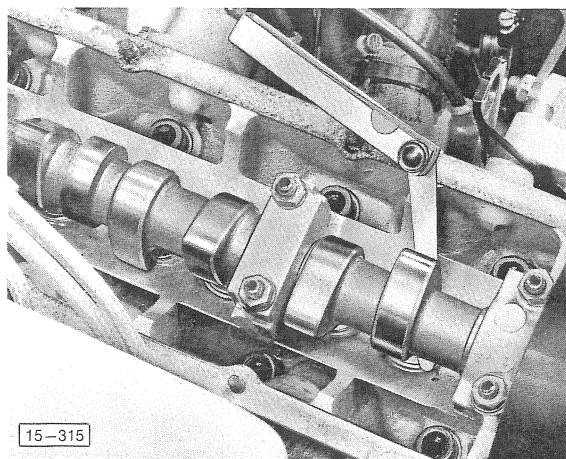


15-037

The discs should be stored in the special tray 10-212.

Adjusting:

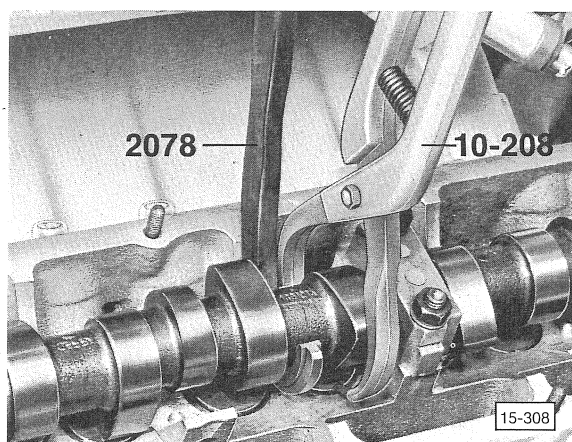
- Take cylinder head cover off.



- Turn crankshaft until the cams on the cylinder to be adjusted are pointing upwards uniformly
- Check valve clearance.
- Turn engine with screwdriver through hole in clutch housing or at the securing screw for vacuum exhaustor pulley (via vibration damper/exhaustor belts).

If the clearances are within the tolerances given it is not necessary to replace the adjusting discs. If the tolerances are exceeded, the clearances should be adjusted to mean value e. g. 0.25 mm.

Example	Exhaust	Inlet
Specified setting	0.40–0.50 mm	0.20–0.30 mm
Measured clearance	0.35 mm	0.35 mm
Clearance is	0.05 mm too small	0.05 mm too large



- Correct the clearances.

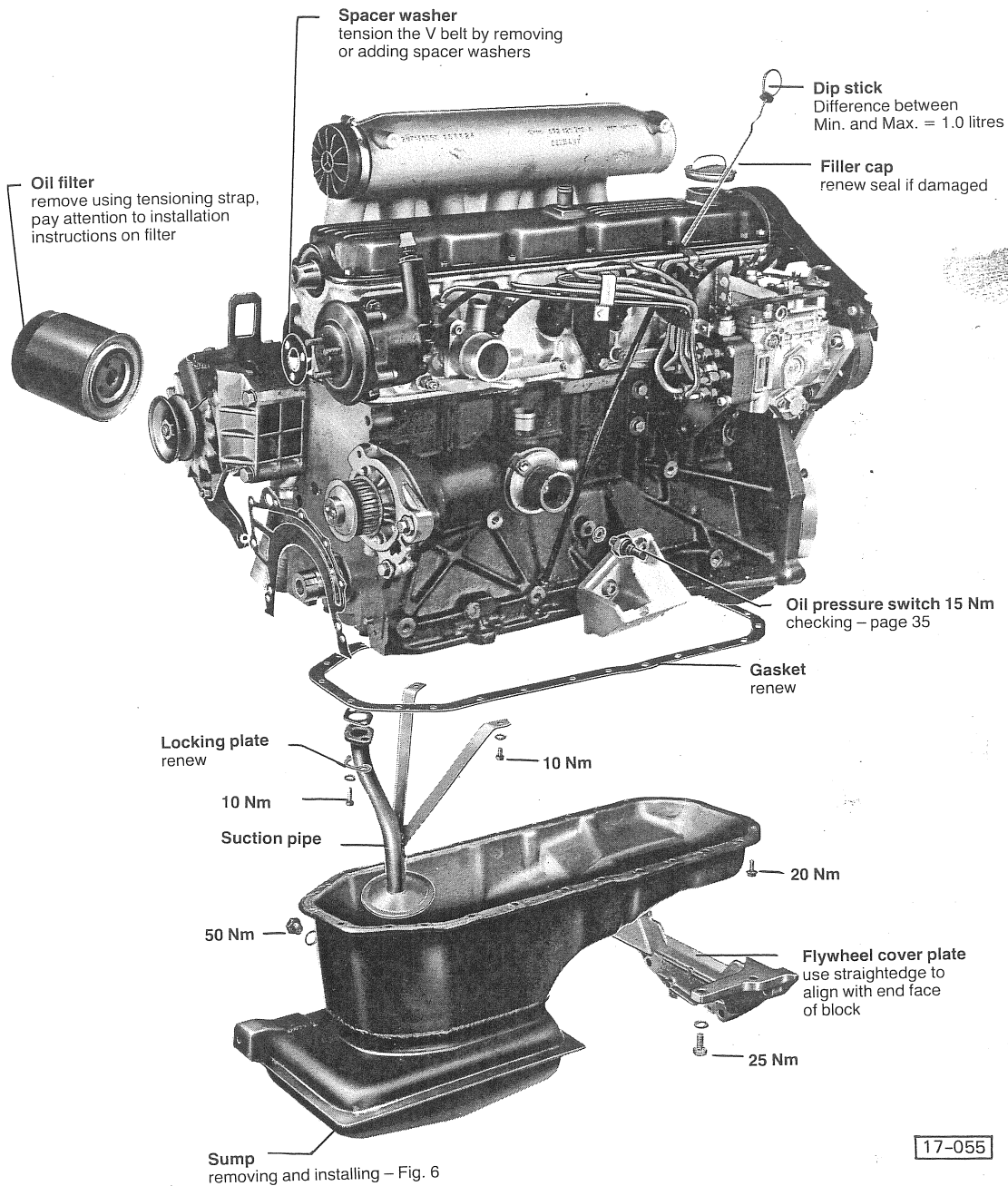
Caution!

The pistons must not be at TDC when adjusting the valves. Turn crankshaft about 1/4 of a turn further so that the valves do not contact the pistons when the tappets are pressed down.

- Press tappet down with special tool.
- Lift disc out with pliers.
- Insert the required disc (marking downwards).

Note:

All parts of the lubrication system can be removed and installed with the engine in situ.



17-055

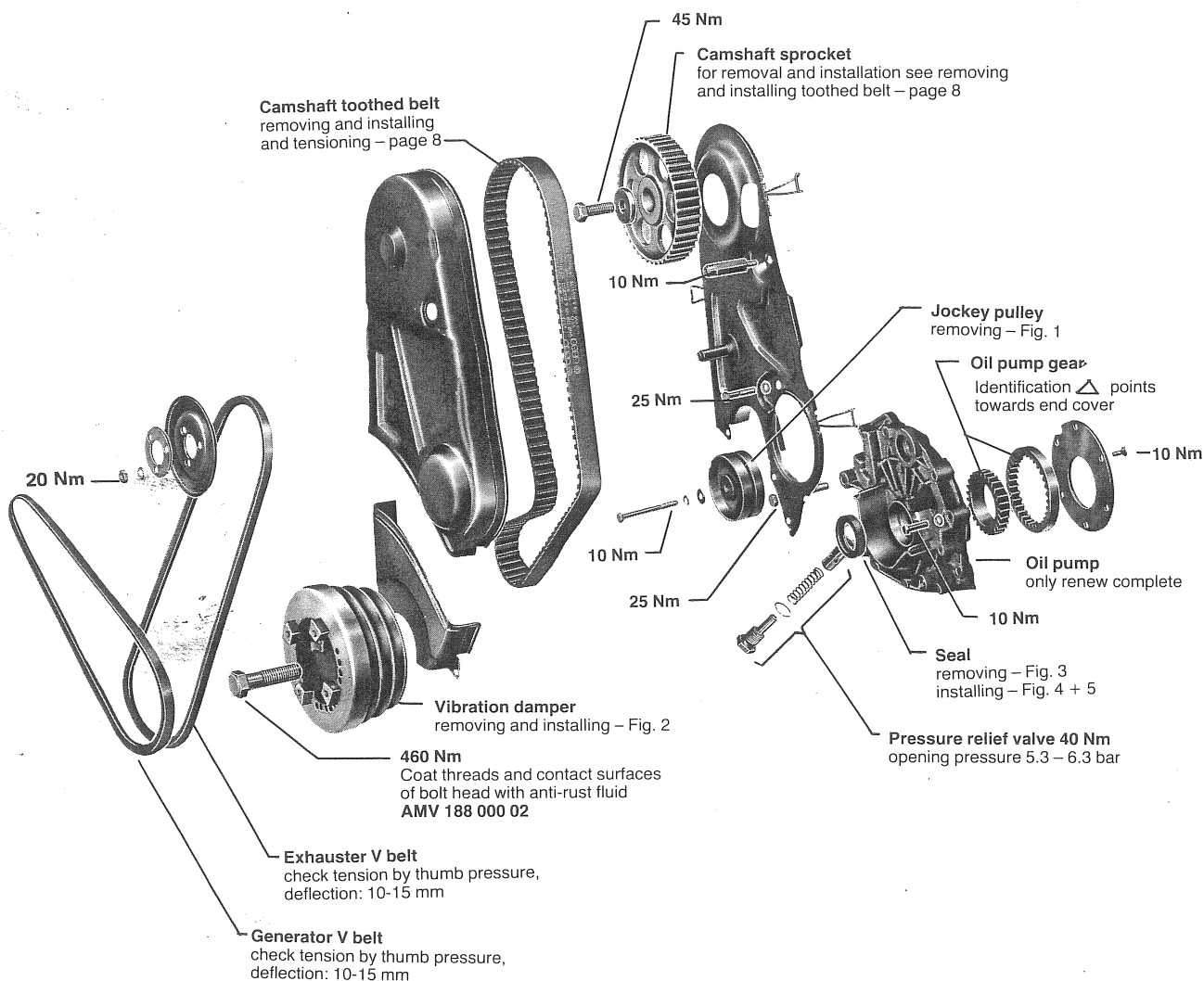
REMOVING AND INSTALLING PARTS OF LUBRICATION SYSTEM

Oil capacity:

Without filter change – 6.0 litres
With filter change – 6.5 litres

Type of oil – Fig. 7

Checking oil pressure – page 35



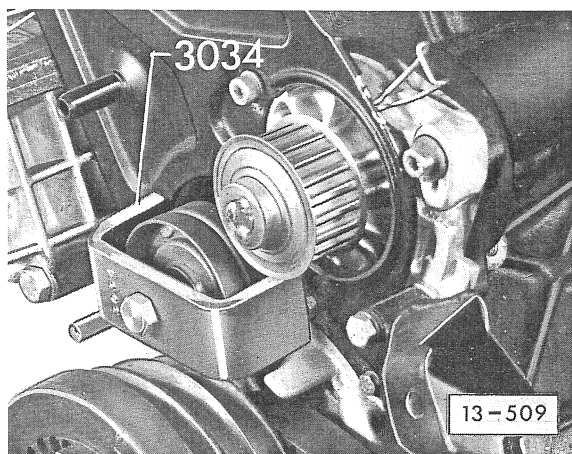


Fig. 1 Removing jockey pulley

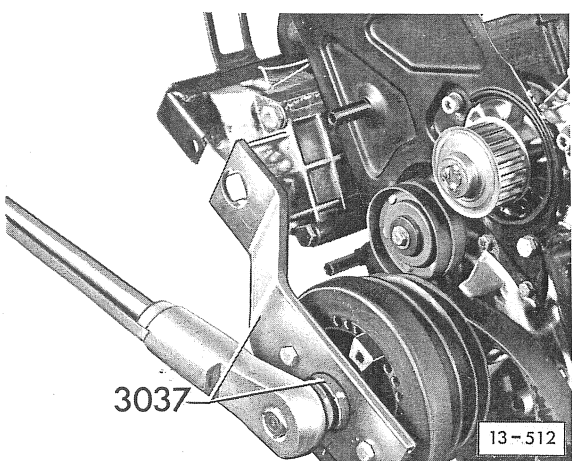


Fig. 2 Removing and installing vibration damper

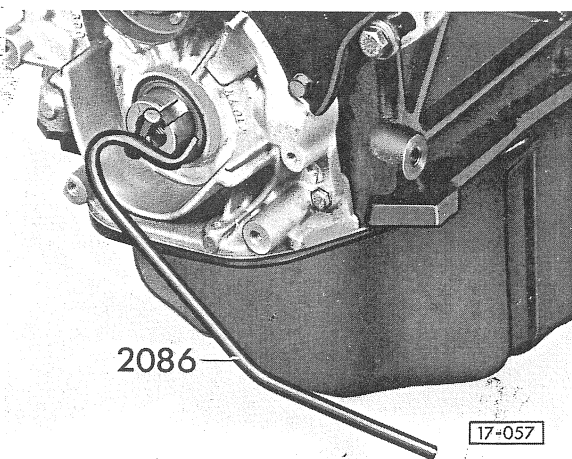


Fig. 3 Removing crankshaft oil seal – pulley end

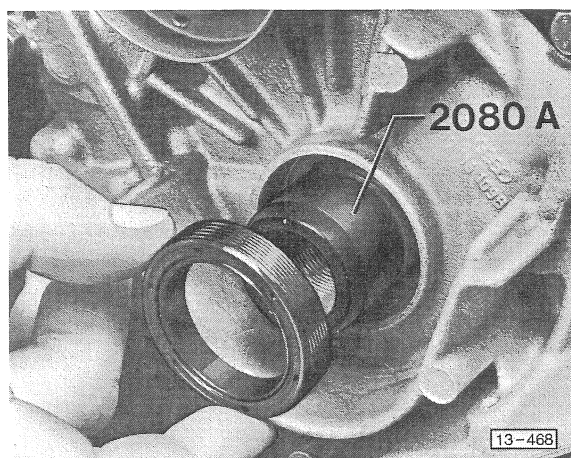


Fig. 4 Starting crankshaft pulley end oil seal

- Place guide sleeve on end of crankshaft
- Oil the seal inside and out
- Push seal over guide sleeve

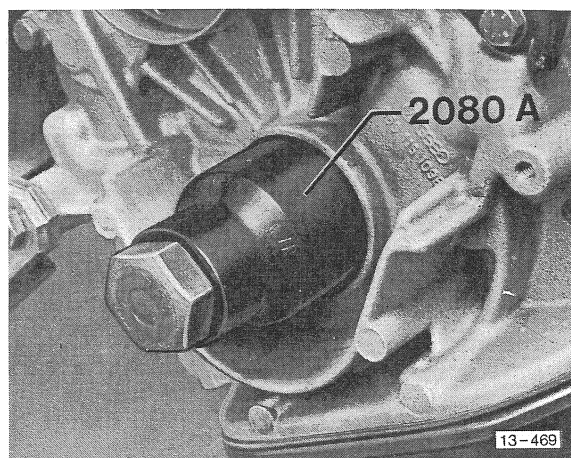


Fig. 5 Pressing pulley end oil seal in

- Push thrust sleeve over guide sleeve.
- Press seal in with vibration damper screw.

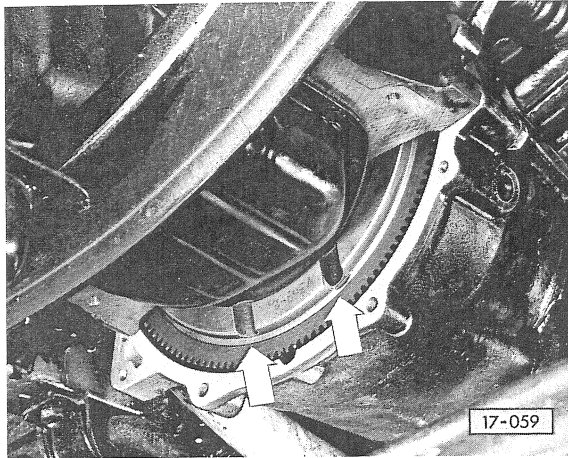


Fig. 6 Removing and installing sump

To remove the 2 rear securing screws, turn flywheel so the recesses are pointing down vertically.

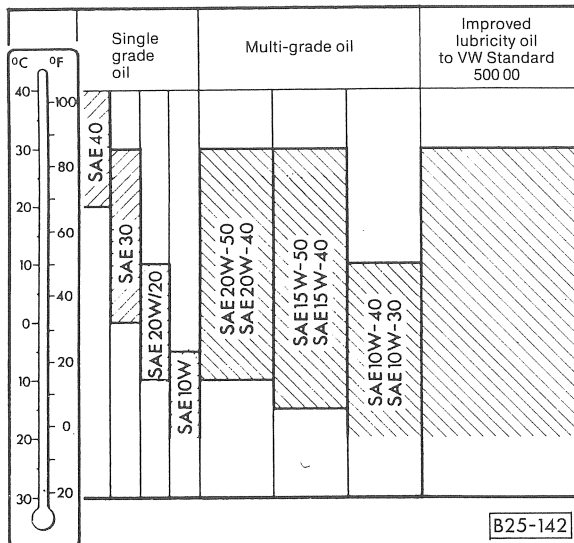
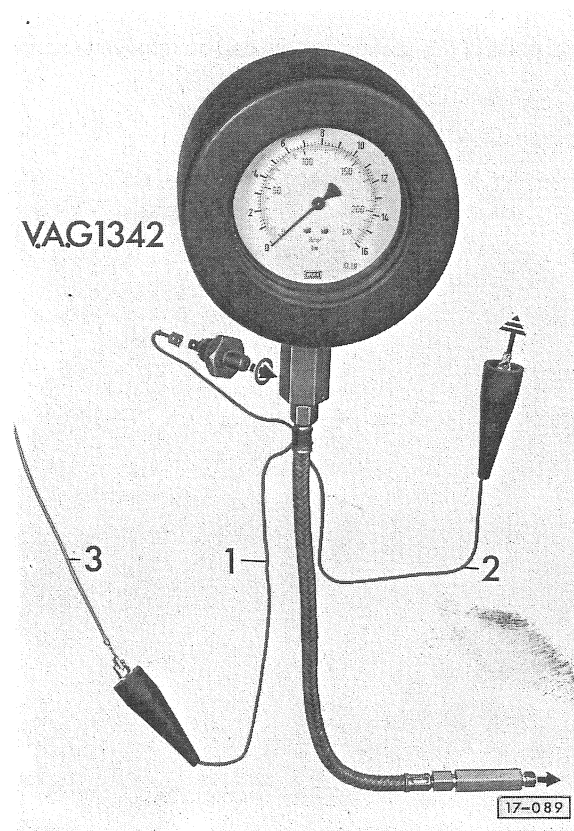


Fig. 7 Engine oil viscosity classes

Engine oil quality: CC or CD according to API specifications or improved lubricity to VW Standard 500 000.

CHECKING OIL PRESSURE AND OIL PRESSURE SWITCH



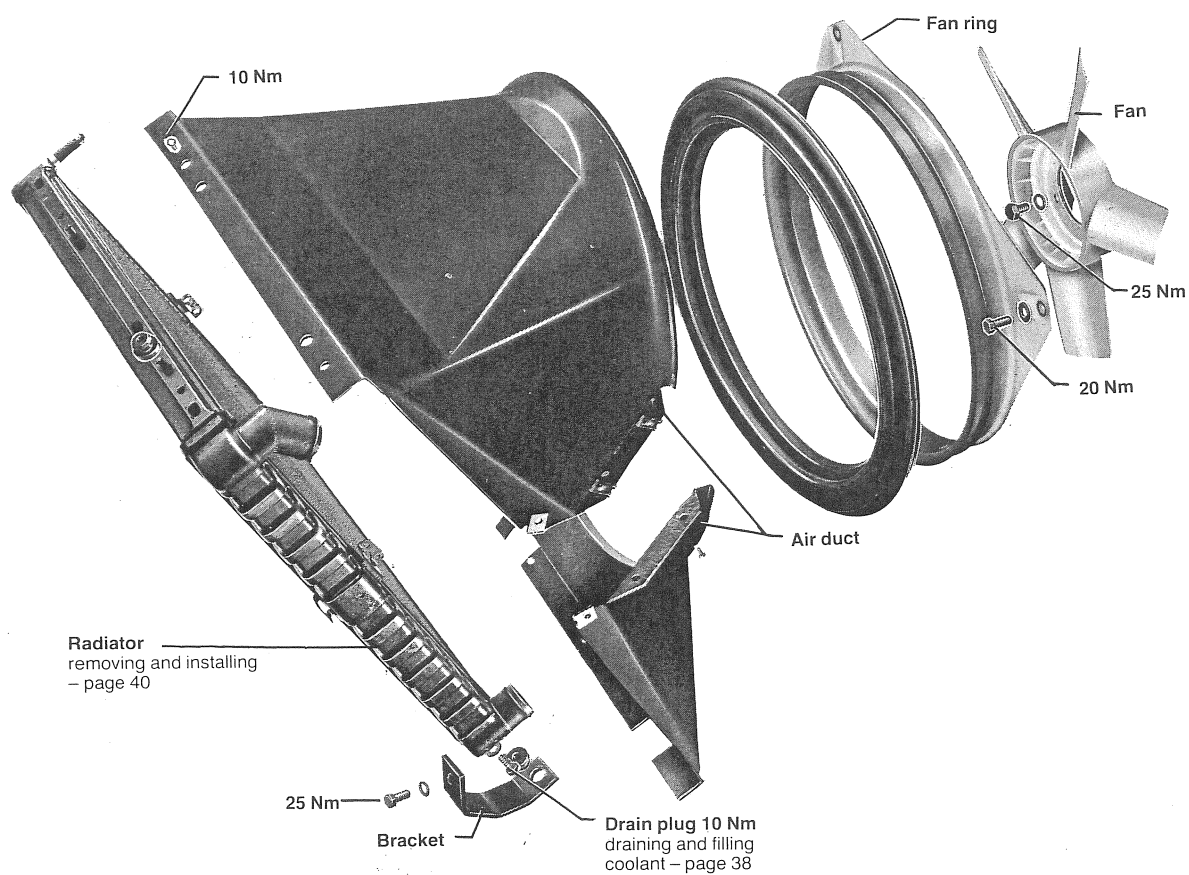
- Remove oil pressure switch and screw it into tester.
- Screw tester into cylinder head in place of the switch.
- Connect wire – 1 – (blue) of tester to oil pressure switch and wire from oil pressure switch – 3 –. Earth wire – 2 – (brown).
- Switch ignition on. Warning lamp should light up (assuming bulb and wiring is OK). Otherwise fit new switch.
- Start engine and increase speed slowly. At a pressure of 0.15 – 0.45 bar the lamp should go out, otherwise a new switch should be fitted.
- Increase speed further.
At 2000 rpm and an oil temperature of 80°C minimum oil pressure should be 2.0 bar.

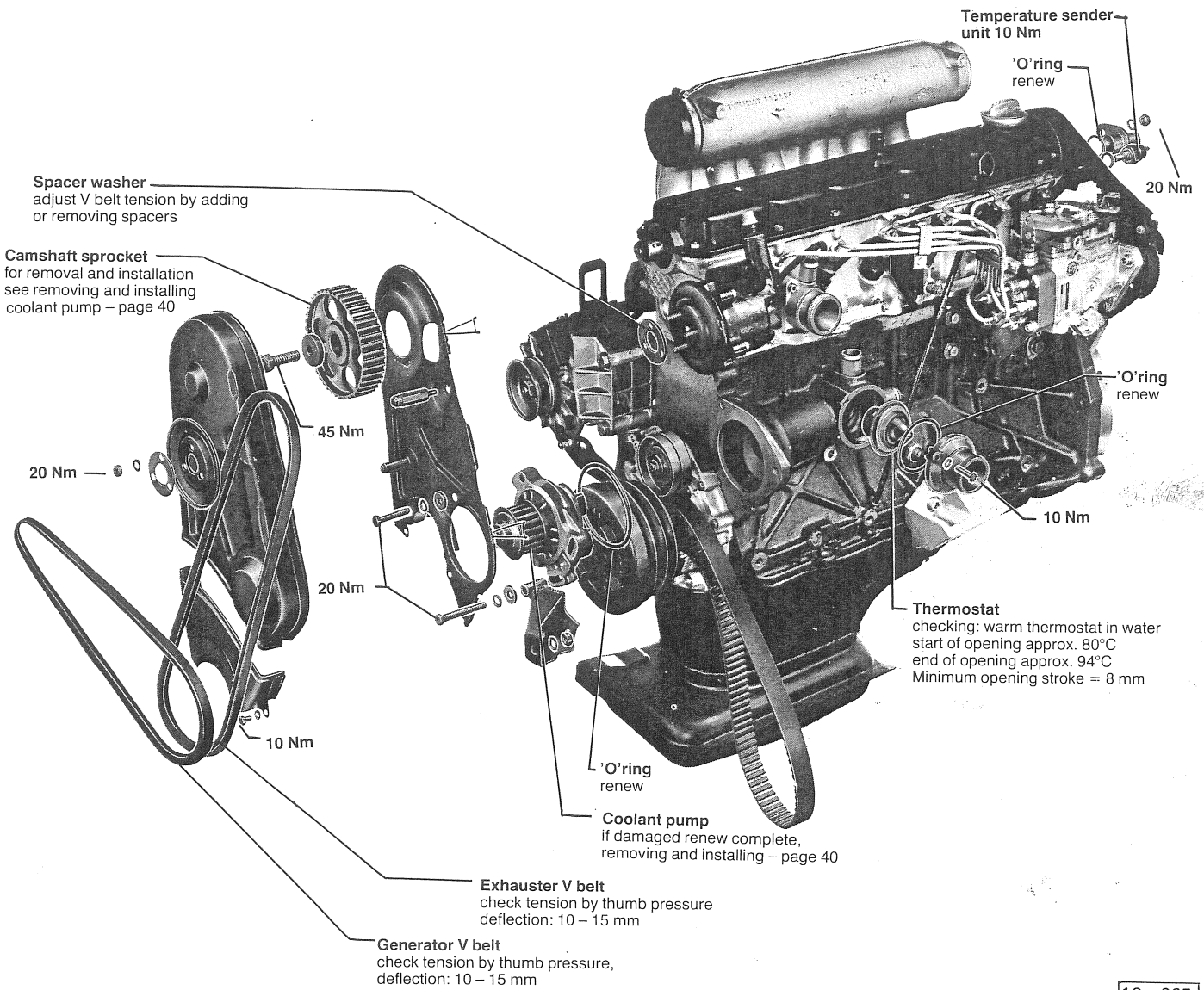
19 Cooling

REMOVING AND INSTALLING PARTS OF COOLING SYSTEM

Note:

All parts of the cooling system can be removed and installed with the engine in situ.

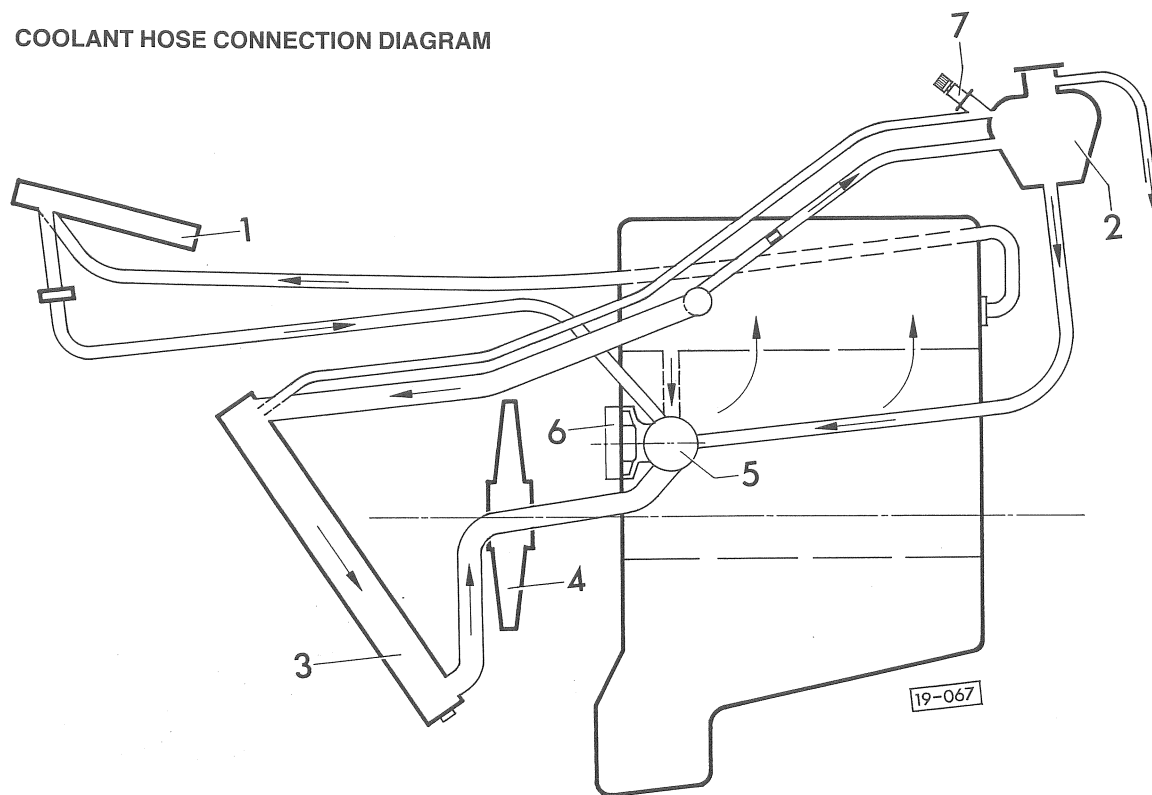




19 - 065

19 Cooling

COOLANT HOSE CONNECTION DIAGRAM



- 1 – Heating
- 2 – Expansion tank:
- 3 – Radiator
- 4 – Fan

- 5 – Thermostat housing
- 6 – Coolant pump
- 7 – Vent valve

DRAINING AND FILLING COOLING SYSTEM

Note:

The cooling system is filled at the factory with a mixture of water and frost and corrosion protective solution G 10. G 10 prevents frost and corrosion damage, formation of chalk and also raises the boiling point of the water.

For these reasons the cooling system must be filled with this coolant mixture all the year round. Due to the higher boiling point the coolant is an aid to operational efficiency when the engine is operating on full load, particularly in tropical climates.

Recommended mixtures:

Frost protection down to	G 10	Water
-25°C	4.8l	7.2l
-35°C*)	6.0l	6.0l

*) For countries with cold climates.

Draining

- Fully open heater control valve.
- Take cap off expansion tank.
- Drain coolant from drain plug on radiator.

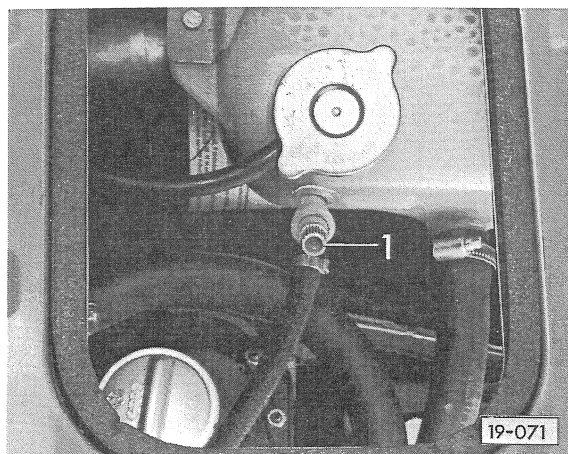
Note:

As the coolant contains G 10, it should be saved for further use.

- Detach lower coolant hose from expansion tank and seal tank. Pull coolant hose down and allow rest of coolant to drain from engine block.

Filling cooling system

- Fully open the heater control valve.

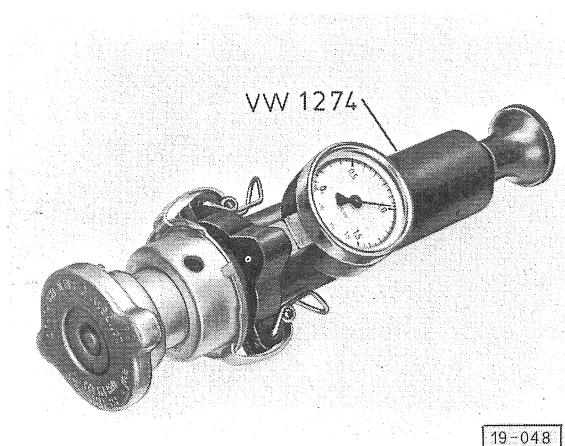


- Open vent valve – 1 – on expansion tank.
- Fill system with coolant up to the mark on the expansion tank.
- Fit expansion tank cap and run engine for about 1 minute at a fast idling speed in order to bleed the coolant system.
- Close vent valve.
- Check coolant level and top up again if necessary to the mark.

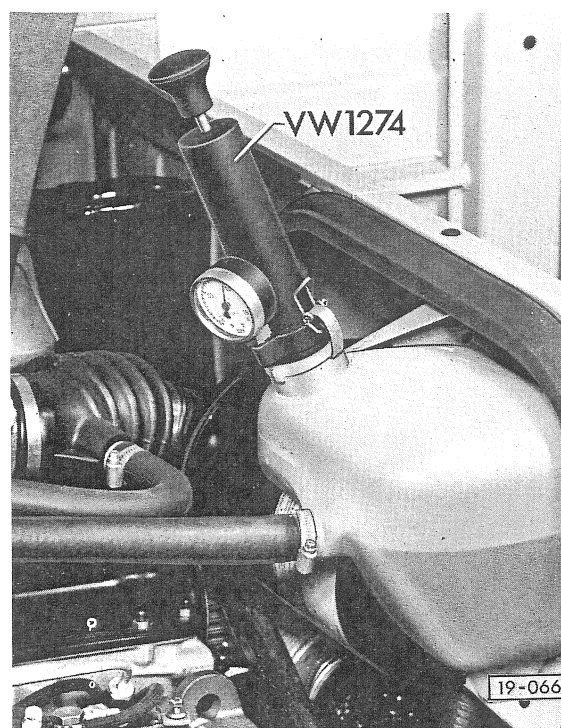
CHECKING COOLING SYSTEM AND RADIATOR CAP

Leakages in the cooling system and the operation of the pressure relief valve in the cap can be checked with a testing device VW 1274.

Checking radiator cap



- Place the cap on the tester.
- Build up the pressure with hand pump.
Between 0.9 and 1.14 bar the pressure relief valve should open.

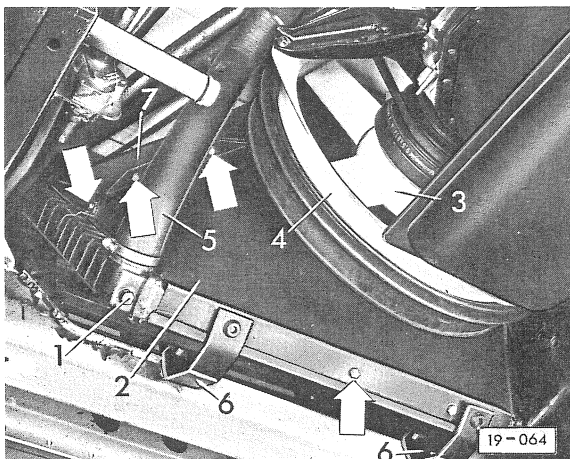


Checking cooling system

- Set the testing device up on the expansion tank.
- Using a hand pump, pump up a pressure of approx. 1.0 bar.
If the pressure drops, look for and eliminate leaks.

REMOVING AND INSTALLING RADIATOR

Removing



- Drain coolant from drain plug - 1 - and catch it for further use.
- Remove lower air duct - 2 - (remove securing screws at side and bottom) - arrow - and take air duct off.
- Remove fan - 3 -.
- Remove fan cowl - 4 -.
- Disconnect coolant hose - 5 -.
- Detach bracket - 6 - on body and lower cooler.
- Remove upper air duct and disconnect upper coolant hose.
- Take radiator out.

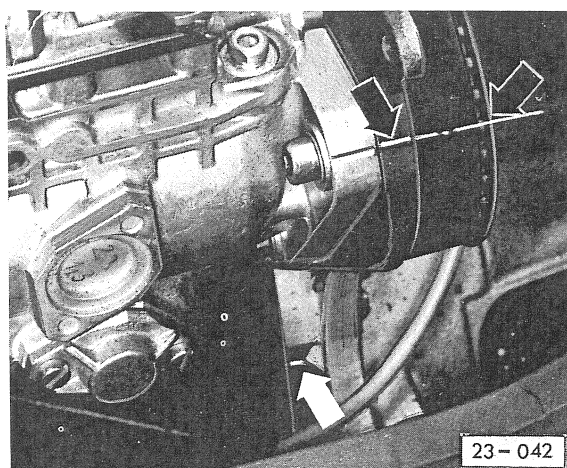
Installing

- Install in reverse sequence.
- Ensure that the radiator is located properly in the upper mounting.
- Fill cooling system - page 39.

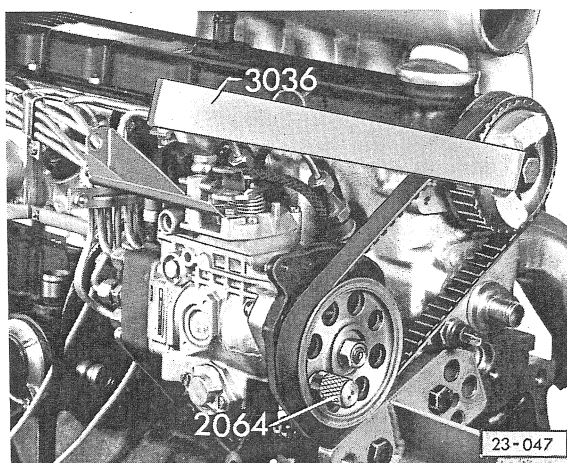
REMOVING AND INSTALLING COOLANT PUMP

Removing

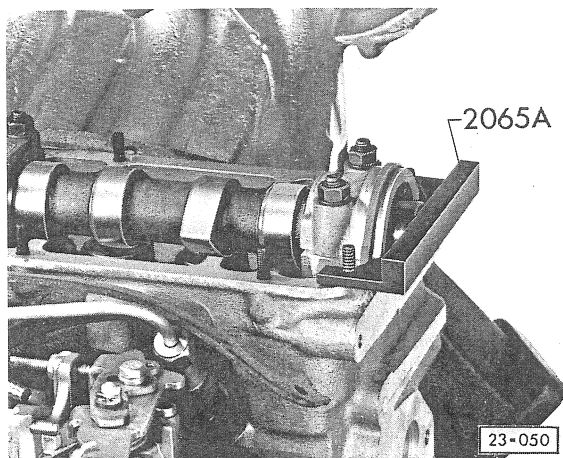
- Drain coolant - page 39
- Remove exhauster belt, to do this remove front half of pulley.
- Remove belt guards for both toothed belts.
- Detach expansion tank and place on one side with hoses connected.
- Remove air cleaner.



- Set crankshaft to TDC on No. 1 cylinder: Marks on flywheel/clutch housing - white arrow - and injection pump gear/console - black arrow - must be aligned.



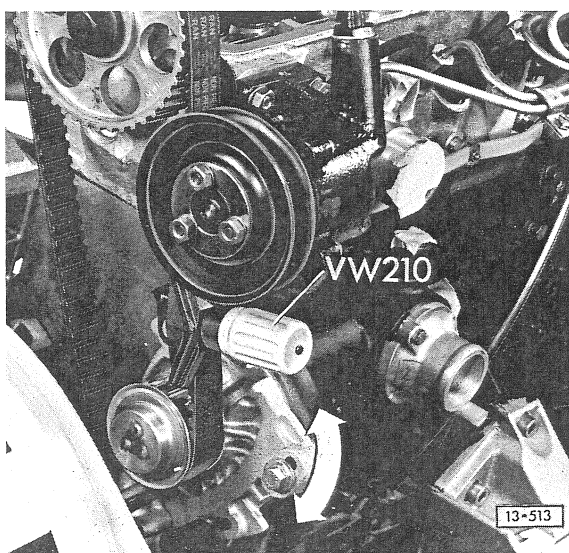
- Hold injection pump gear in position with pin 2064.
- Hold pump drive gear with special bar. Remove securing screw and take drive gear off with toothed belt.



- Set crankshaft to TDC on No. 1 cylinder again and secure camshaft with setting bar.
- Loosen securing screw for camshaft 1 turn.
- Slacken toothed belt tension (loosen coolant pump and turn it).
- Loosen camshaft gear on camshaft taper by tapping with a drift through the opening in the cover plate.
- Remove rear toothed belt cover.
- Remove coolant pump.

Installing

- Insert coolant pump and attach it loosely.
- Install rear toothed belt cover.
- Install camshaft gear loosely together with toothed belt.



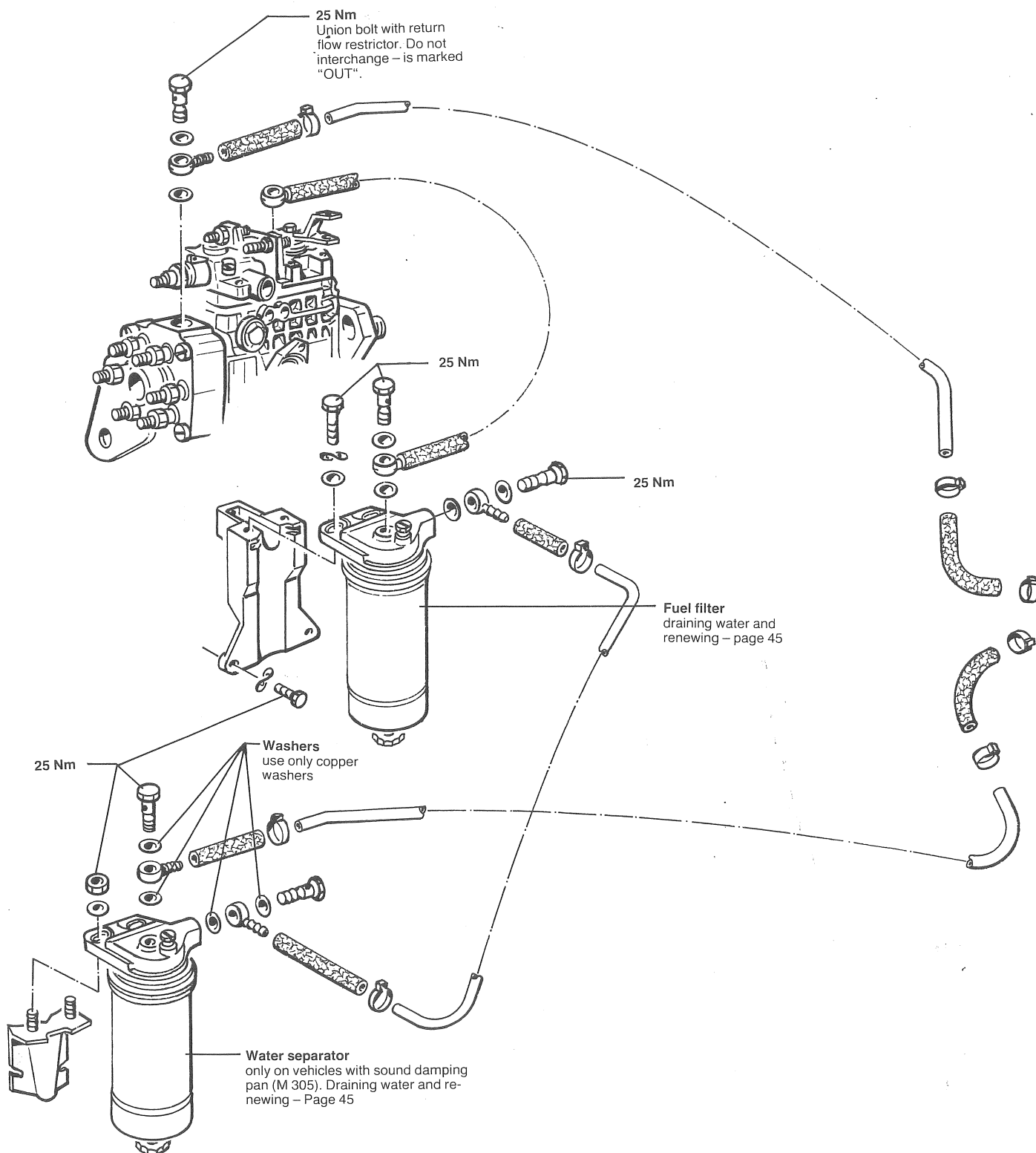
- Tension toothed belt by turning the coolant pump. Setting: 12 ... 13 scale value (tester VW 210).

- Check that crankshaft is still at TDC on No. 1 cylinder and correct if necessary.
- Tighten camshaft gear screw to 45 Nm and remove setting bar.
- Fit and tension belts for generator and exhauster (thumb test – 10 – 15 mm deflection).
- Fit toothed belt for injection pump and pump drive gear. Tighten drive gear screw until gear can still just be turned by hand.
- Check toothed belt tension and adjust by moving console and support on block to give scale value of 12 ... 13 (Tester VW 210) – see page 10.
- Check that crankshaft is still at TDC on No. 1 cylinder and correct if necessary.
- Hold injection pump drive gear with bar and tighten screw to 100 Nm.
- Remove pin 2064.
- Check injection timing – see page 50
- Install toothed belt guard and cylinder head cover.

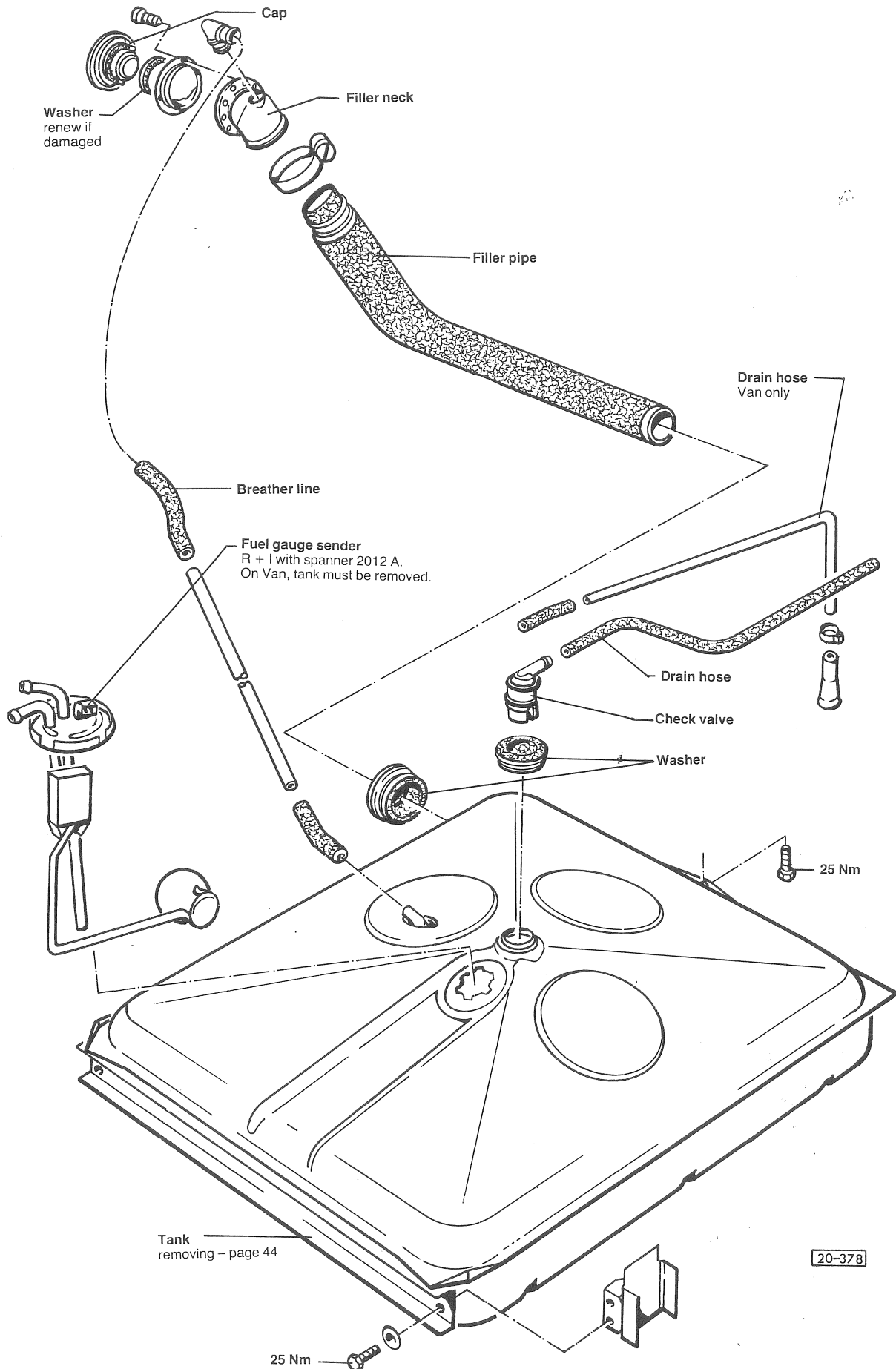
REMOVING AND INSTALLING PARTS OF FUEL SYSTEM

Note:

Always renew hose clips and washers.
See rules on cleanliness – page 44.



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Fuel system

RULES FOR CLEANLINESS WHEN WORKING ON FUEL SYSTEM

Important

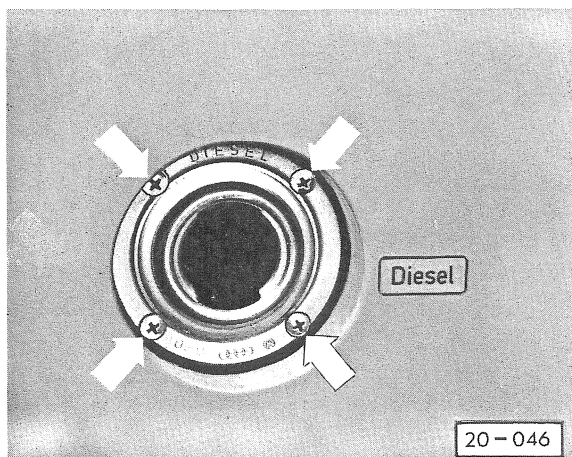
When working on the fuel system be careful to keep everything absolutely clean; bear in mind the following 5 points:

- 1 – Thoroughly clean all unions etc. and the area near the connection **before** disconnecting.
- 2 – Place parts that have been removed on a **clean** surface and cover over. Use paper or plastic sheet. Do not use fluffy cloths.
- 3 – Components that have been opened or dismantled must be covered or sealed carefully if the repair cannot be carried out immediately.
- 4 – Only install **clean** components.
 - Only unpack replacement parts immediately before they are installed.
 - Do not use parts that have been stored loose (for instance in toolboxes etc.).
- 5 – When the fuel system is open:
 - Do not work with compressed air if this can be avoided.
 - Do not move the vehicle unless absolutely necessary.

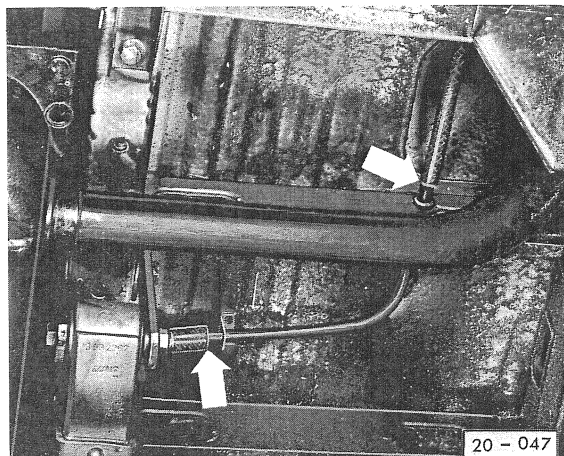
Also ensure that Diesel fuel does not get onto the coolant hoses. If it does the hoses must be cleaned immediately. Hoses damaged by Diesel fuel must be renewed.

REMOVING AND INSTALLING FUEL TANK

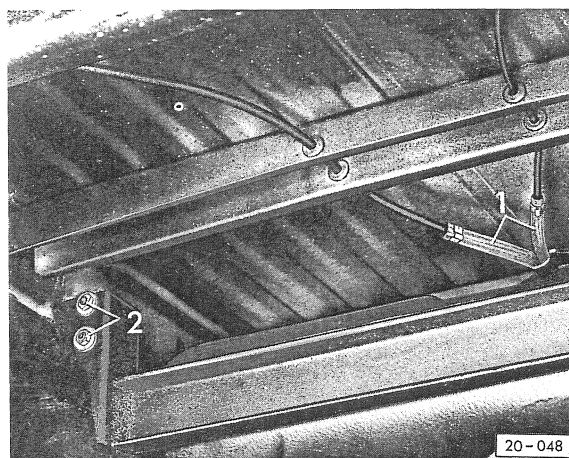
- Disconnect battery earth strap.
- Drain fuel tank.



- Remove screws for lower part of cap. Take lower part off and press filler neck back.



- Pull breather hoses off breather pipe on both sides – arrows –.
- Remove rear securing screw and take retainer off.



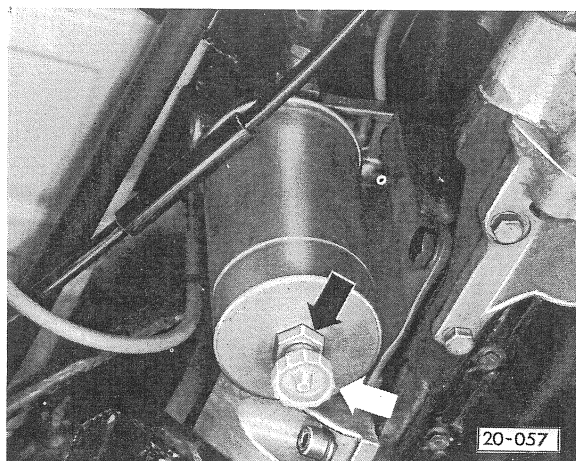
- Disconnect fuel hoses – 1 –.
- Remove front securing screws – 2 – right and left.
- Lower tank, pull wire off sender and lift tank out.

DRAINING AND RENEWING FUEL FILTER

Attention

When working on the fuel injection system, care must be taken to ensure that no Diesel fuel contacts the coolant hoses. If this happens, clean off immediately.

Draining water



- Slacken off the bleeder screw on the upper part of filter a few turns.
- Drain off approx. 100 cm³ fluid at the water drain plug – white arrow –.
- Retighten water drain plug and bleeder screw.
- Check fuel system for leaks.

Renewing

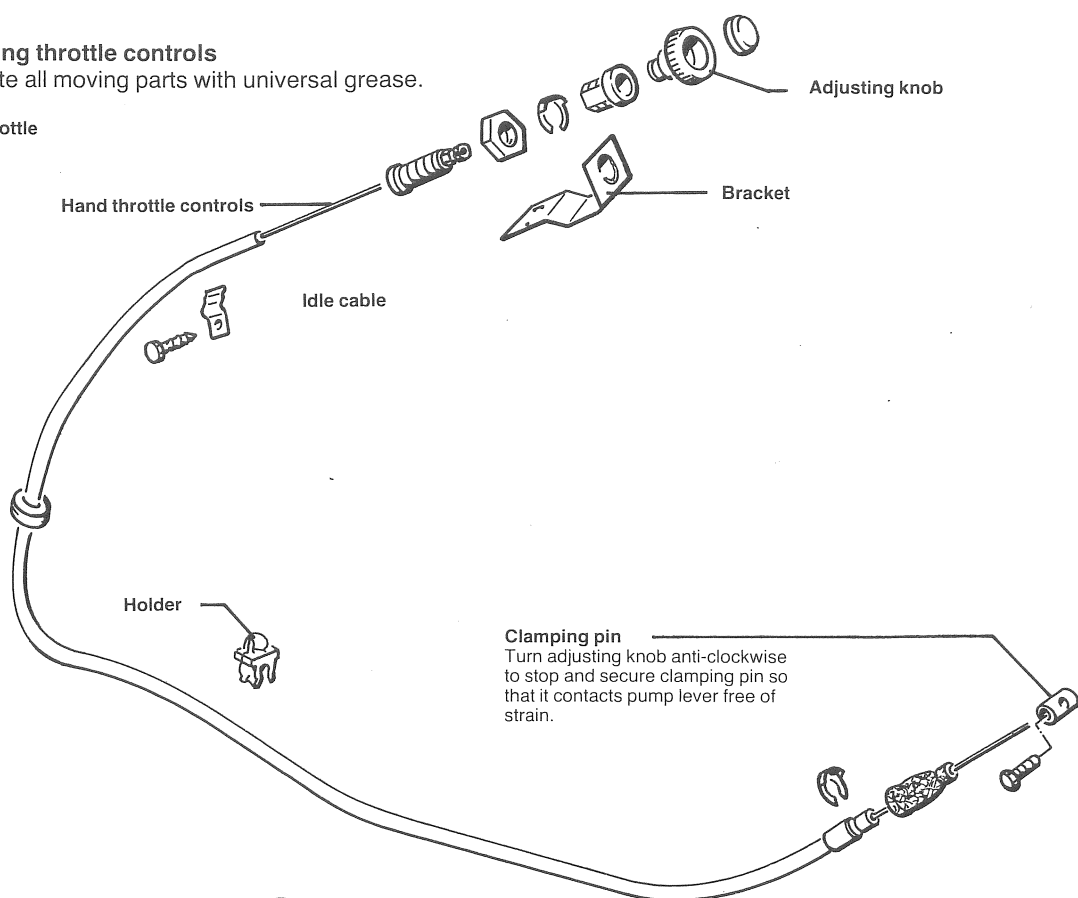
- Remove fuel filter by slackening off the hexagon head screw – black arrow –.
- Lightly oil the rubber seal with Diesel fuel.
- Screw filter in position and tighten by hand only.
- Check fuel system for leaks.

20 Fuel system

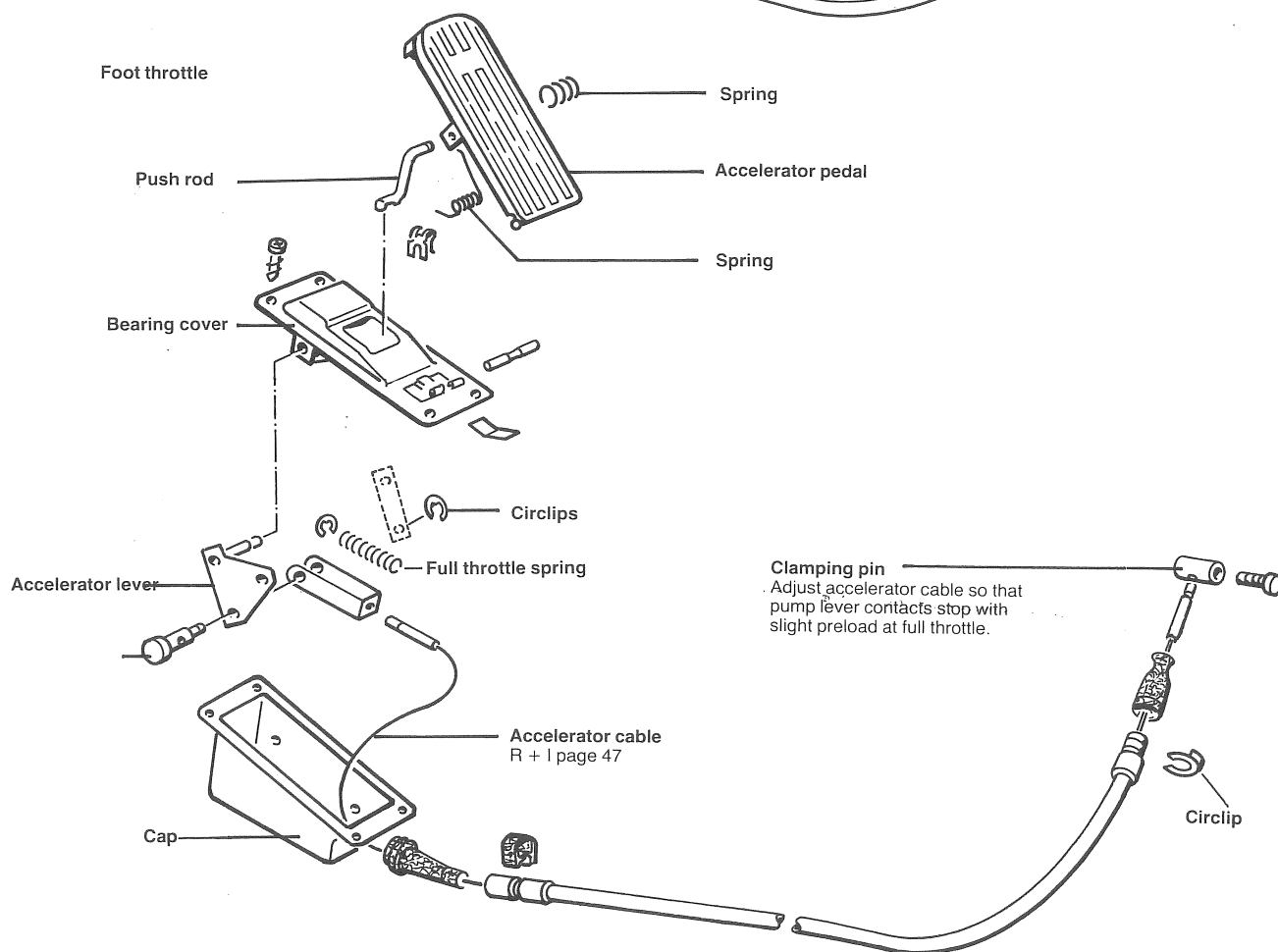
Repairing throttle controls

Lubricate all moving parts with universal grease.

Hand throttle



Foot throttle

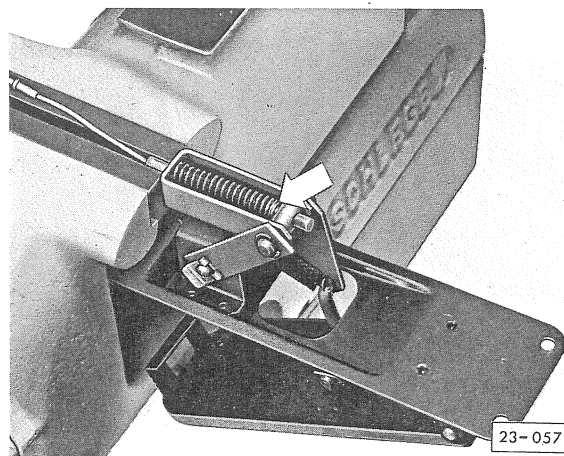


20-379

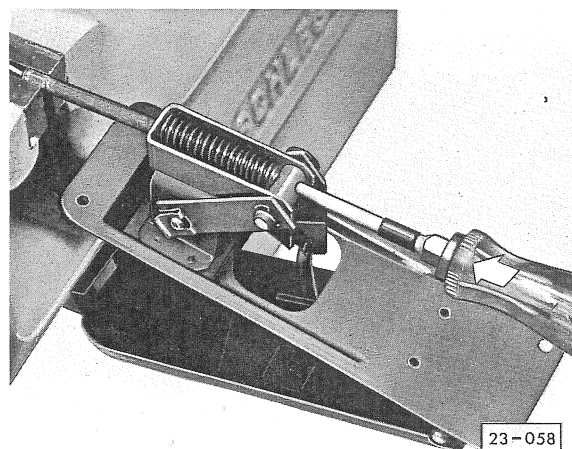
REMOVING AND INSTALLING ACCELERATOR CABLE

To avoid trouble with the full throttle spring on the pedal when removing and installing the accelerator cable, proceed as follow:

- Remove cable complete with pedal.



- Clamp pedal in vice at rear end of cable as shown and press circlip for full throttle spring – arrow – off with a screwdriver.



- Pull pedal off cable while pushing with a screwdriver through the spring.

Note!

If a screwdriver is not pushed through, the spring will jump out of retainer.

- Clamp rear end of new cable in vice.
- Push pedal on and pull screwdriver back at same time.
- Press spring back with screwdriver or suitable long-nosed pliers and insert circlip.
- Install pedal and cable.
- Connect cable to pump lever so that lever contacts stop with a slight preload in the full throttle position.

23 Injection system

REPAIRING INJECTION SYSTEM

Important

When working on the fuel system be careful to keep everything absolutely clean; bear in mind the following 5 points:

- 1 – Thoroughly clean all unions etc. and the area near the connection **before** disconnecting.
- 2 – Place parts that have been removed on a **clean** surface and cover over. Use paper or plastic sheet. Do not use fluffy cloths.
- 3 – Components that have been opened or dismantled must be covered or sealed carefully if the repair cannot be carried out immediately.
- 4 – Only install **clean** components.
 - Only unpack replacement parts immediately before they are installed.
 - Do not use parts that have been stored loose (for instance in toolboxes etc.).
- 5 – When the fuel system is open:
 - Do not work with compressed air if this can be avoided.
 - Do not move the car unless absolutely necessary.

Also ensure that Diesel fuel does not get onto the coolant hoses. If it does the hoses must be cleaned immediately. Hoses damaged by Diesel fuel must be renewed.

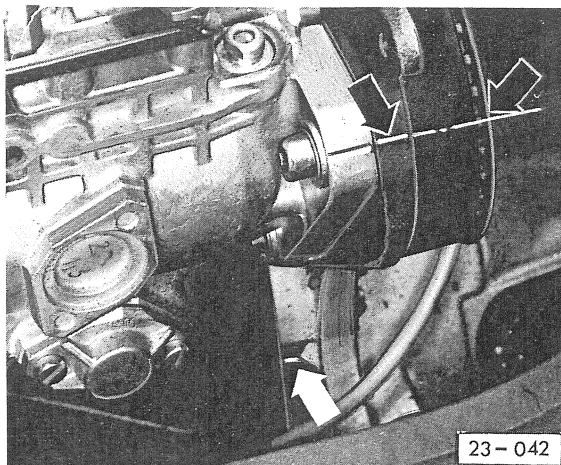
Note:

If the injection pump is found to be faulty it can only be replaced, as repairs are not possible without proper test equipment.

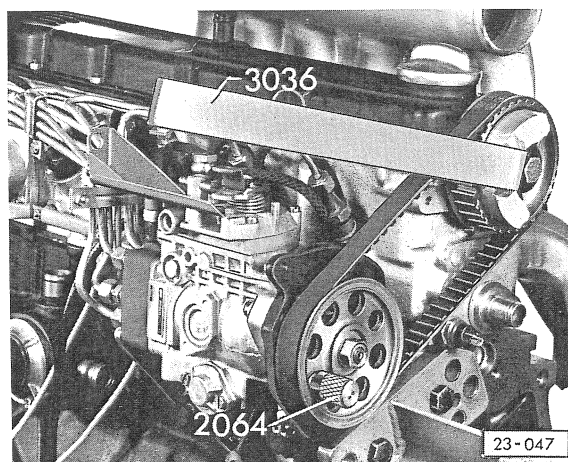
REMOVING AND INSTALLING INJECTION PUMP

Removing

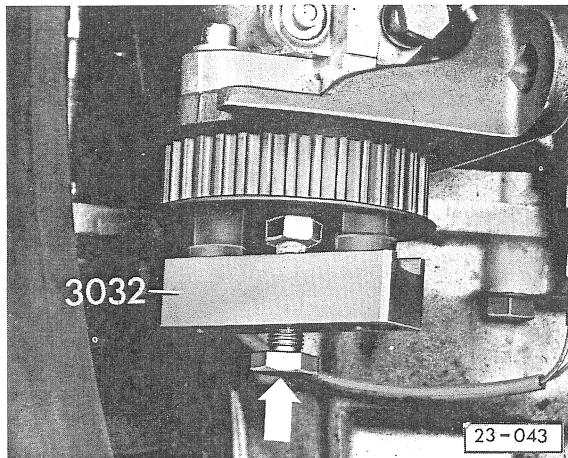
- Remove guard for injection pump toothed belt.
- Detach expansion tank and place it on one side with hoses attached.
- Remove air cleaner.



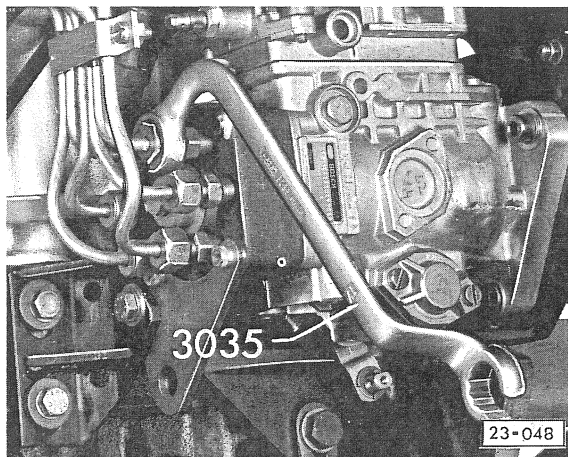
- Set crankshaft to TDC on No. 1 cylinder:
Marks on flywheel/clutch housing – white arrow – and injection pump gear/console – black arrow – must be aligned.



- Fix injection pump gear with setting pin.
- Hold injection pump drive gear with bar. Loosen securing screw, remove screw and take drive gear off together with toothed belt.
- Loosen injection pump gear securing nut about 1 turn and take setting pin out.



- Tension injection pump gear with puller.
- Loosen injection pump gear on pump taper by tapping lightly on the spindle of the puller – arrow –.
- Take securing nut off and remove injection gear.
- Disconnect injector pipes, fuel supply and return pipes, wire for stop control and accelerator cable.

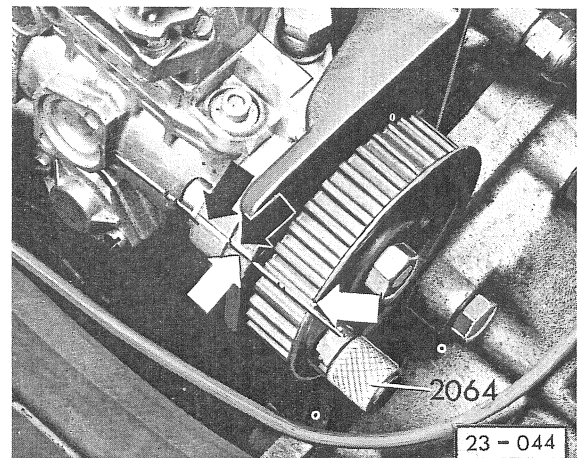


- To loosen the injector pipes use special ring spanner.
- Remove bolts from console and support and take pump off.

Note:

To slacken the two rear securing bolts use the 200 mm long x 6 mm socket head screw wrench.

Installing



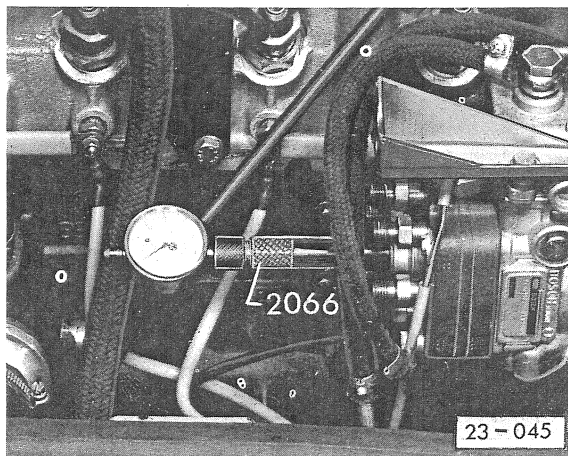
- Install injection pump so that marks on injection pump flange and on console are aligned – black arrow –.

- Insert screws and tighten lightly.

- Align rear support so that it contacts block and pump free of strain and tighten in this position.

Install injection pump gear and turn it so that the marks on gear and console are aligned – white arrow –. Fix pump gear position with setting pin and tighten securing nut to **45 Nm**.

- Install toothed belt and injection pump drive gear. Tighten bolt for drive gear so far that the drive gear can still be turned by hand.
- Check toothed belt tension and adjust if necessary by moving injection pump console and support on block to give scale value of 12 ... 13 (tester VW 210) – see page 10.
- Check TDC mark on flywheel and set to reference mark if necessary.
- Hold injection pump drive gear with bar and tighten securing bolt to **100 Nm**.
- Remove setting pin 2064.



- Install adapter and small dial gauge (0 ... 3.0 mm) with 2.5 mm preload in place of plug.

Note

Always renew plug washer.
Tightening torque 15 Nm. If plug leaks it may be tightened to max. 25 Nm

- Turn crankshaft with screwdriver through hole in bell housing anti-clockwise slowly until the dial gauge needle stops moving.
- Set dial gauge to "O" with about 1 mm preload.
- Turn crankshaft clockwise until TDC mark on flywheel is in line with reference mark. The dial gauge should show a lift of 0.97 ± 0.02 mm.
- If necessary, loosen pump bolts and set lift to 0.97 ± 0.02 mm by turning the pump.
- Tighten pump securing screws to **25 Nm**.
- Attach fuel injection pipes, fuel return and supply pipes, wire for stop control and accelerator cable.
- Tightening torques:
Unions and injection pipes – **25 Nm**.

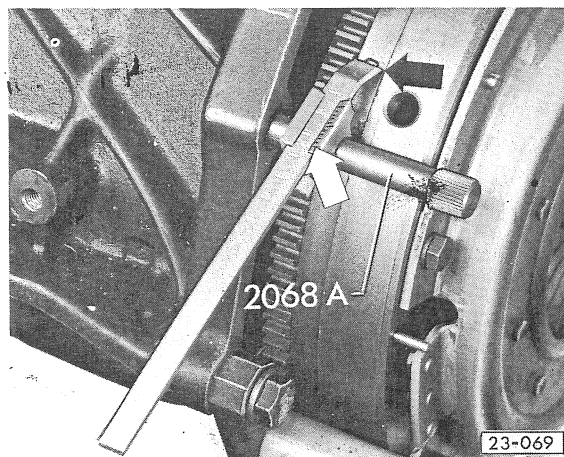
Caution!

Do not interchange the fuel line unions. The union for the return line is fitted with a restrictor and is marked "OUT" on the hexagon head.

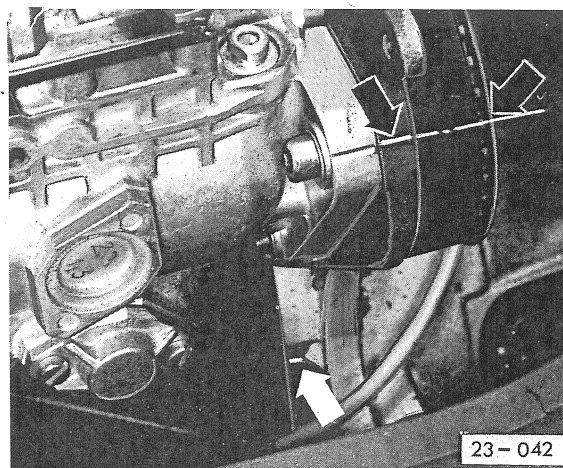
- Install toothed belt guard.
- Set idling and maximum speeds – page 52.

CHECKING AND ADJUSTING POINT OF INJECTION

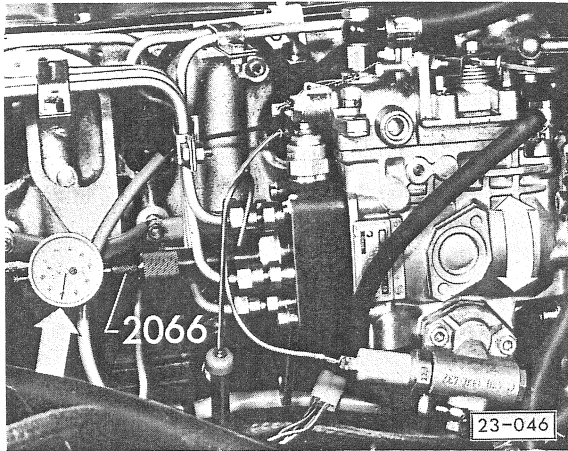
- Set engine to TDC on cylinder No. 1



- Engine out:
Adjust setting appliance to 125.5 mm – white arrow – (the left hand notch on the vernier is the reference point).
Turn crankshaft until TDC mark on flywheel is in line with edge of setting appliance – black arrow – and the marks on injection pump gear and console are aligned.



- Engine installed:
Turn crankshaft until TDC mark on flywheel and boss on bell housing – white arrow – and the marks on injection pump gear and console – black arrow – are aligned.
- Take plug out of injection pump cover.



- Install adaptor and dial gauge (range 0 ... 3.0 mm) in place of plug and preload gauge to about 2.5 mm.

Note

Always renew plug washer.
Tightening torque 15 Nm. If plug leaks it may be tightened to max. 25 Nm

- Turn crankshaft slowly with screwdriver through hole in bell housing in anti-clockwise direction until the dial gauge needle stops moving.
- Zero dial gauge with about 1 mm preload.
- Turn crankshaft in clockwise direction until TDC mark on flywheel and reference mark are aligned.
- Read off point of injection on gauge:
Test value = 0.90 – 1.0 mm lift
Setting value = 0.97 ± 0.02 mm lift

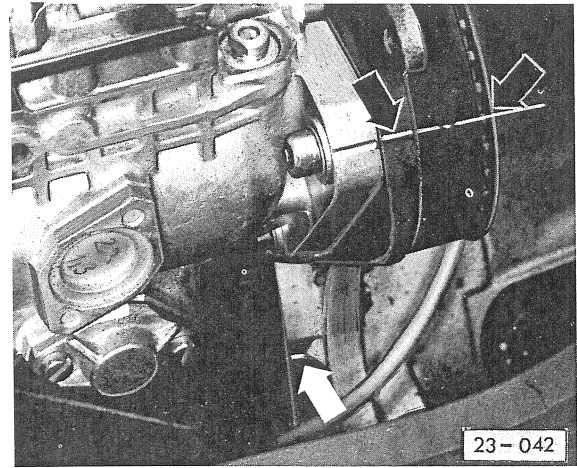
Note

If test value is within the given tolerance it is not necessary to reset the timing.

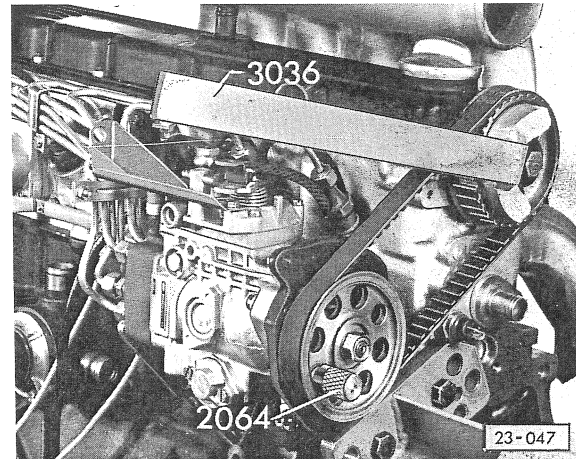
- The setting can be corrected by loosening the bolts in the console and support and turning the pump – white double arrow –.

CHECKING AND ADJUSTING VALVE TIMING

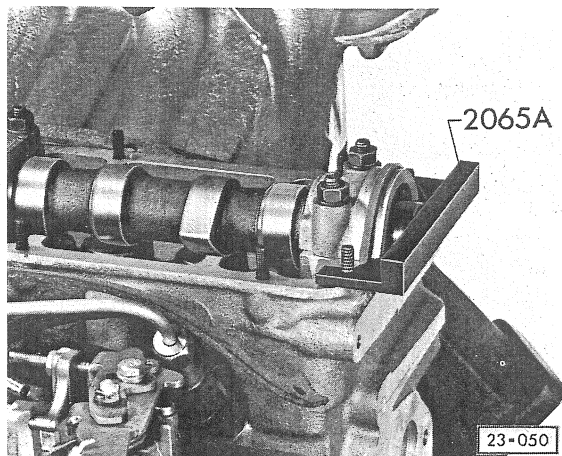
Remove cylinder head cover and toothed belt guard for injection pump drive.



- Set crankshaft to TDC on cylinder No. 1:
Marks on flywheel/clutch housing – white arrow – and injection pump gear/console – black arrow – must be in line.

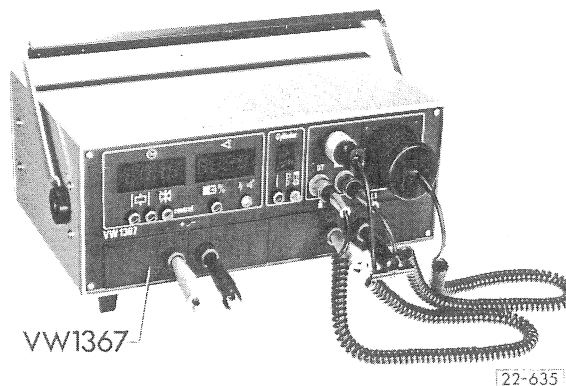


- Fix injection pump gear in position with setting pin.
- Hold injection pump drive gear with bar. Remove securing screw and take off drive gear together with toothed belt.
- Check again to ensure that the TDC mark on flywheel is in line with reference mark, and adjust if necessary.



- Setting bar should fit in the recess in the camshaft.
- If the setting bar does not fit, timing must be set as follows.
- Turn crankshaft so that setting bar will fit.
- Remove toothed belt guard from camshaft drive and loosen securing screw for camshaft gear approx. 1 turn.
- Loosen camshaft gear on camshaft taper by tapping with a drift inserted through hole in cover.
- Turn crankshaft until TDC mark on flywheel and boss on clutch housing are aligned.
- Tighten camshaft gear to **45 Nm** and remove setting bar.
- Install toothed belt and injection pump drive gear. Tighten drive securing bolt until drive can just be turned by hand.
- Check toothed belt tension and adjust if necessary by moving injection pump console and support on block to give setting of 12 ... 13 scale value (tester VW 210) – see page 10.
- Check TDC mark on flywheel and set to reference mark if necessary.
- Hold injection pump drive gear with bar and tighten securing bolt to **100 Nm**.
- Remove setting pin 2064.
- Check point of injection – page 50
- Install toothed belt guard and cylinder head cover.

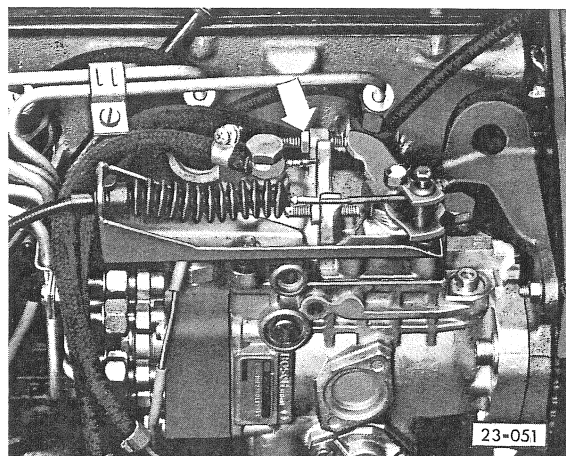
CHECKING AND ADJUSTING ENGINE SPEED



The engine speed can be measured with the ignition tester VW 1367 via the TDC sender.

Checking and adjusting idling speed.

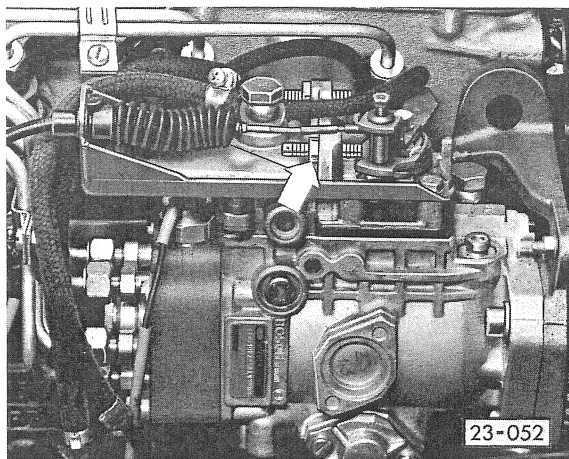
- Minimum oil temperature 60°C
- Connect ignition tester VW 1367 in accordance with instructions.



- Set idling speed with adjusting screw (arrow) to 750 ± 50 rpm.
- Lock adjusting screw and seal it.

Checking and adjusting max. speed (no load)

- Connect ignition tester VW 1367 in accordance with instructions.



- Accelerate engine to full throttle and adjust speed with adjusting screw (arrow) to 5000 ± 50 rpm.
- Lock adjusting screw and seal it.

REMOVING AND INSTALLING INJECTORS

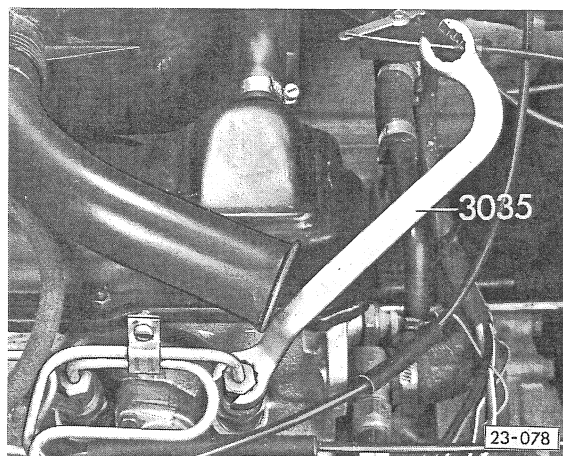
Note:

The first signs of injector trouble usually appear as follows:

- Misfiring
- Knocking in one more cylinders.
- Engine overheating.
- Loss of power
- Smoky black exhaust.
- Increased fuel consumption.

Faulty injectors can be located by loosening the pipe union on each injector in turn with the engine running at a fast idle. If the engine speed remains constant after loosening a pipe union, this denotes a faulty injector.

Removing

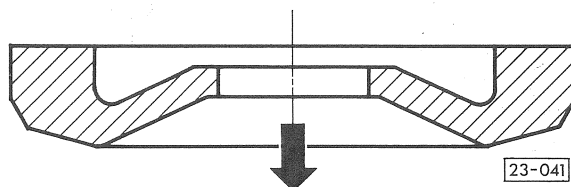


- Detach injector pipes using slotted ring spanner 3035.
- Remove injector with a 27 mm socket spanner.

Installing

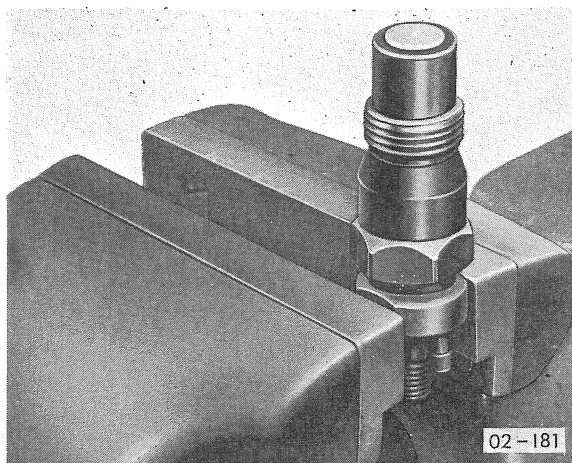
Note

Always renew heat shields between cylinder head and injector

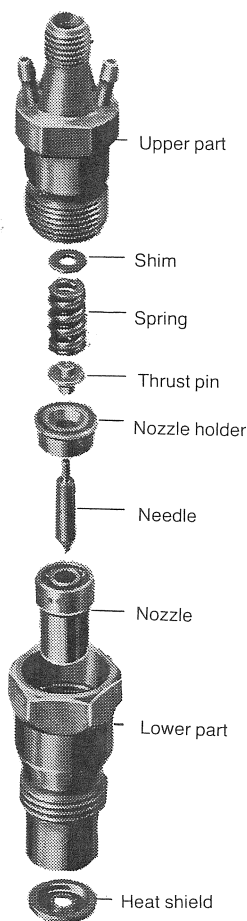


- Fitting position of heat shields (arrow points towards cylinder head).
- Tightening torque
Injector pipes = 25 Nm
Injector = 70 Nm

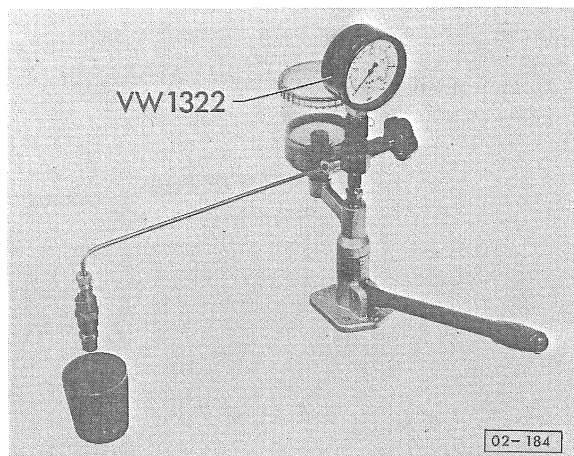
SERVICING INJECTORS



- Clamp upper part in vice and loosen hexagon.
- To prevent parts from falling out, clamp lower part in vice and dismantle.



- When dismantling, keep all individual parts together and do not interchange with parts from other injectors.
- Tightening torque for upper and lower parts = 70 Nm.



- Check injectors for spray formation, noise, breaking pressure and leakage.

Caution!

When testing injectors take care not to expose the hands to the injector spray as the working pressure will cause the fuel oil to penetrate the skin.

Spray test

Gauge isolated:

With rapid short strokes of the testing pump lever (4-6/sec) the sprays should be even and cut off cleanly. The injectors must not drip.

Noise test

Gauge isolated:

Long slow strokes with pump lever (1-2 strokes/sec). When injector is working properly it makes a "pinging" sound as fuel emerges.

Breaking pressure test

Gauge working:

- Move pump lever down slowly. Watch pressure at which injector works and adjust it if necessary by altering the shims.

Specified pressure for used injectors:

120-130 atmospheres (bar)

Pressure for new injectors:

130-138 atmospheres (bar)

- **Thicker shim = increases pressure**
- **Thinner shim = decreases pressure**
- Increasing shim thickness by 0.05 mm increases the pressure by about 5.0 bar.
- Shims are available in thickness from 1.00 ... 1.95 mm in 0.05 mm steps.

Note:

The injectors should be set to the breaking pressure for new injectors.

Leakage test

Gauge working:

Press pump lever down slowly and hold a pressure of about 110 bar for 10 seconds. No fuel should leak from the nozzle tip.

26 Exhaust System

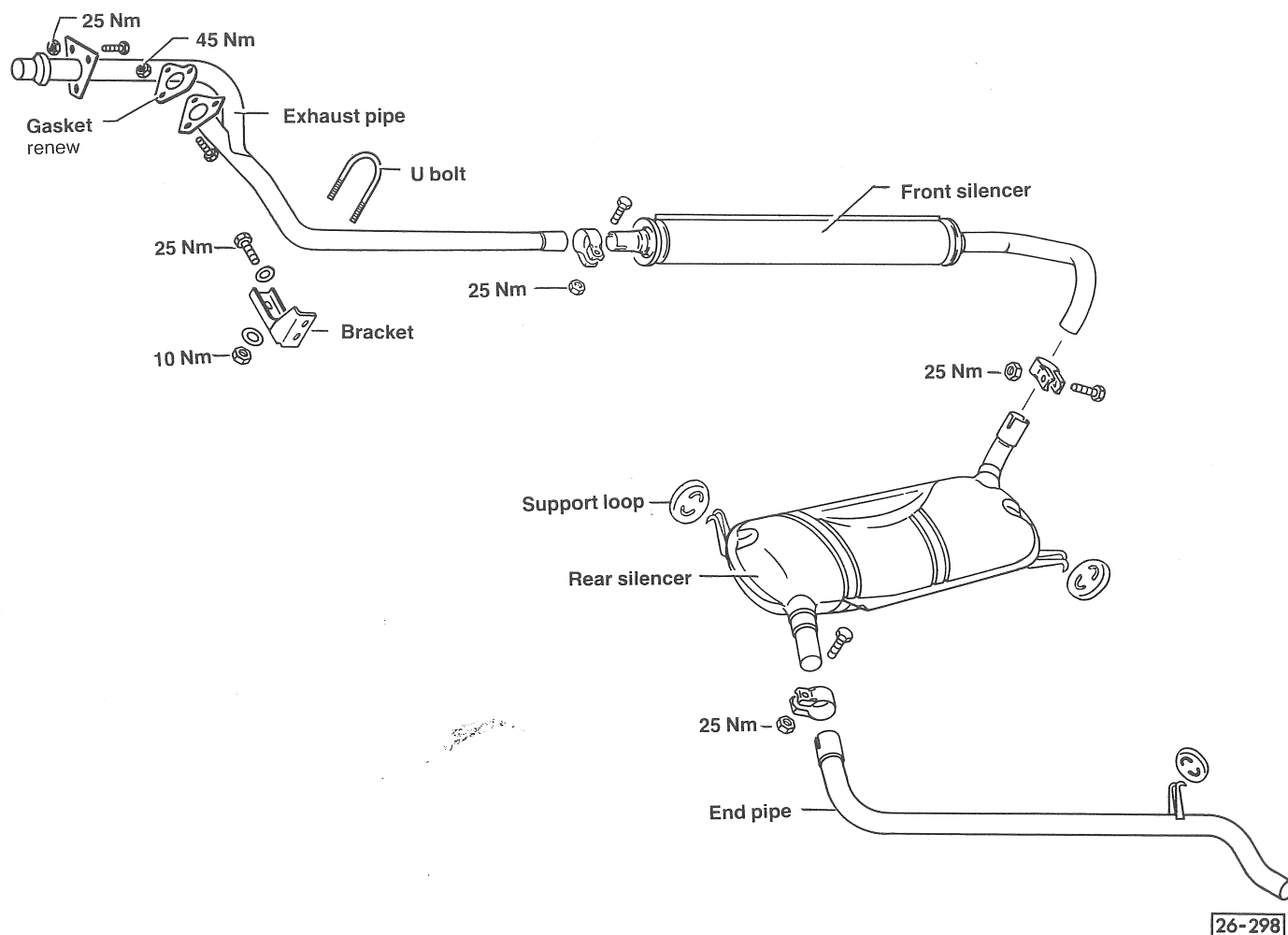
REPAIRING EXHAUST SYSTEM

Note:

Always fit new self locking nuts.

After working on the exhaust system, ensure that the exhaust pipes etc. are not strained.

If necessary, slacken off all clips and align front and rear silencers and end pie by twisting and pushing longitudinally until the support loops are uniformly loaded.



28 Glow Plug System

CHECKING GLOW PLUG SYSTEM

Note:

For differences between quick glow and normal glow systems see Fig. 4

Test conditions: Battery OK.

Checking voltage supply

- Connect test lamp between current supply to cylinders 1-3 or 4-6 in turn and earth (Fig. 2)
- Pull wire off engine temperature sensor.
- Turn ignition key to heating position for max. 15 seconds. Test lamp should light up.
- Connect wire to engine temperature sensor again.

Test lamp
does not light up

Test lamp
lights up

See page 60

Check glow plug current supply

With V.A.G 1315 A
or V.A.G 2000

With test lamp

Note

The following instructions
are for one glow plug circuit.
The others are done in the
same way.

Checking current supply (with V.A.G 1315 A or V.A.G 2000)

- Connect power supply for tester.
- Place glow plug lead in current clamp (Fig. 3)
- Press button for current test with current clamp.
- Disconnect lead from engine temperature sensor.
- Turn ignition key to heating position for **not more than 15 sec.**
- Read off current draw.

approx. 36 A quick
approx. 27 A normal

zero or below
36 A quick
37 A normal

Glow plugs OK.
(fault is in fuel system)

Checking glow plugs.

- Remove lead and bus bar for glow plugs.
- Connect test lamp to battery positive (+) and apply probe to each glow plug in turn (Fig. 1)
- Lamp lights up: glow plug is OK.
- Lamp does not light up: glow plug is defective renew (tightening torque **40 Nm**). If glow plug electrodes are burnt, see notes on page 59.

Note:

Current draw should stabilize at about 9 amps. per glow plug with normal system or about 12 amps with quick system. If glows plugs give a current draw of about

Normal glow system

Quick glow system

18 A –
9 A –
0 A –

24 A – 1 glow plug defective
12 A – 2 glow plugs defective
0 A – 3 glow plugs defective

These values can only be obtained with a battery voltage of not less than 11.5 V.

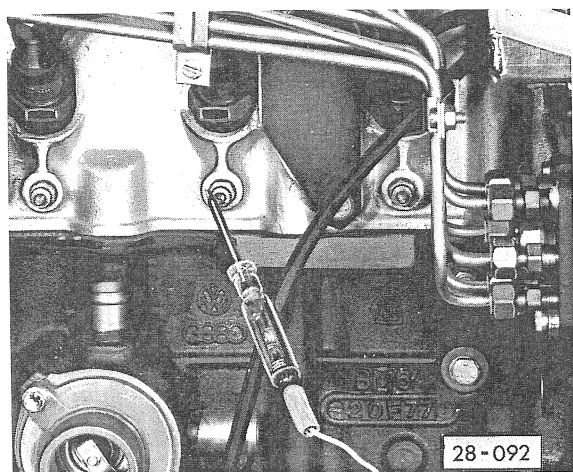


Fig. 1 Checking glow plugs

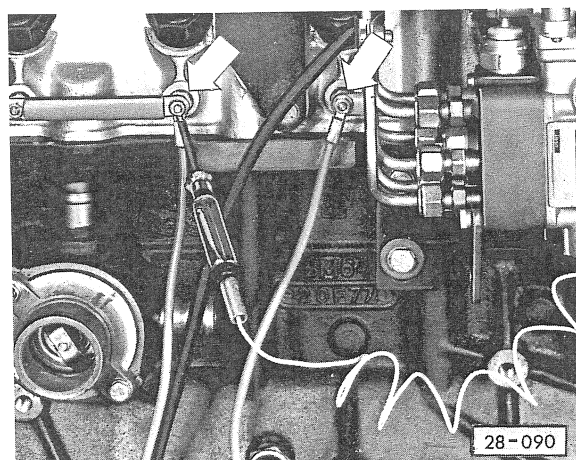


Fig. 2 Checking voltage supply

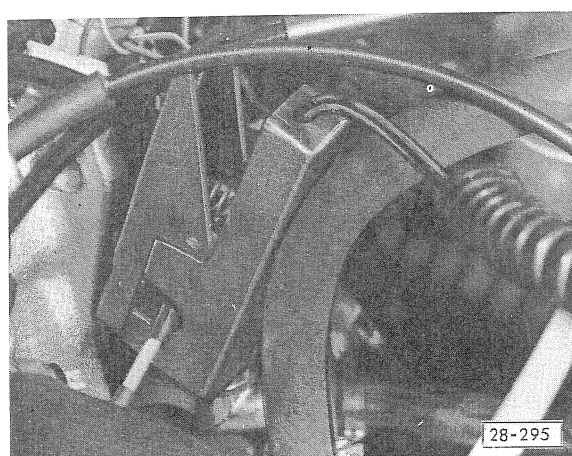


Fig. 3 Placing glow plug supply wire in current clamp

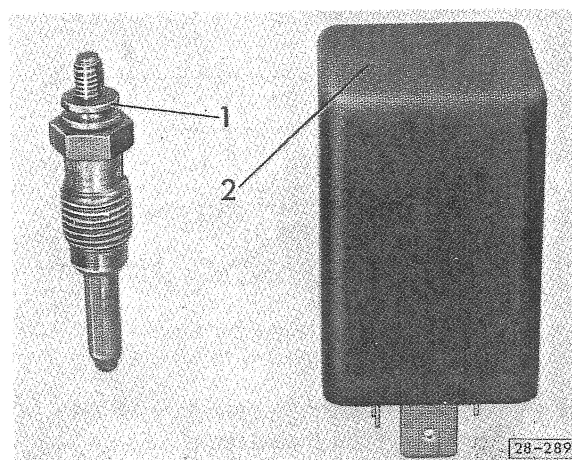


Fig. 4 Glow plug system identification

Quick glow system

- 1 – Brass nut
- 2 – Red lettering

Normal system

- 1 – Aluminium nut
- 2 – White lettering

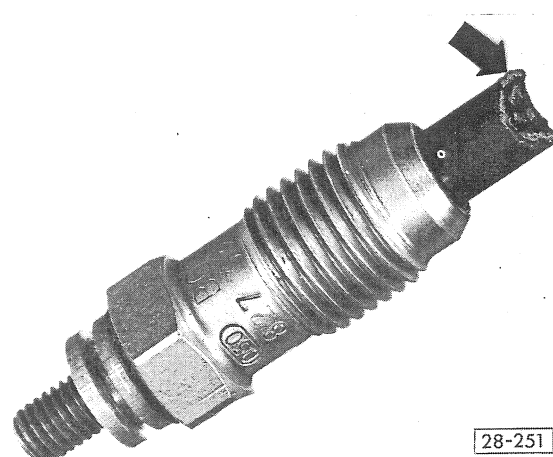
Note

The glow plugs and relay of quick glow system must not be combined with parts of normal system.

By replacing the glow plugs and the relay the normal system can be converted to the quick system.

Glow plugs with burnt electrodes

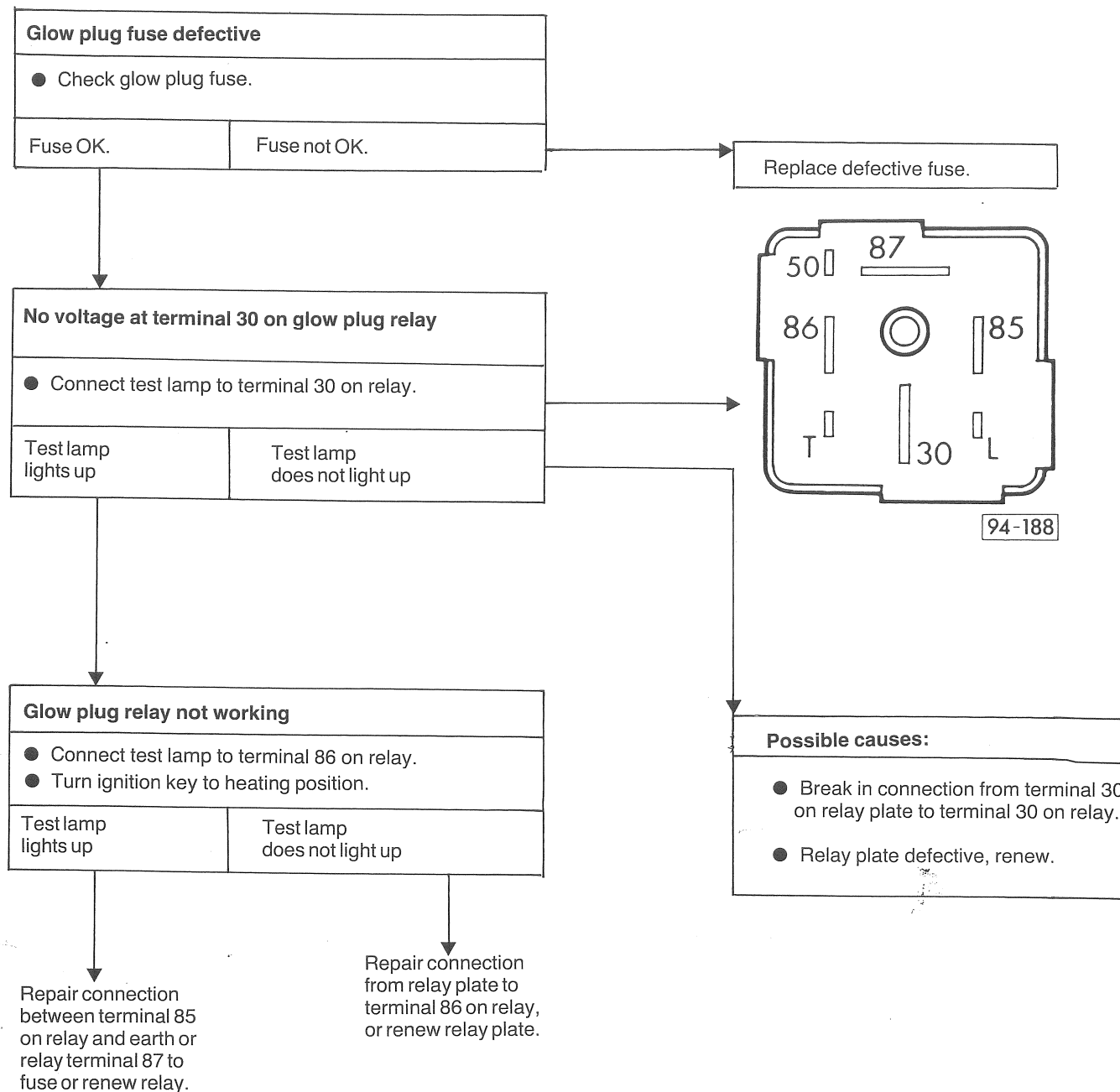
Burnt electrodes in glow plugs are frequently caused by faulty injectors. Damage of this nature is not due to faults in or on the glow plugs.



When damage of this nature is found – arrow – it is not sufficient merely to renew the glow plug. The injectors must also be tested for spray, noise, breaking pressure and leakage – see page 54.

Check particularly that the spray pattern is compact and well atomised when lever is operated with short rapid strokes (4–6 strokes per sec.).

28 Glow Plug System

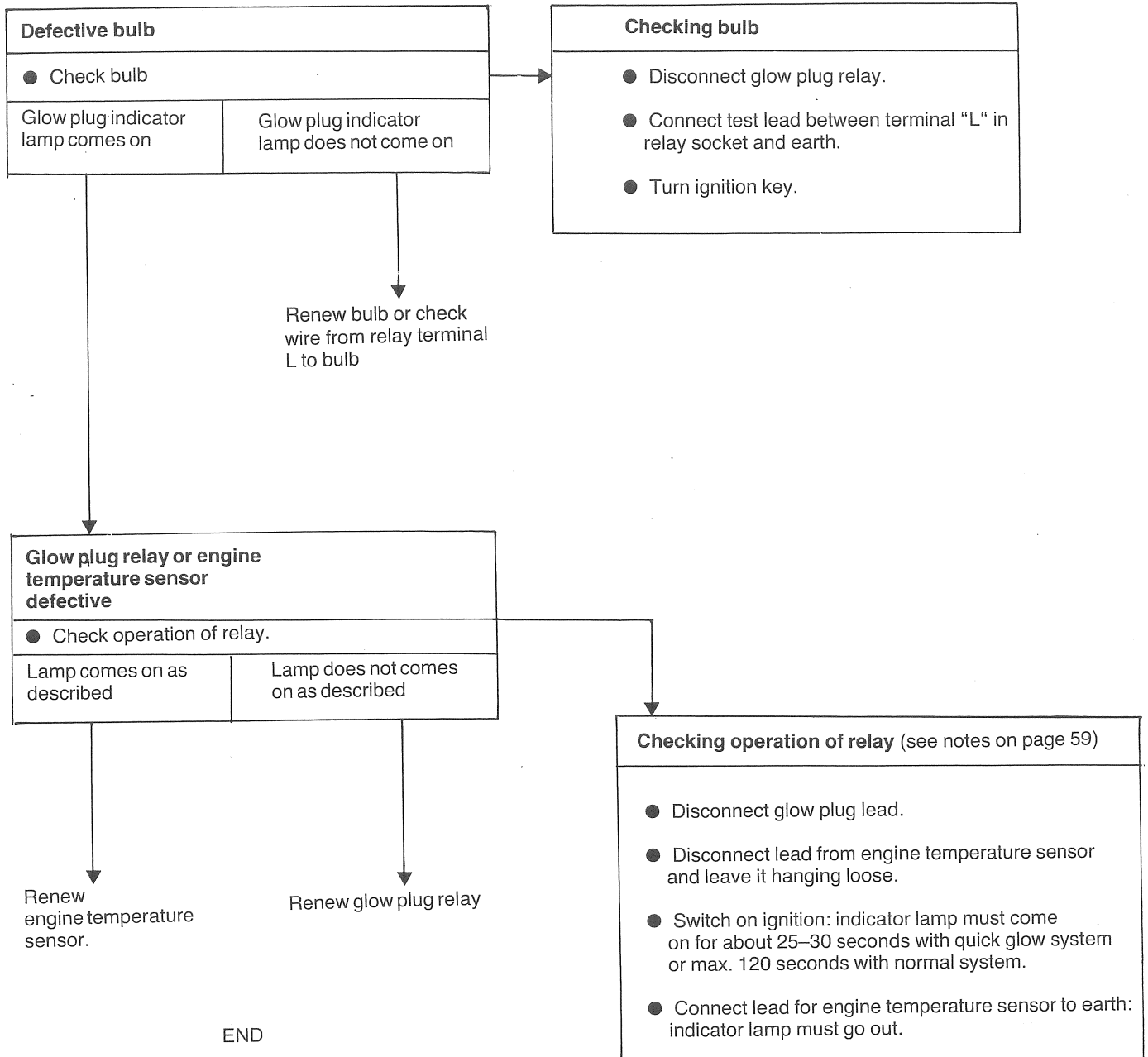


Note:

If the engine is difficult to start at any time, the operation of the automatic after-glow and the operation of the glow plugs while starting up should also be checked.

1. At the end of the pre-glow period, which depends on temperature (indicator goes out), there should be voltage at the glow plugs for another 6 to 7 seconds with the quick glow system or 10 to 25 seconds with the normal system. Do not operate starter motor for this test. If there is no voltage at the glow plugs, renew the relay.
2. When the starter motor is operating at coolant temperatures below 50°C there must be voltage at the glow plugs. If there is no voltage at the glow plugs, repair the wire from terminal 50 on the glow plug relay to the relay plate, or renew glow plug relay.
3. The wiring is shown in the appropriate current flow diagram.

GLOW PLUG INDICATOR LAMP DOES NOT COME ON



This manual is intended only for internal use within the V.A.G Organization and is not to be passed on to any other person or persons.

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