Workshop Manual
Golf - Jetta 2005 ➢

4-cylinder injection engine, 2005 ▸									
Engine ID	BHY								

Edition 09.2005

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Technical information should always be available to the forement and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

Contents

00 – Technical data

1 Technical data

Engine number ⇒ page 1 .

Engine data ⇒ page 1 .

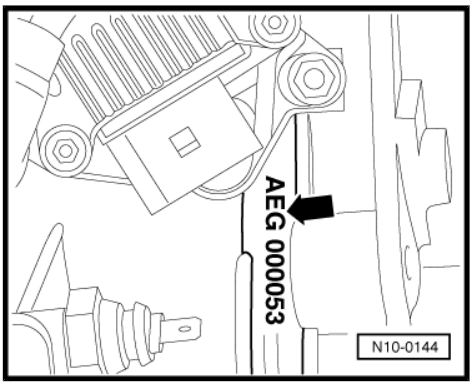
1.1 Engine number

The engine number (“engine code” and “serial number”) can be found at the front on the joint between engine and gearbox.

The engine number consists of up to nine characters (alphanumeric). The first part (maximum 3 characters) makes up the “engine code”, and the second part (6 characters), the “serial number”. If more than 999,999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.

In addition, there is a sticker on the toothed belt guard with “engine code” and “serial number”.

The engine code is also included on the vehicle data sticker.



1.2 Engine data

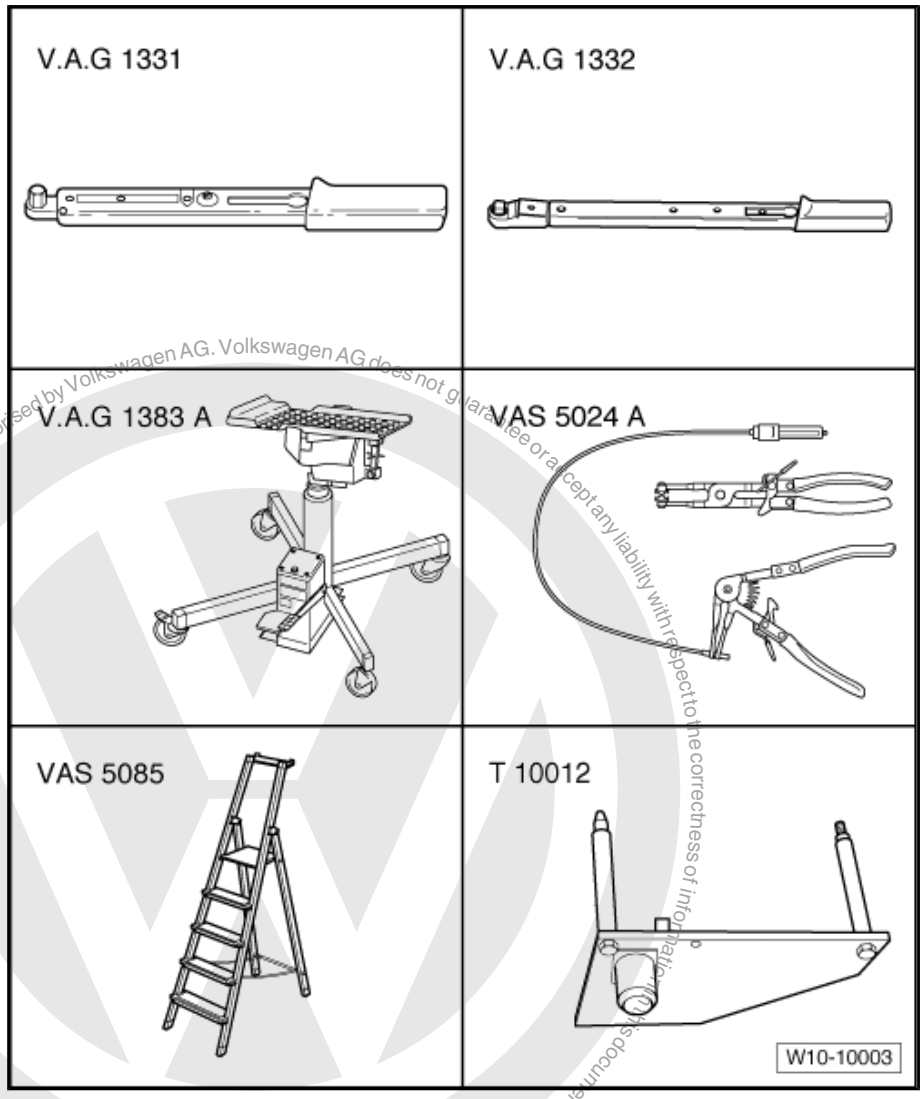
Engine code		BHY
Displacement	cc	1984
Output	kW at rpm	85/5200
Torque	Nm at rpm	175/4000
Bore	∅ mm	82.5
Stroke	mm	92.8
Compression ratio		10.5
RON	min.	Coast 95 unleaded
		Inland 91 unleaded
Injection, ignition		Bosch ME 7.5.1
Knock control		yes
Self-diagnosis		yes
Lambda regulation		yes
Catalytic converter		yes
Exhaust gas recirculation		no
Turbocharging/supercharging		no
Electronic power control		yes

10 – Removing and installing engine

1 Removing and installing engine

Special tools and workshop equipment required

- Torque wrench -V.A.G 1331-
- Torque wrench -V.A.G 1332-
- Engine-/gearbox jack -V.A.G 1383/A-
- Pliers -VAS 5024/A-
- Step ladder -VAS 5085-
- Engine bracket -T10012-
- Cable ties



Removing engine ⇒ page 2 .
Securing engine to assembly stand ⇒ page 7 .
Installing engine ⇒ page 8 .
Assembly mountings ⇒ page 10 .

1.1 Removing engine

Securing engine to assembly stand ⇒ page 7 .

Note

- *Before carrying out further work, disconnect battery earth strap. First check whether a coded radio is fitted. Obtain radio code first if necessary.*
- *The engine is removed downwards together with the gearbox.*
- *All cable ties which are opened or cut through when engine is removed must be replaced in the same position when engine is installed.*

Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to the cramped conditions:

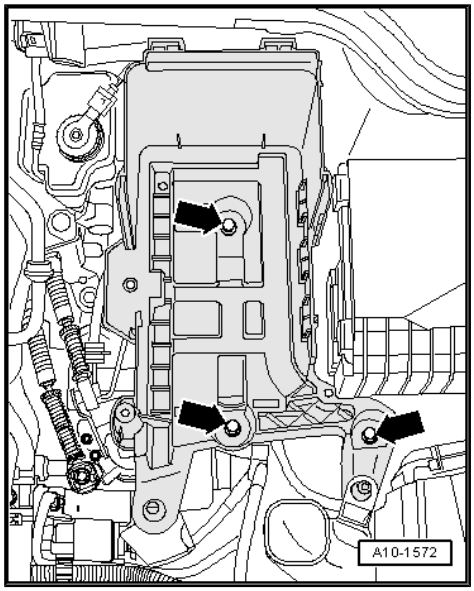
- ***Route all types of lines (e.g. for fuel, hydraulics, active charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***To avoid damage to lines, ensure sufficient clearance to all moving or hot components.***

– Disconnect earth strap at battery with ignition switched off ⇒ Electrical system; Rep. Gr. 27; Disconnecting and connecting battery.

– Remove engine cover.

– Remove air filter housing with connecting hoses.

– Remove battery and battery tray -arrows-.
– Remove top part of intake manifold.
– Remove plenum chamber bulkhead ⇒ General body repairs, exterior; Rep. Gr. 50 ; Body front; Plenum chamber bulkhead.
– Detach connectors from the following components:



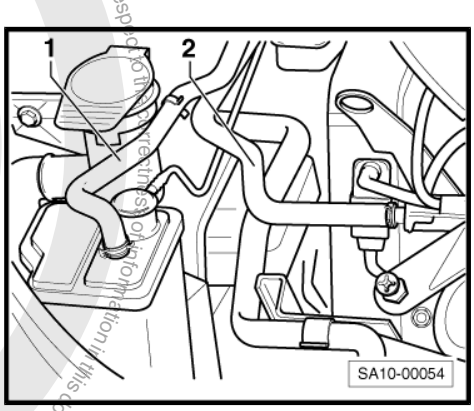
- Ignition transformer -N152-
- Injector for cylinder 1 -N30-
- Injector for cylinder 2 -N31-
- Injector for cylinder 3 -N32-
- Injector for cylinder 4 -N33-
- Coolant temperature sender -G62-
- Engine speed sender -G28-
- Knock sensor 1 -G61-
- Knock sensor 2 -G66-
- Secondary air pump motor -V101-
- Oil pressure switch -F1-
- Throttle valve control module -J338-
- If necessary A/C system shutoff thermal switch -F163-

– Pull engine wiring harness connector off engine control unit.
– Separate all connectors between engine wiring harness and body and lay engine wiring harness on engine.

WARNING

The fuel supply line is under pressure! Wear protective glasses and clothing to avoid injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

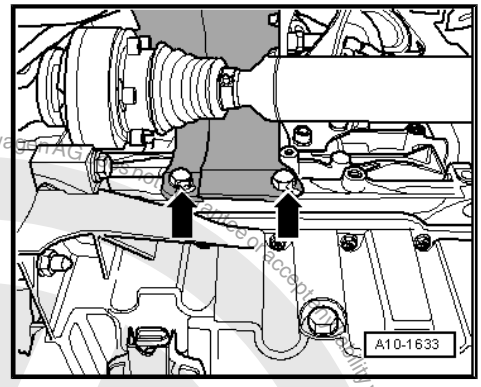
– Disconnect breather line -1-and fuel supply line -2-.



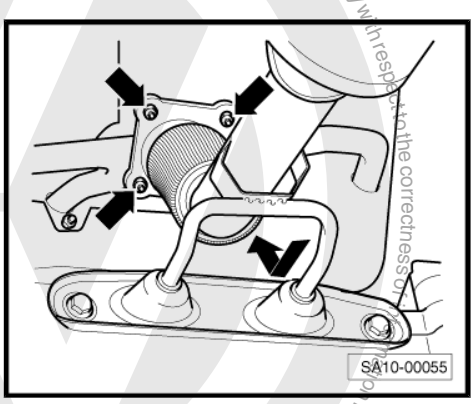
– Remove noise insulation tray ⇒ General body repairs, exterior; Rep. Gr. 50 ; Body front; Noise insulation.
– Bring lock carrier into service position ⇒ General body repairs; Rep. Gr. 50 ; Body front; Lock carrier service position .
– Drain coolant ⇒ page 69 .
– Remove left wheel housing liner.

– Unbolt heat shield for right-hand drive shaft -arrows-.

– Remove right drive shaft and then left drive shaft at gearbox ⇒ Running gear, axles, steering; Rep. Gr. 40 ; Removing and installing drive shaft .



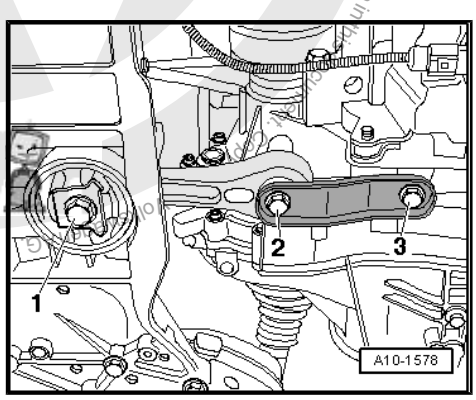
– Remove securing nuts -arrows- for front exhaust pipe/exhaust manifold and pull front exhaust pipe off exhaust manifold.



– Remove bolts -1, 2 and 3- and remove pendulum support.

– Pull off or disconnect all other electrical connections from engine and gearbox as necessary and lay to side.

– Separate all connection, coolant, vacuum and intake hoses from engine.



Vehicles with air conditioning

Note

To prevent damage to condenser or to refrigerant pipes and hoses, ensure that pipes and hoses are not stretched, kinked or bent.

To facilitate removing and installing engine without opening refrigerant circuit:

– Remove poly V-belt ⇒ page 16 .

– Separate air conditioner compressor from compact bracket ⇒ Heating, air conditioning; Rep. Gr. 87 ; Removing and installing compressor bracket .

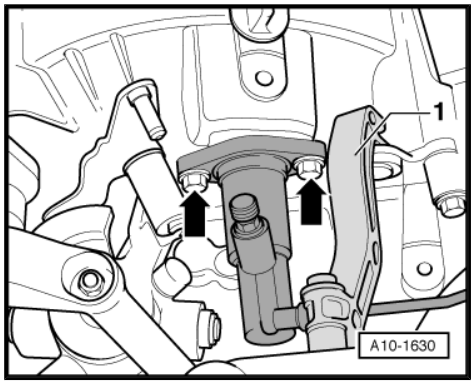
– Secure air conditioner compressor to lock carrier so that refrigerant lines are free of stress.

Vehicles with manual gearbox

– Remove selector mechanism from gearbox ⇒ Manual gearbox; Rep. Gr. 34 ; Repairing selector mechanism .

– Remove strut -1-.

– Remove slave cylinder -arrows- and lay to side. Do not open hydraulic system.



Caution

Do not operate clutch pedal after slave cylinder has been removed. This can damage the slave cylinder.

Vehicles with automatic gearbox

– Disconnect selector lever cable from gearbox ⇒ Automatic gearbox 09G; Rep. Gr. 37 ; Repairing selector mechanism .

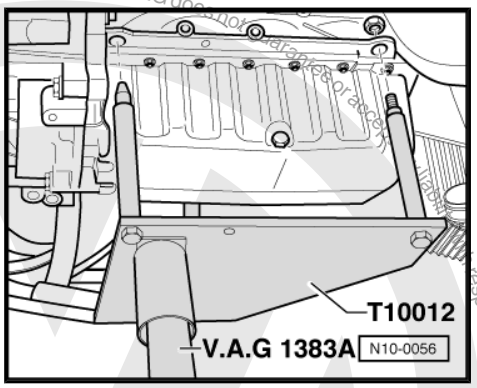
All vehicles (continued):

– Insert engine bracket -T10012- in engine-/gearbox jack -V.A.G 1383/A- .

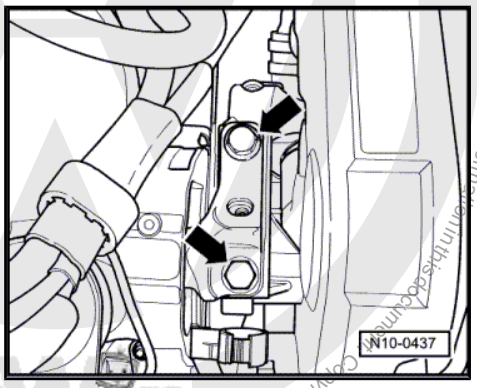
– Fit engine bracket -T10012- to front of cylinder block with M10x25/ 8.8 bolt.

– Tighten securing nut exhaust side by hand.

– Lift engine and gearbox slightly using engine-/gearbox jack -V.A.G 1383/A- .



– From above, unbolt engine side of assembly mounting from engine bracket -arrows-.

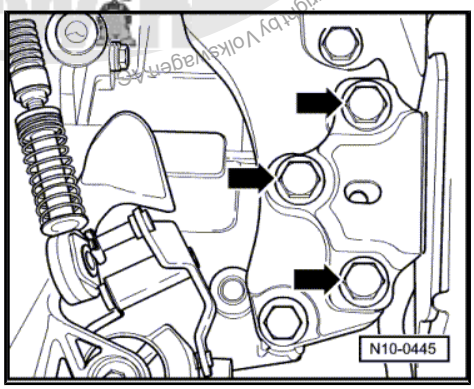


Note

To remove securing bolts, use stepladder -VAS 5085- .

– From above, unbolt gearbox side of assembly mounting from gearbox bracket -arrows-.

– Carefully lower engine with gearbox.



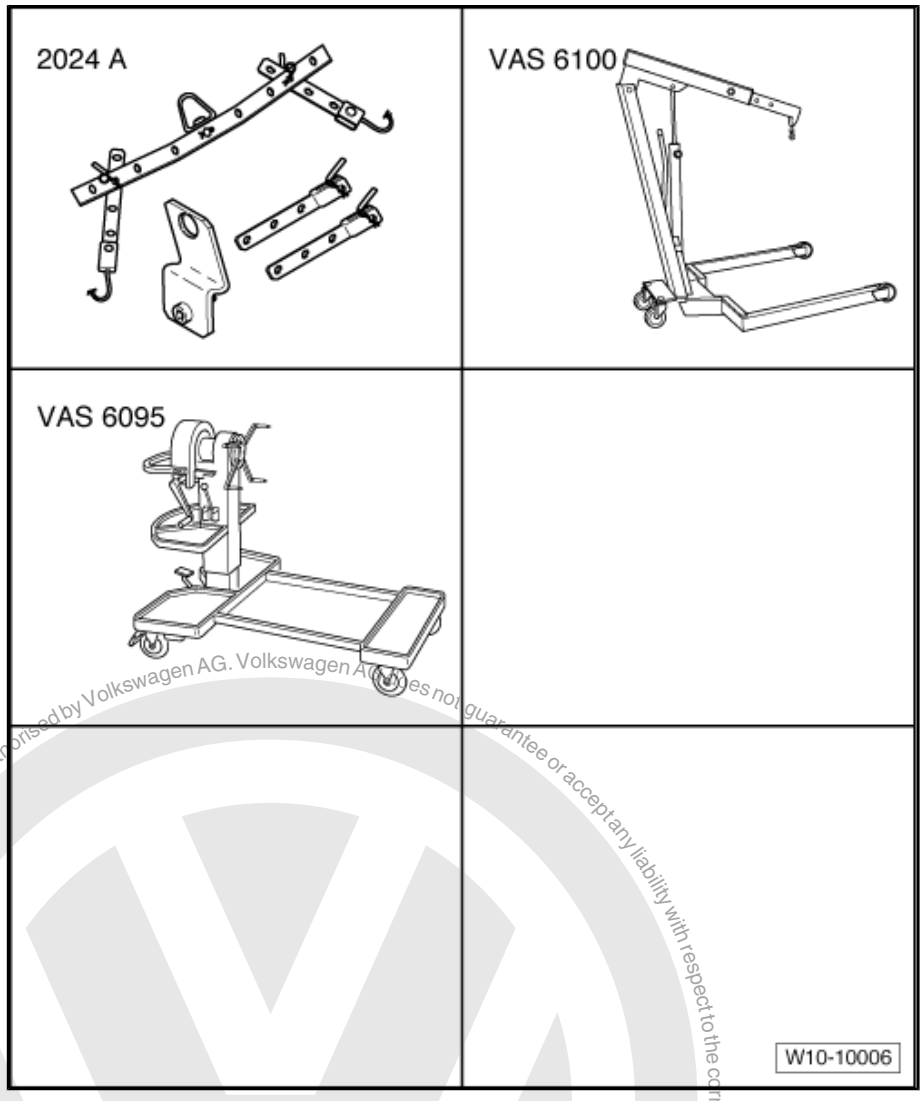
Note

Engine and gearbox must be guided carefully when lowering to prevent damage to the bodywork, hoses and lines.

1.1.1 Securing engine to assembly stand

Special tools and workshop equipment required

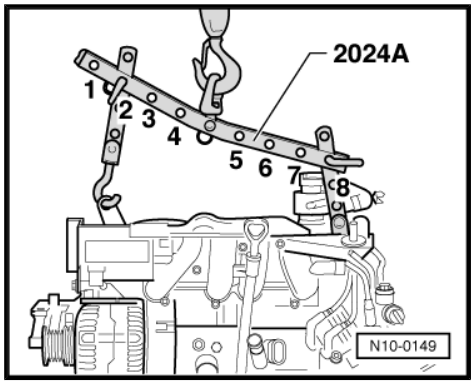
- Lifting appliance -VAS 2024A-
- Workshop crane -VAS 6100-
- Engine and gearbox support -VAS 6095-



– Secure engine on engine and gearbox support -VAS 6095- to carry out repairs.

– Remove gearbox.

– Attach lifting appliance -VAS 2024A- as follows and lift from engine-/gearbox jack -V.A.G 1383/A- using workshop crane -VAS 6100- .



Pulley end: 3rd hole in hook at position 2.

Flywheel end: 3rd hole in hook at position 8.

Caution

Use securing pins on hooks and locking pins to avoid damage to engine and vehicle.

- The positions marked 1...4 on the bar must be towards the pulley end.
- The holes in the hooks are counted up from the hook.

– Secure engine to engine and gearbox support -VAS 6095- .

1.2 Installing engine

Assembly mountings ⇒ page 10 .

Installation is carried out in the reverse order. When installing, note the following:

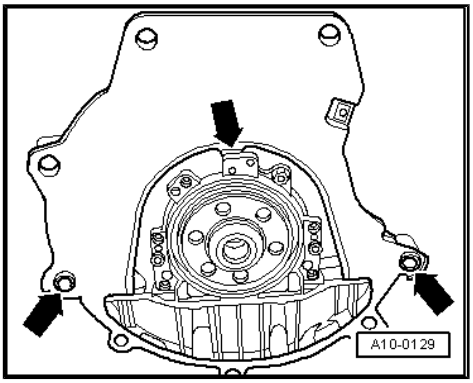
Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to the cramped conditions:

- ***Route all types of lines (e.g. for fuel, hydraulics, active charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***To avoid damage to lines, ensure sufficient clearance to all moving or hot components.***

– Insert new dowel sleeves in cylinder block for centering engine and gearbox.

– Hook intermediate plate onto sealing flange and slide onto dowel sleeves -arrows-.



Vehicles with manual gearbox

– Lightly grease input shaft splines with grease -G 000 100- .

– Check clutch and clutch control and install ⇒ Manual gearbox; Rep. Gr. 30 ; Repairing clutch control .

Continuation for all vehicles

– When installing engine and gearbox assembly, ensure sufficient clearance to subframe and radiator.

– Align engine mountings tension free by shaking. If necessary, loosen engine mounting on body.

– Install pendulum support.

Note

♦ *Torque settings for engine and gearbox mountings* *⇒ page 10* .

♦ *Electrical connections and routing ⇒ Electrical system; Rep. Gr. 97 .*

– Install right-hand drive shaft and bolt or slot left-hand drive shaft onto gearbox ⇒ Running gear; Rep. Gr. 40 ; Removing and installing drive shaft .

Vehicles with manual gearbox

– Install selector mechanism and adjust mechanism if necessary ⇒ Manual gearbox; Rep. Gr. 34 ; Repairing selector mechanism .

– Install slave cylinder for hydraulic clutch ⇒ Manual gearbox; Rep. Gr. 30 ; Repairing clutch mechanism; Assembly overview - hydraulics .

Vehicles with automatic gearbox

– Install selector lever cable and adjust if necessary ⇒ Automatic gearbox 09G; Rep. Gr. 37 ; Repairing selector mechanism .

All vehicles (continued):

– Install air conditioner compressor ⇒ Heating, air conditioning; Rep. Gr. 87 ; Removing and installing compressor bracket .

– Install poly V-belt ⇒ page 16 .

– Install sound insulation tray ⇒ General body repairs, exterior; Rep. Gr. 50 ; Body front; Assembly overview .

– Install plenum chamber bulkhead ⇒ General body repairs, exterior; Rep. Gr. 50 ; Body front; Plenum chamber bulkhead .

– Fill coolant system with coolant ⇒ page 71 .

– Adapt engine control unit ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .

– Carry out road test and then read fault memory.

Torque settings

Threaded connection		Torque setting
Bolts, nuts	M 6	10 Nm
	M 7	15 Nm
	M 8	25 Nm
	M 10	40 Nm
	M 12	60 Nm

1.2.1 Assembly mountings

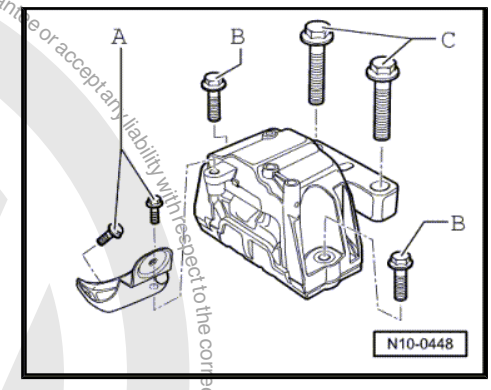
Engine assembly mounting

A[1)] = 20 Nm + 1/4 turn (90 °) further

B[1)] = 40 Nm + 1/4 turn (90 °) further

C[1)] = 60 Nm + 1/4 turn (90 °) further

1) Renew

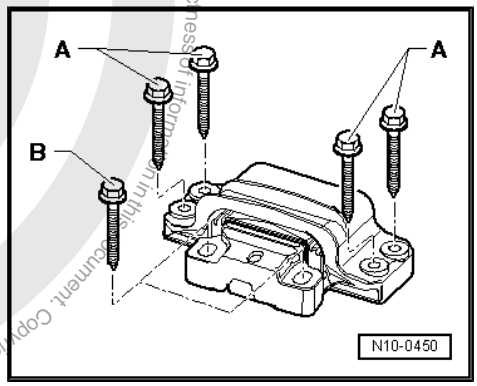


Gearbox assembly mounting

A[2)] = 40 Nm + 1/4 turn (90 °) further

B[2)] = 60 Nm + 1/4 turn (90 °) further

2) Renew

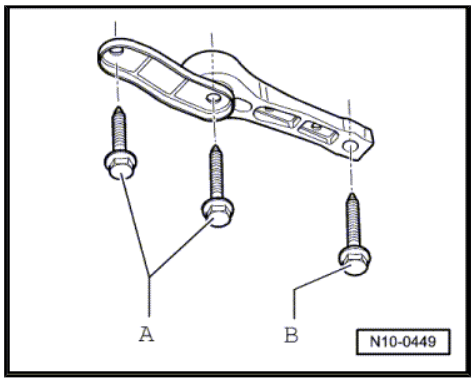


Pendulum support

A[3)] = 40 Nm + 1/4 turn (90 °) further

B[3)] = 100 Nm + 1/4 turn (90 °) further

3) Renew



13 – Crankshaft group

1 Dismantling and assembling engine

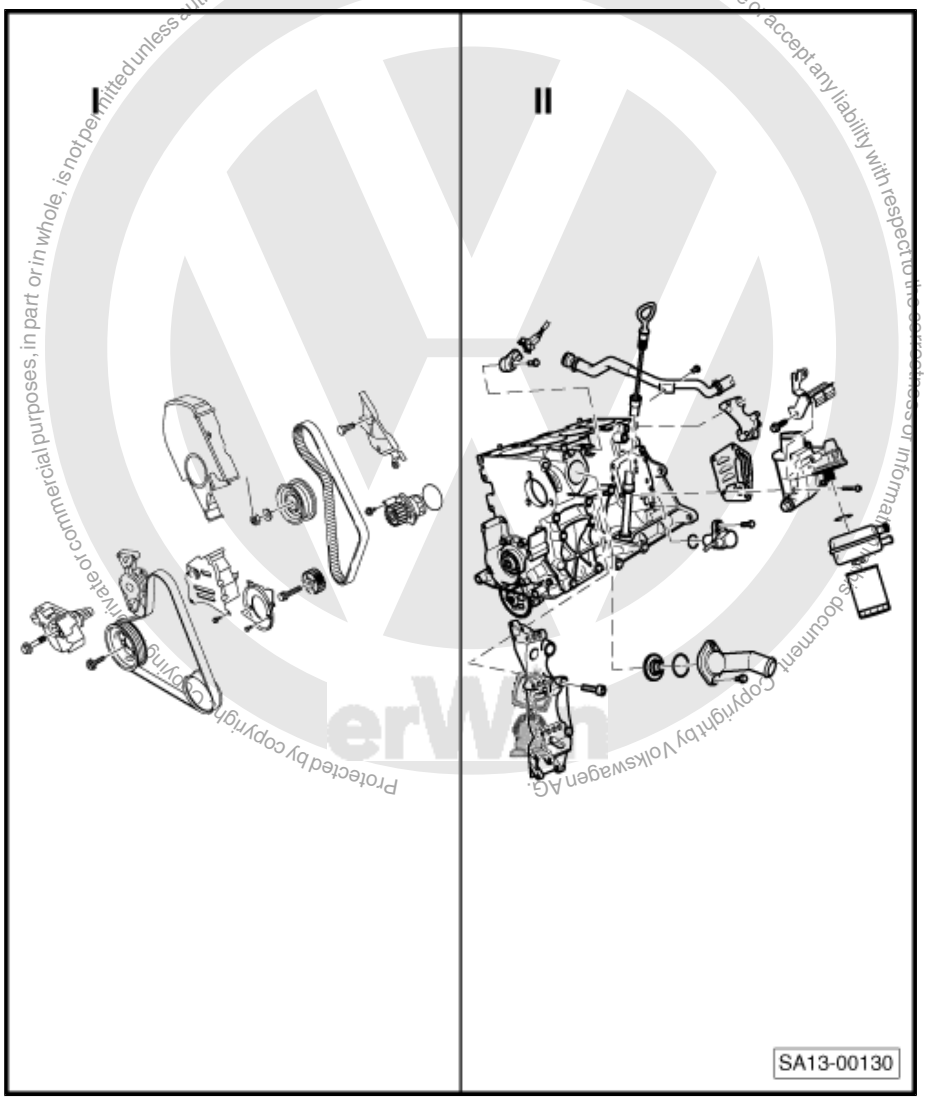
Note

- *Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent subsequent damage, perform the following after repairs:*
- *Thoroughly clean oil channels.*
- *Renew oil spray jets.*
- *Renew oil cooler.*
- *Renew oil filter.*

Assembly overview ⇒ page 12 .

Removing and installing poly V-belt ⇒ page 15 .

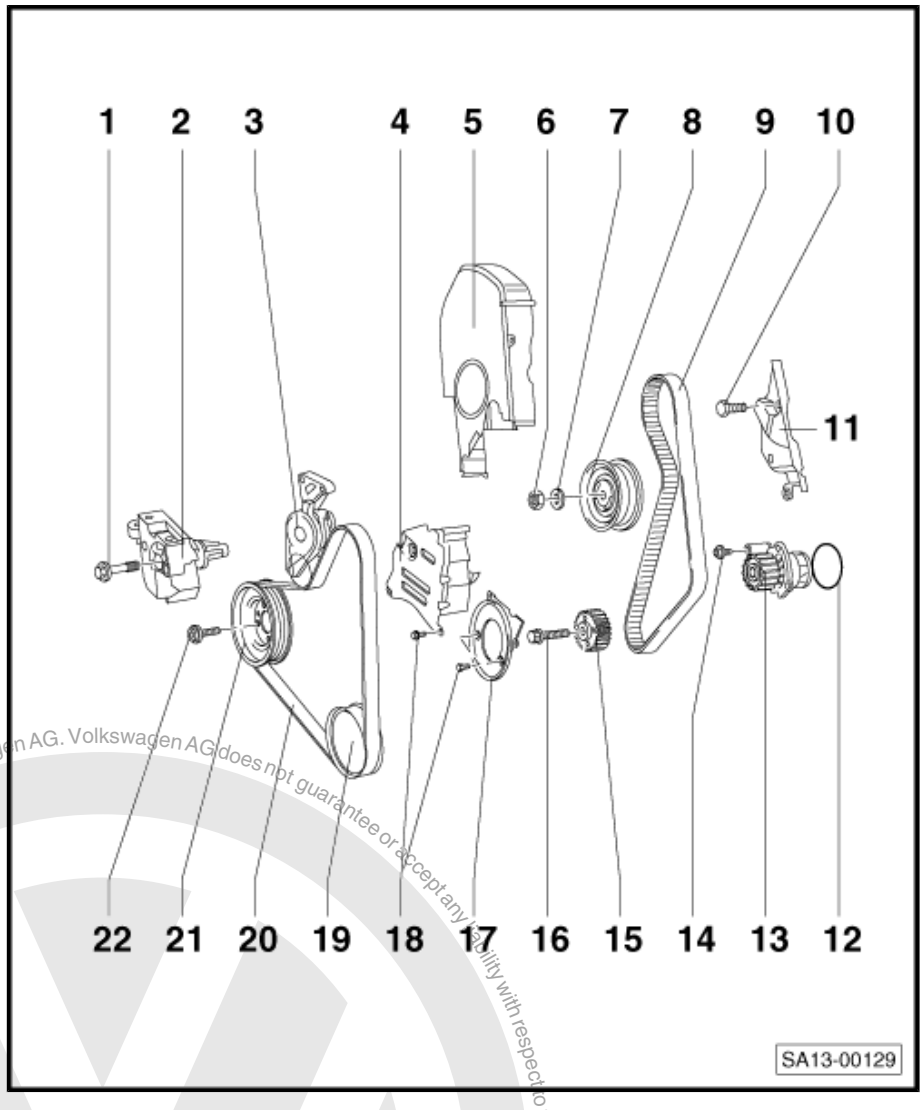
1.1 Assembly overview



Part I ⇒ page 13

Part II ⇒ page 14

1.1.1 Part I



1 - Bolt
- ❑ 45 Nm

2 - Engine bracket

3 - Poly V-belt tensioner
- ❑ Swivel with open jaw spanner to slacken poly V-belt ⇒ page 15

4 - Toothed belt guard - centre part

5 - Toothed belt guard - upper part

6 - Nut
- ❑ 20 Nm

7 - Washer

8 - Tensioning roller
- ❑ Checking semi-automatic toothed belt tensioning roller ⇒ page 33

9 - Toothed belt
- ❑ Mark direction of rotation before removing
- ❑ Check for wear
- ❑ Do not kink
- ❑ Removing, installing and tensioning ⇒ page 28

10 - Bolt
- ❑ 20 Nm

11 - Rear toothed belt guard

12 - O-ring
- ❑ Renew

13 - Coolant pump
- ❑ Check for ease of movement
- ❑ If damaged or leaking, renew complete
- ❑ Removing and installing ⇒ page 72

14 - Bolt
- ❑ 15 Nm

15 - Crankshaft belt pulley

16 - Bolt
- ❑ 90 Nm + 1/4 turn (90 °) further
- ❑ Renew
- ❑ Threads and shoulder must be free of oil and grease
- ❑ Use counterhold tool -3415- to loosen and tighten

17 - Toothed belt guard - lower part

18 - Bolts

- ❑ 10 Nm
- ❑ Renew

19 - Pulley

- ❑ For aircon

20 - Poly V-belt

- ❑ Mark direction of rotation before removing
- ❑ Check for wear
- ❑ Do not kink
- ❑ Removing and installing ⇒ page 15

21 - Pulley and vibration damper

- ❑ Can only be installed in one position, holes are offset
- ❑ Note position when installing toothed belt ⇒ page 28

22 - Bolt

- ❑ 25 Nm

1.1.2 Part II

1 - Knock sensor 1 -G61-

- ❑ Gold-plated contacts

2 - Connector

- ❑ Knock sensor 1 -G61-
- ❑ Gold-plated contacts
- ❑ Do not interchange ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

3 - Bolt

- ❑ 20 Nm
- ❑ The torque setting influences the function of the knock sensor

4 - Coolant pipe

5 - Oil dipstick

- ❑ The oil level must not be above the max. mark!
- ❑ Markings ⇒ page 57

6 - Bolt

- ❑ 10 Nm

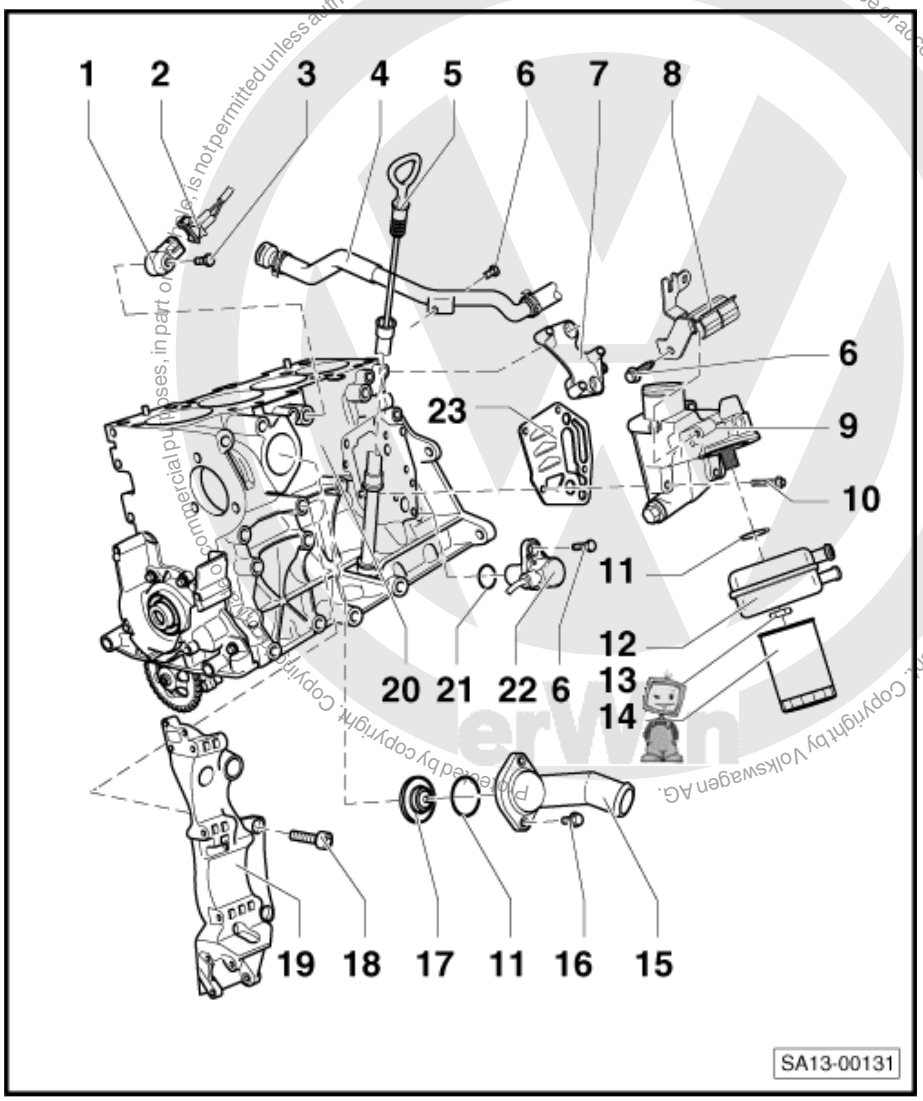
7 - Bracket

- ❑ For ignition coil

8 - Bracket

9 - Oil filter bracket

- ❑ Dismantling and assembling ⇒ page 59



10 - Bolt

- ❑ 15 Nm + 1/4 turn (90 °) further
- ❑ Renew

11 - O-ring

- ❑ Renew

12 - Oil cooler

- ❑ Coat contact surface to oil filter bracket outside the seal with sealing paste -AMV 188 100 02-
- ❑ Ensure clearance to adjacent components

13 - Nut

- ❑ 25 Nm

14 - Oil filter

- ❑ Loosen with strap wrench
- ❑ Tighten by hand
- ❑ Observe installation instructions on oil filter

15 - Connection

16 - Bolt

- ❑ 15 Nm

17 - Thermostat

- ❑ Checking: heat thermostat in water
- ❑ Opening begins at approx. 86° C
- ❑ Opening lift min. 7 mm
- ❑ Removing and installing ⇒ page 74

18 - Bolt

- ❑ 45 Nm

19 - Compact bracket

- ❑ For poly V-belt tensioner, alternator and air conditioner compressor

20 - Cylinder block

- ❑ Removing and installing sealing flange and flywheel/drive plate
- ❑ Removing and installing crankshaft ⇒ page 24
- ❑ Dismantling and assembling pistons and conrods

21 - O-ring

- ❑ Renew if damaged

22 - Engine speed sender

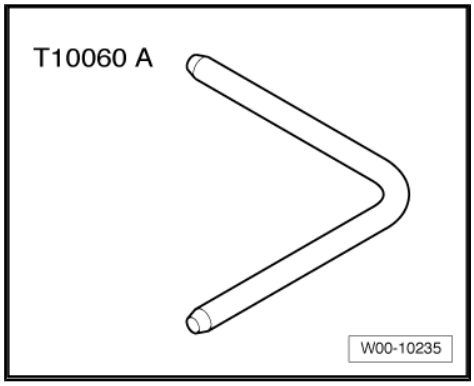
23 - Gasket

- ❑ Renew

1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

♦ Mandrel -T10060A-

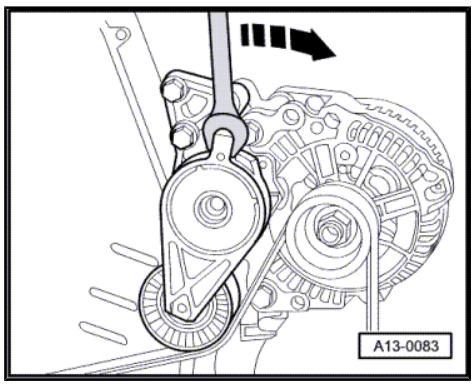


1.2.1 Removing poly V-belt

– Remove right-hand insulation tray: ⇒ Rep. Gr. 50 .

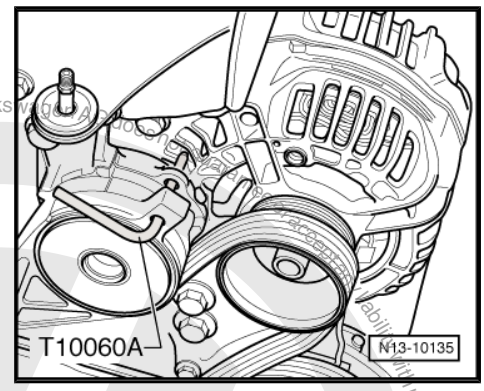
– Mark direction of rotation of poly V-belt.

– Swing tensioning device in direction of -arrow- to relieve tension on poly V-belt.



– Lock tensioning element using locking pin -T10060A- .

– Remove poly V-belt.



1.2.2 Installing poly V-belt

– Installation is carried out in the reverse sequence of removal.

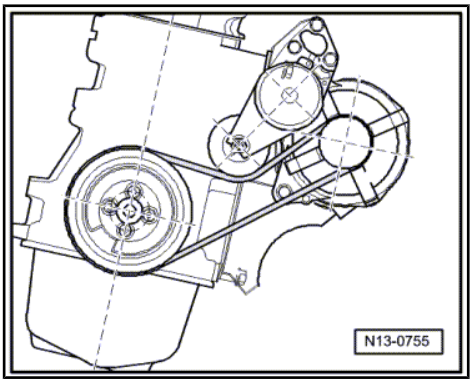
Note

- *Before installing poly V-belt, ensure that all ancillary assemblies (alternator, air conditioner compressor) are secured tightly.*
- *When fitting poly V-belt, check direction of belt rotation and proper seating of belt in pulleys.*
- *For vehicles without air conditioning, fit poly V-belt on alternator last.*
- *For vehicles with air conditioning, fit poly V-belt on air conditioner compressor last.*

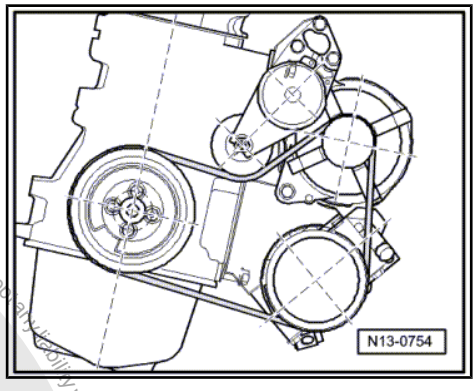
After completing repairs always:

– Start engine and check belt running.

Belt drive without air conditioner compressor.



Belt drive with air conditioner compressor.

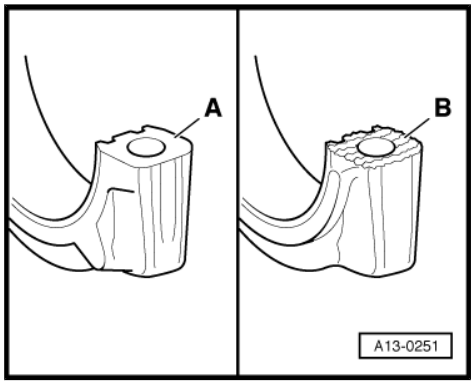


2 Dismantling and assembling pistons and conrods

Gradual introduction of industrially cracked conrods.

Identification:

- -A- conventional conrods (smooth joining surface)
- -B- industrially cracked conrods (rough joining surface)



Assembly overview - Pistons and conventional conrods
⇒ page 19 .

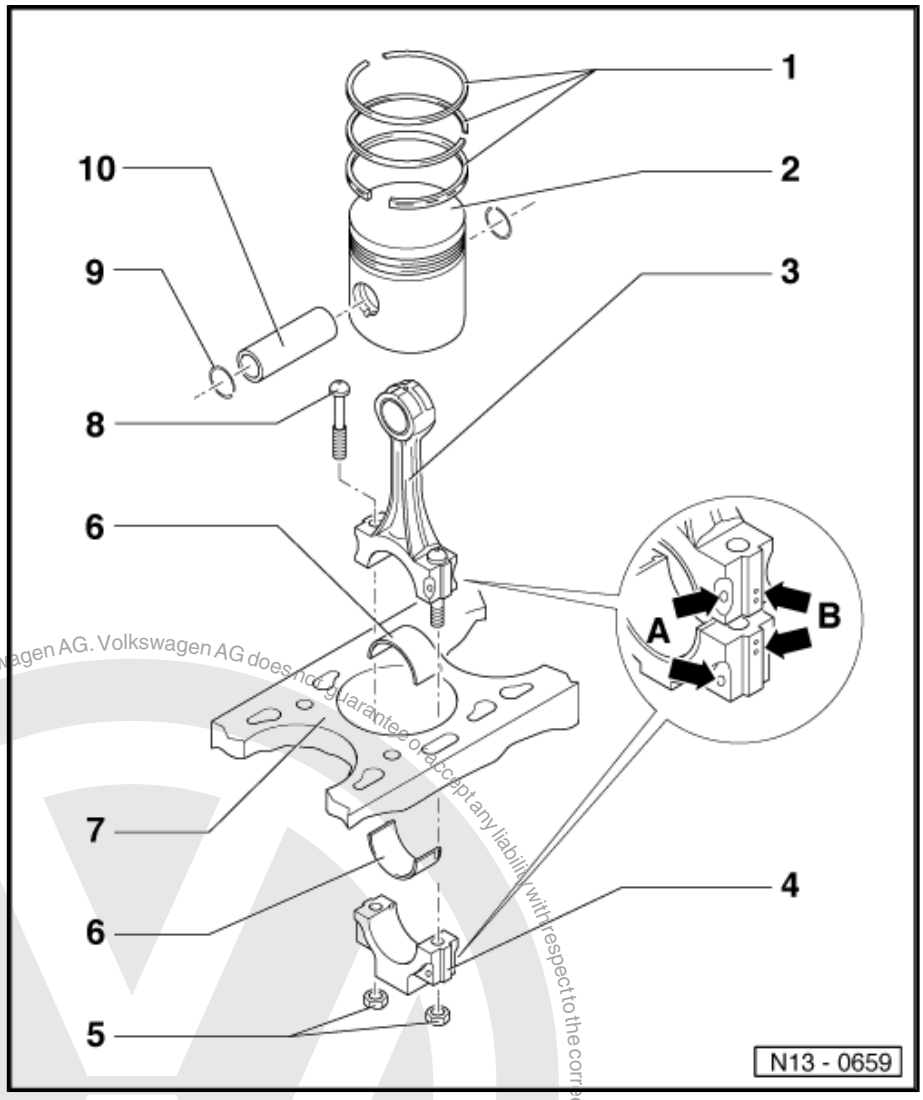
Assembly overview - Pistons and industrially cracked conrods
⇒ page 20 .

2.1 Assembly overview - Pistons and conrods

Conventional conrods ⇒ page 19 .

Industrially cracked conrods ⇒ page 20 .

2.1.1 Conventional conrods



1 - Piston rings

- ❑ Offset gaps by 120°
- ❑ Remove and install using piston ring pliers
- ❑ “TOP” faces towards piston crown
- ❑ Checking ring gap ⇒ page 21

2 - Piston

- ❑ Checking ⇒ page 22
- ❑ Mark installation position and cylinder number
- ❑ Arrow on piston crown points to pulley end
- ❑ Oil scraper ring, 2 part
- ❑ Checking ring-to-groove clearance ⇒ page 21
- ❑ Install using piston ring clamp

3 - Conrod

- ❑ Renew as set only
- ❑ Mark cylinder number -B-
- ❑ Installation position: marking -A- faces towards pulley end

4 - Conrod bearing cap

- ❑ Mark cylinder number -B-
- ❑ Installation position: marking -A- faces towards pulley end

5 - Nuts

- ❑ 30 Nm + $^1/_4$ turn (90 °) further
- ❑ Renew
- ❑ Oil threads and contact surface
- ❑ To measure radial clearance, tighten to 30 Nm but not further

6 - Bearing shell

- ❑ Note installation position
- ❑ Do not interchange used bearing shells
- ❑ Ensure retaining lug fits tightly in recess
- ❑ Upper bearing shell with oil drilling for piston pin lubrication
- ❑ Axial clearance new: 0.05...0.31 mm, wear limit: 0.37 mm
- ❑ Check radial clearance with Plastigage: new: 0.01...0.06 mm, wear limit: 0.12 mm. Do not rotate crankshaft when checking radial clearance

7 - Cylinder block

- ❑ Checking cylinder bores ⇒ page 23
- ❑ Piston and cylinder dimensions ⇒ page 23

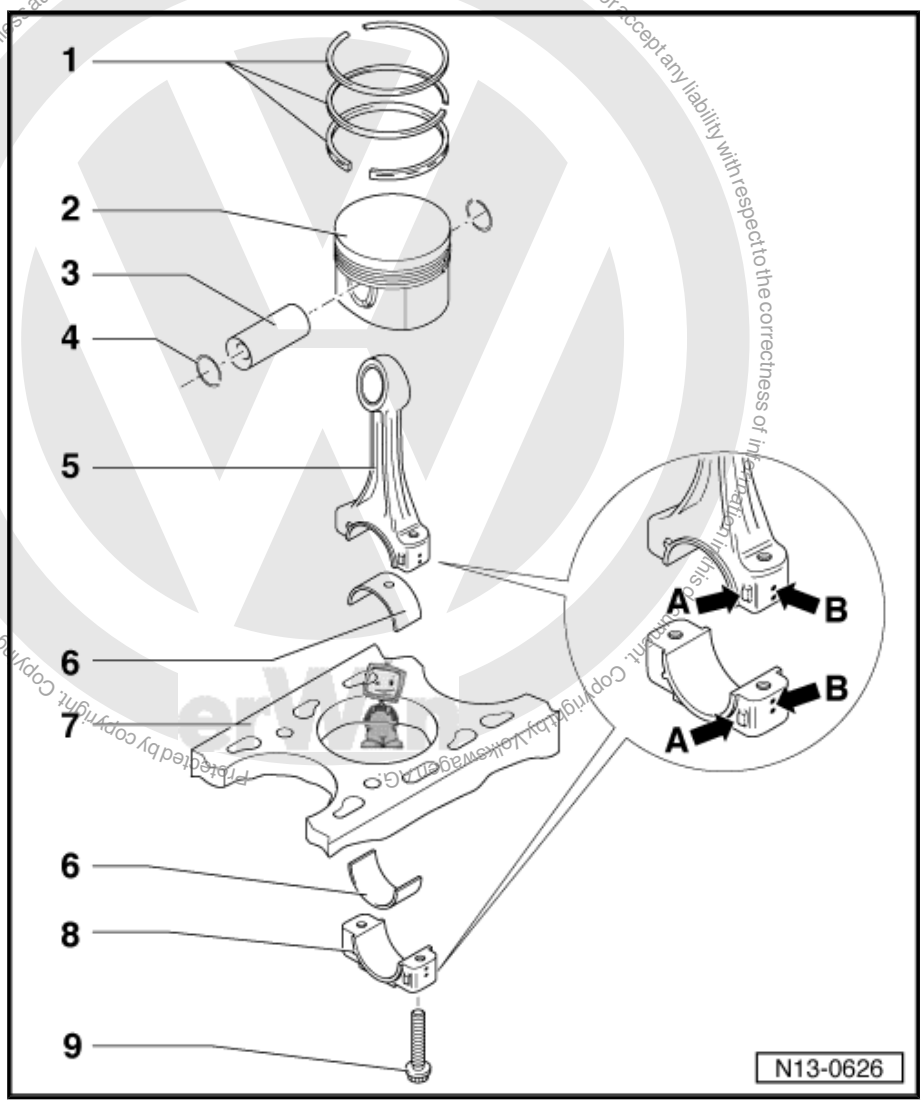
8 - Conrod bolt

9 - Circlip

10 - Piston pin

- ❑ If difficult to remove, heat piston to 60 °C
- ❑ Remove and install with drift -VW 222A-

2.1.2 Industrially cracked conrods



1 - Piston rings

- ❑ Offset gaps by 120°
- ❑ Remove and install using piston ring pliers
- ❑ “TOP” faces towards piston crown
- ❑ Checking ring gap ⇒ page 21
- ❑ Checking ring-to-groove clearance ⇒ page 21

2 - Piston

- ❑ Checking ⇒ page 22
- ❑ Mark installation position and cylinder number
- ❑ Arrow on piston crown points to pulley end
- ❑ Install using piston ring clamp

3 - Piston pin

- ❑ If difficult to remove, heat piston to 60° C
- ❑ Remove and install with drift -VW 222A-

4 - Circlip

5 - Conrod

- ❑ With industrially cracked bearing caps
- ❑ Renew as set only
- ❑ Mark cylinder number -B-
- ❑ Installation position: marking -A- faces towards pulley end

6 - Bearing shell

- ❑ Note installation position ⇒ page 22
- ❑ Insert bearing shells centrally
- ❑ Do not interchange used bearing shells
- ❑ Check for secure seating
- ❑ Axial clearance new: 0.10...0.35 mm, wear limit: 0.4 mm
- ❑ Check radial clearance with Plastigage: new: 0.01...00.05 mm, wear limit: 0.12 mm. Do not rotate crankshaft when checking radial clearance

7 - Cylinder block

- ❑ Checking cylinder bores ⇒ page 23
- ❑ Piston and cylinder dimensions ⇒ page 23

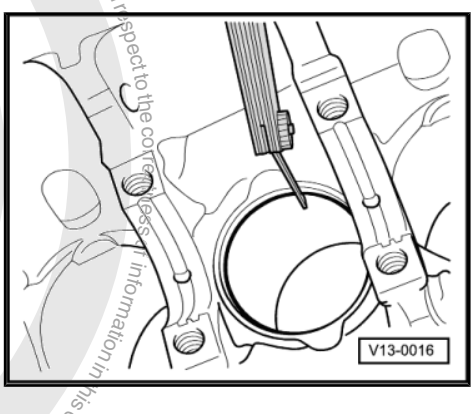
8 - Conrod bearing cap

- ❑ Note installation position
- ❑ The caps only fit in one position and only on the appropriate conrod due to the breaking procedure (cracking) separating the cap from the conrod

9 - Bolt

- ❑ 30 Nm + $^1/_4$ turn (90 °) further
- ❑ Torx T10
- ❑ Renew
- ❑ Oil threads and contact surface
- ❑ To measure radial clearance, tighten to 30 Nm but not further

2.2 Checking pistons, piston rings and cylinder bores



Checking piston ring gap

Special tools and workshop equipment required

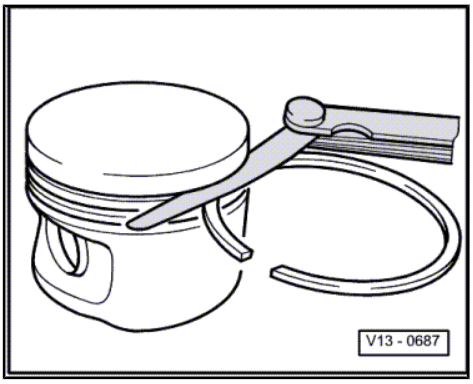
♦ Feeler gauges

Test sequence:

– Push ring squarely from above down to approx. 15 mm from bottom end of cylinder.

Piston ring		Gap	
		New	Wear limit
Compression rings (top)	mm	0.15…0.35	0.8
Compression rings (bottom)	mm	0.40...0.40	0.8
Oil scraper ring	mm	0.20…0.70	0.9

Checking ring-to-groove clearance



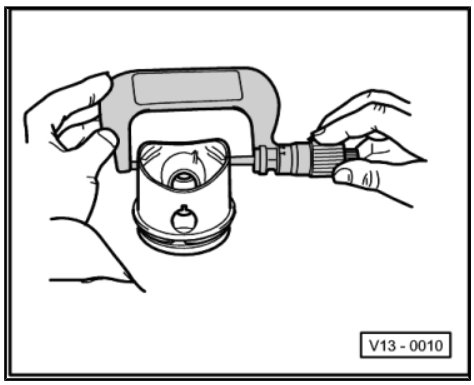
Special tools and workshop equipment required

♦ Feeler gauges

Clean groove before check.

Piston ring		Ring-to-groove clearance	
		New	Wear limit
Top compression rings	mm	0.04…0.075	0.15
Middle compresion rings	mm	0.02...0.055	0.15
Oil scraper ring	mm	0.05…0.13	0.20

Checking piston



Special tools and workshop equipment required

♦ External micrometer 75...100 mm

Measure pistons approx. 10 mm from the lower edge of skirt, at 90° to the piston pin axis.

Deviation from nominal dimension max. 0.04 mm.

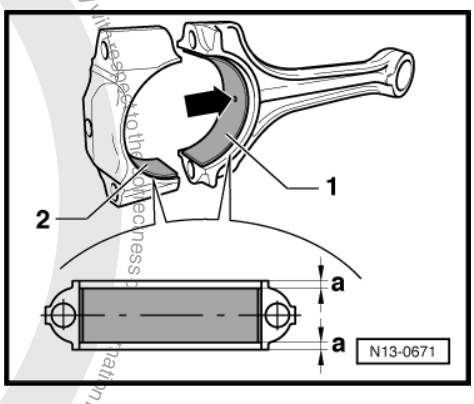
Bearing shells - installation position

Bearing shell -1- with oil hole -arrow- for conrod.

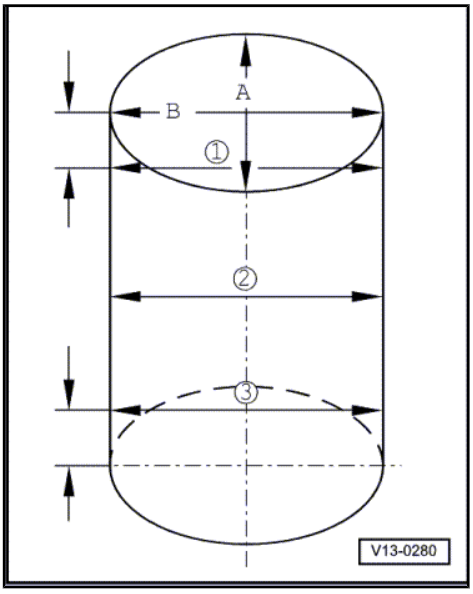
Bearing shell -2- without oil hole for conrod bearing cap.

– Fit bearing shells in centre of conrod and conrod cap.

Dimension -a- must be the same on the left and right, max. deviation: 0.2 mm.



Checking cylinder bores



Special tools and workshop equipment required

- Cylinder gauge 50...100 mm
- Measure at 3 positions both across -A- and in-line with engine -B-
- Deviation from nominal dimension max. 0.08 mm

Note

Cylinder bores must not be measured when cylinder block is mounted on a repair stand with engine and gearbox support -VW 540- , as measurements may then be incorrect.

2.3 Piston and cylinder dimensions

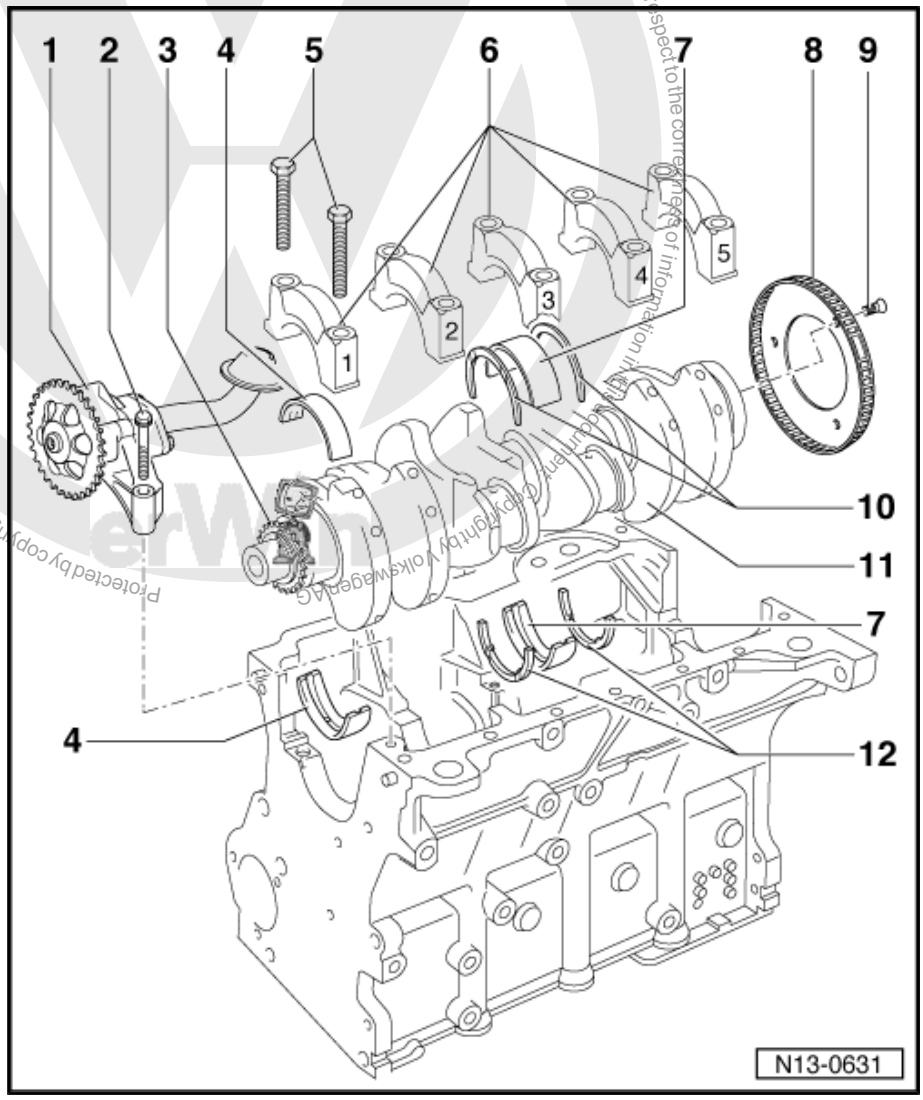
Honing dimension		Piston Ø	Cylinder bore Ø
Basic dimension	mm	82.465 (± 0.009)[4)]	82.50 (+0.015 +0.005)
1st oversize	mm	82.965[4)]	83.01

4) Dimension without graphite coating (thickness 0.02 mm). The graphite coating wears away.

3 Removing and installing crankshaft

Note

- *Before removing crankshaft, ensure that a suitable surface for storing crankshaft is prepared so that sender wheel (⇒ Item 8 (page 24)) does not contact anything and cannot be damaged.*
- *When working on engine, secure to repair stand using engine and gearbox support -VW 540- and supplementary kit -VW 540/1B- .*



1 - Oil pump

- ❑ With 12 bar pressure relief valve
- ❑ Before installing, check that both dowel sleeves for centring oil pump on cylinder block are fitted
- ❑ Removing and installing ⇒ page 56

2 - Bolt

- ❑ 15 Nm

3 - Sprocket

- ❑ For oil pump drive

4 - Bearing shells 1, 2, 3, 4 and 5

- ❑ Classification for ordering spare parts ⇒ page 25
- ❑ For bearing cap without oil groove
- ❑ For cylinder block with oil groove
- ❑ Do not interchange used bearing shells (mark)

5 - Bolts

- ❑ 65 Nm +90 ° ($^1/_4$turn) further
- ❑ Renew
- ❑ Threaded along complete length
- ❑ Tighten crankshaft to 65 Nm when measuring radial clearance

6 - Bearing cap

- ❑ Bearing cap 1: Pulley end
- ❑ Bearing cap 3 with recesses for thrust washers
- ❑ Bearing shell retaining lugs in cylinder block and bearing caps must be on the same side

7 - Bearing shell 3

- ❑ ⇒ Item 4 (page 24)
- ❑ Do not interchange used bearing shells (mark)

8 - Sender wheel

- ❑ Renew

- ❑ Engine speed sender -G28-
- ❑ Can only be installed in one position, holes are offset

9 - Bolt

- ❑ 10 Nm + $^1/_4$ turn (90 °) further
- ❑ Renew

10 - Thrust washer

- ❑ For bearing cap, bearing 3
- ❑ Note fixing arrangement
- ❑ Lettering faces bearing pedestal

11 - Crankshaft

- ❑ Axial clearance new: 0.07...0.23 mm, wear limit: 0.30 mm
- ❑ Check radial clearance with Plastigage, new: 0.01...0.04 mm, wear limit: 0.15 mm
- ❑ Do not rotate crankshaft when checking radial clearance
- ❑ Crankshaft dimensions ⇒ page 25

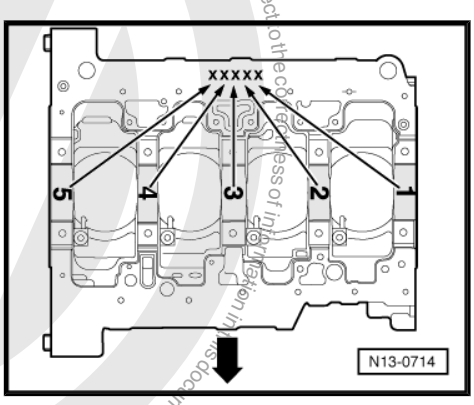
12 - Thrust washer

- ❑ For cylinder block, bearing 3
- ❑ Lettering faces bearing pedestal

Identification for upper main bearing shell (gradual introduction)

Upper main bearing shells of the proper thickness are allocated to the cylinder block in the factory. Coloured spots serve to identify the thickness of the bearing shells.

Which bearing thickness is to be used at each place is marked by letters on the lower sealing surface of the cylinder block.



3.1 Colour identification

Letter on cylinder block		Bearing colour
S	=	Black
R	=	Red
G	=	Yellow

Note

- ♦ *Arrow points in direction of travel.*
- ♦ *If the colour marks are not yet stamped in or are no longer legible, use medium (red) bearing shells.*
- ♦ *As a replacement part only colour code "yellow" is supplied for lower main bearing shells.*

3.2 Crankshaft dimensions

(dimensions in mm)

Honing dimension	Main journal ∅	Conrod journal ∅
Basic dimension	-0.017 54.00 -0.037	-0.022 47.80 -0.042
1st oversize	-0.017 53.75 -0.037	-0.022 47.55 -0.042
2nd oversize	-0.017 53.50 -0.037	-0.022 47.30 -0.042
3rd oversize	-0.017 53.25 -0.037	-0.022 47.05 -0.042

15 – Cylinder head, Valve gear

1 Removing and installing cylinder head

Checking compression ⇒ page 39 .

Note

- *When installing an exchange cylinder head with fitted camshaft, the contact surfaces between the bucket tappets and the cam must be oiled before installing the cylinder head cover.*
- *The plastic packing pieces for protecting the open valves must not be removed until immediately before fitting cylinder head.*
- *If the cylinder head is renewed, the entire coolant must also be renewed.*
- *Removing and installing intake manifold ⇒ page 113 .*

1 - Cap

2 - Nut
- ❑ 10 Nm

3 - Gasket

4 - Cylinder head cover

5 - Cylinder head cover gasket
- ❑ Renew if damaged
- ❑ Before fitting coat transition points between bearing cap and cylinder head with sealant -D 454 300 A2-

6 - Plug
- ❑ 15 Nm
- ❑ Renew

7 - Seal
- ❑ Renew

8 - Connection

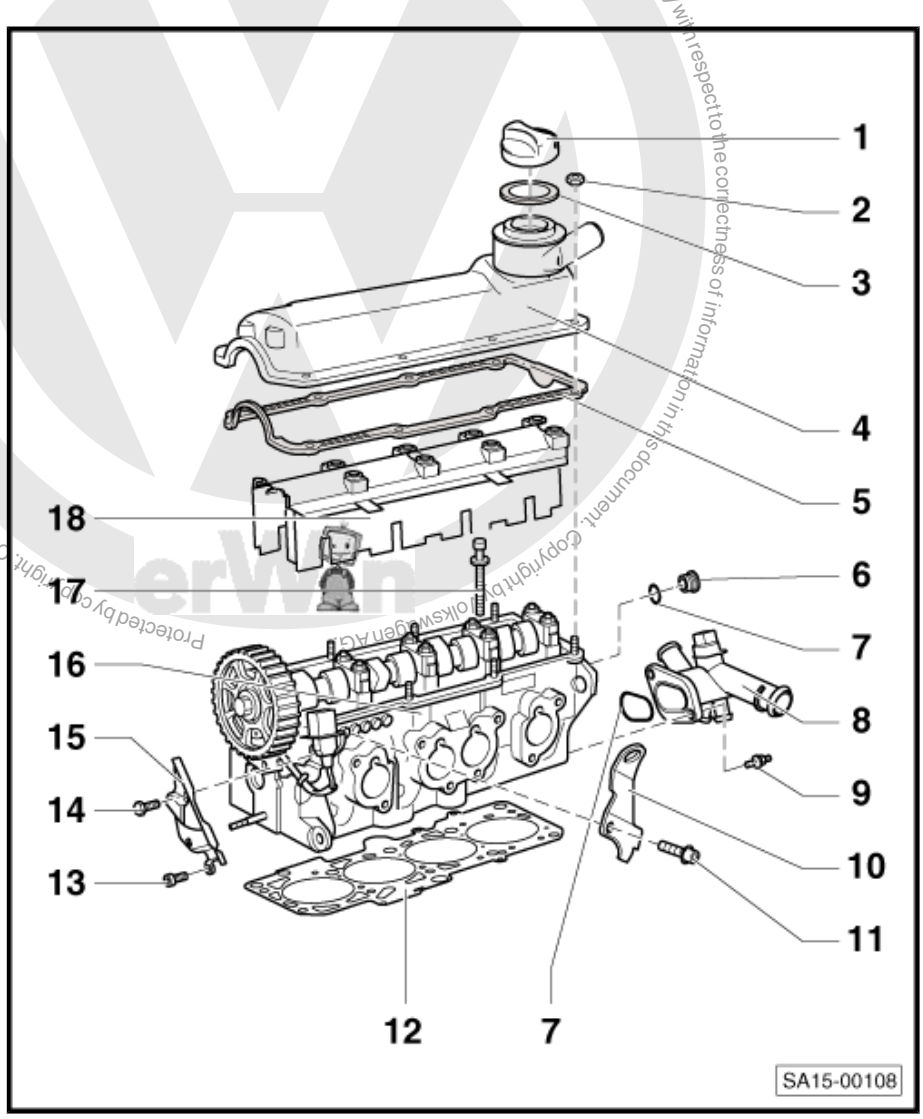
9 - Bolt
- ❑ 10 Nm

10 - Lifting eye

11 - Bolt
- ❑ 20 Nm

12 - Cylinder head gasket
- ❑ Renew
- ❑ After renewing, renew entire coolant

13 - Bolt
- ❑ 15 Nm



14 - Bolt

- ❑ 20 Nm

15 - Rear toothed belt guard

16 - Cylinder head

- ❑ Check for distortion ⇒ page 28
- ❑ Reworking sealing surface ⇒ page 42
- ❑ Removing and installing ⇒ page 34
- ❑ After renewing, renew entire coolant

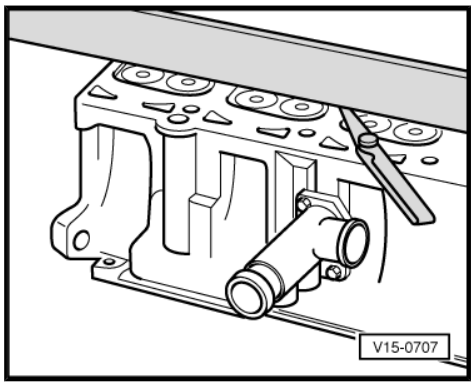
17 - Cylinder head bolt

- ❑ Renew
- ❑ Remove and install polydrive cylinder head bolt using special wrench, long reach -T10070-
- ❑ Sequence when loosening and tightening ⇒ page 34

18 - Oil deflector

Checking cylinder head for distortion

Max. permissible distortion: 0.1 mm.

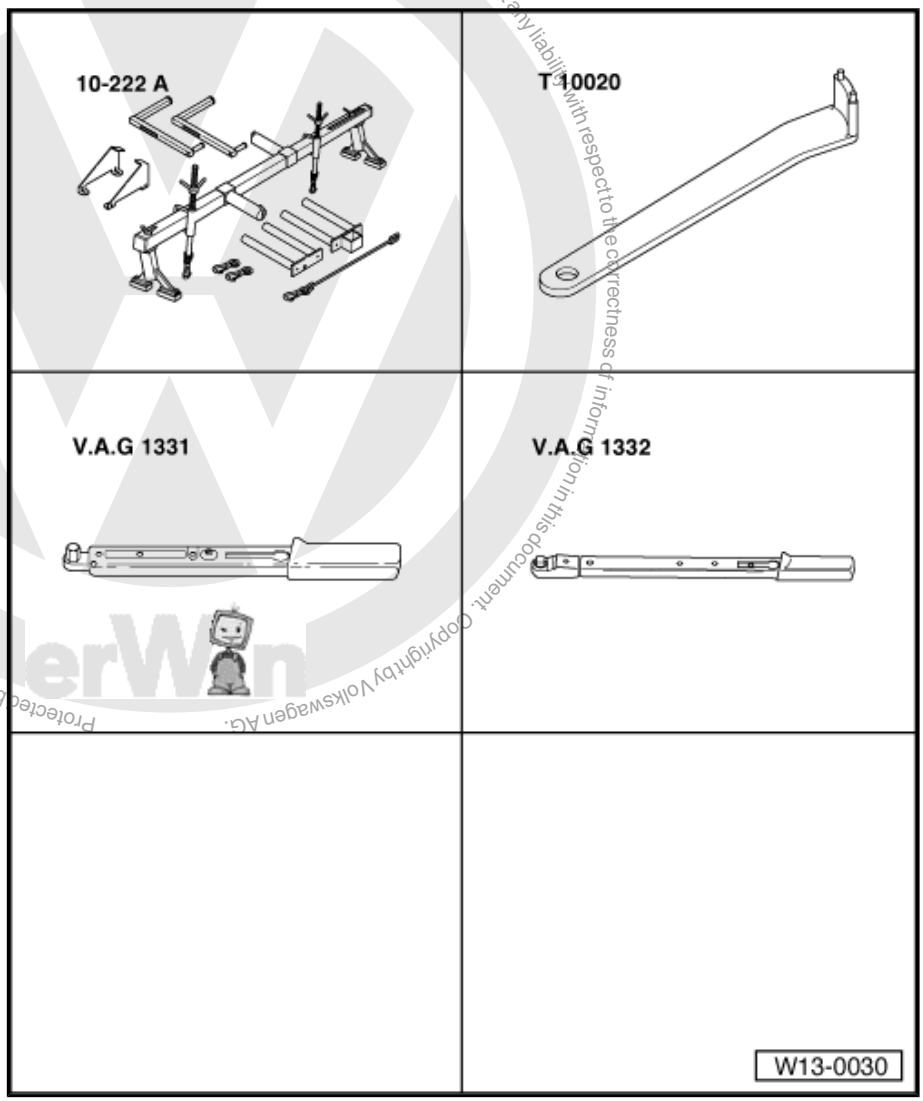


1.1 Removing, installing and tensioning toothed belt

(Adjusting valve timing)

Special tools and workshop equipment required

- Engine support bracket -V.A.G 10-222A- with frame -V.A.G 10-222A/1-
- Pin wrench -T10020-
- Torque wrench -V.A.G 1331- (5..50 Nm)
- Torque wrench -V.A.G 1332- (40...200 Nm)



1.1.1 Removing

– Remove engine cover.

– Remove right-hand insulation tray: ⇒ Rep. Gr. 50 .

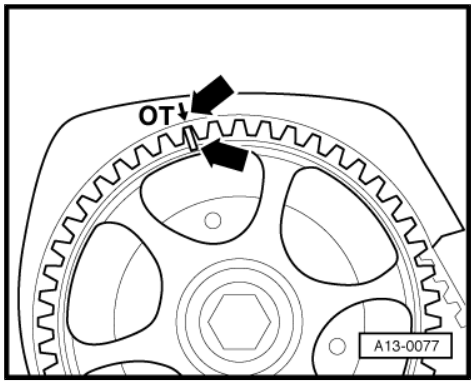
– Remove poly V-belt ⇒ page 16 .

– Remove poly V-belt tensioner.

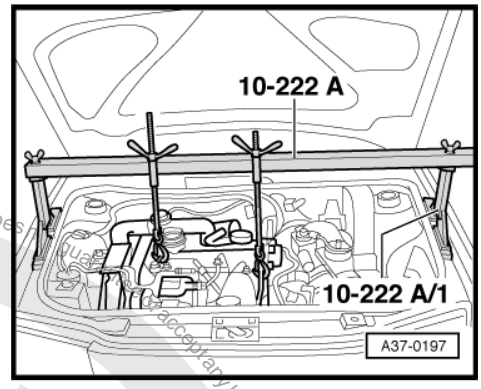
– Remove coolant expansion tank (coolant hoses remain connected).

– Remove toothed belt guard - upper part.

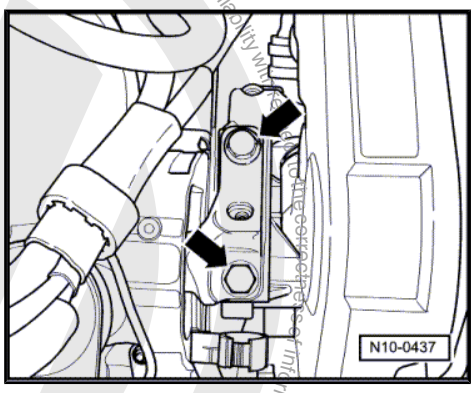
– Set camshaft belt pulley to TDC no. 1 cylinder by turning crankshaft. Marking on camshaft belt pulley must align with arrow on toothed belt guard.



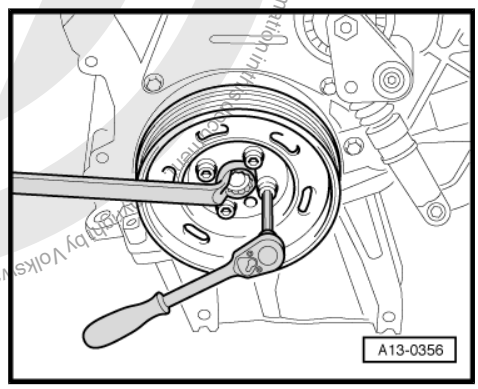
– Fit engine support bracket -V.A.G 10-222A- with frame -V.A.G 10-222A/1- as shown.



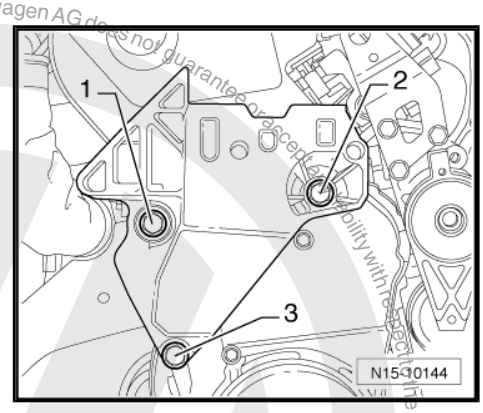
– Remove securing bolts from assembly mounting/engine bracket, assembly mounting/body and assembly mounting/body bracket -arrows- and remove assembly mounting complete.



– Remove belt pulley with vibration damper.



– Unbolt engine bracket from cylinder block-1-, -2- and -3-.



Note

When loosening the front engine bracket bolt the engine must be raised slightly with the support bracket.

– Remove centre and lower parts of toothed belt guard.
– Mark direction of rotation of toothed belt.
– Loosen tensioning roller and remove toothed belt.
– Turn crankshaft back slightly.

1.1.2 Installing

• The pistons must not be positioned at TDC.

– Place toothed belt on crankshaft belt pulley and coolant pump (observe direction of rotation).

Note

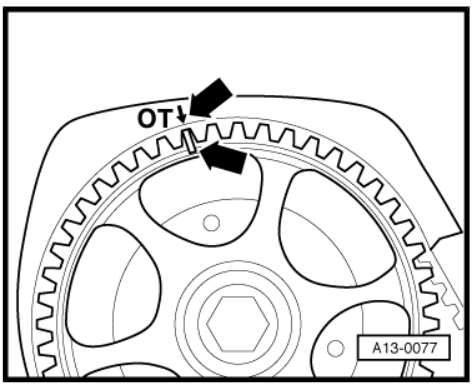
♦ *With engine removed: install lower toothed belt guard and vibration damper/belt pulley in advance.*

♦ *When camshaft is turned, crankshaft must not be at TDC. Danger of damage to valves and piston crowns.*

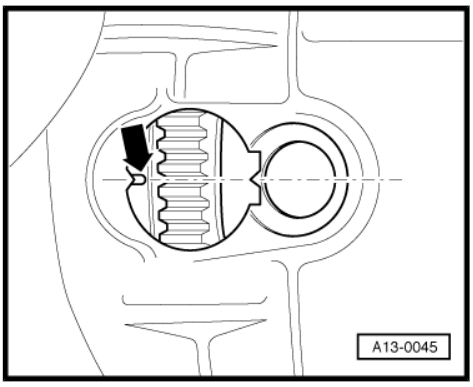
Adjusting valve timing

– Align mark on camshaft belt pulley with mark on toothed belt guard.

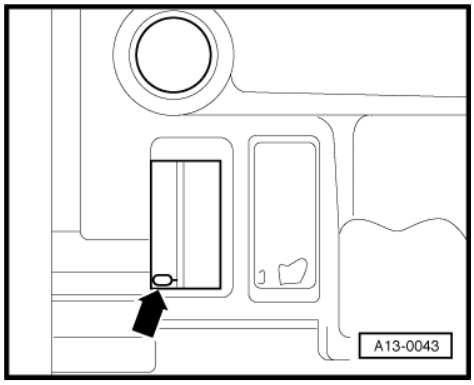
Engine installed:



– Turn crankshaft to TDC No.1 cylinder (vehicles with manual gearbox).

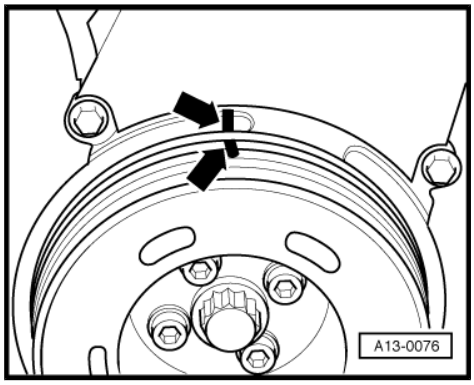


– Turn crankshaft to TDC No.1 cylinder (vehicles with automatic gearbox).



Engine removed:

– Set vibration damper to TDC No. 1 cylinder -arrows-.



– Fit toothed belt to tensioning roller and camshaft belt pulley.

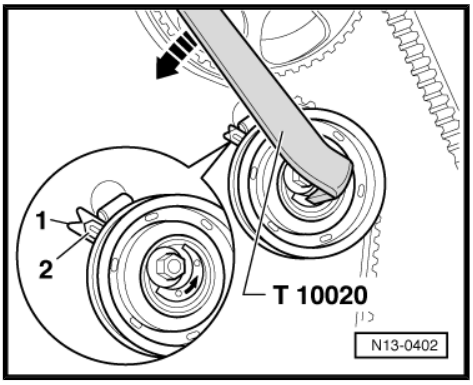
Tensioning toothed belt

- The engine must be no more than warm to touch.
- Camshaft belt pulley is at TDC no. 1 cylinder.
- Before tensioning toothed belt, turn tensioning roller on eccentric to stop five times in both directions using pin wrench -T10020- .

Procedure:

– Tension toothed belt. To do this, turn pin wrench -T10020- on eccentric to left -in direction of arrow- onto stop.
– Then reduce tension on toothed belt until notch -1- and indicator -2- align (use mirror).
– Tighten securing nut to 20 Nm.
– Turn crankshaft two full revolutions in direction of engine rotation until engine is again at TDC No. 1 cylinder. It is important that the last 45° of rotation ($^1/_8$ turn) is performed without interruption.
– Check belt tension again.

♦ Specification: indicator and notch align.



Continuation, fully installing toothed belt:

– Install centre and lower toothed belt guard.
– Install vibration damper/belt pulley.

♦ Torque: 25 Nm

– Fit engine mounting bracket to cylinder block.

♦ Torque: 45 Nm

– Install engine mounting complete.

Note

Before installing engine mounting insert bolts into mounting.

– Remove frame -V.A.G 10-222A/1- .
– Install upper toothed belt guard.
– Install poly V-belt tensioning element.

♦ Torque: 25 Nm

– Install poly V-belt ⇒ page 16
– Install coolant expansion tank.
– Install right-hand insulation tray: ⇒ Rep. Gr. 50 .
– Fit engine cover.

1.2 Checking semi-automatic toothed belt tensioning roller

Installation position

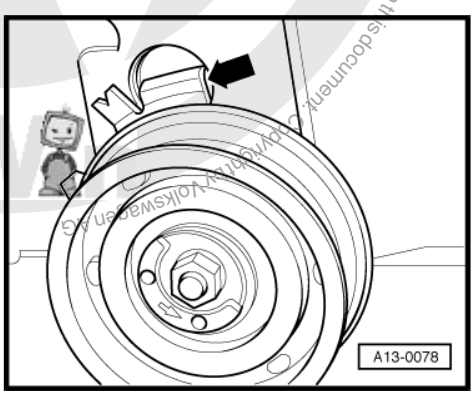
The retainer -arrow- must locate in notch in cylinder head.

Condition

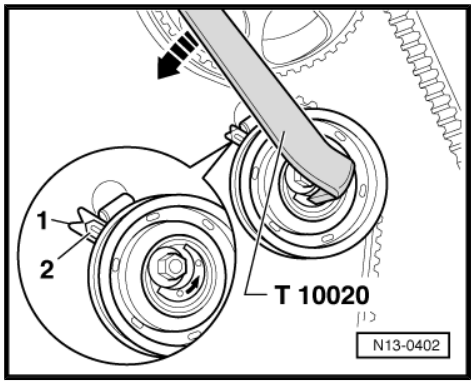
• The engine must be no more than warm to touch.

Test procedure

– Position crankshaft at TDC for cylinder No. 1.



– Press toothed belt forcefully with thumb. The indicator -2- must move.
– Release toothed belt and turn crankshaft two full revolutions in direction of engine rotation until engine is again at TDC No. 1 cylinder. It is important that the last 45° of rotation ($^1/_8$ turn) is performed without interruption.
– The tensioning roller must return to its initial position. (Notch -1- and indicator -2- align again.)



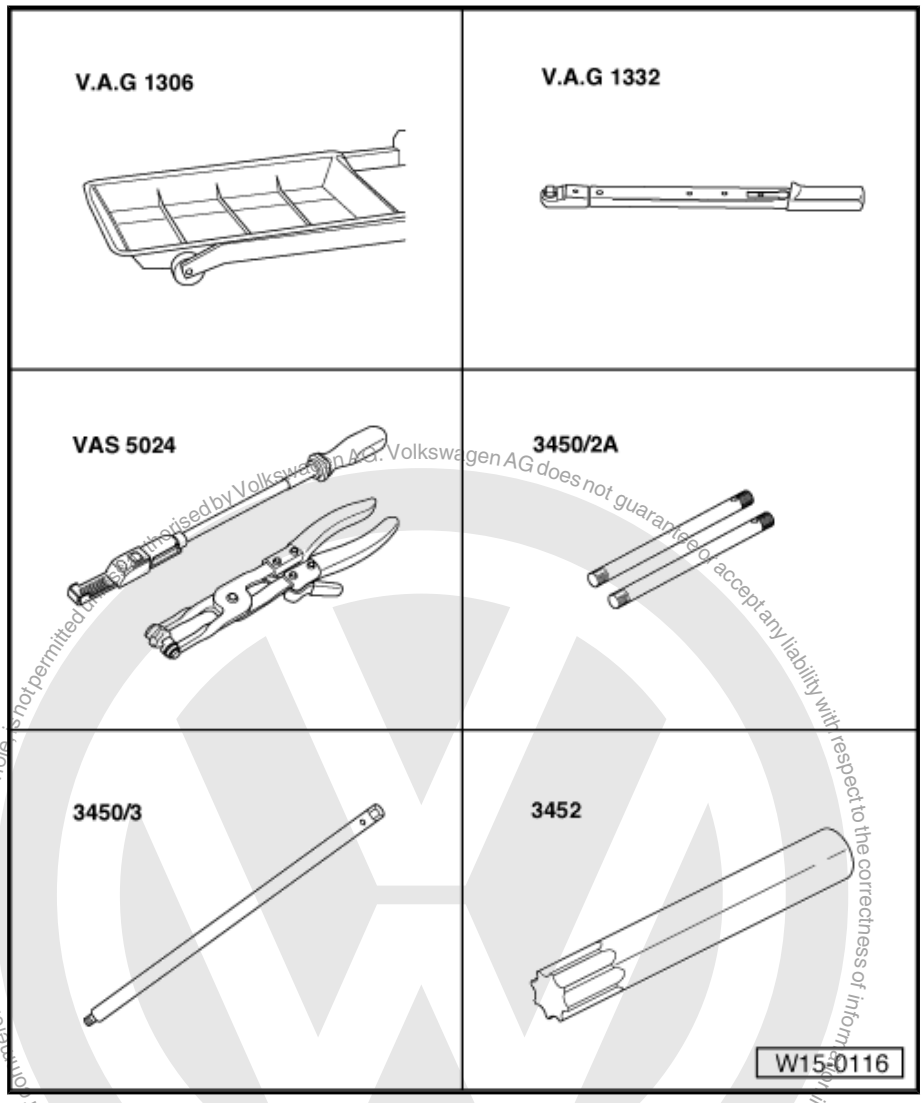
Note

Check using a mirror.

1.3 Removing and installing cylinder head

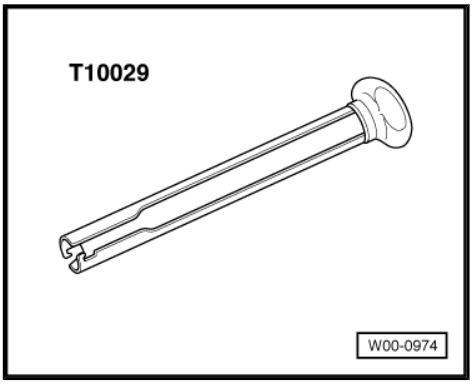
Special tools and workshop equipment required

- Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-
- Torque wrench -V.A.G 1332- (40...200 Nm)
- Pliers -VAS 5024/-
- Guide pins -3450/2A-
- Removal tool -3450/3-
- Polydrive key -3452- or special wrench, long-reach -T10070-



Special tools and workshop equipment required

♦ Assembly tool -T10029-



1.3.1 Removing

- The engine must be no more than warm to touch.

WARNING

When doing any repair work, especially in the engine compartment, pay attention to the following due to the cramped conditions:

- ***Route all types of line (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

Note

Before carrying out further work, disconnect battery earth strap. First check whether a coded radio is fitted. Obtain radio code first if necessary.

– With the ignition switched off, disconnect battery earth strap.
– All cable ties which are opened or cut open when engine is removed must be replaced in the same position when engine is installed.
– Remove engine cover.
– Drain coolant ⇒ page 69 .
– Remove upper part of intake manifold ⇒ page 110 .

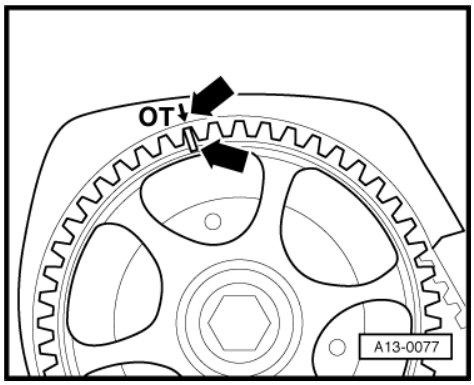
Note

Seal intake ports in the lower part of intake manifold using a clean cloth.

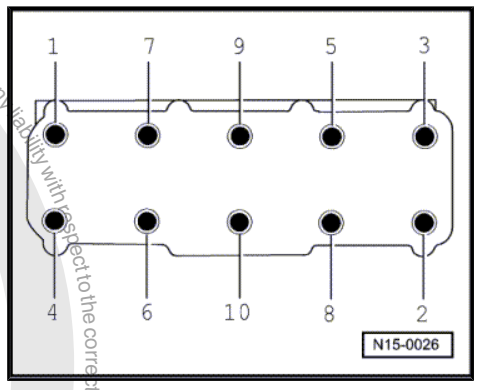
WARNING

Fuel system is under pressure! Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

– Pull the fuel supply line (white mark) off the fuel rail and place the wiring harness down forwards.
– Seal lines so that fuel system is not contaminated by dirt.
– Remove the connections with coolant hoses.
– Remove secondary air pump intake and pressure lines.
– Remove bracket of pressure line.
– Unbolt secondary air pump motor -V101- and bracket and remove.
– Pull off the following connectors:
♦ For secondary air pump motor -V101-
♦ For injectors (unclip cable guide)
♦ For spark plugs (with assembly tool -T10029-)
– Unbolt front exhaust pipe with catalytic converter and manifold support.
– Remove poly V-belt ⇒ page 16 .
– Remove poly V-belt tensioner.
– Remove toothed belt guard - upper part.
– Turn crankshaft to set camshaft belt pulley to TDC of cylinder no. 1. Marking on camshaft belt pulley must align with arrow on toothed belt guard.



– Release tensioning roller and remove toothed belt from camshaft belt pulley.
– Turn crankshaft back slightly.
– Remove cylinder head cover.
– Remove rear toothed belt guard upper bolt.
– Loosen socket head bolts in specified sequence and then remove completely.



Note

Use special wrench, long reach -T10070- for polydrive cylinder head bolts.

– Carefully lift cylinder head off.

1.3.2 Installing

Note

- *There must be no oil or coolant in the cylinder head bolt pockets in the cylinder head.*
- *Do not remove new cylinder head gasket from its packing until immediately before installing.*
- *Handle new gasket with extreme care. Damage will cause leakage.*

– Place clean cloths in cylinders so that no dirt or emery cloth particles can get in between cylinder wall and piston.

– Also prevent dirt and emery cloth particles from getting into coolant.

– Now carefully clean sealing surfaces of cylinder head and cylinder block. Ensure thereby that surfaces are not scored or scratched (if abrasive paper is used, grade must not be less than 100).

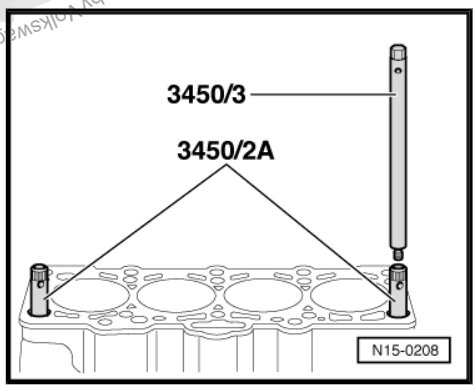
– Carefully remove metal particles, emery residue and cloths.

– If crankshaft has been turned in the meantime, position No. 1 cylinder piston to TDC and then turn crankshaft back slightly.

– To centralize, screw guide pins -3450/2A- into front outer cylinder head bolt threaded holes.

Note

The tolerance of the centring holes is reduced in the upper section. Therefore, before positioning cylinder head, check that guide pins can be removed upwards. If necessary, knurled part of guide pins may be ground off slightly.



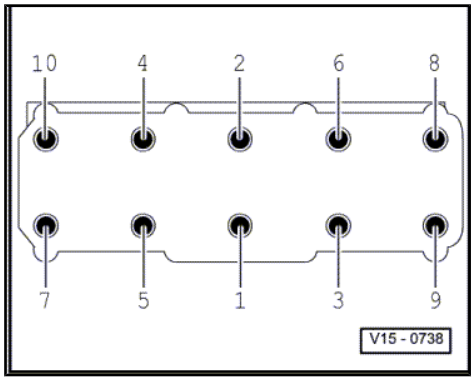
– Fit new cylinder head gasket.

– Fit cylinder head, screw in 8 remaining cylinder head bolts and tighten by hand.

– Remove guide pins with removal tool through bolt holes. To do this, turn removal tool anti-clockwise until pins are free.

– Now insert last two cylinder head bolts and tighten them hand-tight also.

– Tighten cylinder head bolts in tightening sequence as follows:
– Pre-tighten all bolts to 40 Nm.
– Then tighten all bolts 1/4 turn (90 °) further using a rigid spanner.
– Finally tighten all bolts again 1/4 turn (90 °) further.



Further assembly is basically the reverse of the dismantling procedure.

Note

When camshaft is turned, crankshaft must not be at TDC. Danger of damage to valves and piston crowns.

Installing toothed belt and adjusting valve timing ⇒ page 28 .

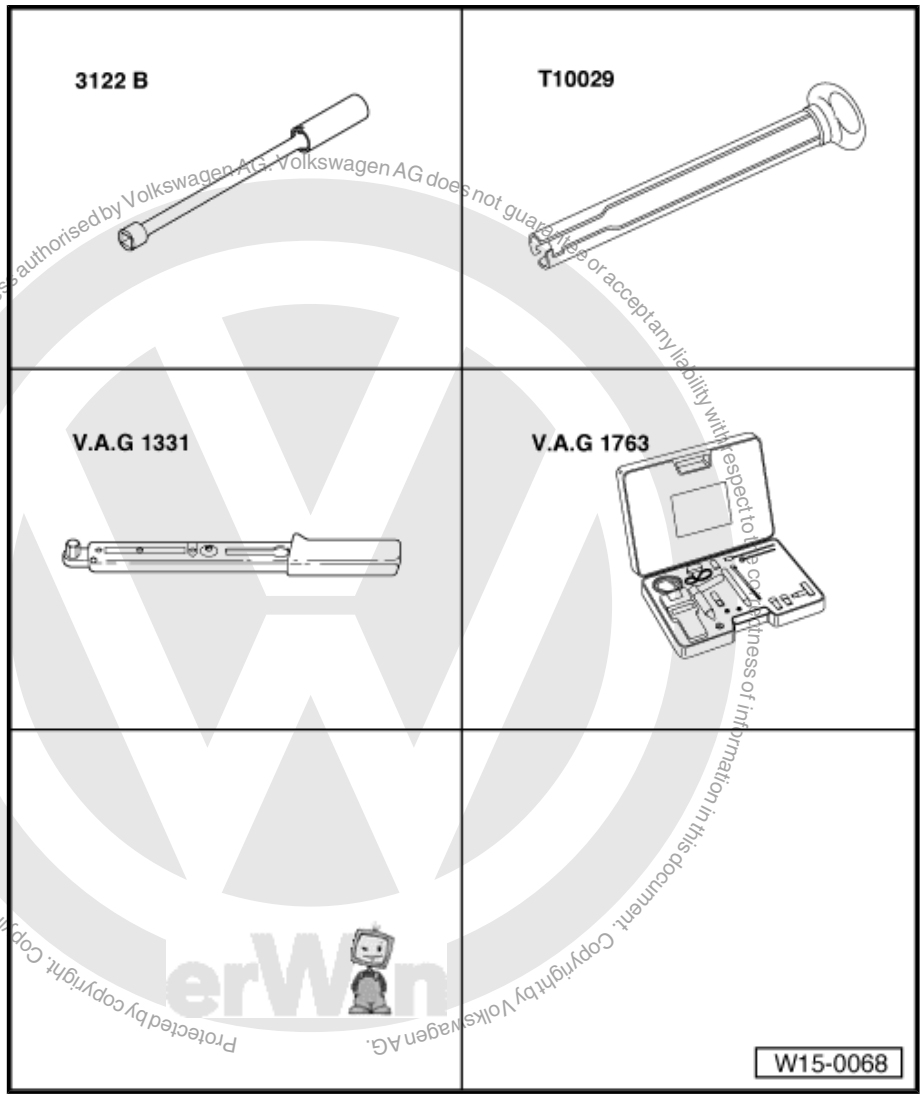
– Install poly V-belt tensioning element.
♦ Torque setting: 25 Nm
– Install poly V-belt ⇒ page 16 .

Filling with new coolant ⇒ page 71 .

1.4 Checking compression

Special tools and workshop equipment required

- Plug spanner -VAS 3122B-
- Assembly tool -T10029-
- Torque wrench -V.A.G 1331- (5..50 Nm)
- Compression tester -V.A.G 1763-



Test prerequisite

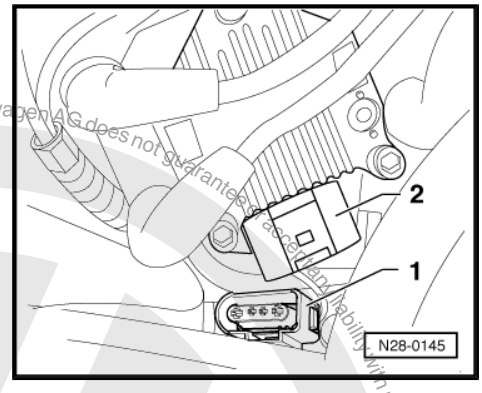
- Engine oil temperature must be at least 30° C.
- Voltage supply OK.

Procedure

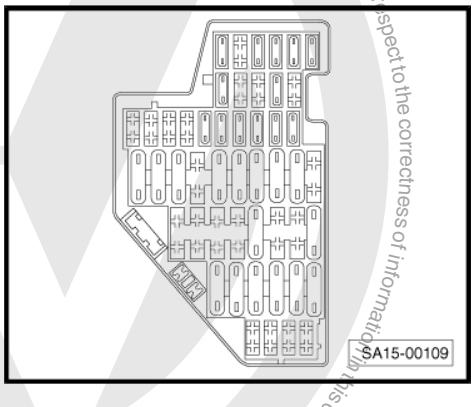
– Remove engine cover.

– Remove upper part of intake manifold.

– Pull 4 pin connector -1- off output stage for ignition coils -2-.



– Remove fuse 28 for fuel pump.
– Pull off spark plug connectors using assembly tool -T10029- .
– Remove spark plugs using plug spanner -VAS 3122B- .
– Have a second mechanic fully depress the accelerator pedal.
– Check compression using compression tester -V.A.G 1763- .



Note

How to use test instrument ⇒ operating instructions .

– Operate starter until tester shows no further pressure increase.

Compression pressures

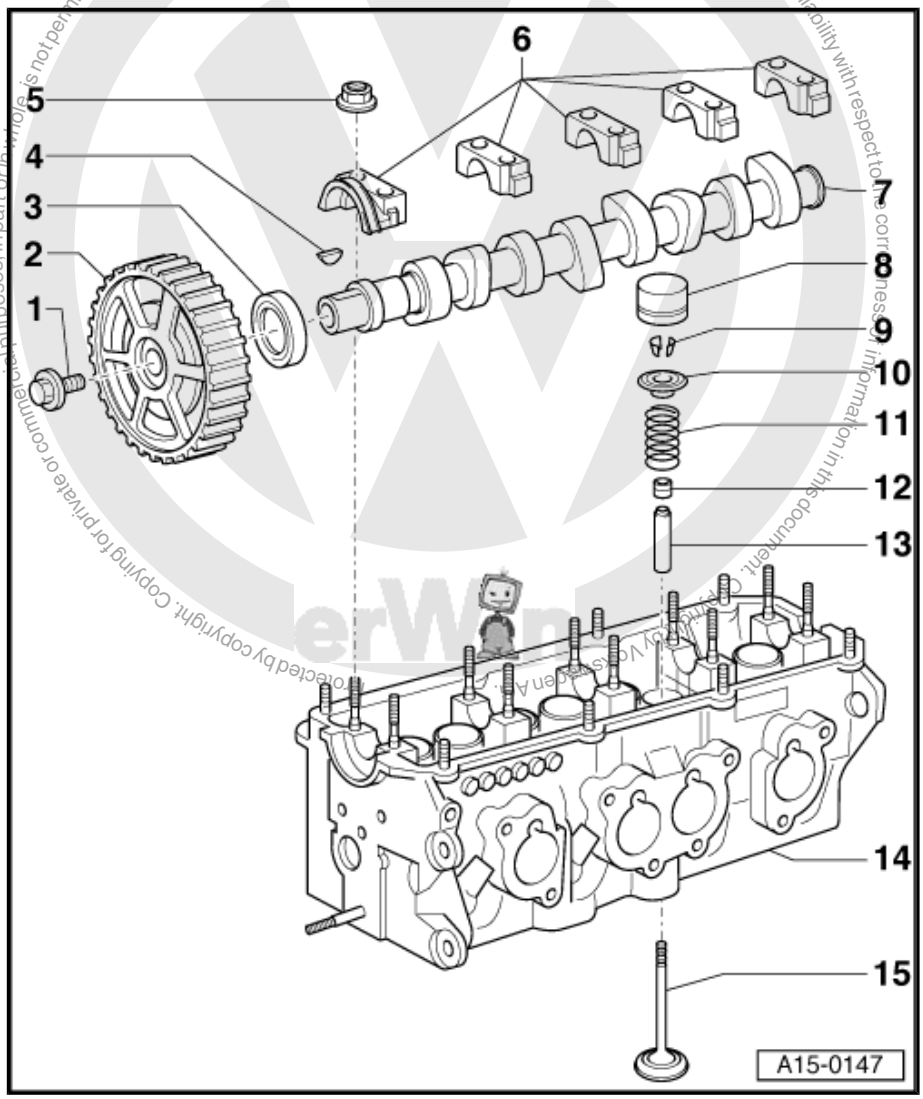
New: 10...13 bar pressure, wear limit: 7.5 bar pressure.

Maximum permissible difference between all cylinders: 3 bar.

2 Repairing valve gear

Note

- *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug thread are cracked.*
- *When new bucket tappets have been installed the engine must not be started for about 30 minutes. (Otherwise valves will contact pistons.) Then turn crankshaft two full revolutions.*



1 - Bolt

- ❑ 100 Nm
- ❑ Use counterhold tool -3415- to loosen and tighten

2 - Camshaft toothed belt pulley

3 - Seal

- ❑ Renew ⇒ page 46

4 - Woodruff key

- ❑ Check for secure seating

5 - Nut

- ❑ 20 Nm

6 - Bearing cap

- ❑ Installation position ⇒ page 43
- ❑ Installation sequence ⇒ page 48 , removing and installing camshaft
- ❑ Lightly coat contact surface of bearing cap 1 with sealant -AMV 174 004 01-

7 - Camshaft

- ❑ Checking axial clearance ⇒ page 42
- ❑ Removing and installing ⇒ page 48
- ❑ Check radial clearance with plastigage, wear limit: 0.1 mm
- ❑ Runout: max. 0.05 mm

8 - Bucket tappet

- ❑ Do not interchange
- ❑ With hydraulic valve clearance compensation
- ❑ Checking ⇒ page 50
- ❑ Store with cam contact surface downwards
- ❑ Before installing check camshaft axial clearance ⇒ page 42

- ❑ Oil contact surface

9 - Cotters

10 - Upper valve spring plate

11 - Valve spring

- ❑ Removing and installing: with cylinder head removed, use valve spring compressor -2037- ; with cylinder head installed ⇒ page 53

12 - Valve stem seal

- ❑ Renew ⇒ page 53

13 - Valve guide

- ❑ Checking ⇒ page 51
- ❑ Renew ⇒ page 52
- ❑ Service version with collar

14 - Cylinder head

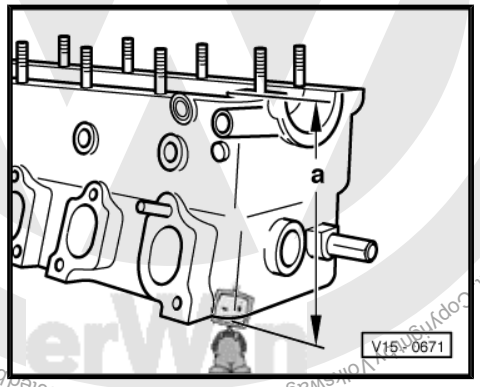
- ❑ Reworking sealing surface ⇒ page 42
- ❑ Reworking valve seats ⇒ page 43

15 - Valves

- ❑ Do not rework, only lapping-in is permitted
- ❑ Valve dimensions ⇒ page 43

Reworking cylinder head sealing surface

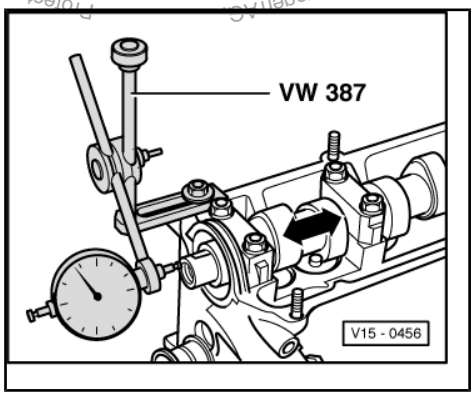
Cylinder head reworking dimension: a = at least 132.6 mm.



Note

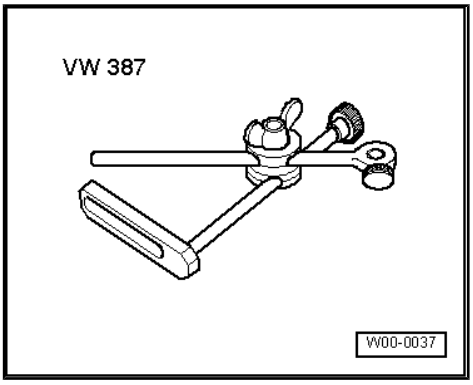
If sealing surface is reworked, valves must be set deeper by the same distance.

Checking camshaft axial clearance



Special tools and workshop equipment required

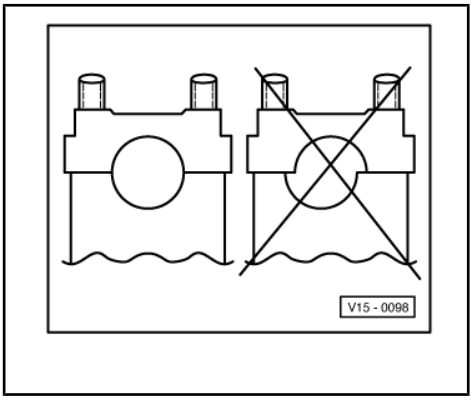
- Universal dial gauge bracket -VW 387-



- Dial gauge

Check with bucket tappets removed and first and last bearing caps fitted.

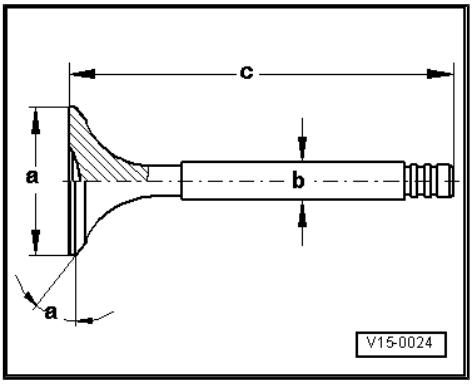
Wear limit: max. 0.15 mm.



Fitting position of camshaft bearing caps

Note that bearing caps are not symmetrical. Before installing camshaft, fit bearing caps and determine installation positions.

Valve dimensions



Note

Valves must not be reworked. Only lapping-in is permitted.

Dimension		Inlet valve	Exhaust valve
∅ a	mm	39.5 ± 0.15	32.9 ± 0.15
∅ b	mm	6.98 ± 0.007	6.96 ± 0.007
c	mm	91.85	91.15
α	∠°	44.66	44.66

2.1 Reworking valve seats

Special tools and workshop equipment required

- Depth gauge
- Valve seat refacing tool

Note

- *When repairing engines with leaking valves, it is not sufficient to reface or renew valve seats and valves. There is also a requirement to check the valve guides for wear. This particularly important on high mileage engines.*
- *Valve seats should be reworked only enough to produce a perfect seating pattern. Before beginning to rework valve seats, calculate the maximum permissible reworking dimension. If the reworking dimension is exceeded, hydraulic valve compensation can no longer be guaranteed and the cylinder head should be renewed.*

The max. permissible reworking dimension is calculated as follows:

– Insert valve and press firmly against seat.

Note

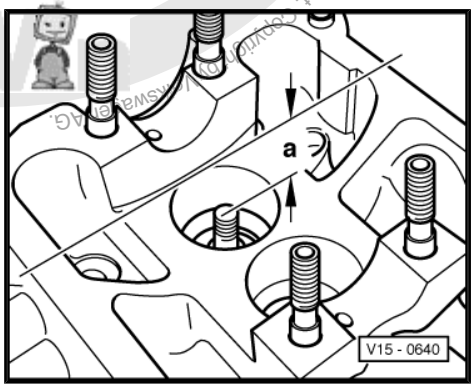
If the valve is to be renewed as part of a repair, use a new valve for the calculation.

– Measure distance -a- between end of valve stem and upper edge of cylinder head.
– Calculate maximum permissible reworking dimension from measured distance -a- and minimum dimension.

Minimum dimension: inlet valve 33.8 mm, exhaust valve 34.1 mm

Measured distance -a- minus minimum dimension = maximum permissible reworking dimension.

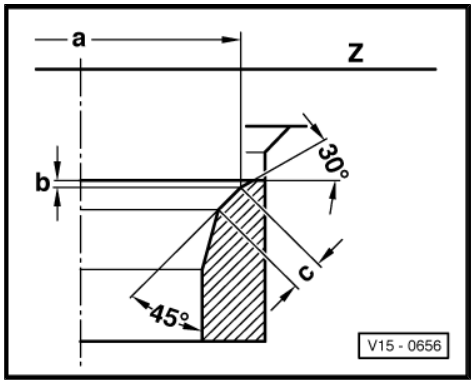
Example:



Measured distance -a- Minimum dimension	35.1 34.1	mm mm
Max. perm. rework dimension [5)]	1.0	mm

5) The max. permissible reworking dimension is shown on illustrations for reworking valve seats as dimension “b”.

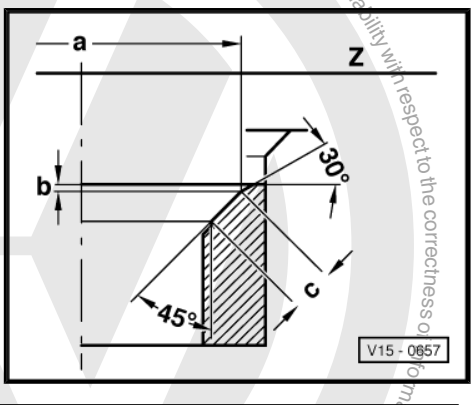
Reworking inlet valve seat



Dimension		Inlet valve seat
∅ a	mm	39.2

Dimension		Inlet valve seat
b	mm	Max. permissible rework dimension
c	mm	1.8…2.2
Z		Lower edge of cylinder head
45°		Valve seat angle
30°		Upper correction angle

Reworking exhaust valve

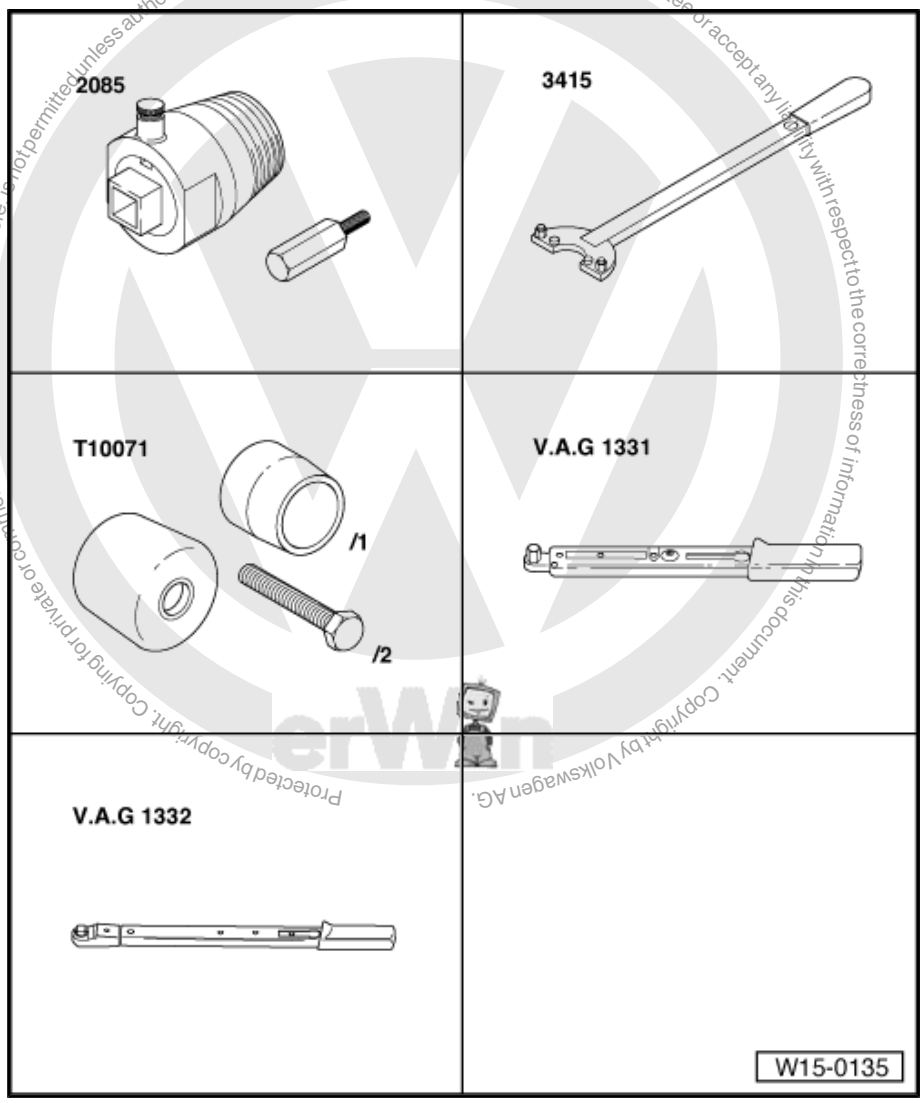


Dimension		Exhaust valve seat
∅ a	mm	32.4
∅ b	mm	Max. permissible rework dimension
c	mm	2.2…2.6
Z		Lower edge of cylinder head
45°		Valve seat angle
30°		Upper correction angle

2.2 Renewing camshaft oil seal

Special tools and workshop equipment required

- Oil seal extractor -2085-
- Counterhold tool -3415-
- Fitting tool -T10071-
- Torque wrench -V.A.G 1331- (5..50 Nm)
- Torque wrench -V.A.G 1332- (40...200 Nm)



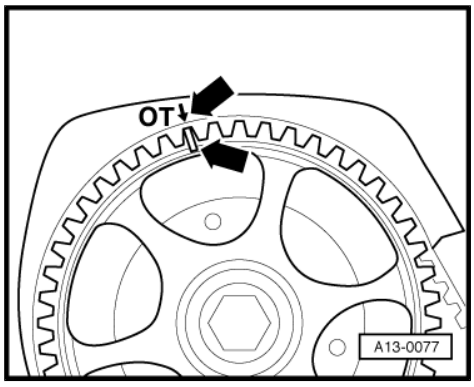
2.2.1 Removing

– Remove toothed belt guard - upper part.

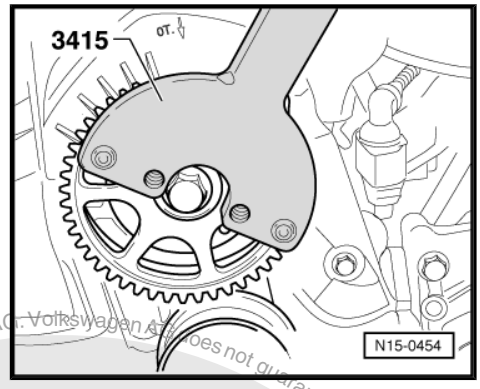
– Turn crankshaft to set camshaft belt pulley to TDC of cylinder no. 1. Marking on camshaft belt pulley must align with arrow on toothed belt guard.

– Release tensioning roller and remove toothed belt from camshaft belt pulley.

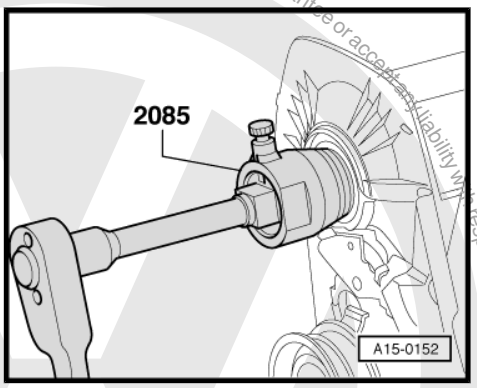
– Turn crankshaft back slightly.



– Remove camshaft belt pulley. When loosening camshaft sprocket, hold with counterhold tool -3415- .
– Remove woodruff key from camshaft.
– Screw securing bolt of camshaft belt pulley into camshaft to stop.
– Screw inner part of oil seal extractor -2085- two turns (approx. 3 mm) out of outer part and lock with knurled screw.



– Lubricate threaded head of oil seal extractor -2085- , place it in position and forcefully screw it as far as possible into oil seal.
– Loosen knurled screw and turn inner part against camshaft until the oil seal is pulled out.
– Clamp flats of oil seal extractor -2085- in vice. Remove oil seal with pliers.



2.2.2 Installing

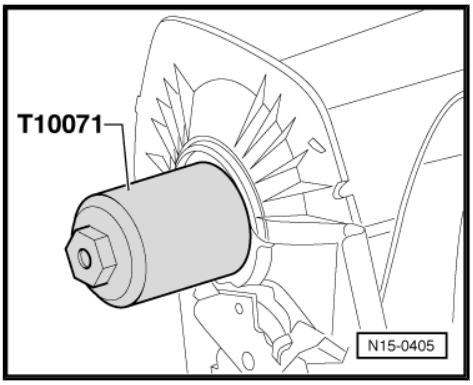
Condition

- The pistons must not be positioned at TDC.

Note

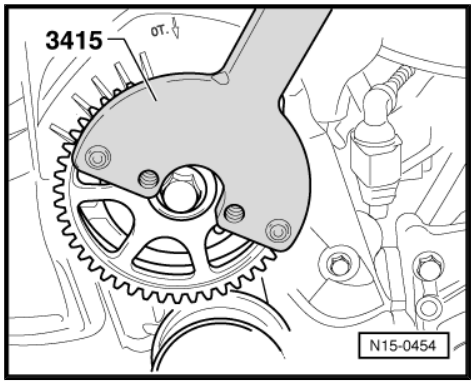
Gradual introduction of PTFE seals (poly-tetra-fluoro-ethylene). Identification: has no circular spring, sealing lip is wider. The sealing lip of this oil seal must not be additionally oiled or greased. A radial shaft seal of the old type (with circular spring) can be replaced with a PTFE seal - but not the other way around.

– Position seal using assembly tool -T10071- and press in onto stop using press sleeve -T10071/1- and bolt -T10071/2- .
– Insert woodruff key in camshaft.



– Install camshaft belt pulley. When tightening bolt of camshaft belt pulley, hold with counterhold -3415- .

♦ Torque setting: 100 Nm



Note

When camshaft is turned, crankshaft must not be at TDC. Danger of damage to valves and piston crowns.

Further assembly is basically the reverse of the dismantling procedure.

Installing toothed belt and adjusting valve timing ⇒ page 28 .

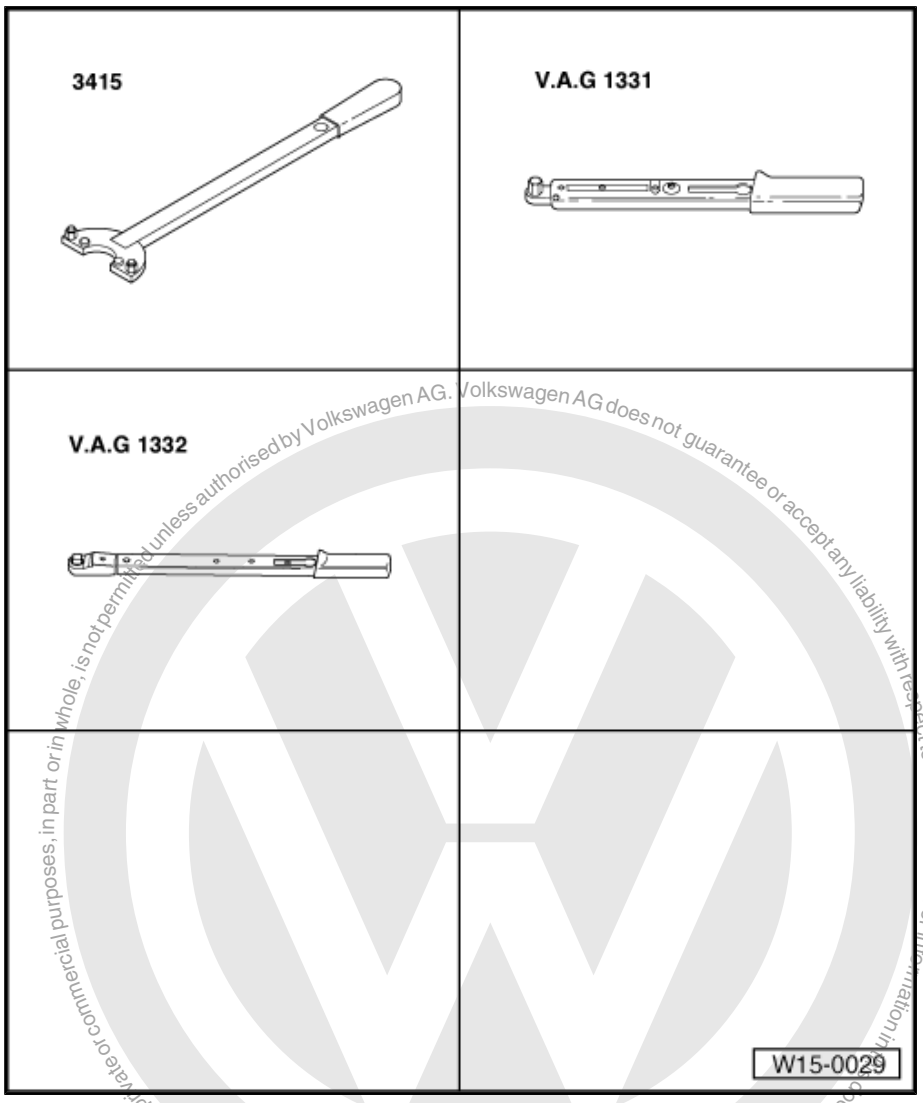
2.3 Removing and installing camshaft

Special tools and workshop equipment required

♦ Counterhold tool -3415-

♦ Torque wrench -V.A.G 1331- (5..50 Nm)

♦ Torque wrench -V.A.G 1332- (40...200 Nm)



Not illustrated:

♦ Sealant -AMV 174 004 01-

2.3.1 Removing

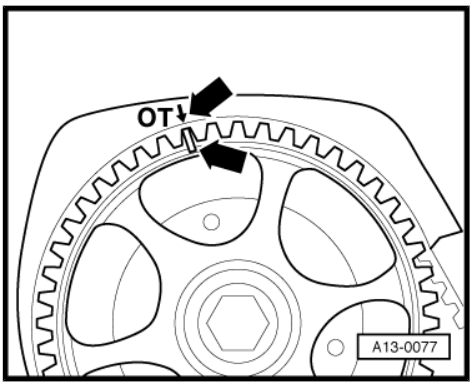
– Remove engine cover.

– Remove upper part of intake manifold ⇒ page 110 .

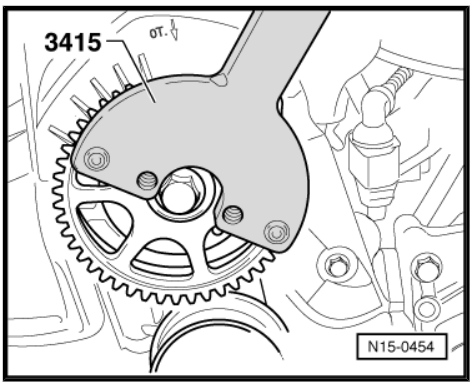
Note

Seal intake ports in the lower part of intake manifold using a clean cloth.

– Remove toothed belt guard - upper part.
– Turn crankshaft to set camshaft belt pulley to TDC of cylinder no. 1. Marking on camshaft belt pulley must align with arrow on toothed belt guard.
– Release tensioning roller and remove toothed belt from camshaft belt pulley.
– Turn crankshaft back slightly.



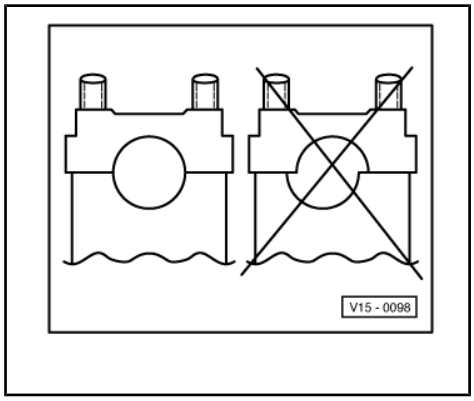
– Remove camshaft belt pulley. When loosening camshaft sprocket, hold with counterhold tool -3415- .
– Remove woodruff key from camshaft.
– Remove cylinder head cover.
– First remove bearing caps 5, 1 and 3. Loosen bearing caps 2 and 4 alternately and diagonally.



2.3.2 Installing

Prerequisite

• The pistons must not be positioned at TDC.



Note

- *When camshaft is installed, No. 1 cylinder cams must point upwards.*
- *When installing bearing caps, note that caps are not symmetrical; before installing bearing cap, set in place and determine fitting position.*

Procedure

– Oil camshaft running surfaces.

– Insert camshaft.

– Tighten bearing caps 2 and 4 alternately and diagonally to 20 Nm.

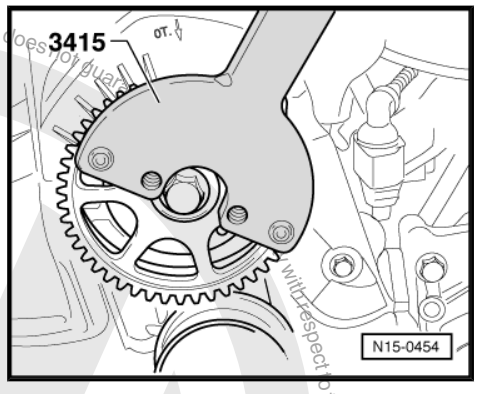
– Lightly coat contact surface of bearing cap 1 with sealant -AMV 174 004 01- .

– Install bearing caps 3, 1, and 5 and tighten to 20 Nm.

– Insert woodruff key in camshaft.

Caution

When camshaft is turned, crankshaft must not be at TDC. Danger of damage to valves and piston crowns.



– Install camshaft belt pulley. When tightening bolt of camshaft belt pulley, hold with counterhold -3415- .

- Torque setting: 100 Nm

Further assembly is basically the reverse of the dismantling procedure.

Installing toothed belt and adjusting valve timing ⇒ page 28 .

Note

When new bucket tappets have been installed the engine must not be started for about 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

2.4 Checking hydraulic bucket tappets

Special tools and workshop equipment required

- Feeler gauges
- Wood or plastic wedge

Note

- *Renew defective bucket tappets complete (cannot be adjusted or repaired).*
- *Irregular valve noises when starting engine are normal.*

Test procedure

– Start engine and run until radiator fan has switched on once.

– Increase engine speed to about 2500 rpm for approx. 2 minutes.

If hydraulic tappets are still noisy, locate defective tappets as follows:

– Remove upper part of intake manifold ⇒ page 110 .

Note

Seal intake ports in the lower part of intake manifold using a clean cloth.

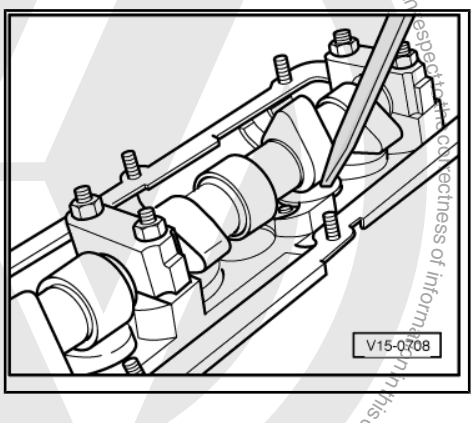
– Remove cylinder head cover.

– Rotate crankshaft clockwise until cam of tappet to be checked is pointing upwards.

– Determine play between cam and bucket tappet.

– If play exceeds 0.2 mm, renew bucket tappet. If play is less than 0.1 mm or there is no play, continue with check as follows:

– Push bucket tappet down lightly with a wooden or plastic wedge. If when bucket tappet is pushed down, a 0.2 mm feeler gauge can be pushed between camshaft and bucket tappet, bucket tappet must be renewed.



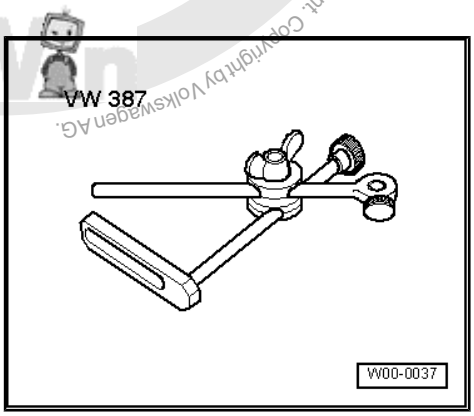
Note

When new bucket tappets have been installed the engine must not be started for about 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

2.5 Checking valve guides

Special tools and workshop equipment required

♦ Universal dial gauge bracket -VW 387-

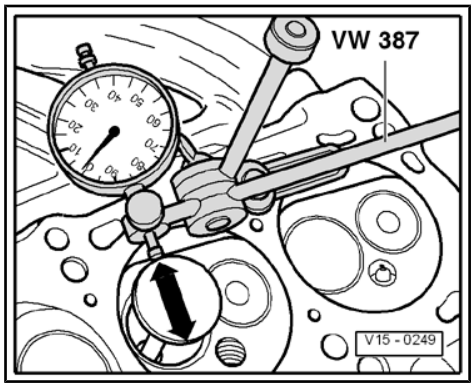


♦ Dial gauge

Test procedure

– Insert new valve in guide. End of valve stem must be flush with guide. Due to differences in stem diameters, use only an inlet valve in inlet guide and an exhaust valve in exhaust guide.

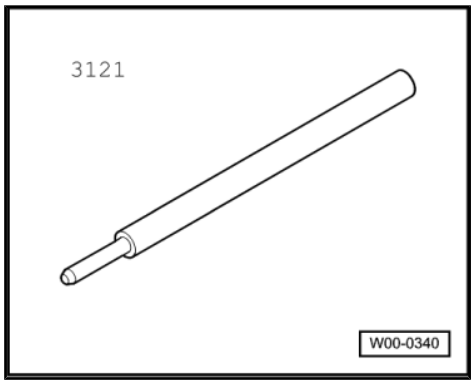
– Determine rock. Wear limit: inlet valve guide = 1.0 mm; exhaust valve guide = 1.3 mm.



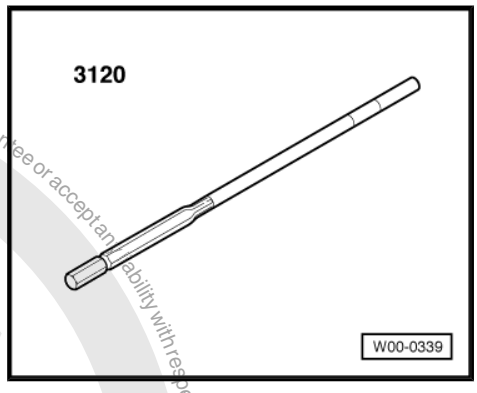
2.6 Renewing valve guides

Special tools and workshop equipment required

♦ Drift -3121-



♦ 7 mm reamer -3120- and cutting fluid



Removing

– Clean and check cylinder head. Cylinder heads in which the valve seats can no longer be reworked (observe minimum dimension ⇒ page 43), or cylinder heads which have already been machined to the minimum dimension (⇒ page 42), should not have the valve guides renewed.

– Press out worn valve guides with drift -3121- from camshaft side (repair version with shoulder - from combustion chamber side).

Installing

– Using drift -3121- , press in new, oil coated guides from camshaft side to shoulder in cold cylinder head.

Note

When the shoulder on guide makes contact, the pressure must not exceed 10 kN (approx. 1.0 t) otherwise shoulder may break off.

– Ream valve guide with 7 mm reamer -3120- . Use plenty of cutting fluid.

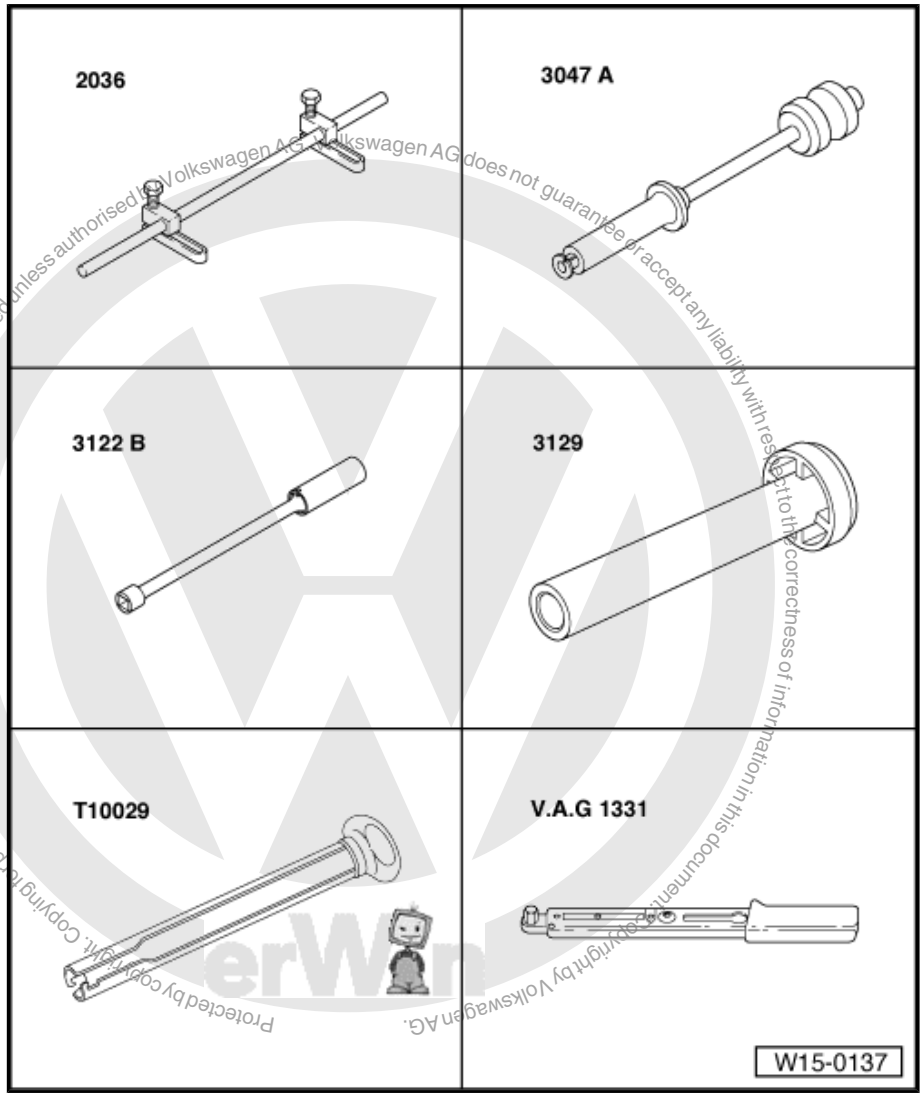
– Reworking valve seats ⇒ page 43 .

2.7 Renewing valve stem seals

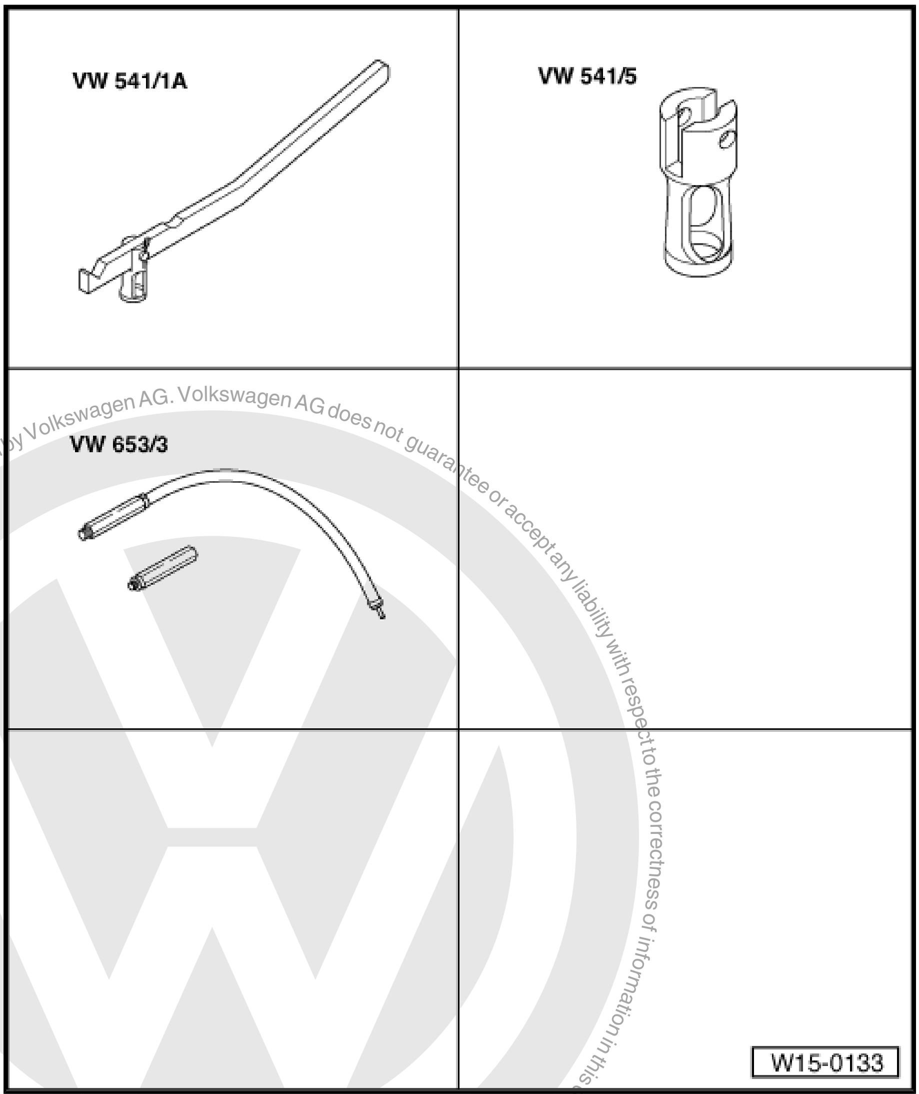
(With cylinder head installed)

Special tools and workshop equipment required

- Valve assembly device -2036-
- Puller -VAS 3047A-
- Plug spanner -VAS 3122B-
- Fitting tool -3129-
- Assembly tool -T10029-
- Torque wrench -V.A.G 1331- (5..50 Nm)



- Valve lever -VW 541/1A-
- Thrust piece for VW 541/1A and 2037 -VW 541/5-
- Pressure hose -VW 653/3-



Removing

– Remove camshaft ⇒ page 48 .

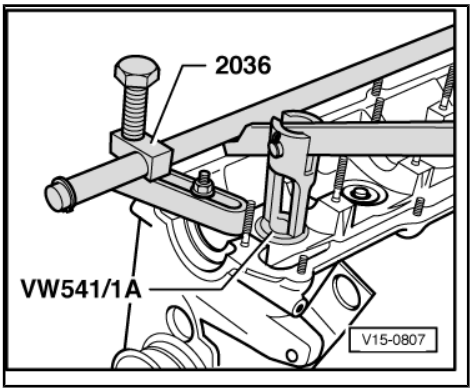
– Remove bucket tappets and place bucket tappets with the contact surface downwards. When doing this, ensure that tappets are not interchanged.

– Pull off spark plug connectors using assembly tool -T10029- .

– Remove spark plugs using plug spanner -VAS 3122B- .

– Set piston of respective cylinder to “bottom dead centre”.

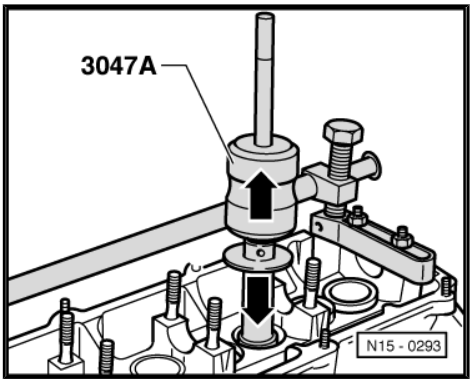
– Fit valve assembly tool -2036- and adjust mountings to height of studs.
– Screw pressure hose -VW 653/3- into spark plug thread.
– Connect pressure hose to compressed air source of at least 6 bar.
– Remove valve springs using valve lever -VW 541/1A- and thrust piece for VW 541/1A and 2037 -VW 541/5- .



Note

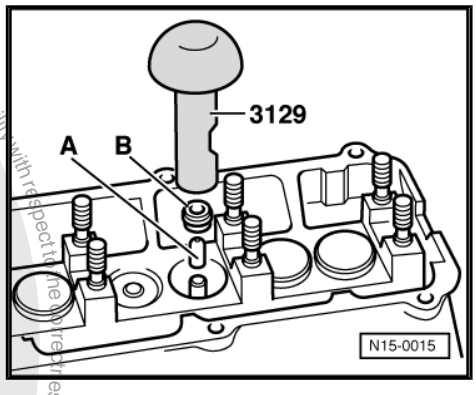
Tight cotters can be loosened by tapping lightly on lever.

– Pull off valve stem seals using puller -VAS 3047A- .



Installing

– Place the plastic sleeve -A- supplied on the respective valve stem. This will prevent the new valve stem seal -B- being damaged.
– Place new valve stem seal in fitting tool -3129- .
– Oil valve stem seal sealing lip and press carefully onto the valve guide.



17 – Lubrication

1 Removing and installing parts of the lubrication system

Note

- *Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent subsequent damage, perform the following after repairs:*
- *Thoroughly clean oil channels.*
- *Renew oil spray jets.*
- *Renew oil cooler.*
- *Renew oil filter.*
- *The oil level must not be above the max. mark - danger of damage to catalytic converter! Markings ⇒ page 57 .*

Engine oil ⇒ page 56 .

Assembly overview - Oil filter bracket ⇒ page 59 .

Assembly overview - Oil pump ⇒ page 58 .

Checking oil pressure and oil pressure switch ⇒ page 63 .

1.1 Engine oil

Oil capacities:

With oil filter 4.0 l.

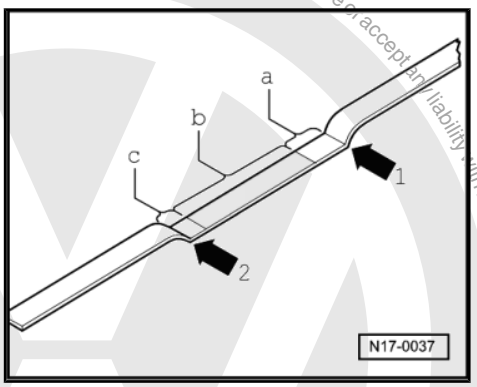
Latest figures ⇒ Exhaust emissions test binder .

Engine oil specification: Vehicles ‣ 05.99

Engine oil conforming to VW standard 500 00, 501 01 or 502 00 can be used. In exceptional cases only: multi-grade/single-grade oil conforming to ACEA A2/A3.

Engine oil specification: vehicles 05.99 ‣ with LongLife service

Use engine oils conforming to VW standard 503 00.



Note

- *The engine is filled at the factory with engine oil conforming to VW standard 503 00. This engine oil is designed for long service intervals.*
- *Engine oils conforming to VW standard 500 00, 501 01 or 502 00 can continued to be used. These oils must be changed every 12 months or 15,000 kilometres. The service interval display must be programmed accordingly. Procedure: ⇒ Maintenance ; Booklet 37 .*

Markings on oil dipstick

1 - max. mark

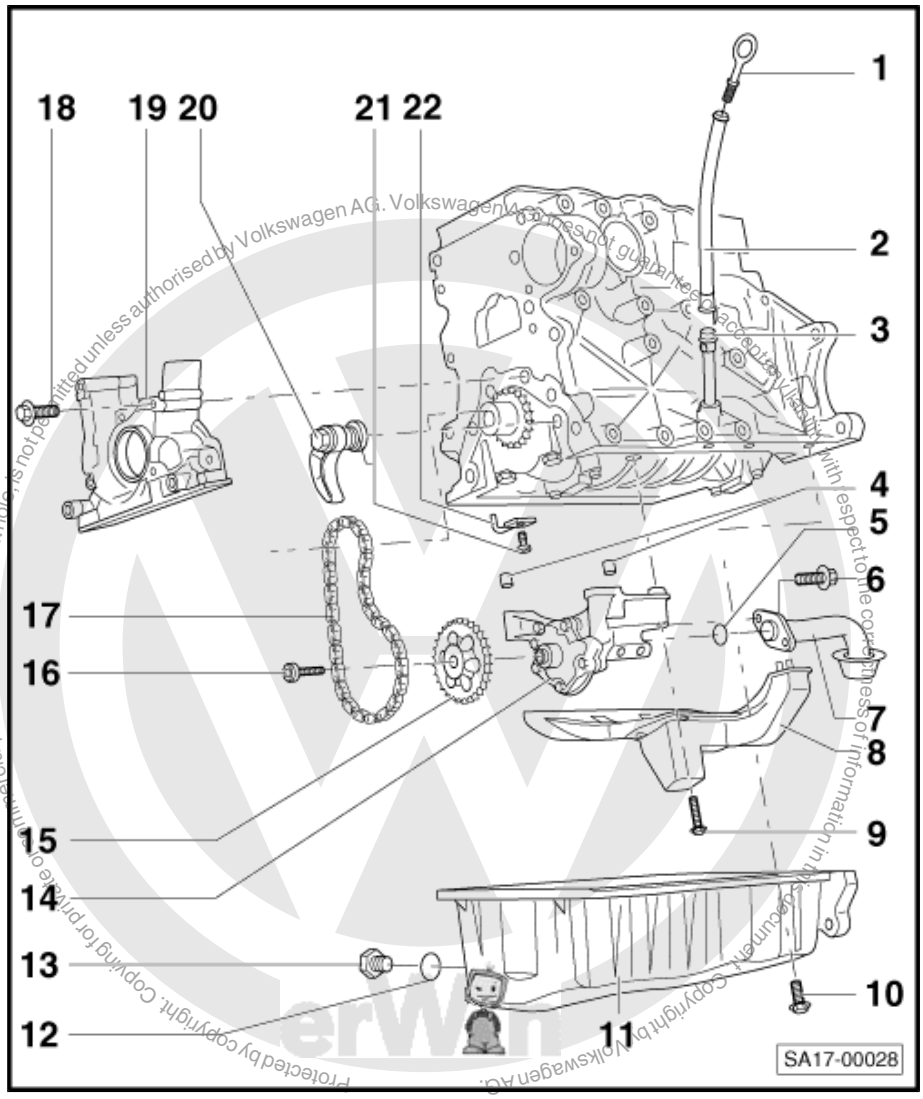
2 - min. mark

a - Area above hatched zone up to max. mark: do not top up with engine oil!

b - Oil level within hatched field: can be topped up with engine oil

c - Area from min. mark up to hatched zone: must be topped up, max. 0.5 l of engine oil!

1.2 Assembly overview - Parts of lubrication system



1 - Oil dipstick
- ❑ The oil level must not be above the max. mark!
- ❑ Markings ⇒ page 57

2 - Dipstick guide
- ❑ Secured to intake manifold
- ❑ Pull out to extract oil

3 - Guide tube

4 - Dowel sleeves

5 - O-ring
- ❑ Renew

6 - Bolt
- ❑ 15 Nm

7 - Suction line
- ❑ Clean strainer if soiled

8 - Baffle plate

9 - Bolt
- ❑ 15 Nm

10 - Bolt
- ❑ 15 Nm

11 - Sump AAAA
- ❑ Clean sealing surface before fitting
- ❑ Install with silicone sealant -D 176 404 A2- ⇒ page 60
- ❑ Removing and installing ⇒ page 60

12 - Seal
- ❑ Renew

13 - Oil drain plug
- ❑ 30 Nm
- ❑ Renew plug with attached seal

14 - Oil pump
- ❑ With 12 bar pressure relief valve
- ❑ Before installing, check that both dowel sleeves for centring oil pump on cylinder block are fitted
- ❑ Renew if running surfaces and gears are scored

15 - Sprocket
- ❑ Note installation position

16 - Bolt
- ❑ 20 Nm
- ❑ Use counterhold tool -T10051- to loosen and tighten

17 - Chain

18 - Bolt

- ❑ 15 Nm

19 - Sealing flange

- ❑ Must seat on dowel sleeves
- ❑ Install with silicone sealant -D 176 404 A2-
- ❑ Removing and installing
- ❑ Renewing crankshaft oil seal - pulley end

20 - Chain tensioner with tensioning rail

- ❑ 15 Nm
- ❑ When installing, pre-tension spring and fit

21 - Pressure relief valve

- ❑ 27 Nm

22 - Oil spray jet

- ❑ For piston cooling

1.3 Assembly overview - Oil filter bracket

1 - Plug

- ❑ 40 Nm
- ❑ Renew

2 - Seal

- ❑ Permanently attached to ⇒ Item 1 (page 59)

3 - Spring

- ❑ For pressure relief valve, approx. 4 bar

4 - Piston

- ❑ For pressure relief valve, approx. 4 bar

5 - Gasket

- ❑ Renew

6 - Non-return valve

- ❑ 8 Nm
- ❑ Different versions: bolted or pressed in
- ❑ Pressed in valves are not available as replacement parts

7 - Seal

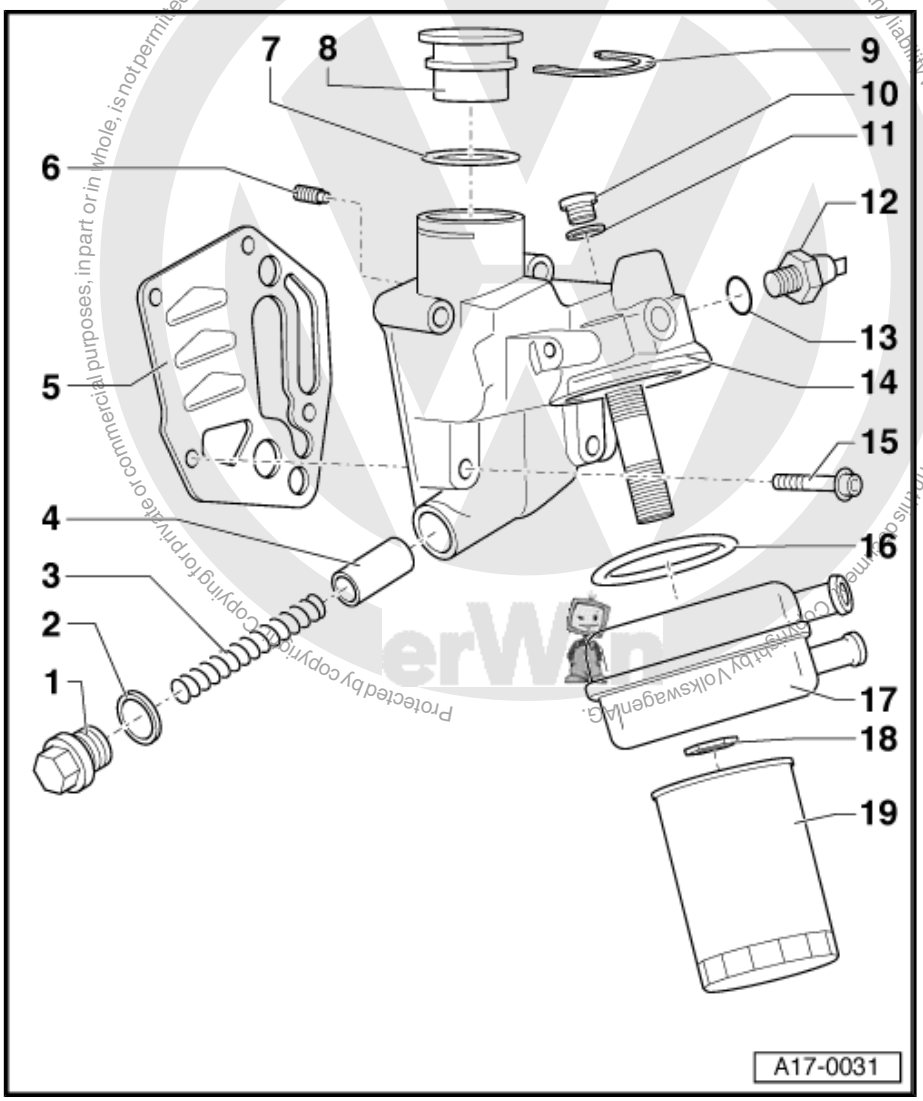
- ❑ Push on up to shoulder of sealing cap ⇒ Item 8 (page 59)

8 - Cap

9 - Securing clip

10 - Plug

- ❑ 15 Nm



11 - Seal

- ❑ If seal is leaking, nip open and renew

12 - 1.4 bar oil pressure switch -F1-

- ❑ 25 Nm
- ❑ Black
- ❑ Checking ⇒ page 63

13 - Seal

- ❑ If seal is leaking, nip open and renew

14 - Oil filter bracket

15 - Bolt

- ❑ 15 Nm + $^{1}/_{4}$ turn (90 °) further
- ❑ Renew

16 - Gasket

- ❑ Renew
- ❑ Fit into lugs on oil cooler

17 - Oil cooler

- ❑ Coat contact surface to oil filter bracket outside the seal with sealing paste -AMV 188 100 02-
- ❑ Ensure clearance to adjacent components

18 - Nut

- ❑ 25 Nm

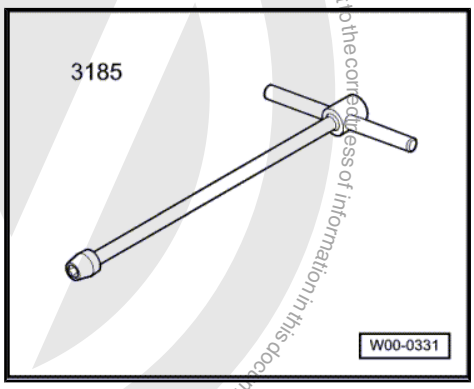
19 - Oil filter

- ❑ Loosen with strap wrench or oil filter tool -3417-
- ❑ Tighten by hand
- ❑ Observe installation instructions on oil filter

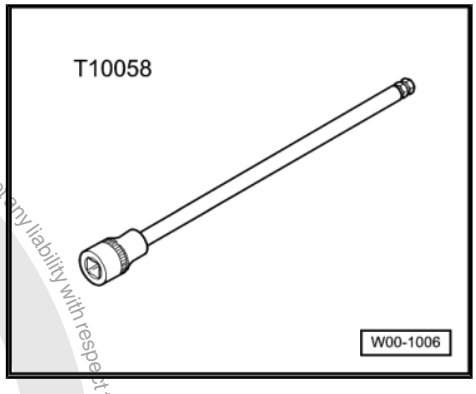
1.4 Removing and installing sump

Special tools and workshop equipment required

- ♦ Jointed wrench 10 mm -3185-



- Special wrench, long reach -T10058-



Not illustrated:

- Hand drill with plastic brush attachment
- Silicone sealant -D 176 404 A2-

1.4.1 Removing

– Remove centre and right-hand insulation tray: ⇒ Rep. Gr. 50 .

– Drain engine oil.

Note

Observe environmental regulations for disposal.

– Pull 3-pin connector off oil level and oil temperature sender -G266- .

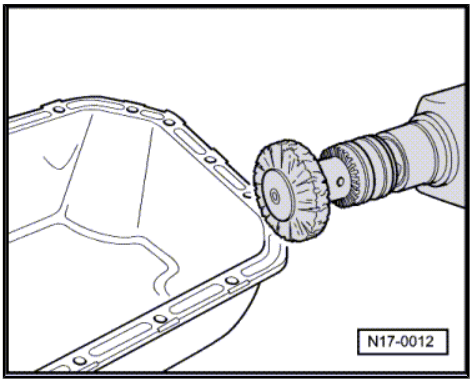
– Loosen and tighten sump bolts using 10 mm jointed wrench -3185- . Loosen or tighten flywheel-end bolts only with allen key, long reach -T10058- .

– Remove sump. If necessary, loosen sump using light blows with rubber-headed hammer.

– Remove sealant residue on cylinder block with a flat scraper.

– Remove sealant residue on sump using a rotating brush, e.g. a hand drill with a plastic brush attachment (wear protective glasses).

– Clean sealing surfaces. They must be free of oil and grease.



1.4.2 Installing

Note

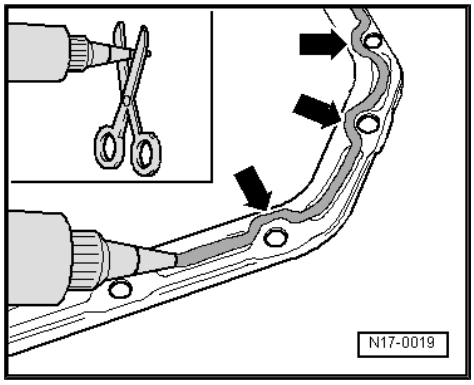
- *Note use-by date of silicone sealant -D 176 404 A2- .*
- *Install oil sump within 5 minutes of applying silicone sealant -D 176 404 A2- .*

– Cut off tube nozzle at forward marking (approx. 3 mm nozzle ∅).

– Apply silicone sealing compound, as shown, to clean sealing surface on oil sump. Sealant bead must be:

♦ 2...3 mm thick

♦ Run bead along inner side of bolt holes -arrows-.



Note

The sealing compound bead must not be thicker. Otherwise excess sealing compound will enter the sump and can block the oil suction line strainer.

– Apply silicon sealant, as shown in diagram, with great care (particularly in area of -arrows-) to clean contact surface of oil sump.

– Fit sump immediately and tighten bolts as follows:

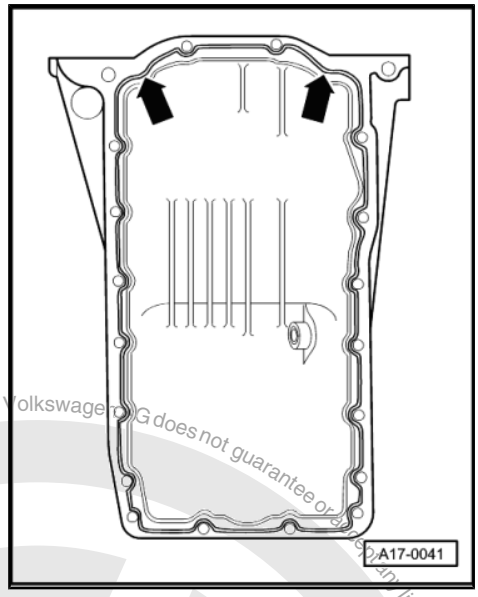
1 - Tighten all bolts between sump and cylinder block only very lightly and in diagonal sequence.

2 - Tighten bolts between sump and gearbox lightly.

3 - Further tighten all bolts between sump and cylinder block lightly and in diagonal sequence.

4 - Tighten bolts between sump and gearbox to 45 Nm.

5 - Tighten all bolts between sump and cylinder block diagonally to 15 Nm.



Note

♦ *When installing sump with engine out of the vehicle, ensure that sump is flush with cylinder block at flywheel end.*

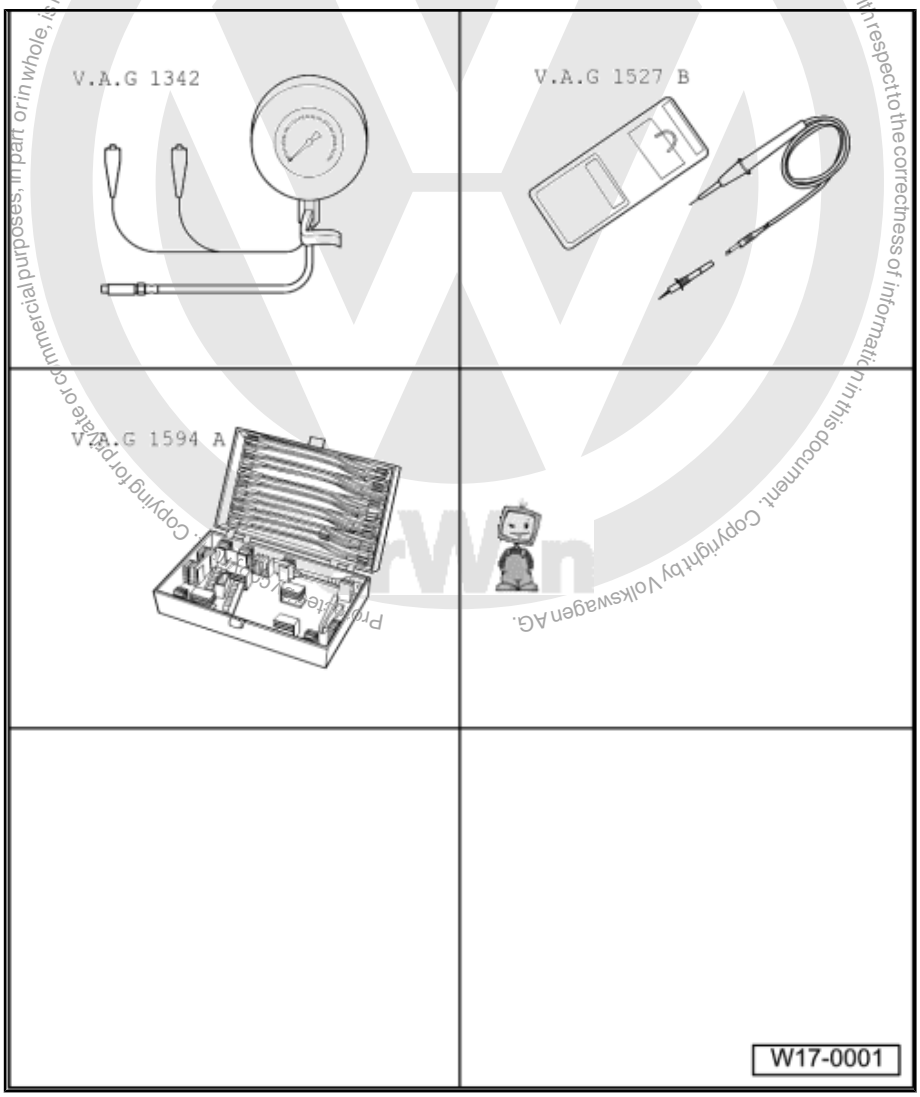
♦ *Let sealing compound dry for approx. 30 minutes after installing sump. Only then fill with engine oil.*

Further assembly is basically the reverse of the dismantling procedure.

1.5 Checking oil pressure and oil pressure switch

Special tools and workshop equipment required

- Oil pressure tester -V.A.G 1342-
- Voltmeter -V.A.G 1527/B-
- Auxiliary measuring set -V.A.G 1594/A- or auxiliary measuring set -V.A.G 1594/C-



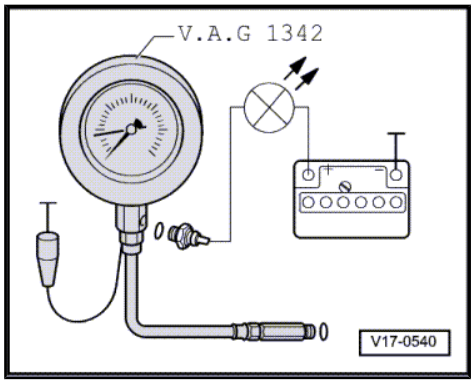
Test prerequisites

- Engine oil level OK, checking ⇒ page 57
- Engine oil temperature at least 80 °C (radiator fan must have run once)

Note

Functional check and repair of the visual and acoustic oil pressure warning ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

Test procedure



- Remove oil pressure switch -F1- and screw it into tester.
- Screw tester into oil filter bracket in place of oil pressure switch.
- Connect brown wire of tester to earth (-).
- Connect voltmeter -V.A.G 1527/B- to battery positive (+) and oil pressure switch using cables from auxiliary measuring set -V.A.G 1594/A- or auxiliary measuring set -V.A.G 1594/C- . LED must not light up.
- If the LED lights up, renew 1.4 bar oil pressure switch -F1- .

If LED does not light up:

- Start engine and run at idling speed. At 1.2...1.6 bar, the LED must light up. Otherwise replace oil pressure switch.
- Increase engine speed further. At 2000 rpm and at an oil temperature of 80° C, the oil pressure should be between 2.7...4.5 bar.

At higher engine speeds, the oil pressure must not exceed 7.0 bar.

If the specifications are not obtained:

- Check strainer in suction line for dirt ⇒ Item 7 (page 58) .

Note

Mechanical damage, e.g. to bearings, could also be the cause behind the oil pressure being too low.

- If necessary, renew oil filter bracket with pressure relief valve ⇒ Item 14 (page 60) or oil pump.

If the specification is exceeded:

- Check oil channels.
- If necessary, replace oil filter bracket with pressure relief valve ⇒ Item 14 (page 60) .

19 – Cooling system

1 Removing and installing parts of cooling system

WARNING

Steam may escape when expansion tank is opened. Wear protective glasses and clothing to avoid eye injuries and scalding. Cover cap with cloth and open carefully.

Note

- *When the engine is warm, the cooling system is under pressure. If necessary, release pressure before beginning repair work.*
- *Secure all hose connections with hose clamps comparable to production standard.*
- *Hose clip pliers -V.A.G 1921- or pliers -VAS 5024/- are recommended for installation of spring-type clips.*
- *Replace gaskets and seals.*
- *The arrows on the coolant pipes and on the ends of the hoses must be aligned with each other.*

Assembly overview - parts of cooling system - engine side ⇒ page 66 .

Assembly overview - parts of cooling system - body side ⇒ page 68 .

Draining and filling coolant ⇒ page 69 .

Removing and installing coolant pump ⇒ page 72 .

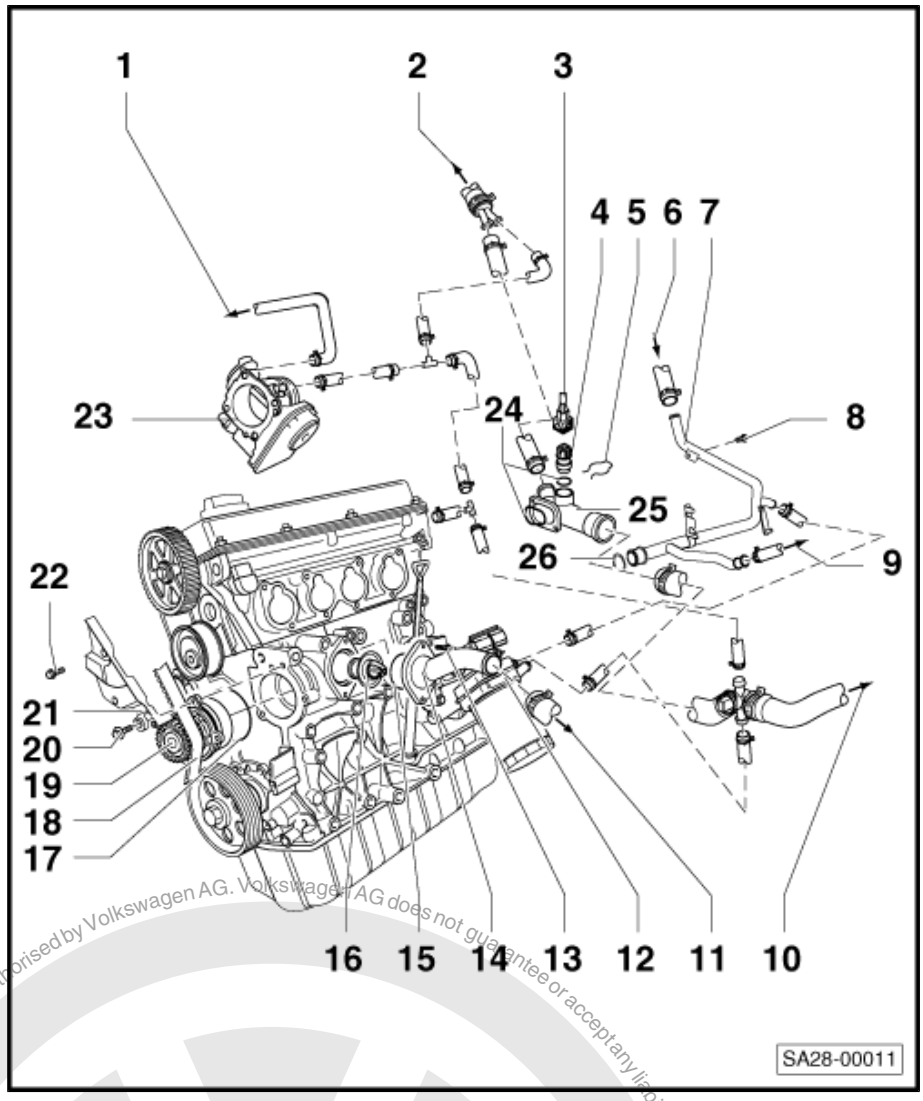
Removing and installing thermostat ⇒ page 74 .

Removing and installing radiator fan -V7- and radiator fan 2 -V177- ⇒ page 75 .

Removing and installing radiator ⇒ page 76 .

Checking cooling system for leaks ⇒ page 78 .

1.1 Assembly overview - parts of cooling system - engine side



1 - To top of expansion tank

2 - To heat exchanger

3 - Connector

- ❑ 4-pin
- ❑ Wire of chamber 1 or C and wire of chamber 3 or D for coolant temperature sender -G62-
- ❑ Contacts for coolant temperature sender -G62- , gold-plated

4 - Sender for coolant temperature sender -G62-

- ❑ For engine control unit
- ❑ With sender for coolant temperature gauge sender -G2-
- ❑ Contacts for coolant temperature sender -G62- , gold-plated
- ❑ If necessary, release pressure in cooling system before removing

5 - Securing clip

- ❑ Check for secure seating

6 - From heat exchanger

7 - Coolant pipe

8 - Bolt

- ❑ 10 Nm

9 - To bottom of expansion tank

10 - To top of radiator

11 - To bottom of radiator

12 - Oil cooler

- ❑ Ensure clearance to adjacent components

13 - Bolt

- ❑ 10 Nm

14 - Connection

15 - O-ring

- ❑ Renew

16 - Thermostat

- ❑ Checking: heat thermostat in water
- ❑ Opening begins at approx. 86 °C
- ❑ Opening lift min. 7 mm
- ❑ Removing and installing ⇨ page 74

17 - O-ring

- ❑ Renew

18 - Toothed belt

- ❑ Mark D.O.R. before removing
- ❑ Check for wear
- ❑ Do not kink
- ❑ Removing, installing and tensioning ⇒ page 28

19 - Coolant pump

- ❑ Check for ease of movement
- ❑ If damaged or leaking, renew complete
- ❑ Removing and installing ⇒ page 72

20 - Bolt

- ❑ 15 Nm

21 - Rear toothed belt guard

22 - Bolt

- ❑ 20 Nm

23 - Throttle valve control module

- ❑ Heated by coolant

24 - O-ring

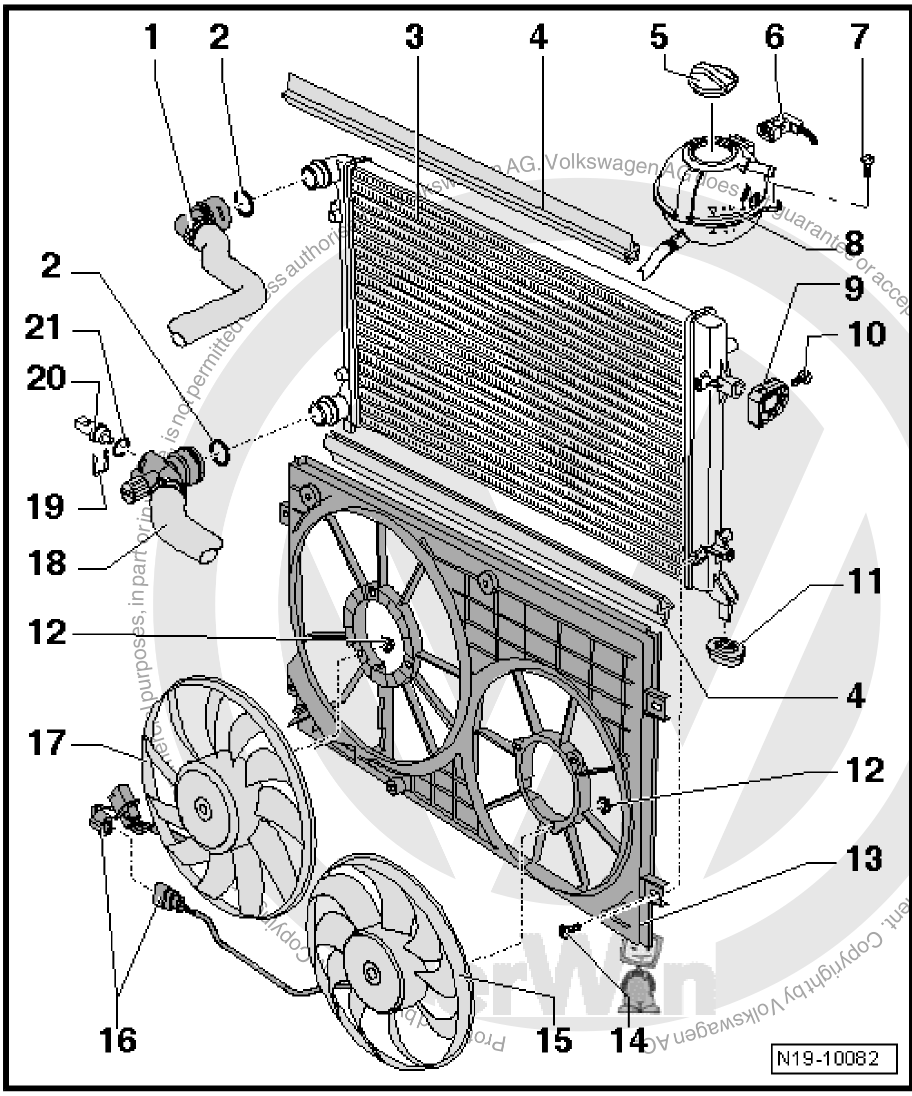
- ❑ Renew if damaged

25 - Connection

26 - O-ring

- ❑ Renew if damaged

1.2 Assembly overview - parts of cooling system - body side



1 - Upper coolant hose
- ❑ To connection on cylinder head

2 - O-ring
- ❑ Renew if damaged

3 - Radiator
- ❑ Removing and installing ⇒ page 76
- ❑ After renewing, renew entire coolant

4 - Seal

5 - Cap
- ❑ Check using cooling system tester -V.A.G 1274- and adapter for cooling system tester -V.A.G 1274/9-
- ❑ The pressure relief valve must open at a pressure of 1.4...1.6 bar

6 - Connector

7 - Screw
- ❑ 5 Nm

8 - Expansion tank
- ❑ Test for leaks in cooling system using cooling system tester -V.A.G 1274- and adapter for expansion tank -V.A.G 1274/8-

9 - Bracket
- ❑ For radiator

10 - Screw
- ❑ 5 Nm

11 - Support

12 - Nut
- ❑ 10 Nm

13 - Cowling

14 - Screw
- ❑ 5 Nm

15 - Radiator fan 2 -V177-
- ❑ Removing and installing ⇒ page 75

16 - Connector

17 - Radiator fan -V7-
- ❑ Removing and installing ⇒ page 75
- ❑ With radiator fan control unit -J293-

18 - Lower coolant hose
- ❑ To connection for thermostat

19 - Securing clip

20 - Radiator outlet coolant temperature sender -G83-

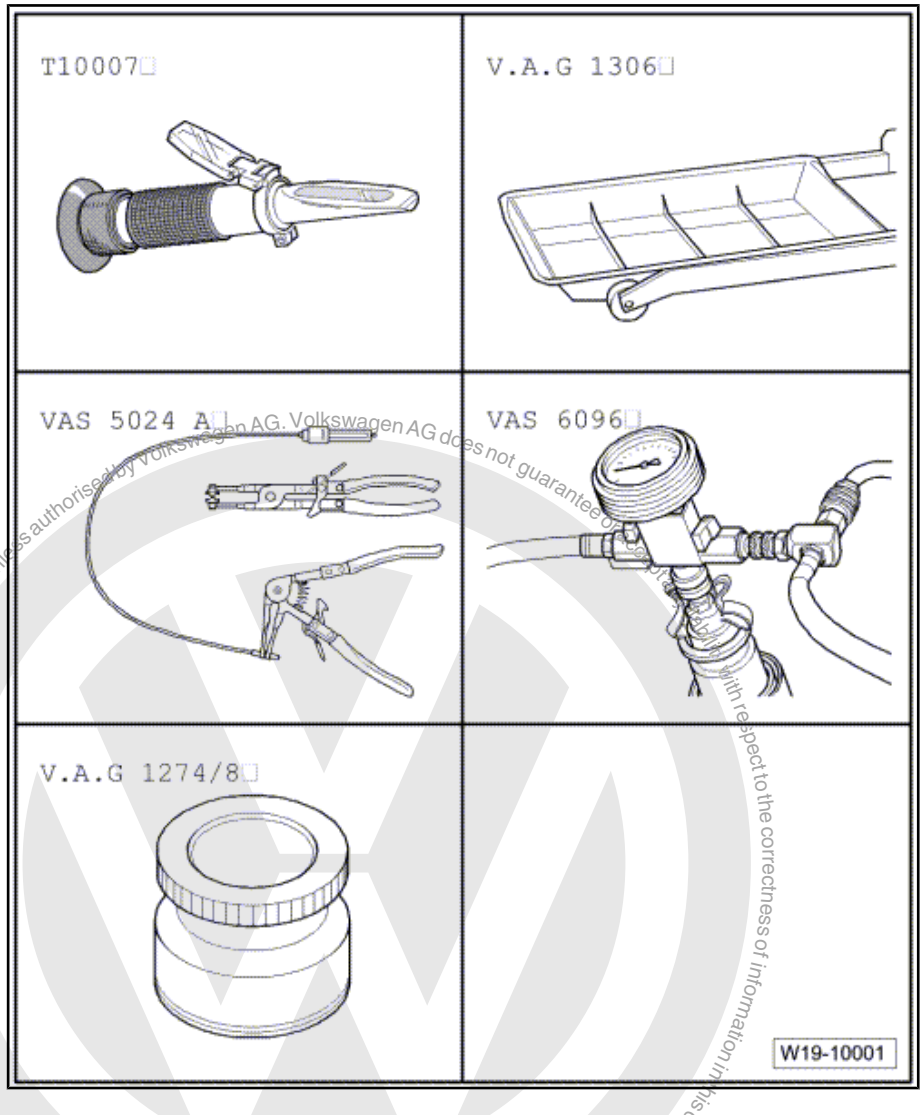
21 - O-ring

❑ Renew

1.3 Draining and filling coolant

Special tools and workshop equipment required

- Cooling system tester adapter -V.A.G 1274/8-
- Drip tray -V.A.G 1306-
- Pliers -VAS 5024/-
- Cooling system charge unit -VAS 6096-
- Refractometer -T10007-



Draining coolant ⇒ page 69 .

Filling with coolant ⇒ page 71 .

1.3.1 Draining coolant

Note

- *Catch drained-off coolant in a clean container for re-use or disposal.*
- *Observe waste disposal regulations.*

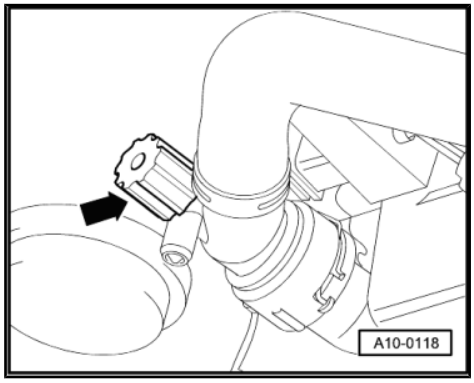
WARNING

Steam may escape when expansion tank is opened. Wear protective glasses and clothing to avoid eye injuries and scalding. Cover cap with cloth and open carefully.

– Open cap on coolant expansion tank.

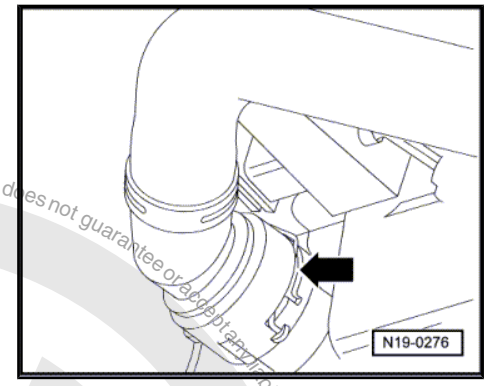
– Remove noise insulation tray ⇒ General body repairs, exterior; Rep. Gr. 50 ; Body front; Noise insulation .

– Open drain plug -arrow- on radiator. If necessary fit drain hose to connection.



Note

If there is no drain plug, release quick-release coupling -arrow- and pull coolant hose off radiator.



1.3.2 Filling with coolant

Note

- *Use only coolant additive G 12 in accordance with TL VW 774 F. Identification: purple colour.*
- *G 12 purple (in accordance with TL VW 774 F) can be mixed with the previous coolant additive G 12 red!*
- *G 12 and coolant additives marked “Conforming to TL VW 774 F” prevent frost and corrosion damage, scaling and also raise boiling point of coolant. Therefore, the cooling system must be filled all year round with frost and corrosion protection additives.*
- *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *Frost protection is required down to about -25 °C (in countries with arctic climates: down to about -35 °C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The frost protection additive must be at least 40% of mixture.*
- *If for climatic reasons greater frost protection is required, the amount of G 12 can be increased, but only up to 60% (frost protection to about -40°C). Otherwise frost protection and cooling effectiveness are reduced again.*
- *If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.*

Recommended mixture proportions:

Frost protection to	Anti-freeze proportion	G 12[6)]	Water[6)]
-25 °C	40 %	3.2 l	4.8 l
-35 °C	50 %	4.0 l	4.0 l

6) The quantity of coolant can vary depending upon vehicle equipment.

– Close drain plug -arrow-.

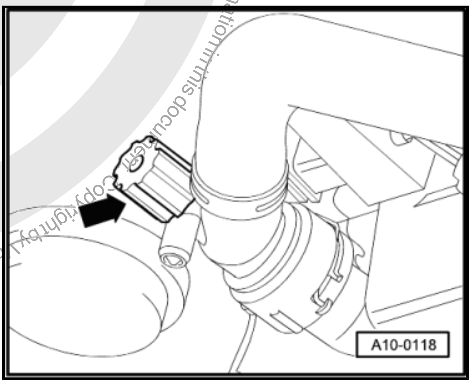
– Install noise insulation tray ⇒ General body repairs, exterior; Rep. Gr. 50 ; Body front; Noise insulation .

With cooling system filler unit -VAS 6096-

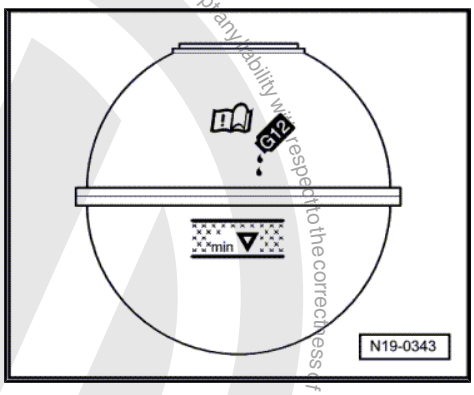
– Screw adapter for cooling system tester -V.A.G 1274/8- onto expansion tank.

– Fill coolant circuit using cooling system charge unit -VAS 6096- ⇒ Operating instructions for cooling system charge unit 6096 .

Without cooling system filler unit -VAS 6096-



– Slowly fill coolant to upper marking of shaded field on expansion tank.
– Fit expansion tank cap.
– Start engine and maintain an engine speed of about 2000 rpm for about 3 minutes.
– Run engine until radiator fan cuts in.



WARNING

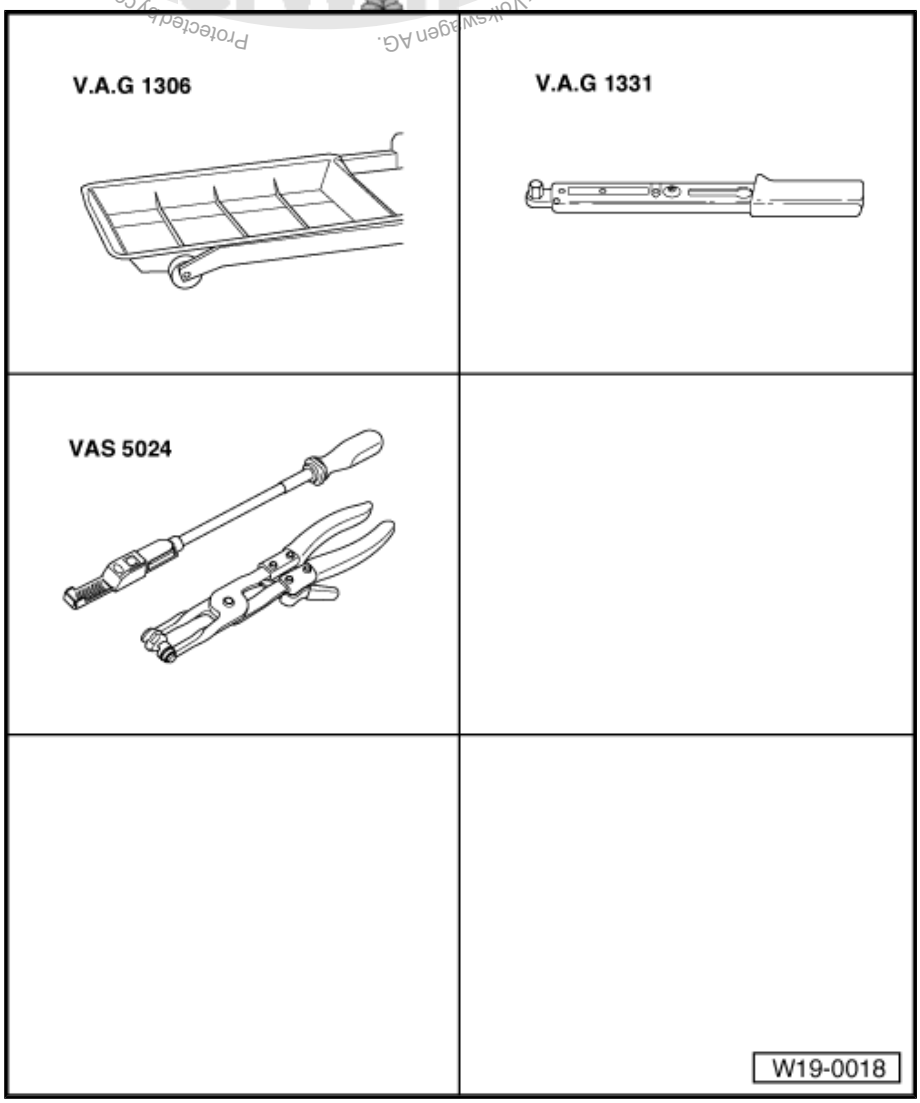
Steam may escape when expansion tank is opened. Wear protective glasses and clothing to avoid eye injuries and scalding. Cover cap with cloth and open carefully.

– Check coolant level and top-up if necessary. When the engine is at normal operating temperature, the coolant level must be at the upper mark; when the engine is cold, in the middle of the shaded field.

1.4 Removing and installing coolant pump

Special tools and workshop equipment required

- Refractometer -T10007-
- Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-
- Torque wrench -V.A.G 1331- (5..50 Nm)
- Assembly tool for spring-type clips -VAS 5024- or spring-type clip pliers -VAS 5024/A-

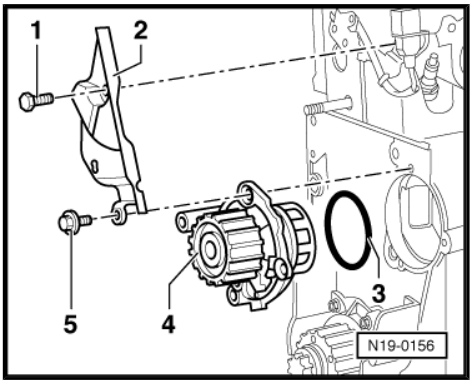


Removing

Note

- *Always renew seals and gaskets.*
- *The lower part of the toothed belt guard need not be removed.*
- *The toothed belt remains on the crankshaft belt pulley.*
- *Cover toothed belt with a cloth to protect it from coolant before removing coolant pump.*

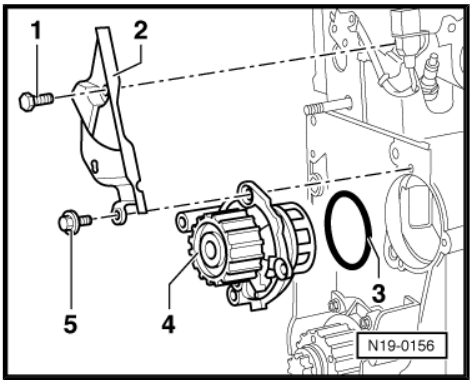
– Drain coolant ⇒ page 69 .
– Remove poly V-belt ⇒ page 16 .
– Remove poly V-belt tensioner.
– Remove toothed belt guard upper and centre parts.
– Take toothed belt off coolant pump belt pulley ⇒ page 28 .
– Remove securing bolt -1- from rear toothed belt guard -2-.
– Unscrew coolant pump securing bolts -5- and remove coolant pump -4-.



Installing

Installation is carried out in the reverse order. When installing, note the following:

– Moisten new O ring -3- with coolant.
– Fit coolant pump -4-. Installation position: drain plug in housing faces downwards.
– Tighten securing bolts -5-.
- Torque: 15 Nm
– Tighten rear toothed belt guard -2- securing bolt -1- to cylinder head.
- Torque: 20 Nm



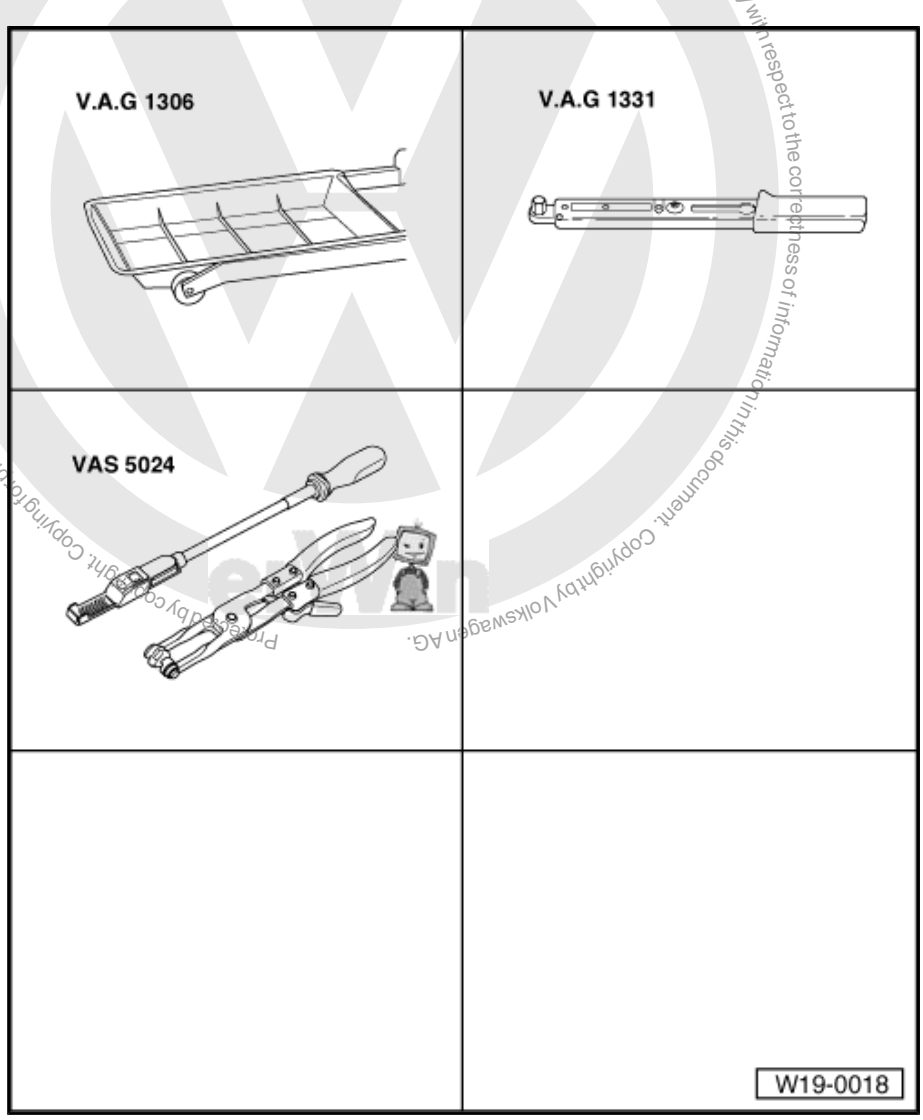
Installing toothed belt and adjusting valve timing ⇒ page 28 .

– Install poly V-belt tensioning element.
- Torque: 25 Nm
– Install poly V-belt ⇒ page 16 .
– Fill with coolant ⇒ page 71 .

1.5 Removing and installing thermostat

Special tools and workshop equipment required

- Refractometer -T10007-
- Drip tray -V.A.G 1306- or drip tray for workshop hoist -VAS 6208-
- Torque wrench -V.A.G 1331- (5..50 Nm)
- Assembly tool for spring-type clips -VAS 5024- or spring-type clip pliers -VAS 5024/A-



Removing

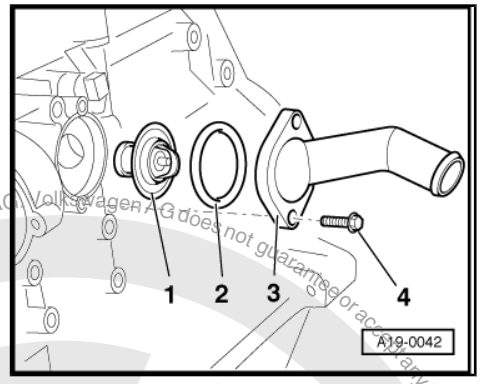
Note

Always renew seals and gaskets.

– Drain coolant ⇒ page 69 .

– Pull coolant hose off connection -3-.

– Remove connecting flange -3- securing bolts -4- and remove connecting flange -3- with thermostat -1-.



Installing

Installation is carried out in the reverse order. When installing, note the following:

– Moisten new O ring -2- with coolant.

– Fit connection -3- with thermostat -1- into engine block.

Note

The brace on the thermostat must be almost vertical.

– Tighten securing bolts -4-.

♦ Torque setting: 15 Nm

– Fill with coolant ⇒ page 71 .

1.6 Removing and installing radiator fan - V7- and radiator fan 2 -V177-

Removing radiator fan:

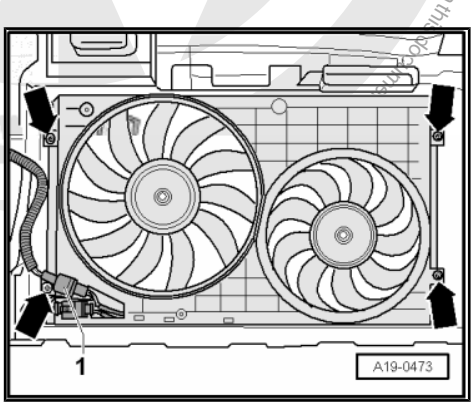
– Remove engine cover.

– Remove air cowling on lock carrier.

– Remove cowl securing bolts -arrows-.

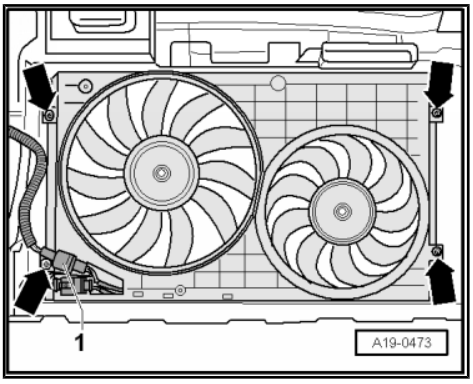
– Drain coolant ⇒ page 69 .

– Unclip lower coolant hose on radiator.

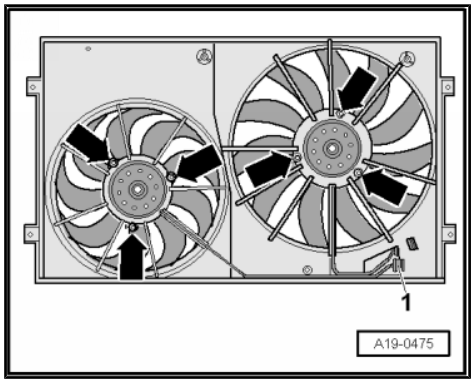


– Separate electrical connector -1- and unbolt lower cowling securing bolts -arrows-.

– Remove cowl downwards.



– Disconnect electrical connection -1- and free wiring.
– Remove nuts -arrows- and remove fans.



Installing radiator fan:

Installation is carried out in the reverse order; note the following:

– Install cowling from below.

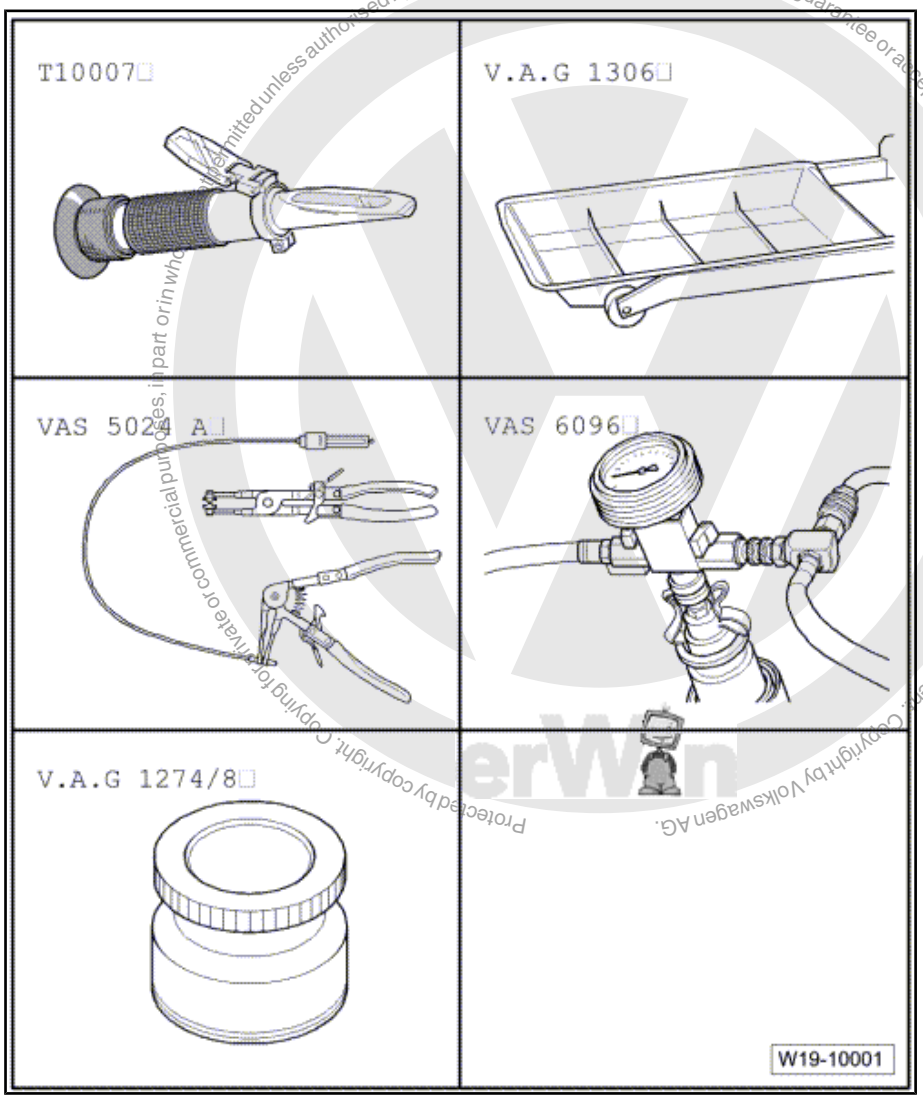
Torque settings

Component	Nm
Radiator fan to cowling	10
Cowling to radiator	5

1.7 Removing and installing radiator

Special tools and workshop equipment required

- Cooling system tester adapter -V.A.G 1274/8-
- Drip tray -V.A.G 1306-
- Spring-type clip pliers -VAS 5024/A-
- Cooling system charge unit -VAS 6096-
- Refractometer -T10007-



Removing radiator:

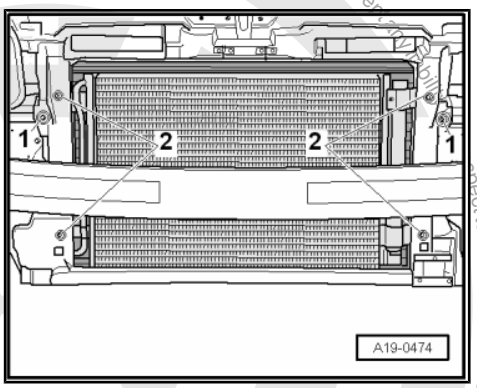
– Drain coolant ⇒ page 69 .
– Bring lock carrier into service position ⇒ General body repairs; Rep. Gr. 50 ; Body front; Lock carrier service position .
– Pull coolant hoses off radiator.

– Remove cowling with radiator fans ⇒ page 75 .

Note

To prevent damage to condenser or to refrigerant pipes and hoses, ensure that pipes and hoses are not stretched, kinked or bent.

– Remove bolts -1- from radiator mounting.
– Swing radiator slightly to back.
– Remove condenser securing bolts -2-.
– Remove radiator upwards.



Installing radiator:

Installation is carried out in the reverse order. When installing, note the following:

– If a new radiator is installed, the old coolant may not be reused.
– Fill with coolant ⇒ page 71 .

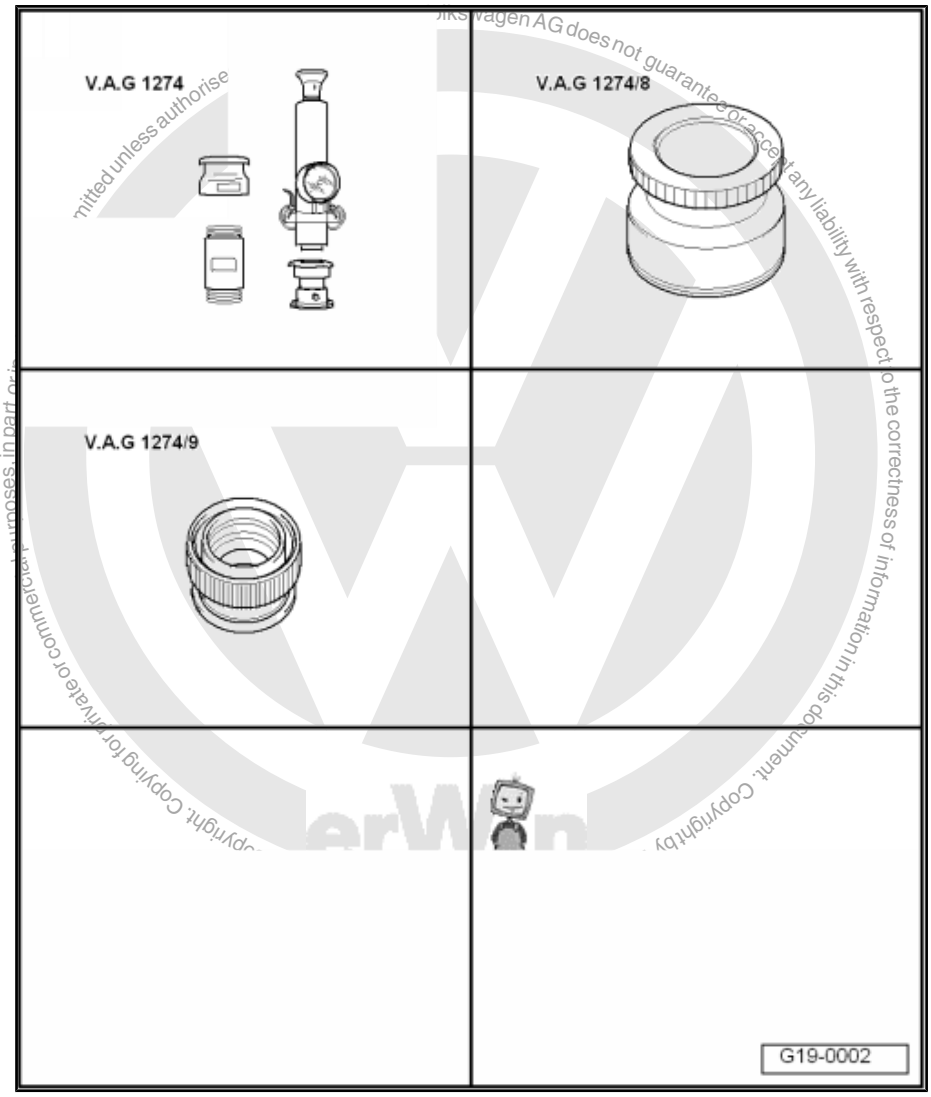
Torque settings

Component	Nm
Radiator mounting to lock carrier	5
Condenser to radiator	5
Cowling to radiator	5

1.8 Checking cooling system for leaks

Special tools and workshop equipment required

- Cooling system tester - V.A.G 1274-
- Cooling system tester adapter -V.A.G 1274/8-
- Cooling system tester adapter -V.A.G 1274/9-



Checking pressure relief valve in filler cap ⇒ page 79

- Engine at operating temperature.

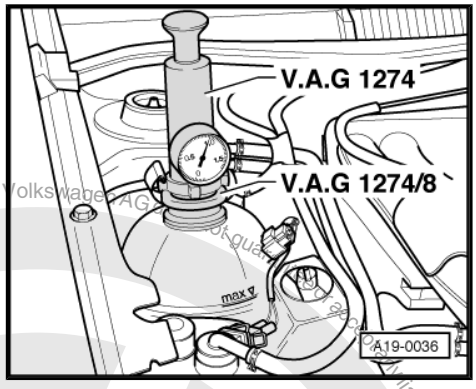
Test sequence

WARNING

Steam may escape when expansion tank is opened. Wear protective glasses and clothing to avoid eye injuries and scalding. Cover cap with cloth and open carefully.

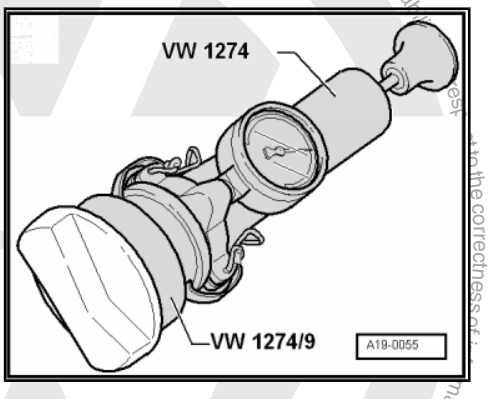
– Open cap on coolant expansion tank.

– Set cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/8- on coolant reservoir.
– Use hand pump on tester to create a pressure of about 1.0 bar.
– If pressure drops find leaks and rectify.



1.8.1 Testing pressure relief valve in filler cap

– Set cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/9- on cap.
– Operate hand pump.
• Pressure relief valve should open at between 1.4 and 1.6 bar.



20 – Fuel supply system

1 Fuel tank

Safety precautions when working on fuel supply system ⇒ page 80 .

Rules for cleanliness ⇒ page 80 .

Assembly overview - fuel tank ⇒ page 81 .

Emptying fuel tank ⇒ page 82 .

Removing and installing fuel tank ⇒ page 84 .

1.1 Safety precautions when working on the fuel supply system

⚠ Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to the cramped conditions:

- *Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.*
- *To avoid damage to lines, ensure sufficient clearance to all moving or hot components.*

When removing and installing fuel gauge sender or fuel pump (fuel delivery unit) from a full or partly full fuel tank, observe the following:

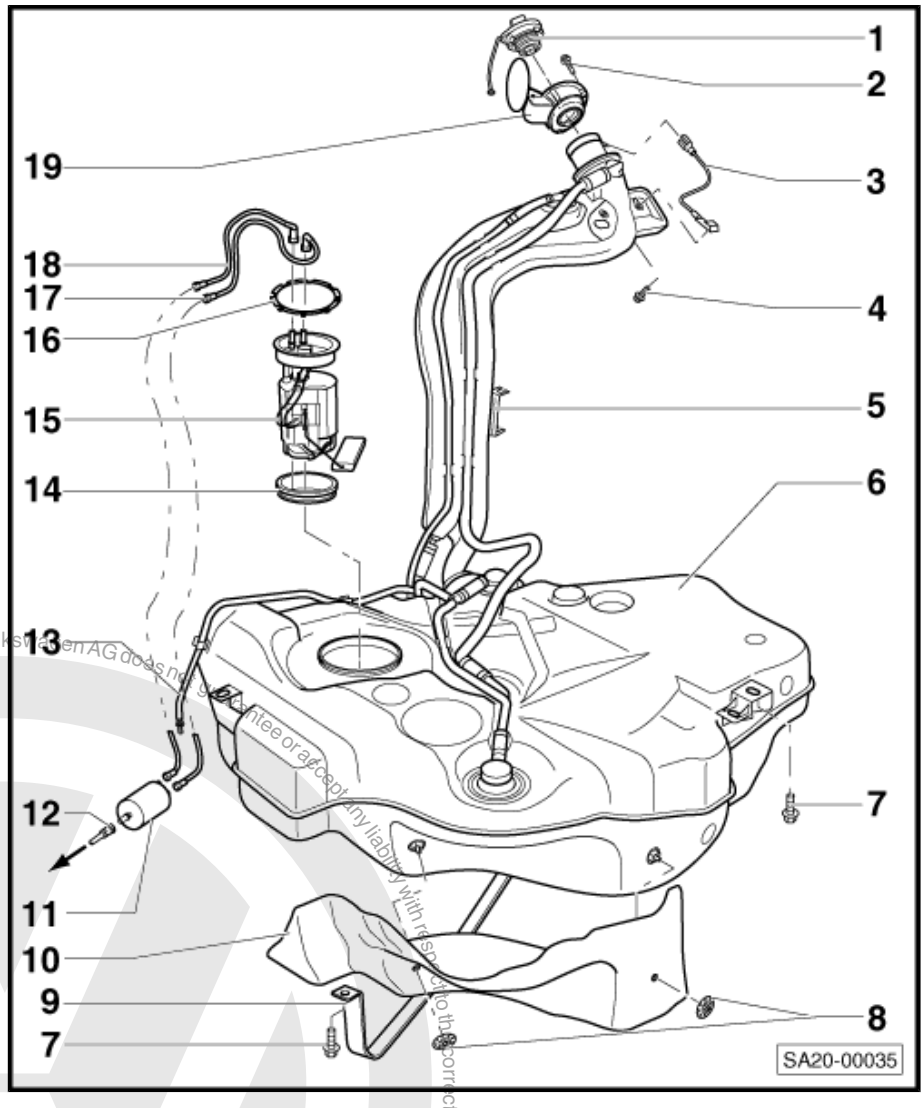
- Before commencing work, switch on exhaust extraction system and place an extraction hose close to the sender opening in the fuel tank to extract escaping petrol fumes. If no exhaust extraction system is available, a radial fan with a displacement of at least 15 m^3/h can be used (the fan motor must be clear of the air stream).
- Prevent skin contact with fuel! Wear fuel-resistant gloves.

1.2 Rules for cleanliness

When working on the fuel supply and injection system, pay careful attention to the following “5 rules”:

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths!
- Carefully cover or seal open components if repairs cannot be carried out immediately.
- Only install clean components: replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

1.3 Assembly overview - fuel tank



1 - Cap
- ❑ Renew if damaged

2 - Securing bolt

3 - Earth connection
- ❑ Check for secure seating

4 - Bolt
- ❑ 10 Nm

5 - Cable guide

6 - Fuel tank
- ❑ When removing, support using engine-/gearbox jack -V.A.G 1383/A-
- ❑ Removing and installing ⇒ page 84

7 - Bolts
- ❑ 25 Nm
- ❑ Renew

8 - Clamping washer

9 - Securing strap

10 - Heat shield

11 - Fuel filter
- ❑ Fitting position: arrow indicates direction of flow

12 - Supply line
- ❑ To fuel rail
- ❑ Check for secure seating

13 - Breather line
- ❑ Clipped onto side of fuel tank
- ❑ Check for secure seating

14 - Seal
- ❑ Renew if damaged
- ❑ When installing, insert seal dry into fuel tank opening
- ❑ Moisten with fuel only when installing flange

15 - Fuel delivery unit
- ❑ Removing and installing ⇒ page 89
- ❑ If fuel delivery unit was replaced, adapt the engine control unit to the fuel pump ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions”
- ❑ Checking fuel pump ⇒ page 92
- ❑ Note installation position on fuel tank ⇒ page 82
- ❑ With fuel gauge sender -G-
- ❑ Removing and installing fuel sender ⇒ page 91
- ❑ Clean strainer if soiled

16 - Locking ring

- ❑ 110 Nm
- ❑ Check for secure seating
- ❑ Remove and install using wrench -T10202-

17 - Supply line

- ❑ Black
- ❑ Clipped onto side of fuel tank
- ❑ Check for secure seating

18 - Return line

- ❑ Blue
- ❑ Clipped onto side of fuel tank
- ❑ Check for secure seating

19 - Tank flap unit

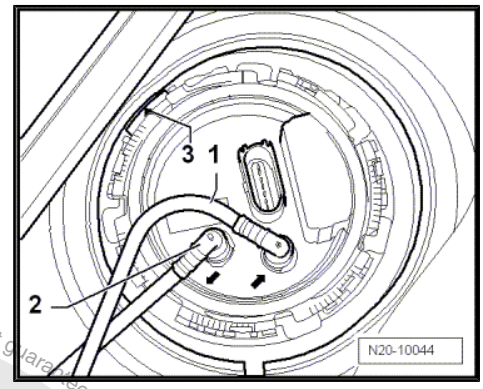
- ❑ With rubber cup
- ❑ Removing and installing ⇒ General body repairs, exterior; Rep. Gr. 55 ; Tank flap unit; Removing and installing fuel tank flap unit

Fitting position of fuel delivery unit flange

Marking -3- on sender points opposite direction of travel.

Return line (blue or with blue mark) -1-.

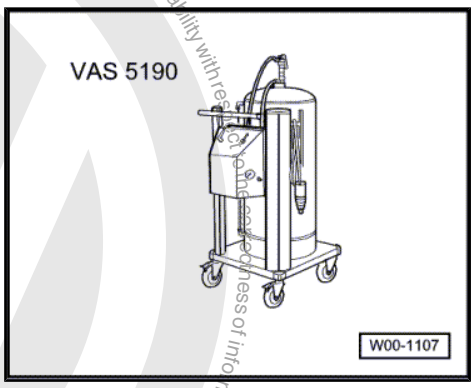
Supply line (black) -2-.



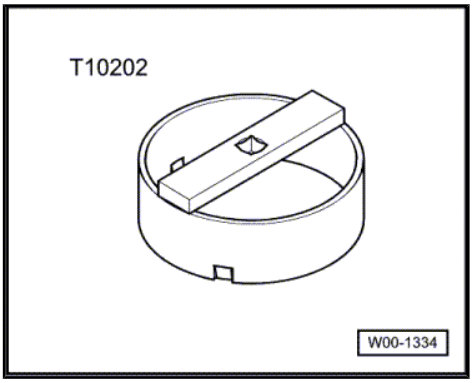
1.4 Emptying fuel tank

Special tools and workshop equipment required

- ◆ Fuel extractor -VAS 5190-



◆ Wrench -T10202-



◆ Torque wrench (40...200 Nm) -V.A.G 1332-

– Note safety precautions before beginning work ⇒ page 80 .

Emptying fuel tank if it is more than $^3/_4$ full ⇒ page 83

Emptying fuel tank if it is less than $^3/_4$ full ⇒ page 84

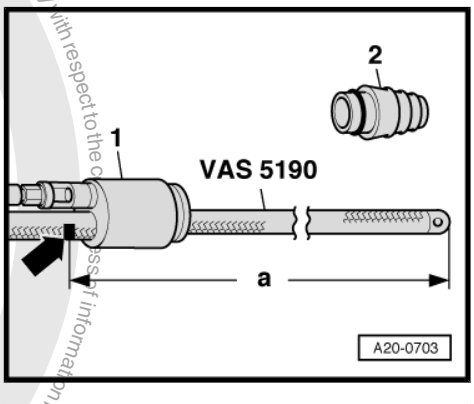
1.4.1 Emptying fuel tank if it is more than $^3/_4$ full

Caution

Secure earth wire of fuel extractor -VAS 5190- to a bare metal part on the body.

– Detach tapered adapter -2- from shaft end -1- of fuel extractor -VAS 5190- .

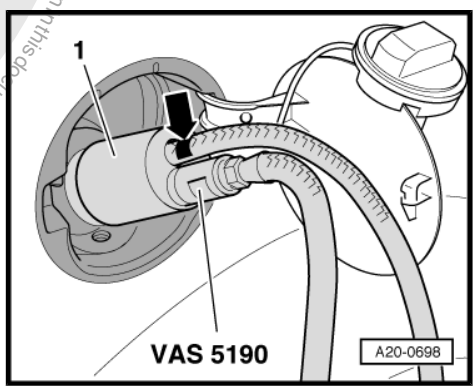
– Use insulating tape to mark the extraction hose -arrow- at a distance of -a- = 1.180 mm from the end of the hose.

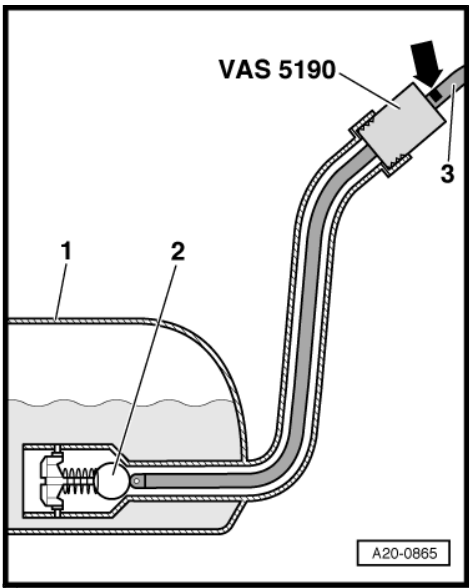


– Remove filler cap from fuel filler neck.

– Fit shaft end -1- of fuel extractor -VAS 5190- onto fuel filler neck.

– Push extraction hose into fuel tank until marking on hose -arrow- coincides with shaft end.





Note

A ball valve -2- is located at the bottom of the filler neck in the fuel tank -1-; it must not be damaged by the extraction hose -3-. Therefore, only push the hose in as far as the tape marking -arrow-.

– Drain fuel tank as much as possible through fuel filler neck.

– Carefully remove extraction hose.

Note

- *When no more fuel is extracted, the tank is emptied just enough for the sender flange to be opened without danger. The tank may be removed while containing remaining fuel.*
- *Emptying the fuel tank completely* ⇒ page 84 .

1.4.2 Emptying fuel tank if it is less than 3/4 full

– Remove seat bench ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seat; Removing and installing seat bench .

– Remove cover from fuel delivery unit.

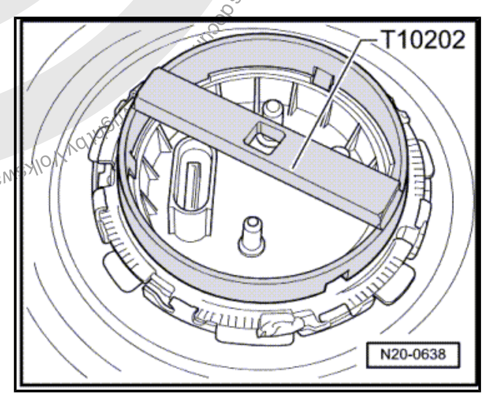
> **WARNING**
>
> *Fuel supply line is pressurized. Wear eye protection and protective clothing to avoid injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.*

– Pull connector and fuel lines off flange.

Note

Press buttons on hose couplings to do this.

– Open locking ring using wrench -T10202- .



– Lift sender flange.

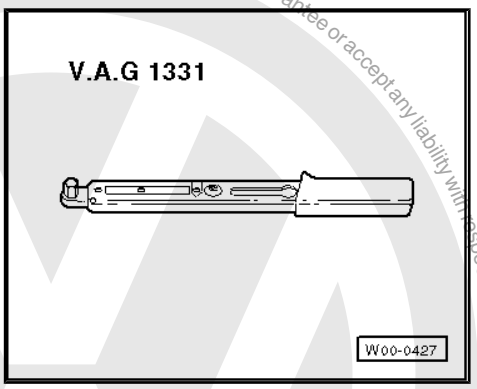
– Insert suction hose of fuel extractor -VAS 5190- as far as possible into fuel tank and extract fuel.

If fuel tank needed only to be emptied, reinstall sender flange ⇒ page 89 .

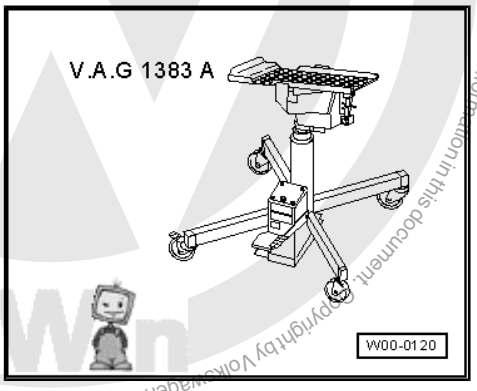
1.5 Removing and installing fuel tank

Special tools and workshop equipment required

♦ Torque wrench (5...50 Nm) -V.A.G 1331-



♦ Engine-/gearbox jack -V.A.G 1383/A-



Removing fuel tank

– Note safety precautions before beginning work ⇒ page 80 .

– First check whether a coded radio is fitted. If so, obtain anti-theft coding.

Note

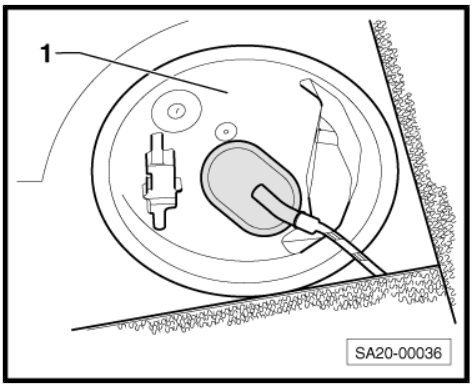
Before disconnecting battery, open fuel filler flap and, if applicable, take wheel lock adapter out of luggage compartment.

– Disconnect earth strap at battery with ignition switched off ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and connecting battery .

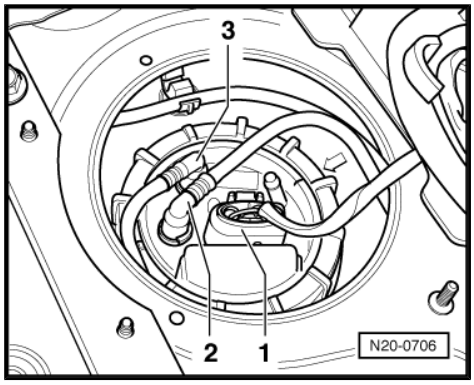
If necessary, empty fuel tank using fuel extractor -VAS 5190- ⇒ page 82 .

– Remove seat bench ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seat; Removing and installing seat bench .

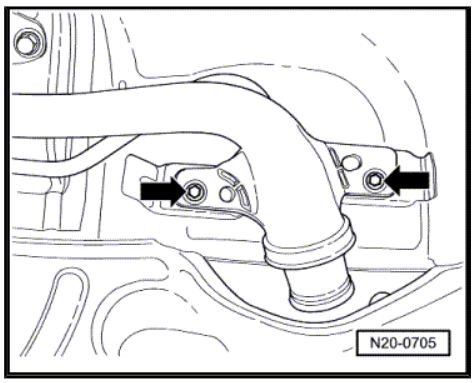
– Remove cover -1- from fuel delivery unit.



– Pull 5-pin connector -1- off flange.
– Remove right rear wheel.
– Remove rear right wheel housing liner ⇒ General body repairs, exterior; Rep. Gr. 66 ; Removing and installing wheel housing liner; Rear wheel housing liner .
– Unscrew tank flap unit securing bolt and remove tank flap unit ⇒ General body repairs, exterior; Rep. Gr. 55 ; Tank flap unit .



– Unbolt filler pipe from body -arrows-.
– Unclip electrical wiring from filler pipe.
– Remove middle and rear silencers.
– Remove heat shields from middle and rear silencers.



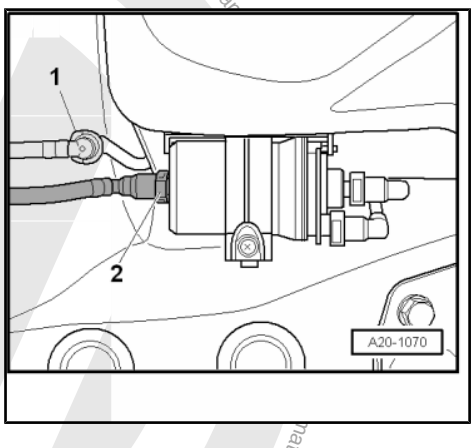
WARNING

The fuel supply line is under pressure! Wear protective glasses and clothing to avoid injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

Note

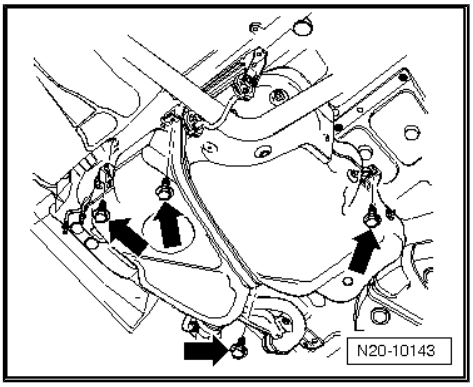
Press in safety ring to release fuel lines.

– Disconnect breather hose -1- (white) and fuel line -2- (black) at connecting point.



– Remove securing strap bolt and securing strap. When doing this, support fuel tank with engine-/gearbox jack -V.A.G 1383/ A- .

– Lower fuel tank.



Installing fuel tank

Installation is performed in the reverse sequence. In the process, note the following:

- Install breather and fuel lines free of kinks.
- Do not interchange supply and return hose (return hose blue or with blue markings, supply hose black).
- Ensure that fuel line connections are tight.
- Check earth connection between tank and body of filler neck.
- If fuel delivery unit was renewed, adapt engine control unit to fuel pump ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .

2 Repairing fuel supply

Note

- *Fuel hoses on engine must be secured only with spring-type clips which conform to production standard.*
- *Spring-type clip pliers -VAS 5024/A- or hose clip pliers -V.A.G 1921- are recommended for installation of spring-type clips.*
- *If fuel delivery unit was renewed, adapt engine control unit to fuel pump ⇒ Vehicle diagnosis, testing and information system VAS 5051; "Guided functions" .*

Safety precautions when working on fuel supply system ⇒ page 88 .

Rules for cleanliness ⇒ page 88 .

Removing and installing fuel delivery unit ⇒ page 89 .

Checking fuel pump ⇒ page 92 .

2.1 Safety precautions when working on the fuel supply system

Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to the cramped conditions:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***To avoid damage to lines, ensure sufficient clearance to all moving or hot components.***

When removing and installing fuel gauge sender or fuel pump (fuel delivery unit) from a full or partly full fuel tank, observe the following:

- Before commencing work, switch on exhaust extraction system and place an extraction hose close to the sender opening in the fuel tank to extract escaping petrol fumes. If no exhaust extraction system is available, a radial fan with a displacement of at least 15 m^3/h can be used (the fan motor must be clear of the air stream).
- Prevent skin contact with fuel! Wear fuel-resistant gloves.

2.2 Rules for cleanliness

When working on the fuel supply and injection system, pay careful attention to the following "5 rules":

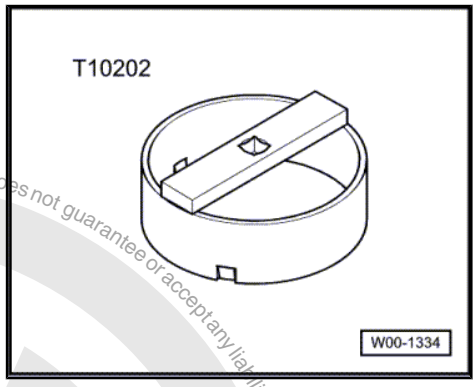
- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths!
- Carefully cover or seal open components if repairs cannot be carried out immediately.

- Only install clean components: replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

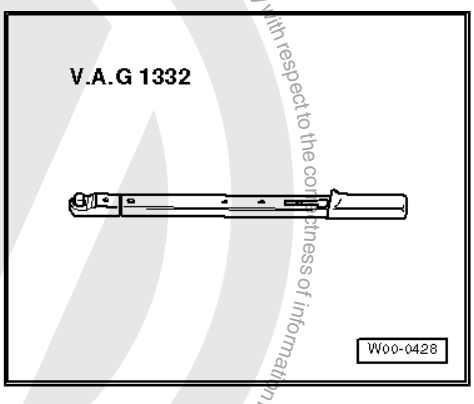
2.3 Removing and installing fuel delivery unit

Special tools and workshop equipment required

- Wrench -T10202-



- Torque wrench (40...200 Nm) -V.A.G 1332-



Removing ⇒ page 89 .

Installing ⇒ page 90 .

2.3.1 Removing

- Fuel tank should be no more than 1/2 full.

Note

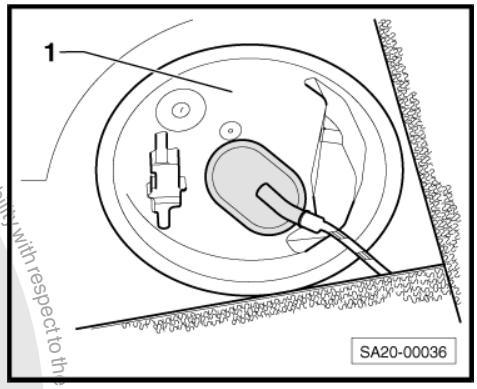
- *If necessary, empty fuel tank using fuel extractor -VAS 5190- .*
- *Note safety precautions before beginning work ⇒ page 88 .*
- *Observe rules for cleanliness ⇒ page 88 .*

– First check whether a coded radio is fitted. If so, obtain anti-theft coding.

– Disconnect earth strap at battery with ignition switched off ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and connecting battery .

– Remove seat bench ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seat; Removing and installing seat bench .

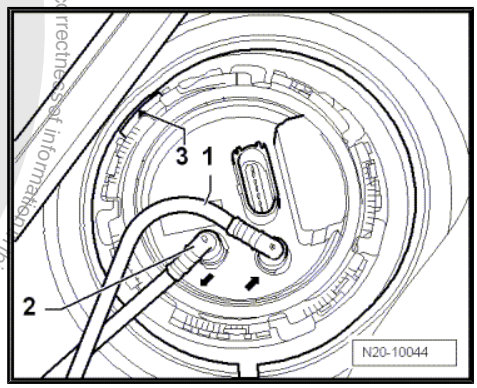
– Remove cover -1- from fuel delivery unit.



WARNING

The fuel supply line is under pressure! Wear protective glasses and clothing to avoid injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

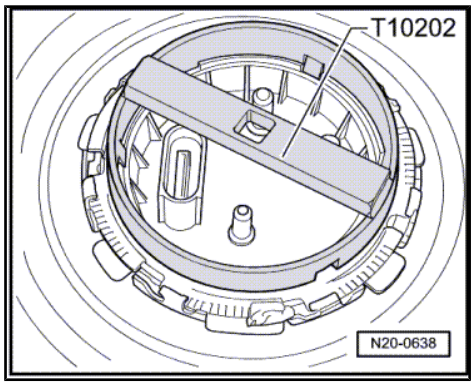
– Pull connector as well as supply and return lines -1 and 2- off flange.



Note

Press in safety ring to release fuel lines.

– Open locking ring using wrench -T10202- and raise flange slightly.



– Pull fuel delivery unit and seal out of the opening in fuel tank.

Note

If delivery unit is to be renewed, drain old delivery unit before disposal.

2.3.2 Installing

Installation of fuel delivery unit is carried out in reverse order. In the process, note the following:

- When inserting fuel delivery unit, ensure that fuel gauge sender is not bent.
- Insert seal for fuel delivery unit dry into opening of fuel tank.
- Moisten seal with fuel only when installing fuel delivery unit.
- Observe fitting position of fuel delivery unit flange ⇒ page 82
- Do not interchange supply and return hose (return hose blue or with blue markings, supply hose black).
- Ensure that fuel line connections are tight.
- If fuel delivery unit was renewed, adapt engine control unit to fuel pump ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .
- Observe required procedures after connecting battery ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and connecting battery .

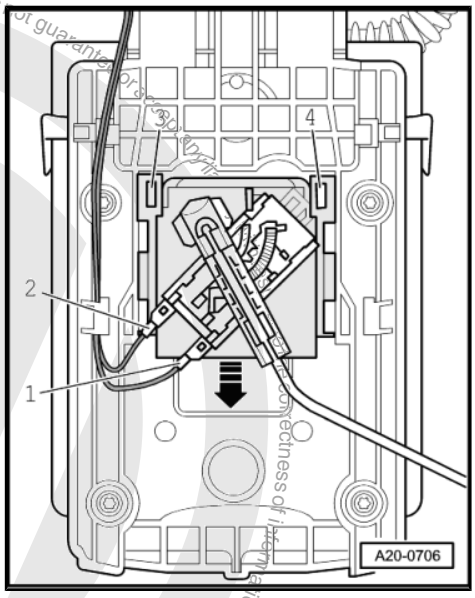
2.4 Removing and installing fuel gauge sender -G-

Removing

– Remove fuel delivery unit ⇒ page 89 .

– Release connectors for lines -1- and -2- and pull off.

– Raise retaining tabs -3- and -4- using a screwdriver and pull fuel gauge sender off downwards -arrows-.



Installing

– Insert fuel sender -G- into guides on fuel delivery unit and press upwards until it engages.

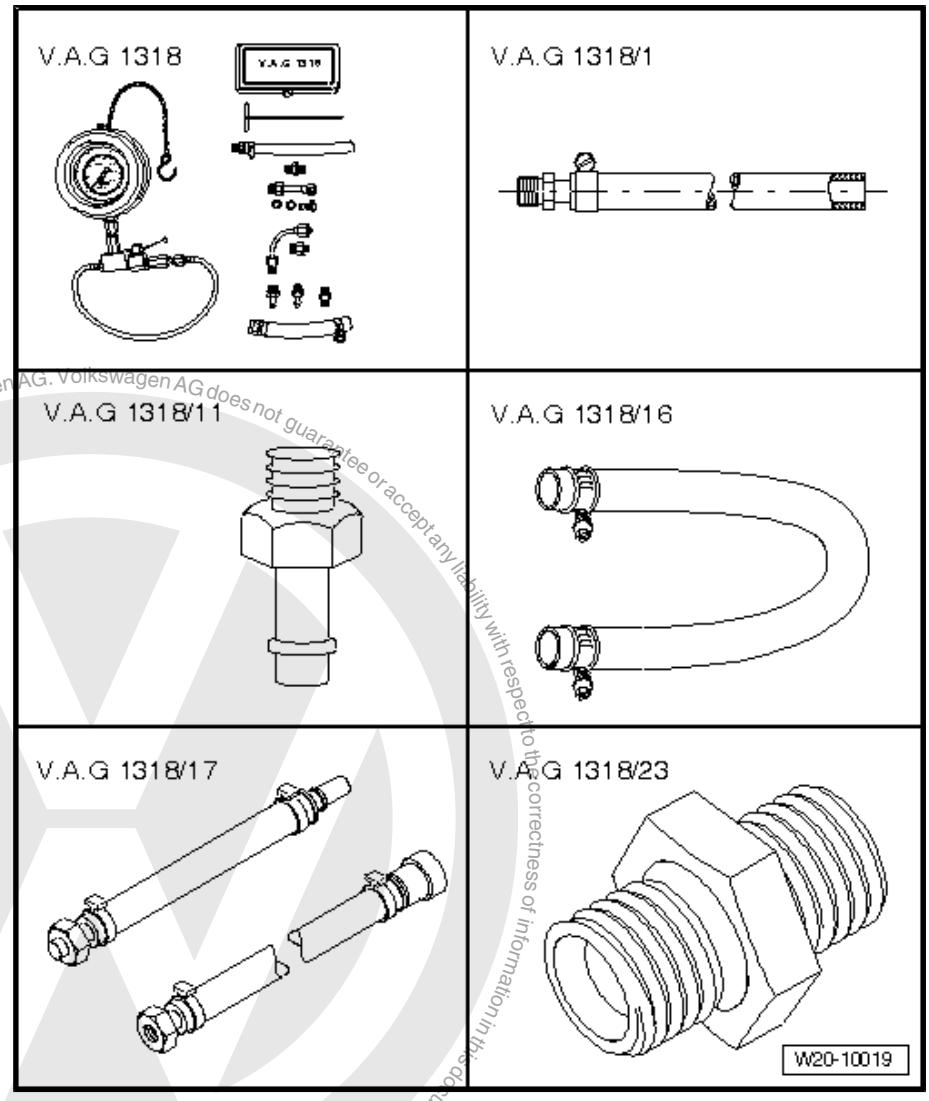
– Reconnect connector and check that it has engaged correctly.

– Install fuel delivery unit ⇒ page 90 .

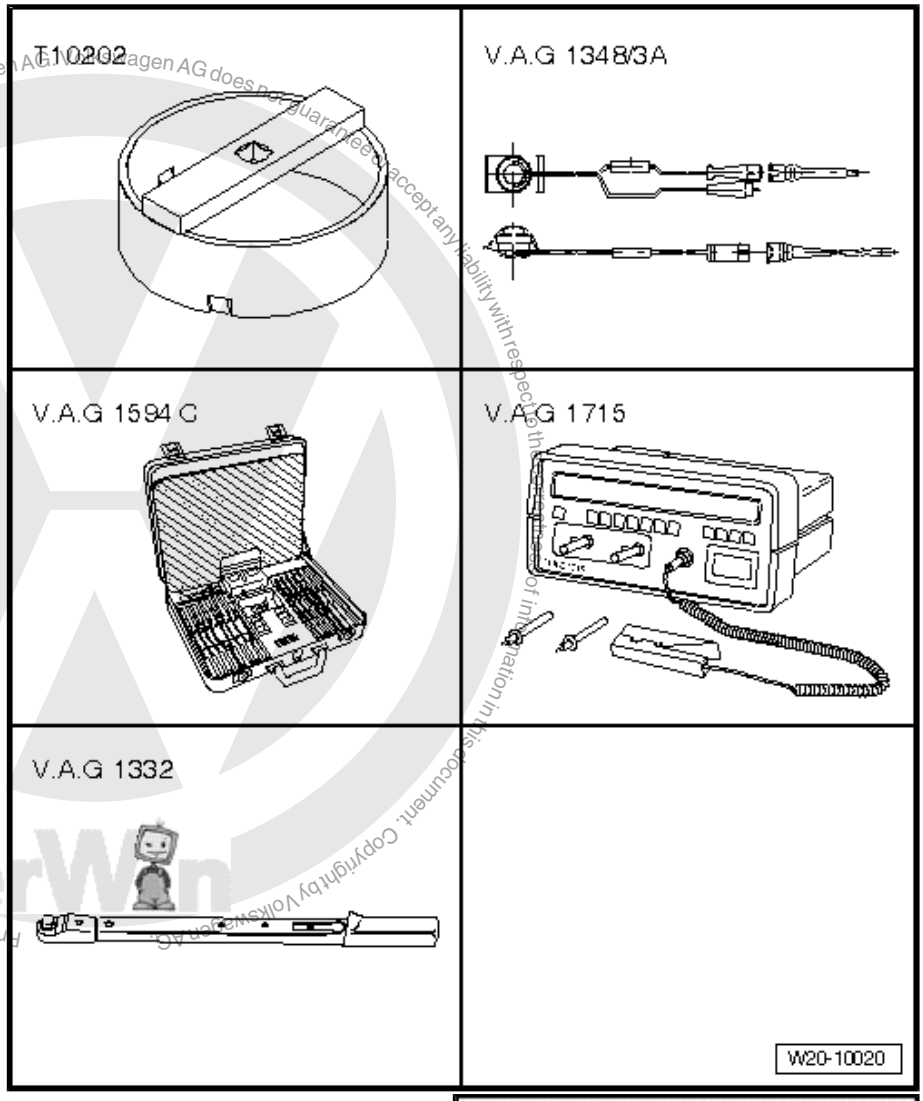
2.5 Checking fuel pump

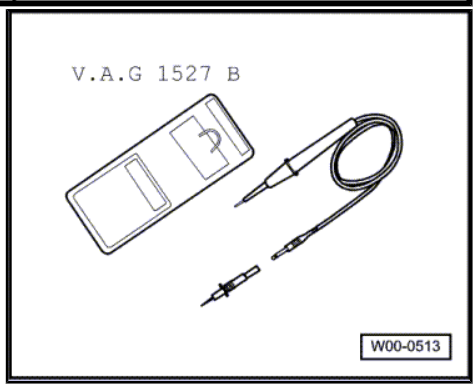
Special tools and workshop equipment required

- Pressure tester -V.A.G 1318-
- Adapter -V.A.G 1318/1-
- Adapter -V.A.G 1318/11-
- Hose adapter -V.A.G 1318/16-
- Adapter -V.A.G 1318/17-
- Connector -V.A.G 1318/23-



- Wrench -T10202-
- Remote control -V.A.G 1348/3A-
- Auxiliary measuring set -V.A.G 1594/C-
- Multimeter -V.A.G 1715-
- Torque wrench (40..0.200 Nm) -V.A.G 1332-
- Measuring container
- Voltmeter -V.A.G 1527/B-





2.5.1 Checking function and voltage supply

- Battery charge at least 11.5 V.
- Fuse SC27 on fuse holder OK.
- Fuel pump control unit -J538- is OK.
- Fuel pressure sender for low pressure -G410- is OK.

– Switch on ignition. Fuel pump must run briefly.

Note

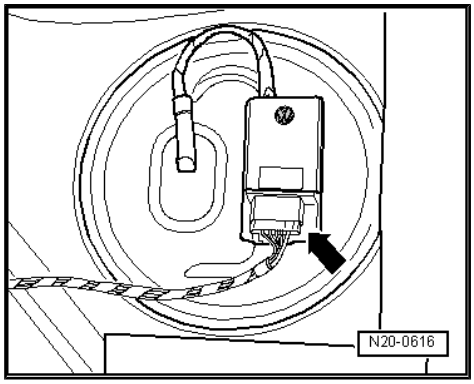
The fuel pump runs very quietly.

– Switch off ignition.

If fuel pump does not run

– Remove seat bench ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seat; Removing and installing seat bench .

– Pull connector off fuel pump control unit -J538- .

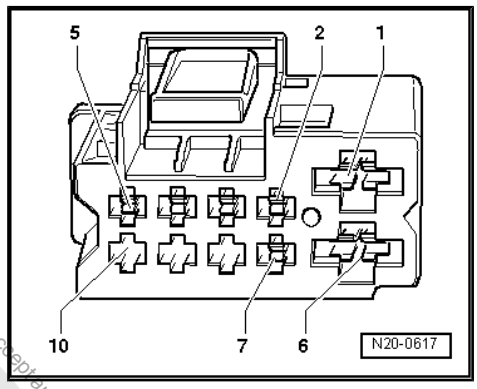


– Check voltage supply between contacts -1- and -6- using voltmeter -V.A.G 1527/B- . The LED must light up.

If LED does not light up.

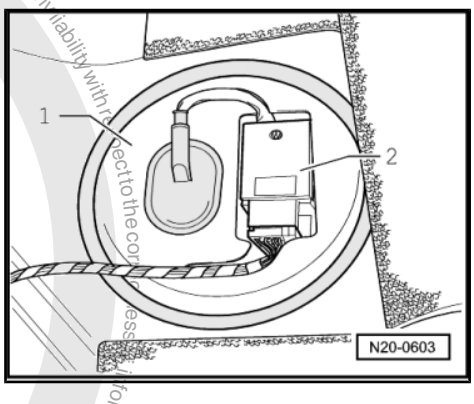
– Locate and eliminate open circuit using current flow diagram ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

If LED lights up (voltage supply OK).



– Remove cover -1- with fuel pump control unit -J538- -2- from fuel delivery unit.

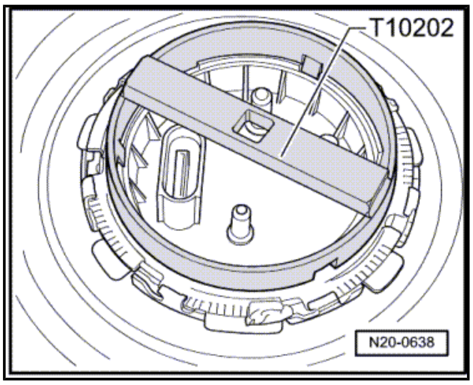
– Pull 5-pin connector off fuel delivery unit flange.



– Open locking ring using wrench -T10202- .
– Check that electrical wires between flange and fuel pump are connected.

If no open circuit can be found.

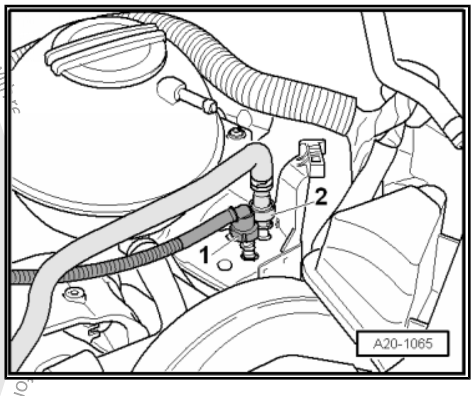
– Fuel pump is defective. Renew fuel delivery unit ⇒ page 89 .



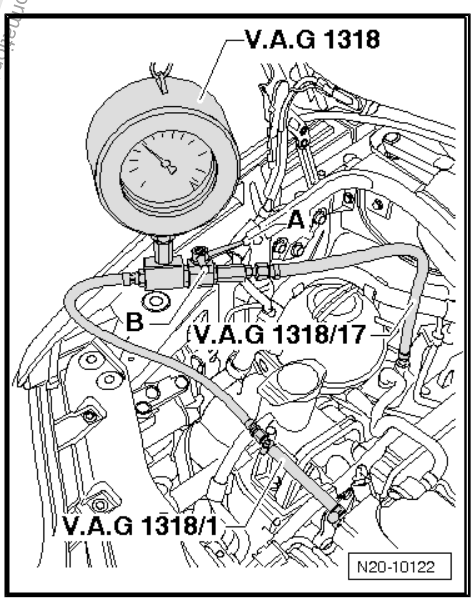
2.5.2 Checking fuel pressure

> **WARNING**
>
> *The fuel supply line is under pressure! Wear protective glasses and clothing to avoid injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.*

– Remove supply line -2- and collect escaping fuel with a cloth.



– Connect pressure tester -V.A.G 1318- , replacing fuel supply line with adapter -V.A.G 1318/1- and adapter set -V.A.G 1318/17- .
– Close cut-off tap of pressure tester. The lever then points in position -A-.
– Switch on ignition repeatedly until fuel pressure does not rise any more on pressure gauge.
– Read fuel pressure on pressure gauge. Specification: 3.5 to 5.0 bar.



If fuel pressure is OK., check residual pressure ⇒ page 96 .

If the specification is exceeded:

– Check return line between fuel filter and fuel pump for kinking and blockages.

If no fault is found.

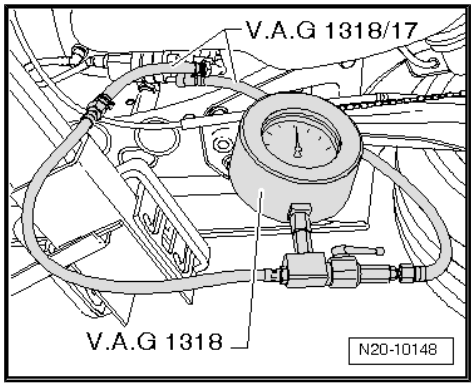
– Pressure limiting valve in fuel filter defective. Replace fuel filter.

If specification is not reached:

– Check fuel delivery rate upstream of fuel filter. Connect pressure tester -V.A.G 1318- with adapter set -V.A.G 1318/17- between fuel filter and supply pipe.

– Open the pressure tester shut-off tap. The handle points in direction of flow.

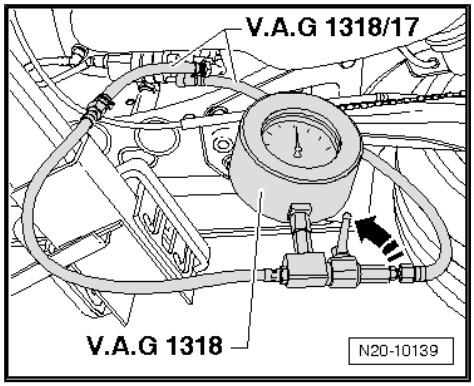
– Start engine and run at idling speed.



Caution

Close the cut-off tap only slowly. At a fuel pressure of 8 bar, reopen the cut-off tap immediately to prevent damage to the pressure tester.

– Slowly close cut-off tap of pressure tester. The pressure must rise to 6.0 bar. When 6 bar have been reached, immediately reopen cut-off tap.



If pressure has risen:

– Fuel pump is OK. Pressure limiting valve in fuel filter is defective. Renew fuel filter.

If pressure does not rise:

– Fuel pump is defective. Renew fuel delivery unit ⇒ page 89 .

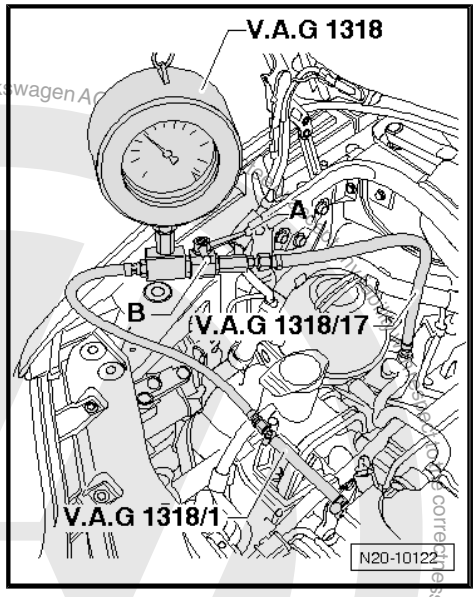
2.5.3 Checking residual pressure

• Fuel pressure is OK and pressure tester -V.A.G 1318- is connected. Checking fuel pressure ⇒ page 95 .

– Switch on ignition repeatedly until fuel pressure does not rise any more on pressure gauge.

– Read fuel pressure on pressure gauge. Specification: 3.5 to 5.0 bar.

– Watch pressure drop on pressure gauge. After 10 minutes, pressure must not drop below 3.0 bar.



If the pressure continues to drop:

– Switch on ignition repeatedly until fuel pressure does not rise any more on pressure gauge.

– Immediately close pressure tester cut-off tap. The lever then points in direction -B-.

If the pressure drops again:

– Check fuel pipe to high-pressure pump for leaks.

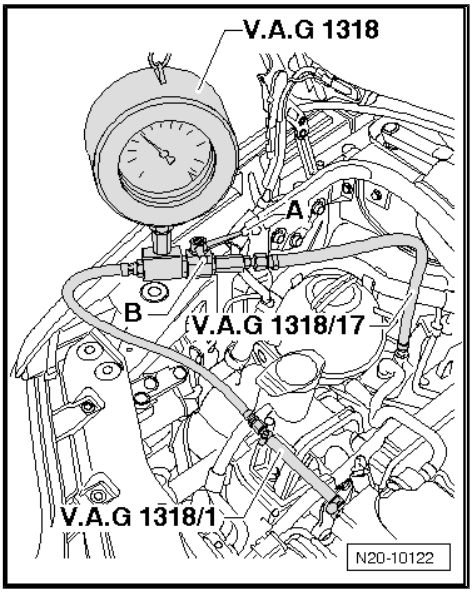
If no fault is found.

– Renew high-pressure pump.

If pressure does not drop any further:

– Check fuel line to fuel filter for leaks.

If no fault in the fuel line is detected:

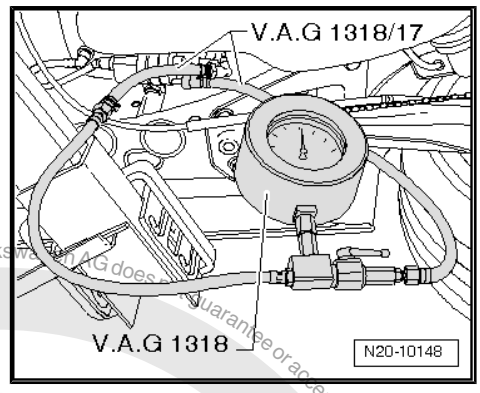


– Check the check valve in the fuel delivery unit. Connect pressure tester -V.A.G 1318- with adapter set -V.A.G 1318/17- between fuel filter and supply pipe.

– Open the pressure tester shut-off tap. The handle points in direction of flow.

– Switch on ignition repeatedly until fuel pressure does not rise any more on pressure gauge.

– Read fuel pressure on pressure gauge. Specification: 3.5 to 5.0 bar.



– After pressure has built up, immediately close pressure tester cut-off tap.

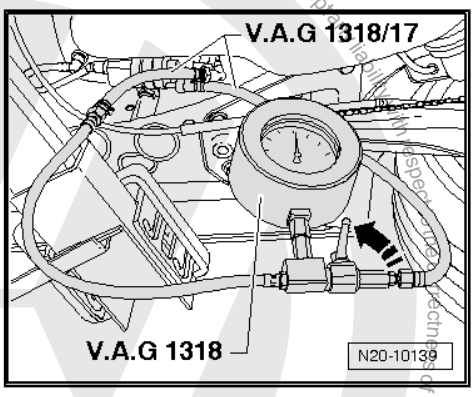
– Watch pressure drop on pressure gauge. After 10 minutes, pressure must not drop below 3.0 bar.

If pressure drops.

– Fuel pump non-return valve is defective, renew fuel delivery unit ⇒ page 89 .

If the pressure does not drop:

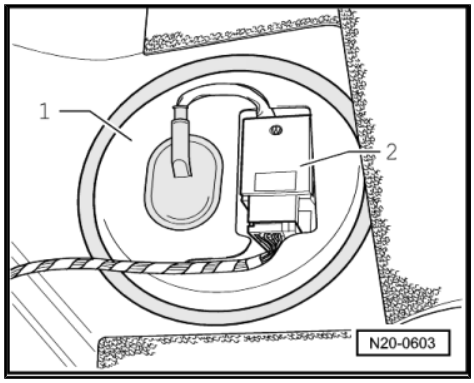
– Pressure limiting valve in fuel filter defective. Replace fuel filter.



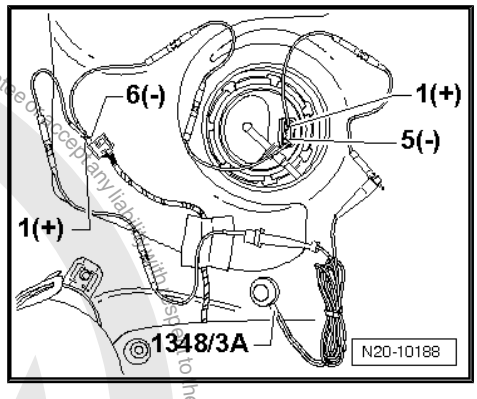
2.5.4 Checking delivery rate

– Remove seat bench ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seat; Removing and installing seat bench .

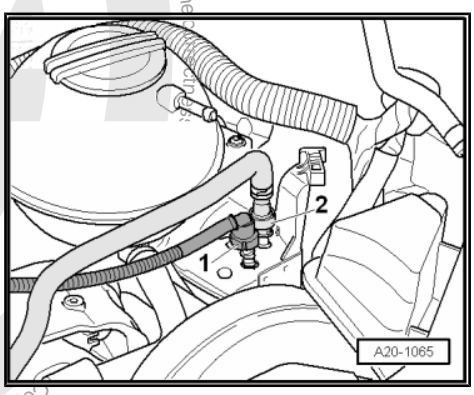
– Remove cover -1- with fuel pump control unit -J538- -2- from fuel delivery unit.
– Pull 5-pin connector off fuel delivery unit flange.



– Connect remote control -V.A.G 1348/3A- to contact -1 (+)- of fuel pump and contact -1 (+)- of connector using adapter cables.
– Connect contacts -6 (-)- of connector and -5 (-)- of fuel pump using an adapter cable from auxiliary measuring set -V.A.G 1594/C- .
– Remove filler cap from fuel tank filler neck.



– Pull off supply line -2- and catch escaping fuel with a cloth.

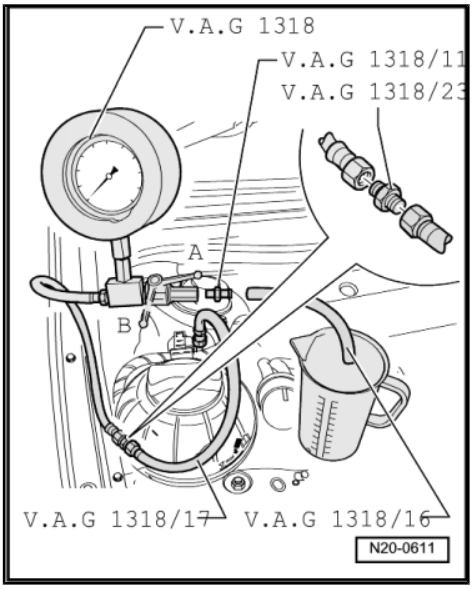


Note

Press in safety ring to release fuel lines.

– Connect pressure tester -V.A.G 1318- with connector -V.A.G 1318/23- and adapter set -V.A.G 1318/17- .

– Push hose adapter -V.A.G 1318/16- onto adapter -V.A.G 1318/11- of pressure tester and hold it in measuring container.



WARNING

Danger of spray when shut-off tap is opened. Wear protective glasses and clothing to avoid injuries and skin contact. Hold container over free connection of pressure tester.

– Close cut-off tap of pressure tester. The lever then points in direction of flow -A-.

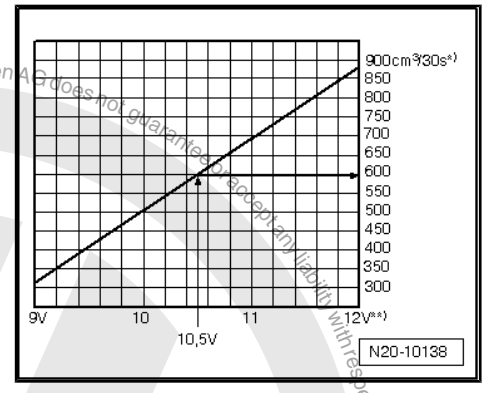
– Operate remote control -V.A.G 1348/3A- . Then slowly close cut-off tap until a pressure of 4 bar is displayed on pressure gauge. From this point on do not move position of cut-off tap.

– Empty measuring container.

– The quantity delivered by the fuel pump depends on the battery voltage. Therefore connect multimeter -V.A.G 1715- with adapter cables from auxiliary measuring set -V.A.G 1594/C- to vehicle battery.

– Operate remote control for 30 seconds while measuring battery voltage.

– Compare quantity of fuel delivered with specification.



*) Minimum delivery rate cm^3/30 seconds.

**) Voltage at fuel pump with engine not running and pump running (approx. 2 volts less than battery voltage).

Example

During the test a voltage of 12.5 volts is measured at the battery. As the voltage at the pump is approx. 2 volts less than the battery voltage, this will equate to a minimum delivery rate of approx. 580cm^3/30 seconds.

If the minimum delivery rate is not attained.

– Check fuel lines for possible restrictions (kinks) or blockages.

If no fault is found.

WARNING

The fuel supply line is under pressure! Wear protective glasses and clothing to avoid injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

– Pull supply hose -1- off fuel filter inlet.
– Connect pressure tester -V.A.G 1318- with adapter set -V.A.G 1318/17- to hose.
– Repeat delivery rate check.

If the minimum delivery rate is now attained.

– Renew fuel filter.

If the minimum delivery rate is again not attained.

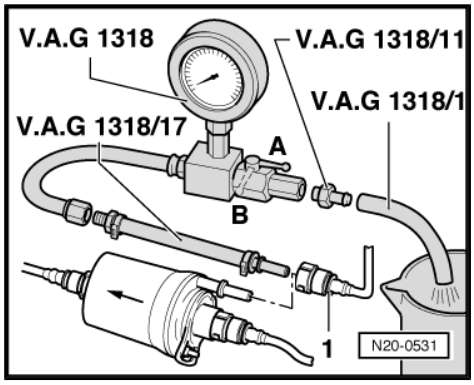
– Remove fuel delivery unit and check for dirt in filter strainer.

Only if still no fault has been detected.

– Renew fuel delivery unit.

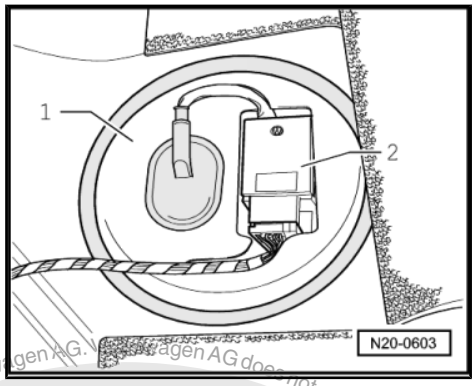
If delivery rate has been attained, but nevertheless you suspect a fuel supply system fault (e.g. intermittent failure of fuel supply system):

– Measure current consumption of fuel pump ⇒ page 100 .

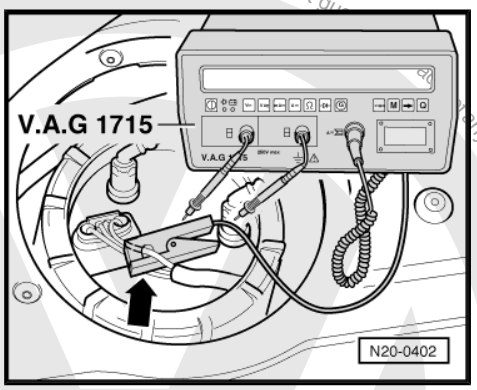


2.5.5 Checking current consumption

– Remove seat bench ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seat; Removing and installing seat bench .
– Remove cover -1- with fuel pump control unit -J538- -2- from fuel delivery unit.



– Connect multimeter -V.A.G 1715- to contact 1 -arrow- of 5-pin connector using pick-up clamp.
– Start engine and run at idling speed.
– Measure current consumption of fuel pump. Specification: max. 9 amps.



Note

If the fuel system malfunction is intermittent, you can perform the check during a road test, but a 2nd person is necessary.

If the current consumption is exceeded.

– Fuel pump is defective. Renew fuel delivery unit ⇒ page 89 .

3 Checking electronic power control (EPC)

Function of EPC system ⇒ page 101 .

Assembly overview - accelerator pedal module ⇒ page 102 .

Removing and installing accelerator module ⇒ page 102 .

3.1 Function of EPC system

With the E-Gas system, the throttle valve is not operated by a cable. There is no mechanical connection between the accelerator and the throttle valve.

The position of the accelerator pedal is transmitted to the engine control unit by two accelerator pedal position senders (variable resistors together in one housing) connected to the accelerator pedal.

The position of the accelerator pedal (driver's requirement) is a main input value for the engine control unit.

The throttle valve is operated over the complete engine speed and load range by an electric motor (throttle valve positioner) in the throttle valve module.

The throttle valve is operated by the throttle valve positioner which is controlled by the engine control unit.

When the engine is not running and the ignition is switched on, the engine control unit moves the throttle valve exactly as prescribed by the accelerator pedal position sender. That is, when the accelerator is depressed halfway, the throttle valve positioner opens the throttle valve by the same amount. The throttle is then approximately half open.

When the engine is running (under load), the engine control unit can open or close the throttle valve independently of the accelerator pedal position sender.

This means that the throttle valve can already be completely open even though the accelerator pedal is depressed half way. This has the advantage of preventing throttling losses at the throttle valve.

After evaluating the torque requirements of various components (e.g. air conditioning system, automatic gearbox, ABS/ESP and so on), the engine control unit calculates the optimal throttle valve opening angle for the respective situation.

This also results in significantly improved consumption and exhaust emission values under certain load conditions.

“EPC” is a system comprising all components which contribute to determining, controlling or monitoring the position of the throttle valve, e.g. accelerator pedal position sender, the throttle valve control part, the EPC warning lamp and the engine control unit.

3.2 Assembly overview - accelerator pedal module

1 - Connector

- ❑ Black, 6-pin

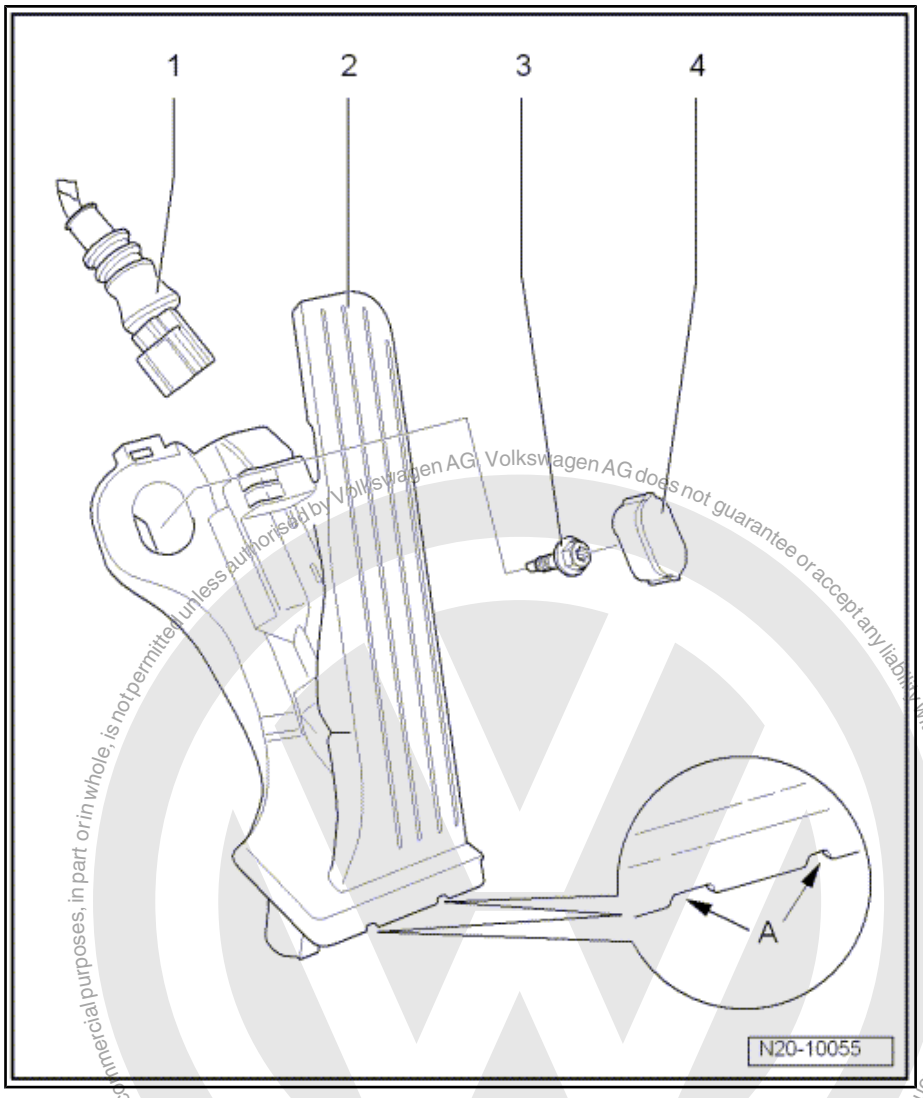
2 - Accelerator pedal position - G79- with sender 2 for accelerator pedal position -G185-

- ❑ Cannot be adjusted
- ❑ The accelerator position sender passes the position of the accelerator on to the engine control unit
- ❑ -A- openings for release tool
- ❑ Removing and installing ⇒ page 102

3 - Bolt

- ❑ 10 Nm

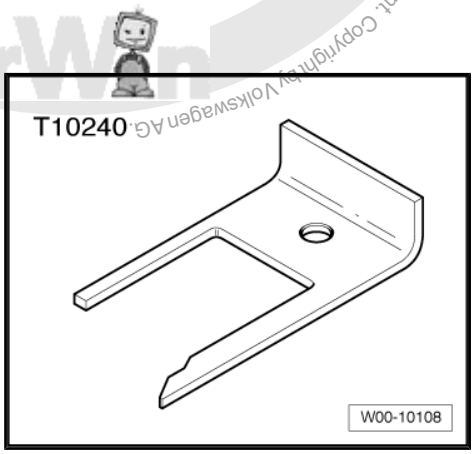
4 - Cap



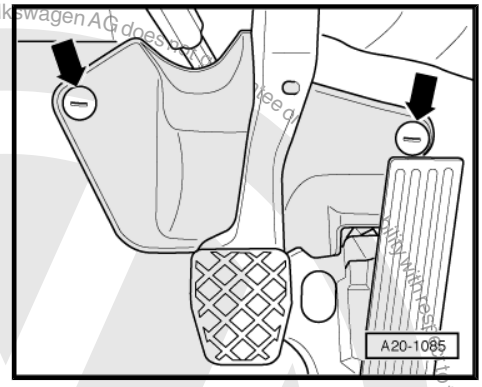
3.3 Removing and installing accelerator module

Special tools and workshop equipment required

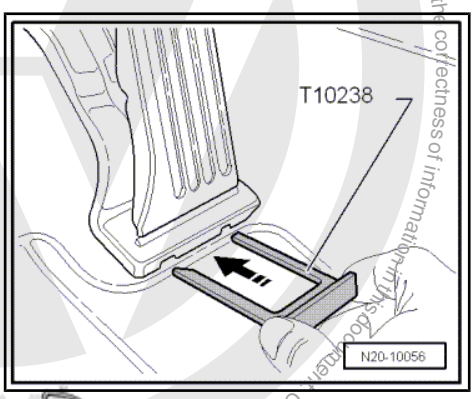
♦ Release tool -T10240-



– Remove steering column cover -arrows-.
– Lever out cap ⇒ Item 4 (page 102) using a screwdriver.
– Remove securing bolt ⇒ Item 3 (page 102).

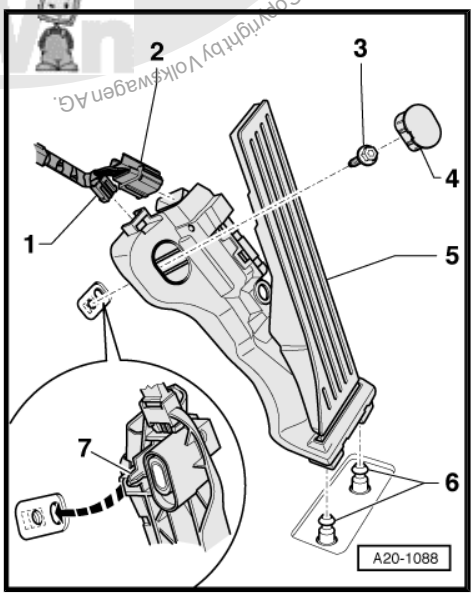


– Push release tool -T10240- into intended holes as shown to stop and remove accelerator pedal module.
– Separate electrical connection and pull wire guide off accelerator pedal.



Installing

– Push wiring guide -1- and electrical connector -2- onto accelerator pedal.
– Press accelerator pedal module onto securing pins -6-.
– Insert centring pin -7- into hole in floor of vehicle.
– Secure accelerator pedal with bolt -3-, torque setting 10 Nm and install cap -4-.
– Install steering column trim.



4 Active charcoal filter system

Function ⇒ page 104 .

Assembly overview - active charcoal filter system ⇒ page 105 .

Checking fuel tank breather ⇒ page 105 .

4.1 Function

Depending upon the air pressure and ambient temperature, fuel vapour will form above the level of fuel in the tank.

The active charcoal filter system prevents these HC emissions escaping to the atmosphere.

In limited quantities, fuel vapours pass through a gravity valve (which closes at an angle of 45°) located at the highest point in the tank and through a pressure retention valve into the activated charcoal filter.

The activated charcoal stores these vapours like a sponge.

When the car is being driven and the lambda control is active (engine warm), the active charcoal filter solenoid valve 1 -N80- , also known as regeneration valve, is activated (pulsed) by the engine control unit depending upon load and engine speed. The opening period depends on the input signals.

During the purging procedure (regeneration of the activated charcoal), the intake manifold vacuum draws in fresh air through the vent opening on the underside of the activated charcoal filter. The fuel vapours stored in the activated charcoal and fresh air are fed to combustion in metered quantities.

The pressure retention valve prevents fuel vapours from being drawn from the tank when the solenoid valve is open and intake manifold vacuum is present. It thus ensures that the evacuation of the activated charcoal filter has priority.

When not energised (e.g. open circuit), the solenoid valve is closed. The activated charcoal filter will not be purged.

Note

- *Hose connections are secured with either spring-type or clamp-type clips.*
- *Always replace clamp-type clips with spring-type clips.*
- *Spring-type clip pliers -VAS 5024 A- are recommended for installation of spring-type clips.*

4.2 Assembly overview - active charcoal filter system

1 - Activated charcoal filter

- ❑ Location: in engine compartment on right

2 - Pressure retention valve with connecting hose

3 - Connecting hose

- ❑ Check for secure seating
- ❑ From fuel tank

4 - Bolt and nut

- ❑ 10 Nm

5 - Activated charcoal filter solenoid valve 1 -N80-

- ❑ Valve closed with ignition switched off
- ❑ When engine is warm, valve will be actuated (pulsed) by engine control unit

6 - Connecting hose

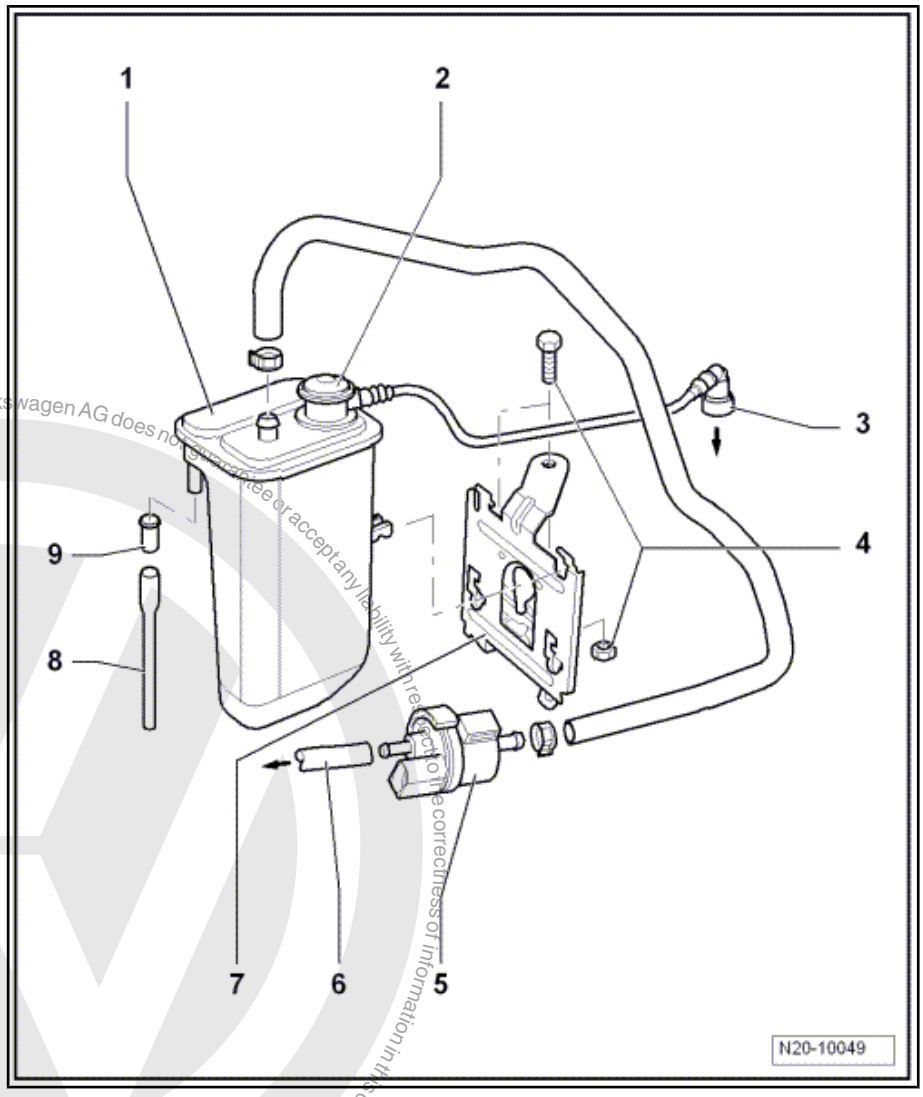
- ❑ To intake manifold
- ❑ Check for secure seating

7 - Bracket

- ❑ For activated charcoal filter

8 - Breather hose

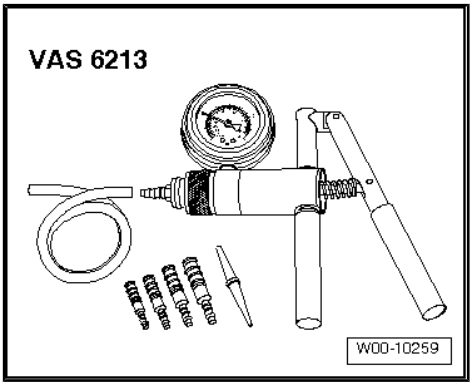
9 - Sealing grommet



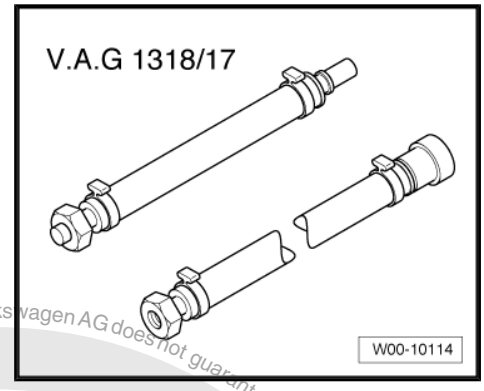
4.3 Checking fuel tank breather

Special tools and workshop equipment required

- ♦ Hand vacuum pump -VAS 6213-



♦ Adapter set -V.A.G 1318/17-



Test prerequisite

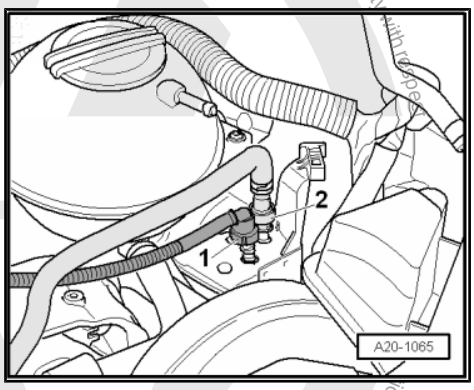
- Ignition must be switched off.

Test procedure

– Pull off breather line -1-. To do this, press release button.

– Then connect hand vacuum pump -VAS 6213- using adapter set -V.A.G 1318/17- to the activated charcoal filter line.

– Operate hand vacuum pump -VAS 6213- several times. Vacuum must not build up.



If vacuum builds up.

– Check breather hose ⇒ Item 8 (page 105) on activated charcoal filter for soiling and clean if necessary.

If vacuum does not build up.

– Hold breather connection ⇒ Item 8 (page 105) shut and operate vacuum pump again several times. A vacuum must build up.

If vacuum does not build up.

– Renew activated charcoal filter.

24 – Mixture preparation, Injection

1 Repairing injection system

1.1 General notes on injection

- Fuel hoses in engine compartment must be secured only with spring-type clips which conform to production standard. The use of clamp or screw-type clips is not permissible.
- The battery must be disconnected only with ignition switched off. If a coded radio is installed, ascertain code before disconnecting battery.
- Observe required procedures after connecting battery ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and connecting battery .
- For trouble-free operation of electrical components, a voltage of at least 11.5 V is necessary.
- Do not use sealants containing silicone. Particles of silicone drawn into the engine will not be burnt in the engine and damage the Lambda probe.
- During some checks, it is possible that the control unit will detect and store a fault. Therefore, after completing all checks and repairs, read the fault memory and erase if necessary ⇒ page 123 .
- Vehicles with an airbag are fitted with a crash fuel shut-off. It reduces the danger of a fire in a crash as the fuel pump is switched off via the fuel pump relay.
- When driver door is opened, the fuel pump is activated for 2 seconds to develop pressure in the fuel system. This improves the quality of the start behavior.

Safety precautions ⇒ page 108 .

Rules for cleanliness ⇒ page 108 .

Technical data ⇒ page 109 .

1.2 Safety precautions

WARNING

Fuel system is under pressure! Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

To prevent injuries to persons and/or damage to the fuel injection and ignition system, the following must be noted:

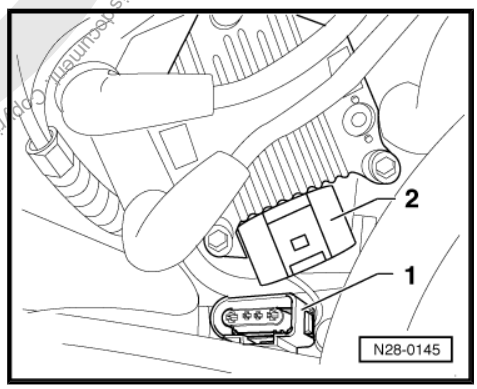
- ***Do not touch or disconnect ignition wiring when the engine is running or being turned at starter speed.***
- ***The ignition must be switched off before connecting or disconnecting injection or ignition system wiring or tester cables.***

Observe following if test and measuring instruments are required during a test drive:

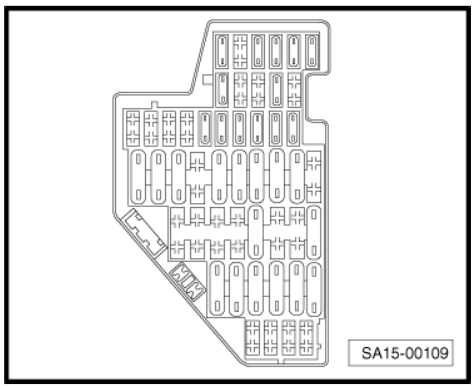
- ***Test and measuring instruments must be secured to rear seat and operated by a 2nd person from this location.***
- ***If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.***

If the engine is to be turned at starter speed, without starting:

– Pull 4 pin connector -1- off output stage for ignition coils -2-.



– Remove fuse 32.



Note

Removing fuse 32 interrupts the voltage supply to the injectors.

1.3 Rules for cleanliness

When working on the fuel supply and injection system, pay careful attention to the following “5 rules”:

- Thoroughly clean all unions and the adjacent areas before disconnecting.

- Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths!
- Carefully cover or seal open components if repairs cannot be carried out immediately.
- Only install clean components: replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

1.4 Technical data

Engine codes		BHY
Idling check		
Idling speed[7]	rpm	620...800
Engine control unit[8]		
System designation		Motronic Bosch ME 7.5.1
Part number		⇒ Electronic parts catalogue
Engine speed governor	rpm	approx. 6800
Fuel pressure		
Low pressure	bar	approx. 4.0...6.0
High pressure	bar	about 40...110

7) If voltage supply to engine control unit drops below 12 Volt, idling speed will be raised incrementally up to 990 rpm. The idling speed cannot be adjusted.

8) Renew engine control unit ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .

1.5 Dismantling and assembling intake manifold - upper part

1 - Bolt
- ❑ 8 Nm

2 - Throttle valve module - J338- *
- ❑ If replaced match engine control unit

3 - Seal
- ❑ Renew if damaged

4 - Rubber bush
- ❑ For engine cover

5 - Intake manifold - upper part

6 - 8 Nm
- ❑ For securing intake manifold - upper part

7 - 5 Nm
- ❑ For engine cover

8 - To intake manifold - lower part

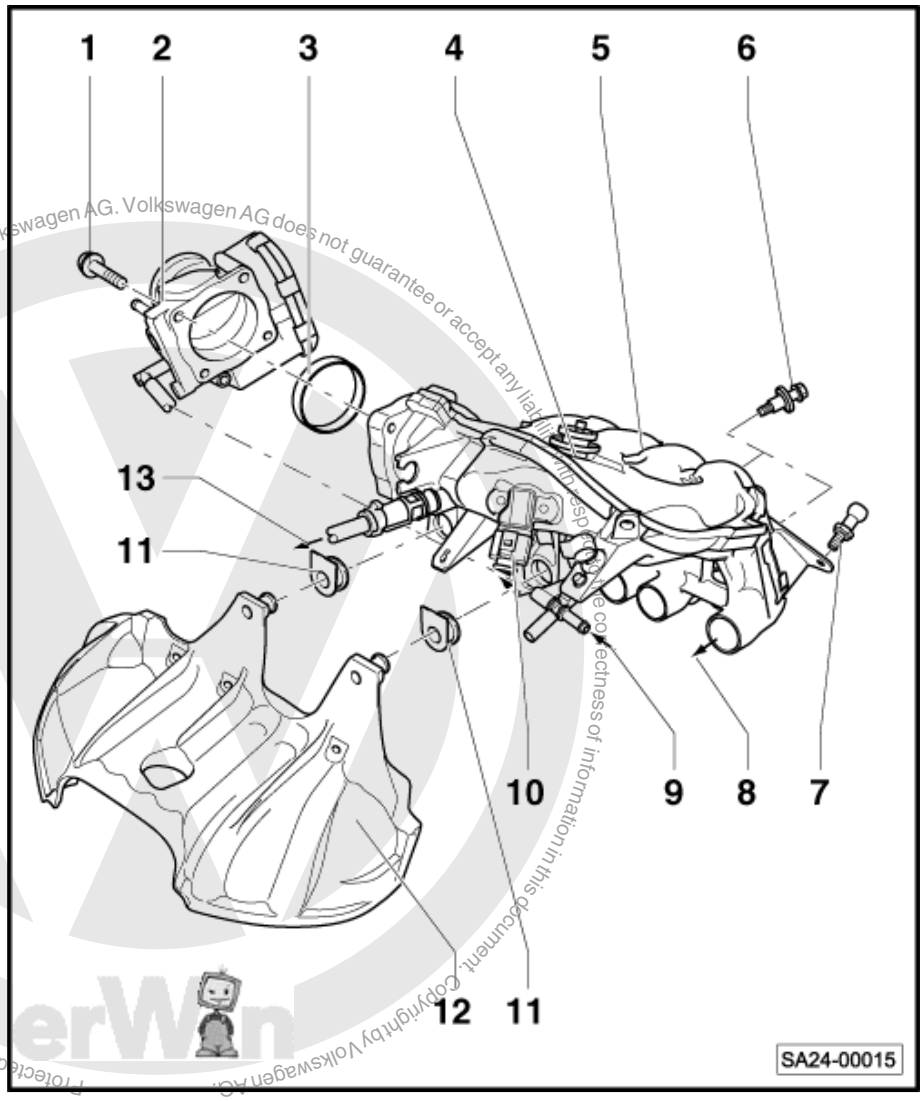
9 - From activated charcoal filter system solenoid valve I (pulsed) -N80-
- ❑ Activated charcoal filter system ⇒ page 104

10 - Intake manifold pressure sensor -G71- with intake air temperature sender -G72-

11 - Rubber bush

12 - Warm air deflector plate with intake manifold support

13 - To brake servo



1.6 Dismantling and assembling intake manifold - lower part

1 - Fuel rail with injectors

2 - Bolt

- ❑ 8 Nm

3 - Cable strip

4 - To intake manifold - upper part

- ❑ ⇒ Item 8 (page 110)

5 - Sealing

- ❑ Renew if damaged

6 - Bolt

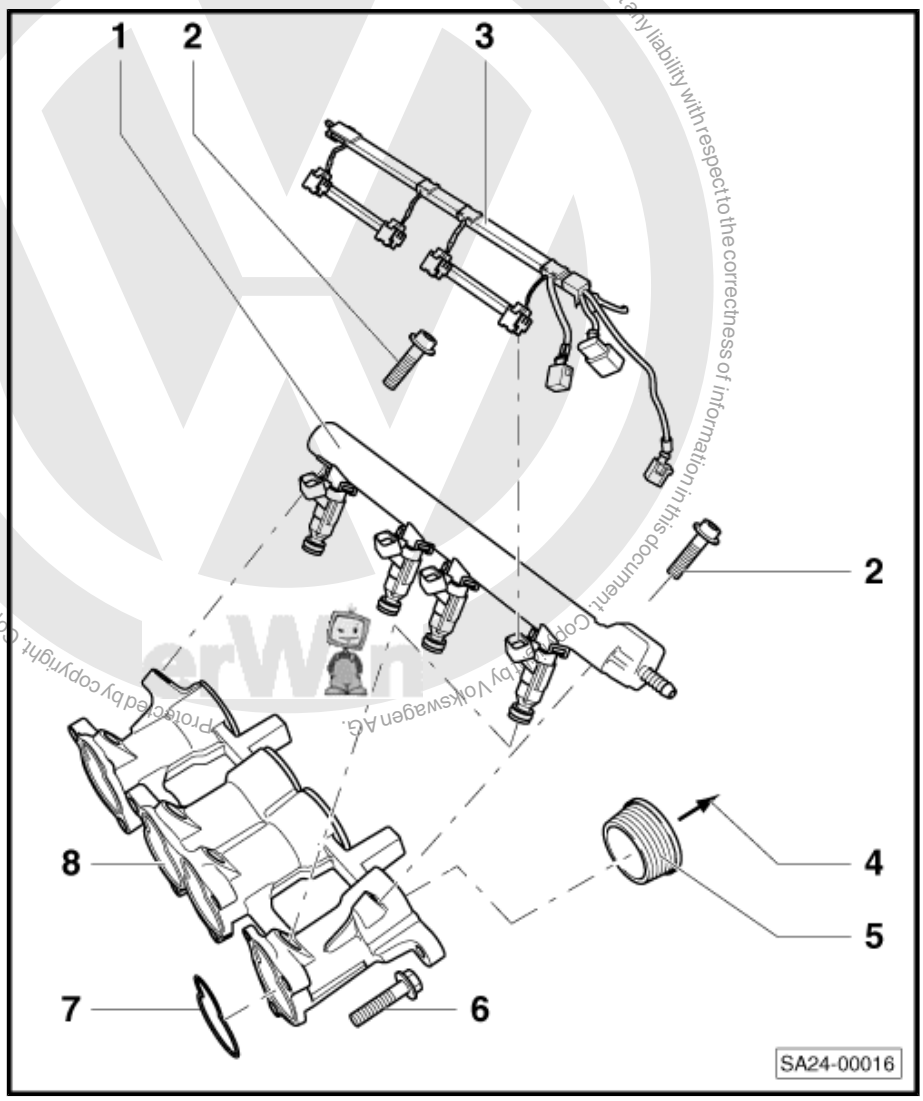
- ❑ 25 Nm

7 - Seal ring

- ❑ Renew if damaged

8 - Intake manifold - lower part

- ❑ For air shrouded injectors



1.7 Fuel rail

1 - Supply line

- ❑ Secure with spring type clips
- ❑ Check for secure seating
- ❑ From fuel filter

2 - Fuel rail

3 - Securing clip

- ❑ Ensure seated correctly at injector and fuel rail

4 - Injectors -N30, N31, N32, N33-

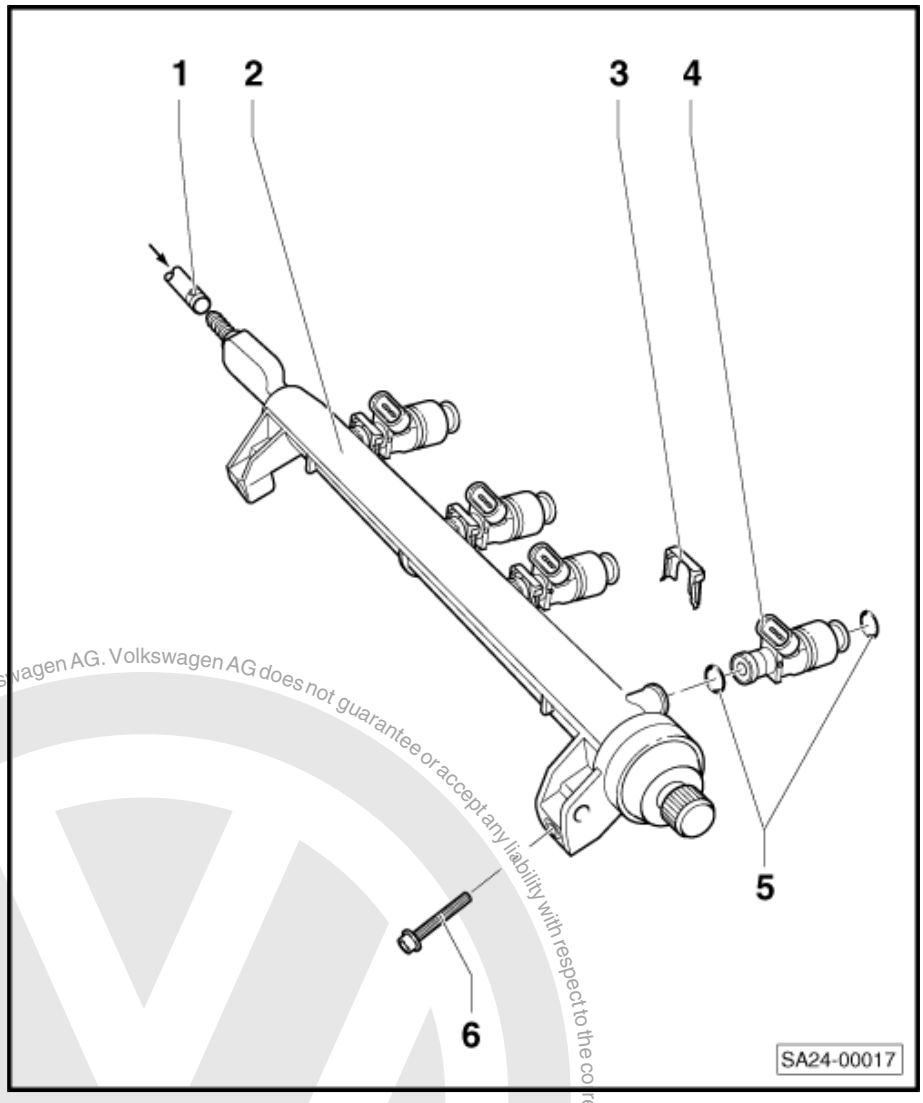
- ❑ When renewing erase fault memory

5 - Sealing ring

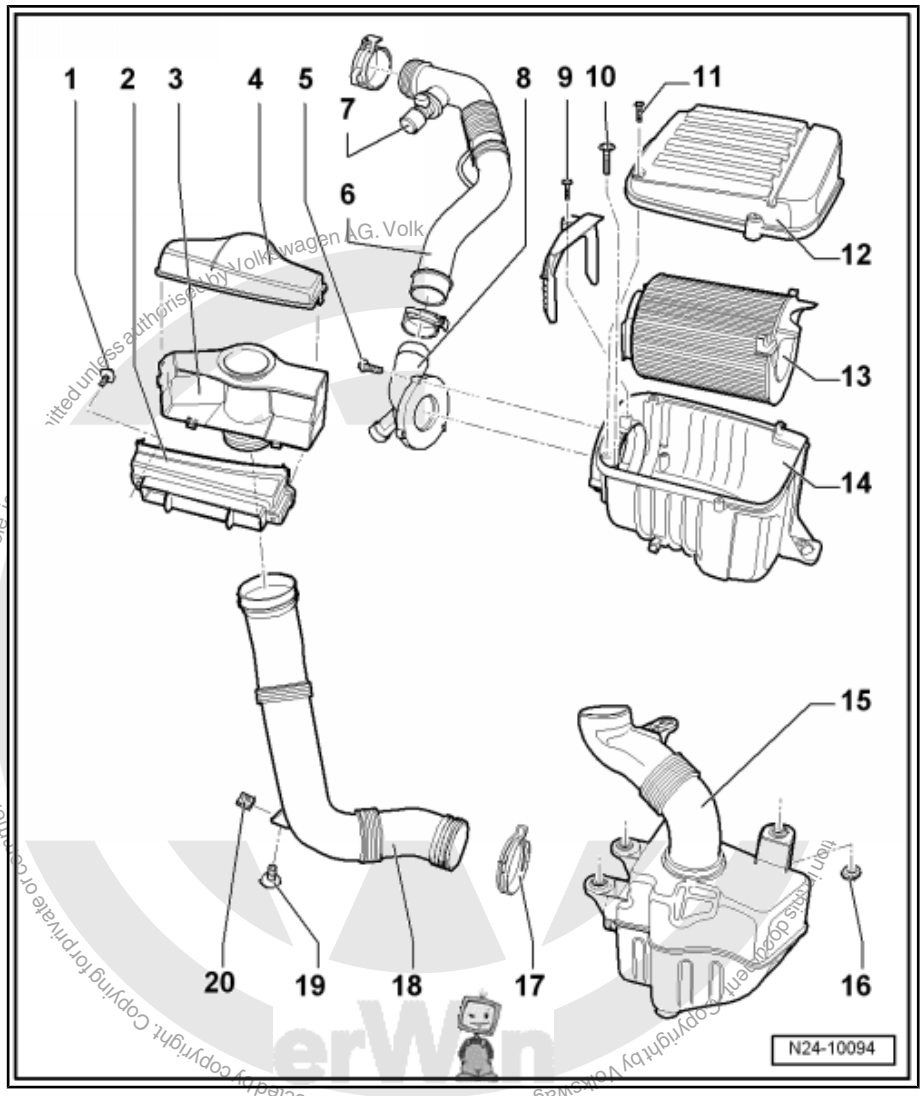
- ❑ Renew
- ❑ Before installing moisten with clean engine oil

6 - Bolt

- ❑ 8 Nm



1.8 Dismantling and assembling air cleaner



1 - Screw
- ❑ 5 Nm

2 - Air duct
- ❑ To bumper

3 - Air duct

4 - Slider

5 - Screw
- ❑ 2 Nm

6 - Intake hose
- ❑ With crankcase breather valve

7 - Connection for crankcase breather
- ❑ With resistance heater for cold climates

8 - Air duct

9 - Screw
- ❑ 2 Nm

10 - Screw
- ❑ 8 Nm

11 - Screw
- ❑ 3 Nm

12 - Air cleaner upper part

13 - Filter element

14 - Air cleaner housing

15 - Resonator

16 - Nut
- ❑ 20 Nm

17 - Spring type clip

18 - Intake air duct

19 - Screw
- ❑ 2 Nm

20 - Speed nut

1.9 Removing and installing intake manifold

Note

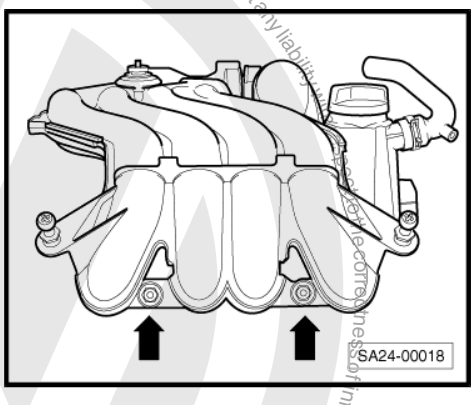
- *Always follow safety precautions* ⇒ page 108 .
- *Observe rules for cleanliness* ⇒ page 108 .

– Remove engine cover.

– Pull hoses off vacuum reservoir and remove it.

– Pull coolant hoses off throttle valve housing.
– Separate all electrical connections on intake manifold.
– Remove intake manifold securing nuts -arrows-.
– Remove intake manifold upwards.

Installation is carried out in the reverse sequence of removal.



1.10 Removing and installing fuel rail with intake manifold flaps

If the fuel rail is replaced, the intake manifold flap potentiometer -G336- must be adapted to the engine control unit, ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .

Removing ⇒ page 114 .

Installing ⇒ page 115 .

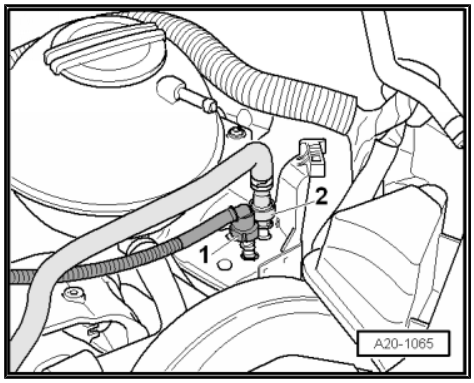
1.10.1 Removing

– Remove intake manifold ⇒ page 113 .

WARNING

The fuel supply line is under pressure! Wear protective glasses and clothing to avoid injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

– Pull off fuel supply line -2-.
– Separate all electrical connections on fuel rail.

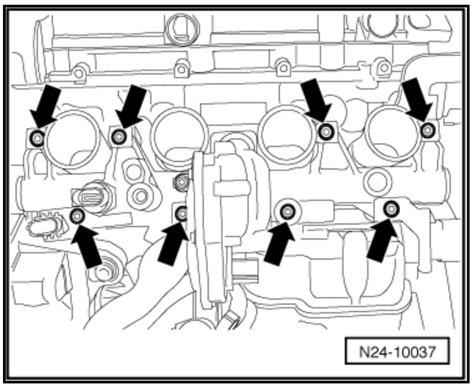


WARNING

The fuel pressure in the high-pressure pump can reach 120 bar! Wear protective glasses and clothing to avoid injuries and skin contact. Before loosening fuel pipes, wrap a cloth around the connection. Then release pressure by carefully loosening banjo bolt.

– Remove fuel lines.

– Loosen fuel rail securing bolts -arrows-.
– Pull fuel rail with intake manifold flaps off injectors.



1.10.2 Installing

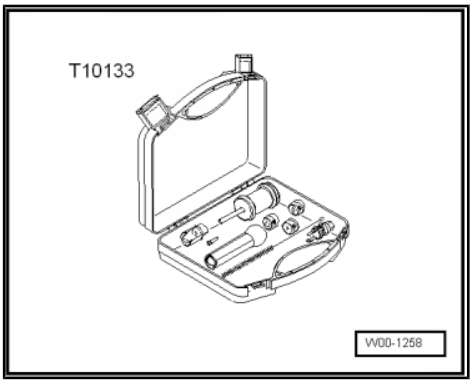
Installation is carried out in the reverse order. When installing, note the following:

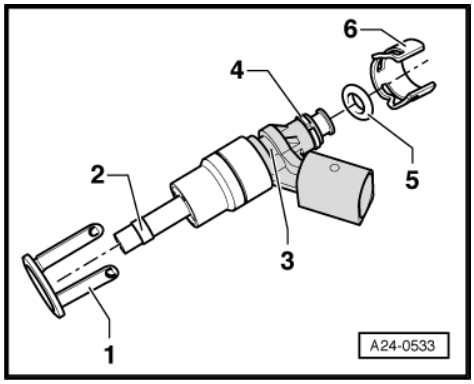
- Before installation, connectors must be pushed onto injectors.
- If an injector was pulled out of the cylinder head when the fuel rail was removed, Teflon seal must be renewed ⇒ page 118 .
- Renew O-rings between injector and fuel rail and moisten slightly with clean engine oil.
- If the fuel rail was replaced, the intake manifold flap potentiometer -G336- must be adapted to the engine control unit, ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .
- Set fuel rail on cylinder head and evenly press onto injectors.

1.11 Removing and installing injectors

Special tools and workshop equipment required

- Puller -T10133-





Injector components

1 - Radial compensation, renew if damaged.

2 - Combustion chamber seal (Teflon seal), renew. When installed, ring must not be greased or treated with any other lubricant.

3 - Groove in injector.

4 - Support washer (renew).

5 - O-ring (renew; to install, lightly lubricate with clean engine oil.)

6 - Support ring.

Removing ⇒ page 116 .

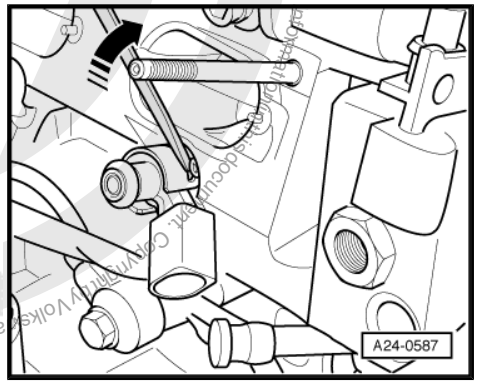
Installing ⇒ page 117 .

1.11.1 Removing

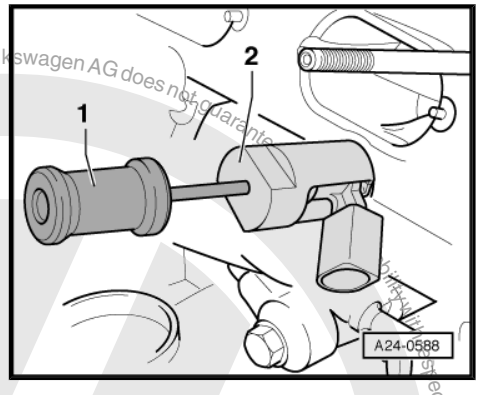
– Remove intake manifold ⇒ page 113 .

– Remove fuel rail with intake manifold flaps ⇒ page 114 .

– Using a screwdriver, bend locking lugs to side and pull support ring off injector valve.



– Screw slide hammer -T10133/3- to puller -T10133/2- . Then guide puller -T10133/2- into groove in injector and carefully hammer injector out. This may destroy radial compensation (locking lugs break off). This part must be renewed when injector is installed.



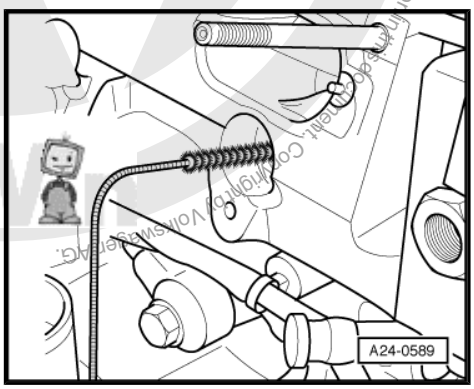
1.11.2 Installing

Note

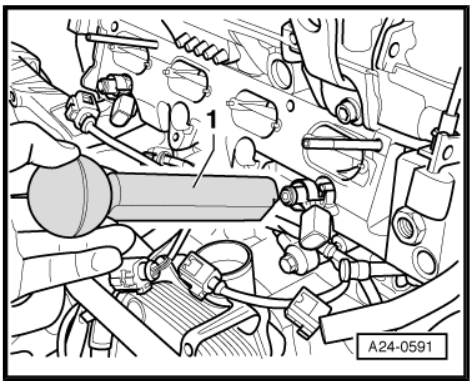
- *The Teflon injector seal must not be oiled or lubricated.*
- *It is possible that an open inlet valve hinders cleaning. In this case, turn engine by hand using spanner.*

– Thoroughly clean holes in cylinder head for high-pressure injectors using nylon brush -T10133/4- .

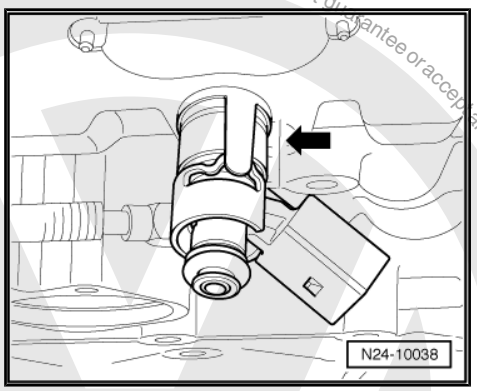
– Renew O-ring and Teflon seal for injector ⇒ page 118 .



– Insert injector in hole in cylinder head to stop using drift -T10133/9- .



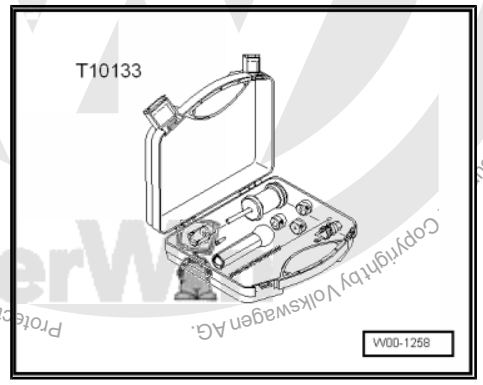
– Insure correct position of injectors in cylinder head.



1.12 Renewing Teflon seal on injector

Special tools and workshop equipment required

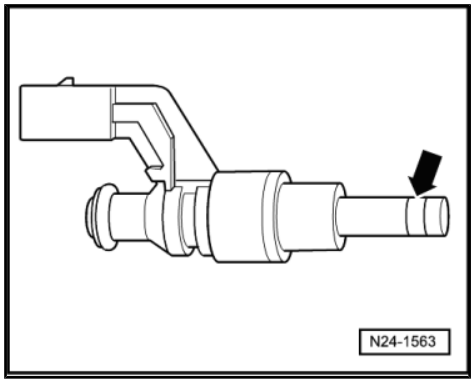
♦ Puller -T10133-



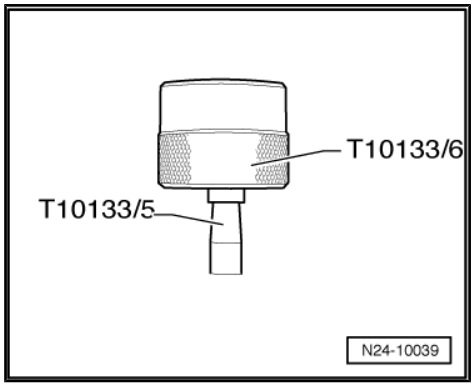
Note

The seal must not be oiled.

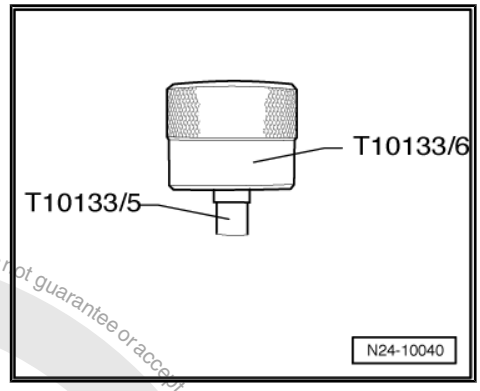
– Carefully clean injector in area of seal -arrow-. Remove coking deposits using a wire brush.
– Carefully cut open seal with a knife.
– Clean groove for seal.



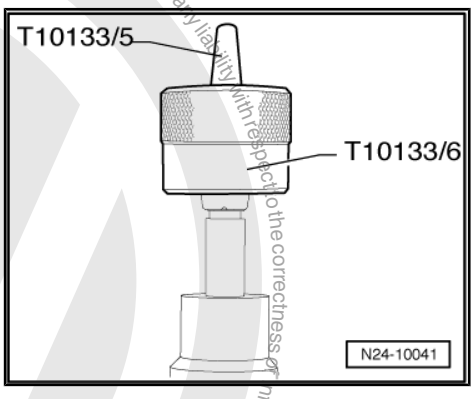
– Push new seal onto assembly cone -T10133/5- . Push seal as far as possible onto assembly cone -T10133/5- using assembly sleeve -T10133/6- .



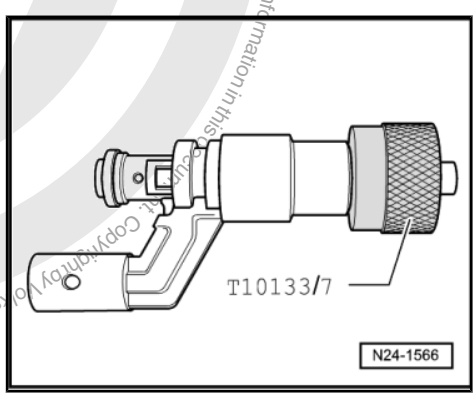
– Turn assembly sleeve -T10133/6- around and push seal to end of assembly cone -T10133/5- .



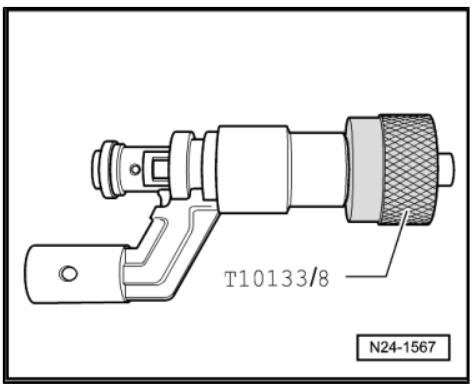
– Fit assembly cone -T10133/5- on injector and push seal onto injector using assembly sleeve -T10133/6- .
– Remove assembly cone -T10133/5- and push seal into groove using assembly sleeve -T10133/6- .



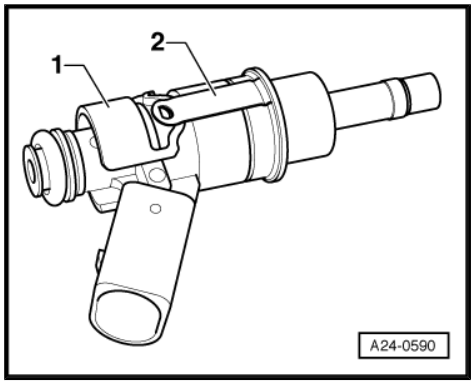
– Press calibration sleeve -T10133/7- onto injector to stop by turning gently (approx. 180°).
– Pull off calibrating sleeve -T10133/7- by turning in opposite direction.



– Now press calibration sleeve -T10133/8- onto injector to stop by turning gently (approx. 180°).
– Pull off calibrating sleeve -T10133/8- by turning in opposite direction.
– Renew O-ring on injector and on support washer.



– Attach support ring -1- to injector and clip radial compensation -2- into support ring.



1.13 Cleaning throttle valve module -J338-

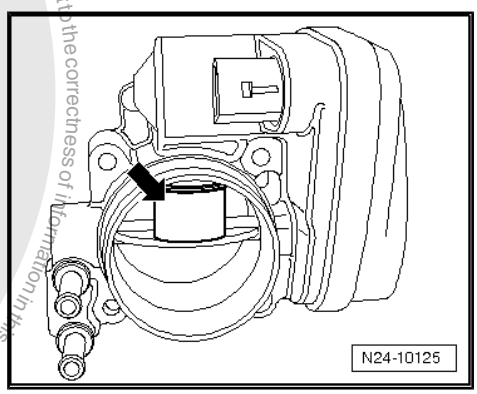
Note

- *If a new engine control unit is installed the throttle valve module must be adapted. Adaption must only be performed with a new or cleaned throttle valve module, because soiling/coking in closed throttle valve can lead to incorrect adaption values.*
- *When cleaning the throttle valve housing it must not be scratched.*

– Undo the air filter housing and pull the intake hose off the throttle valve housing.

– Remove throttle valve module.

– Open the throttle valve by hand and, with a suitable object, block the throttle valve in its open position -arrow-.



WARNING

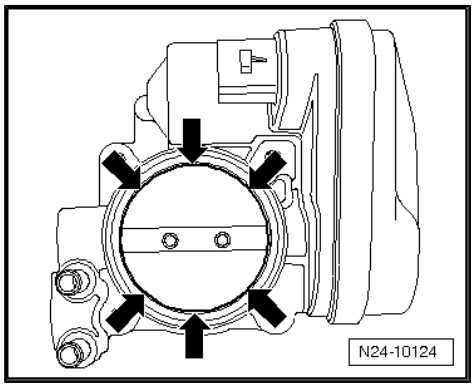
Acetone is highly inflammable. Please observe the accidental regulations and safety notes when handling with highly inflammable fluids. Do not use compressed air when cleaning the throttle valve. Wear protective glasses and clothing to avoid injuries and skin contact.

– Thoroughly clean throttle valve housing, especially around the closed throttle valve using commercially available acetone according to DIN 53247 and a cleaning brush.

– Wipe off throttle valve housing using a lint-free cloth.

– Wait until the acetone is fully evaporated and reinstall the cleaned throttle valve module.

– Adapt the engine control unit to throttle valve module ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .



2 Engine control unit

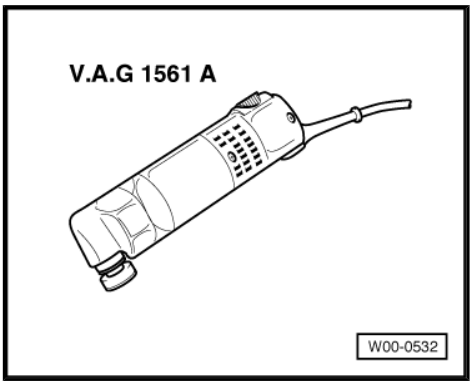
Removing and installing anti-theft engine control unit
⇒ page 121 .

Reading and erasing engine control unit fault memory
⇒ page 123 .

2.1 Removing and installing anti-theft engine control unit

Special tools and workshop equipment required

- Electric cutter -V.A.G 1561/A-
- Saw set -V.A.G 1561/14-
- Pliers



Note

- *If the engine control unit is to be replaced, connect diagnostic operation center -VAS 5051/- and perform "Renewing engine control unit" in Guided functions.*
- *If engine control unit is renewed, throttle valve module must be cleaned ⇒ page 120 .*

Removing ⇒ page 121 .

Installing ⇒ page 122 .

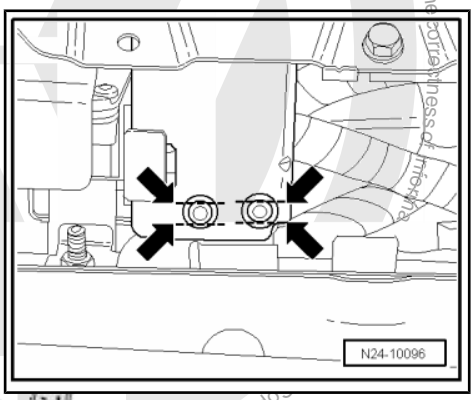
2.1.1 Removing

– Switch off ignition.

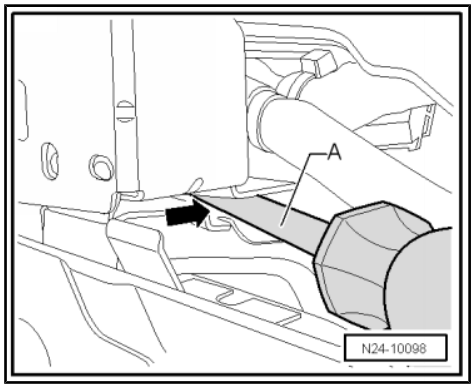
– Remove wiper arms, plenum chamber cover and plenum bulkhead ⇒ Electrical system; Rep. Gr. 92 ; Windscreen wiper system; Removing and installing windscreen wiper system .

– Cut into heads of shear bolts so that two parallel surfaces are created -arrows-.

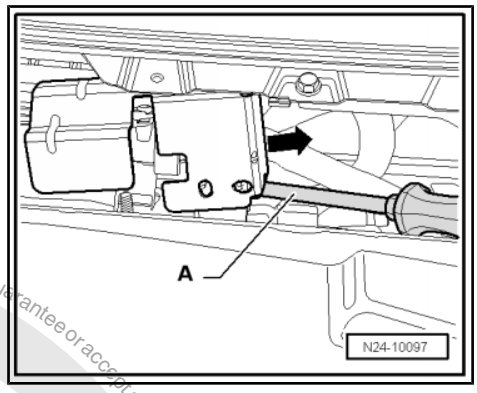
– Remove bolts with pliers .



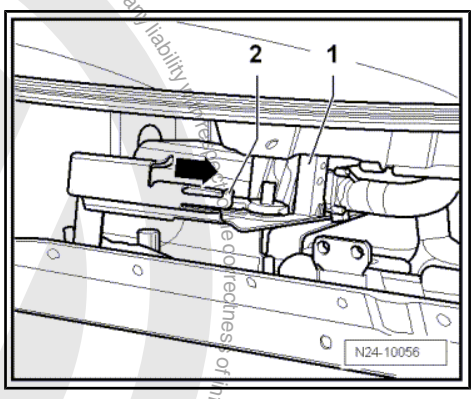
– Insert a screwdriver between protective housing -A- and retaining plate -arrow-.



– Lever up protective housing using screwdriver -A- and pull to side off retaining plate -arrow-.

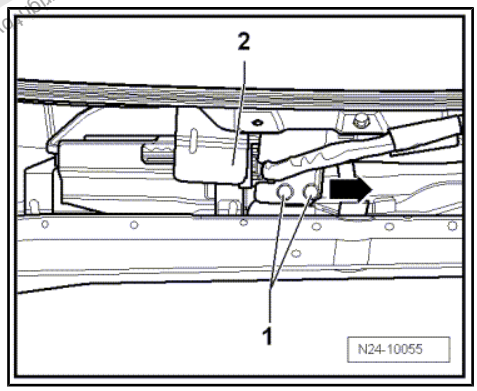


– Release front connector -1- from engine control unit and pull it off.
– Lever up catch -2- slightly.
– Then push engine control unit out of retainer -arrow-.
– Now release rear connector on engine control unit and pull it off.



2.1.2 Installing

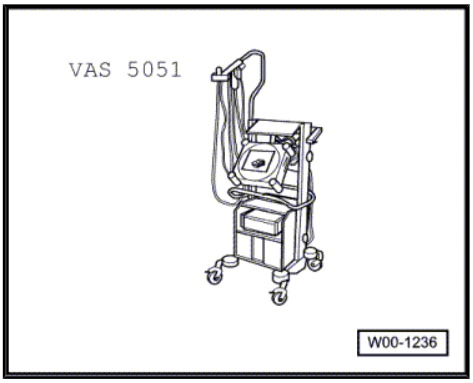
– Fit rear connector to engine control unit and lock it in position.
– Push engine control unit onto bracket.
– Fit front connector to engine control unit and lock it in position.
– Push protective housing onto bracket.
– Tighten new shear bolts -1- evenly until heads shear off.
– Install plenum chamber bulkhead, plenum chamber cover and wiper arms ⇒ Electrical system; Rep. Gr. 92 ; Windscreen wiper system; Removing and installing windscreen wiper system .



2.2 Reading and erasing engine control unit fault memory

Special tools and workshop equipment required

- Diagnostic operation center -VAS 5051/-



– Connect diagnostic operation center -VAS 5051/- as follows:
– Push diagnosis lead connector onto diagnosis connector in driver footwell.
– Start engine and run at idling speed.

Only when engine does not start:

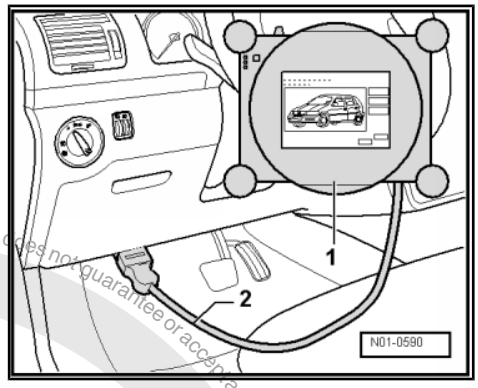
– Switch on ignition.

Select operating mode:

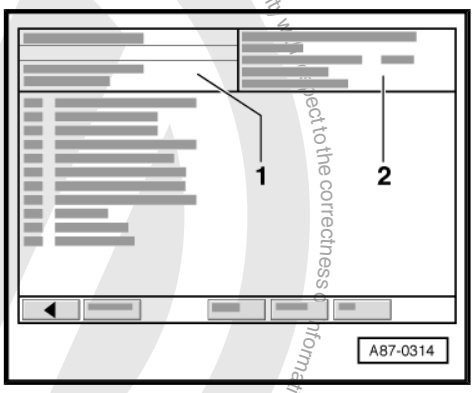
– Press button on display for “Vehicle self-diagnosis”.

Select vehicle system:

– Press button “01 - Engine electronics” on display.



The control unit identification with code -2- as well as chassis number and immobilizer identification number will be indicated in the middle section of the display.



Note

A print-out can be made if needed. Press the “Print” key.

Select diagnostic function:

– Press button “02 - Interrogate fault memory” on display.
– If no fault is stored in engine control unit “0 fault(s) detected” is displayed.
– If faults are stored in the engine control unit, these are shown one below the other on the display.
– Press the ↵ key.
– Press button “05 - Erase fault memory” on display.
– Press function “06 - End output”.

Note

Regenerate readiness code after erasing fault memory ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions”.

26 – Exhaust system

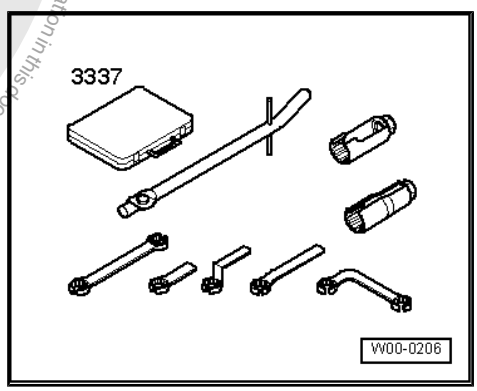
1 Removing and installing parts of exhaust system

Note

- *After working on the exhaust system, ensure that the system is not under stress and that there is sufficient clearance to the bodywork. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the bodywork at all points and the mountings are evenly loaded.*
- *Always renew seals, gaskets and self-locking nuts.*

Special tools and workshop equipment required

- Lambda probe open ring spanner set -3337-



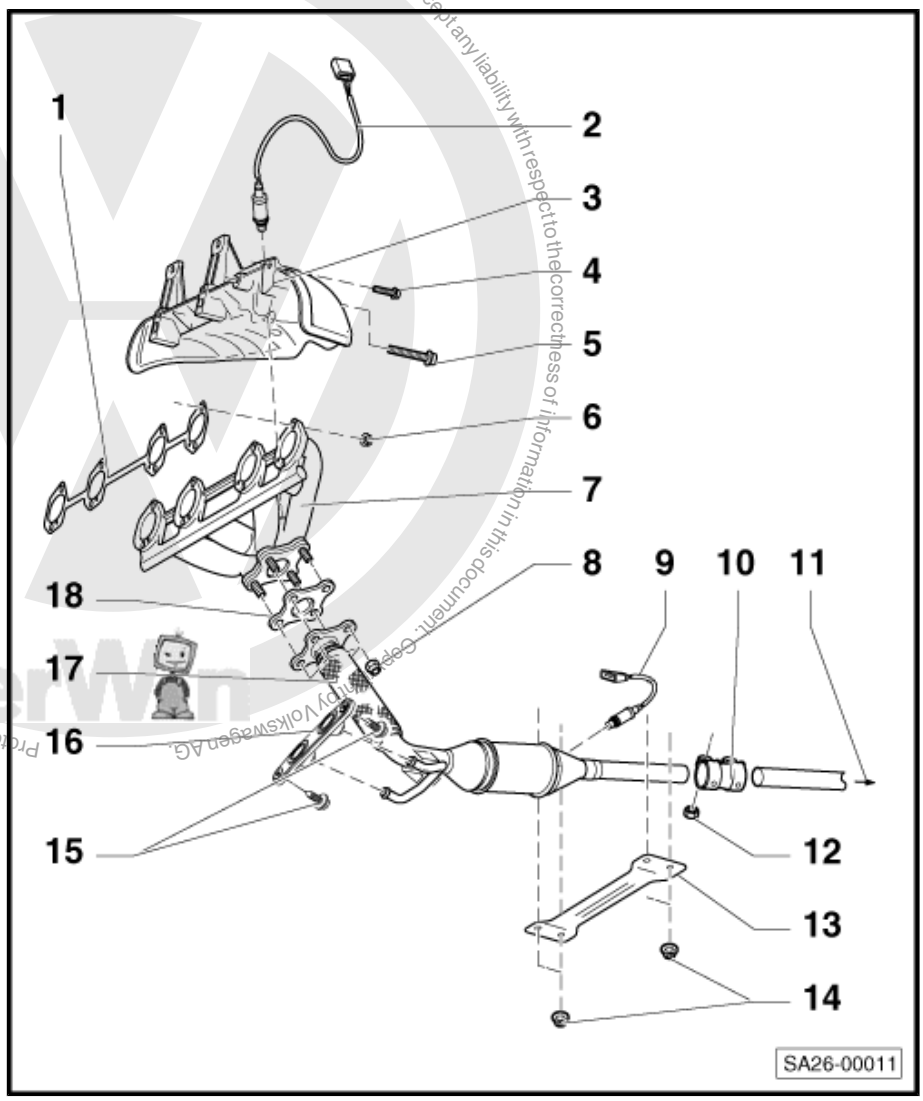
Front exhaust pipe and catalytic converter with attachments ⇒ page 125 .

Silencer with mountings ⇒ page 126 .

Separating middle and rear silencers ⇒ page 126 .

Aligning exhaust system stress free ⇒ page 127 .

1.1 Front exhaust pipe and catalytic converter with attachments



1 - Gasket
- ❑ Renew

2 - Lambda probe -G39-
- ❑ 50 Nm
- ❑ Grease thread only with hot bolt paste -G 052 112 A3- ; hot bolt paste -G 052 112 A3- must not get into the slots of the probe body
- ❑ Remove and install with lambda probe open ring spanner set -3337- .

3 - Warm air collector plate

4 - Bolt
- ❑ 10 Nm

5 - Bolt
- ❑ 25 Nm

6 - Nut
- ❑ 25 Nm
- ❑ Renew

7 - Exhaust manifold

8 - Nut
- ❑ 40 Nm
- ❑ Renew

9 - Lambda probe after catalytic converter -G130-
- ❑ 50 Nm
- ❑ Grease thread only with hot bolt paste -G 052 112 A3- ; hot bolt paste -G 052 112 A3- must not get into the slots of the probe body
- ❑ Remove and install with lambda probe open ring spanner set -3337- .

10 - Front clamp
- ❑ Align exhaust system free of stress before tightening clamp ⇒ page 127
- ❑ Installation position ⇒ page 127
- ❑ Tighten bolted connections evenly

11 - To middle silencer

12 - Nut
- ❑ 25 Nm

13 - Tunnel bridge

14 - Nuts
- ❑ 20 Nm

15 - Bolts
- ❑ 25 Nm

16 - Mounting
- ❑ Renew if damaged

17 - Front pipe

18 - Gasket

- ❑ Renew

1.2 Silencer with mountings

1 - From catalytic converter

2 - Mounting

3 - Bolts

- ❑ 25 Nm

4 - Middle silencer

- ❑ In initial equipment, component with rear silencer. Can be renewed separately for repairs
- ❑ Aligning exhaust system free of stress ⇒ page 127
- ❑ Separate exhaust system ⇒ page 126

5 - Retainers

- ❑ Renew if damaged

6 - Rear silencer

- ❑ In initial equipment, component with middle silencer. Can be renewed separately for repairs
- ❑ Aligning exhaust system free of stress ⇒ page 127
- ❑ Separate exhaust system ⇒ page 126

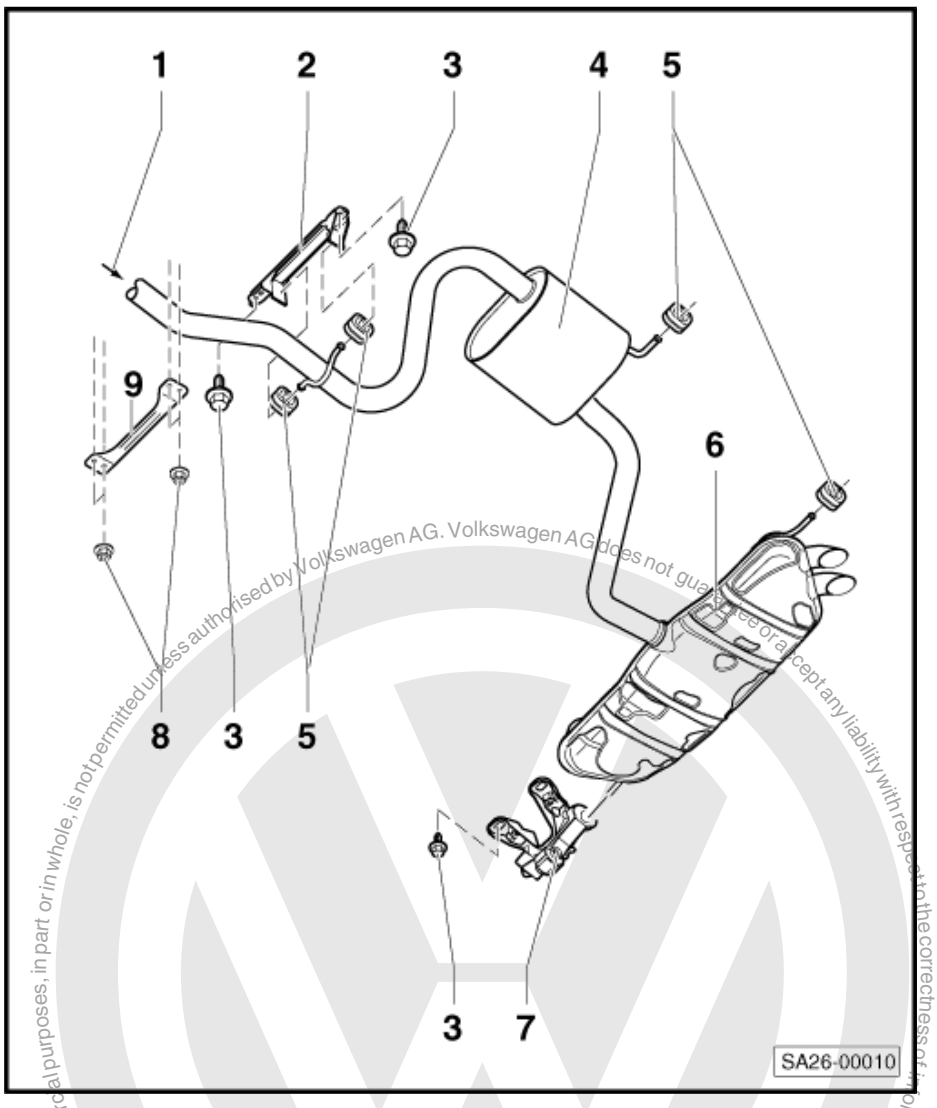
7 - Mounting

- ❑ Renew if damaged

8 - Nuts

- ❑ 20 Nm

9 - Tunnel bridge

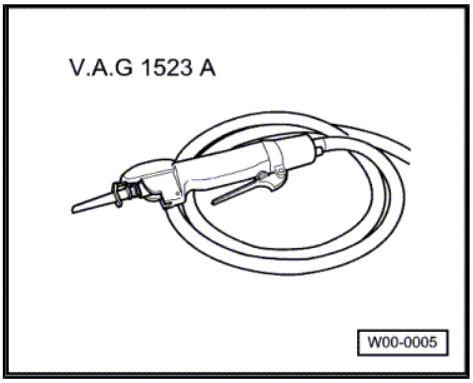


1.3 Separating middle and rear silencers

- ♦ Only front-wheel drive vehicles.
- ♦ The connecting pipe can be cut through at the point marked in order to renew the middle and rear silencers separately.
- ♦ The cutting point is marked with an indentation on the outside of the exhaust pipe.

Special tools and workshop equipment required

♦ Body saw -V.A.G 1523/A-



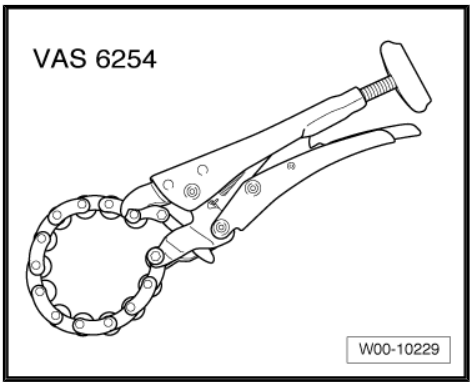
or

♦ Chain-type pipe cutter -VAS 6254-

♦ Protective glasses

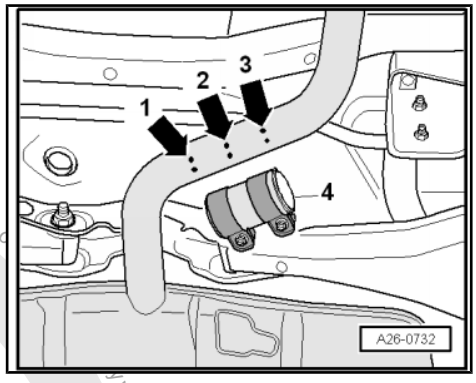
WARNING

To avoid injury from metal shavings, wear eye protection and protective clothing.



– Cut through exhaust pipe at right angles using e.g. body saw -V.A.G 1523/A- at separating point -arrow 2-.

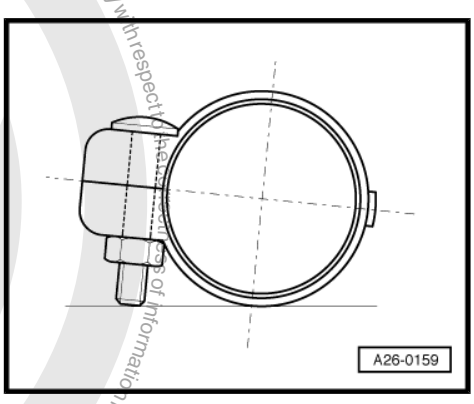
– When installing, position clamp -4- at side markings -arrow 1- and -arrow 3-.



– Install clamp so that end of bolt does not extend beyond lower edge of clamp.

• Bolted connection faces rear.

– Align exhaust system free of tension ⇒ page 127 .

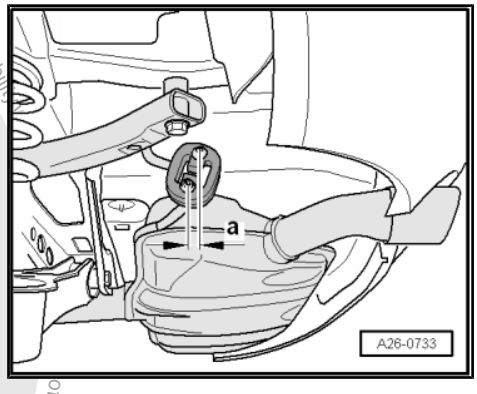


1.4 Aligning exhaust system stress free

• The exhaust system must be aligned when cold.

– Loosen bolted connections of front clamp.

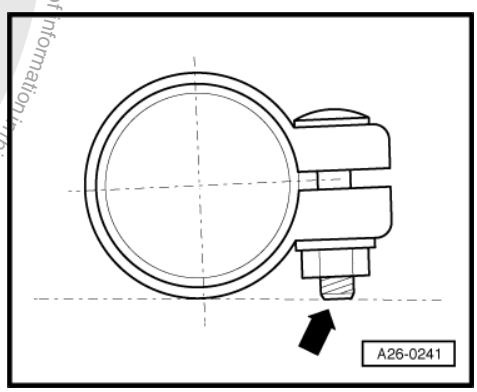
– Push exhaust system forward until preload on rear silencer retainer is -dimension a- 5...11 mm.



Installation position of front clamp

– Install clamp so that end of bolt does not extend beyond lower edge of clamp.

• Bolted connection faces right.

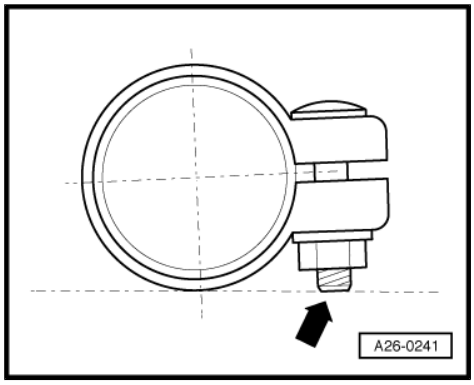


Installation position of rear clamp

– Install clamp so that end of bolt does not extend beyond lower edge of clamp.

• Bolted connection faces rear.

– Tighten bolted connections of clamp evenly to 25 Nm.



28 – Ignition system

1 Repairing ignition system

General notes on ignition system ⇒ page 129 .

Safety precautions ⇒ page 129 .

Assembly overview - ignition system ⇒ page 130 .

Test data, spark plugs ⇒ page 130 .

1.1 General notes on ignition system

- For trouble-free operation of electrical components, a voltage of at least 11.5 V is necessary.
- During some checks, it is possible that the control unit will detect and store a fault. Therefore, after completing all checks and repairs, read the fault memory and erase if necessary ⇒ page 123 .
- If, after fault finding, repairs or component tests, the engine starts, runs for a short period and then stops, then the fault may be that the immobilizer is blocking the engine control unit. In this case, the control unit must be adapted ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided functions” .

1.2 Safety precautions

To prevent injuries to persons and/or damage to the injection and ignition system, the following must be observed:

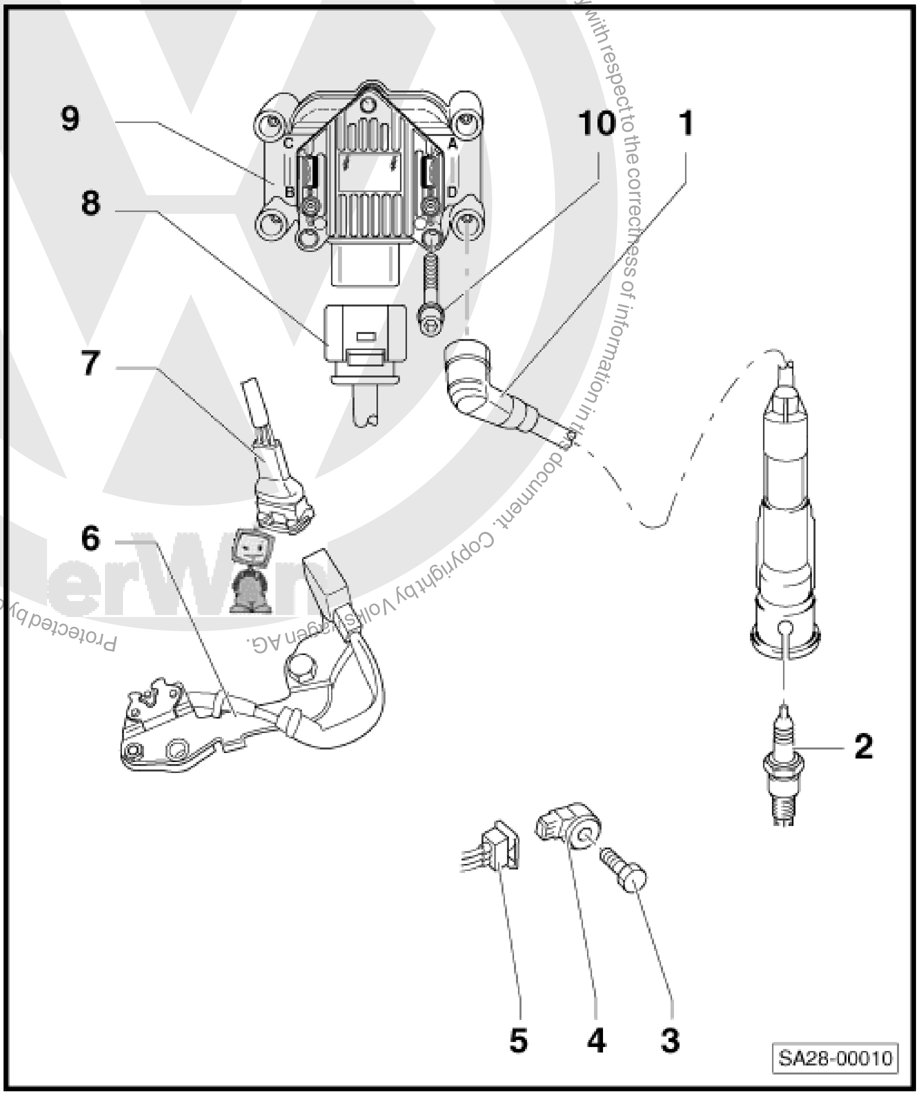
- Do not touch or pull off ignition coils with output stage when engine is running or turning at starter speed.
- Switch off ignition before connecting or disconnecting injection and ignition system wiring as well as test instrument cables.

Observe following if test and measuring instruments are required during a test drive:

- Test and measuring instruments must be secured to rear seat and operated by a second person from this location.

If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

1.3 Assembly overview - ignition system



1 - H.T. cable

- ❑ 4...8 kw
- ❑ With suppression connector and spark plug connector

2 - Spark plug

- ❑ 25 Nm
- ❑ Type and electrode gap ⇒ page 130
- ❑ Remove and install with plug spanner -VAS 3122B-

3 - Bolt

- ❑ 20 Nm
- ❑ The torque setting influences the function of the knock sensor

4 - Knock sensor 1 -G61-

- ❑ Contacts gold plated

5 - 3–pin connector

- ❑ Contacts gold plated
- ❑ Black

6 - Hall sensor -G40-

7 - 3–pin connector

- ❑ Black
- ❑ For hall sensor -G40-

8 - 4–pin connector

- ❑ Black

9 - Ignition coil with output stage -(N70, N127, N291, N292)-

- ❑ With output stage -N122-

10 - Bolt

- ❑ 10 Nm

1.4 Spark plugs

Engine codes	BHY
Firing order	1-3-4-2
Spark plugs	
VW/Audi	101 905 620
Manufacturer's designation	PZFR5N-11TG
Electrode gap	1.0...1.1 mm
Torque setting	25 Nm