Workshop Manual

Golf 2004 ➢

6-cylinder injection engine VW Individual									
Engine ID	CBR A								

Edition 10.2009

List of Workshop Manual Repair GroupsList of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

Repair Group

00 - Technical data
10 - Removing and installing engine
13 - Crankshaft group
15 - Cylinder head, valve gear
17 - Lubrication
19 - Cooling
20 - Fuel supply system
24 - Mixture preparation - injection
26 - Exhaust system
28 - Ignition system

Technical information should always be available to the foremen 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
1 Engine number 1
2 Engine data 2
10 - Removing and installing engine 3
1 Removing and installing engine 3
1.1 Removing engine 4
1.2 Securing engine on engine and gearbox support VAS 6095 10
1.3 Installing engine 11
1.4 Specified torques for assembly mounting 13
13 - Crankshaft group 14
1 Dismantling and assembling engine 14
1.1 Part I: assembly overview - chain drive 16
1.2 Part II: assembly overview - crankshaft group 18
1.3 Removing and installing poly V-belt 20
2 Sealing flanges and flywheel 22
2.1 Assembly overview - sealing flange 22
2.2 Removing and installing crankshaft seal on gearbox side 23
2.3 Renewing crankshaft sealing flange -vibration damper side- 25
2.4 Removing and installing flywheel 26
2.5 Removing and installing drive plate 28
3 Crankshaft 30
3.1 Assembly overview - crankshaft 30
3.2 Allocation of crankshaft bearing shells (classification) 31
3.3 Fitting sender wheel to crankshaft 33
3.4 Pulling needle bearing out of and driving into crankshaft 33
4 Pistons and conrods 36
4.1 Assembly overview - pistons and conrods 36
4.2 Checking pistons, piston rings and cylinder bores 38
4.3 Installing piston 39
4.4 Piston and cylinder dimensions 40
15 - Cylinder head, valve gear 41
1 Cylinder head 41
1.1 Assembly overview - cylinder head 42
1.2 Removing and installing cylinder head 44
1.3 Assembly overview - cover 53
1.4 Checking valve timing 54
1.5 Installing camshaft adjuster with timing chain for camshaft drive 57
1.6 Installing timing chain for intermediate shaft drive and camshaft drive 62
1.7 Removing and installing cylinder head cover 67
1.8 Checking compression 69
2 Valve gear 71
2.1 Assembly overview 71
2.2 Removing and installing camshafts 73
2.3 Removing and installing camshaft control valves 80
2.4 Valve stem oil seals 83
2.5 Checking valve guides 86
2.6 Reworking valve seats 87
17 - Lubrication 89

1 Parts of lubrication system . . . 89
1.1 Engine oil . . . 89
1.2 Assembly overview - sump . . . 90
1.3 Removing and installing oil sump . . . 92
1.4 Assembly overview - oil filter bracket . . . 95
1.5 Removing and installing oil filter bracket . . . 96
1.6 Assembly overview - oil pump . . . 97
1.7 Checking oil pressure and oil pressure switch . . . 99

19 - Cooling . . . 103
1 Removing and installing parts of cooling system . . . 103
1.1 Assembly overview - parts of cooling system, body side . . . 104
1.2 Assembly overview - cooling system, engine side . . . 106
1.3 Assembly overview - thermostat housing . . . 107
1.4 Coolant hose schematic diagram . . . 109
1.5 Draining and filling coolant . . . 110
1.6 Removing and installing fan support with fans . . . 113
1.7 Removing and installing radiator . . . 115
1.8 Checking continued coolant circulation pump . . . 116
1.9 Removing and installing coolant pump . . . 118
1.10 Removing and installing thermostat housing . . . 120
1.11 Removing and installing thermostat . . . 123
1.12 Removing and installing coolant pipe . . . 124
1.13 Checking cooling system for leaks . . . 126

20 - Fuel supply system . . . 128
1 Safety precautions when working on fuel supply system . . . 128
2 Rules for cleanliness . . . 129
3 Fuel tank . . . 130
3.1 Assembly overview - fuel tank . . . 130
3.2 Emptying fuel tank . . . 132
3.3 Removing and installing fuel tank . . . 137
4 Repairing fuel supply . . . 141
4.1 Removing and installing fuel delivery unit . . . 141
4.2 Removing and installing fuel gauge sender 2 G169 . . . 144
4.3 Removing and installing suction-jet pump . . . 146
4.4 Removing and installing fuel gauge sender G . . . 146
4.5 Assembly overview - fuel filter with attachments . . . 148
4.6 Removing and installing fuel filter . . . 148
4.7 Checking fuel pump . . . 150
4.8 Bleeding fuel system . . . 157
5 Electronic power control (EPC) . . . 160
5.1 Assembly overview - accelerator module . . . 160
5.2 Removing and installing accelerator module . . . 160
6 Activated charcoal filter system . . . 163
6.1 Assembly overview - activated charcoal filter system . . . 163
6.2 Checking fuel tank breather . . . 164

24 - Mixture preparation - injection . . . 166
1 Repairing injection system . . . 166
1.1 General notes on the injection system . . . 166
1.2 Technical data . . . 166
1.3 Assembly overview - intake manifold . . . 167
1.4 Removing and installing throttle valve module J338 . . . 170
1.5 Removing and installing intake manifold . . . 170

1.6 Assembly overview - fuel rail . . . 173
1.7 Assembly overview - air filter . . . 174
1.8 Assembly overview - resonator with resonance air pipe . . . 175
1.9 Checking intake air preheating . . . 175
2 Checking components . . . 177
2.1 Checking vacuum unit for intake manifold flaps . . . 177
2.2 Checking injectors for leaks and quantity injected . . . 179
2.3 Checking fuel pressure regulator and holding pressure . . . 181
3 Engine control unit . . . 185
3.1 Removing and installing engine control unit . . . 185
3.2 Removing and installing anti-theft engine control unit . . . 185

26 - Exhaust system . . . 189
1 Exhaust manifold, front exhaust pipe with catalytic converters and Lambda probes . . . 189
1.1 Assembly overview - exhaust manifold, front exhaust pipe with catalytic converters . . . 191
1.2 Removing and installing Lambda probe G39 and Lambda probe 2 G108 . . . 192
1.3 Removing and installing exhaust manifold . . . 194
1.4 Removing and installing front exhaust pipe with catalytic converters . . . 195
2 Silencer with mountings . . . 198
2.1 Assembly overview - silencers with mountings . . . 198
2.2 Checking exhaust flap . . . 199
2.3 Aligning exhaust system free of stress . . . 200
3 Secondary air system . . . 202
3.1 Function . . . 202
3.2 Assembly overview - secondary air system . . . 203
3.3 Removing and installing secondary air pump motor V101 . . . 204
3.4 Checking combination valve for secondary air system . . . 205
3.5 Removing and installing combination valve for secondary air system . . . 205

28 - Ignition system . . . 206
1 Ignition system . . . 206
1.1 General notes on ignition system . . . 206
1.2 Safety precautions . . . 206
1.3 Assembly overview - parts of ignition system . . . 207
1.4 Removing and installing ignition coils with output stage . . . 208
1.5 Test data, spark plugs . . . 210

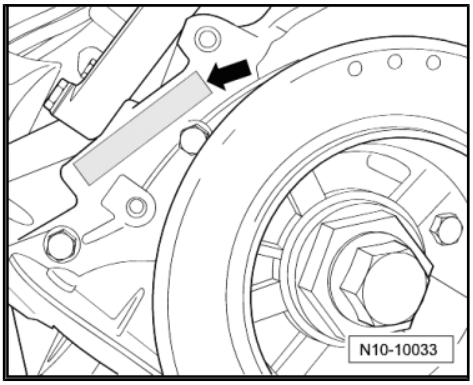
00 – Technical data

1 Engine number

The engine number (“engine code” and “serial number”) is located next to the vibration damper -arrow- on the cylinder block.

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.

Additionally, a sticker with “engine code” and “serial number” is attached to the camshaft cover.



2 Engine data

Engine code		CBRA
Manufactured		06.07 ▸
Emissions fulfil		LEV2 standard
Cylinder arrangement		VR[1)]
Cylinder angle		15.0°
Capacity	cm^3	3189
Output	kW at rpm	184/6300
Torque	Nm at rpm	320/2500 … 3000
Bore	∅ mm	84.0
Stroke	mm	95.9
Compression ratio		10.85
Valves per cylinder		4
RON	min.	98 unleaded[2)]
Injection, ignition		Motronic ME7.1.1
Firing order		1-5-3-6-2-4
Knock control		2 knock sensors
Lambda control		4 probes
Catalytic converter		yes
Exhaust gas recirculation		no
Turbocharging/supercharging		no
Secondary air system		yes
Electronic power control		yes
Variable intake manifold		yes
Variable valve timing		yes [3)]
Leak diagnosis system		yes

[1)] VR = V-arrangement in compact in-line design.

[2)] In exceptional circumstances min. 95 RON, however with reduced performance.

[3)] Two independently variable camshafts.

10 – Removing and installing engine

1 Removing and installing engine

Removing engine ⇒ page 4 .

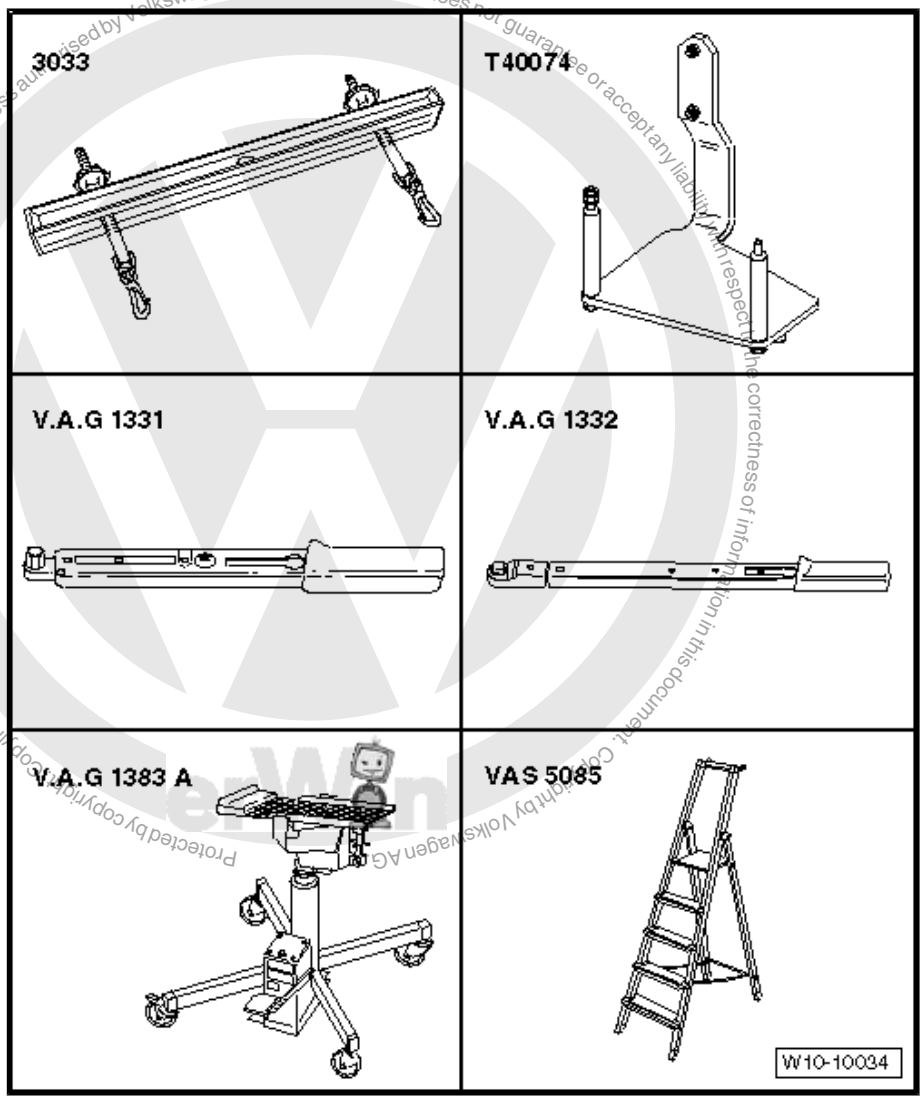
Securing engine to assembly stand ⇒ page 10 .

Installing engine ⇒ page 11 .

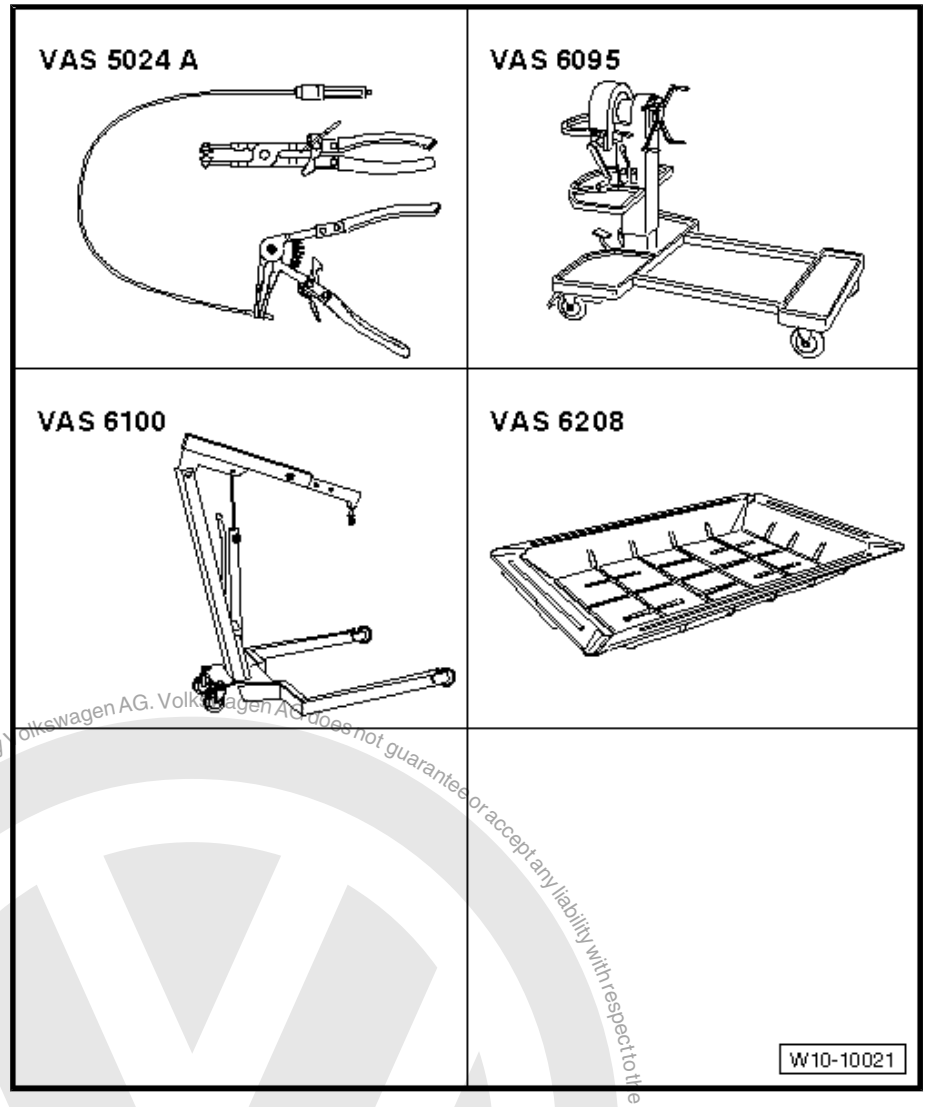
Specified torques for assembly mountings ⇒ page 13 .

Special tools and workshop equipment required

- Lifting tackle -3033-
- Engine bracket -T40074-
- Torque wrench -V.A.G 1331-
- Torque wrench -V.A.G 1332-
- Engine and gearbox jack -V.A.G 1383 A-
- Stepladder -VAS 5085-



- Spring-type clip pliers -VAS 5024 A-
- Engine and gearbox support -VAS 6095- with engine bracket -3269-
- Workshop crane -VAS 6100-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-



Not illustrated:

- Container for removed parts -V.A.G 1698-
- Engine bung set -VAS 6122-
- Cable ties
- High-temperature grease -G 052 133 A2-

1.1 Removing engine

The engine is removed downwards with gearbox.

– Before removing, read the fault memories of all control units ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided fault finding”.

Note

- *All cable ties which are opened or cut through when engine is removed must be replaced in the same position when engine is installed.*
- *Leave ignition key in ignition lock to prevent steering lock from engaging.*
- *It is advisable to remove the front wheels before beginning engine removal. The vehicle can then be lowered on hoist until the brake disc splash plates are just above the floor. This provides the most ergonomic working position regarding accessibility of engine compartment components.*
- *Some components cannot be removed, or removed only with difficulty, with the engine installed. Therefore, you should determine all defective components before removing engine and renew them while engine is removed.*
- *To prevent damage to removed components, place them in the container for removed parts -V.A.G 1698- .*

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 and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***To avoid damage to lines/wiring, ensure sufficient clearance to all moving or hot components.***

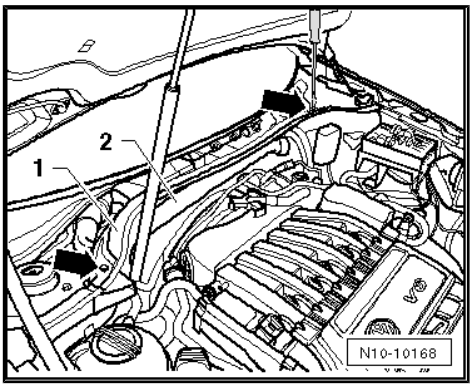
– Disconnect earth strap at battery with ignition switched off ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and reconnecting battery .

– Completely remove air filter together with connecting hose to throttle valve module -J338- ⇒ page 174 .

– Remove bracket from air filter.

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

– Unscrew securing bolts -arrows- of plenum chamber bulkhead -1- and remove together with resonance air pipe -2-.



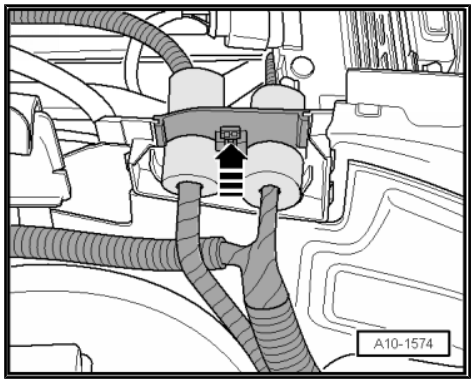
Vehicles with anti-theft secured engine control unit

– Remove protective housing from engine control unit ⇒ page 185 .

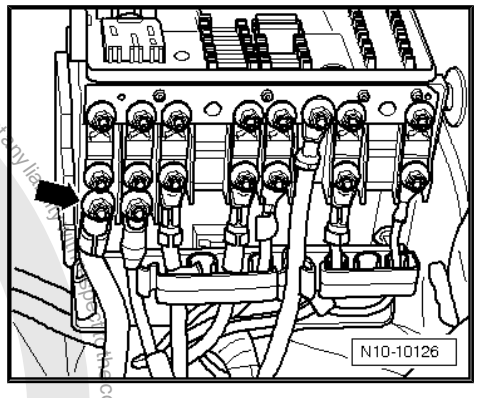
Continuation for all vehicles

– Pull engine wiring harness connector off engine control unit.

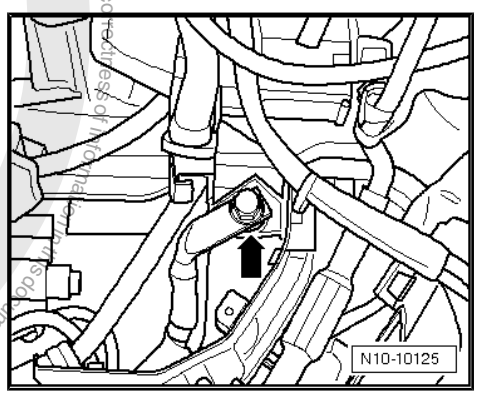
– Release feed-through for engine wiring harness -arrow- and pull off upwards.



– Unscrew cable from alternator at fuse holder -arrow-.

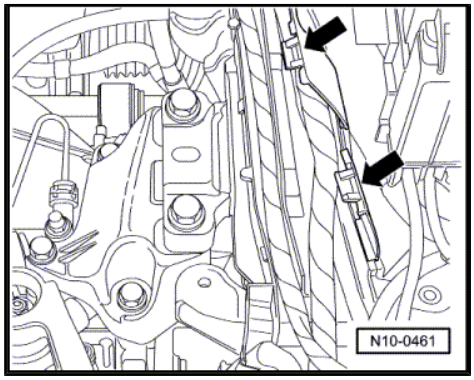


– Unscrew earth cable from longitudinal member -arrow-.



– Open wiring guide catches on longitudinal member -arrows-.

– Separate all connectors between engine wiring harness and body and lay engine wiring harness on engine.



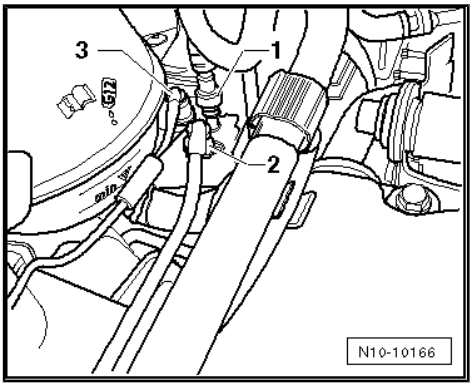
WARNING

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

– Observe rules for cleanliness ⇒ page 129 .

– Separate fuel supply line -1- (black) and catch escaping fuel with a cloth.

– Disconnect breather line -2- (white) and remove activated charcoal filter.

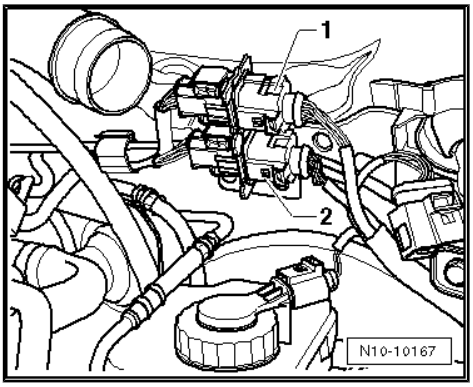


Note

- *Press in securing ring to release fuel lines.*
- *On vehicles with auxiliary heater the fuel line -3- of the metering pump -V54- must also be separated.*

– Seal line so that fuel system is not contaminated by dirt.

– Separate Lambda probe connectors at plenum chamber bulkhead and release cables.



1 - Lambda probe 2 -G108- , 6-pin connector (brown)

2 - Lambda probe -G39- , 6-pin connector (black)

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

– Pull vacuum line for brake servo off intake manifold.

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

– Remove selector mechanism from gearbox ⇒ 6-speed dual clutch gearbox 02E; Rep. Gr. 34 ; Selector mechanism .

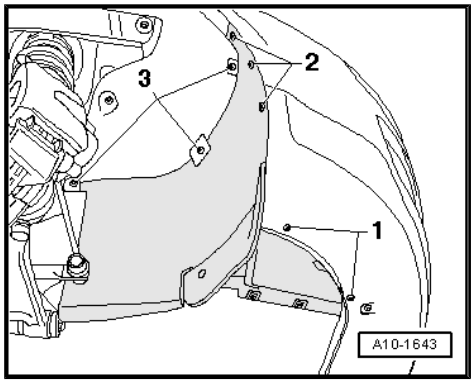
WARNING

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

– Open and close expansion tank cap to release pressure in cooling system.

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

– Remove front parts of wheel housing liners ⇒ General body repairs, exterior; Rep. Gr. 66 ; Removing and installing wheel housing liner .
– Move lock carrier into its service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier, service position .
– Pull connector off oil level and oil temperature sender -G266- .
– Pull wiring retainer for oil level and oil temperature sender -G266- off subframe.
– Remove front exhaust pipe with catalytic converters ⇒ page 195 .



Note

The flexible joint in the front exhaust pipe must not be bent by more than 20° - risk of damage. To remove, ask for the assistance of a second mechanic.

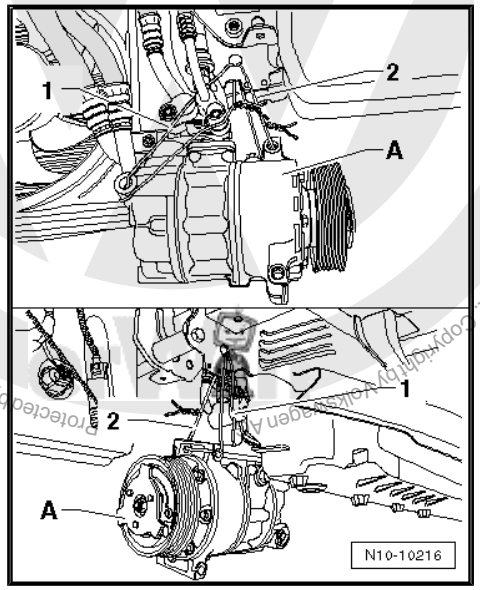
– Remove front propshaft ⇒ Final drive 02D, 0AV; Rep. Gr. 39 ; Assembly overview - repairing propshaft

Note

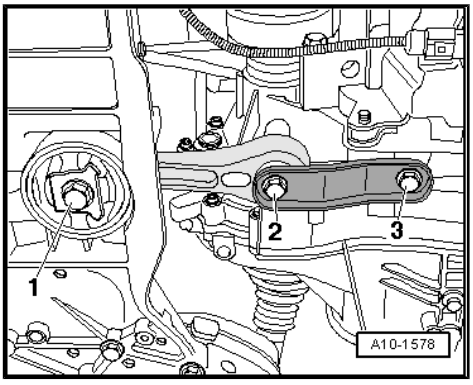
To prevent damage to condenser or to refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.

To facilitate removing and installing engine without opening refrigerant circuit:

– Remove poly V-belt ⇒ page 20 .
– Open refrigerant line brackets on body.
– Remove air conditioner compressor with connected refrigerant lines from ancillary bracket ⇒ Heating, air conditioning; Rep. Gr. 87 ; Removing and installing compressor bracket .
– Secure air conditioner compressor -A- to lock carrier as illustrated (securing points -1 and 2-.
– Remove drive shaft protection for right drive shaft.
– Remove drive shafts ⇒ Running gear, axles, steering; Rep. Gr. 40 ; Removing and installing drive shafts



– Unscrew bolts -1…3- and remove pendulum support.



– Drain coolant ⇒ page 110 .
– Pull coolant hose quick-release couplings off heat exchanger and radiator.
– Pull off coolant hoses to expansion tank.

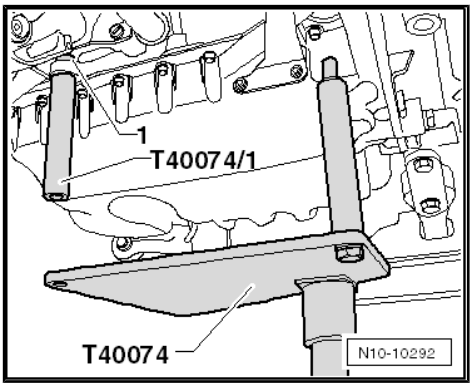
Vehicles with auxiliary heater

– Disconnect coolant hoses to auxiliary heater and to heater coolant shut-off valve -N279- .

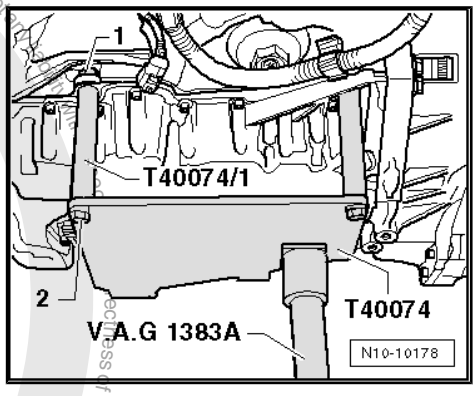
Continuation for all vehicles

– Insert engine bracket -T40074- in engine and gearbox jack -V.A.G 1383 A- .

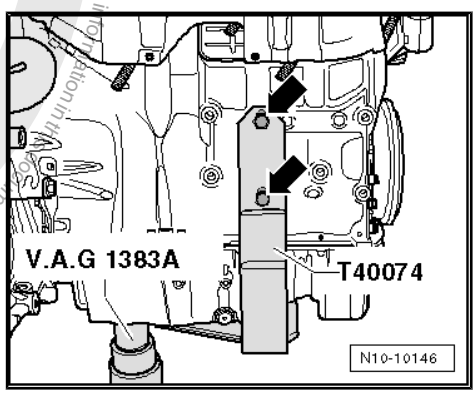
– Remove adapter -T40074/1- from engine support -T40074- and screw with nut -1- onto cylinder block.



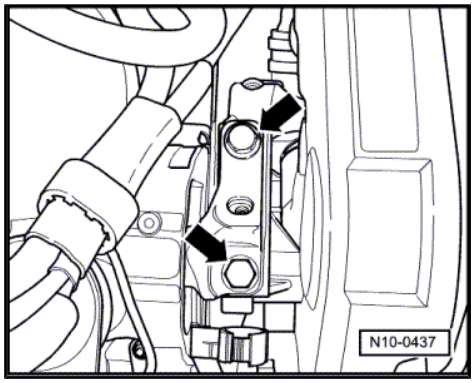
– Position engine support -T40074- on engine as shown and retighten adapter -T40074/1- with engine support -T40074- -2-.



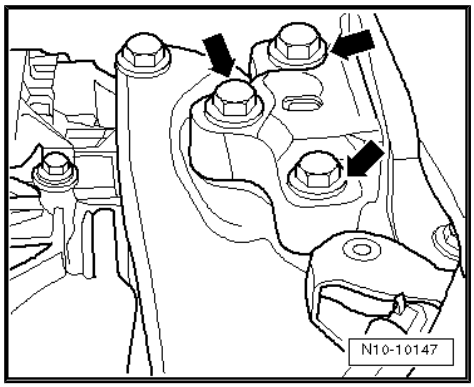
– Fit engine support -T40074- with M10x25 bolts on exhaust side as shown and tighten to approx. 20 Nm on cylinder block -arrows-.
– Lift engine and gearbox lightly using engine and gearbox jack -V.A.G 1383 A- .



– Unbolt engine side of assembly mounting from engine bracket from above -arrows-.



– Unbolt gearbox side of assembly mounting from gearbox bracket -arrows- from above.



Note

- *To remove securing bolts use stepladder -VAS 5085- .*
- *Engine with gearbox must be guided carefully when lowered to prevent damage to bodywork.*

– Carefully lower engine with gearbox.

1.2 Securing engine on engine and gearbox support -VAS 6095-

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

Procedure

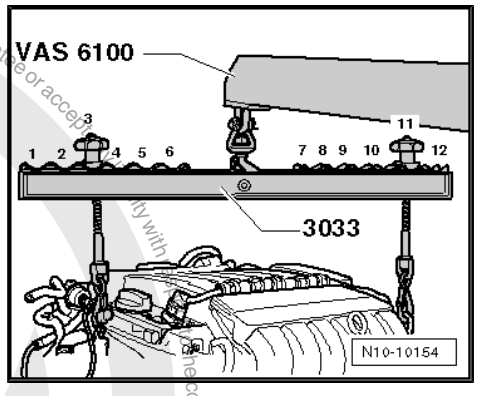
– Unbolt gearbox.

– Attach lifting tackle -3033- as follows and lift engine from engine and gearbox jack -V.A.G 1383 A- using workshop crane -VAS 6100- .

Vibration damper end: position 3.

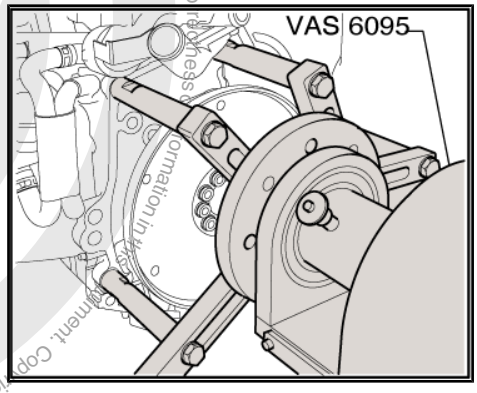
Flywheel end: position 11.

When using engine and gearbox support -VAS 6095- with universal mountings:

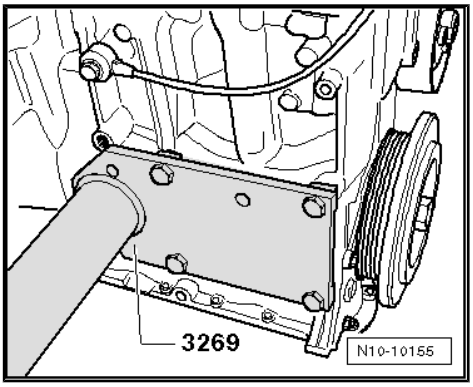


– Secure engine to engine and gearbox support -VAS 6095- as shown.

When using engine bracket -3269- :



– Bolt engine bracket -3269- to cylinder block as shown.



1.3 Installing engine

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 the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant and 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.***

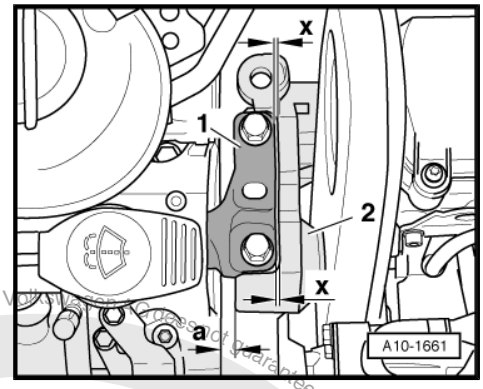
– A needle bearing must be fitted in the crankshaft on vehicles with DSG®. Install needle bearing where necessary ⇒ page 33 .

– Lightly lubricate used needle bearings with high-temperature grease -G 052 133 A2- .

– Check whether dowel sleeves for centring engine/gearbox have been fitted in cylinder block, insert if necessary.

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

– Align engine mountings as follows:



- There must be a distance of -a- at least 10 mm between engine support and longitudinal member (right side).
- The side surface of the engine support -2- should be located parallel to the support arm -1-.

– Install pendulum support ⇒ page 13 .

Note

Specified torques for assembly mountings ⇒ page 13 .

– Install drive shafts ⇒ Running gear, axles, steering; Rep. Gr. 40 ; Removing and installing drive shafts .

– Install front propshaft ⇒ Final drive 02D, 0AV; Rep. Gr. 39 ; Assembly overview - repairing propshaft

– Install front exhaust pipe together with catalytic converters ⇒ page 195 .

Note

Ensure that the exhaust system is installed free of stress ⇒ page 200 .

– If necessary, adjust selector lever cable ⇒ 6-speed dual clutch gearbox 02E; Rep. Gr. 34 ; Selector mechanism; Adjusting selector lever cable .

– Electrical connections and routing ⇒ Electrical system; Rep. Gr. 97 .

– Install air conditioner compressor ⇒ Heating, air conditioning; Rep. Gr. 87 .

– Install poly V-belt ⇒ page 20 .

– Reset service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier, service position .

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

– Replenish coolant ⇒ page 110 .

– Carry out vehicle system test ⇒ Vehicle diagnosis, testing and information system VAS 5051 “Guided fault finding”.

– Finish the vehicle system test so that any fault entries stored during assembly can be deleted automatically.

– Generate the readiness code in combination with a road test.

Observe applicable safety precautions during road test.

– Carry out road test.

– Then carry out vehicle system test again and rectify any faults which may have occurred.

Specified torques

Threaded connection		Specified torque
Bolts, nuts	M6	10 Nm
	M7	15 Nm
	M8	25 Nm
	M10	40 Nm
	M12	60 Nm

Note

Specified torques for assembly mountings ⇒ page 13 .

1.4 Specified torques for assembly mounting

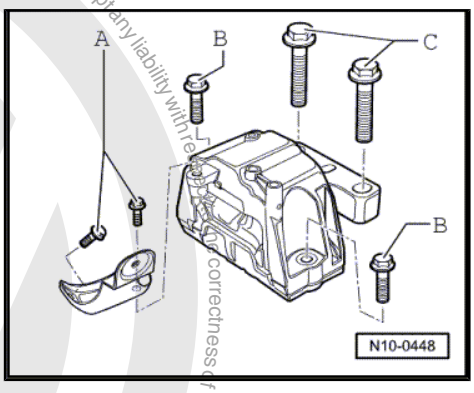
Engine assembly mountings

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

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

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

[1)] Renew.

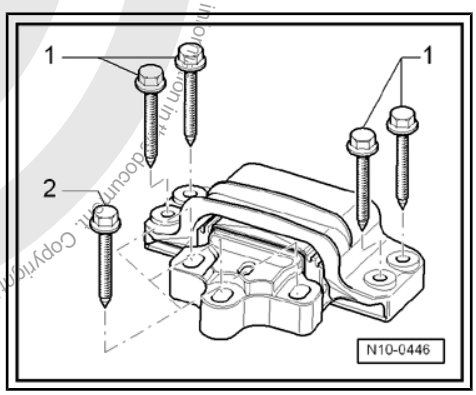


Gearbox assembly mounting

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

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

[1)] Renew.



Pendulum support

Note

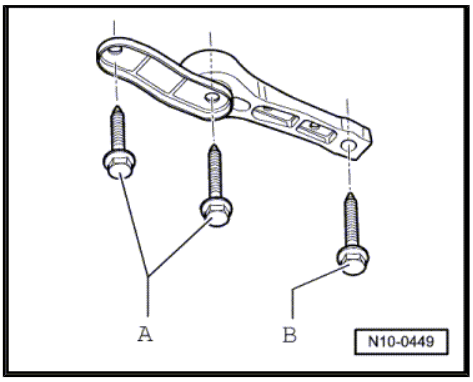
Bolt pendulum support to gearbox and then to subframe.

A - Strength rating 8.8 = 40 Nm + 90° ($^1/_4$ turn) further [1)]

A - Strength rating 10.9 = 50 Nm + 90° ($^1/_4$ turn) further [1)]

B - = 100 Nm + 90° ($^1/_4$ turn) further [1)]

[1)] Renew.



13 – Crankshaft group

1 Dismantling and assembling engine

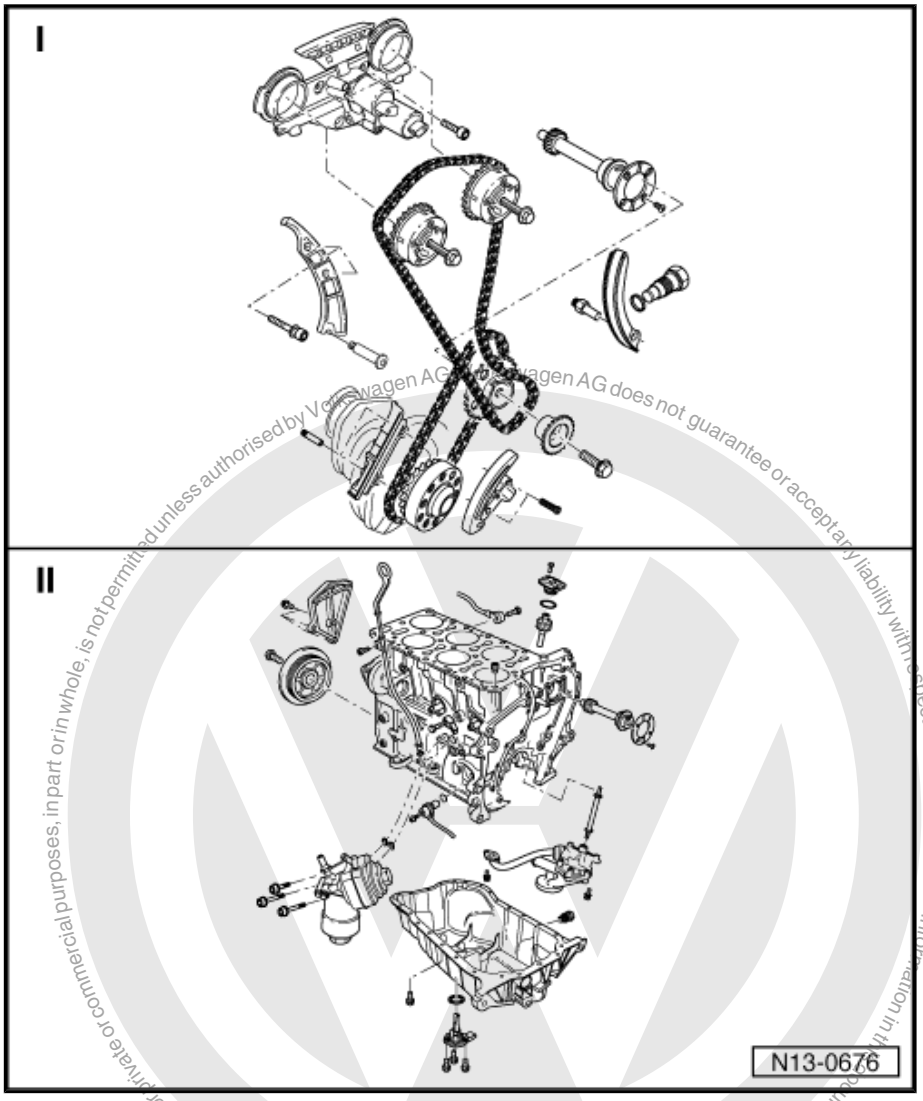
Note

- *Secure engine to engine and gearbox support -VAS 6095- to carry out assembly work ⇒ page 10 .*
- *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 this from causing further damage, perform the following repairs:*
- *Thoroughly clean oil channels.*
- *Renew oil spray jets.*
- *Renew oil cooler.*
- *Renew oil filter.*

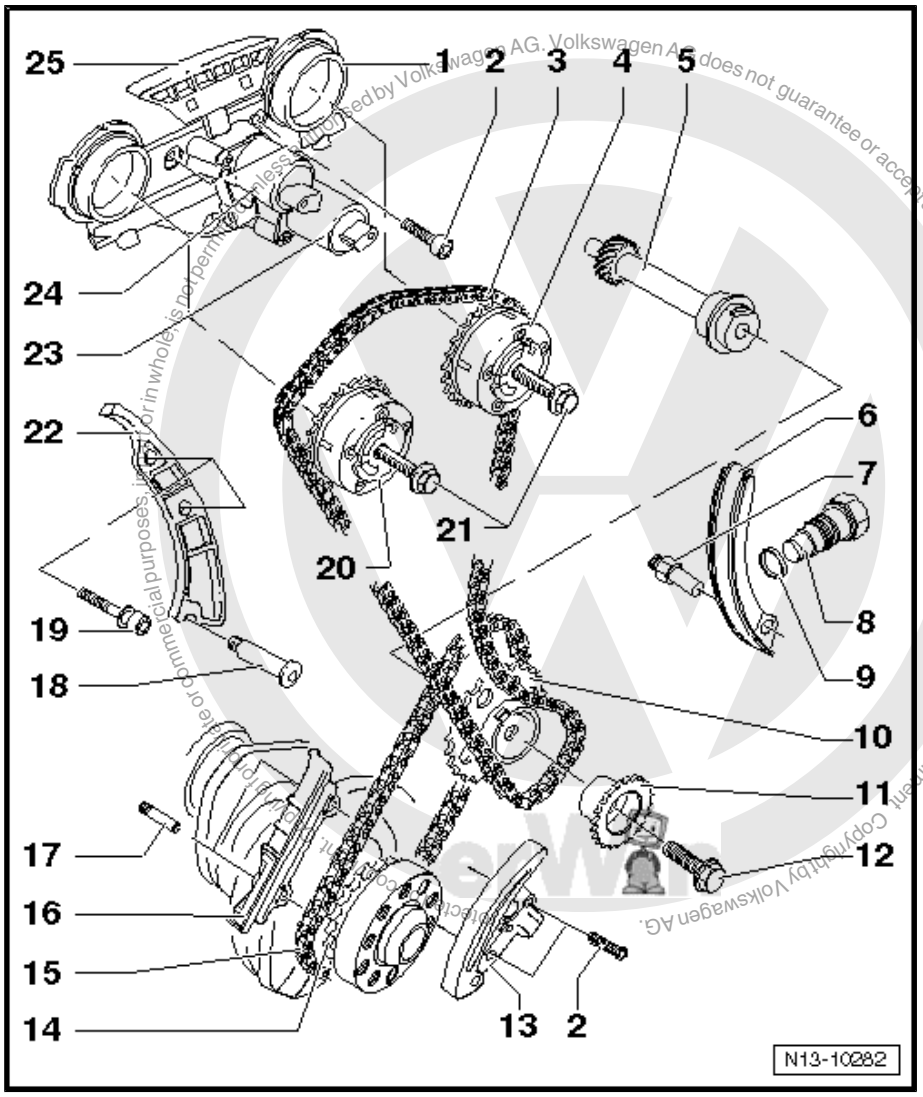
Part I: assembly overview - chain drive ⇒ page 16

Part II: assembly overview - crankshaft group ⇒ page 18

Removing and installing poly V-belt ⇒ page 20 .



1.1 Part I: assembly overview - chain drive



1 - Valve timing housing

- ❑ Markings on valve timing housing ⇒ page 57 .
- ❑ Lightly lubricate contact surfaces of oil seals before installing.
- ❑ Removing and installing ⇒ page 73 .
- ❑ Dismantling and assembling ⇒ page 73 .
- ❑ Before installing valve timing housing, check strainer for soiling ⇒ page 73 .

2 - 8 Nm

- ❑ Insert with locking fluid - D 000 600 A2- .

3 - Camshaft timing chain

- ❑ Before removing, mark direction of rotation (installation position) ⇒ page 18 .
- ❑ Installing ⇒ page 62 .

4 - Exhaust camshaft adjuster

- ❑ Identification: 32A.
- ❑ Rotate engine only with camshaft adjuster installed.
- ❑ Installing ⇒ page 62 .

5 - Intermediate shaft

6 - Tensioning plate

- ❑ For camshaft timing chain ⇒ Item 3 (page 16)

7 - Pivot pin, 18 Nm

8 - Chain tensioner, 50 ± 2 Nm

- ❑ For camshaft timing chain ⇒ Item 3 (page 16)
- ❑ Only rotate engine when chain tensioner is installed.

9 - Seal

- ❑ Renew if damaged or leaking.

10 - Chain sprocket

- ❑ For timing chain ⇒ Item 15 (page 17) .
- ❑ Installing ⇒ page 62 .

11 - Chain sprocket

- ❑ For camshaft timing chain ⇒ Item 3 (page 16)
- ❑ Installing ⇒ page 62 .

12 - 60 Nm + 1/4 turn (90°) further

- ❑ Renew.
- ❑ Use counterhold -T10069- to loosen and tighten ⇒ page 62 .

13 - Chain tensioner with tensioning plate

- ❑ For timing chain ⇒ Item 15 (page 17) .
- ❑ Before installing, release locking splines in chain tensioner using a small screwdriver and press tensioning plate against chain tensioner.
- ❑ Only rotate engine when chain tensioner is installed.

14 - Drive gear wheel

- ❑ Built into crankshaft.
- ❑ Ground down tooth to bearing joint = TDC No. 1 cyl. ⇒ page 62

15 - Timing chain

- ❑ Before removing, mark direction of rotation (installation position) ⇒ page 18 .
- ❑ Installing ⇒ page 62 .

16 - Guide rail

- ❑ Remove and install together with roller chain ⇒ page 62

17 - Locating pin without collar, 10 Nm

- ❑ For guide rail ⇒ Item 16 (page 17) .

18 - 18 Nm

19 - 23 Nm

20 - Inlet camshaft adjuster

- ❑ Identification: 24E
- ❑ Rotate engine only with camshaft adjuster installed.
- ❑ Installing ⇒ page 62 .

21 - 60 Nm + 1/4 turn (90°) further

- ❑ Renew.
- ❑ Contact surface of sender wheel must be dry around bolt head when installed.
- ❑ To remove and install, counterhold with 32 mm open-end spanner on camshaft ⇒ page 73 .

22 - Guide rail

- ❑ For camshaft timing chain ⇒ Item 3 (page 16)

23 - Exhaust camshaft control valve 1 -N318-

- ❑ For exhaust camshaft.
- ❑ Removing and installing ⇒ page 80 .
- ❑ Before removing, mark connector belonging to component.

24 - Inlet camshaft control valve 1 -N205-

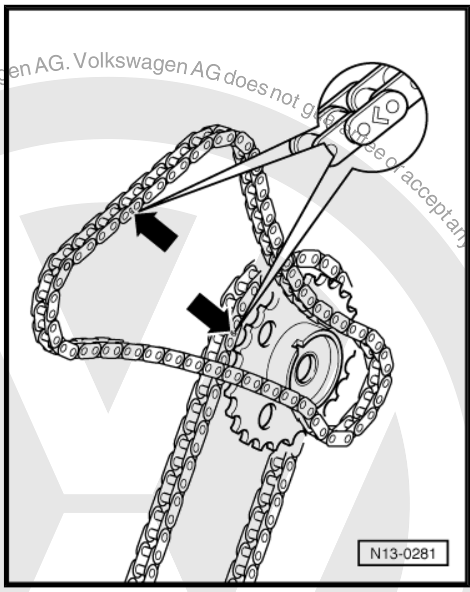
- ❑ For inlet camshaft.
- ❑ Removing and installing ⇒ page 80 .
- ❑ Before removing, mark connector belonging to component.

25 - Guide rail

- ❑ For camshaft timing chain
- ❑ Clipped into valve timing housing.

Marking timing chains

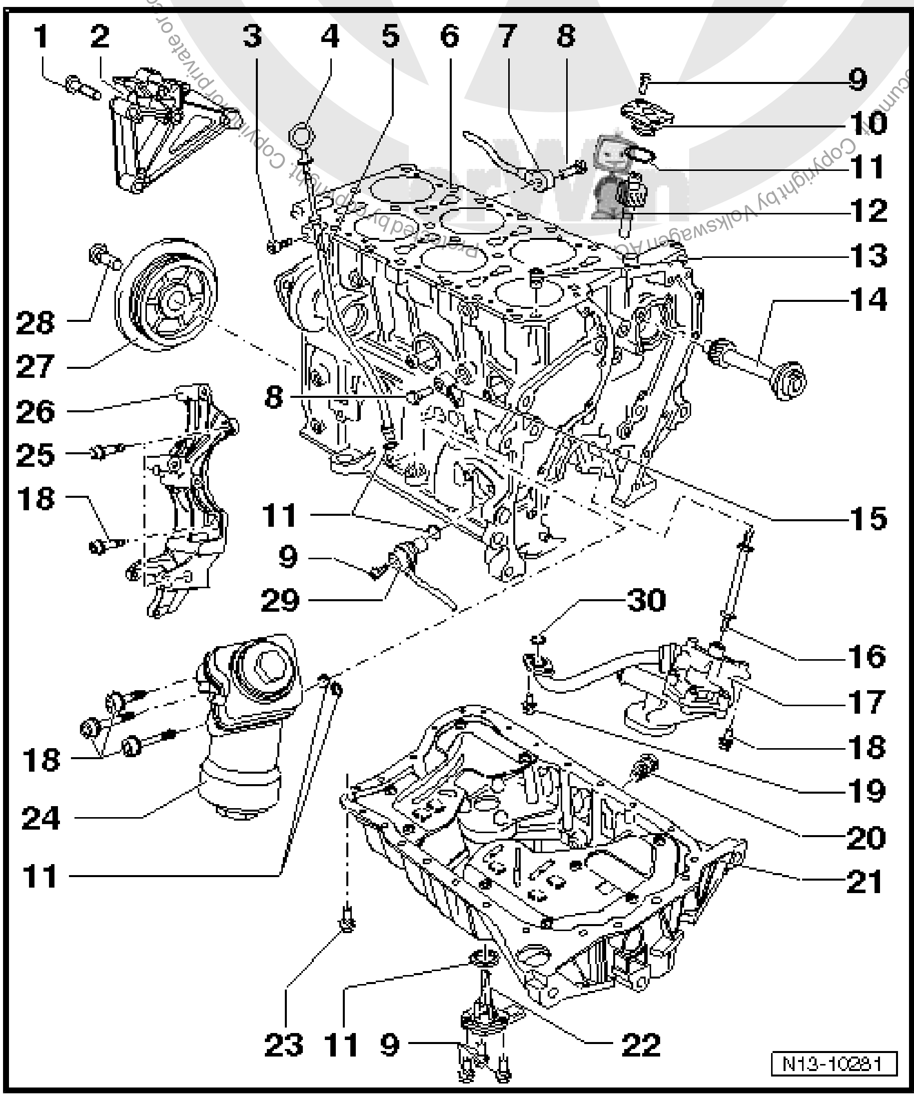
– Mark roller chains before removing (e.g. with paint, arrow pointing in direction of rotation).



Note

Do not mark chain by way of centre punch, notch or the like.

1.2 Part II: assembly overview - crankshaft group



1 - 45 Nm

2 - Engine bracket

3 - 5 Nm

- ❑ Secured to intake manifold.

4 - Oil dipstick

- ❑ The oil level must not be above the max. mark!
- ❑ Markings ⇒ page 89 .

5 - Guide tube

- ❑ For oil dipstick.
- ❑ Secured with bolt to intake manifold.

6 - Cylinder block

- ❑ Removing and installing sealing flange and dual-mass flywheel ⇒ page 22 .
- ❑ Removing and installing crankshaft ⇒ page 30 .
- ❑ Dismantling and assembling pistons and conrods ⇒ page 36 .

7 - Knock sensor 1 -G61-

- ❑ Fitting location: between cylinder 1 and cylinder 3.

8 - 20 Nm

- ❑ The specified torque influences the function of the knock sensor.

9 - 10 Nm

10 - Oil pump drive cover

11 - O-ring

- ❑ Renew.
- ❑ Oil before installing.

12 - Oil pump drive

13 - Oil non-return valve, 5 Nm

- ❑ Note installation position.
- ❑ Clean if badly soiled
- ❑ See note ⇒ page 14 .

14 - Intermediate shaft

15 - Knock sensor 2 -G66-

- ❑ Fitting location: between cylinder 4 and cylinder 6.

16 - Drive shaft

- ❑ For oil pump drive.

17 - Oil pump

- ❑ Assembly overview - oil pump ⇒ page 97

18 - 23 Nm

19 - 8 Nm

- ❑ Renew.

20 - Oil drain plug, 30 Nm

- ❑ Renew seal

21 - Oil sump

- ❑ Removing and installing ⇒ page 92 .

22 - Oil level and oil temperature sender -G266-

23 - 12 Nm

24 - Oil filter bracket

- ❑ Assembly overview - oil filter bracket ⇒ page 95
- ❑ Coolant hose schematic diagram ⇒ page 109 .

25 - Fitted bolt, 23 Nm

26 - Bracket for ancillaries

- ❑ For alternator, air conditioner compressor and power-assisted steering vane pump

27 - Vibration damper

- ❑ Use counterhold -T10069- to remove and install ⇒ page 20 .
- ❑ Removing and installing poly V-belt ⇒ page 20 .

28 - 100 Nm + 1/2 turn (180°) further

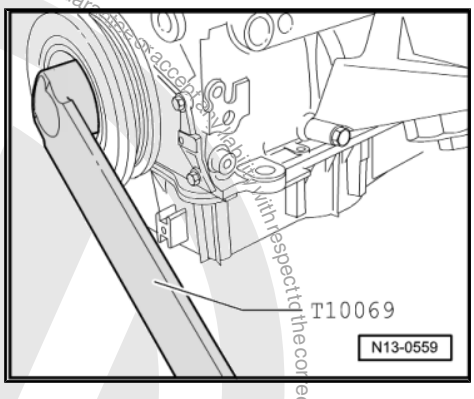
- ❑ Loosening and tightening ⇒ page 20

29 - Engine speed sender -G28-

30 - Seal

- ❑ Renew if damaged.

Loosening and tightening vibration damper securing bolt



– To loosen and tighten, lock vibration damper using counter-hold -T10069- .
– Clean thread in crankshaft with a threaded chaser M18 x 1.5.
– Renew securing bolt for vibration damper.
– Tighten securing bolt using torque wrench -V.A.G 1601- .

Specified torque: 100 Nm + $^1/_2$ turn (180°).

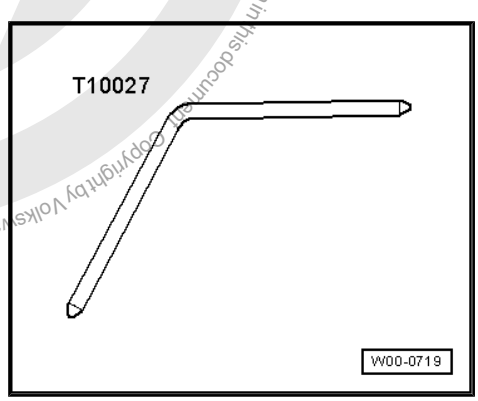
Note

Turning further in several stages is permitted.

1.3 Removing and installing poly V-belt

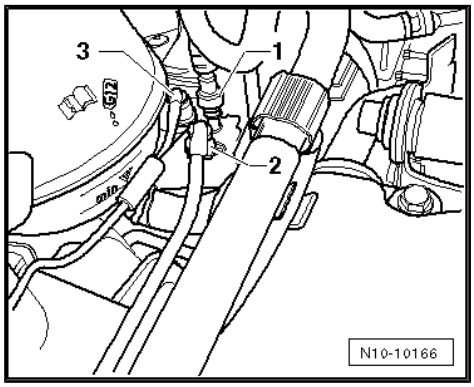
Special tools and workshop equipment required

♦ Locking pin -T10027-



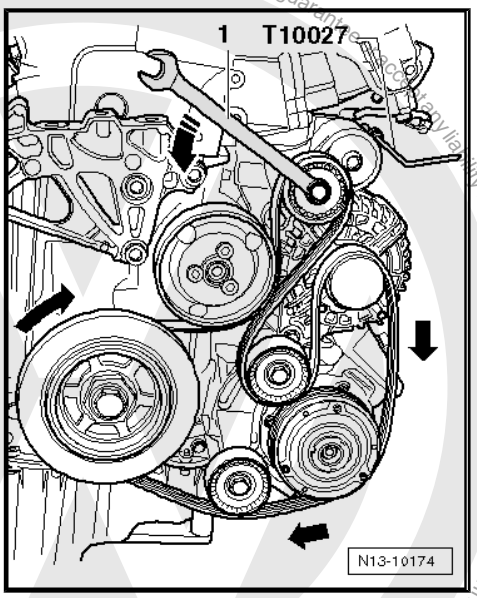
Removing poly V-belt

– Remove noise insulation ⇒ General body repairs, exterior; Rep. Gr. 50 ; Noise insulation .
– Disconnect breather line -2- (white) and remove activated charcoal filter from bracket.
– Before removing, mark direction of rotation of poly V-belt.



– Position spanner -1- onto tensioning roller securing bolt and turn in -direction of arrow- until locking pin -T10027- can be inserted on tensioning roller.

– Remove poly V-belt.

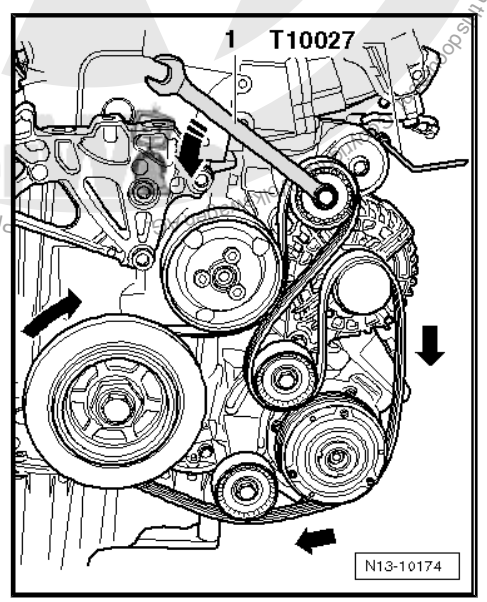


Installing poly V-belt

Note

- *Ensure, before installing poly V-belt, that all ancillaries (alternator, air conditioner compressor) are secured tightly.*
- *Check that idler rollers turn easily.*
- *The poly V-belt must not be kinked.*
- *When fitting poly V-belt, check direction of belt rotation and ensure proper seating of belt in pulleys.*

– Fit poly V-belt as shown.



– Then press tensioning roller slightly in direction of -arrow-, using spanner -1-. This relieves the locking pin -T10027- in the tensioning roller, allowing it to be pulled out.

After completing repairs always:

– Start engine and check that belt runs properly.

2 Sealing flanges and flywheel

Assembly overview - sealing flange ⇒ page 22 .

Removing and installing crankshaft seal on gearbox side ⇒ page 23 .

Renewing crankshaft sealing flange -vibration damper side- ⇒ page 25 .

Removing and installing flywheel ⇒ page 26 .

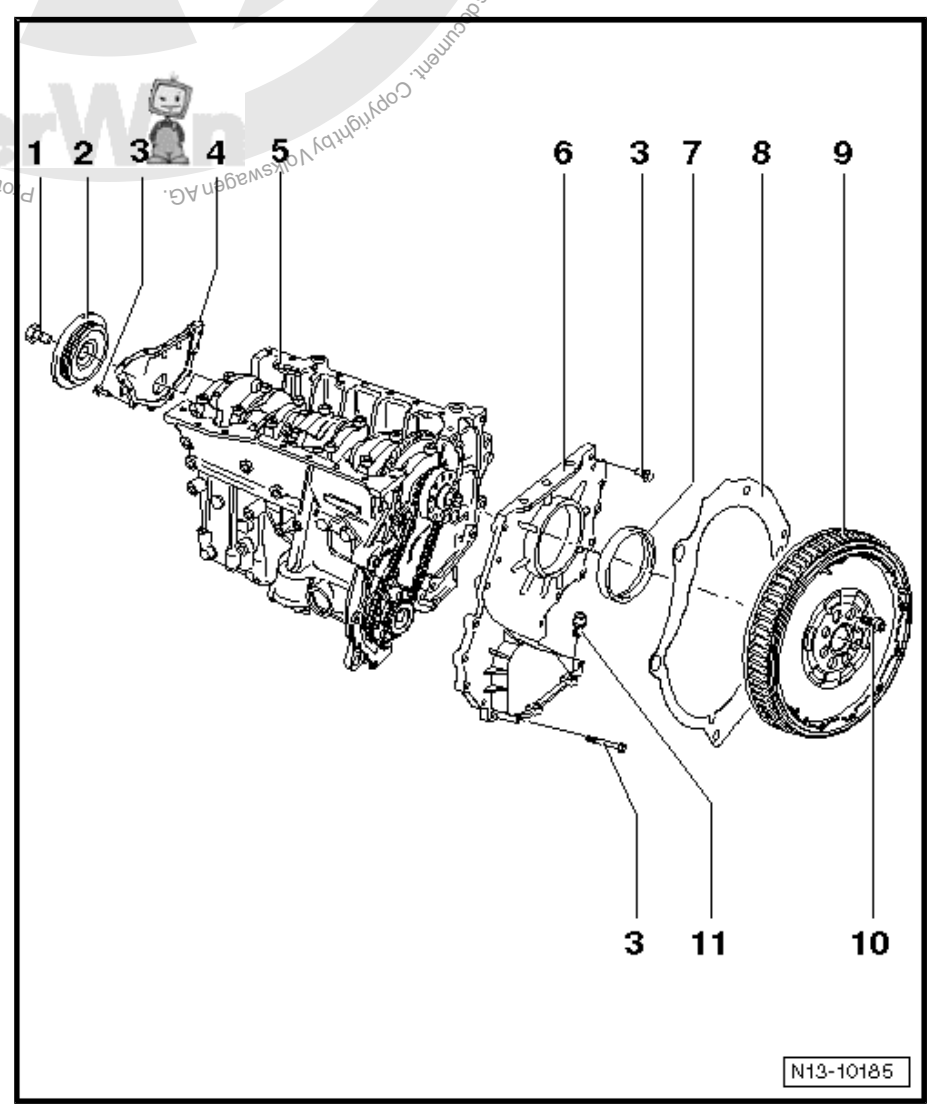
Removing and installing drive plate ⇒ page 28 .

Repairing clutch ⇒ 6-speed manual gearbox 02Q, four-wheel drive; Rep. Gr. 30 ; Repairing clutch .

Note

Secure engine to engine and gearbox support -VAS 6095- to carry out assembly work ⇒ page 10 .

2.1 Assembly overview - sealing flange



1 - 100 Nm + 1/2 turn (180°) further

- ❑ Renew.
- ❑ To loosen and tighten, use counterhold -T10069- ⇒ page 25 .
- ❑ Tighten using torque wrench -V.A.G 1601- .

2 - Vibration damper

- ❑ Use counterhold -T10069- to remove and install ⇒ page 20 .

3 - 10 Nm

4 - Sealing flange

- ❑ Coat sealing surfaces with sealant -D 176 501 A1- .
- ❑ With seal.
- ❑ Renewing ⇒ page 25 .

5 - Cylinder block

- ❑ Removing and installing crankshaft ⇒ page 30 .
- ❑ Dismantling and assembling pistons and conrods ⇒ page 36 .

6 - Sealing flange

- ❑ Coat sealing surfaces with sealant -D 176 501- .

7 - Seal

- ❑ Remove using extractor hook -T20143/2- .

- ❑ PTFE-type oil seal

  Identification: Without inner coil spring.
- ❑ Do not additionally oil or grease the oil seal sealing lip.
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth.
- ❑ Removing and installing ⇒ page 23 .

8 - Intermediate plate

9 - Dual-mass flywheel

- ❑ Removing and installing ⇒ page 26 .

10 - 60 Nm + 1/4 turn (90°) further

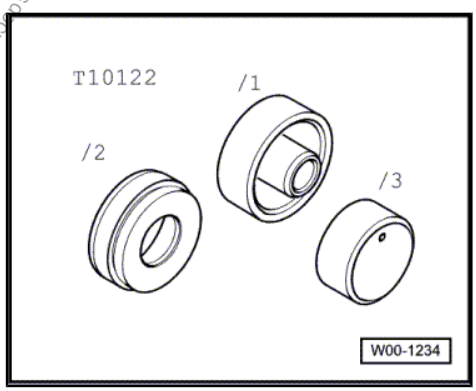
- ❑ Renew.
- ❑ To loosen and tighten, use counterhold -T10044- (with 5 mm spacers) or counterhold -T10069- .

11 - 25 Nm

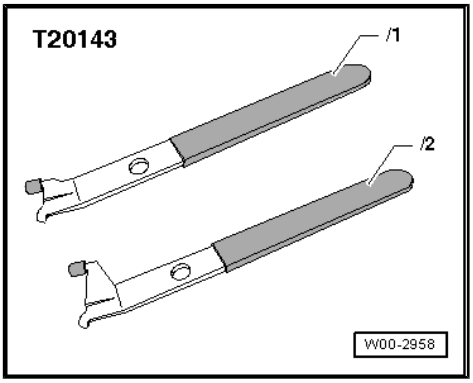
2.2 Removing and installing crankshaft seal on gearbox side

Special tools and workshop equipment required

- ♦ Fitting sleeves -T10122-



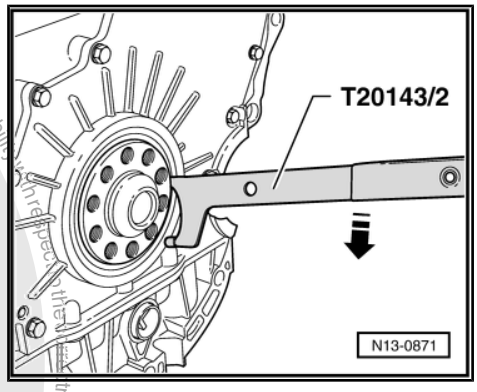
- ♦ Puller hooks -T20143-



Removing

– Fit puller hooks -T20143/2- behind sealing lip of oil seal as shown in illustration.

– Support puller hook -T20143/2- on sealing flange and lever seal out in direction of -arrow-.

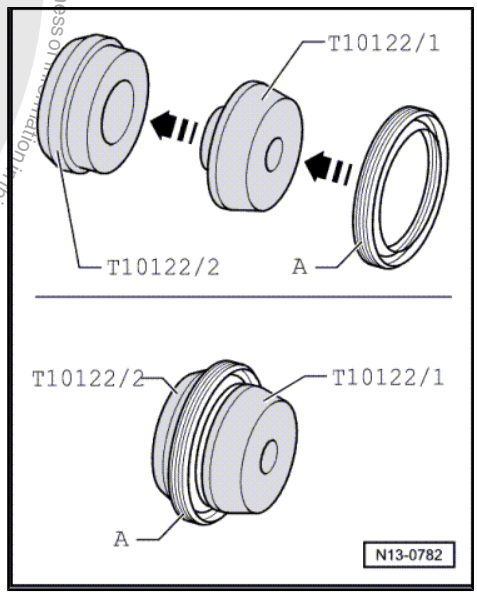


Installing

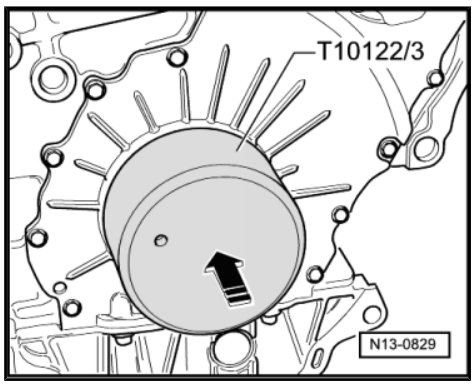
– Pull oil seal -A- by the outside over the sleeve -T10122/1- onto pulling sleeve -T10122/2- .

Separate the two fitting sleeves.

– Then set pulling sleeve -T10122/2- with dry oil seal onto crankshaft journal.



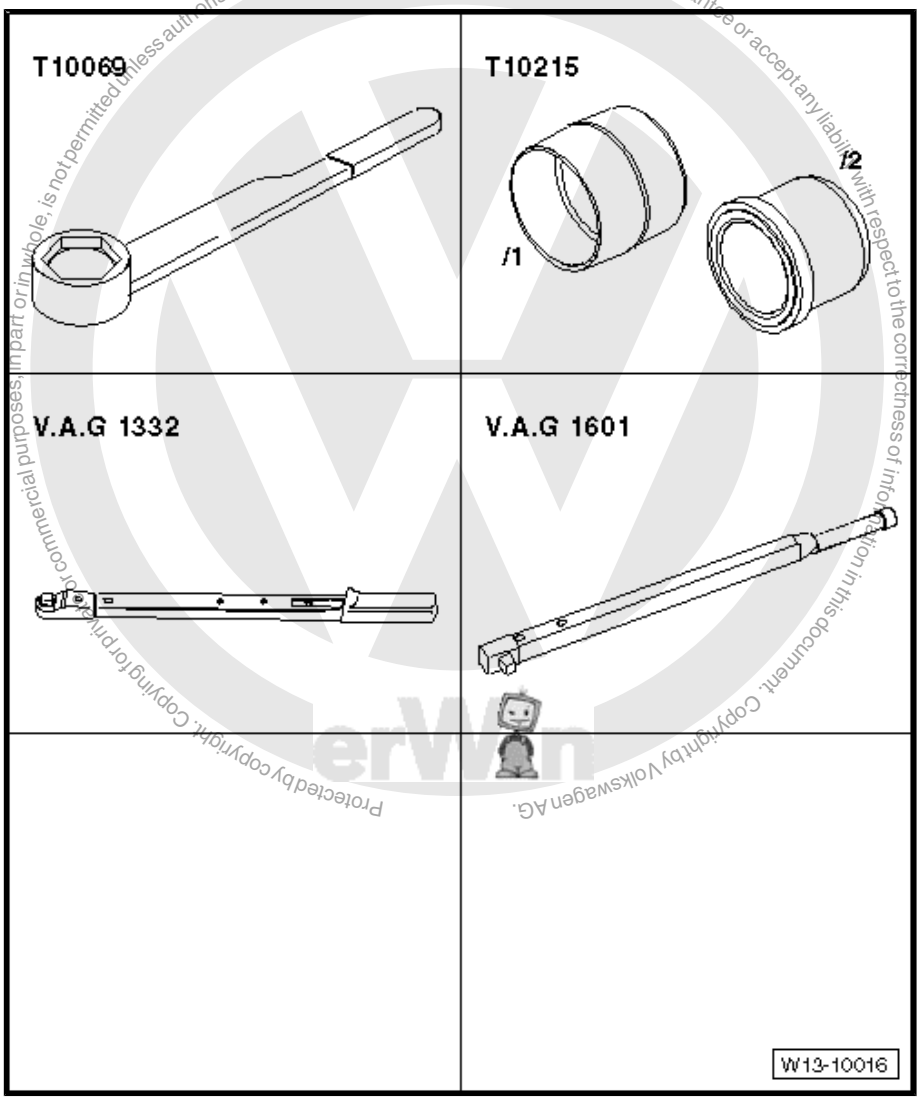
– Now drive it into sealing flange to stop using thrust piece -T10122/3- .



2.3 Renewing crankshaft sealing flange -vibration damper side-

Special tools and workshop equipment required

- Counterhold -T10069-
- Assembly tool -T10215-
- Torque wrench -V.A.G 1601-
- Torque wrench -V.A.G 1332-
- Sealant -D 176 501 A1-



Removing

– Remove poly V-belt ⇒ page 20 .

– Remove vibration damper. To do this, lock vibration damper using counterhold -T10069- .

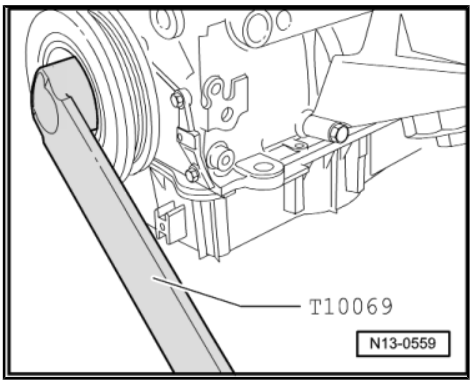
– Remove sump ⇒ page 92 .

– Unbolt sealing flange.

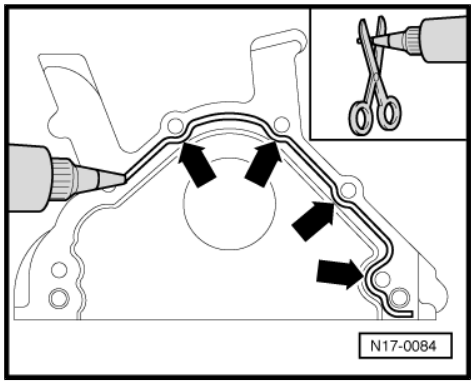
– Remove remaining sealant from sealing surfaces.

Installing

– Remove oil residue from crankshaft journal using clean cloth.



– Cut off tube nozzle at forward marking (approx. 3 mm nozzle ∅).
– Apply sealant bead sealant -D 176 501 A1- of about 2…3 mm as shown -arrows- to clean sealing surface of sealing flange.

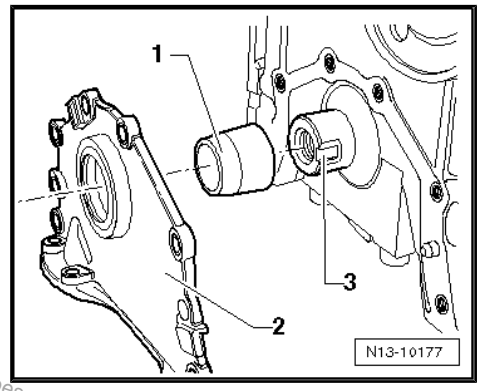


Note

- *Before applying sealant bead, cover sealing ring with a clean cloth.*
- *The sealing compound bead must not be thicker that 2…3 mm. Otherwise excessive sealing compound will enter the sump and may block the oil suction pipe strainer.*
- *Observe expiry date of sealing compound.*
- *The sealing flange must be installed within 5 minutes after applying the silicone sealant.*

– Push guide sleeve -T10215/1- -1- at front onto crankshaft journal -3-.
– Now slide sealing flange with oil seal -2- carefully over guide sleeve.

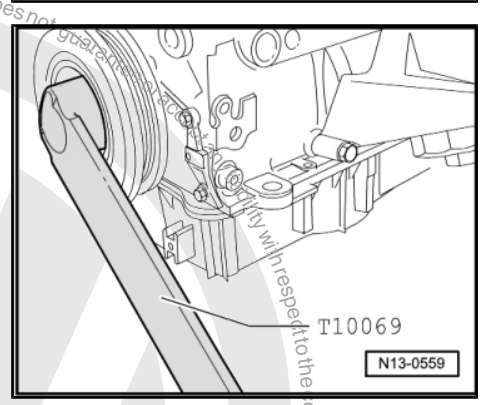
– Bolt sealing flange to cylinder block.
– Install oil sump ⇒ page 92 .



Note

- *Renew securing bolt for vibration damper.*
- *Tighten securing bolt using torque wrench -V.A.G 1601- .*

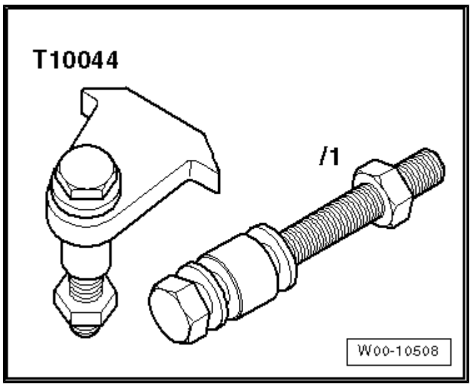
– Install vibration damper and lock with counterhold -T10069- .
– Tighten new securing bolt to 100 Nm + $^{1}/_{2}$ turn (180°) further.
– Install poly V-belt ⇒ page 20 .



2.4 Removing and installing flywheel

Special tools and workshop equipment required

♦ Counterhold -T10044-



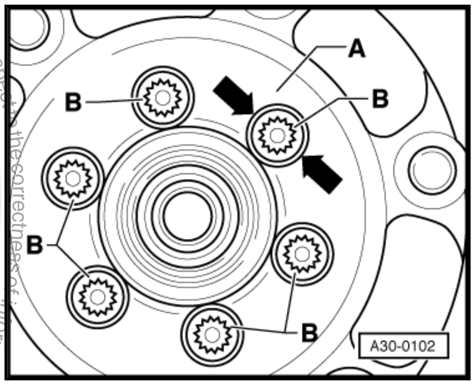
Removing:

Note

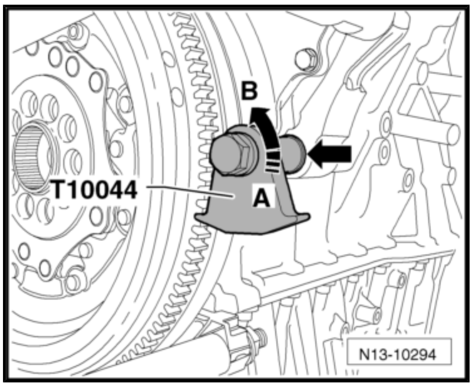
To prevent damage to the dual-mass flywheel when removing, the bolts -B- must not be removed with an impact wrench or similar. The bolts -B- must be unscrewed by hand without power tools.

– Rotate the dual-mass flywheel -A- so that the bolts -B- align centrally with the holes -arrows-.

– When removing bolts -B-, make sure that screw heads do not jam on flywheel.



– Tighten counterhold -T10044- on cylinder block with washer -arrow-. Bring counterhold -T10044- to -position A- to loosen flywheel.



– Mark position of flywheel in relation to engine.

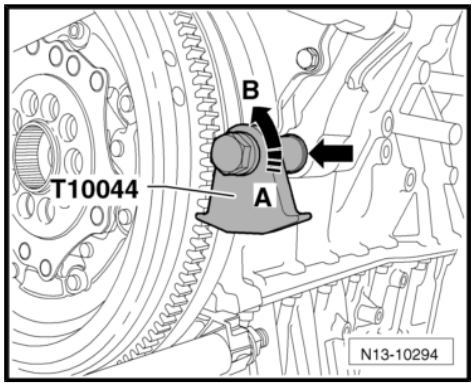
– Unbolt flywheel.

Installing:

Install in reverse order. In the process, note the following:

– Renew bolts.

Bring counterhold -T10044- to -position B- to tighten flywheel.



Specified torque

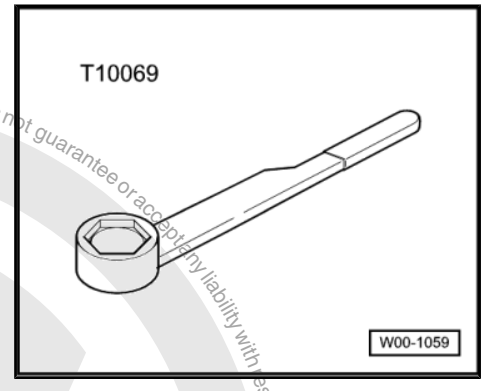
Component	Nm
Flywheel to crankshaft	60 + 90°[1)]

1) 90° equals a quarter of a turn

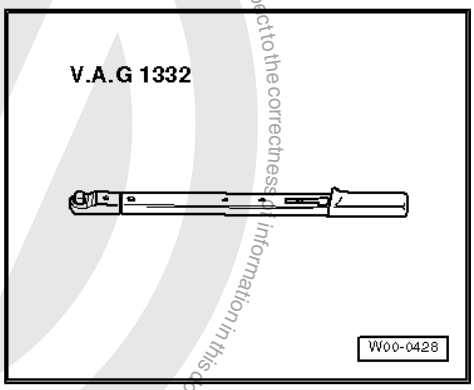
2.5 Removing and installing drive plate

Special tools and workshop equipment required

- Counterhold -T10069-

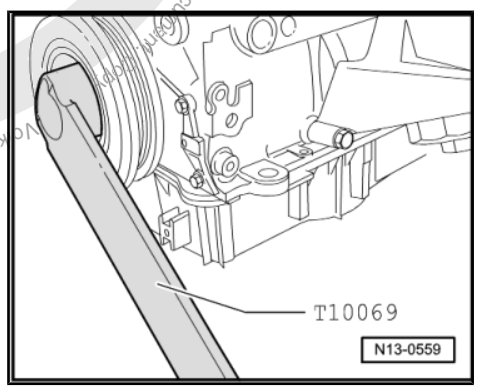


- Torque wrench -V.A.G 1332-
- Depth gauge
- Straight edge



Removing

– Remove drive plate. To do this, lock vibration damper using counterhold -T10069- .



– Loosen drive plate securing bolts diagonally and remove.

– Remove drive plate.

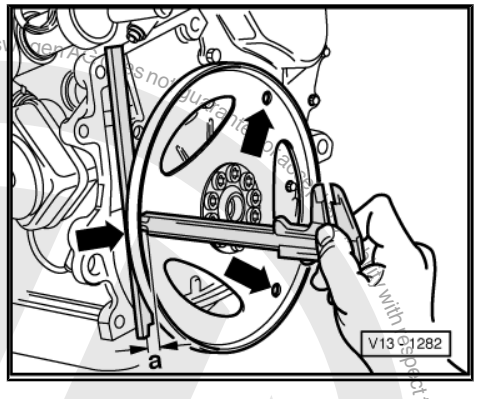
Installing

– Fit drive plate on crankshaft.

– Insert at least 3 old securing bolts and tighten to 30 Nm.

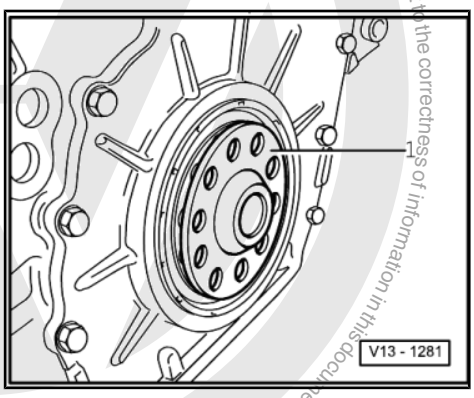
– Check dimension -a- through the three holes for securing the torque converter using a straightedge and depth gauge and calculate average.

– Compare average with specification (measured distance + thickness of straight edge). Specification: 15.7…16.5 mm



If specification is not attained:

– Remove drive plate again and fit appropriate shim -1-.



Note

Only one shim of the appropriate thickness may be used for compensation.

When specification is attained:

– Insert new securing bolts and tighten by hand.

– Tighten securing bolt to 60 Nm + 90° (1/4 turn) further.

3 Crankshaft

Assembly overview - crankshaft ⇒ page 30 .

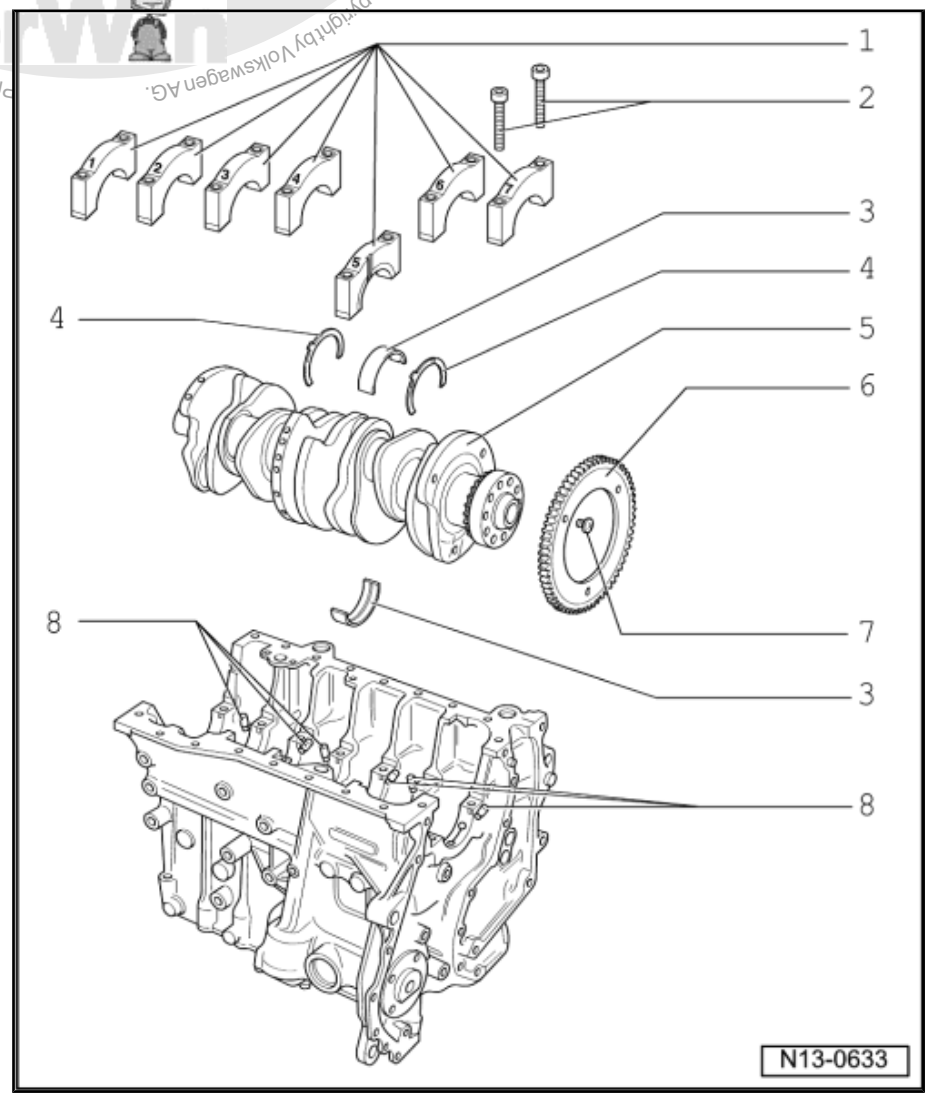
Fitting sender wheel to crankshaft ⇒ page 33 .

Pulling needle bearing out of and driving into crankshaft ⇒ page 33 .

Note

- *Before removing crankshaft, ensure that a suitable surface for storing crankshaft is prepared to ensure that sender wheel is not damaged and is not touching any other item.*
- *When working on engine, secure engine to engine and gearbox support -VAS 6095- or engine and gearbox support -VW 540- with supplementary set for engine and gearbox support -VW 540/1 B- .*

3.1 Assembly overview - crankshaft



1 - Bearing cap

- ❑ Bearing cap 1: vibration damper end
- ❑ Bearing cap 5 with recesses for thrust washers.
- ❑ Bearing shell retaining lugs in cylinder block and bearing caps must align.

2 - 30 Nm + 1/2 turn (180°) further

- ❑ Renew.
- ❑ 2 x 90° further is permitted.

3 - Bearing shells 1...7

- ❑ For bearing cap without oil groove.
- ❑ For cylinder block with oil groove.
- ❑ Do not interchange used bearing shells (mark).

4 - Thrust washer

- ❑ For bearing cap 5.
- ❑ Note fixing arrangement.

5 - Crankshaft

- ❑ If the crankshaft is renewed, the bearing shells must be reallocated ⇒ page 31
- ❑ Before removing, see notes ⇒ page 30 .
- ❑ Removing and installing needle bearing ⇒ page 33

- ❑ Axial clearance

  New: 0.07…0.23 mm

  Wear limit: 0.30 mm.
- ❑ Checking radial clearance with Plastigage:

  New: 0.02…0.06 mm

  Wear limit: 0.10 mm.
- ❑ Do not rotate crankshaft when checking radial clearance.
- ❑ Crankshaft dimensions:

  Main bearing: 59.958…59.978 mm

  Conrod bearing: 53.958…53.978 mm
- ❑ Reworking is not permitted

6 - Sender wheel

- ❑ For engine speed sender -G28- .
- ❑ Renew.
- ❑ Installing ⇒ page 33 .

7 - 10 Nm + 1/4 turn (90°) further

- ❑ Renew.

8 - Oil spray jet

- ❑ For crankshaft bearings 2…7
- ❑ For piston cooling.
- ❑ Opening pressure: 2.0 bar
- ❑ Removing and installing ⇒ page 91 .
- ❑ See note ⇒ page 14 .

3.2 Allocation of crankshaft bearing shells (classification)

Main bearing shells of the correct thickness are allocated to the cylinder block and crankshaft at the factory. Coloured dots are used to identify the thickness of the bearing shells.

If the cylinder block or crankshaft is renewed, the bearing shells must be reallocated.

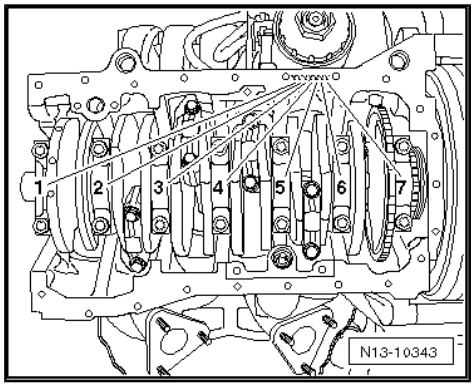
Always insert bearing shell for cylinder block (upper bearing shell) with yellow colour marking.

Determine the correct colour marking for the bearing shell in bearing cap (lower bearing shell) with regard to the letters on the cylinder block and crankshaft.

The first letter is allocated to bearing cap one, the second to bearing cap two, etc.

Cylinder block identification:

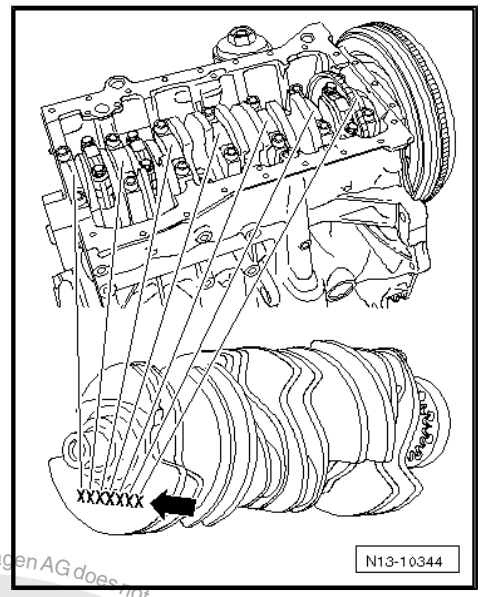
The letters are located on the sealing surface of sump.



Crankshaft identification:

The letters are located on the outer crankshaft web of No. 1 cylinder.

– Make a note of the letters and determine the colour marking for installation with regard to the table.



Letter on cylinder block	Letter on crankshaft web	Colour marking of bearing shell for bearing cap	Colour marking of bearing shell for cylinder block
A, B, C, D, E	R	red	yellow
A, B, C, D, E	G	red	yellow
A, B, C, D, E	B	yellow	yellow
A, B, C, D, E	V	blue	yellow
G, H, I	R	red	yellow
G, H, I	G	red	yellow
G, H, I	B	yellow	yellow
G, H, I	V	blue	yellow
K, L, M	R	red	yellow
K, L, M	G	yellow	yellow
K, L, M	B	blue	yellow
K, L, M	V	Purple	yellow

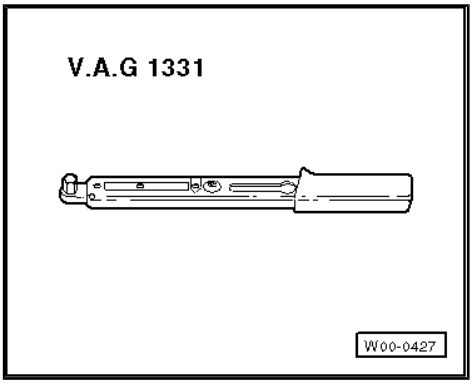
Example:

Bearing cap	1	2	3	4	5	6	7
Letters on cylinder block	G	H	H	H	G	E	G
Letters on crankshaft web	G	B	B	V	B	B	G
Colour marking of bearing shell for bearing cap	red	yellow	yellow	blue	yellow	yellow	red

3.3 Fitting sender wheel to crankshaft

Special tools and workshop equipment required

- Torque wrench -V.A.G 1331-



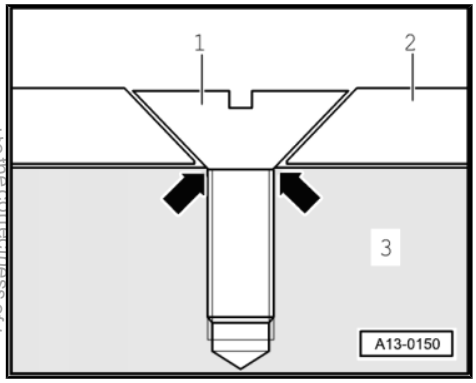
- Locking fluid -D 154 100 A1-

Procedure

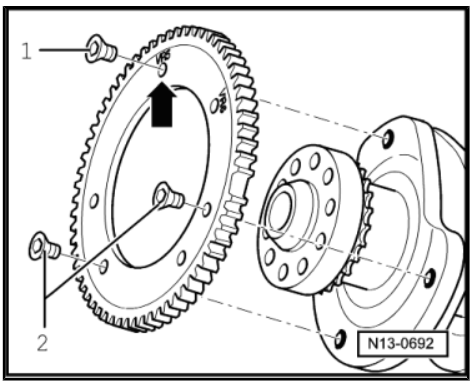
Ensure that contact surfaces of crankshaft and sender wheel are free of oil and grease.

Note

The sender wheel must only be installed once, because after fastening for a second time, the attachment points -arrows- of countersunk head bolts -1- in sender wheel -2- are deformed to such an extent that the bolt heads make contact with the crankshaft -3- and the sender wheel below the bolts is loose.



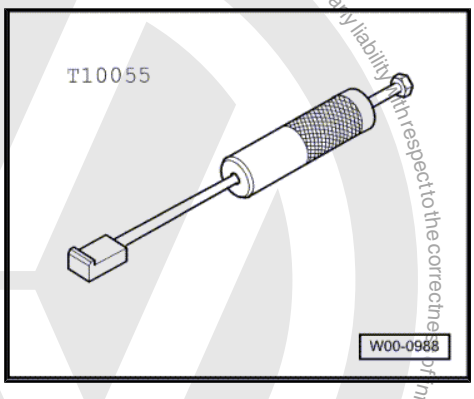
– Lightly coat contact surfaces of crankshaft and sender wheel with locking fluid -D 154 100 A1- for additional security.
– Ensure during installation that marking “VR6” -arrow- is positioned over single threaded hole.
– First tighten all new securing bolts lightly by hand.
– First tighten securing bolt -1- to 10 Nm + 90° ($^1/_4$ turn) further.
– Then tighten securing bolts -2- to 10 Nm + 90° (1/4 turn) further.



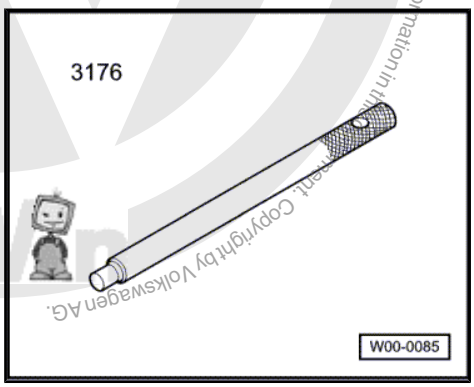
3.4 Pulling needle bearing out of and driving into crankshaft

Special tools and workshop equipment required

- Puller -T10055- with adapter -T10055/3-



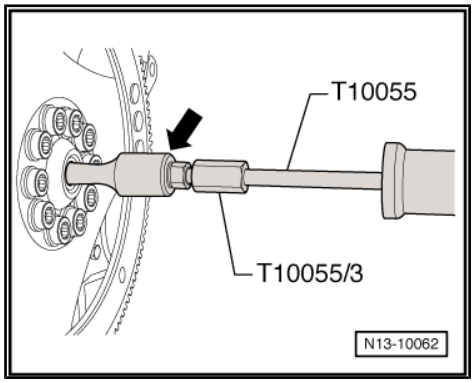
- Centring drift -3176- or drift -VW 207 C-



- Puller, e.g. Kukko -21/2-

Removing

– Pull out using commercially available puller, e.g. Kukko -21/2- -arrow-, adapter -T10055/3- and puller -T10055- .

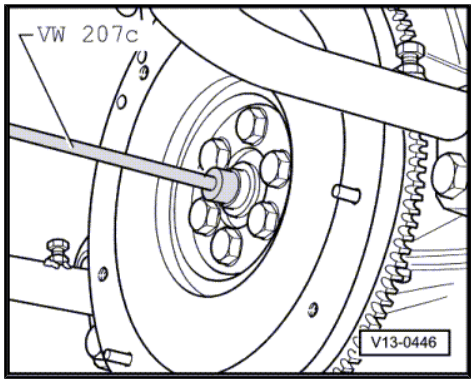


Installing

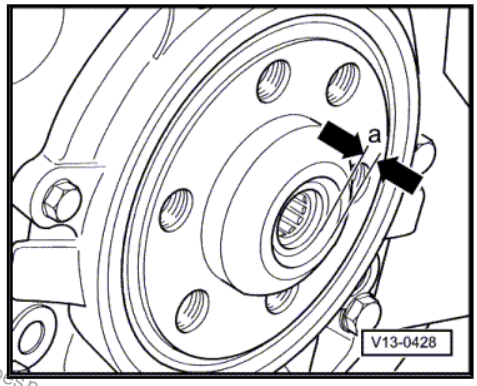
Note

The lettering on the needle bearing must be visible when installed.

– Drive in with drift -VW 207 C- or centring mandrel -3176- .



Installation depth: dimension -a- = 1.5 mm.



4 Pistons and conrods

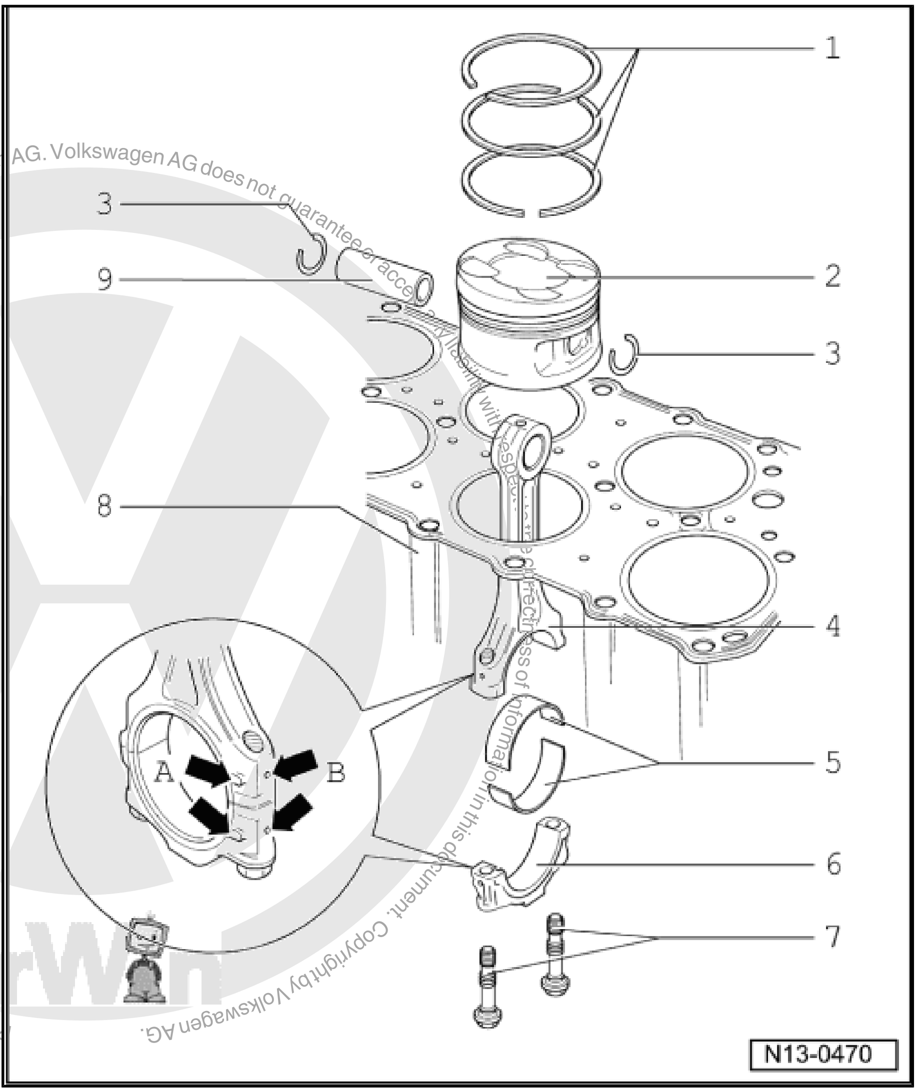
Assembly overview - pistons and conrods ⇒ page 36 .

Checking pistons, piston rings and cylinder bores ⇒ page 38 .

Installing piston ⇒ page 39 .

Piston and cylinder dimensions ⇒ page 40 .

4.1 Assembly overview - pistons and conrods



1 - Piston rings

- ❑ Offset gaps by 120°.
- ❑ Use piston ring pliers to remove and install.
- ❑ "TOP" faces towards piston crown
- ❑ Checking ring gap ⇒ page 38 .
- ❑ Checking ring-to-groove clearance ⇒ page 38 .

2 - Piston

- ❑ Checking ⇒ page 38 .
- ❑ Mark cylinder number and installation position relative to conrod.
- ❑ Low point of piston crown faces to centre of cylinder block.
- ❑ Installing piston ⇒ page 39 .

3 - Circlip

4 - Conrod

- ❑ Renew as set only.
- ❑ Mark cylinder number -B-.
- ❑ Installation position: marks -A- must be above one another.

5 - Bearing shell

- ❑ Note installation position.
- ❑ Do not interchange used bearing shells.
- ❑ The lugs on bearing shells must fit tightly in the recesses.
- ❑ Axial clearance:

  New: 0.05…0.31 mm

  Wear limit: 0.40 mm.
- ❑ Checking radial clearance with Plastigage:

  New: 0.02…0.07 mm

  Wear limit: 0.10 mm.
- ❑ Do not rotate crankshaft when checking radial clearance

6 - Conrod bearing cap

- ❑ Mark cylinder number -B-.
- ❑ Installation position: marks -A- must be above one another.

7 - 30 Nm + 1/4 turn (90°) further

- ❑ Renew.
- ❑ Oil threads and contact surface.
- ❑ To measure radial clearance, tighten to 30 Nm but not turn further.

8 - Cylinder block

- ❑ Checking cylinder bores ⇒ page 39.
- ❑ Removing and installing crankshaft ⇒ page 30 .
- ❑ Piston and cylinder dimensions ⇒ page 40 .

9 - Piston pin

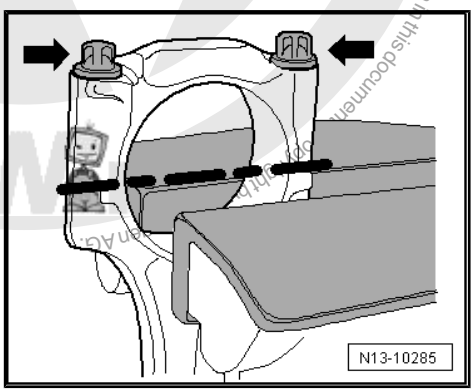
- ❑ If difficult to remove, heat piston to 60 °C.
- ❑ Remove and install using drift -VW 222 A- .

4.1.1 Separating new conrod

On a new conrod, it is possible that the breaking point has not fully separated. Proceed as follows, when the conrod bearing cap cannot be removed by hand:

– Mark cylinder allocation of conrod ⇒ Item 4 (page 36)

– Lightly clamp the conrod in a vice using aluminium vice clamps, as shown in the illustration.

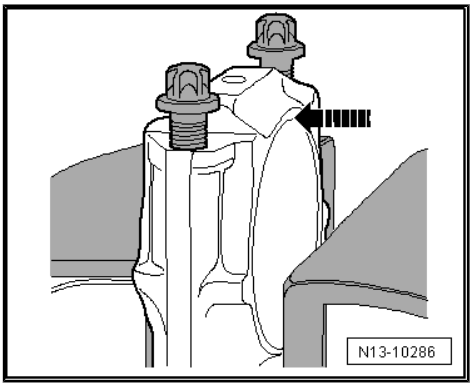


Note

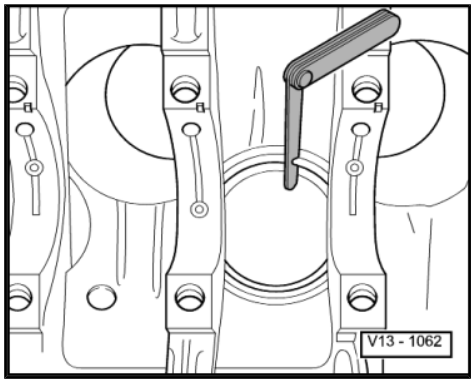
- ♦ *To prevent damage to the conrod, only clamp conrod in lightly.*
- ♦ *Conrod is clamped below the dashed line.*

– Unscrew the two bolts -arrows- approx. 5 turns.

– Using a plastic hammer, carefully knock against conrod bearing cap in -direction of arrow- until it is loose.



4.2 Checking pistons, piston rings and cylinder bores



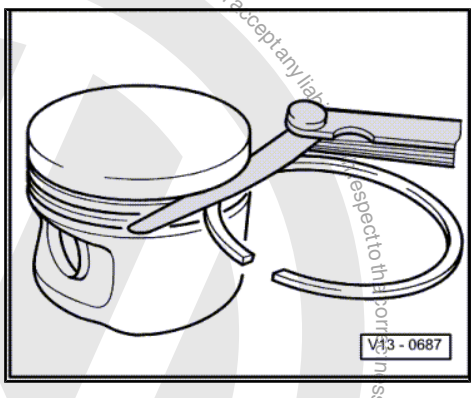
Checking piston ring gap

Special tools and workshop equipment required

- Feeler gauges

Test procedure

– Push ring at right angles from above down to approx. 15 mm from bottom end of cylinder. Push in using a piston without rings.



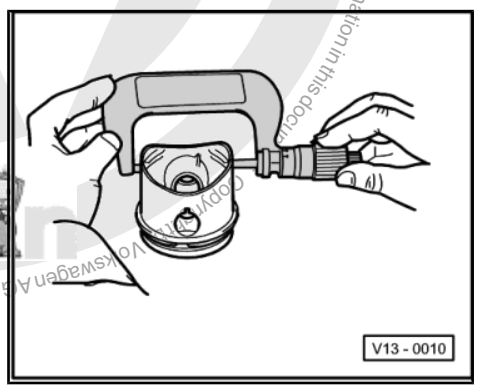
Piston ring		Ring gap	
		New	Wear limit
Rectangular-section ring	mm	0.20 … 0.40	1.0
Tapered stepped ring	mm	0.20 … 0.40	1.0
Oil scraper ring	mm	0.25 … 0.50	1.0

Checking ring-to-groove clearance

Special tools and workshop equipment required

- Feeler gauges

– Clean annular groove before check.



Piston ring		Clearance	
		New	Wear limit
Rectangular-section ring	mm	0.04 … 0.09	0.15
Tapered stepped ring	mm	0.03 … 0.06	0.15
Oil scraper ring	mm	0.02 … 0.06	0.15

Checking piston

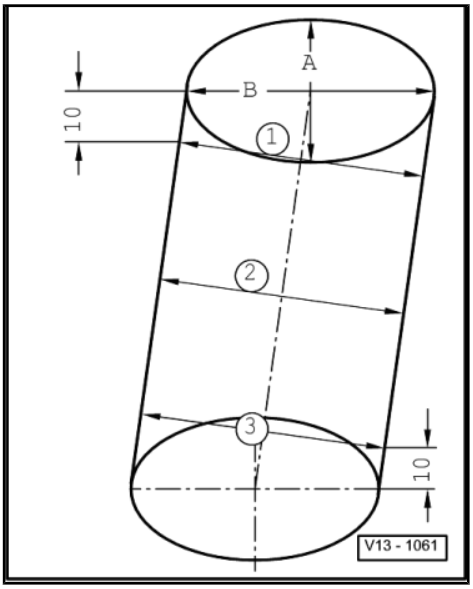
Special tools and workshop equipment required

- External micrometer 75…100 mm

– Measure pistons approx. 6 mm from the lower edge of skirt, at 90° to the piston pin axis.

- Deviations from nominal dimension: 0.04 mm

Checking cylinder bores



Special tools and workshop equipment required

- Internal dial test indicator 50…100 mm

Test procedure

– Take measurements at 3 positions in both lateral direction -A- and longitudinal direction -B-.

- Deviations from nominal dimension: 0.08 mm

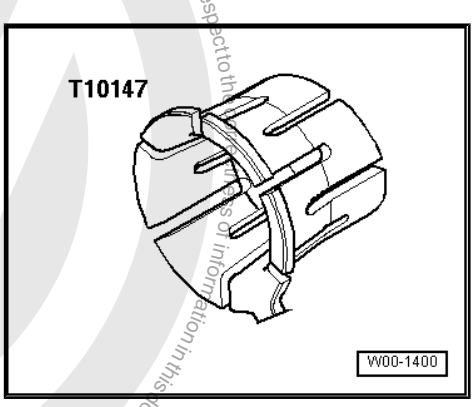
Note

Cylinder bores must not be measured when the cylinder block is mounted on engine and gearbox support -VAS 6095- or engine and gearbox support -VW 540- , as measurements may be incorrect.

4.3 Installing piston

Special tools and workshop equipment required

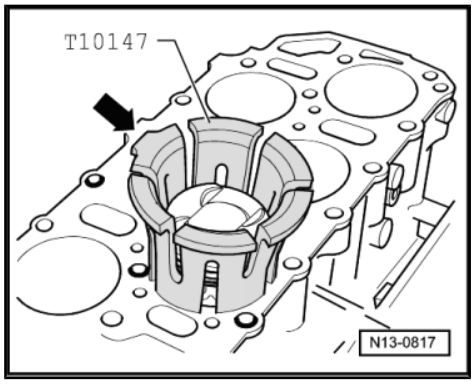
- Piston fitting tool -T10147-



Note

If a new piston fitting tool -T10147- is used to install the pistons, first pass piston with oiled piston rings twice through the tool and then remove any resulting metal shavings. Only then install piston with piston rings.

Procedure



– Push piston into oiled piston fitting tool -T10147- by hand. Low point of piston crown must face lug on the piston fitting tool -arrow-.
– Hold tool (with piston inserted) on upper edge and press piston in with both thumbs.
– Push piston in until it protrudes by approx. 15 mm from the lower edge of the piston fitting tool.
– Place piston in respective cylinder bore. Lug on piston fitting tool -arrow- must face centre of cylinder block.
– Hold fitting tool tightly against cylinder block and push piston in.

4.4 Piston and cylinder dimensions

Honing dimension		Piston ∅	Cylinder bore ∅
Basic dimension	mm	83.965	84.010

15 – Cylinder head, valve gear

1 Cylinder head

Note

- *If an exchange cylinder head is installed, all the contact surfaces between the supporting elements, roller rocker fingers and the running surfaces of the camshafts must be oiled before the cylinder head cover is installed.*
- *The plastic protectors fitted to protect the open valves must be removed only immediately before the cylinder head is fitted.*
- *When cylinder head is renewed, the complete coolant must be renewed ⇒ page 110 .*
- *Removing and installing intake manifold ⇒ page 67 .*
- *Dismantling and assembling intake manifold ⇒ page 167 .*

Assembly overview - cylinder head ⇒ page 42 .

Removing and installing cylinder head ⇒ page 44 .

Assembly overview - cover ⇒ page 53 .

Checking valve timing ⇒ page 54 .

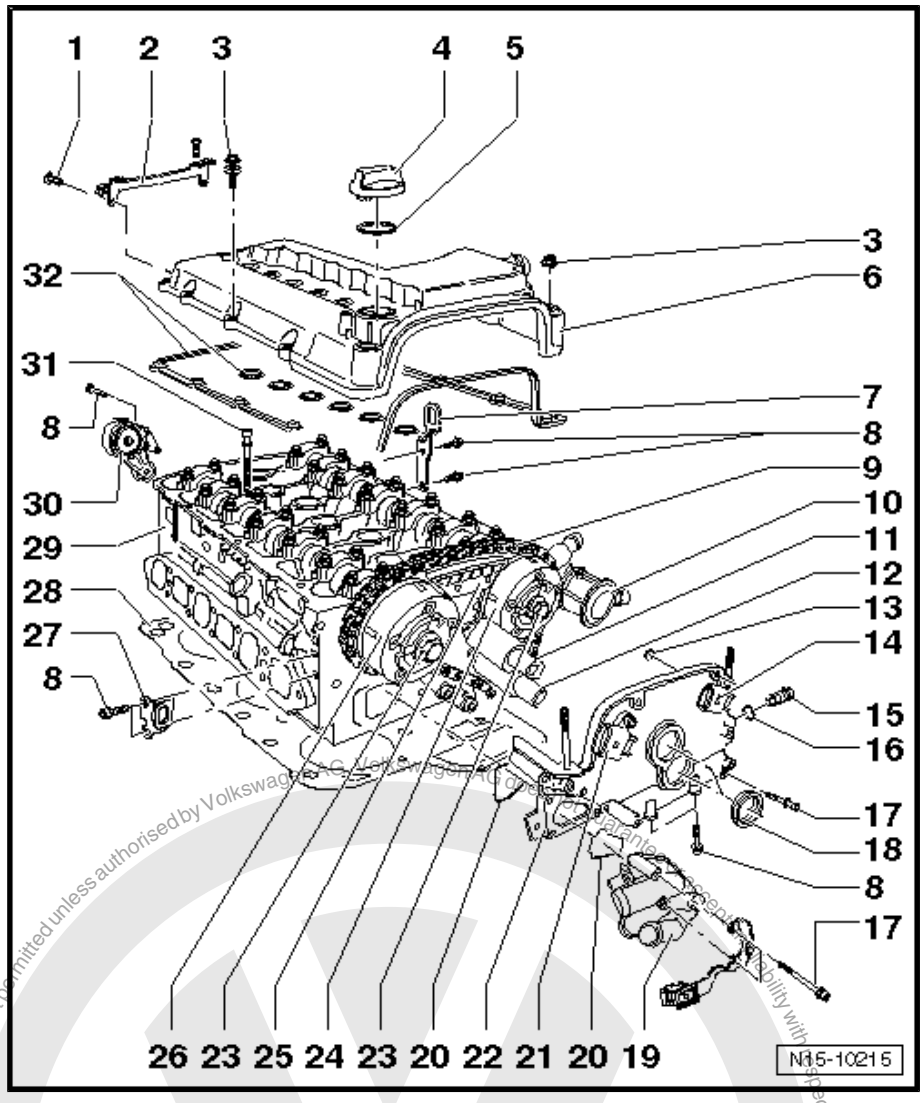
Installing camshaft adjuster with timing chain for camshaft drive ⇒ page 62 .

Installing timing chain for intermediate shaft drive and camshaft drive ⇒ page 62 .

Removing and installing cylinder head cover ⇒ page 67 .

Checking compression ⇒ page 69 .

1.1 Assembly overview - cylinder head



1 - 10 Nm

2 - Bracket

- ❑ For fuel lines

3 - 10 Nm

- ❑ With spacer sleeve and seal.
- ❑ Renew seal if damaged.

4 - Cap

- ❑ Renew seal if damaged.

5 - O-ring

- ❑ Renew if damaged.
- ❑ Oil before installing.
- ❑ For ignition coil with output stage.

6 - Cylinder head cover

- ❑ Removing and installing ⇒ page 67 .
- ❑ Renew if damaged.

7 - Lifting eye

8 - 23 Nm

9 - Timing chain for camshaft drive

- ❑ Before removing, mark direction of rotation (installation position) ⇒ page 18 .
- ❑ Installing ⇒ page 62 .

10 - Combination valve

- ❑ Checking ⇒ page 205 .
- ❑ Removing and installing ⇒ page 205 .

11 - Inlet camshaft control valve 1 -N205-

- ❑ For inlet camshaft.
- ❑ Removing and installing ⇒ page 80 .
- ❑ Before removing, mark connector belonging to component.

12 - Exhaust camshaft control valve 1 -N318-

- ❑ For exhaust camshaft.
- ❑ Removing and installing ⇒ page 80 .
- ❑ Before removing, mark connector belonging to component.

13 - O-ring

- ❑ For sealing oil channel.
- ❑ Renew.
- ❑ Oil before installing.

14 - Hall sender 2 -G163-

- ❑ For exhaust camshaft.
- ❑ Before removing, mark connector belonging to component.

15 - Chain tensioner, 50 ± 2 Nm

- ❑ For camshaft timing chain ⇒ Item 9 (page 42)
- ❑ Only rotate engine when chain tensioner is installed.

16 - Seal

- ❑ Renew if damaged or leaking.

17 - 8 Nm

18 - Oil seals

- ❑ For inlet camshaft control valve 1 -N205- ⇒ Item 11 (page 42) and exhaust camshaft control valve 1 -N318- ⇒ Item 12 (page 42)
- ❑ Renew if damaged or leaking.
- ❑ Installing ⇒ page 54 .

19 - Thermostat housing

- ❑ Dismantling and assembling ⇒ page 107 .
- ❑ Coolant hose schematic diagram ⇒ page 109 .

20 - Seal

- ❑ Renew.

21 - Hall sender -G40-

- ❑ For inlet camshaft.
- ❑ Before removing, mark connector belonging to component.

22 - Cover

- ❑ Can be removed and installed with engine installed.
- ❑ Removing and installing ⇒ page 53 .
- ❑ If only cover has been removed, prepare cylinder head gasket for assembly ⇒ page 51 .
- ❑ With O-ring for sealing oil channel ⇒ Item 13 (page 42)

23 - 60 Nm + 1/4 turn (90°) further

- ❑ Renew.
- ❑ Contact surface of sender wheel must be dry around bolt head when installed.
- ❑ To remove and install, counterhold with 32 mm open-end spanner on camshaft ⇒ page 73 .

24 - Exhaust camshaft adjuster

- ❑ Identification: 32A.
- ❑ Rotate engine only with camshaft adjuster installed.
- ❑ Installing ⇒ page 62 .

25 - Guide rail

- ❑ For camshaft timing chain ⇒ Item 9 (page 42)
- ❑ Clipped into valve timing housing.

26 - Inlet camshaft adjuster

- ❑ Identification: 24E
- ❑ Rotate engine only with camshaft adjuster installed.
- ❑ Installing ⇒ page 62 .

27 - Lifting eye

28 - Cylinder head gasket

- ❑ Metal gasket.
- ❑ Renew.
- ❑ Preparing cylinder head gasket for assembly ⇒ page 51 .
- ❑ After renewing, renew entire coolant.

29 - Cylinder head

- ❑ Check for distortion ⇒ page 44 .

- ❑ Removing and installing ⇒ page 44 .
- ❑ After renewing, renew entire coolant.

30 - Tensioning element

- ❑ For poly V-belt
- ❑ Removing and installing poly V-belt ⇒ page 20 .

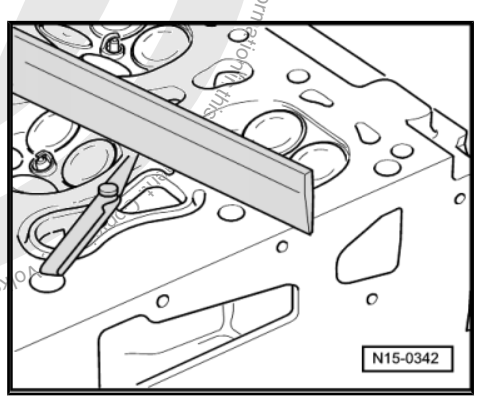
31 - Cylinder head bolt

- ❑ Renew.
- ❑ Follow installation instructions and sequence when loosening and tightening ⇒ page 44 .

32 - Gasket for cylinder head cover

- ❑ Renew if damaged or leaking.
- ❑ Note installation position.

Checking cylinder head for distortion



Special tools and workshop equipment required

- ♦ Straightedge 500 mm -VAS 6075-
- ♦ Feeler gauges

Max. permissible distortion: 0.05 mm.

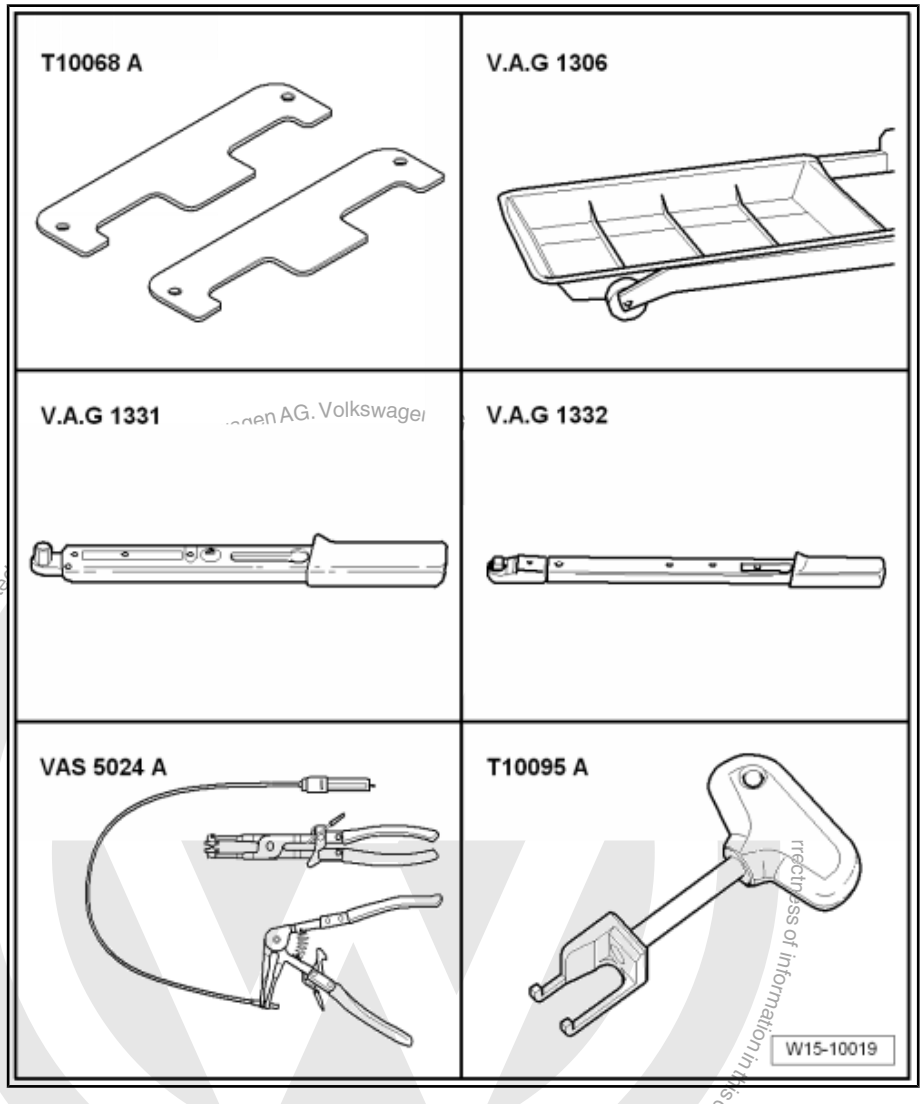
1.2 Removing and installing cylinder head

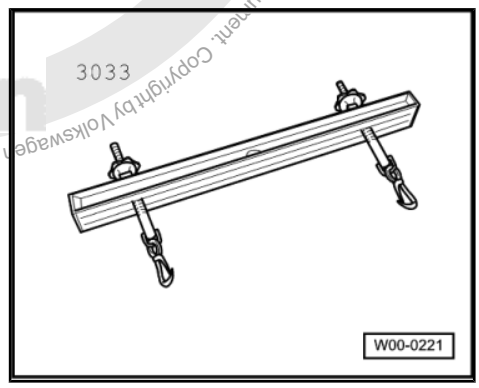
Removing ⇒ page 46 .

Installing ⇒ page 50 .

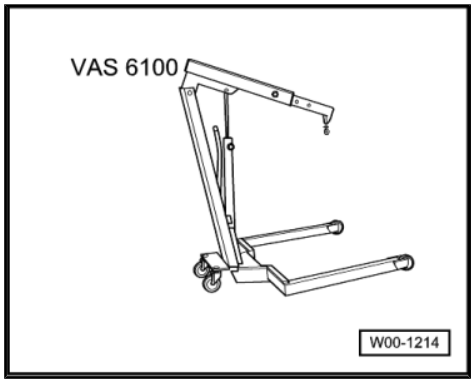
Special tools and workshop equipment required

- Camshaft bar -T10068 A-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench - V.A.G 1331-
- Torque wrench - V.A.G 1332-
- Spring-type clip pliers -VAS 5024A-
- Puller -T10095 A-





- Lifting tackle -3033-
- Workshop crane -VAS 6100-
- Sealant -D 176 501 A1-



Prerequisites

The engine must be no more than warm to touch.

1.2.1 Removing

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 and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***To avoid damage to lines/wiring, ensure sufficient clearance to all moving or hot components.***

All cable ties which are opened or cut open when engine is removed must be replaced in the same position when engine is installed.

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

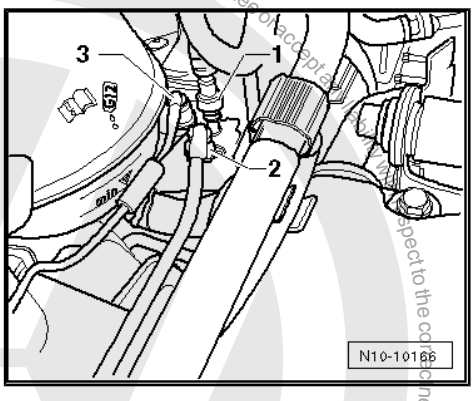
Disconnect earth strap at battery with ignition switched off ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and reconnecting battery .

– Remove air filter with intake hose ⇒ page 174 .
– Remove noise insulation ⇒ General body repairs, exterior; Rep. Gr. 50 ; Noise insulation .
– Remove front bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 ; Front bumper .
– Move lock carrier into its service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier, service position .

WARNING

Fuel supply lines are under pressure! Wear eye protection and gloves 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.

– Separate fuel supply line -1- and catch escaping fuel with a cloth.



Note

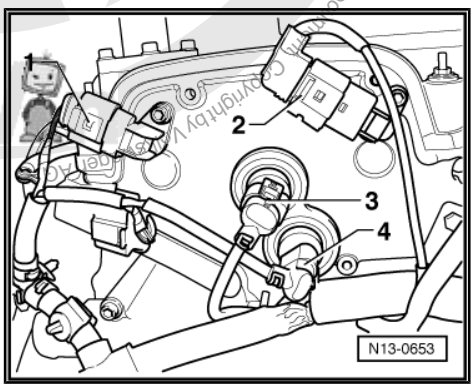
Press in securing ring to release fuel line.

– Seal lines so that fuel system is not contaminated by dirt.
– Unclip fuel line on cylinder head cover.
– Remove intake manifold ⇒ page 170 .
– Unscrew heat shield over exhaust manifold.

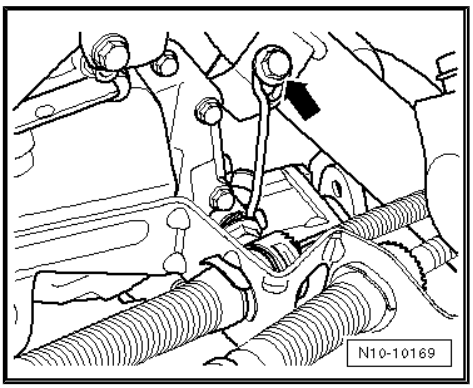
Note

Before removing connectors, mark each connector and component to which it belongs.

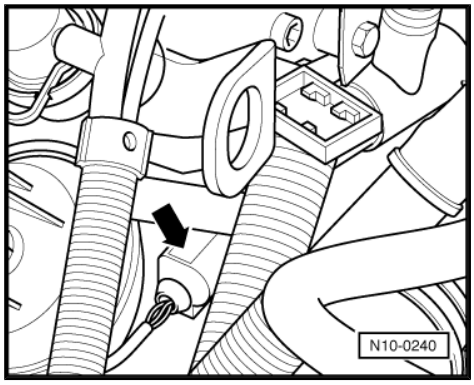
– Pull connectors off Hall sender -G40- -1- and Hall sender 2 -G163- -2-.
– Pull off connectors -3- and -4-.



– If fitted, unscrew support from front exhaust pipe -arrow-.
– Unbolt front exhaust pipe from exhaust manifolds ⇒ page 191 .

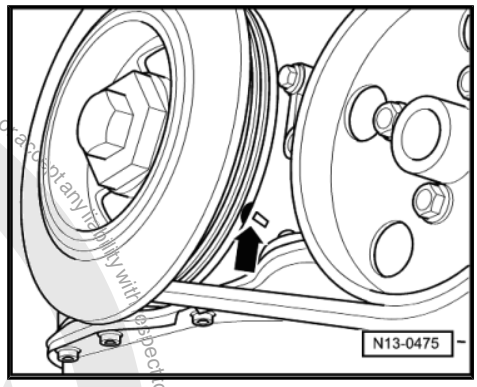


– Pull 2 pin connector off coolant temperature sender -G62- -arrow-.

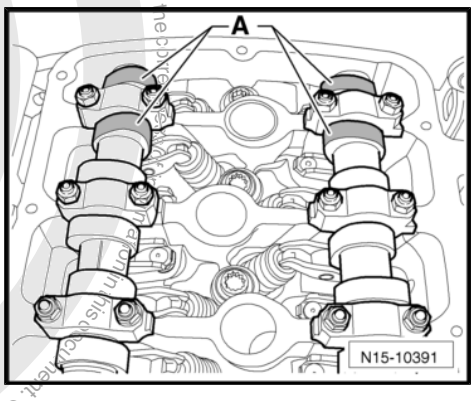


– Drain coolant ⇒ page 110 .
– Remove thermostat housing ⇒ page 107 .
– Unbolt combination valve from cylinder head.
– Remove the coolant hose underneath from cylinder head to heat exchanger.
– Unscrew coolant pipes from intake pipe support and from cylinder head and, on vehicles with an auxiliary heater, auxiliary heater coolant pipes on cylinder block.
– Separate mounting on cylinder head for engine wiring harness and pressure hose for combi-valve.
– Remove cylinder head cover ⇒ page 67 .

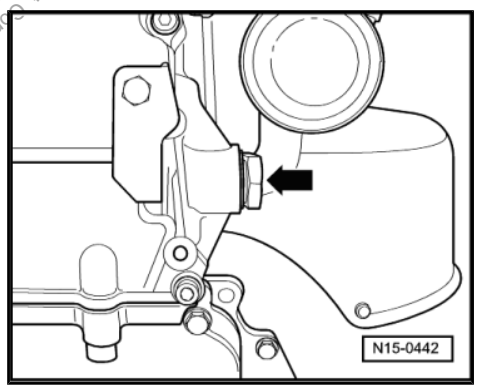
– Set crankshaft to TDC No. 1 cylinder marking -arrow- by turning crankshaft on the vibration damper securing bolt in direction of engine rotation.



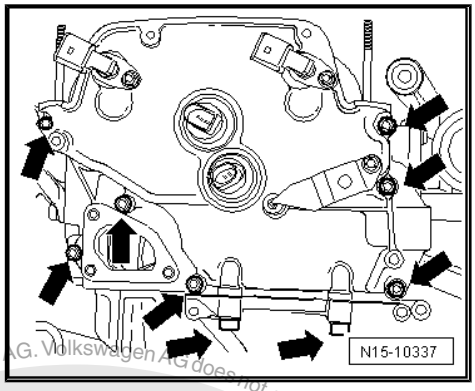
Cams -A- of cylinder 1 must face each other.



– Remove chain tensioner for camshaft timing chain -arrow-.



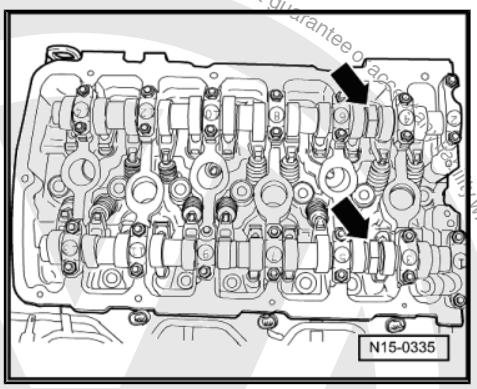
– Remove securing bolts -arrows- for cover. Remove cover.



Note

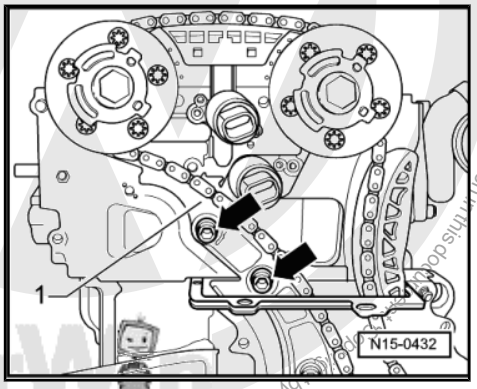
Only counterhold at camshaft with 32 mm open-end spanner -arrow-. The camshaft bar -T10068 A- must not be fitted when camshaft adjuster is loosened or tightened.

– Now remove camshaft adjuster.

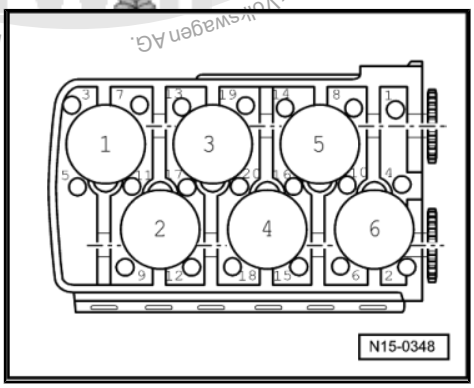


– Remove guide rail securing bolts -arrows- and remove guide rail -1-.

– Lay camshaft timing chain aside.

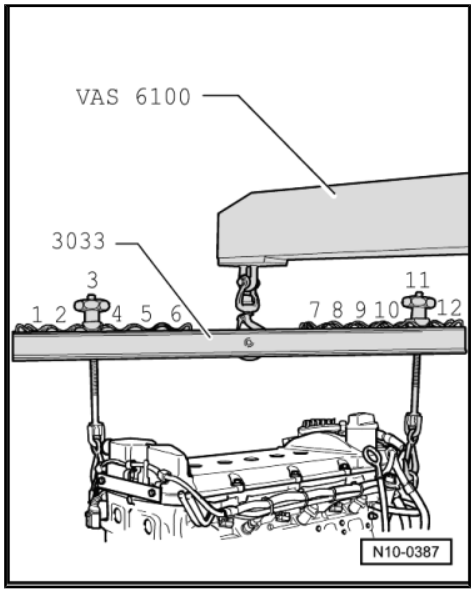


– Loosen cylinder head bolts in the sequence given starting at the outside and working inwards and then remove completely.



– Attach lifting tackle -3033- as described below and carefully lift off cylinder head with workshop crane -VAS 6100- .

  Vibration damper end: -position 3-
  Flywheel end: -position 11-.



Note

- *The positions marked 1…12 on the bar face the flywheel end.*
- *Adjust length of threaded spindles according to need.*

– Carefully remove cylinder head.

– 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.

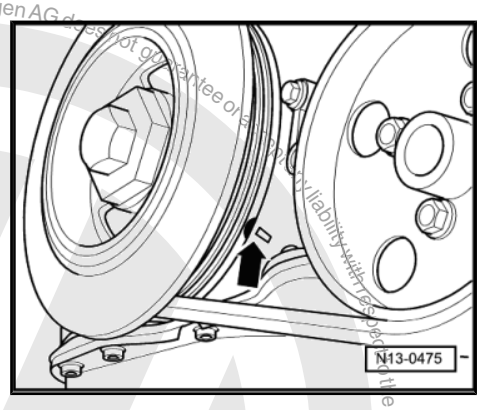
– Now carefully clean sealing surfaces of cylinder head and cylinder block. When doing this, ensure that surfaces are not scored or scratched (if abrasive paper is used, grade must not be less than 100).

1.2.2 Installing

– Carefully remove metal particles, emery residue and cloths.

If the piston for No. 1 cylinder is not at TDC:

– Turn crankshaft on the vibration damper securing bolt in direction of engine rotation to TDC No. 1 cylinder marking -arrow- while a second mechanic guides camshaft timing chain by hand.



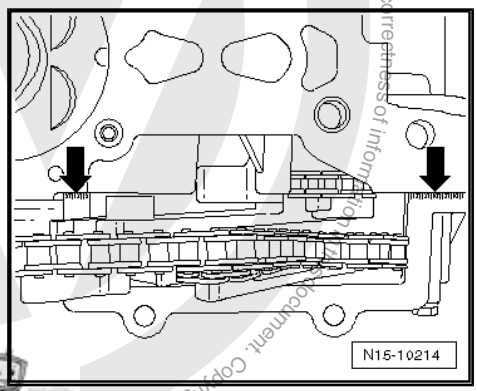
Note

- *Do not remove new cylinder head gasket from its packing until immediately before installing.*
- *Handle new gasket with extreme care. Damage will cause leakage.*

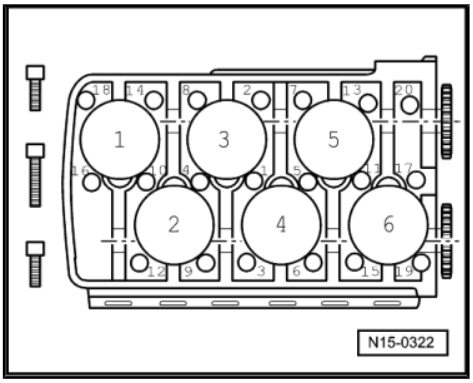
– Apply a 2 mm thick bead of sealant -D 176 501 A1- onto joint between cylinder block and sealing flange as shown -arrows-.

– Immediately fit new cylinder head gasket. Inscription (Part No.) must be readable.

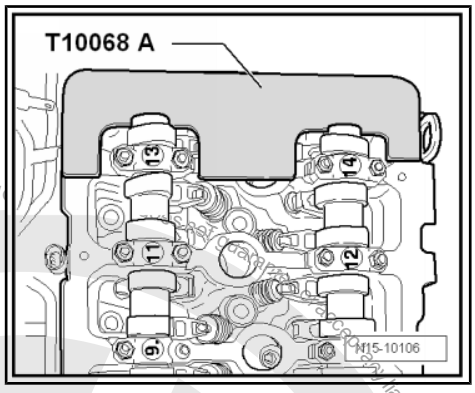
– Additionally insert a little sealant -D 176 501 A1- into the two 3 mm bores in the cylinder head gasket, which lie on the sealant bead.



– Ensure that dowel sleeves are inserted into cylinder block holes 12 and 20, and that cylinder head gasket is located.
– Position camshafts in cylinder head to TDC No. 1 cylinder.



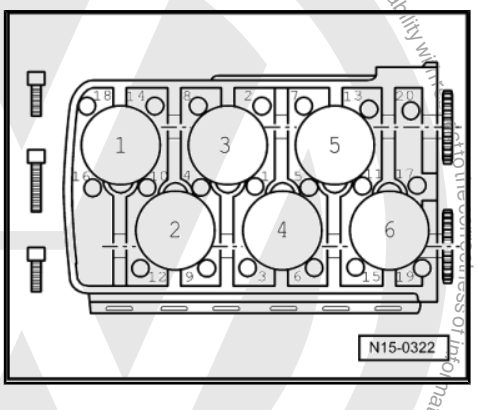
– The camshaft bar -T10068 A- must engage in grooves in both shafts.
– Fit cylinder head, screw in new cylinder head bolts and tighten hand tight.



Note

The longer cylinder head bolts must be inserted in the centre holes of cylinder head.

– Tighten cylinder head bolts in tightening sequence shown working from inside to outside:
– Pre-tighten all bolts to 30 Nm.
– Then tighten all bolts to 50 Nm.
– Then tighten all bolts $^{1}/_{4}$ turn (90°) further using a rigid wrench.
– Then tighten all bolts again $^{1}/_{4}$ turn (90°) further.



Further assembly is basically the reverse of the dismantling sequence.

Note

Ensure that the O-ring for sealing the oil channel and the seal are fitted in the cover.

– Installing camshaft adjuster with timing chain for camshaft drive ⇒ page 57 .
– Install cylinder head cover and intake manifold ⇒ page 67 .
– Fill with new coolant ⇒ page 110 .

Note

It is not necessary to retighten cylinder head bolts after repairs.

1.2.3 Preparing cylinder head gasket for assembly

Special tools and workshop equipment required

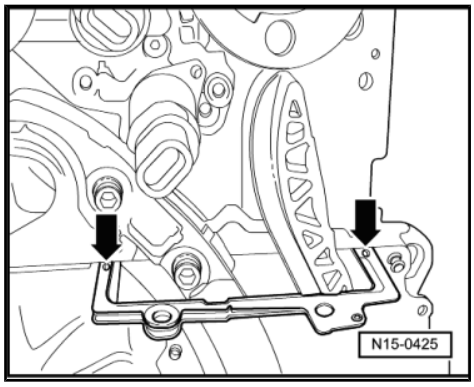
♦ Sealant -D 176 501 A1-

If only cover was removed:

– Remove old sealant from 3 mm holes in cylinder head gasket -arrows-.

– Fill 3 mm holes in the cylinder head gasket with sealant -D 176 501 A1- and coat sealing surfaces on cover with sealant -D 176 501 A1- .

– Install cover immediately.

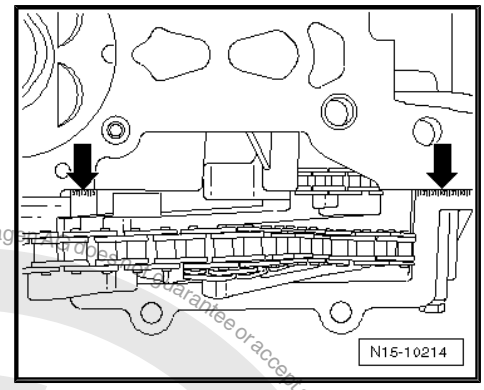


If the cylinder head gasket was renewed

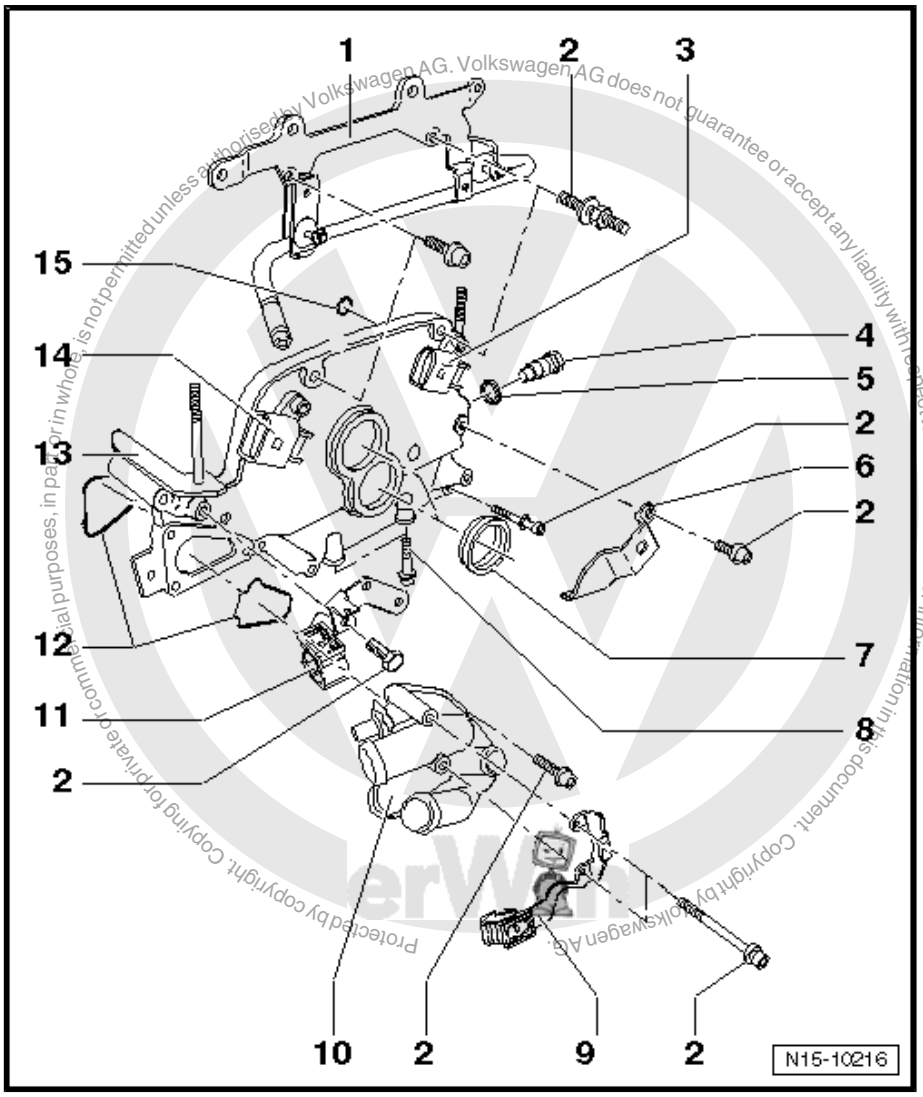
– Apply a 2 mm thick bead of sealant -D 176 501 A1- onto joint between cylinder block and sealing flange as shown -arrows-.

– Immediately fit new cylinder head gasket. Inscription (Part No.) must be readable.

– Additionally insert a little sealant -D 176 501 A1- into the two 3 mm bores in the cylinder head gasket, which lie on the sealant bead.



1.3 Assembly overview - cover



1 - Cable guide

- ❑ For wiring harness.
- ❑ With coolant pipe
- ❑ Coolant hose schematic diagram ⇒ page 109 .

2 - Stud, 8 Nm

- ❑ For earth connection

3 - Hall sender 2 -G163-

- ❑ For exhaust camshaft.
- ❑ Before removing, mark connector belonging to component.

4 - Chain tensioner, 50 ± 2 Nm

- ❑ For timing chain ⇒ Item 9 (page 42)
- ❑ Only rotate engine when chain tensioner is installed.

5 - Seal

- ❑ Renew if damaged or leaking.

6 - Bracket

7 - Oil seals

- ❑ For inlet camshaft control valve 1 -N205- ⇒ Item 11 (page 42) and exhaust camshaft control valve 1 -N318- ⇒ Item 12 (page 42)
- ❑ Renew if damaged or leaking.
- ❑ Installing ⇒ page 54 .

8 - 23 Nm

9 - Bracket

- ❑ For wiring harness.

10 - Thermostat housing

- ❑ Dismantling and assembling ⇒ page 107 .
- ❑ Coolant hose schematic diagram ⇒ page 109 .

11 - Bracket

- ❑ For wiring harness.

12 - Seal

- ❑ Renew.

13 - Cover

- ❑ Coat sealing surfaces with sealant -D 176 501 A1- .
- ❑ Preparing cylinder head gasket for assembly ⇒ page 51 .

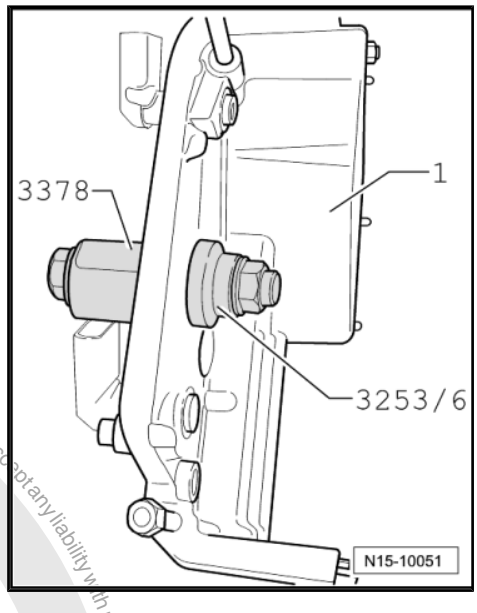
14 - Hall sender -G40-

- ❑ For inlet camshaft.
- ❑ Before removing, mark connector belonging to component.

15 - O-ring

- ❑ For sealing oil channel.
- ❑ Renew.
- ❑ Oil before installing.

Installing cover oil seals



Special tools and workshop equipment required

- ♦ Fitting sleeve -3378-
- ♦ Fitting sleeve -3253/6-

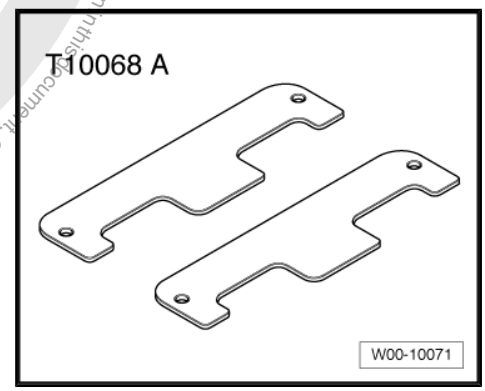
– Do not lubricate seals.

– Install oil seal with fitting sleeve -3378- in cover -1- and pull in flush using fitting sleeve -3253/6- .

1.4 Checking valve timing

Special tools and workshop equipment required

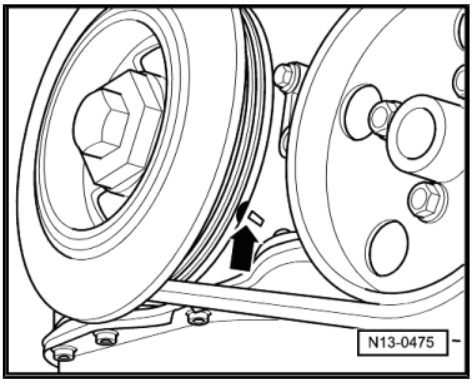
- ♦ Camshaft bar -T10068 A-



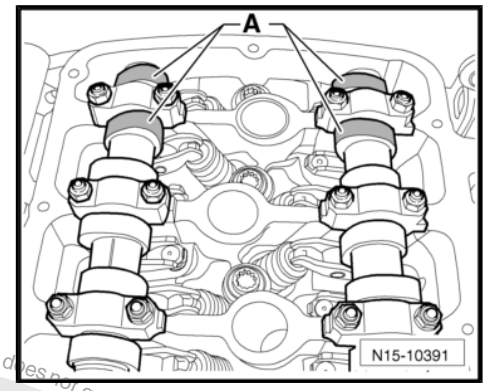
Test procedure

– Remove cylinder head cover and intake manifold ⇒ page 67 .

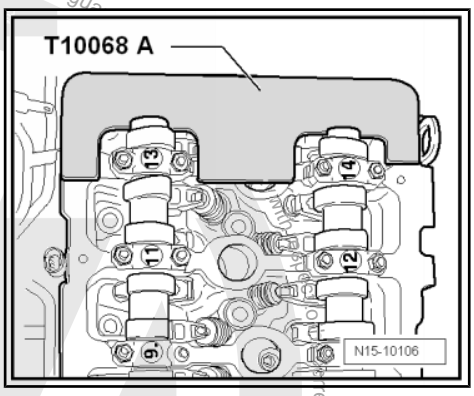
– Set crankshaft to TDC No. 1 cylinder marking -arrow- by turning crankshaft on the vibration damper securing bolt in direction of engine rotation.



– Cams -A- of cylinder 1 must face each other.



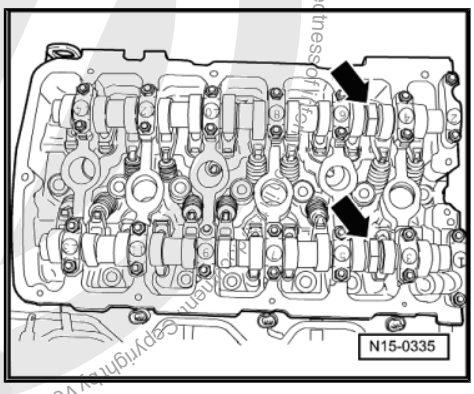
– Insert camshaft bar -T10068 A- in both shaft grooves.



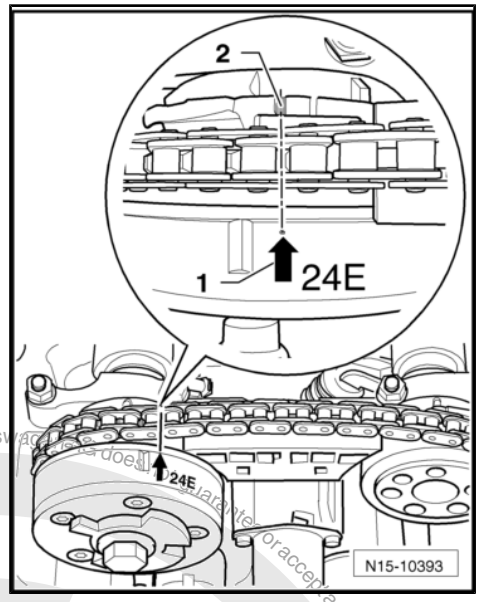
Note

The grooves of the camshafts might not be exactly vertical due to the function of camshaft adjusters. Therefore, move the camshafts back and forth slightly if necessary when inserting the camshaft bar -T10068 A- using an open-end spanner.

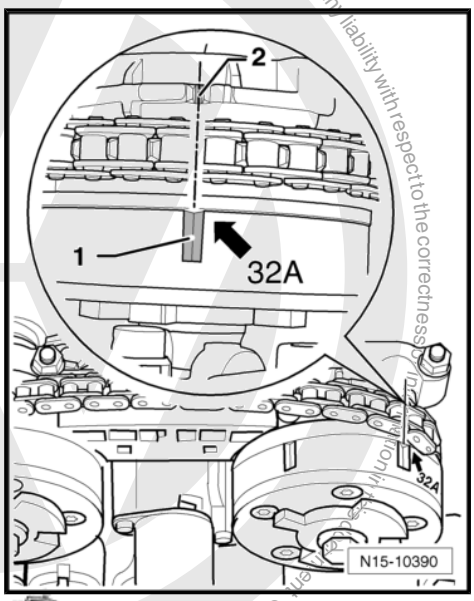
Check setting marks of camshaft adjusters against marks on control housing:



- “Arrow” -1- on the camshaft adjuster of the inlet camshaft must align with the left notch -2- on the control housing. Markings on valve timing housing ⇒ page 57 .



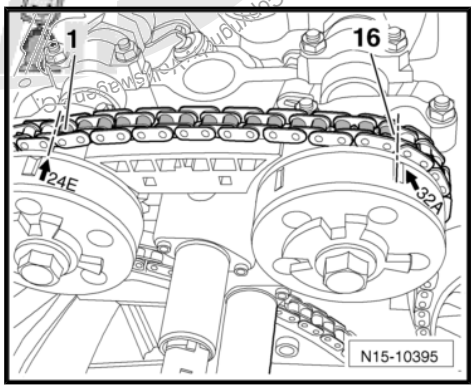
- Marking -1- on the camshaft adjuster of the exhaust camshaft, to which the “arrow” points, must align with the left notch -2- on the control housing. Markings on valve timing housing ⇒ page 57 .



Note

A slight offset between marking -1- and notch -2- is permissible.

– The gap between markings of camshaft adjuster must be exactly 16 rollers of camshaft timing chain.



Note

Figure shows view with cover removed.

If the markings do not align:

– Adjusting valve timing ⇒ page 62 .

If the markings align:

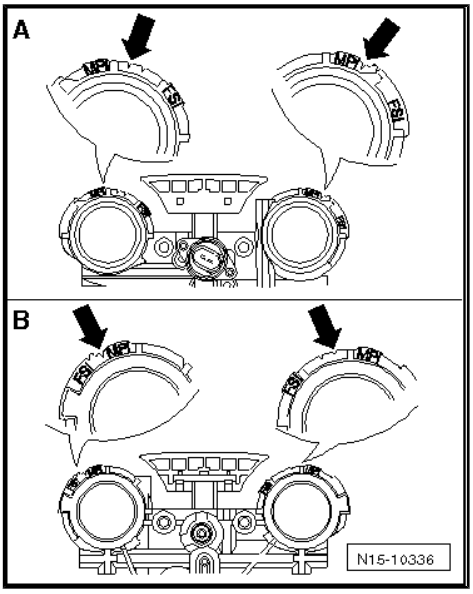
– Install cylinder head cover and intake manifold ⇒ page 67 .

Markings on valve timing housing on MPI engines

-A- View from flywheel end

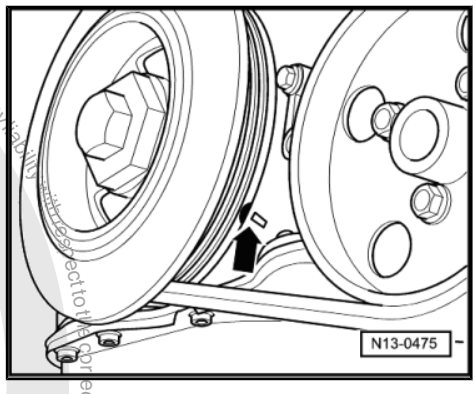
-B- View from vibration damper end

The markings on camshaft adjusters must align with notches -arrows-.

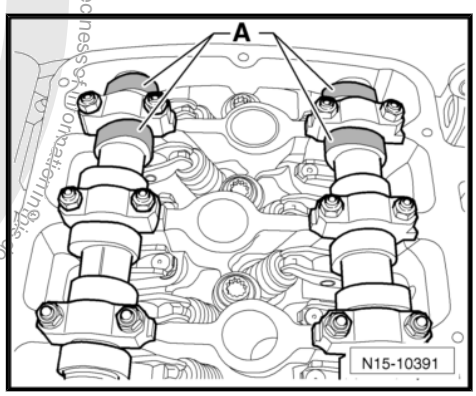


1.5 Installing camshaft adjuster with timing chain for camshaft drive

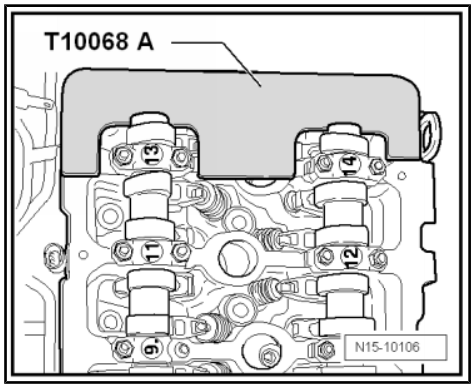
– Set crankshaft to TDC No. 1 cylinder marks -arrow- by turning crankshaft on the vibration damper securing bolt in direction of engine rotation.



– Cams -A- of cylinder 1 must face each other.

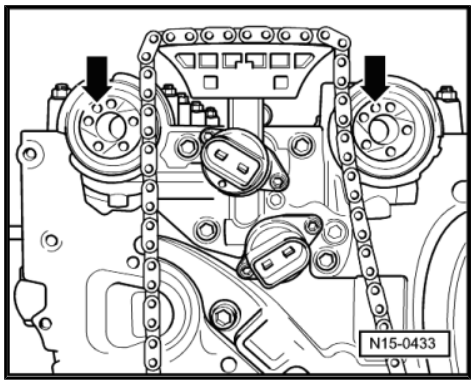


– Insert camshaft bar -T10068 A- in both shaft grooves. If necessary, move the camshafts back and forth slightly with an open-end spanner.

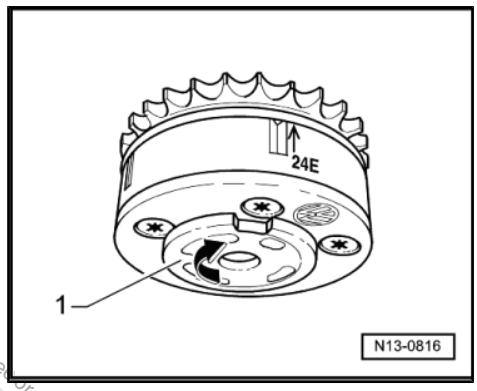


Note

Both camshaft adjusters (marking: "24E" on inlet side and "32A" on exhaust side) can be screwed at camshaft mounting in one position only -arrows- due to a dowel pin.



– Now turn sender wheel -1- on removed inlet camshaft adjuster to right stop in -direction of arrow- and hold adjuster in this position.

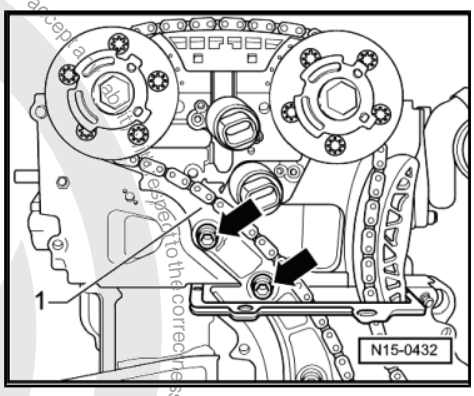


Note

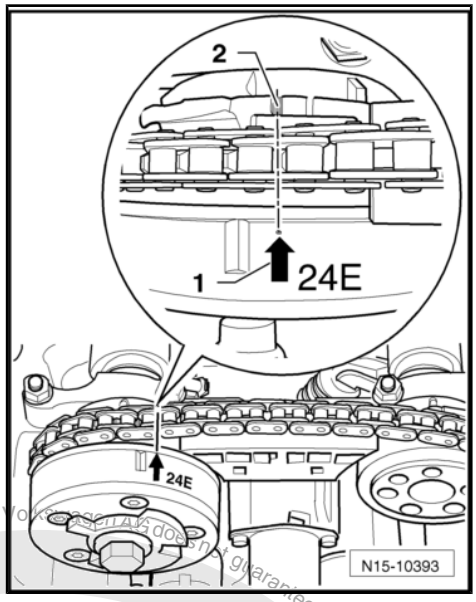
If inlet camshaft adjuster is bolted to the camshaft, turn adjuster with chain sprocket to left accordingly and then fit camshaft timing chain.

– Ensure the camshaft timing chain is "tight" against guide rail -1- and does not "sag".

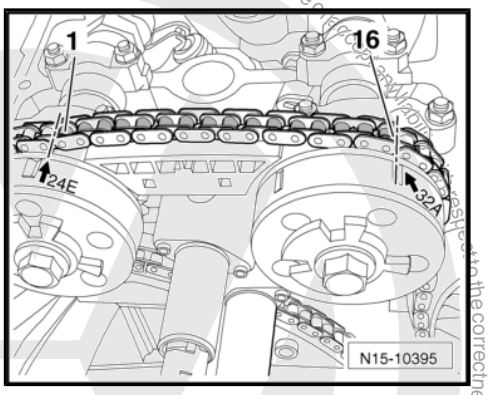
It must be possible to easily position adjuster and tighten it hand-tight with camshaft timing chain positioned "tautly" on inlet camshaft.



- “Arrow” -1- on the camshaft adjuster of the inlet camshaft must align with the left notch -2- on the control housing. Markings on valve timing housing ⇒ page 57 .



– Now, from the tooth that is aligned with the “24E” marking, count exactly 16 rollers on the timing chain to the right. Mark this roller with a coloured pen.

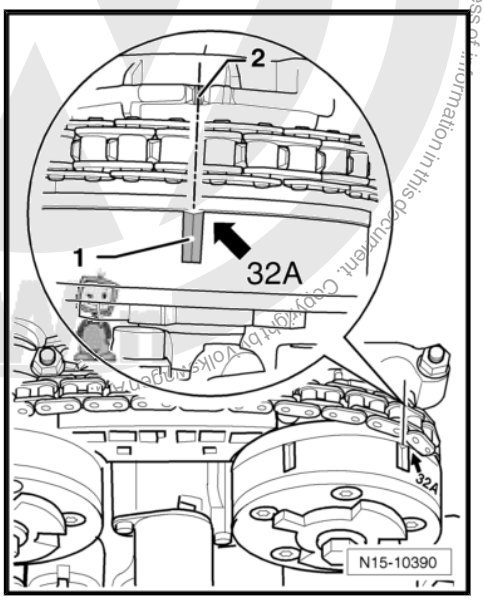


Note

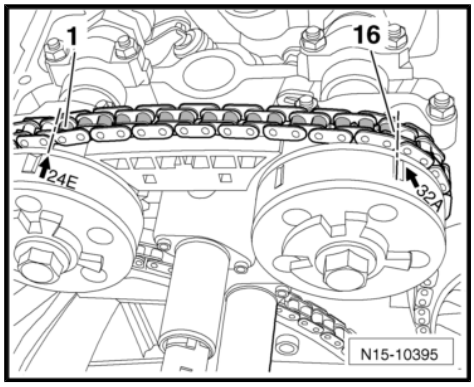
The exhaust camshaft adjuster is locked when “at rest”. This prevents the sender wheel from turning when adjusting the valve timing. If the locking mechanism is not engaged (locked) when “at rest”, turn the adjuster in both directions by hand until it is locked. If this is not possible, renew camshaft adjuster.

– Insert exhaust camshaft adjuster “32A” into camshaft timing chain with tooth on marking -1- so that the previously counted 16 rollers lie precisely between marking “24E” and “32A”, and markings -1- and -2- align.

– It must be possible to easily position the exhaust camshaft adjuster onto the exhaust camshaft and tighten it hand-tight.



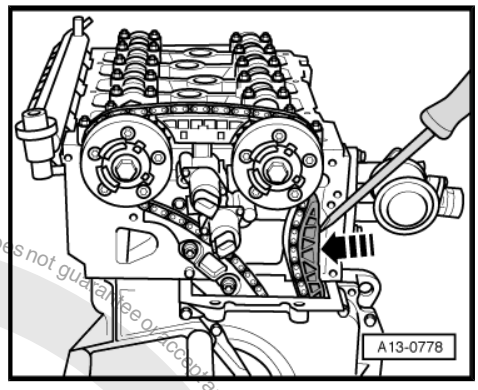
– Check the position of both camshaft adjusters again to ensure the setting is correct.
– Remove camshaft bar -T10068 A- .



Note

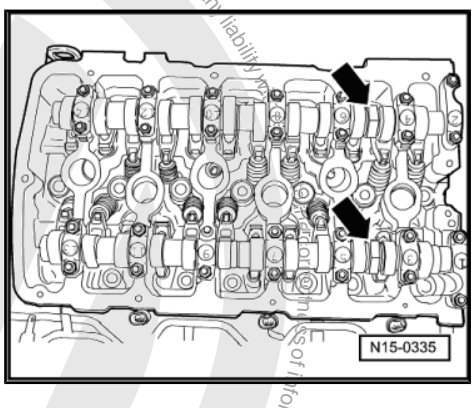
So that the camshaft timing chain does not jump a tooth when the crankshaft is turned, the tensioner plate must be pressed against the camshaft timing chain by hand instead of with chain tensioner .

– Turn crankshaft two full turns in direction of engine rotation and check valve timing ⇒ page 54.



If the markings align:

– Hold camshaft which is to be tightened using a 32 mm open-end spanner -arrow-



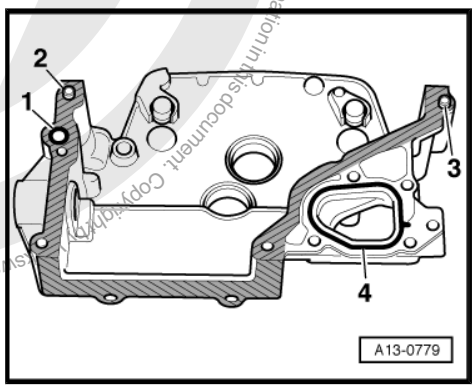
Note

Camshaft bar -T10068 A- must be removed while this is done.

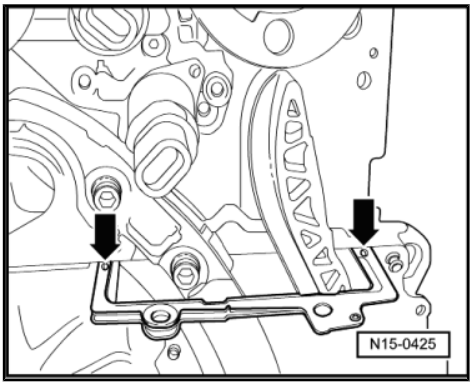
– Tighten securing bolts of inlet and exhaust camshaft adjusters to 60 Nm + 90° (1/4 turn) further.

If seals in cover are to be renewed ⇒ page 54 .

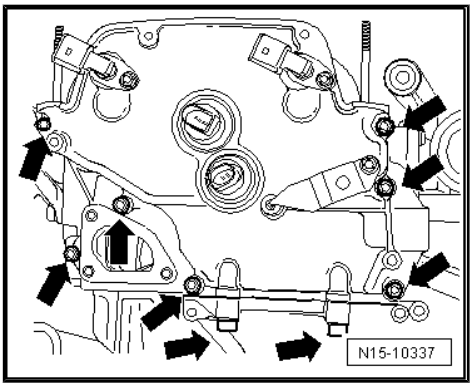
– Clean sealing surface on cover and cylinder head.
– Lubricate O-ring for oil channel seal -1- and insert in cover.
– Check that dowel sleeves -2- and -3- are inserted.
– Insert seal -4- in cover.



– Remove old sealant from 3 mm holes in cylinder head gasket -arrows-.
– Fill 3 mm holes in cylinder head gasket with sealant -D 176 501 A1- . Coat sealing surface of cover with sealant -D 176 501 A1- and immediately install cover.



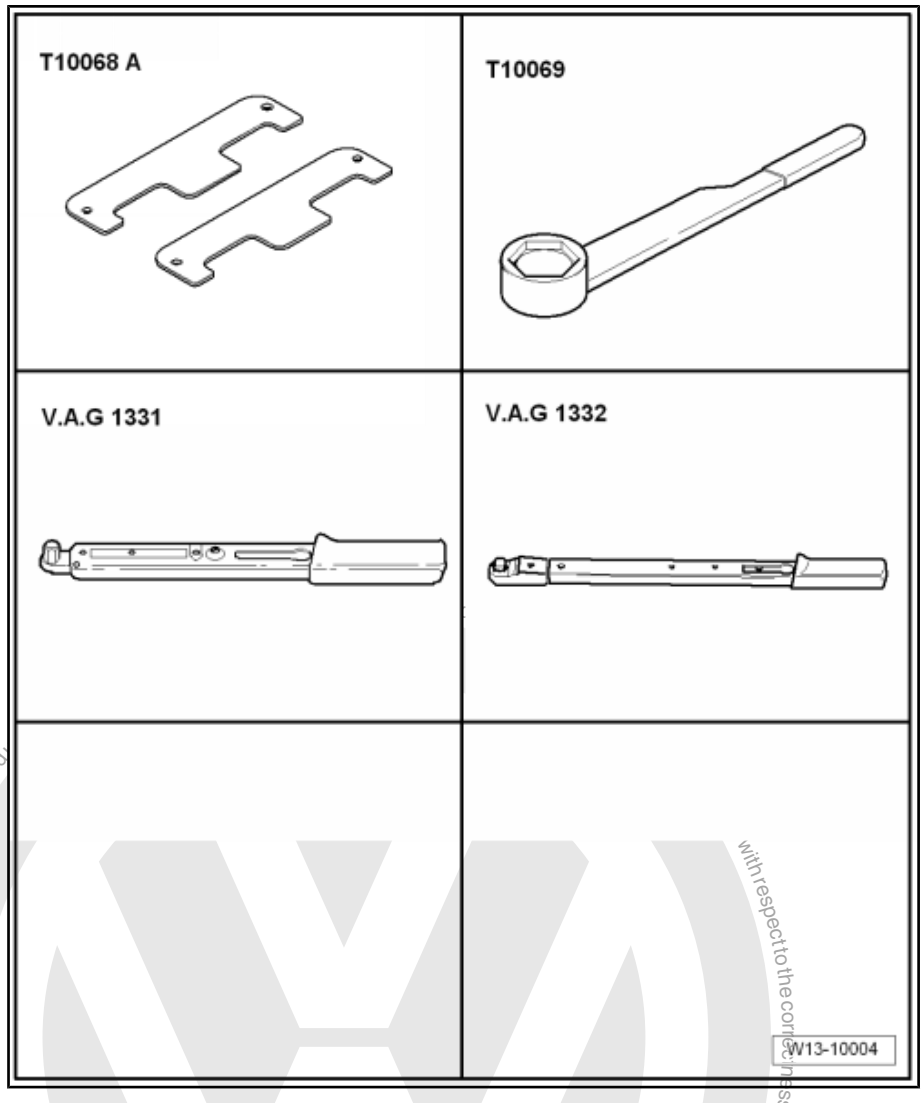
– First insert all securing bolts -arrows- and tighten lightly.
– Tighten M8 securing bolts ⇒ Item 8 (page 53) to 23 Nm. Tighten M6 securing bolts ⇒ Item 2 (page 53) to 8 Nm.
– Install chain tensioner for camshaft timing chain and tighten to 50 ± 2 Nm.
– Turn crankshaft two full turns in direction of engine rotation and check valve timing again.
– Install cylinder head cover and intake manifold ⇒ page 67 .



1.6 Installing timing chain for intermediate shaft drive and camshaft drive

Special tools and workshop equipment required

- Camshaft bar -T10068 A-
- Counterhold -T10069-
- Torque wrench - V.A.G 1331-
- Torque wrench - V.A.G 1332-
- Sealant -D 176 501 A1-



Procedure

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 and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.*
- *To avoid damage to lines/wiring, ensure sufficient clearance to all moving or hot components.*

Note

The following procedure is only possible and described with engine removed. You can start with adjustments at the relevant point, depending on how far the engine has been dismantled. The sump is removed and may only be fitted after installing the sealing flange.

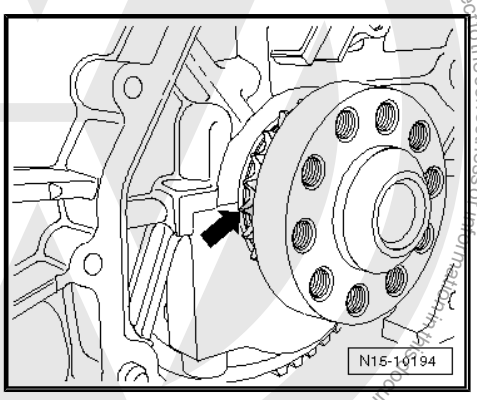
Install timing chain and chain tensioner with tensioning plate for intermediate shaft drive:

– First set crankshaft to TDC No. 1 cylinder. For this, the ground down tooth of drive sprocket -arrow- must align with bearing joint.

– Install both pins without collar for guide rail and tighten to 10 Nm. Fit guide rail on studs.

– Turn intermediate shaft with flattened side upwards.

– Insert timing chain into guide rail and place on crankshaft.



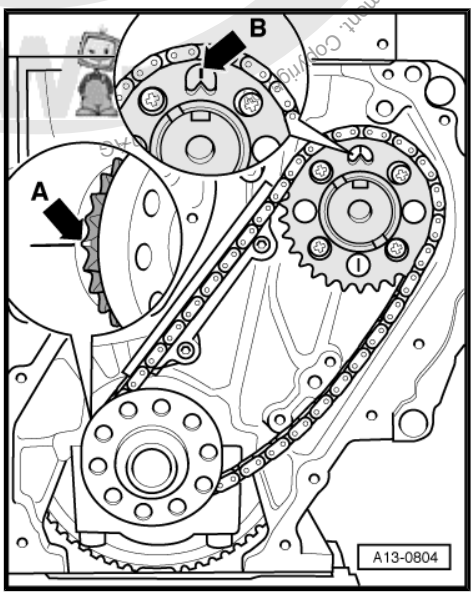
– Insert large chain sprocket into timing chain so that lug on chain sprocket aligns with lug behind on cylinder block -B-.

– Fit chain sprocket onto intermediate shaft.

When installing, ensure that timing chain runs completely straight in guide rail from crankshaft to intermediate shaft.

- Ground tooth of drive chain sprocket -arrow A- must align with bearing joint.
- Lug on chain sprocket of intermediate shaft must align with lug behind -arrow B-.

– If large chain sprocket cannot be fitted, turn intermediate shaft slightly.



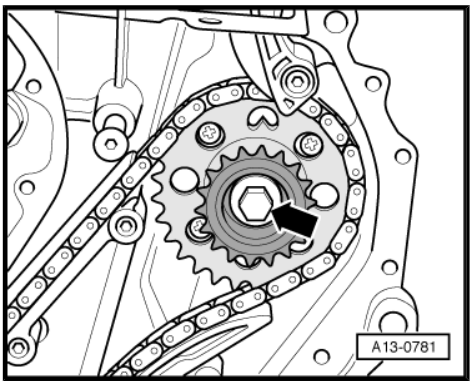
Note

If timing chain has already been used, note marking for direction of rotation ⇒ page 18 *.*

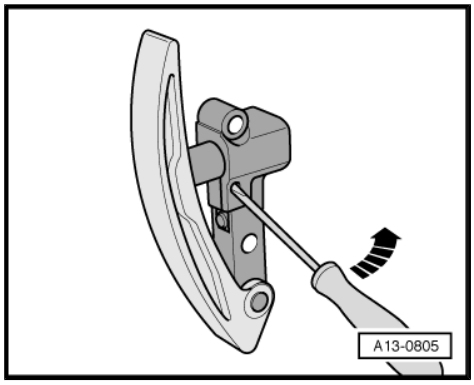
– Fit small chain sprocket of intermediate shaft. Installation is only possible in one position.

– Tighten bolt -arrow- hand-tight only as small chain sprocket has to be taken off again.

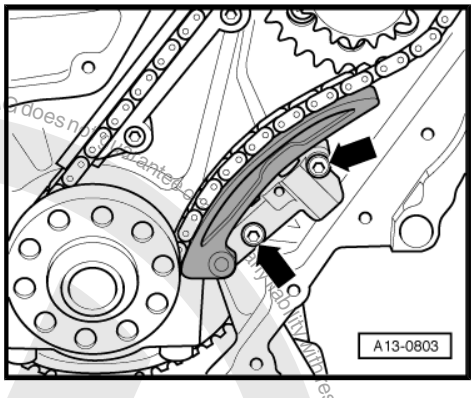
– Now install chain tensioner.



– To do this, release locking teeth of chain tensioner -A- with a small screwdriver and press tensioning plate against chain tensioner.



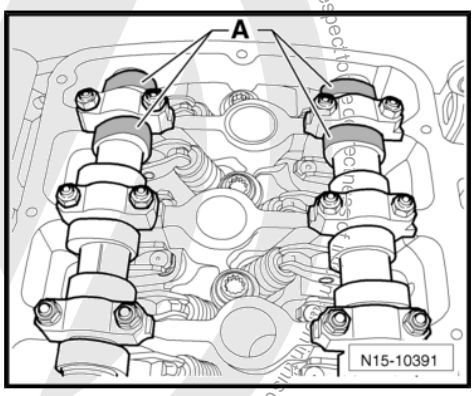
– Install chain tensioner in this position and tighten to 8 Nm -arrows-.



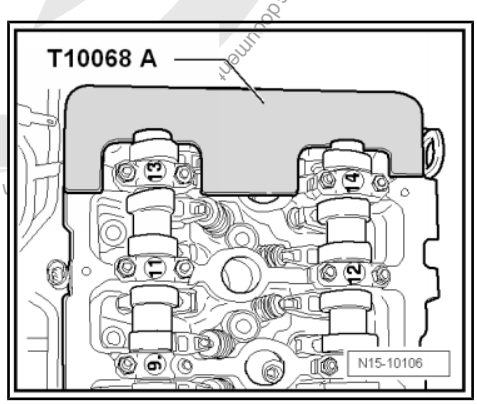
Installing timing chain for camshaft drive:

Prerequisites

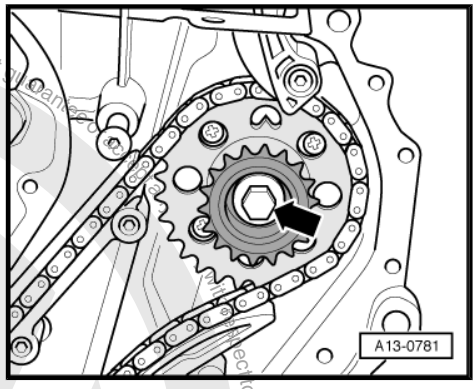
- The camshaft adjusters are installed.
- Cams -A- of cylinder 1 must face each other.



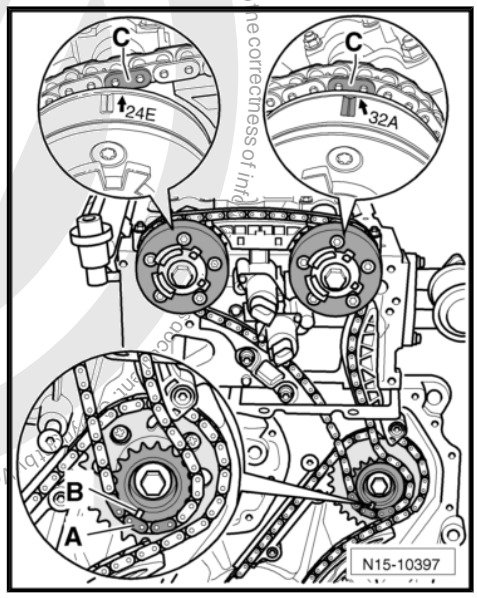
– Insert camshaft bar -T10068 A- in both shaft grooves.



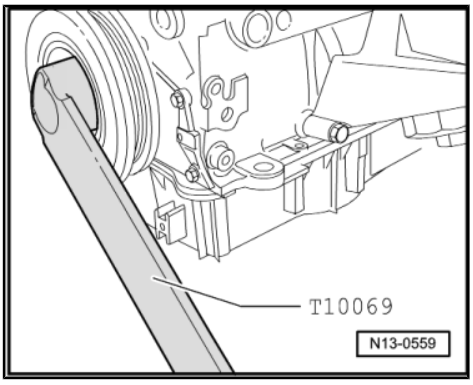
– Remove small chain sprocket on intermediate shaft. The large chain sprocket must not be pulled off.
– Route chain between tensioning bar and guide rail in direction of valve timing housing.



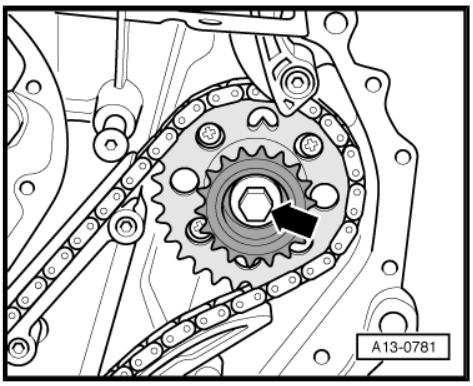
– Fit timing chain onto camshaft adjuster so that the 2 individual copper coloured chain links -C- align with the markings on the camshaft adjuster. It might be necessary to turn the inlet camshaft adjuster slightly.
– Fit small chain sprocket of intermediate shaft into timing chain. Marking -B- must align with middle copper coloured chain link -A-.
– Fit small chain sprocket with timing chain attached onto intermediate shaft. Installation is only possible in one position.



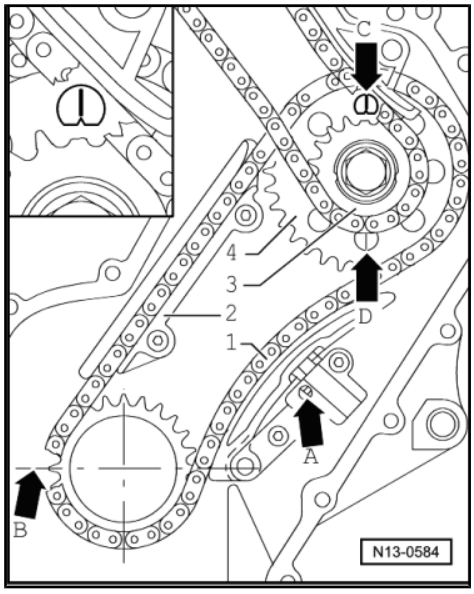
– Lock vibration damper using counterhold -T10069- .



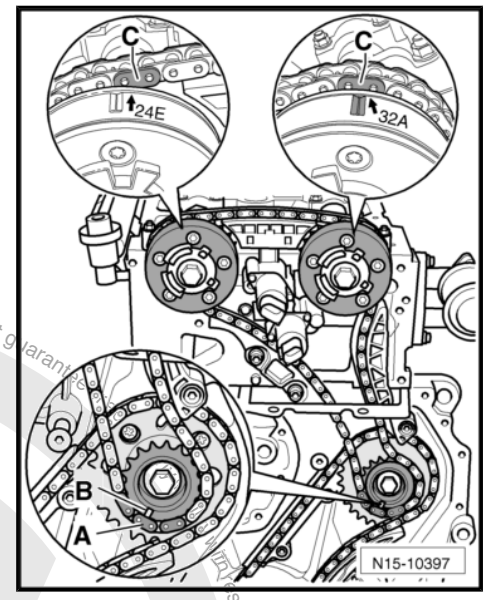
– Tighten new securing bolt for intermediate shaft chain sprocket -arrow- to 60 Nm + 90° ($^1/_4$ turn) further. Turning further can be done in several stages.
– Check position of crankshaft to intermediate shaft once again.



- Ground tooth of drive chain sprocket -arrow B- must align with bearing joint.
- Lug on chain sprocket of intermediate shaft must align with lug behind -arrow C-.



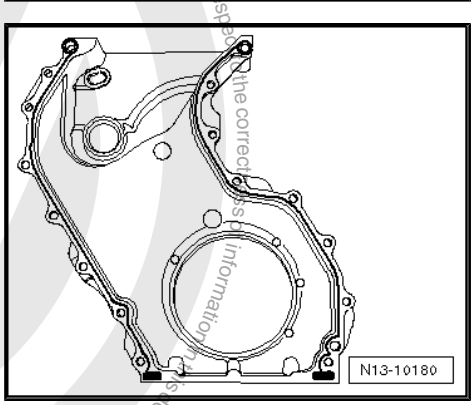
– Check position of copper coloured chain links to adjustment markings.



Note

The copper coloured chain links no longer align with the adjustment markings once the crankshaft has been turned.

– Apply sealant -D 176 501 A1- onto clean sealing surface of sealing flange as shown.



Note

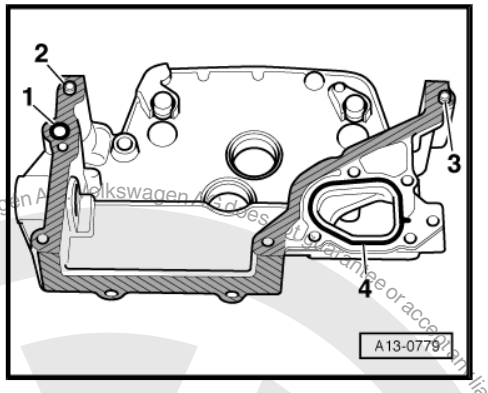
Observe dowel pins in cylinder block.

– Immediately install sealing flange.
– Insert all securing bolts by hand and tighten to 10 Nm.
– Now install oil seal for crankshaft in sealing flange ⇒ page 23 .
– Now install sump ⇒ page 92 .

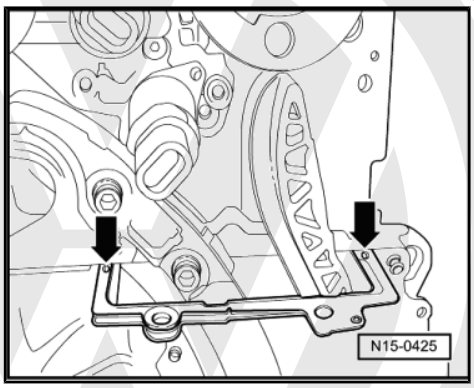
If seals in cover are to be renewed ⇒ page 54 .

– Clean sealing surface on cover and cylinder head.

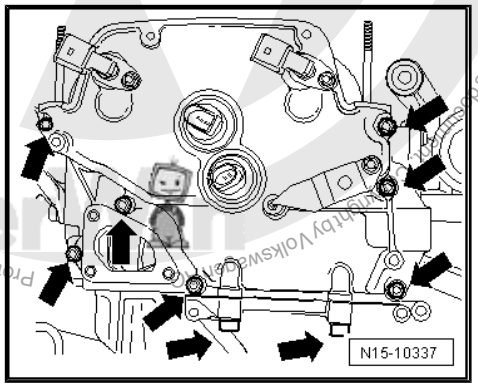
– Lubricate O-ring for oil channel seal -1- and insert in cover.
– Check that dowel sleeves -2- and -3- are inserted.
– Insert seal -4- in cover.



– Remove old sealant from 3 mm holes in cylinder head gasket -arrows-.
– Fill 3 mm holes in cylinder head gasket with sealant -D 176 501 A1- . Coat sealing surface of cover with sealant -D 176 501 A1- and immediately install cover.



– First insert all securing bolts -arrows- and tighten lightly.
– Tighten M8 securing bolts ⇒ Item 8 (page 53) to 23 Nm. Tighten M6 securing bolts ⇒ Item 2 (page 53) to 8 Nm.
– Install chain tensioner for camshaft timing chain and tighten to 50 ± 2 Nm.
– Turn crankshaft two full turns in direction of engine rotation and check valve timing again ⇒ page 54 .



Note

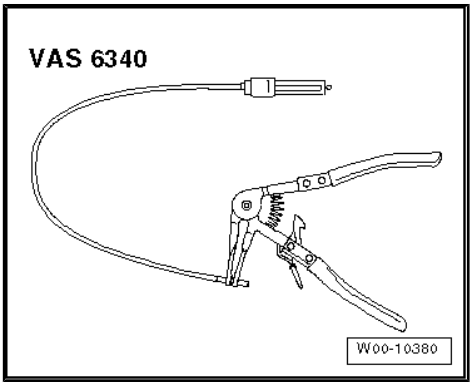
The copper coloured chain links no longer align with the adjustment markings once the crankshaft has been turned.

– Install cylinder head cover and intake manifold ⇒ page 67 .

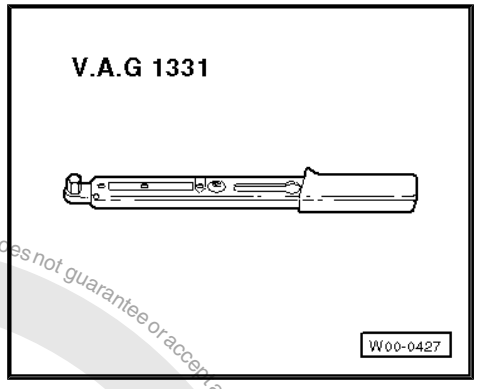
1.7 Removing and installing cylinder head cover

Special tools and workshop equipment required

♦ Spring-type clip pliers -VAS 6340-



♦ Torque wrench -V.A.G 1331-



Removing

Note

Before carrying out further work, disconnect battery earth strap. Check whether a coded radio is fitted. Obtain anti-theft coding 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 intake manifold ⇒ page 170 .
– Unbolt line guide ⇒ Item 1 (page 53) .
– Unbolt fuel line bracket ⇒ Item 2 (page 42) .
– Remove cylinder head cover.

Installing

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

– First tighten all securing bolts by hand and then to the prescribed specified torque “diagonally”.
– Install intake manifold ⇒ page 170 .

Note

♦ *Renew cylinder head cover or gasket if damaged or leaking.*
♦ *Bolt intake manifold first to cylinder head. Then tighten the two bolts for heat shield and the bolts for intake manifold support.*
♦ *Ensure the fuel hose is fitted securely in the brackets.*

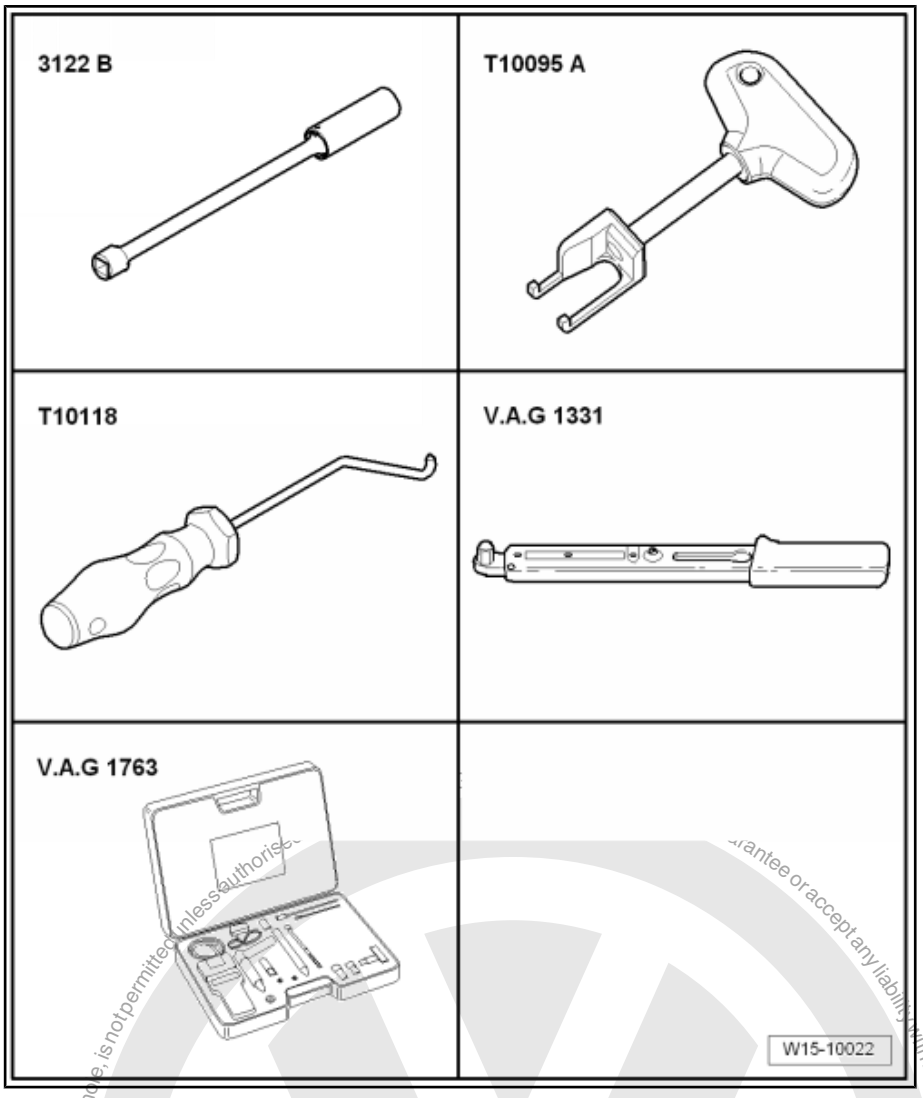
Specified torques

Threaded connection	Specified torque
Cylinder head cover to cylinder head	10 Nm
Intake manifold to cylinder head	15 Nm
Intake manifold to support	20 Nm
Heat shield to exhaust manifold	23 Nm
Dipstick guide tube to intake manifold	5 Nm

1.8 Checking compression

Special tools and workshop equipment required

- Spark plug socket and extension -3122 B-
- Puller -T10095 A-
- Assembly tool -T10118-
- Torque wrench -V.A.G 1331-
- Compression tester -V.A.G 1763-

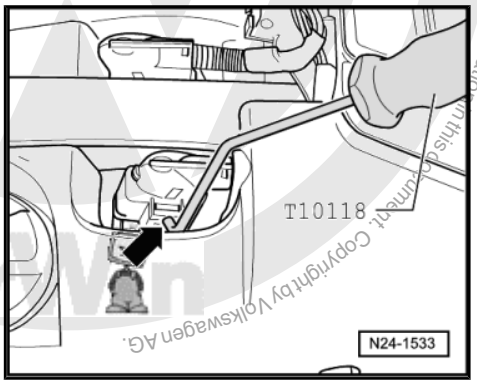


Test prerequisites

- Engine oil temperature at least 30 °C.
- The battery voltage must be at least 11.5 V.

Test procedure

– Place assembly tool -T10118- on locking button -arrow- release connector locking mechanism and carefully pull connectors downwards and off ignition coils 1…6.



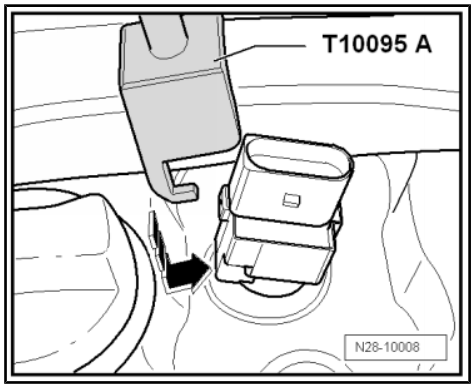
– Push puller -T10095 A- on from flat side of connector in -direction of arrow- and pull out ignition coil with output stage.

– Remove fuse SC 27 from fuse holder ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

Removing fuse SC 27 interrupts the voltage supply to the fuel pump relay.

– The spark plugs are removed using spark plug socket and extension -3122 B- .

– Check compression using compression tester -V.A.G 1763- .



Note

Using compression tester ⇒ Operating instructions.

– Operate starter until tester shows no further pressure increase.

Compression pressures:

Engine code	New bar	Wear limit bar	Difference between cylinders bar
CBRA	10.0 … 13.0	7.5	max. 3.0

– Then reinstall spark plugs and ignition coils with output stage again ⇒ page 208 .

After the test has been completed:

– Carry out vehicle system test ⇒ Vehicle diagnosis, testing and information system VAS 5051 “Guided fault finding”.

– Finish the vehicle system test so that any fault entries stored during assembly can be deleted automatically.

– Generate the readiness code in combination with a road test.

Observe applicable safety precautions during road test.

– Carry out road test.

– Then carry out the vehicle system test again and correct any faults that have been created.

2 Valve gear

Assembly overview ⇒ page 71

Removing and installing camshafts ⇒ page 73 .

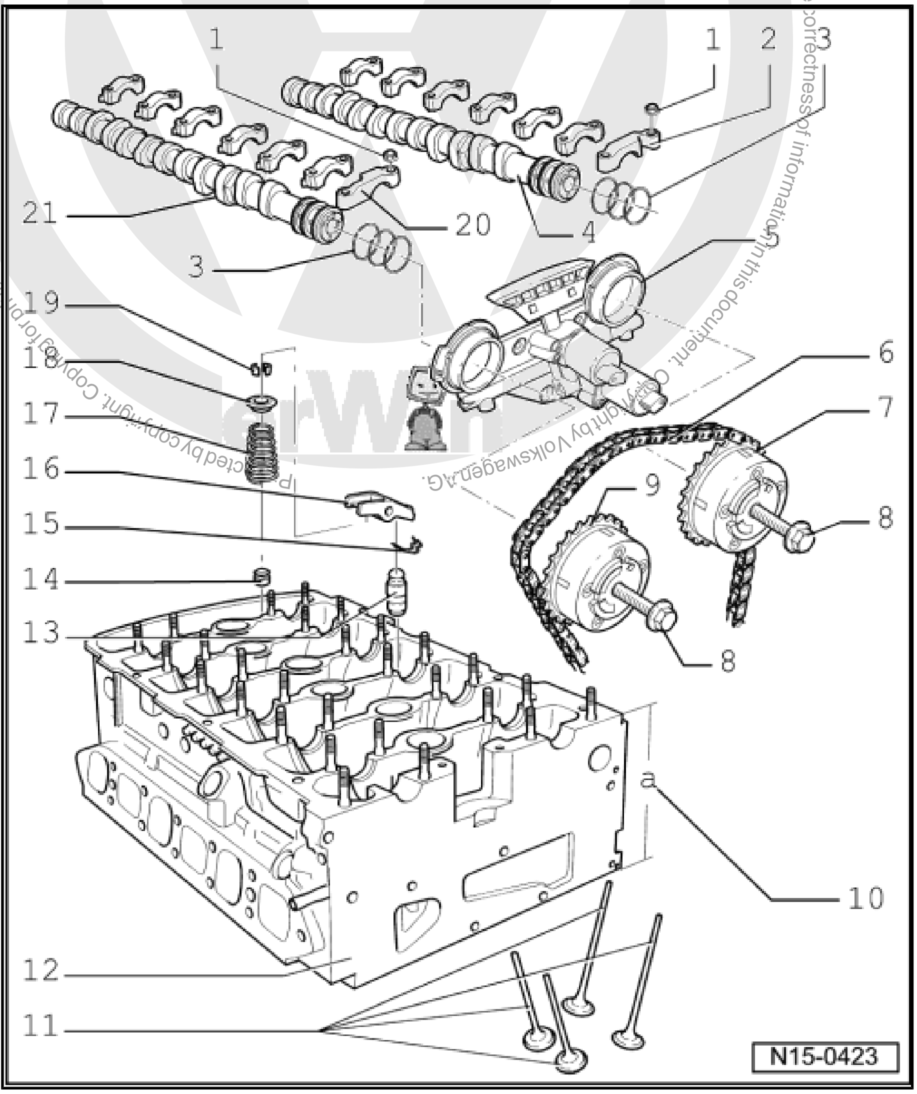
Removing and installing camshaft control valves ⇒ page 80 .

Renewing valve stem seals ⇒ page 83 .

Checking valve guides ⇒ page 86 .

Reworking valve seats ⇒ page 87 .

2.1 Assembly overview



1 - 5 Nm + $^{1}/_{8}$ turn (45°) further

2 - Exhaust camshaft bearing cap

- ❑ Installation sequence ⇒ page 73

3 - Seal

- ❑ Renew if leaking.
- ❑ When installing valve timing housing, lightly lubricate contact surfaces of seal.
- ❑ When replacing seals, do not spread too widely.

4 - Exhaust camshaft

- ❑ Checking radial clearance with Plastigage; wear limit: 0.1 mm.
- ❑ Runout: max. 0.04 mm.
- ❑ Checking axial clearance ⇒ page 85 .
- ❑ Identification and valve timing ⇒ page 86
- ❑ Removing and installing ⇒ page 73 .

5 - Valve timing housing

- ❑ Lightly lubricate contact surfaces of oil seals before installing.
- ❑ Dismantling and assembling ⇒ page 73 .
- ❑ Before installing valve timing housing, check strainer for soiling ⇒ page 73 .
- ❑ Removing and installing ⇒ page 73 .

6 - Camshaft timing chain

- ❑ Before removing, mark direction of rotation (installation position) ⇒ page 18 .
- ❑ Installing ⇒ page 62 .

7 - Exhaust camshaft adjuster

- ❑ Identification: 32A.
- ❑ Only rotate engine when camshaft adjuster is installed and chain is fitted

- ❑ Installing ⇒ page 62 .

8 - 60 Nm + 1/4 turn (90°) further

- ❑ Renew.
- ❑ Contact surface of sender wheel must be dry around bolt head when installed.
- ❑ To remove and install, counterhold with 32 mm open-end spanner on camshaft ⇒ page 73 .

9 - Inlet camshaft adjuster

- ❑ Identification: 24E
- ❑ Only rotate engine when camshaft adjuster is installed and chain is fitted
- ❑ Installing ⇒ page 62 .

10 - Cylinder head height

- ❑ Minimum height: a = 139.9 mm.

11 - Valves

- ❑ Do not rework, only lapping-in is permitted.
- ❑ Valve dimensions ⇒ page 86 .

12 - Cylinder head

- ❑ Check for distortion ⇒ page 44 .
- ❑ Removing and installing ⇒ page 44 .
- ❑ Reworking valve seats ⇒ page 87 .
- ❑ After renewing, renew entire coolant.

13 - Support element

- ❑ Before installing, check camshaft axial clearance ⇒ page 85 .
- ❑ Do not interchange.
- ❑ With hydraulic valve clearance compensation.

14 - Valve stem seal

- ❑ Renewing ⇒ page 83 .

15 - Securing clip

- ❑ Check for secure seating.

16 - Roller rocker finger

- ❑ Before installing, check camshaft axial clearance ⇒ page 85 .
- ❑ Do not interchange.
- ❑ Check roller bearing for ease of movement.
- ❑ Oil contact surfaces.
- ❑ When installing, secure to supporting element using securing clip.

17 - Valve spring

- ❑ Note installation position.
- ❑ Removing and installing ⇒ page 83 .

18 - Valve spring plate

19 - Valve cotters

20 - Inlet camshaft bearing cap

- ❑ Installation sequence ⇒ page 73

21 - Inlet camshaft

- ❑ Checking radial clearance with Plastigage; wear limit: 0.1 mm.
- ❑ Runout: max. 0.04 mm.
- ❑ Checking axial clearance ⇒ page 85 .
- ❑ Identification and valve timing ⇒ page 86
- ❑ Removing and installing ⇒ page 73 .

Dismantling and assembling valve timing housing

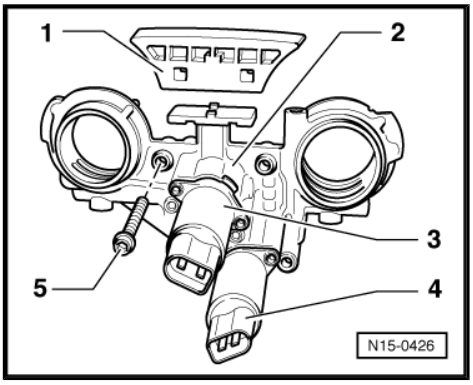
1 - Guide rail: clipped into valve timing housing

2 - Valve timing housing

3 - Inlet camshaft control valve 1 -N205-

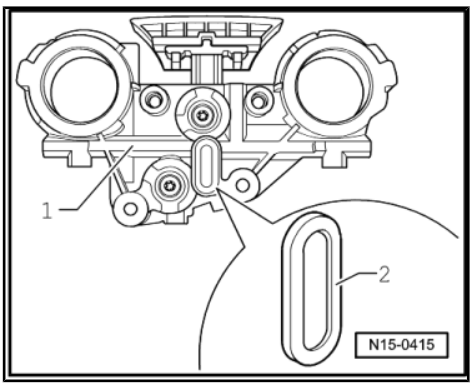
4 - Exhaust camshaft control valve 1 -N318-

5 - 8 Nm (insert with locking fluid -D 000 600 A2-).



Checking valve timing housing strainer for soiling.

– Unclip strainer -2- from back of valve timing housing -1- and remove any dirt.



2.2 Removing and installing camshafts

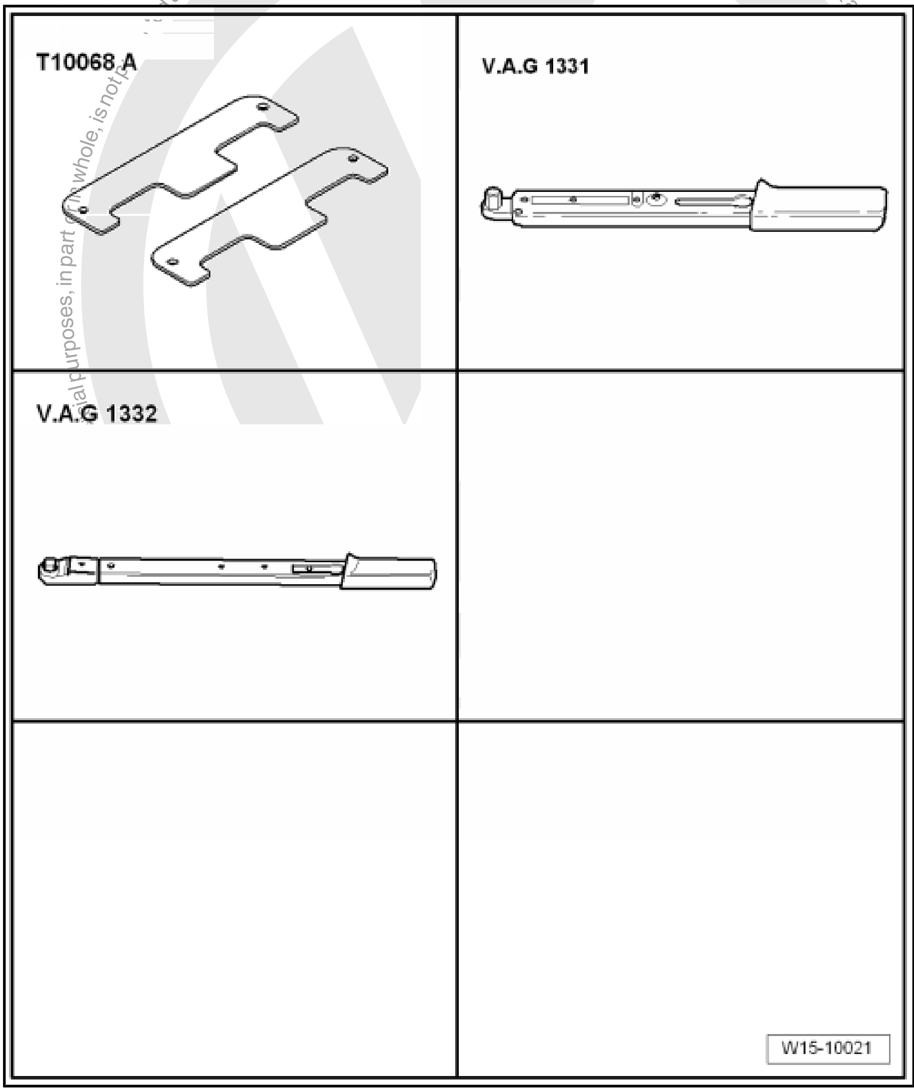
Removing ⇒ page 74 .

Installing ⇒ page 77 .

(With cylinder head installed)

Special tools and workshop equipment required

- ♦ Camshaft bar -T10068 A-
- ♦ Torque wrench -V.A.G 1331-
- ♦ Torque wrench -V.A.G 1332-
- ♦ Sealant -D 176 501-
- ♦ Lubrication paste -G 052 723 A2-



2.2.1 Removing

⚠ Caution

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

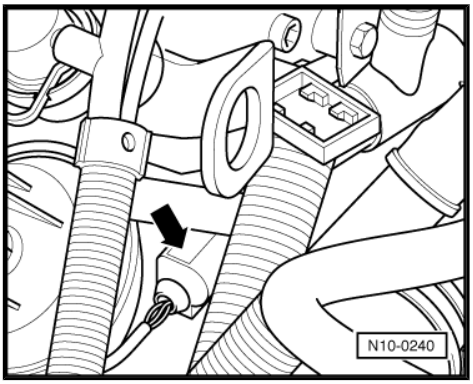
- ♦ *Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.*
- ♦ *To avoid damage to lines/wiring, ensure sufficient clearance to all moving or hot components.*

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

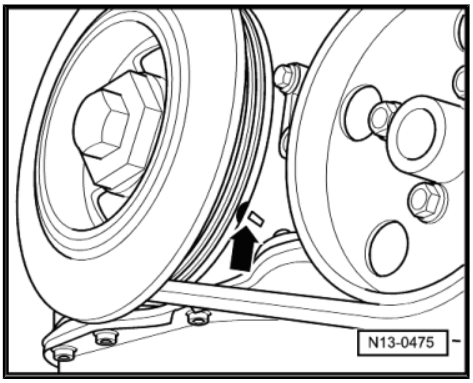
Disconnect earth strap at battery with ignition switched off ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and reconnecting battery .

– Move lock carrier into its service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier, service position .

– 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 intake manifold ⇒ page 170 .
– Pull 2 pin connector off coolant temperature sender -G62- -arrow-.
– Drain coolant ⇒ page 110 .
– Now remove thermostat housing ⇒ page 107 .

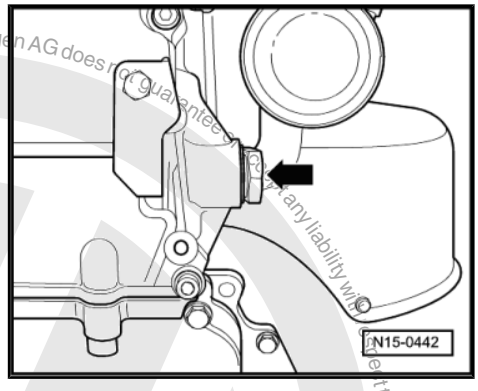


– Set crankshaft to TDC No. 1 cylinder marks -arrow- by turning crankshaft on the vibration damper securing bolt in direction of engine rotation.



– Remove chain tensioner for camshaft timing chain -arrow-.
– Disconnect connectors from the following components of cover:

♦ Inlet camshaft control valve 1 -N205-
♦ Exhaust camshaft control valve 1 -N318-
♦ Hall sender -G40-
♦ Hall sender 2 -G163-

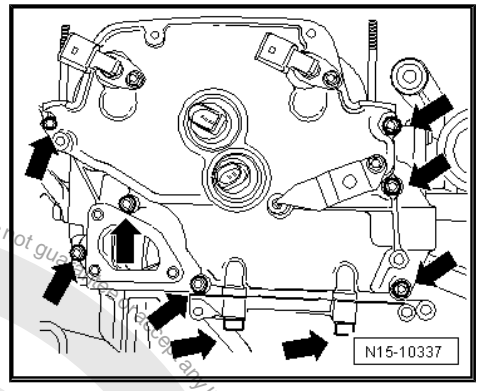


Note

Before removing connectors, mark each connector and component to which it belongs.

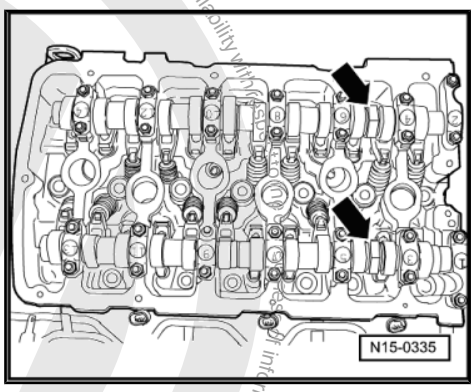
– Move wiring harness clear.

– Now unscrew camshaft cover -arrows-.
– First remove exhaust camshaft adjuster.



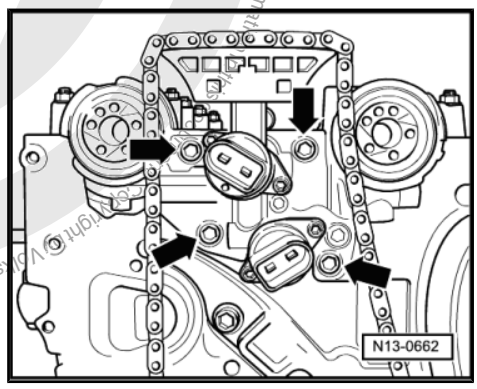
Note

Only counterhold at camshaft with 32 mm open-end spanner -arrow-. The camshaft bar -T10068 A- must not be fitted when camshaft adjuster is loosened or tightened.



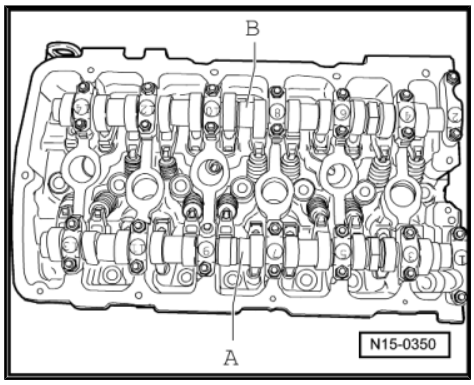
– Now remove camshaft adjuster together with camshaft timing chain from inlet camshaft.
– Lay camshaft timing chain aside.

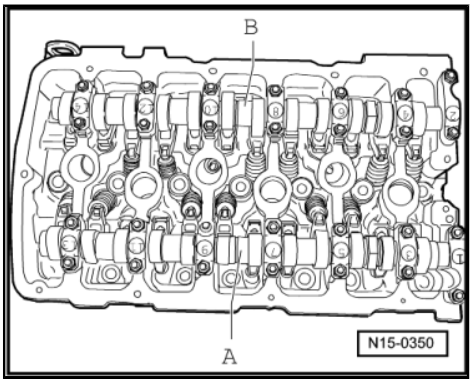
– Unbolt control housing from cylinder head -arrows-.
– Pull valve timing housing carefully off camshaft seals.



A - inlet camshaft

– First remove bearing caps 1 and 13.
– Remove bearing caps 3 and 11.
– Remove bearing cap 7.
– Loosen bearing caps 5 and 9 alternately and diagonally.





B - exhaust camshaft

– First remove bearing caps 2 and 14.

– Remove bearing caps 4 and 12.

– Remove bearing cap 8.

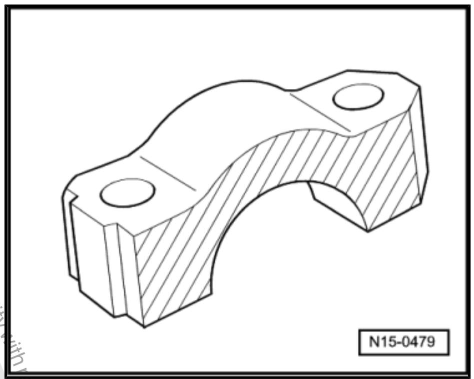
– Loosen bearing caps 6 and 10 alternately and diagonally.

– Carefully remove camshafts and lay aside on clean surface.

– Remove roller rocker fingers together with support elements and lay aside on a clean surface.

– Ensure that roller rocker fingers and support elements are not interchanged.

2.2.2 Installing

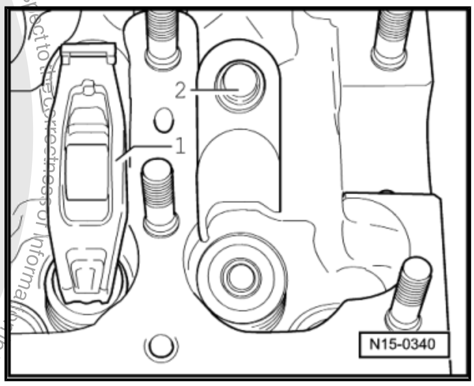


Lightly coat contact surfaces of bearing caps 7 and 8 with lubricating paste -G 052 723 A2- before installing.

Prerequisites

• When camshafts are installed, cams for No. 1 cylinder must point upwards.

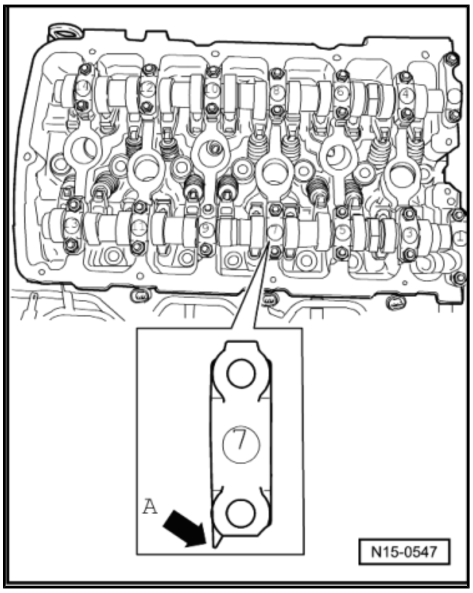
– Install supporting elements in cylinder head and fit respective roller rocker finger onto respective valve stem end or supporting element.



– Ensure that all roller rocker fingers -1- seat properly on valve stem ends and are clipped into their respective support elements -2-.

– Oil cams and running surfaces of camshafts.

– Carefully place each camshaft in its respective bearing in the cylinder head. When doing this, observe camshaft identification ⇒ page 86 .



Note

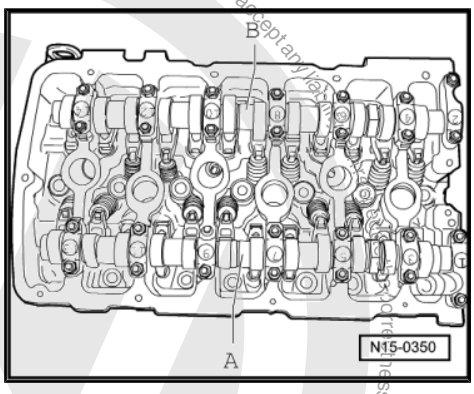
♦ *Observe fitting position of bearing caps:*

♦ *Points of bearing caps -arrow A- of inlet and outlet camshafts face outwards.*

♦ *Identification on bearing caps is right side up when viewed from inlet side.*

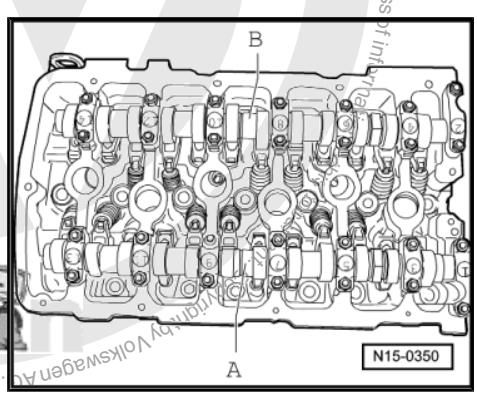
A - inlet camshaft

- Tighten bearing caps 5 and 9 alternately and diagonally to 5 Nm + 1/8 turn (45°).
- Install bearing caps 1 and 13 and tighten to 5 Nm + 1/8 turn (45°).
- Install bearing cap 7 and tighten to 5 Nm and turn 1/8 (45°) further.
- Install bearing caps 3 and 11 and also tighten to 5 Nm + 1/8 turn (45°).

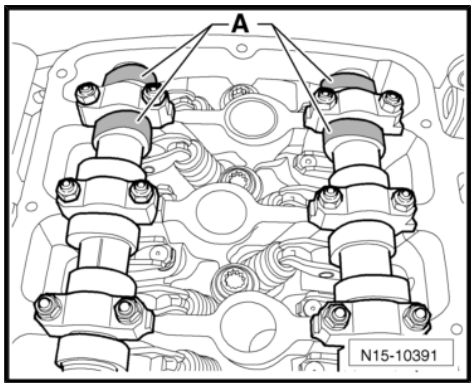


B - exhaust camshaft

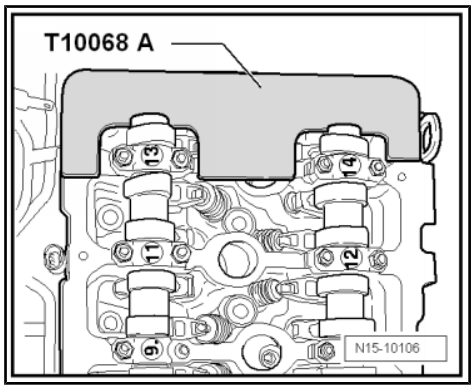
- Tighten bearing caps 6 and 10 alternately and diagonally to 5 Nm + 1/8 turn (45°).
- Install bearing caps 2 and 14 and tighten to 5 Nm + 1/8 turn (45°).
- Install bearing cap 8 and tighten to 5 Nm and turn 1/8 (45°) further.
- Install bearing caps 4 and 12 and also tighten to 5 Nm + 1/8 turn (45°).



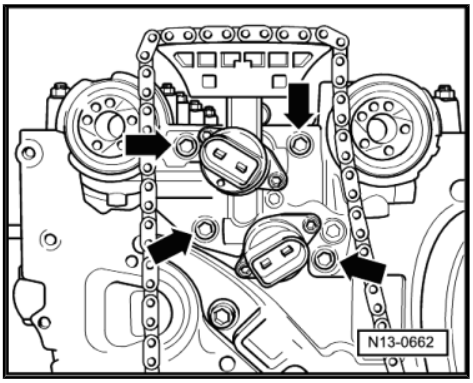
- Place camshafts carefully into cylinder head camshaft bearings; cylinder 1 cams -A- must point towards each other.



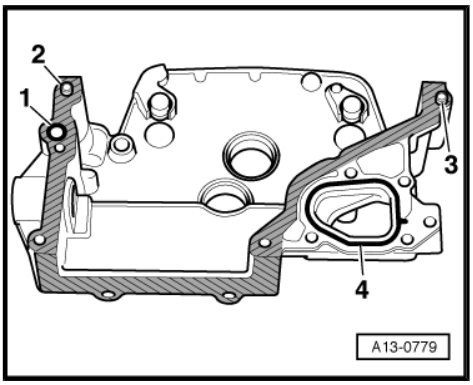
- The camshaft bar -T10068 A- must engage in grooves in both shafts.
- Before installing, check valve timing housing strainer for soiling ⇒ page 73 .
- Before installing control housing, lightly lubricate control housing surfaces contacting camshaft seals.
- Lightly lubricate camshaft seals and slowly push control housing over camshaft seals.



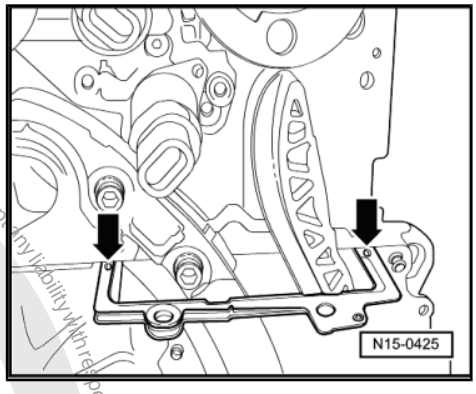
– Install timing housing and insert securing bolts -arrows- with locking fluid -D 000 600 A2- and tighten to specified torque of 8 Nm.
– Installing camshaft adjuster with timing chain for camshaft drive ⇒ page 57 .
– Clean sealing surface on cover and cylinder head.



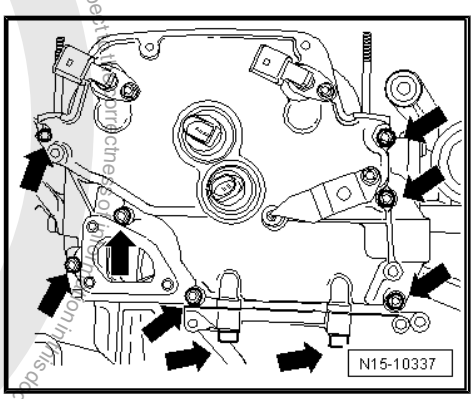
– Lubricate O-ring for oil channel seal -1- and insert in cover.
– Check that dowel sleeves -2- and -3- are inserted.
– Insert seal -4- in cover.



– Remove old sealant from 3 mm holes in cylinder head gasket -arrows-.
– Fill 3 mm holes in cylinder head gasket with sealant -D 176 501 A1- . Coat sealing surface of cover with sealant -D 176 501 A1- and immediately install cover.



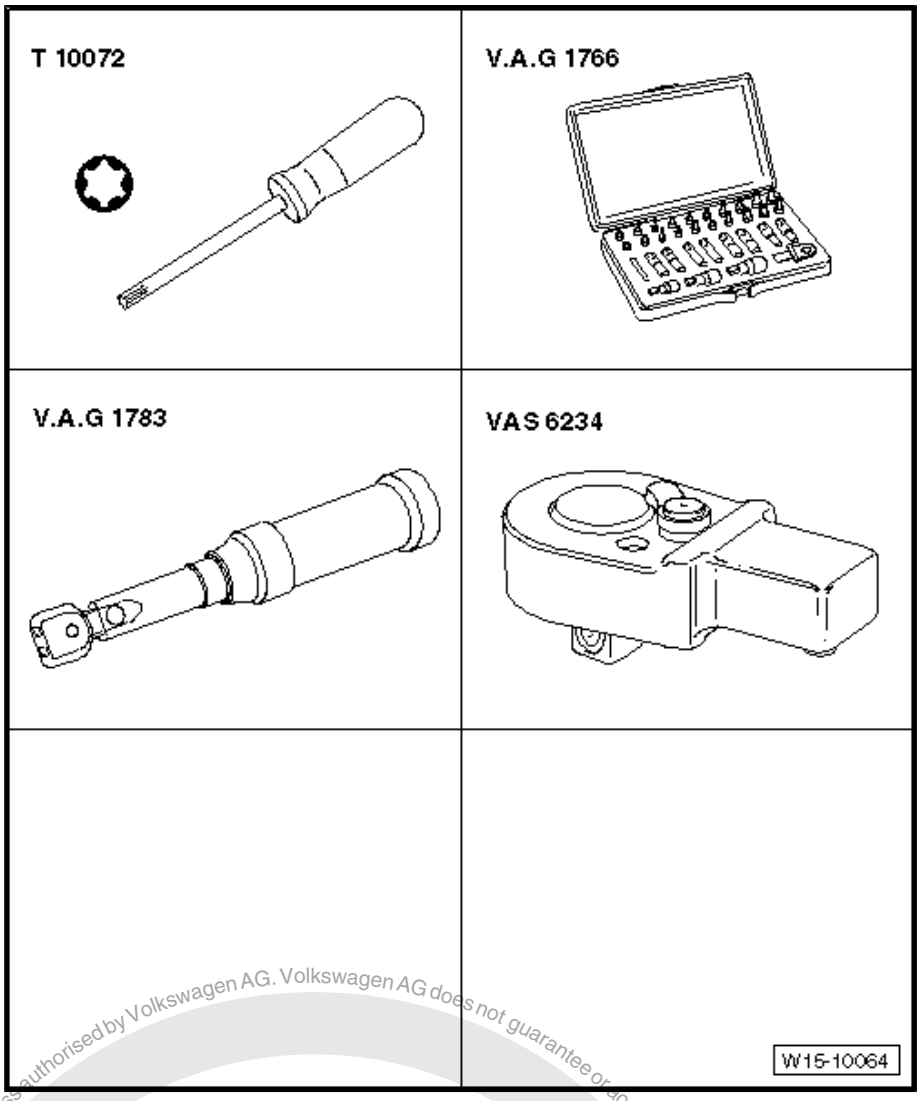
– First insert all securing bolts -arrows- and tighten lightly.
– Then tighten M8 securing bolts ⇒ Item 8 (page 53) to 23 Nm and M6 securing bolts ⇒ Item 2 (page 53) to 8 Nm.
– Install chain tensioner for camshaft timing chain ⇒ Item 15 (page 42) and tighten to 50 ± 2 Nm.
– Install cylinder head cover ⇒ page 67 and intake manifold ⇒ page 170 .



2.3 Removing and installing camshaft control valves

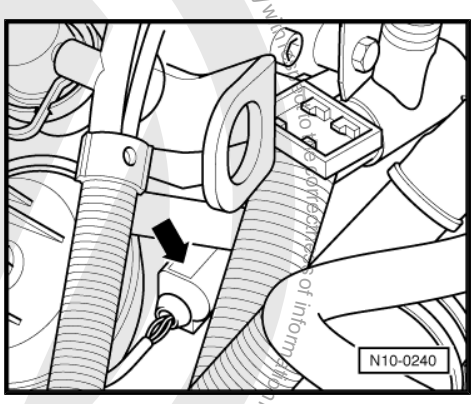
Special tools and workshop equipment required

- Torque wrench -V.A.G 1783-
- Torx bit set -V.A.G 1766-
- 1/4" drive ratchet -VAS 6234-
- Special wrench, long reach -T10072-



Removing:

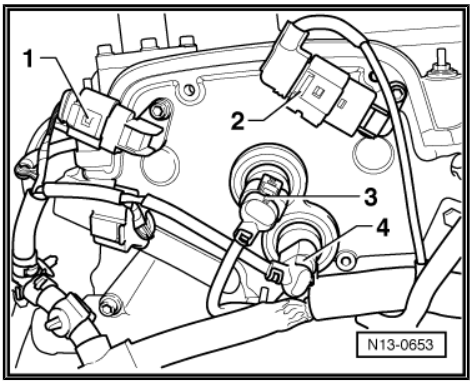
– Remove intake manifold ⇒ page 170 .
– Pull 2 pin connector off coolant temperature sender -G62- -arrow-.
– Drain coolant ⇒ page 110 .
– Remove thermostat housing ⇒ page 107 .
– Remove cylinder head cover ⇒ page 67 .



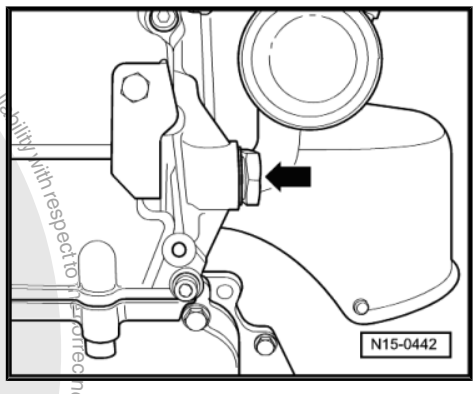
Note

Before removing connectors, mark each connector and component to which it belongs.

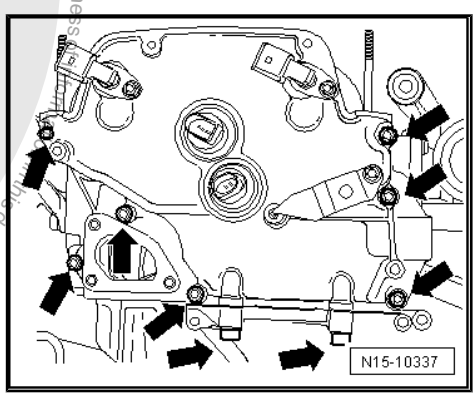
– Pull connectors off Hall sender -G40- -1- and Hall sender 2 - G163- -2-.
– Pull off connectors -3- and -4-.
– Move wiring harness clear.



– Remove chain tensioner for camshaft timing chain -arrow-.



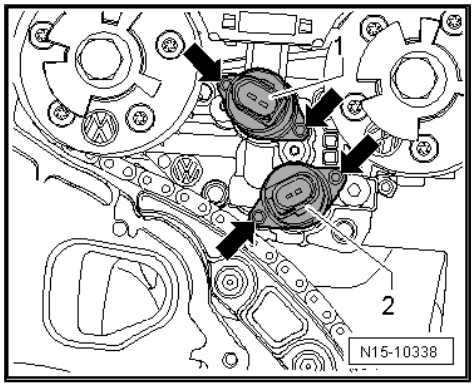
– Unscrew securing bolts -arrows- for cover.
– When all securing bolts have been removed, cover can be carefully levered off.



Caution

- ***The securing bolts of the camshaft control valves should not be unscrewed completely, so that when the valve is pulled out it is not canted.***
- ***Cover lower chain housing carefully so that no parts can fall into it.***

– Unscrew securing bolts for camshaft control valves approx. 3 mm (5 turns) with socket -T10072- -arrows-.
– Pull camshaft control valve out of seat in control housing and slide it along loosened bolts.
– Completely remove securing bolts and pull camshaft control valve out of control housing.



Installing:

Caution

- *The valve seat in the control housing must not be scored or scratched.*
- *The camshaft control valves and the control housing must be free of dirt and soiling.*
- *Ensure the camshaft control valves are protected from knocks and impacts.*
- *Only unpack the new camshaft control valves immediately prior to installation.*
- *The camshaft control valves must not be pulled into their seat with the securing bolts. Only insertion by hand is permitted.*

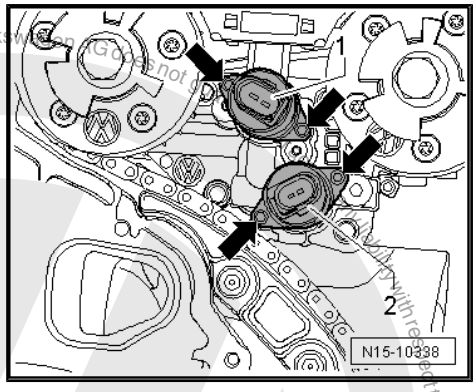
– Moisten seals with clean engine oil.
– Carefully insert camshaft control valve into housing and push vertically to valve axis to stop by hand.

– Tighten securing bolts -arrows- to 3.8 Nm.

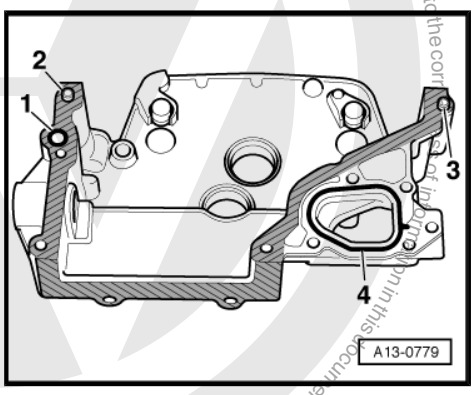
-1- Camshaft control valve 1 -N205- .

-2- Exhaust camshaft control valve 1 -N318- .

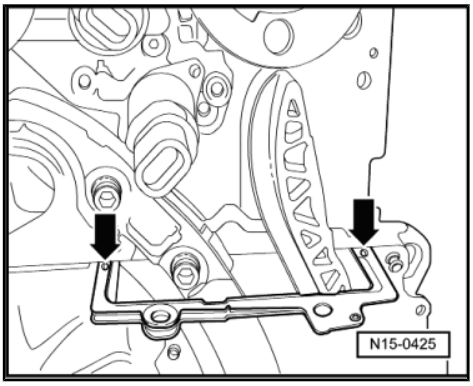
– Clean sealing surface on cover and cylinder head.



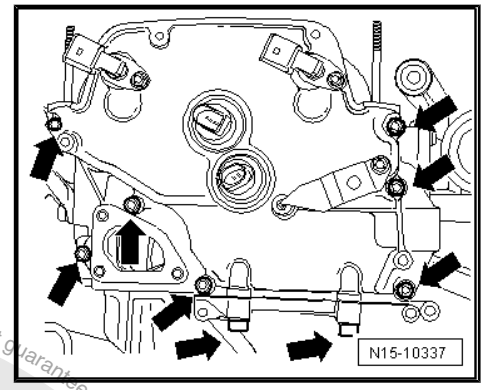
– Lubricate O-ring for oil channel seal -1- and insert in cover.
– Check that dowel sleeves -2- and -3- are inserted.
– Insert seal -4- in cover.



– Remove old sealant from 3 mm holes in cylinder head gasket -arrows-.
– Fill 3 mm holes in cylinder head gasket with sealant -D 176 501 A1- . Coat sealing surface of cover with sealant -D 176 501 A1- and immediately install cover.



– First insert all securing bolts -arrows- and tighten lightly.
– Then tighten M8 securing bolts ⇒ Item 8 (page 53) to 23 Nm and M6 securing bolts ⇒ Item 2 (page 53) to 8 Nm.
– Install chain tensioner for camshaft timing chain ⇒ Item 15 (page 42) and tighten to 50 ± 2 Nm.
– Install cylinder head cover ⇒ page 67 and intake manifold ⇒ page 170 .



Further assembly is basically the reverse of the dismantling sequence.

2.4 Valve stem oil seals

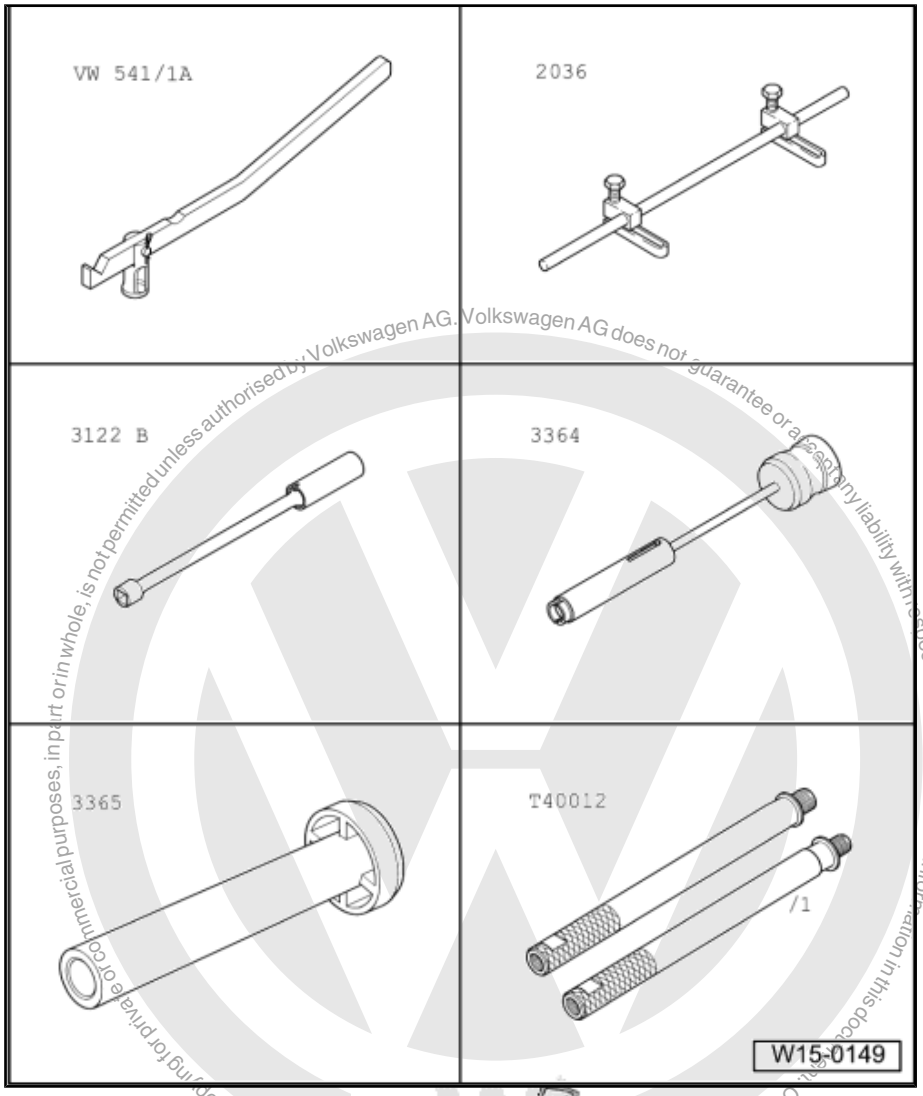
Removing ⇒ page 84 .

Installing ⇒ page 85 .

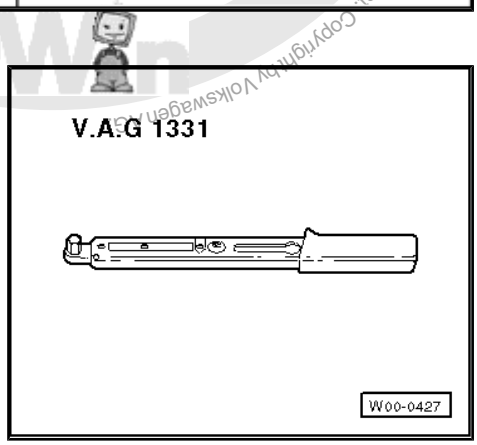
(With cylinder head installed)

Special tools and workshop equipment required

- Valve lever -VW 541/1 A- with thrust piece for VW 541 / 1 A and 2037 -VW 541/6-
- Valve assembly device -2036- with adapter plates -2036/1-
- Spark plug socket and extension -3122 B-
- Valve stem seal puller -3364-
- Valve stem seal fitting tool -3365-
- Adapter -T40012- and adapter -T40012/1-



- Torque wrench -V.A.G 1331-



2.4.1 Removing

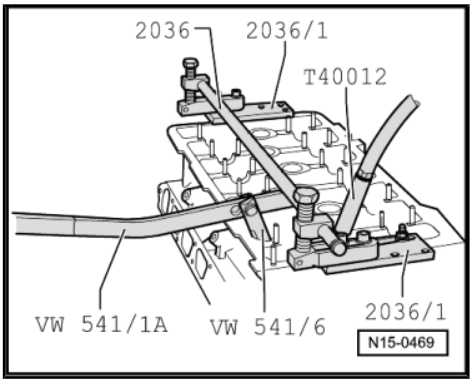
– Remove camshafts ⇒ page 73 .

– Remove roller rocker fingers together with support elements and lay aside on a clean surface.

– Remove spark plugs using spark plug socket and extension -3122 B- .

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

– Set up valve assembly device -2036- with adapter plates -2036/1- and adjust mounting.
– Screw adapter -T40012- or adapter -T40012/1- in spark plug thread.
– Connect to compressed air line with a commercial adapter and apply a constant pressure of at least 6 bar.
– Remove valve springs using valve lever -VW 541/1 A- and thrust piece for VW 541 / 1 A and 2037 -VW 541/6- .



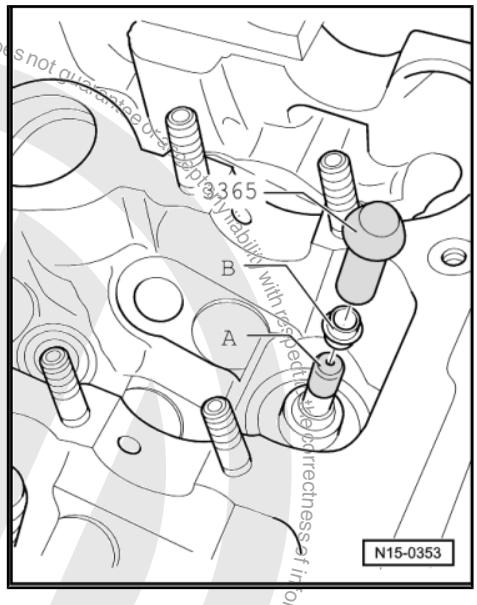
Note

Tight cotters can be loosened by tapping lightly on lever.

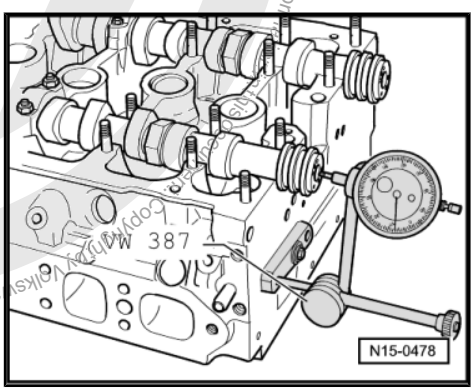
– Pull off valve stem seals using valve stem seal puller -3364- .

2.4.2 Installing

– To prevent damage to new valve stem seals, place plastic sleeve -A- on valve stem.
– Lubricate sealing lip of valve stem seal -B-, place it in the valve stem oil seal fitting tool -3365- and push carefully onto valve guide.
– Install camshafts ⇒ page 73 .



Camshafts, checking axial clearance



Special tools and workshop equipment required

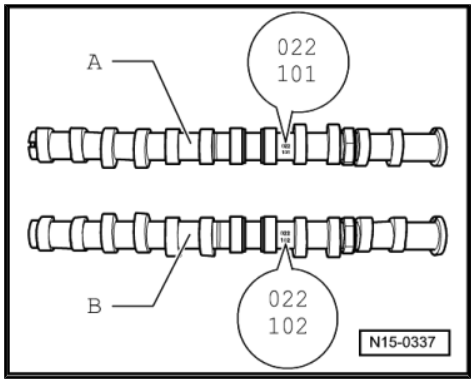
♦ Universal dial gauge bracket -VW 387-
♦ Dial gauge

Test procedure

Perform measurements with support elements and roller rocker fingers removed.

Middle bearing cap of respective camshaft installed.

Wear limit: max. 0.40 mm



Camshaft identification, valve timing

Camshaft identification

Identification between cam pair for cylinders 4 and 5 of respective camshaft.

Camshaft	Identification
A - exhaust camshaft	022 101 Index
B - inlet camshaft	022 102 Index

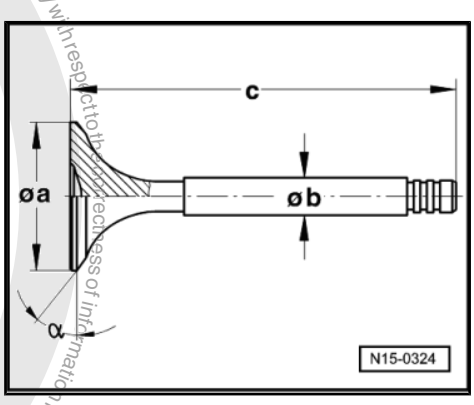
Valve timing at 1 mm valve lift

	Inlet valve	Exhaust valve
Opens BTDC	---	211.5°
Closes BTDC	---	6.5°
Opens ATDC	18.50°	---
Closes ATDC	223.5°	---

Valve dimensions

Note

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



Valve dimensions for inlet valves

Dimension		short inlet valve	long inlet valve
∅ a	mm	33.20	33.20
∅ b	mm	5.98	5.98
c	mm	102.46	136.36
α	∠°	44° 40'	44°40'

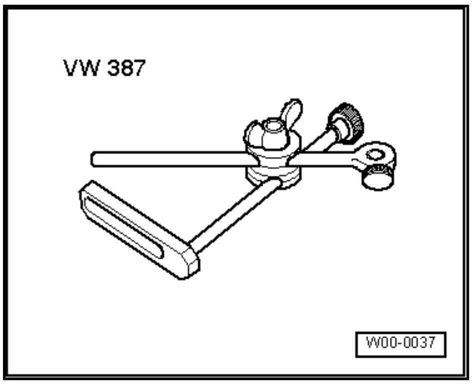
Valve dimensions for exhaust valves

Dimension		short exhaust valve	long exhaust valve
∅ a	mm	30.20	30.20
∅ b	mm	5.97	5.97
c	mm	102.20	136.20
α	∠°	44° 40'	44° 40'

2.5 Checking valve guides

Special tools and workshop equipment required

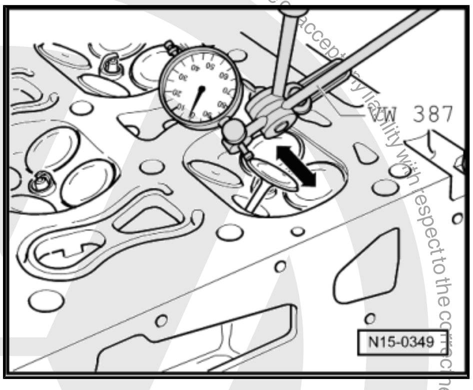
- Universal dial gauge bracket -VW 387-



- Dial gauge

Test procedure

– Insert new valve into guide. The end of the valve stem must be flush with the guide. On account of differing stem diameters, only use inlet valve in inlet guide and exhaust valve in exhaust guide.



– Determine rock.

• Wear limit: 0.8 mm.

If rock tolerance is exceeded:

– Renew cylinder head.

2.6 Reworking valve seats

Special tools and workshop equipment required

- Depth gauge
- Valve seat refacing tool

Procedure

Note

- *When repairing engines with leaking valves, it is not sufficient to rework or renew valve seats and valves. Particularly on high mileage engines, it is necessary also to check valve guides for wear* *⇒ page 86* *.*
- *Valve seats are only to be reworked to the extent required to yield a proper surface appearance. Before beginning to rework valve seats, calculate the maximum permissible reworking dimensions. If the reworking dimension is exceeded, the hydraulic valve clearance compensation can no longer be guaranteed and the cylinder head must be renewed.*

– Remove camshafts ⇒ page 73 .

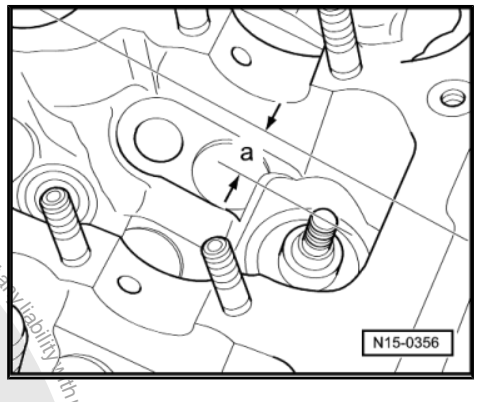
The max. permissible reworking dimension is calculated as follows:

– 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:

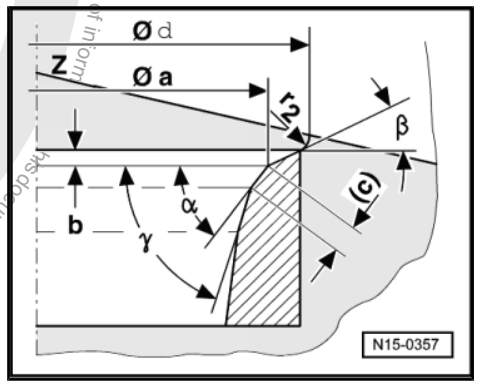
Short inlet valve	mm	31.8
Long inlet valve	mm	10.2
Short exhaust valve	mm	31.8
Long exhaust valve	mm	10.2

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

Example:

	Measured distance	10.6 mm
−	Minimum dimension	10.2 mm
=	Max. permissible reworking dimension	0.4 mm

Reworking inlet valve seat



a - = ∅ 32.8 mm

b - = max. permissible reworking dimension

c - = 0.9…1.5 mm

d - = max. ∅ 38.0 mm

r2 - = radius 2.0 mm

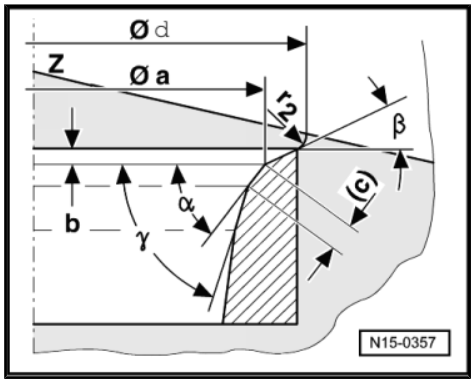
Z - = bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle

Reworking exhaust valve seat



a - = ∅ 29.8 mm

b - = max. permissible reworking dimension

c - = 1.2…1.7 mm

d - = max. ∅ 35.0 mm

r2 - = radius 2.0 mm

Z - = bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle

17 – Lubrication

1 Parts of lubrication system

Note

- *The oil level must not be above the max. mark - danger of damage to catalytic converter!*
- *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 this from causing further damage, perform the following repairs:*
- *Thoroughly clean oil channels.*
- *Renew oil non-return valve.*
- *Renew oil spray jets.*
- *Renew oil cooler.*
- *Renew oil filter.*

Engine oil ⇒ page 89 .

Assembly overview - sump ⇒ page 90 .

Removing and installing sump ⇒ page 92 .

Assembly overview - oil filter bracket ⇒ page 95 .

Removing and installing oil filter bracket ⇒ page 96 .

Assembly overview - oil pump ⇒ page 97 .

Checking oil pressure and oil pressure switch ⇒ page 99 .

1.1 Engine oil

Oil capacities

- Without oil filter: 5.0 l
- With oil filter 5.5 l

Engine oil specifications

⇒ Maintenance ; Booklet 38 ; Service tables .

Markings on oil dipstick

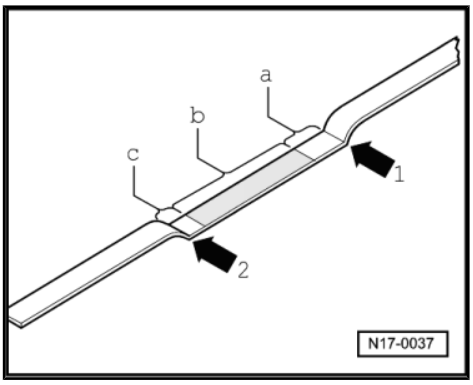
1 - Max. mark

2 - Min. mark

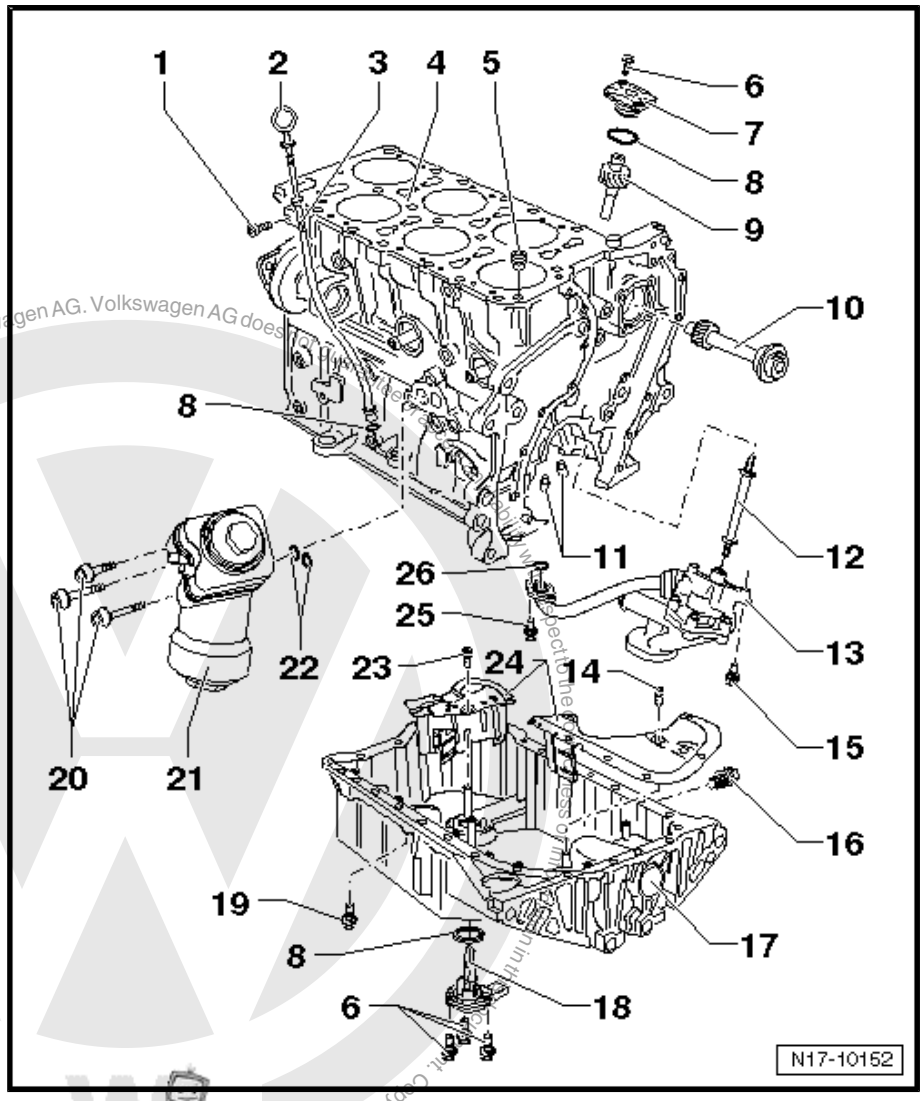
a - Area above hatched field up to max. mark: Do not top up with engine oil!

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

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



1.2 Assembly overview - sump



1 - 5 Nm

- ❑ Secured to intake manifold.

2 - Oil dipstick

- ❑ The oil level must not be above the max. mark!
- ❑ Markings ⇒ page 89 .

3 - Guide tube

- ❑ For oil dipstick.
- ❑ Secured with bolt to intake manifold.

4 - Cylinder block

- ❑ Removing and installing sealing flange and dual-mass flywheel ⇒ page 22 .
- ❑ Removing and installing crankshaft ⇒ page 30 .
- ❑ Dismantling and assembling pistons and conrods ⇒ page 36 .

5 - Oil non-return valve

- ❑ Removing and installing ⇒ page 92 .
- ❑ Note installation position.
- ❑ Clean if badly soiled

6 - 8 Nm

7 - Oil pump drive cover

8 - O-ring

- ❑ Renew.
- ❑ Oil before installing.

9 - Oil pump drive

10 - Intermediate shaft

11 - Oil spray jet

- ❑ For crankshaft bearings 2…7
- ❑ For piston cooling.
- ❑ Opening pressure: 2.0 bar
- ❑ Removing and installing ⇒ page 91 .
- ❑ See note ⇒ page 89 .

12 - Drive shaft

- ❑ For oil pump drive.

13 - Oil pump

- ❑ Assembly overview - oil pump ⇒ page 97

14 - 8 Nm

- ❑ Insert with locking fluid -D 000 600 A2- .

15 - 23 Nm

16 - Oil drain plug, 30 Nm

- ❑ Renew if seal is attached

17 - Oil sump

- ❑ Removing and installing ⇒ page 92 .

18 - Oil level and oil temperature sender -G266-

19 - 12 Nm

20 - 23 Nm

21 - Oil filter bracket

- ❑ Assembly overview - oil filter bracket ⇒ page 95
- ❑ Coolant hose schematic diagram ⇒ page 109 .

22 - Seal

- ❑ Renew.
- ❑ Oil before installing.

23 - 10 Nm

- ❑ Insert with locking fluid -D 000 600 A2- .

24 - Baffle plate

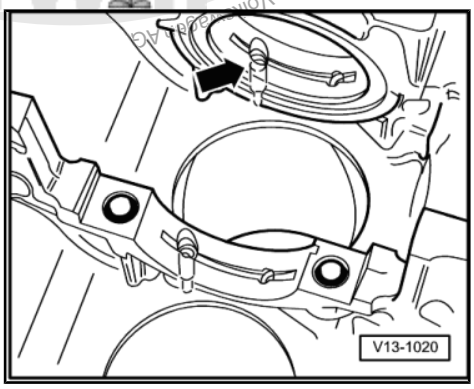
25 - 8 Nm

- ❑ Renew.

26 - Seal

- ❑ Renew if damaged.

Removing and installing oil spray jet



Special tools and workshop equipment required

- ♦ 4 mm ∅ drift
- ♦ 6 mm ∅ drift

Note

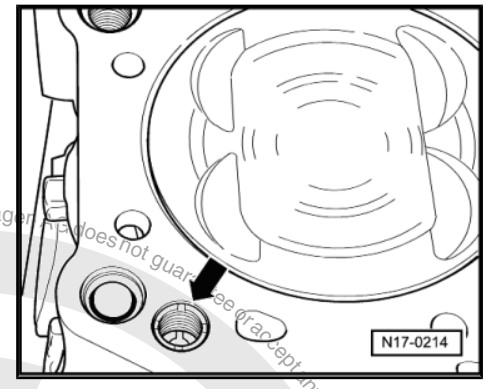
Oil spray jets are installed in main crankshaft bearings 2…7.

Removing

– Press oil spray jet out towards bearing using a 4 mm ∅ drift.

Installing

– To install, press oil spray jet in by hand using a 6 mm ∅ drift -arrow-.



Removing and installing oil non-return valve

Special tools and workshop equipment required

♦ Bolt -M8 x 1,5-

Removing

– Screw commercially available M8 x 1.5 bolt about 4 full turns into valve -arrow- and pull it out of bore.

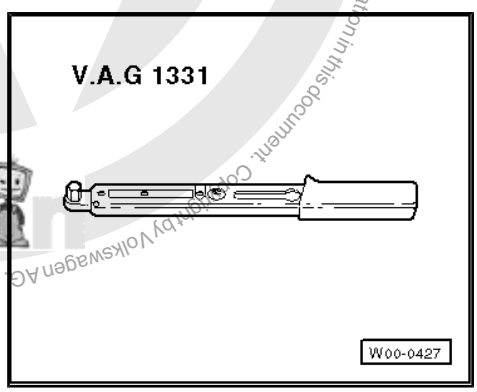
Installing

– Before installing, moisten O-ring with oil. Press valve into oil channel by hand.

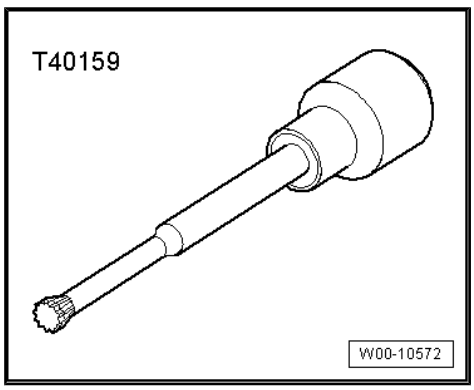
1.3 Removing and installing oil sump

Special tools and workshop equipment required

♦ Torque wrench -V.A.G 1331-



♦ Bit XZN 8 -T40159-



Not illustrated:

♦ Used oil collection and extraction unit -V.A.G 1782-

♦ Silicone sealant -D 176 501 A1-

- Hand drill with plastic brush attachment
- Flat scraper
- Eye protection

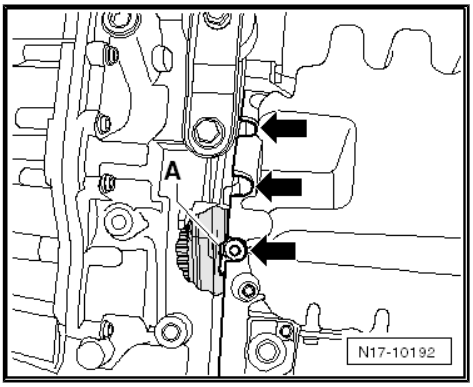
Removing

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

– Pull 3-pin connector off oil level and oil temperature sender -G266- (if fitted).

– Unbolt secondary air pump motor -V101- retainer from sump.

– Drain engine oil.



Note

- *Follow disposal regulations for engine oil!*
- *On vehicles with DSG® gearbox the flywheel has an indentation -A- to fit the sump bolts. Turn flywheel so that the bolt head is accessible.*

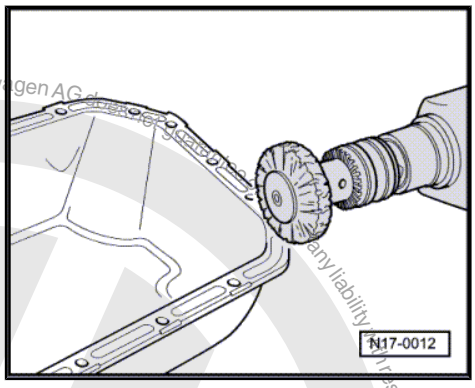
– Remove sump bolts on the gearbox side -arrows- using bit XZN 8 -T40159- .

– Remove remaining sump bolts and remove sump.

– Loosen sump with light blows of a rubber headed hammer if necessary.

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

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



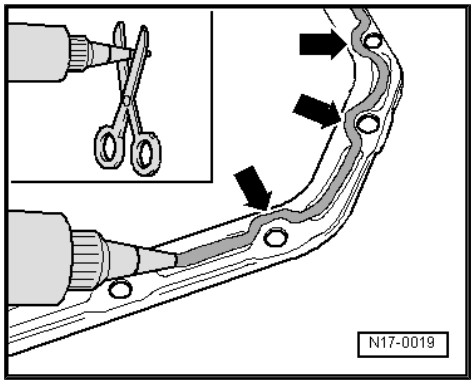
– Clean sealing surfaces; they must be free of oil and grease.

Installing

Note

- *Observe expiry date of sealing compound.*
- *The sump must be installed within 5 minutes of applying silicone sealing compound.*

– Cut off tube nozzle at forward marking (approx. 3 mm nozzle ∅).
– Apply sealant -D 176 501 A1- , as shown, to clean sump sealing surface. Sealant bead must be:

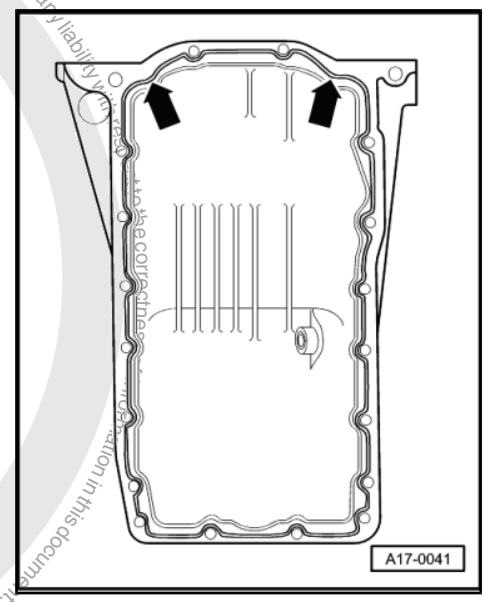


♦ 2…3 mm thick.
♦ Run bead along inner side of bolt holes -arrows-.

Note

♦ *The sealant bead must not be thicker, otherwise excessive sealant enters the sump and may block the oil suction pipe strainer.*
♦ *Let sealing compound dry for approx. 30 minutes after installing oil sump. Only then fill with engine oil.*

– Apply sealant -D 176 501 A1- as shown in figure to clean sealing surface of sump.
– Install sump immediately and tighten all sump bolts lightly.
– Tighten bolts between sump and gearbox by hand so that sump rests on gearbox.



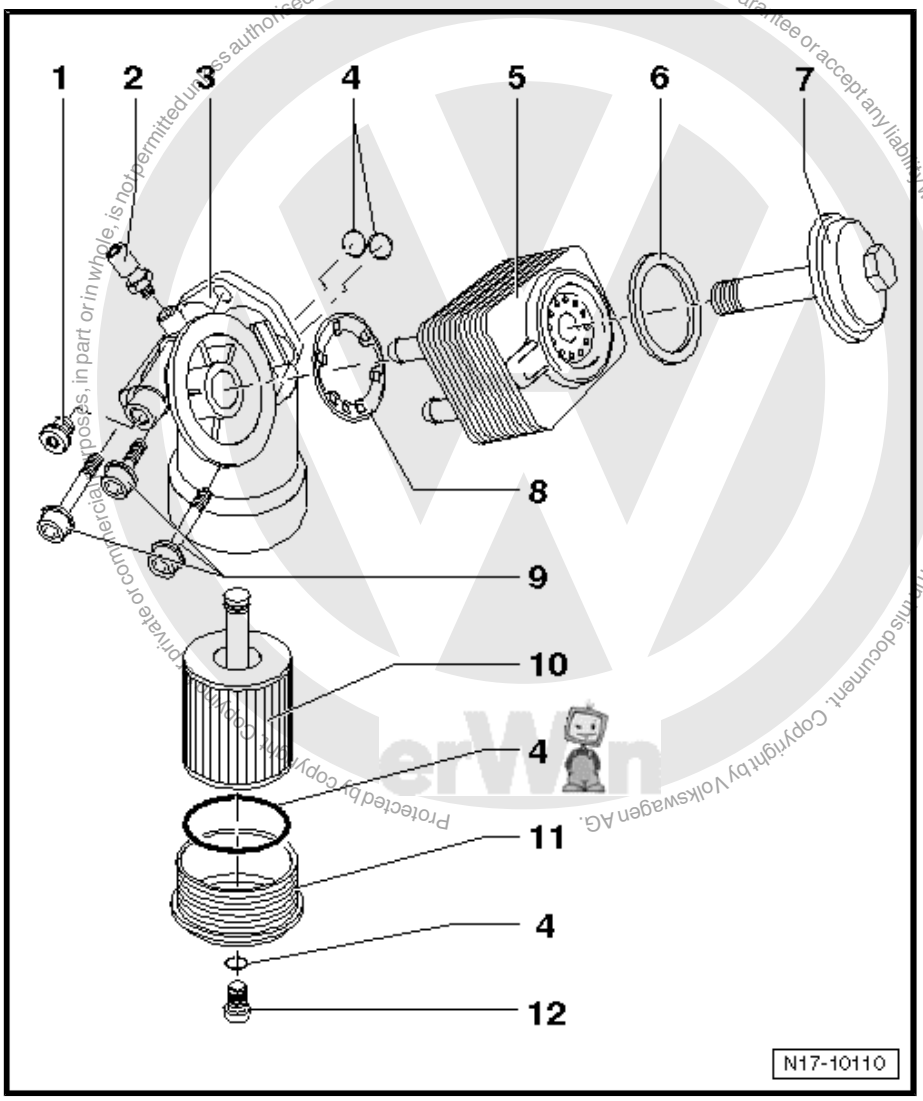
Note

If gearbox is removed, sump must align smoothly with cylinder block.

– Tighten oil sump bolts to 12 Nm.
– Tighten bolts securing sump to gearbox to 45 Nm.

Further assembly is basically the reverse of the dismantling sequence.

1.4 Assembly overview - oil filter bracket



1 - Plug, 15 Nm

- ❑ If seal is leaking, nip open and renew.

2 - Oil pressure switch -F1- , 20 Nm

- ❑ 0.9 bar switch
- ❑ If seal is leaking, nip open and renew.
- ❑ Checking ⇒ page 99 .

3 - Oil filter bracket

- ❑ With non-return valve.
- ❑ Opening pressure: 0.05 bar

4 - O-ring

- ❑ Renew.
- ❑ Oil before installing.

5 - Oil cooler

- ❑ Ensure clearance to adjacent components.
- ❑ See note ⇒ page 89 .
- ❑ Coolant hose schematic diagram ⇒ page 109 .

6 - Seal

- ❑ Renew.
- ❑ Oil before installing.

7 - Oil cooler cover, 25 Nm

8 - Oil cooler seal

- ❑ Renew.
- ❑ Note installation position ⇒ page 96 .
- ❑ Oil before installing.
- ❑ Insert into lugs on oil cooler

9 - 23 Nm

10 - Oil filter element

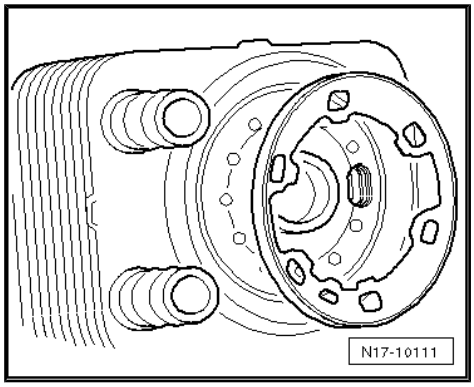
- ❑ Observe change intervals.
- ❑ See note ⇒ page 89 .

11 - Screw cap, 25 Nm

12 - Oil drain plug, 10 Nm

Installation position of oil cooler seal

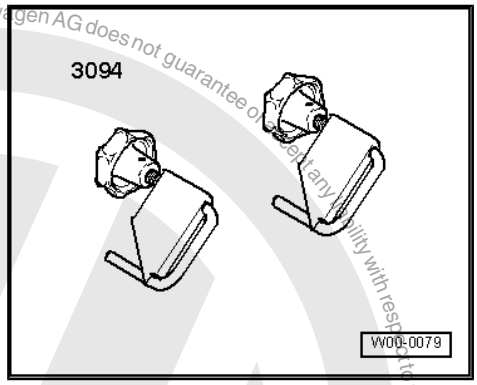
– Insert seal moistened with oil into oil cooler as illustrated. When doing this note installation position.



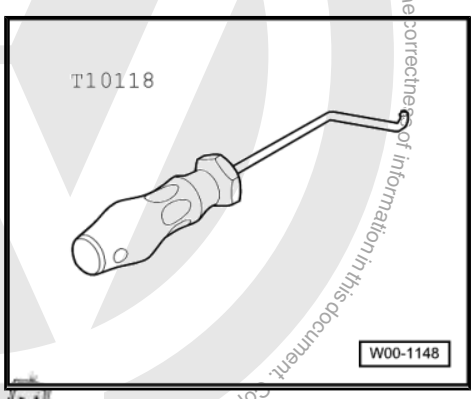
1.5 Removing and installing oil filter bracket

Special tools and workshop equipment required

♦ Hose clamps up to 25 mm Ø -3094-



♦ Assembly tool -T10118-



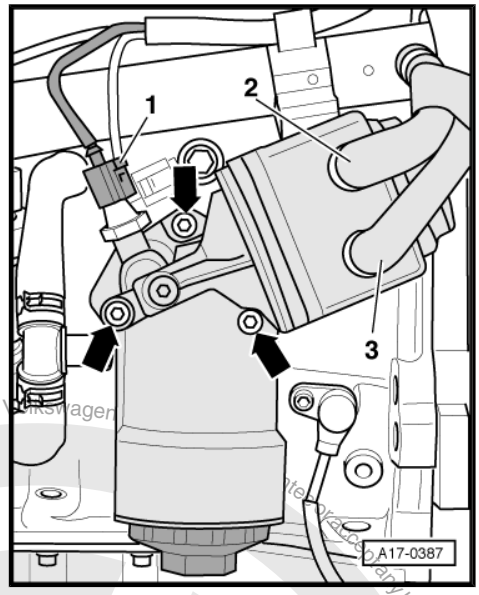
Removing

> **WARNING**
>
> ***Steam or hot coolant may escape when expansion tank is opened. Cover cap with cloth and open carefully.***

– Open cap for coolant expansion tank.

– Remove secondary air pump motor -V101- ⇒ page 204 .

– Detach coolant hoses -2- and -3- using hose clips -3094- .
– Disconnect electrical connector -1- at oil pressure switch using assembly tool -T10118- .
– Detach coolant hoses -2- and -3- on oil filter bracket.
– Unscrew bolts -arrows- and remove oil filter bracket.



Installing

Install in reverse order. In the process, note the following:

Note

Renew seals.

– Fill with coolant ⇒ page 110 .

Specified torque

Component	Nm
Oil filter bracket to cylinder block	23

1.6 Assembly overview - oil pump

Note

When installing the oil pump, note the following: first tighten all securing bolts by hand. Then tighten oil pressure pipe ⇒ Item 7 (page 98) to cylinder block and then to oil pump ⇒ Item 3 (page 98) . Finally tighten oil pump with securing bolts ⇒ Item 4 (page 98) .

1 - Shim

2 - Drive shaft

- ❑ For oil pump drive.

3 - Oil pump housing

4 - 23 Nm

5 - Oil pump cover with pressure relief valve

- ❑ Opening pressure: 5.3…5.7 bar.
- ❑ Clean strainer if soiled.

6 - Gears

- ❑ Checking backlash ⇒ page 98 .
- ❑ Checking axial clearance ⇒ page 99 .

7 - Oil pressure pipe

- ❑ On oil pump housing coat with AMV 188 001 02
- ❑ Secure only with new “microencapsulated” bolts

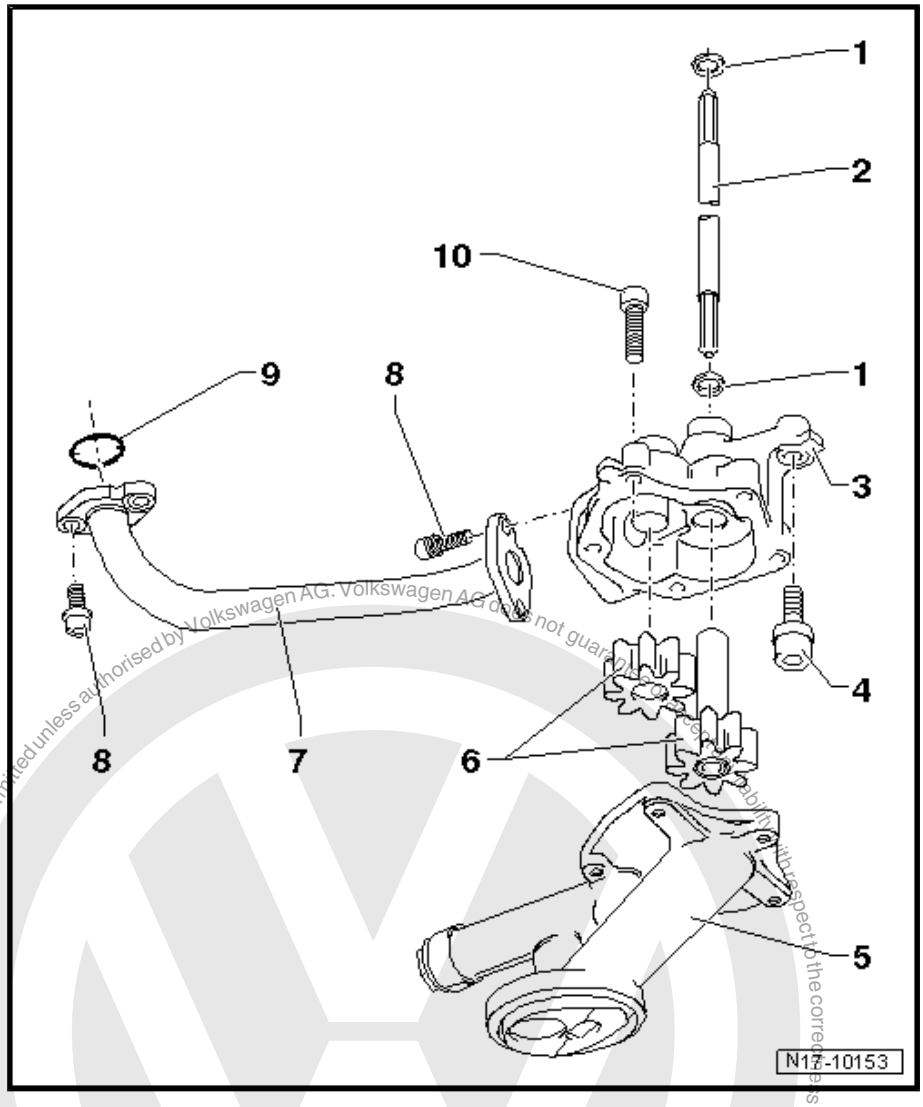
8 - 8 Nm

- ❑ Renew.

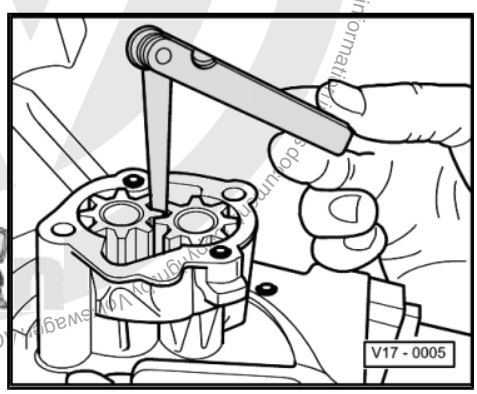
9 - Seal

- ❑ Renew if damaged.

10 - 8 Nm



Checking oil pump backlash

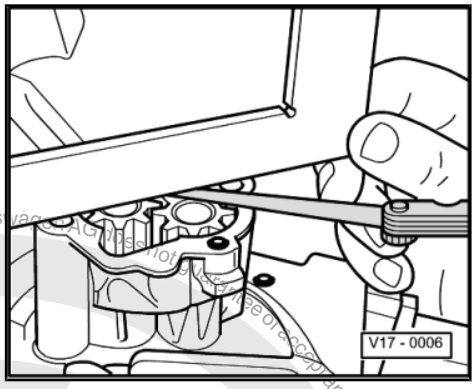


Special tools and workshop equipment required

♦ Feeler gauges

Wear limit: 0.20 mm.

Checking oil pump axial clearance



Special tools and workshop equipment required

- Straight edge
- Feeler gauges

Wear limit: 0.10 mm.

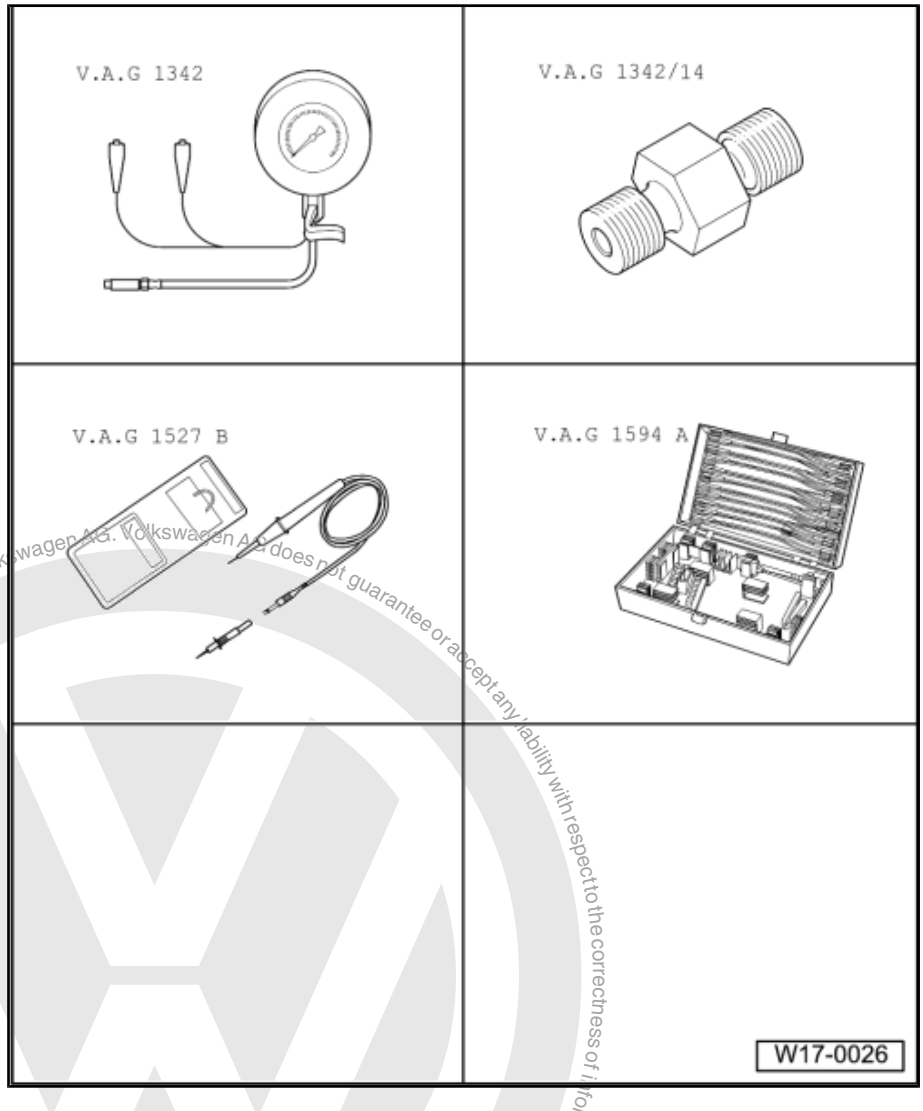
1.7 Checking oil pressure and oil pressure switch

Checking oil pressure switch ⇒ page 100 .

Checking oil pressure ⇒ page 101 .

Special tools and workshop equipment required

- Oil pressure tester -V.A.G 1342-
- Adapter -V.A.G 1342/14-
- Voltage tester -V.A.G 1527B-
- Auxiliary measuring set -V.A.G 1594C-



Note

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

Test prerequisites

- Engine oil level OK.
- Engine oil temperature at least 80 °C (radiator fan must have run once)

1.7.1 Checking oil pressure switch

– Move lock carrier into its service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier, service position .

– Unscrew sealing plug ⇒ Item 1 (page 95) from oil filter bracket. Collect leaking engine oil.

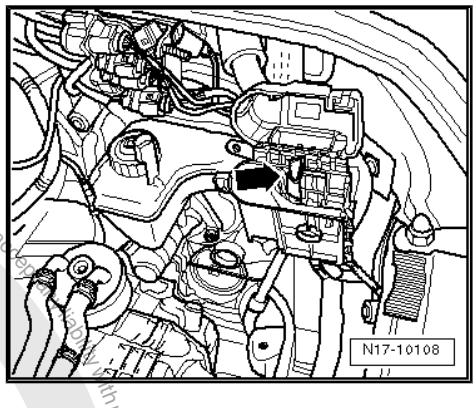
– Seal inspection hole for oil pressure switch on oil pressure tester -V.A.G 1342- using sealing plug for oil filter bracket,

– Screw oil pressure tester -V.A.G 1342- into oil filter bracket in place of plug using adapter -V.A.G 1342/14- .

Note

Observe installation position of adapter: the conical connecting piece of adapter must be screwed into pressure hose of tester.

– Connect brown wire of tester to earth (-).
– Connect voltage tester -V.A.G 1527B- with cables from auxiliary measuring set -V.A.G 1594C- to battery positive (+) (connection in engine compartment -arrow-) and oil pressure switch.



• LED must not light up.

If the LED lights up:

– Renew oil pressure switch -F1- ⇒ Item 2 (page 95) .

If LED does not light up:

Note

Observe tester and LED while starting, as switching point of oil pressure switch may already be exceeded when starting.

– Start engine and run at idling speed.
• At 0.7…1.1 bar the LED must light up; otherwise renew oil pressure switch -F1- ⇒ Item 2 (page 95) .

1.7.2 Checking oil pressure

Procedure

– Screw oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14- into oil filter bracket in place of sealing plug ⇒ page 100 .
– Check oil pressure at different revolutions:

♦ 1500 rpm: at least 1.7 bar
♦ 2000 rpm: 3.0…5.5 bar
♦ Over 2000 rpm: maximum 7.0 bar

If the specifications are not attained:

– Check strainer in oil suction pipe for contamination/soiling.
– Check pressure pipe between oil pump and cylinder block for leaks.

Note

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

If no fault can be found despite oil pressure being too low:

– Renew oil pump ⇒ page 97 .

Oil pressure must not exceed 7.0 bar.

If 7.0 bar is exceeded:

– Check oil channels.

Pressure relief valve in oil pump may be stuck.

– Renew oil pump ⇒ page 97

19 – Cooling

1 Removing and installing parts of cooling system

Caution

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

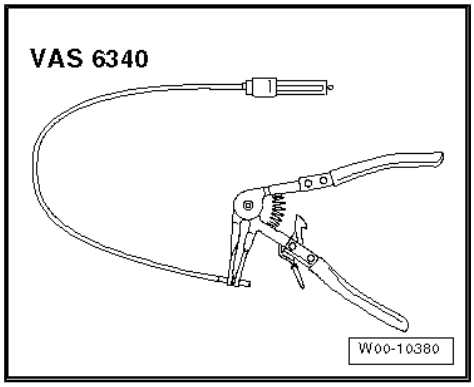
- *Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.*
- *Ensure that there is sufficient clearance to all moving or hot components.*

WARNING

Steam may escape when expansion tank is opened. Wear eye protection and protective 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.*
- *Hoses are secured with spring-type clips. In case of repair, only use spring-type clips.*
- *Spring-type clip pliers -VAS 6340- or spring-type clip pliers -VAS 5024A- are recommended for installation of spring-type clips.*
- *When installing coolant hoses, position them so they are free of tension and do not come into contact with other components.*
- *The arrows on the coolant pipes and on the ends of the hoses must be aligned with each other.*
- *Renew gaskets and seals.*



Test for leaks in cooling system using cooling system tester -V.A.G 1274- and adapters -V.A.G 1274/8- and -V.A.G 1274/9- .

Assembly overview - cooling system, body side ⇒ page 104 .

Assembly overview - cooling system, engine side ⇒ page 106 .

Assembly overview - thermostat housing ⇒ page 107 .

Coolant hose schematic diagram ⇒ page 109 .

Draining and filling with coolant ⇒ page 110 .

Coolant mixture ratios ⇒ page 110 , draining and filling with coolant.

Removing and installing fan support with fans ⇒ page 113 .

Removing and installing radiator ⇒ page 115 .

Checking continued coolant circulation pump ⇒ page 116 .

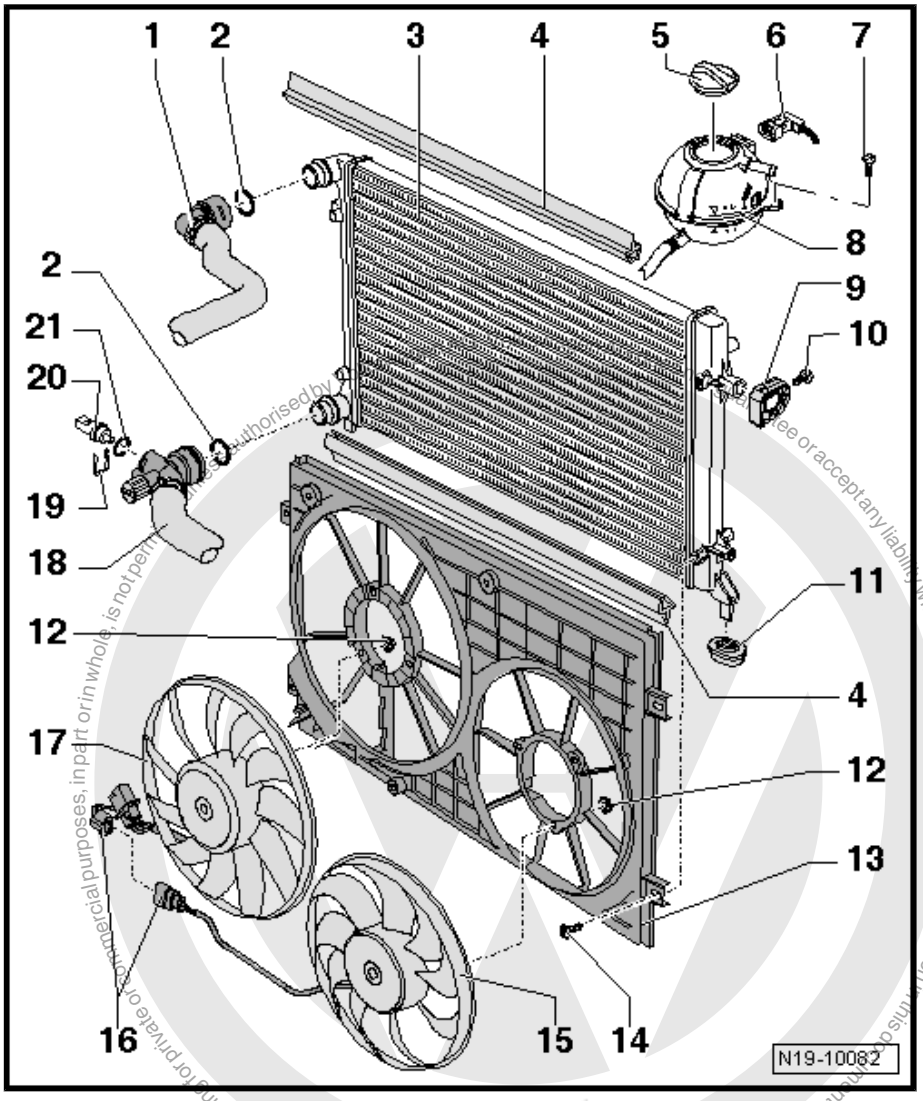
Removing and installing coolant pump ⇒ page 118 .

Checking cooling system for leaks ⇒ page 126 .

1.1 Assembly overview - parts of cooling system, body side

Note

Coolant hose schematic diagram ⇒ page 109 .



1 - Upper coolant hose

- ❑ From thermostat housing.

2 - O-ring

- ❑ Renew if damaged.

3 - Radiator

- ❑ Removing and installing ⇒ page 115 .
- ❑ After renewing, renew entire coolant.

4 - Gasket

5 - Cap

- ❑ Pressure relief valve must open at between 1.4…1.6 bar.
- ❑ Checking ⇒ page 126 .

6 - Connector

7 - 3 Nm

8 - Expansion tank

- ❑ Checking cooling system for leaks ⇒ page 126 .

9 - Bracket

- ❑ For radiator.

10 - 7 Nm

11 - Support

12 - 5 Nm

13 - Fan support

- ❑ Removing and installing fan support with fans ⇒ page 113 .

14 - 5 Nm

15 - Radiator fan 2 -V177-

- ❑ Removing and installing fan support with fans ⇒ page 113 .

16 - Connector

17 - Radiator fan -V7-

- ❑ With radiator fan control unit -J293-
- ❑ Removing and installing fan support with fans ⇒ page 113 .

18 - Lower coolant hose

- ❑ To thermostat housing.

19 - Retaining clip

20 - Radiator outlet coolant temperature sender -G83-

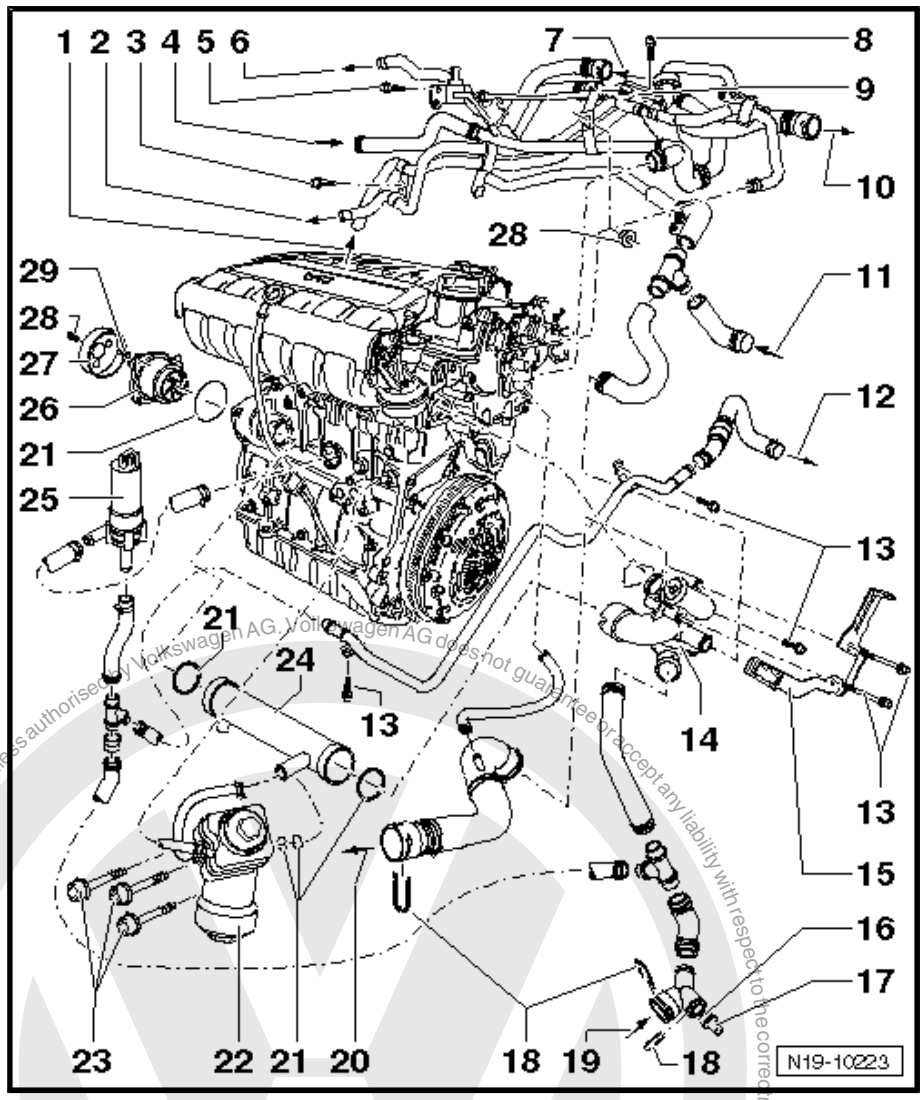
21 - O-ring

- ❑ Renew.

1.2 Assembly overview - cooling system, engine side

Note

- *Coolant hose schematic diagram* ⇒ page 109 .
- *Fitting locations of non-return valves* ⇒ page 109 , *coolant hose schematic diagram*



1 - From auxiliary heater

- ❑ Vehicles with optional equipment only

2 - To auxiliary heater

- ❑ Vehicles with optional equipment only

3 - 45 Nm

4 - From bottom of expansion tank

5 - 10 Nm

6 - To top of expansion tank

7 - From heater coolant shut-off valve -N279-

- ❑ Vehicles with optional equipment only

8 - 10 Nm

9 - To heater coolant shut-off valve -N279-

- ❑ Vehicles with optional equipment only

10 - To heat exchanger

11 - From gearbox oil cooler

12 - To gearbox oil cooler

13 - 8 Nm

14 - Thermostat housing

- ❑ Assembly overview - thermostat housing ⇒ page 107

15 - Bracket

16 - O-ring

- ❑ Renew.

17 - Radiator outlet coolant temperature sender -G83-

18 - Retaining clip

- ❑ Check for secure seating.

19 - From bottom of radiator

20 - To top of radiator

21 - O-ring

- ❑ Renew.

22 - Oil filter bracket

- ❑ With oil cooler

23 - 23 Nm

24 - Coolant pipe

- ❑ To thermostat housing.
- ❑ Removing and installing ⇒ page 120 .

25 - Continued coolant circulation pump -V51-

- ❑ Bolted to ancillary unit bracket to 8 Nm.
- ❑ To remove, remove bracket for ancillaries ⇒ Heating, air conditioning system; Rep. Gr. 87 .
- ❑ Location of continued coolant circulation pump -V51- ⇒ page 107
- ❑ Checking continued coolant circulation pump -V51- ⇒ page 116

26 - Coolant pump

- ❑ Check for ease of movement.
- ❑ Removing and installing ⇒ page 118 .

27 - Belt pulley

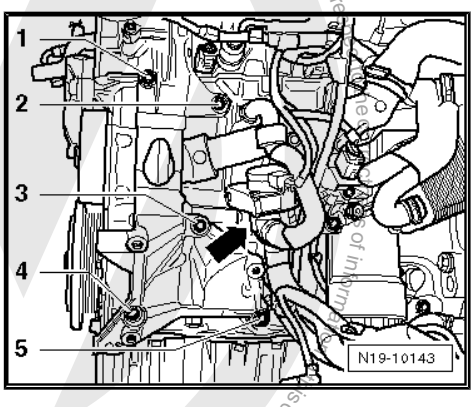
- ❑ For coolant pump.
- ❑ Removing and installing ⇒ page 118 , Removing and installing coolant pump

28 - 20 Nm

29 - 8 Nm

Location of continued coolant circulation pump -V51-

The continued coolant circulation pump -V51- is secured to ancillary unit bracket -arrow-.



– To remove, ancillary bracket must be removed from cylinder block.

Bolt-tightening sequence for ancillary bracket:

– First tighten both fitted bolts -2- and -4- hand tight.

– Then tighten bolts -1-, -3- and -5- by hand

– Then tighten all bolts evenly and diagonally.

Specified torque: 23 Nm.

1.3 Assembly overview - thermostat housing

Note

Coolant hose schematic diagram ⇒ page 109 .

1 - O-ring

- ❑ Renew.

2 - Retaining clip

- ❑ Check for secure seating.

3 - Thermostat housing

- ❑ Removing and installing ⇒ page 120 .

4 - 8 Nm

5 - Coolant pipe

- ❑ To gearbox oil cooler

6 - Bracket

7 - Thermostat

- ❑ Removing and installing ⇒ page 123 .
- ❑ Checking: heat thermostat in water.
- ❑ Opening begins at approx. 80 °C.
- ❑ Ends at approx. 105 °C
- ❑ Opening lift min. 7 mm

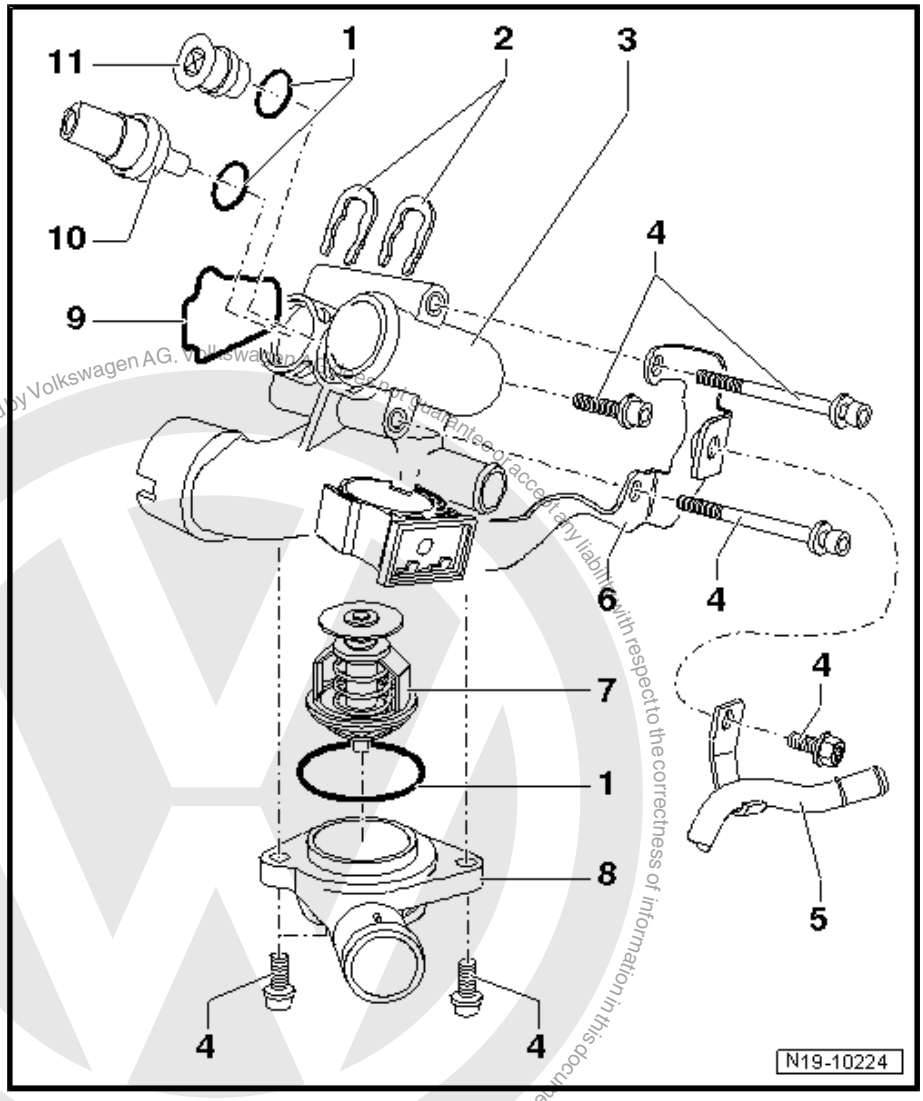
8 - Connection

9 - Seal

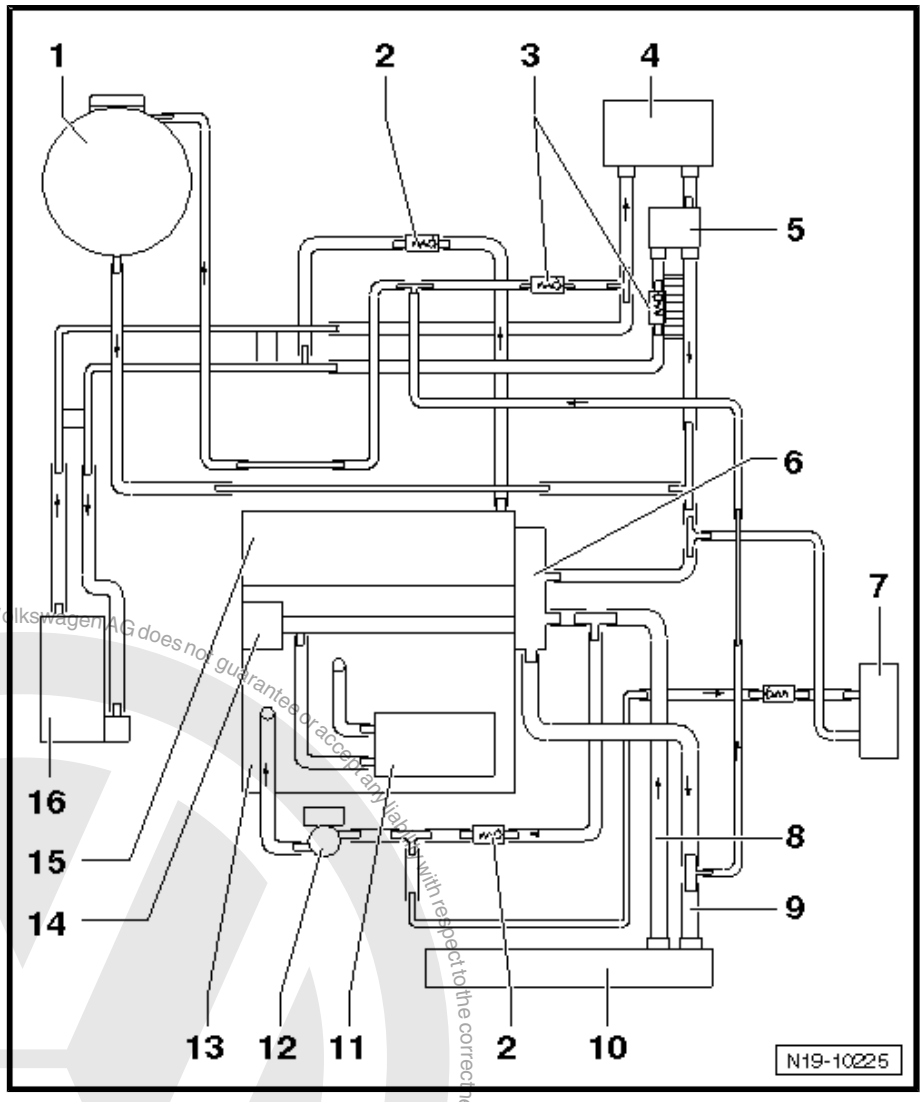
- ❑ Renew.

10 - Coolant temperature sender -G62-

11 - Plug



1.4 Coolant hose schematic diagram



1 - Expansion tank

2 - Non-return valve

- ❑ Note installation position.
- ❑ Arrow on non-return valve points in direction of flow

3 - Non-return valve

- ❑ Integrated in coolant hose, not visible from outside

4 - Heat exchanger for heater unit

- ❑ If renewed, refill system with fresh coolant.

5 - Heater coolant shut-off valve -N279-

- ❑ Vehicles with optional equipment only

6 - Thermostat housing

7 - Gearbox oil cooler

8 - Lower coolant hose

9 - Upper coolant hose

10 - Radiator

11 - Oil cooler

- ❑ For engine oil.

12 - Continued coolant circulation pump -V51-

13 - Cylinder block

14 - Coolant pump

15 - Cylinder head

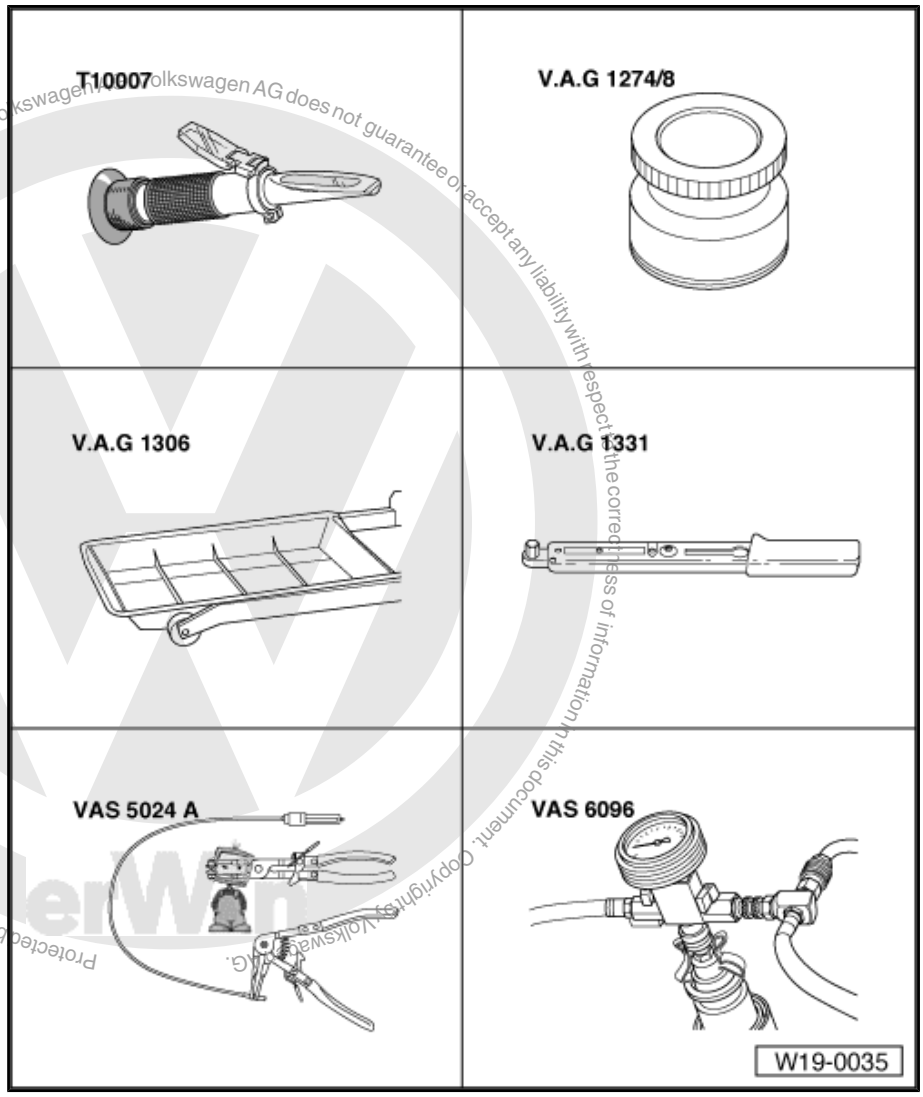
16 - Auxiliary heater

- ❑ Vehicles with optional equipment only

1.5 Draining and filling coolant

Special tools and workshop equipment required

- Refractometer -T10007-
- Adapter for cooling system tester -V.A.G 1274/8-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench -V.A.G 1331-
- Spring-type clip pliers -VAS 5024A-
- Cooling system charge unit -VAS 6096-



Drain coolant:

Note

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

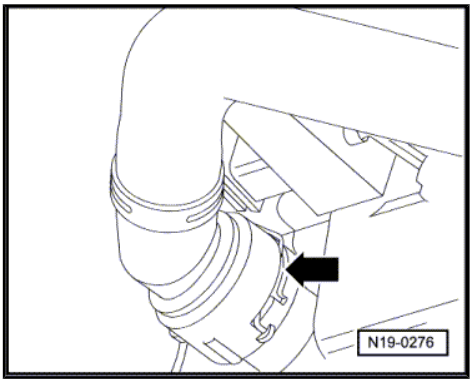
WARNING

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

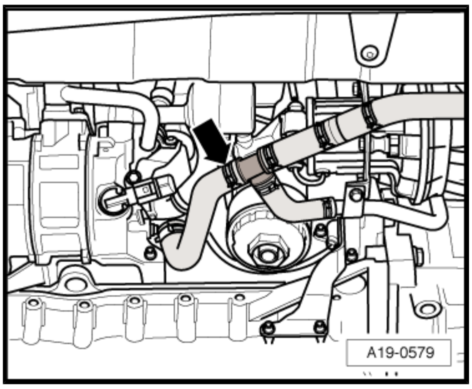
– Carefully open cap on coolant expansion tank.

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

– Release quick-release coupling -arrow- and remove lower coolant hose from radiator.



– Remove additional bottom coolant hose to continued coolant circulation pump -V51- -arrow- and allow remaining coolant to drain out.



Note

Follow disposal regulations for coolant!

Filling with coolant:

Caution

For mixing, only potable water may be used. Soiled water does not have the required quality to ensure the coolant's function.

Note

- *In vehicles as of model year 2008, only G 12 plus-plus according to TL VW 774 G may be used as coolant additive.*
- *The coolant additive G 12 plus-plus can be mixed with the previous coolant additive G 12 plus. Identification: both are coloured purple.*
- *Coolant additives marked “according to TL VW 774 G” or “according to TL VW 774 F” prevent frost and corrosion damage, scaling. Such additives also raise the boiling point of the coolant. Therefore, the cooling system must be filled all year round with coolant additive.*
- *Because of its higher boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *The frost protection must be guaranteed to approx. -25 °C. In countries with an arctic climate, to approx. -35 °C.*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The coolant additive concentration must be at least 40 %.*
- *If a stronger anti-freeze mixture is necessary due to harsher weather conditions, it can be increased using G 12 plus-plus. It may only be strengthened, however, to 60 % (antifreeze protection to about -40 °C). Otherwise, the antifreeze protection will be reduced again and the cooling effect will be impaired.*
- *The refractometer -T10007- is recommended for determining the current anti-freeze density.*
- *If radiator, heat exchanger, cylinder head or cylinder head gasket is renewed, do not reuse old coolant.*

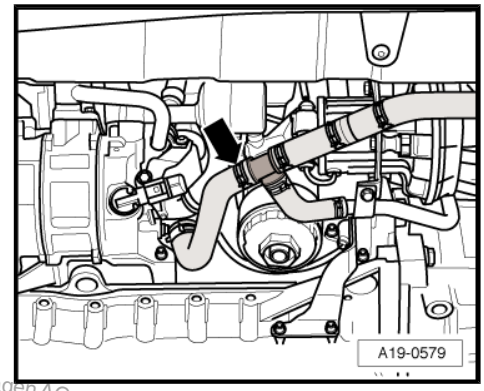
Recommended mixture ratios:

Frost protection to	Anti-freeze proportion	G 12 plus-plus G 12 plus[1]	Tap water [1]
-25 °C -35 °C	40 % 50 %	3.6 l 4.5 l	5.4 l 4.5 l

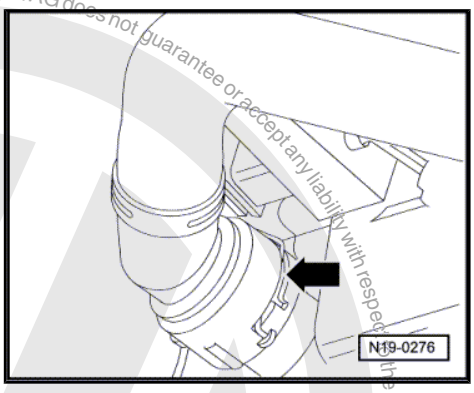
1) The quantity of coolant can vary depending upon vehicle equipment.

Procedure

– Reconnect coolant hose to continued coolant circulation pump -V51- -arrow-.



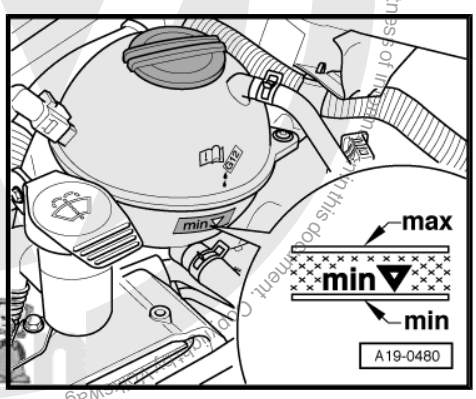
– Push lower coolant hose onto radiator union and secure.
– Screw adapter for cooling system tester -V.A.G 1274/8- onto expansion tank.
– Fill coolant circuit using cooling system charge unit - VAS 6096- ⇒ Operating instructions for cooling system charge unit VAS 6096.



WARNING

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

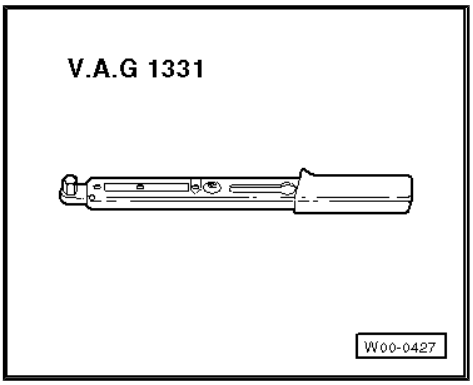
– Check coolant level and top-up if necessary. When the engine is at normal operating temperature, the coolant level must be at the upper mark; when the engine is cold, in the middle of the shaded field.
– Install noise insulation ⇒ General body repairs, exterior; Rep. Gr. 50 ; Noise insulation. .



1.6 Removing and installing fan support with fans

Special tools and workshop equipment required

♦ Torque wrench -V.A.G 1331-



Removing

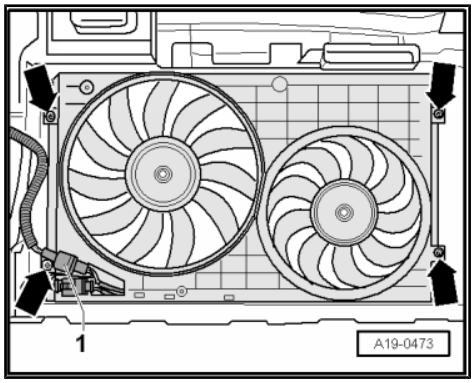
– Remove noise insulation ⇒ General body repairs, exterior; Rep. Gr. 50 ; Noise insulation .

– Unclip coolant hose from fan support.

– Remove air duct system from air filter ⇒ page 174 .

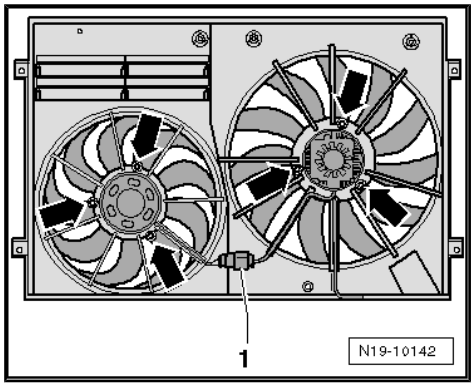
– Separate connector -1- and remove fan support securing bolts -arrows-.

– Remove fan support with fans.



– Separate connection -1- and free wiring.

– Remove securing nuts -arrows- and remove fans.



Installing

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

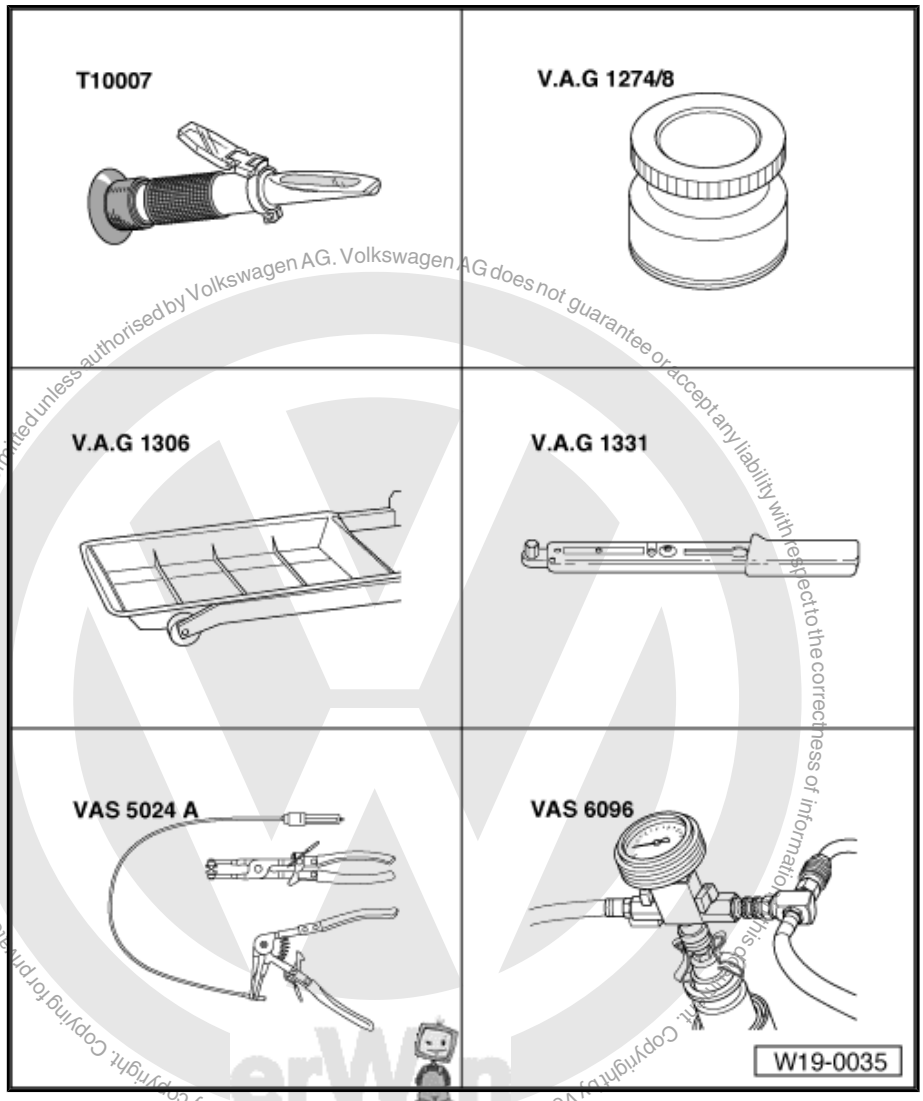
Specified torques:

Component	Nm
Radiator fans to fan support	5
Fan support to radiator	5

1.7 Removing and installing radiator

Special tools and workshop equipment required

- Refractometer -T10007-
- Adapter for cooling system tester -V.A.G 1274/8-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench -V.A.G 1331-
- Spring-type clip pliers -VAS 5024A-
- Cooling system charge unit -VAS 6096-



Removing

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

– Remove front bumper ⇒ General body repairs, exterior; Rep. Gr. 63 ; Front bumper .

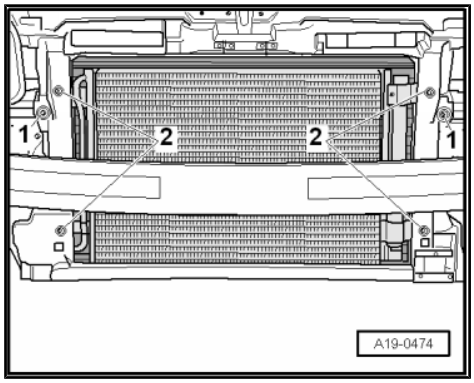
– Move lock carrier into its service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier, service position .

– Drain coolant ⇒ page 110 .

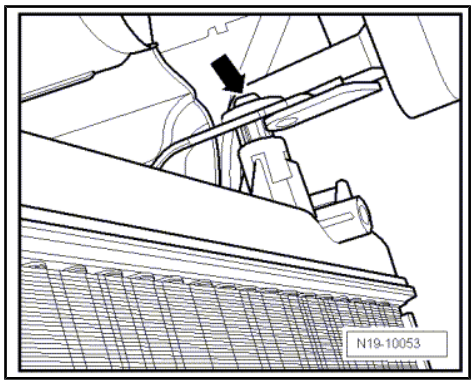
– Pull all coolant hoses off radiator.

– Remove fan support with fans ⇒ page 113 .

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



– Unscrew lateral securing bolt -arrow- from condenser on radiator.
– Remove radiator upwards.



Installing

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

Note

If a new radiator is installed, the old coolant may not be reused.

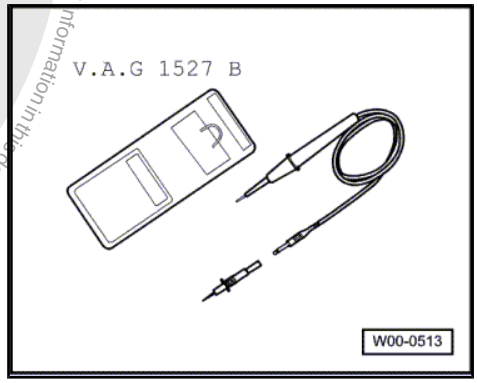
– Fill cooling system with coolant ⇒ page 110 .

Component	Nm
Radiator mounting to lock carrier	5
Condenser to radiator	5
Fan support to radiator	5

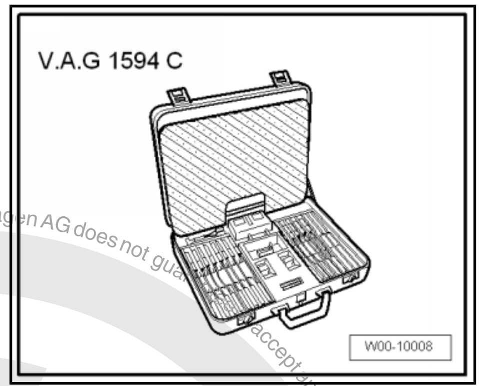
1.8 Checking continued coolant circulation pump

Special tools and workshop equipment required

◆ Voltage tester -V.A.G 1527B-



♦ Auxiliary measuring set -V.A.G 1594C-



♦ Current flow diagram

Test prerequisite

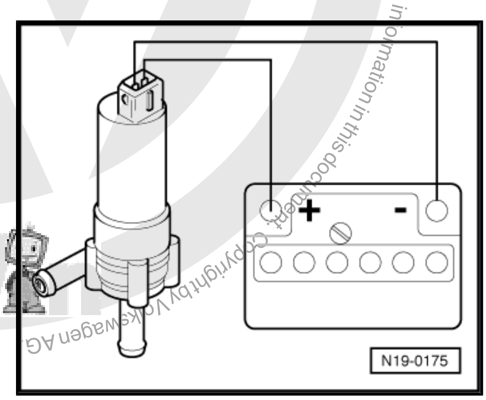
• Fuses must be OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

Test procedure

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

– Pull 2-pin connector off continued coolant circulation pump -V51- .

– Connect contacts of continued coolant circulation pump -V51- to battery using adapter cables from auxiliary set -V.A.G 1594C- .



• The continued coolant circulation pump must run.

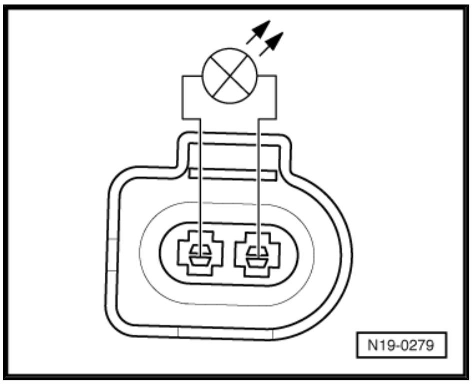
If the continued coolant circulation pump -V51- does not run:

– Renew continued coolant circulation pump -V51- .

If the continued coolant circulation pump -V51- runs:

– Switch ignition off and on again.

– Connect voltage tester -V.A.G 1527B- to connector detached from continued coolant circulation pump -V51- using auxiliary cables from adapter set -V.A.G 1594C- .



• The LED must light up.

Note

This check must be performed within 10 minutes of ignition being switched off.

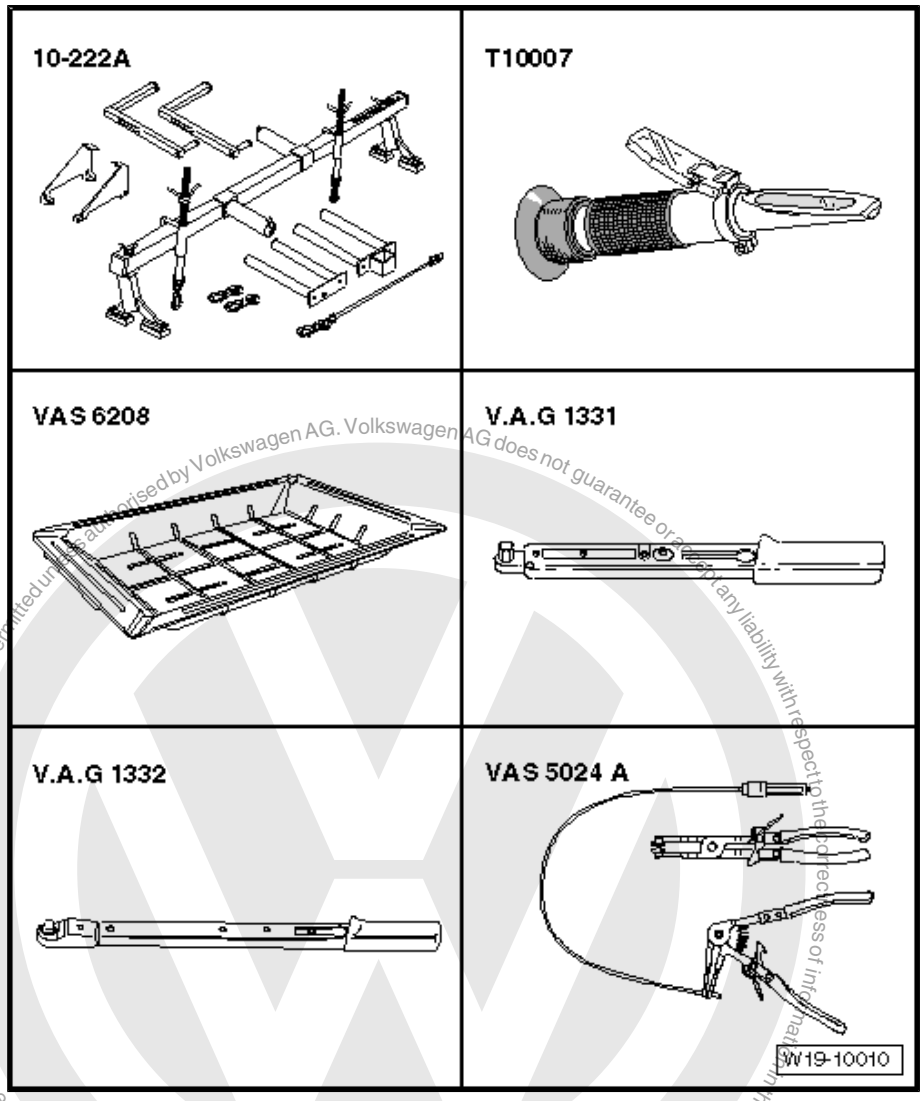
If LED does not light up:

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

1.9 Removing and installing coolant pump

Special tools and workshop equipment required

- Support bracket -10 - 222 A- with hooks -10 - 222 A / 10- , shackle -10 - 222 A / 12- and adapter -10 - 222 A /13- and adapter -10 - 222 A /18-
- Refractometer -T10007-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench -V.A.G 1331-
- Torque wrench -V.A.G 1332-
- Spring-type clip pliers -VAS 5024 A-

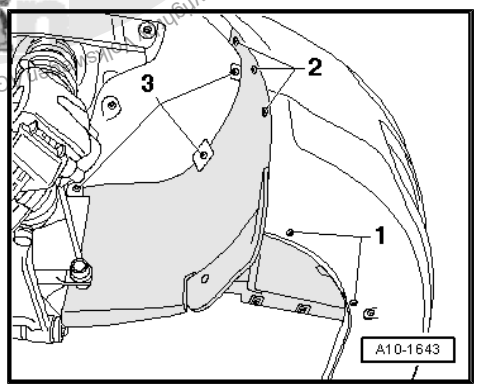


Removing

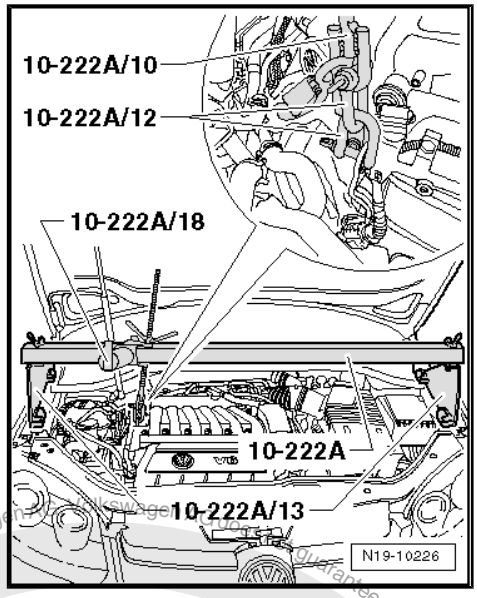
– Drain coolant ⇒ page 110 .

– Remove front right part of wheel housing liners ⇒ General body repairs, exterior; Rep. Gr. 66 ; Removing and installing wheel housing liner .

– Remove poly V-belt ⇒ page 20 .



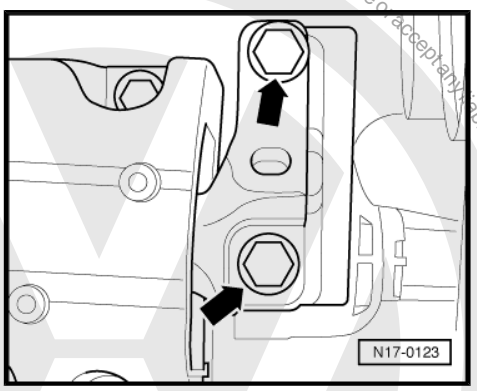
– Fit support bracket -10 - 222 A- with hooks -10 - 222 A /10- , shackle -10 - 222 A /12- , adapter -10 - 222 A /13- and adapter -10 - 222 A /18- as shown and take up weight of engine in installation position at right lifting eye.



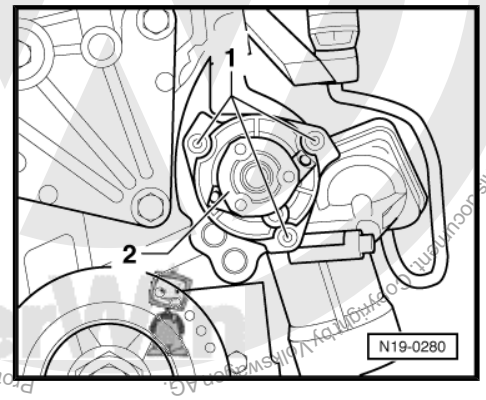
– Unbolt engine side of assembly mounting from engine bracket -arrows-.

– Lower engine 40 mm using support bracket -10 - 222 A- .

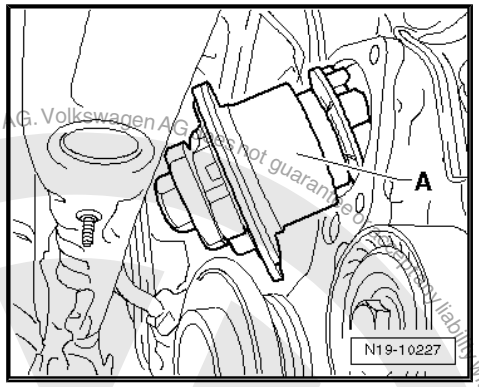
– Remove coolant pump belt pulley. To do this, counterhold belt pulley with a drift (commercially available).



– Unscrew coolant pump securing bolts -1-.



– Swing out coolant pump -A- as illustrated.



Installing

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

– Moisten new O-ring with coolant.

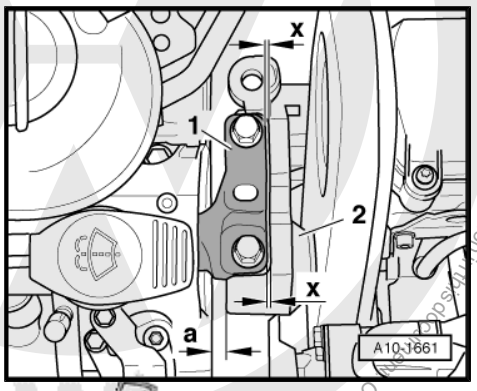
– Fit coolant pump.

– Tighten securing bolts for coolant pump. Specified torque: 8 Nm.

– Install belt pulley for coolant pump. Specified torque: 20 Nm.

– Raise engine again using support bracket -10 - 222 A- and fit with new securing bolts to assembly mounting.

– Align engine mountings as follows:



♦ There must be a distance of -a- at least 10 mm between engine support and longitudinal member (right side).

♦ The side surface of the engine support -2- should be located parallel to the support arm -1-.

Note

Specified torques for assembly mountings ⇒ page 13 .

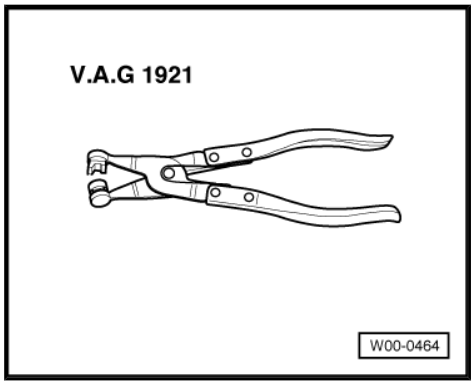
– Install poly V-belt ⇒ page 20 .

– Replenish coolant ⇒ page 110 .

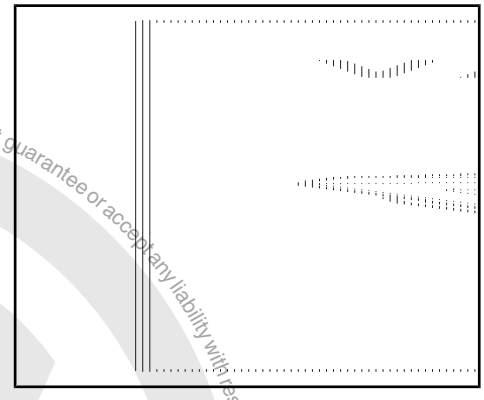
1.10 Removing and installing thermostat housing

Special tools and workshop equipment required

♦ Hose clip pliers -V.A.G 1921-



♦ Drip tray for workshop hoist -VAS 6208-



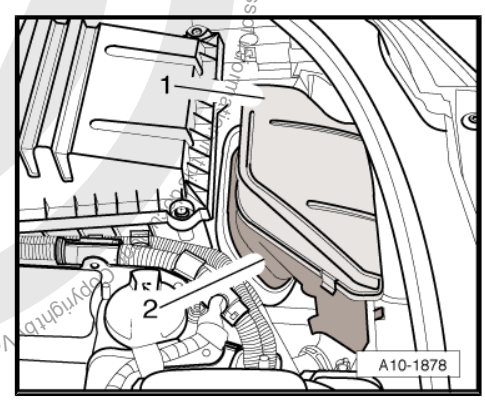
Removing

– Drain coolant ⇒ page 110 .

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

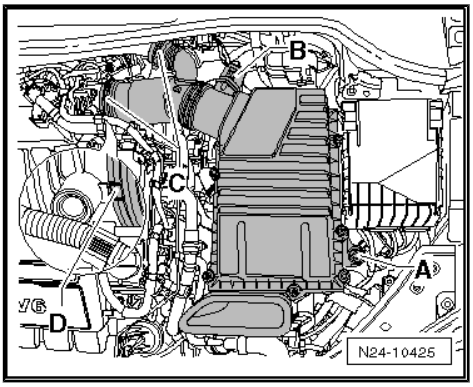
– Pull cover -1- off air duct. Release fasteners on side for this.

– Unclip air duct -2-.



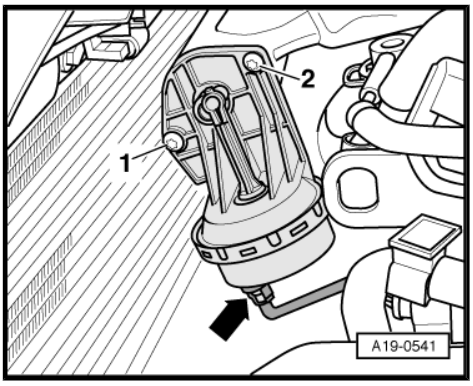
– Remove air filter housing and connecting hose. To do this, unscrew bolt -A-, pull off connector -B- and loosen spring-type clips -C-. Note marking -D- when reinstalling.

– Pull off air filter housing upwards.

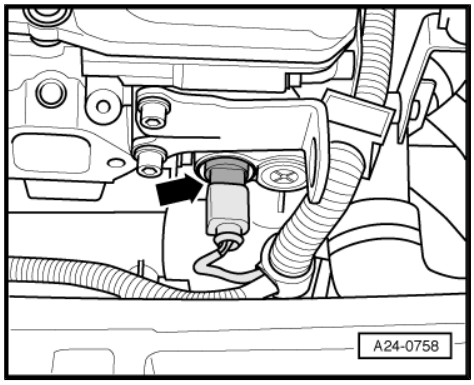


– Pull off vacuum hose -arrow- from positioner element for variable intake manifold changeover.

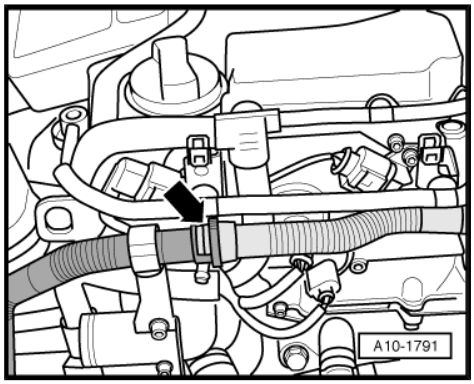
– Unscrew bolts -1- and -2- and pull off positioner element from intake manifold.



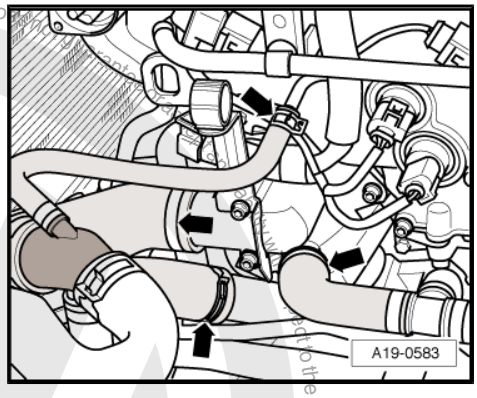
– Disconnect electrical connector -arrow- on coolant temperature sender -G62- .



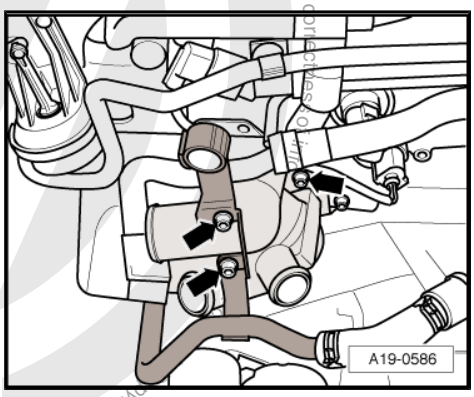
– Detach secondary air hose at position marked by -arrow-.
– Place air hose on bracket to one side.



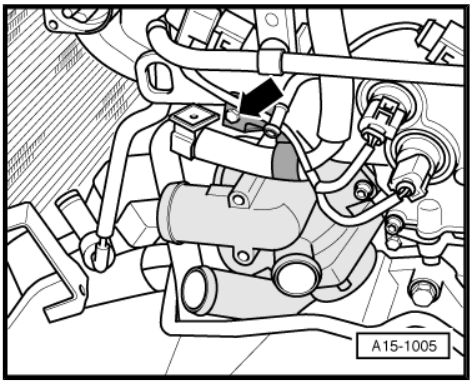
– Detach coolant hoses at positions marked by -arrows-.



– Unscrew bolts -arrows-.
– Pull bracket for coolant pipe of gear oil cooler to left.
– Swivel bracket for secondary air hose forwards.



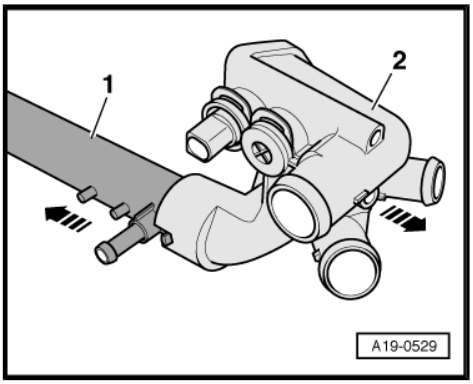
– Remove bolt -arrow- on bracket for wiring harness.



Caution

Use lever to push coolant pipe in direction of coolant pump when pulling off thermostat housing so that pipe is not pulled off as well.

– Pull off coolant thermostat housing -2-. Push coolant pipe -1- towards coolant pump with a lever when doing this.



Installing

Install in reverse order. In the process, note the following:

Note

Renew seals and gaskets.

– Fill with coolant ⇒ page 110 .

– Connect battery. Necessary measures ⇒ Rep. Gr. 27 .

Specified torques

Component	Nm
Thermostat housing to engine	10
Wiring harness bracket to engine	10
Air filter housing on body	10

1.11 Removing and installing thermostat

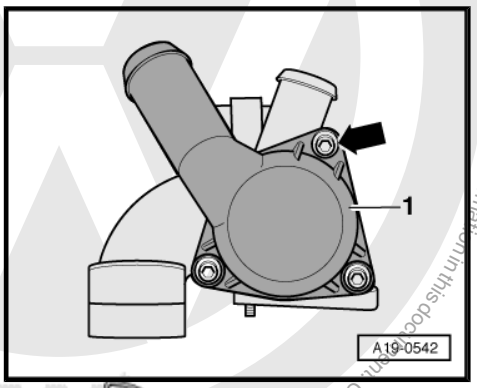
Removing

Note

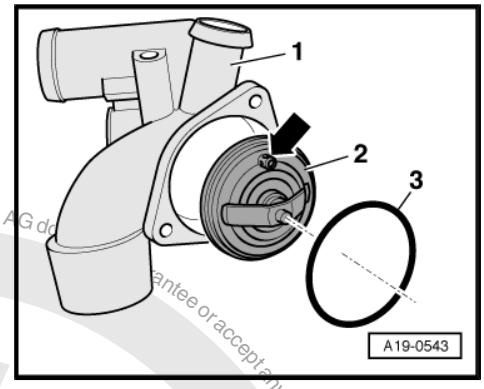
Collect drained coolant in a clean container for re-use or disposal.

– Remove thermostat housing ⇒ page 120 .

– Unscrew bolts -arrows- and remove union -1-.



– Remove O-ring -3- with thermostat -2- from thermostat housing -1-.



Installing

Install in reverse order. In the process, note the following:

Note

Renew gaskets and seals.

– Clean sealing surface for O-ring.
– Install thermostat.
• Installation position: Align breather valve -arrow- as shown in illustration.
– Moisten new O-ring -1- with coolant.
– Screw on union to thermostat housing.
– Install thermostat housing ⇒ page 120 .

Specified torque

Component	Nm
Union to thermostat housing	10

1.12 Removing and installing coolant pipe

Removing

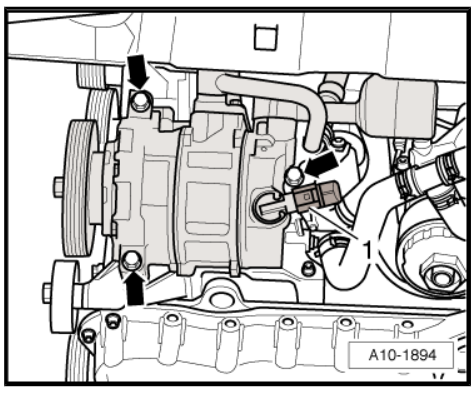
Note

Collect drained coolant in a clean container for re-use or disposal.

Caution

Observe notes on procedure for disconnecting the battery ⇒ Rep. Gr. 27 .

– Remove thermostat housing ⇒ page 120 .
– Remove secondary air pump motor -V101- ⇒ page 204 .
– Remove poly V-belt ⇒ page 20 .
– Disconnect electrical connector -1- for magnetic coupling on air conditioner compressor and place electric cable to one side.

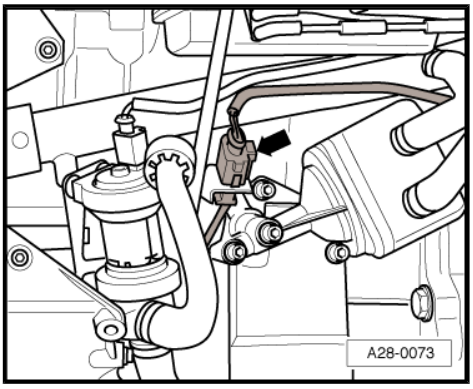


WARNING

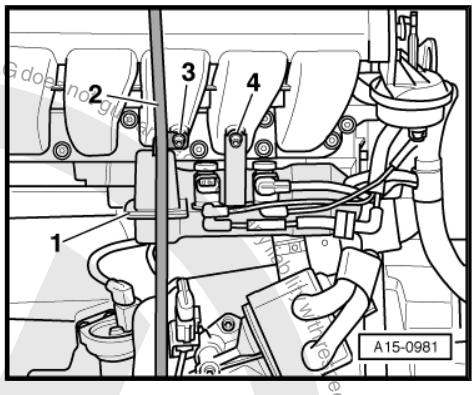
The air conditioner refrigerant circuit must not be opened.

– Remove bolts -arrow- for air conditioner compressor.
– Tie up air conditioner compressor with refrigerant lines connected to front of side member.

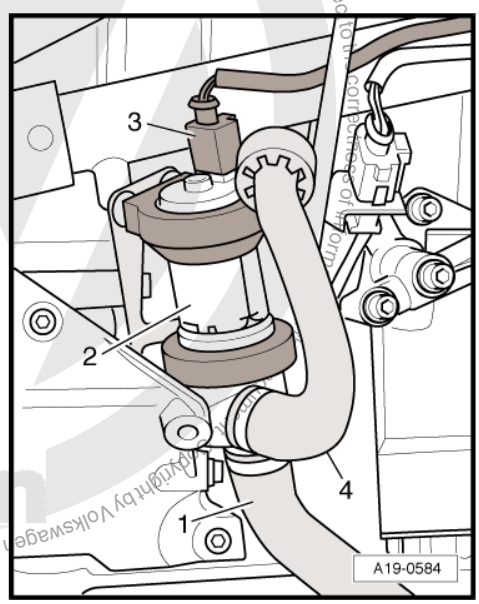
– Unhook connector -arrow- for engine speed sender -G28- from bracket on dipstick guide tube.



– Unscrew bolt -3- and pull out dipstick guide tube -2-.
– Unscrew bolt -4- and pull vacuum reservoir -1- off intake manifold.
– Place vacuum reservoir to side (hoses remain attached).



– Separate electrical connection -3- on continued coolant circulation pump -V51- -item 2-.
– Pull pump downwards out of rubber hoops of bracket. Spray rubber hoops with non-silicon lubricant if necessary.
– Unscrew bracket of continued coolant circulation pump -V51- .
– Unclip right wiring harness bracket from coolant pipe.
– Detach left wiring harness on coolant pipe from bracket.
– Pull coolant hose off coolant pipe for oil cooler.
– Pull out coolant pipe from cylinder block.



Installing

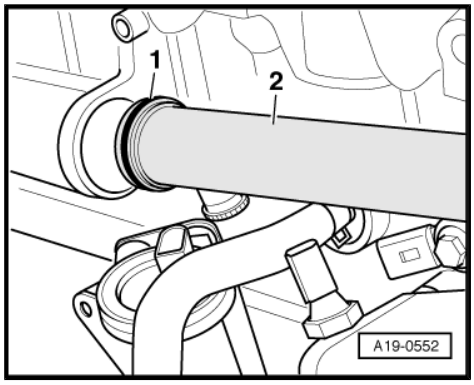
Install in reverse order. In the process, note the following:

Note

Renew O-rings.

– Before installing, clean or buff sealing surface for O-ring in cylinder block.

– Lubricate new O-ring -1- with coolant and push onto coolant pipe -2-.
– Push coolant pipe into hole on cylinder head.
– Install thermostat housing ⇒ page 120 .
– Install air conditioner compressor ⇒ Rep. Gr. 87 .
– Install poly V-belt ⇒ page 20 .
– Fill with coolant ⇒ page 110 .



Specified torque

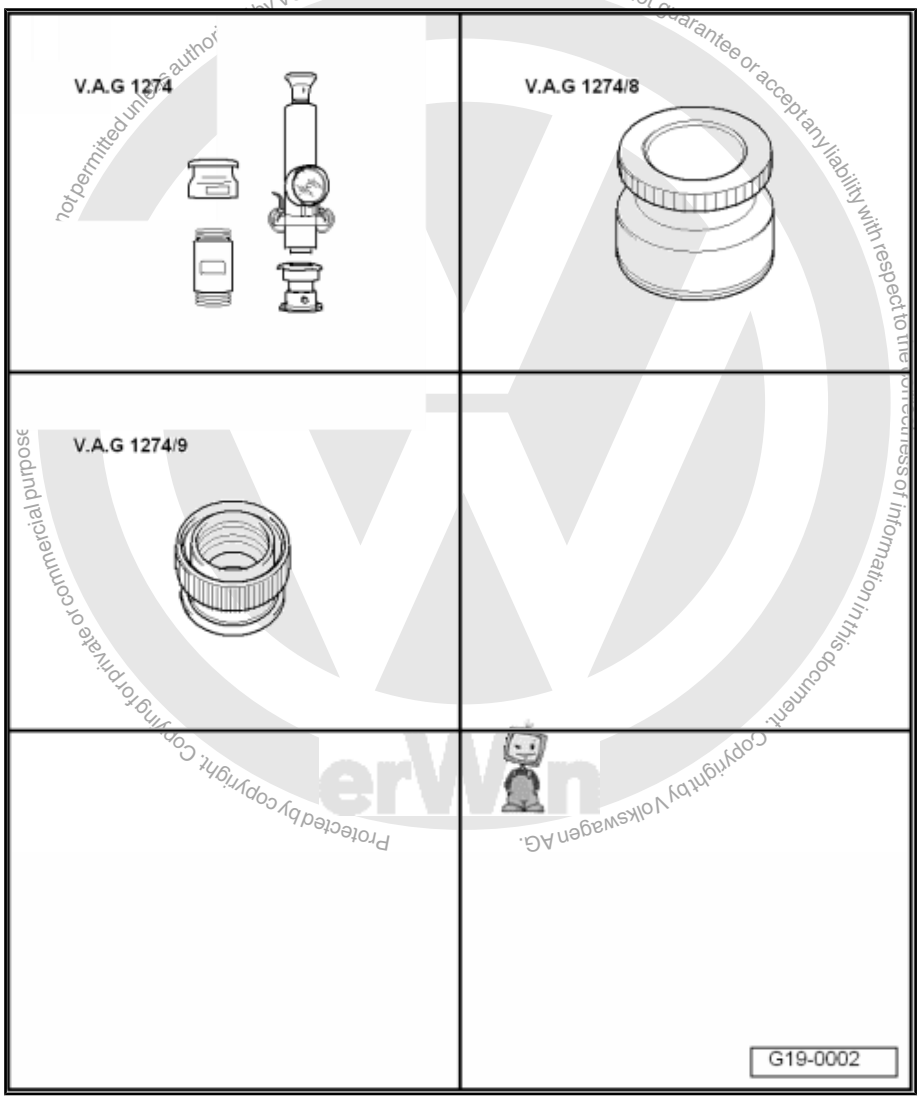
Component	Nm
Bracket for coolant pump to bracket for ancillaries	10

1.13 Checking cooling system for leaks

Checking pressure relief valve in cap ⇒ page 127

Special tools and workshop equipment required

- Cooling system tester -V.A.G 1274-
- Adapter for cooling system tester -V.A.G 1274/8-
- Adapter for cooling system tester -V.A.G 1274/9-



Test prerequisite

- Engine at operating temperature.

Test sequence:

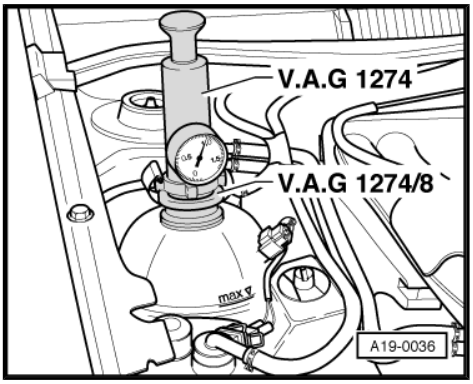
WARNING

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

– Open cap for coolant expansion tank.
– Attach cooling system tester -V.A.G 1274- with cooling system tester adapter -V.A.G 1274/8- to expansion tank.
– Use hand pump on tester to create a pressure of about 1.0 bar.

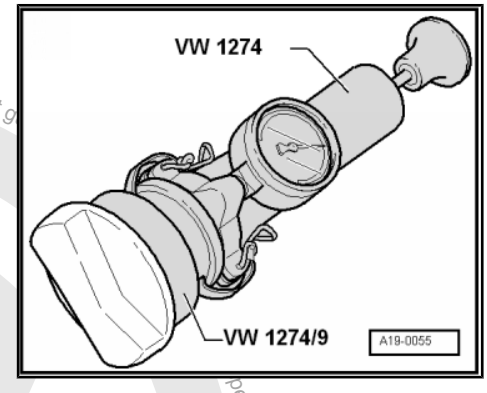
If pressure drops:

– Find leaks and rectify.



1.13.1 Checking pressure relief valve in filler cap

– Attach cooling system tester -V.A.G 1274- with adapter -V.A.G 1274/9- to cap.
– Operate hand pump.
• The pressure relief valve should open at a pressure of 1.4 … 1.6 bar.



20 – Fuel supply system

1 Safety precautions when working on fuel supply system

WARNING

- *The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.*
- *For safety reasons, when the battery is not disconnected, the fuse for the fuel pump must be removed before opening the fuel system, otherwise the fuel pump could be activated by the driver door contact switch. Fuse assignment ⇒ Current flow diagrams, Electrical fault finding and Fitting locations*

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 and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.*
- *To avoid damage to lines/wiring, 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:

- Even before work commences, the extraction hose of an activated fume extraction system has to be placed in the vicinity of the assembly opening of the fuel tank to extract any escaping fumes. If no exhaust extraction system is available, a radial fan with a displacement greater than 15 m³/h can be used providing that motor is not in air flow.
- Prevent skin contact with fuel! Wear fuel-resistant gloves!

2 Rules for cleanliness

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

- Thoroughly clean all unions and adjacent areas before disconnecting.
- Place removed parts on a clean surface and cover. Use only lint-free cloths.
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Install clean components only. Do not remove replacement parts from packing until immediately before installing. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

3 Fuel tank

Safety precautions when working on fuel supply system ⇒ page 128 .

Rules for cleanliness ⇒ page 129 .

Assembly overview - fuel tank ⇒ page 130 .

Draining fuel tank ⇒ page 132 .

Removing and installing fuel tank ⇒ page 137 .

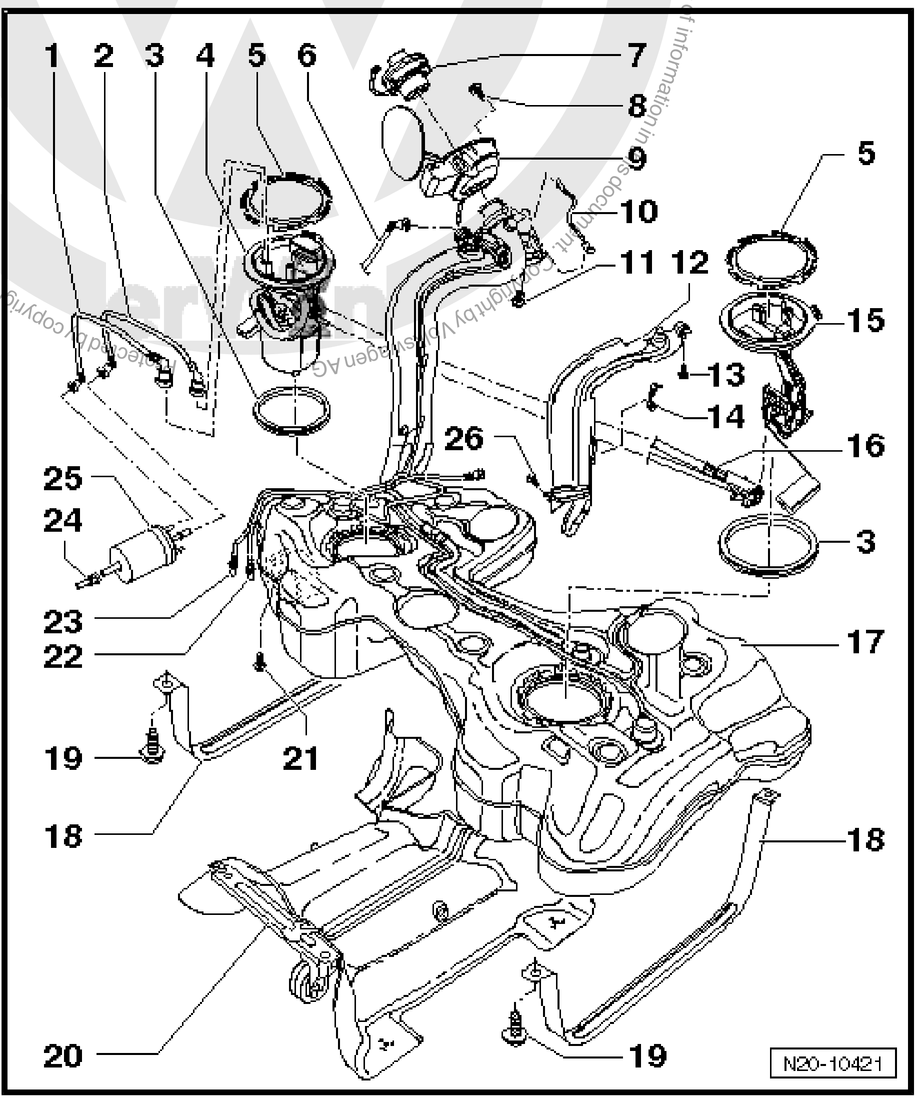
Removing and installing fuel delivery unit ⇒ page 141

Removing and installing fuel gauge sender -G- ⇒ page 146 .

Removing and installing fuel gauge sender 2 -G169- ⇒ page 144 .

Removing and installing suction jet pump ⇒ page 146 .

3.1 Assembly overview - fuel tank



1 - Supply line
- ❑ Black.
- ❑ Check for secure seating.

2 - Return line
- ❑ Blue.
- ❑ Check for secure seating.

3 - Seal
- ❑ Renew.
- ❑ When installing, fit dry in fuel tank opening.
- ❑ Moisten with fuel only when installing flange.

4 - Fuel delivery unit
- ❑ Removing and installing ⇒ page 141 .
- ❑ If fuel delivery unit was renewed, adapt engine control unit to fuel pump ⇒ Vehicle diagnosis, testing and information system VAS 5051 “Guided functions”
- ❑ Checking fuel pump ⇒ page 150 .
- ❑ Note installation position on fuel tank ⇒ page 132 .
- ❑ With fuel gauge sender -G- .
- ❑ Removing and installing fuel gauge sender ⇒ page 144 .
- ❑ Clean strainer if soiled.

5 - Locking ring, 110 Nm
- ❑ Check for secure seating.

- ❑ Remove and install using wrench -T10202- .

6 - Breather line

- ❑ From gravity valve to activated charcoal filter
- ❑ Clip on bracket in wheel housing
- ❑ To pull off, press release button on connection.

7 - Cap

- ❑ Renew if damaged.

8 - Securing bolt

9 - 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 .

10 - Earth connection

- ❑ Check for secure seating.

11 - 10 Nm

12 - Protective plate

- ❑ For fuel filler neck
- ❑ Ensure that earth connection is securely seated

13 - 10 Nm

14 - Cable retainer

- ❑ Clipped onto protective plate.

15 - Fuel gauge sender 2 -G169-

- ❑ Removing and installing ⇒ page 144 .
- ❑ Note installation position on fuel tank ⇒ page 132 .

16 - Suction-jet pump

- ❑ Clipped onto fuel gauge sender 2 -G169- .
- ❑ Removing and installing ⇒ page 146 .

17 - Fuel tank

- ❑ When removing, support using engine and gearbox jack -V.A.G 1383 A- .
- ❑ Removing and installing ⇒ page 137 .

18 - Securing strap

- ❑ Note installation position.

19 - 25 Nm

- ❑ Renew.
- ❑ To secure the securing straps for the fuel tank, only bolts with loose washers must be used. If different bolts are used, the securing straps might twist during tightening. Bolts ⇒ ETKA (electronic parts catalogue) .

20 - Heat shield

- ❑ Riveted to exhaust pipe mounting

21 - 3 Nm

22 - Breather line

- ❑ White
- ❑ From activated charcoal filter to activated charcoal filter solenoid valve 1 -N80- .
- ❑ Do not kink.
- ❑ To pull off, press release button on connection.
- ❑ Clipped onto fuel tank.

23 - Vacuum line

- ❑ Green.
- ❑ From fuel system diagnosis pump -V144- to intake manifold.
- ❑ Clipped onto fuel tank.
- ❑ Check for secure seating.

24 - Supply line

- ❑ To fuel rail.

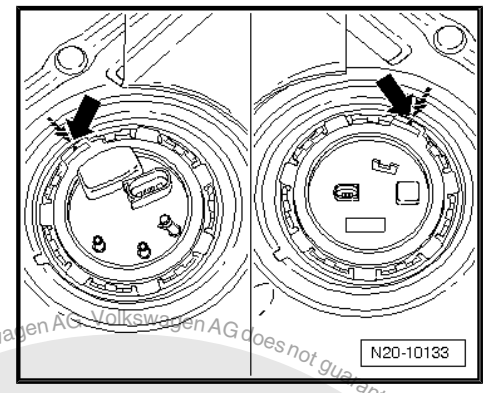
25 - Fuel filter

- ❑ Installation position: arrow indicates direction of flow.
- ❑ Removing and installing ⇒ page 148 .

26 - 8 Nm

Installation position of flange for fuel delivery unit and fuel gauge sender 2 -G169-

The marking on the flange must align with the marking on the fuel tank -arrow-.

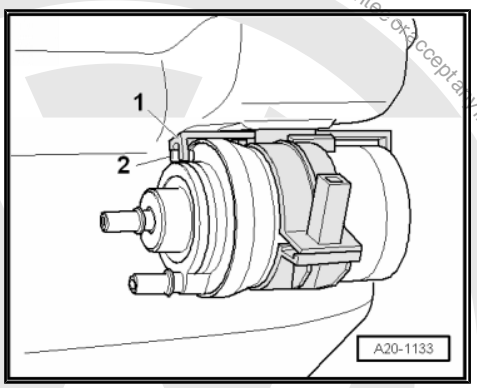


Note

The marking on the fuel tank is not clearly visible.

Location of fuel filter

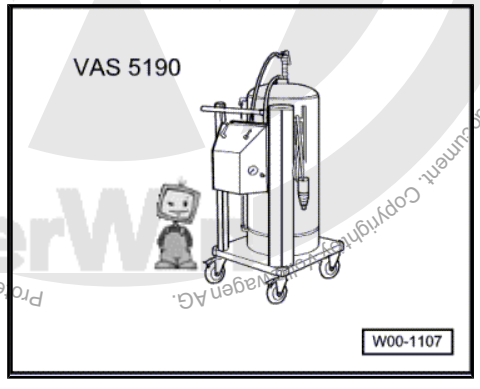
Pin -2- on filter housing must engage in notch of guide -1- in filter bracket.



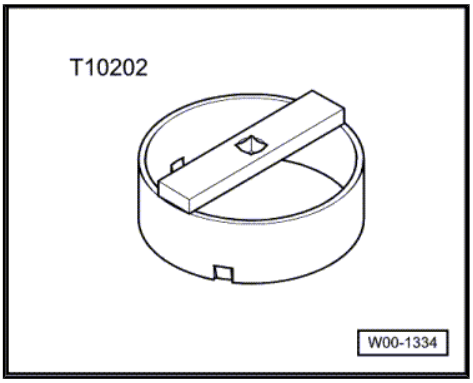
3.2 Emptying fuel tank

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 128 .

Emptying fuel tank with fuel pump intact ⇒ page 133 .

Emptying fuel tank if it is more than 3/4 full ⇒ page 134 .

Emptying fuel tank if less than 3/4 full ⇒ page 135

3.2.1 Emptying fuel tank with fuel pump intact

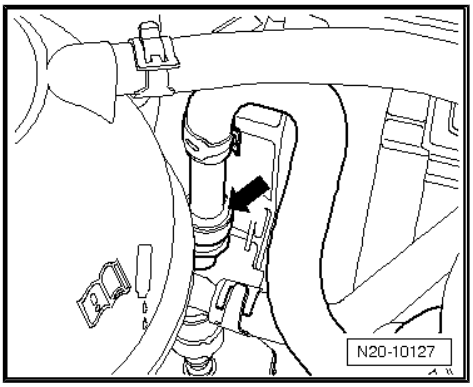
Special tools and workshop equipment required

- Adapter for fuel extraction -VAS 5190 /3-
- Test instrument adapter/DSO (5-pin) -VAS 5565-
- Remote control -V.A.G 1348/3A-

WARNING

- ***Fuel supply line is pressurised. Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.***
- ***Connect fuel extractor -VAS 5190- earth wire to vehicle earth.***

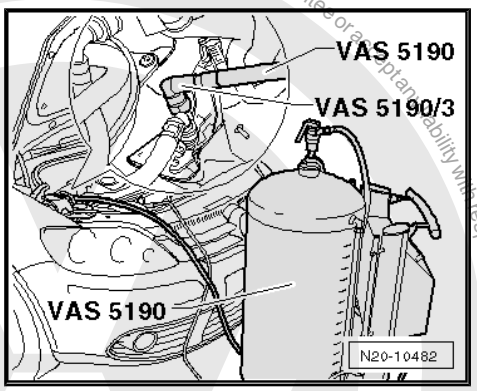
– Pull off supply line (metal coupling) -arrow- and catch escaping fuel with a cloth.



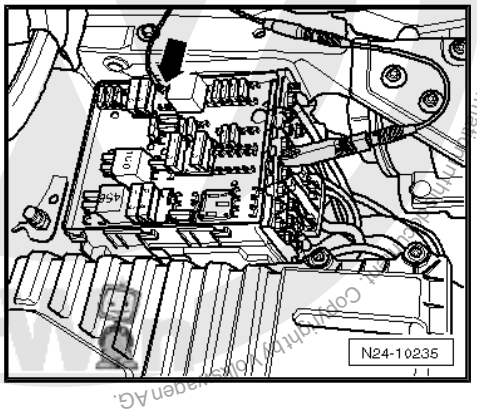
Note

Press in securing ring to release fuel lines.

– Connect fuel extractor -VAS 5190- with adapter for fuel extractor -VAS 5190 /3- to fuel supply line.
– Open cover of relay and fuse holder of engine compartment electronics box.
– Pull fuse SB6 on socket F6 off hose holder. Fuse assignment ⇒ Current flow diagrams, Electrical fault finding and Fitting locations



– Connect remote control -V.A.G 1348/3 A- with adapter cable -V.A.G 1348/3-3- to left terminal (viewed looking forwards) of fuse socket F6 -arrow-.
– Tape off 2nd connector contact of adapter cable -V.A.G 1348/3-3- with insulating tape to prevent short circuits.
– Connect crocodile clip to vehicle battery (+).



Note

This step serves only to have the fuel pump running when the engine is stopped.

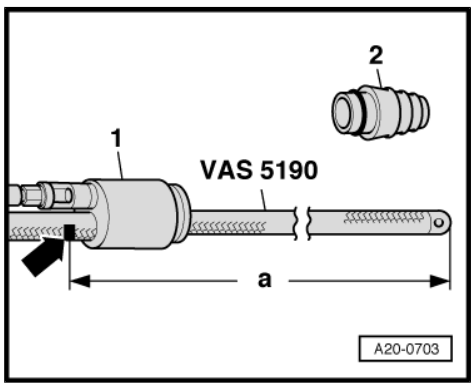
– Remove filler cap from fuel tank filler neck.
– Operate remote control -V.A.G 1348/3A- and shut-off tap on fuel extractor -VAS 5190- until fuel tank is empty.

3.2.2 Emptying fuel tank if it is more than 3/4 full

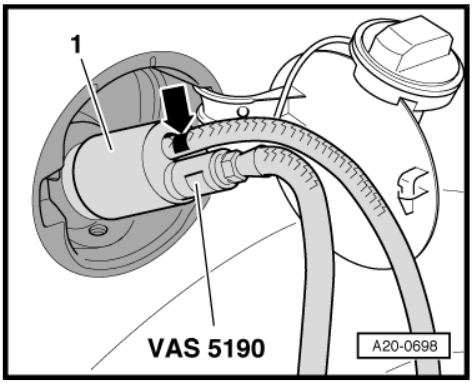
Caution

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

– Remove cotter -2- from shaft -1- of fuel extractor -VAS 5190- .
– At distance -a- = 1180 mm from end, mark extraction hose with insulating tape -arrow-.
– Remove filler cap from fuel tank filler neck.



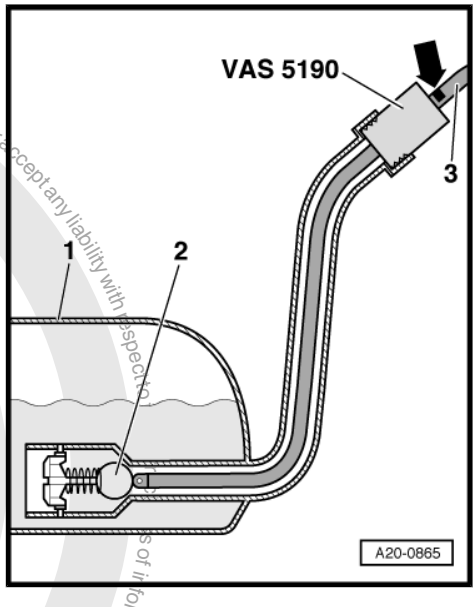
– Screw shaft end -1- of fuel extractor unit -VAS 5190- onto fuel filler neck.
– Push extraction hose into fuel tank until marking on hose -arrow- coincides with shaft end.



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 push hose into filler neck only as far as marking -arrow-.

– Drain fuel tank as much as possible through fuel filler neck.
– Carefully pull out 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 135* .

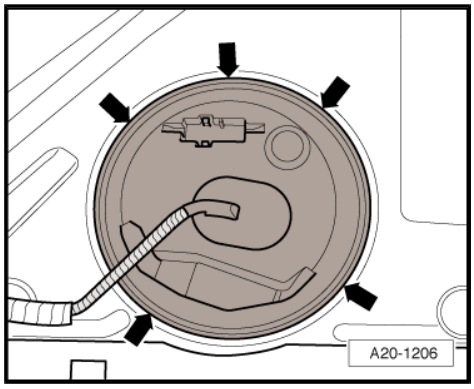
3.2.3 Emptying fuel tank if it is less than 3/4 full

Note

To drain fuel tank completely: fuel must be extracted from fuel delivery unit flange and also from fuel pump sender 2 -G169- flange.

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

– Remove cover from fuel delivery unit.



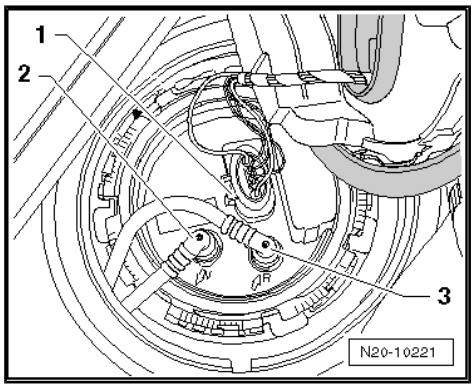
Note

For vehicles with auxiliary heater the metering pump -V54- connector must be disconnected additionally.

WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

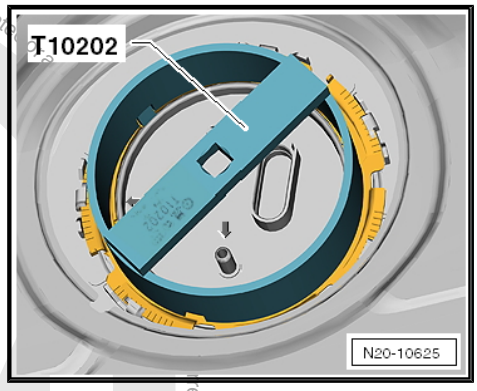
– Pull connector -1- and fuel lines -2 and 3- off flange.



Note

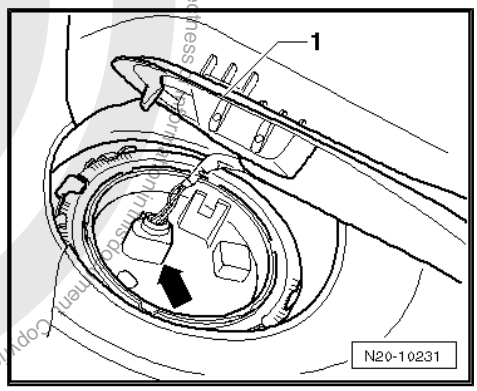
- *Press in securing ring to release fuel lines.*
- *Vehicles with an auxiliary heater have an additional fuel line (with smaller diameter) for the metering pump -V54- , this must also be disconnected from the flange.*

– Open locking ring using wrench -T10202- .
– Lift sender flange.
– Insert extraction hose of fuel extractor -VAS 5190- as deeply as possible into fuel tank and extract fuel.

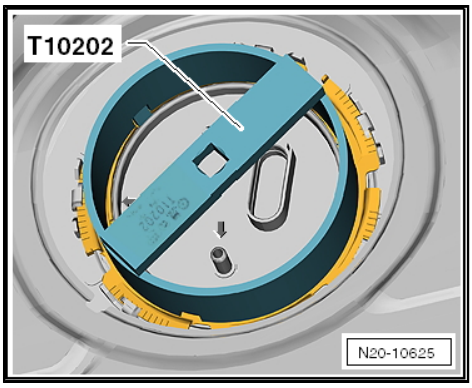


Draining fuel tank at fuel gauge sender 2 -G169- flange

– Remove cover -1- and pull 3-pin connector -arrow- off flange.



– Open locking ring using wrench -T10202- .



– Lift flange.

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

If fuel tank needed only to be emptied, reinstall sender flange ⇒ page 132 .

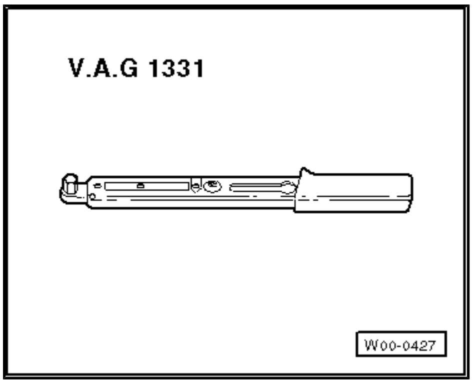
3.3 Removing and installing fuel tank

Note

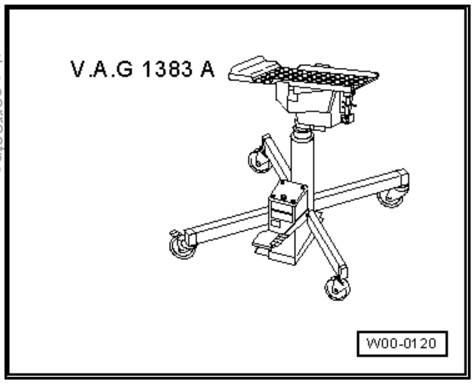
Vehicles up to 06/2007 are fitted with a two-part propshaft. For these vehicles it is sufficient to remove the rear propshaft. Vehicles from 06/2007 are fitted with a single part propshaft. For these vehicles the complete propshaft must be removed.

Special tools and workshop equipment required

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



◆ Engine and gearbox jack -V.A.G 1383 A-



Removing fuel tank ⇒ page 137

Installing fuel tank ⇒ page 139

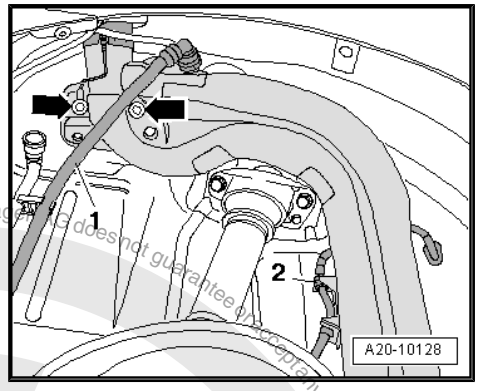
3.3.1 Removing fuel tank

– Note safety precautions before beginning work ⇒ page 128 .

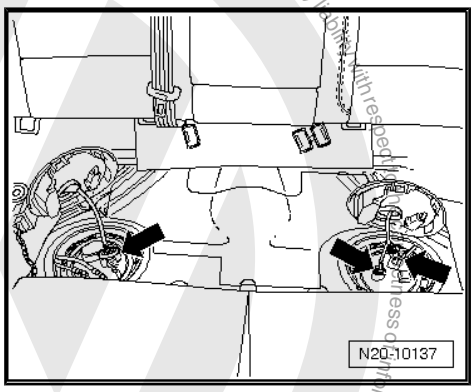
If necessary, empty fuel tank using fuel extractor -VAS 5190- ⇒ page 132 .

– Remove rear right 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 neck from body -arrows-.
– Unclip electrical wiring -2- from filler neck.
– Remove bench seat ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seats; Removing and installing bench seat .



– Remove covers and separate electrical connectors -arrows-.



Note

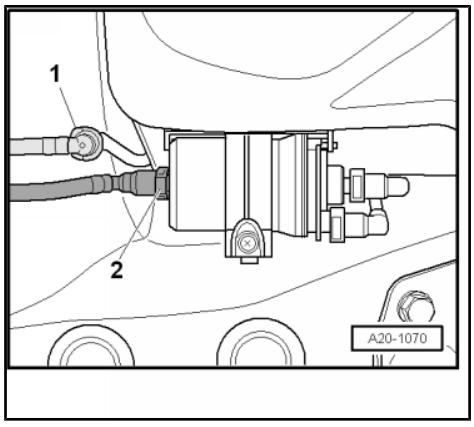
For vehicles with auxiliary heater the metering pump -V54- connector must be separated additionally.

– Remove centre and rear silencers.
– Remove front exhaust pipe with catalytic converters ⇒ page 195 .
– Remove complete propshaft ⇒ Propshaft and rear final drive; Rep. Gr. 39 ; Repairing propshaft - Golf .

WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

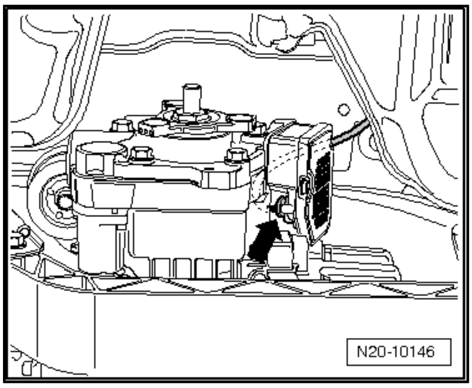
– Disconnect breather line -1- (white) and fuel line -2- (black) at connecting point.



Note

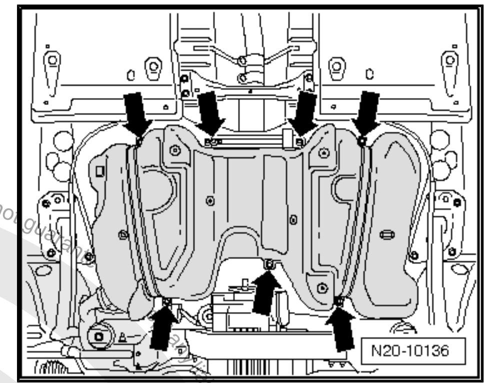
Vehicles with auxiliary heater, the fuel line of the metering pump -V54- must also be separated.

– Pull off adapter cable on four-wheel drive control unit -J492- .



– Unscrew securing straps and securing bolts. First support fuel tank with engine and gearbox jack -V.A.G 1383 A- .

– Slowly lower fuel tank.



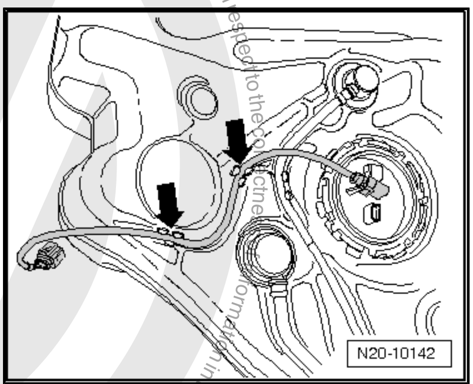
Note

The filler neck must be “guided out” between body and rear axle. To do this, take the fuel tank off engine and gearbox jack -V.A.G 1383 A- with the assistance of a 2nd mechanic.

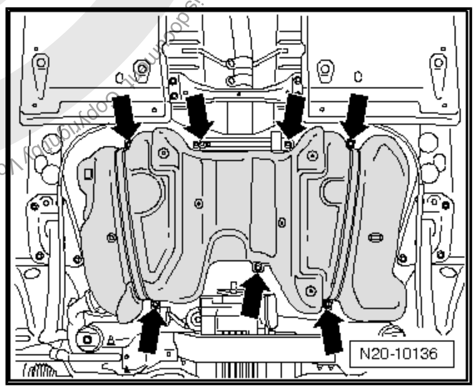
3.3.2 Installing fuel tank

– Clip in cable for four-wheel drive control unit -J492- on fuel tank.

– With the assistance of a 2nd mechanic, guide the filler neck in between rear axle and body. Then place the fuel tank on the engine and gearbox jack -V.A.G 1383 A- .



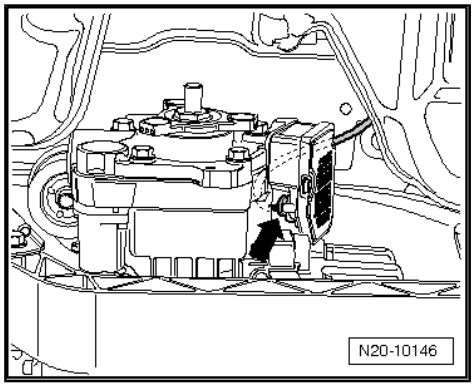
– Raise the fuel tank slowly up to the installation position and secure -arrows-.



Note

To secure the securing straps for the fuel tank, only bolts with loose washers must be used. If different bolts are used, the securing straps might twist during tightening. Bolts ⇒ ETKA (electronic parts catalogue) .

– Fit adapter cable on four-wheel drive control unit -J492- .



The remaining installation steps are carried out in the reverse sequence. In the process, note the following:

- Install breather and fuel lines free of kinks.
- Do not interchange supply and return lines (return line blue or with blue markings, supply line black).
- Ensure wiring/line connections are secured properly by pulling back on connection.
- Check earth connection on fuel tank and body to filler neck.

4 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 6340- or space saving hose clip pliers -VAS 6362- are recommended for installing and removing spring-type clips.*

Safety precautions when working on fuel supply system ⇒ page 128 .

Rules for cleanliness ⇒ page 129 .

Removing and installing fuel delivery unit ⇒ page 141 .

Removing and installing fuel gauge sender -G- ⇒ page 146 .

Removing and installing fuel filter ⇒ page 148 .

Assembly overview - fuel filter with attachments ⇒ page 148 .

Check fuel pump ⇒ page 150 .

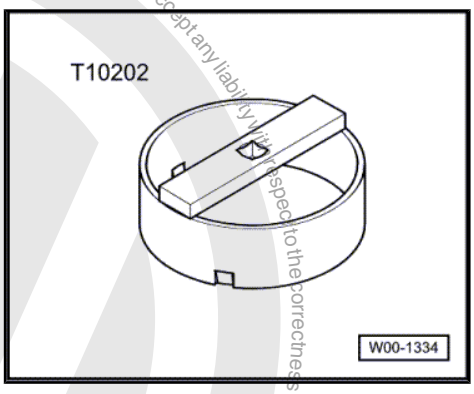
Bleeding fuel system ⇒ page 157 .

Checking fuel pressure regulator and holding pressure ⇒ page 181 .

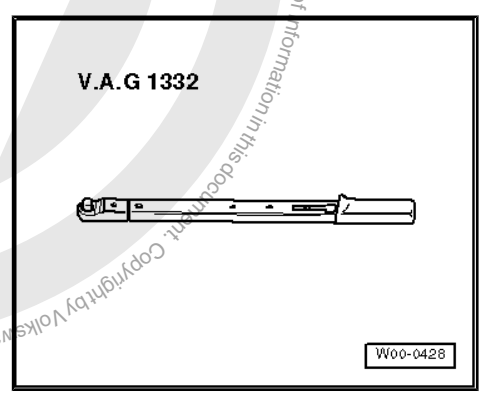
4.1 Removing and installing fuel delivery unit

Special tools and workshop equipment required

- Wrench -T10202-



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



Removing

Caution

Prerequisites:

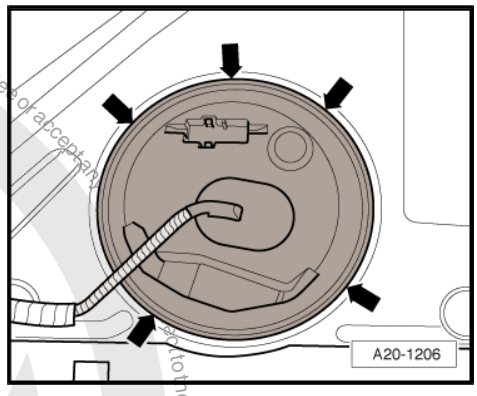
- *Fuel tank must not be more than 3/4 full. This ensures that the fill level is below the flange of the fuel delivery unit.*

Note

- *After removing fuel delivery unit, check fuel tank for heavy soiling and clean if necessary.*
- *If necessary, empty fuel tank using fuel extractor -VAS 5190- ⇒ page 132 .*
- *Note safety precautions before beginning work ⇒ page 128 .*
- *Observe rules for cleanliness ⇒ page 129 .*

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

– Remove covers from fuel pump unit.



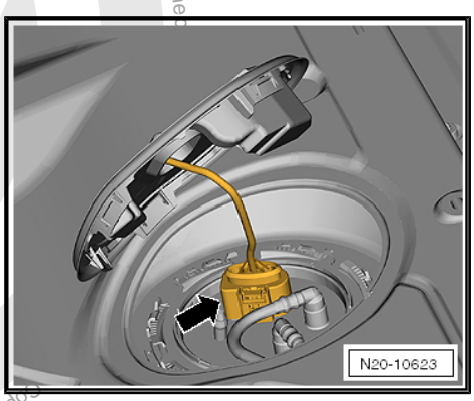
Note

For vehicles with auxiliary heater the metering pump -V54- connector must be disconnected additionally.

– First check that the connector -arrow- is fitted securely by pulling the connector without pressing the catch. The connector can cause a fault if it has not been fitted correctly.

– Now pull off connector.

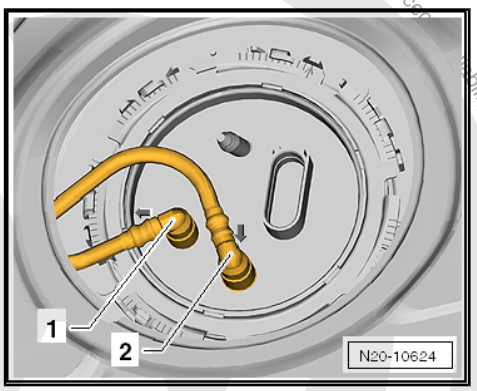
– Check the contacts on the connector and on the fuel delivery unit for damage.



WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

– Pull fuel lines -1- and -2- off flange.

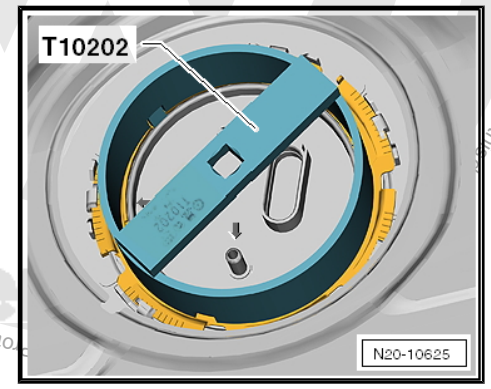


Note

- *Press in securing ring to release fuel lines.*
- *Vehicles with auxiliary heater, the fuel line of the metering pump -V54- must also be separated.*

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

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



Note

- *When removing fuel delivery unit, ensure that fuel gauge sender is not bent.*
- *If delivery unit is to be renewed, drain old delivery unit before disposal.*

Installing

– Renew seal.

– Insert seal for fuel delivery unit dry into opening of fuel tank.

– Coat inner side of seal with fuel.

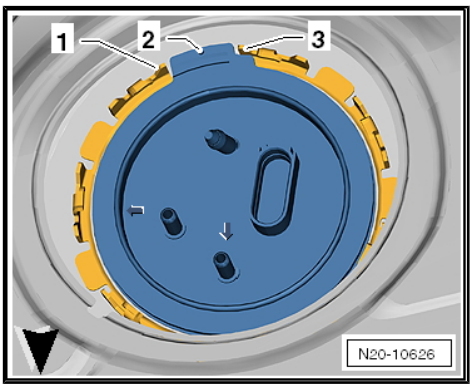
– When inserting fuel delivery unit, ensure that fuel gauge sender is not bent.

– Press sealing flange down against spring pressure, and move sealing flange to installation position.

- Tab -2- on sealing flange must be between lugs -1- and -3- on fuel tank.
- The -arrow- points forwards.

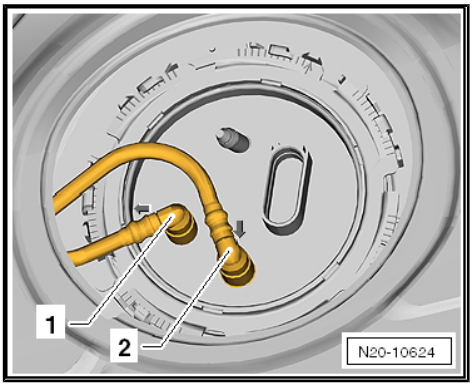
– Tighten sealing flange.

- Specified torque: 110 Nm.



– Reconnect supply line-1- (black).

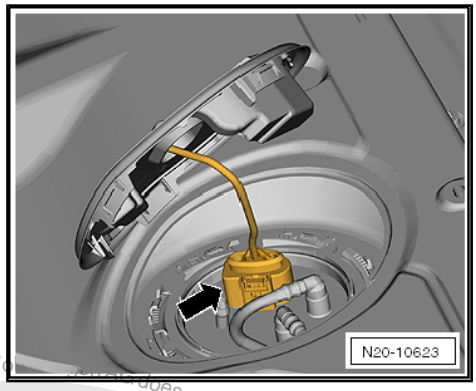
– Reconnect fuel return line -2- (blue or blue marking).



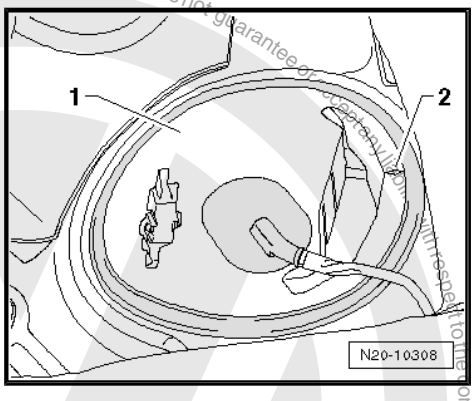
– Reconnect connector -arrow-.

– Ensure push-fit couplings and electrical connectors are secured properly by pulling back on coupling/connector.

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



- Observe installation position of fuel feed line to auxiliary heater ⇒ Auxiliary heater; Rep. Gr. 82 ; Fuel feed Thermo Top V .
- Ensure wiring/line connections are secured properly by pulling back on connection.
- Arrow on cover points in direction of normal travel -2-.



4.2 Removing and installing fuel gauge sender 2 -G169-

- Fuel tank must not be more than 1/2 full.

Note

- *Ensure that the fuel gauge sender is not bent.*
- *If necessary, empty fuel tank using fuel extractor -VAS 5190- ⇒ page 132 .*
- *Note safety precautions before beginning work ⇒ page 128 .*
- *Observe rules for cleanliness ⇒ page 129 .*

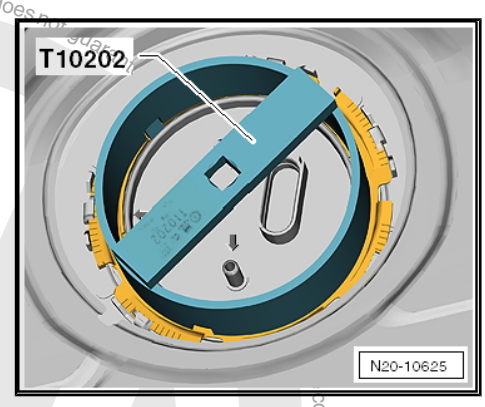
Removing:

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

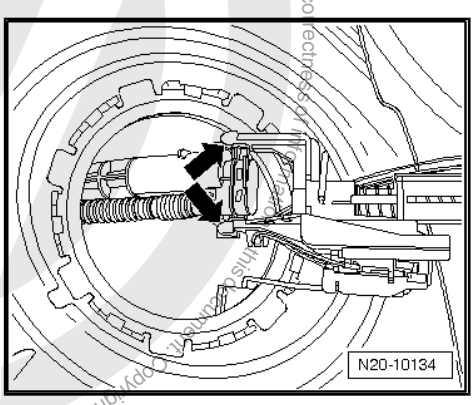
– Remove left cover (as seen facing direction of normal travel) from fuel gauge sender 2 -G169- .

– Disconnect electrical connectors.

– Open locking ring using wrench -T10202- .



– Pull fuel gauge sender 2 -G169- upwards slightly and unclip it from the suction-jet pump.



Installing:

> **Caution**
>
> ***When installing do not bend fuel gauge sender 2 -G169- float arm.***

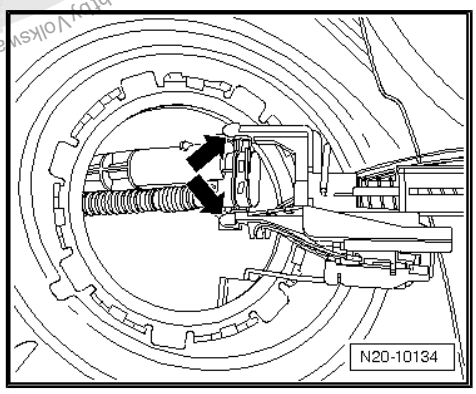
– Place fuel gauge sender 2 -G169- in fuel tank.

– Fit suction-jet pump on sender on inside of fuel tank. Locating lugs must engage.

– Place a new flange seal dry into aperture in fuel tank and moisten only inside (contact to flange) with fuel.

– Note installation position of fuel gauge sender 2 -G169- ⇒ page 132 .

– Check correct position of seal.

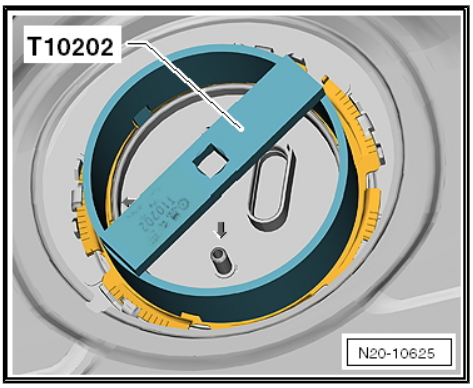


– Tighten locking ring using wrench -T10202- . Specified torque: 110 Nm.

– Fit connectors.

– Install cover.

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



4.3 Removing and installing suction-jet pump

Note

- *On vehicles with four-wheel drive, fuel must be pumped from the area of fuel gauge sender 2 -G169- to the fuel pump unit due to the shape of the fuel tank. A suction-jet pump pumps fuel from left chamber to right chamber of fuel tank.*
- *Checking fuel gauge sender 2 -G169- is only necessary when the engine stops due to lack of fuel, even though the fuel gauge shows that the tank is still 1/4 full.*

Procedure

– Remove fuel delivery unit ⇒ page 141 .

– Remove fuel gauge sender 2 -G169- ⇒ page 144 .

– Now the suction-jet pump can be pulled out from the side of the fuel gauge sender 2 -G169- (left side of vehicle).

– Check that the fuel lines on suction-jet pump are fitted securely and are not damaged.

– Additionally check suction-jet pump for possible soiling.

4.4 Removing and installing fuel gauge sender -G-

Note

Gradual introduction of fuel delivery units with revised fuel gauge senders -G- .

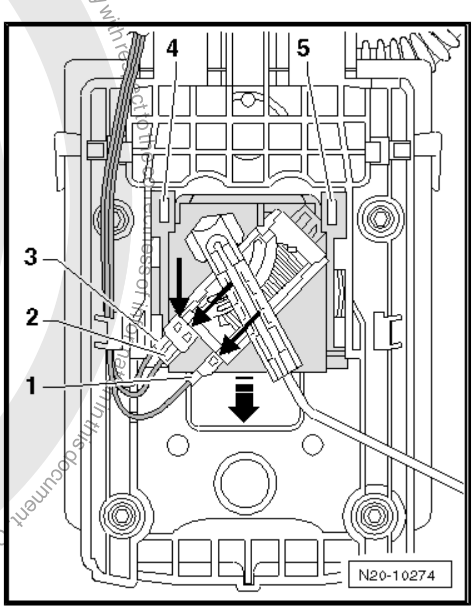
Removing (old version):

– Remove fuel delivery unit ⇒ page 141 .

– Note colour co-ordination of cables for reinstallation.

– Release connectors -arrows- and pull off connectors -1, 2 and 3-. Then bend back locking lugs of connectors.

– Raise retaining tabs -4- and -5- using a screwdriver and pull fuel gauge sender -G- off downwards -arrow-.



Installing:

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

– Connect connectors -1…3-. Observe colour co-ordination.

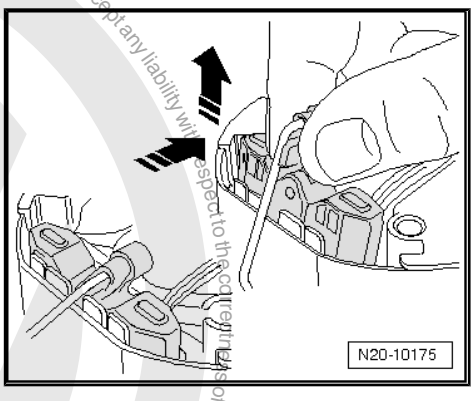
– Check connectors are secured properly by pulling back on connector.

– Install fuel delivery unit ⇒ page 141 .

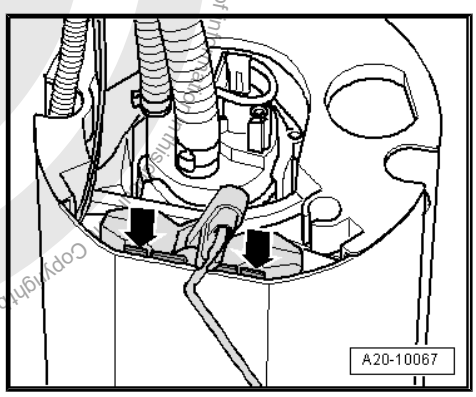
Removing (new version):

– Remove fuel delivery unit ⇒ page 141 .

– Pull fuel gauge sender -G- slightly to side and upwards at the same time

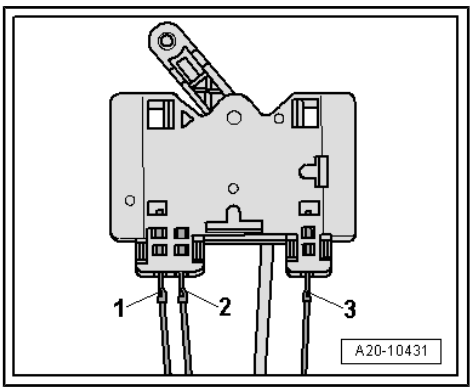


– If the sender cannot be released in this way, the retaining tabs -arrows- must also be pushed to the side slightly.
– Note colour co-ordination of cables for reinstallation.

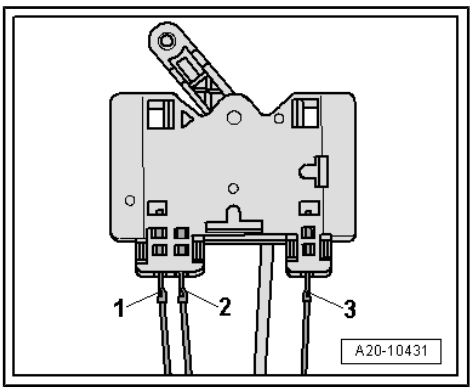


– Release electrical connectors -1…3- and pull them off. Then bend back locking lugs of connectors.

Installing:



– Connect connectors -1…3-. Observe colour co-ordination.
– Check connectors are secured properly by pulling back on connector.
– Insert fuel gauge sender -G- into guide on fuel delivery unit and press down until it engages.
– Install fuel delivery unit ⇒ page 141 .



4.5 Assembly overview - fuel filter with attachments

Note

From October 2005, the fuel pressure regulator has been integrated in the fuel filter and cannot be renewed individually.

1 - Fuel filter

- ❑ Direction of flow is marked with arrows.
- ❑ Do not interchange connections.
- ❑ Removing and installing ⇒ page 148 .
- ❑ Installation position: Pin on filter housing must engage in notch of guide in filter bracket ⇒ page 149

2 - Fuel supply line

- ❑ Black.
- ❑ From fuel tank
- ❑ To pull off, press release button on connection.

3 - Fuel return line

- ❑ Blue.
- ❑ To fuel tank.
- ❑ To pull off, press release button on connection.

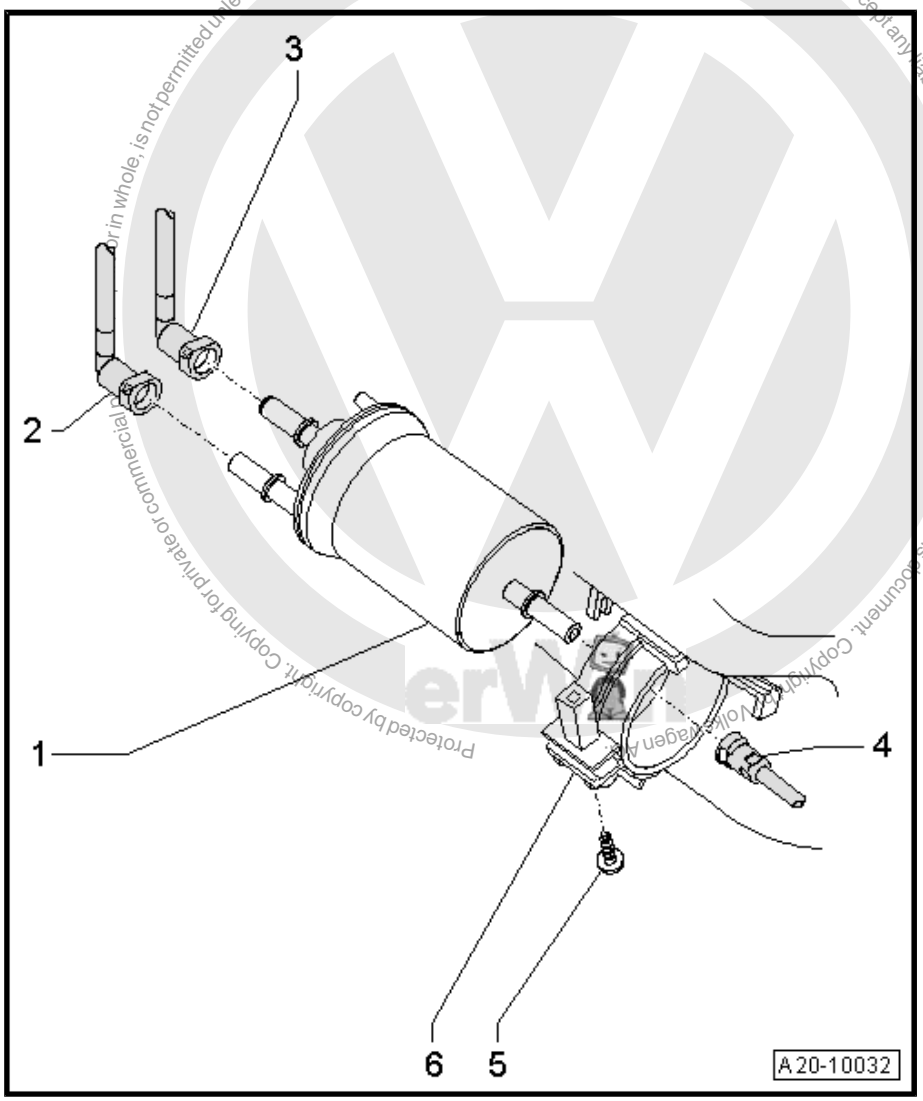
4 - Fuel supply line

- ❑ Black.
- ❑ To engine.
- ❑ To pull off, press release button on connection.

5 - 3 Nm

6 - Bracket

- ❑ For fuel filter.
- ❑ Secured to fuel tank.



4.6 Removing and installing fuel filter

Special tools and workshop equipment required

♦ Receptacle for fuel

Removing

Observe safety precautions ⇒ page 128 .

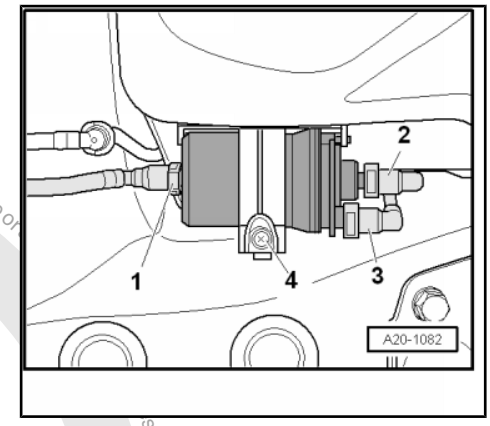
Observe rules for cleanliness ⇒ page 129 .

– Place container under fuel filter.

WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury 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 lines -1-, -2- and -5- by pressing release button.
– Remove bolt -4-.
– Remove fuel filter.



Installing

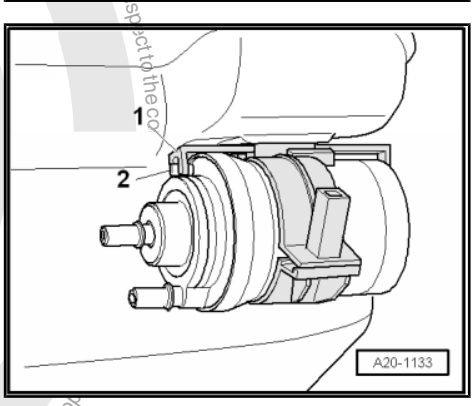
Installation is carried out in the reverse order. When installing, note the following:

Direction of flow is indicated with an arrow on filter housing.

– Bleed fuel system ⇒ page 157 .

Installation position

Pin -2- on filter housing must engage in notch of guide -1- in filter bracket.



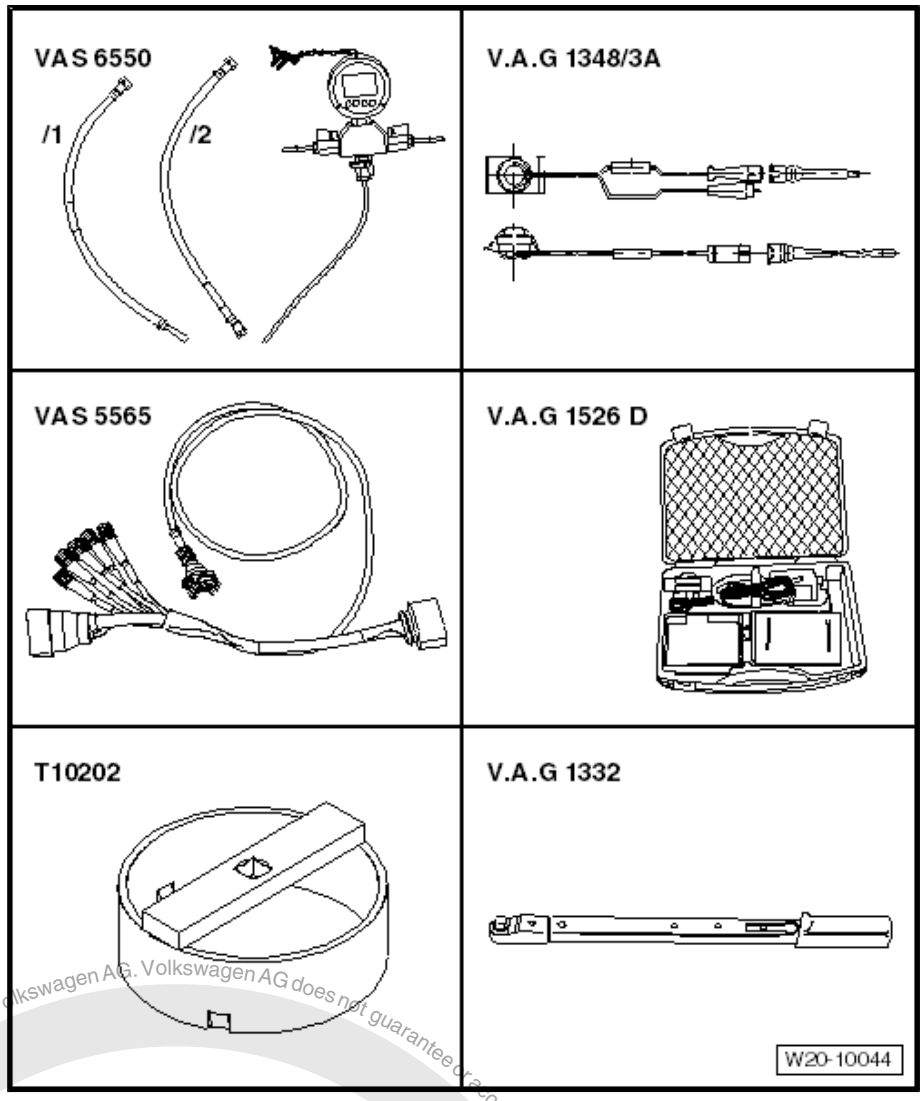
Specified torque:

Component	Nm
Retaining clamp for fuel filter	3

4.7 Checking fuel pump

Special tools and workshop equipment required

- Pressure gauge -VAS 6550-
- Remote control -V.A.G 1348/3A-
- Test instrument adapter/ DSO (5-pin) -VAS 5565-
- Hand-held multimeter - V.A.G 1526D- or pickup clamp -V.A.G 1526B/2-
- Wrench -T10202-
- Torque wrench -V.A.G 1332-
- Measuring container, capacity 2 litres
- Vehicle diagnosis tester



Checking function and voltage supply ⇒ page 150 .

Checking fuel delivery rate ⇒ page 152 .

Checking current draw ⇒ page 155 .

Check fuel pump non-return valve ⇒ page 156 .

Checking fuel pressure regulator and holding pressure ⇒ page 181 .

4.7.1 Checking function and voltage supply

- Fuel pump relay -J17- OK
- Battery voltage at least 11.5 V.
- Fuse for fuel pump OK. Fuse assignment ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

Note

- *Function of fuel pump is checked using final control diagnosis.*
- *The engine must be started briefly before final control diagnosis can be re-selected a second time.*

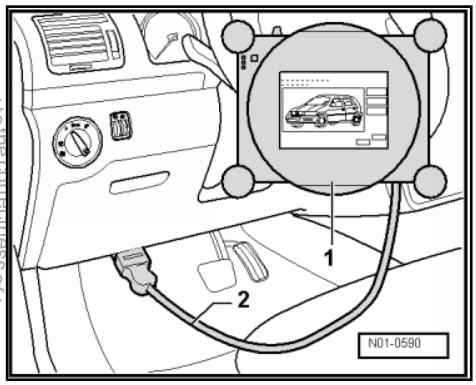
– Connect vehicle diagnosis tester as follows:

– Push diagnostic cable connector onto diagnostic connection in driver footwell.

– Switch on ignition.

– Press buttons on display one after the other for `Vehicle self-diagnosis`, `Self-diagnosis`, `Engine electronics` and `Final control diagnosis`.

– Press right arrow button □ on display until fuel pump relay -J17- is actuated.



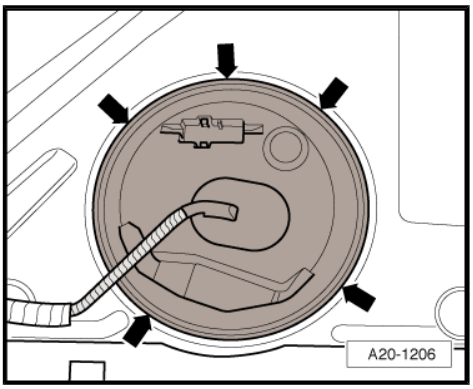
Fuel pump -G6- must be actuated in pulses.

– Switch off ignition.

If fuel pump does not run:

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

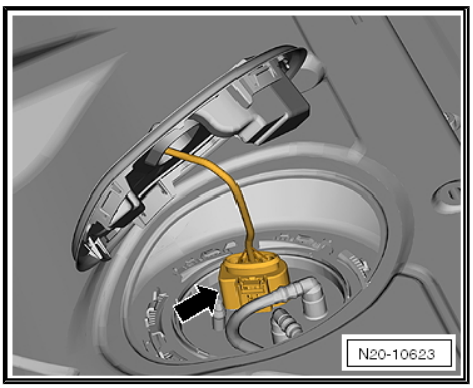
– Remove cover from fuel delivery unit.



– First check that the connector -arrow- is fitted securely by pulling the connector without pressing the catch. If connector was not inserted correctly, repeat functional check of fuel pump.

– Now pull off connector.

– Check the contacts on the connector and on the fuel delivery unit for damage.

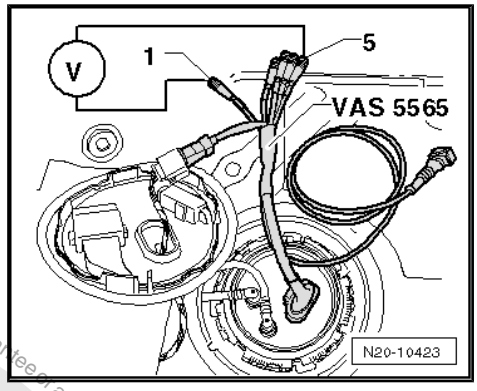


– Connect test instrument adapter/DSO (5-pin) -VAS 5565- to connector and fuel delivery unit.

– Connect multimeter -V.A.G 1526D- to cables -1- and -5- of test instrument adapter/DSO (5-pin) -VAS 5565- .

– Initiate final control diagnosis again and measure voltage at fuel pump.

• Specification: approx. 2 volt less that battery voltage.



Voltage supply not OK:

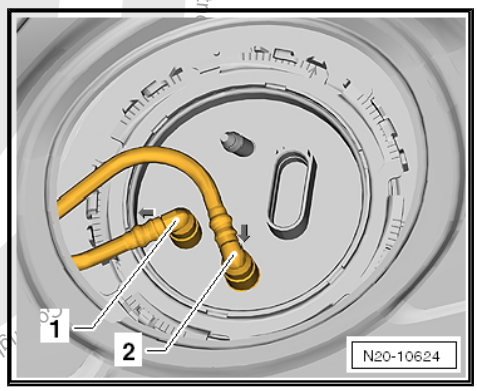
– Locate and eliminate open circuit referring to current flow diagram ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

Voltage supply OK:

WARNING

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

– Pull fuel lines -1- and -2- off flange.



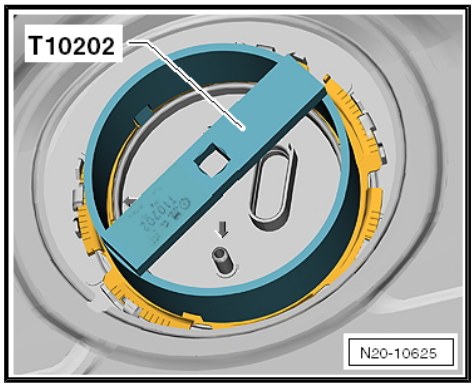
Note

♦ *Press in securing ring to release fuel lines.*

♦ *On vehicles with auxiliary heater the connector and the fuel line of the metering pump -V54- must also be separated.*

– 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 defective, renew fuel delivery unit ⇒ page 141 .

4.7.2 Checking fuel delivery rate

• Voltage supply OK.

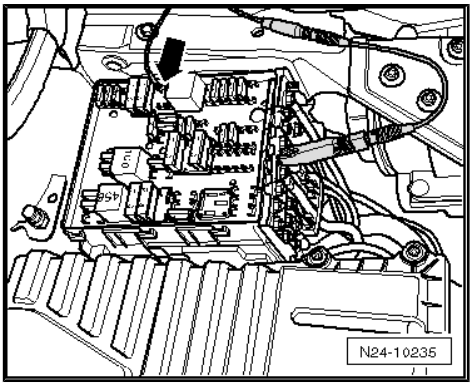
• Fuel pressure regulator and holding pressure OK, checking ⇒ page 181 .

• Fuel filter OK.

– Open cover of relay and fuse holder of engine compartment electronics box.

– Pull fuse SB6 on socket F6 off hose holder. Fuse assignment ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

– Connect remote control -V.A.G 1348/3 A- with adapter cable -V.A.G 1348/3-3- to left terminal (viewed looking forwards) of fuse socket F6 -arrow-.



– Tape off 2nd connector contact of adapter cable - V.A.G 1348/3-3- with insulating tape to prevent short circuits.

– Connect crocodile clip to vehicle battery (+).

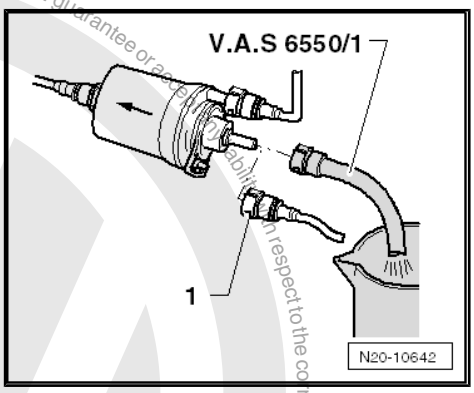
Note

- *This step serves only to have the fuel pump running when the engine is stopped.*
- *Delivery rate of fuel pump must be measured at 4 bar. Therefore, test fuel pressure before measuring delivery rate.*

WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

– Pull off return line -1- from fuel pressure regulator.



Note

Press in securing ring to release fuel line.

– Connect adapter set -VAS 6550/1- to fuel pressure regulator and hold end of adapter in measuring container.

– Operate remote control -V.A.G 1348/3A- about 5 seconds to fill fuel filter.

– Empty measuring container.

– The delivery rate of the fuel pump depends on the voltage. Therefore, connect multimeter to battery.

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

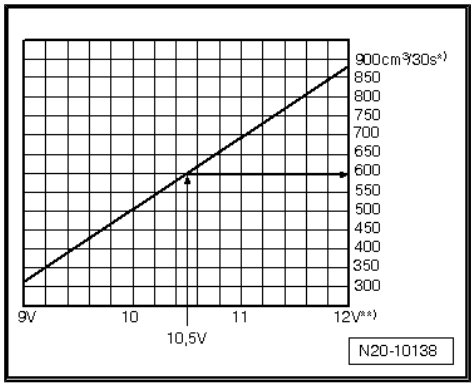
– Compare quantity of fuel delivered with specification.

*) Minimum delivery rate cm³/30 s

**) 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. 580 cm³/30 s.



If the specification is not attained:

– Check supply line to filter for possible restrictions (kinks) or blockages.

If fuel line is OK

– Remove cap from fuel filler neck and repeat check. If fuel delivery rate is now reached, check fuel tank breather.

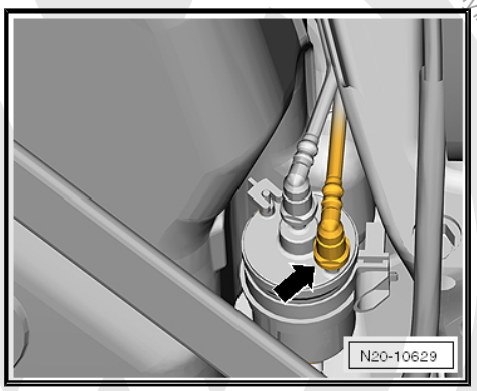
If the specifications are still not attained:

– Check fuel filter. Proceed as follows:

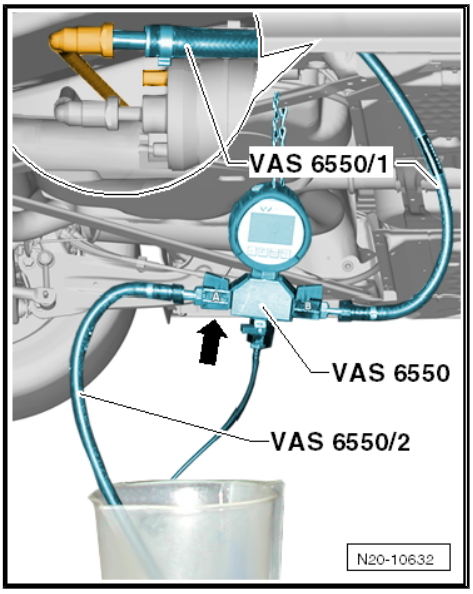
WARNING

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

– Pull fuel supply line -arrow- off fuel filter.



– Connect pressure tester -VAS 6550- to fuel supply line with adapter -VAS 6550/1- . Hold adapter -VAS 6550/2- in a measuring container.
– Make sure that drain tap is closed and cut-off taps are open.
– Operate remote control -V.A.G 1348/3A- . Then slowly close shut-off tap -A- until a pressure of 4 bar is displayed on pressure gauge. From this point on do not move position of shut-off tap.
– Drain measuring container.
– 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 filter strainer for soiling.

Only if still no fault has been detected:

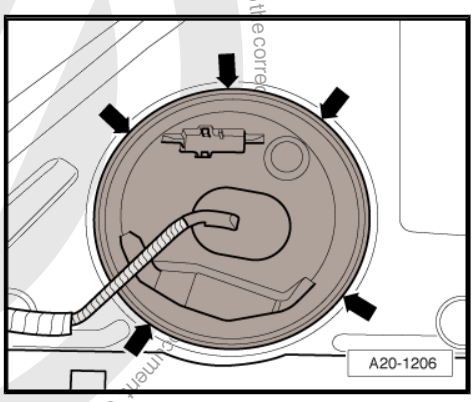
– Renew fuel delivery unit ⇒ page 141 .
– Reconnect all disconnected fuel lines.
– Bleed fuel system ⇒ page 157 .

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

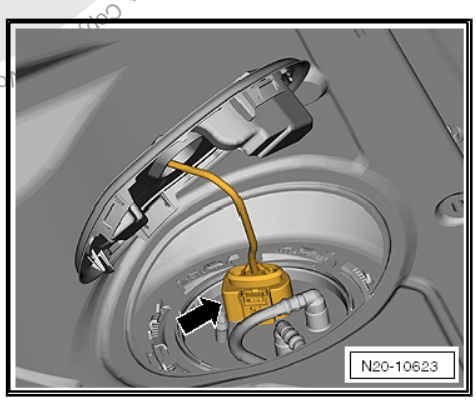
– Measure current draw of fuel pump ⇒ page 155 .

4.7.3 Checking current draw

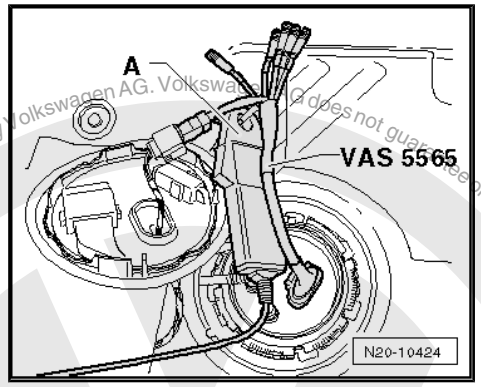
– Remove bench seat ⇒ General body repairs, interior; Rep. Gr. 72 ; Rear seats; Removing and installing bench seat .
– Remove cover from fuel delivery unit.



– First check that the connector -arrow- is fitted securely by pulling the connector without pressing the catch. The connector can cause a fault if it has not been fitted correctly.
– Now pull off connector.
– Check the contacts on the connector and on the fuel delivery unit for damage.



– Connect test instrument adapter/DSO (5-pin) -VAS 5565- to connector and fuel delivery unit.
– Connect pick-up clamp -A- to red terminal with lettering “pick-up clamp” for test instrument adapter/DSO (5-pin) -VAS 5565- .
– Start engine and run at idling speed.
– Measure current draw of fuel pump.
• Specification: max. 9 amps.



Note

♦ *The starting current for the fuel pump can lie briefly above specifications when starting the engine.*

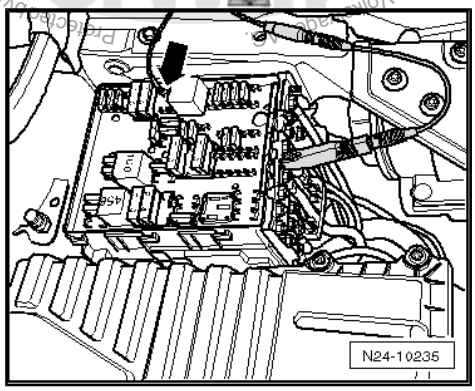
♦ *If the fault in the fuel system is not always evident, the check can also be carried out during a road test. A 2nd person is required to do this, however.*

If the current draw is exceeded:

– Fuel pump defective, renew fuel delivery unit ⇒ page 141 .

4.7.4 Checking non-return valve for fuel pump

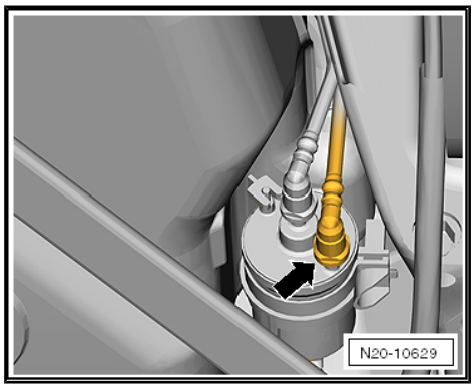
– Open cover of relay and fuse holder of engine compartment electronics box.
– Pull fuse SB6 on socket F6 off hose holder. Fuse assignment ⇒ Current flow diagrams, Electrical fault finding and Fitting locations
– Connect remote control -V.A.G 1348/3 A- with adapter cable -V.A.G 1348/3-3- to left terminal (viewed looking forwards) of fuse socket F6 -arrow-.
– Tape off 2nd connector contact of adapter cable -V.A.G 1348/3-3- with insulating tape to prevent short circuits.
– Connect crocodile clip to vehicle battery (+).



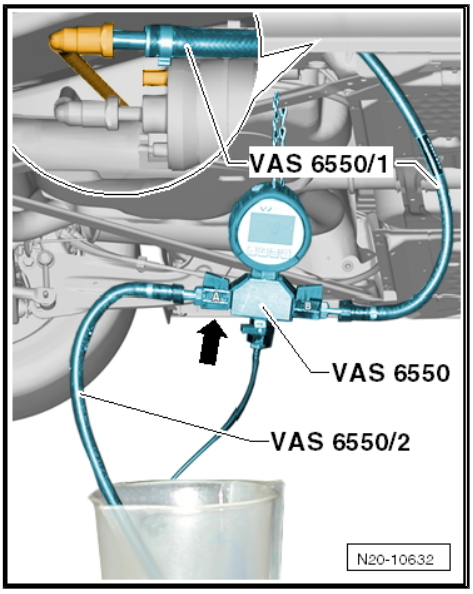
WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

– Pull fuel supply line -arrow- off fuel filter.



– Connect pressure tester -VAS 6550- to fuel supply line with adapter -VAS 6550/1- . Hold adapter -VAS 6550/2- in a measuring container.
– Close pressure gauge -VAS 6550- shut-off tap -A- (lever at right angles to direction of flow).
– Operate remote control at short intervals until a pressure of approx. 4 bar has built up.



WARNING

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

– If pressure builds up too high, relieve excess pressure by carefully opening shut-off tap.
– Watch pressure drop on pressure gauge. After 10 minutes, pressure must not drop below 3 bar.

If the pressure drops further:

– Check line connections for leaks.

If no fault can be found on the lines:

– Fuel pump non-return valve is defective, renew fuel delivery unit ⇒ page 141 .

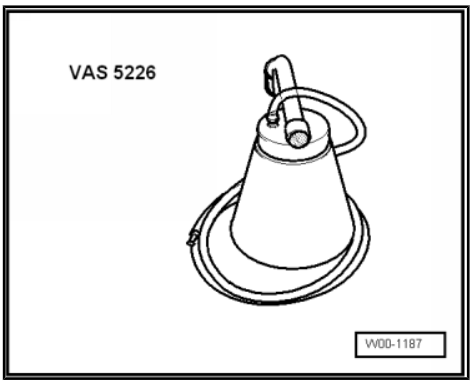
4.8 Bleeding fuel system

Note

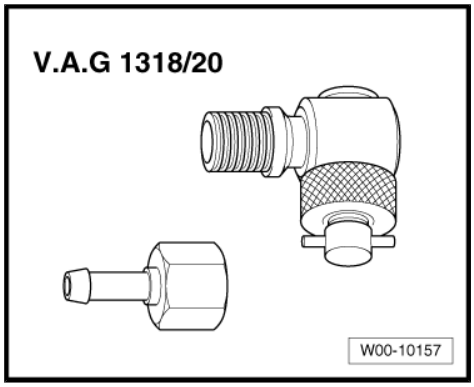
- *In order to prevent damage to the catalytic converter, the fuel system without return pipe must be bled after working on the fuel pipes or the fuel filter. Do not start the engine until the fuel system has been bled.*
- *Observe rules for cleanliness ⇒ page 129 .*

Special tools and workshop equipment required

- Diesel extractor -VAS 5226-



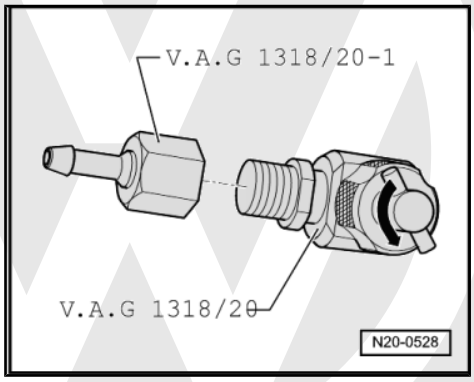
- Adapter -V.A.G 1318/20-



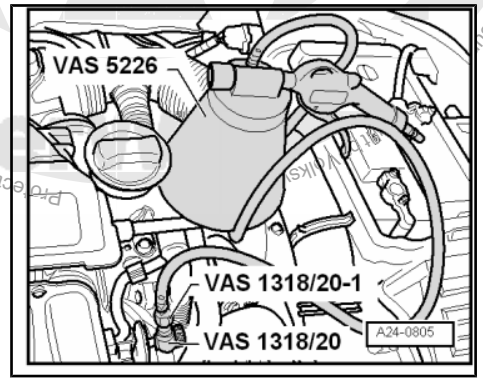
WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- Unscrew protective cap ⇒ Item 9 (page 173) from bleeder valve ⇒ Item 8 (page 173) .
- Turn valve on T-piece -arrow- anti-clockwise until it is entirely open.
- Screw adapter -V.A.G 1318/20–1- onto adapter -V.A.G 1318/20- .
- Now screw assembled adapter -V.A.G 1318/20- hand-tight onto bleeder valve.



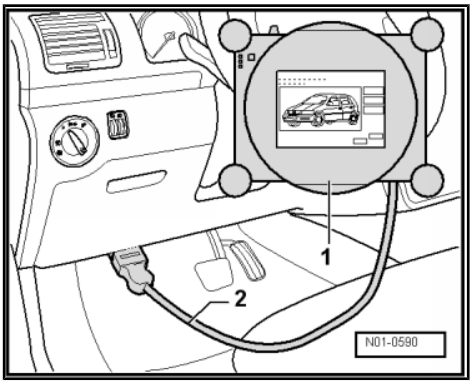
- Connect hose of diesel extractor -VAS 5226- as illustrated.
- Screw valve (on T-piece) clockwise to stop into bleed valve.
- Check adapter and hose connections for leaks.



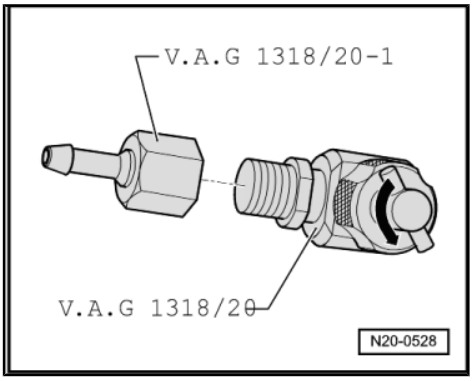
Note

- *Function of fuel pump is checked using final control diagnosis.*
- *The engine must be started briefly before final control diagnosis can be re-selected a second time.*

– Connect vehicle diagnosis tester as follows:
– Push diagnostic cable connector onto diagnostic connection in driver footwell.
– Switch on ignition.
– Press buttons on display one after the other for `Vehicle self-diagnosis`, `Self-diagnosis`, `Engine electronics` and `Final control diagnosis`.
– Press right arrow button □ on display until fuel pump relay -J17- is actuated. This actuates the fuel pump.
– Finish final control diagnosis and switch off ignition once fuel flows out of breather valve without bubbles.



– Turn valve on T-piece -arrow- anti-clockwise until it is entirely open again.
– Clamp off hose from diesel extractor -VAS 5226- (e.g. using hose clips up to 25 mm -3094-) and pull it off adapter -V.A.G 1318/20–1- .
– Unscrew adapter -V.A.G 1318/20- from bleed valve.
– Screw protective cap ⇒ Item 9 (page 173) of bleeder valve on again.



5 Electronic power control (EPC)

Assembly overview - accelerator module ⇒ page 160

Removing and installing accelerator module ⇒ page 160

5.1 Assembly overview - accelerator module

1 - Connector

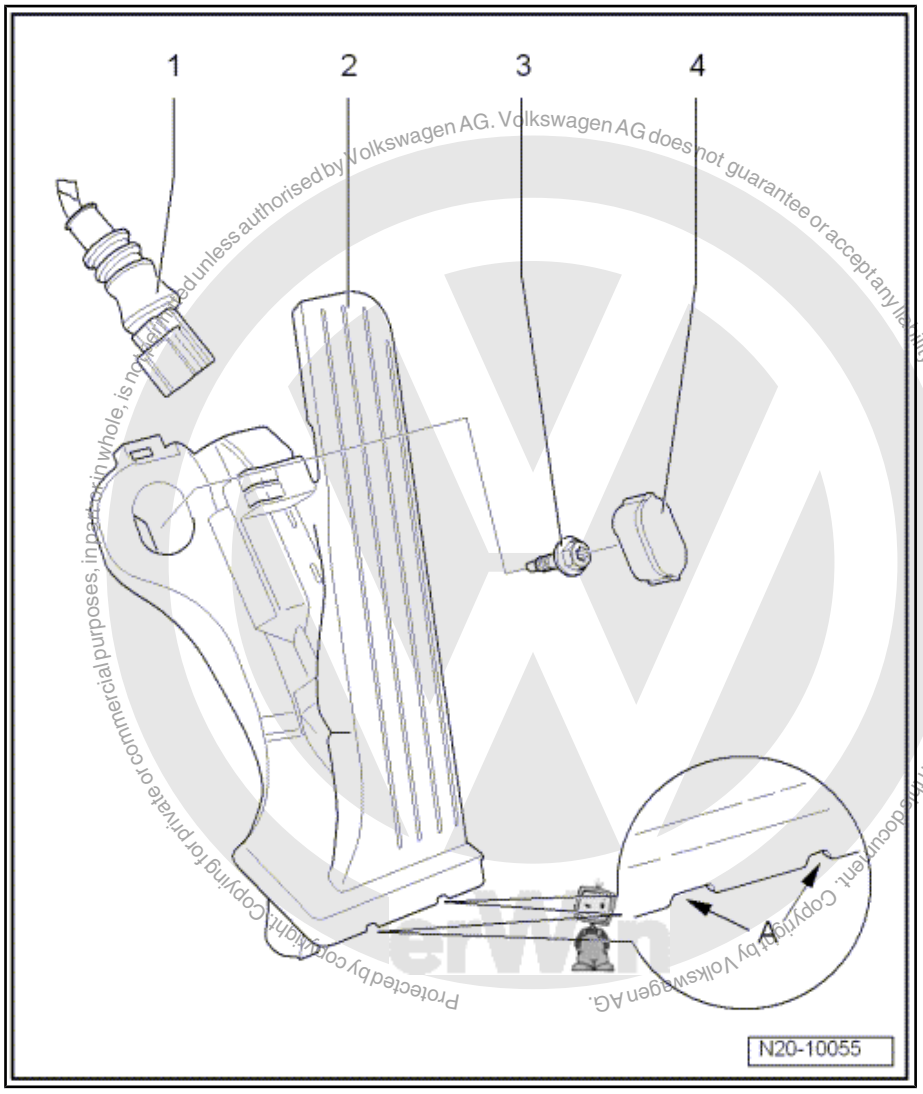
- ❑ Black, 6-pin.

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

- ❑ Not adjustable.
- ❑ 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 160 .

3 - 10 Nm

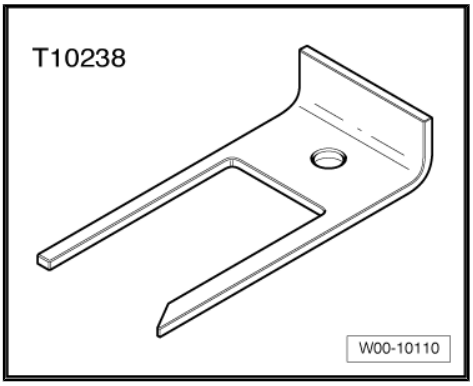
4 - Cap



5.2 Removing and installing accelerator module

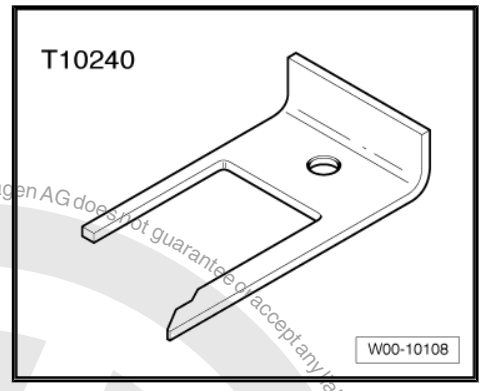
Special tools and workshop equipment required

♦ For left-hand drive vehicles: release tool -T10238-



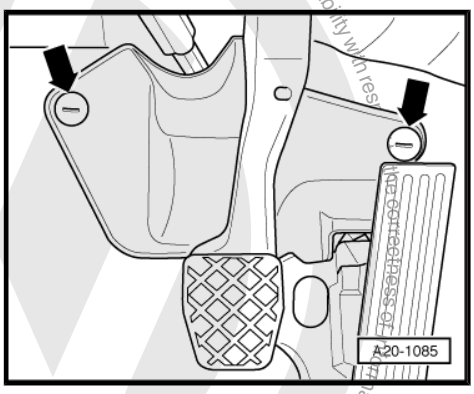
or

♦ For right-hand drive vehicles: release tool -T10240-



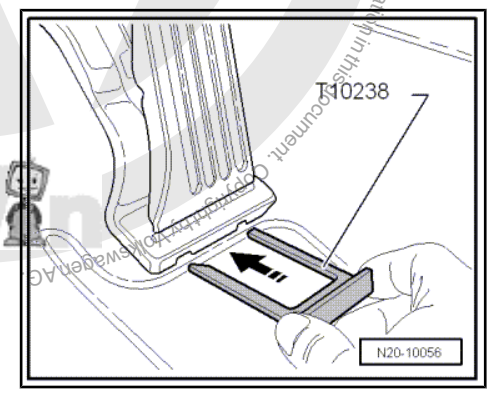
Removing

– Remove steering column cover -arrows-.



– Lever out cap ⇒ Item 4 (page 160) using a screwdriver.
– Remove securing bolt ⇒ Item 3 (page 160) .

– Push release tool -T10238- (for right-hand drive vehicles release tool -T10240-) into intended holes as shown to stop and remove accelerator module.
– Pull connector off accelerator module. Press connector securing element downwards for this.



Installing

– Reconnect connector -2- to accelerator module.

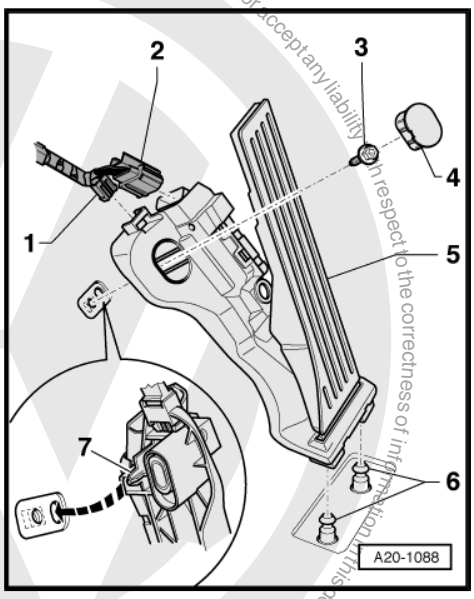
  The connector must audibly engage.

– Press accelerator module onto securing pins -6-.

– Insert centring pin -7- into hole in floor of vehicle.

– Secure accelerator module with bolt -3-, specified torque 10 Nm and install cap -4-.

– Install steering column trim.



6 Activated charcoal filter system

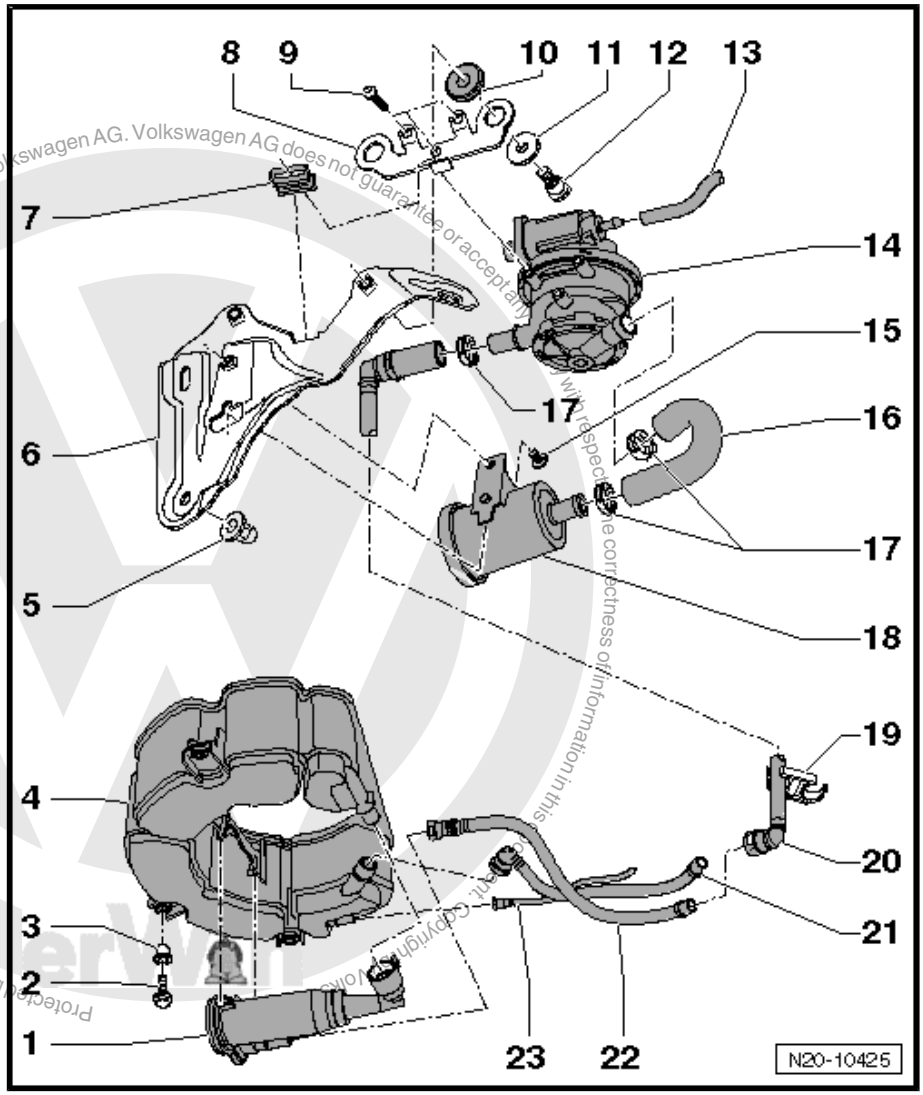
Note

- *Hose connections are secured with either spring-type or clamp-type clips.*
- *Hose clip pliers -VAS 6362- are recommended to install spring-type clips.*

Assembly overview - activated charcoal filter system
⇒ page 163 .

Checking fuel tank breather ⇒ page 164 .

6.1 Assembly overview - activated charcoal filter system



1 - Activated charcoal filter

2 - 8 Nm

3 - Sleeve

4 - Activated charcoal filter

- ❑ Location: down in spare wheel well

5 - 6 Nm

6 - Bracket

7 - Support

8 - Bracket

9 - 4 Nm

10 - Rubber grommet

11 - Washer

12 - 8 Nm

13 - Vacuum line

- ❑ To engine.

14 - Fuel system diagnostic pump -V144-

- ❑ Location: in rear right wheel housing beneath liner.
- ❑ Checking fuel system for leaks ⇒ page 164 .

15 - 4 Nm

16 - Connecting hose

17 - Clamp

18 - Air filter

- ❑ For fuel system diagnostic pump -V144-

19 - Bracket

20 - Connecting pipe

- ❑ Clip onto bracket.
- ❑ To pull off, press release button on connection.

21 - Breather line

- ❑ To filler neck on fuel tank
- ❑ To pull off, press release button on connection.

22 - Breather line

- ❑ To pull off, press release button on connection.

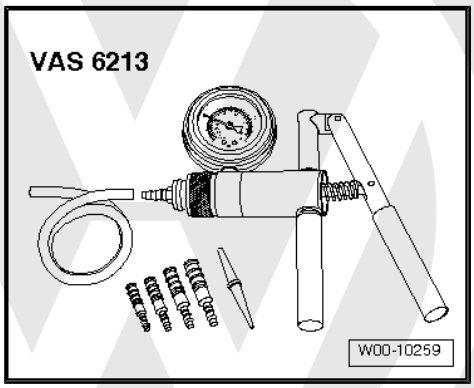
23 - Breather line

- ❑ To activated charcoal filter solenoid valve 1 -N80-
- ❑ To pull off, press release button on connection.

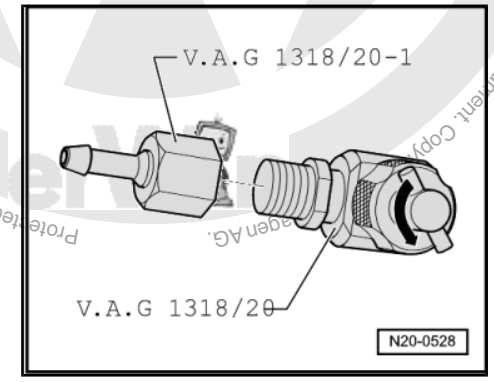
6.2 Checking fuel tank breather

Special tools and workshop equipment required

- ♦ Hand vacuum pump -VAS 6213-



- ♦ Adapter -V.A.G 1318/20–1-

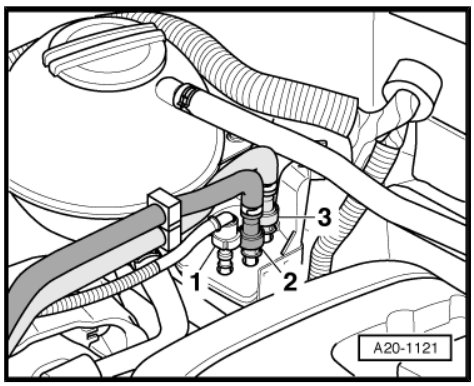


Test prerequisite

- Ignition must be switched off.

Test sequence:

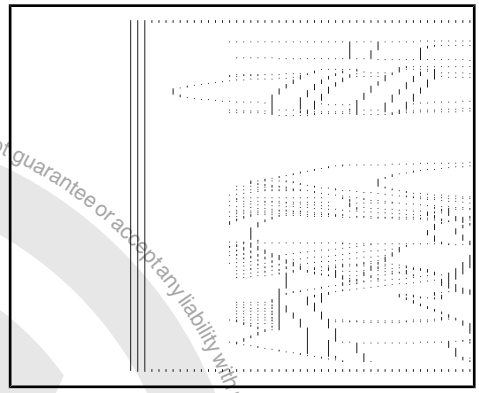
– Pull off breather line -2-. To do this, press release button.



Note

The connection -1- is only installed on vehicles with auxiliary heater.

– Then connect hand vacuum pump -VAS 6213- -1- to breather line -2- for activated charcoal filter as shown.



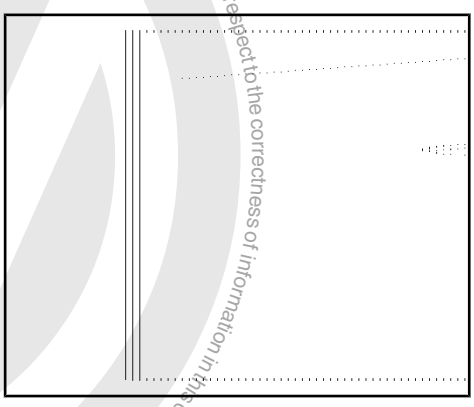
– Operate hand vacuum pump -VAS 6213- several times. Vacuum must not build up.

If vacuum builds up:

– Check breather opening -arrow- on activated charcoal filter for soiling and clean if necessary.

If pressure does not build up:

– Seal breather hole -arrow- and operate vacuum pump again several times. Vacuum must build up.



If vacuum does not build up:

– Renew activated charcoal filter.

24 – Mixture preparation - injection

1 Repairing injection system

General notes on the injection system ⇒ page 166 .

Safety precautions ⇒ page 128 .

Rules for cleanliness ⇒ page 129 .

Technical data ⇒ page 166 .

Assembly overview - intake manifold ⇒ page 167 .

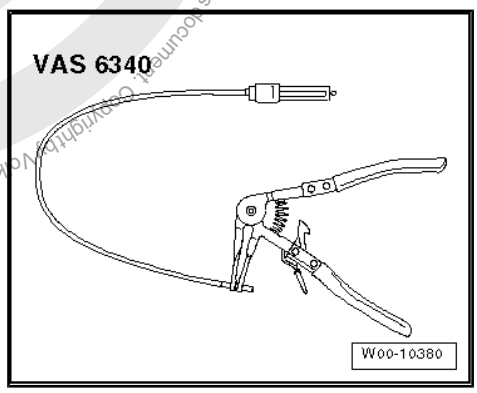
Removing and installing intake manifold ⇒ page 170 .

Assembly overview - fuel rail ⇒ page 173 .

Assembly overview - air filter ⇒ page 174 .

Assembly overview - resonator with resonance air pipe ⇒ page 175 .

1.1 General notes on the injection system



- 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.
- Spring-type clip pliers -VAS 6340- or spring-type clip pliers -VAS 5024 A- are recommended for installation of spring-type clips.
- 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 reconnecting battery ⇒ Electrical system; Rep. Gr. 27 ; Disconnecting and reconnecting 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.
- 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.
- To complete work, read fault memory of engine control unit. Delete all fault entries which may have occurred during tests and repairs. If the fault memory was cleared, the readiness code must be generated ⇒ Vehicle diagnosis, testing and information system VAS 5051 “Guided functions”.
- 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 behaviour.

1.2 Technical data

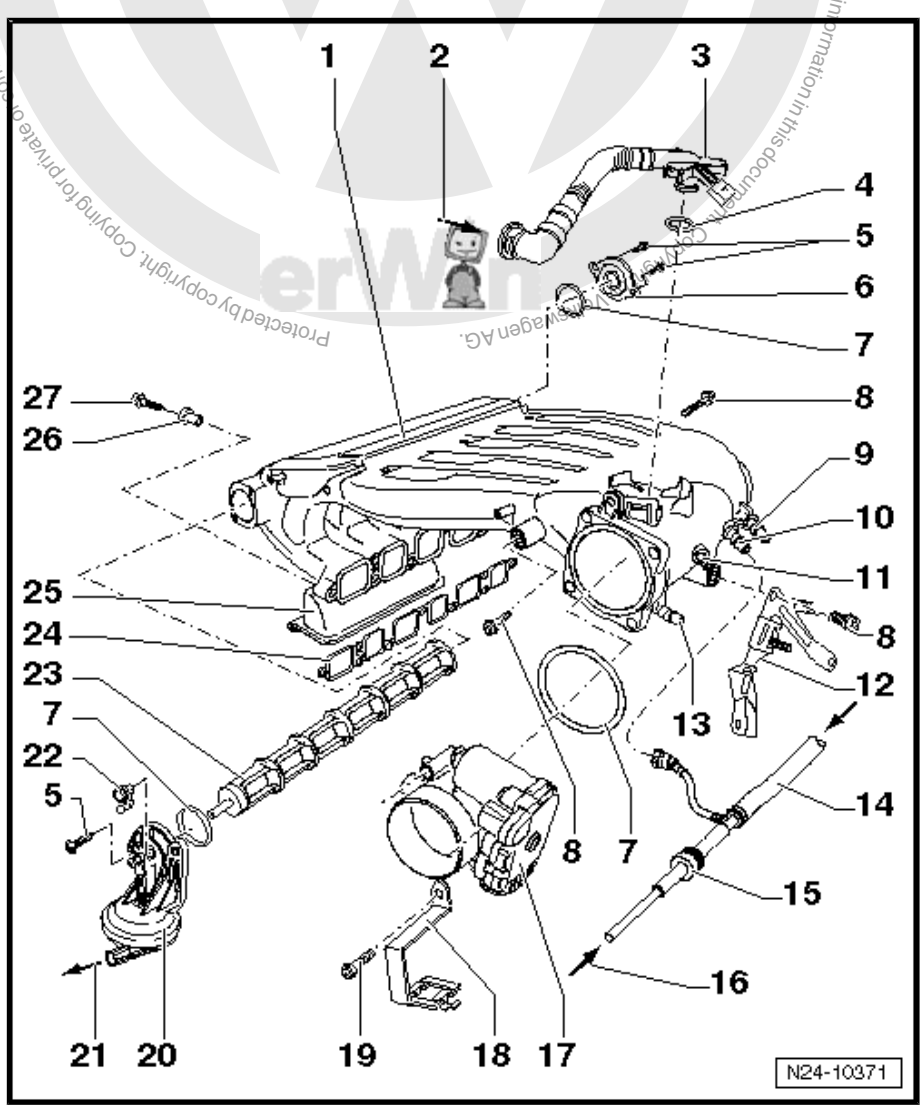
Engine code	CBRA
Idling check	

Engine code		CBRA
Idling speed[2)]	rpm	590 … 850
Engine control unit		
System designation		Motronic ME 7.1.1
Part number		⇒ Electronic parts catalogue
Governed speed	rpm	approx. 7000

2) The idling speed cannot be adjusted.

1.3 Assembly overview - intake manifold

Connection for variable intake manifold changeover valve -N156-
⇒ page 169



1 - Intake manifold
- ❑ Vacuum reservoir
- ❑ Check vacuum reservoir for leaks with hand vacuum pump -VAS 6213- .
- ❑ Removing and installing intake manifold ⇒ page 170 .

2 - From cylinder head cover.

3 - Crankcase breather valve
- ❑ With crankcase breather heater element -N79- .

4 - Seal
- ❑ Renew.

5 - 10 Nm

6 - Bearing cap
- ❑ For intake manifold change-over barrel

7 - Seal
- ❑ Renew.

8 - 20 Nm

9 - Vacuum connection
- ❑ For brake servo.

10 - Vacuum connection
- ❑ To exhaust flap 1 valve -N321-

11 - Vacuum connection
- ❑ To vacuum reservoir.

12 - Rear intake manifold support

13 - Vacuum connection
- ❑ For activated charcoal filter system solenoid valve 1 -N80-

14 - Vacuum hose for fuel system diagnostic pump -V144-
- ❑ Vehicles for USA/Canada only

15 - Non-return valve

- ❑ Black connector faces towards T piece

16 - From exhaust flap 1 valve -N321-

- ❑ ⇒ page 199

17 - Throttle valve module -J338-

- ❑ Removing and installing ⇒ page 170 .
- ❑ Including throttle valve drive (electric throttle operation) -G186- , angle sender 1 for throttle valve drive (electric throttle operation) -G187- and angle sender 2 for throttle valve drive (electric throttle operation) -G188-
- ❑ If renewed, adapt engine control unit to throttle valve module ⇒ Vehicle diagnosis, testing and information system VAS 5051; “Guided function” .

18 - Bracket

19 - 10 Nm

20 - Vacuum unit

- ❑ For intake manifold change-over.
- ❑ Checking vacuum unit for intake manifold flaps ⇒ page 177 .

21 - To intake manifold changeover valve -N156- .

- ❑ ⇒ Item 7 (page 169)

22 - Positioning lever

- ❑ For change-over barrel.
- ❑ Check for secure seating.

23 - Change-over barrel

24 - Gasket

- ❑ Note installation position.
- ❑ Renew if damaged.

25 - Vacuum reservoir

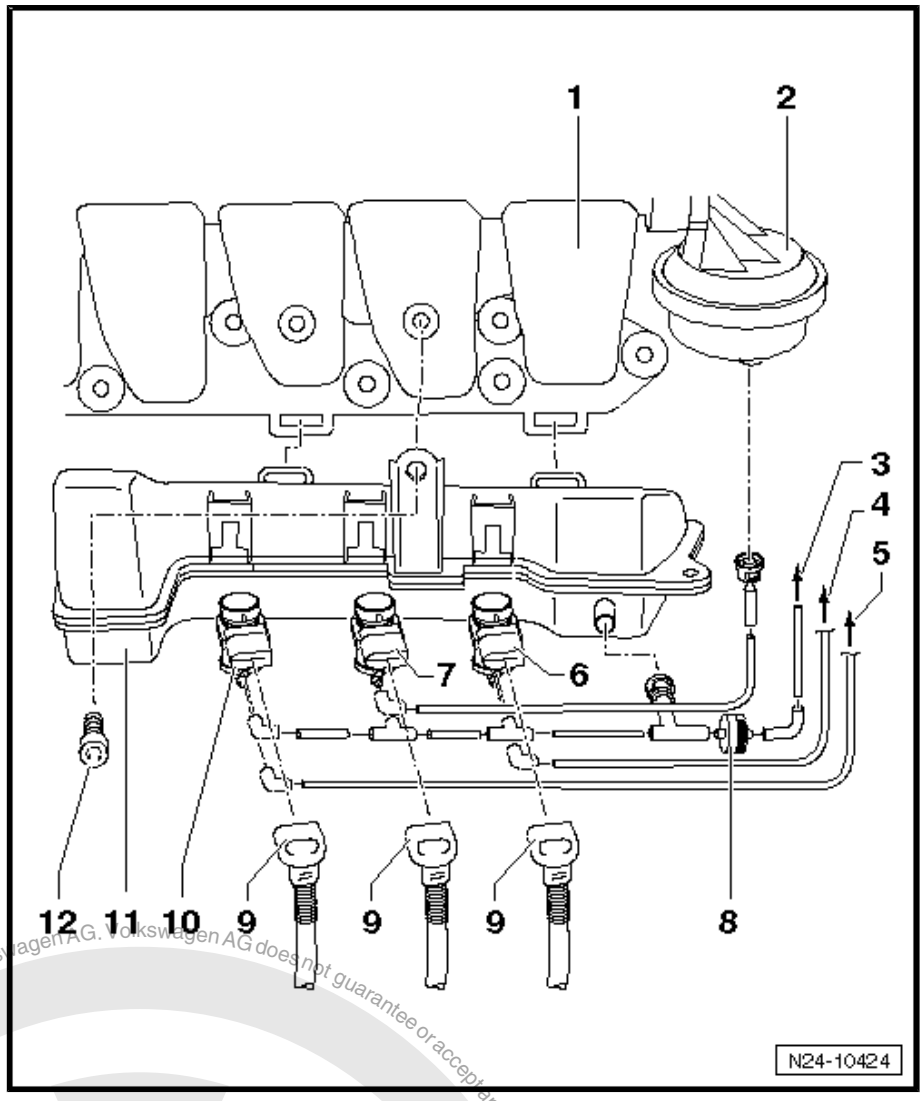
- ❑ For intake manifold change-over.
- ❑ Check vacuum reservoir for leaks with hand vacuum pump -VAS 6213- .

26 - Dowel sleeve

- ❑ To secure intake manifold.
- ❑ To locate seal.

27 - 13 Nm

1.3.1 Assembly overview - vacuum system



1 - Intake manifold

2 - Vacuum unit

- ❑ For intake manifold change-over.
- ❑ Checking vacuum unit for intake manifold flaps ⇒ page 177 .

3 - To intake manifold

- ❑ ⇒ Item 11 (page 167)

4 - To left combination valve

- ❑ For secondary air.
- ❑ ⇒ Item 2 (page 203)

5 - To right combination valve

- ❑ For secondary air.
- ❑ ⇒ Item 12 (page 203)

6 - Secondary air inlet valve - N112-

- ❑ Clipped to vacuum reservoir
- ❑ To remove, bring lock carrier into service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier; service position

7 - Variable intake manifold changeover valve -N156-

- ❑ Clipped to vacuum reservoir
- ❑ To remove, bring lock carrier into service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier; service position

8 - Non-return valve

- ❑ Installation position (light/dark side): as shown in illustration

9 - Connector

10 - Secondary air inlet valve 2 -N320-

- ❑ Clipped to vacuum reservoir
- ❑ To remove, bring lock carrier into service position ⇒ General body repairs, exterior; Rep. Gr. 50 ; Lock carrier; service position

11 - Vacuum reservoir

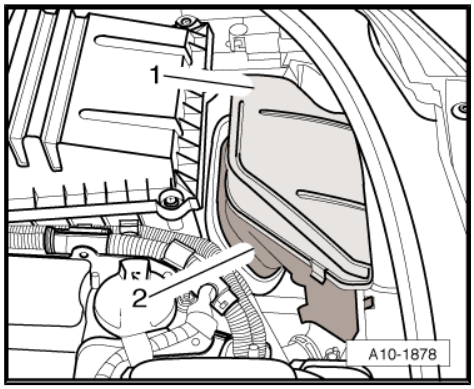
12 - 10 Nm

1.4 Removing and installing throttle valve module -J338-

Removing

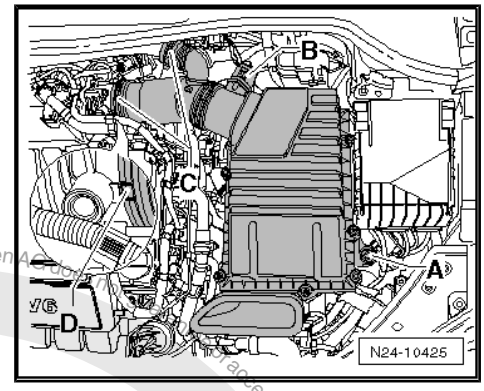
– Pull cover -1- off air duct. Release fasteners on side for this.

– Unclip air duct -2-.

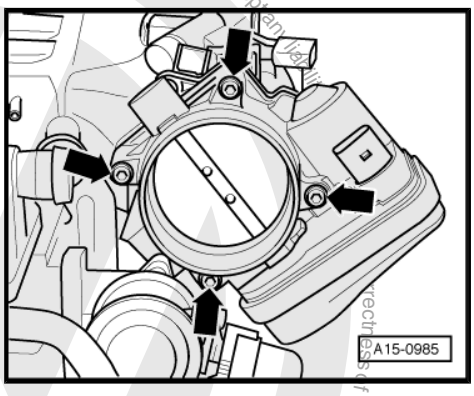


– Remove air filter housing and connecting hose. To do this, unscrew bolt -A-, pull off connector -B- and loosen spring-type clips -C-. Note marking -D- when reinstalling.

– Disconnect electrical connector on throttle valve module -J338- .



– Unbolt throttle valve module -J338- from intake manifold -arrows-.



Installing

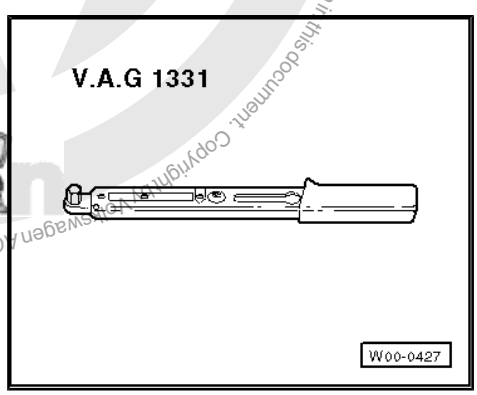
Install in reverse order. In the process, note the following:

– If a new throttle valve module -J338- was installed, adapt the engine control unit to throttle valve module -J338- ⇒ Vehicle diagnosis, testing and information system VAS 5051 “guided functions”.

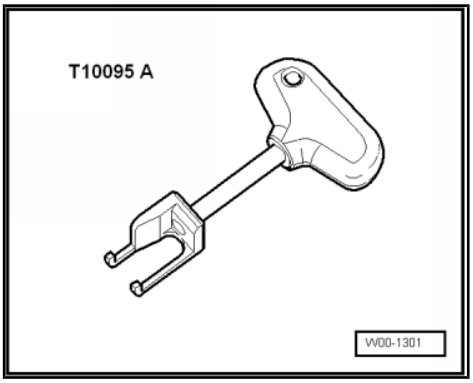
1.5 Removing and installing intake manifold

Special tools and workshop equipment required

♦ Torque wrench -V.A.G 1331-



- Puller -T10095 A-



Removing

Note

- *Note safety precautions before beginning work ⇒ page 128 .*
- *Observe rules for cleanliness ⇒ page 129 .*
- *Assembly overview - intake manifold ⇒ page 167 .*
- *All cable ties which are opened or cut open 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 the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***To avoid damage to lines/wiring, 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 reconnecting battery .

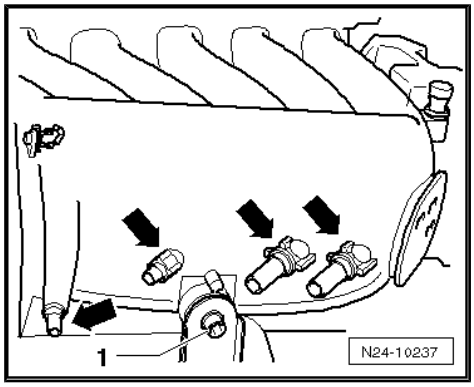
– Remove throttle valve module -J338- ⇒ page 174 .

– Pull connector off crankcase breather heater element -N79- and off activated charcoal filter solenoid valve 1 -N80- .

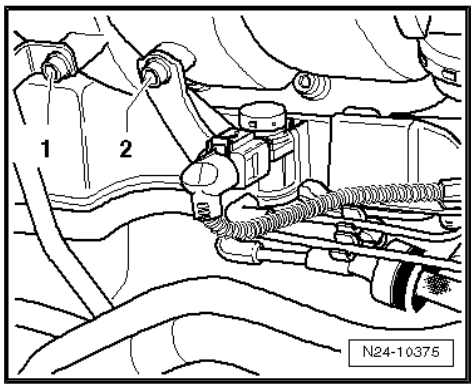
– Remove wiring harness for ignition coils with output stages from intake manifold.

– Remove ignition coils with output stage ⇒ page 208 .

– Pull vacuum lines -arrows- off intake manifold.
– Unbolt intake manifold supports on left and right of intake manifold.
– Remove bolt -1- for intake manifold support, rear (exhaust side).
– Pull crankcase breather connection hose off cylinder head cover.
– Bring lock carrier into service position ⇒ General body repairs; Rep. Gr. 50 ; Lock carrier, service position .
– Pull vacuum hose off intake manifold flap vacuum unit.



– Unscrew securing bolt from oil dipstick guide tube -1-.
– Unscrew bolt -2- and pull vacuum reservoir -1- off intake manifold.
– Remove intake manifold securing bolts ⇒ Item 27 (page 168) from cylinder head.
– Remove intake manifold and place it on a suitable surface so that the vacuum unit will not be damaged.



Note

Seal intake ports in intake manifold and in cylinder head with a clean cloth.

Installing

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

Note

- *Tighten intake manifold to cylinder head first, specified torque: 13 Nm*
- *Then tighten the two bolts of intake manifold support on left and right: specified torque: 20 Nm*
- *Then tighten rear intake manifold support: specified torque: 20 Nm*

1.6 Assembly overview - fuel rail

1 - 10 Nm

2 - Fuel supply line
- ❑ From fuel tank

3 - Fuel rail

4 - Injector, cylinder 6 -N84-
- ❑ Checking ⇒ page 179 .

5 - Cylinder head

6 - Seal
- ❑ Renew.
- ❑ Before installing, moisten lightly with clean engine oil.

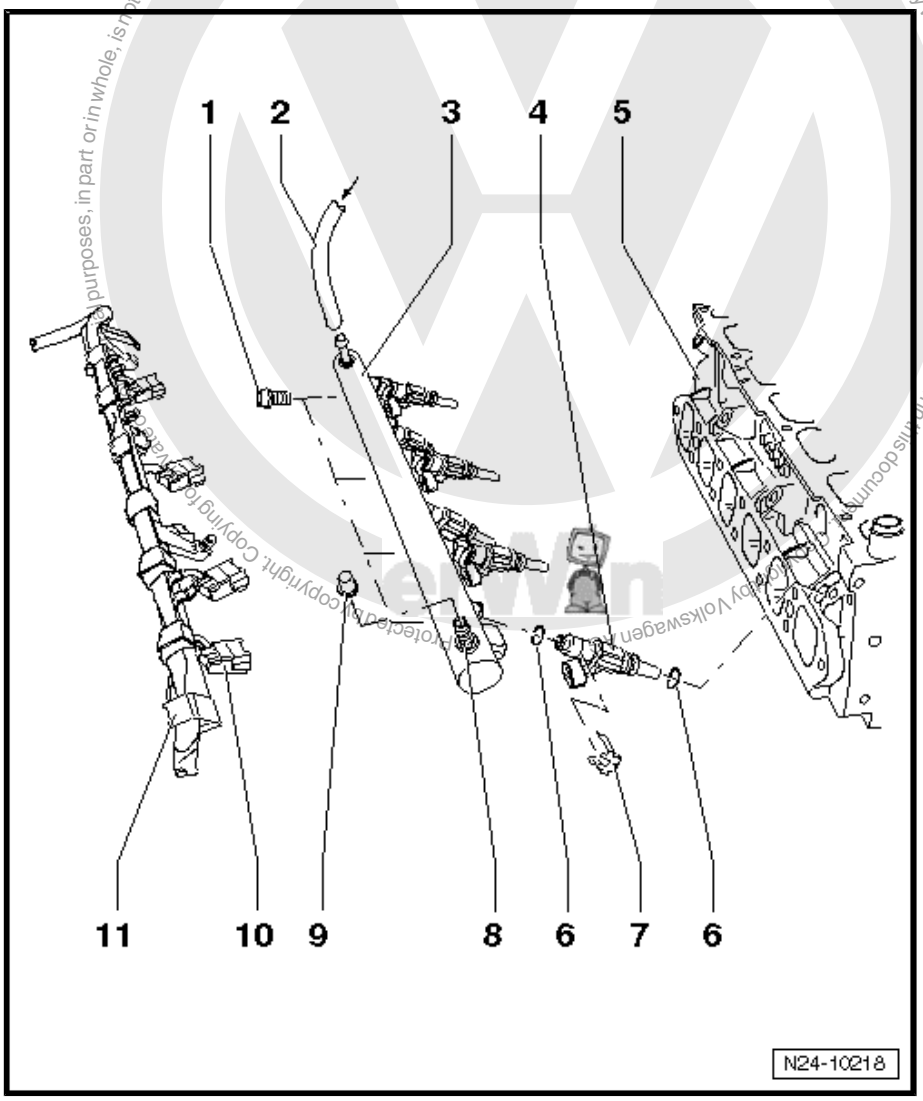
7 - Retaining clip
- ❑ Check for secure seating.

8 - Breather valve
- ❑ For checking fuel pressure
- ❑ For bleeding fuel system

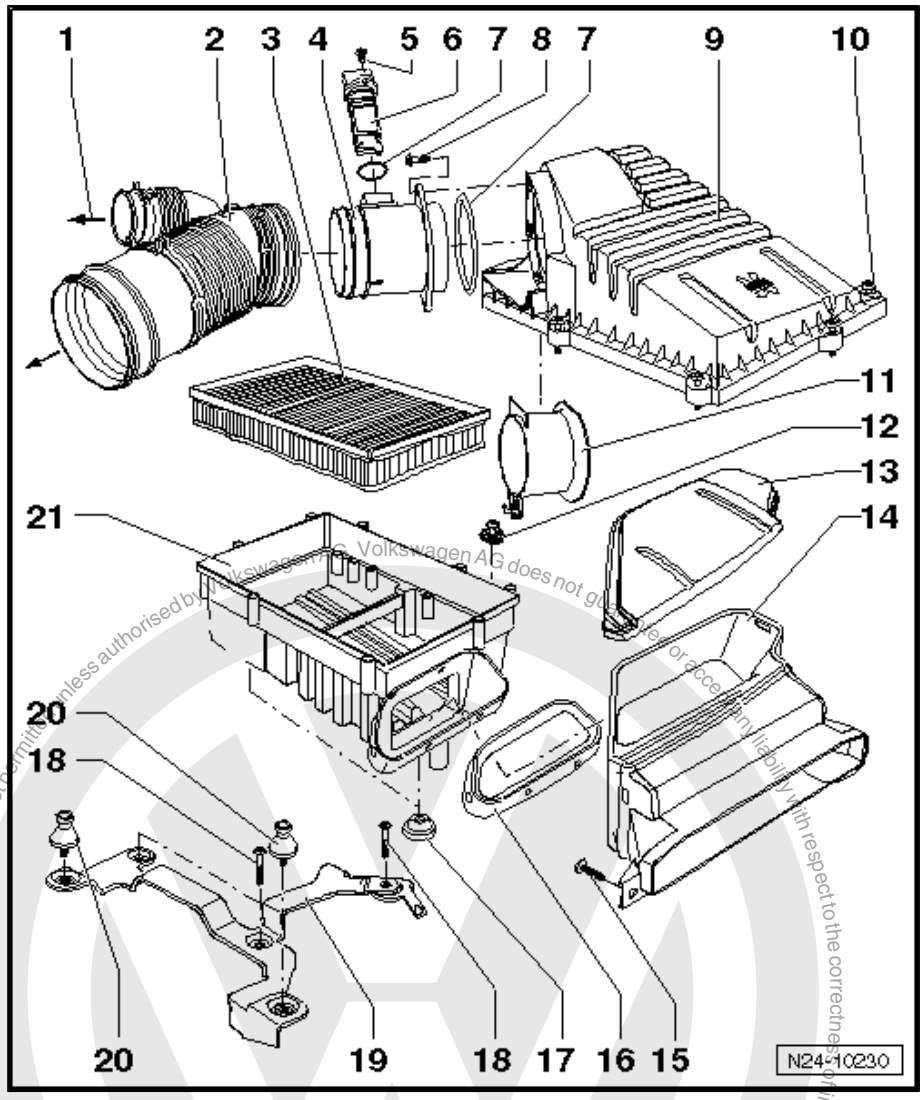
9 - Protective cap

10 - Connector
- ❑ Black, 2-pin.
- ❑ Check for secure seating.

11 - Wiring harness
- ❑ With connectors for injectors.
- ❑ Clipped into wiring channel



1.7 Assembly overview - air filter



1 - To resonance air pipe

- ❑ Assembly overview - resonator with resonance air pipe ⇒ page 175

2 - Connecting hose

- ❑ To throttle valve module -J338- .

3 - Filter element

4 - Housing

- ❑ For air mass meter -G70-

5 - 3 Nm

6 - Air mass meter -G70-

7 - O-ring

- ❑ Renew.

8 - 2 Nm

9 - Air filter upper part

10 - 2 Nm

11 - Connection

- ❑ Clipped into air filter upper part

12 - 8 Nm

13 - Cover

14 - Air duct

- ❑ Secured to lock carrier.

15 - 5 Nm

16 - Gasket

- ❑ Renew if damaged.

17 - Rubber bush

18 - 10 Nm

19 - Bracket

- ❑ For air filter

20 - Mounting pin, 9 Nm

21 - Air filter lower part

1.8 Assembly overview - resonator with resonance air pipe

1 - 10 Nm

2 - Plenum chamber bulkhead

3 - Rubber bush

4 - Spacer sleeve

5 - From connecting hose

- ❑ For air filter/ throttle valve module -J338- ⇒ Item 1 (page 174)

6 - 10 Nm

7 - Resonance air pipe

8 - Connecting hose

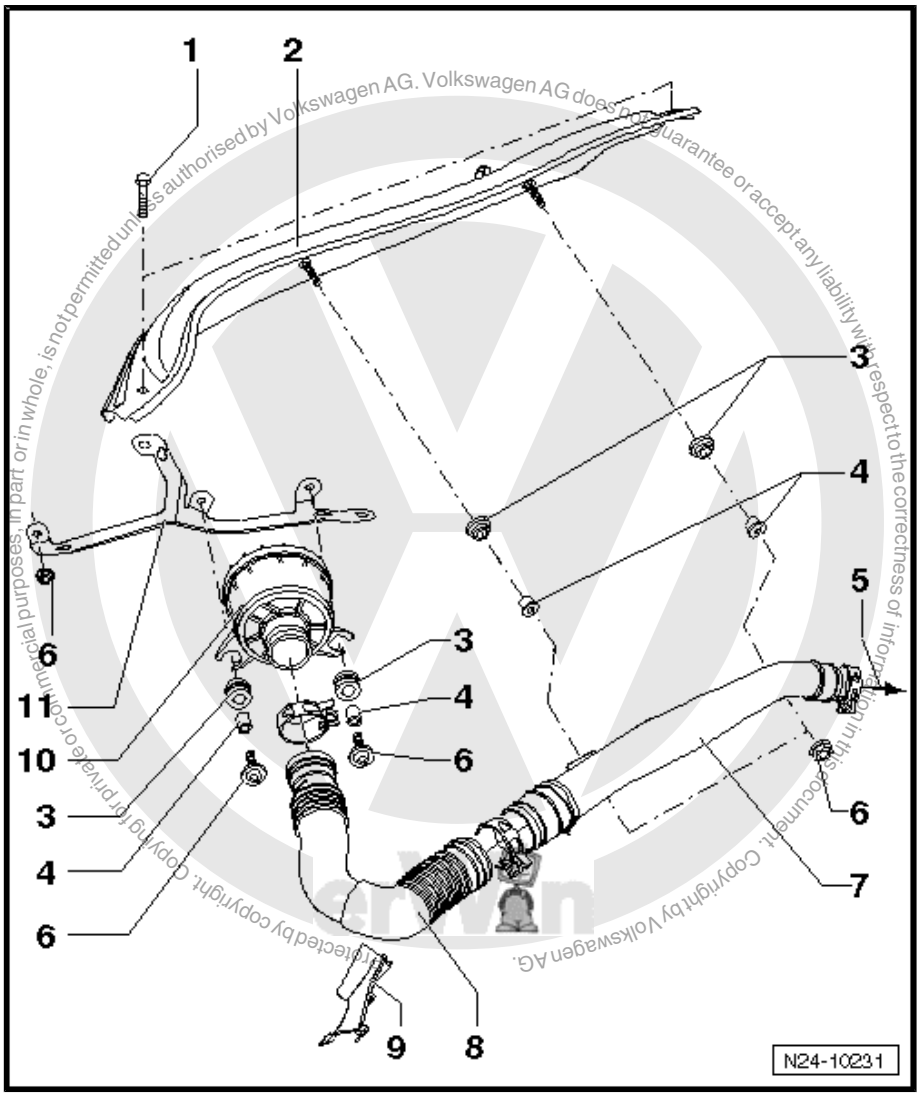
9 - Bracket

- ❑ For feed-through on plenum chamber

10 - Resonator

11 - Bracket

- ❑ For resonator



1.9 Checking intake air preheating

Special tools and workshop equipment required

♦ Chilling spray (commercially available)

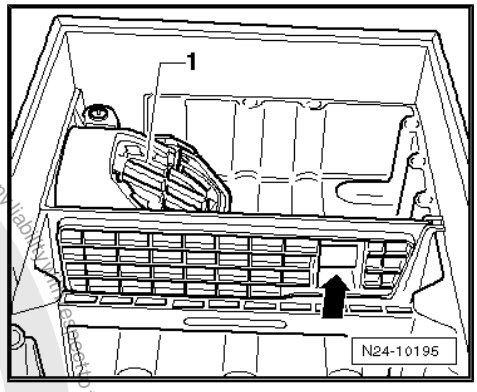
Note

Only installed on vehicles for cold climate zones.

Checking regulating flap:

– Remove air filter upper part and filter element ⇒ page 174 .

– Check regulating flap position -1-.



– Spray thermal element -arrow- with chilling spray.

♦ At above +14 °C, the regulating flap must have completely closed the hot air connection.

♦ At below + 0 °C, the regulating flap must have completely opened the hot air connection.

2 Checking components

Note safety precautions before beginning work ⇒ page 128 .

Observe rules for cleanliness ⇒ page 129 .

Check vacuum unit for intake manifold flaps ⇒ page 177 .

Checking injectors for leaks and quantity injected ⇒ page 179 .

Checking fuel pressure regulator and holding pressure ⇒ page 181 .

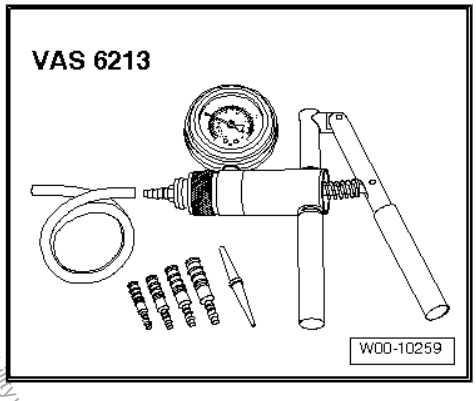
2.1 Checking vacuum unit for intake manifold flaps

Note

Perform this test only if torque is insufficient, that is when elasticity or pulling power is inadequate.

Special tools and workshop equipment required

- Hand vacuum pump -VAS 6213- or hand vacuum pump with accessories -V.A.G 1390-



Prerequisites

- The variable intake manifold changeover valve -N156- is tested with the vehicle diagnosis, testing and information system -VAS 5051B- in “Guided fault finding”.

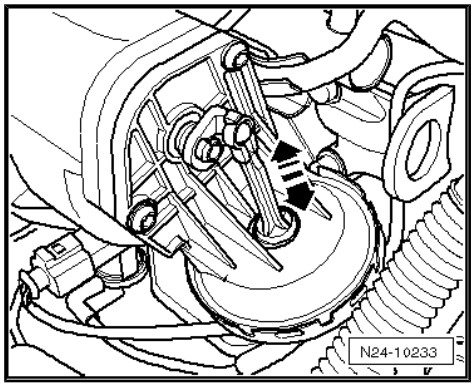
Test procedure

If the variable intake manifold changeover valve -N156- is OK:

– Start engine and run at idling speed.

– Have second person abruptly increase engine speed (throttle burst). Observe vacuum unit for intake manifold change-over:

• The actuator must switch.



If the changeover does not function as described:

– Check vacuum system for leaks including vacuum reservoir on intake manifold.

– Check mechanical change-over components for ease of movement. To do this, operate rods by hand.

– Check that vacuum lines are connected correctly.

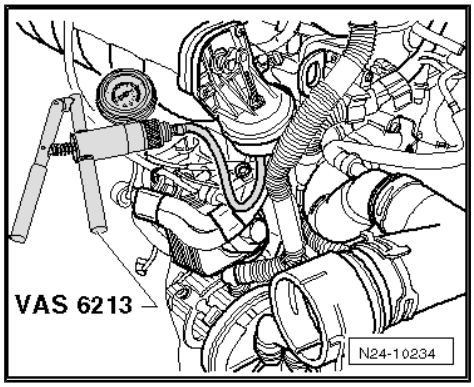
– Check vacuum hoses for porosity.

If no fault was found:

– Remove air filter ⇒ page 174 .

– Pull vacuum hose off vacuum unit.

– Connect hand vacuum pump -VAS 6213- to vacuum unit.



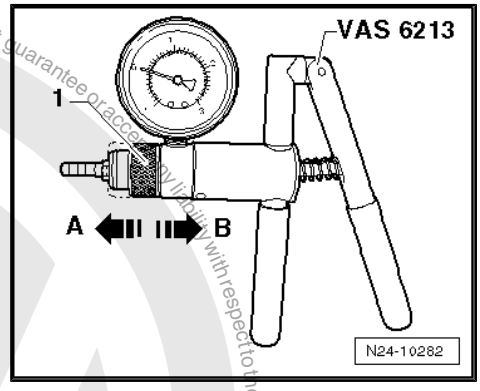
– Move slide ring -1- on hand vacuum pump -VAS 6213- to position -A- for “vacuum”.

– Operate hand vacuum pump repeatedly.

• The operating rod must move.

– Pull hand vacuum pump from vacuum unit.

• The operating rod must move back to its original position.



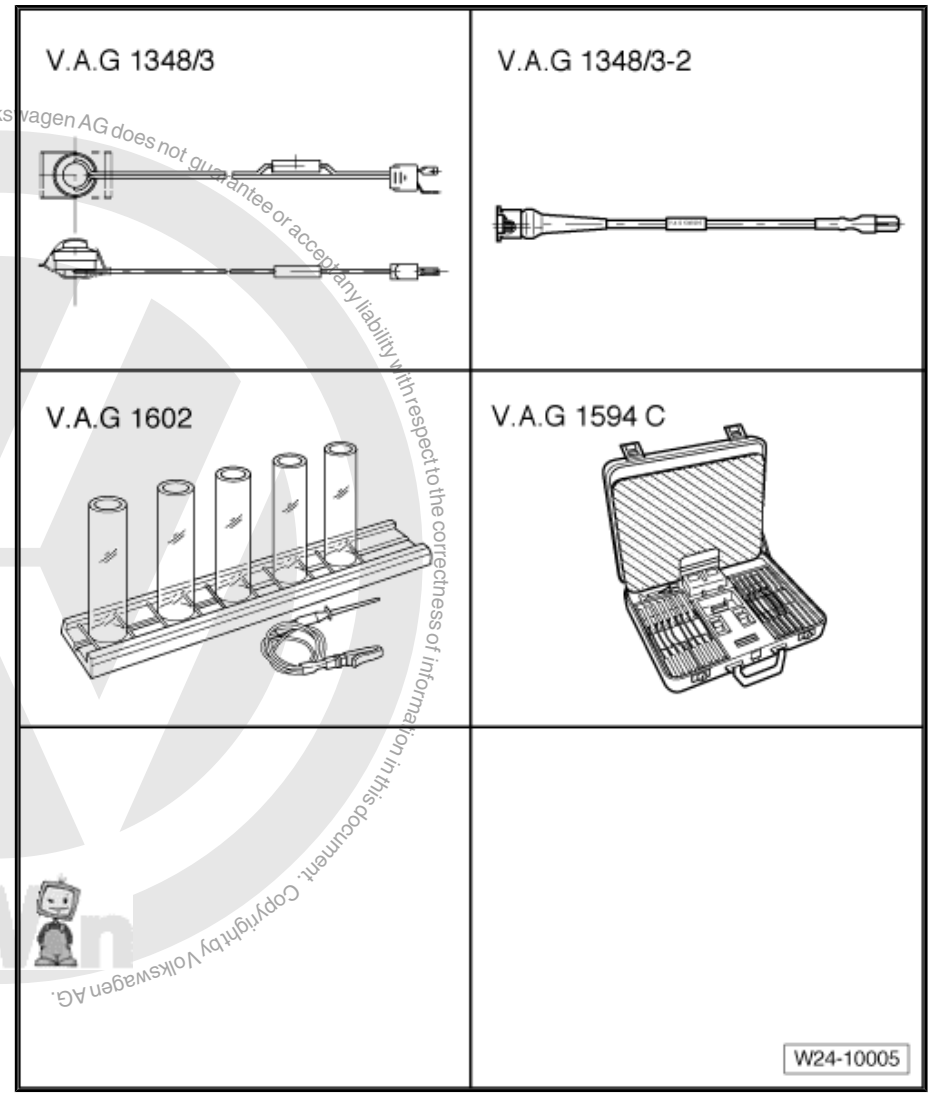
If the operating rod does not move as described:

– Renew vacuum unit.

2.2 Checking injectors for leaks and quantity injected

Special tools and workshop equipment required

- Remote control for V.A.G 1348 -V.A.G 1348/3 A-
- Adapter cable -V.A.G 1348/3 - 2-
- Injection rate tester -V.A.G 1602-
- Auxiliary measuring set - V.A.G 1594 C-



Checking for leaks ⇒ page 179 .

Checking injection rate ⇒ page 180 .

2.2.1 Checking for leaks

WARNING

The fuel system is pressurised! Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

- The fuel pressure must be in order, checking ⇒ page 181 .

Procedure

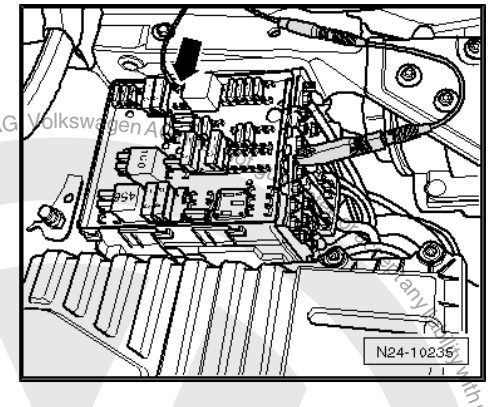
– Remove intake manifold ⇒ page 170 .

– Pull connectors off injectors.

– Now remove complete fuel rail (fuel lines remain connected) ⇒ page 173 .

– Pull fuse SB6 on socket F6 off hose holder. Fuse assignment ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

– Connect left terminal (viewed looking forwards) of fuse socket F6 and battery positive (+) using auxiliary cables from auxiliary measuring set -V.A.G 1594 C- so that fuel pump runs.



Note

This step serves only to have the fuel pump running when the engine is stopped.

– Check injectors for leaks (visual check).

- No more than 1 to 2 drops per minute must escape from each valve when fuel pump is running.

If the fuel loss is greater:

– Separate connection between fuse socket and battery positive and renew leaking injector ⇒ page 173 .

Install injectors in reverse order. In the process, note the following:

- Renew O-rings on all injectors and lightly moisten with clean engine oil.
- Insert injectors vertically and in the correct position into the fuel rail and secure with retaining clips.
- Fit fuel rail with secured injectors on cylinder head and press in evenly.

Note

If injectors are renewed, clear learnt values and adapt engine control unit again ⇒ Vehicle diagnosis, testing and information system VAS 5051 "Guided functions".

2.2.2 Checking quantity injected

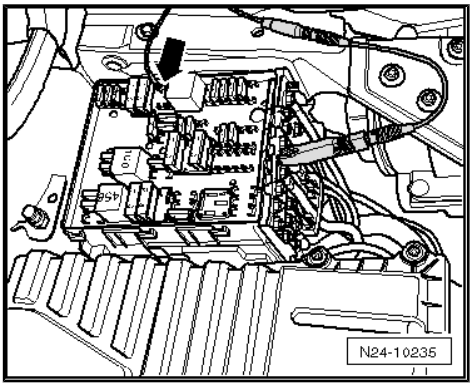
- The fuel pressure must be in order, checking ⇒ page 181 .
- Intake manifold removed.
- Injectors installed in fuel rail and fuel line connected.

Procedure

– Insert injector to be checked into measuring glass from injection rate tester -V.A.G 1602- .

– Pull fuse SB6 on socket F6 off hose holder. Fuse assignment ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

– Connect left terminal (viewed looking forwards) of fuse socket F6 and battery positive (+) using auxiliary cables from auxiliary measuring set -V.A.G 1594 C- so that fuel pump runs.

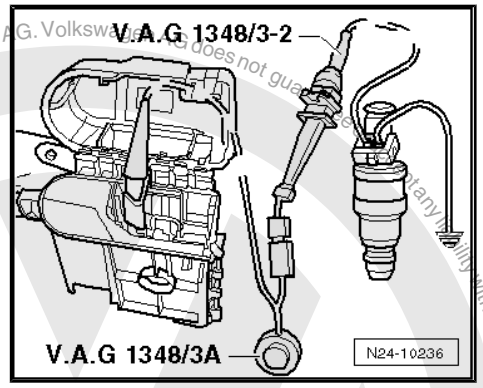


Note

This step serves only to have the fuel pump running when the engine is stopped.

– Connect a contact of injector to be tested to engine earth using auxiliary cables from auxiliary measuring set -V.A.G 1594 C-.

– Connect second injector contact with auxiliary cable to remote control for V.A.G 1348 -V.A.G 1348/3 A- using adapter cable -V.A.G 1348/3 - 2- .



– Connect crocodile clip to battery positive (positive pole in engine compartment).

– Operate remote control for V.A.G 1348 -V.A.G 1348/3 A- for 30 seconds.

– Repeat check on other injectors. Use new measuring beakers.

– After all injectors have been activated, place measuring beakers on a level surface and compare the quantity injected.

• Specification: 128…140 ml per injector.

When checking the quantity injected, check the spray pattern as well.

• The spray patterns must be the same for all injectors.

If the measured values of one or more injectors are above or below the prescribed specifications:

– Separate connection between fuse socket and battery positive and renew defective injector ⇒ page 173.

Install injectors in reverse order. In the process, note the following:

♦ Renew O-rings on all injectors and lightly moisten with clean engine oil.

♦ Insert injectors vertically and in the correct position into the fuel rail and secure with retaining clips.

♦ Fit fuel rail with secured injectors on cylinder head and press in evenly.

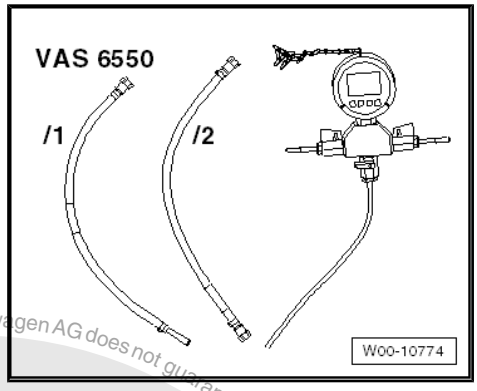
Note

If injectors are renewed, clear learnt values and adapt engine control unit again ⇒ Vehicle diagnosis, testing and information system VAS 5051 “Guided functions”.

2.3 Checking fuel pressure regulator and holding pressure

Special tools and workshop equipment required

- Pressure gauge -VAS 6550-



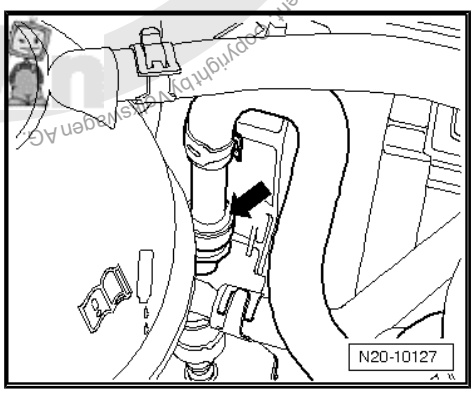
Note

- *The fuel pressure regulator regulates the fuel pressure to approx. 4.0 bar.*
- *The fuel pressure regulator is located on the fuel filter. From October 2005, the fuel pressure regulator has been integrated in the fuel filter and cannot be renewed individually.*
- *Always follow safety precautions ⇒ page 206 .*
- *Observe rules for cleanliness ⇒ page 129 .*

WARNING

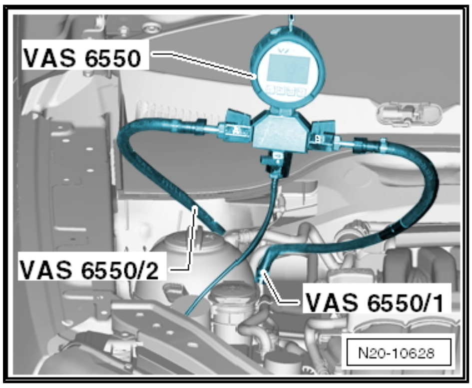
Fuel supply line is pressurised. Wear eye protection and protective clothing to avoid possible injury and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

– Pull off supply line (metal coupling) -arrow- and catch escaping fuel with a cloth.



Note

Press in securing ring to release fuel line.



– Connect pressure tester -VAS 6550- to fuel supply line with adapter -VAS 6550/1- and -VAS 6550/2- .
– Make sure that drain tap is closed and cut-off taps are open.
– Start engine and run at idling speed.

Note

If engine does not start, activate fuel pump with final control diagnosis ⇒ page 150 .

– Read fuel pressure on pressure gauge. Specification: 3.8… 4.2 bar.

If fuel pressure is OK, check holding pressure ⇒ page 183 .

If the specification is exceeded:

– Check fuel return line between fuel filter and flange for possible restrictions (kinks) or blockages.

If no fault is found:

– Fuel pressure regulator defective. Renew fuel pressure regulator and/or fuel filter.

If the specification is not attained:

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

If no fault is found:

– Renew fuel pressure regulator and/or fuel filter.
– Repeat check.

If the specifications are still not attained:

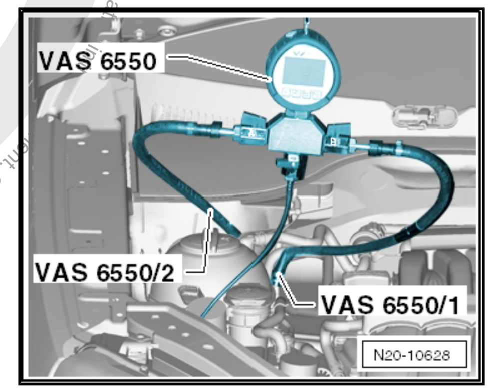
– Fuel pump is defective. Renew fuel delivery unit ⇒ page 141 .

If the specification is attained, check holding pressure.

Checking holding pressure

Prerequisites:

• Fuel pressure on pressure gauge 3.8 … 4.2 bar
– Switch off ignition.

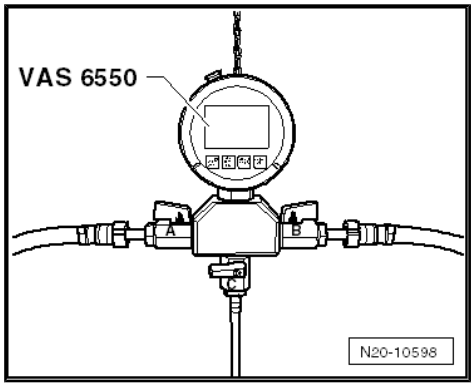


– Watch pressure drop on pressure gauge. After 10 minutes, pressure must not drop below 3.0 bar.

If the pressure drops further:

– Start engine and run at idling speed.

– Switch off ignition and close shut-off tap -B- of pressure tester immediately.



If the pressure does not drop now:

Search for leak on engine side. Repeat holding pressure test. This time, close shut-off tap -A- to check whether leak actually is on engine side.

– Check fuel rail and injectors for leaks.

If the pressure drops again:

(Leak - fuel tank side)

– Check fuel lines for leaks.

If no fault can be found on the fuel lines:

– Check fuel pump non-return valve ⇒ page 156 .

If no fault is found

– Renew fuel pressure regulator and/or fuel filter.

When the pressure tester is removed after the test has been completed:

– Switch off ignition.

– Wrap a cloth around the joint to catch any escaping fuel.

3 Engine control unit

Removing and installing engine control unit ⇒ page 185 .

Removing and installing anti-theft engine control unit ⇒ page 185 .

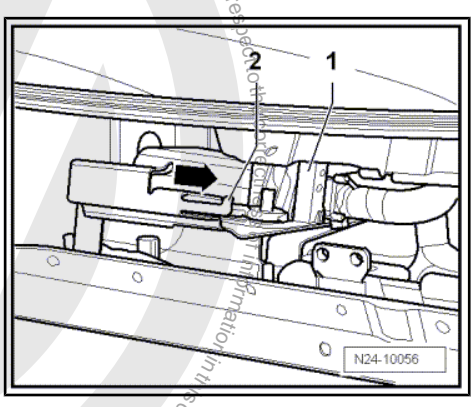
3.1 Removing and installing engine control unit

Note

If the engine control unit is to be renewed, connect vehicle diagnosis, testing and information system -VAS 5051B- and perform "Renewing engine control unit" in guided functions.

Removing

- Switch off ignition.
- Remove wiper arms, plenum chamber cover and plenum chamber bulkhead: ⇒ Electrical system; Rep. Gr. 92 ; Windscreen wiper system; Removing and installing windscreen wiper system .
- 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-.
- Then release rear connector on engine control unit and pull it off.



Installing

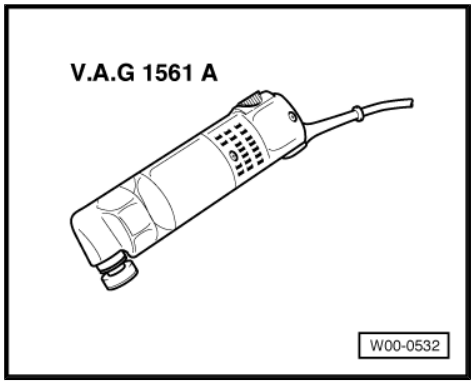
- Fit rear connector to engine control unit and lock in position.
- Push engine control unit onto bracket.
- Fit front connector to engine control unit and lock it in position.
- Install plenum chamber bulkhead, plenum chamber cover and wiper arms ⇒ Electrical system; Rep. Gr. 92 ; Windscreen wiper system; Removing and installing windscreen wiper system .

3.2 Removing and installing anti-theft engine control unit

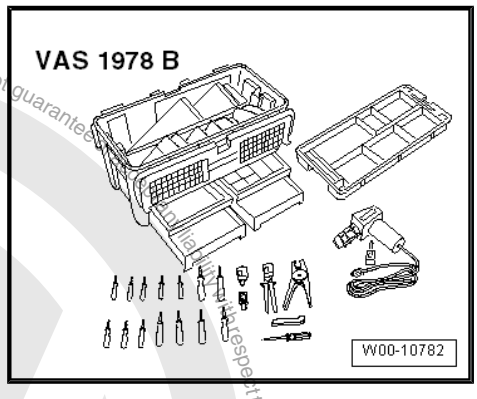
Special tools and workshop equipment required

- Saw set -V.A.G 1561/14-
- Grip pliers

- Electric cutter -V.A.G 1561 A-



- Hot air blower from wiring harness repair set -VAS 1978 B-



- Small nozzle attachment from wiring harness repair set -VAS 1978 B-

Note

If the engine control unit is to be renewed, connect vehicle diagnosis, testing and information system -VAS 5051B- and perform "Renewing engine control unit" in guided functions.

Removing

– Switch off ignition.

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

Note

The shear-head bolt threads are coated with locking compound. Heating the shear-head bolt with a hot air blower releases the locking effect of the locking compound.

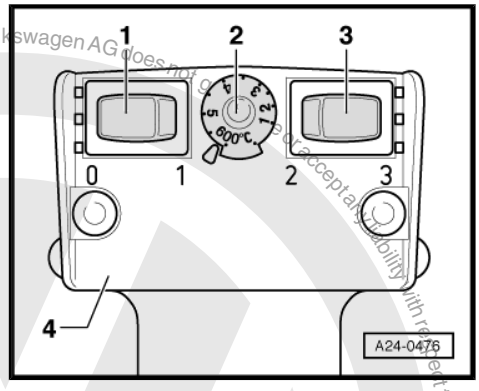
Caution

Cover lines, connections and control units in the vicinity of the engine control unit to prevent damage through heat (scorching/melting of plastics etc.).

Perform settings on hot air blower -4- as shown:

– Turn temperature settings potentiometer -2- to a maximum heat output of 600 °C.

– Set two-stage switch for volume of air -3- to position 3.



WARNING

When shear-head bolts are heated up, parts of the protective housing will be subjected to a large amount of heat. Wear protective gloves to avoid possible injury.

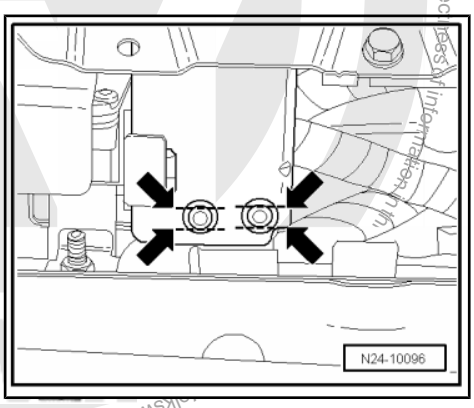
– Place nozzle of hot air blower close to shear-head bolt.

– Switch on hot air blower and heat the bolts.

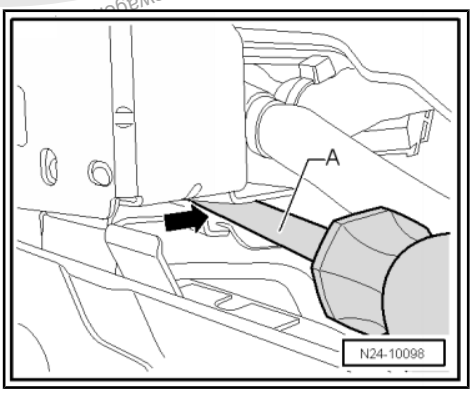
– Remove bolts with grip pliers.

Note

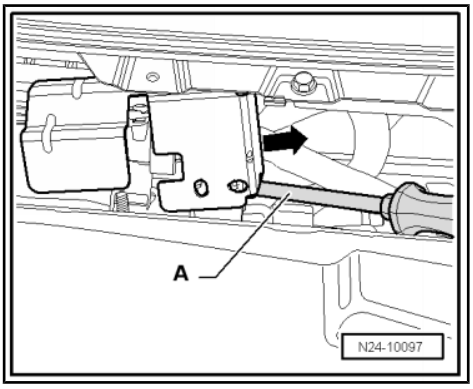
If the bolts will not move, saw into heads of shear-head bolts so that two parallel slots are created -arrows- and then remove the bolts.



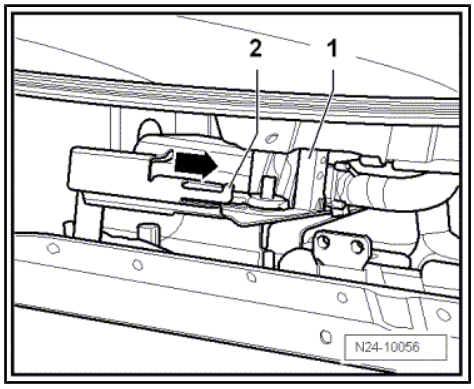
– Insert a screwdriver between protective housing -A- and bracket -arrow-.



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



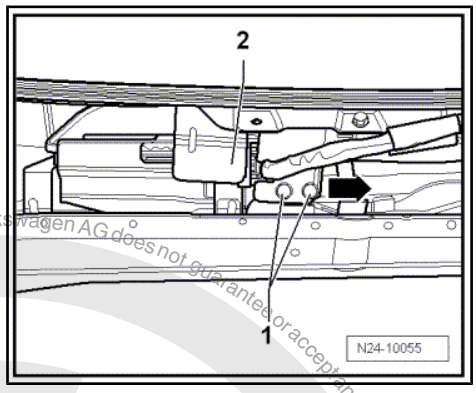
– Release front connector -1- from engine control unit and pull it off.
– Lever up catch -2- slightly.
– Then push engine control unit out of retainer -arrow-.
– Then release rear connector on engine control unit and pull it off.



Installing

– Fit rear connector to engine control unit and lock 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-head bolts -1- evenly until head shears 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 .



26 – Exhaust system

1 Exhaust manifold, front exhaust pipe with catalytic converters and Lambda probes

Caution

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

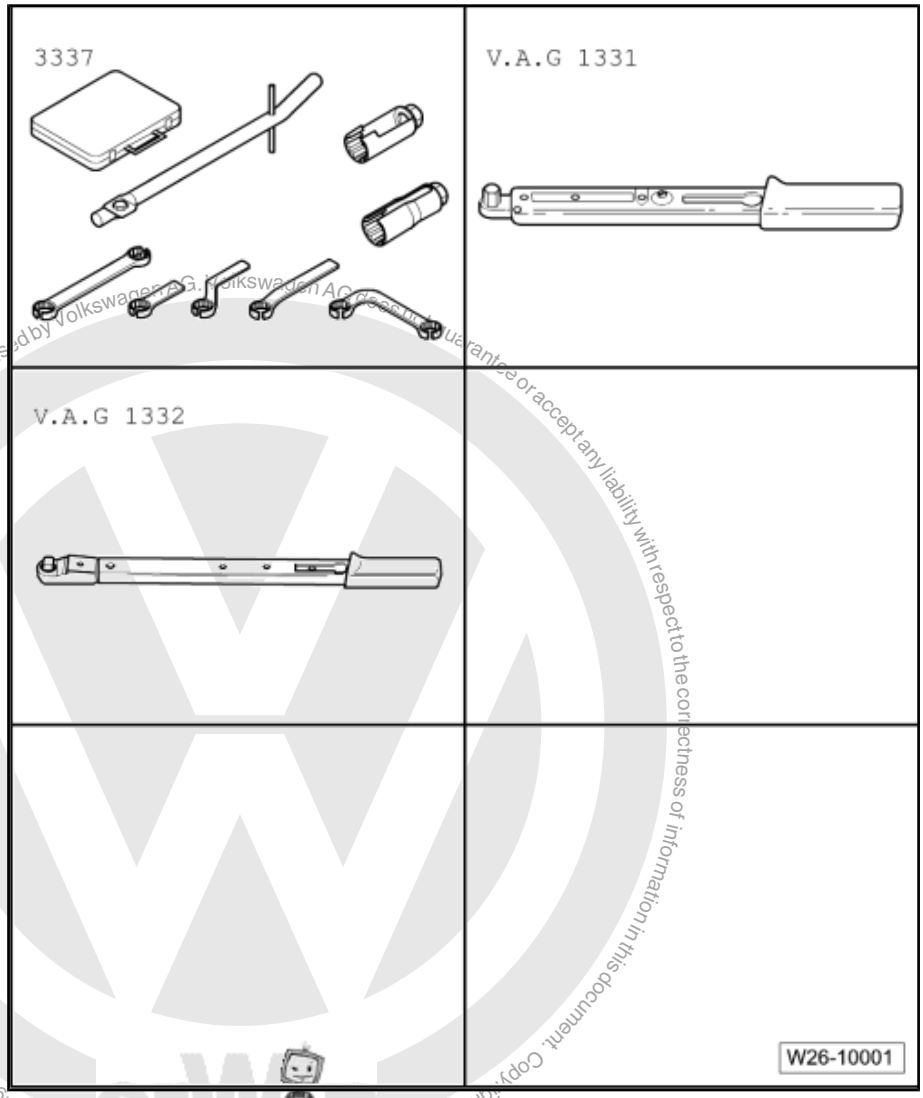
- *Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.*
- *Ensure that there is sufficient clearance to all moving or hot components.*

Note

- *After working on the exhaust system, ensure that the system has sufficient clearance to the bodywork. If necessary, loosen double clamp on front exhaust pipe and realign silencer and exhaust pipe.*
- *Do not use sealants containing silicone. Silicone particles drawn into the engine will not be burnt in the engine and will damage the Lambda probes.*
- *Renew self-locking nuts.*

Special tools and workshop equipment required

- Lambda probe open ring spanner set -3337-
- Torque wrench -V.A.G 1331-
- Torque wrench -V.A.G 1332-



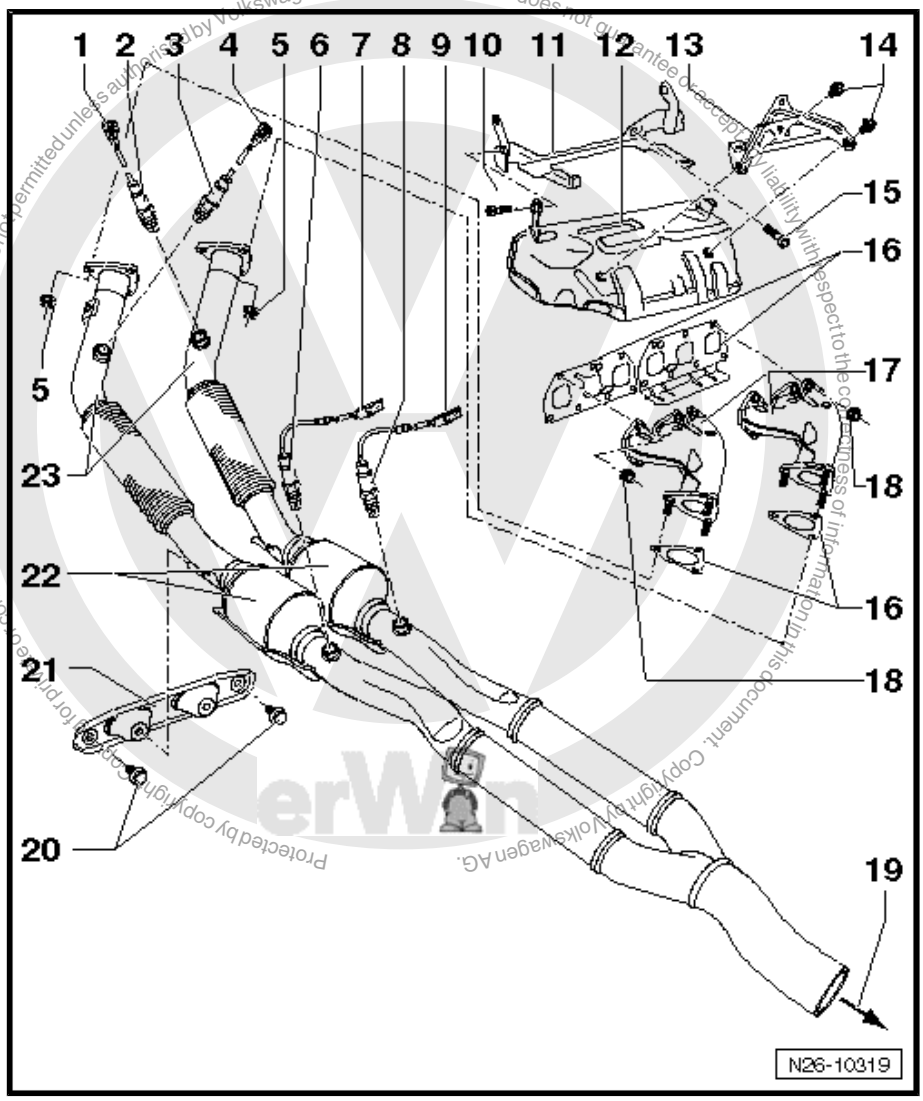
Assembly overview - exhaust manifold, front exhaust pipe with catalytic converters ⇒ page 191

Removing and installing Lambda probe -G39- and Lambda probe 2 -G108- ⇒ page 192

Removing and installing front exhaust pipe with catalytic converters ⇒ page 195

Assembly overview - silencers with mountings ⇒ page 198

1.1 Assembly overview - exhaust manifold, front exhaust pipe with catalytic converters



1 - Connector

- ❑ Black, 6-pin.

2 - Lambda probe -G39- , 55 Nm

- ❑ Bank 1, probe 1
- ❑ Installed in exhaust gas stream of cylinders 1, 2 and 3
- ❑ Grease only the threads with high-temperature paste -G 052 112 A3-; high-temperature paste -G 052 112 A3- must not get into the slots of probe body.
- ❑ Remove and install with Lambda probe open ring spanner set -3337-.

3 - Lambda probe 2 -G108- , 55 Nm

- ❑ Bank 2, probe 1
- ❑ Installed in exhaust gas stream of cylinders 4, 5 and 6
- ❑ Grease only the threads with high-temperature paste -G 052 112 A3- ; high-temperature paste -G 052 112 A3- must not get into the slots of probe body.
- ❑ Remove and install with Lambda probe open ring spanner set -3337- .

4 - Connector

- ❑ Brown, 6-pin

5 - 40 Nm

- ❑ Renew.

6 - Lambda probe 2 after catalytic converter -G131- , 55 Nm

- ❑ Bank 2, probe 2
- ❑ Installed in exhaust gas stream of cylinders 4, 5 and 6
- ❑ Grease only the threads with high-temperature paste -G 052 112 A3- ; high-temperature paste -G 052 112 A3- must not get into the slots of probe body.
- ❑ Remove and install with Lambda probe open ring spanner set -3337- .

7 - Connector

- ❑ Brown, 4-pin

8 - Lambda probe after catalytic converter -G130- , 55 Nm

- ❑ Bank 1, probe 2
- ❑ Installed in exhaust gas stream of cylinders 1, 2 and 3
- ❑ Grease only the threads with high-temperature paste -G 052 112 A3- ; high-temperature paste -G 052 112 A3- must not get into the slots of probe body.
- ❑ Remove and install with Lambda probe open ring spanner set -3337- .

9 - Connector

- ❑ Black, 4-pin.

10 - 20 Nm

11 - Front intake manifold support

12 - Heat shield

13 - Rear intake manifold support

14 - 20 Nm

15 - 25 Nm

16 - Gasket

- ❑ Renew.

17 - Exhaust manifold

18 - 25 Nm

- ❑ Renew.

19 - To centre silencer

- ❑ ⇒ Item 4 (page 198)

20 - 25 Nm

21 - Mounting

- ❑ For front exhaust pipe

22 - Catalytic converter

- ❑ Installed in exhaust gas stream of cylinders 1, 2, 3 right and 4, 5 and 6 left

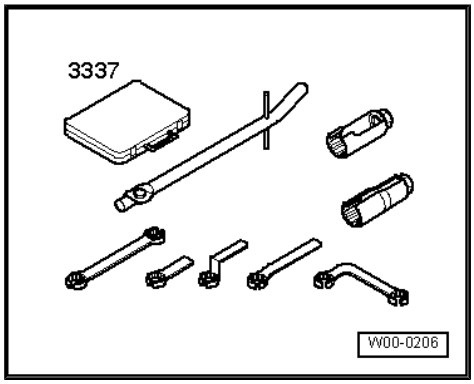
23 - Front exhaust pipe

- ❑ With flexible connection (de-coupling element).
- ❑ Flexible joints must not be bent more than 20° when removing - risk of damage.
- ❑ Removing and installing front exhaust pipe with catalytic converters ⇒ page 195

1.2 Removing and installing Lambda probe -G39- and Lambda probe 2 -G108-

Special tools and workshop equipment required

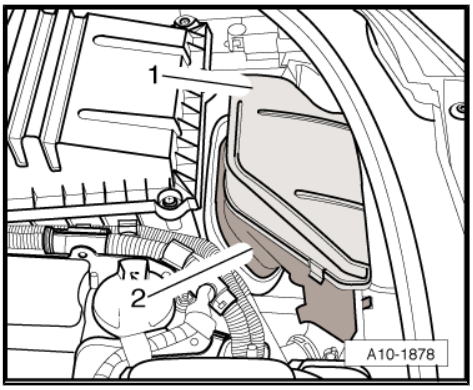
- ♦ Lambda probe open ring spanner set -3337-



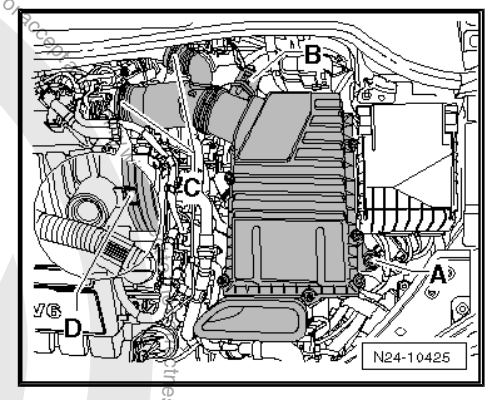
Removing

– Pull off cover -1- for air duct. Disengage locking clasps on side to do this.

– Unclip air duct -2-.

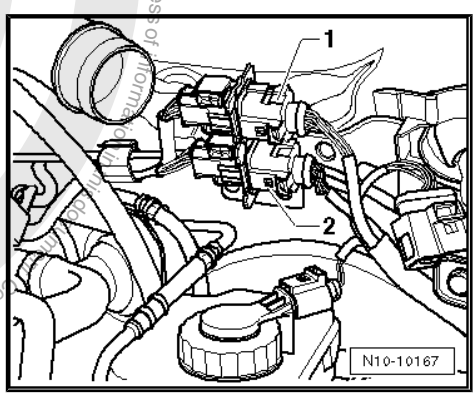


– Remove air filter housing with connection hose. To do this, unscrew bolt -A-, pull off connector -B- and detach spring-type clips -C-. Note marking -D- when reinstalling.

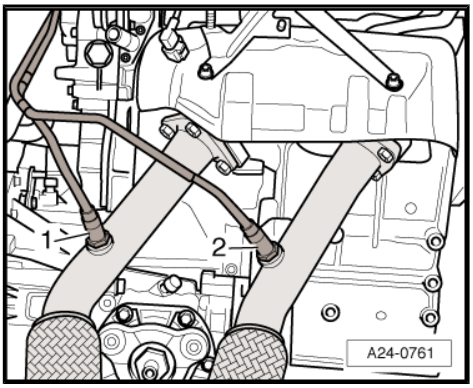


– Separate electrical connectors -1- and -2- for Lambda probe - G39- and Lambda probe 2 -G108- .

– Move electrical wiring to Lambda probes clear.



– Unscrew Lambda probe 2 -G108- -1- and Lambda probe - G39- -2-.



Installing

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

– On used Lambda probes, grease thread with high-temperature paste. There must be no paste on the slots of the probe body

– Restore wiring to original position.

1.3 Removing and installing exhaust manifold

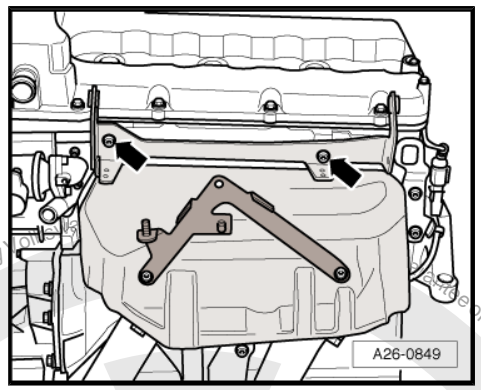
Removing

Note

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 intake manifold ⇒ page 170 .

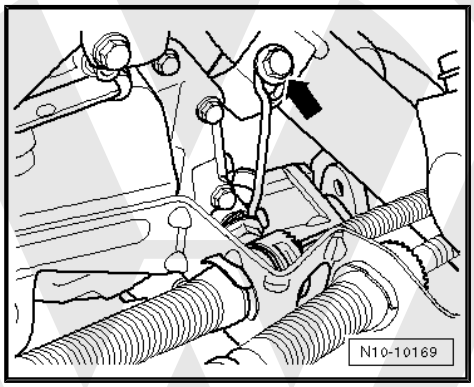
– Unbolt heat shield above exhaust manifold -arrows-.



– If fitted, unscrew bracket from front exhaust pipe -arrow-.

Note

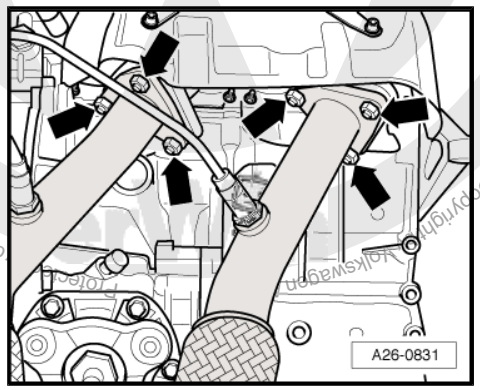
The flexible joints in the front exhaust pipe must not be bent more than 20° - risk of damage.



– Unbolt front exhaust pipe from exhaust manifolds -arrows- and push pipe back slightly.

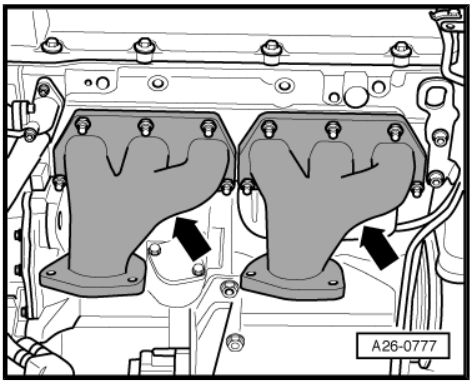
Note

The Lambda probes remain in situ.



– Unscrew 7 nuts each -arrows- on both exhaust manifolds and remove with washers.

– Pull off exhaust manifolds towards rear.



Installing

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

Note

Renew seals, gaskets and self-locking nuts.

– Install intake manifold ⇒ page 170 .

Specified torques

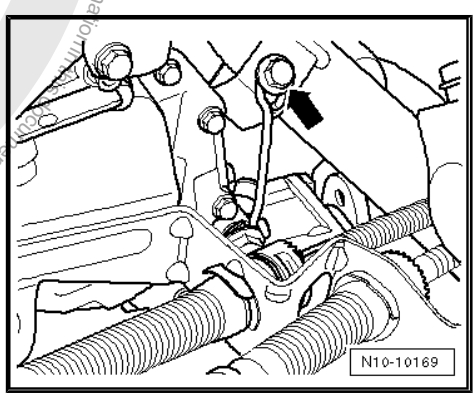
Component	Nm
Exhaust manifold to cylinder head	23 3)
Front exhaust pipe to exhaust manifold	40 3)
Heat shield for exhaust manifold to cylinder head	20

3) Renew nuts.

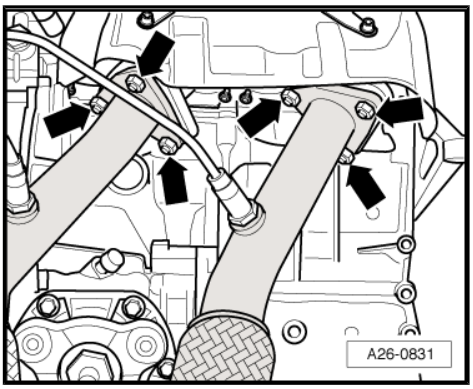
1.4 Removing and installing front exhaust pipe with catalytic converters

– Remove Lambda probe -G39- and Lambda probe 2 -G108- ⇒ page 192 .

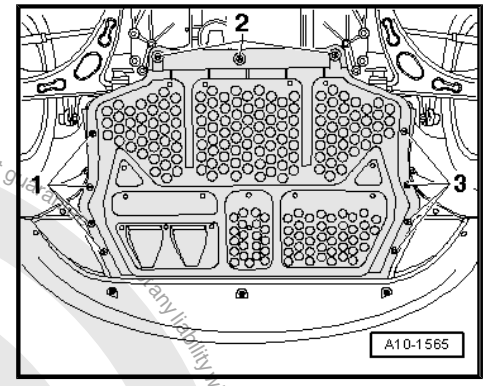
– If fitted, unscrew bracket from front exhaust pipe -arrow-.



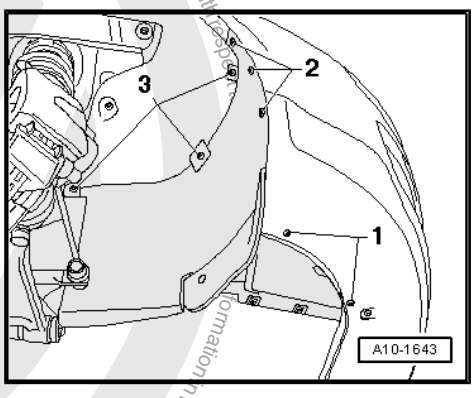
– Unscrew nuts for front exhaust pipe - accessible from above - from exhaust manifolds -arrows-.



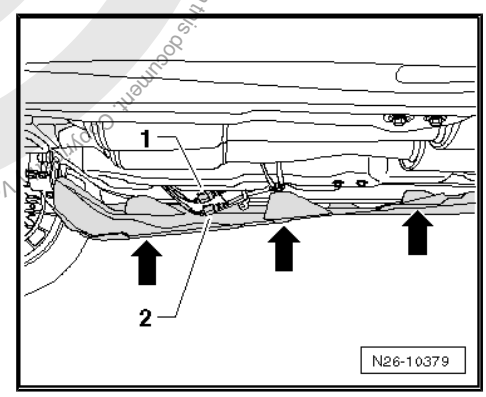
– Remove middle noise insulation.



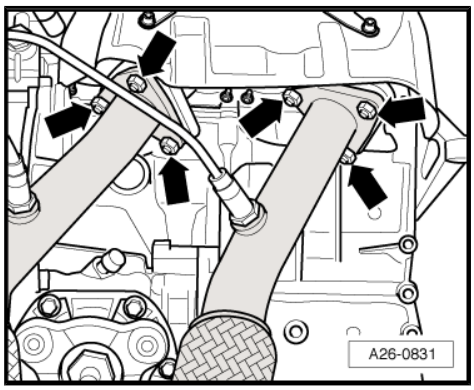
– Remove right wheel housing liner front part.



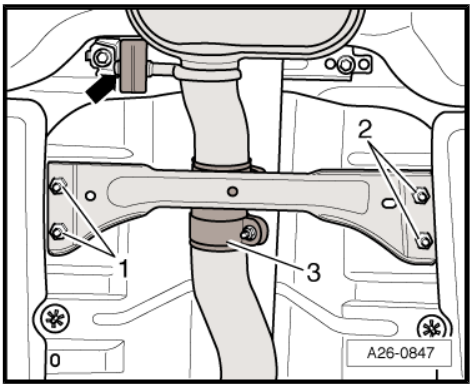
– Remove three screws of underbody cover on right -arrows-.
– Separate electrical connectors for Lambda probe after catalytic converter -G130- -1- and Lambda probe 2 after catalytic converter -G131- -2- on vehicle underbody.
– Remove push-fit coupling from bracket and place wiring for Lambda probe after catalytic converter -G130- and Lambda probe 2 after catalytic converter -G131- to one side.



– Unscrew nuts for front exhaust pipe (accessible from below) from exhaust manifolds -arrows-.



– Remove front cross member for underbody. To do this, unscrew nuts -1- and -2-.

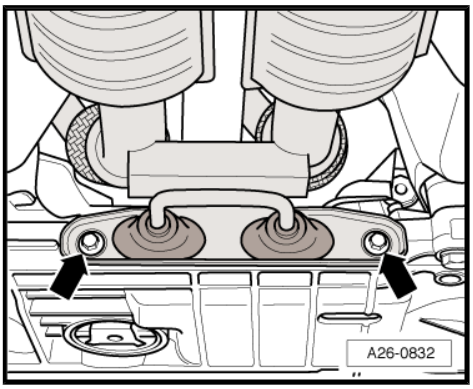


Note

The flexible joints in the front exhaust pipe must not be bent more than 20° - risk of damage.

– Separate exhaust system at clamp -3-.

– Unbolt bracket for exhaust system -arrows-.



– Remove front exhaust pipe with catalytic converters.

Installing

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

Note

Renew seals, gaskets and self-locking nuts.

– Align exhaust system free of tension ⇒ page 200 .

Specified torques

Component	Nm
Front exhaust pipe to exhaust manifold	40 4)
Catalytic converter to front exhaust pipe	23 4)
Lambda probe in front exhaust pipe	50
Bracket for exhaust system to subframe	23

4) Renew bolts and nuts.

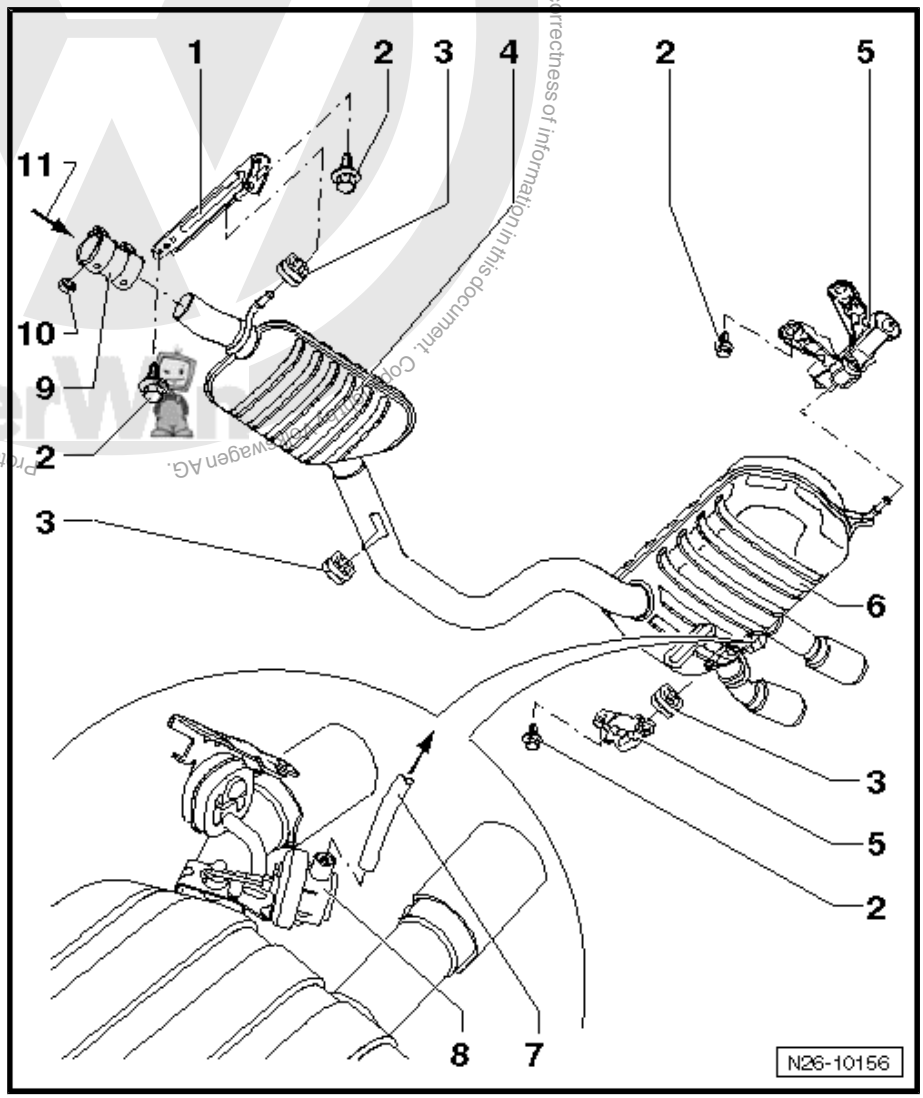
2 Silencer with mountings

Assembly overview - silencers with mountings ⇒ page 198

Aligning exhaust system free of stress ⇒ page 200 .

Checking exhaust flap ⇒ page 199

2.1 Assembly overview - silencers with mountings



1 - Mounting

- ❑ Renew if damaged.

2 - 25 Nm

3 - Rubber mounting

- ❑ Renew if damaged.

4 - Centre silencer

- ❑ Assembly with rear silencer

5 - Mounting with rubber mounting

- ❑ Renew if damaged.

6 - Rear silencer

- ❑ Assembly with centre silencer

7 - To vacuum unit

- ❑ Fitting location in rear left wheel housing.
- ❑ Individual parts ⇒ page 199
- ❑ To remove, remove wheel housing liner

8 - Vacuum unit

- ❑ Checking ⇒ page 199 .

9 - Clamp

- ❑ Align exhaust system before tightening ⇒ page 200
- ❑ Tighten bolted connections evenly.
- ❑ Installation position of clamp ⇒ page 200 .

10 - 25 Nm

11 - From catalytic converter

Individual parts of vacuum unit

1 - Separating point

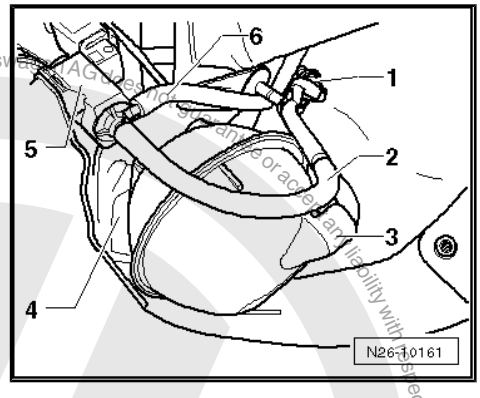
2 - To intake manifold ⇒ Item 10 (page 167)

3 - Vacuum reservoir

4 - Tighten bracket to 25 Nm.

5 - Exhaust flap 1 valve -N321-

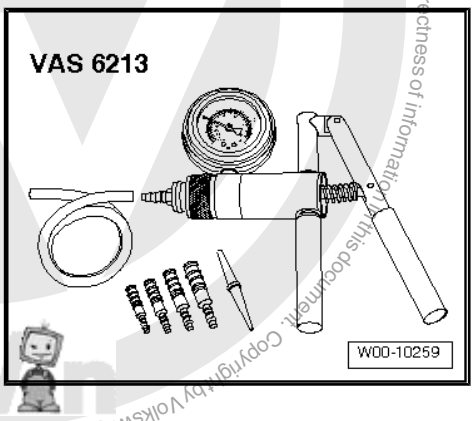
6 - To exhaust flap vacuum unit ⇒ Item 8 (page 198)



2.2 Checking exhaust flap

Special tools and workshop equipment required

♦ Hand vacuum pump -VAS 6213-

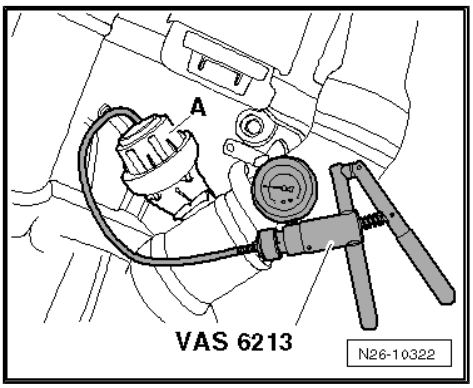


Test procedure

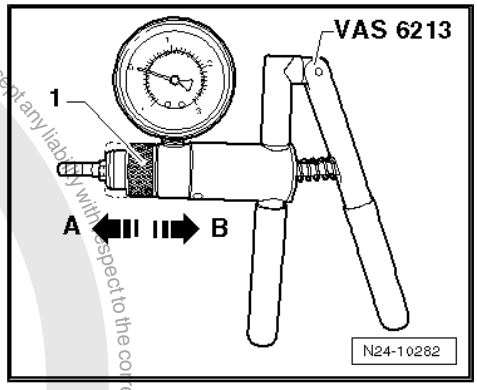
- Vacuum pipes and hose connections free of leaks.
- Vacuum hoses not blocked or porous.

– Pull hose off exhaust flap vacuum element.

– Connect hand vacuum pump -VAS 6213- to vacuum element -A-.



– Move slide ring -1- on hand vacuum pump -VAS 6213- to position -A- for “vacuum”.

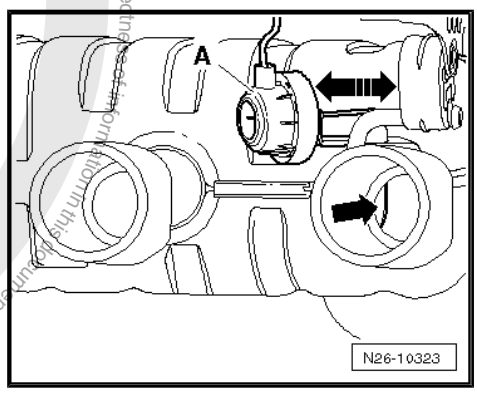


– Create a vacuum using the hand vacuum pump -VAS 6213- and observe the linkage.

• The linkage must move to the left and the exhaust flap -arrow- must close.

– Vent hand vacuum pump -VAS 6213- .

• The linkage must move to the right and the exhaust flap -arrow- must open.



If the linkage does not move:

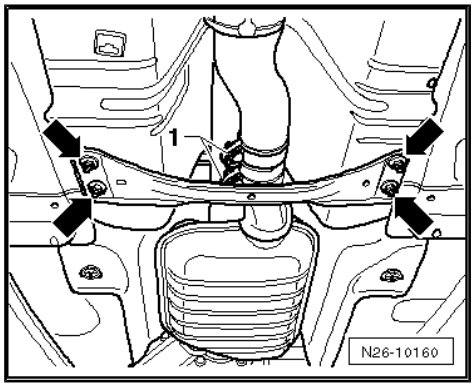
– Check the linkage for ease of movement and/or check the vacuum element is not leaking.

2.3 Aligning exhaust system free of stress

• The exhaust system must be aligned when cold.

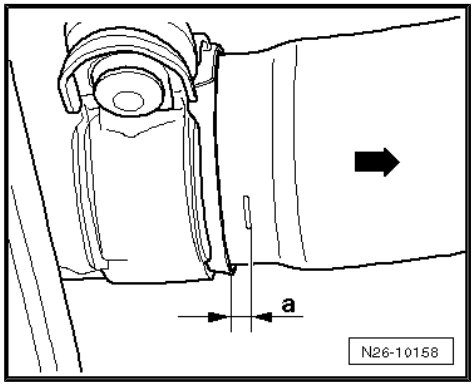
Procedure

– Separate exhaust system at clamp -1-.



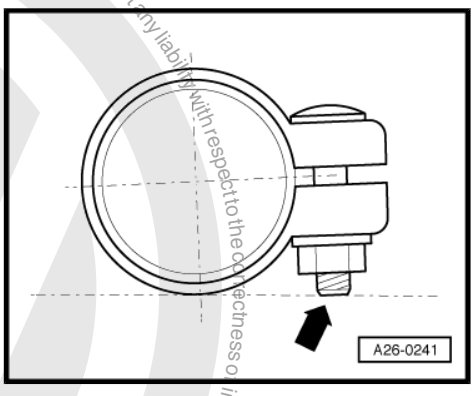
– Align clamping sleeve on front exhaust pipe in consideration of dimension -a-. -Arrow- points in direction of travel. Dimension -a- = 5 mm.

– Tighten front bolts on clamp to 25 Nm.



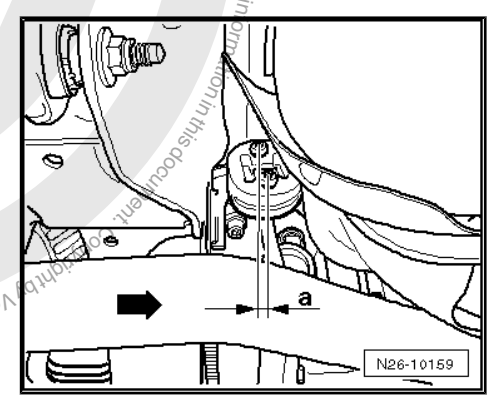
Note

- *The bolted connections on the clamp point to the right.*
- *Note the installation position of the clamp, the bolt ends must not protrude beyond the bottom of the clamp.*



– Taking dimension -a- into account, align silencers at mounting. -Arrow- points in direction of travel. Dimension -a- = 7 … 9 mm.

– Tighten rear bolts on clamp to 25 Nm.



3 Secondary air system

Function ⇒ page 202

Assembly overview - secondary air system ⇒ page 203 .

Removing and installing secondary air pump ⇒ page 204 .

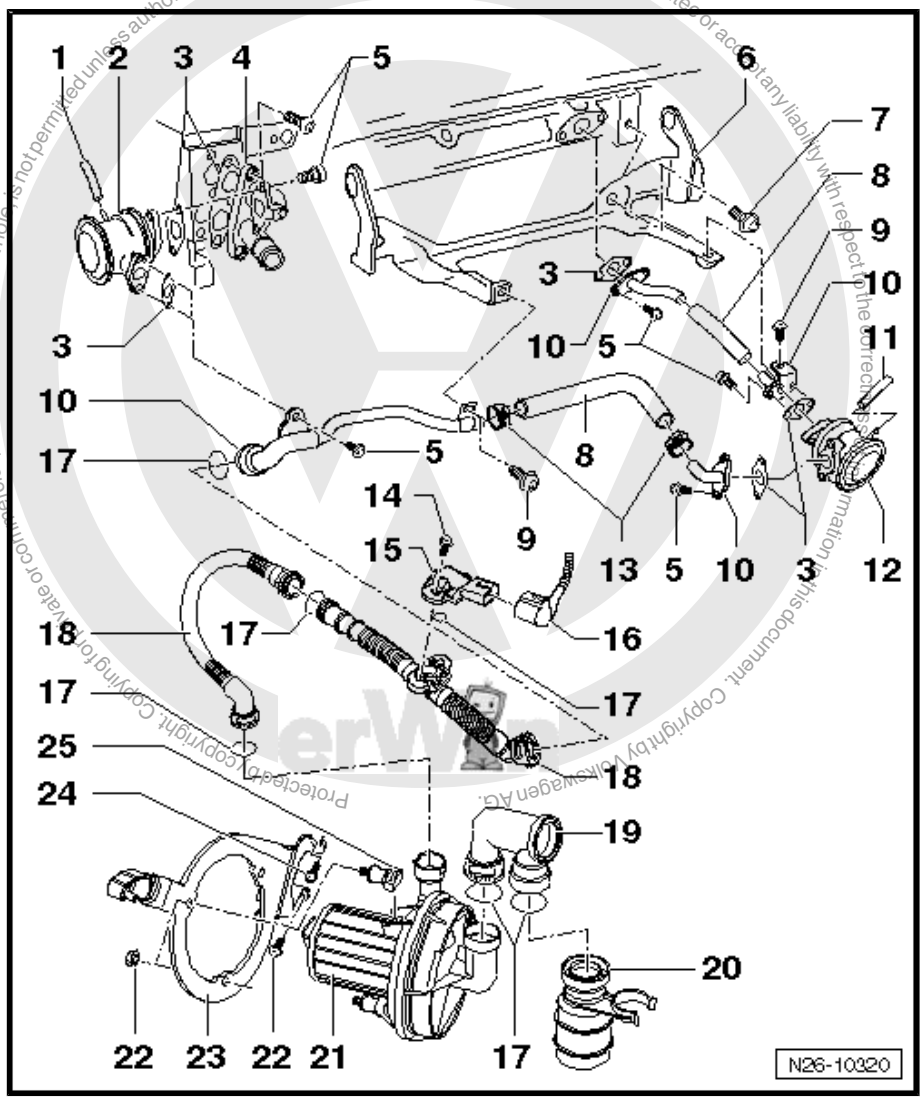
Checking combination valve for secondary air system ⇒ page 205 .

Removing and installing combination valve for secondary air system ⇒ page 205 .

3.1 Function

Air is blown from the secondary air system behind the exhaust valves for 65 seconds during a cold start (+15 °C…+35 °C coolant temperature). This produces an oxygen rich exhaust gas, causing afterburning and reducing the heat-up phase of the catalytic converter. The activation is initiated by the engine control unit via the secondary air pump relay -J299- to combination valve. The combination valve is self-opening. Additionally, after each subsequent engine start (up to max. 80 C engine temperature), the secondary air system will, after a 20 second delay, switch in for 5 seconds during idling and will be checked by the self-diagnosis.

3.2 Assembly overview - secondary air system



1 - To secondary air inlet valve -N112-

- ❑ ⇒ Item 6 (page 169)

2 - Left combination valve

- ❑ Checking ⇒ page 205 .
- ❑ To remove, remove throttle valve module -J338- ⇒ Item 17 (page 168)

3 - Gasket

- ❑ Renew.

4 - Connection

- ❑ For combination valve.

5 - 10 Nm

6 - Front intake manifold support

- ❑ Removing intake manifold ⇒ page 170 .

7 - 20 Nm

8 - Connecting hose

9 - 9 Nm

10 - Connection

11 - To secondary air inlet valve 2 -N320-

- ❑ ⇒ Item 10 (page 169)

12 - Right combination valve

- ❑ Checking ⇒ page 205 .
- ❑ To remove, remove intake manifold ⇒ page 170

13 - Spring-type clip

14 - 2 Nm

15 - Sender 1 for secondary air pressure -G609-

16 - Connector

17 - O-ring

- ❑ Renew if damaged.

18 - Pressure hose

- ❑ Check for secure seating.

19 - Connecting piece

20 - Air filter

- ❑ Clean if soiled.

21 - Secondary air pump motor -V101-

22 - 10 Nm

23 - Bracket

- ❑ For secondary air pump motor.

24 - 20 Nm

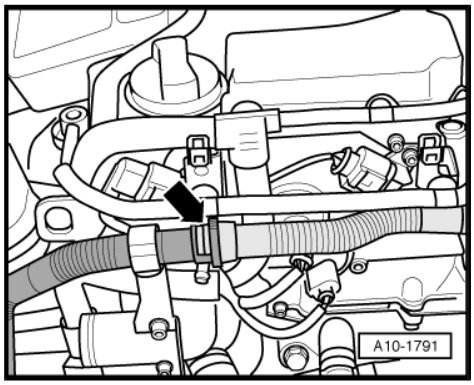
25 - Rubber bush

3.3 Removing and installing secondary air pump motor -V101-

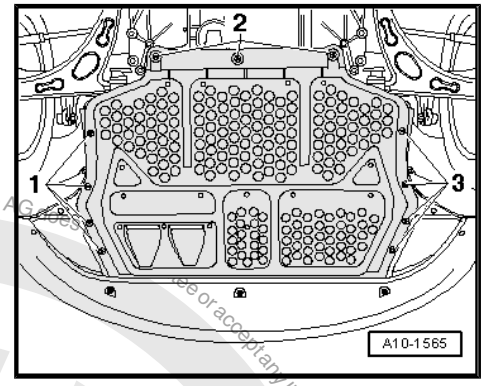
Removing

– Detach secondary air hose at position marked by -arrow-.

– Place air hose to secondary air pump motor -V101- to one side.



– Remove middle noise insulation.



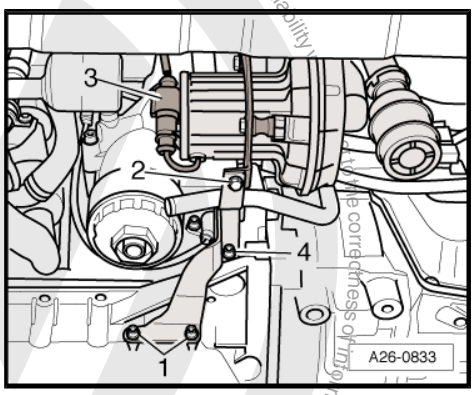
– Place bottom coolant hose on fan shroud to one side.

– Disconnect electrical connector -3- for secondary air pump motor -V101- and place electric cable to one side.

– Unscrew bracket -2- for coolant pipe to gear oil cooler on vehicles with DSG®.

– Remove bolts -1-.

– Loosen bolt -4- and remove secondary air pump with bracket.

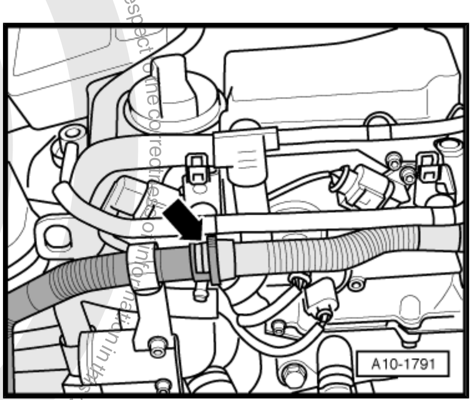


Installing

Install in reverse order.

Specified torques ⇒ page 203 .

3.4 Checking combination valve for secondary air system



Procedure:

– Separate hose for secondary air -arrow- and connect auxiliary hose at hose to secondary air combination valve.

– Blow from mouth into auxiliary hose using light pressure. Do not use compressed air.

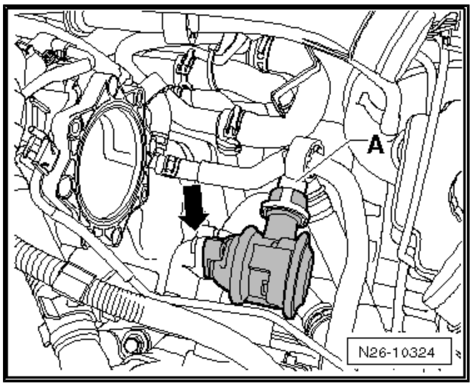
• The combination valve for secondary air system must be closed. Blowing through must not be possible.

– Blow from mouth into auxiliary hose using greater pressure. Do not use compressed air.

• Combination valve for secondary air system must open. Blowing through must be possible.

– If switch point cannot be detected, renew secondary air combination valve ⇒ page 205 .

3.5 Removing and installing combination valve for secondary air system



Removing

– Remove throttle valve module -J338- ⇒ page 170 .

– Disconnect pressure hose -A- at secondary air combination valve.

– Unscrew 2 securing bolts -arrow- and remove combination valve.

Installing

Install in reverse order. In the process, note the following:

Note

Renew seals and gaskets.

Specified torques

Component	Nm
Secondary air combination valve to bracket	10
Throttle valve module -J338- to intake manifold	10

28 – Ignition system

1 Ignition system

General notes on ignition system ⇒ page 206 .

Safety precautions ⇒ page 206 .

Assembly overview - parts of ignition system ⇒ page 207

Removing and installing ignition coils with output stage ⇒ page 208 .

Test data, spark plugs ⇒ page 210

1.1 General notes on ignition system

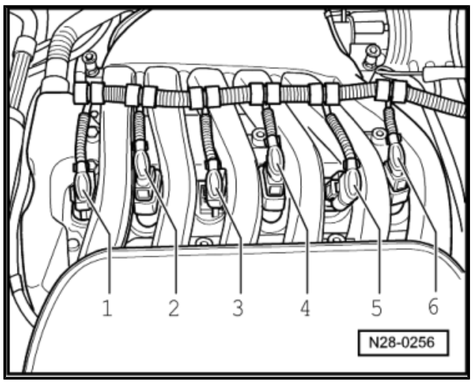
- Only the components which specifically relate to the ignition system are dealt with here. For other components of the injection and ignition system, ⇒ page 166 .
- For trouble-free operation of electrical components, a voltage of at least 11.5 V is necessary.
- Certain tests may lead to a fault being detected by the control unit and stored. Then after completing all checks and repairs, read fault memory and erase if necessary ⇒ vehicle diagnosis tester "Guided functions".
- 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 using ⇒ vehicle diagnosis tester under "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.
- If the engine is to be turned at starter speed without starting:

– Pull connectors off ignition coils 1…6 using assembly tool -T10118- .



Note the following if testers and measuring instruments have to be used during a road test:

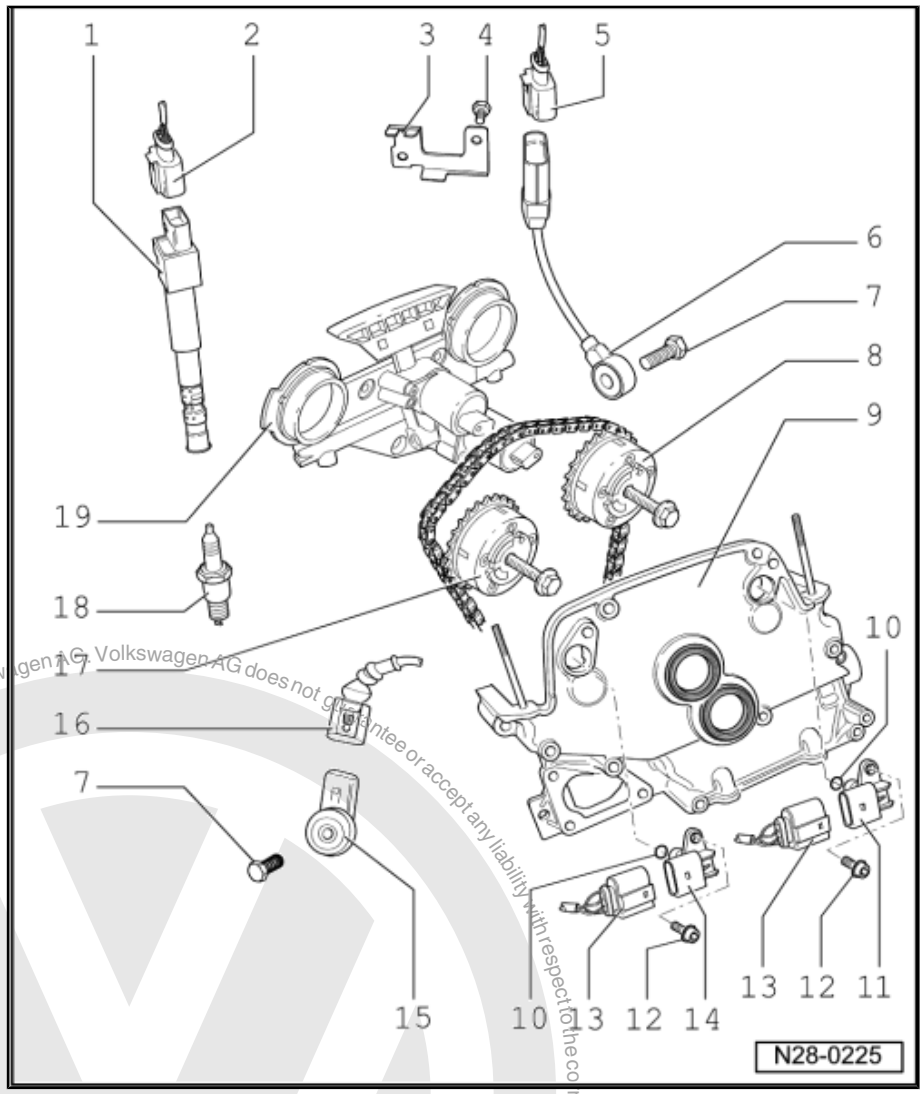
- Test and measuring instruments must always be secured to rear seat and operated by a second person from this location.

If test and measuring instruments are operated from front passenger 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 - parts of ignition system

Note

The engine speed sender -G28- can be found on the cylinder block ⇒ Item 29 (page 19) .



1 - Ignition coil 1 with output stage -N70-

- ❑ Ignition coil 2 with output stage -N127-
- ❑ Ignition coil 3 with output stage -N291-
- ❑ Ignition coil 4 with output stage -N292-
- ❑ Ignition coil 5 with output stage -N323-
- ❑ Ignition coil 6 with output stage -N324-
- ❑ Remove using puller - T10095 A- ⇒ page 208

2 - Connector

- ❑ 4-pin

3 - Bracket

- ❑ For connector for knock sensor 1 -G61- .

4 - 10 Nm

5 - Connector

- ❑ Black, 3-pin.
- ❑ Gold-plated contacts on sensor and connector.

6 - Knock sensor 1 -G61-

- ❑ Gold-plated contacts on sensor and connector.
- ❑ Location: cylinder block exhaust side

7 - 20 Nm

- ❑ The specified torque influences the function of the knock sensor.

8 - Exhaust camshaft adjuster

- ❑ With sender wheel for Hall sender 2 -G163-
- ❑ If the camshaft adjuster has been removed, adjust timing ⇒ page 62

9 - Cover

- ❑ Removing and installing ⇒ page 53 .

10 - Seal

- ❑ Renew.

11 - Hall sender 2 -G163-

- ❑ For exhaust camshaft.
- ❑ Gold-plated contacts on sensor and connector.

12 - 10 Nm

13 - Connector

- ❑ Black, 3-pin.
- ❑ Gold-plated contacts on sensor and connector.
- ❑ Mark connector before removing.

14 - Hall sender -G40-

- ❑ For inlet camshaft.
- ❑ Gold-plated contacts on sensor and connector.

15 - Knock sensor 2 -G66-

- ❑ Gold-plated contacts on sensor and connector.
- ❑ Fitting location: cylinder block intake side

16 - Connector

- ❑ Black, 2-pin.
- ❑ Gold-plated contacts on sensor and connector.

17 - Inlet camshaft adjuster

- ❑ With sender wheel for Hall sender -G40-
- ❑ If the camshaft adjuster has been removed, adjust timing ⇒ page 62

18 - Spark plug

- ❑ If a spark plug is replaced, regrease ignition coil with final output stage ⇒ page 208 .
- ❑ Remove and install with spark plug socket and extension -3122 B-.
- ❑ Type, specified torque and electrode gap ⇒ page 210

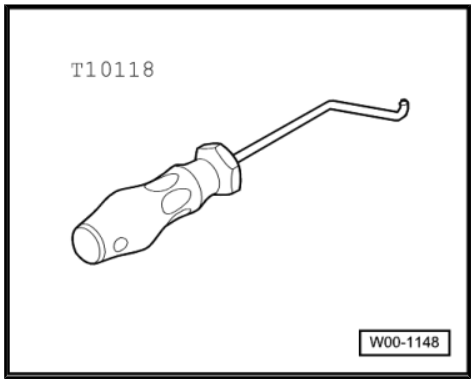
19 - Valve timing housing

- ❑ For camshaft adjustment.
- ❑ Removing and installing ⇒ page 73 .

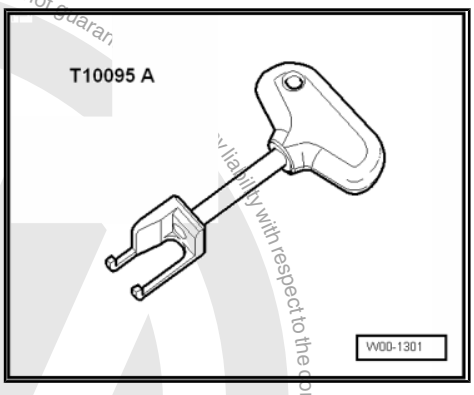
1.4 Removing and installing ignition coils with output stage

Special tools and workshop equipment required

- ♦ Assembly tool -T10118-



♦ Puller -T10095 A-

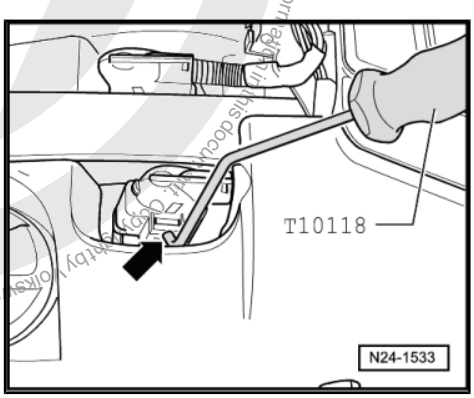


♦ Lubricating paste -G 052 141 A2-

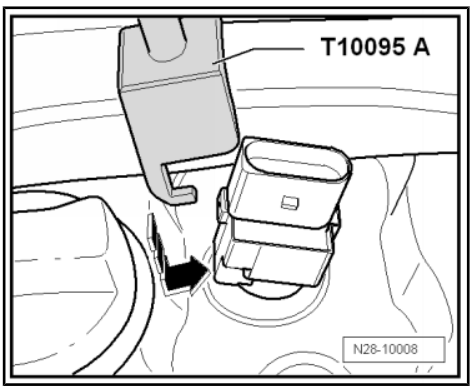
Removing

– Unclip cover from connector rail.

– Fit assembly tool -T10118- on to locking mechanism button -arrow- and carefully pull connector off each ignition coil with output stage .



– Push puller -T10095 A- on from flat side of connector in -direction of arrow- and pull out ignition coil with output stage .



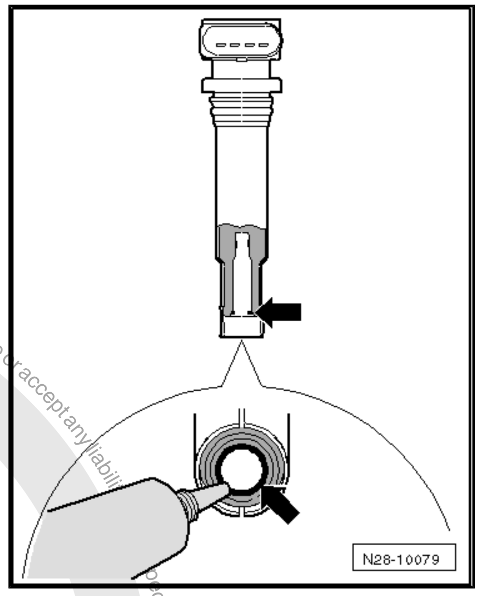
Installing

Note

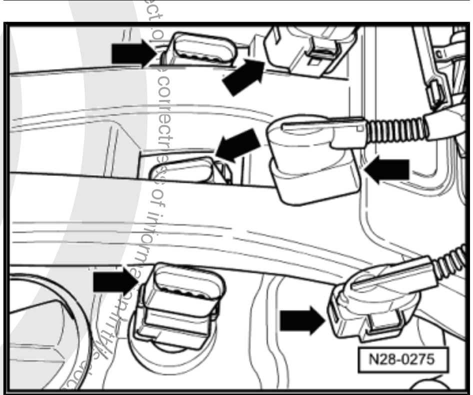
♦ *When fitting new spark plugs, the ignition coil must be re-greased using lubricating paste -G 052 141 A2- This will stop the ignition coil sealing hose from "sticking" to the spark plug. The lubricating paste must be distributed on the spark plug when inserting on the ignition coil.*

♦ *New ignition coils with output stage are lubricated when delivered.*

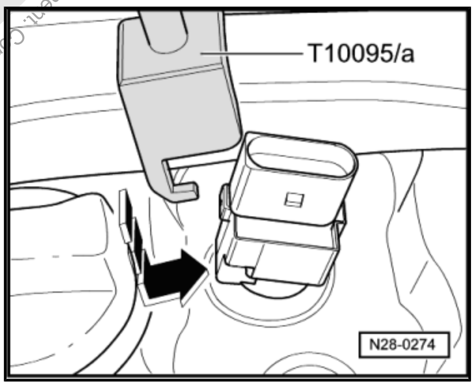
– Apply a thin line of lubricating paste -G 052 141 A2- around the ignition coil sealing hose -arrow-. The bead must be 1…2 mm thick.



– To install, insert ignition coil with output stage into respective spark plug hole so that the flat sides of connectors fit with each other -arrows-.



– Push puller -T10095 A- on from flat side of connector in -direction of arrow- and push ignition coil with output stage onto spark plug.



1.5 Test data, spark plugs

Engine code	CBRA[6)]
Firing order	1-5-3-6-2-4
Spark plugs[5)]	
VW/Audi	101 905 606 A
Electrode gap	0.8…0.9 mm
Specified torque	18 Nm
Change interval	⇒ Maintenance ; Booklet 23 ; Time or distance dependent additional work

5) Remove and install spark plugs with spark plug socket and extension -3122 B- .

6) For removal of ignition coils with output stage, use only puller -T10095 A- .