Workshop Manual

Amarok 2011 ➤

4-cylinder injection engine (2.0 l direct injection engine, turbocharger)									
Engine ID	CFP A								

Edition 02.2011

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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 Technical data

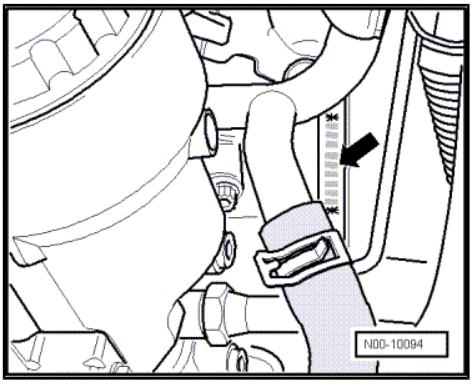
Engine number

Engine data

1.1 Engine number

New four digit engine codes have been introduced since model year 2008. The first 3 digits refer to the mechanical configuration of the engine. They are stamped onto the engine. The fourth digit denotes the power output of the engine and depends on the engine control unit. The four digit engine code can be found on the identification plate, the vehicle data sticker and the engine control unit.

The engine number („engine code“ and „serial number“) can be found at the joint between engine and gearbox -arrow-.



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

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

The engine number consists of up to nine characters (alphanumeric). The first part (maximum 4 characters) makes up the „engine code“, and the second part (6 characters), the „serial number“. If more than 999,999 engines were produced with the same code letters, the first of the six digits is replaced by a letter.

1.2 Engine data

Engine code		CFPA
Manufactured	From - to	12.10 ▸
Emissions fulfil		EU2 ddk., EU4
Capacity	l	2.0
Output	kW at rpm	118 kW at 3800 to 5500 rpm
Torque	Nm at rpm	300 Nm at 1600 to 3750 rpm
Capacity	cm^3	1984 cm^3
Bore	∅ mm	82.5mm
Stroke	mm	92.8mm
Valves per cylinder		4
Compression ratio		9.6:1
Fuel	according to	DIN EN 228
Firing order		1-3-4-2
Balancer shafts		2
Catalytic converter		yes
Exhaust gas recirculation		yes
Turbocharging/supercharging		yes
Charge air cooler		yes
Camshaft timing control		yes
Secondary air injection		no

1) If petrol with a RON rating of less than 95 is used, reduced power output and torque must be expected.

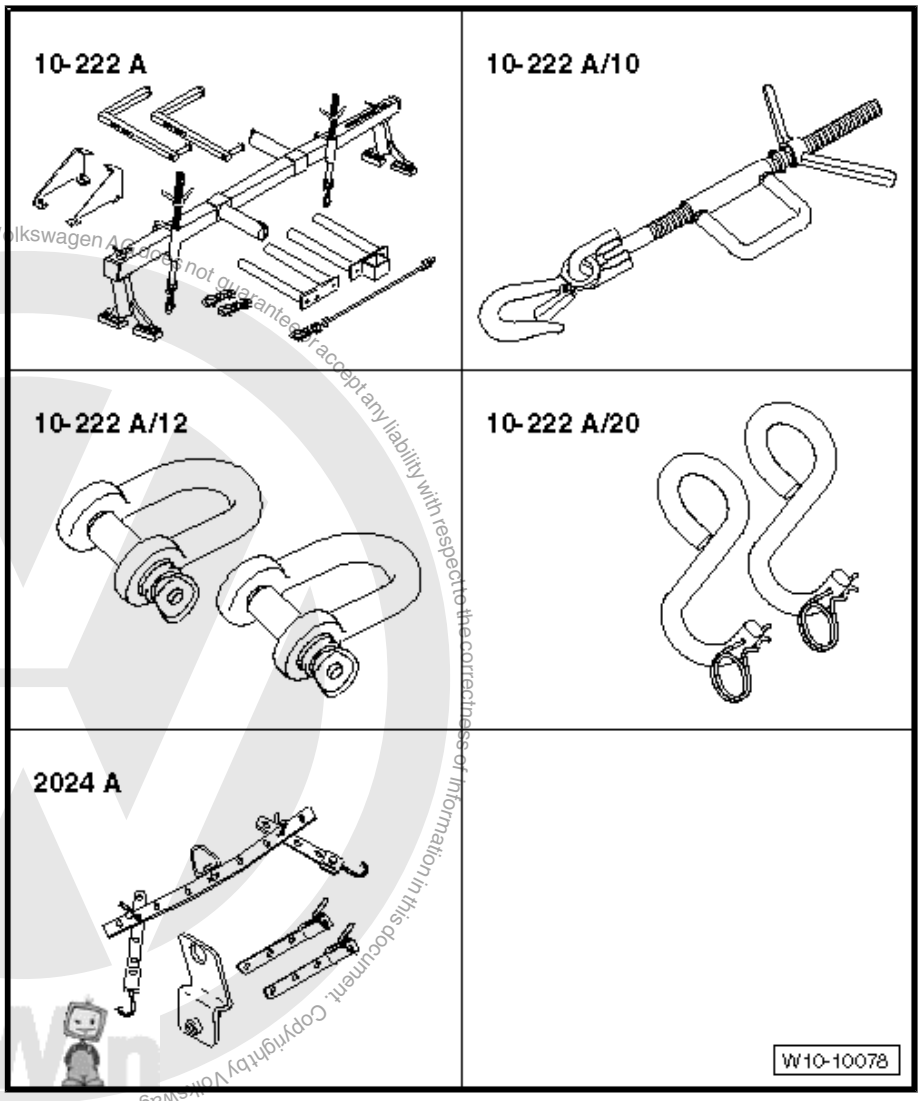
10 – Removing and installing engine

1 Removing and installing engine

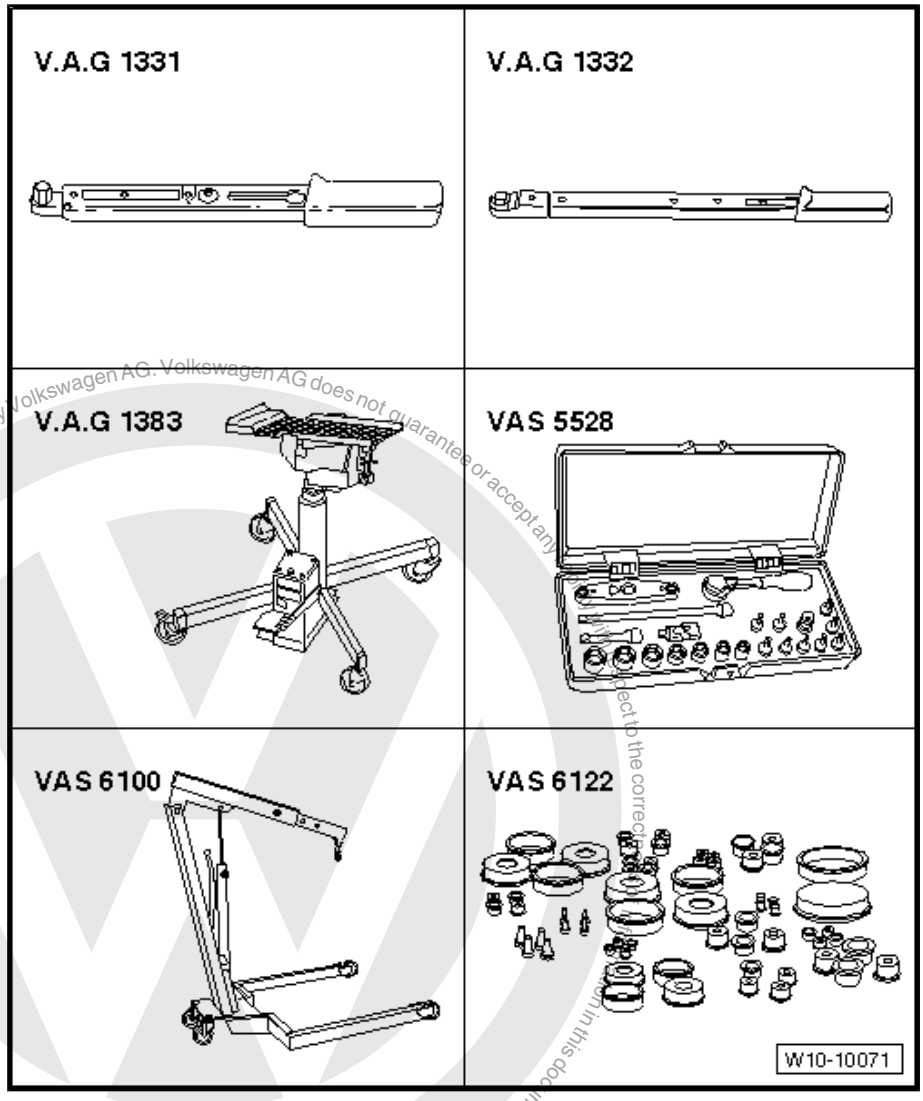
1.1 Removing engine

Special tools and workshop equipment required

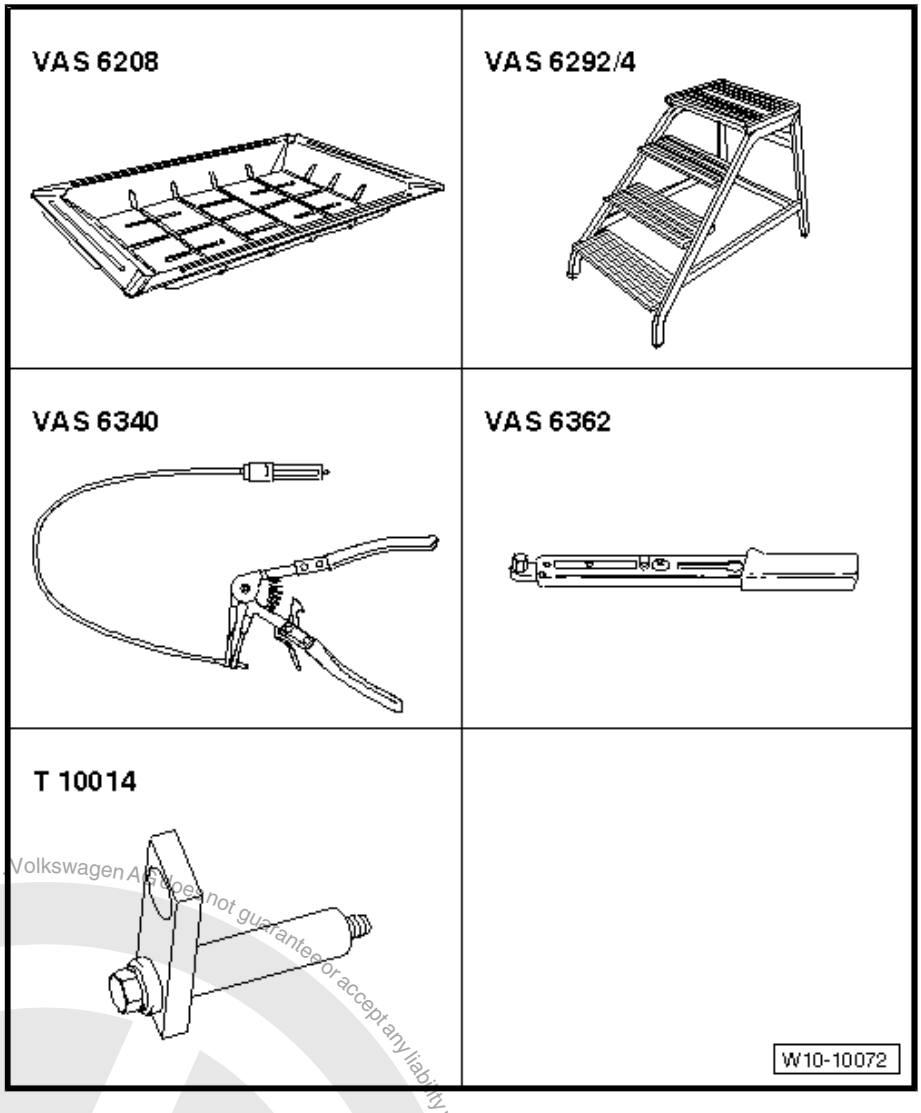
- Lifting tackle -2024 A-
- Support bracket -10 - 222 A-
- Hook -10 - 222 A /10-
- Shackle -10 - 222 A /12-
- Adapter -10 - 222 A /20- qty. 2



- Torque wrench -V.A.G 1331-
- Torque wrench -V.A.G 1332-
- Engine and gearbox jack -V.A.G 1383 A-
- Socket set 1/4", 22-piece -VAS 5528-
- Workshop hoist -VAS 6100-
- Engine bung set -VAS 6122-



- Drip tray for workshop hoist -VAS 6208-
- Step -VAS 6292/4-
- Hose clip pliers -VAS 6340-
- Hose clip pliers -VAS 6362-
- Retainer -T10014-
- High-temperature grease - G 052 133 A2-
- Cable ties
- Square timber 10 x 30 x 10 cm



Procedure

Note

- *Before carrying out further work, remove the battery. Check whether a coded radio is fitted. Obtain anti-theft coding beforehand if necessary.*
- *The engine is removed upwards.*
- *The gearbox remains installed.*
- *All cable ties that are opened or cut through when the engine is removed must be renewed/replaced in the same position when the engine is installed.*
- *Seal open lines and unions with clean plugs from engine bung set -VAS 6122- .*
- *Collect drained coolant in a clean container for re-use or disposal.*

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 from all moving or hot components.***
- ***Cut through cable ties carefully and reinstall in the same position.***

– Remove bonnet ⇒ General body repairs, exterior; Rep. gr. 55 ; Bonnet .

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

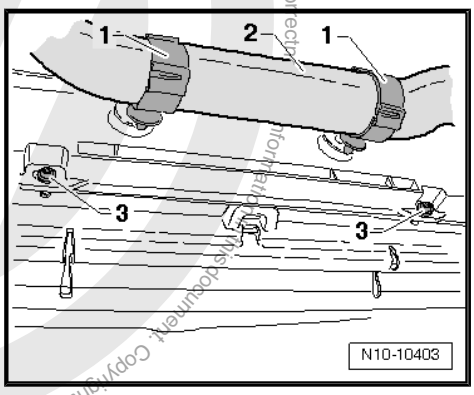
– Remove starter ⇒ Electrical system; Rep. gr. 27 ; Removing and installing starter .

– Drain coolant ⇒ page 133 .

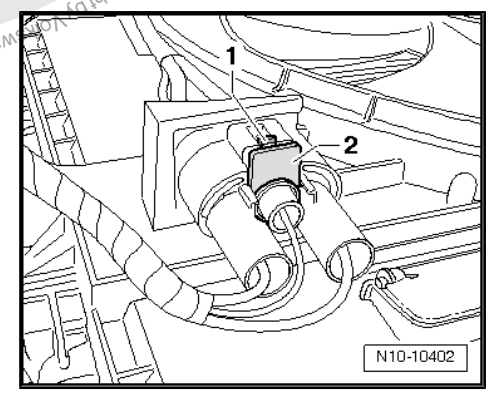
– Detach coolant hose -2- with both brackets -1-.

– Unscrew bolts -3-.

– Pull latch -2- back.

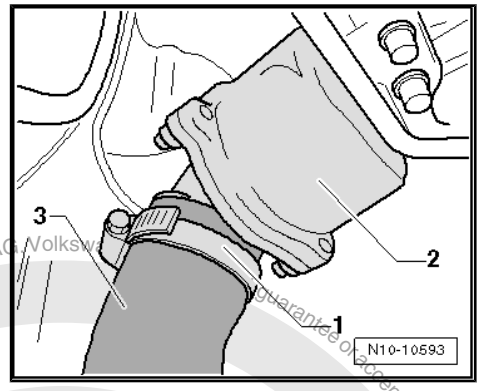


– Press retaining lever -1- down and pull connector off.



– Detach clip -1- of charge air hose -3- from connector nozzle -2- of turbocharger.

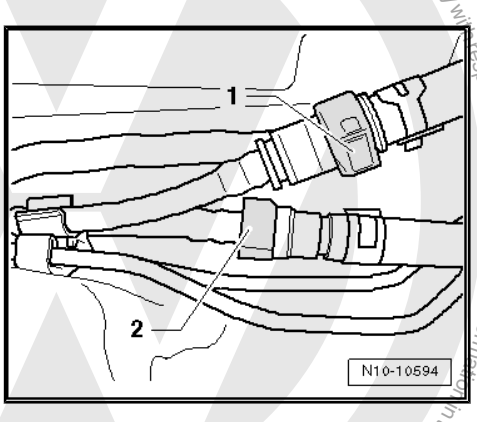
– Remove poly V-belt ⇒ page 22 .



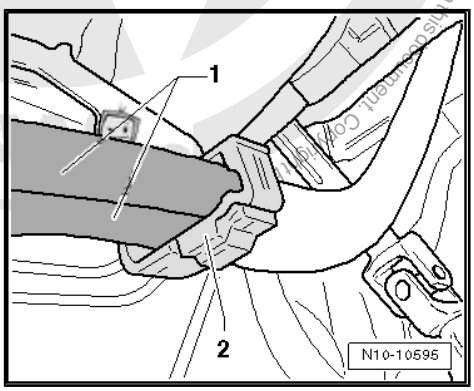
WARNING

- *The fuel and the fuel lines in the fuel system can become very hot (danger of scalding)!*
- *The fuel system is also under pressure! Before opening the system, place cloths around the connections. Then carefully loosen connection to release the pressure!*
- *Wear eye and hand protection when performing any type of repair work on the fuel system!*

– Disconnect fuel lines -1 and 2-.



– Disconnect fuel lines -1- from bracket -2-.



Vehicles with air conditioning system:

Note

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

To facilitate removing and installing engine without opening refrigerant circuit:

– Secure air conditioner compressor to body so that the refrigerant lines and hoses are not under tension.

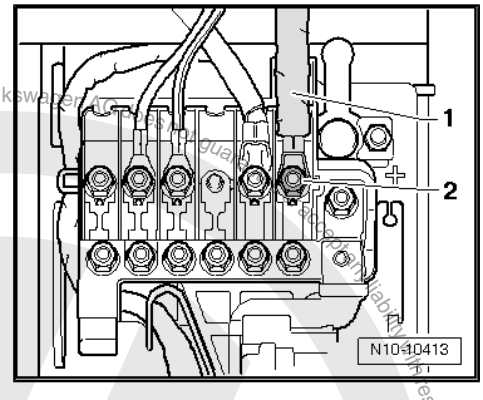
– Remove AC compressor with hoses connected and secure to body ⇒ Heating, air conditioning system; Rep. gr. 87 ; Removing and installing air conditioner compressor .

Continuation for all vehicles

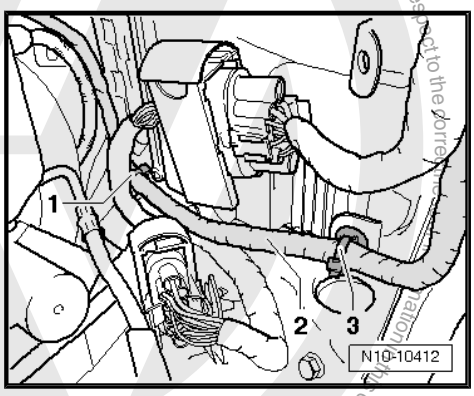
– Remove catalytic converter ⇒ page 240 .

– Remove cover from fuse box above battery.

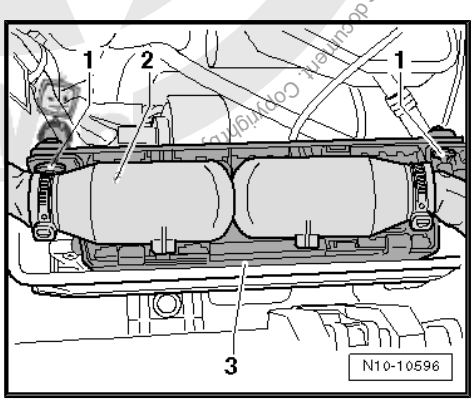
– Unscrew nut -2- of battery positive cable -1-.



– Unhook clips -1- and -3-.
– Uncover cable harness -2-.



– Unscrew shear bolts -1- and remove bow -3-.

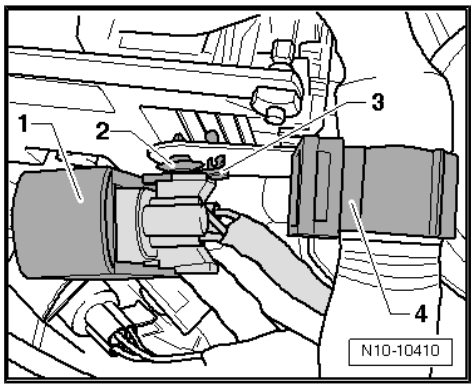


Note

Shear bolts must always be renewed.

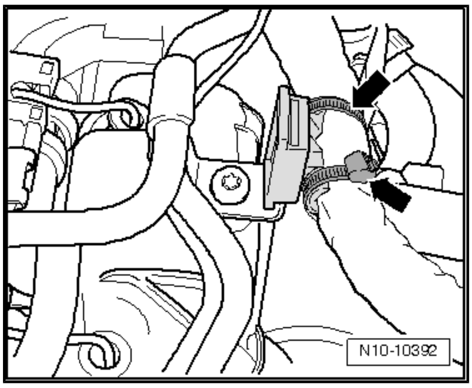
– Release and pull off connector -2-.

– Unhook clips -2- and -3-.
– Release and pull off connector -1-.
– Open bracket -4- and detach wiring harness.

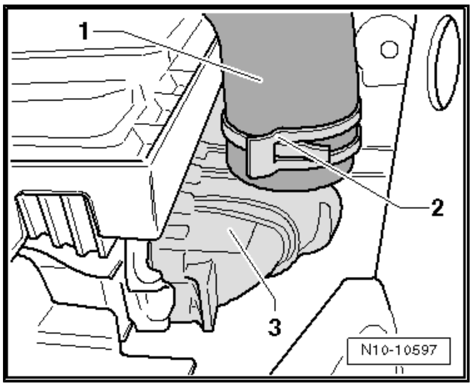


– Carefully cut through cable ties -arrows-.

– Lay wiring harness on engine and secure.

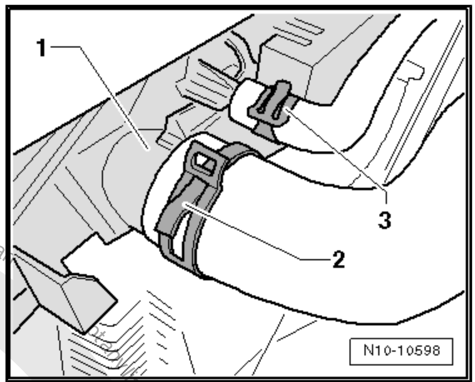


– Release clip -2-, disconnect water hose -1- from radiator -3- at bottom right and allow water to drain.



– Disconnect water hoses -2 and 3- from radiator -1- at top left.

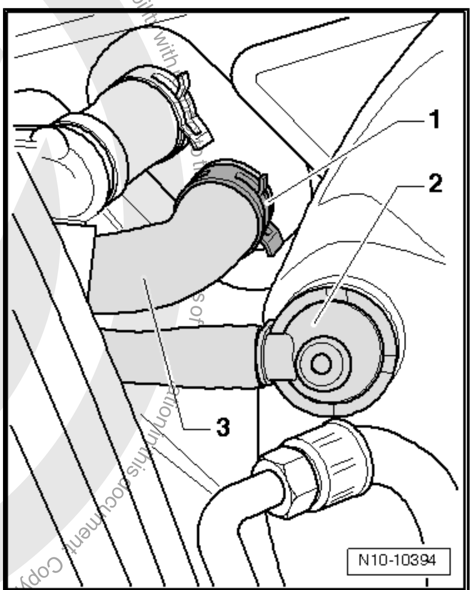
– Disconnect water hoses from water pipes.



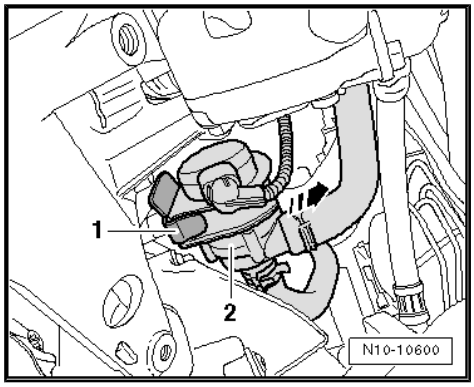
– Pull line -2- out of brake servo.

– Open clip -1- and remove coolant hose -3-.

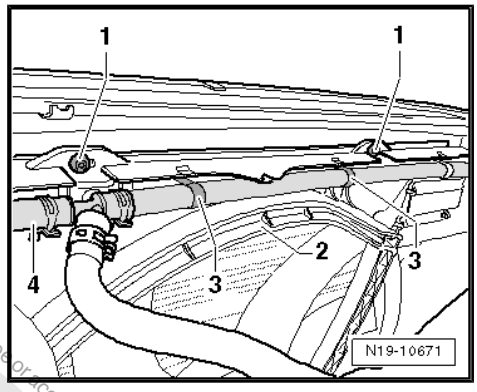
– Remove vane pump for power steering with hoses connected and secure to body ⇒ Running gear, axles, steering; Rep. gr. 48 ; Removing and installing vane pump .



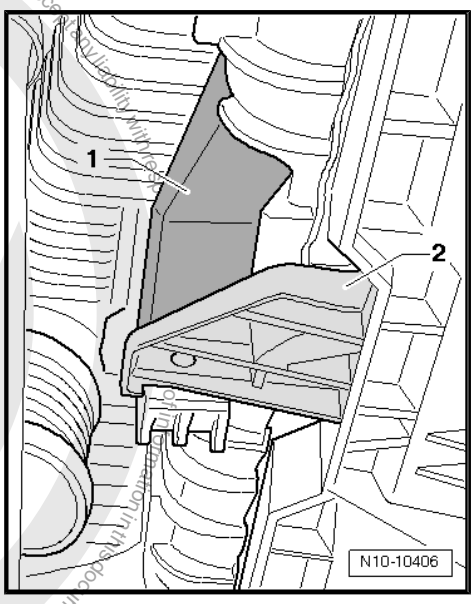
– To do this, release circulating pump V 51 -2- from bracket -1- in order to access bolt.
– Remove air filter housing ⇒ page 207 .
– Unplug all necessary electrical connectors.
– Disconnect all necessary vacuum hoses.
– Remove bolts -1-.



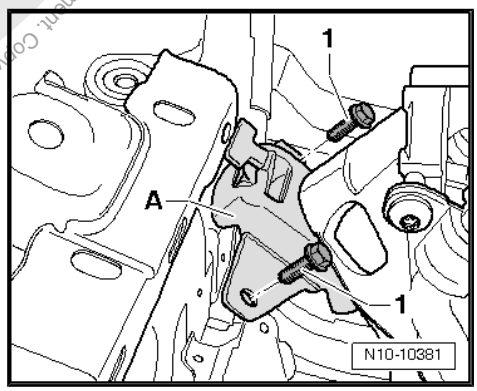
– Detach retaining clips -3- with water hose -4- from cowling -2-.



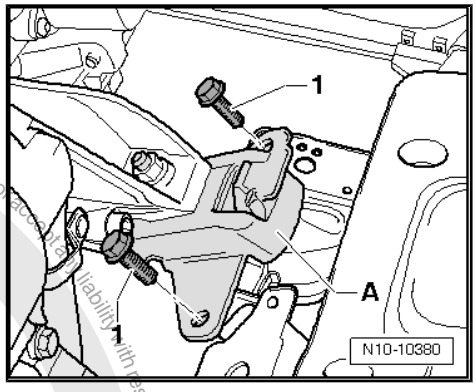
– Disengage cowling -2- at left and right. To do this, press retaining lever -1- forwards using a screwdriver and raise cowling -2- slightly.
– Remove cowling.



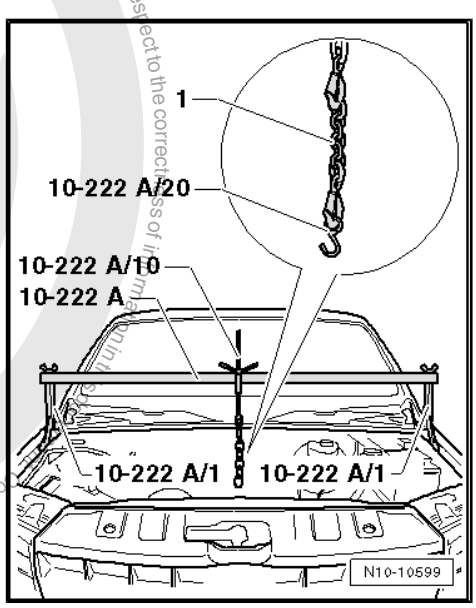
– Unscrew bolts -1- from left engine mounting -A-.



– Unscrew bolts -1- from right engine mounting -A-.



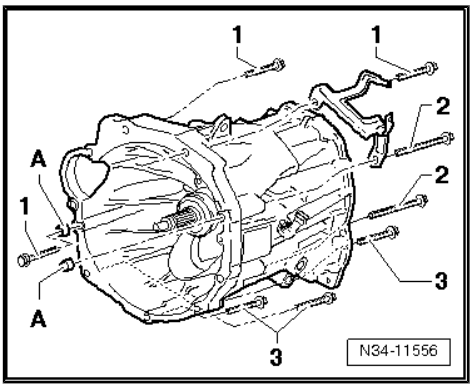
– Install support bracket -10 - 222 A- .
– Secure hook -10 - 222 A /10- and adapter -10 - 222 A /20- to support bracket -10 - 222 A- .
– Connect adapter -10 - 222 A /20- to gearbox transport eye.
– Remove bolts -2- and -3-.



– Only unscrew bolt -1- beneath starter.

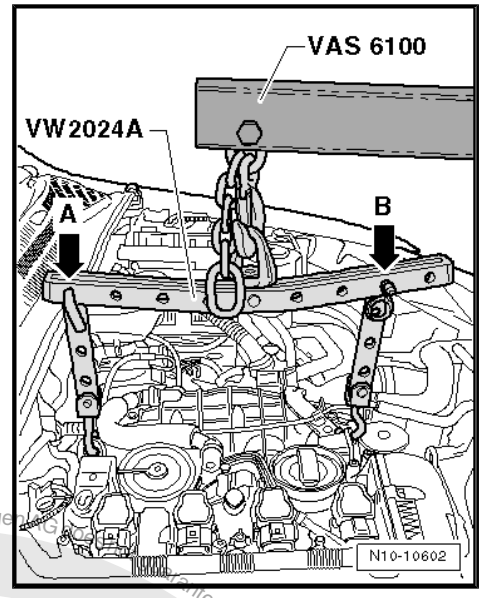
Caution

- *Do not unscrew the two upper bolts -1-.*

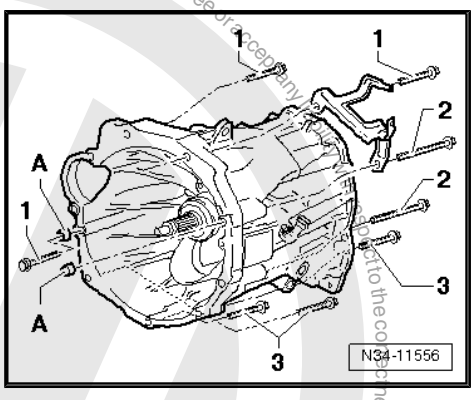


– Unscrew all connecting bolts for engine/gearbox at bottom and in middle. The two upper bolts initially remain screwed in.
– Engage lifting tackle -2024 A- on workshop hoist -VAS 6100- and attach to engine.
– Connect adapter -10 - 222 A /20- to lifting tackle -2024 A- and workshop hoist -VAS 6100- and secure with retaining clip.

– Hang up lifting tackle -2024 A- as shown in figure, using hole 1 -arrow A- and hole 7 -arrow B-.



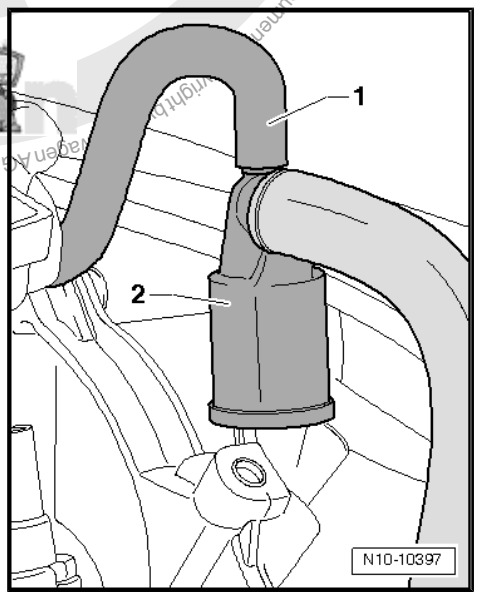
– Unscrew the two upper bolts -1-.
– If necessary, disconnect all connecting, coolant, vacuum and intake hoses that have to be disconnected from the engine in order to remove it.
– Carefully pull engine from gearbox in longitudinal direction. Do not damage needle bearing in the crankshaft whilst doing this.



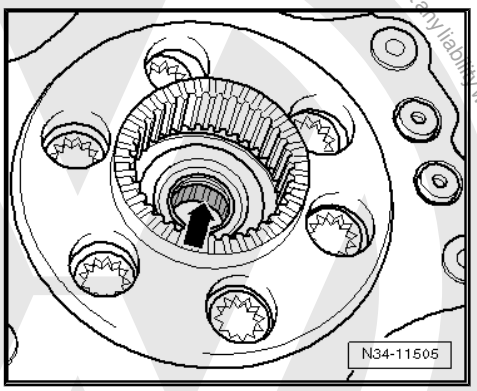
Caution

- *Only a few millimetres of space are available between plenum chamber and radiator/lock carrier for removing and installing the engine. The engine must therefore be guided carefully when raising and lowering.*
- *Raise and lower the engine slowly with the assistance of a second mechanic.*
- *The workshop hoist -VAS 6100- must also be guided carefully when raising and lowering the engine.*

– When raising and lowering engine, make sure that neither vacuum hose -1- nor connection -2- on vacuum pump are damaged.
– Guide vacuum hose -1-, connection -2- and vacuum pump past plenum chamber when raising and lowering.
– When raising and lowering engine, make sure that rollers of belt drive and turbocharger do not damage radiator.
– When raising and lowering engine, pay attention to lines and hoses to prevent these from being damaged.



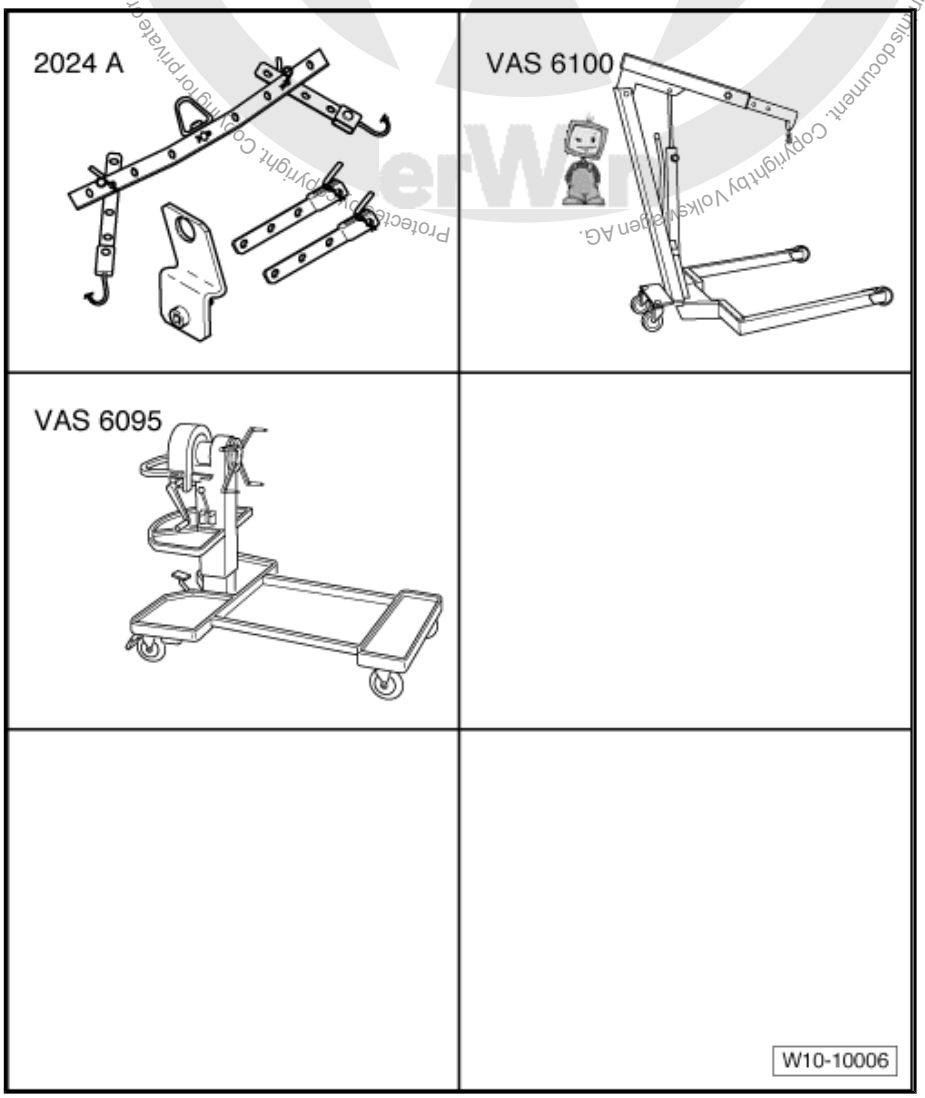
– Check needle bearing -arrow- in crankshaft. If it is damaged or has turned blue, it must be renewed ⇒ page 44 .
– If it is not damaged, lightly grease with high-temperature grease -G 052 133 A2- .
– Slightly grease the journal (not the teeth) of the gears as well.



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

Special tools and workshop equipment required

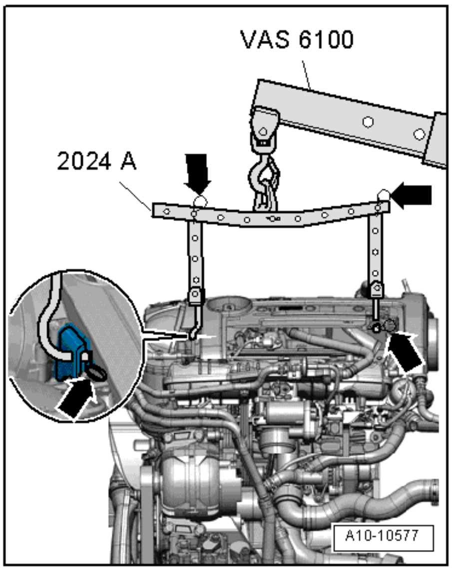
- Lifting tackle -2024 A-
- Workshop hoist -VAS 6100-
- Engine and gearbox support -VAS 6095-



Prerequisite

- Engine with gearbox removed and mounted on engine support -T10359- .

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



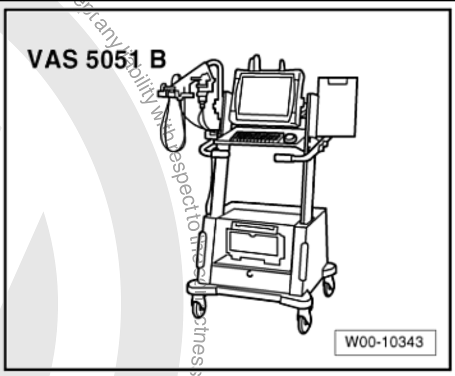
> ⚠ **Caution**
>
> *Use securing pins arrows on hooks and locking pins to avoid damage to engine.*

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

1.3 Notes on installing

Special tools and workshop equipment required

♦ Vehicle diagnosis, testing and information system -VAS 5051B-

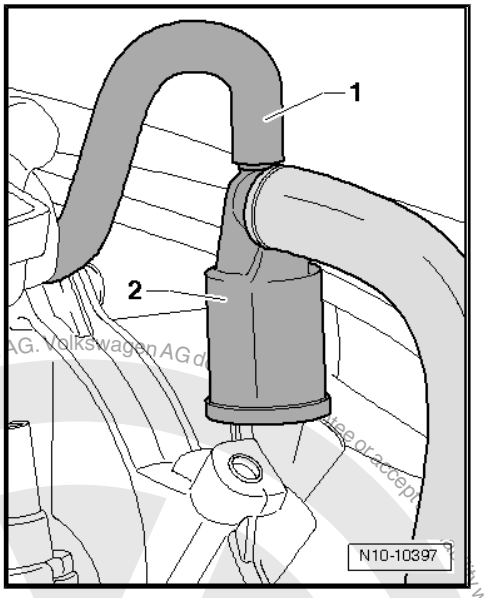


Procedure

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

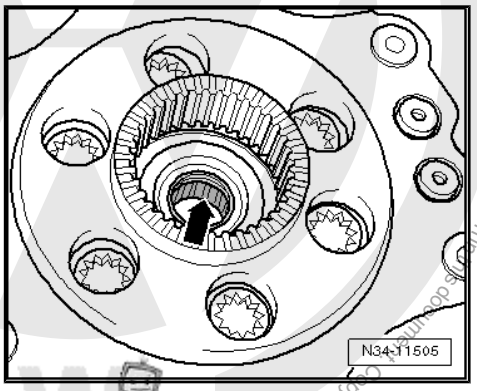
> ⚠ **Caution**
>
> ♦ *Only a few millimetres of space are available between plenum chamber and radiator/lock carrier for removing and installing the engine. The engine must therefore be guided carefully when raising and lowering.*
>
> ♦ *Raise and lower the engine slowly with the assistance of a second mechanic.*
>
> ♦ *The workshop hoist -VAS 6100- must also be guided carefully when raising and lowering the engine.*

– When raising and lowering engine, make sure that neither vacuum hose -1- nor connection -2- on vacuum pump are damaged.
– Guide vacuum hose -1-, connection -2- and vacuum pump past plenum chamber when raising and lowering.
– When raising and lowering engine, make sure that rollers of belt drive and turbocharger do not damage radiator.
– When raising and lowering engine, pay attention to lines and hoses to prevent these from being damaged.
– Check whether dowel sleeves for centering engine/gearbox are in cylinder block, install if necessary (gearbox removed).
– Check clutch release bearing for wear and, if necessary, replace (gearbox removed).



Caution

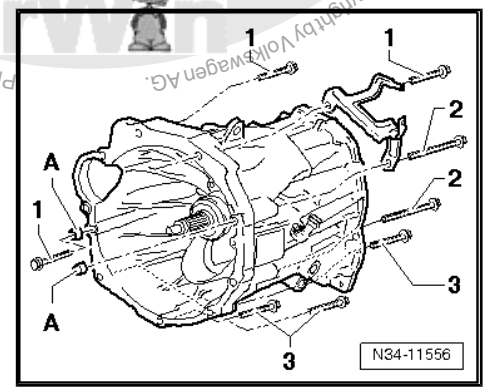
- ***Bring engine and gearbox together in longitudinal direction, not at an incline.***
- ***When bringing engine and gearbox together, make sure that needle bearing -arrow- is not damaged.***



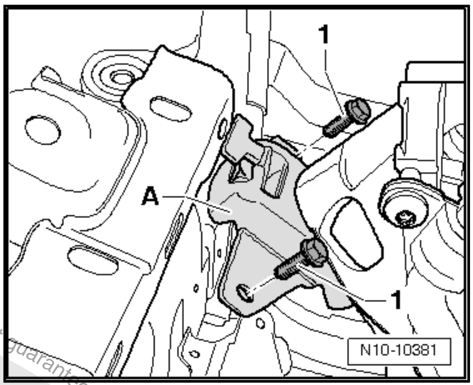
– First tighten the two upper bolts -1-.

Note

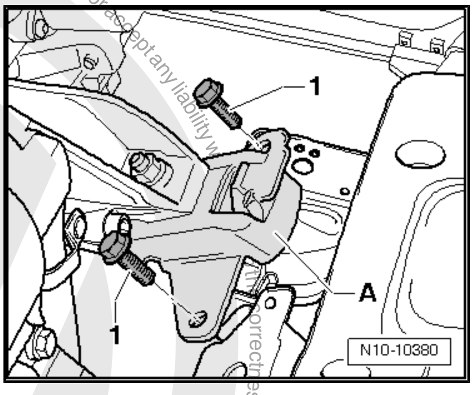
♦ *Specified torques for assembly mountings ⇒ page 17 .*
♦ *Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 .*



– Tighten new bolts -1- for left engine mounting -A-.



– Tighten new bolts -1- for right engine mounting -A-.



– Install catalytic converter ⇒ page 240 .
– Install air conditioner compressor ⇒ Heating, air conditioning; Rep. gr. 87 .
– Install vane pump for power steering ⇒ Running gear, axles, steering; Rep. gr. 48 ; Removing and installing vane pump .
– Install starter ⇒ Electrical system; Rep. gr. 27 ; Removing and installing starter .
– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .
– Install bonnet ⇒ General body repairs, exterior; Rep. gr. 55 ; Bonnet .
– Fit new screw-type clips with „barb“, notes on screw-type clips ⇒ page 184 .

To prevent the high-pressure pump from running while it is empty and to ensure that the engine starts quickly after parts have been renewed, it is important to observe the following:

♦ If components of fuel system between fuel tank and high-pressure pump are removed or renewed, „Bleeding fuel system“ function must be carried out to bleed fuel system using vehicle diagnosis tester in „Guided Functions“ ⇒ page 209 .
♦ This process takes 130 seconds. Fuel pumps are actuated a total of 3 times in this case. The process must not be terminated prematurely.

– Check oil level ⇒ page 115 .

Note

♦ *Only reuse drained coolant if neither cylinder head nor cylinder block have been renewed.*
♦ *Soiled coolant must not be reused.*

– Replenish coolant ⇒ page 133 .
– Carry out road test and read fault memory.

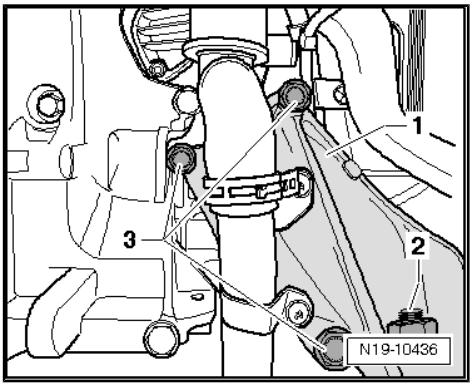
Specified torques ⇒ page 17 .

1.4 Assembly and gearbox mountings

Left and right engine support to crankcase

Caution

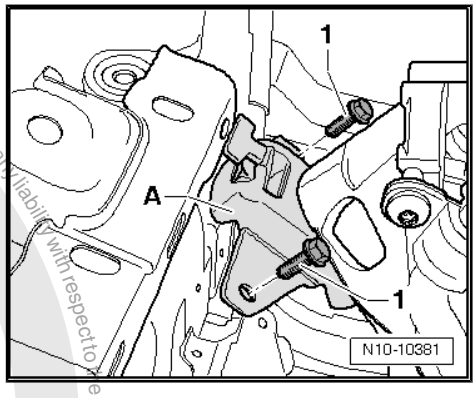
- *Nut -2- must not be loosened.*
- *If nut -2- is loosened, engine mounting must subsequently be renewed.*
- *Engine mounting connection to engine support may only be loosened if engine mounting is to be renewed.*



– Secure engine support -1- to crankcase with bolts -3-.
– Always renew bolts -3- and tighten to 50 Nm + 180° (1/2 turn).

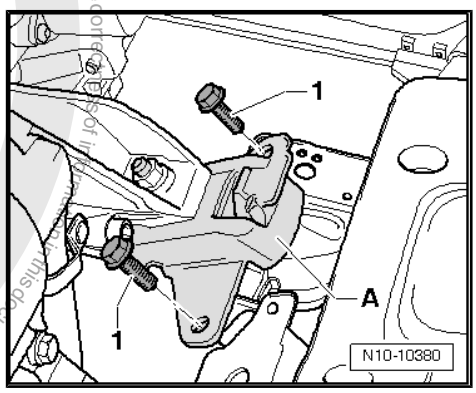
Right engine mounting to frame

– Secure engine mounting -A- to frame with bolts -1-.
– Always renew bolts -1- and tighten to 50 Nm + 90° (1/4 turn).



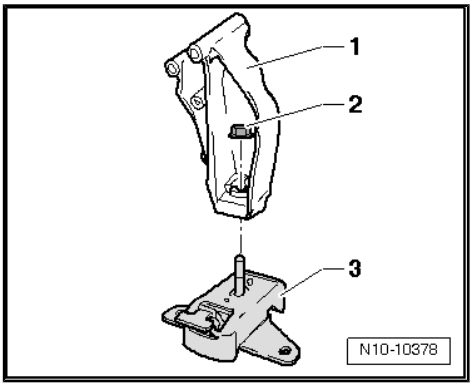
Left engine mounting to frame

– Secure engine mounting -A- to frame with bolts -1-.
– Always renew bolts -1- and tighten to 50 Nm + 90° (1/4 turn).



Left engine mounting to engine support

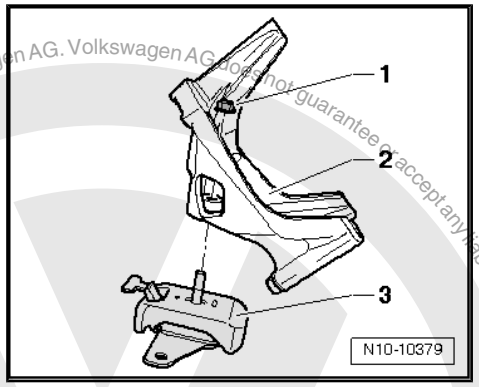
– Bolt new engine mounting -3- to engine support -1- with nut -2-.
– Always renew nut -2- and tighten to 90 Nm + 90° (1/4 turn).



Right engine mounting to engine support

– Bolt new engine mounting -3- to engine support -2- with nut -1-.

– Always renew nut -1- and tighten to 90 Nm + 90° (1/4 turn).

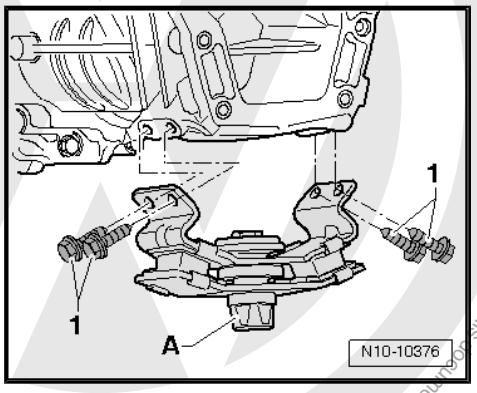


Gearbox mounting to gearbox

– Secure gearbox mounting -A- to gearbox with bolts -1-.

– Always renew bolts -1- and tighten to 50 Nm + 90° (1/4 turn).

– Removing and installing gearbox mounting ⇒ Rep. gr. 34

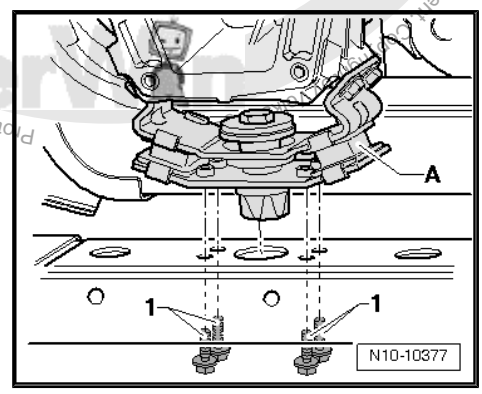


Gearbox mounting to gearbox cross member

– Secure gearbox mounting -A- to gearbox cross member with bolts -1-.

– Always renew bolts -1- and tighten to 30 Nm + 90° (1/4 turn).

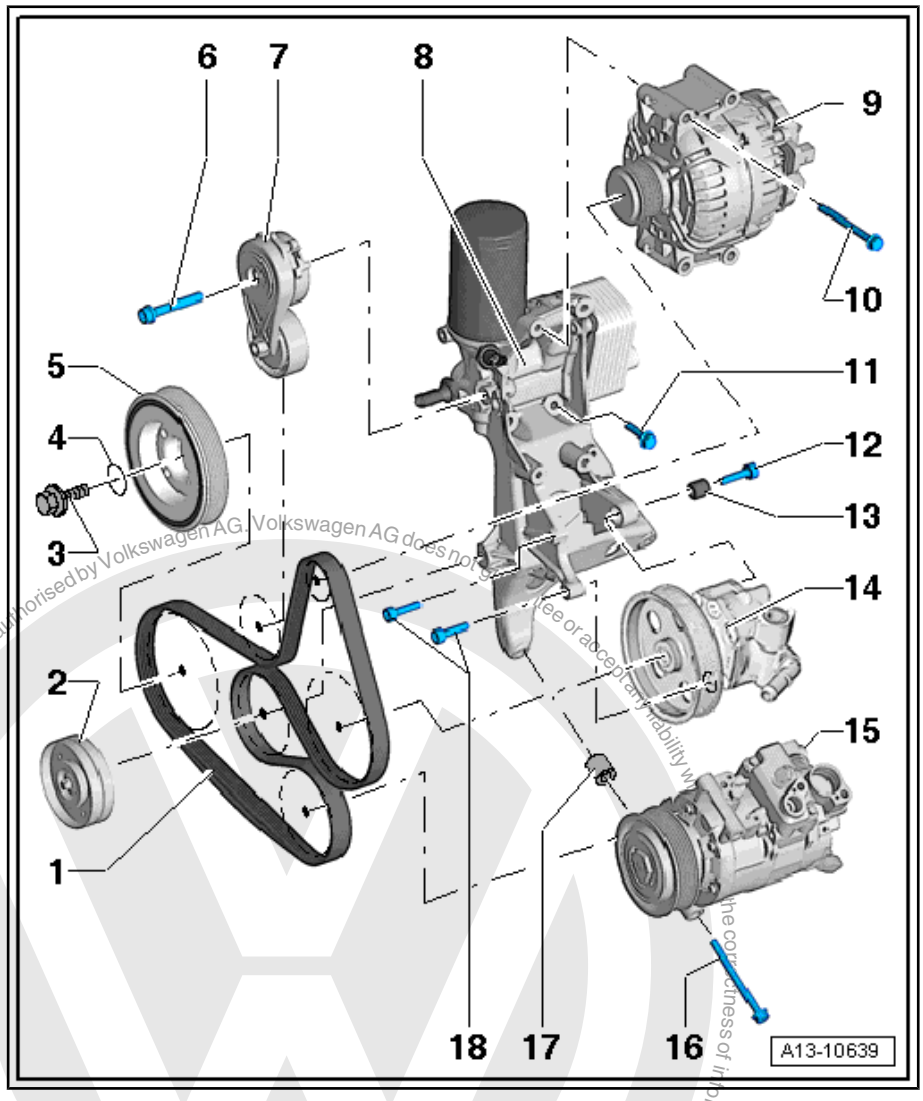
– Removing and installing gearbox mounting ⇒ Rep. gr. 34



13 – Crankshaft group

1 Cylinder block (pulley end)

1.1 Assembly overview - poly V-belt drive



1 - Poly V-belt

- ❑ Check for wear.
- ❑ Do not kink.
- ❑ Poly V-belt routing ⇒ page 21 .

> **Caution**
> *If a used belt runs in the opposite direction when it is refitted, this can cause breakage.*
> *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*

- ❑ Removing and installing ⇒ page 22 .
- ❑ When installing, make sure it is properly seated on pulleys.

2 - Guide roller

- ❑ 20 Nm

3 - Bolt

- ❑ Renew.
- ❑ 150 Nm + 90° further
- ❑ Use counterhold - T10355- when loosening and tightening

> **Caution**
> *Risk of damage to engine.*
> *To avoid disturbing valve timing, do not turn crankshaft when bolt has been removed.*

4 - O-ring

- ❑ Renew.

5 - Vibration damper

- ❑ With poly V-belt pulley.
- ❑ Removing and installing ⇒ page 27 .

Caution

Risk of damage to engine.
To avoid disturbing valve timing, do not turn crankshaft out of „TDC“ position when vibration damper is removed.

6 - Bolt

- ❑ 40 Nm

7 - Tensioning element for poly V-belt

- ❑ Swing with spanner to slacken poly V-belt.
- ❑ Lock with locking tool -T40098- .
- ❑ Removing and installing ⇒ page 21 .

8 - Bracket for ancillaries

- ❑ With oil filter and engine oil cooler
- ❑ Removing and installing ancillary bracket ⇒ page 24 .
- ❑ Removing and installing engine oil cooler ⇒ page 129 .

9 - Alternator

- ❑ Removing and installing ⇒ Rep. gr. 27 .

10 - Bolt

- ❑ Specified torque ⇒ Rep. gr. 27

11 - Bolt

- ❑ Tightening sequence ⇒ page 21 .

12 - Bolt

- ❑ Specified torque ⇒ Rep. gr. 48

13 - Sleeve

14 - Vane pump

- ❑ Removing and installing ⇒ Rep. gr. 48 .

15 - Air conditioner compressor

- ❑ Do not unscrew or disconnect refrigerant hoses or pipes.
- ❑ Removing and installing ⇒ Rep. gr. 87 .

16 - Bolt

- ❑ Specified torque ⇒ Rep. gr. 87

17 - Dowel sleeve

- ❑ For air conditioner compressor.

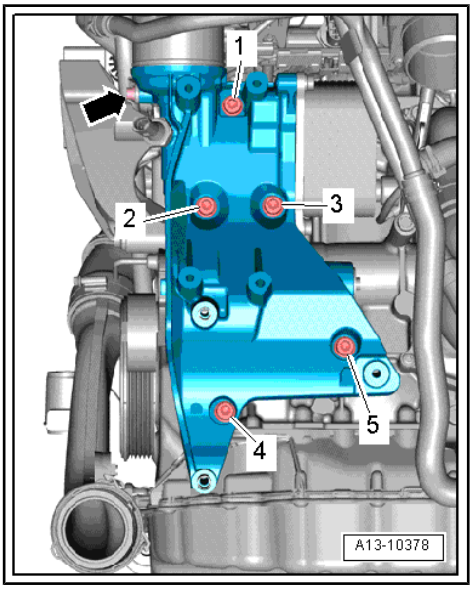
18 - Bolt

- ❑ Specified torque ⇒ Rep. gr. 48

Bracket for ancillaries - tightening sequence

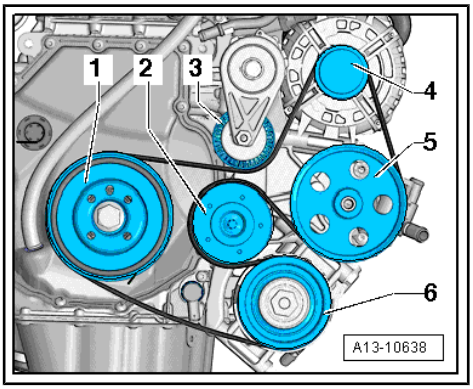
– Fit bracket for ancillaries (first tighten bolt -4-).
– Tighten bolts in the sequence -1 … 5- in 3 stages as follows:

1. Tighten bolts hand tight.
2. Tighten bolts to 20 Nm.
3. Turn bolts 90° further.



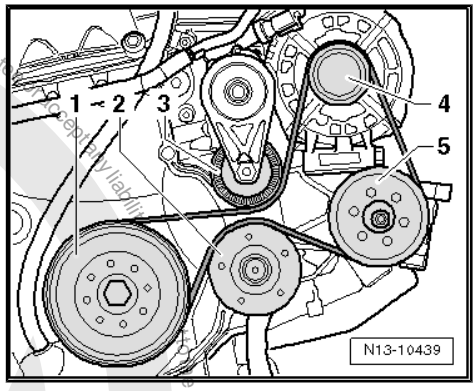
Poly V-belt route with air conditioning system

1 - Vibration damper
2 - Guide roller
3 - Poly V-belt tensioning element
4 - Alternator
5 - Vane pump
6 - Air conditioner compressor



Poly V-belt route without air conditioner

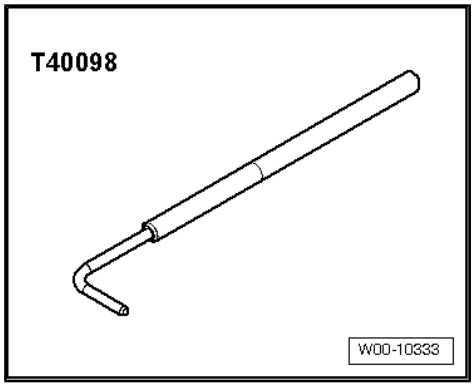
1 - Vibration damper
2 - Guide roller
3 - Poly V-belt tensioning element
4 - Alternator
5 - Vane pump



1.2 Removing and installing tensioner for poly V-belt

Special tools and workshop equipment required

♦ Locking tool -T40098-



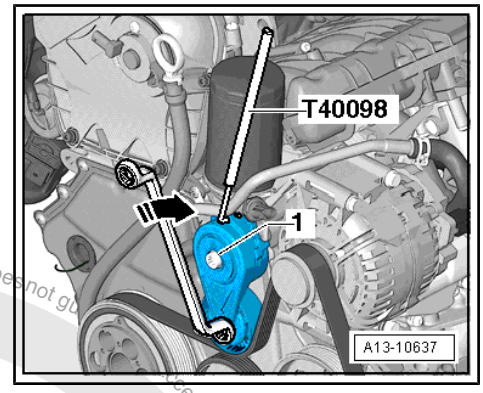
Removing

Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ♦ ***Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.***

– To slacken poly V-belt turn tensioner in direction of -arrow-.
– Lock tensioner with locking tool -T40098- .
– Remove poly V-belt from tensioner.
– Remove bolt -1- and take off tensioner for poly V-belt from bracket for ancillaries.



Installing

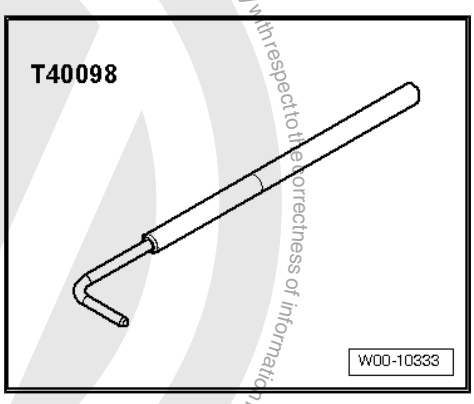
Installation is carried out in the reverse order. When installing, note the following:

- Specified torque ⇒ page 19 .
– Install poly V-belt ⇒ page 22 .

1.3 Removing and installing poly V-belt

Special tools and workshop equipment required

♦ Locking tool -T40098-



Removing

Caution

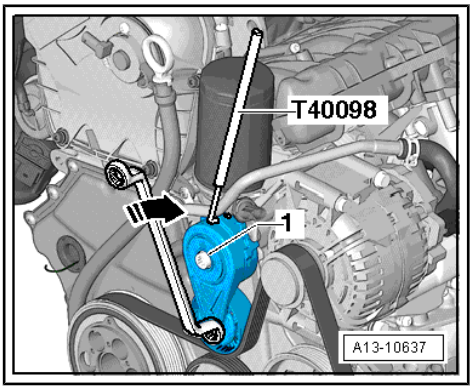
If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ***Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.***

– To slacken poly V-belt turn tensioner in direction of -arrow-.

– Lock tensioner with locking tool -T40098- .

– Remove poly V-belt.



Installing

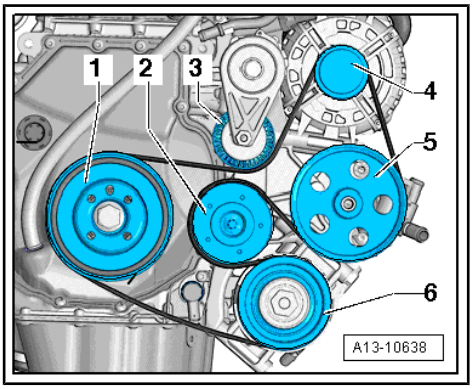
Installation is carried out in the reverse order. When installing, note the following:

Note

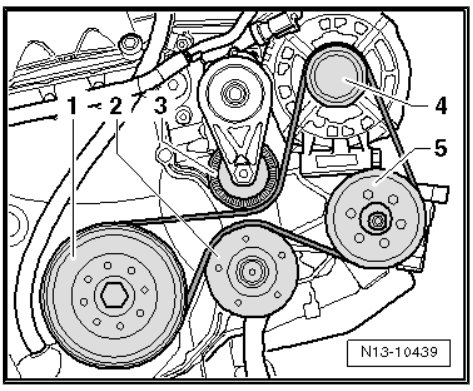
Alternator and air conditioner compressor must be firmly mounted before poly V-belt is installed.

– Fit poly V-belt as shown in figure.

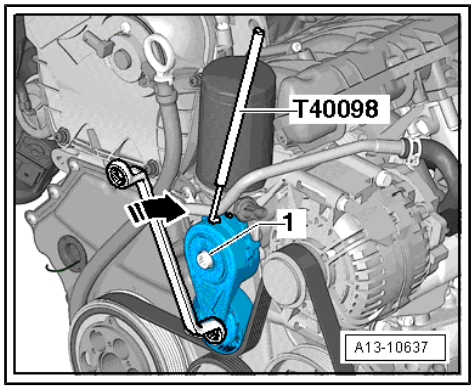
Vehicles with air conditioner



Vehicles with no air conditioner



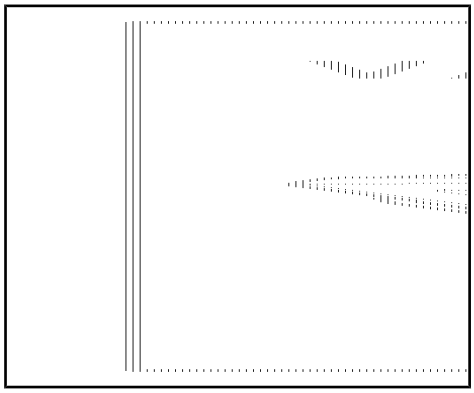
– Turn tensioner in -direction of arrow- and withdraw locking tool -T40098- .
– Release tensioner.
– Check that poly V-belt is properly seated.
– Start engine and check that poly V-belt runs properly.



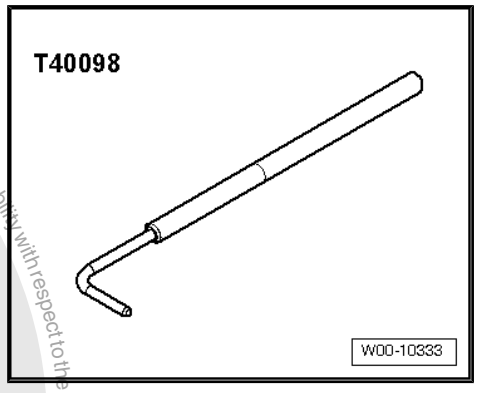
1.4 Removing and installing ancillary bracket

Special tools and workshop equipment required

♦ Drip tray for workshop hoist -VAS 6208-



♦ Locking tool -T40098-



Removing

– Drain coolant ⇒ page 133 .

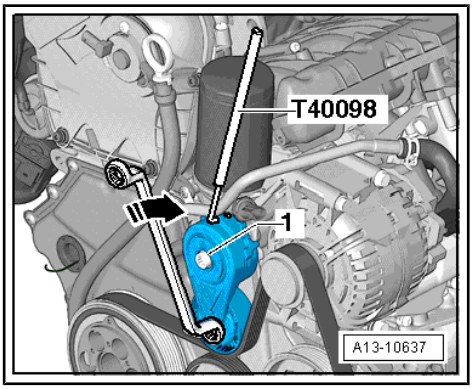
Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

♦ ***Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.***

– To slacken poly V-belt turn tensioner in direction of -arrow-.

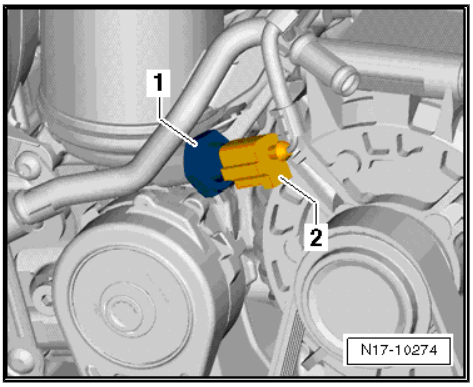
– Lock tensioner with locking tool -T40098- .
– Remove poly V-belt.
– Remove bolt -1- and take off tensioner for poly V-belt from bracket for ancillaries.



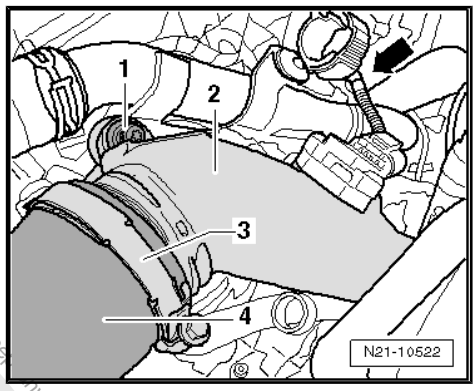
Note

Place a cloth underneath bracket for ancillaries to catch any escaping engine oil.

– Detach connector -2- from oil pressure switch -F22- -1-.
– Unbolt water pipe ⇒ Item 19 (page 141) from bracket for ancillaries.
– Release clip -3- from pressure hose -4-.

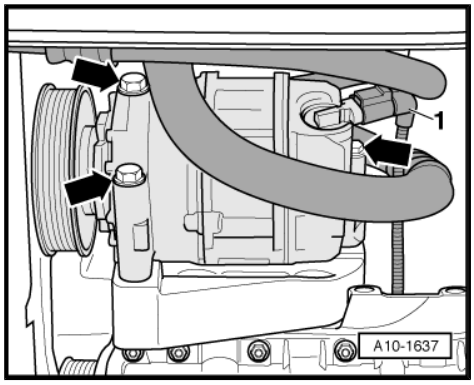


– Release hose clip -arrow- from throttle valve module -J338- .
– Unscrew bolt -1- from pressure pipe -2- and remove pressure pipe -2-.
– Remove alternator ⇒ Rep. gr. 27 .



Vehicles with air conditioner

– Disconnect electrical connector -1- for magnetic clutch on air conditioner compressor.



WARNING

Risk of injury caused by refrigerant.

- *The air conditioner refrigerant circuit must not be opened.*

– Remove bolts -arrows- for air conditioner compressor.

Caution

Danger of damage to refrigerant lines and hoses.

- *Do NOT stretch, kink or bend refrigerant lines and hoses.*

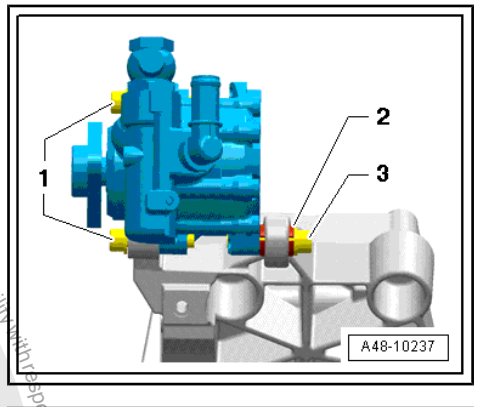
– Tie up air conditioner compressor together with refrigerant hoses to longitudinal member (refrigerant hoses remain connected).

Continuation for all vehicles

Note

Hydraulic lines and vane pump remain connected.

– Unscrew bolts -1- from front through belt pulley, unscrew bolt -2- from rear.

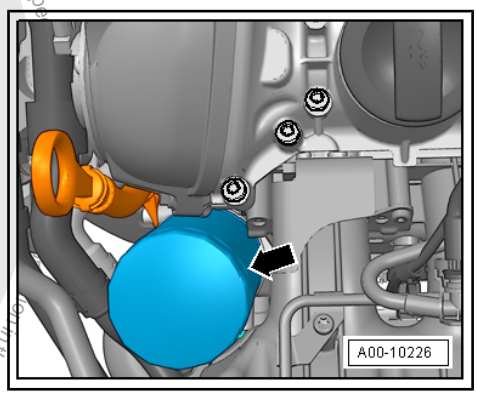


Note

The vane pump is shown without a belt pulley and without hydraulic lines in the figure.

– Place vane pump with attached hydraulic lines on longitudinal member.

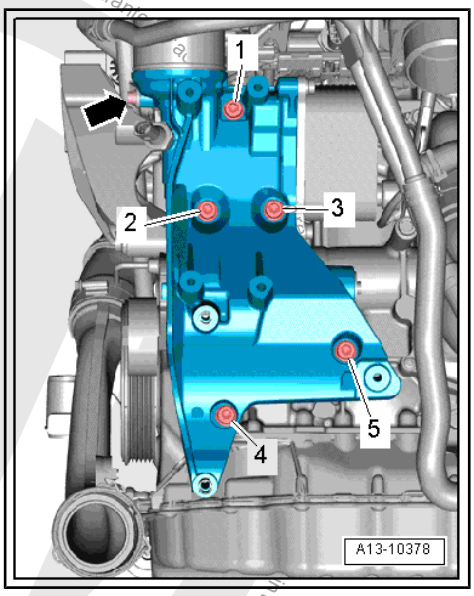
– Release oil filter -arrow- using oil filter tool -3417- and remove oil filter.



– Remove bolts from bracket of continued coolant circulation pump -V51- .

– Remove bolt -arrow- for dipstick guide tube.

– Unscrew bolts -1 … 5- and detach bracket for ancillary units from coolant pump housing.



Installing

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

- Specified torques ⇒ page 19 .

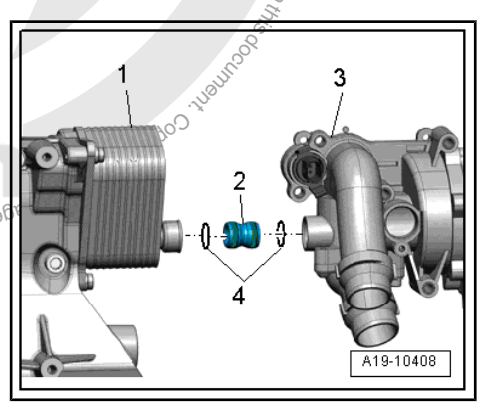
Note

- *Renew bolts that are tightened with specified further tightening angle.*
- *Renew O-rings and seals.*

– Coat O-rings -4- with coolant additive, coolants ⇒ Electronic parts catalogue .

– Insert connection -2- into coolant pump housing -3-.

– Push bracket for ancillaries -1- onto connection, fit bolts and tighten, tightening sequence.



– Install vane pump ⇒ Rep. gr. 48 .

– If present, fit air conditioner compressor ⇒ Rep. gr. 87 .

– Install alternator ⇒ Rep. gr. 27 .

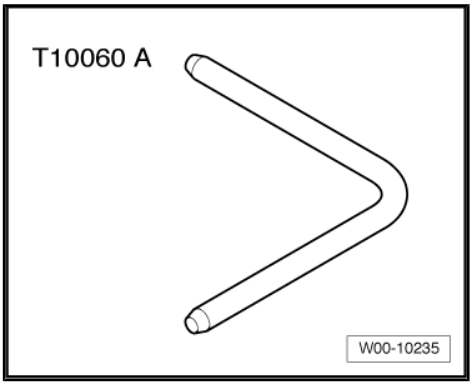
– Install poly V-belt ⇒ page 22 .

– Replenish coolant ⇒ page 133 .

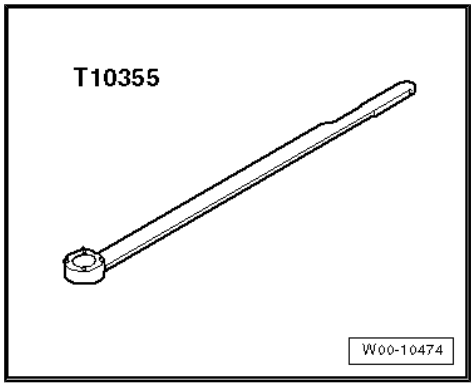
1.5 Removing and installing vibration damper

Special tools and workshop equipment required

- Locking pin -T10060 A-



♦ Counterhold tool -T10355-



Removing

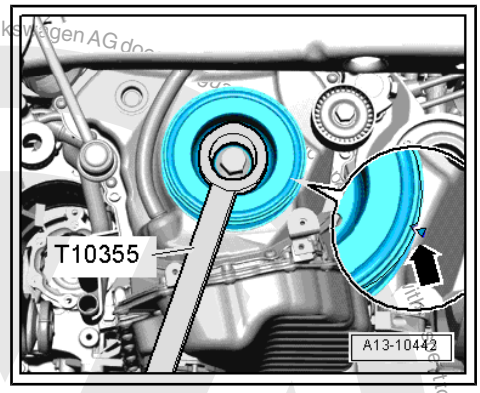
– Remove poly V-belt ⇒ page 22 .

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

• Notch on vibration damper must align with arrow marking on cover for timing chains (bottom).

– Remove bolt for vibration damper using counterhold -T10355- .



Caution

Risk of damage to engine.

♦ ***To avoid disturbing valve timing, do not turn crankshaft out of „TDC“ position when vibration damper is removed.***

Installing

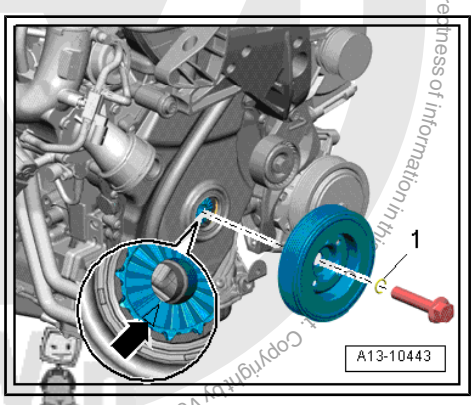
• Specified torque ⇒ page 19 .

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

Note

♦ *Renew bolt for vibration damper.*

♦ *Renew O-ring -1-.*

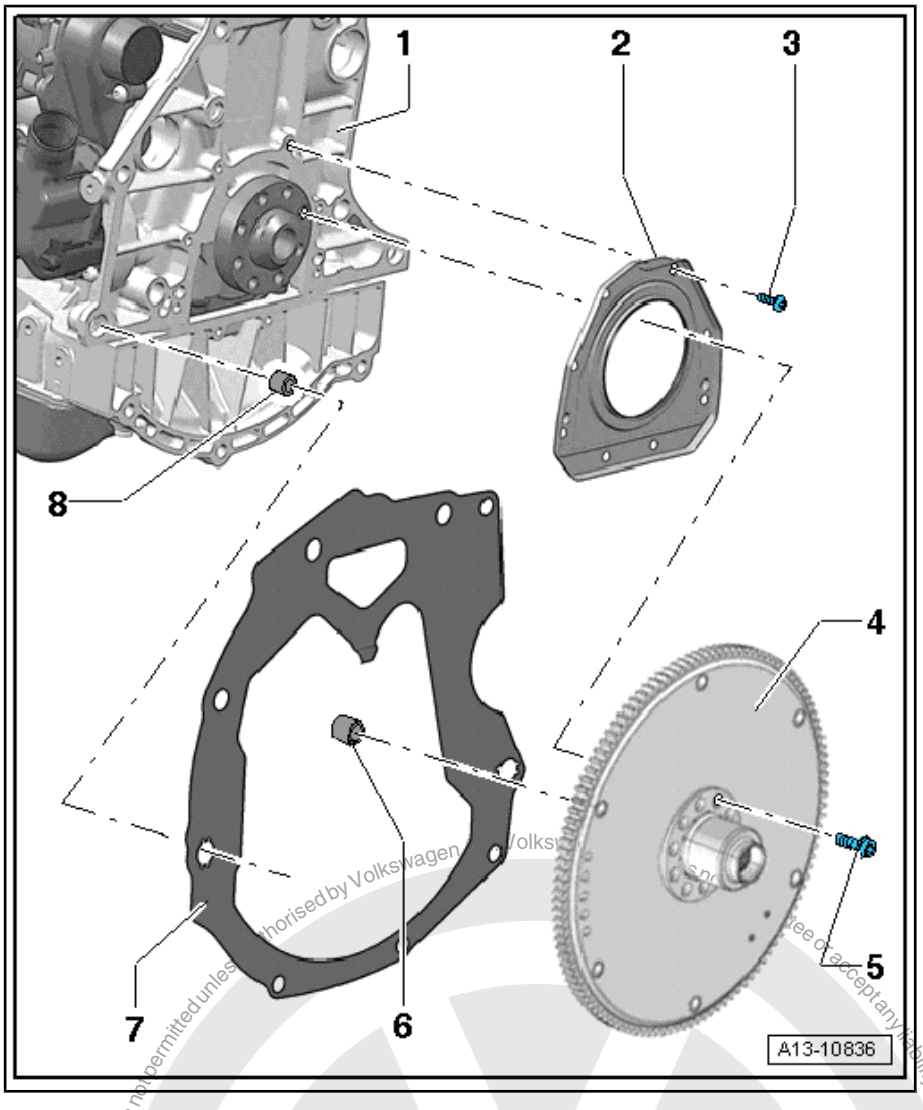


– Lubricate sealing lip of oil seal with gear oil.

– Fit vibration damper (pay attention to shape of tooth -arrow-).

2 Cylinder block (gearbox end)

2.1 Assembly overview - sealing flange and drive plate



1 - Cylinder block

2 - Sealing flange with oil seal

- ❑ Removing and installing ⇒ page 33 .
- ❑ Renew complete only.
- ❑ Do not oil or grease oil seal sealing lip.
- ❑ Use support sleeve supplied when installing.
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth.

3 - Bolt

- ❑ Tightening sequence ⇒ page 30 .

4 - Drive plate

- ❑ To loosen securing bolts, lock using 3067.
- ❑ Removing and installing ⇒ page 30 .

5 - Bolt

- ❑ 60 Nm + 90°
- ❑ Renew.

6 - Needle bearing

- ❑ Removing and installing needle bearing ⇒ page 32

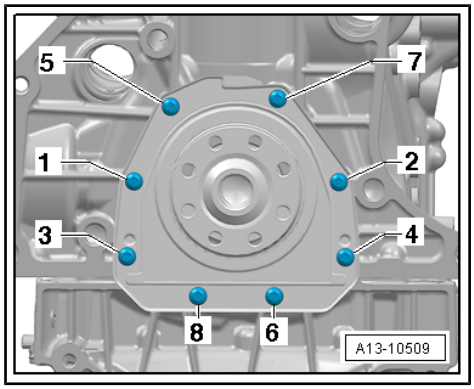
7 - Intermediate plate

- ❑ Must seat on dowel sleeves.
- ❑ Do not damage or bend when assembling.
- ❑ Is fitted onto sealing flange ⇒ page 30

8 - Dowel sleeve

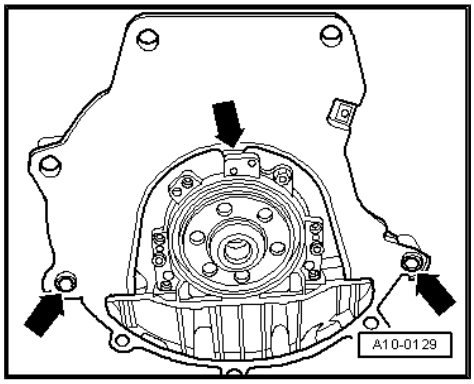
Sealing flange at gearbox end - tightening sequence

– Tighten bolts -1 to 8- in the sequence shown:
– 1. Screw in bolts hand-tight.
– 2. Tighten bolts to 9 Nm.



Installing intermediate plate

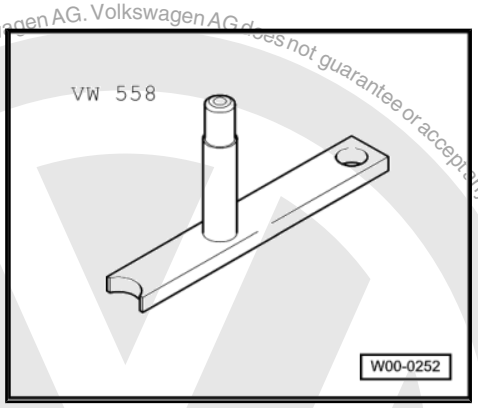
– Hook intermediate plate onto sealing flange and slide onto dowel sleeves -arrows-.



2.2 Removing and installing drive plate

Special tools and workshop equipment required

♦ Counterhold tool -VW 558-

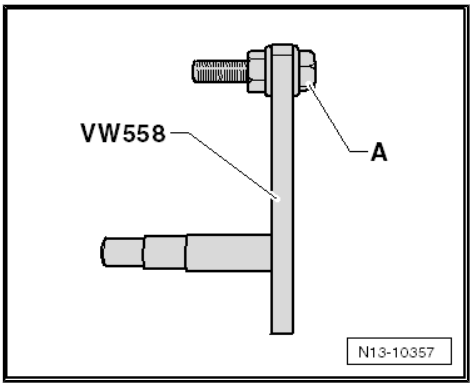


♦ Depth gauge
♦ Hexagon bolt M8×40 and hexagon nut M8

– Remove gearbox ⇒ Power transmission; Rep. gr. 37 ; Removing and installing gearbox .

Preparing counterhold tool -VW 558- :

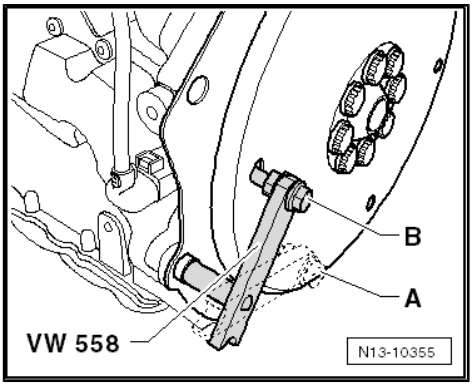
– Tighten hexagon bolt M8x40 -A- with hexagon nut on clutch counter-hold tool -VW 558- .



Loosening and tightening drive plate:

– Insert counterhold -VW 558- in cylinder block and drive plate as shown.

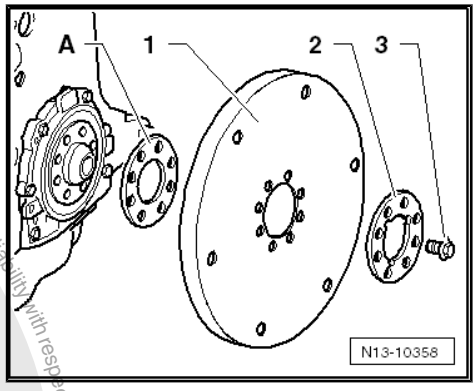
Installation position of counterhold: -A- to loosen, -B- to tighten.



Installing drive plate:

– Fit drive plate without washer -A- first.

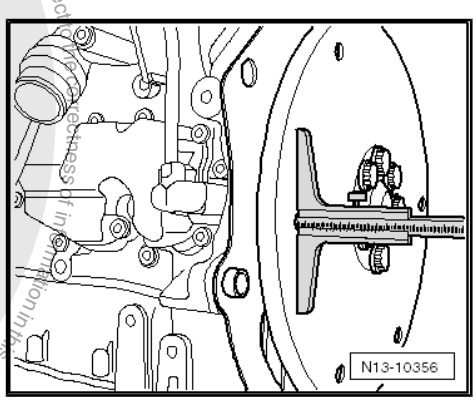
– Fit used securing bolts -3- and tighten to 30 Nm.



– Check dimension between drive plate and cylinder block at three points and calculate average.

Note

Measure through hole in drive plate to milled surface of cylinder block. When measuring intermediate plate, plate thickness has to be taken into account.



- Specification measured without intermediate plate: 19.5… 21.1 mm
- Specification measured with intermediate plate: 18.8… 20.4 mm

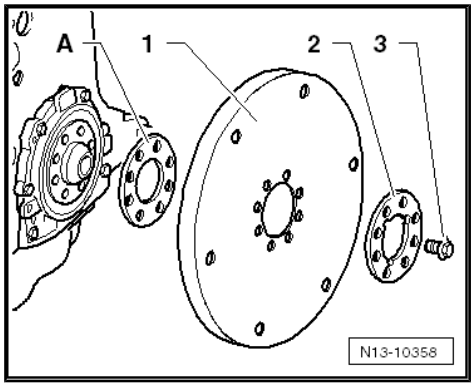
If the specification is not reached, replace all securing bolts and tighten.

If specification is not attained:

– Remove drive plate again and fit shim -A-. Tighten bolts -3- again to 30 Nm.

– Repeat measurement. If the specification is not reached, replace all securing bolts and tighten.

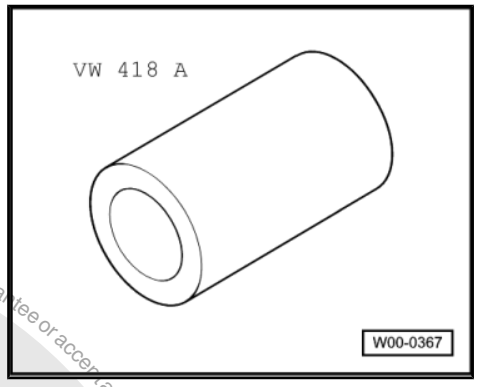
• Specified torque ⇒ page 29



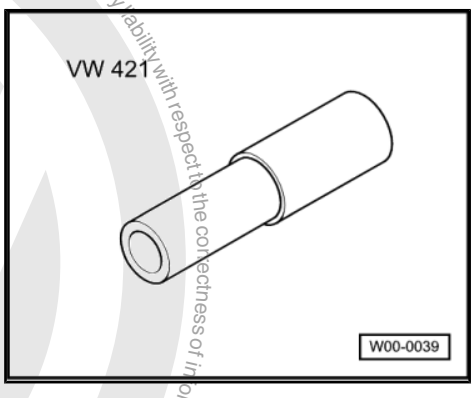
2.3 Removing and installing needle bearing in/from drive plate

Special tools and workshop equipment required

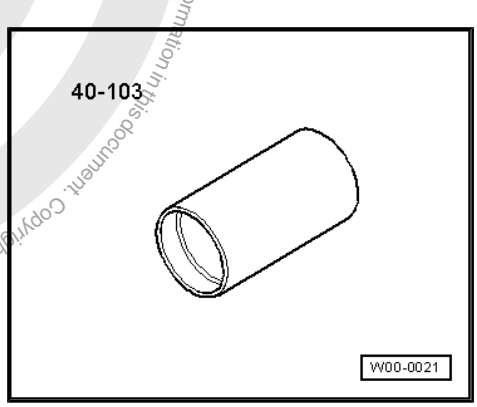
♦ Pipe section -VW 418 A-



♦ Pipe section -VW 421-



♦ Support -40 - 103-



Procedure

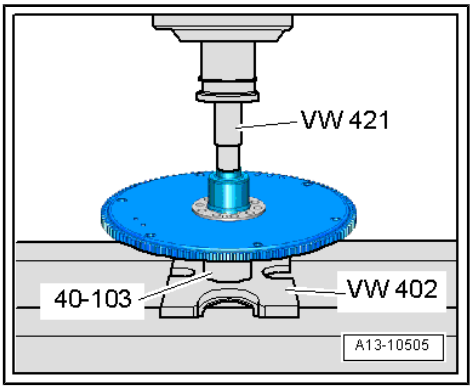
- Gearbox removed.

– Remove drive plate ⇒ page 30 .

– Place support -40 - 103- under drive plate when removing or installing it.

– Remove needle bearing using pipe section -VW 421- and workshop press.

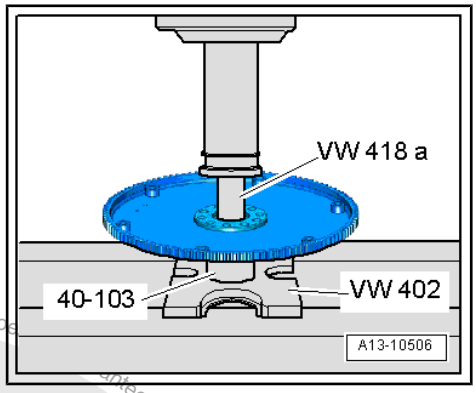
- Thinner ∅ of pipe section -VW 421- to drive plate.



– Press in needle bearing using pipe section -VW 418 A- and workshop press as far as stop.

- Installation position: closed side of needle bearing to engine.

– Install drive plate ⇒ page 30 .



2.4 Removing and installing sealing flange on gearbox side

Special tools and workshop equipment required

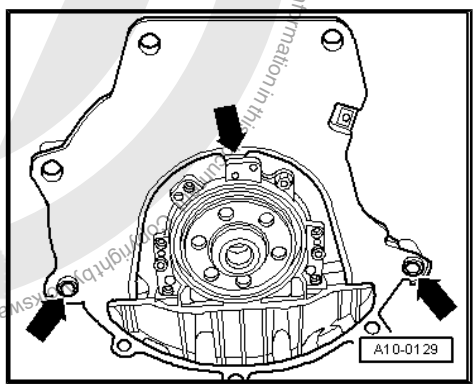
- ♦ Hand drill with plastic brush attachment
- ♦ Eye protection
- ♦ Sealant ⇒ Electronic parts catalogue
- ♦ Guide sleeve -T20097-

Removing

- Gearbox removed.

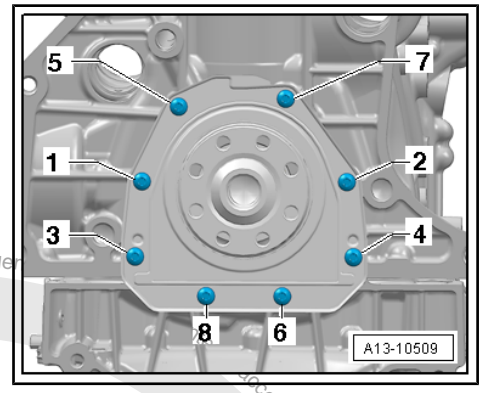
– Remove drive plate ⇒ page 30 .

– Detach intermediate plate from sealing flange and dowel pins -arrows-.



– Remove bolts -1 … 8-.

– Remove sealing flange at gearbox end.



Installing

- Specified torques
- ♦ Silicone sealant: ⇒ Electronic parts catalogue

Note

- ♦ *Observe use-by date of silicone sealant.*
- ♦ *The sealing flange must be installed within 5 minutes of applying the silicone sealant.*

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

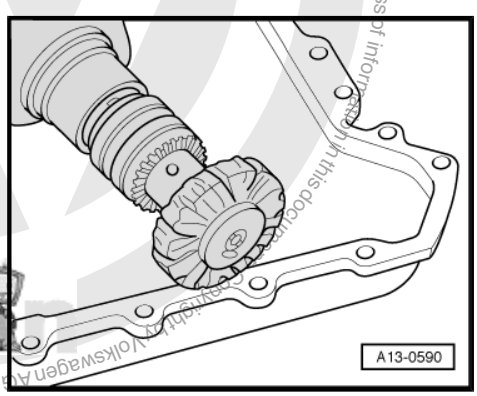
WARNING

Risk of eye injury.

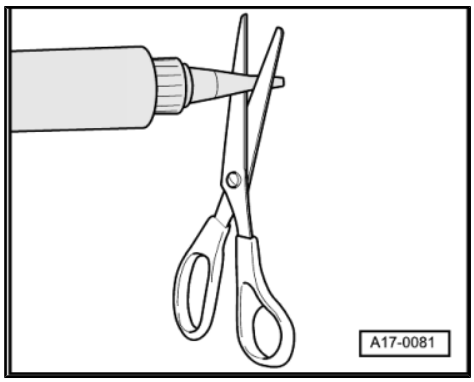
- ♦ ***Wear safety goggles.***

– Remove sealant residues from sealing flange, e.g. with rotating plastic brush.

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

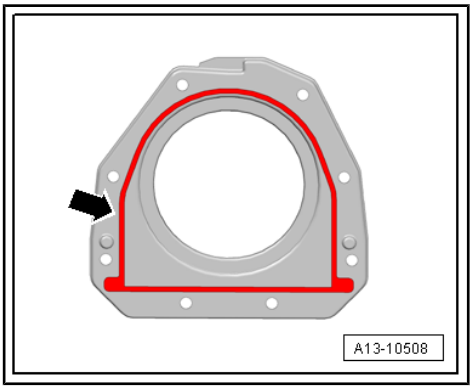


– Cut off nozzle on tube at front marking (∅ of nozzle approx. 2 mm).



– Apply silicone sealant onto clean sealing surface of cover, as illustrated.

♦ Thickness of sealant bead: 2 ... 3 mm.



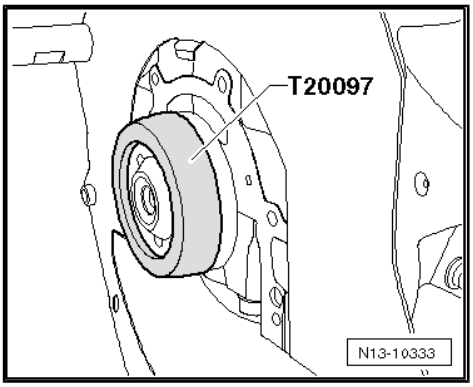
Note

♦ *The sealing flange must be installed within 5 minutes after applying the silicone sealant.*

♦ *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*

– Fit guide sleeve -T20097- onto crankshaft journal.

– Push sealing flange over guide sleeve -T20097- onto crankshaft journal and tighten bolts immediately, tightening sequence



Note

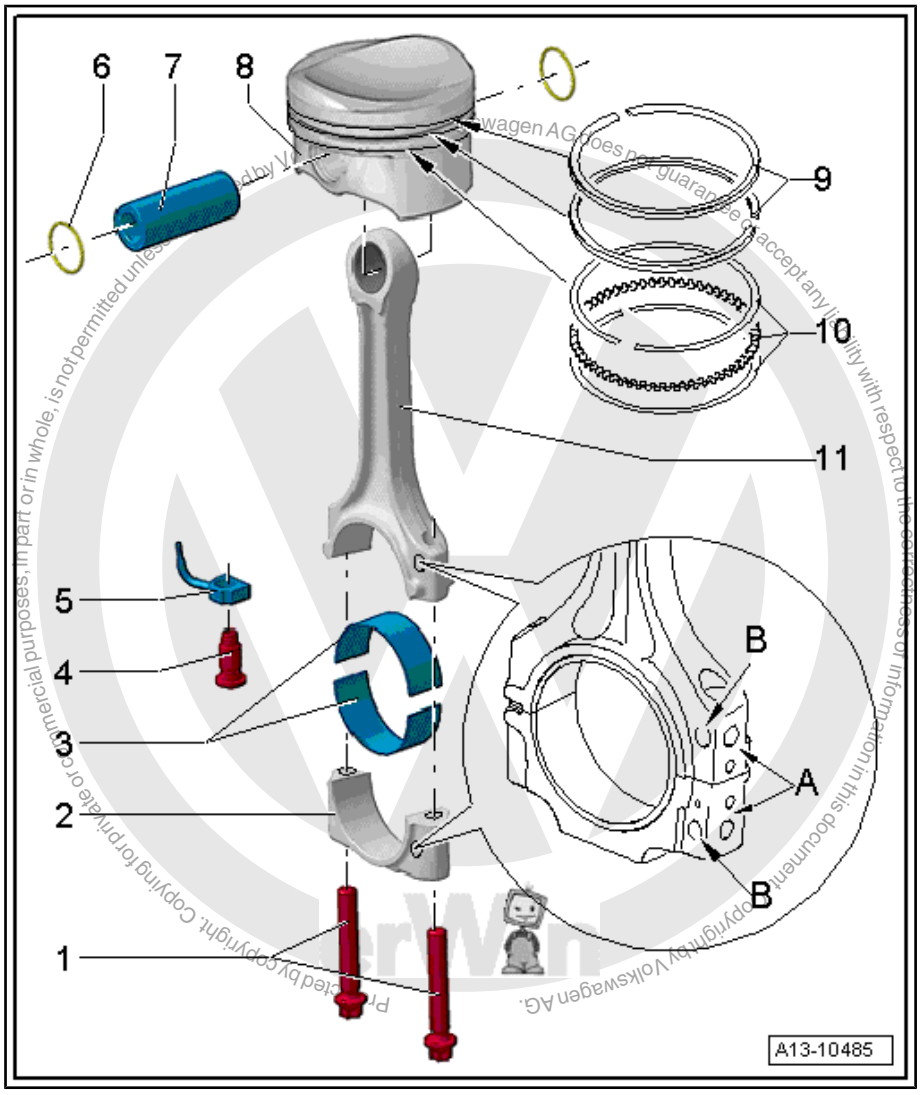
After installing the sealing flange, wait about 30 minutes for the sealant to dry. Only then fill with engine oil.

Perform further assembly analogously in reverse order of removal. When doing this, observe the following:

– Install drive plate ⇒ page 30 .

3 Pistons and conrods

3.1 Assembly overview - pistons and conrods



1 - Conrod bolt

- ❑ 45 Nm + 90° further
- ❑ Renew.
- ❑ Oil threads and contact surface.
- ❑ Use old bolt for measuring radial clearance.
- ❑ To measure radial clearance, tighten to 30 Nm but not further.

2 - Conrod bearing cap

- ❑ Note installation position.
- ❑ The conrod bearing cap only fits in one position and only on the appropriate conrod due to the breaking procedure (cracking) separating the cap from the conrod.
- ❑ Mark with cylinder number -A-.
- ❑ Installation position: Marking -B- faces towards pulley end.
- ❑ Separating new conrod ⇒ page 39 .

3 - Bearing shells

- ❑ Installation position ⇒ page 38 .
- ❑ Do not interchange used bearing shells (mark).
- ❑ Axial clearance new: 0.10…0.35 mm, wear limit: 0.40 mm
- ❑ Measure radial clearance using Plastigage; new: 0.02…0.06 mm; wear limit: 0.09 mm. Do not rotate crankshaft when checking radial clearance.

4 - Pressure relief valve

- ❑ 27 Nm

5 - Oil spray jet

- ❑ For piston cooling.

6 - Circlip

7 - Piston pin

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

8 - Piston

- ❑ Check ⇒ page 38 .

- ❑ Mark installation position and cylinder number.
- ❑ Arrow on piston crown points to belt pulley end.
- ❑ Install using piston ring clamp.
- ❑ Piston and cylinder dimensions ⇒ page 39 .
- ❑ Checking cylinder bores ⇒ page 38 .

9 - Compression rings

- ❑ Offset gaps by 120°.
- ❑ Use piston ring pliers to remove and install.
- ❑ „TOP“ or „R“ marking must face upwards towards piston crown.
- ❑ Checking ring gap ⇒ page 37 .
- ❑ Checking ring-to-groove clearance ⇒ page 37 .

10 - Oil scraper ring

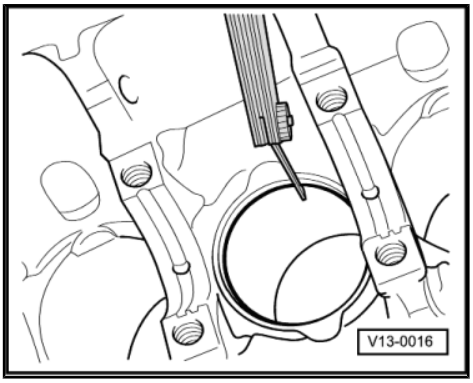
- ❑ 2 parts
- ❑ Install such that upper steel band ring gap is offset by 120° relative to adjacent compression ring
- ❑ „TOP“ or „R“ marking must face upwards towards piston crown.
- ❑ Offset gaps of individual parts of oil scraper ring.
- ❑ Checking ring gap ⇒ page 37 .
- ❑ Ring-to-groove clearance cannot be checked.

11 - Conrod

- ❑ Renew as set only.
- ❑ Mark with cylinder number -A-.
- ❑ Installation position: Marking -B- faces towards pulley end.
- ❑ Separating new conrod ⇒ page 39 .

Checking piston ring gap

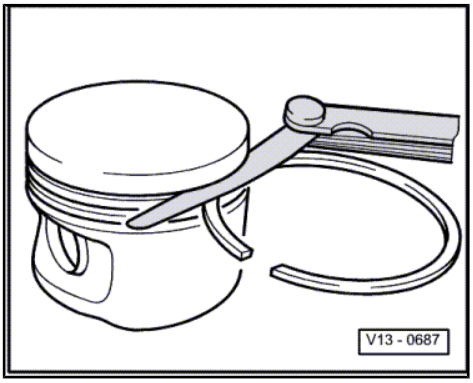
– Push ring at right angles from above down to approx. 15 mm from bottom end of cylinder. Push in using a piston without rings.



Piston ring dimensions in mm	New	Wear limit
compression ring	0.20...0.40	0.80
Oil scraper ring	0.25...0.50	0.80

Checking ring-to-groove clearance

– Clean annular groove of piston before check.

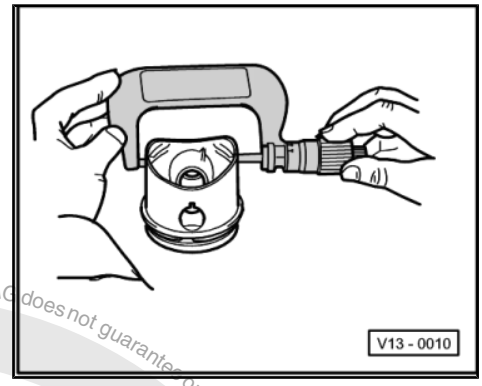


Piston ring dimensions in mm	New	Wear limit
1st compression ring	0.06 … 0.09	0.20
2nd compression ring	0.03 … 0.06	0.15
Oil scraper rings	Not measurable	

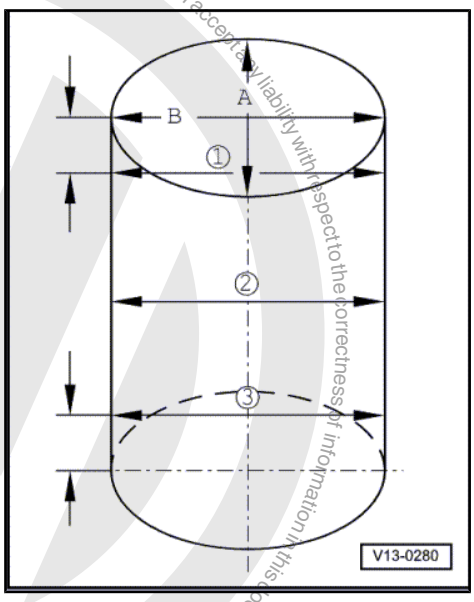
Checking piston

– Measure approx. 10 mm from lower edge, offset 90° from piston pin axis.

♦ Difference between actual and nominal diameter max. 0.04 mm.



Checking cylinder bores



Special tools and workshop equipment required

♦ Inside caliper 50 … 100 mm.

Caution

The cylinder bore may not be worked on (reboring, honing, grinding) may not be carried out using workshop tools! This will damage the surface of the cylinder bore.

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

♦ Difference between actual and nominal diameter max. 0.08 mm.

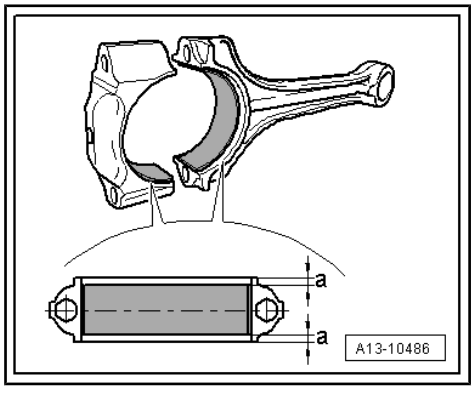
Note

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

Bearing shells - installation position

– Position bearing shells in centre of conrod and conrod bearing cap when fitting.

Dimension -a- must be identical on both sides.

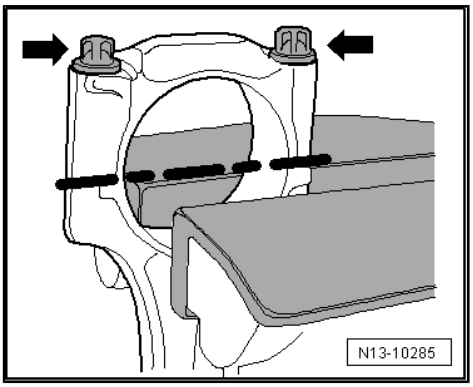


3.2 Separating new conrod

On a new conrod, it is possible that the breaking point has not fully separated. Procedure if conrod bearing cap cannot be removed manually:

– Mark allocation of conrod to cylinder.

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

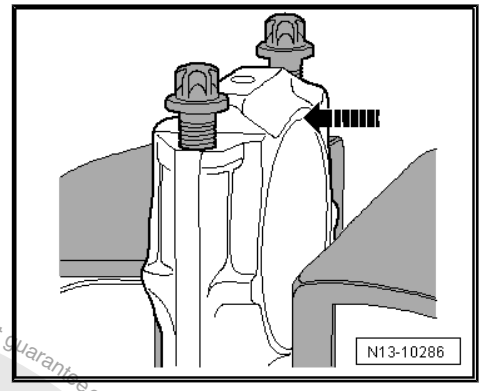


Note

- *Only clamp the conrod lightly in order to avoid damaging it.*
- *Conrod is clamped below dashed line.*

– Unscrew both bolts -arrows- approx. 5 turns.

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



3.3 Piston and cylinder dimensions

Caution

The cylinder bore may not be worked on (reboring, honing, grinding) may not be carried out using workshop tools! This will damage the surface of the cylinder bore.

		Piston Ø	Cylinder bore Ø
Basic dimension	mm	82.465 1)	82.51

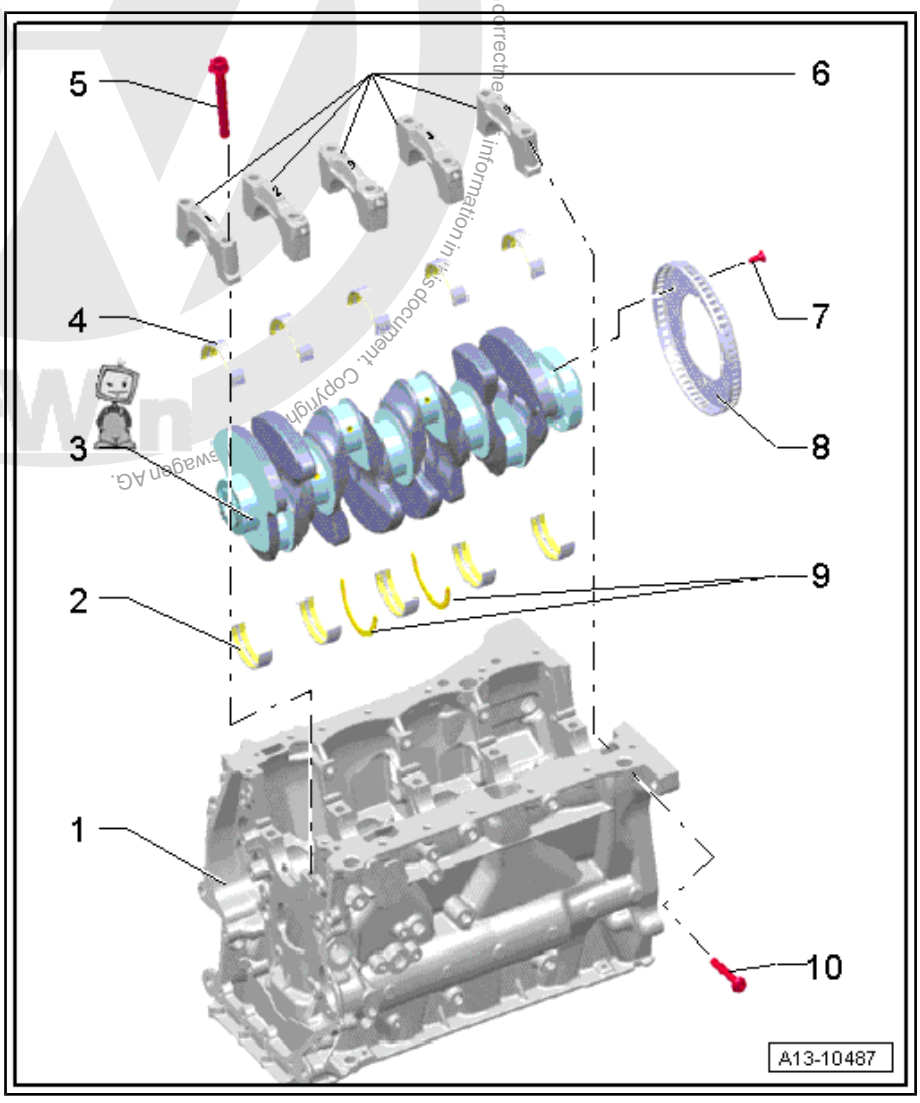
• 1) Dimensions without graphite coating (thickness 0.02 mm). The graphite coating will wear down.

4 Crankshaft

4.1 Assembly overview - crankshaft

Note

Secure engine to repair stand using engine and gearbox support -VAS 6095- when dismantling/assembling engine ⇒ page 13 .



1 - Cylinder block

2 - Bearing shell for cylinder block

- ❑ With oil groove.
- ❑ Do not interchange used bearing shells (mark).
- ❑ Marking of crankshaft bearing shells (classification) ⇒ page 41

3 - Crankshaft

- ❑ After removing, place it down so that the sender wheel -item 5- is not damaged and the crankshaft does not rest on the sender wheel
- ❑ If the crankshaft is renewed, the bearing shells must be reallocated to bearing cap ⇒ page 41
- ❑ Axial clearance ⇒ page 43
- ❑ Radial clearance ⇒ page 43
- ❑ Do not rotate crankshaft when checking radial clearance.
- ❑ Crankshaft dimensions ⇒ page 42 .

4 - Bearing shell for bearing cap

- ❑ Without oil groove.
- ❑ Do not interchange used bearing shells (mark).
- ❑ Marking of crankshaft bearing shells (classification) ⇒ page 41

5 - Bolt

- ❑ Renew.
- ❑ Tightening sequence ⇒ page 41 .

6 - Bearing cap

- ❑ Bearing cap 1: belt pulley end.
- ❑ Bearing shell retaining lugs in cylinder block and bearing caps must align.

7 - Bolt

- ❑ 10 Nm + 90° further
- ❑ Renew.
- ❑ Always renew sender wheel if securing bolts have been unscrewed.

8 - Sender wheel

- ❑ For engine speed sender -G28-
- ❑ Can only be installed in one position, holes are offset.
- ❑ Always renew sender wheel if securing bolts have been unscrewed.
- ❑ Removing and installing ⇒ Item 7 (page 40) .

9 - Thrust washers

- ❑ For bearing 3.

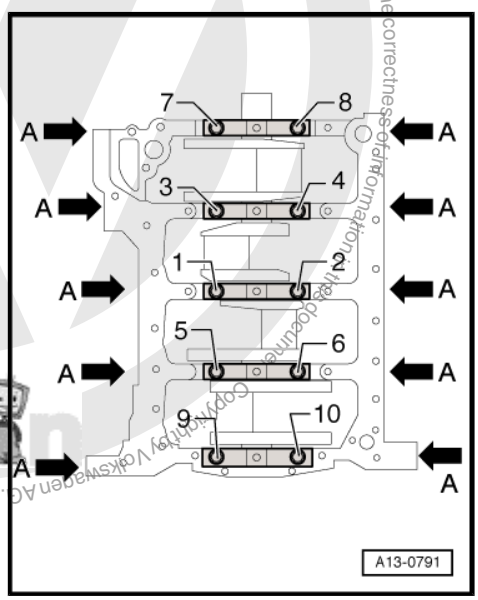
10 - Bolt

- ❑ Renew.
- ❑ Tightening sequence ⇒ page 41 .

Crankshaft tightening sequence

– Tighten crankshaft bolts in the sequence -1 … 5- as follows:

1. Bolts -1 ... 10- and -arrows - - hand-tighten
2. Bolts -1 ... 10- - pre-tighten to 65 Nm
3. Bolts -1 ... 10- - turn 90° further with fixed wrench
4. Pre-tighten bolts -arrows- to 20 Nm.
5. Turn bolts -arrows- 90° further using a fixed wrench.



4.2 Allocation of crankshaft bearing shells (classification)

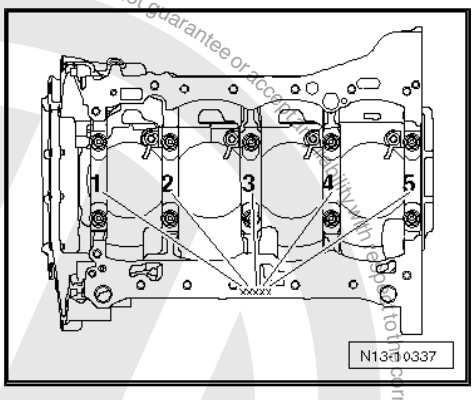
Bearing shells of the correct thickness are allocated to the cylinder block at the factory. Coloured dots are used to identify the thickness of the bearing shells.

Which bearing shell is to be inserted at each place in the cylinder block (upper bearing shell) is marked by letters on the lower sealing surface or on the front side of cylinder block.

Which bearing shell is to be inserted at each place in bearing cap (lower bearing shell) is marked by letters on the crankshaft.

The first letter is allocated to bearing cap 1, the second to bearing cap 2, etc.

Marking on bearing shell for cylinder block:

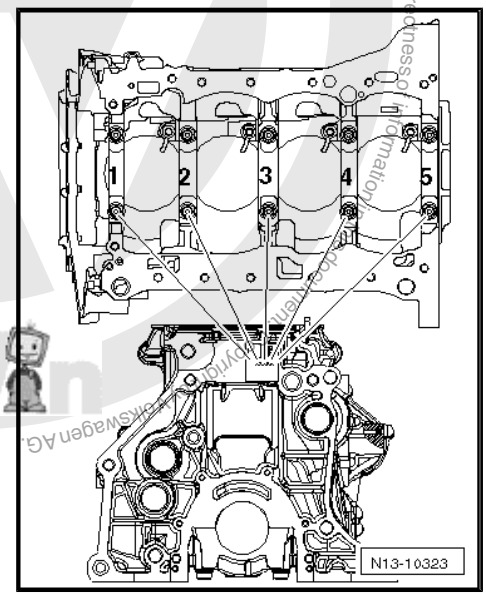


Note

The marking on the cylinder block can be found engraved either in the sump sealing surface or in the front end (gearbox side) of the cylinder block.

Identification on cylinder block is allocated to upper bearing shell (bearing shell for cylinder block).

– Note letters and identify colour code to be installed based on table.

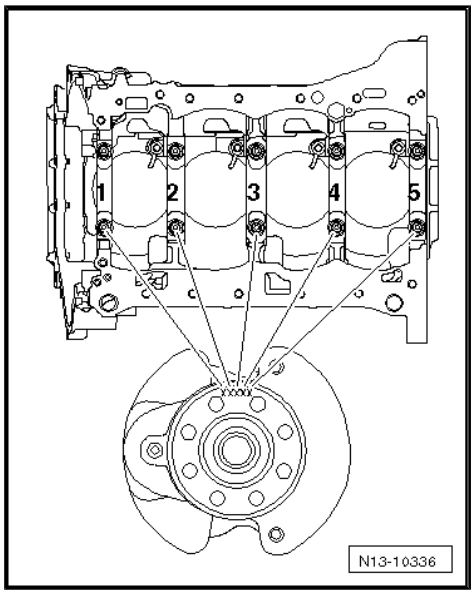


Marking on bearing shell for bearing cap:

Identification on crankshaft is allocated to lower bearing shell (bearing shell for bearing cap).

– Note letters and identify colour code to be installed based on table.

S	=	Black
R	=	Red
G	=	Yellow
B	=	Blue
W	=	White



4.3 Crankshaft dimensions

(Dimensions in mm)

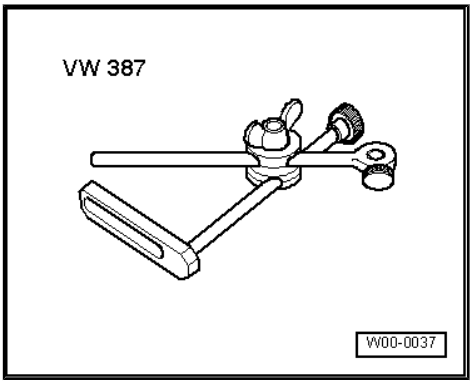
Honing dimension 1)	Main journal ∅	Conrod journal ∅
Basic dimension	58.00	47.80

[1] No provision has yet been made to recondition worn crankshafts.

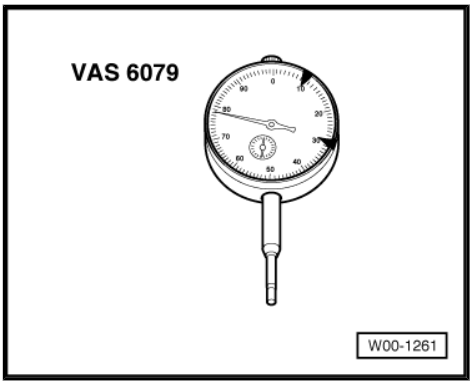
4.4 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

- Universal dial gauge bracket -VW 387-



- Dial gauge -VAS 6079-

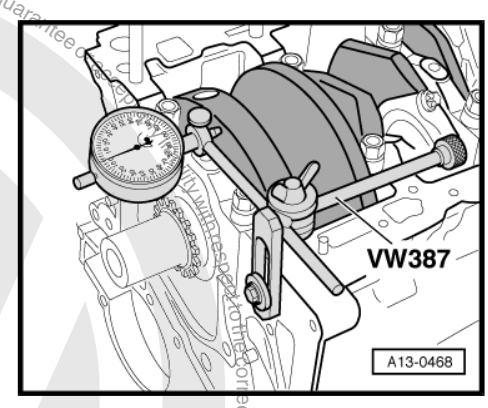


Procedure

– Screw dial gauge -VAS 6079- with universal dial gauge holder -VW 387- onto cylinder block and set against crank web.

– Press crankshaft against dial gauge by hand and set gauge to „0“.

– Push crankshaft away from dial gauge and read off value.



Axial clearance:

- New: 0.07… 0.23 mm.
- Wear limit: 0.30 mm

4.5 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

- Plastigage

Procedure

Note

- *Do not interchange used bearings.*
- *Bearing shells worn down to nickel layer must be renewed.*

– Remove main bearing caps and clean bearing caps and journals.
– Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or in the bearing shells.

• Plastigage must rest in middle of bearing shell.

– Fit main bearing caps and tighten to 60 Nm without rotating crankshaft.
– Remove main bearing cap again.
– Compare width of Plastigage with the measurement scale.

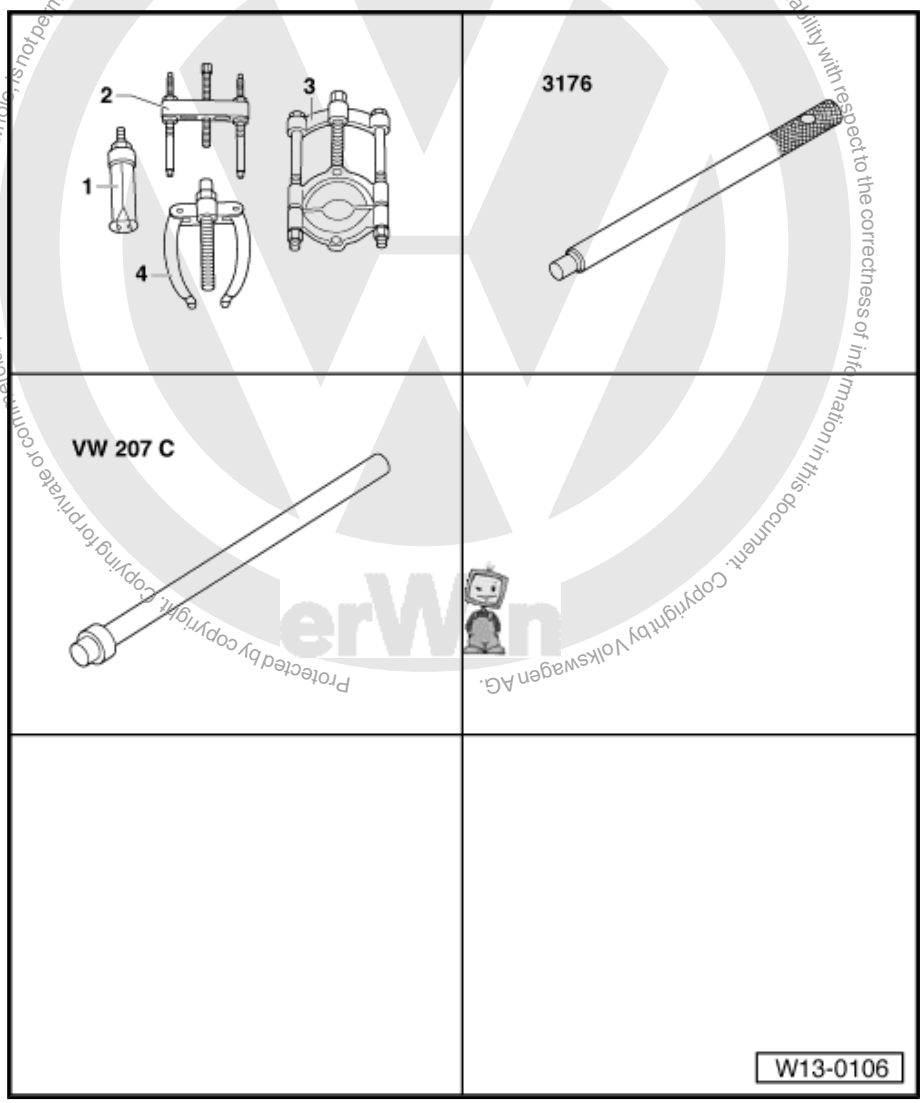
Radial clearance:

• New: 0.017 … 0.037 mm.
• Wear limit: 0.15 mm

4.6 Pulling needle bearing out of and driving into crankshaft

Special tools and workshop equipment required

- Internal puller -Kukko 21/2- and internal puller -Kukko 22/1-
- Centring mandrel -3176-
- Drift -VW 207 C-

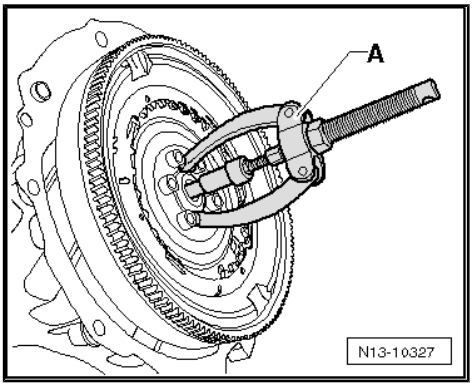


Removing

Procedure

• Gearbox is separated from engine.

– Pull needle bearing out using commercially available internal puller, e.g. KUKKO 21/2 and KUKKO 22/1, -A-.

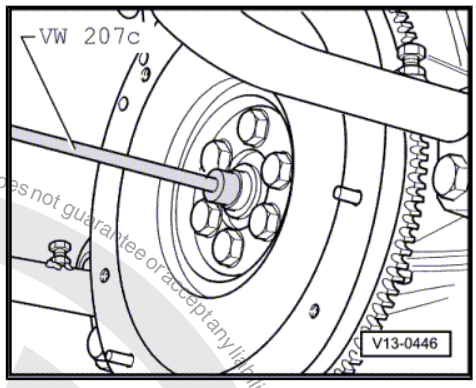


Installing

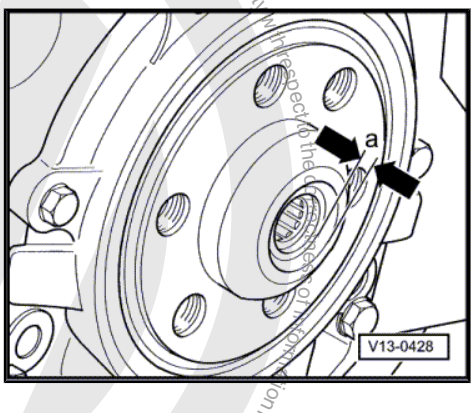
Note

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

– Drive in needle bearing using drift -VW 207 C- or centring mandrel -3176- .
– Drive needle bearing in carefully.
– Constantly measure insertion depth when driving in.
– Renew bearing, if driving depth is too deep.



Installation depth dimension -a- = 1.5 to 1.8 mm.



15 – Cylinder head, valve gear

1 Cylinder head

1.1 Assembly overview - cylinder head

Note

- *Renew cylinder head bolts.*
- *During fitting work, renew self-locking nuts, bolts which have been tightened further as well as oil seals and gaskets.*
- *The plastic protectors fitted to protect the open valves must only be removed immediately before fitting the cylinder head.*
- *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*

1 - Cylinder head gasket
- ❑ Renew.
- ❑ Observe installation position: Part number to cylinder head

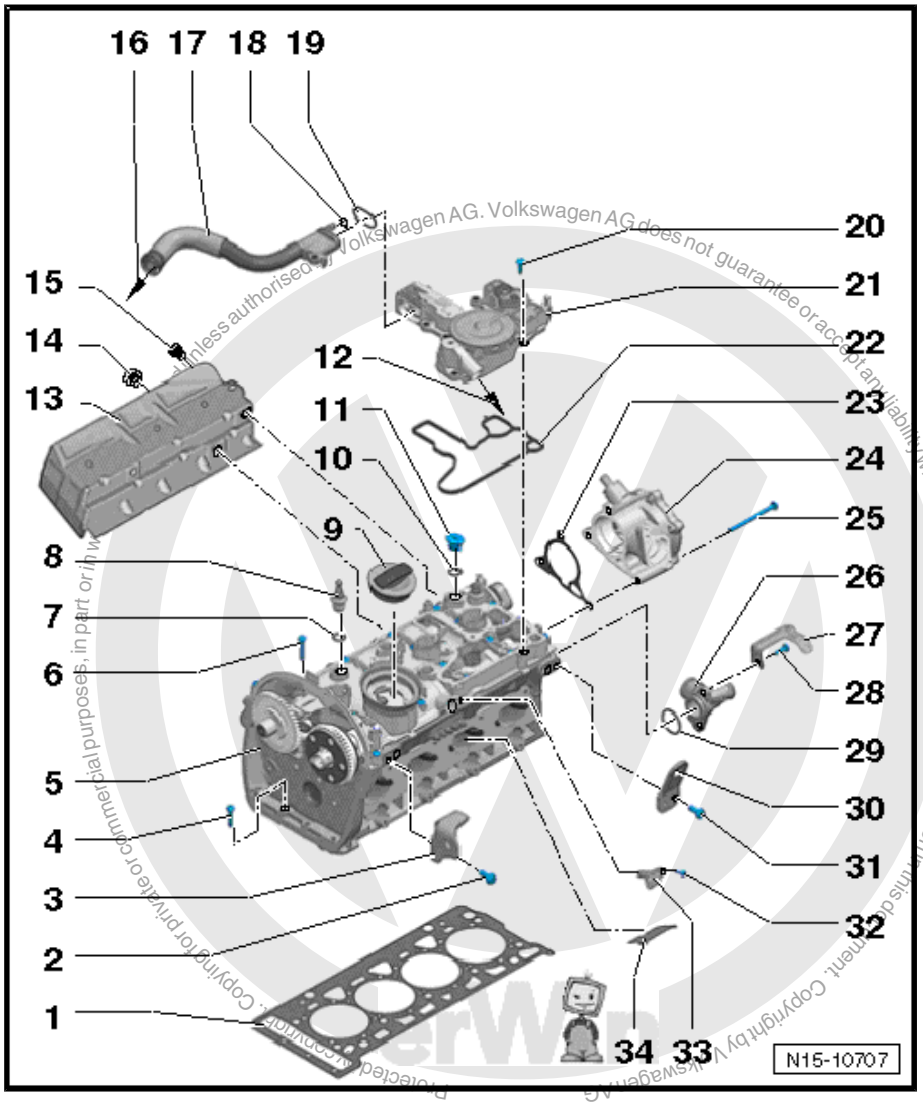
2 - Bolt
- ❑ 25 Nm

3 - Transport lug

4 - Bolt
- ❑ Tighten in 2 stages:
  1. Tighten to 8 Nm
  2. Use fixed wrench to turn 90° further

5 - Cylinder head
- ❑ Removing and installing ⇒ page 48 .
- ❑ Check for distortion ⇒ page 48 .

6 - Cylinder head bolt
- ❑ Renew.
- ❑ Note procedure when loosening ⇒ page 48 .
- ❑ Note procedure when tightening ⇒ page 46 .
- ❑ Tighten in 3 stages:
  1. Tighten to 40 Nm
  2. Use fixed wrench to turn 90° further
  3. Use fixed wrench to turn 90° further



7 - O-ring

- ❑ Renew.
- ❑ Lubricate with engine oil

8 - Plug

- ❑ 5 Nm
- ❑ With ball head for engine cover panel

9 - Cap

- ❑ With seal.

10 - O-ring

- ❑ Renew.
- ❑ Lubricate with engine oil

11 - Plug

12 - To intake manifold.

13 - Heat shield

14 - Bolt

- ❑ 20 Nm

15 - Bolt

- ❑ 20 Nm

16 - To intake manifold/turbocharger

17 - Breather pipe

18 - O-ring

- ❑ No replacement part available

19 - Seal

- ❑ No replacement part available

20 - Bolt

- ❑ Tightening sequence ⇒ page 48 .

21 - Crankcase breather

22 - Seal

- ❑ No replacement part available

23 - Seal

- ❑ Renew if damaged.

24 - Vacuum pump

- ❑ Removing and installing ⇒ page 63 .

25 - Bolt

- ❑ Specified torque: 9 Nm.

26 - Connection

27 - Retaining plate

28 - Bolt

- ❑ 9 Nm

29 - O-ring

- ❑ Renew.
- ❑ Lubricate with coolant

30 - Transport lug

31 - Bolt

- ❑ 25 Nm

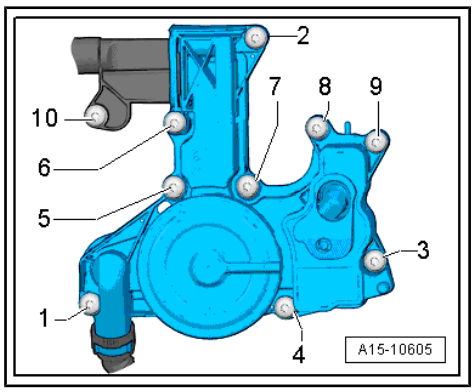
32 - Bolt

- ❑ 9 Nm

33 - Hall sender -G40-

34 - Partition

Crankcase breather system - tightening torque

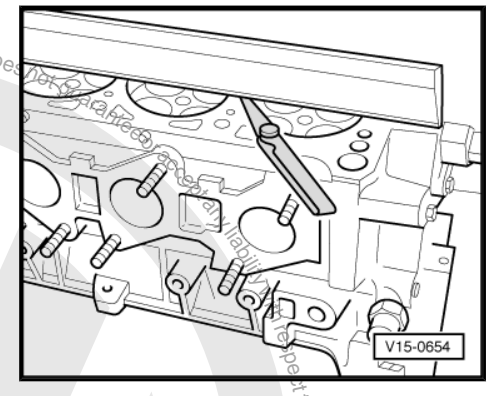


Note

- *Bolts are self-tapping. When renewing cylinder head, only genuine bolts may be used since cylinder head is supplied without thread to attach crankcase breather system.*
- *Threads may not be tapped with a thread tap.*

– Tighten bolts for crankcase breather in the sequence -1 … 10- to 11 Nm.

Checking cylinder head for distortion



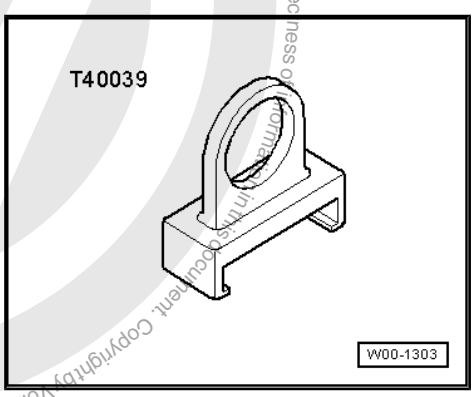
– Use straight edge and feeler gauge to measure cylinder head for distortion at several points.

- Max. permissible distortion: 0.05 mm.

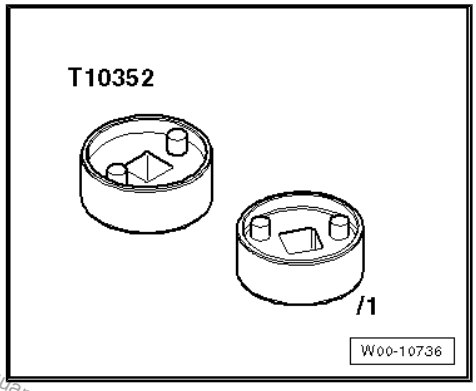
1.2 Removing and installing cylinder head

Special tools and workshop equipment required

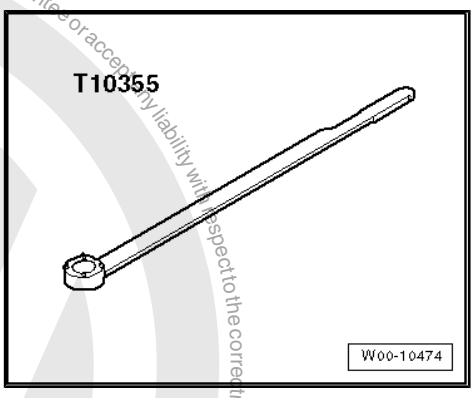
- Puller -T40039-



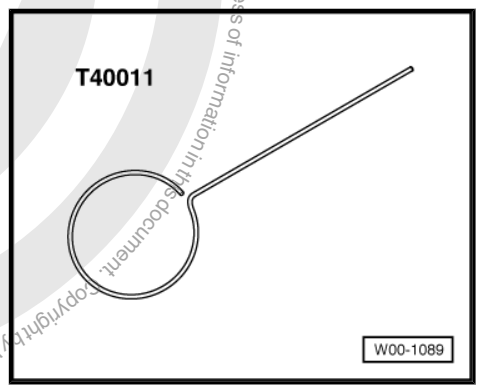
- Removal tool -T10352- and removal tool -T10352/1-



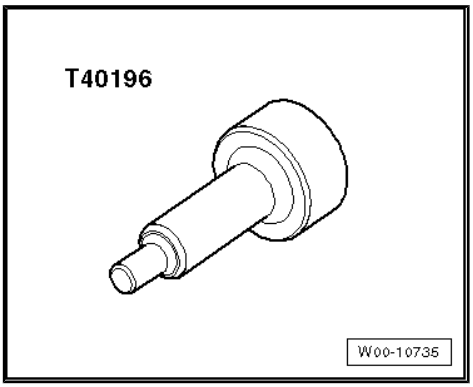
- Counterhold tool -T10355-



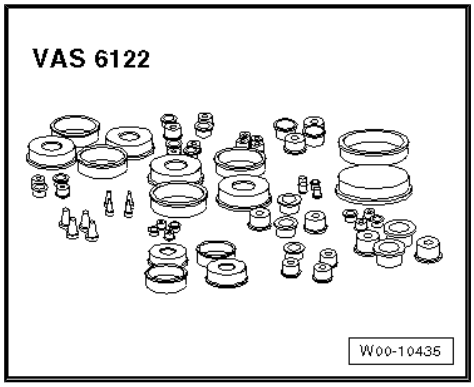
- Locking pin -T40011-



- Assembly pin -T40196-



- Engine bung set -VAS 6122-



Removing

Note

- *Fit cable tie in same place when installing.*
- *Always seal open channels of intake and exhaust system with suitable plugs, for example from engine bung set -VAS 6122- .*

WARNING

Hot steam/hot coolant can escape - risk of scalding.

- ***The cooling system is under pressure when the engine is hot.***
- ***Cover filler cap on expansion tank with a cloth and open carefully to dissipate pressure.***

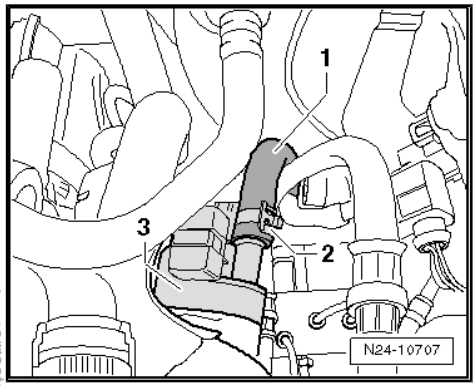
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .
– Drain coolant ⇒ page 133 .
– Remove catalytic converter ⇒ page 240 .
– Release brake servo vacuum line.
– Remove rear coolant hoses from cylinder head.

Caution

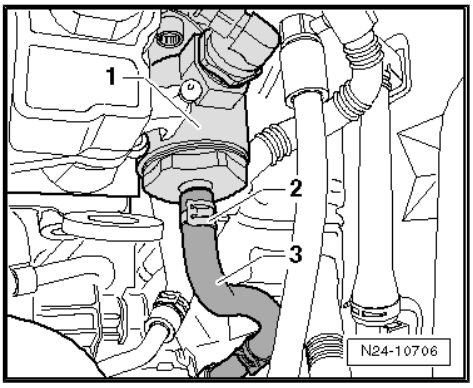
Danger of soiling fuel system.

- ***Observe safety precautions when working on injection system ⇒ page 160 .***

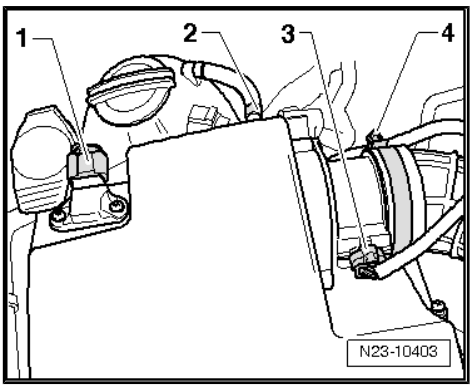
– Release and remove clip -2- for fuel return line -1-.



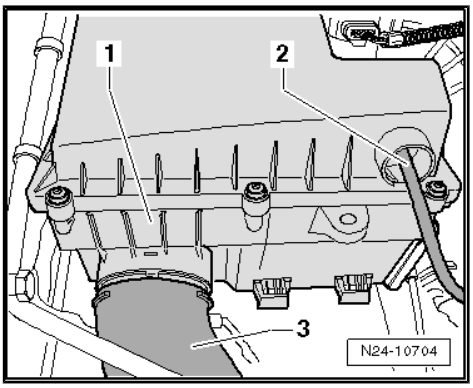
– Release clip -2- for fuel pressurisation line -3- and detach from high-pressure pump -1-.



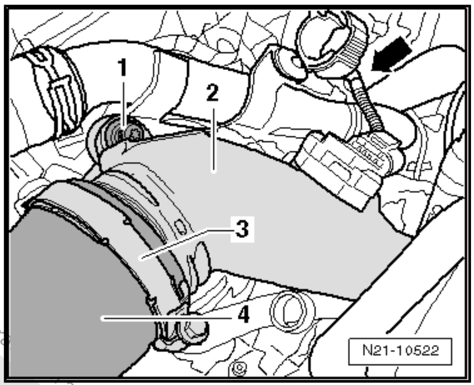
– Disconnect electrical connectors -1 and 3- from air filter housing.



– Release air intake hose -3- from air filter housing -1-.
– Pull off vacuum hose -2-.
– Unscrew securing bolt for air filter housing in area of coolant expansion tank.
– Withdraw air filter housing upwards.
– Release clip -3- from pressure hose -4-.



– Release hose clip -arrow- from throttle valve module -J338- .
– Unscrew bolt -1- from pressure pipe -2- and remove pressure pipe -2-.



– Unplug following electrical connectors.

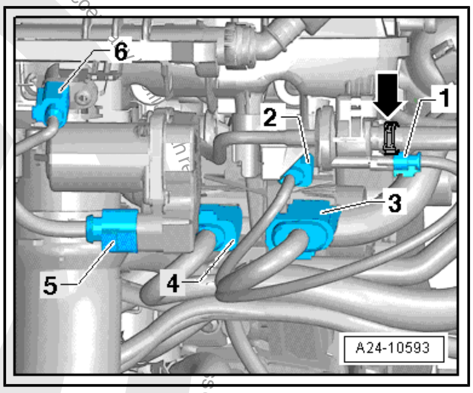
2 - From knock sensor 1 -G61- and lay to one side.

3 - From variable intake manifold valve -N316- , fuel pressure sender -G247- and Hall sender -G40- .

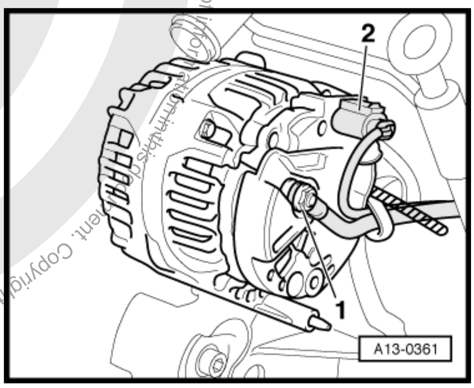
4 - From injectors.

5 - From throttle valve module -J338- .

6 - From intake air temperature sender -G42- .



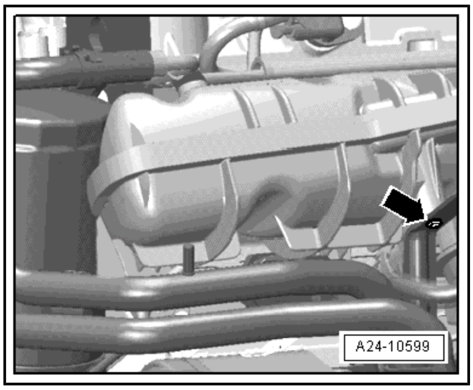
– Unplug electrical connections -1 and 2- and lay wiring to one side.



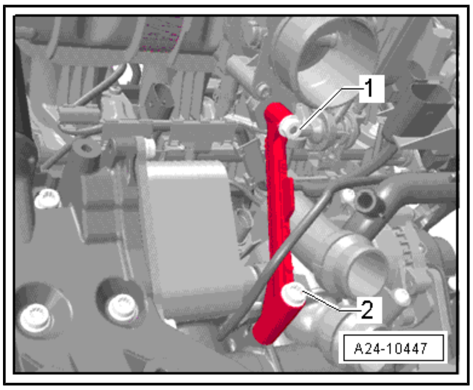
– Unscrew bracket coolant line -arrow-.

Note

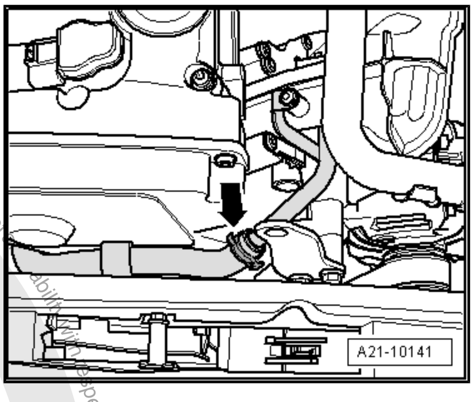
For reasons of clarity, following diagrams show installation position with engine removed.



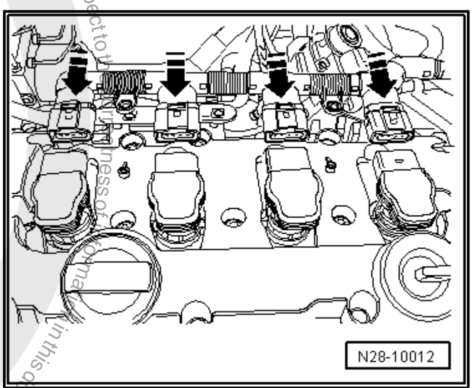
– Remove intake manifold support (remove securing nut -1- and bolt -2-).



– Disconnect coolant hose -arrow-.

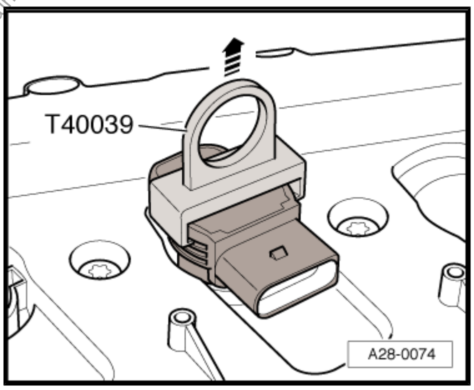


– Release connectors -arrows- and simultaneously detach all connectors from ignition coils.



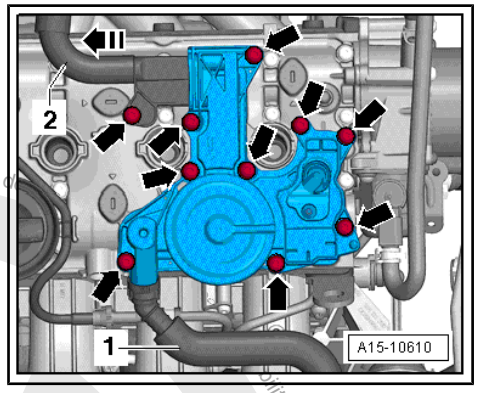
– Remove ignition coils using puller -T40039- .

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



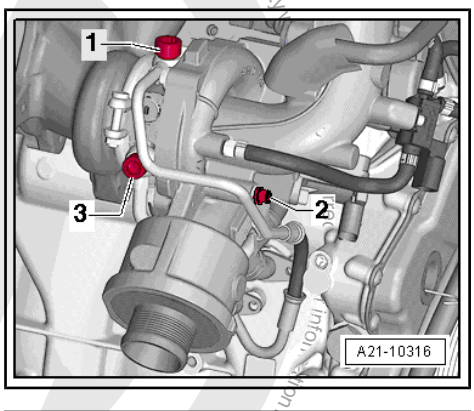
– Disconnect crankcase breather hose -1-.

– Unscrew bolts -arrows-, remove crankcase breather system and detach from hose -2- for crankcase breather system in -direction of arrow-.

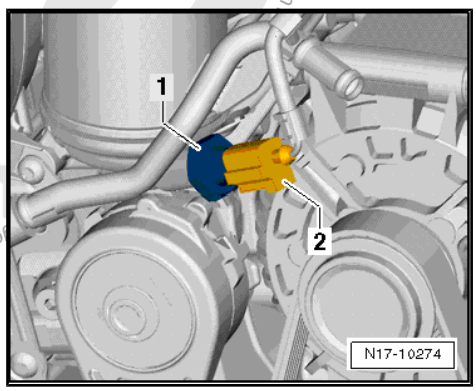


– Unscrew bolts -1 and 2- and lay oil supply line to one side.

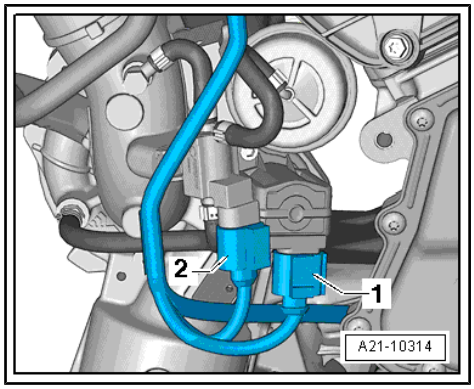
– Unscrew bolt -3- and lay coolant line to one side.



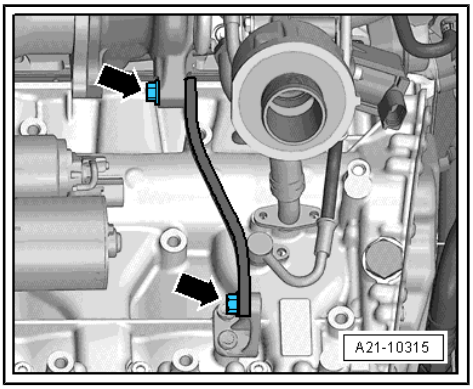
– Detach connector -2- from oil pressure switch -F22- -1-.



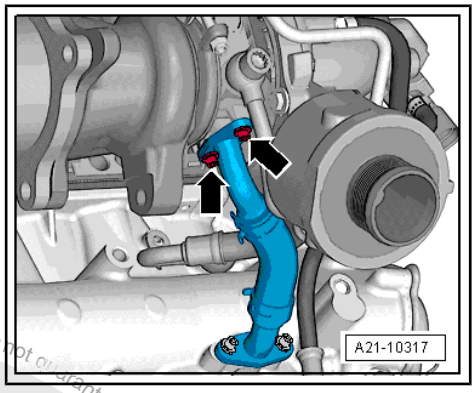
– Unplug electrical connections -1 and 2- and lay wiring to one side.



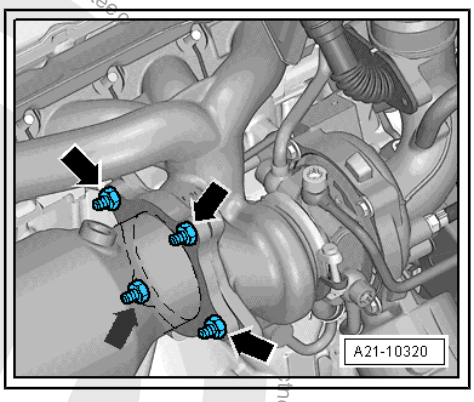
– Unscrew bolts -arrows- and remove support for turbocharger.



– Unscrew bolts -arrows- on oil return line.

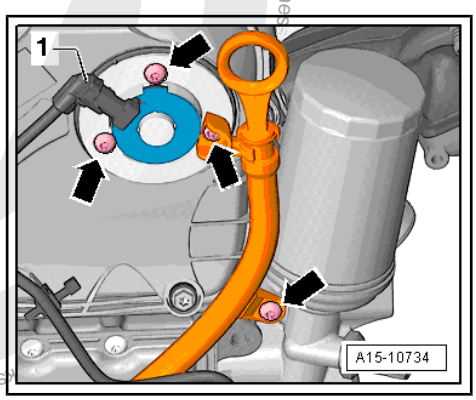


– Unscrew nuts -arrows- and remove catalytic converter ⇒ page 240 .

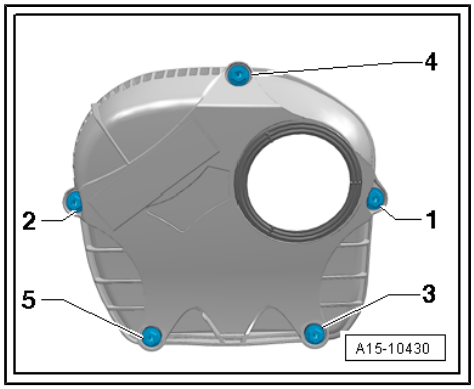


– Detach connector from inlet camshaft control valve 1 -N205- -1-.

– Unscrew bolts -arrows- and remove inlet camshaft control valve 1 -N205- .

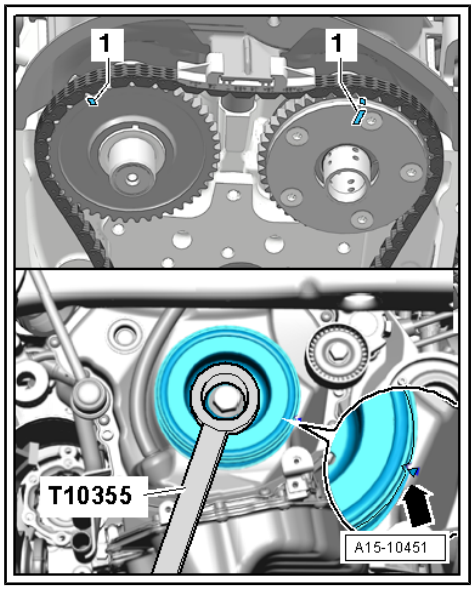


– Unscrew bolts -1 to 5- and detach top cover for timing chain.



– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

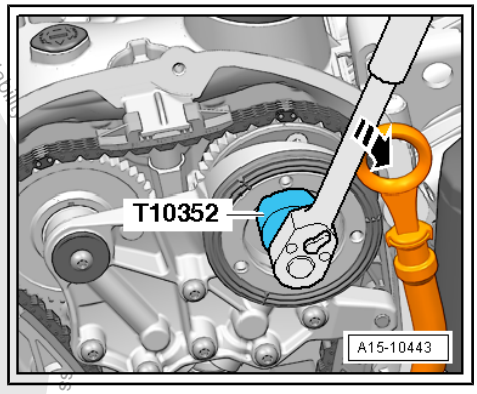
- Notch on vibration damper must align with arrow marking on bottom cover for timing chains.
- Markings -1- on camshafts must face upwards.



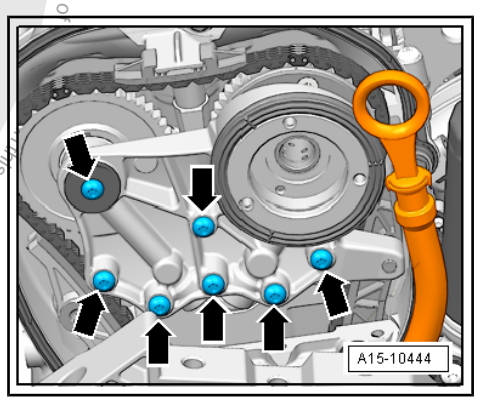
Caution

The timing valve has a left-hand thread.

Depending on model, remove regulating valve using removal tool -T10352- or removal tool -T10352/1- in -direction of arrow-.

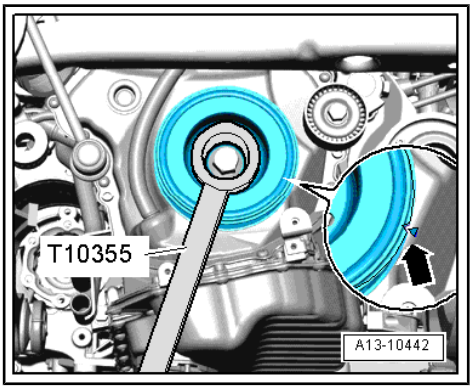


Remove bolts -arrows- and detach bearing saddle.

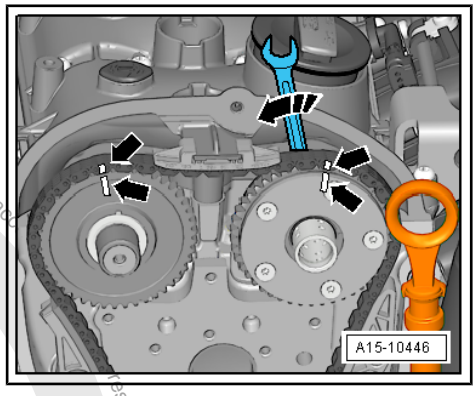


– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

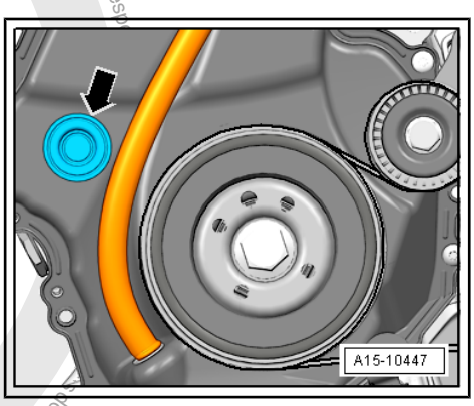
• Notch on vibration damper must align with arrow marking on cover for timing chains (bottom).



– Use a waterproof pen to mark drive chain/chain sprockets -arrows-.

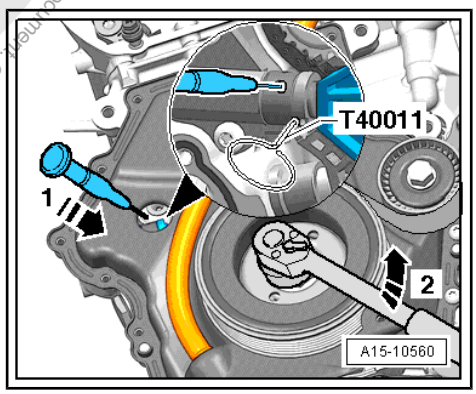


– Remove sealing plug -arrow-.



– Insert scriber or suitable screwdriver in hole of chain tensioner in direction of -arrow 1- and lift locking element for chain tensioner.

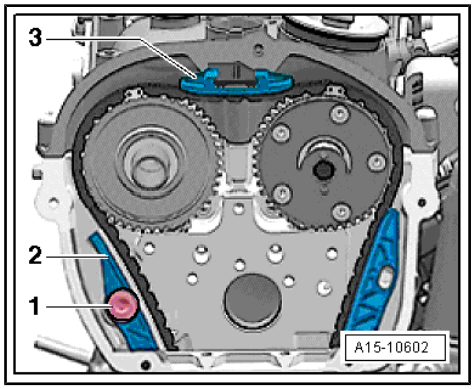
– Turn crankshaft in opposite direction to normal rotation -arrow 2- and lock in place using locking pin -T40011- .



Note

Inlet camshaft will move in direction of engine rotation.

– Remove bolt -1- and guide tensioning rail -2- downwards.
– Use screwdriver to release catch and press off top guide rail -3- forwards.
– Remove camshaft timing chain from camshaft sprockets.

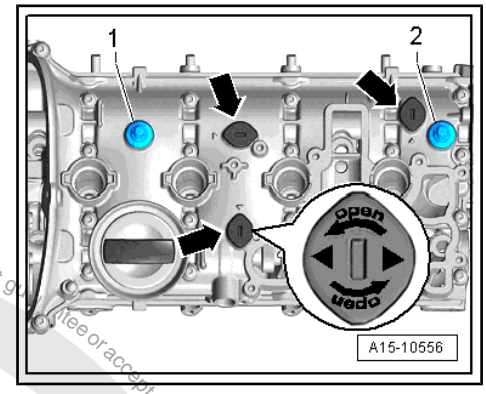


Caution

Avoid damage to valves and piston crowns.

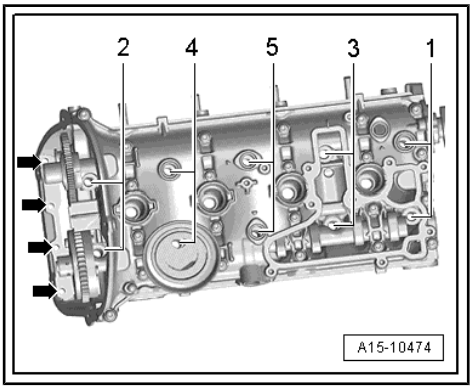
- *Do not turn the crankshaft after the camshaft timing chain has been removed from the cylinder head.*

– Turn sealing plugs -arrows- 90° anti-clockwise -arrow- and remove.
– Unscrew ball head -1 … 2-.
– Remove filler cap.



– Unscrew bolts -arrows-.

– Unscrew cylinder head bolts in the sequence -1 … 5- with special wrench, long reach -T10070- apart from 2 bolts.



Note

- *If necessary, use spanner to turn camshafts before removing cylinder head bolts.*
- *Make sure all hoses/pipes and wiring on component are removed.*
- *Ensure tensioning rail and guide rail are not damaged when lifting off cylinder head.*

– Remove cylinder head.

– Place cylinder head onto soft surface (foam plastic).

Installing

• Specified torques ⇒ page 46 .

Caution

Avoid damage to sealing surfaces.

- *Carefully remove sealant residue from cylinder head and cylinder block.*
- *Ensure that no long scores or scratches are made on the surfaces.*

Avoid damage to cylinder block.

- *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*

Ensure that cylinder head gasket seals properly:

- *Carefully remove remains of emery and abrasives.*
- *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- *Handle the cylinder head gasket very carefully to prevent damage to the silicone coating or the indented area of the gasket.*

Avoid damage to open valves.

- *When installing an exchange cylinder head, the plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*

Avoid damage to valves and piston crowns after working on valve gear.

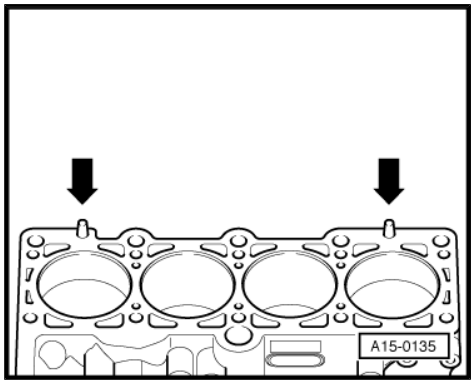
- *Turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

Note

- *Renew bolts that are tightened with specified further tightening angle.*
- *Renew gaskets, oil seals and self-locking nuts.*
- *Please note different sealants for sealing surfaces, bolts and cylinder head.*
- *Secure hose connections with hose clips corresponding to the series equipment ⇒ Electronic parts catalogue .*
- *After fitting a new cylinder head or cylinder head gasket, the engine oil and coolant must be changed.*

– Position cylinder head gasket.

- Note centring pins in cylinder block -arrows-.
- Check installation position of cylinder head gasket. The part number should be legible from the inlet side.



WARNING

When turning crankshaft, make sure that no components are damaged by timing chain.

– If crankshaft is turned in the meantime, position piston of No. 1 cylinder at TDC and turn crankshaft back slightly.

– Fit cylinder head.

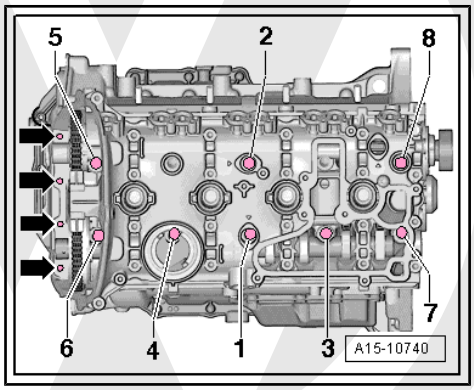
Note

To enable insertion of the cylinder head bolts, the inlet camshaft must be turned with a wrench.

– Insert bolts -1 … 8-.

– Tighten bolts for cylinder head in sequence -1 … 8- in 3 stages in total ⇒ page 46 .

– Tighten bolts -arrows- in 2 stages in total.

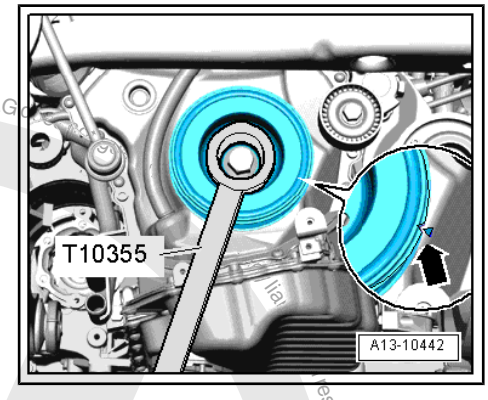


Note

After repair work it is not necessary to retighten the cylinder head bolts.

– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

• Notch on vibration damper must align with arrow marking on bottom cover for timing chains.

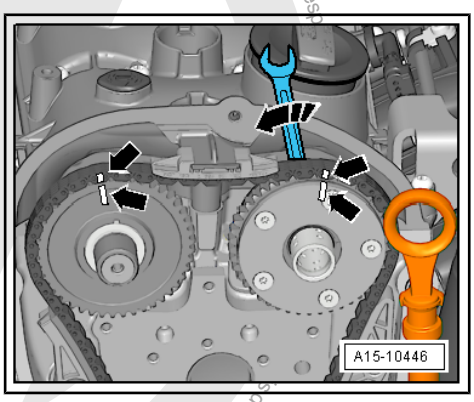


Note

The timing chain links with markings must be positioned at the markings on the chain sprockets.

– Fit camshaft timing chain: the drive chain/sprocket markings must align -arrows-.

– Use spanner to turn inlet camshaft in direction of -arrow- and fit timing chain.

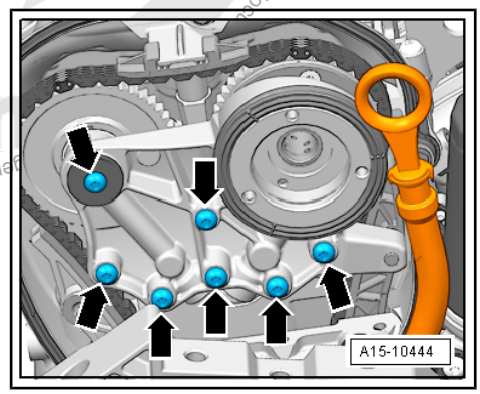


– Attach bearing saddle and screw in bolts -arrows- hand-tight.

– Remove locking pin -T40011- .

– Tighten bolts -arrows- for bearing saddle.

– Install regulating valve.



– Insert bolts -1 … 2-.

– Tighten bolts for cylinder head in sequence -1 and 2- in 3 stages in total ⇒ page 46 .

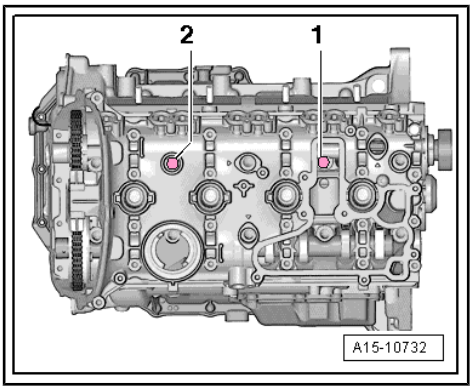
Perform further assembly analogously in reverse order of removal. When doing this, observe the following:

– Install timing chain cover (top) ⇒ page 65 .

– Fill cooling system with fresh coolant ⇒ page 133 .

– Install catalytic converter ⇒ page 240 .

– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .



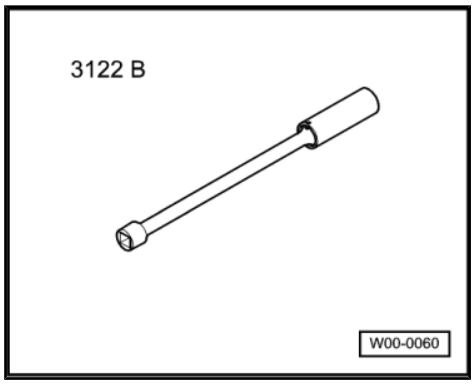
WARNING

Never use battery charging equipment for boost starting. There is the risk of damaging the vehicle's control units.

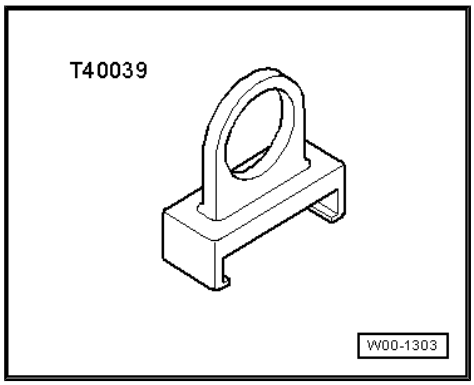
1.3 Checking compression

Special tools and workshop equipment required

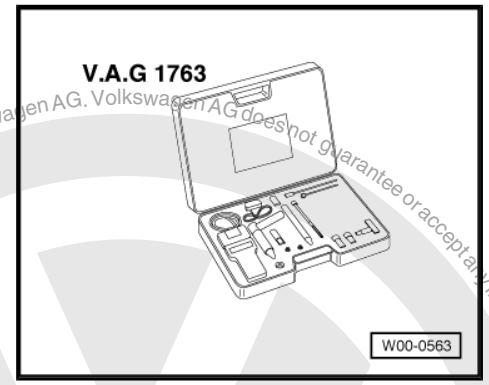
- Spark plug socket and extension -3122 B-



- Puller -T40039-



- Compression tester -V.A.G 1763-

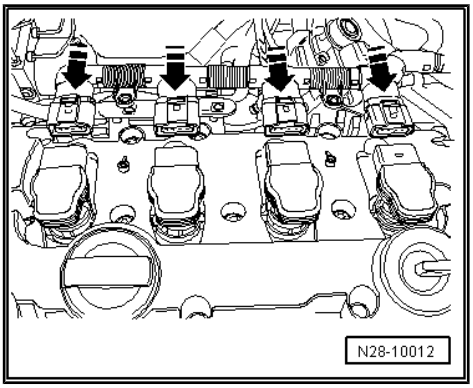


Test procedure

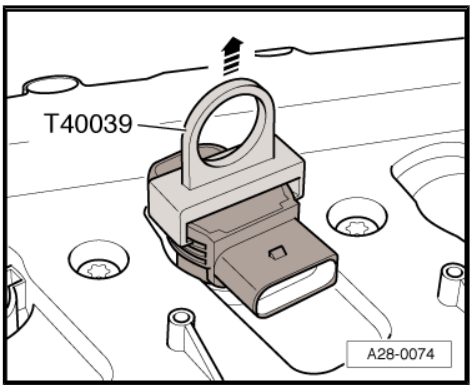
Note

- *Engine oil temperature min. 30 °C.*
- *Battery voltage at least 12.7 V*

– Release connectors -arrows- and simultaneously detach all connectors from ignition coils.



– Remove ignition coils using puller -T40039- .



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

– Check compression using compression tester -V.A.G 1763- and adapter -V.A.G 1763/6- .

Note

Using compression tester: ⇒ Operating instructions .

– Operate starter until tester shows no further pressure increase.

Compression pressures:

New bar pressure	Wear limit bar bar pressure	Difference between cylinders bar pressure
11.0 ... 14.0	7.0	max. 3.0

– Install ignition coils with final output stages ⇒ Rep. gr. 28 .

Note

Faults will have been stored in the memory because connectors have been disconnected. Read and, if necessary, clear the event memory after the test.

– Read event memory of engine control unit.⇒ Vehicle diagnosis, testing and information system VAS 5051 in ”Guided fault finding” function .

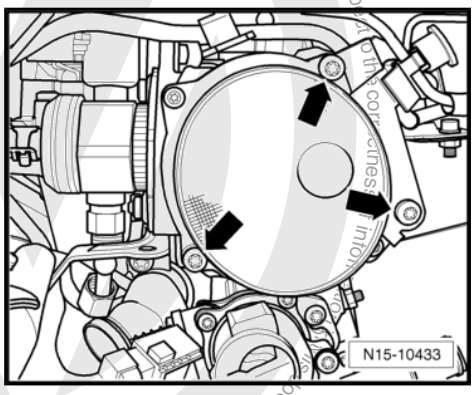
1.4 Removing and installing vacuum pump

Removing

– Remove high-pressure pump with »roller tappet« ⇒ page 226 .

– Unbolt earth cable -1- and remove bolt.
– Remove vacuum hose -3- from vacuum pump -2.-

– Unscrew bolts -arrows- and remove vacuum pump.



Note

The vacuum pump must not be dismantled.

Installing:

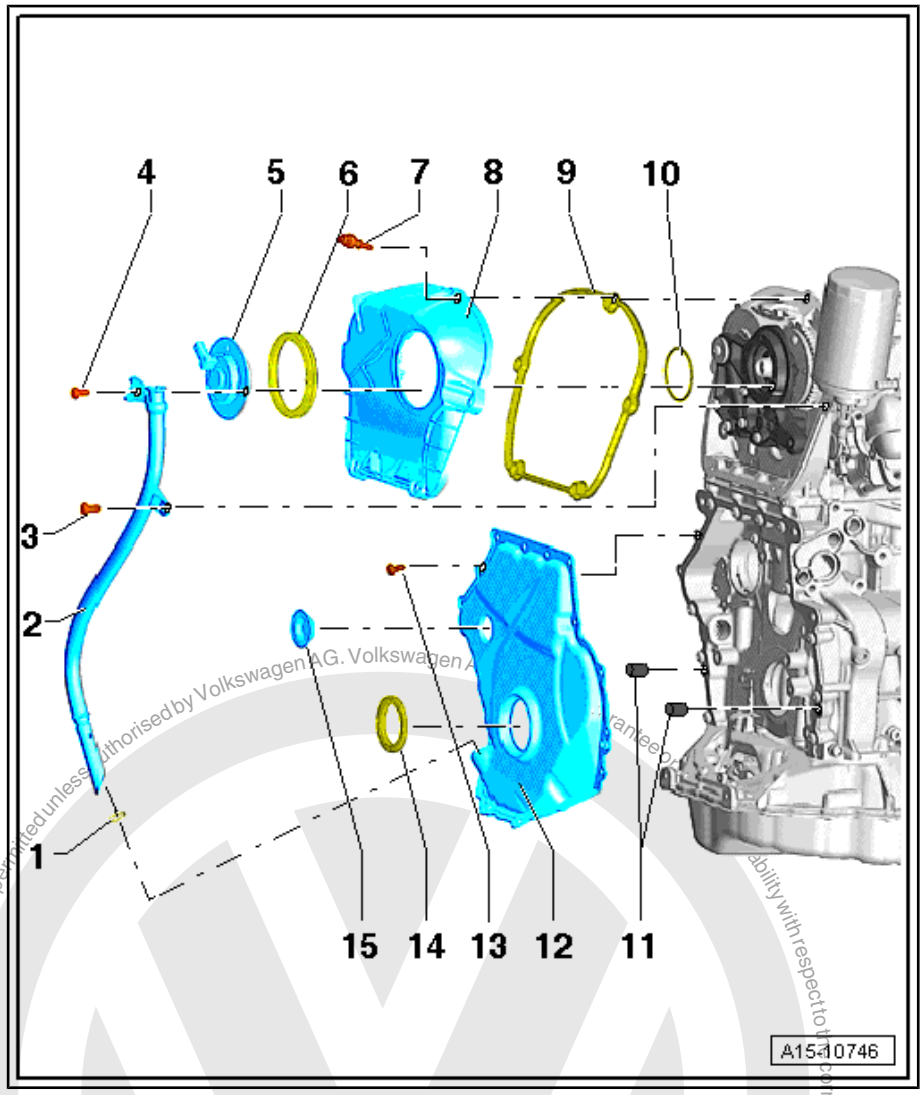
- Specified torques ⇒ page 46 .

Perform assembly in reverse order of removal. When doing this, observe the following:

– Clean sealing surfaces.
– Place gasket on vacuum pump, insert 2 bolts and then fit on cylinder head.

2 Chain drive

2.1 Assembly overview - timing chain cover



1 - O-ring
- ❑ Renew.
- ❑ Lubricate before installing.

2 - Dipstick guide tube

3 - Bolt
- ❑ 9 Nm

4 - Bolt
- ❑ 9 Nm

5 - Inlet camshaft control valve 1 -N205-
- ❑ Removing and installing ⇒ page 66 .

6 - Seal
- ❑ Lubricate before installing.
- ❑ Renew if damaged.

7 - Bolt
- ❑ Tightening sequence ⇒ page 66 .

8 - Timing chain cover (top)
- ❑ Removing and installing ⇒ page 66 .

9 - Seal
- ❑ Renew if damaged.

10 - O-ring
- ❑ Renew.
- ❑ Lubricate before installing.

11 - Dowel pins
- ❑ For centring cover

12 - Lower timing chain cover
- ❑ Removing and installing ⇒ page 67 .

13 - Bolt
- ❑ Renew.
- ❑ Tightening sequence ⇒ page 66 .

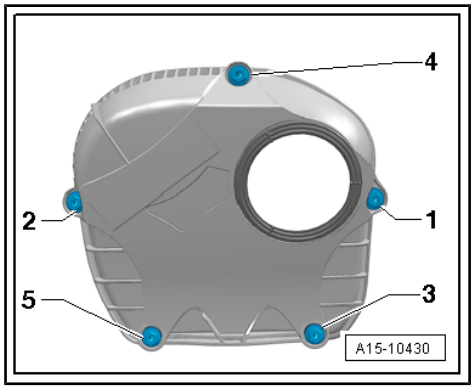
14 - Oil seal
- ❑ For vibration damper
- ❑ Renewing ⇒ page 71 .

15 - Plug
- ❑ Renew.

Timing chain cover (top), tightening sequence

– Tighten bolts -1 to 5- in the sequence shown:

1. Tighten bolts to 9 Nm.

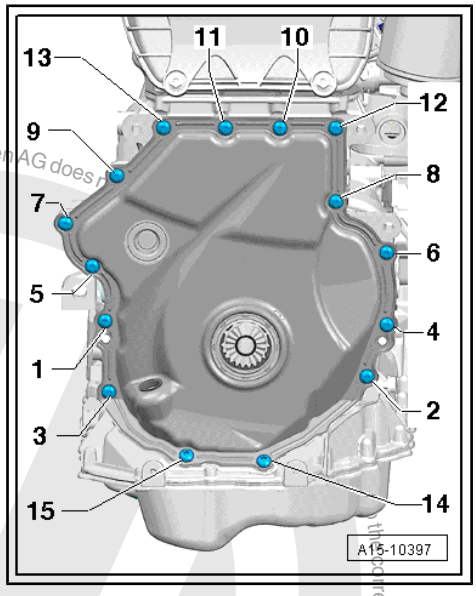


Timing chain cover (bottom), tightening sequence

– Tighten bolts -1 to 15- in two stages in the sequence shown:

– 1. Tighten bolts to 8 Nm.

– 2. Turn bolts 45° further



2.2 Removing and installing inlet camshaft control valve 1 -N205-

Removing

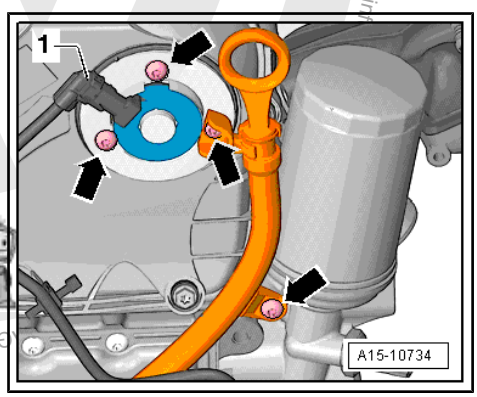
– Detach connector from inlet camshaft control valve 1 -N205- -1-.

– Unscrew bolts -arrows- and remove inlet camshaft control valve 1 -N205- .

Installing

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

- Specified torque
  ⇒ „2.1 Assembly overview - timing chain cover“, page 65 .



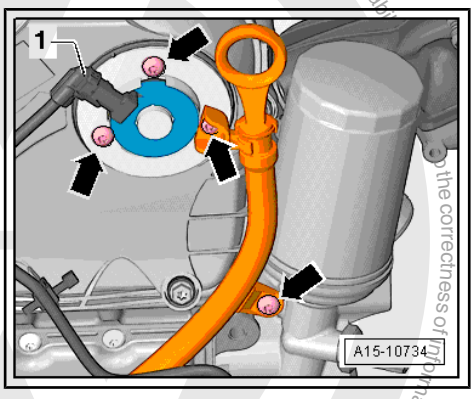
Note

Renew O-ring.

– Lubricate seal and O-ring with engine oil.

2.3 Removing and installing upper timing chain cover

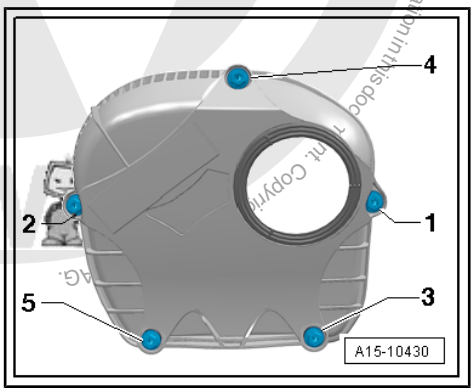
Removing



– Detach connector from inlet camshaft control valve 1 -N205- -1-.

– Unscrew bolts -arrows- and remove inlet camshaft control valve 1 -N205- .

– Unscrew bolts -1 to 5- and detach top cover for timing chain.



Installing

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

- Specified torque
  ⇒ „2.1 Assembly overview - timing chain cover“, page 65 .

Note

Renew O-ring.

– Lubricate seal and O-ring with engine oil.

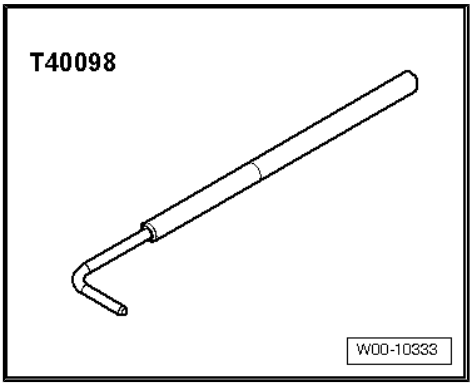
– Install timing chain cover (top), tightening sequence
  ⇒ Fig. “„Timing chain cover (top), tightening sequence““ , page 66 .

– Install inlet camshaft control valve 1 -N205- ⇒ page 66 .

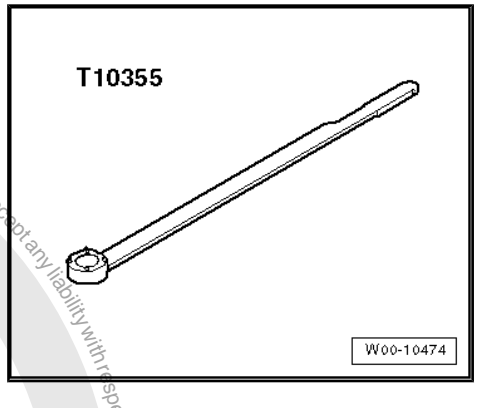
2.4 Removing and installing timing chain cover (bottom)

Special tools and workshop equipment required

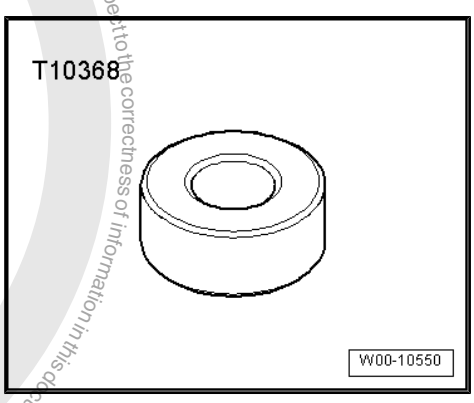
♦ Locking tool -T40098-



- Counterhold tool -T10355-



- Thrust piece -T10368-



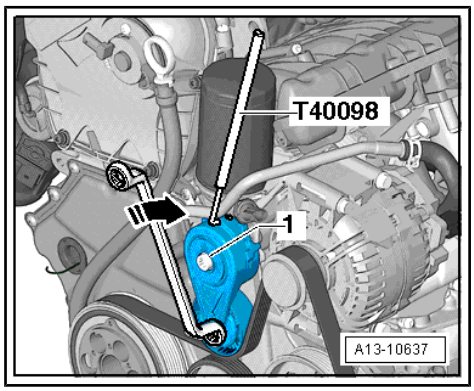
Removing

Caution

If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

- ***Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.***

– To slacken poly V-belt turn tensioner in direction of -arrow-.
– Lock tensioner with locking tool -T40098- .
– Remove bolt -1- and take off tensioner for poly V-belt from bracket for ancillaries.
– Remove poly V-belt.

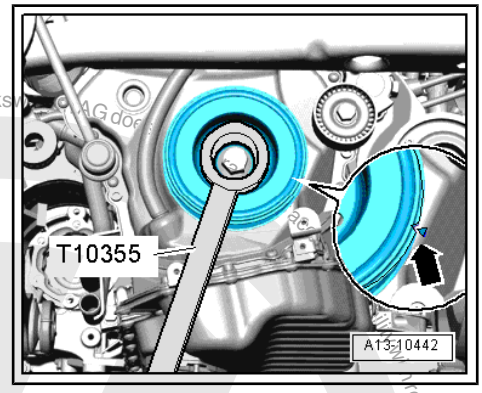


– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

• Notch on vibration damper must align with arrow marking on bottom cover for timing chains.

– Remove bolt for vibration damper using counterhold -T10355- .

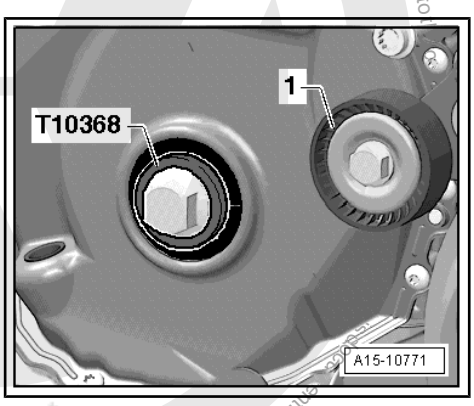
– Remove vibration damper.



Note

Always use thrust piece -T10368- when fitting bolt for vibration damper to avoid damaging splines.

– Screw bolt for vibration damper and thrust piece -T10368- back in.



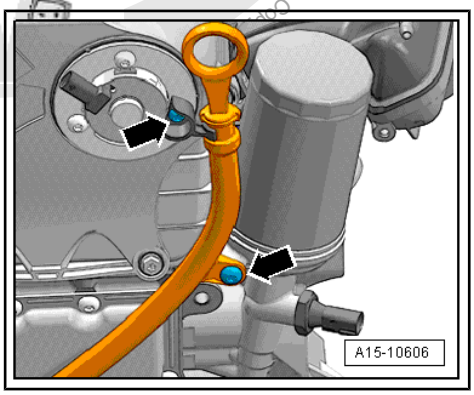
Caution

Risk of damage to engine.

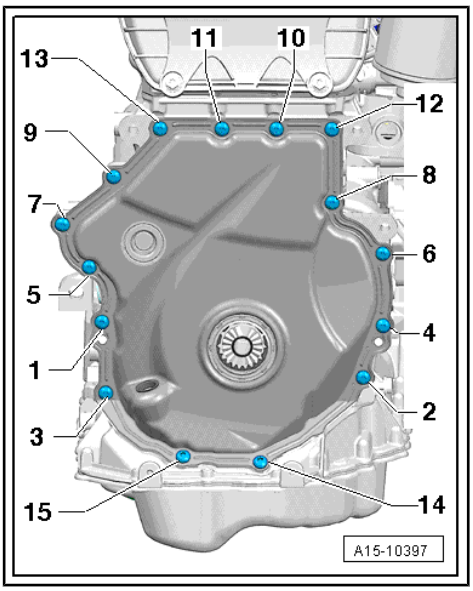
- ***To avoid disturbing valve timing, do not turn crankshaft out of „TDC“ position when bolt for vibration damper is removed.***

– Remove guide roller -1-.

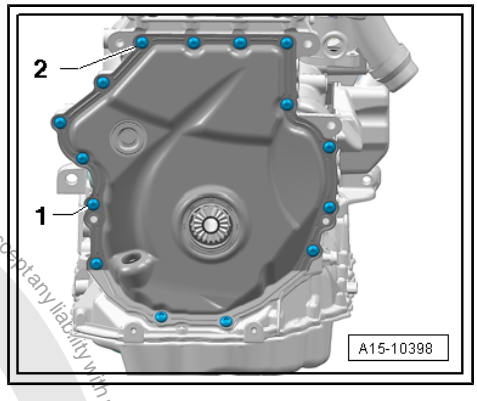
– Remove bolts -arrows- and pull guide tube for oil dipstick out of timing chain cover.



– Remove bolts -1 … 15-.



– Lever off timing chain cover (bottom) (start at points -1 and 2-).



Note

To prevent damaging the timing chain cover, apply tool only at the bolt holes.

Installing

- Specified torques
  ⇒ „2.1 Assembly overview - timing chain cover“, page 65 .

♦ Silicone sealant: ⇒ Electronic parts catalogue

Note

♦ *Observe use-by date of silicone sealant.*

♦ *The cover must be installed within 5 minutes after applying the silicone sealant.*

♦ *Renew bolts that are tightened with specified further tightening angle.*

♦ *Gaskets, oil seals and self-locking nuts must be renewed*

– Spray sealing surface with sealant remover and leave to act.

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

WARNING

Risk of eye injury.

♦ ***Wear safety goggles.***

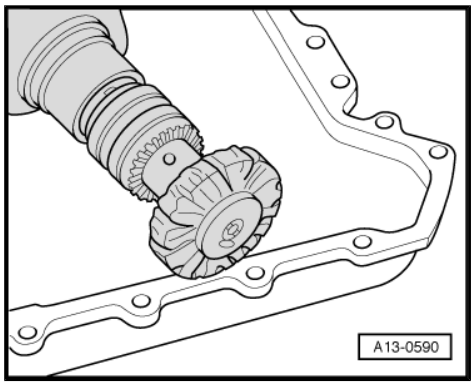
– Mask oil seal on both sides with adhesive tape to make sure the seal remains clean.

– Remove remaining sealant from cover, e.g. using rotating plastic brush.

– Remove any oil and grease from sealing surfaces.

– Use old bolts when fitting cover and tighten to 8 Nm.

– Use feeler gauge to measure distance between cover and crankcase (max. distance is 0.2 mm).

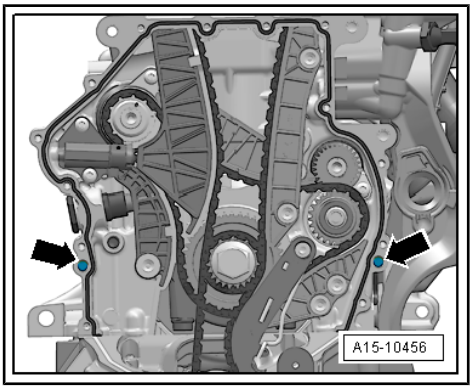


Note

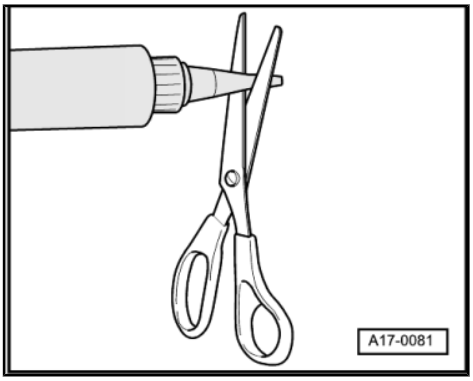
♦ *Renew cover if distance exceeds 0.2 mm.*

♦ *It is not possible to measure distance between cover and sump (top section); check visually to ensure that sealing surface is even.*

– Check that both dowel pins are fitted in cover -arrows-.

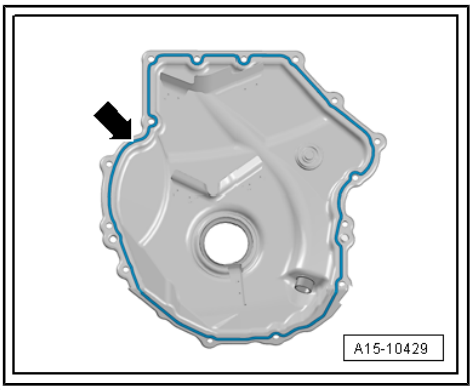


– Cut off nozzle on tube at front marking (∅ of nozzle approx. 3 mm).



– Apply silicone sealant onto clean sealing surface of cover, as illustrated.

♦ Thickness of sealant bead: 2 ... 3 mm.



Note

♦ *The cover must be installed within 5 minutes after applying the silicone sealant.*

♦ *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*

– Install cover immediately and tighten bolts, tightening sequence
⇒ Fig. “„Timing chain cover (bottom), tightening sequence““ , page 66 .

Note

After fitting cover, let sealant dry for approx. 30 minutes. Only then fill with engine oil.

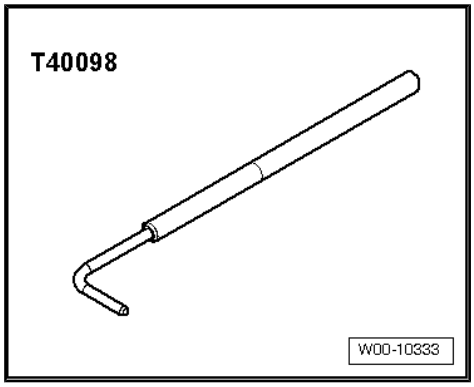
– Install tensioner for poly V-belt ⇒ page 21 .

– Install poly V-belt ⇒ page 22 .

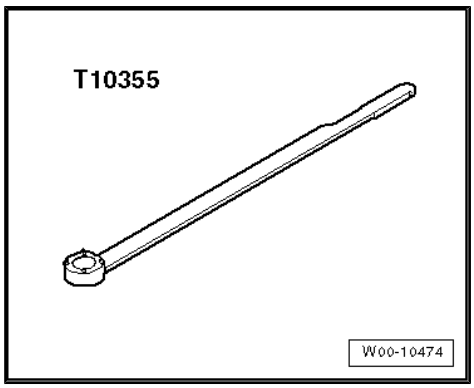
2.5 Renewing oil seal for vibration damper

Special tools and workshop equipment required

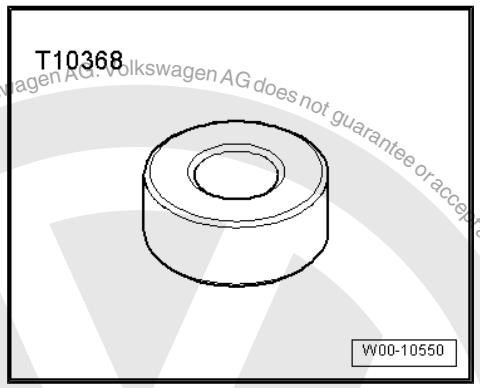
- Locking tool -T40098-



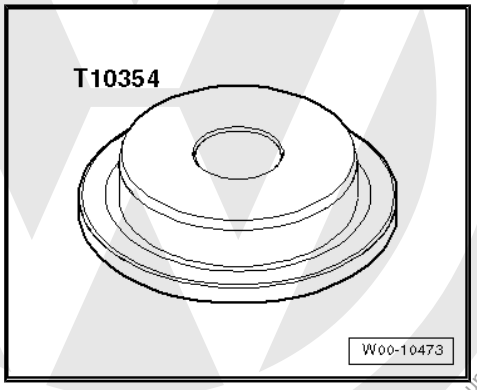
- Counterhold tool -T10355-



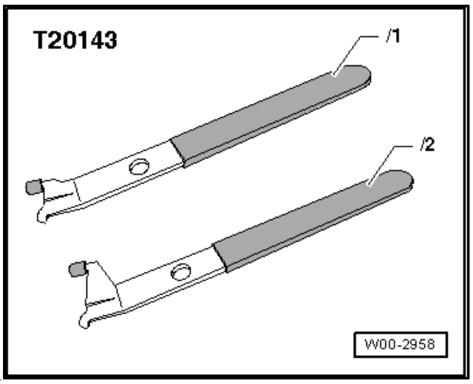
- Thrust piece -T10368-



- Thrust piece -T10354-



♦ Puller hooks -T20143-



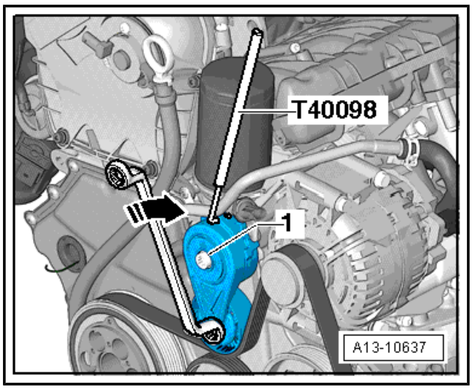
Removing

> ⚠ Caution
>
> *If a used belt runs in the opposite direction when it is refitted, this can cause breakage.*
>
> ♦ *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped pen for re-installation.*

– To slacken poly V-belt turn tensioner in direction of -arrow-.

– Lock tensioner with locking tool -T40098- .

– Remove poly V-belt from pulley on vibration damper.



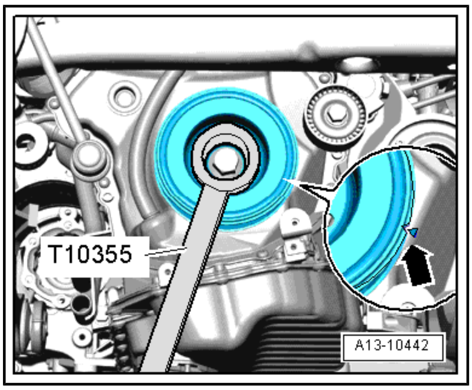
> ⚠ Caution
>
> *Risk of damage to engine.*
>
> ♦ *To avoid disturbing valve timing, do not turn crankshaft out of „TDC“ position when vibration damper is removed.*

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

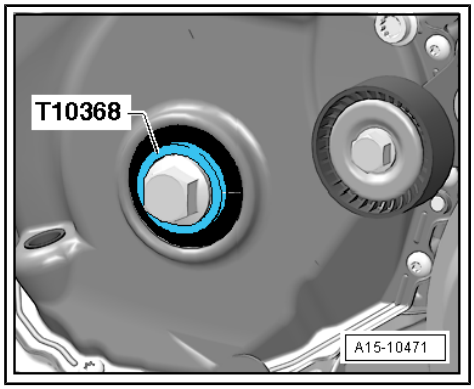
• Notch on vibration damper must align with arrow marking on cover for timing chains (bottom).

– Remove bolt for vibration damper using counterhold -T10355- .



– Remove vibration damper and screw on thrust piece -T10368- in its place.

– Pull out oil seal using puller hooks -T20143/2- .



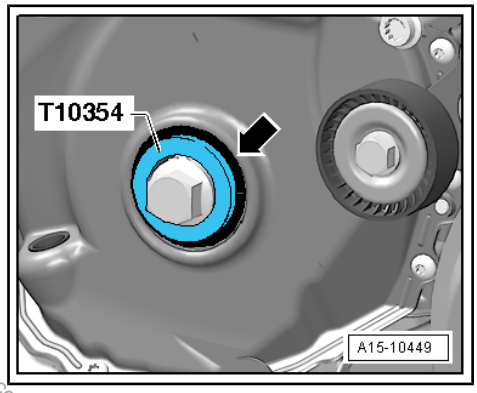
Installing

• Specified torques ⇒ page 65 .

– Clean contact surface and sealing surface.

– Unscrew thrust piece -T10368- .

– Use thrust piece -T10354- and bolt for vibration damper to pull in oil seal -arrow- onto stop.



Note

♦ *Renew bolt for vibration damper.*

♦ *Renew O-ring.*

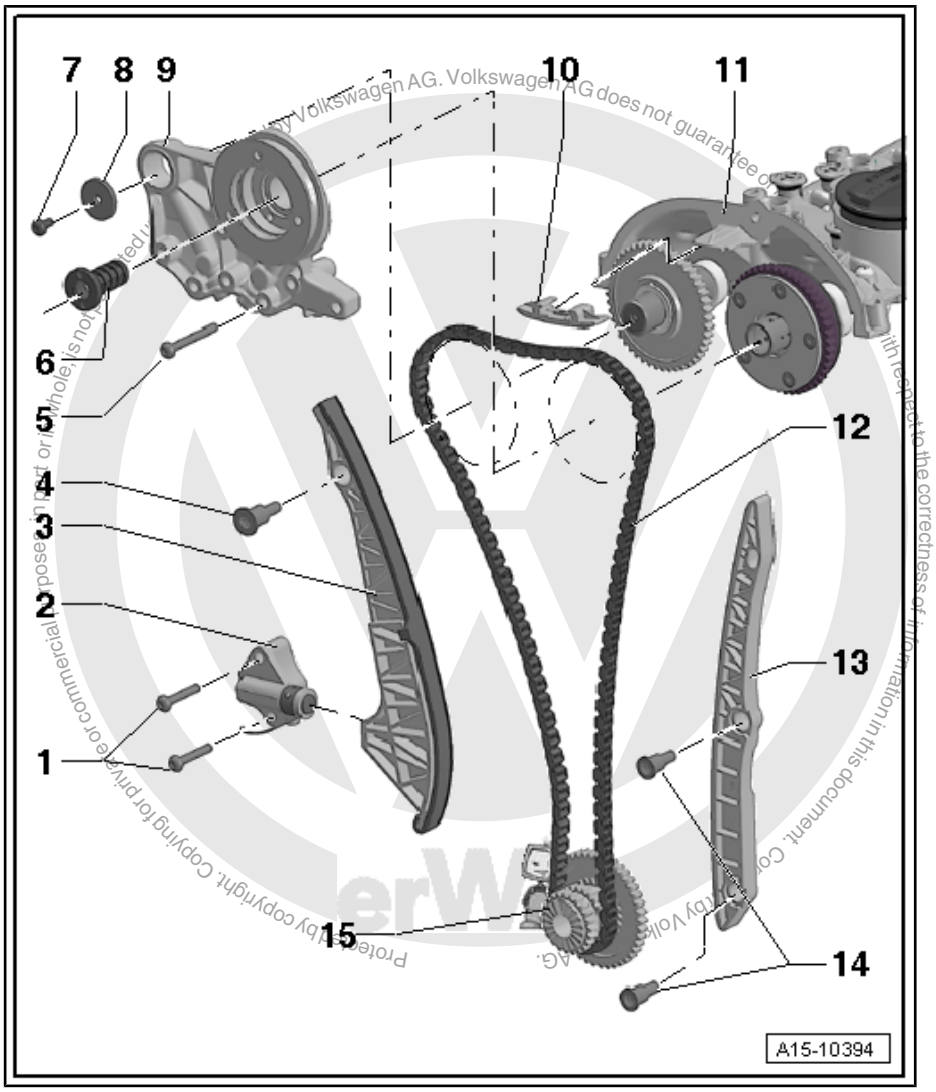
Further assembly is basically the reverse of the dismantling sequence. In the process, note the following:

– Install vibration damper ⇒ page 27 .

– Install poly V-belt ⇒ page 22 .

– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .

2.6 Camshaft timing chain - exploded view



1 - Bolt
- ❑ 9 Nm

2 - Chain tensioner
- ❑ Is spring-loaded
- ❑ Before removing, lock in place using locking pin -T40011-

3 - Tensioning rail for timing chain

4 - Guide pins
- ❑ 20 Nm

5 - Bolt
- ❑ 9 Nm

6 - Regulating valve
- ❑ Left-hand thread.
- ❑ 35 Nm
- ❑ Depending on model, remove using removal tool -T10352- or removal tool -T10352/1- .

7 - Bolt
- ❑ Renew.
- ❑ 20 Nm + 90° further

8 - Washer

9 - Bearing saddle

10 - Guide rail for camshaft timing chain

11 - Camshaft housing

12 - Camshaft timing chain
- ❑ Before removing, mark running direction with paint.

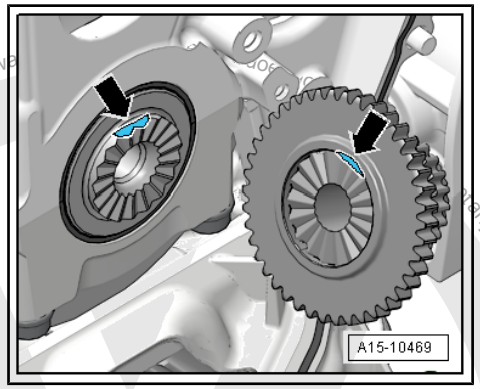
13 - Guide rail for camshaft timing chain

14 - Guide pins
- ❑ 20 Nm

15 - Chain sprocket
- ❑ Crankshaft
- ❑ Installation position ⇒ page 76 .

Crankshaft chain sprocket - installation position

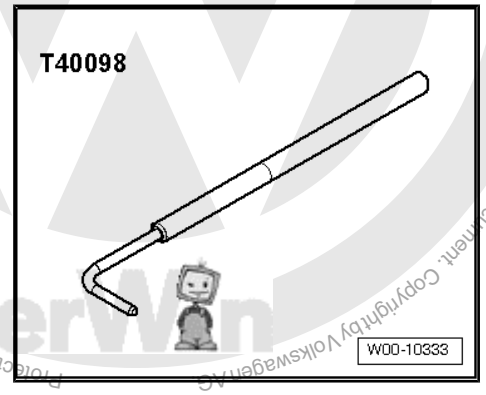
- The two sections -arrows- must be aligned.



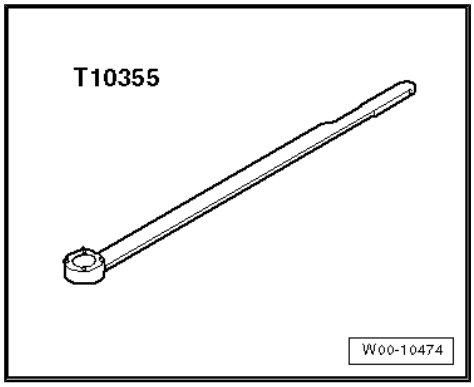
2.7 Removing and installing camshaft timing chain

Special tools and workshop equipment required

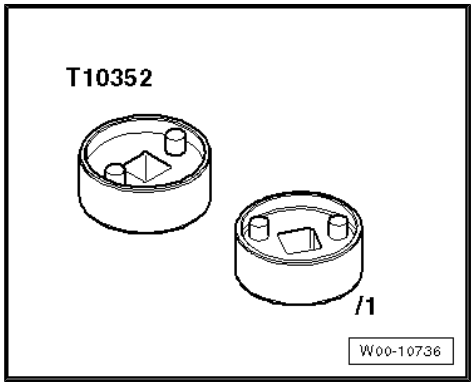
♦ Locking tool -T40098-



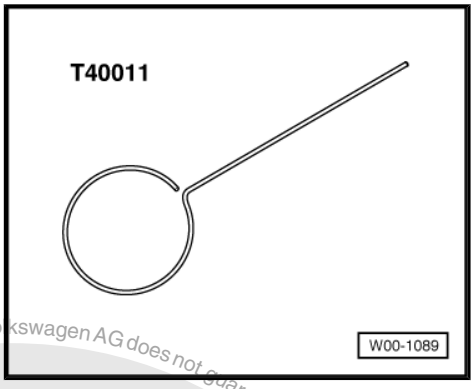
♦ Counterhold tool -T10355-



♦ Removal tool -T10352- and removal tool -T10352/1-



♦ Locking pin -T40011-



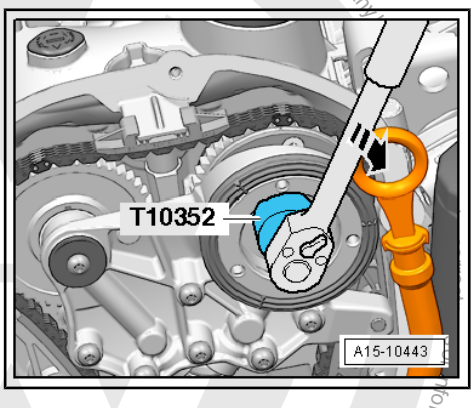
Removing

– Remove timing chain cover (top) ⇒ page 67 .

Caution

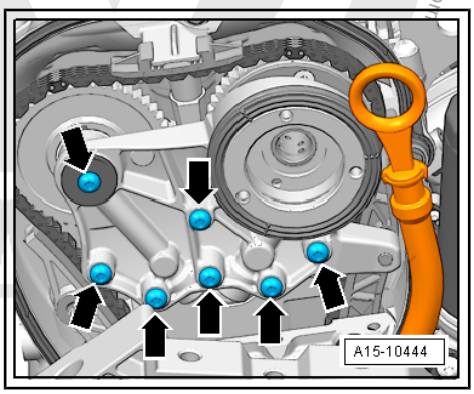
The timing valve has a left-hand thread.

– Depending on model, remove regulating valve using removal tool -T10352- or removal tool -T10352/1- in -direction of arrow-.



– Remove bolts -arrows- and detach bearing saddle.

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

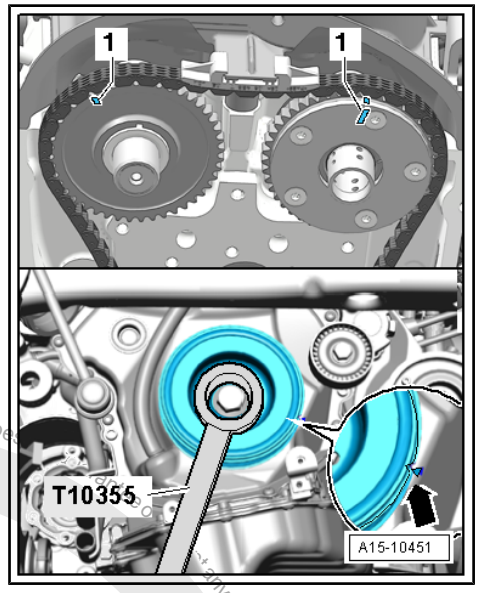


– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

• Notch on vibration damper must align with arrow marking on bottom cover for timing chains.

• Markings -1- on camshafts must face upwards.

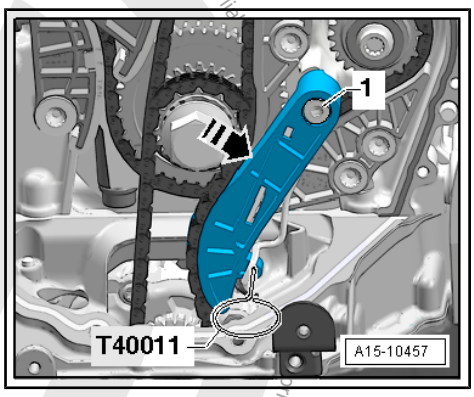
– Remove lower timing chain cover ⇒ page 67 .



– Press oil pump chain tensioner in direction of -arrow- and lock in place using locking pin -T40011- .

– Remove oil pump chain tensioner -1-.

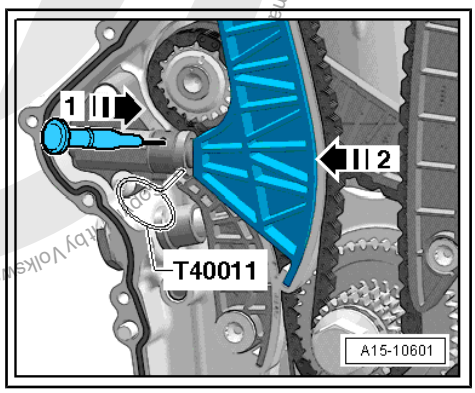
– Remove oil pump chain.



– Insert scriber or suitable screwdriver in hole of chain tensioner in direction of -arrow 1- and lift locking element for chain tensioner.

– Press tensioning rail for timing change in -direction of arrow 2- and secure with locking pin -T40011- .

– Remove camshaft timing chain from cylinder head.



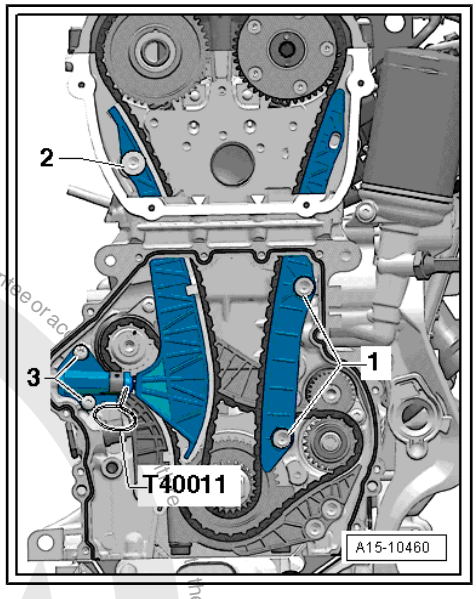
Note

Inlet camshaft will move in direction of engine rotation.

– Remove tensioning rail for timing chain -2-.
– Remove guide rail for camshaft timing chain -1-.
– Remove timing chain.

Installing

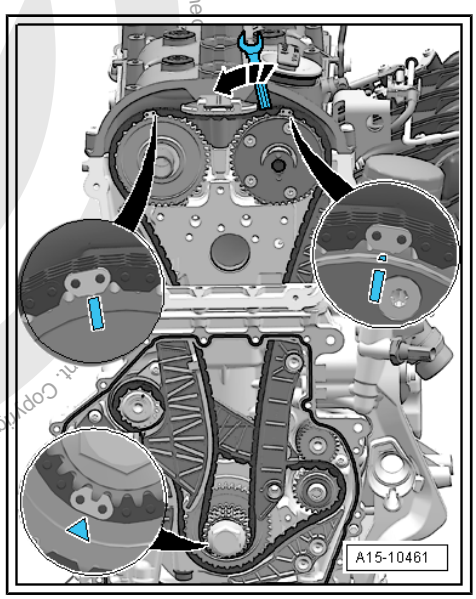
- Specified torque
⇒ „2.6 Camshaft timing chain - exploded view“, page 75.



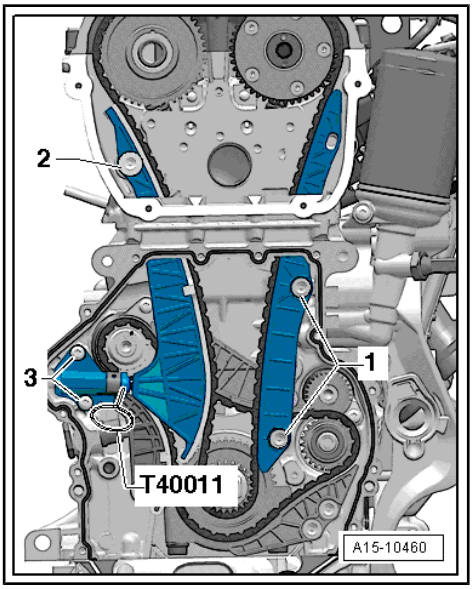
Note

- *Following procedure must be carried out in a single operation. This requires a 2nd mechanic.*
- *Timing chain links with coloured markings must be positioned at markings on chain sprockets.*
- *Continue to hold wrench until tensioning rail is installed.*

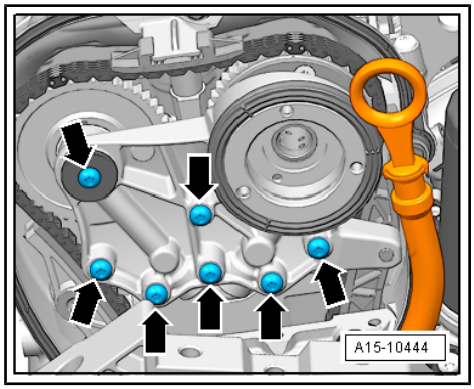
– Fit timing chain onto exhaust camshaft.
– Fit timing chain onto crankshaft.
– Use spanner to turn inlet camshaft in direction of -arrow- and fit timing chain.



– Fit tensioning rail for timing chain and tighten bolt -2-.
– Fit guide rail for camshaft timing chain and tighten bolts -1-.



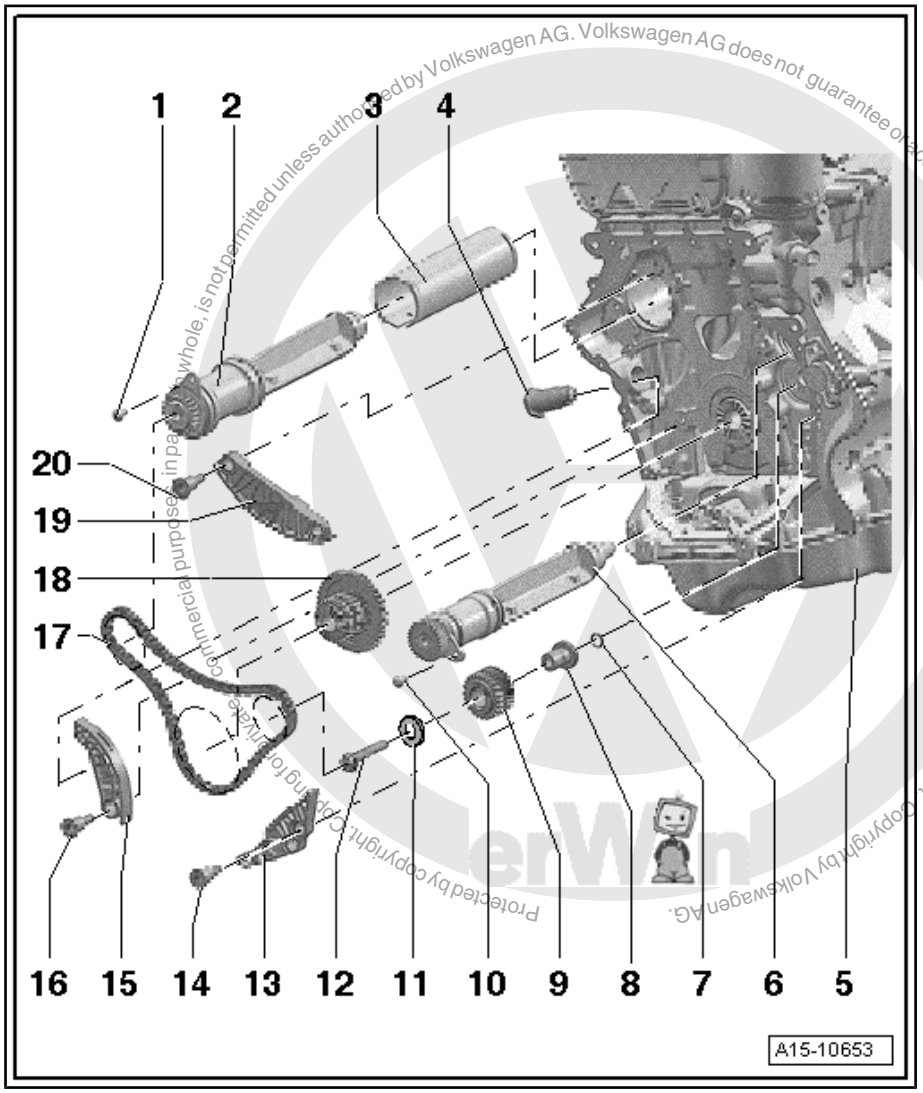
– Attach bearing saddle and screw in bolts -arrows- hand-tight.
– Remove locking pin -T40011- .
– Tighten bolts -arrows- for bearing saddle ⇒ page 75 .
– Install regulating valve ⇒ Item 6 (page 75) .



Further assembly is basically the reverse of the dismantling sequence. In the process, note the following:

– Install timing chain cover (bottom) ⇒ page 67 .
– Install timing chain cover (top) ⇒ page 67 .
– Install tensioner for poly V-belt ⇒ page 21 .
– Install poly V-belt ⇒ page 22 .
– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .

2.8 Assembly overview - balancer shaft timing chain



1 - Bolt
- ❑ Renew.
- ❑ 9 Nm

2 - Balancer shaft
- ❑ Exhaust side
- ❑ Must always be renewed if removed.
- ❑ Lubricate bearing with engine oil
- ❑ Renewing ⇒ page 87 .

3 - Tube for balancer shaft
- ❑ Installation position ⇒ page 81 .

4 - Chain tensioner
- ❑ 65 Nm

5 - Cylinder block

6 - Balancer shaft
- ❑ Inlet side
- ❑ Must always be renewed if removed.
- ❑ Lubricate bearing with engine oil
- ❑ Renewing ⇒ page 84 .

7 - O-ring
- ❑ Lubricate with engine oil

8 - Bearing mounting
- ❑ Lubricate with engine oil
- ❑ Installation position ⇒ page 81 .

9 - Intermediate shaft sprocket
- ❑ For balancer shaft.
- ❑ If bolt ⇒ Item 12 (page 81) has been loosened, intermediate shaft sprocket will need to be renewed.

10 - Bolt

- ❑ Renew.
- ❑ 9 Nm

11 - Washer

12 - Bolt

- ❑ If bolt has been loosened, intermediate shaft sprocket ⇒ Item 9 (page 80) will need to be renewed.
- ❑ Tightening sequence ⇒ page 82 .

13 - Guide rail

- ❑ For timing chain.

14 - Guide pins

- ❑ 20 Nm

15 - Tensioning plate

- ❑ For timing chain.

16 - Guide pins

- ❑ 20 Nm

17 - Timing chain

- ❑ Removing ⇒ page 82

18 - Chain sprocket

- ❑ Installation position ⇒ page 76 .

19 - Guide rail

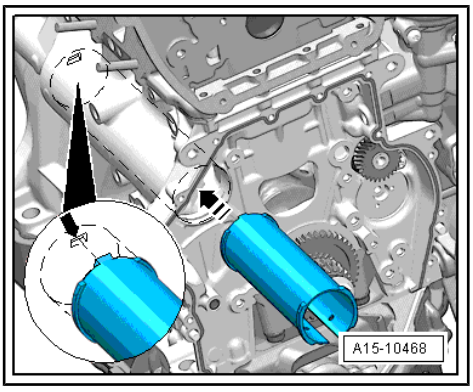
- ❑ For balancer shaft timing chain

20 - Guide pins

- ❑ 20 Nm

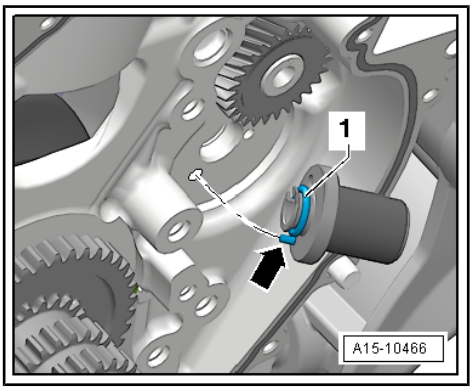
Tube for balancer shaft - installation position

- Lug on tube for balancer shaft must engage in slot -arrow-.

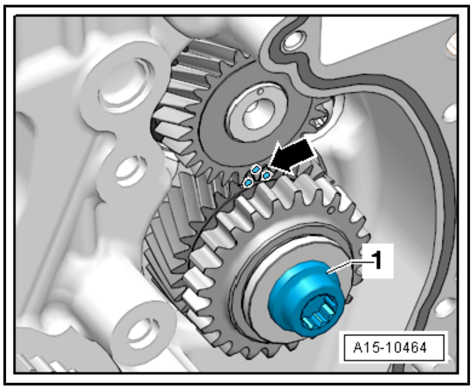


Bearing mounting - installation position

- Renew O-ring -1- and lubricate with oil.
- Dowel pin -arrow- for bearing mounting must engage in bore in cylinder block.
- Lubricate bearing mounting.



Intermediate shaft sprocket - tightening sequence



> ⚠ Caution
>
> *The intermediate shaft sprocket must be replaced. Otherwise no tooth backlash is set, engine damage.*
>
> *The new intermediate shaft sprocket is coated with a solid film lubricant that wears off after a short period and thus the tooth backlash is automatically set.*

– With new bolt tighten as follows.

1. Tighten with torque wrench initially to 10 Nm.
2. Turn intermediate shaft sprocket.

There must be no play in intermediate shaft sprocket; otherwise loosen bolt and tighten again.

3. Tighten with torque wrench to 25 Nm.
4. Use fixed wrench to turn 90° further.

2.9 Removing and installing balancer shaft module

Removing

– Remove timing chain cover (top) ⇒ page 67 .

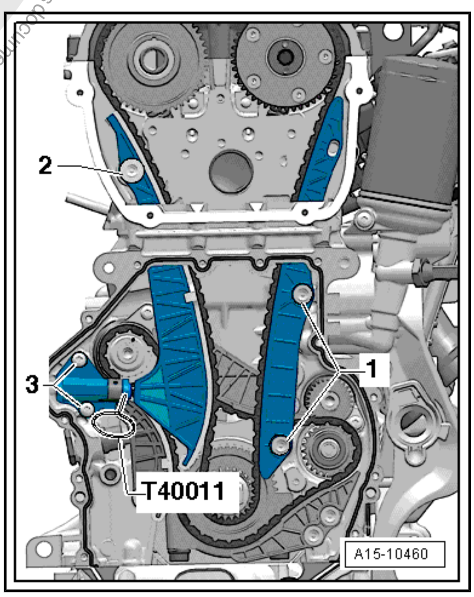
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

– Remove lower timing chain cover ⇒ page 67 .

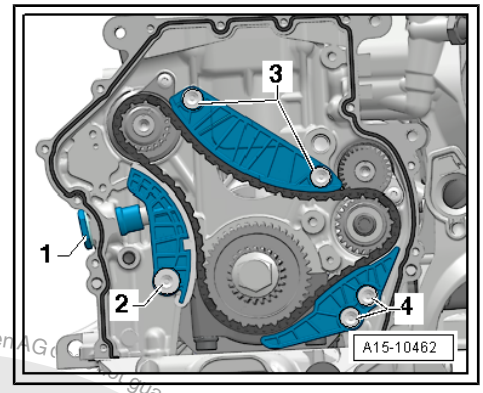
– Remove camshaft timing chain ⇒ page 76 .

– Remove guide rail for camshaft timing chain -1-.

– Remove chain tensioner for camshaft timing chain -3-.



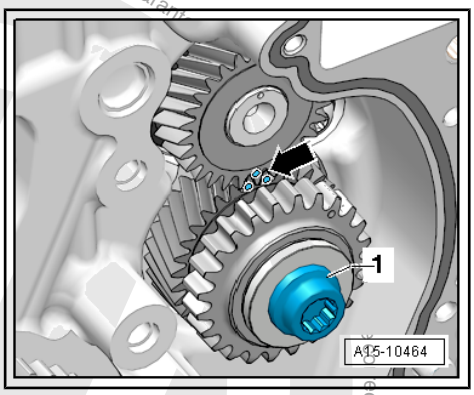
– Remove chain tensioner for balancer shaft timing chain -1-.
– Remove tensioning rail -2-.
– Remove guide rail -3-.
– Remove guide rail -4-.
– Remove timing chain.



Installing

- Specified torque
  ⇒ „2.8 Assembly overview - balancer shaft timing chain“, page 80 .

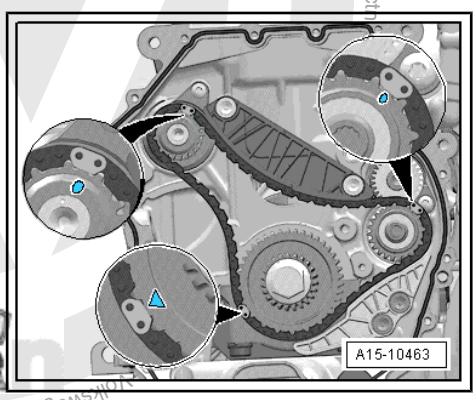
– Turn intermediate shaft sprocket/balancer shaft to markings -arrows-.



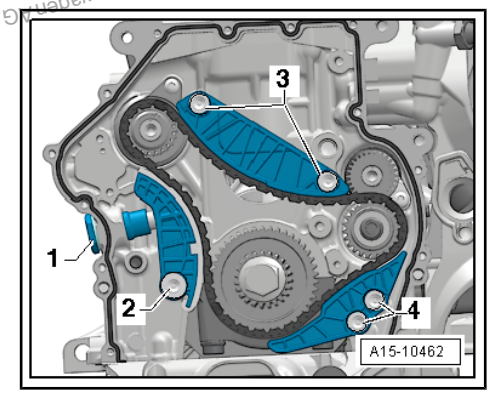
Note

Timing chain links with coloured markings must be positioned at markings on chain sprockets.

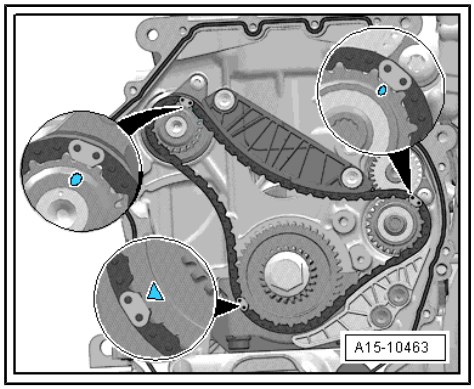
– Fit timing chain. The timing chain links with coloured markings must be positioned at the markings on the chain sprockets.



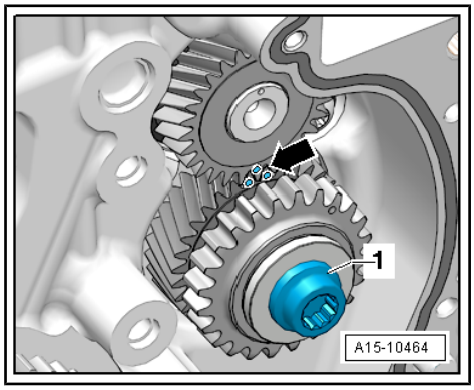
– Fit guide rail for timing chain and tighten bolts -4-.
– Fit guide rail for timing chain and tighten bolts -3-.
– Fit tensioning rail for timing chain and tighten bolt -2-.
– Insert chain tensioner of timing chain -1- with locking fluid ⇒ Electronic parts catalogue .



– Check adjustment again.



– Check markings on intermediate shaft sprocket/balancer shaft -arrow-.



Note

For illustration purposes, the markings on intermediate shaft sprocket/balancer shaft are shown with the chain removed.

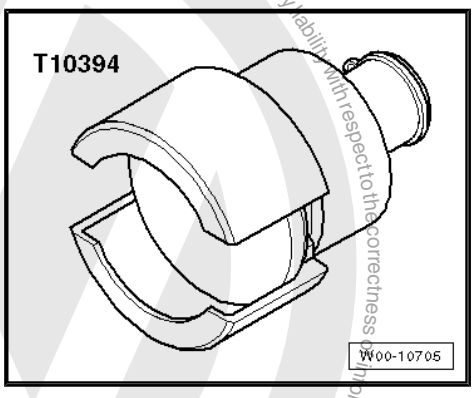
Further assembly is basically the reverse of the dismantling sequence. In the process, note the following:

– Install camshaft timing chain ⇒ page 76 .
– Install timing chain cover (bottom) ⇒ page 67 .
– Install timing chain cover (top) ⇒ page 67 .
– Install tensioner for poly V-belt ⇒ page 21 .
– Install poly V-belt ⇒ page 22 .
– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .

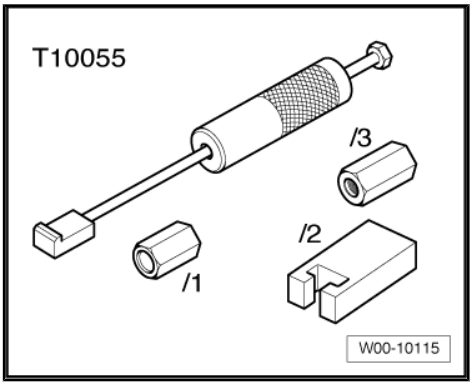
2.10 Renewing balancer shaft for inlet camshaft

Special tools and workshop equipment required

♦ Puller -T10394-



♦ Puller -T10055-

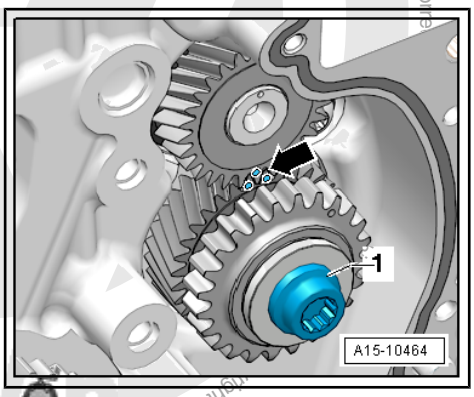


Removing

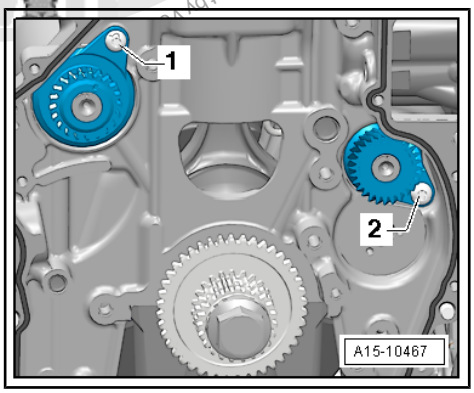
Note

The balancer shaft for the inlet camshaft must always be renewed after removing.

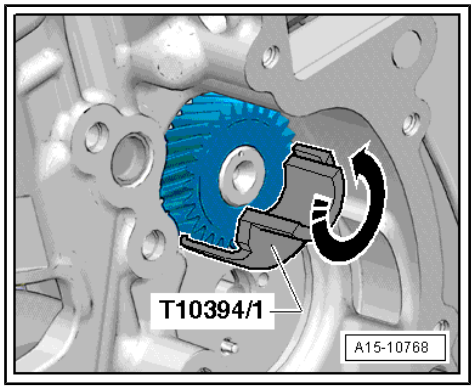
– Remove toothed belt for coolant pump ⇒ page 146 .
– Remove timing chain cover (top) ⇒ page 67 .
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .
– Remove lower timing chain cover ⇒ page 67 .
– Remove camshaft timing chain ⇒ page 76 .
– Remove balancer shaft timing chain ⇒ page 82 .
– Remove intermediate shaft sprocket -1-.



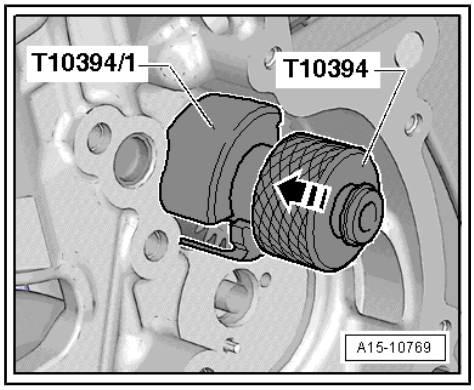
– Unscrew bolt -2- for inlet camshaft balancer shaft.



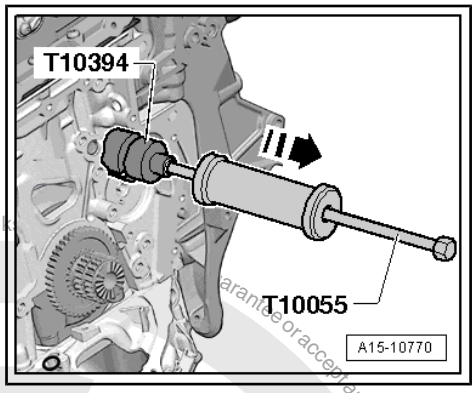
– Insert shell half -T10394/1- from puller -T10394- and turns upwards in direction of arrow.



– Insert puller -T10394- and push locking collar in -direction of arrow-.



– Screw puller -T10055- into puller -T10394- and force out balancer shaft in -direction of arrow-.



Installing

Note

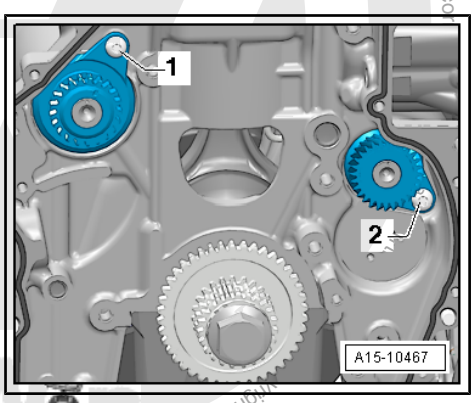
Due to the small amount of play between the balancer shaft and cylinder block, the balancer shaft may need to be installed chilled. Check whether the balancer shaft can be fitted into the cylinder block without exerting force. If this is not the case, the balancer shaft must be chilled before installing.

- Specified torque
  ⇒ „2.8 Assembly overview - balancer shaft timing chain“, page 80 .

– Place new balancer shaft in freezer compartment for 30 minutes, if necessary, or spray with commercially available cooling spray.

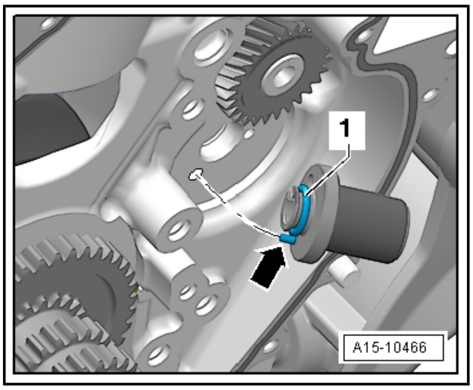
– Lubricate balancer shaft bearing with engine oil.

– Install new balancer shaft for inlet camshaft and tighten bolt -2-.



– Renew O-ring -1- and lubricate with engine oil.

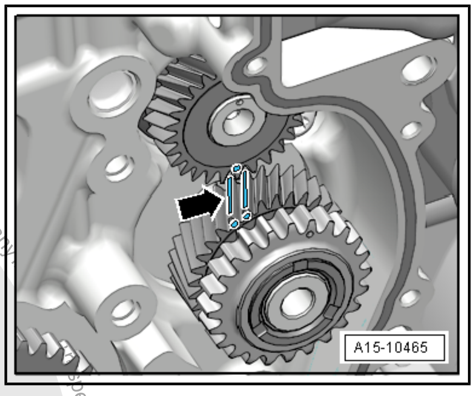
– Lubricate bearing mounting with engine oil and install; dowel pin -arrow- for bearing mounting must engage in bore in cylinder block.



> ⚠ Caution
>
> *The intermediate shaft sprocket must be replaced. Otherwise no tooth backlash is set, engine damage.*
>
> *The new intermediate shaft sprocket is coated with a solid film lubricant that wears off after a short period and thus automatically sets the tooth backlash.*

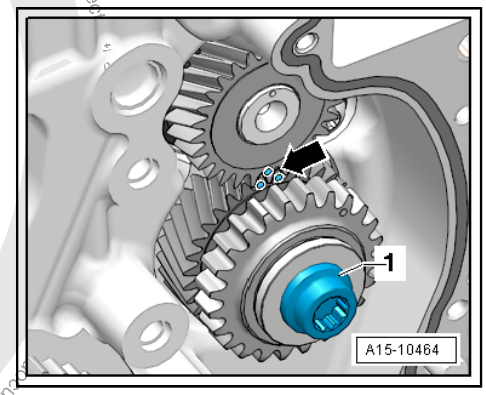
– Mark faces of gear teeth of intermediate shaft sprocket with paint -arrows-.

– Insert intermediate shaft sprocket; marking on balancer shaft must be positioned between markings on faces of gear teeth.



– Tighten bolt -1- for intermediate shaft sprocket: tightening sequence ⇒ page 82 .

– Check markings on intermediate shaft sprocket/balancer shaft -arrow-.



Assembly is performed analogously in the reverse order of removal. In the process, note the following:

– Install balancer shaft module ⇒ page 82 .

– Install camshaft timing chain ⇒ page 76 .

– Install timing chain cover (bottom) ⇒ page 67 .

– Install timing chain cover (top) ⇒ page 67 .

– Install tensioner for poly V-belt ⇒ page 21 .

– Install poly V-belt ⇒ page 22 .

– Renew oil seal for coolant pump drive ⇒ page 148 .

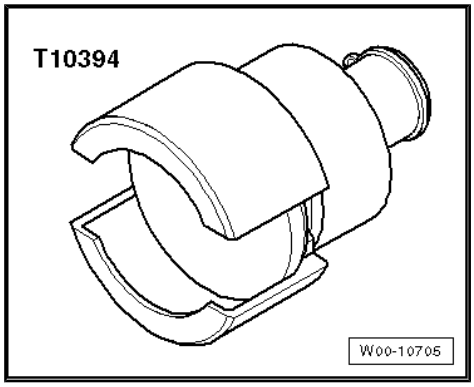
– Fit toothed belt for coolant pump ⇒ page 146 .

– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .

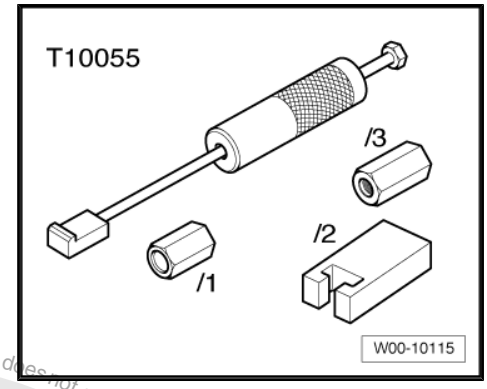
2.11 Renewing balancer shaft for exhaust camshaft

Special tools and workshop equipment required

♦ Puller -T10394-



♦ Puller -T10055-

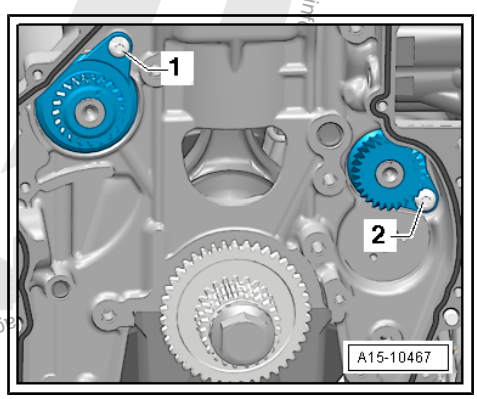


Removing

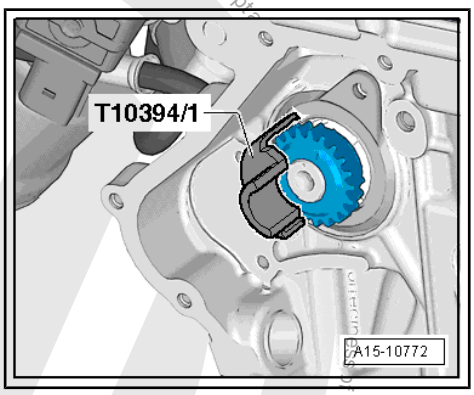
Note

The balancer shaft for the inlet camshaft must always be renewed after removing.

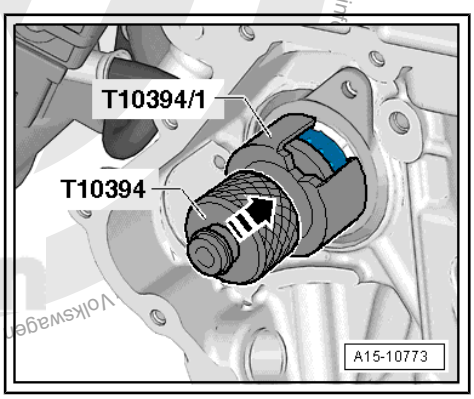
– Remove timing chain cover (top) ⇒ page 67 .
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .
– Remove lower timing chain cover ⇒ page 67 .
– Remove camshaft timing chain ⇒ page 76 .
– Remove balancer shaft timing chain ⇒ page 82 .
– Unscrew bolt -1- for exhaust camshaft balancer shaft.



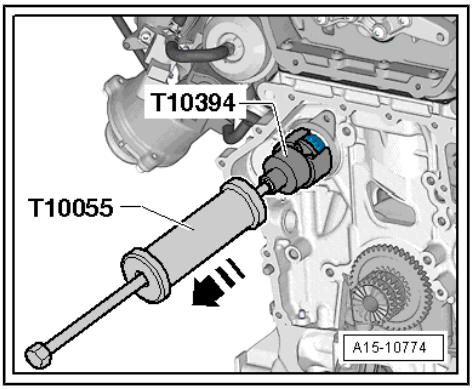
– Insert shell half -T10394/1- from puller -T10394- .



– Insert puller -T10394- and push locking collar in -direction of arrow-.



– Screw puller -T10055- into puller -T10394- and force out balancer shaft.



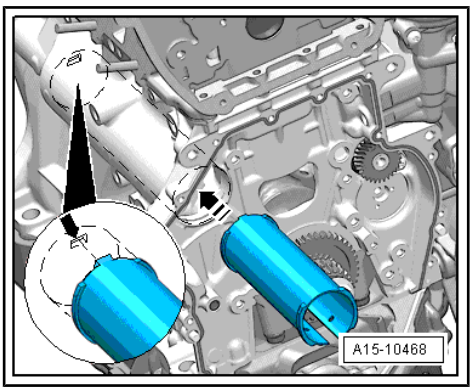
Installing

Note

Due to the small amount of play between the balancer shaft and cylinder block, the balancer shaft may need to be installed chilled. Check whether the balancer shaft can be fitted into the cylinder block without exerting force. If this is not the case, the balancer shaft must be chilled before installing.

- Specified torque
⇒ „2.8 Assembly overview - balancer shaft timing chain“, page 80 .

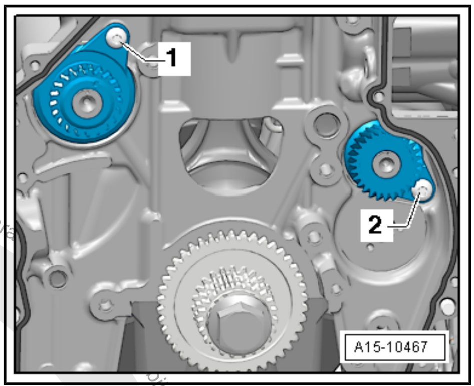
– Check installation position of tube for balancer shaft -arrow-.



Lug -arrow- must engage in slot.

– Place new balancer shaft in freezer compartment for 30 minutes, if necessary, or spray with commercially available cooling spray.

– Lubricate balancer shaft bearing with engine oil.



– Install balancer shaft for exhaust camshaft.

– Before tightening bolt -1-, check that balancer shaft rests flat against crankcase.

Note

If the balancer shaft does not rest flat, the pipe for balancer shaft must be inserted again.

Further assembly is basically the reverse of the dismantling sequence. In the process, note the following:

– Install balancer shaft module ⇒ page 82 .

– Install camshaft timing chain ⇒ page 76 .

– Install timing chain cover (bottom) ⇒ page 67 .

– Install timing chain cover (top) ⇒ page 67 .

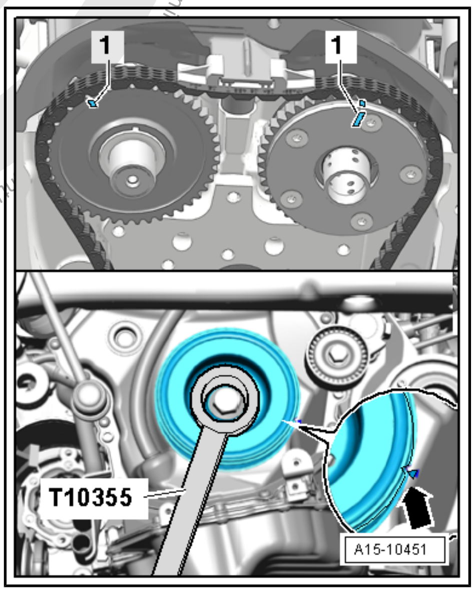
– Install tensioner for poly V-belt ⇒ page 21 .

– Install poly V-belt ⇒ page 22 .

– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .

2.12 Checking valve timing

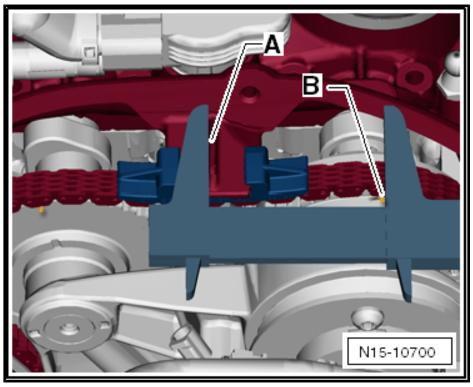
– Remove timing chain cover (top) ⇒ page 67 .



Note

Use a ratchet spanner with a 24 mm socket to turn the vibration damper. Always turn the vibration damper in the engine's direction of rotation to the „TDC“ position. Do not correct TDC position by turning the damper in the other direction.

- Notch on vibration damper must align with arrow marking on bottom cover for timing chains (use a mirror).
- Markings -1- on camshafts must face upwards.

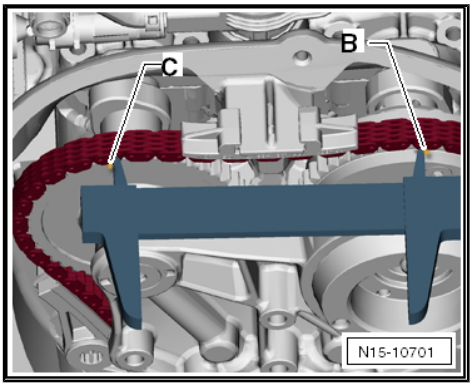


– Measure the distance from the outer edge of web -A- to marking -B- on the inlet camshaft.

- Specification: 61…64 mm.

– If the specified value is achieved, measure the distance between the marking on the inlet camshaft -B- and the marking on the exhaust camshaft -C-.

• Specification: 124…126 mm

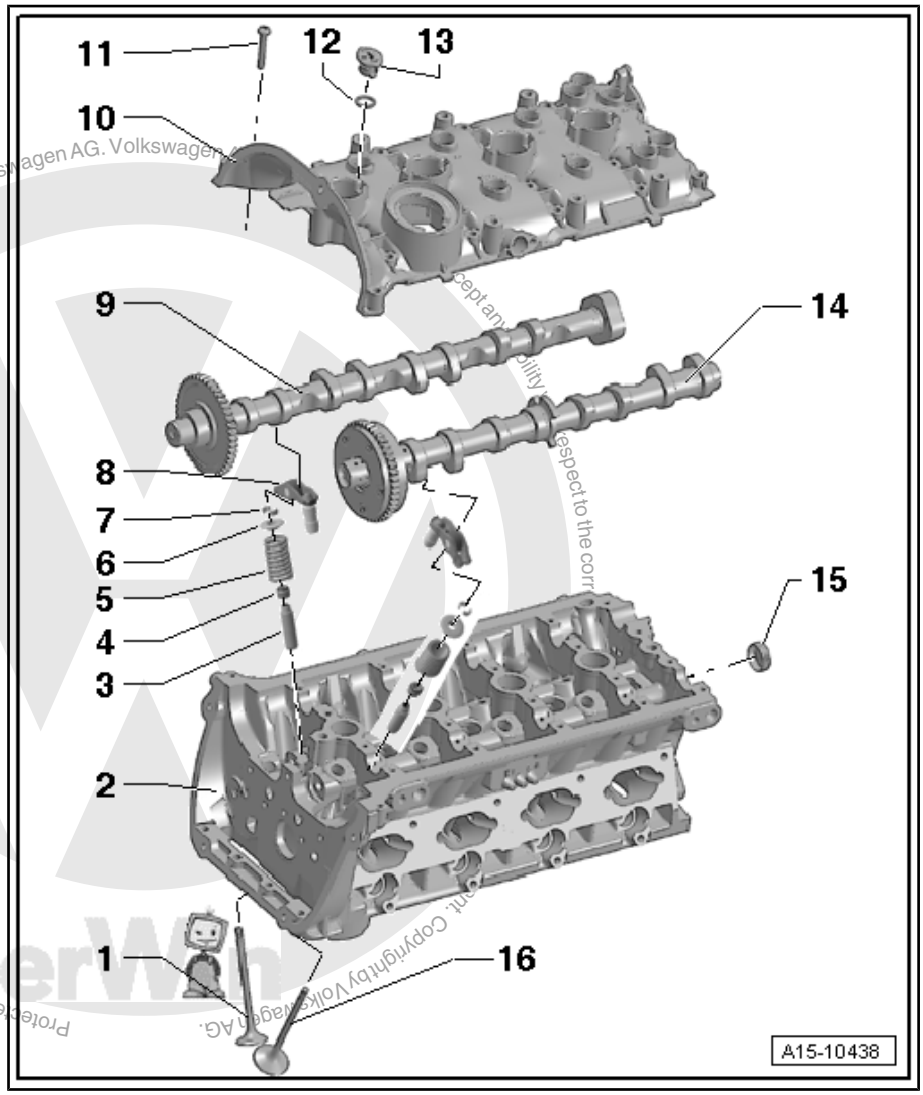


Note

Offset of one tooth means a deviation of approx. 6 mm from the specified value. If an offset is found, the timing chain must be refitted.

3 Valve gear

3.1 Assembly overview - valve gear



1 - Exhaust valve

- ❑ Do not rework. Only lapping in is permitted.
- ❑ Valve dimensions ⇒ page 94 .
- ❑ Checking valve guides ⇒ page 112 .

2 - Cylinder head

3 - Valve guide

- ❑ Check ⇒ page 112 .

4 - Valve stem seal

- ❑ Renew: with cylinder head fitted ⇒ page 109 , with cylinder head removed ⇒ page 109

5 - Valve spring

6 - Valve spring plate

7 - Valve cotters

8 - Hydraulic compensation element

- ❑ Do not interchange.
- ❑ Oil contact surface.

9 - Exhaust camshaft

- ❑ Removing and installing ⇒ page 94 .
- ❑ Check radial clearance with Plastigage (roller rocker fingers removed).
- ❑ Radial clearance: 0.024 … 0.066 mm.
- ❑ Runout: max. 0.04 mm.

10 - Cylinder head cover

- ❑ With integrated camshaft bearings.
- ❑ Clean sealing surface; reworking not permitted.
- ❑ Remove sealant residue.

11 - Bolt

- ❑ Renew.
- ❑ Loosen ⇒ page 93
- ❑ Tightening sequence ⇒ page 93 .

12 - O-ring

- ❑ Renew.
- ❑ Lubricate with engine oil

13 - Plug

14 - Inlet camshaft

- ❑ Removing and installing ⇒ page 94 .
- ❑ Check radial clearance with Plastigage (roller rocker fingers removed).
- ❑ Radial clearance: 0.024 … 0.066 mm.
- ❑ Runout: max. 0.04 mm.

15 - Cap

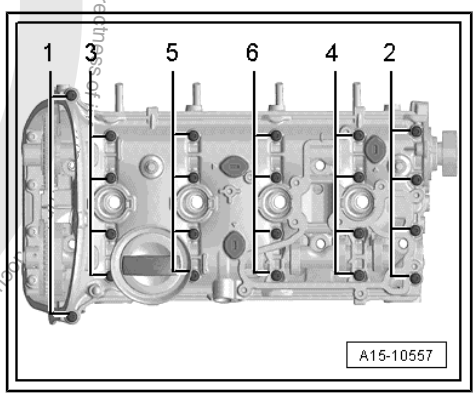
- ❑ Renew.
- ❑ Remove with cylinder head cover installed, pierce on one side of cover with an awl and pry out

16 - Inlet valve

- ❑ Do not rework. Only lapping in is permitted.
- ❑ Valve dimensions ⇒ page 94 .
- ❑ Checking valve guides ⇒ page 112 .

Cylinder head cover - release

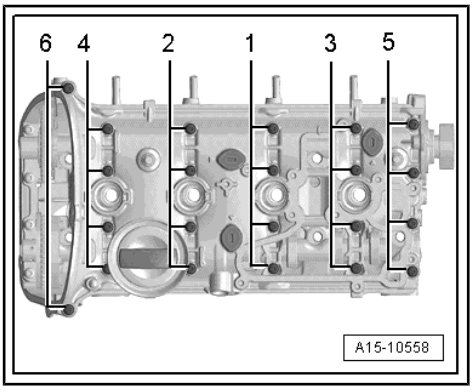
– Undo and remove cylinder head cover in the sequence 1 … 6.



Tightening sequence for cylinder head cover

– Renew bolts.

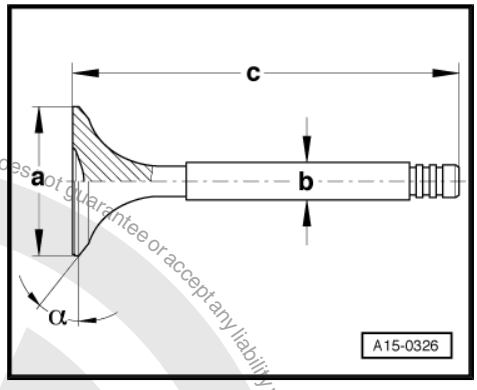
1. Fit bolts in the sequence -1 … 6- and hand-tighten in several stages.
2. Tighten bolts in the sequence -1 … 6- to 8 Nm using torque wrench.
3. Turn 90° further in the sequence -1 … 6- using a fixed wrench.



Note

Take care to keep cylinder head cover level.

Valve dimensions



Note

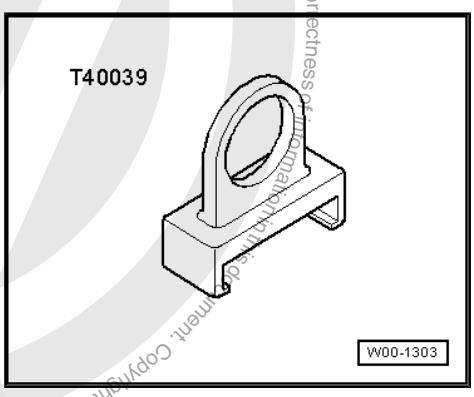
Inlet and exhaust valves must not be reworked. Only lapping-in is permitted.

Dimension		Inlet valve	Exhaust valve
∅ a	mm	33.85 ± 0.10	28.0 ± 0.1
∅ b	mm	5.98 ± 0.01	5.96 ± 0.01
c	mm	104.0 ± 0.2	101.9 ± 0.2
α	∠°	45	45

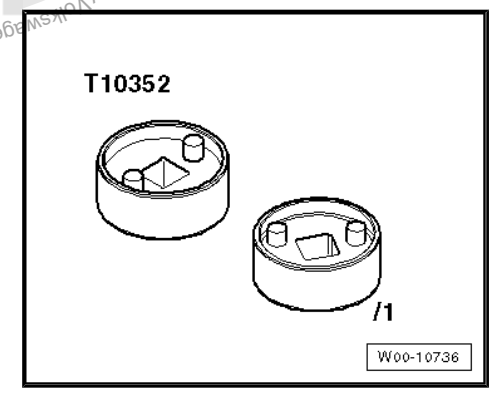
3.2 Removing and installing camshafts

Special tools and workshop equipment required

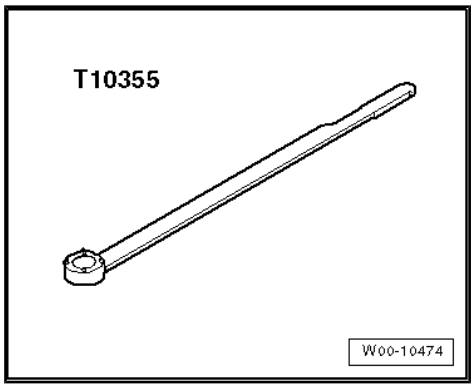
- Puller -T40039-



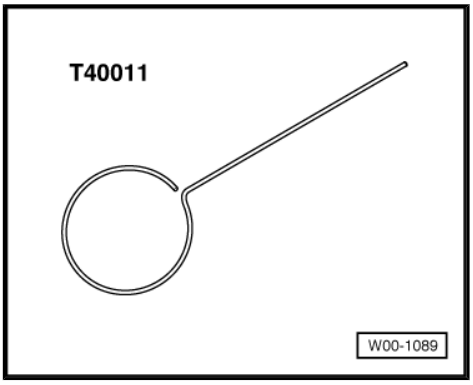
- Removal tool -T10352/1-



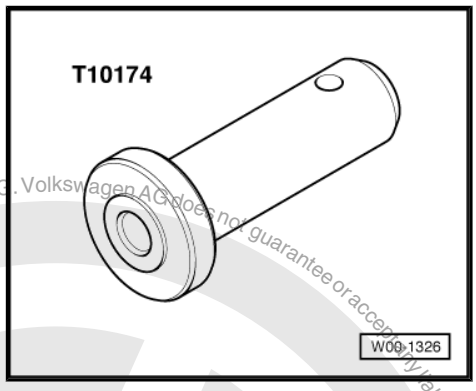
- Counterhold tool -T10355-



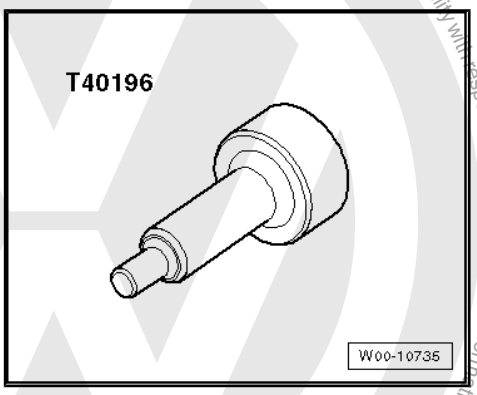
- Locking pin -T40011-



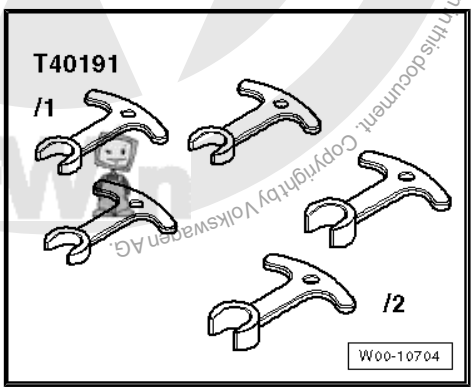
- Thrust piece -T10174-



- Assembly pin -T40196-



- Spacers -T40191-

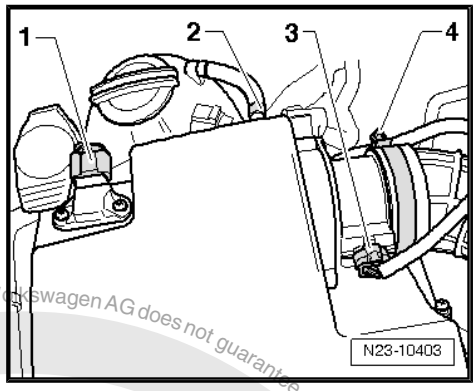


Removing

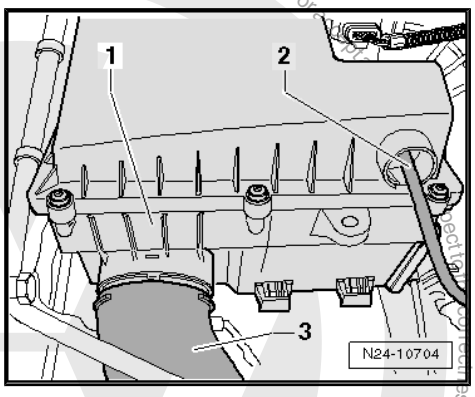
Note

- *Sealing surfaces at bottom of cylinder head cover and top of cylinder head must not be machined.*
- *Camshaft bearings are integrated into cylinder head and cylinder head cover. Camshaft timing chain must be relieved of tension before you remove cylinder head cover.*
- *Renew sealing cap if cylinder head cover has been detached.*
- *Fit cable tie in same place when installing.*

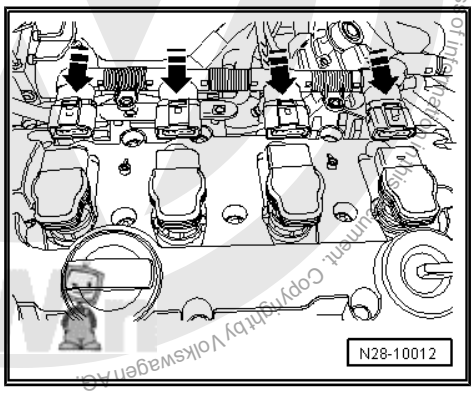
– Disconnect electrical connectors -1 and 3- from air filter housing.
– Release clip -4- and detach hose.
– Release air intake hose -3- from air filter housing -1-.



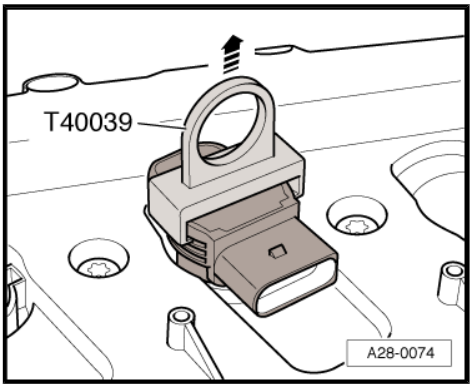
– Pull off vacuum hose -2-.
– Unscrew securing bolt for air filter housing in area of coolant expansion tank.
– Withdraw air filter housing upwards.



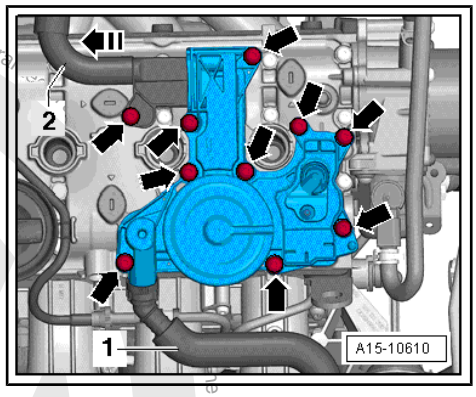
– Release connectors -arrows- and simultaneously detach all connectors from ignition coils.



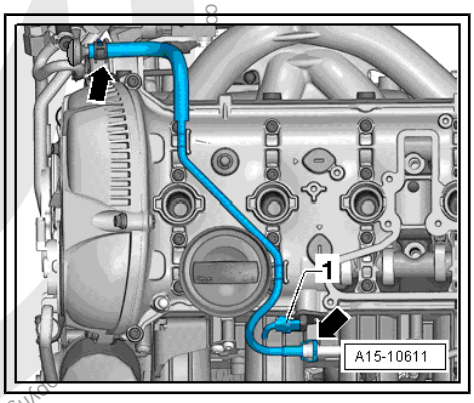
– Remove ignition coils using puller -T40039- .



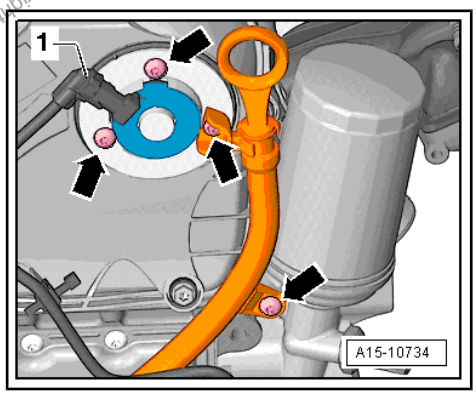
– Disconnect crankcase breather hose -1-.
– Unscrew bolts -arrows-, remove crankcase breather system and detach from hose -2- for crankcase breather system in -direction of arrow-.



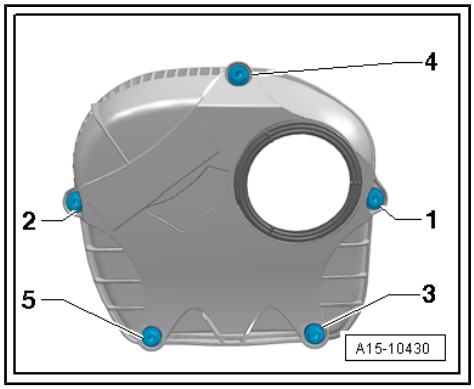
– Disconnect line -arrows-.
– Detach and remove electrical connector -1- from Hall sender -G40- .



– Detach connector from inlet camshaft control valve 1 -N205- -1-.
– Unscrew bolts -arrows- and remove inlet camshaft control valve 1 -N205- .



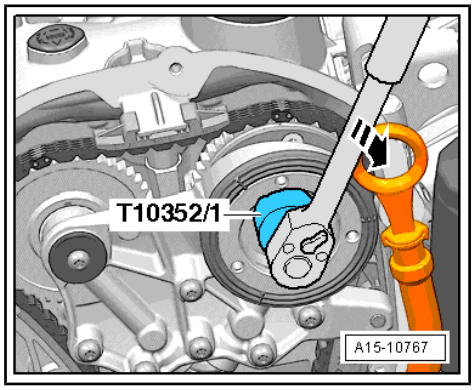
– Unscrew bolts -1 to 5- and detach top cover for timing chain.



Caution

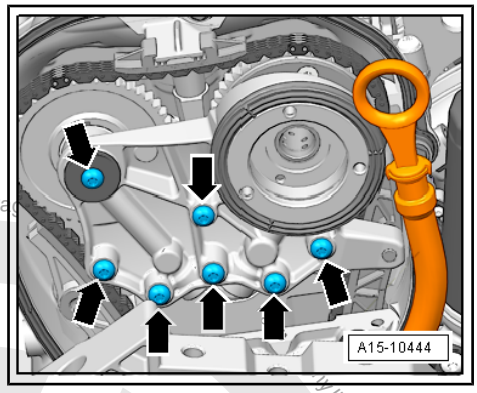
The timing valve has a left-hand thread.

– Remove regulating valve using removal tool -T10352/1- in direction of -arrow-.



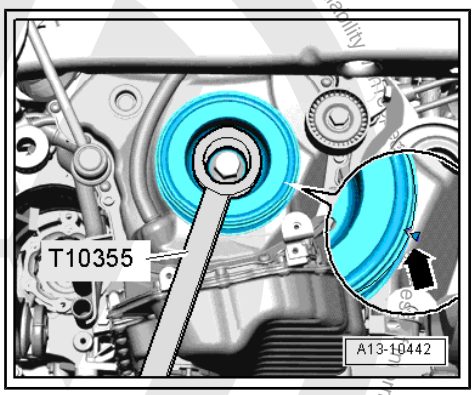
– Remove bolts -arrows- and detach bearing saddle.

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .



– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

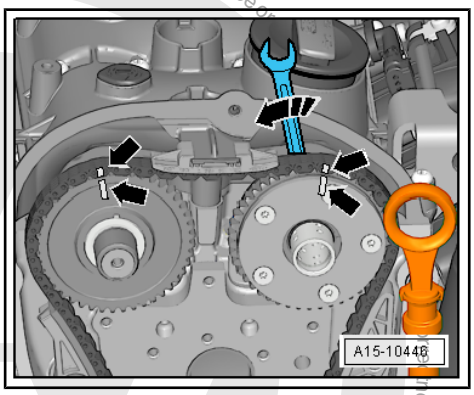
• Notch on vibration damper must align with arrow marking on cover for timing chains (bottom).



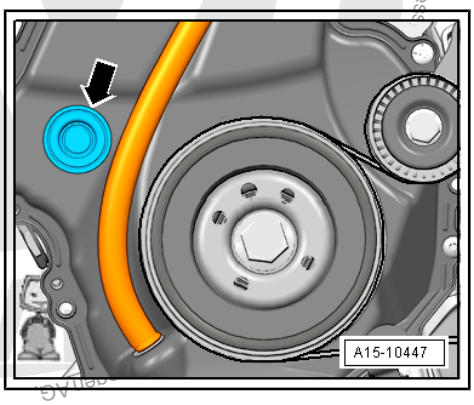
Note

Engine must be at „TDC“ again.

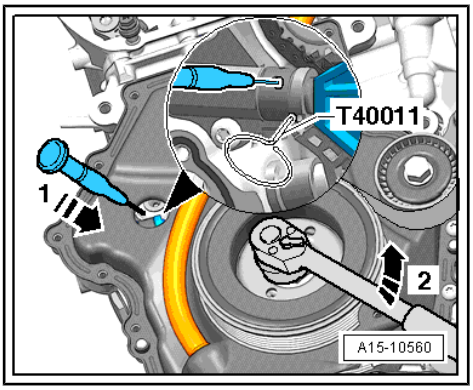
– Use a waterproof pen to mark drive chain at marks on chain sprockets -arrows-.

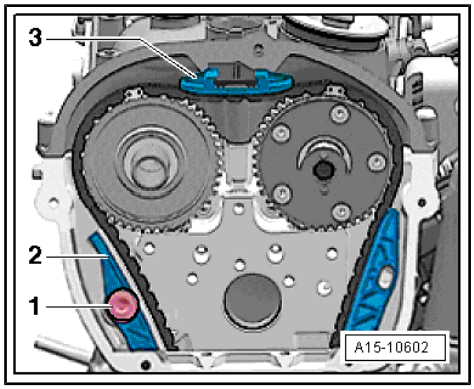


– Remove sealing plug -arrow-.



– Insert scriber or suitable screwdriver in hole of chain tensioner in direction of -arrow 1- and lift locking element for chain tensioner.
– Turn crankshaft in opposite direction to normal rotation -arrow 2- and lock in place using locking pin -T40011- .





Note

Inlet camshaft will move in direction of engine rotation.

– Remove bolt -1- and guide tensioning rail -2- downwards.
– Use screwdriver to release catch and press off top guide rail -3- forwards.
– Remove camshaft timing chain from camshaft sprockets.

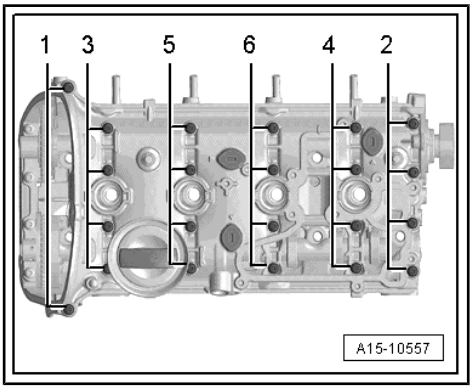
Caution

Avoid damage to valves and piston crowns.

- ***Do not turn the crankshaft after the camshaft timing chain has been removed from the cylinder head.***

– Remove high-pressure pump⇒ Rep. gr. 24 .
– Remove vacuum pump ⇒ Rep. gr. 47 .

– Undo and remove cylinder head cover bolts in the sequence -1 … 6-.



– Remove cylinder head cover.

– Detach camshafts.

Caution

Danger of soiling lubrication system and bearings.

- ***Cover open parts of engine.***

Installing

- Specified torques ⇒ page 92 .

Note

- *Sealing surfaces must be free of oil and grease.*
- *Pistons must not be positioned at TDC.*
- *Ensure that all roller rocker fingers are properly seated on valve stem ends.*

– Remove sealant remaining on cylinder head with flat scraper.

WARNING

Risk of eye injury.

- ***Wear safety goggles.***

Caution

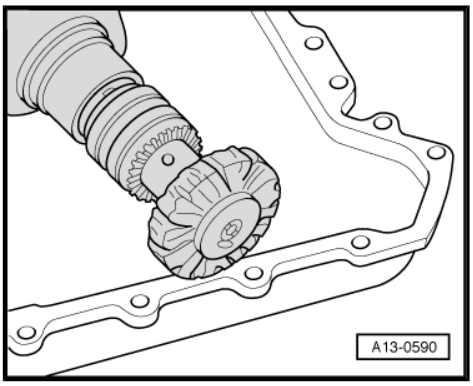
Danger of soiling lubrication system and bearings.

- ***Cover open parts of engine.***

– Remove sealant left in groove of cylinder head cover and on sealing surfaces, e.g. using a rotating plastic brush.

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

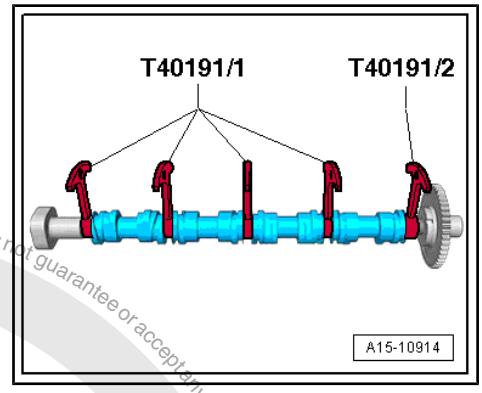
– Oil running surfaces of both camshafts.



WARNING

Risk of eye injury.

- *Wear safety goggles.*

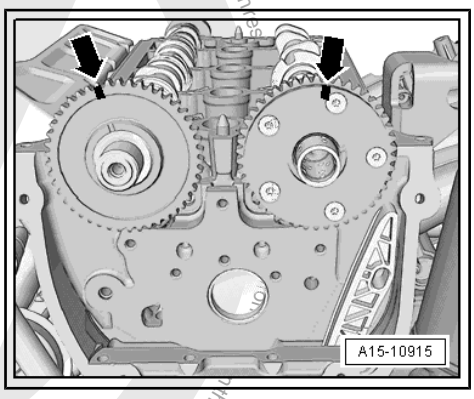


– Lock camshaft with spacers -T40191- as shown; if necessary, slide forked sleeves into correct position.

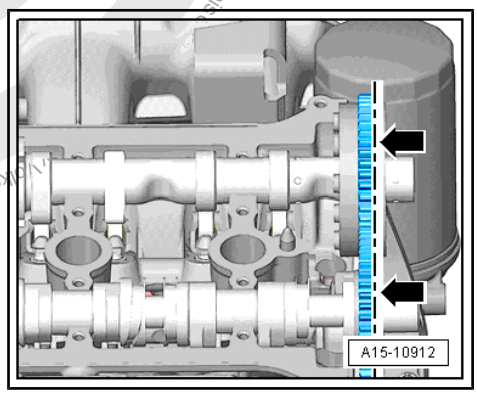
Note

If available, use 2nd set of spacers -T40191- or reuse -T40191/1- .

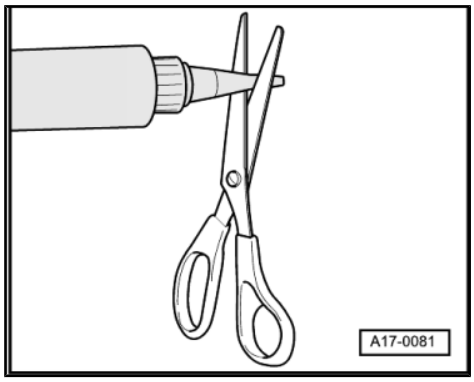
– Insert camshafts in cylinder head; markings -arrows- must be positioned as shown.



– Check alignment -arrows- of camshafts.

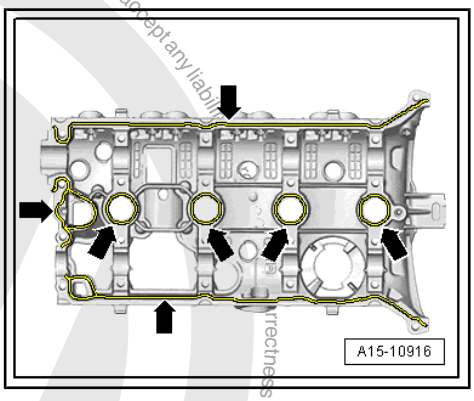


– Cut off nozzle on tube at front marking (∅ of nozzle approx. 2 mm).



– Apply silicone sealant onto clean sealing surface of cylinder head cover, as illustrated -arrows-.

♦ Thickness of sealant bead: 2 ... 3 mm.



Note

♦ *The cylinder head cover must be installed within 5 minutes after applying the silicone sealant.*

♦ *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*

♦ *Observe expiry date of sealing compound.*

Sealant ⇒ Electronic parts catalogue .

– Fit cylinder head cover onto cylinder head.

– Renew bolts for cylinder head cover.

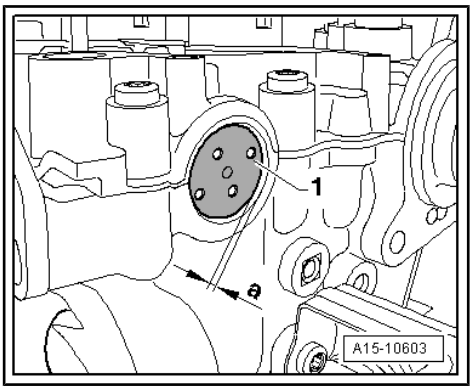
– Tighten bolts in several stages, tightening sequence ⇒ page 92 .

Note

Take care to keep cylinder head cover level.

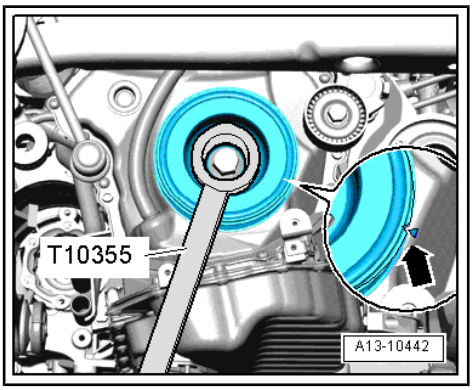
– Use thrust piece -T10174- to drive in sealing cap -1- (do not apply sealant).

- a -: 1 ... 2 mm



– Turn vibration damper to „TDC“ position -arrow- using counterhold -T10355- .

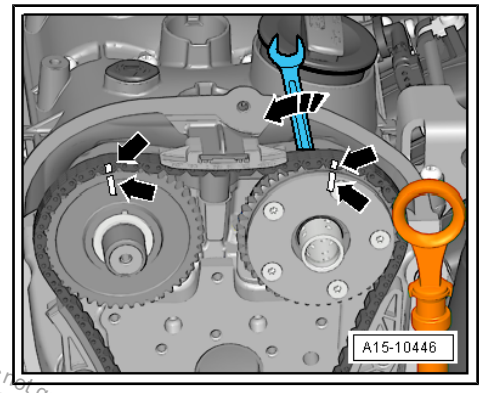
• Notch on vibration damper must align with arrow marking on bottom cover for timing chains.



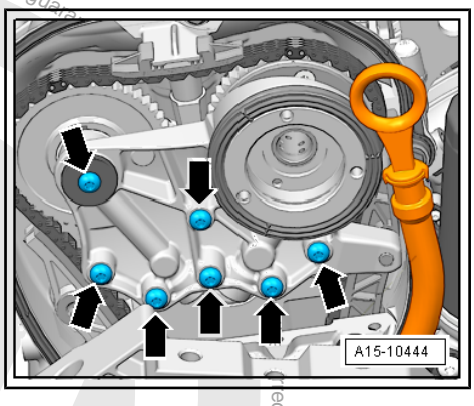
Note

The timing chain links with markings must be positioned at the markings on the chain sprockets.

– Fit camshaft timing chain: the drive chain/sprocket markings must align -arrows-.
– Use spanner to turn inlet camshaft in direction of -arrow- and fit timing chain.



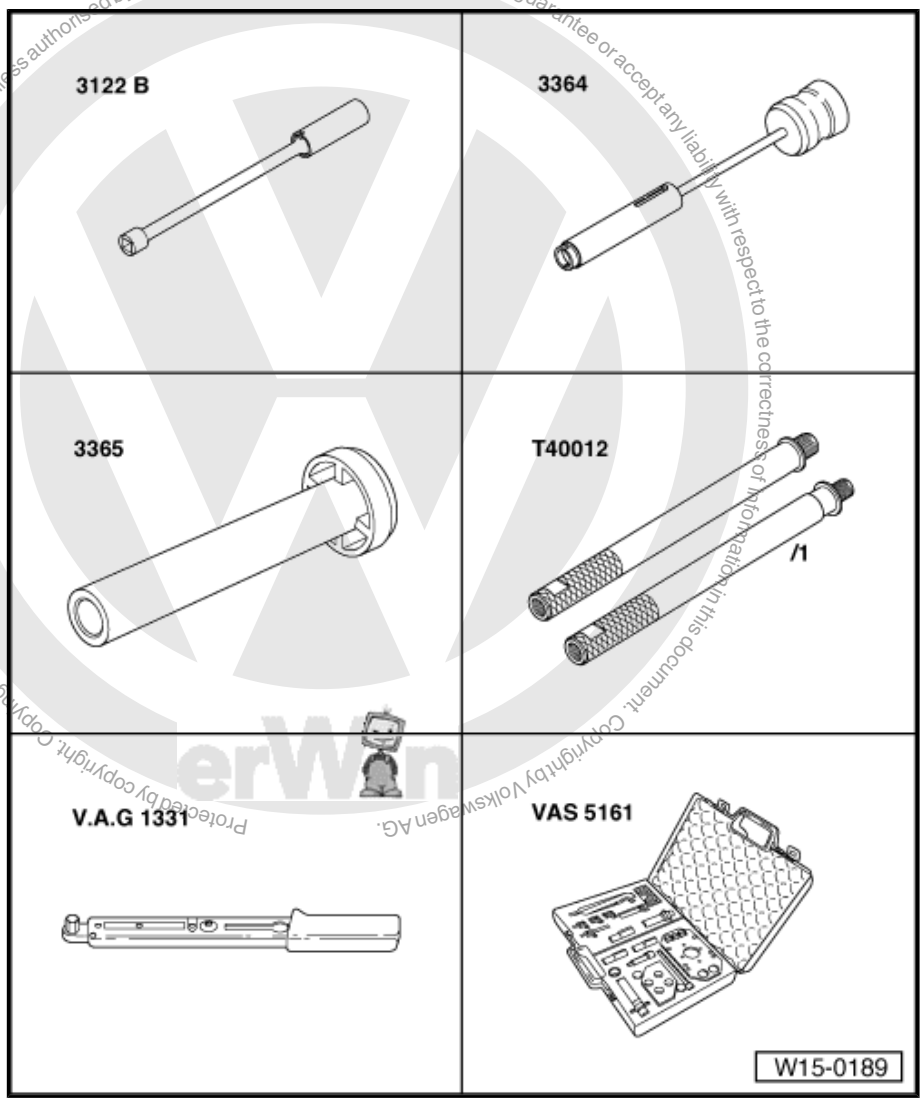
– Attach bearing saddle and screw in bolts -arrows- hand-tight.
– Remove locking pin -T40011- .
– Tighten bolts -arrows- for bearing saddle.
– Install regulating valve.
– Turn crankshaft 4 times in direction of engine's rotation.
– Install timing chain cover (top) ⇒ page 65 .
– Install vacuum pump ⇒ Rep. gr. 47 .
– Installing high-pressure pump ⇒ Rep. gr. 24 .
– Install air filter housing ⇒ Rep. gr. 24 .
– Fit engine guard, if available ⇒ Body, front; Rep. gr. 50 ; Engine guard .



3.3 Renewing valve stem seals with cylinder head installed

Special tools and workshop equipment required

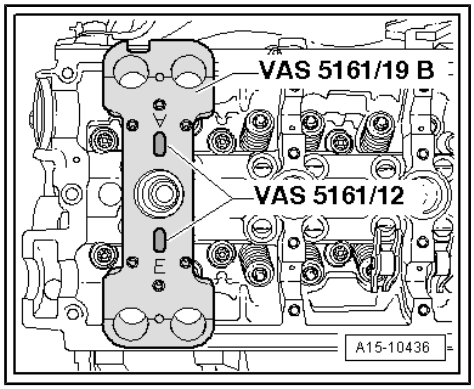
- Spark plug socket and extension -3122 B-
- Valve stem seal puller -3364-
- Valve stem seal fitting tool -3365-
- Adapter -T40012-
- Torque wrench -V.A.G 1331-
- Dismantling and assembling device for valve cotters -VAS 5161-
- Guide plate for 2.0 l and 3.0 l FSI engine -VAS 5161/19B-



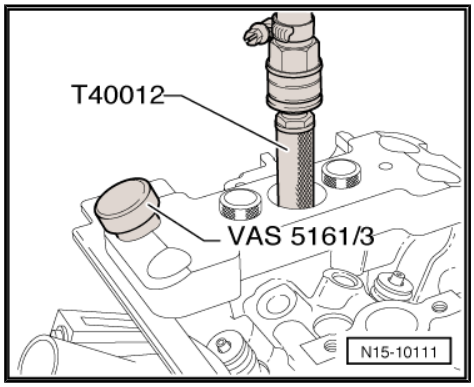
Removing valve stem oil seals

– Remove camshafts ⇒ page 94 .
– Mark allocation of roller rocker fingers and hydraulic compensation elements for reinstallation.
– Remove roller rocker fingers together with hydraulic compensation elements and place down on a clean surface.
– Unscrew spark plugs using spark plug socket and extension -3122 B- .

– Secure guide plate for 2.0 ltr. and 3.0 ltr. FSI engine -VAS 5161/19B- with knurled screws -VAS 5161/12- to cylinder head as shown.
– Set piston of respective cylinder to „bottom dead centre“.

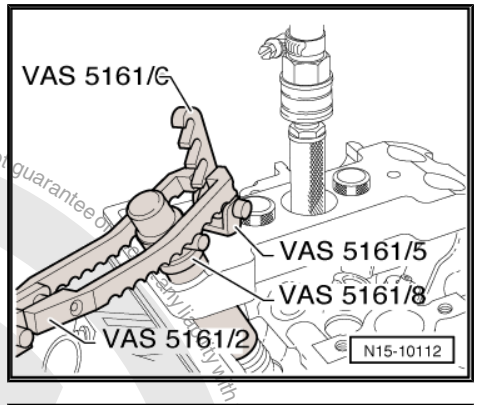


– Screw adapter -T40012- into spark plug thread.
– Connect compressed air with pressure rating of at least 6 bar.
– Strike tight valve cotters with drift -VAS 5161/3- and a plastic hammer.



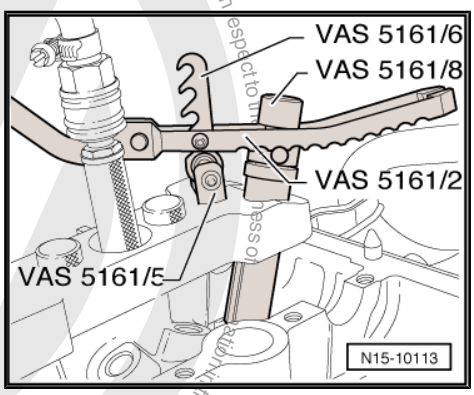
For inlet side

– Screw retainer -VAS 5161/6- with guide fork -VAS 5161/5- into centre thread of guide plate for 2.0 ltr. and 3.0 ltr. FSI engine -VAS 5161/19B- .
– Insert assembly cartridge -VAS 5161/8- into guide plate for 2.0 ltr. and 3.0 ltr. FSI engine -VAS 5161/19B- .
– Attach pressure fork -VAS 5161/2- to retainer -VAS 5161/6- .

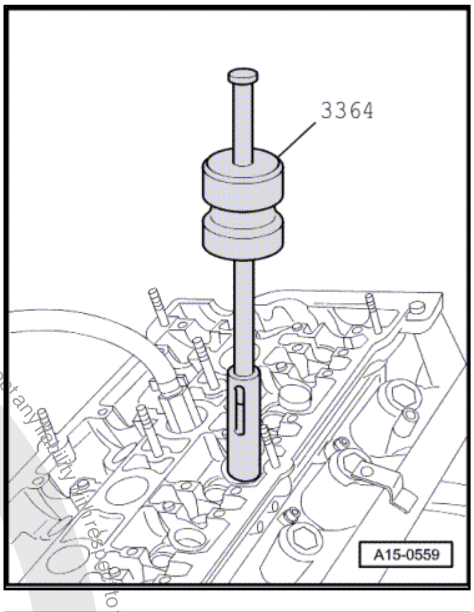


For exhaust side

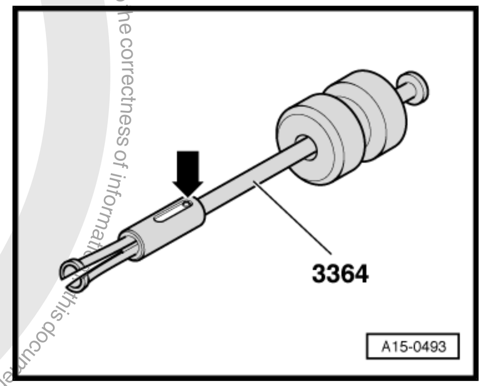
– Screw retainer -VAS 5161/6- with guide fork -VAS 5161/5- into outer threads of guide plate for 2.0 ltr. and 3.0 ltr. FSI engine -VAS 5161/19B- .
– Press installation cartridge -VAS 5161/8- down and turn knurled screw of installation cartridge -VAS 5161/8- to right until tips engage in valve cotters.
– Move knurled screw back and forth slightly to press apart valve cotters and capture them in the assembly cartridge.
– Release pressure fork -VAS 5161/2- .
– Remove installation cartridge -VAS 5161/8- .



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



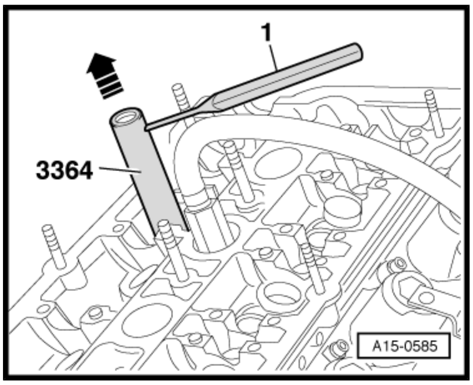
– If valve stem seal puller -3364- cannot be used on account of restricted space, knock out pin -arrow- with a punch and remove the impact extractor attachment.



– Place lower part of valve stem seal puller -3364- onto valve stem seal.

– Insert punch -1- into bore in lower part of puller.

– Place installation lever on puller and pull out valve stem seal -arrow-.



Installing valve stem seals

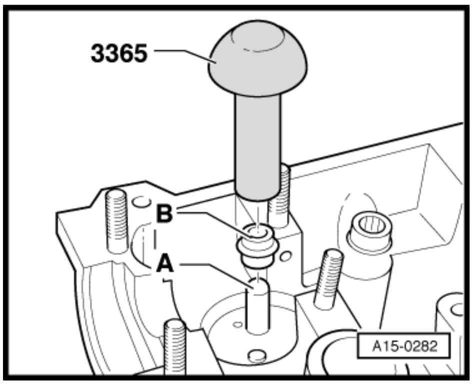
– To prevent damage to new valve stem seals -B-, attach plastic sleeve -A- to valve stem.

– 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.

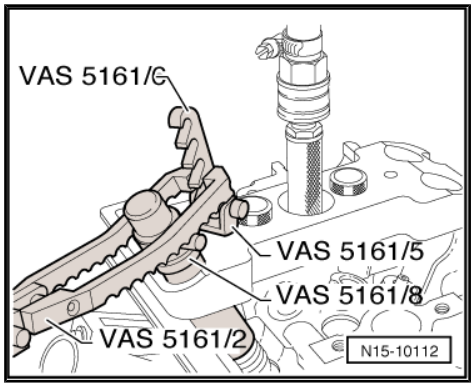
– Remove plastic sleeve -A-.

– Insert valve spring and valve spring plate.

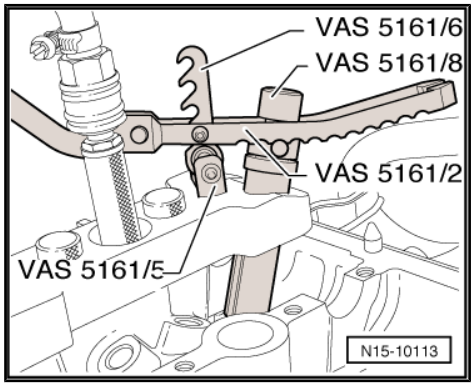
– Install removal and installation device for valve cotters -VAS 5161- as shown.



Inlet side

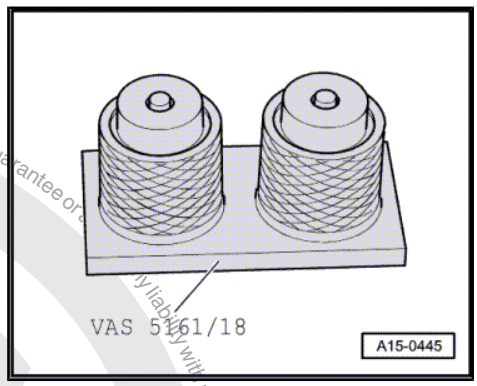


Exhaust side



Note

- *If the valve cotters have been removed from the installation cartridge, they must first be inserted into the insertion device -VAS 5161/18- .*
- *Press assembly cartridge -VAS 5161/8- onto insertion device from above and pick up valve cotters.*



– Press installation cartridge -VAS 5161/8- down with pressure fork -VAS 5161/2- , and turn installation cartridge knurled screw back and forth whilst pulling upwards.

– Relieve pressure fork -VAS 5161/2- whilst pulling on knurled screw.

– Remove removal and installation device -VAS 5161- .

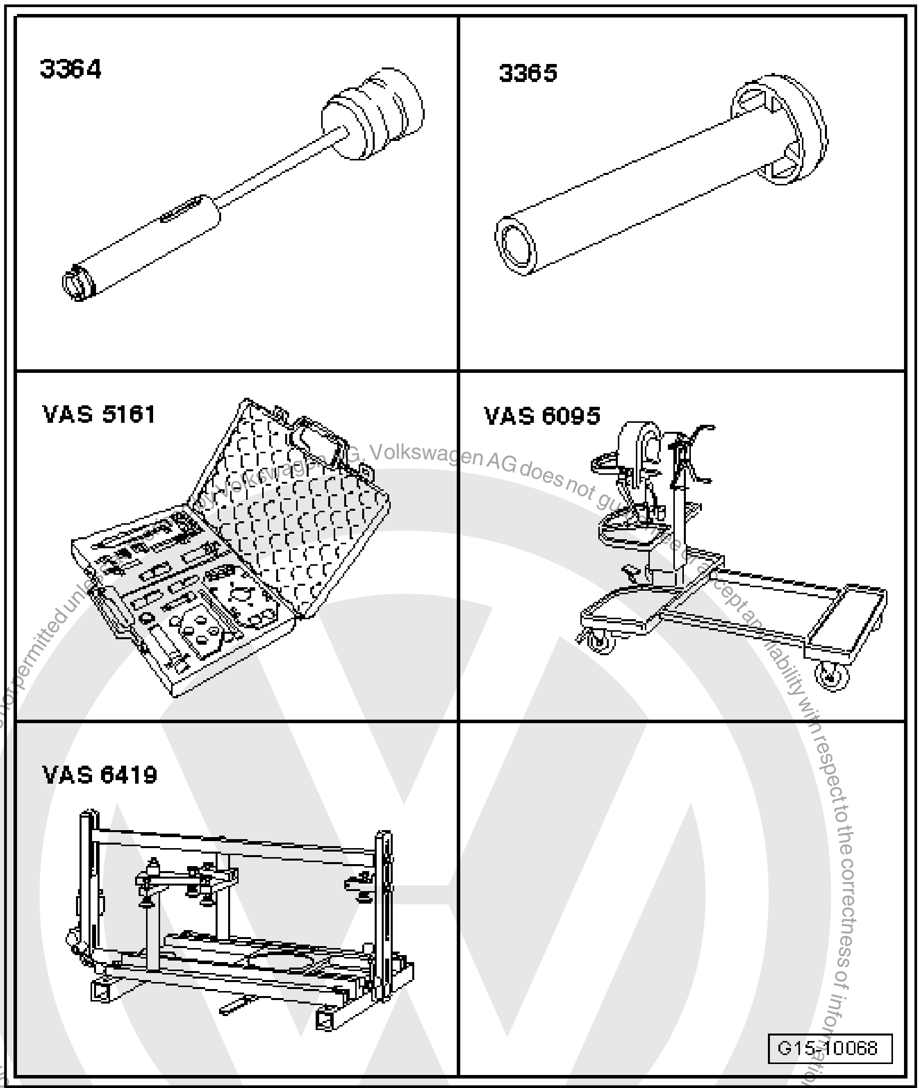
Perform assembly analogously in reverse order of removal. When doing this, observe the following:

– Install camshafts ⇒ page 94 .

3.4 Renewing valve stem seals with cylinder head removed

Special tools and workshop equipment required

- ♦ Valve stem seal puller -3364-
- ♦ Valve stem seal fitting tool -3365-
- ♦ Dismantling and assembling device for valve cotters -VAS 5161-
- ♦ Guide plate for 2.0 l and 3.0 l FSI engine -VAS 5161/19B-
- ♦ Engine and gearbox support -VAS 6095-
- ♦ Cylinder head tensioning device -VAS 6419-



Procedure

– Remove camshafts ⇒ page 94 .

– Mark allocation of roller rocker fingers and hydraulic compensation elements for reinstallation.

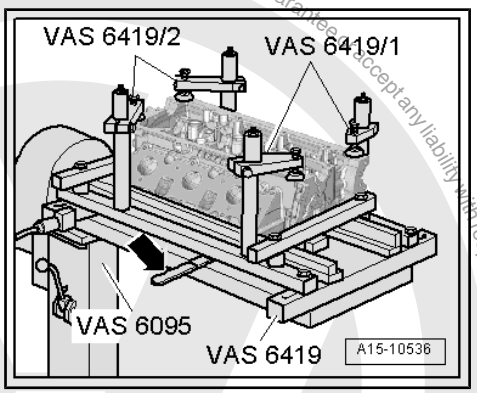
– Remove roller rocker fingers together with hydraulic compensation elements and place down on a clean surface.

– Insert cylinder head tensioning device -VAS 6419- into engine and gearbox support -VAS 6095- .

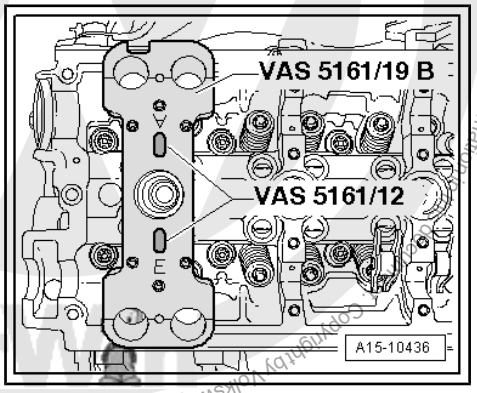
– Tension cylinder head on cylinder head tensioning device as shown in illustration.

– Connect cylinder head tensioning device to compressed air.

– Use lever -arrow- to slide air cushion under combustion chamber from which valve stem seal is to be removed.
– Allow compressed air to flow into air cushion until it lies against valve disc.

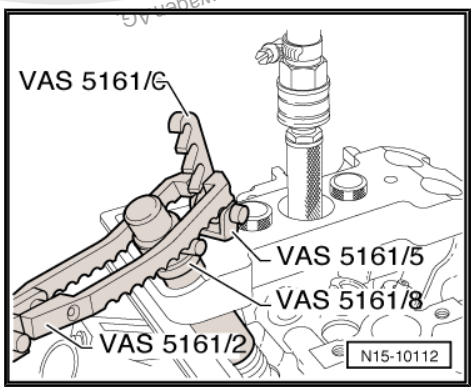


– Secure guide plate for 2.0 litre. and 3.0 ltr. FSI engine -VAS 5161/19B- with knurled screws -VAS 5161/12- to cylinder head as shown.
– Set piston of respective cylinder to „bottom dead centre“.
– Insert drift -VAS 5161/3- into guide plate and use a plastic hammer to knock loose the firmly seated valve cotters.



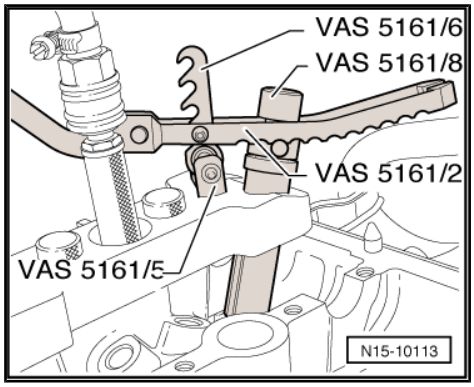
For inlet side

– Screw retainer -VAS 5161/6- with guide fork -VAS 5161/5- into centre thread of guide plate for 2.0 ltr. and 3.0 ltr. FSI engine -VAS 5161/19B- .
– Insert assembly cartridge -VAS 5161/8- into guide plate for 2.0 ltr. and 3.0 ltr. FSI engine -VAS 5161/19B- .
– Attach pressure fork -VAS 5161/2- to retainer -VAS 5161/6- .

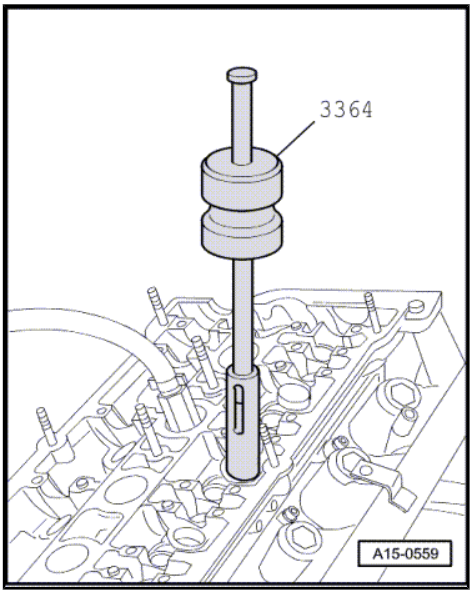


For exhaust side

– Screw retainer -VAS 5161/6- with guide fork -VAS 5161/5- into outer threads of guide plate for 2.0 ltr. and 3.0 ltr. FSI engine -VAS 5161/19B- .
– Press installation cartridge -VAS 5161/8- down and turn knurled screw of installation cartridge -VAS 5161/8- to right until tips engage in valve cotters.
– Move knurled screw back and forth slightly to press apart valve cotters and capture them in the assembly cartridge.
– Release pressure fork -VAS 5161/2- .
– Remove installation cartridge -VAS 5161/8- .



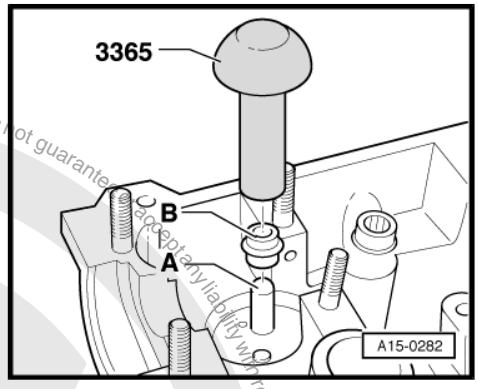
– Pull off valve stem seals using valve stem seal puller -3364- .



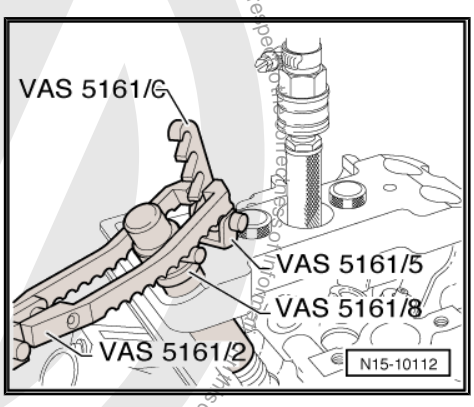
Installing valve stem seals

> **Caution**
>
> ***Risk of damage when installing valve stem seals.***
>
> - ***Place plastic sleeve -A-, enclosed with new valve stem seals -B-, onto valve stem.***

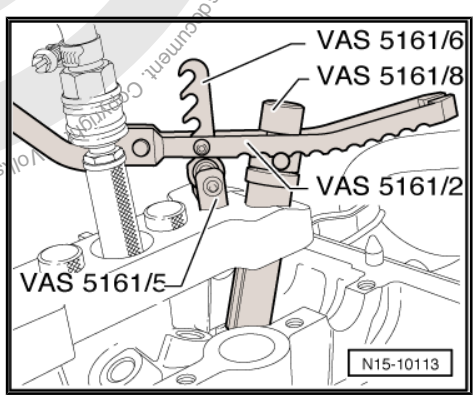
– Lightly oil sealing lip of valve stem seal.
– Push valve stem oil seal onto plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365-.
– Remove plastic sleeve.
– Insert valve spring and valve spring plate.
– Remove removal and installation device for valve cotters -VAS 5161- as shown.



Inlet side

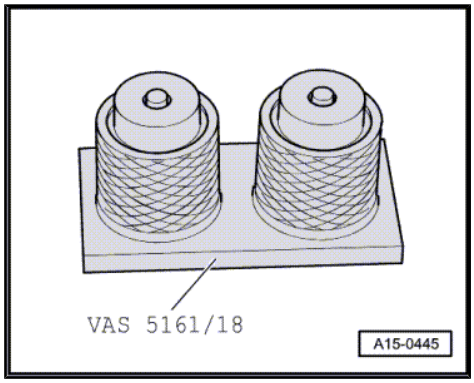


Exhaust side



Note

- *If the valve cotters have been removed from the installation cartridge, they must first be inserted into the insertion device -VAS 5161/18- .*
- *Press assembly cartridge -VAS 5161/8- onto insertion device from above and pick up valve cotters.*



– Press installation cartridge -VAS 5161/8- down with pressure fork -VAS 5161/2- , and turn installation cartridge knurled screw back and forth whilst pulling upwards.
– Relieve pressure fork -VAS 5161/2- whilst pulling on knurled screw.
– Remove removal and installation device for valve cotters -VAS 5161- .

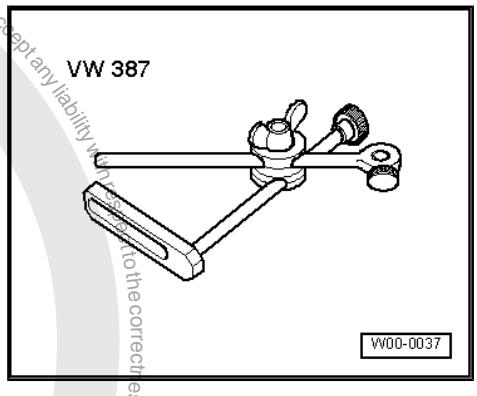
Further assembly is basically the reverse of the dismantling sequence. In the process, note the following:

– Install camshafts ⇒ page 94 .

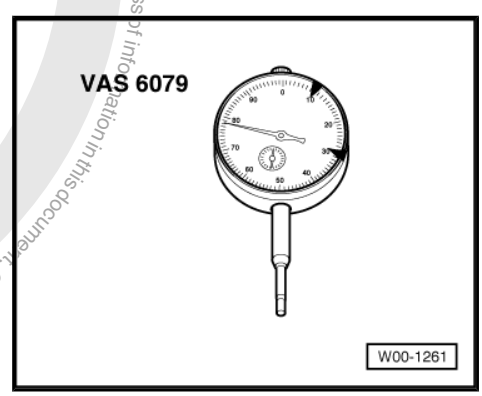
3.5 Checking valve guides

Special tools and workshop equipment required

- Universal dial gauge bracket -VW 387-



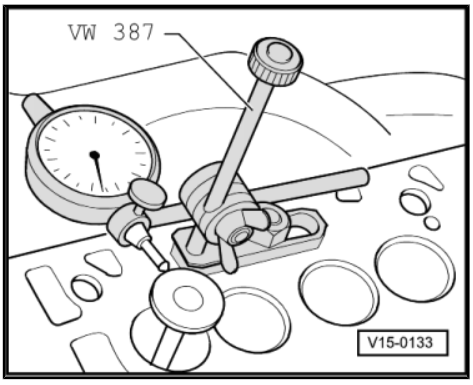
- Dial gauge -VAS 6079-



Test procedure

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

– Determine rock.



Wear limit

Inlet valve guide	Exhaust valve guide
0.80 mm	0.80 mm

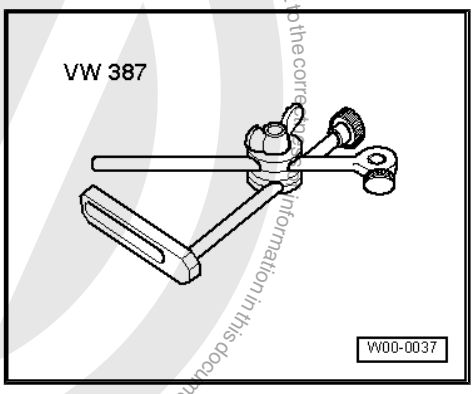
Note

- *If the wear limit is exceeded, repeat the measurement with new valves. If the wear limit is exceeded again, renew the cylinder head.*
- *If the valve is to be renewed as part of a repair, use a new valve for the calculation.*

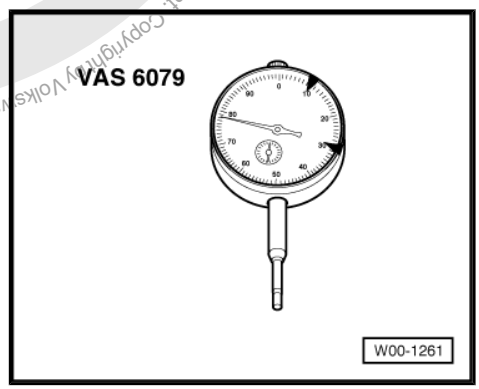
3.6 Checking axial clearance of camshafts

Special tools and workshop equipment required

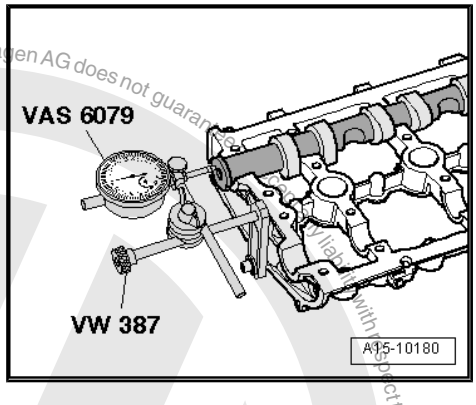
- Universal dial gauge bracket -VW 387-



- Dial gauge -VAS 6079-



Test procedure



– Take measurements with retaining frame removed.
– Fit camshaft to be tested in retaining frame.
– Attach dial gauge -VAS 6079- with universal dial gauge holder -VW 387- to cylinder head.
– Press camshaft against dial gauge by hand.
– Set dial gauge to „0“.
– Press camshaft away from dial gauge and read off value:

• Axial clearance: 0.05 … 0.17 mm.

17 – Lubrication

1 Parts of lubrication system

Draining engine oil ⇒ Maintenance ; Booklet 11

Engine oil ⇒ page 115 .

Assembly overview - oil pump, sump ⇒ page 116

Removing and installing sump ⇒ page 120 .

Assembly overview - oil filter bracket and oil cooler ⇒ page 128

1.1 General notes on the lubrication system

Note

The oil level must not be above the max. mark - danger of damage to catalytic converter!

Caution

If large quantities of metal chips and abraded material are found during engine repair, this may indicate that the crankshaft bearings or conrod bearings are damaged. To avoid any subsequent damage, the following work must be carried out following the repair:

- ***Thoroughly clean oil passages,***
- ***Renew oil spray jets,***
- ***Renew engine oil cooler,***
- ***Renew oil filter element.***

1.2 Engine oil

Oil capacities:

With oil filter change: 7.5 l

Without oil filter change: 7.2 l

Engine oil specifications:

⇒ Maintenance ; Booklet 11

Checking oil level:

Note

The oil level must not be above the max. mark - danger of damage to catalytic converter!

Test prerequisites

- Engine oil temperature at least 60 °C.
- Vehicle must be level (horizontal).
- Wait a few minutes after switching engine off to allow oil to flow back into sump.

Test procedure

– Pull out dipstick, wipe off with a clean cloth and insert it again to stop.

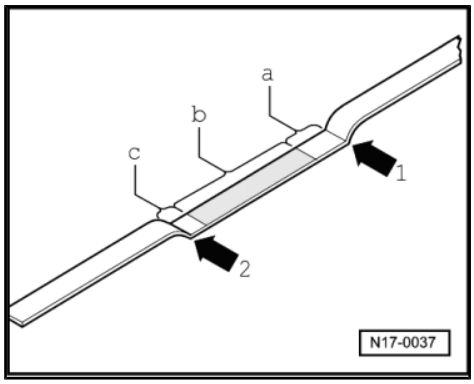
– Pull out dipstick again and read oil level.

Markings on dipstick:

a - Oil is not to be topped up.

b - Oil can be topped up.

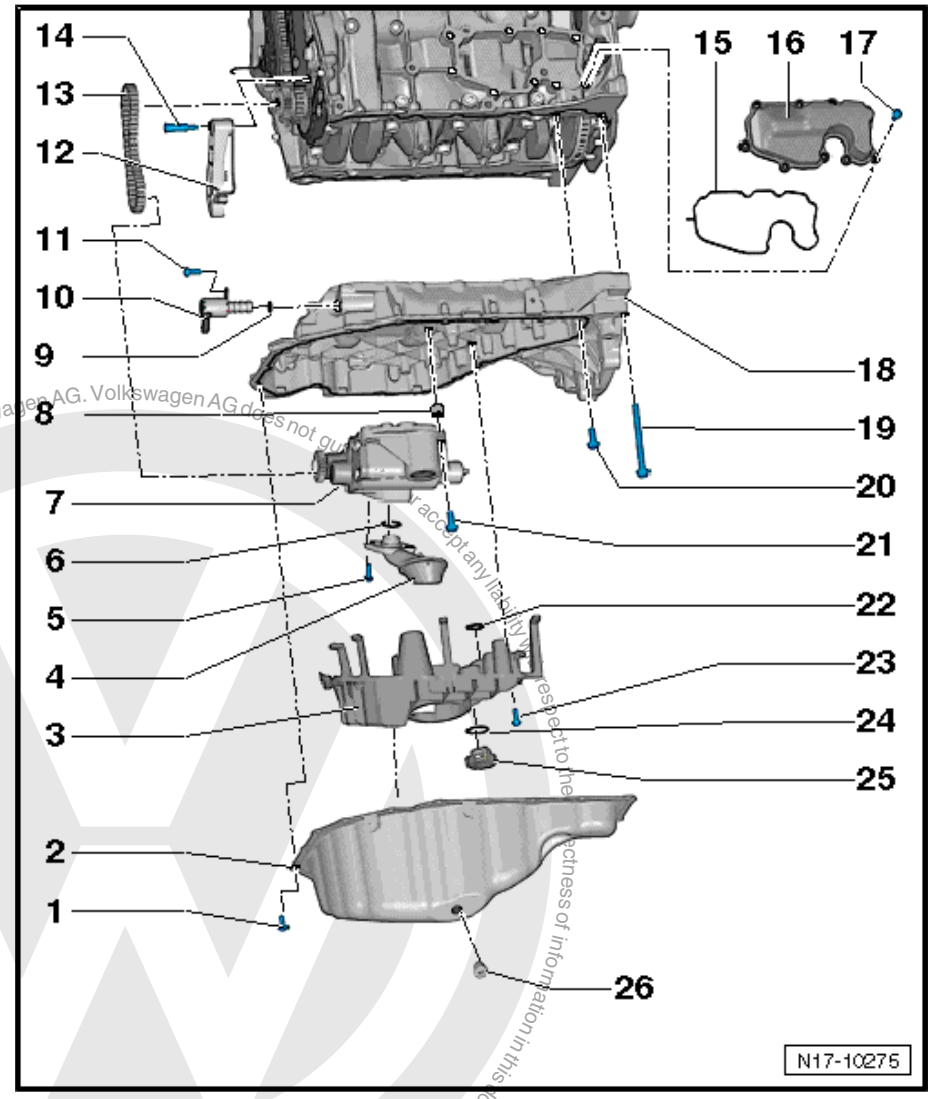
c - Oil must be topped up.



Note

The oil level must not be above the max. marking -arrow 1- nor below the min. marking -arrow 2-.

1.3 Assembly overview - sump, oil pump



1 - Bolt
- ❑ Renew.
- ❑ Tightening sequence ⇒ page 117 .

2 - Lower part of sump
- ❑ Removing and installing ⇒ page 120 .

3 - Baffle plate
- ❑ Renew.

4 - Suction line
- ❑ Clean strainer if soiled.

5 - Bolt
- ❑ 9 Nm

6 - O-ring
- ❑ Renew.
- ❑ Moisten with oil.

7 - Oil pump
- ❑ Removing and installing ⇒ page 119 .

8 - Centring sleeve

9 - O-ring
- ❑ Renew.

10 - Oil pressure control valve -N428-
- ❑ Removing and installing ⇒ page 128 .

11 - Bolt
- ❑ 9 Nm

12 - Chain tensioner

13 - Drive chain for oil pump
- ❑ Mark direction of rotation before removing.

14 - Bolt
- 9 Nm

15 - Seal
- Renew.

16 - Coarse oil separator
- Removing and installing ⇒ page 118 .

17 - Bolt
- Tightening sequence ⇒ page 118 .

18 - Upper part of sump
- Removing and installing ⇒ page 124 .

19 - Bolt
- Renew.
- Tightening sequence ⇒ page 118 .

20 - Bolt
- Renew.
- Tightening sequence ⇒ page 118 .

21 - Bolt
- 20 Nm

22 - Seal

23 - Bolt
- 9 Nm

24 - Seal

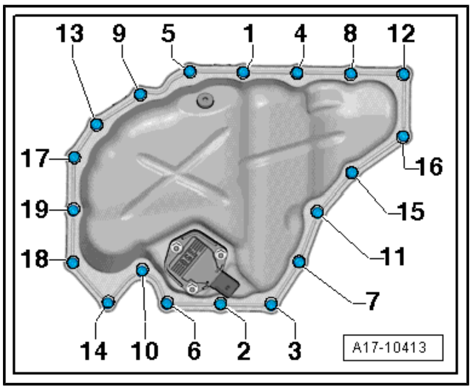
25 - Non-return valve

26 - Oil drain plug
- Renew.
- 30 Nm

Tightening sequence for sump (bottom section)

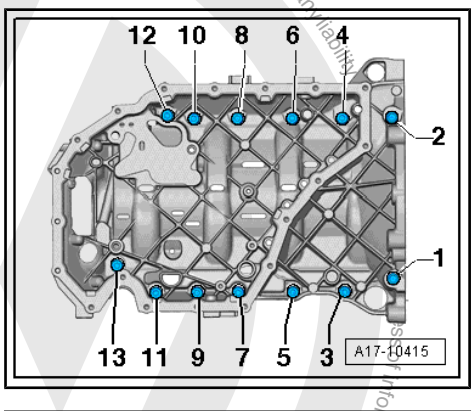
– Tighten bolts in sequence -1 to 19- in 2 stages as follows:

1. Tighten bolts to 8 Nm.
2. Turn bolts 45° further



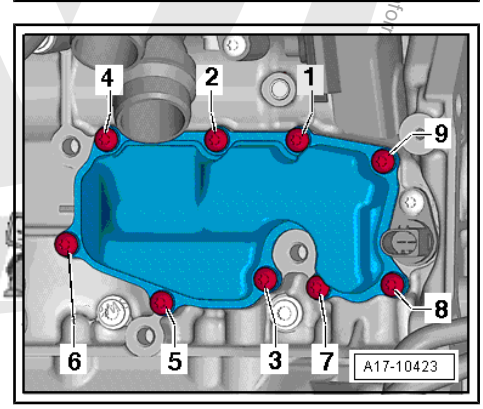
Tightening sequence for sump (top section)

– Tighten bolts in sequence -1 to 13- in 2 stages as follows:
– 1. Tighten bolts to 15 Nm.
– 2. Turn bolts 90° further.



Tightening sequence for coarse oil separator

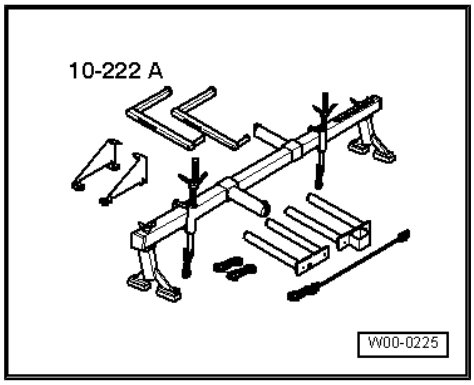
– Tighten bolts in the sequence -1 … 9- to 9 Nm.



1.4 Removing and installing coarse oil separator

Special tools and workshop equipment required

♦ Support bracket -10 - 222 A-



Removing

– Support engine.
– Release clip -3- from pressure hose -4-.

– Release hose clip -arrow- from throttle valve module -J338- .

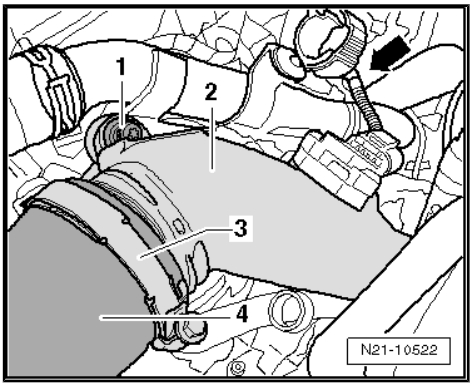
– Unscrew bolt -1- from pressure pipe -2- and remove pressure pipe -2-.

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

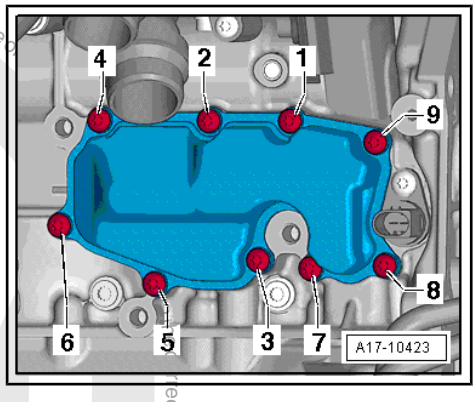
– Remove left engine support ⇒ page 17 .

– Drain coolant ⇒ page 133 .

– Release vacuum hoses ⇒ Item 17 (page 141) and ⇒ Item 13 (page 141) from coolant pump.



– Remove coarse oil separator -1 ... 9-.



Installing

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

– Coarse oil separator, tightening sequence

• Specified torques ⇒ page 116 .

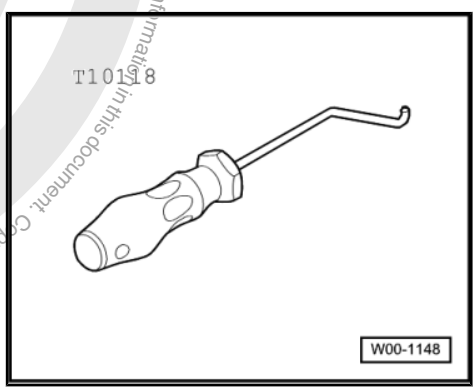
– Replenish coolant ⇒ page 133 .

– Check oil level and top up, if necessary ⇒ page 115 .

1.5 Removing and installing oil pump

Special tools and workshop equipment required

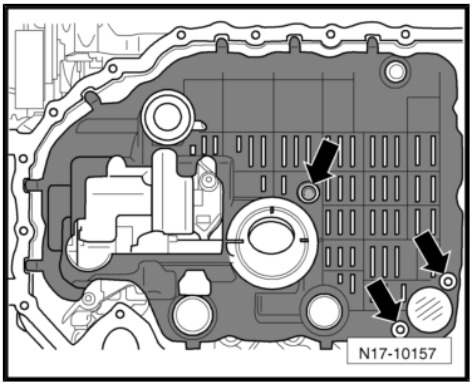
♦ Assembly tool -T10118-



Removing

– Remove sump (bottom section) ⇒ page 120 .

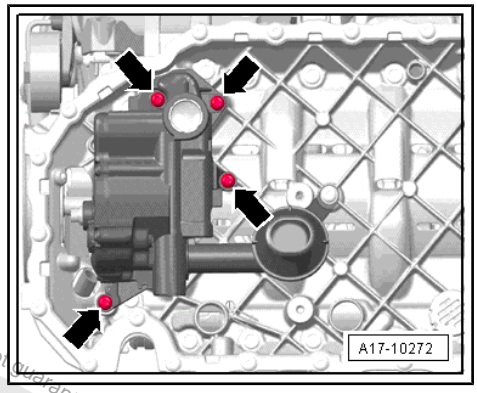
– Remove baffle plate -arrows-.



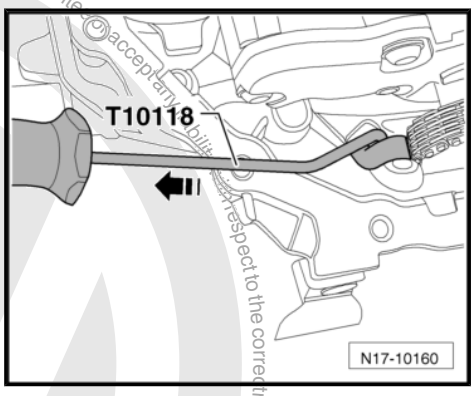
Note

The following procedure must be performed in one operation. A 2nd mechanic is required to assist.

– Unscrew bolts -arrows- and remove oil pump.



– Pull chain tensioner back using assembly tool -T10118- and have oil pump removed by a second mechanic.



Installing

- Specified torques ⇒ page 116 .

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

– Before installing oil pump, check strainer in oil suction pipe and oil galleries in upper part of sump for soiling.

– Check that both centring sleeves for centring oil pump are present.

– Renew baffle plate.

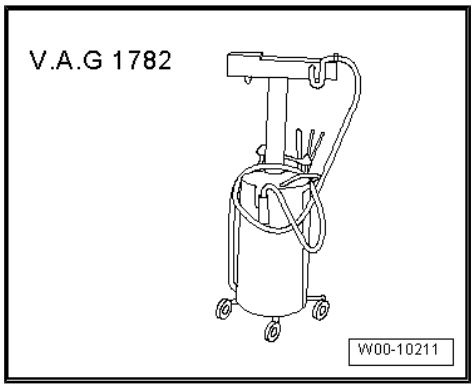
Note

Plastic ribs that are permanently deformed during tightening are located on the baffle plate. The plastic rips ensure that the baffle plate rests without play and does not rattle. For this reason, the baffle plate should always be replaced.

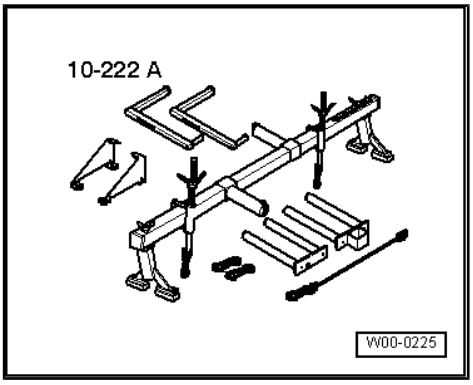
1.6 Removing and installing lower part of sump

Special tools and workshop equipment required

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



- Support bracket -10 - 222 A-



- Hand drill with plastic brush
- Eye protection
- Silicone sealant -D 174 003 A2-

Removing

Note

To remove the sump lower part the engine has to be supported and raised by approx. 15 cm. This ensures the necessary space to remove the sump lower part.

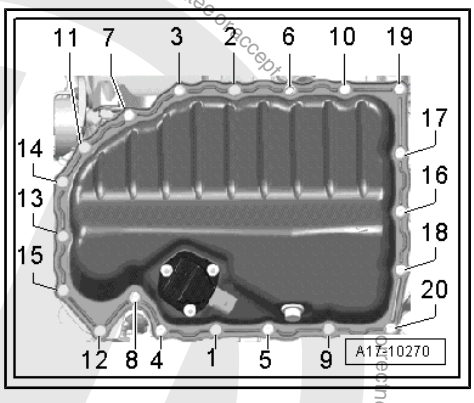
– Support engine with support bracket -10 - 222 A- .
– Unscrew bolts for right and left engine mounting ⇒ page 17 .
– Raise engine by approx. 15 cm.
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .
– Drain off engine oil.

Note

Observe environmental regulations for disposal.

– Unscrew bolts -1 … 20-.

– Remove sump; if necessary, loosen using light blows with a rubber-headed hammer.



Installing

- Specified torques

Note

♦ *Observe use-by date of silicone sealant.*

♦ *The sump must be installed within 5 minutes of applying silicone sealing compound.*

– Remove sealant residues from sump upper part with a flat scraper.

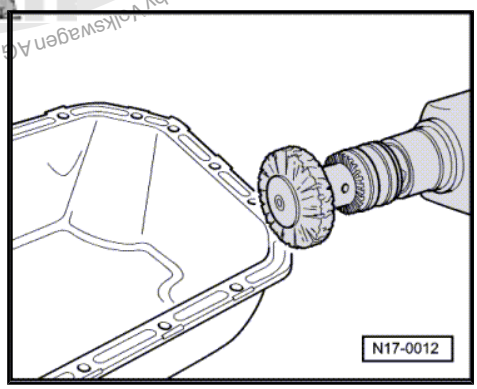
WARNING

Risk of eye injury.

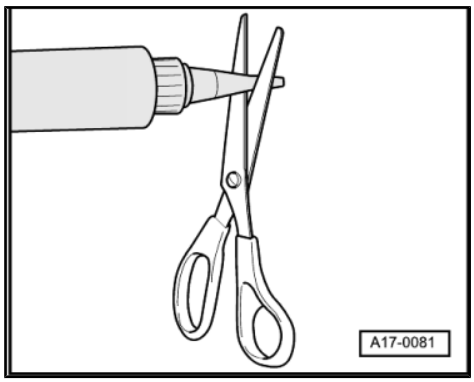
♦ ***Wear safety goggles.***

– Remove sealant residue from bottom part of sump, e.g. with rotating plastic brush.

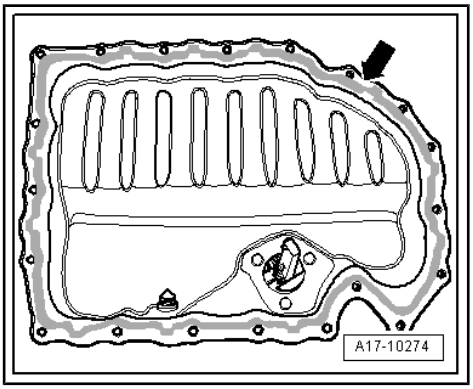
– Clean sealing surfaces until they are all oil- and grease-free.



– Cut off nozzle on tube at front marking (∅ of nozzle approx. 3 mm).



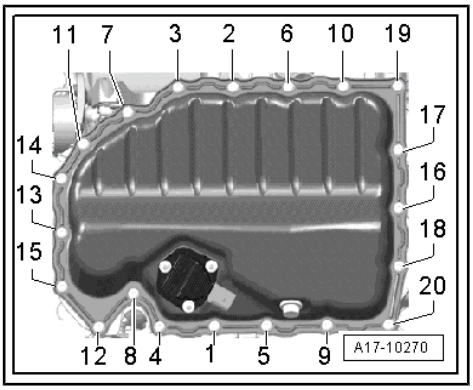
– Apply the bead of silicone sealant -D 174 003 A2- to the clean sealing surface of the sump (lower part), as illustrated.



Note

- *The sump must be installed within 5 minutes of applying silicone sealing compound.*
- *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*
- Thickness of sealant bead: 2…3 mm.

– Fit sump lower part immediately and tighten bolts -1 to 20- in 3 stages as follows:



1 - Tighten bolts hand tight.

2 - Tighten bolts to 8 Nm.

3 - Turn bolts 45° further

Note

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

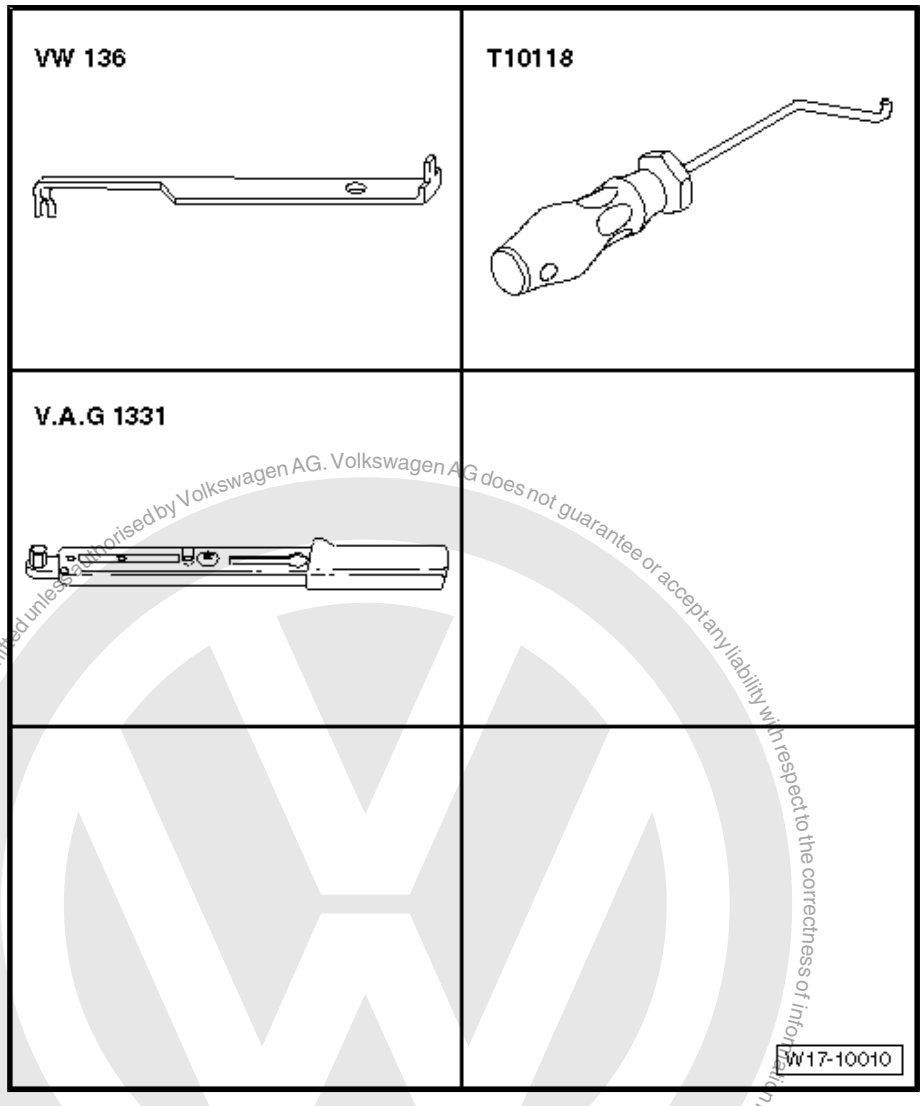
– Top up engine oil, oil capacities ⇒ page 115 .

Assembly is performed analogously in the reverse order of removal.

1.7 Removing and installing upper part of sump

Special tools and workshop equipment required

- Assembly tool -T10118-
- Brake lining wear gauge - VW 136-
- Torque wrench -V.A.G 1331-
- Silicone sealant -D 174 003 A2-

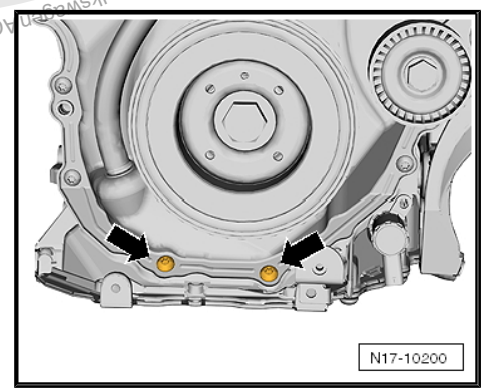


Removing

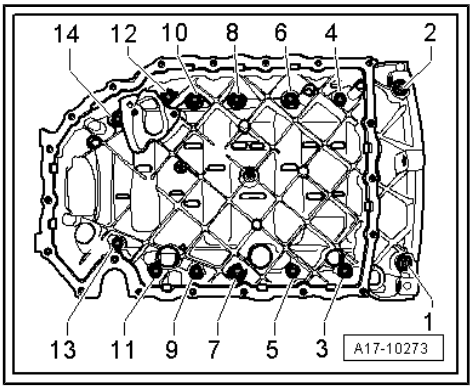
– Remove gearbox ⇒ Rep. gr. 34 .
– Remove oil pump ⇒ page 119 .
– Remove sealing flange on gearbox side ⇒ page 33 .
– Unscrew bolts -arrows-.

DANGER!

Injury risk! When removing upper part of sump, spring of chain tensioner for oil pump drive jumps from upper part of sump to lower timing chain cover. When removing upper part of sump, do not grip between upper part of sump and lower timing chain cover.



– Remove bolts -1 to 14- and lever off upper part of sump.



Caution

Lever off upper part of sump on gearbox side first. When levering off, exercise caution to ensure the timing chain cover is not bent in the process.

Installing

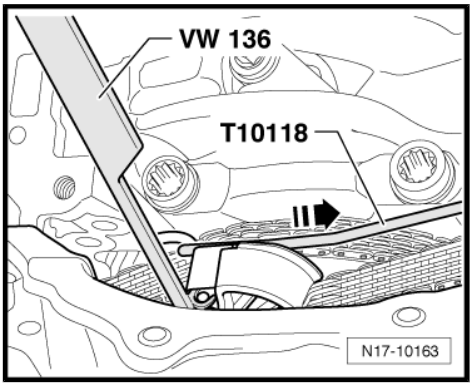
- Specified torque ⇒ page 116 .

Note

- *Observe use-by date of silicone sealant.*
- *The sump upper part must be installed within 5 minutes of applying silicone sealing compound.*

– Use assembly tool -T10118- to pull spring of chain tensioner for oil pump drive in direction of guide rail -arrow-.

– Secure spring by inserting brake lining wear gauge -VW 136- , as shown in illustration, into hole of guide rail.



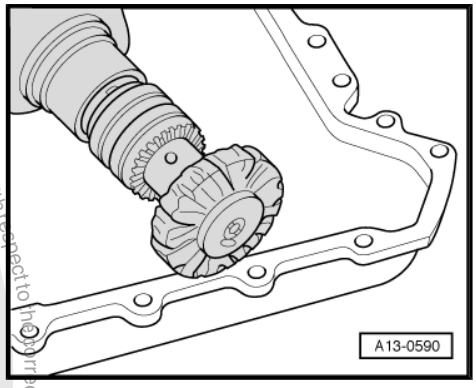
– Remove sealant residues from cylinder block with a flat scraper.

WARNING

Risk of eye injury.

- ***Wear safety goggles.***

– Remove remaining sealant on upper part of sump and lower timing chain cover e.g. using rotating plastic brush.



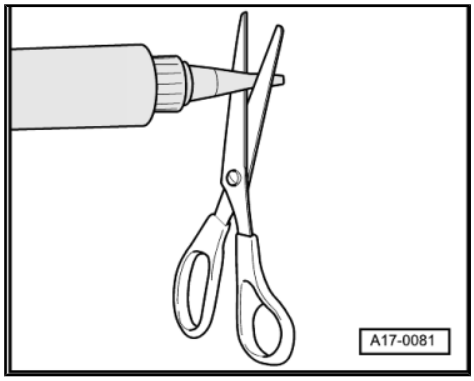
Note

Check timing chain cover for deformation. To do this, fit sump upper part first without sealant and check gap between cover and sump upper part. Renew cover if deformation is found which cannot be corrected. Renew cover once sump upper part has been installed.

– Clean sealing surfaces until they are all oil- and grease-free.

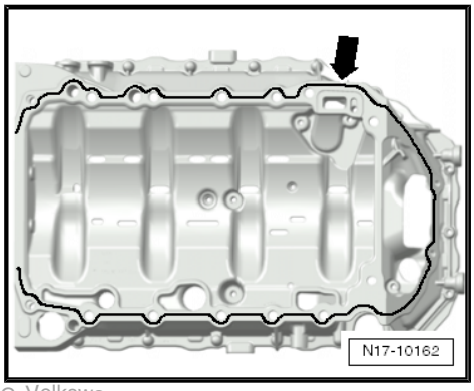
– Check oil galleries in sump upper part and crankcase for soiling.

– Cut off nozzle on tube at front marking (∅ of nozzle approx. 3 mm).



– Apply silicone sealant -D 174 003 A2- onto clean sealing surface of upper part of sump, as illustrated -arrow-.

• Thickness of sealant bead: 2…3 mm



Note

- *The sump upper part must be installed within 5 minutes of applying silicone sealing compound.*
- *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*

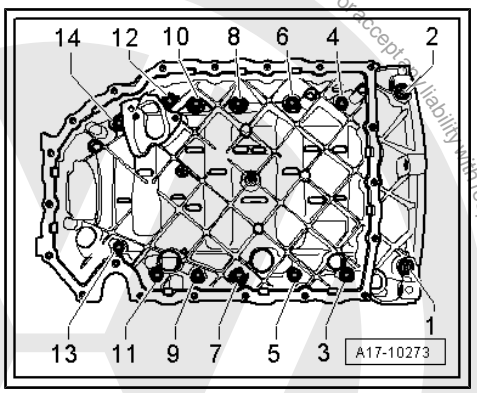
• Sump upper part and crankcase must be flush on gearbox side.

– Fit sump upper part immediately and tighten bolts -1 to 14- in 3 stages as follows:

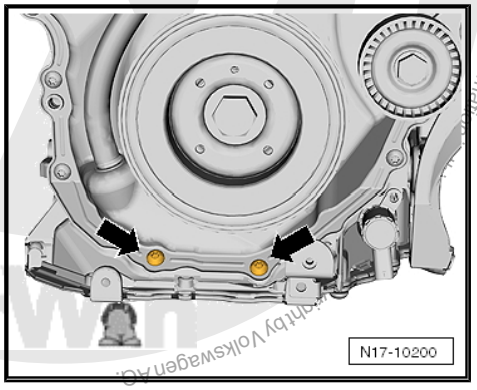
1 - Tighten bolts hand tight.

2 - Tighten bolts to 15 Nm.

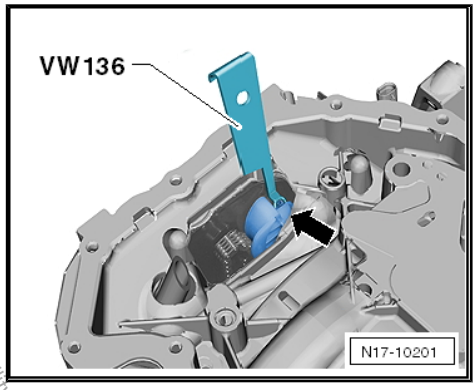
3 - Turn bolts 90° further.



– Install bolts -arrows-. Specified torque.



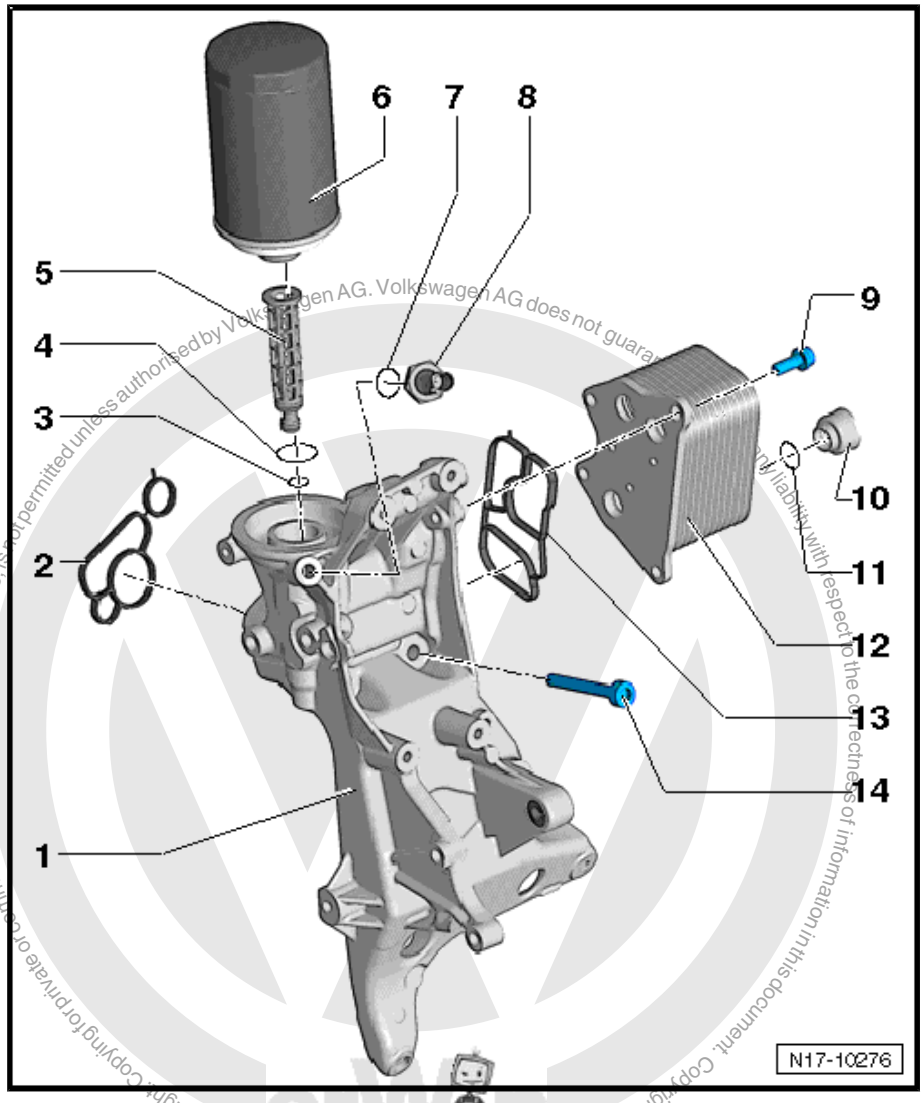
– Pull brake lining wear gauge -VW 136- out of guide rail -arrow-. Spring now jumps back to installation position.



Assembly is performed analogously in the reverse order of removal.

2 Oil filter bracket, oil pressure, engine oil cooler and oil supply line

2.1 Assembly overview - oil filter, engine oil cooler



1 - Bracket for ancillaries
- ❑ Removing and installing ⇒ page 24 .

2 - Seal
- ❑ Renew.

3 - O-ring
- ❑ Not replacement part. Include in items supplied with valve unit

4 - O-ring
- ❑ Not replacement part. Include in items supplied with valve unit

5 - Valve unit
- ❑ With O-rings

6 - Oil filter
- ❑ Removing and installing Amarok ⇒ Maintenance ; Booklet 11 .
- ❑ Remove and install with oil filter tool -3417- .

7 - Seal
- ❑ Renew.

8 - Oil pressure switch -F22-
- ❑ Blue insulation
- ❑ Removing and installing ⇒ page 130 .
- ❑ Check ⇒ Vehicle diagnostic tester.
- ❑ 20 Nm

9 - Bolt
- ❑ 23 Nm

10 - Connection

11 - Seal
- ❑ Renew.
- ❑ Coat with coolant additive; coolant additive ⇒ Electronic parts catalogue .

12 - Engine oil cooler
- ❑ See note ⇒ page 129 .
- ❑ Ensure clearance to adjacent components.
- ❑ Removing and installing ⇒ page 129 .

13 - Seal
- ❑ Renew.

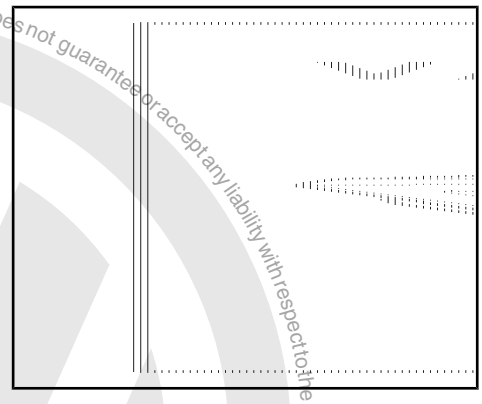
14 - Bolt

❑ Tightening sequence

2.2 Removing and installing engine oil cooler

Special tools and workshop equipment required

♦ Drip tray for workshop hoist -VAS 6208-



Removing

WARNING

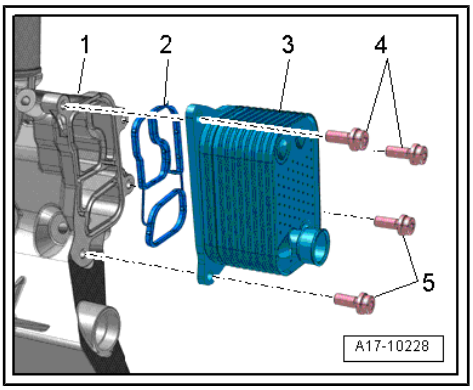
Hot steam/hot coolant can escape - risk of scalding.

- *The cooling system is under pressure when the engine is hot.*
- *Cover filler cap on expansion tank with a cloth and open carefully to dissipate pressure.*

– Drain coolant ⇒ page 133 .

– Remove bracket for ancillaries ⇒ page 24 .

– Unscrew bolts -4 and 5- and remove engine oil cooler -3- together with seal -2-.



Installing

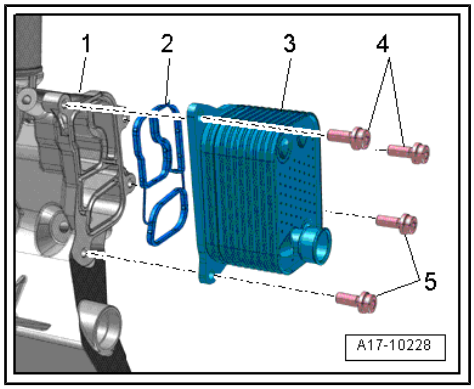
Installation is carried out in the reverse order. When installing, note the following:

- Specified torques ⇒ page 128 .

Note

- *Renew gaskets and seals.*
- *Secure all hose connections with hose clips corresponding to the series equipment ⇒ Electronic parts catalogue .*

– Install engine oil cooler -3- with new seal -2-.
– Install bracket for ancillaries ⇒ page 24 .
– Replenish coolant ⇒ page 133 .

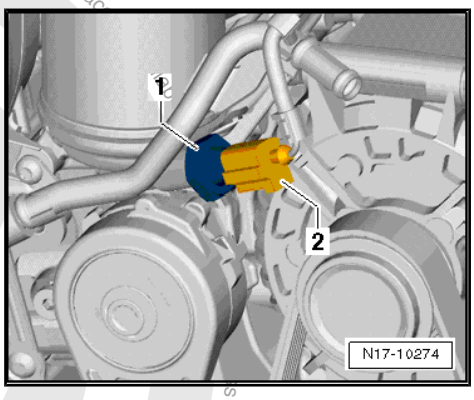


2.3 Removing and installing oil pressure switch -F22-

Removing

Note

Place a cloth underneath bracket for ancillaries to catch any escaping engine oil.



– Detach connector -2- from oil pressure switch -F22- -1-.
– Unscrew oil pressure switch -F22- -2-.

Installing

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

- Specified torque ⇒ page 128 .

Note

- *Renew seal.*
- *Insert new oil pressure switch -F22- immediately in bore to avoid loss of oil.*

2.4 Removing and installing oil supply line to turbocharger

Removing

– Loosing securing bolt for oil supply line ⇒ page 192 .
– Loosen bolt at top and bottom of oil supply line.

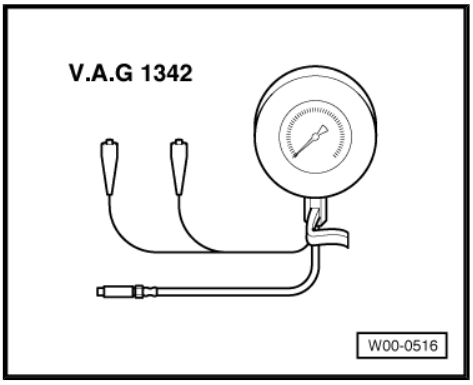
Installing

– Install in reverse order.

2.5 Checking oil pressure

Special tools and workshop equipment required

♦ Oil pressure tester -V.A.G 1342-



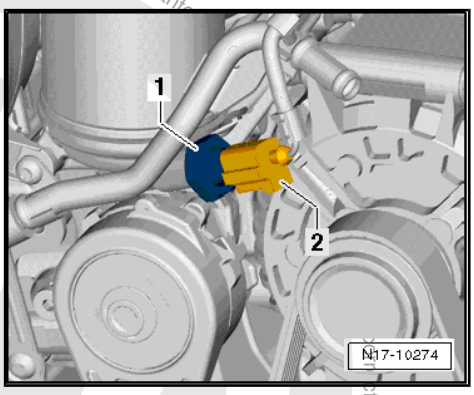
Test prerequisites

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

Test procedure

Note

Place a cloth underneath bracket for ancillaries to catch any escaping engine oil.



– Detach connector -2- from oil pressure switch -F22- -1-, unscrew oil pressure switch -F22- .
– Screw oil pressure tester -V.A.G 1342- into oil filter bracket in place of oil pressure switch.
– Start engine.
• Oil pressure at idling speed:1.2 ... 2.1 bar.
• Oil pressure at 2000 rpm: 1.6 ... 2.1 bar.
• Oil pressure at 3700 rpm: 3.0 ... 4.0 bar.

Note

During the first 1000 km the oil pressure could be 3.0 to 4.0 bar at 2000 rpm.

Reassembly

• Specified torques ⇒ page 128 .
– Install oil pressure switch.

19 – Cooling

1 Cooling system

General notes on cooling system ⇒ page 132

1.1 General notes on cooling system

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.

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 from all moving or hot components.***

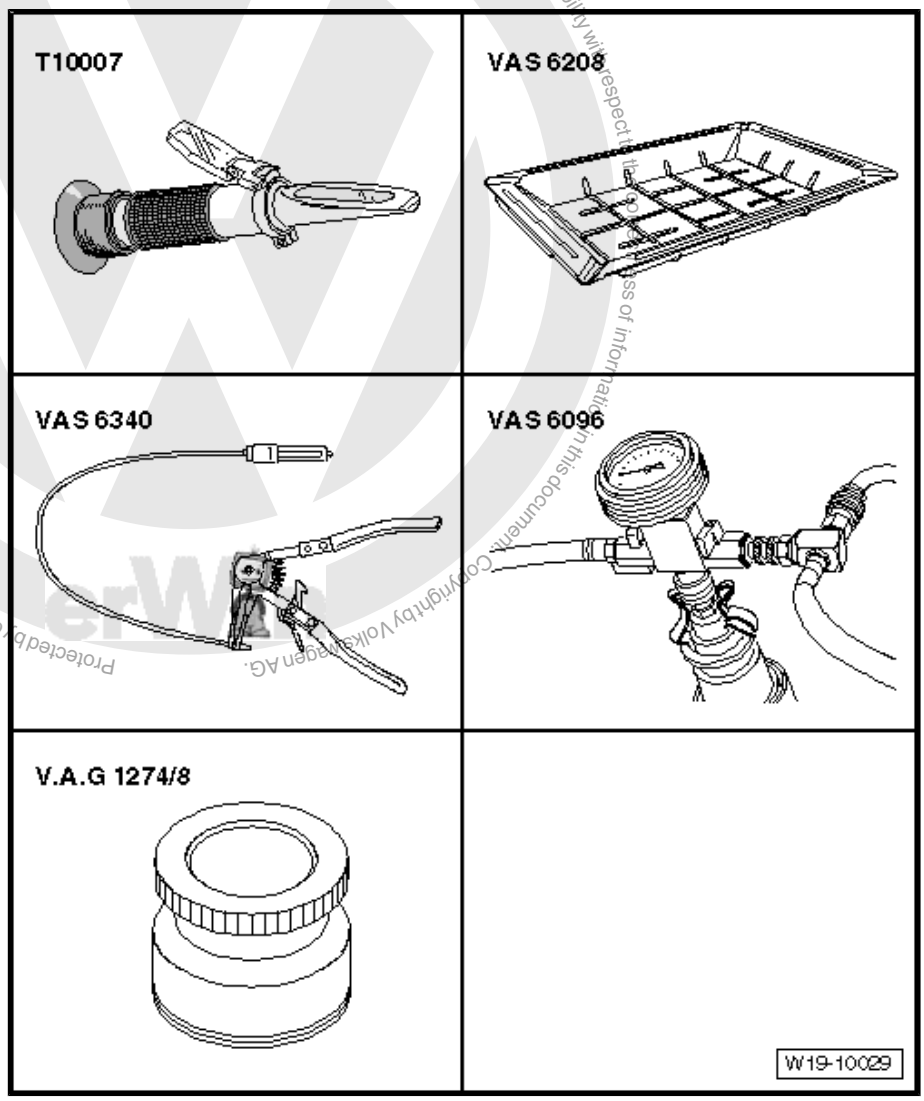
Note

- *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 hose clip pliers -VAS 6362- are recommended for installation of spring-type clips.*
- *When installing coolant hoses, route stress-free so that they do not come into contact with other components (observe markings on coolant connection and hose).*
- *The arrows on the coolant pipes and coolant hoses must be aligned with each other.*
- *Only demineralised / distilled water to standard VDE-0510 may be used for mixing. Tap water does not have the required quality to ensure the coolant's function.*

1.2 Draining and filling coolant

Special tools and workshop equipment required

- Refractometer -T10007-
- Drip tray for workshop hoist -VAS 6208-
- Hose clip pliers -VAS 6340-
- Cooling system charge unit -VAS 6096-
- Adapter for cooling system tester -V.A.G 1274/8-



Procedure:

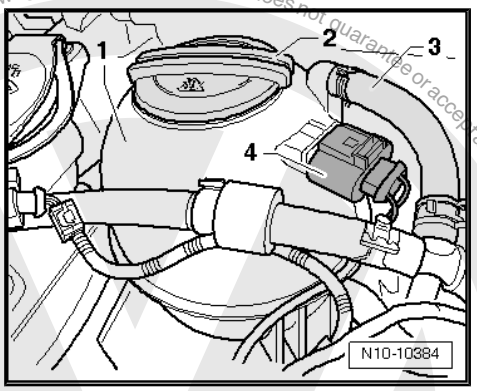
Draining

WARNING

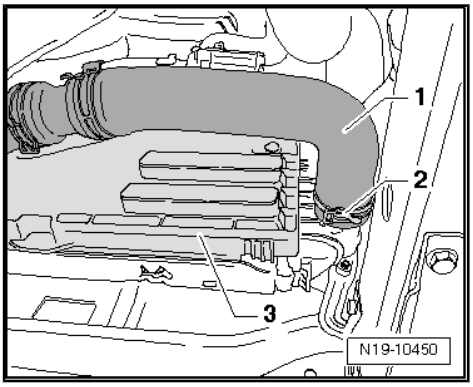
Steam may escape when expansion tank is opened. Wear eye protection and protective clothing to avoid eye injuries and scalding. Cover cap with cloth and open carefully.

– Open filler cap -2- on expansion tank -1-.

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .



– Remove spring-type clip -2 and detach bottom coolant hose -1- from radiator -3-.



Note

Observe environmental regulations for disposal.

Filling

Note

- *G 13 is used as the anti-freeze in series production.*
- *Only demineralised / distilled water to standard VDE-0510 may be used for mixing. Tap water does not have the required quality to ensure the coolant's function.*
- *Only G 13 and G 12 plus-plus in accordance with TL VW 774 G may then be used as coolant additive.*
- *G 13 Plusplus prevents frost and corrosion damage and scaling and also raises the boiling points. 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.*
- *Frost protection is required down to about -25°C (in countries with arctic climates down to about -35°C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The coolant additive concentration must be at least 40%.*
- *If a stronger anti-freeze mixture is necessary due to harsher weather conditions, the percentage of G 13 and G 12 Plusplus can be increased. But only to 60% (frost protection to approx. -40°C), otherwise frost protection and cooling effectiveness are reduced again.*
- *If radiator, heat exchanger, cylinder head or cylinder head gasket is renewed, do not reuse old coolant.*
- *The refractometer -T10007- is recommended for determining the current anti-freeze density.*

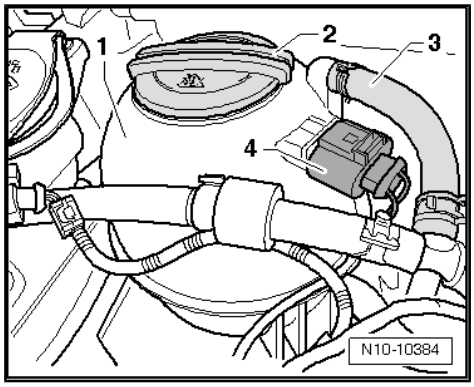
Recommended mixture ratios:

Frost protection to	Anti-freeze ratio	G 13 and G 12 Plus-plus[1)]	Demineral-ised / distil-led water to standard VDE 0510[1)]
-25°C -35°C	40% 50%	5.0l 6.25l	7.5l 6.25l

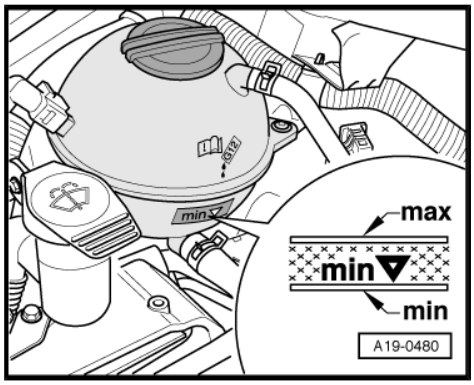
1) The quantity of coolant can vary depending upon vehicle equipment.

Procedure:

– Unscrew filler cap -2- from expansion tank -1-.
– Detach coolant hose -3 from expansion tank -1.
– Fill expansion tank -1 to capacity and reconnect coolant hose -3.
– Seal expansion tank -1- with cap -2-.
– Start engine and keep engine speed at approx. 2000 rpm until radiator fan starts up.



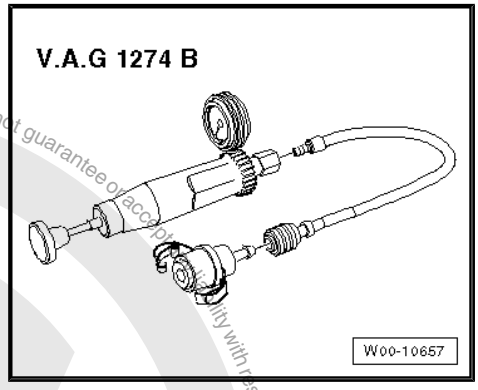
– Check coolant level and top up if necessary. When engine is at normal operating temperature, the coolant level must be at the upper mark; when engine is cold, in the middle of the shaded field.



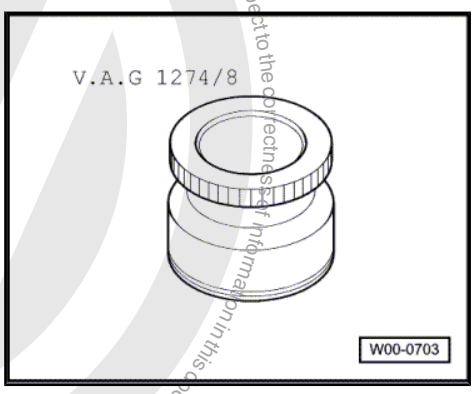
1.3 Checking cooling system for leaks

Special tools and workshop equipment required

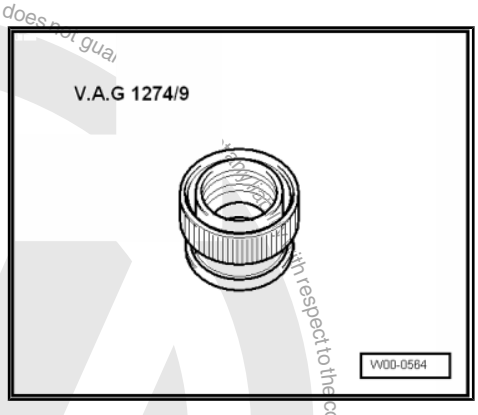
♦ Cooling system tester -V.A.G 1274 B-



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



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



Test prerequisite

- Engine at normal operating temperature

Test sequence:

WARNING

Hot steam may escape when expansion tank is opened. Place cloth over cap and open with caution.

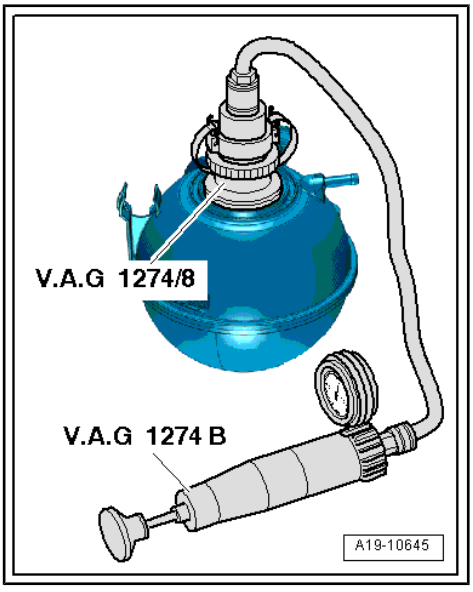
– Open filler cap on coolant expansion tank.

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

– Clamp connector -V.A.G 1274 B/1- into adapter for cooling system tester -V.A.G 1274/8- .

– Join connection piece -V.A.G 1274 B/1- to cooling system tester -V.A.G 1274 B- using connecting hose supplied.

– Using hand pump on tester, build up a pressure of approx. 1.0 bar.



DANGER!

Risk of scalding! Before the cooling system tester -V.A.G 1274 B- is disconnected from the connecting hose or the connector -V.A.G 1274 B/1- it is essential that the pressure is first relieved. To do this, press pressure relief valve on cooling system tester -V.A.G 1274 B- until pressure gauge displays value of »0«.

If pressure drops:

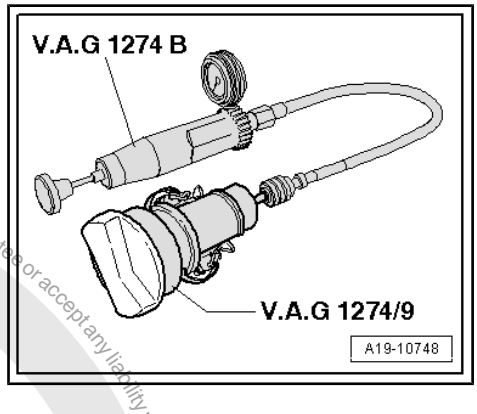
– Find leaks and rectify.

Checking pressure relief valve in filler cap:

– Screw cap into adapter for cooling system tester -V.A.G 1274/9- .

– Clamp connector -V.A.G 1274 B/1- into adapter for cooling system tester -V.A.G 1274/9- .

– Join connection piece -V.A.G 1274 B/1- to cooling system tester -V.A.G 1274 B- using connecting hose supplied.
– Operate hand pump.
• The pressure relief valve should open at a pressure of 1.4 … 1.6 bar.



2 Coolant hose schematic diagram

2.1 Coolant hose schematic diagram for vehicles with heat exchanger

1 - Heat exchanger for heater unit

2 - Cylinder head connection

3 - Circulating pump V 55 (only for Climatronic)

4 - Auxiliary heater

- Depending on equipment.

5 - Circulating pump V 51

6 - Radiator

- Renew coolant after replacing.
- Removing and installing ⇒ page 152 .

7 - Engine oil cooler

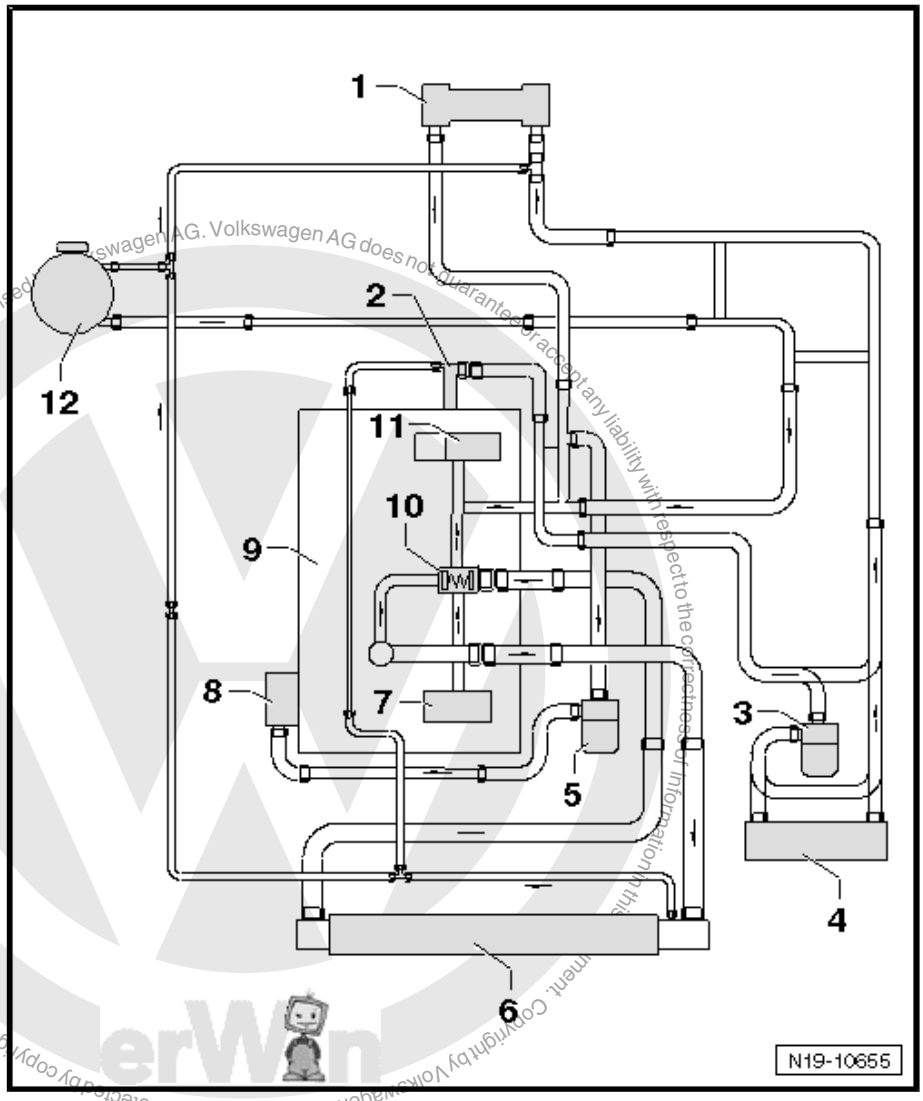
8 - Turbocharger

9 - Cylinder head

10 - Thermostat

11 - Coolant pump

12 - Expansion tank



2.2 Coolant hose schematic diagram for vehicles with 2nd heat exchanger

1 - Connecting pipes for 2nd heat exchanger

2 - Heat exchanger for heater unit

3 - Shut-off valve

4 - Circulating pump V 55 (only for Climatronic)

5 - Auxiliary heater

- ♦ Depending on equipment.

6 - Radiator

- ♦ Renew coolant after replacing.
- ♦ Removing and installing ⇒ page 152 .

7 - Circulating pump V 51

8 - Engine oil cooler

9 - Turbocharger

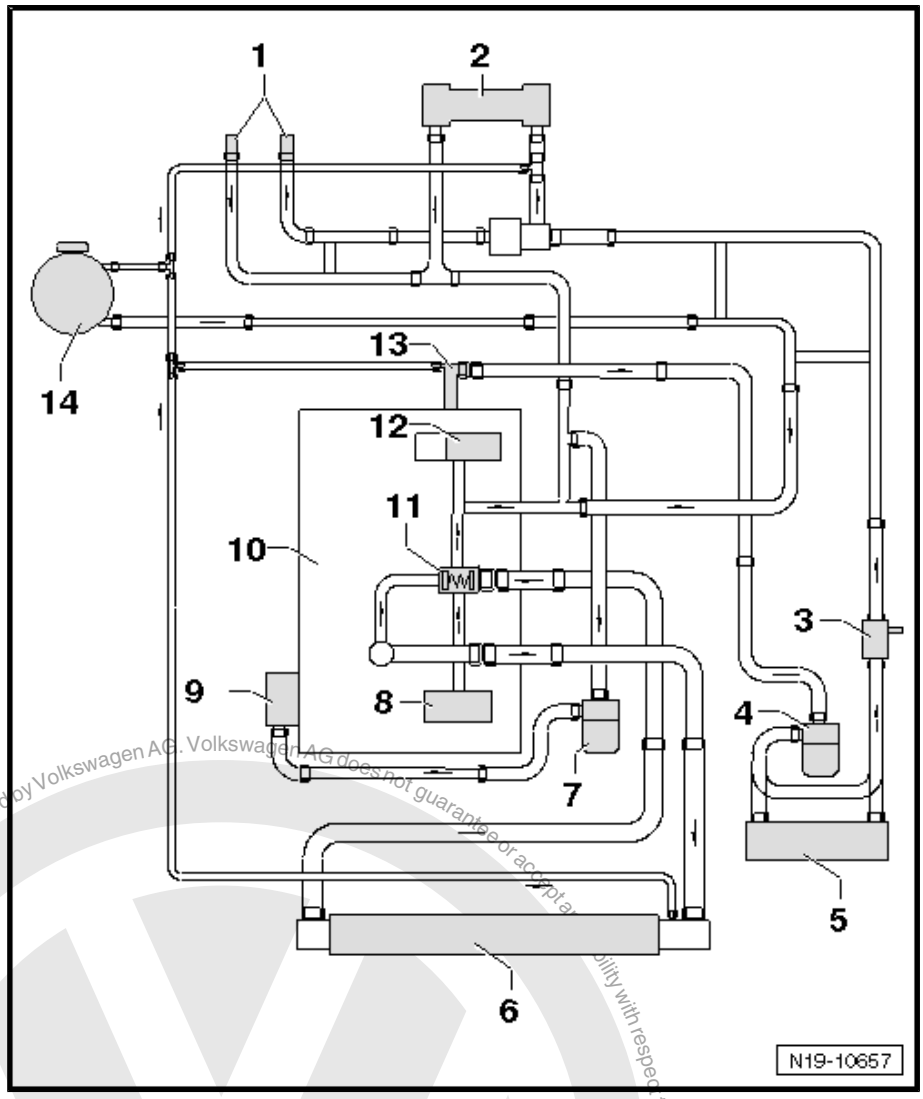
10 - Cylinder head

11 - Thermostat

12 - Coolant pump

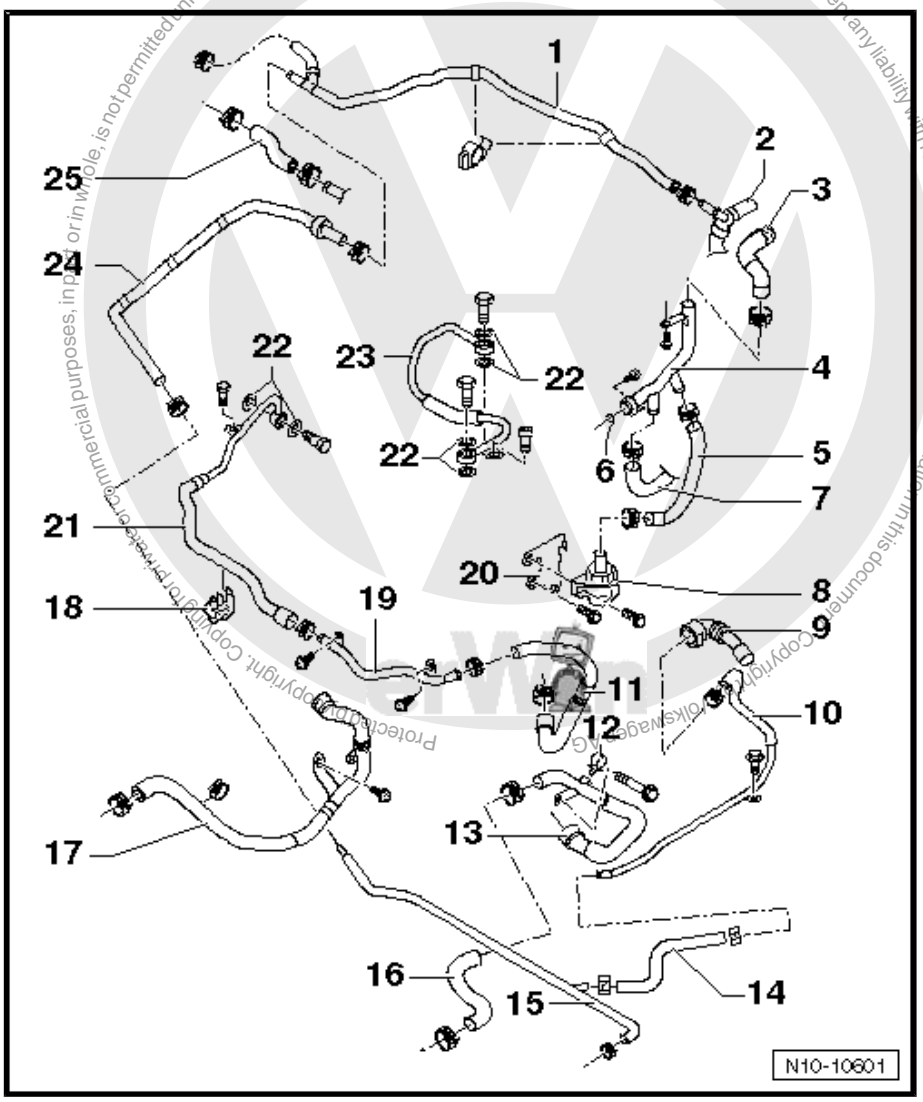
13 - Cylinder head connection

14 - Expansion tank



3 Parts of cooling system, engine side

3.1 Assembly overview - coolant pipes and continued coolant circulation pump -V51-



1 - Coolant hose
- ❑ To expansion tank.

2 - Coolant hose
- ❑ To heat exchanger
- ❑ Return line

3 - Coolant hose
- ❑ To heat exchanger
- ❑ Supply

4 - Coolant pipe

5 - Coolant hose
- ❑ From coolant pipe to supplementary water pump

6 - O-ring

7 - Coolant hose

8 - Continued coolant circulation pump -V51-
- ❑ Removing and installing ⇒ page 142 .

9 - Coolant hose
- ❑ To water connection

10 - Coolant pipe with coolant hose

11 - Coolant hose
- ❑ To supplementary water pump

12 - Retainer

13 - Coolant pipe with coolant hose
- ❑ To coolant pump.

14 - Coolant hose

15 - Coolant hose
- ❑ Radiator top

16 - Coolant hose
- ❑ To radiator
- ❑ Top left

17 - Coolant hose
- ❑ From radiator to coolant pump

18 - Retainer

19 - Coolant pipe

20 - Bracket for continued coolant circulation pump -V51- .

21 - Coolant pipe

- ❑ Return line

22 - Seal

23 - Coolant pipe

- ❑ Supply

24 - Coolant hose

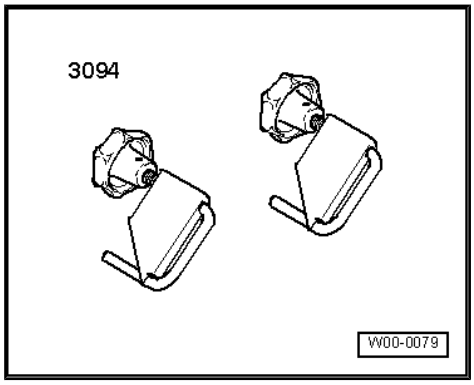
25 - Coolant hose

- ❑ To expansion tank

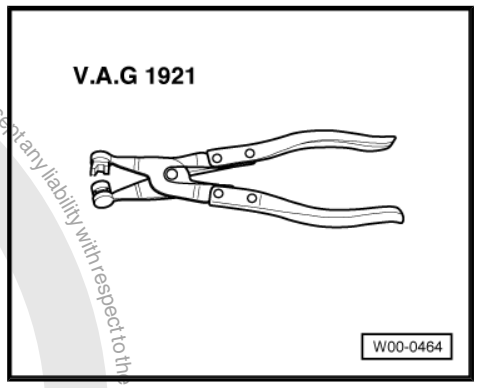
3.2 Removing and installing continued coolant circulation pump -V51-

Special tools and workshop equipment required

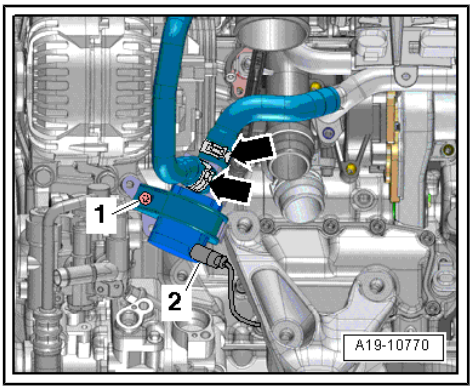
- ♦ Hose clips up to 25 mm -3094-



- ♦ Hose clip pliers -V.A.G 1921-



Removing



Note

Place a cloth under coolant pipe to absorb escaping coolant.

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .
– Clamp off coolant hoses -arrows- using hose clamps to 25 mm -3094- and remove.
– Disconnect electrical connector -2-.
– Remove bolt -1- and detach continued coolant circulation pump -V51- .

Installing

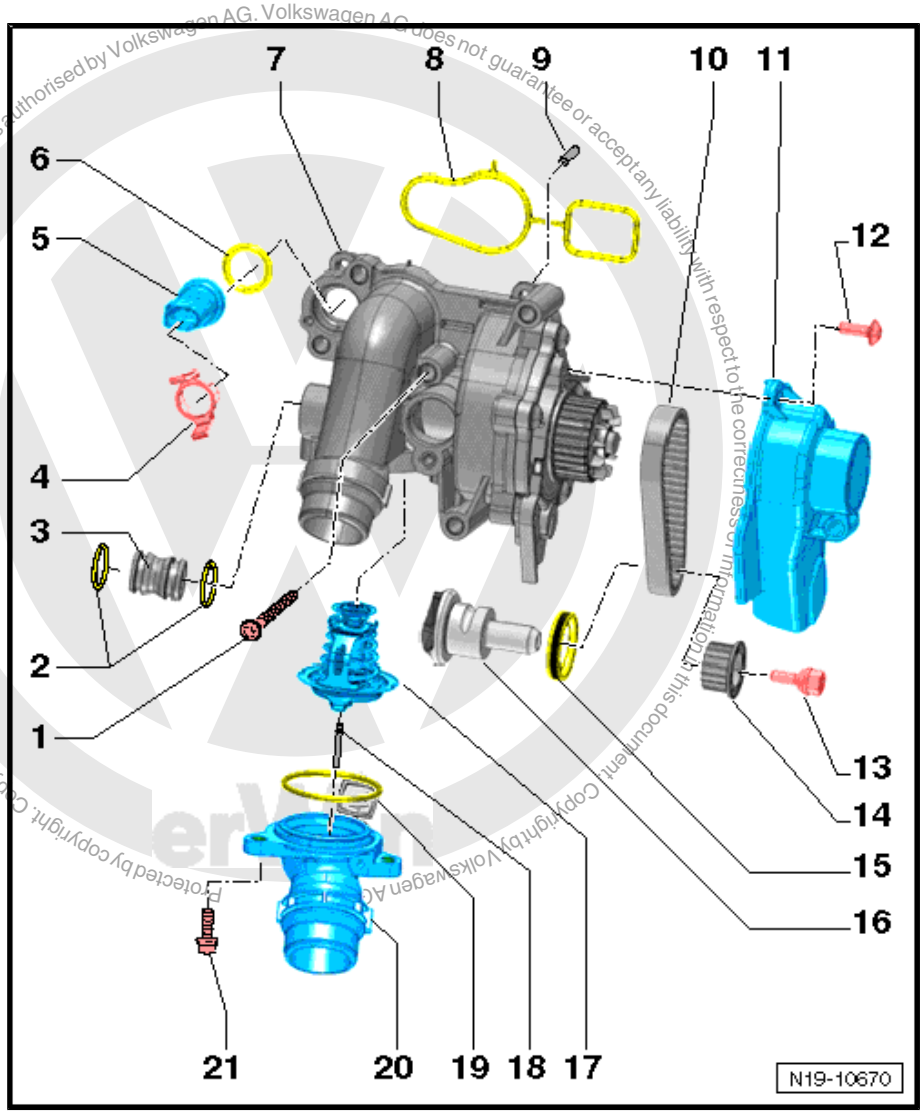
Installation is carried out in the reverse order; note the following:

Note

- *Hose unions and air intake pipes/hoses must be free of oil and grease when installing.*
- *Secure all hose connections with hose clips corresponding to the series equipment ⇒ Electronic parts catalogue .*
- *In order to be able to attach the air ducts on their connections, the screws of the used hose clips have to be sprayed with penetrating spray before installing.*

– Check coolant level ⇒ page 133 .

3.3 Coolant pump and thermostat - exploded view



1 - Bolt
- ❑ Tightening sequence ⇒ page 145 .

2 - O-rings
- ❑ Renew.

3 - Connection

4 - Retaining clip
- ❑ Only for inserted version.
- ❑ Check for secure seating.

5 - Coolant temperature sender -G62-
- ❑ Removing and installing ⇒ page 145

6 - O-ring
- ❑ Renew.

7 - Coolant pump
- ❑ Removing and installing ⇒ page 149 .
- ❑ New coolant pump: remove protective cap

8 - Seal
- ❑ Renew.

9 - Centralising pin
- ❑ Qty. 2.

10 - Toothed belt
- ❑ For coolant pump.
- ❑ Removing and installing ⇒ page 146 .

11 - Toothed belt guard

12 - Bolt
- ❑ 9 Nm

13 - Bolt
- ❑ Left-hand thread.
- ❑ Renew.
- ❑ 10 Nm + 90° further

14 - Toothed belt drive sprocket
- ❑ Note installation position.

15 - Oil seal
- ❑ Renewing ⇒ page 148 .

16 - Balancer shaft

17 - Thermostat
- ❑ Removing and installing ⇒ page 151 .

18 - Centralising pin

19 - O-ring

- ❑ Renew.

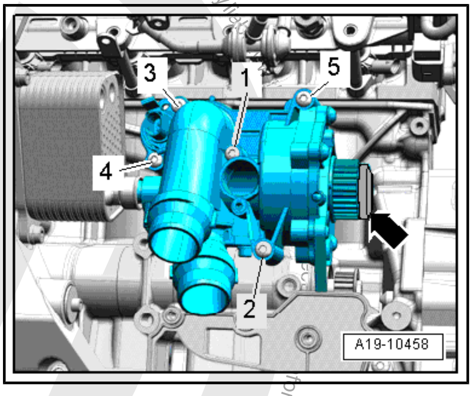
20 - Connection

21 - Bolt

- ❑ 9 Nm

Coolant pump - tightening sequence

– Tighten bolts for coolant pump in the sequence -1 … 5- to 9 Nm.



3.4 Removing and installing coolant temperature sender -G62-

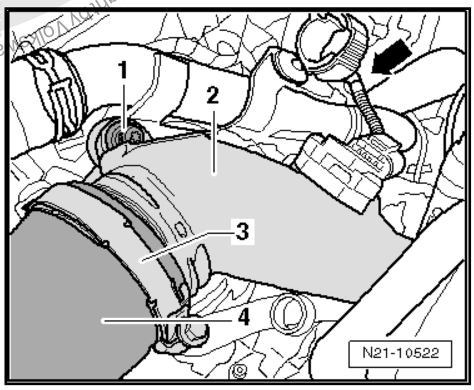
Removing

- Engine cold

– Release clip -3- from pressure hose -4-.

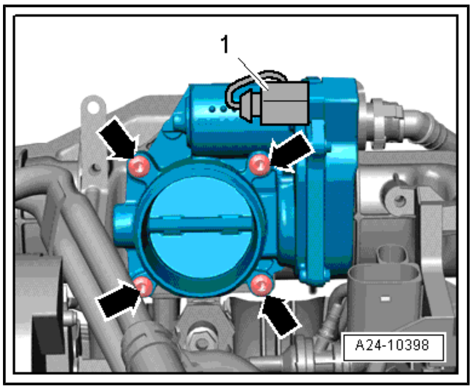
– Release hose clip -arrow- from throttle valve module -J338- .

– Unscrew bolt -1- from pressure pipe -2- and remove pressure pipe -2-.



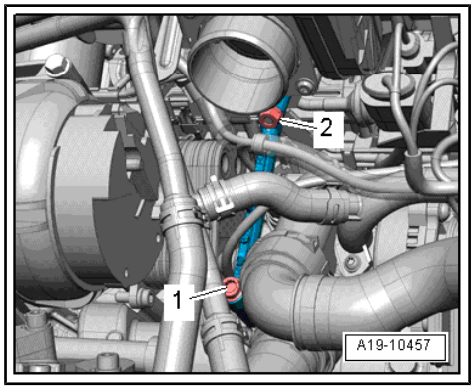
– Disconnect electrical connector -1- at throttle valve module -J338- .

– Remove bolts -arrows- and detach throttle valve module -J338- .

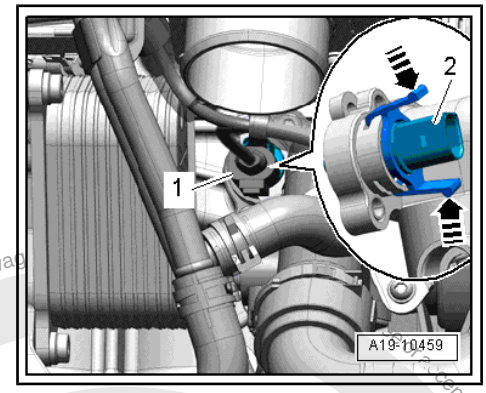


– Remove support for intake manifold (remove nut -2- and bolt -1-).

– Disconnect electrical connector -1- at coolant temperature sender -G62- .



– Detach retaining clip (press release tabs -arrows-).



Note

Place a cloth underneath to absorb escaping coolant.

– Remove coolant temperature sender -G62- -2-.

Installing

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

- Specified torque ⇒ page 144 .

Note

- *Renew O-rings.*
- *Only demineralised / distilled water to standard VDE-0510 may be used for mixing. Tap water does not have the required quality to ensure the coolant's function.*
- *Insert new coolant temperature sender -G62- immediately into connection to avoid loss of coolant.*
- *Hose unions and air intake pipes/hoses must be free of oil and grease when installing.*
- *Secure all hose connections with hose clips corresponding to the series equipment ⇒ Electronic parts catalogue .*
- *In order to be able to securely attach the air ducts on their connections, the screws of the used hose clips have to be sprayed with penetrating spray before installing.*

– Install intake manifold support ⇒ Rep. gr. 24 .

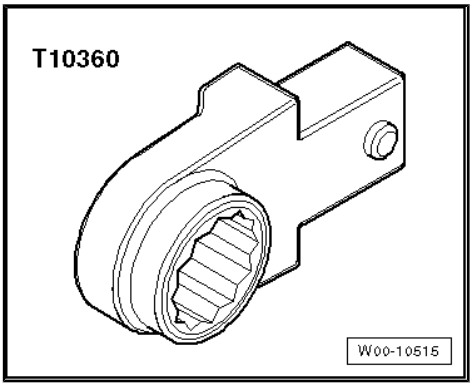
– Install throttle valve module -J338- ⇒ Rep. gr. 24 .

– Check coolant level ⇒ page 133 .

3.5 Removing and installing toothed belt for coolant pump

Special tools and workshop equipment required

- Socket -T10360-

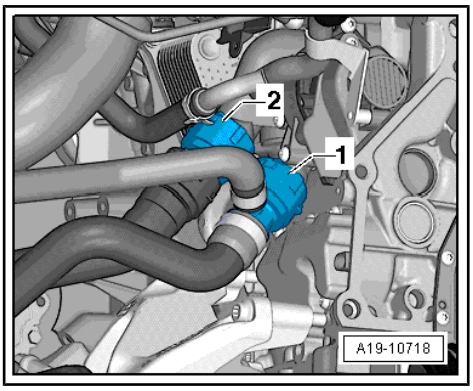


Removing

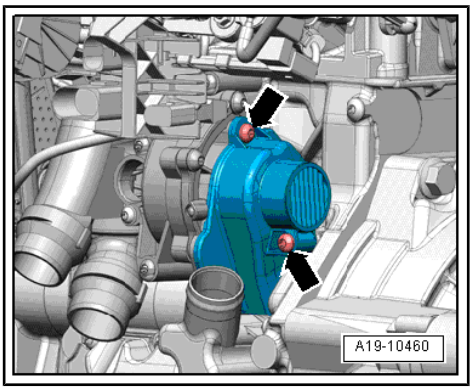
– Remove short coolant pipe ⇒ page 141 .

– Release long coolant pipe and lay aside ⇒ page 141 .

– Disconnect coolant hoses -1 and 2- and move clear to one side.



– Unscrew bolts -arrows- and remove toothed belt guard.



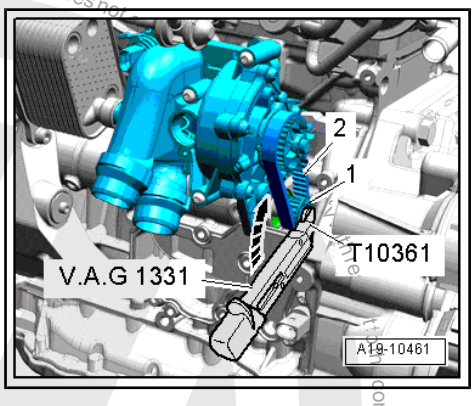
Caution

Risk of damage to thread.

- *The drive sprocket bolt has a left-hand thread.*

– Use torque wrench -V.A.G 1331- and socket -T10360- to remove bolt on coolant pump drive sprocket -1- (counterhold at vibration damper.

– Detach drive sprocket -1- and toothed belt -2-.



Installing

• Specified torque ⇒ page 144 .

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

Note

♦ *Replace bolt for drive sprocket.*

♦ *Renew seals and O-rings.*

♦ *Note installation position of V-belt pulley ⇒ page 144 .*

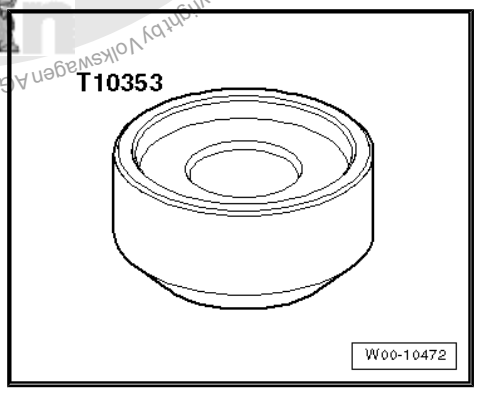
– Install short coolant pipe ⇒ page 141 .

– Replenish coolant ⇒ page 133 .

3.6 Renewing oil seal for coolant pump drive

Special tools and workshop equipment required

♦ Thrust piece -T10353-



Procedure

– Remove short coolant pipe ⇒ page 141 .

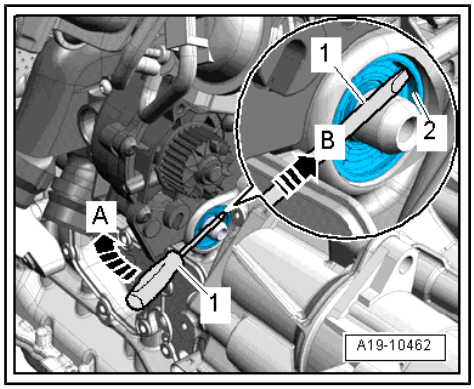
– Release long coolant pipe and lay aside ⇒ page 141 .

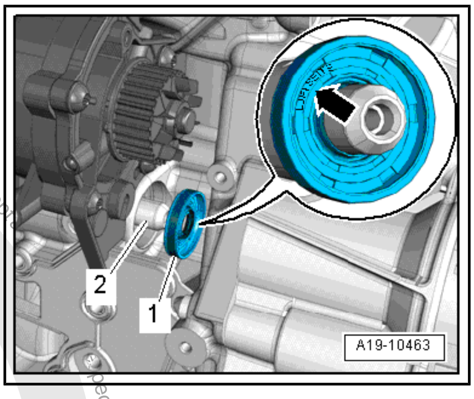
– Remove toothed belt for coolant pump ⇒ page 146 .

– Press screwdriver -1- firmly onto section -2- of oil seal -arrow B-.

– Lever out oil seal -arrow A-.

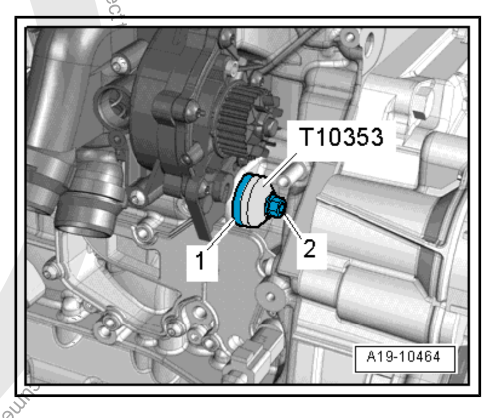
– Clean contact surface and sealing surface.





– Lubricate sealing surface of balance shaft -2- with gear oil.
– Fit oil seal -1- onto balance shaft.
• The marking „Luftseite" („Outside") -arrow- should be legible from the outside.

> ⚠ Caution
>
> *Risk of damage to thread.*
>
> ♦ *The drive sprocket bolt has a left-hand thread.*

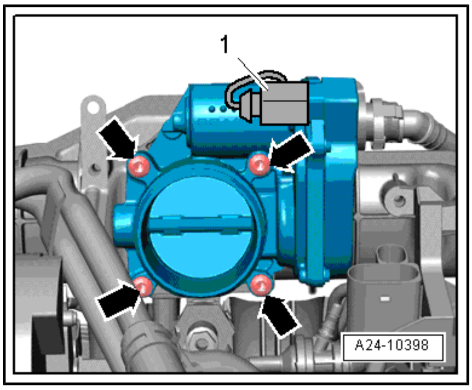


– Apply thrust piece -T10353- to oil seal -1- and press into cylinder block as far as stop using bolt -2- (take care not to tilt oil seal).
– Fit toothed belt for coolant pump ⇒ page 146 .
– Install short coolant pipe ⇒ page 141 .
– Replenish coolant ⇒ page 133 .

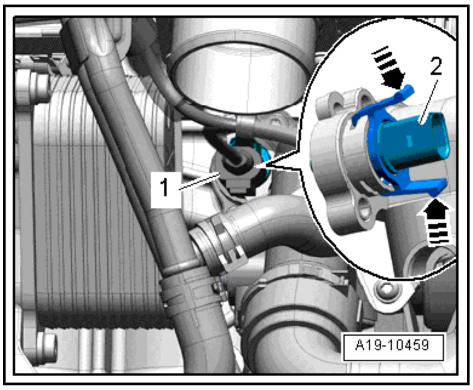
3.7 Removing and installing coolant pump

Removing

– Remove short coolant pipe ⇒ page 141 .
– Release long coolant pipe and lay aside ⇒ page 141 .
– Remove toothed belt for coolant pump ⇒ page 146 .



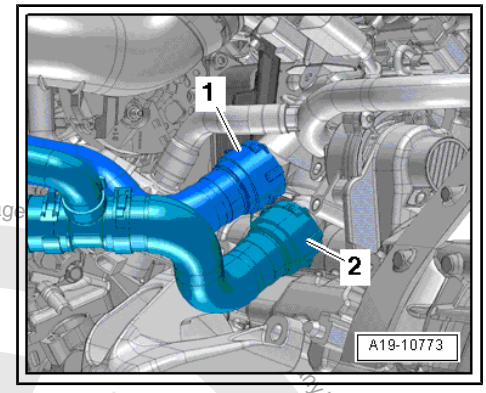
– Disconnect electrical connector -1- at throttle valve module -J338- .
– Remove bolts -arrows- and detach throttle valve module -J338- .



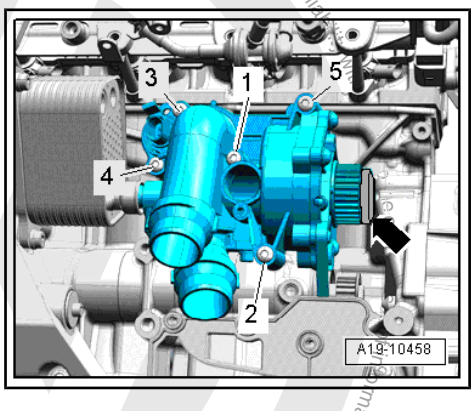
– Disconnect electrical connector -1- at coolant temperature sender -G62- .

> ℹ Note
>
> *-Item 2 and arrows- can be disregarded.*

– Disconnect coolant hoses. To do so, raise retaining clips -1- and -2- and lay coolant hoses to one side.



– Remove bolts -1 … 5-.
– Detach coolant pump from centring pin and pull off engine oil cooler.



Note

Ignore -arrow-.

Installing

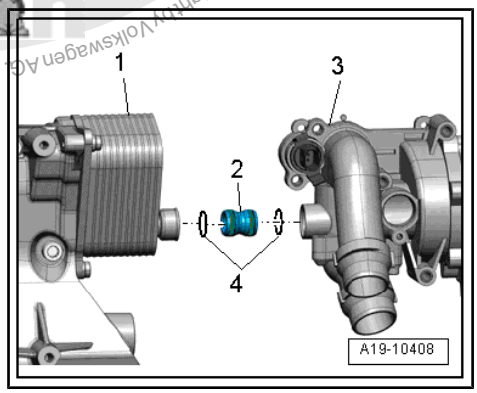
- Specified torque ⇒ page 144 .

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

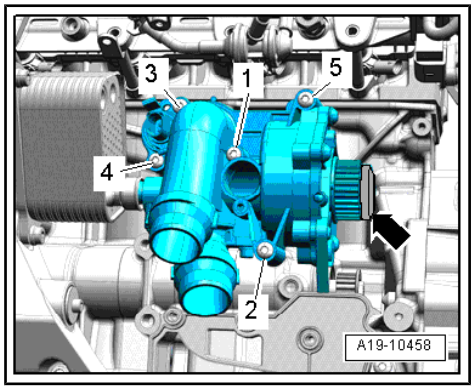
Note

Renew seals and O-rings.

– Coat O-rings -4- with coolant; coolants ⇒ Electronic parts catalogue .
– Check whether the two centring pins are fitted in the cylinder block; install if necessary.
– Fit connecting piece -2- into engine oil cooler -1-.
– Push coolant pump -3- onto connecting piece and centring pin into cylinder block.



– Tighten bolts for coolant pump.



Note

Remove protective cap -arrow- if a new coolant pump has been fitted.

– Fit toothed belt for coolant pump ⇒ page 146 .
– Install throttle valve module -J338- ⇒ Rep. gr. 24 .
– Install short coolant pipe ⇒ page 141 .
– Replenish coolant ⇒ page 133 .

3.8 Removing and installing thermostat

Removing

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

– Drain coolant ⇒ page 133 .

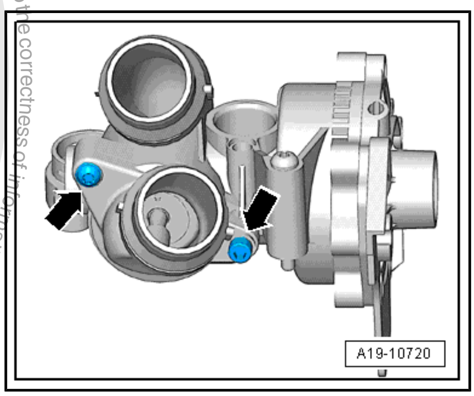
– Disconnect coolant hose ⇒ Item 17 (page 141) arrow from engine mounting.

– Remove engine mounting (left-side) ⇒ page 17 .

– Unscrew continued coolant circulation pump -V51- with bracket.

– Remove coarse oil separator ⇒ page 118 .

– Unscrew bolts -arrows- and remove connection.



– Detach thermostat.

Installing

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

- Specified torques ⇒ page 144 .

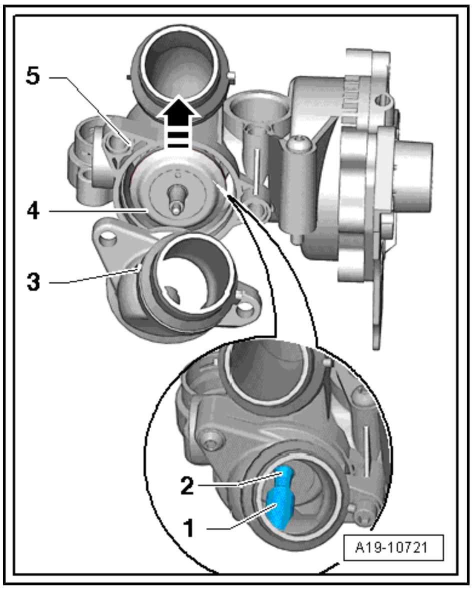
Note

Renew seals and O-rings.

– Clean sealing surface for O-ring.

– Coat O-ring with coolant, Coolants ⇒ Electronic parts catalogue .

– Insert thermostat -4- in coolant pump housing -5- and swivel forwards slightly -arrow-.



– Fit connection -3- carefully (insert centralising pin -2- in guide -1-).

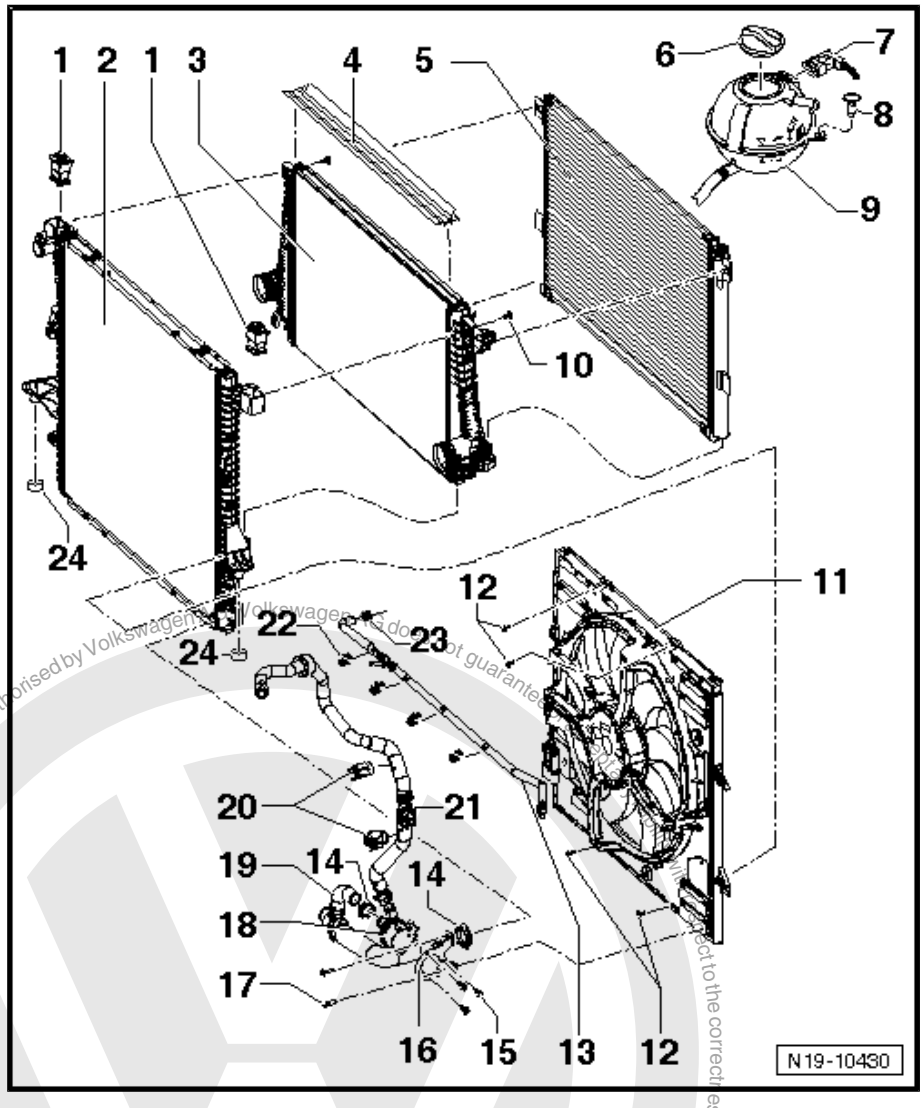
– Install coarse oil separator ⇒ page 118 .

– Install left engine mounting ⇒ page 17 .

– Replenish coolant ⇒ page 133 .

4 Parts of cooling system, body side

4.1 Assembly overview - parts of cooling system, body side



1 - Radiator upper mounting

2 - Radiator

- ❑ Renew coolant after replacing.
- ❑ Removing and installing ⇒ page 155 .

3 - Charge air cooler

4 - Upper cowling

5 - Condenser (only for vehicles with air conditioning system)

6 - Cap

- ❑ Check using cooling system tester -V.A.G 1274- and adapter for cooling system tester -V.A.G 1274/9- .
- ❑ Test pressure 1.4…1.6 bar

7 - Connector

8 - Bolt, 5 Nm

9 - Expansion tank

- ❑ Checking cooling system for leaks with cooling system tester -V.A.G 1274- and adapter -V.A.G 1274/8- ⇒ page 136 .
- ❑ With coolant temperature display sender - G32- .

10 - Bolt, 5 Nm

11 - Cowling with radiator fan -V7-

- ❑ Removing and installing ⇒ page 154 .

12 - Bolt, 4 Nm

13 - Breather line

- ❑ Coolant hose schematic diagram ⇒ page 139 .
- ❑ Secured to radiator at top.

14 - Spring-type clip

- ❑ Hose clip pliers -VAS 6340- or hose clip pliers -VAS 6362- are recommended for installation of spring-type clips.

15 - Bolt, 1.2 Nm

16 - Retainer

- ❑ For continued coolant circulation pump -V51-

17 - Bolt, 4.5 Nm

18 - Continued coolant circulation pump -V51-

19 - Coolant hose

- ❑ Coolant hose schematic diagram ⇒ page 139 .

20 - Retainer

21 - Radiator outlet coolant temperature sender -G83-

- ❑ Coolant hose schematic diagram ⇒ page 139 .

22 - Retainer

23 - Spring-type clip

- ❑ Hose clip pliers -VAS 6362- are recommended to install spring-type clips.

24 - Radiator lower mounting

4.2 Assembly overview - air ducting with radiator fan -V7-

1 - Radiator

2 - Radiator fan -V7-

3 - Bolt, 5 Nm

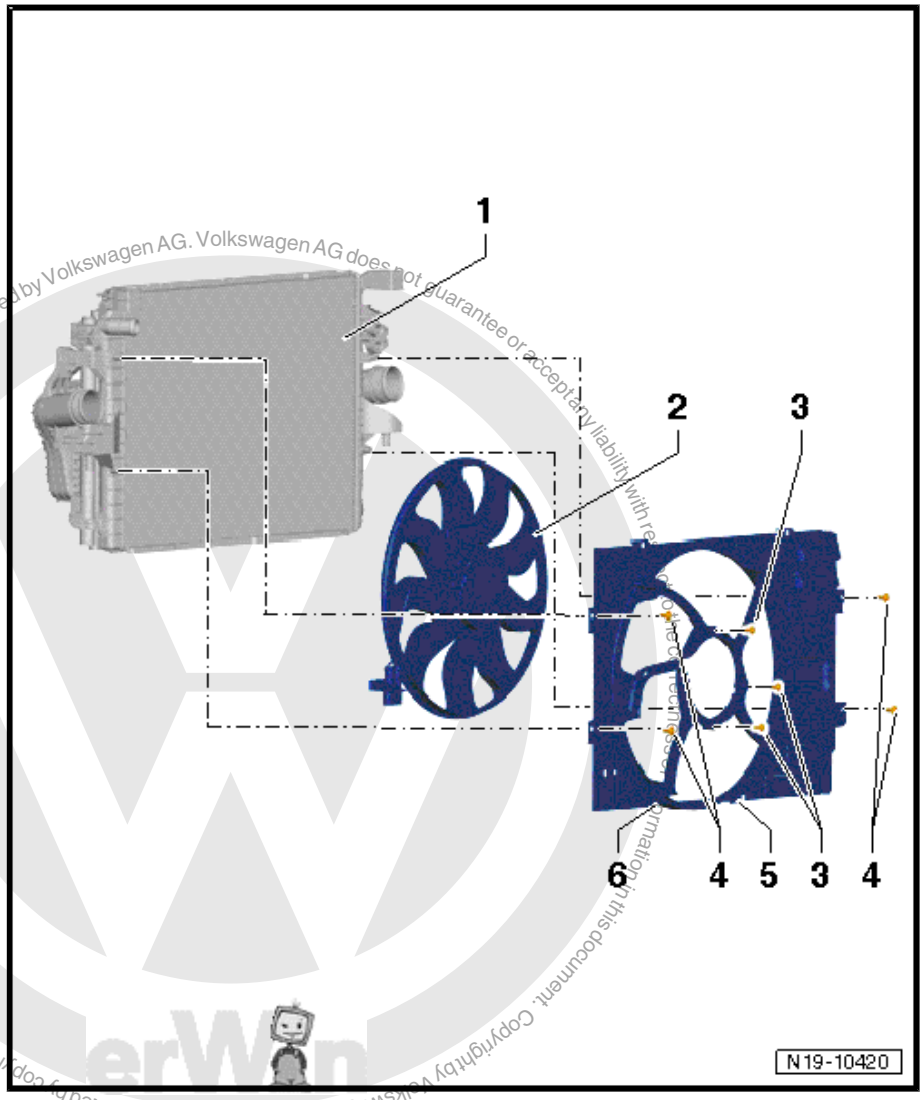
4 - Bolt, 5 Nm

5 - Locking lug

- ❑ Must be engaged in radiator.

6 - Cowling

- ❑ Removing and installing ⇒ page 154 .



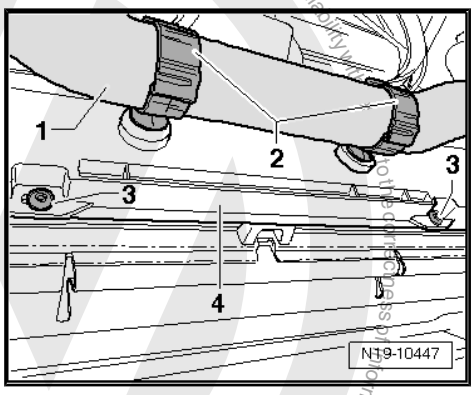
4.3 Removing and installing cowling with radiator fan -V7-

Removing

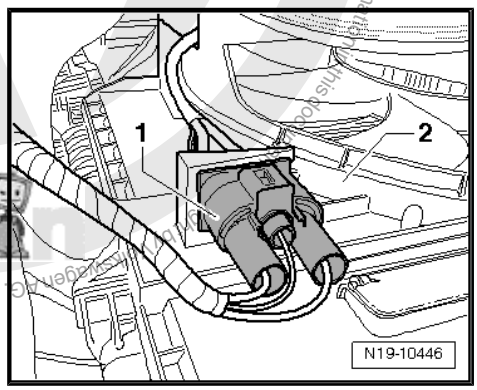
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

– Unclip coolant hose -1- from brackets -2-.

– Unscrew securing bolts -3- for cowling -4-.

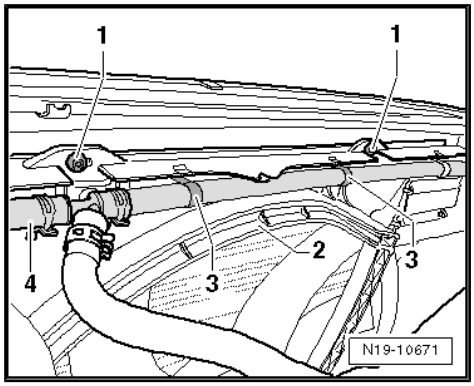


– Separate connector -1- at cowling -2-.



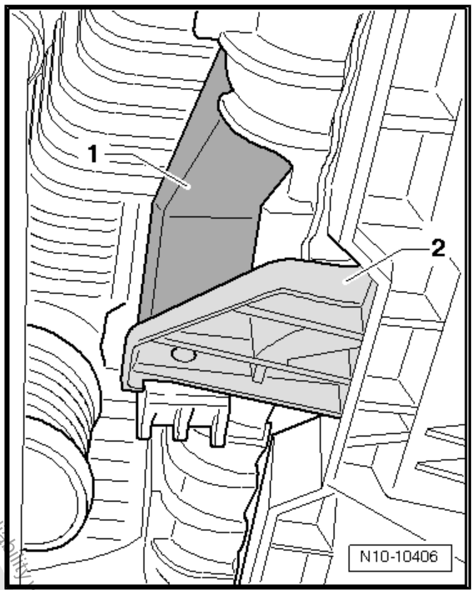
– Remove bolts -1-.

– Detach retaining clips-3- with water hose -4- from cowling -2-.

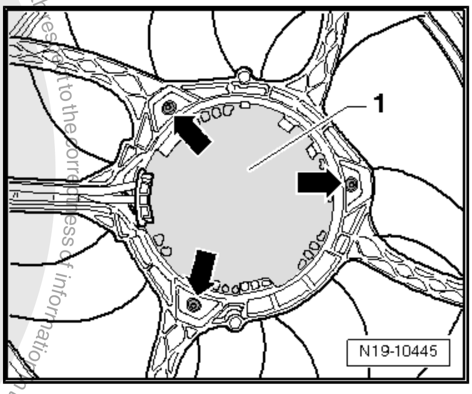


– Disengage cowling -2- at left and right. To do this, press retaining lever -1- forwards using a screwdriver and raise cowling -2- slightly.

– Remove cowling.



– Unscrew bolts -arrows- and remove radiator fan -V7- -1-.



Installing

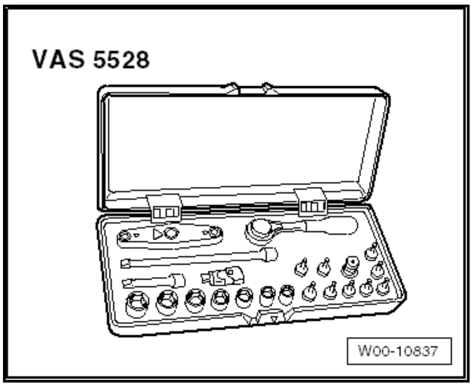
Install in reverse order.

Specified torque -arrows- 6 Nm

4.4 Removing and installing radiator

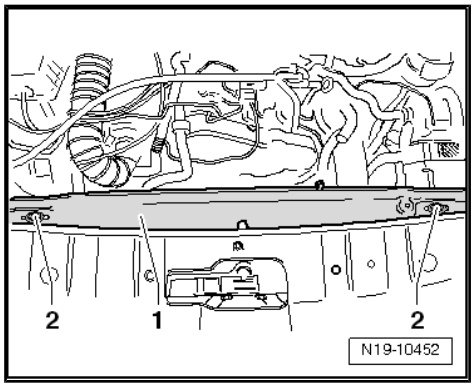
Special tools and workshop equipment required

♦ Socket set 1/4", 22-piece -VAS 5528-



Removing

– Undo and remove bolts -2- that fasten radiator to lock carrier -1-.



Only for vehicles with air conditioning

– Remove lock carrier ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier .

Continuation for all vehicles

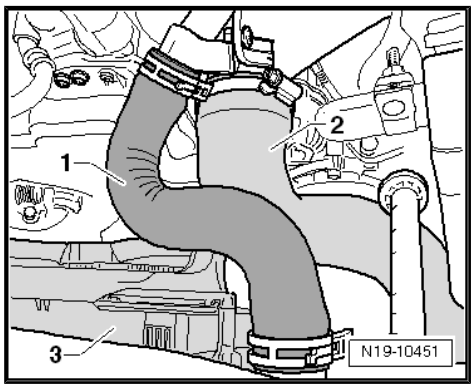
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

– Drain coolant ⇒ page 133 .

– Remove cowling ⇒ page 154 .

Observe instructions for hose connections with screw-type clips ⇒ page 184 .

– Remove coolant hose -1- at radiator -3- and remove connecting hose -2-.

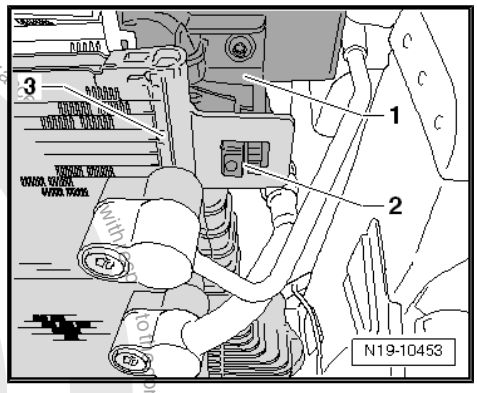


– Remove right connecting hose leading to turbocharger from charge air cooler and place to one side.

– Remove air duct mounting ⇒ page 154 .

– Unclip left radiator fastening -2- at condenser -3-.

– Unclip right radiator fastening as well and pull condenser -3- off radiator -1-.



Caution

- ***Do not bend or stretch the refrigerant lines excessively***

– Support condenser, e.g. with cable ties.

Caution

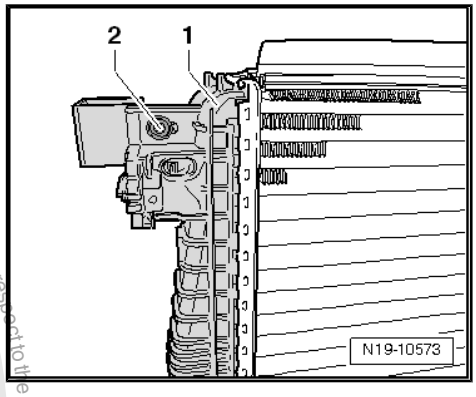
- ***During further removal work, make sure that the refrigerant lines are not bent or stretched excessively.***

– Do not bend or stretch the refrigerant lines excessively.

– Carefully remove radiator upwards together with charge air cooler. When doing so, take the radiator -2- past the refrigerant lines.

Note

- *If the radiator -1- is to be replaced, undo bolts of charge air cooler and remove it from radiator.*
- *Undo and remove bolt -2- on right and left (not shown in illustration) at radiator.*

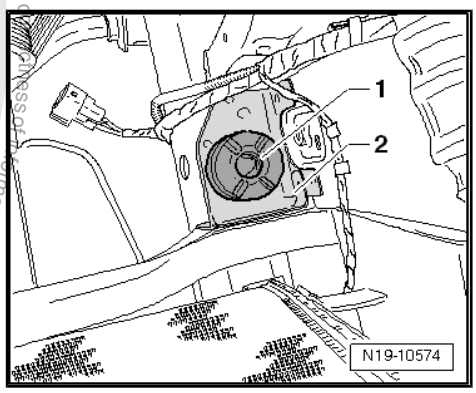


Installing

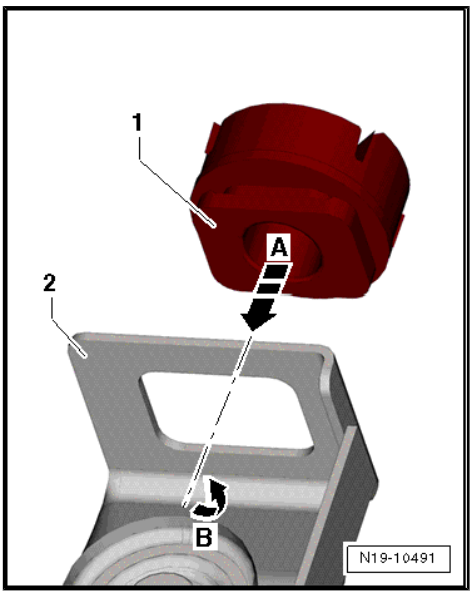
– Install in reverse order. In the process, note the following:

Note

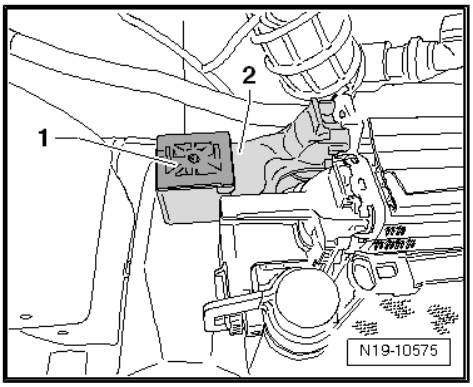
Before installing radiator, check that radiator mountings -1- are correctly seated on front part of car -2- and, if necessary, reposition:



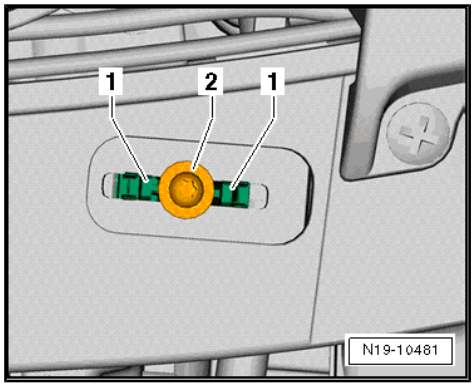
– Insert radiator mounting into lock carrier -2- at bottom -1-, doing so transversely to the direction of travel, and then turn it 90".



– Insert top radiator mountings -1- on right and left into the mounting on radiator -2- appropriately.



– When installing the radiator, make sure that the catches -1- of the radiator mounting on the left and right at the top have engaged completely in the lock carrier.

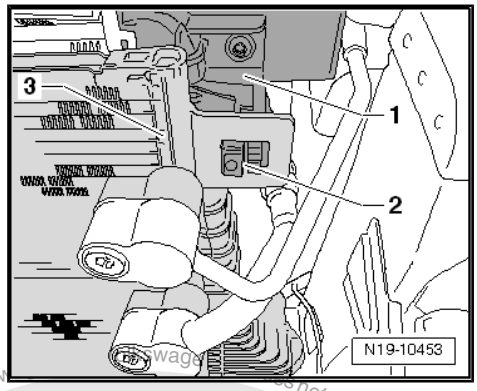


Observe instructions for hose connections with screw-type clips ⇒ page 184 .

Caution

The screw-type clips on the charge air lines must always be tightened to 5.5 Nm. If the torque is too low or too high, the charge air hose may slip off the charge air pipe during vehicle operation.

– Fit condenser -3- on radiator -1- on left and right so that it engages securely in the catches -2-.



Caution

- ***Do not bend or stretch the refrigerant lines excessively***

– Install cowling ⇒ page 154 .

– Replenish coolant ⇒ page 133 .

For vehicles with air conditioning

– Install lock carrier ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier .

Specified torques ⇒ page 152 .

20 – Fuel supply system

1 General notes on fuel system

General notes on fuel system ⇒ page 159

Observe safety precautions ⇒ page 160 .

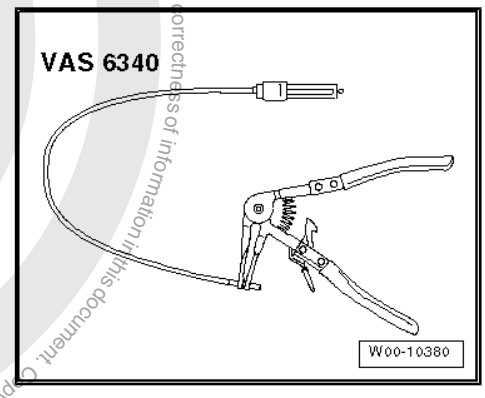
Observe rules for cleanliness ⇒ page 183 .

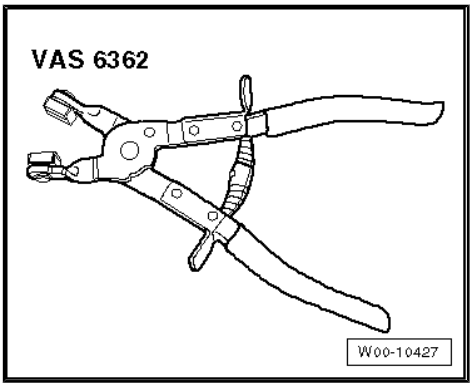
1.1 General notes on fuel system

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.***





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.*
- *When installing or removing spring-type clips, we recommend using spring-type clip pliers -VAS 6340- or*
- *… hose clip pliers -VAS 6362- .*
- *When installing coolant hoses, route stress-free so that they do not come into contact with other components (observe markings on coolant connection and hose).*
- *The arrows on the coolant pipes and on the ends of the hoses must be aligned with each other.*

1.2 Safety precautions when working on fuel supply system

Caution

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

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant 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.***
- ***The fuel and the fuel lines in the fuel system can become very hot (danger of scalding)!***
- ***The fuel system is also under pressure! Before opening the system, place cloths around the connections. Then carefully loosen connection to release the pressure!***
- ***Wear eye and hand protection when performing any type of repair work on the fuel system!***

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 gas extraction system is available, a radial fan with a displacement greater than 15 m^3/h can be used providing that motor is not in air flow.
- Prevent skin contact with fuel! Wear fuel-resistant gloves!

1.3 Rules for cleanliness

When working on the fuel supply and injection system, pay careful attention to the following „6 rules“ for cleanliness:

- Thoroughly clean all unions and surrounding 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 or similar).
- When system is open, do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.
- Also ensure that no diesel fuel comes into contact with the coolant hoses. Should this occur, the hoses must be cleaned immediately. Damaged hoses must be renewed.

1.4 Releasing pressure in high-pressure area

WARNING

The injection system consists of a high-pressure section (maximum approx. 120 bar) and a low-pressure section (approx. 6 bar).

Prior to opening the high-pressure area, e.g. when removing the fuel pressure sender -G247- , the fuel pressure in the high-pressure area must be reduced to a residual pressure of approx. 6 bar. The appropriate procedure is described as follows.

– Connect vehicle diagnostic tester and then carry out Guided Fault Finding, „Reducing high fuel pressure“.

– Switch off ignition.

WARNING

The fuel lines are pressurized! Wear eye protection and protective clothing to avoid eye injuries and skin contact. Before opening the high-pressure section, wrap a cloth around the connection.

– Now place a clean cloth around the connection and carefully open the connection to release the residual pressure of approx. 6 bar. Catch the escaping fuel.

– After completing work, read fault memory of engine control unit and clear all fault entries.

Note

If the fault memory was cleared, the readiness code must be generated ⇒ vehicle diagnosis tester „Guided functions“.

2 Fuel pump

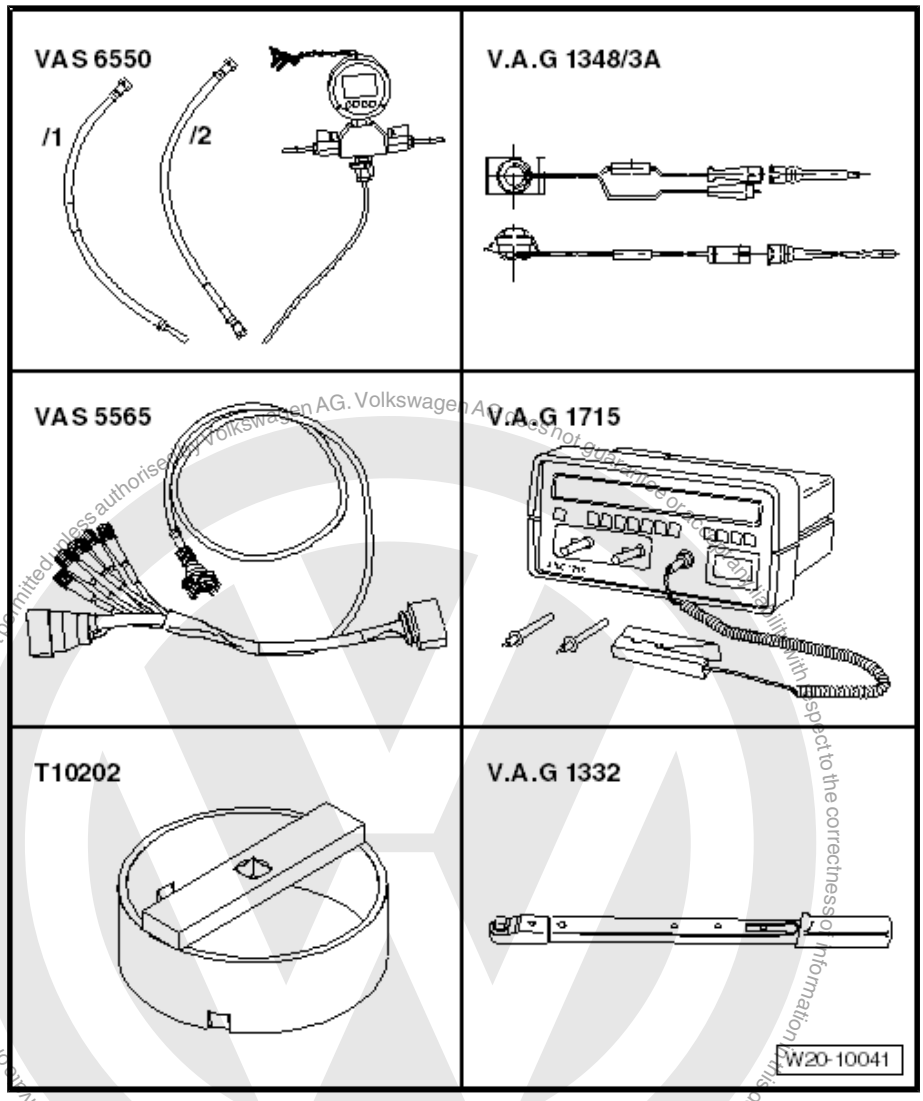
2.1 Checking fuel pump

Note

When replacing fuel delivery unit, check fuel tank for heavy soiling and clean if necessary.

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-
- Multimeter -V.A.G 1715-
- Special wrench -T10202-
- Measuring container, capacity 3 litres



Checking function and voltage supply ⇒ page 162

Check fuel pressure ⇒ page 164 .

Checking holding pressure ⇒ page 165 .

2.1.1 Checking function and voltage supply

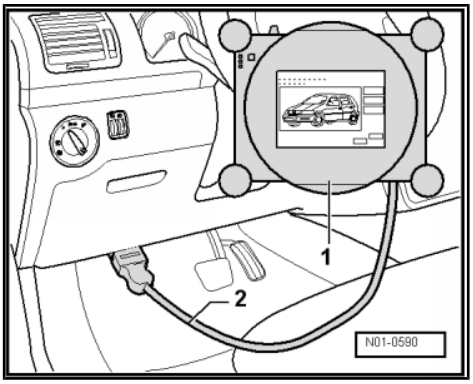
- Battery voltage at least 11.5 V
- Fuse for fuel pump on fuse holder OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

- Fuel pump control unit -J538- OK.

Test sequence:

Note

Function of fuel pump is checked using final control diagnosis.



– Connect vehicle diagnostic tester as follows:
– Connect diagnosis cable connector to diagnostic connection in driver footwell.
– Switch ignition on.
– Press one after the other in the display the buttons for `Vehicle self-diagnosis`, `Engine electronics` and `Final control diagnosis`.
– Press right arrow button ▶ on display to final control diagnosis for fuel pump electronics.

The fuel pump must now run slowly up to maximum speed.

Note

The fuel pump runs very quietly.

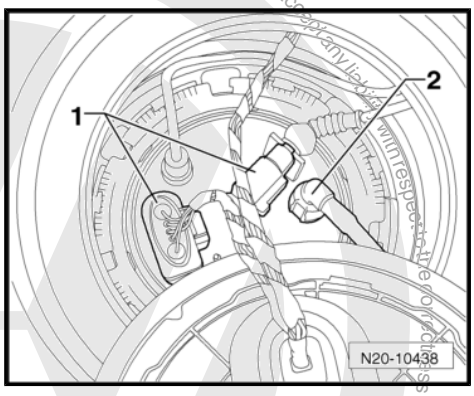
– Switch off ignition.

If fuel pump does not run:

– Lower fuel tank until connectors on fuel delivery unit are accessible.

– First ensure that 5-pin wiring connection -1- is secure by pulling the connector without pressing the catch. If connector was not inserted correctly, repeat functional check of fuel pump.
– Pull off connector -1-.
– Check contacts on plug and on fuel delivery unit for damage.
– Check voltage supply against current flow diagram with multimeter -V.A.G 1715- .

• Specification: approx. battery voltage.



WARNING

Fuel supply lines are under pressure! Wear eye protection and protective clothing to avoid eye injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

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:

– Remove fuel delivery unit ⇒ page 172 .
– Check that electrical wires between flange and fuel pump are connected.

If no open circuit can be found:

– Fuel pump is defective, renew fuel delivery unit ⇒ page 172 .

2.1.2 Checking fuel pressure

Test prerequisites

• Function of fuel pump has been checked ⇒ page 162 .

Test procedure

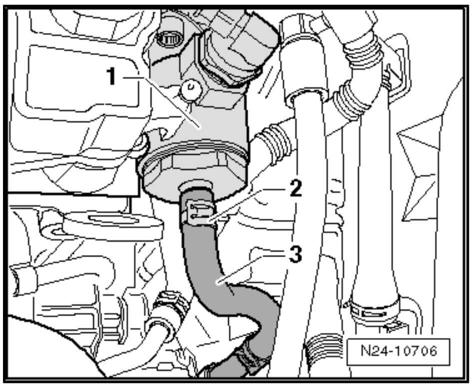
Note

Check fuel pressure using final control diagnosis.

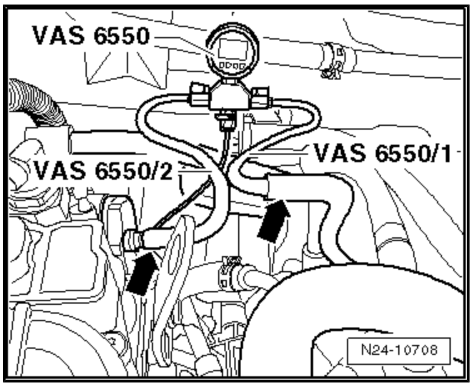
WARNING

Fuel supply lines are under pressure! Wear eye protection and protective clothing to avoid eye injuries and skin contact. Before loosening hose connections, wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

– Release clip -2- and detach fuel pressurisation line -3- from high-pressure pump -1-. Collect escaping fuel with a cloth.



– 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.

– Actuate fuel pump with final control diagnosis to build up fuel pressure.

– Read off fuel pressure on pressure gauge.

• Specification: 4.0…7.0 bar

Fuel pressure OK, check holding pressure ⇒ page 165 .

If the specification is exceeded:

– Pressure limiting valve in fuel delivery unit is defective.

Note

The pressure limiting valve is integrated in the fuel delivery unit and cannot be renewed separately.

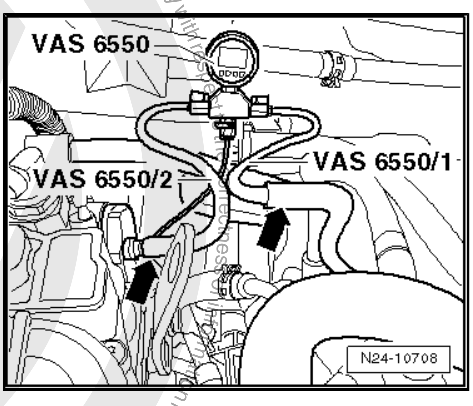
If the specification is not attained:

– Fuel pump is defective, renew fuel delivery unit ⇒ page 172 .

2.1.3 Checking holding pressure

Test prerequisite

• Fuel pressure OK and pressure tester -VAS 6550- connected. Check fuel pressure ⇒ page 164 .



Test sequence:

– Actuate fuel pump with final control diagnosis to build up fuel pressure.

– Read off fuel pressure on pressure gauge.

• Specification: 4.0…7.0 bar

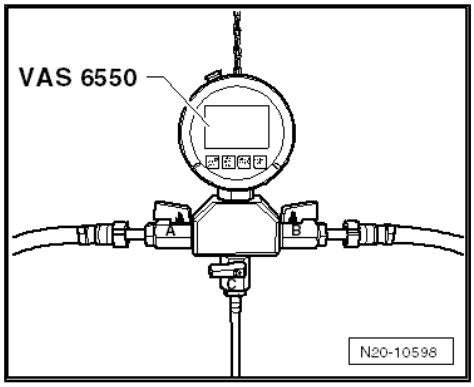
– End self-diagnosis and switch ignition off.

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

If the pressure drops further:

– Actuate fuel pump with final control diagnosis to build up fuel pressure.

– After pressure has built up, cut-off tap -B- of pressure tester immediately. Lever is then at right angle to direction of flow.



If the pressure does not drop now:

Note

Leak must be sought 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 pipe to high-pressure pump for leaks.

If no fault is found:

– Renew high-pressure pump ⇒ page 226 .

If the pressure drops again:

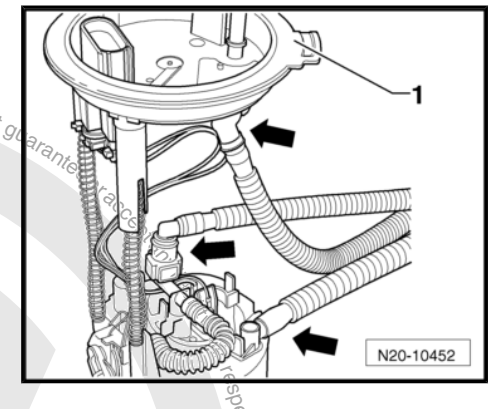
Leak must be sought on fuel tank side; proceed as follows:

– Check fuel line leading to flange for leaks.

If no fault is found:

– Open fuel delivery unit flange -1- ⇒ page 172 .

– Check that all hose connections are connected.



If no fault is found:

– Renew fuel delivery unit.

2.1.4 Checking fuel delivery rate

– Checking fuel delivery rate ⇒ Vehicle diagnostic tester.

3 Fuel tank

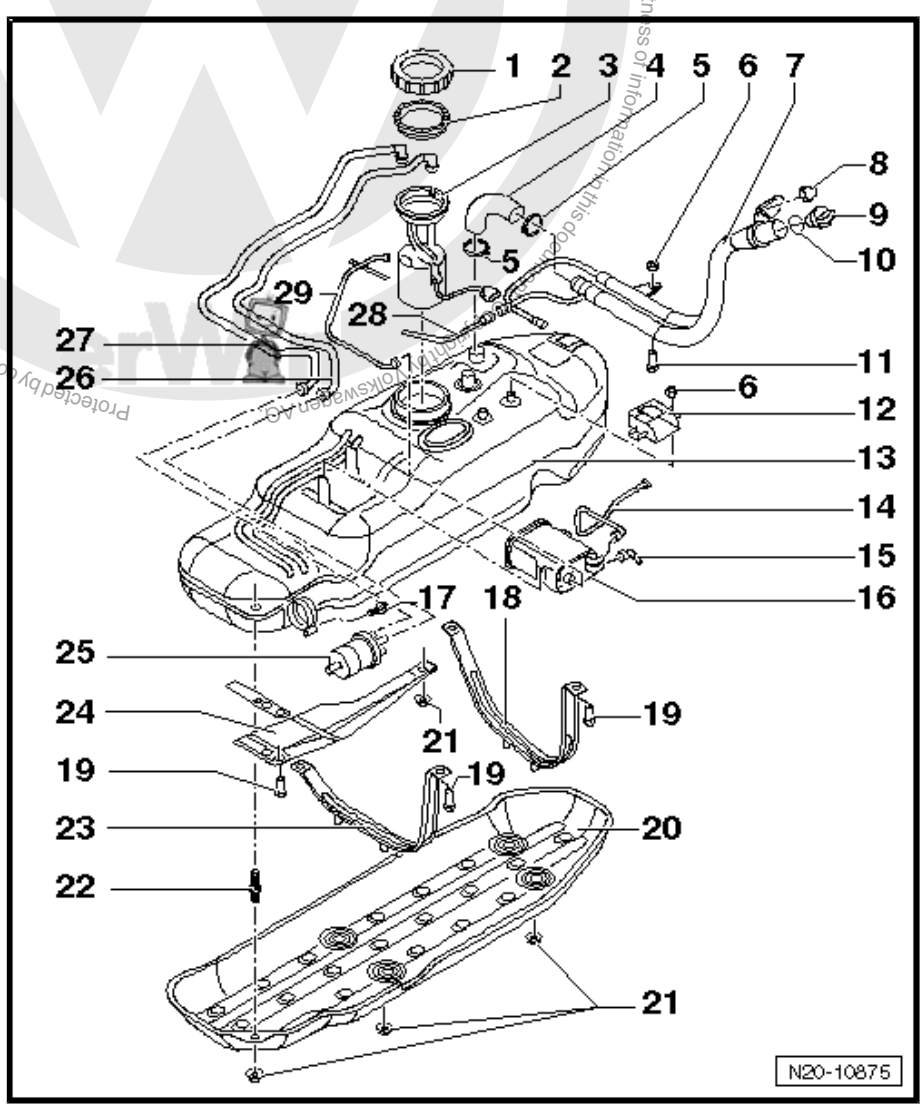
Assembly overview - fuel tank ⇒ page 167 .

Removing and installing fuel tank ⇒ page 169 .

Removing and installing fuel delivery unit ⇒ page 172 .

Removing and installing fuel gauge sender -G- ⇒ page 173 .

3.1 Assembly overview - fuel tank



1 - Union nut, 110 Nm

- ❑ Remove and install using union nut tool -3217- .

2 - Seal

- ❑ Renew if damaged.
- ❑ Moisten with fuel when installing

3 - Fuel delivery unit

- ❑ Note installation position on fuel tank ⇒ page 168 .
- ❑ To remove, first remove fuel tank ⇒ page 169 .
- ❑ Removing and installing fuel gauge sender ⇒ page 173 .

4 - Connecting hose

5 - Spring-type clip

6 - Spring nut

7 - Filler neck

8 - Weld bolt with cap nut

9 - Filler cap with retaining strap

10 - Seal

11 - Slotted pan head screw

12 - Control unit for fuel pump J538

13 - Fuel tank

- ❑ When removing, support using engine and gearbox jack -V.A.G 1383 A- .
- ❑ Removing and installing ⇒ page 169 .
- ❑ Drain fuel tank using fuel extractor -VAS 5190-

14 - Breather line

- ❑ Check for secure seating.

15 - Quick-release coupling

- ❑ Must audibly engage

16 - Activated charcoal filter

- ❑ Removing and installing ⇒ page 181 .

17 - Slotted pan head screw

18 - Rear securing strap

19 - Hexagon bolt

20 - Protective cover

- ❑ For bottom of fuel tank.
- ❑ Depending on equipment.

21 - Securing nuts

- ❑ 20 Nm

22 - Double flange bolt

23 - Centre securing strap

24 - Heat shield for fuel filter

25 - Fuel filter with pressure regulator

- ❑ Removing and installing ⇒ page 177 .

26 - Return line

- ❑ Blue or with blue marking.
- ❑ Clipped onto fuel tank.
- ❑ Check for secure seating.
- ❑ To pull off flange, press release button on connecting piece.

27 - Supply line

- ❑ To fuel filter ⇒ page 167 .
- ❑ Clipped onto fuel tank.
- ❑ Check for secure seating.
- ❑ Black
- ❑ To pull off flange, press release button on connecting piece.

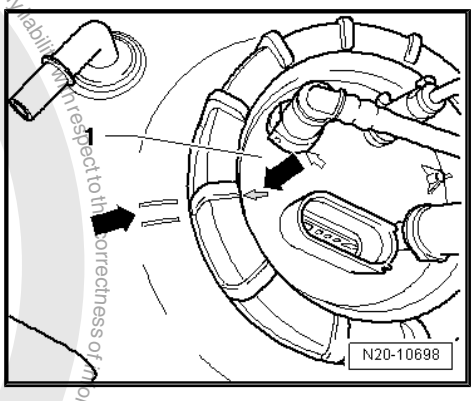
28 - Breather line

29 - Breather line

Installation position of fuel gauge sender

Arrow on sender flange -1- must align with mark on fuel tank -arrows-.

Connections for blue or blue-marked return line and black supply line are marked with arrows on fuel gauge sender flange.



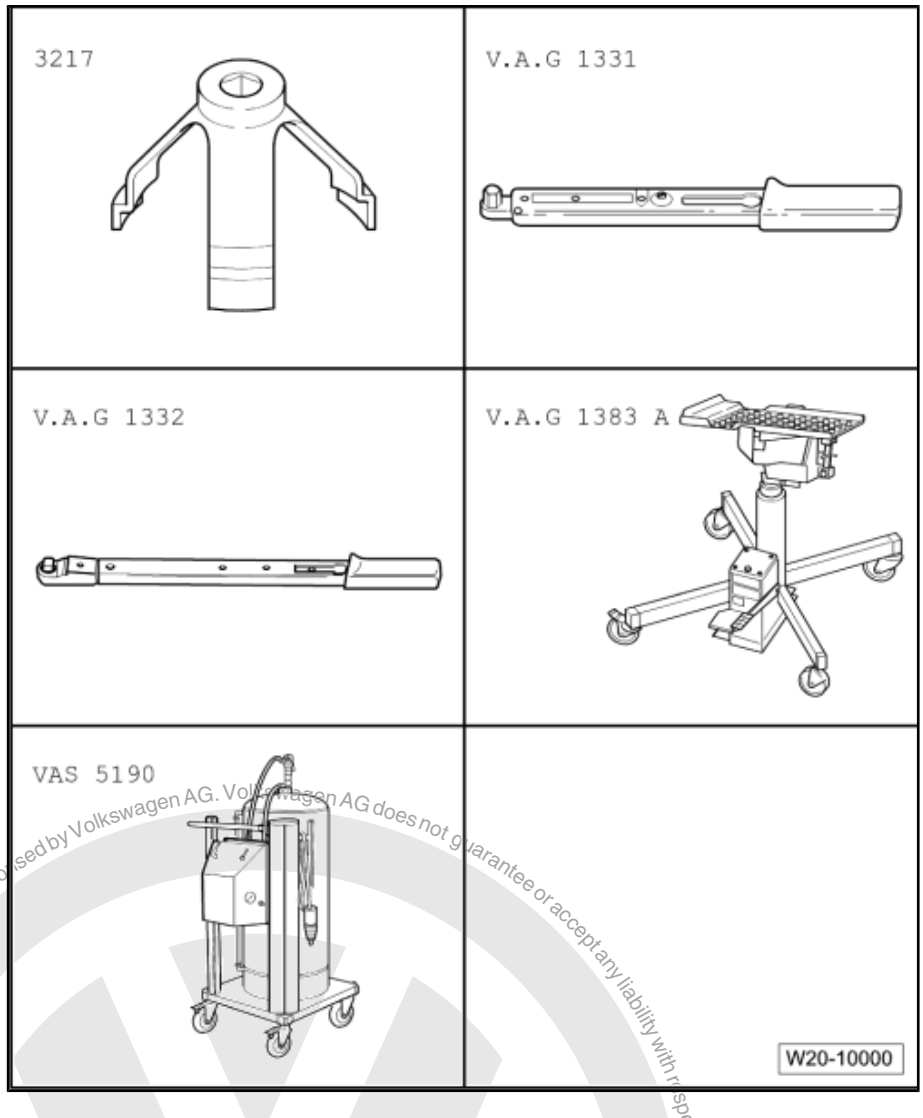
Note

After installing fuel gauge sender, check whether fuel supply and return lines are still clipped onto fuel tank.

3.2 Removing and installing fuel tank

Special tools and workshop equipment required

- Union nut tool -3217-
- Torque wrench -V.A.G 1331-
- Torque wrench -V.A.G 1332-
- Engine and gearbox jack -V.A.G 1383 A-
- Fuel extractor -VAS 5190-



Removing

Note

Fuel tank must be drained. Use the fuel extractor -VAS 5190- to do this.

– Note safety precautions before starting installation work ⇒ page 160 .

– Observe rules for cleanliness ⇒ page 160 .

Note

Before carrying out further work, disconnect battery earth strap. For this reason, first check whether a coded radio is fitted. Obtain anti-theft coding first if necessary.

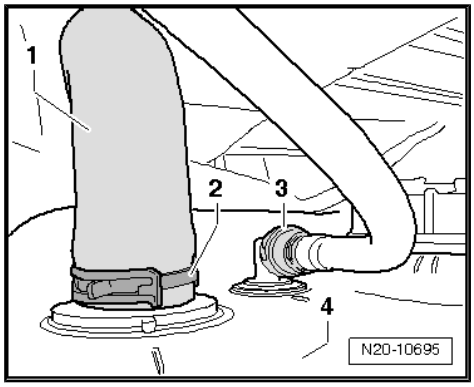
– Thoroughly clean area around filler neck -1- on fuel tank -4-.
– Loosen clamp -2- for connecting hose -1- of filler neck on fuel tank -4- and pull connecting hose off.
– Extract fuel with the fuel extractor -VAS 5190- via the opening.

Vehicles with lower protective cover

– Unbolt protective cover from bottom of fuel tank .

Continuation for all vehicles:

– Support fuel tank with engine and gearbox jack -V.A.G 1383 A- .

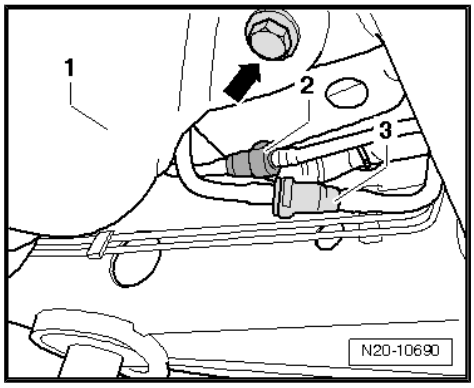


– Disconnect supply line -3- and return line -2-.

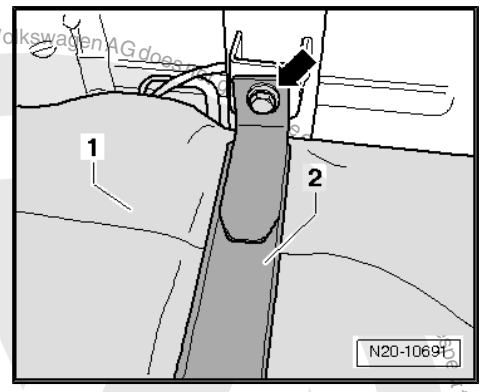
Note

Press in buttons on hose couplings to do this.

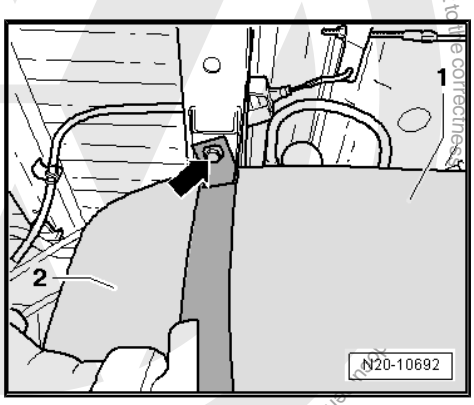
– Unscrew bolt -arrow- for securing fuel tank -1- on left cross member.
– Loosen securing straps in succession:



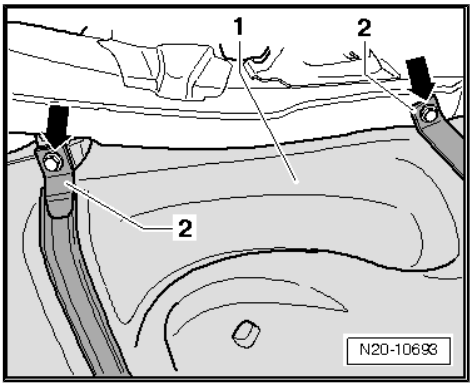
– Unscrew bolt -arrow- for front securing strap -2- for fuel tank -1-.



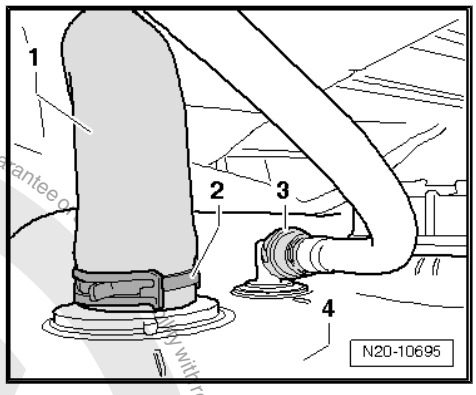
– Unscrew bolt -arrow- for rear securing strap -2- for fuel tank -1-.



– Unscrew bolts -arrows- for securing straps -2- for fuel tank -1-.
– Only lower fuel tank with engine and gearbox jack -V.A.G 1383 A- until filler neck and breather line can be removed.



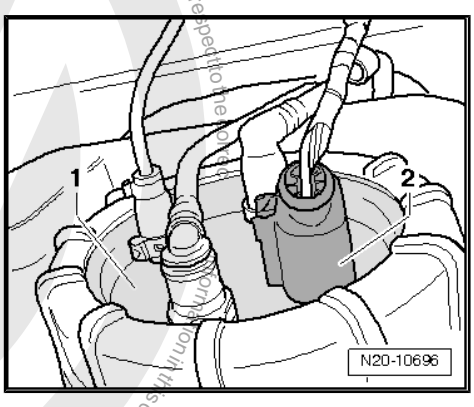
– Loosen clamp -2- for connecting hose -1- of filler neck on fuel tank -4- and pull connecting hose off.
– Unclip breather line -3- on fuel tank -4-.



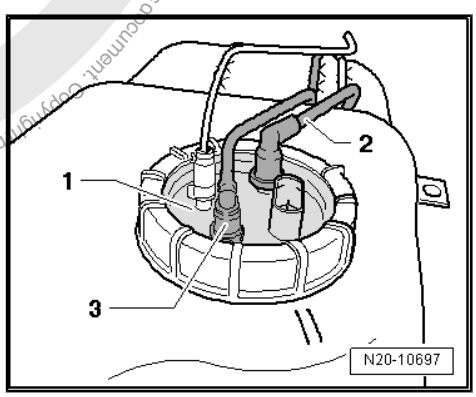
Note

Immediately seal all openings on fuel tank with clean cloths.

– Continue lowering fuel tank with engine and gearbox jack - V.A.G 1383 A- until connector -2- can be pulled off fuel delivery unit -1-.
– Release fuel lines by pressing in circlip.



– Unclip fuel lines -2 and 3- from fuel delivery unit -1-.
– Carefully lower fuel tank.

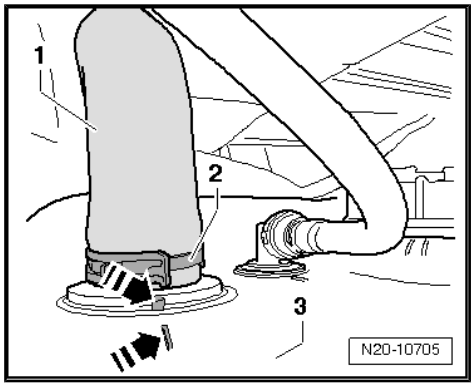


Installing

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

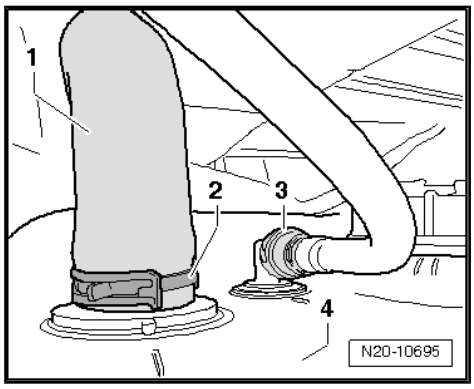
Push hose -1- of filler neck onto connection on fuel tank -3-.

Position clamp -2- at assembly markings -arrows- using hose clip pliers -VAS 6362- .



– Push on breather line -3- and engage securely.

- Connections for breather and fuel lines must engage audibly when joined.
- Clip fuel lines onto fuel tank.
- Push connector onto fuel pump flange and clip wire onto fuel tank.
- Ensure that fuel hose connections are tight.



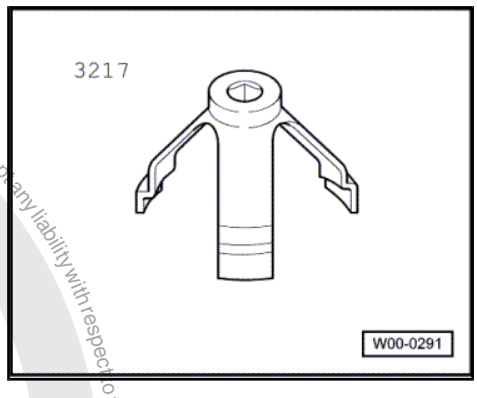
Vehicles with lower protective cover

– Bolt protective cover to bottom of fuel tank .

3.3 Removing and installing fuel delivery unit

Special tools and workshop equipment required

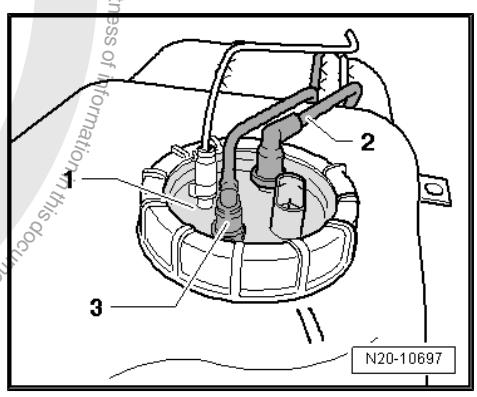
- Union nut tool -3217-



Removing

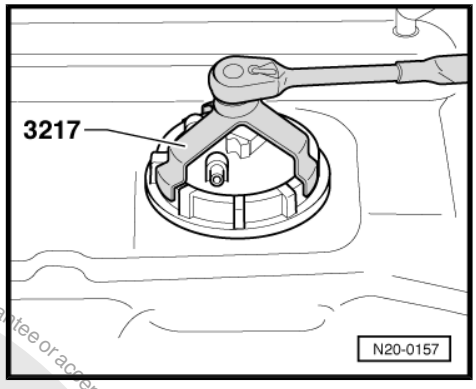
– Remove fuel tank ⇒ page 169 .

– Unclip fuel lines -2 and 3- from fuel delivery unit -1-.



– Unscrew union nut with union nut tool -3217- .

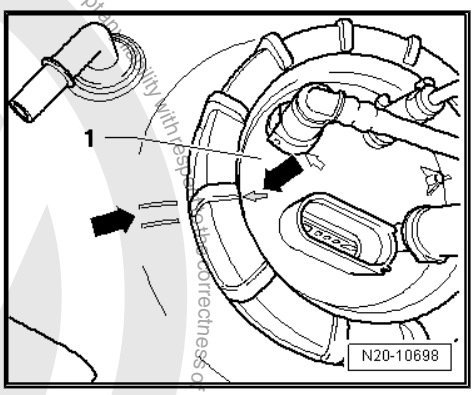
– Take fuel delivery unit out of the fuel tank.



Installing

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

– Install fuel delivery unit so that mark on flange of fuel delivery unit -1- is aligned with mark on fuel tank -arrows-.



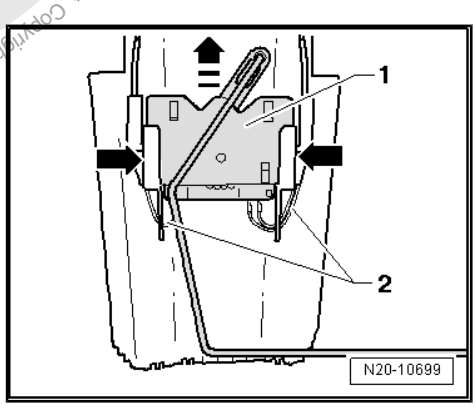
3.4 Removing and installing fuel gauge sender -G-

Removing

– Remove fuel tank ⇒ page 169 .

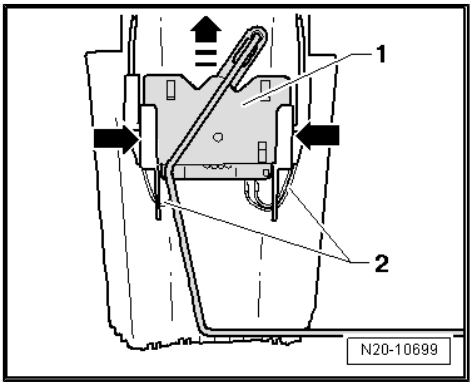
– Remove fuel delivery unit ⇒ page 172 .

– Free lines -2- and unclip fuel gauge sender -G- to side -arrows-.



– Remove fuel gauge sender -G- -1- in -direction of arrow-.

– Release connectors on fuel gauge sender -G- .



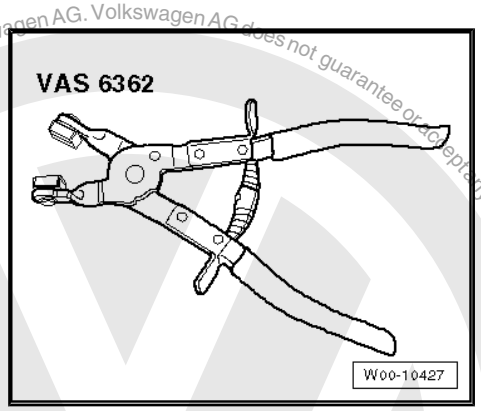
Installing

– Insert fuel gauge sender -G- into guides on fuel pump and press downwards until it engages.

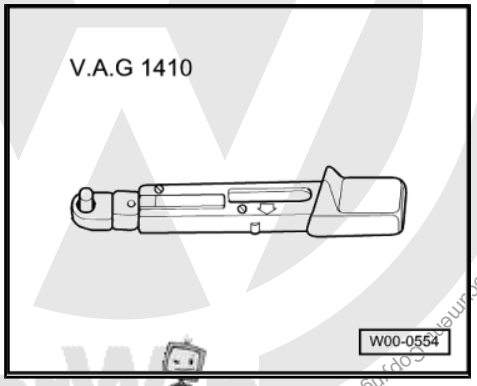
3.5 Removing and installing filler neck

Special tools and workshop equipment required

- Hose clip pliers -VAS 6362-

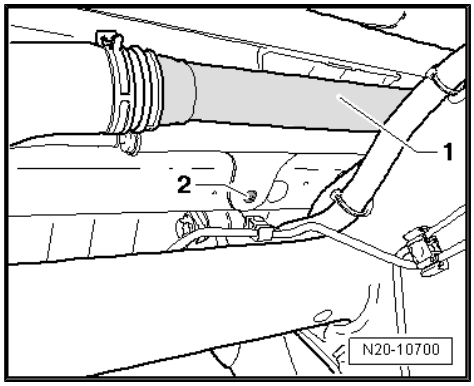


- Torque wrench -V.A.G 1410-

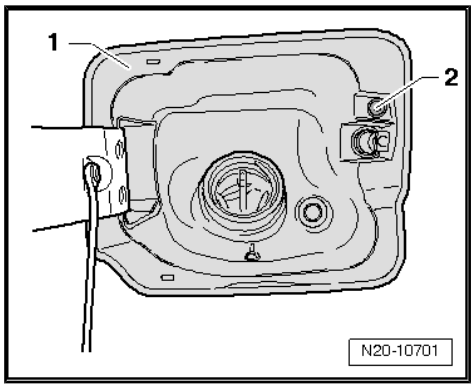


Removing

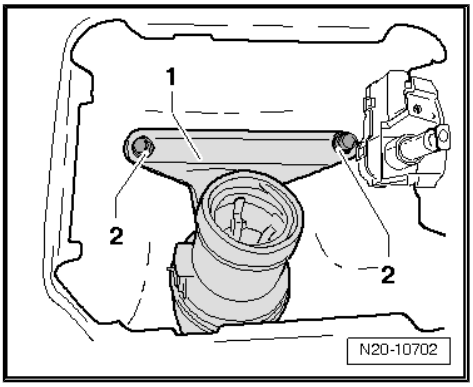
– Remove fuel tank ⇒ page 169 .
– Unscrew bolt -2- for filler neck -1- on underbody.
– Open tank flap and clean inside tank flap unit thoroughly.
– Unscrew cap.



– Unscrew bolt -2- from tank flap unit.
– Unclip tank flap unit and remove completely.



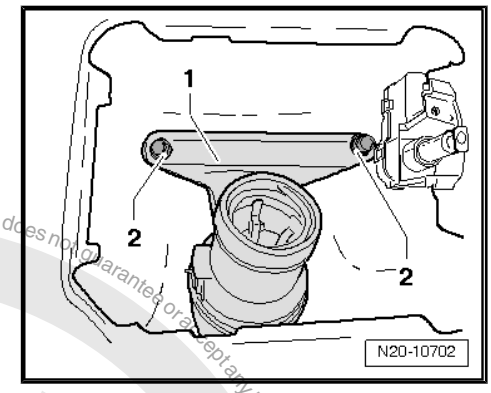
– Unscrew nuts -2- from filler neck -1- at top of tank flap unit cut-out.
– Remove filler neck -1- from below; filler neck must be turned when doing this.



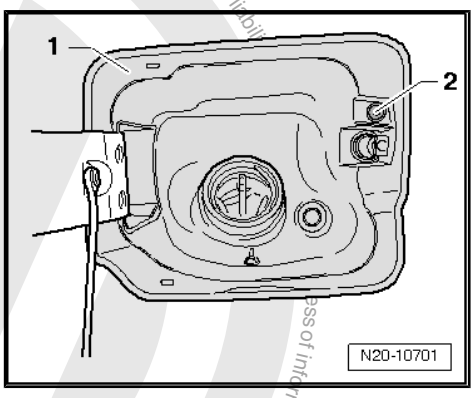
Installing

Install in reverse order.

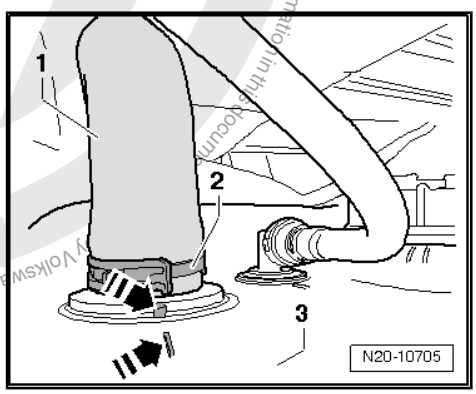
– Thread filler neck -1- in through wheel housing and position at top of tank flap unit cut-out with nuts -2-.
– Tighten nuts -2- to 5 Nm.



– Tighten bolt -2- to 2 Nm.
– Installing fuel tank:

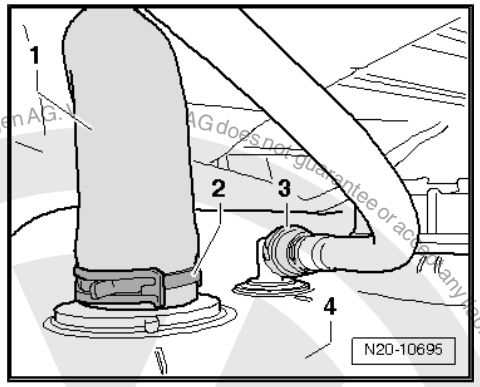


– Push hose -1- of filler neck onto connection on fuel tank -3-.
– Position clamp -2- at assembly markings -arrows- using hose clip pliers -VAS 6362- .

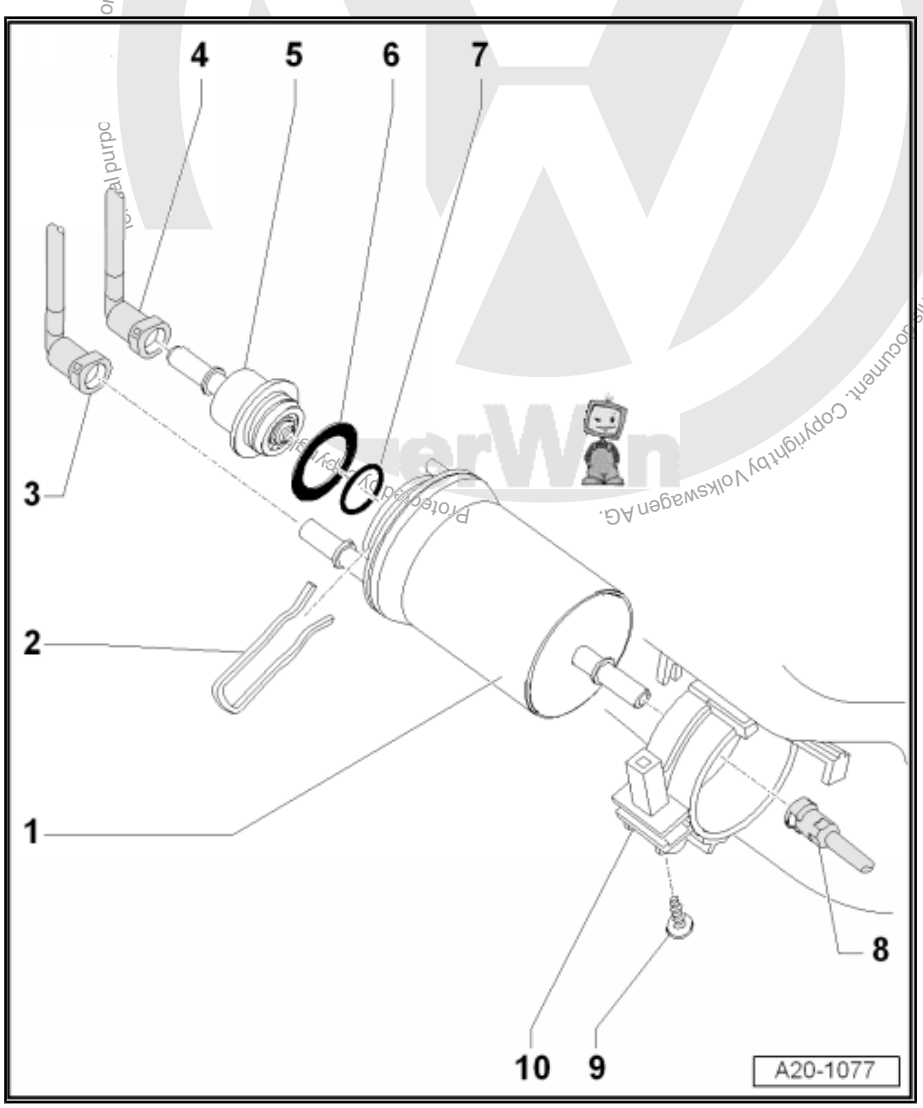


– Push on breather line -3- and engage securely.

- ♦ Connections for breather and fuel lines must engage audibly when joined.
- ♦ Clip fuel lines onto fuel tank.
- ♦ Push connector onto fuel pump flange and clip wire onto fuel tank.
- ♦ Ensure that fuel hose connections are tight.



3.6 Assembly overview - fuel filter with attachments



1 - Fuel filter

- ❑ Direction of flow is marked with arrows.
- ❑ Do not interchange connections.
- ❑ Removing and installing ⇒ page 177 .
- ❑ Installation position: pin on filter housing must engage in notch of guide in filter bracket ⇒ page 177 .

2 - Retaining clip

- ❑ For fuel pressure regulator.
- ❑ Check for secure seating.

3 - Fuel supply line

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

4 - Fuel return line

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

5 - Fuel pressure regulator

- ❑ 4 bar.

6 - Seal

- ❑ Renew.

7 - O-ring

- ❑ Renew.

8 - Fuel supply line

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

9 - 3 Nm

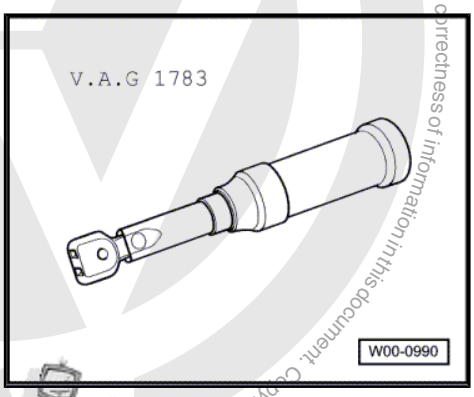
10 - Retainer

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

3.7 Removing and installing fuel filter

Special tools and workshop equipment required

- ♦ Torque wrench -V.A.G 1783-



- ♦ Container

Removing

Note

- ♦ *Note safety precautions before starting installation work* *⇒ page 160* .
- ♦ *Observe rules for cleanliness.*

– Place container under fuel filter.

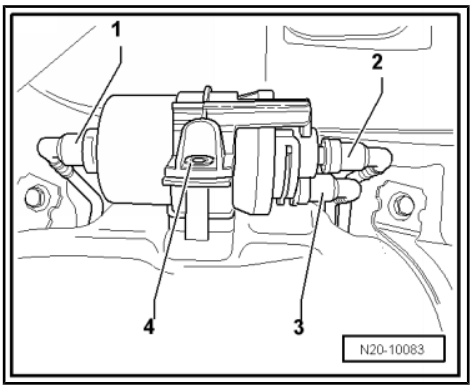
WARNING

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

– Pull off fuel lines -1-, -2- and -3- by pressing release button.

– Remove bolt -4-.

– Remove fuel filter.



Installing

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

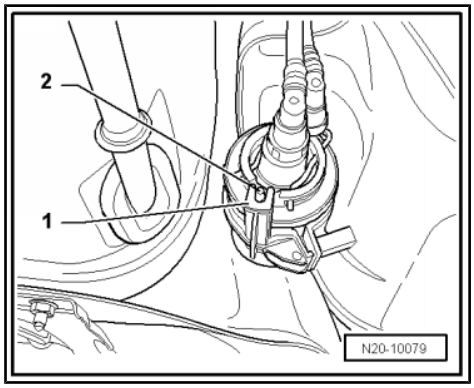
Note

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

– Bleeding fuel system

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

3.8 Removing and installing fuel pump control unit -J538-

Note

The fuel pump control unit -J538- is installed on the fuel tank.

– Lower fuel tank until control unit is accessible.
– Detach connector from fuel pump control unit -J538-.
– Loosen securing nuts.

Installing:

– Installation is performed in the reverse sequence.

4 Electronic power control (EPC)

Assembly overview - accelerator module ⇒ page 179 .

Removing and installing accelerator module ⇒ page 179 .

4.1 Assembly overview - accelerator module

Assembly overview

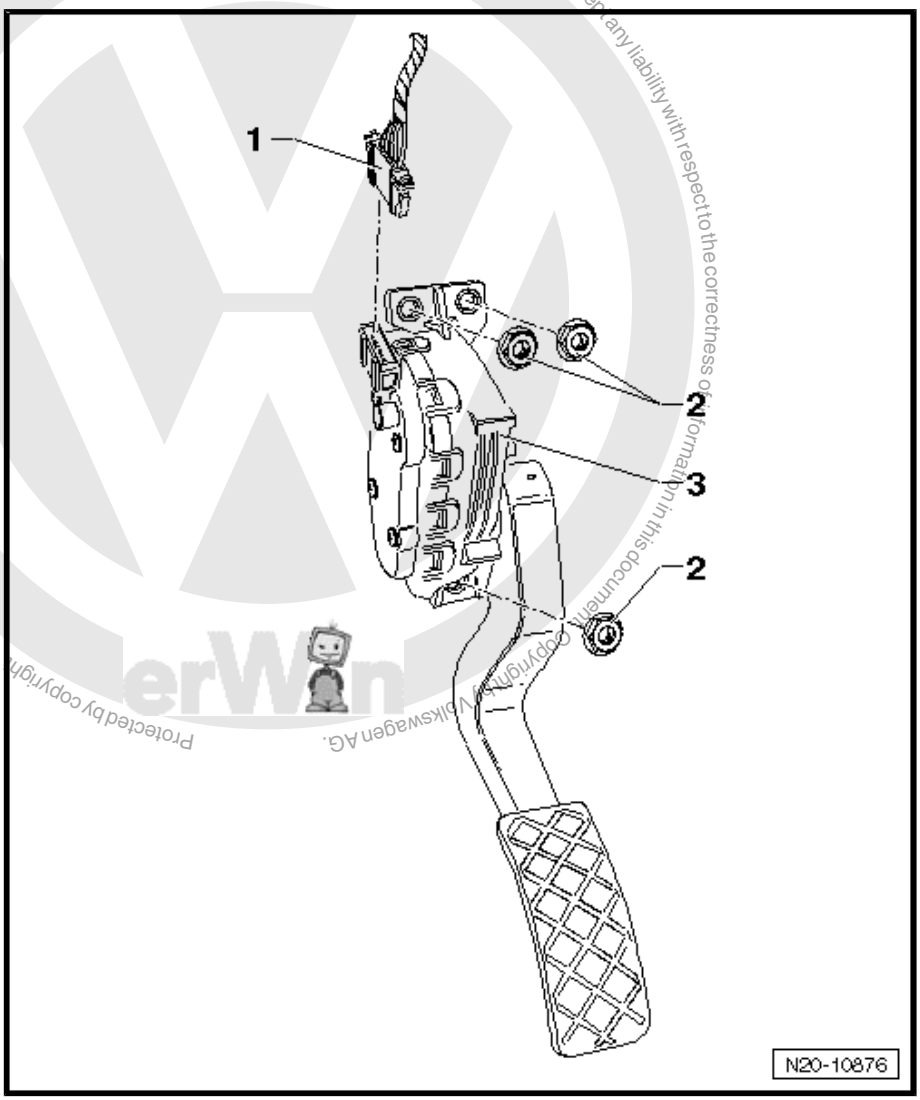
1 - Connector

2 - Securing nuts

- ❑ 10 Nm

3 - Accelerator with electronic module

- ❑ The accelerator position sender passes the position of the accelerator on to the engine control unit.



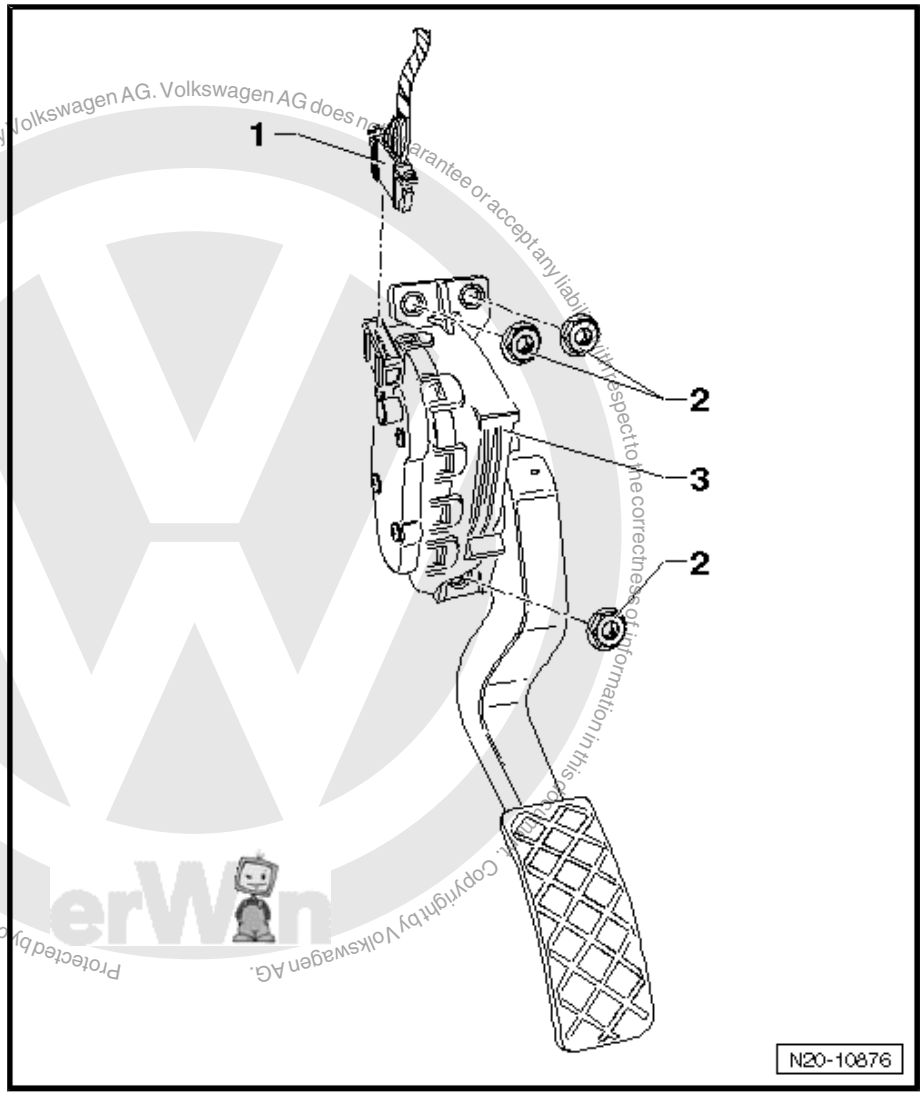
4.2 Removing and installing accelerator module

Removing

– Disconnect connector -1-.

– Unscrew nuts -2-.

– Remove accelerator module -3- towards the front.



Installing

– Installation is performed in the reverse sequence.

Specified torque:

Component	Nm
Accelerator module to body	10

5 Activated charcoal filter system

1 - Breather line

- ❑ Check for secure seating.

2 - Activated charcoal filter

- ❑ Location: on fuel tank, left.
- ❑ Removing and installing only with fuel tank removed

3 - Breather line

- ❑ Check for secure seating.

4 - Quick-release coupling

- ❑ Check for secure seating.

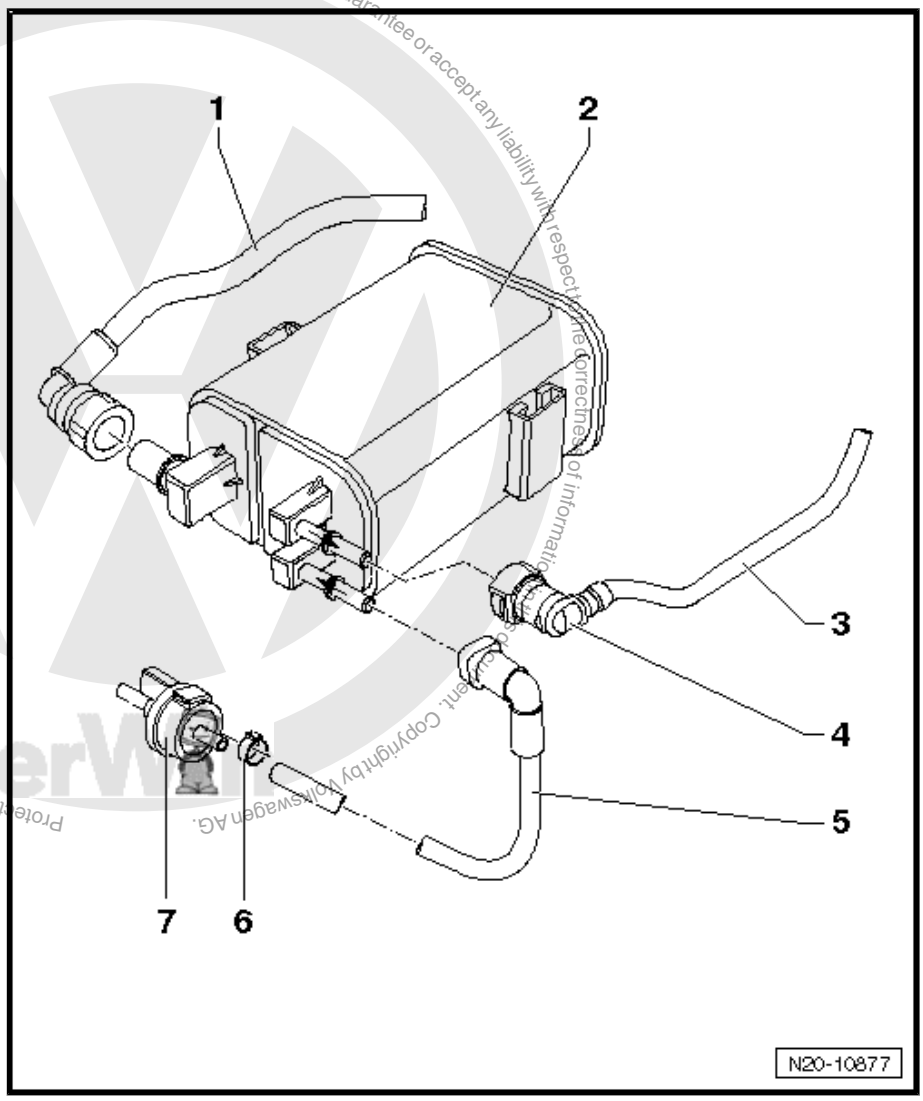
5 - Fuel line

- ❑ Check for secure seating.

6 - Clip

7 - Activated charcoal filter solenoid valve 1 -N80-

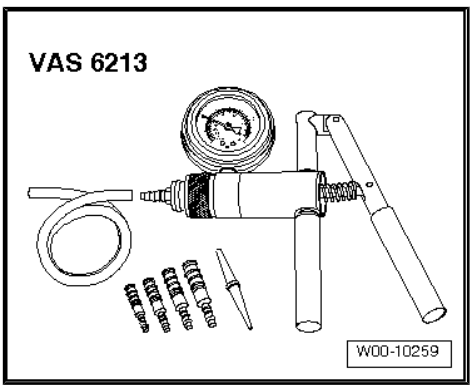
- ❑ Valve closed with ignition switched off.
- ❑ When engine is warm, valve will be activated (pulsed) by engine control unit.



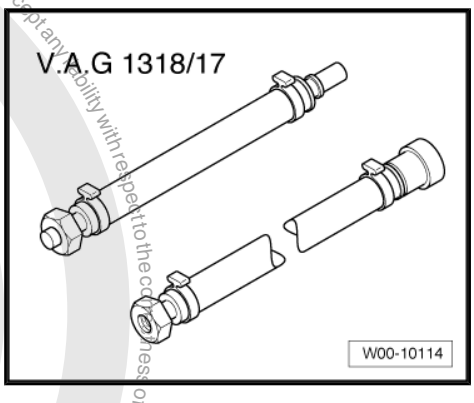
5.1 Checking fuel tank breather

Special tools and workshop equipment required

♦ Hand vacuum pump -VAS 6213-



♦ Adapter set -V.A.G 1318/17-



Test prerequisite

- Ignition must be switched off.
- Fuel tank must be lowered.

Test procedure

– Detach bleeder line ⇒ Item 3 (page 181) .

Note

To do this, press release button.

– Connect hand vacuum pump -VAS 6213- with adapter set -V.A.G 1318/17- to breather line.

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

If vacuum builds up:

– Check breather line ⇒ Item 1 (page 181) on activated charcoal filter for soiling and clean if necessary.

If vacuum does not build up:

– Hold breather line ⇒ Item 1 (page 181) shut and operate vacuum pump again several times. Vacuum must build up.

If vacuum does not build up:

– Renew activated charcoal filter.

21 – Turbocharging/supercharging

1 Charge air system

1.1 Safety precautions

> **WARNING**
>
> *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 the following if testers and measuring instruments have to be used during a road test:

- Test equipment must always be secured on the rear seat and operated by a 2nd person.

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.

1.2 Rules for cleanliness

When working on the charge air system, pay careful attention to the following rules for cleanliness:

- Thoroughly clean all unions and surrounding 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 or similar).
- Existing transport and protective packaging and sealing caps must only be removed immediately prior to installation.
- When making repairs, remove oil from connection and hose ends.
- Do not use substances containing oil, silicone or grease when assembling.
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

1.3 Instructions for hose connections with screw-type clips

Caution

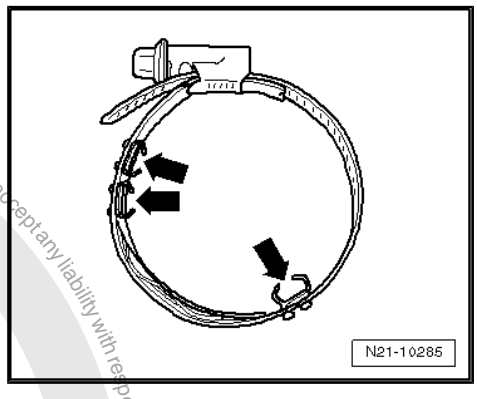
The screw-type clips on the charge air lines must always be tightened to 5.5 Nm. If the torque is too low or too high, the charge air hose may slip off the charge air pipe during vehicle operation.

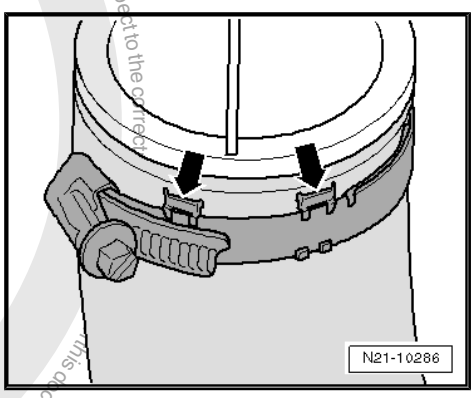
Normal screw-type clips are used on the hose connections on the „intake side“.

On the hose connections on the „delivery side“, there are screw-type clips with „barbs“ -arrows-.

Caution

- *Do not loosen these screw-type clips and pull back over the delivery hose. Risk of damage to the hose!*
- *If a clip has been removed, it must be renewed together with the hose.*





– Screw-type clips with „locking hooks“ -arrows- may only be released. Loosen bolt of screw-type clips sufficiently to remove hoses.

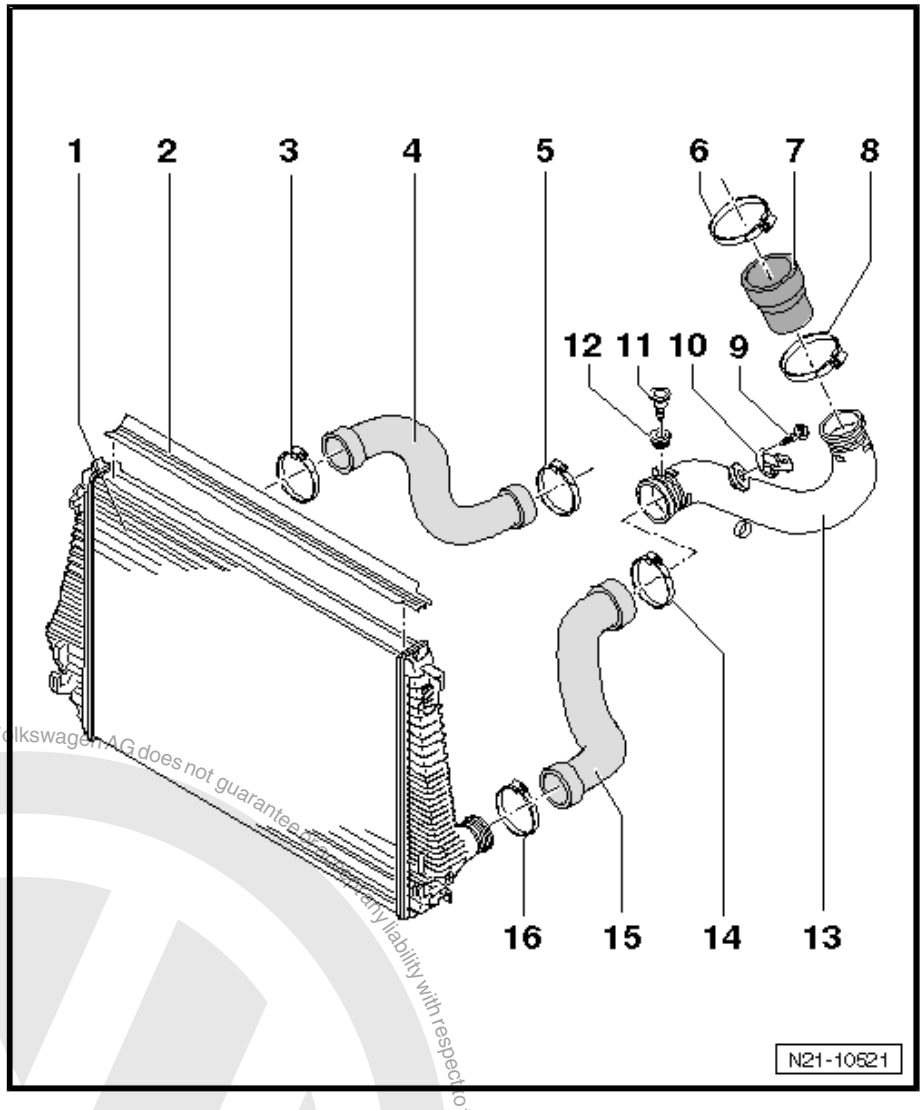
Screw-type clips that are only loosened can be reused.

Hose and clip are supplied together as one part.

– Do not use substances containing oil, silicone or grease when assembling. Only use clean water.

1.4 Assembly overview - charge air cooling

– Observe rules for cleanliness ⇒ page 183 .



1 - Charge air cooler

- ❑ Removing and installing ⇒ page 186 .

Note

2 - Seal

3 - Hose clip

- ❑ Reinforced.
- ❑ 5.5 Nm

4 - Pressure hose

- ❑ To turbocharger.
- ❑ Must be free of oil and grease before installing.

5 - Hose clip

- ❑ Reinforced.
- ❑ 5.5 Nm

6 - Hose clip

- ❑ Reinforced.
- ❑ 5.5 Nm

7 - Pressure hose

- ❑ To throttle valve
- ❑ Must be free of oil and grease before installing.

8 - Hose clip

- ❑ Reinforced.
- ❑ 5.5 Nm

9 - Securing bolt

10 - Pressure sensor

11 - Bolt

12 - Rubber grommet

13 - Pressure pipe

- ❑ Must be free of oil and grease before installing.

14 - Hose clip

- ❑ Reinforced.
- ❑ 5.5 Nm

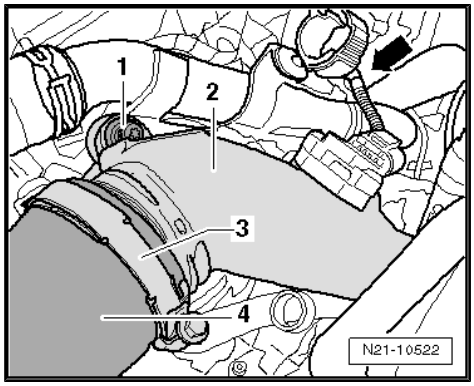
15 - Pressure hose

- ❑ Must be free of oil and grease before installing.

16 - Hose clip

- ❑ Reinforced.
- ❑ 5.5 Nm

1.5 Removing and installing pressure pipe



Removing

– Detach connector from charge pressure sender -G31- .
– Release clip -3- from charge air hose -4-.
– Loosen bolt -1- of pressure pipe -2-.
– Unclip water hose from pressure pipe.
– Release lower clip ⇒ Item 8 (page 185) from socket to throttle valve module -J338- .
– Remove pressure pipe.

Installing

– Installation is performed in the reverse sequence.

1.6 Removing and installing charge pressure sender -G31-

Removing

– Disconnect electrical connector -4- from charge pressure sender -G31- .
– Unscrew bolts -2- and pull charge pressure sender -G31- / -3- out of air duct -1-.

Installing

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

• Specified torque ⇒ page 184 .

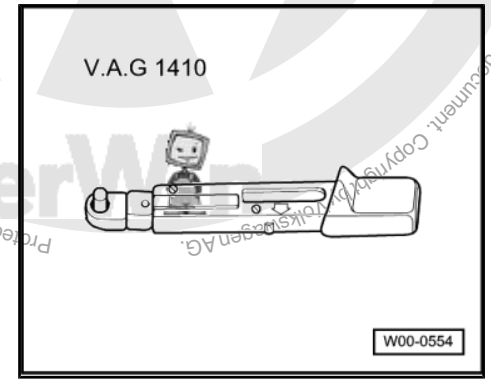
Note

Renew O-ring.

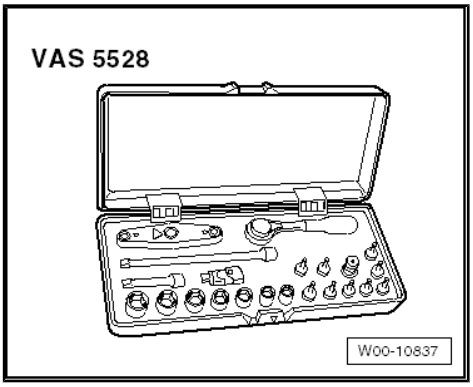
1.7 Removing and installing charge air cooler

Special tools and workshop equipment required

♦ Torque wrench -V.A.G 1410-



♦ Socket set 1/4", 22-piece -VAS 5528-

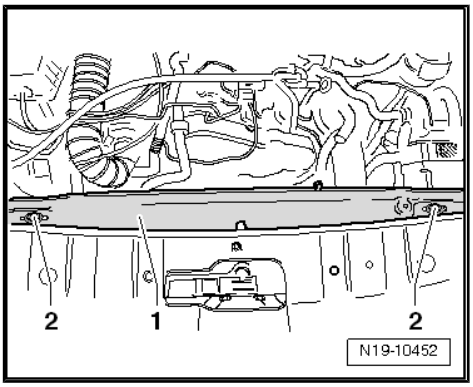


Removing

– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .

– Drain coolant ⇒ page 133 .

– Undo and remove bolts -2- that fasten radiator to lock carrier -1-.



Vehicles with air conditioner

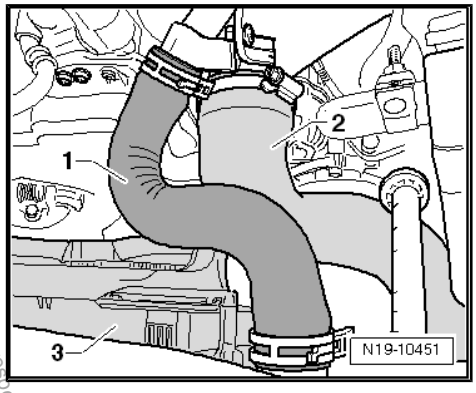
– Remove lock carrier ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier .

Continuation for all vehicles

– Remove cowling ⇒ page 153 .

Observe instructions for hose connections with screw-type clips ⇒ page 184 .

– Remove coolant hose -1- and pressure hose -2-.

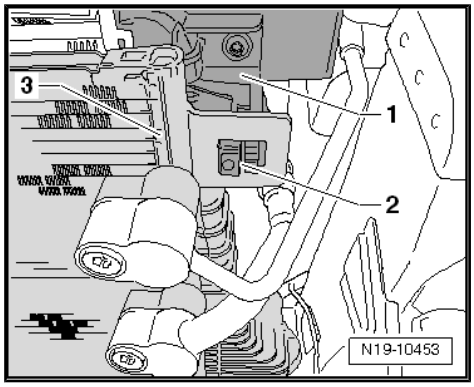


– Remove right pressure hose leading to turbocharger from charge air cooler and place to one side.

– Remove air duct mounting ⇒ page 154 .

Vehicles with air conditioner

– Squeeze left and right catches -2- together and detach condenser -3- from radiator -1-.



Caution

- ***Do not bend or stretch the refrigerant lines excessively***

– Support condenser, e.g. with cable ties.

Caution

- ***During further removal work, make sure that the refrigerant lines are not bent or stretched excessively.***

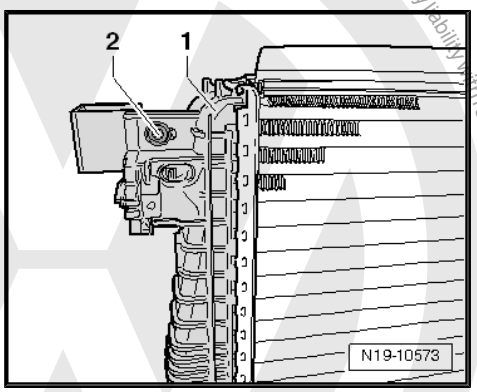
– Do not bend or stretch the refrigerant lines excessively.

Continuation for all vehicles

– Carefully remove radiator upwards together with charge air cooler. When doing so, take the radiator -2- past the refrigerant lines.

Note

- *If the radiator -1- is to be replaced, undo bolts of charge air cooler and remove it from radiator.*
- *Undo and remove bolt -2- on right and left (not shown in illustration) at radiator.*

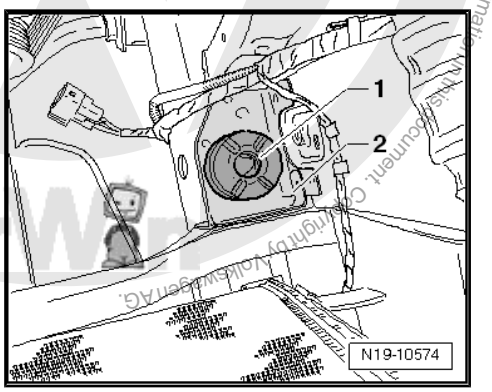


Installing

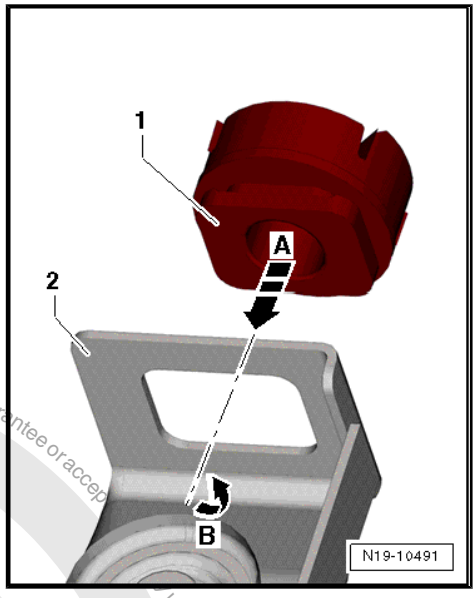
Install in reverse order. In the process, note the following:

Note

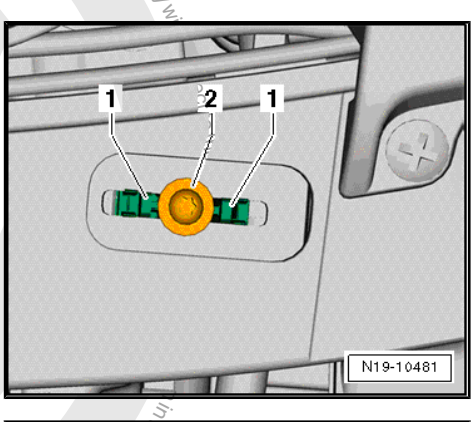
Before installing radiator, check that radiator mountings -1- are correctly seated on front part of car -2- and, if necessary, reposition:



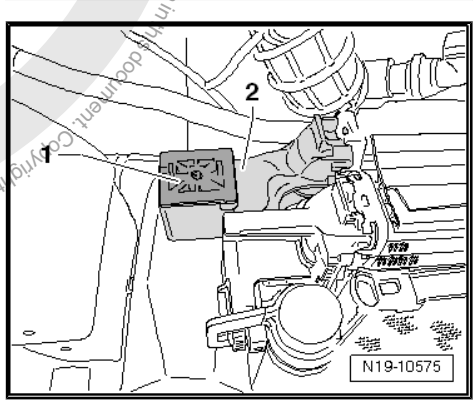
– Insert radiator mounting into lock carrier -2- at bottom -1-, doing so transversely to the direction of travel, and then turn it 90".



– When installing the radiator, make sure that the catches -1- of the radiator mounting on the left and right at the top have engaged completely in the lock carrier.



– Insert top radiator mountings -1- on right and left into the mounting on radiator -2- appropriately.



Observe instructions for hose connections with screw-type clips ⇒ page 184 .

– Install cowling ⇒ page 154 .

– Replenish coolant ⇒ page 133 .

Only for vehicles with air conditioning

– Install lock carrier ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier .

Continuation for all vehicles

Specified torques ⇒ page 152 .

Caution

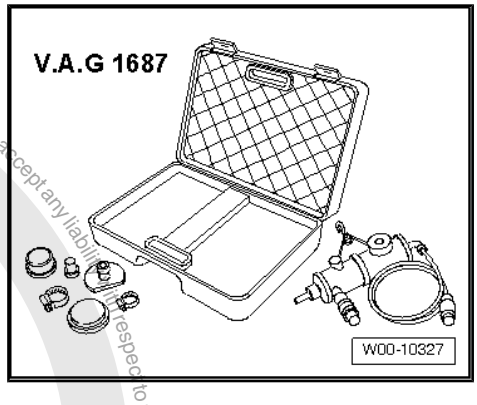
The screw-type clips on the charge air lines must always be tightened to 5.5 Nm. If the torque is too low or too high, the charge air hose may slip off the charge air pipe during vehicle operation.

Hose connections with screw-type clips ⇒ page 184 .

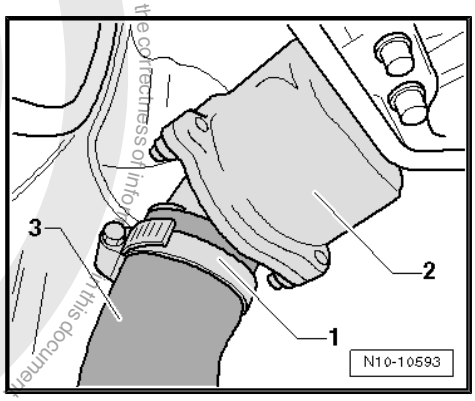
1.8 Checking charge air system for leaks

Special tools and workshop equipment required

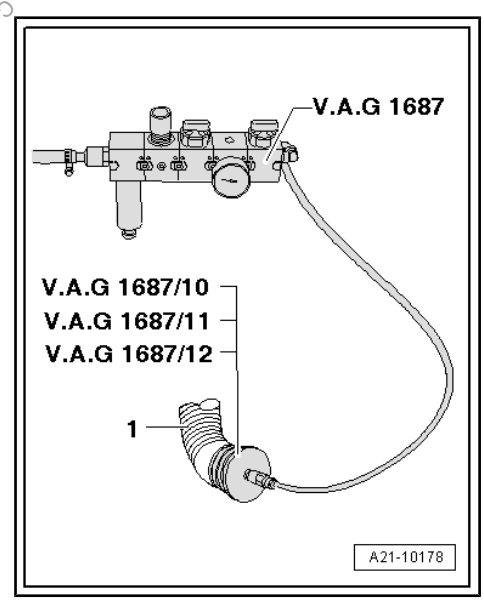
♦ Charge air system tester -V.A.G 1687-



– Release hose clip -1- and detach pressure hose -3- from turbocharger -2-.



– Depending on hose diameter, insert adapter -1687/10- , -1687/11- or -1687/12- in air duct -1- and secure with hose clip.
– Connect charge air system tester -V.A.G 1687- as shown in figure.

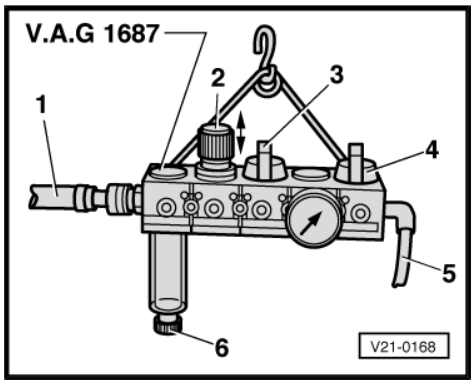


Prepare charge air system tester -V.A.G 1687- as follows:

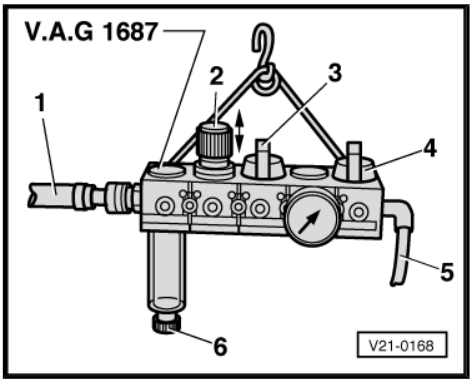
– Unscrew pressure control valve -2- completely, close valves -3- and -4-.

Note

To turn the pressure regulating valve -2- the knob must be pulled upwards.



– Connect charge air system tester -V.A.G 1687- to compressed air -1- via commercial adapter.



Note

If there is water in inspection glass, drain via drain screw -6-.

– Open valve -3-.

Caution

Risk of damage because pressure is set too high.

- ***The pressure must not exceed 0.5 bar!***

– Adjust pressure to 0.5 bar with pressure control valve -2-.

– Open valve -4- and wait until test circuit is full. If necessary, readjust pressure to 0.5 bar.

– Check charge air system for leaks by hearing, touching, with commercially available leak detector spray or using ultrasonic tester -V.A.G 1842- .

Note

- *A small amount of air escapes through the valves and enters the engine. Therefore a holding pressure test is not possible.*
- *How to use the ultrasonic tester -V.A.G 1842- ⇒ operating instructions*
- *Before removing the adapters, depressurise the test circuit by detaching coupling.*
- *Hose unions and air pipes/hoses must be free of oil and grease when installing.*
- *Secure all hose connections with hose clips corresponding to the series equipment ⇒ Electronic parts catalogue .*
- *In order to be able to securely attach the air ducts on their connections, the screws of the used hose clips have to be sprayed with penetrating spray before installing.*

2 Turbocharger

Note

- *Secure all hose connections with hose clips comparable to production standard*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly. The oil seal and sealing surface must be oiled lightly only for connector couplings .*
- *Charge air system must be free of leaks.*
- *Renew self-locking nuts.*
- *Hose clip pliers -VAS 6362- or hose clip pliers -V.A.G 1921- are recommended for installation of spring-type clips.*
- *Fill turbocharger with engine oil at oil supply line connection.*
- *After installing turbocharger, run engine for about 1 minute at idling and do not rev up immediately, this ensures that the turbocharger is fully primed with oil*
- *Observe rules for cleanliness* ⇒ page 183 .

2.1 Assembly overview - turbocharger

Part I

Part II ⇒ page 194

Part III ⇒ page 195

Part IV ⇒ page 196

1 - Turbocharger

- ❑ Can only be renewed together with exhaust manifold and vacuum unit as one unit
- ❑ Removing and installing ⇒ page 197 .

2 - Hose

3 - Vacuum unit for turbocharger

- ❑ Can only be renewed together with turbocharger.

4 - Hose clip

5 - Hose

6 - Hose

7 - Bolt

- ❑ 3 Nm

8 - Charge pressure control solenoid valve -N75-

9 - Hose

10 - Turbocharger air recirculation valve -N249-

- ❑ Note installation position ⇒ page 193 .

11 - Bolt

- ❑ 7 Nm

12 - O-ring

- ❑ Renew.

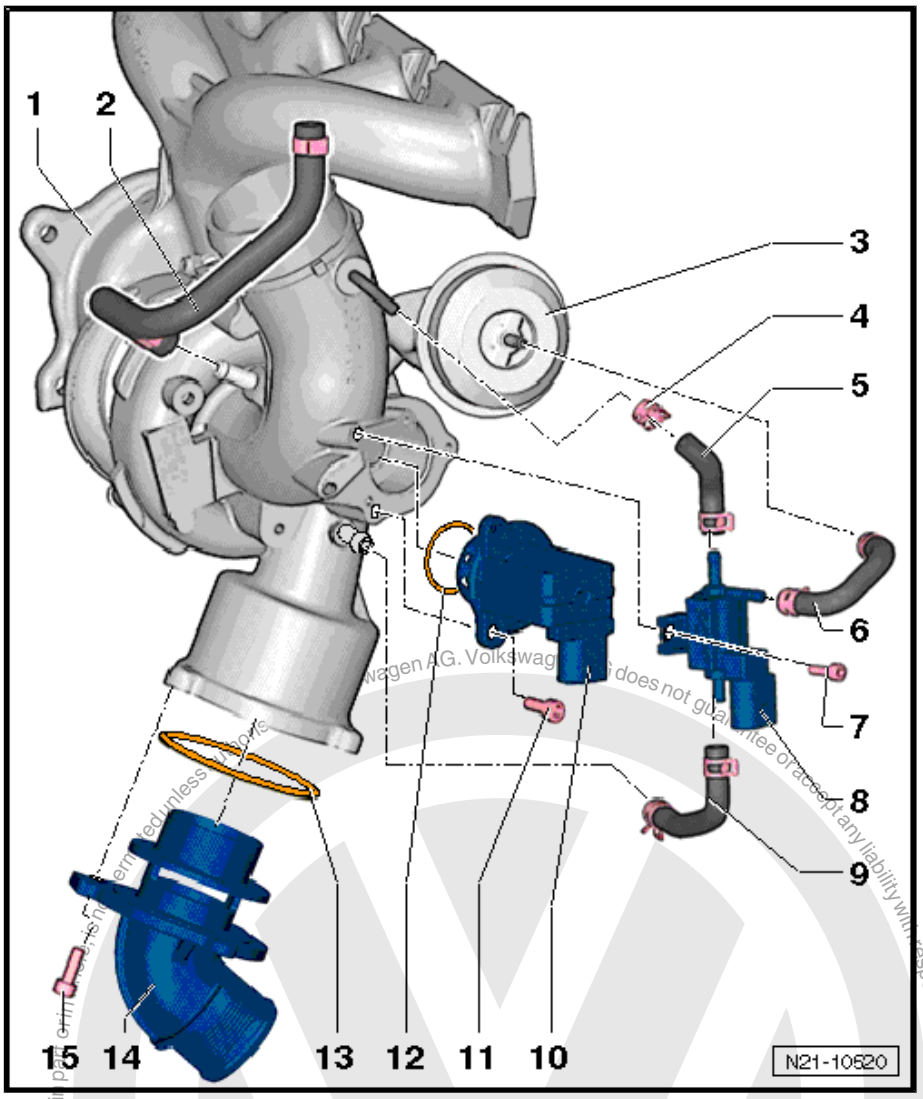
13 - O-ring

- ❑ Renew.

14 - Connection

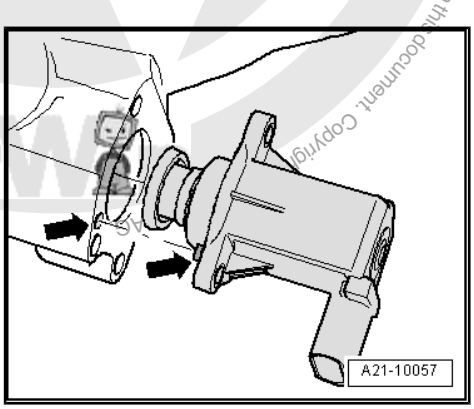
15 - Bolt

- ❑ 9 Nm



Installation location of turbocharger air recirculation valve -N249-

– Note installation position -arrows-.

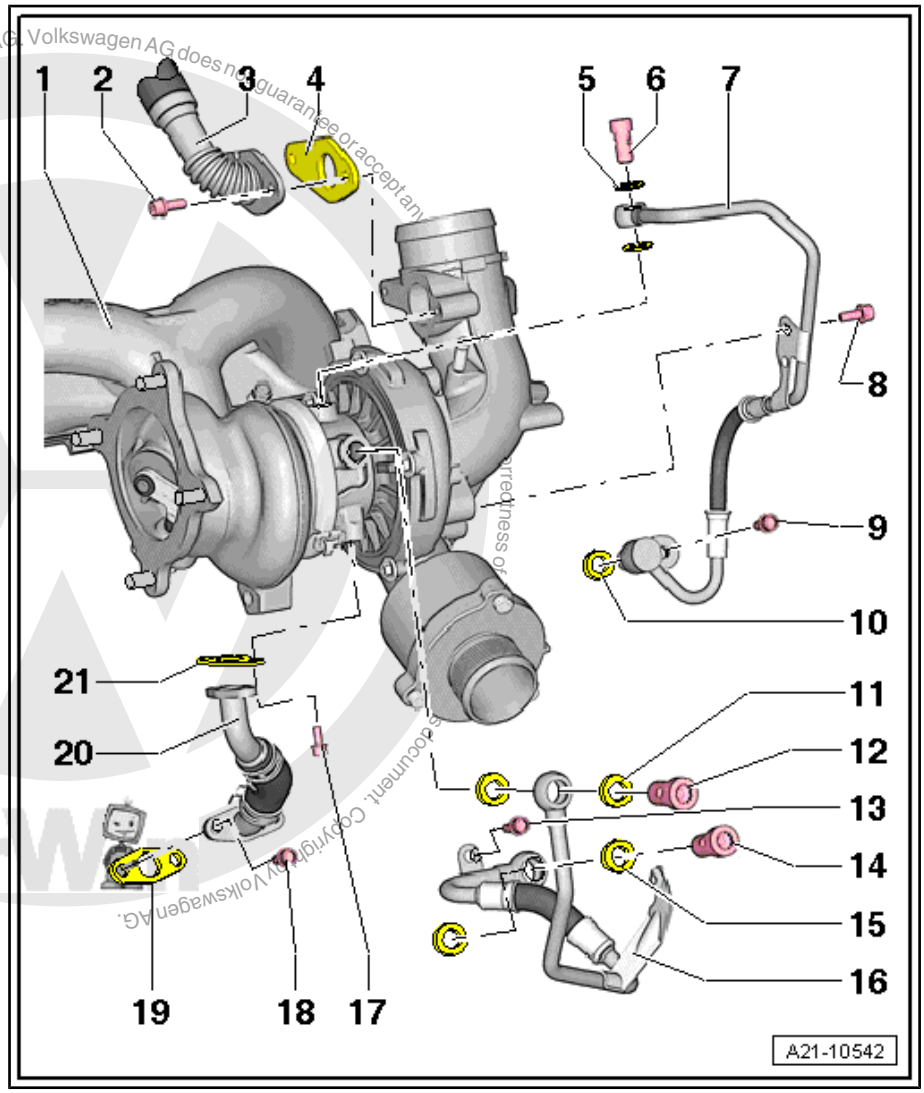


Part II

Part I ⇒ page 192

Part III ⇒ page 195

Part IV ⇒ page 196



1 - Turbocharger
- ❑ Can only be renewed together with exhaust manifold and vacuum unit as one unit
- ❑ Removing and installing ⇒ page 197 .

2 - Bolt
- ❑ 9 Nm

3 - Crankcase breather line

4 - Seal
- ❑ Renew.

5 - Seal
- ❑ Renew.

6 - Bolt
- ❑ 30 Nm

7 - Oil supply line

8 - Bolt
- ❑ 9 Nm

9 - Bolt
- ❑ 9 Nm

10 - O-ring
- ❑ Renew.

11 - Seal
- ❑ Renew.

12 - Bolt
- ❑ 35 Nm

13 - Bolt
- ❑ 9 Nm

14 - Bolt
- ❑ 35 Nm

15 - Seal
- ❑ Renew.

16 - Coolant supply line

17 - Bolt
- ❑ 9 Nm

18 - Bolt
- ❑ 9 Nm

19 - Seal
- ❑ Renew.

20 - Oil return line

21 - Seal

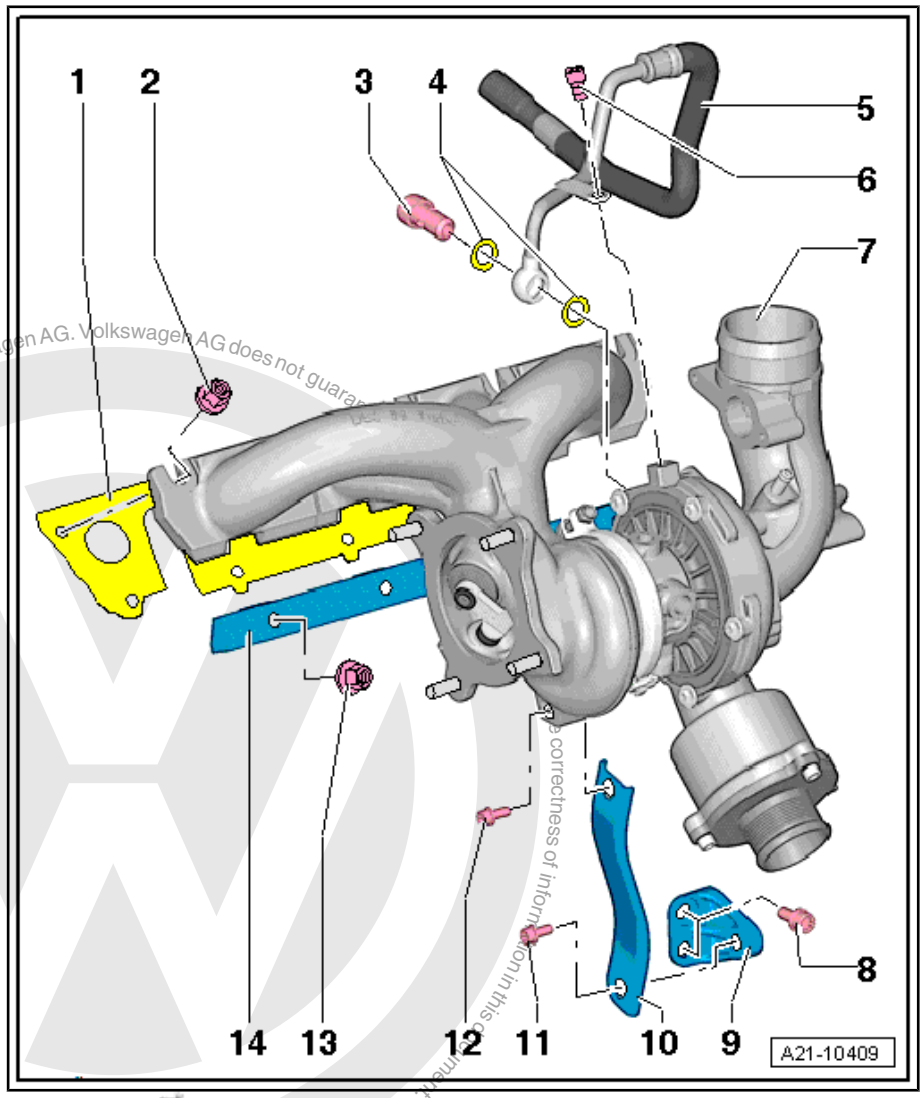
- ❑ Renew.

Part III

Part I ⇒ page 192

Part II ⇒ page 194

Part IV ⇒ page 196



1 - Seal

- ❑ Renew.

2 - Nut

- ❑ Renew.
- ❑ Tightening sequence ⇒ page 196 .
- ❑ Coat exhaust manifold studs with high-temperature paste; high-temperature paste ⇒ Electronic parts catalogue

3 - Bolt

- ❑ 35 Nm

4 - Seal

- ❑ Renew.

5 - Coolant return line

6 - Bolt

- ❑ 9 Nm

7 - Turbocharger

- ❑ Can only be renewed together with exhaust manifold and vacuum unit as one unit
- ❑ Removing and installing ⇒ page 197 .

8 - Bolt

- ❑ 30 Nm

9 - Retainer

10 - Support

11 - Bolt

- ❑ 30 Nm

12 - Bolt

- ❑ 30 Nm
- ❑ Coat bolt with high-temperature paste; high-temperature paste ⇒ Electronic parts catalogue .

13 - Nut

- ❑ Do not unscrew to remove turbocharger
- ❑ Renew.
- ❑ 30 Nm

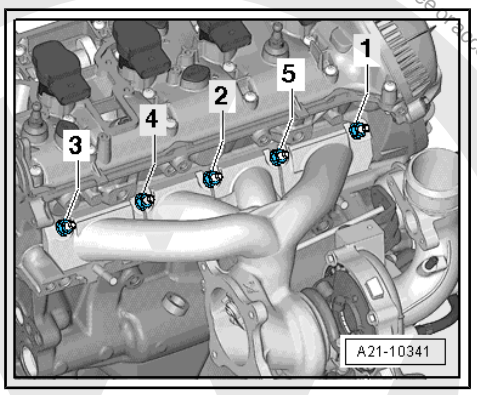
- ❑ Coat exhaust manifold studs with high-temperature paste; high-temperature paste ⇒ Electronic parts catalogue

14 - Clamping rail

Tightening sequence - turbocharger

– Tighten bolts in sequence -1 to 5- in 4 stages as follows:

1. Tighten bolts to 5 Nm.
2. Tighten bolts to 12 Nm.
3. Tighten bolts to 16 Nm.
4. Tighten bolts to 25 Nm.



Part IV

Part I ⇒ page 192

Part II ⇒ page 194

Part III ⇒ page 195

1 - Turbocharger

- ❑ Can only be renewed together with exhaust manifold and vacuum unit as one unit
- ❑ Removing and installing ⇒ page 197 .

2 - Vacuum unit for turbocharger

- ❑ Check ⇒ page 200 .
- ❑ Removing and installing ⇒ page 200 .

3 - Bolt

- ❑ 10 Nm

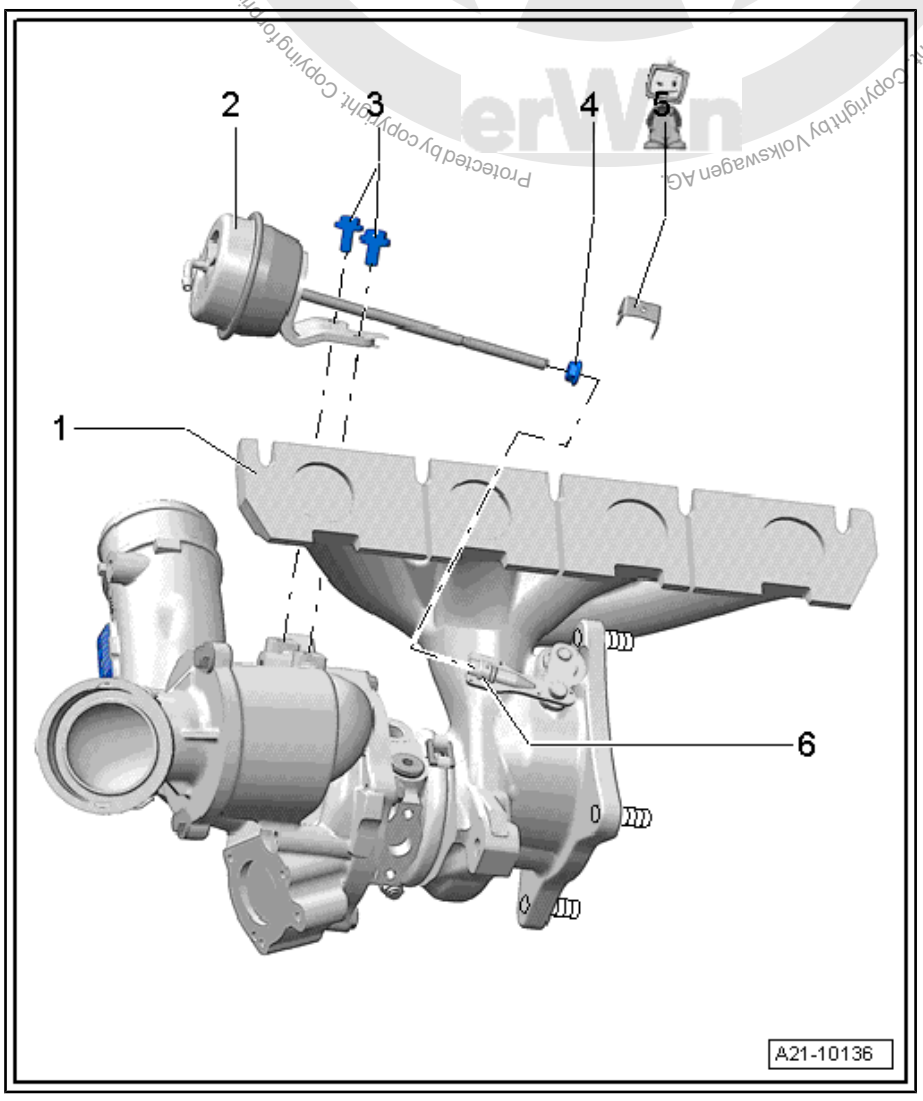
4 - Nut

- ❑ 9 Nm
- ❑ Secure with sealing wax; sealing wax ⇒ Electronic parts catalogue .

5 - Locking plate

- ❑ Renew.

6 - Knurled nut



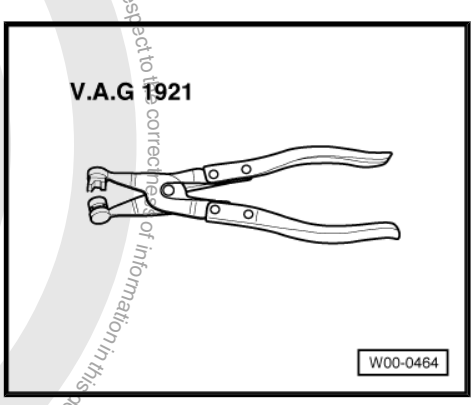
Further specified torques

Component	Nm
Right air duct to sump	10
Air duct to bracket	10

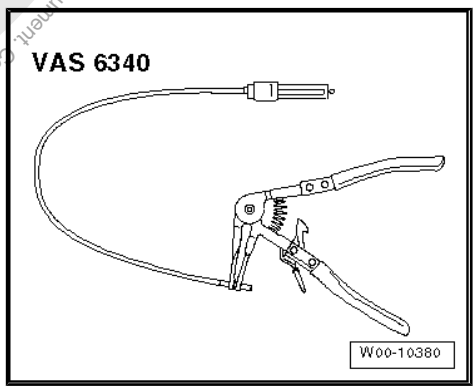
2.2 Removing and installing turbocharger

Special tools and workshop equipment required

- Hose clip pliers -V.A.G 1921-



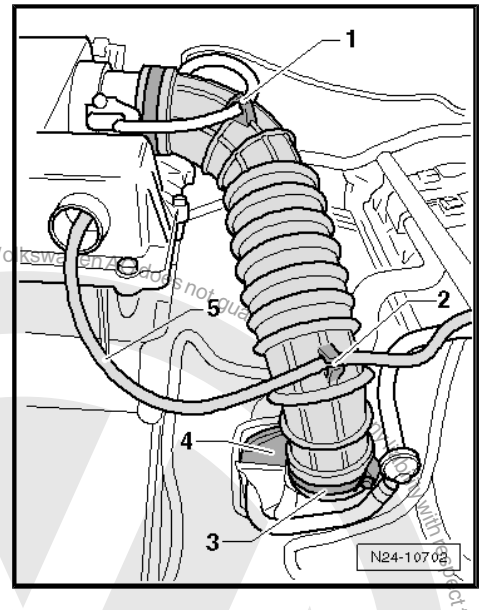
- Hose clip pliers -VAS 6340-



Removing

– Drain coolant ⇒ page 133 .
– Release clip -3-, unclip vacuum line -5- from guideway -2-.
– Unclip line -1- for air mass meter -G70- .

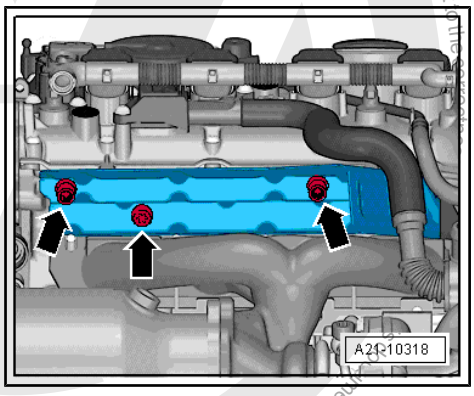
– Detach intake hose -4- from turbocharger.
– Remove air filter housing ⇒ page 207 .
– Remove catalytic converter ⇒ page 240 .
– Disconnect coolant hose from turbocharger.



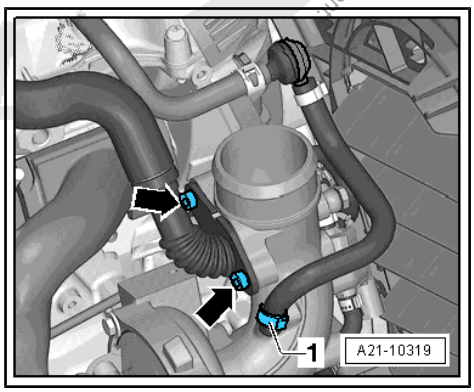
Note

For reasons of clarity, following diagrams show installation position with engine removed.

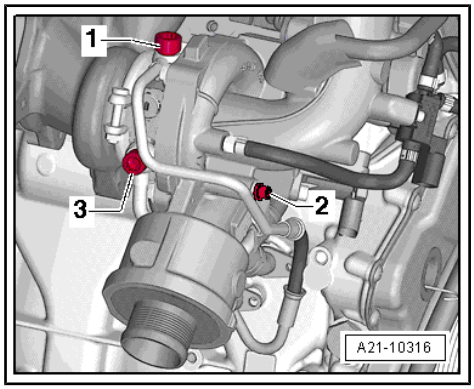
– Remove heat shield -arrows-.



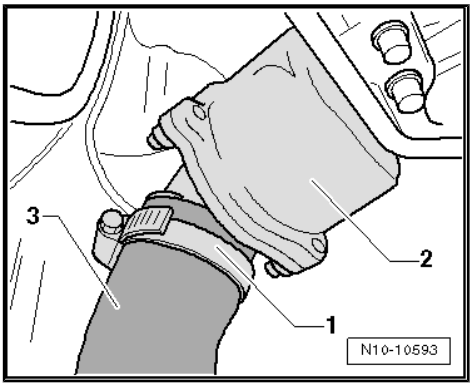
– Unscrew crankcase breather system -arrow- from turbocharger.
– Pull off hose -1- from turbocharger.



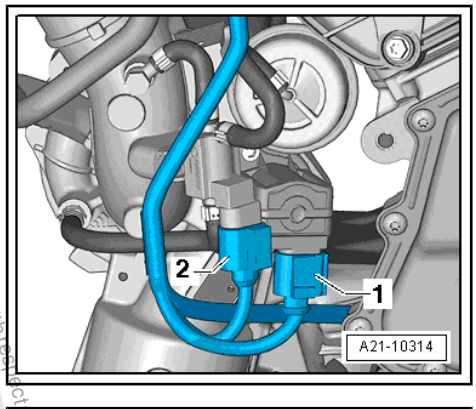
– Unscrew bolts -1 and 2- and lay oil supply line to one side.
– Unscrew bolt -3- and lay coolant line to one side.



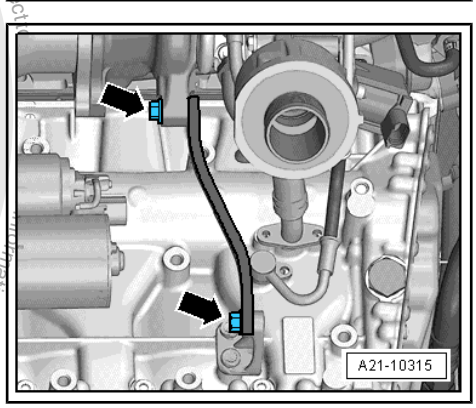
– Release hose clip -1- and detach pressure hose -3- from turbocharger -2-.



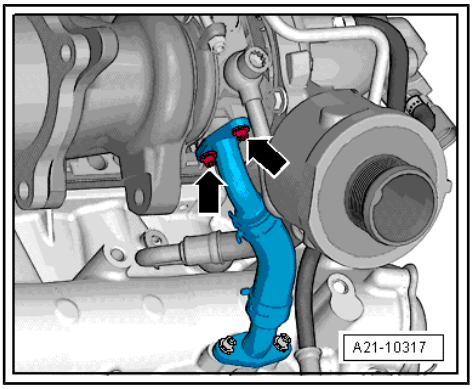
– Unplug electrical connections -1 and 2- and lay wiring to one side.



– Unscrew bolts -arrows- and remove support for turbocharger.

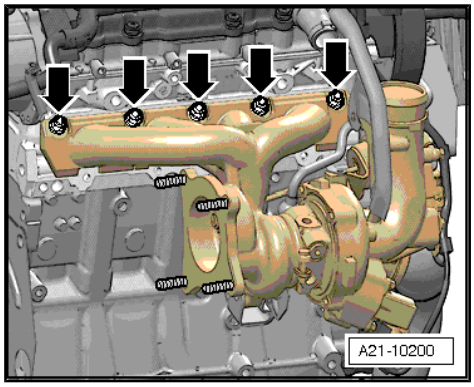


– Unscrew bolts -arrows- on oil return line.



– Remove nuts -arrows-.

– Remove turbocharger with exhaust manifold upwards.



Installing

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

- Specified torques ⇒ page 192 .

Note

- *Renew seals, gaskets, O-rings and self-locking nuts.*
- *Fill turbocharger with engine oil at oil supply line connection.*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- *Secure all hose connections with hose clips corresponding to the series equipment ⇒ Electronic parts catalogue .*

– Install catalytic converter ⇒ page 240 .

– Aligning exhaust system free of stress ⇒ page 243 .

– Replenish coolant ⇒ page 133 .

– Check oil level, Amarok ⇒ Maintenance ; Booklet 11 .

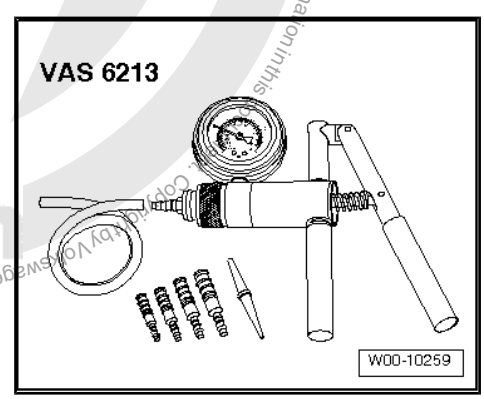
Note

After installing turbocharger, run engine for about 1 minute at idling and do not rev up immediately, this ensures that the turbocharger is fully primed with oil

2.3 Checking vacuum unit for turbocharger

Special tools and workshop equipment required

- Hand vacuum pump -VAS 6213-

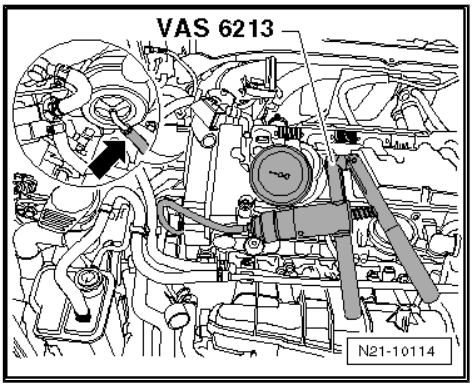


Test prerequisite:

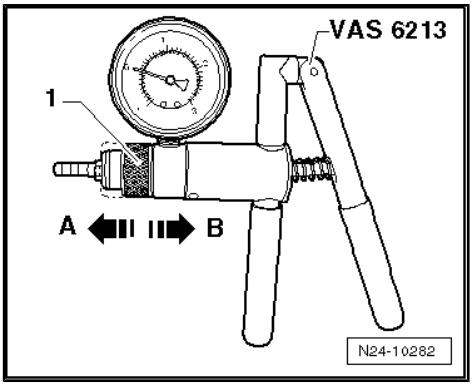
- Hose from turbocharger via charge pressure control solenoid valve -N75- to vacuum unit must have through-flow (not be blocked).
- Charge pressure control solenoid valve -N75- OK.

Procedure:

– Connect hand vacuum pump -VAS 6213- to vacuum unit -arrow-.



– Move slide ring -1- on hand vacuum pump -VAS 6213- to position -B- for „pressure“.



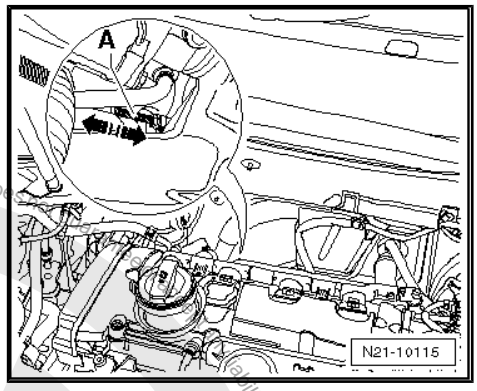
Caution

The pressure must not exceed 750 mbar! If the pressure is exceeded, the vacuum unit can be damaged.

– Operate hand vacuum pump -VAS 6213- repeatedly, observing linkage.

The linkage -A- should start to move at a pressure of approx. 300 mbar and be at its limit stop at a pressure of approx. 700 mbar.

The stroke of the linkage is approx. 10 mm.



Note

If no pressure can be built up using the hand vacuum pump -VAS 6213- or the pressure drops immediately again, check the hand vacuum pump -VAS 6213- and connecting hoses for leaks. If no fault is found: renew vacuum unit ⇒ page 200 .

24 – Mixture preparation - injection

1 Safety precautions and rules for cleanliness

General notes on self-diagnosis ⇒ page 202

Releasing pressure in high-pressure area

Safety precautions ⇒ page 160 .

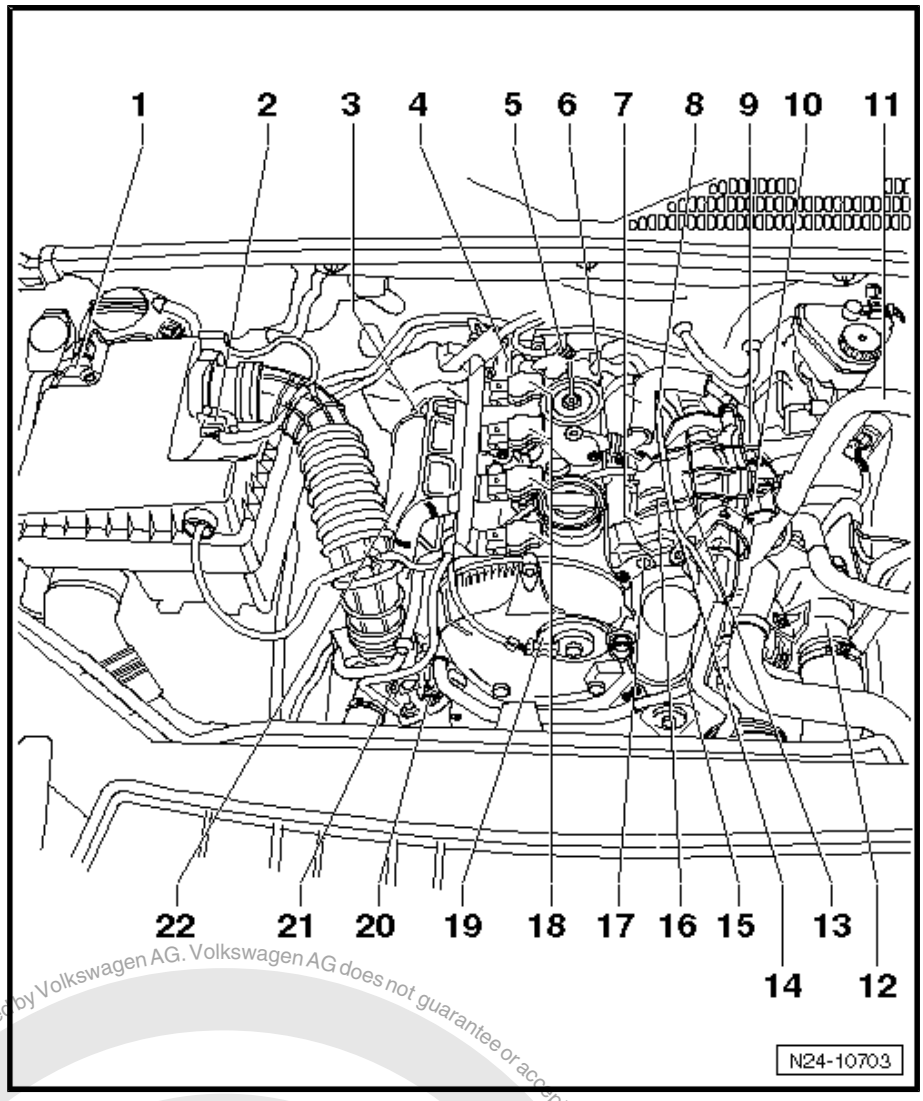
Rules for cleanliness ⇒ page 202 .

1.1 General notes on self-diagnosis

- The engine control unit has a self-diagnosis capability. Before carrying out repairs and fault finding, read fault memory. Also the vacuum hoses and connections must be checked (unmetered air).
- Fuel hoses in engine compartment must be secured only with spring-type clips. The use of clamp or screw-type clips is not permissible.
- For trouble-free operation of electrical components, a voltage of at least 11.5 volts 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.
- Vehicles are fitted with a crash fuel shut-off circuit. This is intended to reduce the danger of a vehicle fire in a crash as the fuel pump is switched off by the fuel pump relay.
- The system also improves the starting characteristics of the engine. When the driver's door is opened, the fuel pump is activated for 2 seconds in order to build up pressure in the fuel system, note safety measures ⇒ page 160 .

2 Injection system

2.1 Overview of fitting locations



1 - Intake manifold pressure sender -G71-

2 - Air mass meter -G70-

- ❑ Removing and installing ⇒ page 209 .

3 - Lambda probe -G39- and Lambda probe heater -Z19-

4 - Vacuum pump

5 - High-pressure pump

- ❑ Removing and installing ⇒ page 226 .

6 - Engine speed sender -G28-

- ❑ Removing and installing ⇒ page 252 .
- ❑ 4.5 Nm

7 - Hall sender -G40-

8 - Activated charcoal filter solenoid valve 1 -N80-

9 - Intake air temperature sender -G42-

10 - Throttle valve module -J338-

- ❑ Throttle valve drive angle sender -G187- and throttle valve drive angle sender 2 -G188-
- ❑ Each time after removing, installing or renewing throttle valve module -J338- it must be re-adapted to engine control unit -J623- .
- ❑ Removing and installing ⇒ page 223 .

11 - Wiring harness to engine control unit

12 - Charge air pressure sender -G31-

- ❑ Removing and installing ⇒ page 186 .

13 - Coolant temperature sender -G62-

- ❑ Removing and installing ⇒ page 145 .

14 - Fuel pressure sender -G247-

- ❑ Removing and installing ⇒ page 222 .

15 - Oil pressure switch -F22-

16 - Knock sensor 1 -G61-

17 - Intake manifold flap potentiometer -G336-

18 - Ignition coils with final output stage

- ❑ Pull all ignition coils out of cylinder head using puller -T40039- .
- ❑ Removing and installing ⇒ page 248 .

19 - Inlet camshaft control valve 1 -N205-

- ❑ Removing and installing ⇒ page 66 .

20 - Turbocharger air recirculation valve -N249-

- ❑ Removing and installing ⇒ page 192 .

21 - Charge pressure control solenoid valve -N75-

- ❑ Removing and installing ⇒ page 192 .

22 - Lambda probe after catalytic converter -G130- and Lambda probe heater 1, after catalytic converter -Z29-

2.2 Assembly overview - air filter

1 - Air duct

- ❑ Check for secure engagement.

2 - Rubber bush

- ❑ Clipped into lower part of air filter

3 - Air filter lower part

4 - 8.5 Nm

- ❑ Rubber bush clipped into lower part of air filter.

5 - Water drainage pipe
⇒ page 207

- ❑ Clipped onto lower part of air filter.
- ❑ Make sure it is mounted in correct position on longitudinal member
- ❑ Clean if soiled.

6 - Filter element

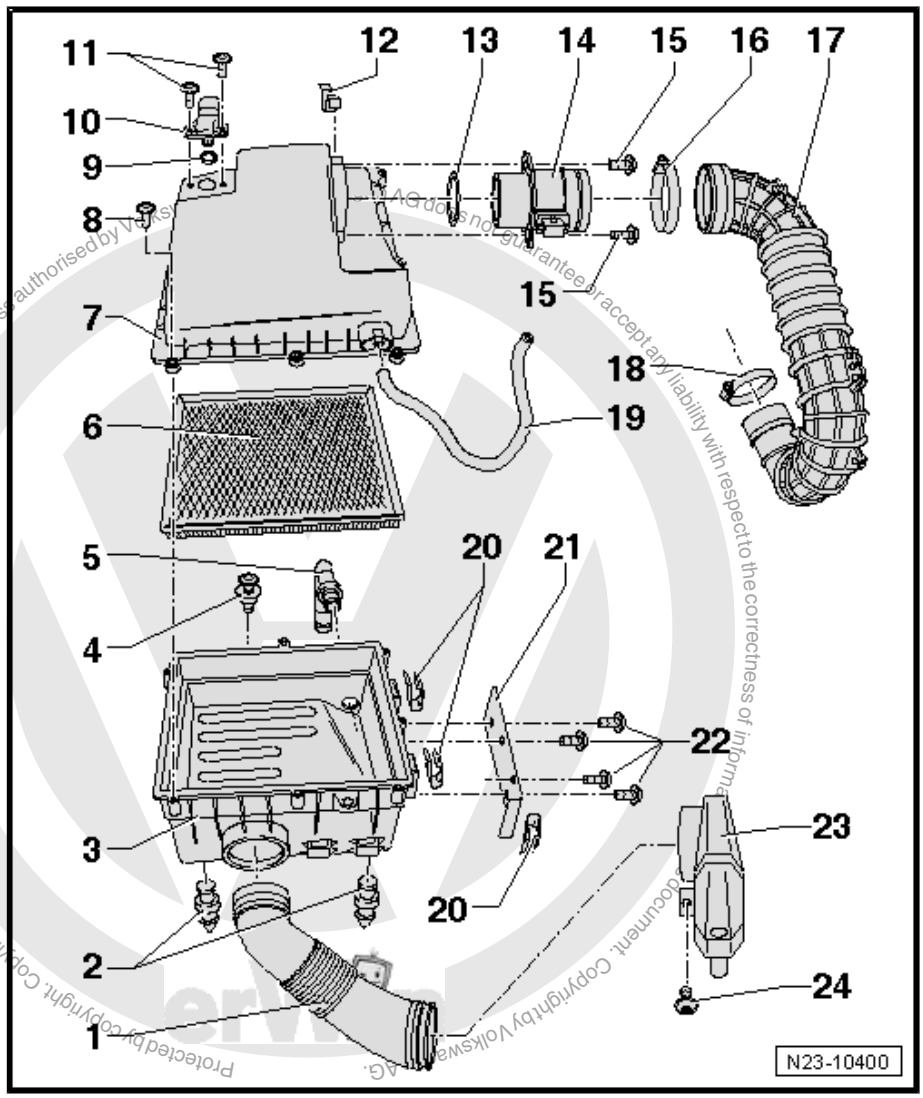
- ❑ Replacing air filter: clean and replace filter element ⇒ Maintenance ; Booklet 11
- ❑ Replacing air filter: with saturation indication in Combi instrument ⇒ Maintenance ; Booklet 11

7 - Air filter upper part

8 - 2 Nm

9 - O-ring

- ❑ Renew if damaged.



10 - Intake manifold pressure sender -G71-

11 - 1.6 Nm

12 - Retainer

- ❑ For coolant hose mounting.

13 - O-ring

- ❑ Renew if damaged.

14 - Air mass meter -G70-

- ❑ Removing and installing ⇒ page 209 .

15 - 1.6 Nm

16 - Screw-type clip, 5.5 Nm

> **Caution**
> *The screw-type clips on the charge air lines must always be tightened to 5.5 Nm. If the torque is too low or too high, the charge air hose may slip off the charge air pipe during vehicle operation.*

17 - Intake hose

- ❑ It is essential that the marks on intake hose be in line with the webs on the turbocharger.
- ❑ Clean oil from ends of hoses before installing.
- ❑ Do not use lubricants containing oil.
- ❑ To turbocharger.
- ❑ With heater element for crankcase breather -N79- and connection for crankcase breather/cylinder head cover connecting pipe.

18 - Screw-type clip, 5.5 Nm

> **Caution**
> *The screw-type clips on the charge air lines must always be tightened to 5.5 Nm. If the torque is too low or too high, the charge air hose may slip off the charge air pipe during vehicle operation.*

19 - Vacuum hose

20 - Retainer

- ❑ For wiring harness.

21 - Heat shield

22 - 2 Nm

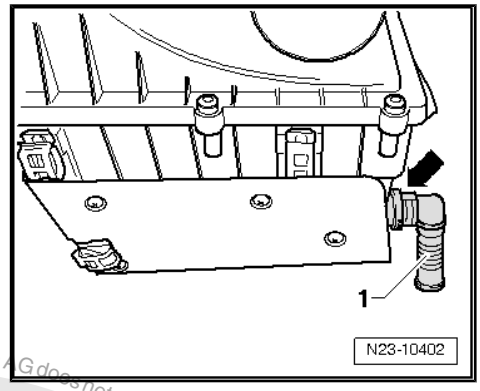
23 - Mounting for air duct

- ❑ Secured to lock carrier.
- ❑ Check for secure engagement.

24 - 8.5 Nm

Water drainage pipe on lower part of air filter

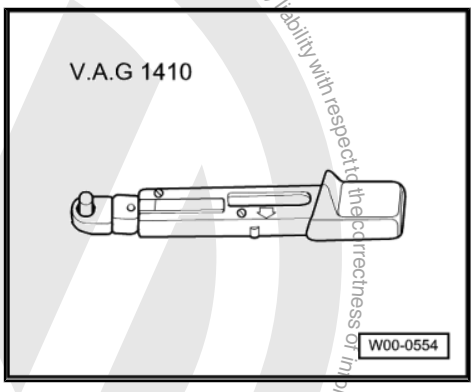
– Water drainage pipe -1- is clipped into lower part of air filter -arrow-.



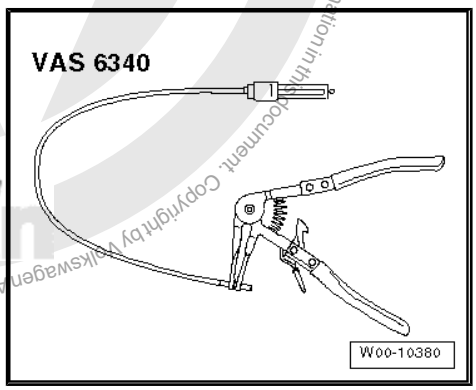
2.3 Removing and installing air filter housing

Special tools and workshop equipment required

♦ Torque wrench -V.A.G 1410-

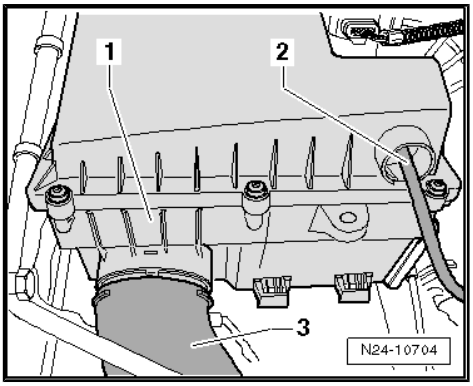


♦ Hose clip pliers -VAS 6340-

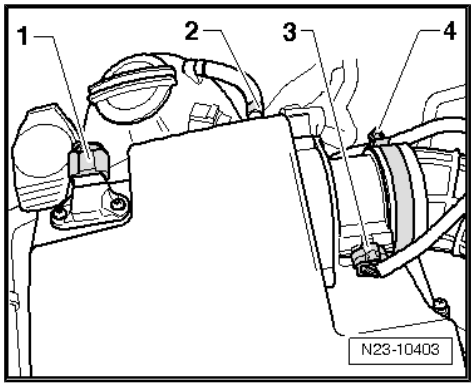


Removing

– Detach vacuum hose -2- from air filter upper part and air duct -3- from air filter lower part -1-.



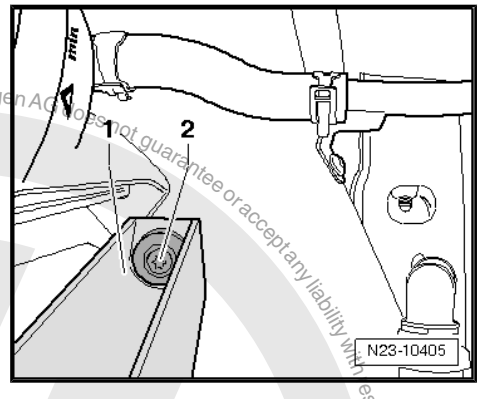
– Disconnect electrical connectors -1 and 3-.
– Loosen screw-type clip -4- and remove intake hose from air mass meter -G70- .



Note

Item 2 can be disregarded.

– Unscrew securing bolt -2- for air filter housing -1- in area of coolant expansion tank.
– Pull air filter out of mountings.

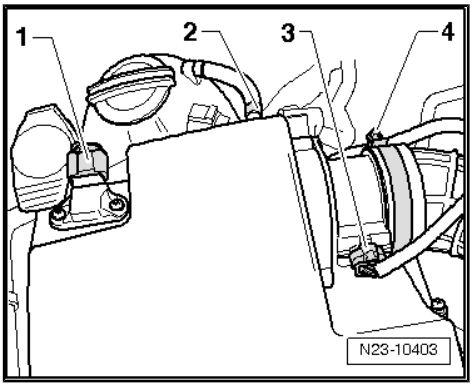


Installing

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

2.4 Removing and installing air filter element

Removing



– Disconnect electrical connector from air mass meter G 70 and intake manifold pressure sender G 71 -1 and 3-.
– Open hose clip on air duct -4- and remove from air mass meter.
– Detach vacuum hose.

Note

Item 2 can be disregarded.

– Unscrew all bolts from air filter upper part and remove upper part.
– Remove air filter insert upwards.

Installing

Note

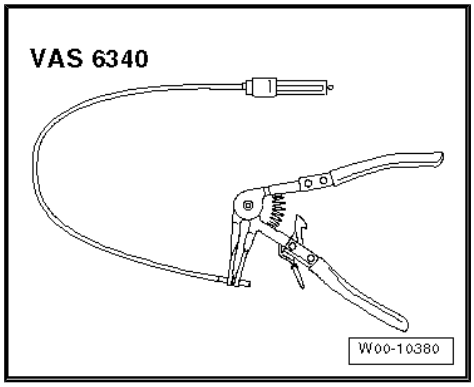
- *Always use genuine part for air filter element.*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do not use lubricants containing silicone during installation.*
- *Air filter housings must be clean.*
- *Secure all hose connections with hose clips corresponding to original equipment: ⇒ Parts catalogue .*
- *To prevent malfunctions, cover all critical engine air ducting components such as air mass meter, intake pipes, etc. with a clean cloth when blowing out the air filter housing with compressed air.*
- *Observe environmental regulations for disposal.*

– Check for salt residue, dirt and leaves in air mass meter and intake hose (engine intake side).
– Check air intake hose of air ducting for contamination.
– Further installation is carried out in the reverse order.

2.5 Removing and installing air mass meter -G70-

Special tools and workshop equipment required

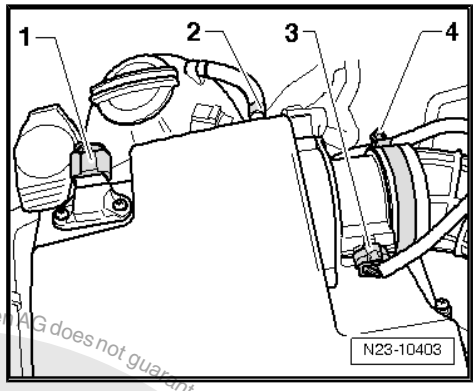
♦ Hose clip pliers -VAS 6340-



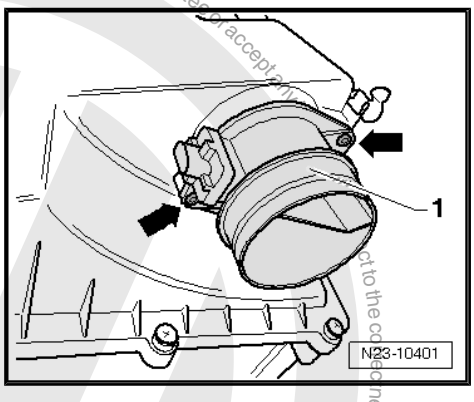
Removing

– Pull off connector -3- for air mass meter -G70- .

– Loosen screw-type clip -4- and remove intake hose from air mass meter -G70- .



– Unscrew bolts -arrows- from air mass meter -G70- and carefully pull air mass meter -G70- -1- out of air filter housing guide.



Installing

To ensure the proper function of the air mass meter -G70- , it is important to observe the following notes and instructions.

Note

♦ *If the air filter element is very dirty or wet, dirt or water could reach the air mass meter -G70- and affect the air mass value. This would lead to loss of power, since a smaller injection quantity is calculated.*

♦ *Always use genuine part for air filter element.*

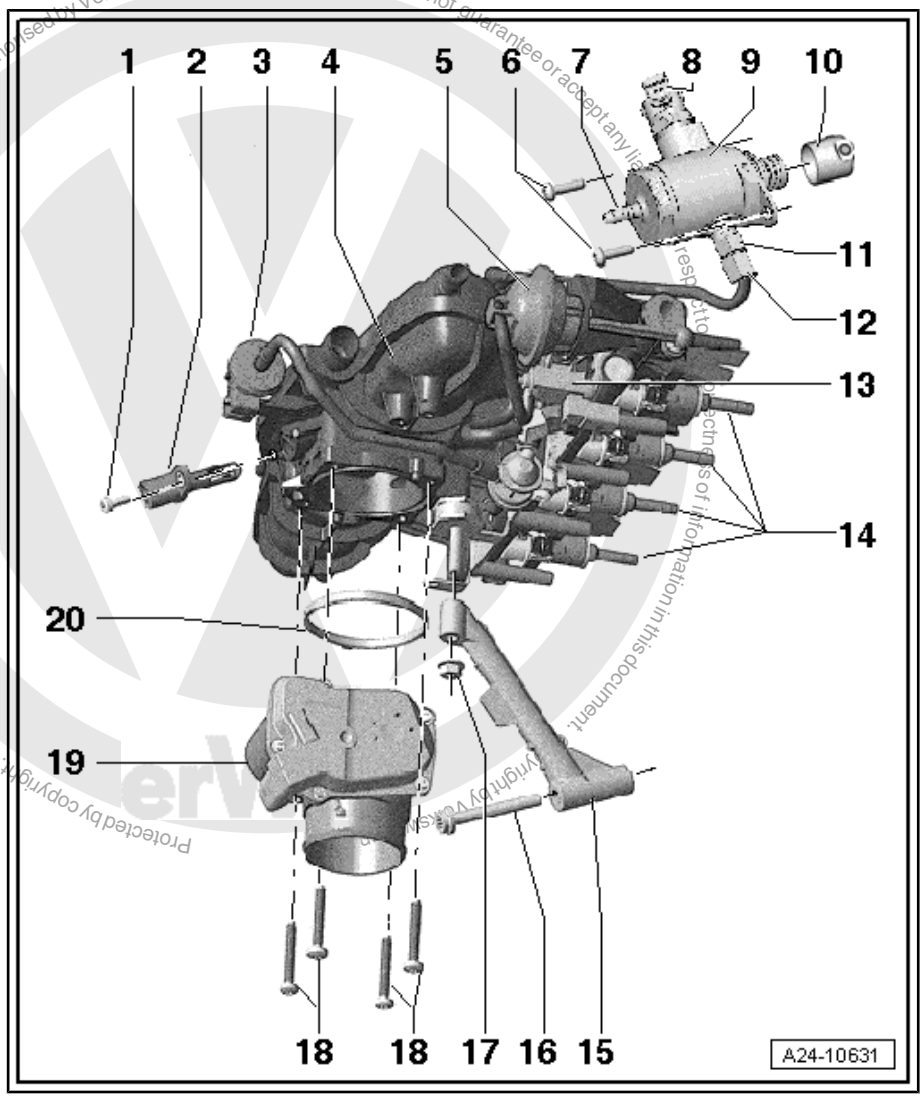
♦ *Use a lubricant (silicon) to amount the air intake hose.*

– Check for salt residues, dirt and leaves in air mass meter -G70- and air intake hose (pure air side).

– Check intake channel for contamination as far as air filter element. If contamination is found, remove salt residues, dirt and leaves from top and bottom part of air filter housing by rinsing out or using a vacuum cleaner if necessary.

Install in reverse order.

2.6 Assembly overview - intake manifold



1 - Screw for intake air temperature sender -G42-

- ❑ 9 Nm

2 - Intake air temperature sender -G42-

- Activated charcoal filter solenoid valve 1 -N80-

- ❑ With double non-return valve, checking ⇒ Vehicle diagnostic tester.

4 - Intake manifold

- ❑ Removing and installing ⇒ page 213 .

5 - Vacuum unit for air flow control flaps (intake manifold flaps)

6 - Bolts for high-pressure pump

- ❑ 20 Nm

7 - Connection for fuel supply line

- ❑ From fuel tank

8 - Fuel pressure regulating valve -N276-

9 - High-pressure pump

- ❑ With fuel pressure regulating valve -N276- .
- ❑ Fuel tank contains electric fuel pump which pumps fuel to mechanical high-pressure pump.
- ❑ When installing the high-pressure pump, it is essential to ensure that no dirt enters the fuel system.
- ❑ The fuel system must not be under pressure when installing the high-pressure pump; procedure for reducing fuel pressure ⇒ page 161
- ❑ Fuel lines must be free of tension when installed.
- ❑ Removing and installing ⇒ page 226 .

10 - Roller tappet

- ❑ Can remain inserted in vacuum pump after removal of high-pressure pump, removable

11 - Connection for fuel supply line

- ❑ Renew.
- ❑ 40 Nm

12 - High-pressure fuel line

- ❑ Fuel lines must be free of tension when installed.
- ❑ 27 Nm

13 - Intake manifold flap air flow control valve -N316-

14 - Injectors

- ❑ Renew O-ring and Teflon ring
- ❑ Check installation location is correct

- ❑ Removing and installing ⇒ page 217 .

15 - Intake manifold support

16 - Bolt for intake manifold support

- ❑ 23 Nm

17 - Nut for intake manifold support

- ❑ 10 Nm

18 - Bolts for throttle valve module -J338-

- ❑ 10 Nm

19 - Throttle valve module -J338- , throttle valve drive for electric throttle operation -G186-

- ❑ Throttle valve drive angle sender 1 for electric throttle -G187- and throttle valve drive angle sender 2 for electric throttle -G188-
- ❑ After removing, installing or renewing throttle valve module -J338- it must be re-adapted to engine control unit -J623- . See „Guided functions“.

20 - Seal

- ❑ Renew.

2.7 Assembly overview - fuel rail

1 - Injector

- ❑ With combustion chamber ring seal (Teflon ring seal), always renew
- ❑ Renew O-rings
- ❑ Check installation location is correct
- ❑ Removing and installing ⇒ page 217 .

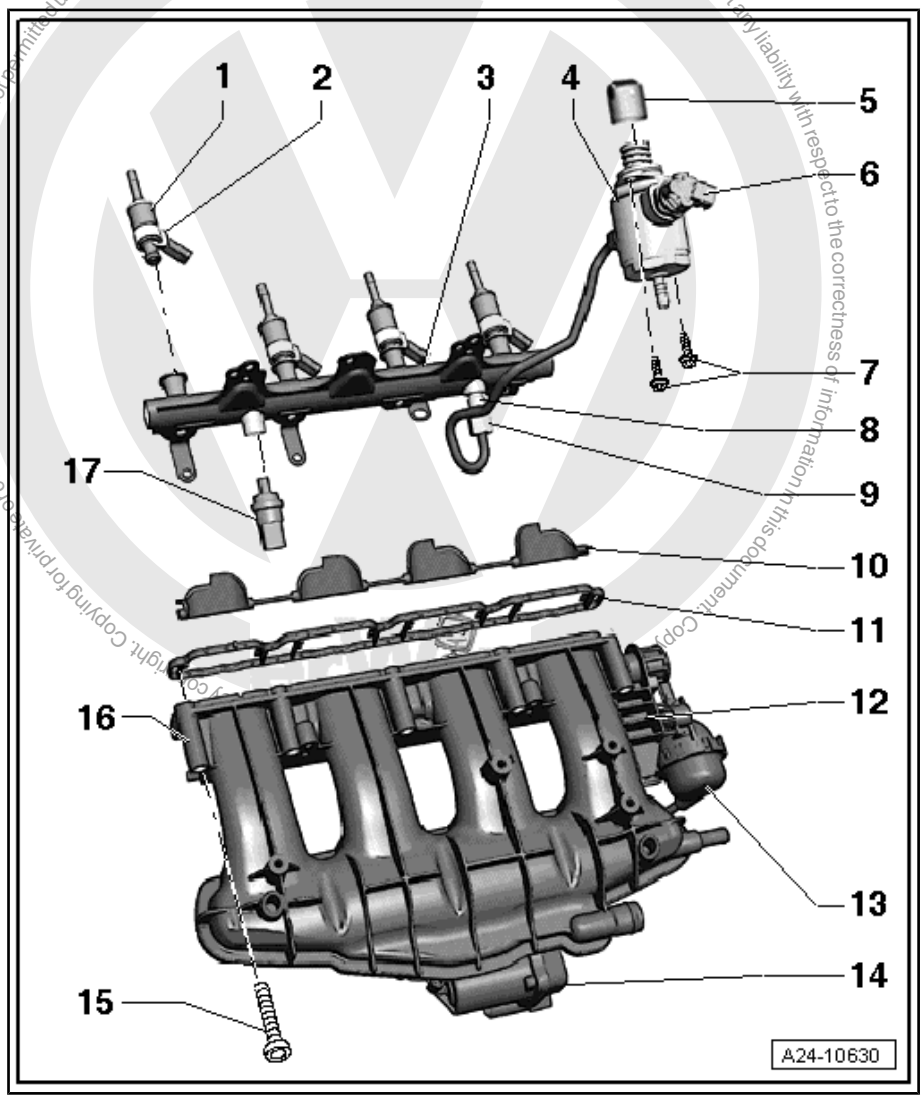
2 - Support ring

3 - Fuel rail

- ❑ Removing and installing ⇒ page 213 .

4 - High-pressure pump

- ❑ With fuel pressure regulating valve -N276- .
- ❑ Fuel tank contains electric fuel pump which pumps fuel to mechanical high-pressure pump.
- ❑ When installing the high-pressure pump, it is essential to ensure that no dirt enters the fuel system.
- ❑ The fuel system must not be under pressure when installing the high-pressure pump; procedure for reducing fuel pressure ⇒ page 161
- ❑ Fuel lines must be free of tension when installed.
- ❑ Removing and installing ⇒ page 226 .



5 - Roller tappet

6 - Fuel pressure regulating valve -N276-

7 - Bolts for high-pressure pump

- ❑ 20 Nm

8 - Connection for fuel pressurisation line to fuel rail

- ❑ Renew.
- ❑ 40 Nm

9 - Union nut of fuel pressurisation line

- ❑ 27 Nm

10 - Air flow control flaps (intake manifold flaps)

11 - Seal

- ❑ Renew.

12 - Intake manifold

- ❑ Removing and installing ⇒ page 213 .

13 - Vacuum unit for air flow control flaps (duct partition)

14 - Throttle valve module -J338- , throttle valve drive for electric throttle operation -G186-

- ❑ Throttle valve drive angle sender 1 for electric throttle -G187- and throttle valve drive angle sender 2 for electric throttle -G188-
- ❑ After removing, installing or renewing throttle valve module -J338- it must be re-adapted to engine control unit -J623- . See „Guided functions“.
- ❑ 7 Nm

15 - Bolts for intake manifold

- ❑ 9 Nm

16 - Intake manifold flap potentiometer -G336-

- ❑ After intake manifold flap potentiometer -G336- has been renewed, intake manifold flap potentiometer -G336- must be adapted to engine control unit -J623- . Use vehicle diagnostic tester for this.
- ❑ Each time after intake manifold flap potentiometer -G336- or intake manifold has been removed or installed, intake manifold flap potentiometer -G336- must be adapted to engine control unit -J623- . See „Guided functions“.

17 - Fuel pressure sender -G247-

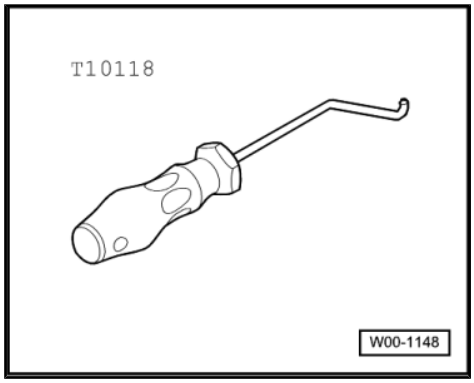
- ❑ 27 Nm
- ❑ Lubricate thread with clean engine oil
- ❑ Always renew connection and tighten to 25 Nm

2.8 Removing and installing intake manifold

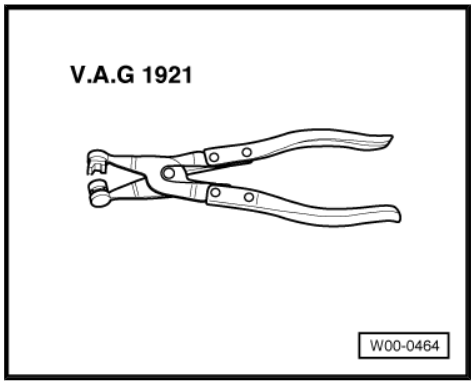
After fuel rail has been removed or renewed, intake manifold flap potentiometer -G336- must be adapted to engine control unit -J623- . Use vehicle diagnostic tester for this.

Special tools and workshop equipment required

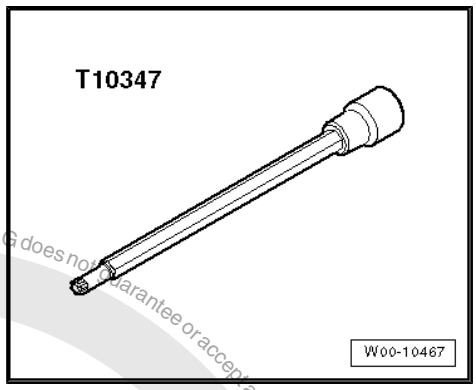
- Assembly tool -T10118-



- Hose clip pliers -V.A.G 1921-



- Special wrench, long reach -T10347-



Removing

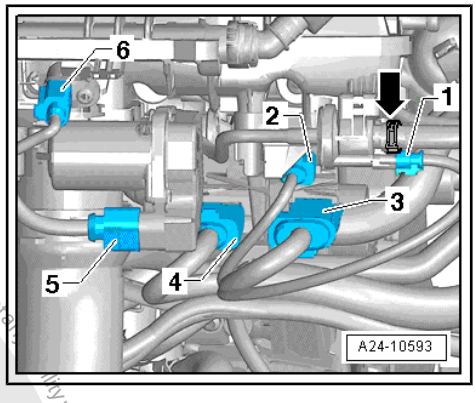
Note

- *The injectors can only be accessed after removal of the intake manifold and fuel rail.*
- *Combustion chamber ring seal (Teflon) and O-ring must always be renewed.*
- *Assembly overview - intake manifold ⇒ page 211 .*
- *Assembly overview - fuel rail ⇒ page 212 .*

WARNING

Fuel system is under pressure! The fuel pressure in the high-pressure part of the injection system must be reduced to a residual pressure prior to opening; for procedure see ⇒ page 161 .

– Disconnect battery from negative terminal.
– Remove pressure pipe ⇒ page 184 .
– Remove throttle valve module ⇒ page 223 .
– Disconnect coolant hose ⇒ Item 19 (page 141) from intake manifold.
– Disconnect coolant hose at front ⇒ Item 14 (page 141) and rear from coolant pipe ⇒ Item 10 (page 141) .
– Unclip wiring harness for oil pressure switch -F1- from intake manifold.
– Disconnect vacuum line -arrow- to activated charcoal filter.
– Unplug following electrical connectors.



1 - Activated charcoal filter solenoid valve 1 -N80-

2 - For knock sensor 1 -G61-

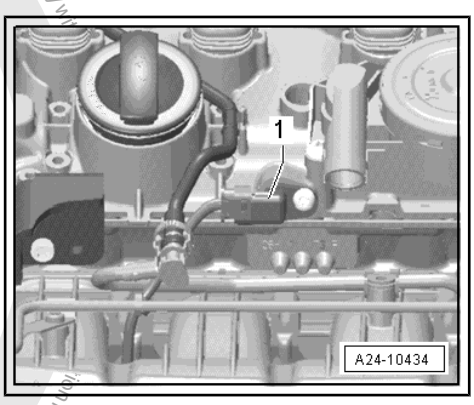
3 - From variable intake manifold valve -N316- , fuel pressure sender -G247- and Hall sender -G40-

4 - From injectors

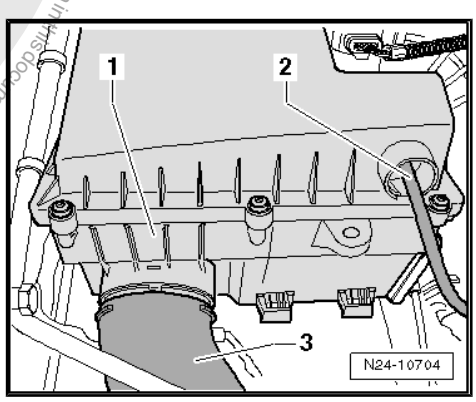
5 - Throttle valve module -J338-

6 - Intake air temperature sender -G42-

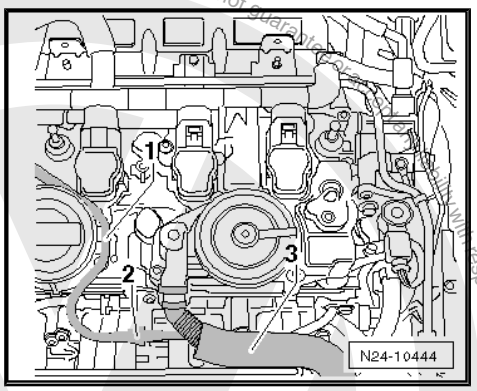
– Detach connector -1- from Hall sender -G40- .



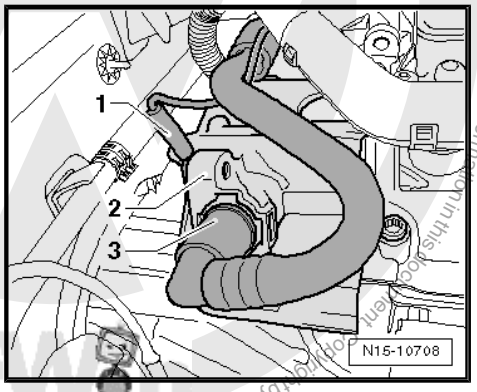
– Unclip vacuum hose to air filter -2- and detach from air filter housing -1-.



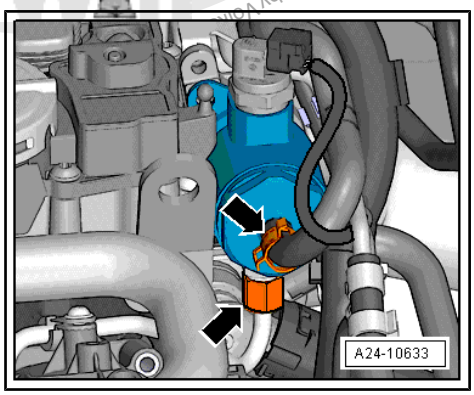
– Detach vacuum hose -1- at disconnection point -2-.
– Remove crankcase breather hose -3-.



– Detach vacuum hose -3- from vacuum pump -2- and brake servo.



– Open spring-type clip -upper arrow- and detach fuel pressurisation line from high-pressure pump.
– Loosen union nut of high-pressure fuel line -lower arrow- at high-pressure pump.

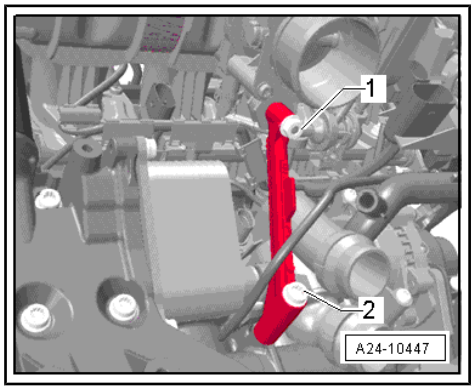


Note

- *Fuel system must be depressurised.*
- *Collect escaping fuel with a clean cloth.*
- *Seal open connections with clean caps. It is essential to ensure that no dirt enters the fuel system.*

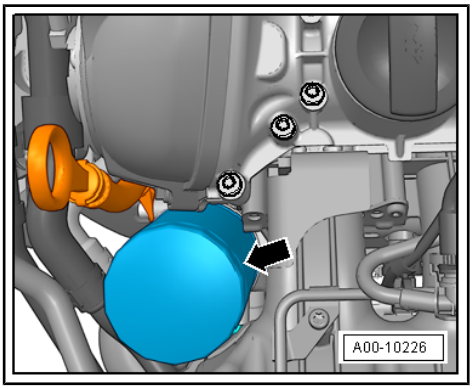
– Disconnect connector from coolant temperature sender - G62- .
– Unclip wiring harness from support.

– Loosen securing nut -1- and unscrew bolt -2- completely.



– Release oil filter with Hazet securing strap -2171-1- or with oil filter tool -3417- and remove oil filter.

– Unscrew bolts from intake manifold using socket -T10347- .



Note

To unscrew inaccessible bolts without socket -T10347- , throttle valve module -J338- has to be removed.

– Carefully pull intake manifold with fuel rail slightly away from cylinder head.

Note

- *Injectors can remain in fuel rail.*
- *Seal intake ports with a clean cloth.*

– Disconnect intake manifold from fuel rail ⇒ page 213 .

Installing

Note

Ensure injectors are installed correctly.

– Fit intake manifold onto studs (left and right) on cylinder head.

– Install in reverse order.

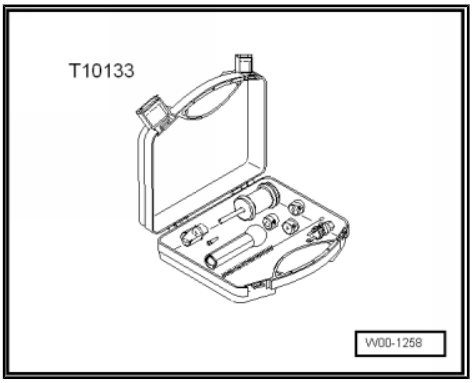
- Specified torque: assembly overview - intake manifold ⇒ page 211 .
- Specified torque: assembly overview - fuel rail ⇒ page 212 .

– Check coolant level ⇒ page 133 .

2.9 Removing and installing injectors

Special tools and workshop equipment required

- Tool case with puller -T10133-



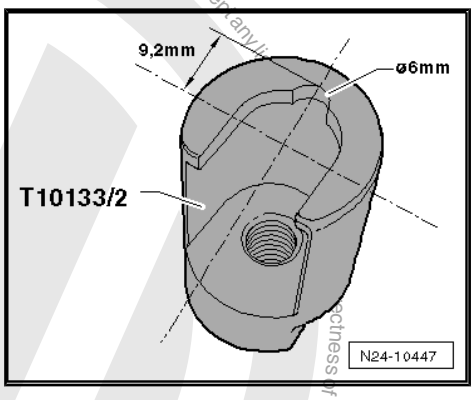
Note

Puller tool T10133/2 has been modified and is now designated puller T10133/2 A . If new tool is not yet available, you can carry out modification yourself.

Rework puller tool T10133/2 to make puller tool T10133/2 A .

– File out a semicircle as illustrated. The recess allows the tool to be pushed further onto the injector so the contact surface is increased.

– For identification purposes, mark the modified tool with the letter „A“ after the tool number.



Special tools and workshop equipment required

♦ Round file approx. 6 mm

Removing

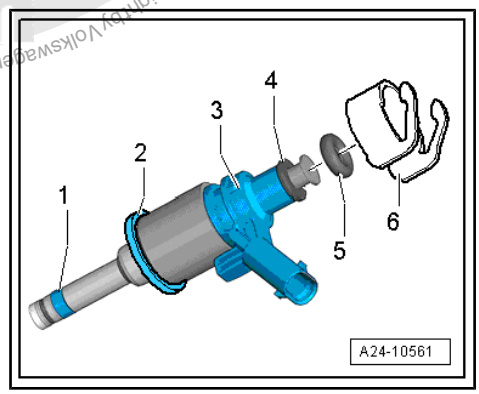
– Remove intake manifold and fuel rail ⇒ page 211 .

Remove injectors if these are still in fuel rail.

Carefully withdraw injectors from fuel rail.

Remove injectors if these are still in cylinder head.

Injector (old version)



1 - Combustion chamber ring seal (Teflon ring seal), renew; when fitting, do not grease ring or use any other lubricant.

2 - The support ring must be replaced with an intermediate ring. See next figure ⇒ page 218

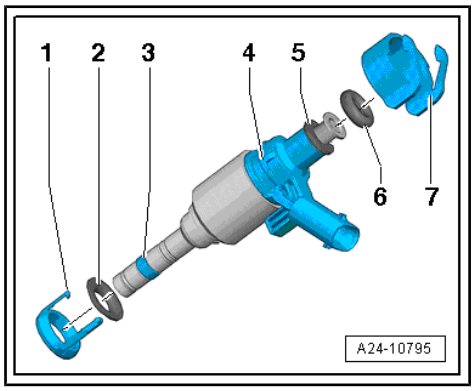
3 - Injector

4 - Spacer (renew if damaged)

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

6 - Support ring (via this support ring, the fuel rail exerts force which secures injector in cylinder head)

Injector (new version)



1 - Replace intermediate ring

2 - Support

3 - Combustion chamber ring seal (Teflon ring seal), renew; when fitting, do not grease ring or use any other lubricant.

4 - Injector

5 - Spacer (renew if damaged)

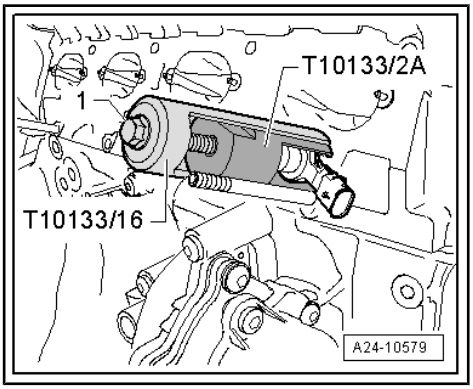
6 - O-ring (renew; to install, lightly lubricate with clean engine oil).

7 - Support ring (via this support ring, the fuel rail exerts force which secures injector in cylinder head)

– Cover open intake ports with a clean cloth.

– Detach electrical connector from injector that is to be removed.

– Insert puller -T10133/2A- into groove in injector.
– Then position removal tool -T10133/16- and pull injector out by turning bolt -1-.



Note

The combustion chamber seal must always be renewed prior to reinstallation of the injector ⇒ page 219 .

2.10 Renewing Teflon seal on injector

Note

The combustion chamber seal must always be renewed prior to reinstallation of the injector

– Carefully remove old Teflon ring using a suitable tool (e.g. cut open ring using razor blade, or prise open ring with small screwdriver and then pull off forwards). It is essential to ensure that groove and continuous ridge in groove surface are not damaged.

Note

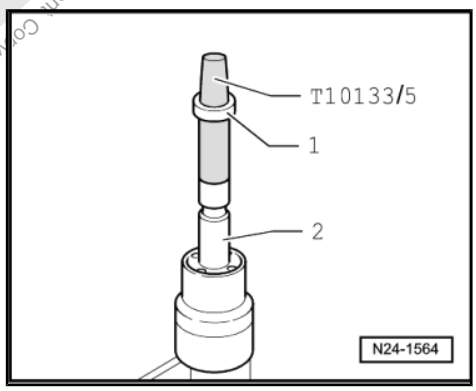
Injector must be renewed if groove is damaged.

– Before fitting new Teflon ring, combustion residues must be cleaned off seal groove and injector shaft using clean cloth.

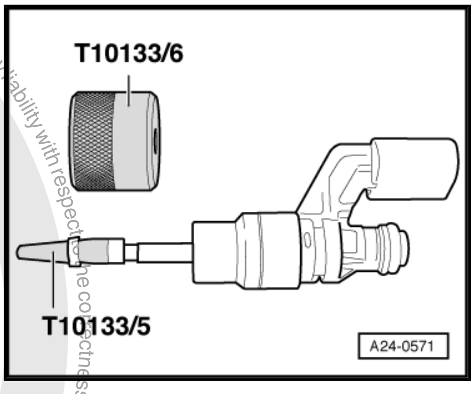
Note

The figure shows an injector with an „angled connector“. This can be ignored in the subsequent procedure since it is not important when renewing the combustion chamber ring seal.

– Place assembly cone -T10133/5- with a new Teflon ring -1- on injector -2-.



– Push Teflon ring with assembly sleeve -T10133/6- further on to assembly cone -T10133/5- until Teflon ring engages in seal ring. No lubricants whatsoever may be used.



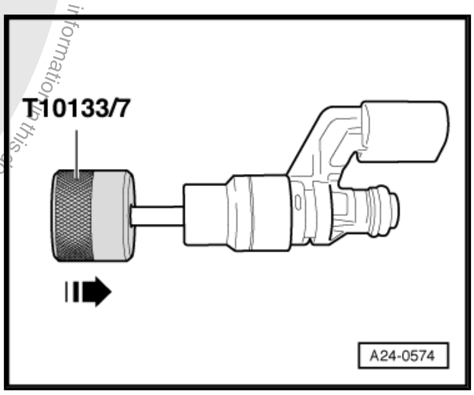
Note

Pushing Teflon ring onto injector stretches Teflon ring. For this reason, the Teflon ring has to be shrunk again after it has been pushed on. This is done in 2 stages. The procedure is described below.

Step 1 of calibration (adaptation) of Teflon ring is carried out with calibration sleeve -T10133/7- .

– Using a twist (approx. 180°) and slight pressure, slide calibration sleeve -T10133/7- over injector until stop is reached. Turn calibration sleeve -T10133/7- in opposite direction.

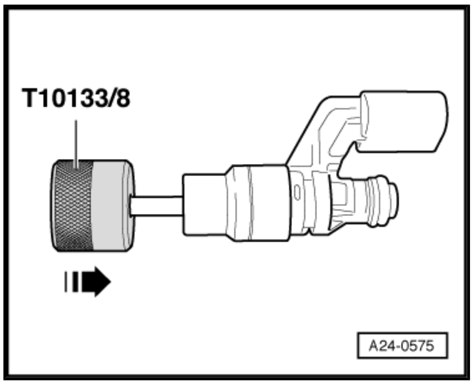
Step 2 of calibration (adaptation) of Teflon ring is carried out with calibration sleeve -T10133/8- .



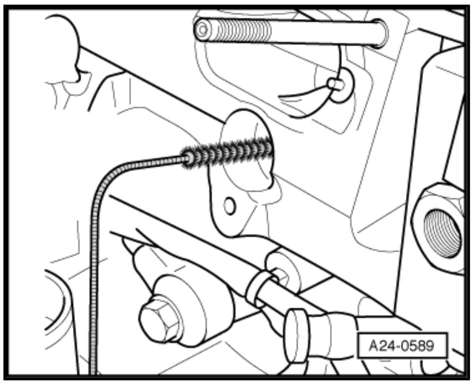
– Using a twist (approx. 180°) and slight pressure, slide calibration sleeve -T10133/7- over injector until stop is reached. Turn calibration sleeve -T10133/7- in opposite direction.

– Renew O-ring on injector. Before installing, lightly moisten O-ring with clean engine oil.

– Teflon ring must not be oiled.



– Before installing injectors, thoroughly clean injector bores in cylinder head with nylon brush provided. -T10133/4- .

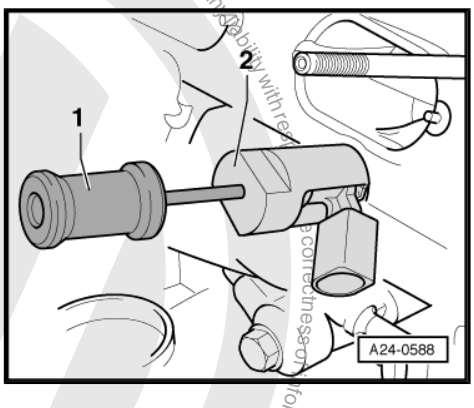


Note

♦ *The Teflon seal on the injector must not be oiled or greased.*

♦ *There must be no cleaning fluid or oil in the bores in the cylinder head when installing the injector.*

– Push injector by hand as far as it will go into cylinder head bore (free of oil and grease). Ensure injectors are positioned correctly in cylinder head.



Note

- *The injector must insert easily. If necessary, wait until the combustion chamber seal has contracted sufficiently.*
- *Ensure the injectors are correctly seated and positioned in the cylinder head.*
- *If it is not possible to insert the injector by hand, use the puller -T10133/2A- -2- with a hammer -T10133/3- to insert the injector.*

– Install analogously in reverse order.

Important: It is essential to observe following points

- Moisten O-rings of high-pressure injectors with clean engine oil to aid insertion into fuel rail.
- Renew all gaskets.
- Fuel rail must be placed on injectors and evenly pressed in.
- Install intake manifold with fuel rail ⇒ page 211 .

2.11 Cleaning injectors

Special tools and workshop equipment required

- Ultrasonic cleaner -VAS 6418-
- Mounting plate for injection modules -VAS 6418/1-
- Cleaning fluid -VAS 6418/2-

Cleaning

– Remove injectors ⇒ page 217 .

Note

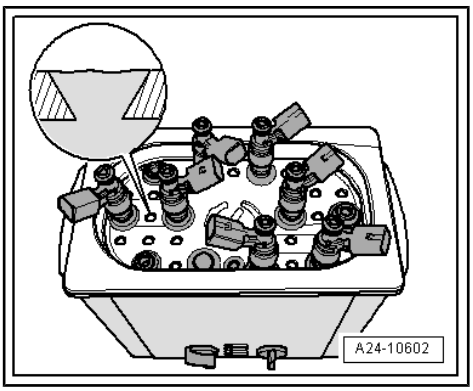
Observe ultrasonic unit safety regulations and operating instructions.

– Ultrasonic unit must be filled with cleaning fluid -VAS 6418/2- .

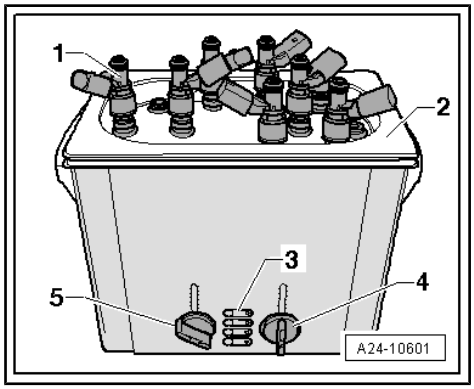
Note

Ultrasonic unit must be filled with cleaning agent up to upper edge of holes (see expanded view).

– Insert injectors-1- into mounting plate for injection modules -VAS 6418/1- as far as stop -2-.



– Dip injectors together with mounting plate for injection modules -VAS 6418/1- into cleaning fluid.
– Set a temperature of 50 degrees with rotary knob -4-.
– Set rotary knob -5- to a cleaning time of 30 minutes.
– Press button -3- to switch ultrasonic unit on.



Note

As soon as the cleaning temperature is 50 degrees, the set time will begin to elapse.

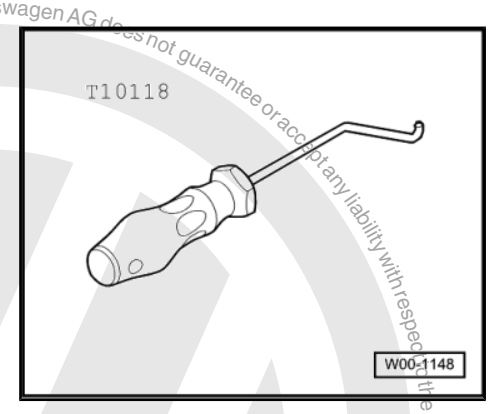
– Each time after cleaning injector, renew combustion chamber ring seal (Teflon ring seal) ⇒ page 219 .
– Then reinstall injectors ⇒ page 217 .

2.12 Removing and installing fuel pressure sender -G247-

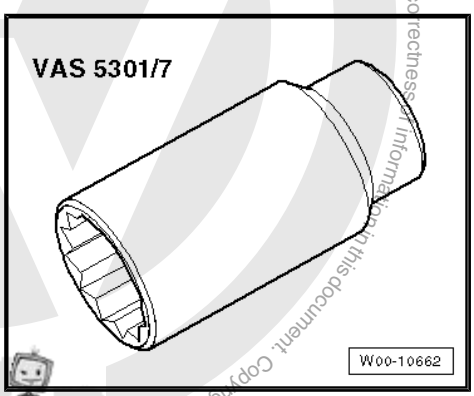
If fuel pressure sender -G247- fails, fuel pressure regulating valve -N276- is switched off, electric fuel pump is is fully actuated, and engine is operated with available fuel pressure. Engine torque is drastically reduced as a result.

Special tools and workshop equipment required

♦ Assembly tool -T10118-



♦ Double hexagon socket, 1/2, 27mm -VAS 5301/7- or commercially available 27 mm socket

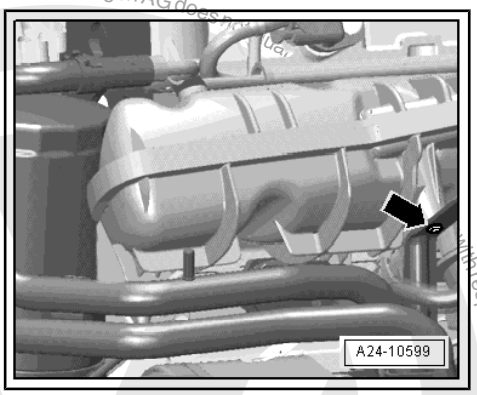


Removing

WARNING

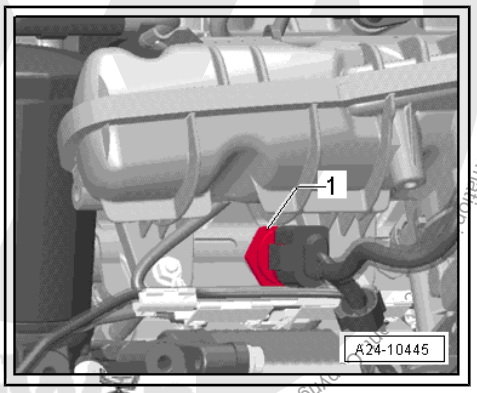
The fuel system is pressurised! The fuel pressure in the high-pressure part of the injection system must be reduced to a residual pressure prior to opening; for procedure see ⇒ page 161 .

– Unscrew coolant line bolt -arrow- from intake manifold.



– Disengage connector from fuel pressure sender -G247- with assembly tool -T10118- .

– Unscrew fuel pressure sender -G247- using double hexagon socket, 1/2, 27mm -VAS 5301/7- .



Installing

– Install in reverse order.

– Check tightening torque of connection before installing fuel pressure sender -G247- .

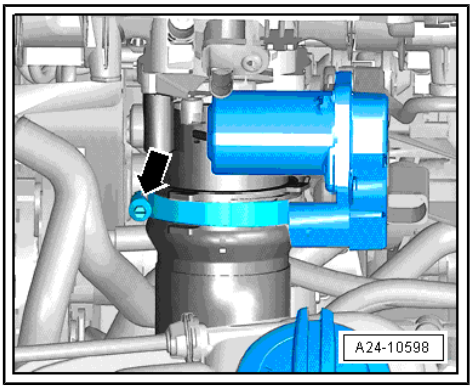
- Specified tightening torque of connection: assembly overview - fuel rail ⇒ page 212 .
- Specified tightening torque of fuel pressure sender -G247- : assembly overview - fuel rail ⇒ page 212 .

2.13 Removing and installing throttle valve module -J338-

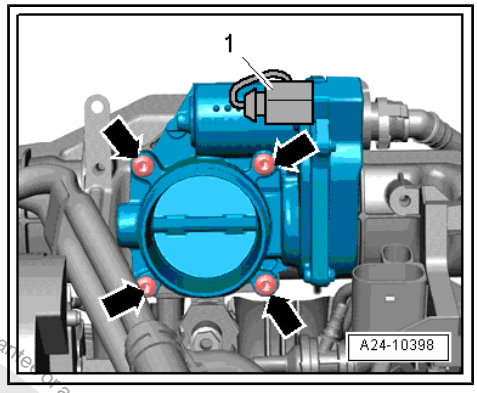
Removing

– Open hose clip -arrow- of air duct and detach this downwards from throttle valve module -J338- .

– Detach electrical connector -1- from throttle valve module -J338- .



– Unscrew 4 bolts -arrows- of throttle valve module -J338- and remove throttle valve module -J338- .



Installing

– Install in reverse order.

– Clean sealing surface for O-ring.

– Renew seal.

• Specified torques: assembly overview - intake manifold ⇒ page 211 .

– After renewing throttle valve module -J338- it must be re-adapted to engine control unit -J623- using vehicle diagnostic tester.

2.14 Cleaning throttle valve module -J338-

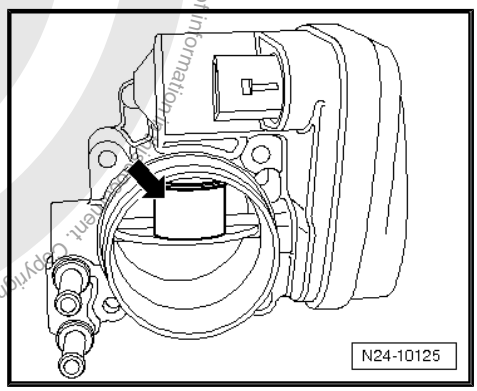
Note

♦ *If a new engine control unit -J623- is installed, the throttle valve module must be adapted.*

♦ *When cleaning the throttle valve nozzle it must not be scratched.*

– Remove throttle valve module -J338- ⇒ page 223 .

– Open throttle valve by hand and lock it in open position using a suitable object (e.g. wood or plastic wedge) -arrow-.



WARNING

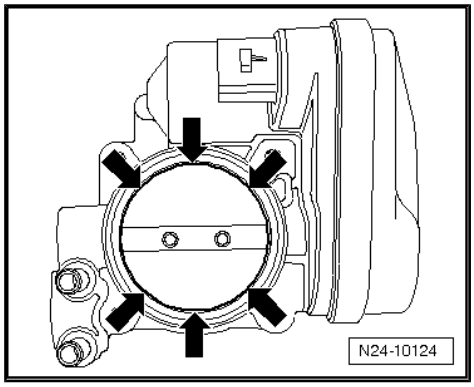
Acetone is highly inflammable. Observe accident prevention regulations and safety notes when handling highly inflammable fluids. Do not use compressed air when cleaning throttle valve. Wear eye protection and protective clothing to avoid eye injuries and skin contact.

– Thoroughly clean throttle valve connection, especially around closed throttle valve -arrows- using commercially available acetone to DIN 53247 and a brush.

– Wipe out throttle valve housing with a lint-free cloth.

– Allow acetone to vent completely and reinstall cleaned throttle valve module.

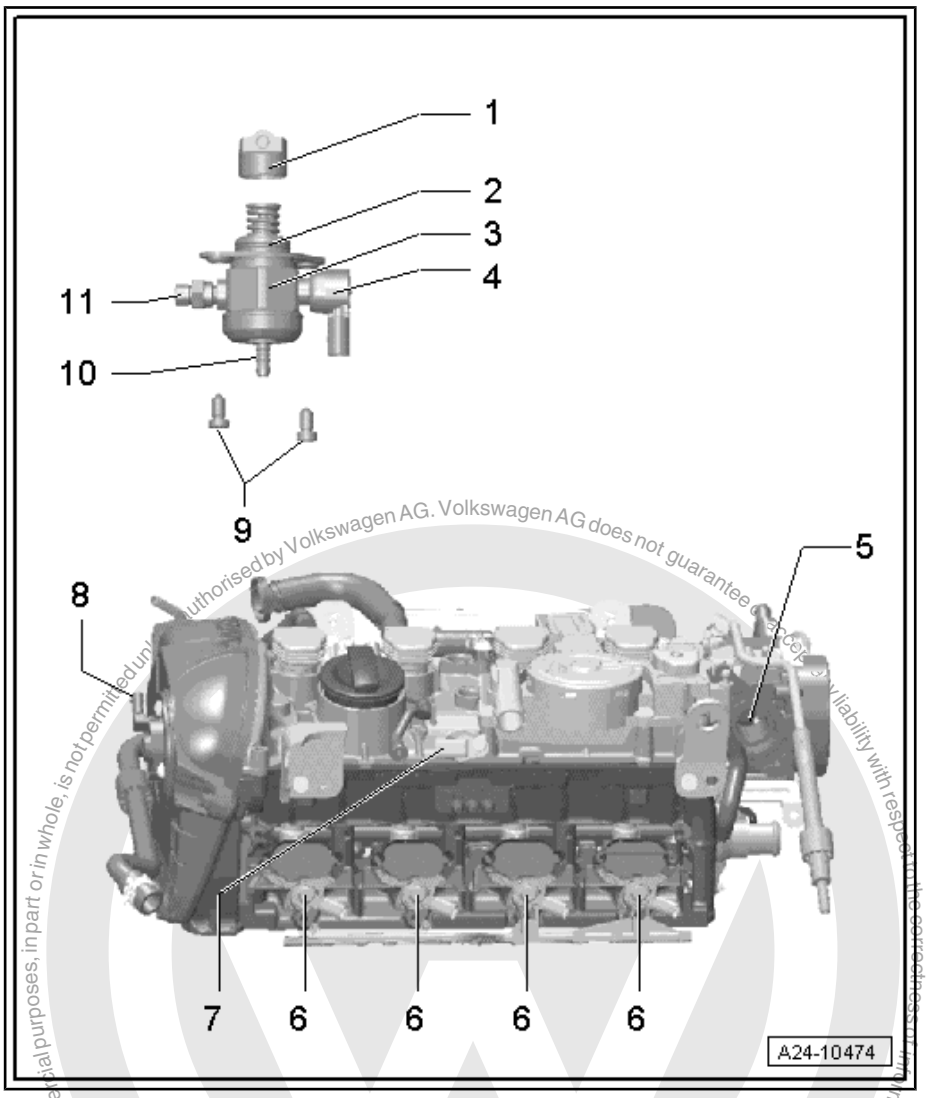
– Clear learned values and adapt engine control unit -J623- to throttle valve module, using vehicle diagnostic tester.



2.15 Assembly overview - high-pressure pump

WARNING

Fuel system is under high pressure! It is essential to reduce fuel pressure before opening system. For procedure, please see ⇒ page 161



1 - Roller tappet

- ❑ Can remain inserted in vacuum pump after removal of high-pressure pump

2 - O-ring

- ❑ Renew.

3 - High-pressure pump

- ❑ Fuel tank contains electric fuel pump which pumps fuel to mechanical high-pressure pump.
- ❑ When installing the high-pressure pump, it is essential to ensure that no dirt enters the fuel system.
- ❑ The fuel system must not be under pressure when installing the high-pressure pump; procedure for reducing fuel pressure ⇒ page 161
- ❑ Fuel lines must be free of tension when installed.
- ❑ Removing and installing ⇒ page 226 .

4 - Fuel pressure regulating valve -N276-

5 - Bore in vacuum pump for high-pressure pump

6 - Injectors

- ❑ Renew O-ring and Teflon ring
- ❑ Check installation location is correct
- ❑ Removing and installing ⇒ page 217 .

7 - Hall sender -G40-

8 - Inlet camshaft control valve 1 -N205-

9 - Bolts for high-pressure pump

- ❑ 20 Nm

10 - Connecting piece for fuel supply line from fuel tank

11 - Connection for fuel supply line

- ❑ Renew.

- ❑ Connection: 40 Nm
- ❑ Specified tightening torque for union nut of fuel pressurisation line: 27 Nm
- ❑ Fuel pressurisation line must not be under tension when installed (ensure cleanliness)

2.16 Removing and installing high-pressure pump

WARNING

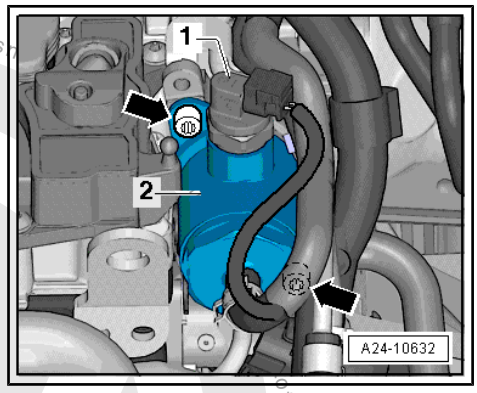
Fuel system is under high pressure! It is essential to reduce fuel pressure before opening system. For procedure, please see ***⇒ page 161***

Note

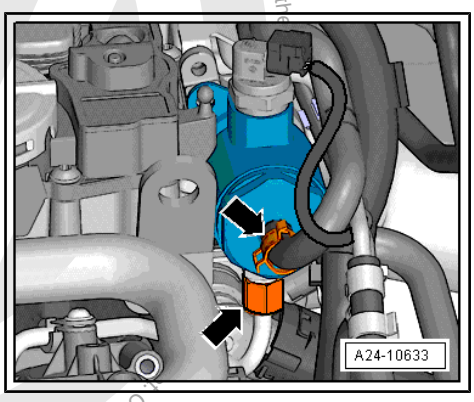
- ♦ *Engine must be cold before high-pressure pump is removed.*
- ♦ *When installing the high-pressure pump, it is essential to ensure that no dirt enters the fuel system.*
- ♦ *Collect escaping fuel with a cleaning cloth.*
- ♦ *O-ring must always be renewed.*
- ♦ *Always ensure that high-pressure fuel line is free of tension when installed.*

Removing

– Detach connector from fuel pressure regulating valve -N276- -1-.

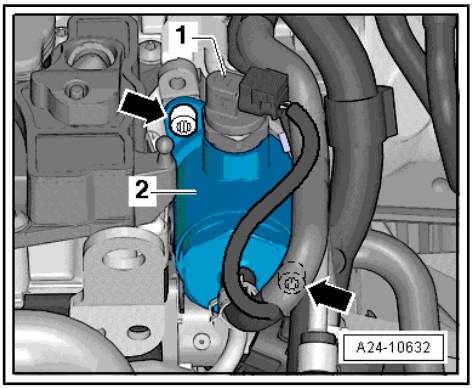


– Open fuel lines -arrows-.



– Remove 2 bolts -arrows-.

– Carefully pull out high-pressure fuel pump. Sleeve can remain inserted in vacuum pump.



Installing

– Renew high-pressure pump O-ring.

– Insert roller tappet in vacuum pump (first check roller tappet for damage).

Note

- *Roller tappet must be at bottom dead centre to enable high-pressure pump to be installed.*
- *If same or a used high-pressure pump is installed, connection for fuel pressurisation line (high-pressure side) must be renewed. See assembly overview - high-pressure pump item 11 ⇒ page 225*

– Turn crankshaft until roller tappet is at bottom dead centre.

– Insert high-pressure pump into vacuum pump and tighten.

– Tighten bolts hand tight.

– Renew high-pressure pump connection.

• Specified torque: assembly overview - high-pressure pump ⇒ page 225 .

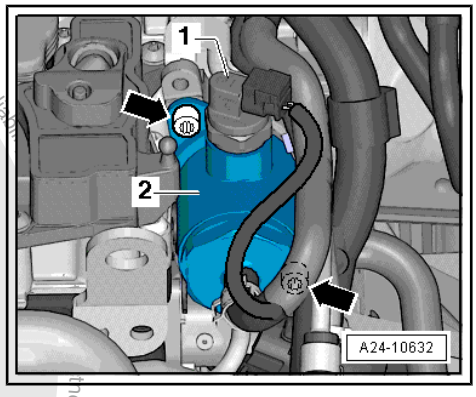
– Now tighten bolts in diagonal sequence to specified torque, see assembly overview - high-pressure pump ⇒ page 225 .

– Tighten union nut of high-pressure line hand-tight. Align free of tension.

• Specified torque for fuel pressurisation line (union nut): assembly overview - intake manifold ⇒ page 213 .

– Reattach connector to fuel pressure regulating valve -N276--1-.

– Put back fuse if it has been removed.



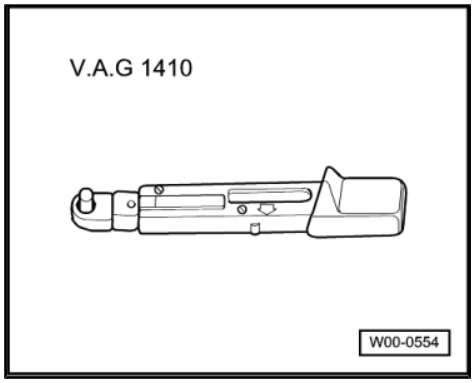
Note

Check fuel system for leaks.

2.17 Removing and installing engine control unit

Special tools and workshop equipment required

♦ Torque wrench -V.A.G 1410-



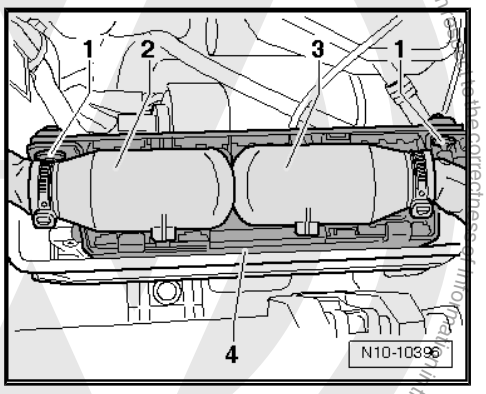
Removing

– Before removing engine control unit, read the control unit identification and, with it, the coding of the control unit used up to now ⇒ Vehicle diagnostic tester.
– Switch off ignition.
– Disconnect battery ⇒ Electrical system; Rep. gr. 27 .
– Remove shear bolts -1- and remove bow -4-.
– Release and pull off connectors -2- and -3-.
– Pull engine control unit out.

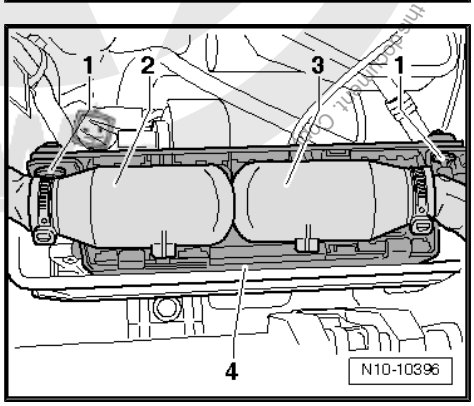
Installing

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

– Insert engine control unit.
– Insert and lock connectors -2- and -3-.



– Fit bow -4- and new shear bolts -1-.
– Connect battery ⇒ Electrical system; Rep. gr. 27 .
– Check previous coding and code new control unit ⇒ Vehicle diagnostic tester.

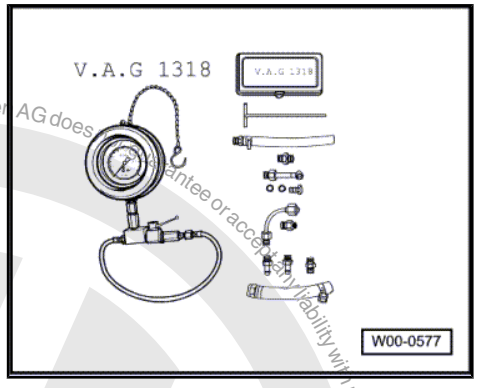


3 Checking components

3.1 Check fuel holding pressure upstream of high-pressure pump

Special tools and workshop equipment required

- K-Jetronic pressure tester -V.A.G 1318-



- Measuring container, fuel-resistant
- Protective gloves

Test prerequisites

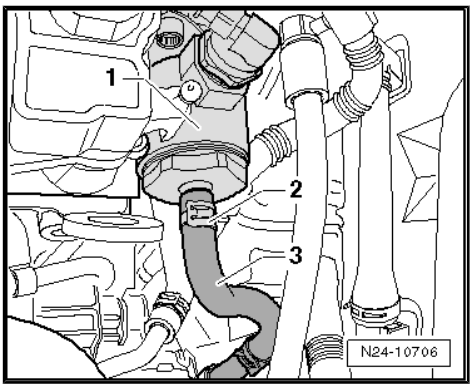
- Battery voltage at least 12.5 V
- Fuel filter OK.
- Fuel tank at least 1/4 full.
- Fuel pump control unit -J538- OK.
- Ignition switched off.

Checking fuel pressure

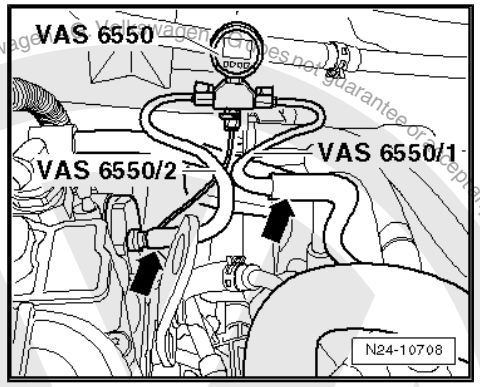
WARNING

- *The pressure in the high-pressure part of the injection system must be reduced to a residual pressure ⇒ page 161 .*
- *A clean cloth must then be wrapped around the connection and the residual pressure dissipated by carefully loosening the connection.*

– Release clip -2- and detach fuel line -3- from high-pressure pump -1-.



– Connect double connection -V.A.G 1318/23- and adapter adapter set -V.A.G 1318/17A- to K-Jetronic pressure tester -V.A.G 1318- .
– Attach adapter adapter set -V.A.G 1318/17A- to detached fuel pressurisation line.
– Screw adapter -V.A.G 1318/11- to K-Jetronic pressure tester -V.A.G 1318- .
– Attach auxiliary hose -arrow- to pressure tester and hold it in collecting container.



– Close pressure tester shut-off valve.

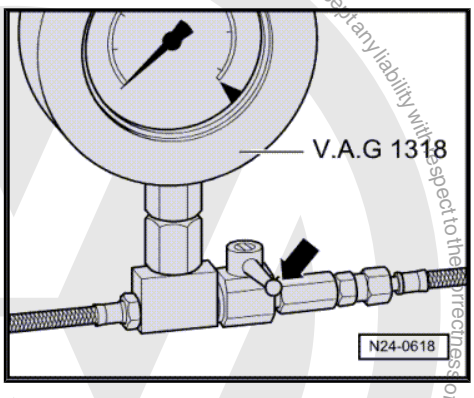
• Lever is at right angle to direction of flow -arrow-.

– Connect vehicle diagnosis tester.

– Select „Engine electronics“ in the self-diagnosis program.

– Then select „final control diagnosis“.

– In selection list select „Fuel pump electronics“ and press „Start“.



Note

This function actuates fuel pump.

– Read off fuel pressure at K-Jetronic pressure tester -V.A.G 1318- .

• Specification: 5 to 8 bar

– Stop procedure once fuel pressure no longer rises at K-Jetronic pressure tester -V.A.G 1318- .

If the specification is not attained:

– Checking fuel pump delivery rate ⇒ Rep. gr. 20

Checking holding pressure

– Check for leaks and check holding pressure by observing pressure drop at K-Jetronic pressure tester -V.A.G 1318- .

• After 10 minutes, there must be a residual pressure of at least 3 bar.

If the holding pressure drops below 3 bar:

♦ Check threaded connection between pressure gauge and fuel line for leaks.

♦ Check pressure gauge for leaks.

♦ Check fuel lines and their connections for leaks.

♦ Checking fuel pump delivery rate ⇒ Rep. gr. 20

♦ Renew fuel filter with integrated fuel pressure regulator ⇒ Rep. gr. 20 .

♦ Fuel pump non-return valve is defective ⇒ Rep. gr. 20 .

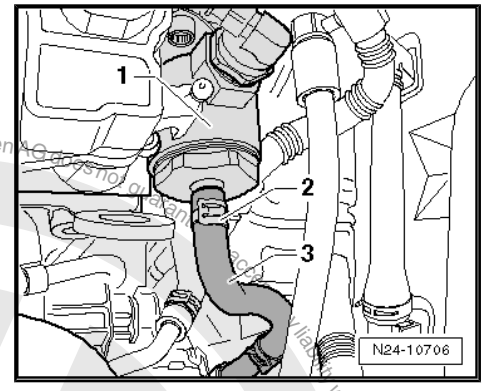
Assembly is carried out in the reverse order. When installing, note the following:

– Switch off ignition.

Note

Fuel pressure must be reduced by opening shut-off valve before removing pressure tester. Hold collecting container at connection as you do so.

– Reconnect fuel pressurisation line -3- to high-pressure pump -1- and attach clip -2- (ensure cleanliness).



Note

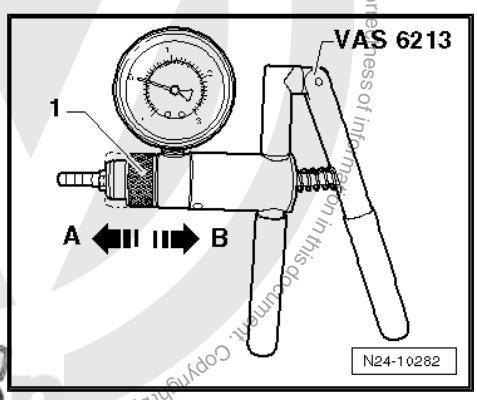
Check fuel system for leaks.

3.2 Checking intake manifold change-over

Perform check only if there is a loss of torque. This means when there is a lack of elasticity or a lack of pulling power.

Special tools and workshop equipment required

♦ Hand vacuum pump -VAS 6213-



Test prerequisite

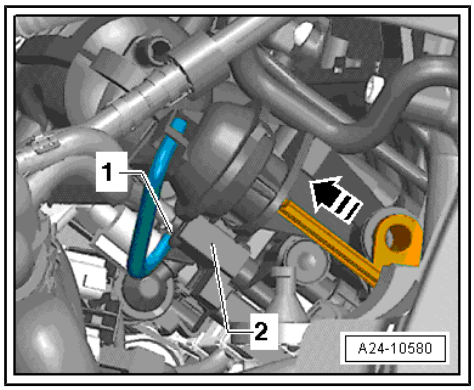
♦ Variable intake manifold valve -N316- has been checked with a vehicle diagnostic tester .

If the intake manifold flap valve -N316- is OK, perform the following tests:

– Start engine and run at idling speed.

– Have second person abruptly increase engine speed (throttle burst). Observe intake manifold changeover vacuum actuator.

• Actuator must move -arrow-.



If changeover does not operate as indicated:

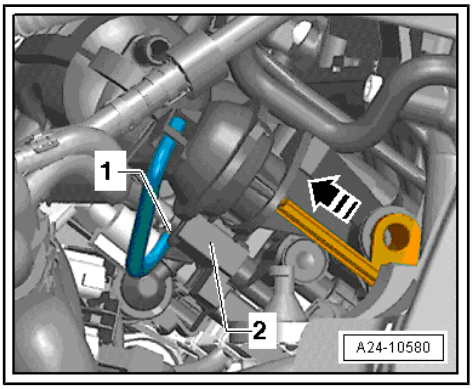
– Check vacuum system for leaks.

– Check changeover mechanism for ease of movement . To do this, operate rods by hand.

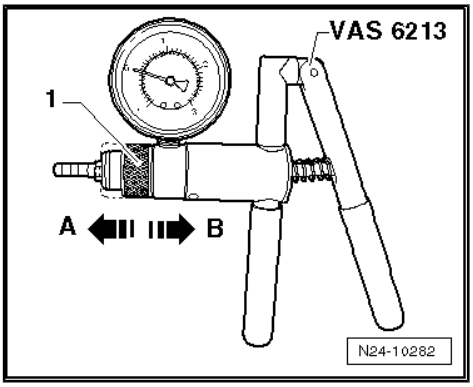
– Check that vacuum lines are correctly connected.

– Check vacuum hoses for porosity.

– Remove vacuum hose -1- leading to actuator for intake manifold valve flap -N316- from intake manifold flap valve -N316- -2-.



– Move slide ring -1- on hand vacuum pump -VAS 6213- to position -A- for "vacuum".

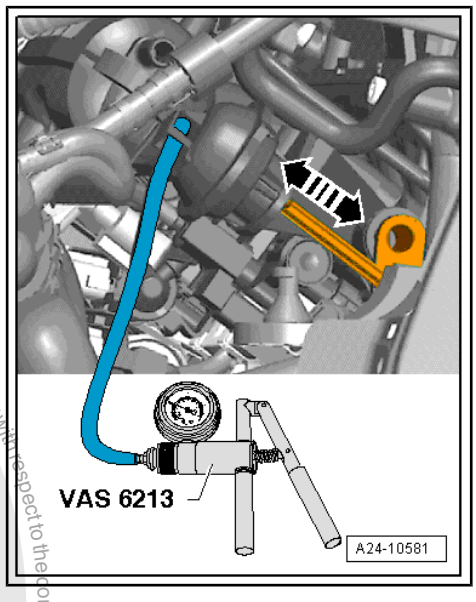


– Connect hand vacuum pump -VAS 6213- to actuator for intake manifold flap valve -N316- .

– Operate hand vacuum pump -VAS 6213- several times.

Vacuum actuator -arrows- must move.

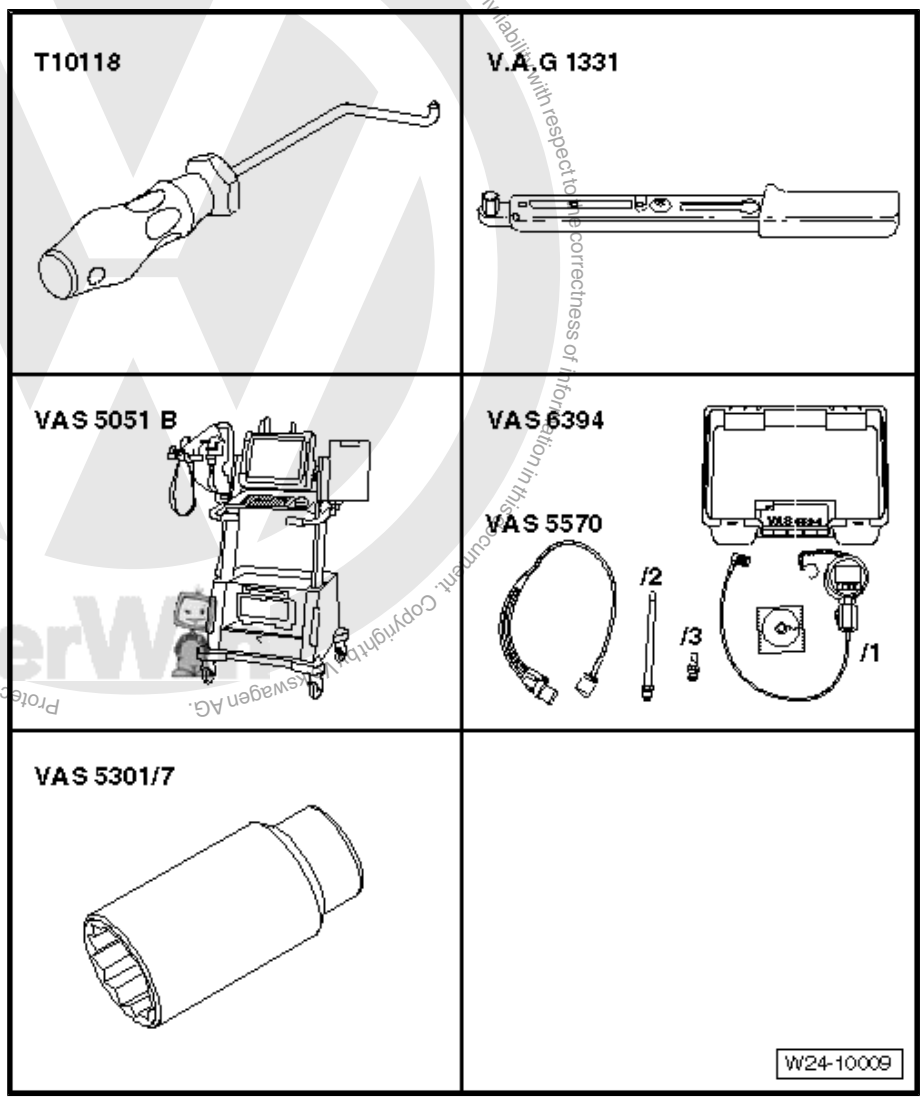
– If vacuum actuator does not move, renew it.



3.3 Checking fuel pressure sender -G247-

Special tools and workshop equipment required

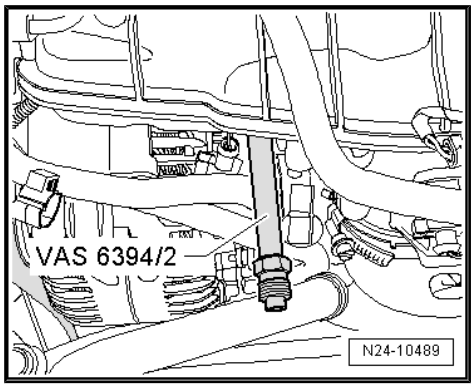
- Assembly tool -T10118-
- Deep hexagon socket, 27 mm -VAS 5301/7-
- Pressure sensor tester -VAS 6394/1-
- Adapter -VAS 6394/2-
- Test adapter -VAS 5570-
- Torque wrench -V.A.G 1331-
- Vehicle diagnosis tester



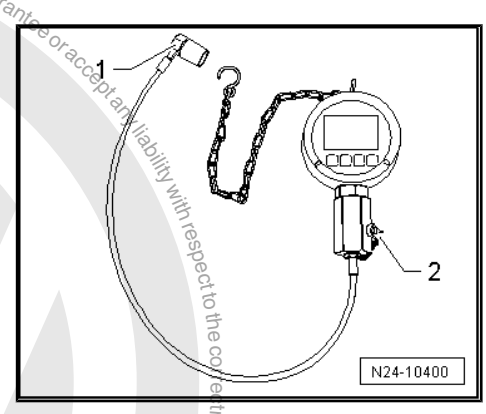
Procedure:

– Remove fuel pressure sender -G247- ⇒ page 222 .

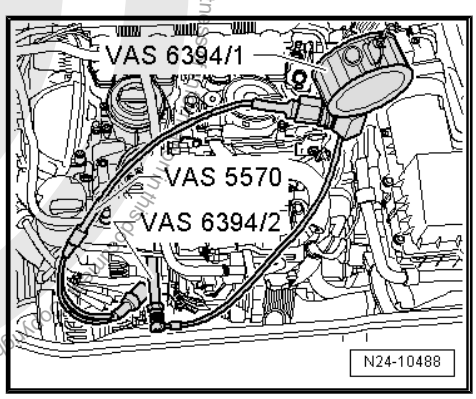
– Moisten tapered seal of adapter -VAS 6294/2- with clean engine oil and screw into fuel rail. Specified torque: 27 Nm.



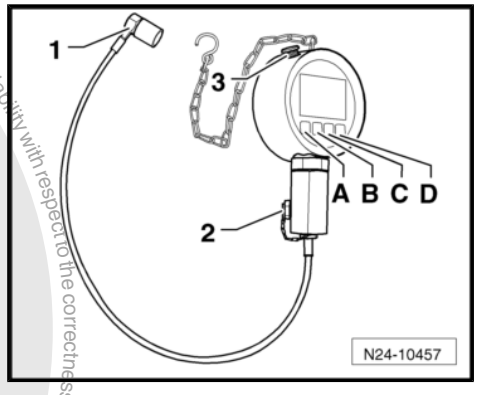
– Unscrew plug -2- and screw fuel pressure sender -G247- into tester -VAS 6394/1-. Specified torque 27 Nm.
– Connect pressure line of tester -VAS 6394/1- to adapter -VAS 6394/2- .



– Connect fuel pressure sender and electrical connector of fuel pressure sender using test instrument adapter -VAS 5570- .



– Switch on tester -VAS 6394/1- by briefly pressing the -A- button once.



Note

- *Press button -A- for 2 seconds, then light will be switched on for 20 seconds.*
- *If the digital pressure gauge -VAS 6394/1- reading is not 0 bar, carry out a zero calibration procedure ⇒ operating instructions .*

– Connect vehicle diagnosis tester to diagnostic connection.

– Switch ignition on.

– Press following buttons on display of diagnostic tester one after the other:

`Vehicle self-diagnosis`

`Self-diagnosis` ▶

`01 - Engine electronics` ▶

`011 - Measured values` ▶

– Select measured value block `1` `4` `0` and acknowledge with `Q`.

The actual fuel pressure value is shown in display zone 3, measured by the fuel pressure sender -G247- .

– Start engine.

– Compare pressure on tester -VAS 6394/1- with actual value displayed on vehicle diagnostic tester .

- A maximum pressure deviation of 5 bar is permissible.

– If deviation is greater than 5 bar, renew fuel pressure sender -G247- .

WARNING

Tester -VAS 6394- is under high fuel pressure! With engine running, detach connector from fuel pressure sender -G247- . This reduces fuel pressure to approx. 6 bar. Switch off ignition. Place a cleaning cloth around fuel pressure sender -G247- , then reduce residual pressure by carefully loosening fuel pressure sender -G247- .

– Repeat test with new fuel pressure sender -G247- and compare two readings.

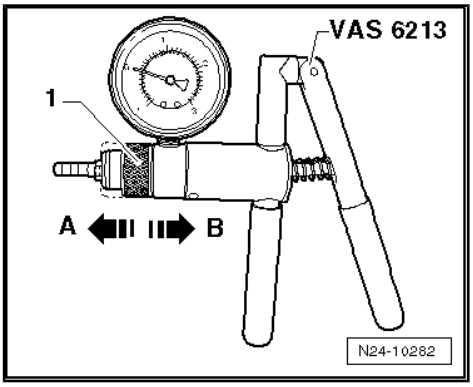
If readings again fail to correspond:

– Perform line test⇒ vehicle diagnostic tester .

3.4 Checking double non-return valve

Special tools and workshop equipment required

♦ Hand vacuum pump -VAS 6213-

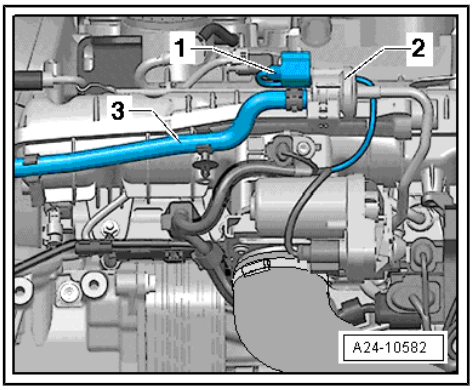


♦ Auxiliary measuring set -V.A.G 1594C-

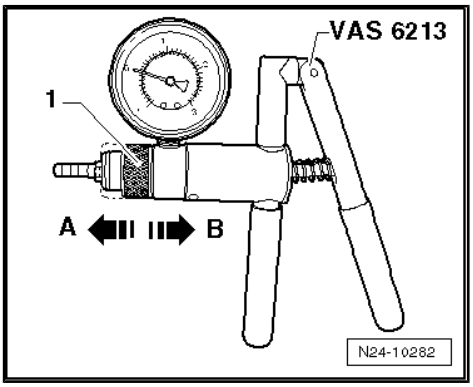
Test prerequisite

- Activated charcoal filter solenoid valve 1 -N80- has been checked with vehicle diagnostic tester and is OK.

– Detach connector -1- and breather hose -3- from activated charcoal filter solenoid valve 1 -N80- -2-.



– Move slide ring -1- on hand vacuum pump -VAS 6213- to position -A- for "vacuum".



– Connect hand vacuum pump -VAS 6213- to activated charcoal filter solenoid valve 1 -N80- .
– Connect contacts of solenoid valve to battery using auxiliary leads -1-. This opens the activated charcoal filter system solenoid valve 1 -N80- .

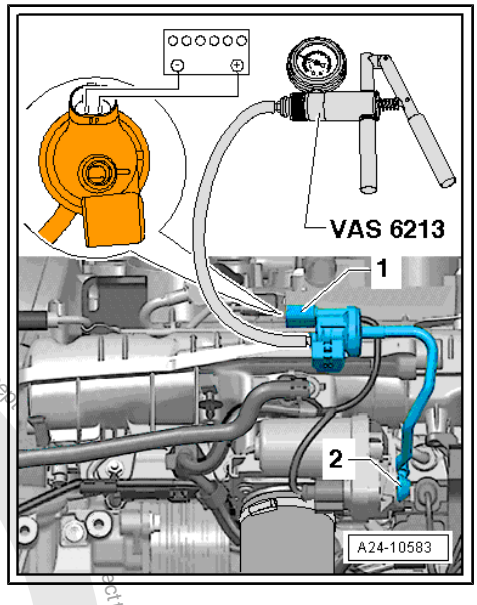
Then operate hand vacuum pump -VAS 6213- several times.

• Vacuum must build up.
– Disconnect battery again (cut power).

If vacuum does not build up:

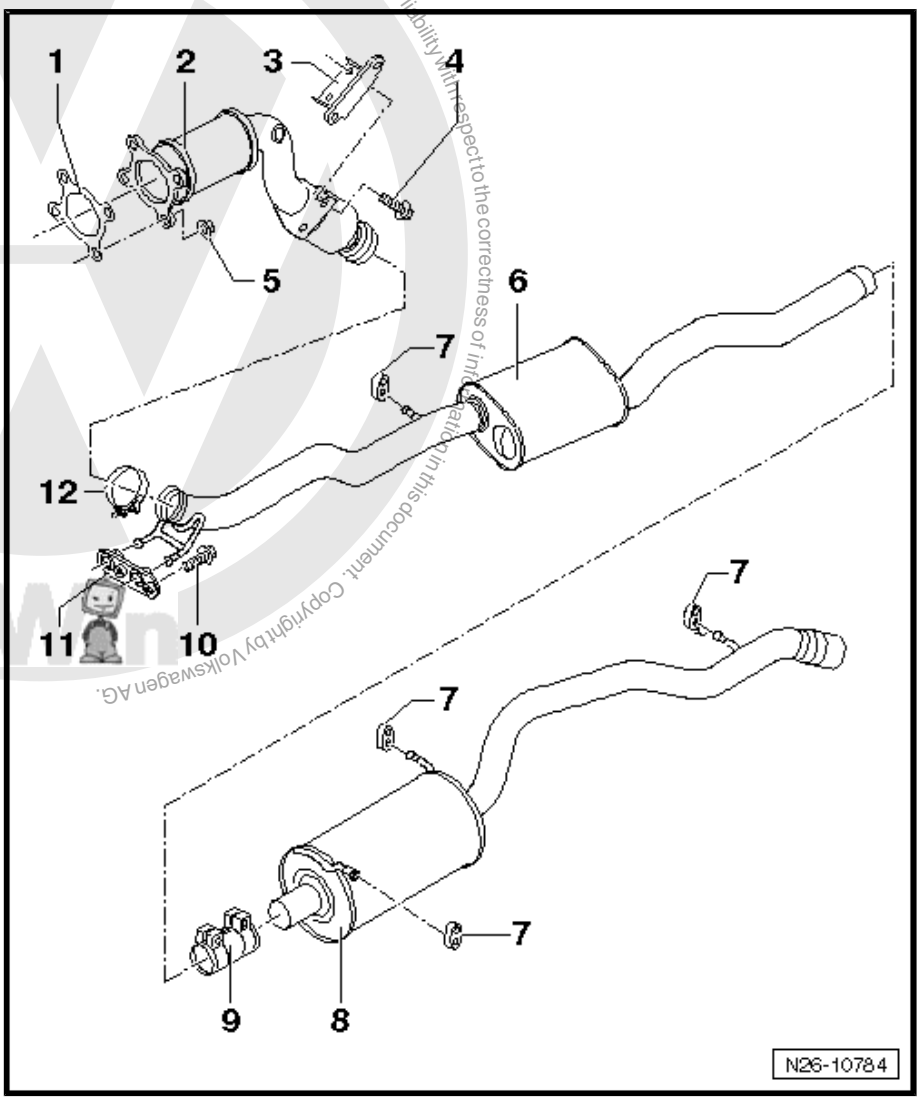
– Renew double non-return valve -1-.

Double non-return valve, activated charcoal filter solenoid valve 1 -N80- and plastic hoses form a single component. To replace it, the intake manifold must be removed.



26 – Exhaust system

1 Assembly overview - parts of the exhaust system



1 - Seal
- ❑ Renew.

2 - Catalytic converter
- ❑ Protect catalytic converter from damage by knocks and impact
- ❑ Removing and installing ⇒ page 240 .
- ❑ Aligning exhaust system free of tension ⇒ page 243 .

3 - Exhaust pipe bracket

4 - Bolt
- ❑ 20 Nm

5 - Nut
- ❑ 40 Nm
- ❑ Renew.
- ❑ Coat studs of turbocharger with high-temperature paste.
- ❑ High-temperature paste ⇒ Electronic parts catalogue .

6 - Centre silencer
- ❑ Cutting point ⇒ page 242
- ❑ Aligning exhaust system free of tension ⇒ page 243 .

7 - Mounting
- ❑ Renew if damaged.
- ❑ Check pretension ⇒ page 243

8 - Rear silencer
- ❑ Aligning exhaust system free of tension ⇒ page 243 .

9 - Rear clamp
- ❑ Align exhaust system free of tension before tightening ⇒ page 243 .
- ❑ Installation position ⇒ page 240 .
- ❑ Tighten bolted connections evenly.

10 - Bolt
- ❑ 20 Nm

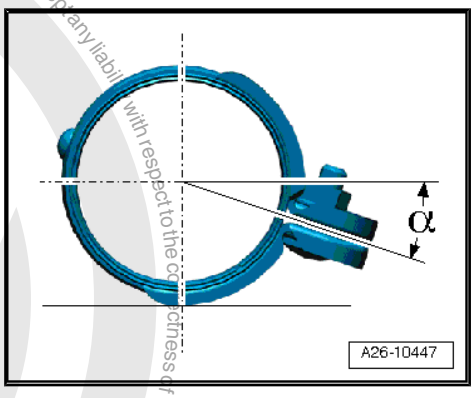
11 - Retainer

12 - Front clamp
- ❑ Align exhaust system free of tension before tightening ⇒ page 243 .
- ❑ Installation position ⇒ page 240 .

❑ Tighten bolted connections evenly.

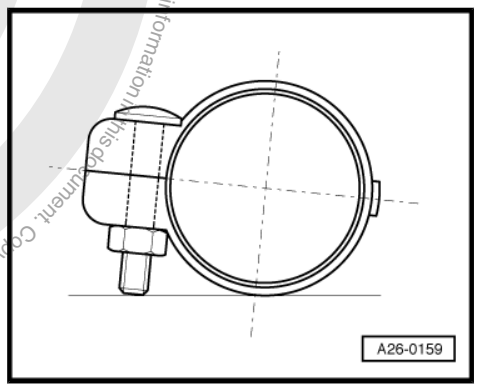
Installation position of front clamp

– Install clamp in illustrated angle position.
• Bolt connections point to the right.
• Nuts point upwards.
• α = approx. 20°



Installation position of rear clamp

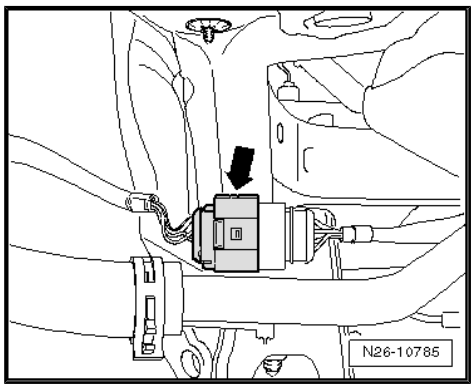
– Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
• Bolt connections point downwards.



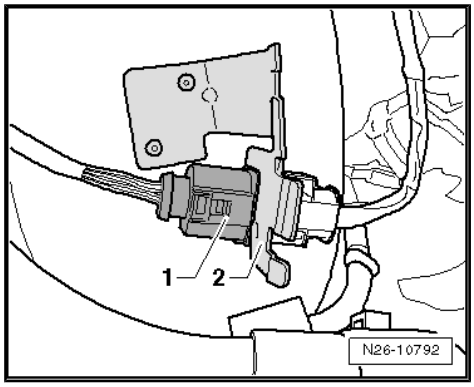
1.1 Removing and installing catalytic converter

Removing

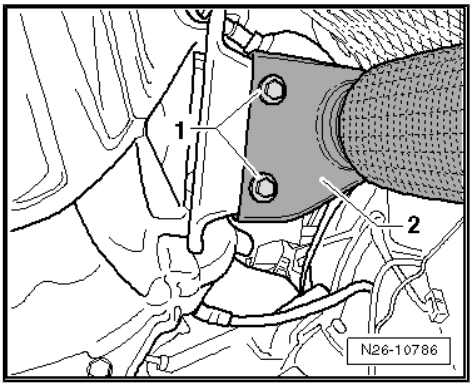
– Detach connector for Lambda probe 1 heater, downstream of catalytic converter -Z29- -arrow- and lay leads to one side.



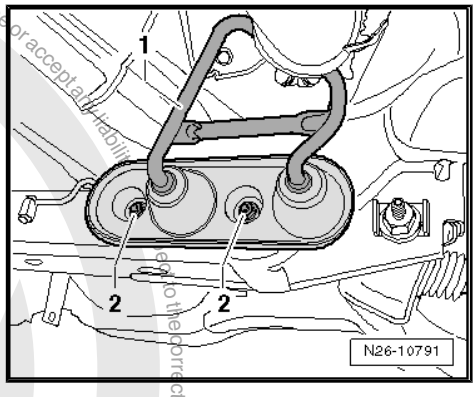
– Detach connector -1- for Lambda probe downstream of catalytic converter -G130- from bracket -2- and lay leads to one side.
– Remove air filter housing ⇒ page 207 .
– Remove engine guard, if fitted ⇒ Body, front; Rep. gr. 50 ; Engine guard .



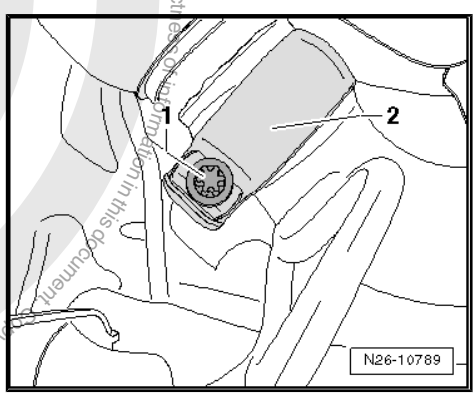
– Unscrew securing bolts -1- for catalytic converter -2-.



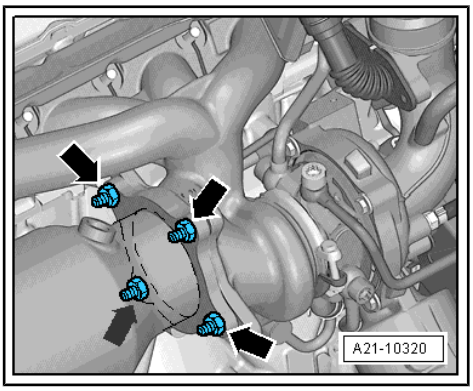
– Unscrew bolts -2- from bracket -1-.



– Release clip -2- between catalytic converter and centre silencer.



– Unscrew nuts -arrows- and remove catalytic converter upwards.



Installing

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

Specified torques ⇒ page 239 .

Note

Renew seals, gaskets and self-locking nuts.

1.2 Removing and installing exhaust manifold

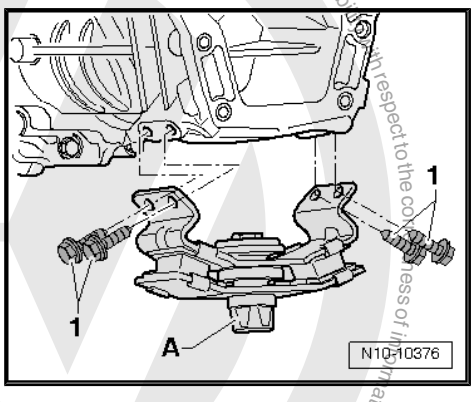
Exhaust manifold and turbocharger are one component; removing and installing ⇒ page 197 .

1.3 Removing and installing centre silencer

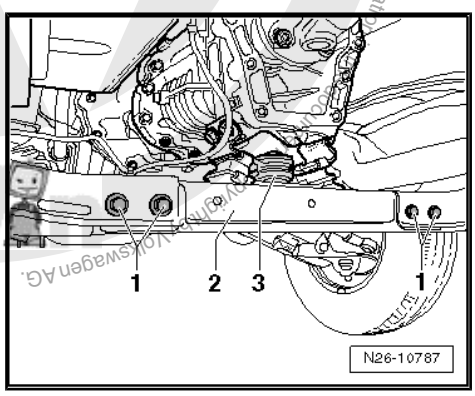
Procedure

Special tools and workshop equipment required

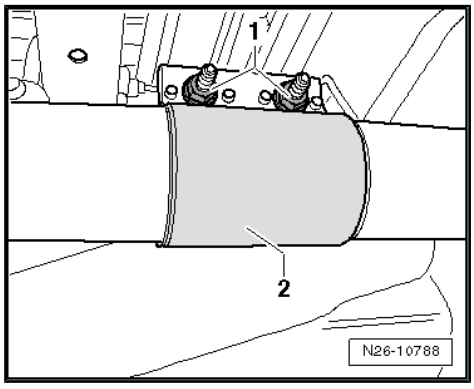
- ♦ Engine and gearbox jack -V.A.G 1383 A-
- – Support gearbox with engine and gearbox support -V.A.G 1383 A- .
- – Release gearbox mounting from gearbox. To do so, loosen bolts -1-.



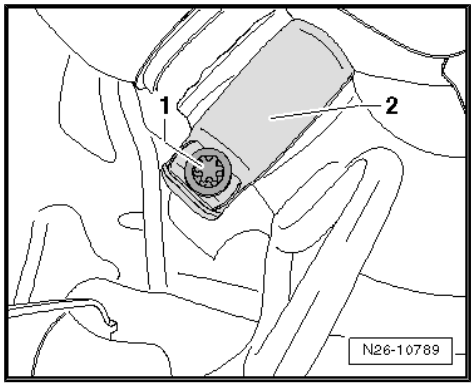
- – Remove cross member -2- for gearbox mounting -3-; to do so, unscrew bolts -1-.



- – Release double clip -2- to rear silencer; to do so, loosen securing nuts -1-.



- – Release clip -2- to catalytic converter.
- – Remove centre silencer downwards.



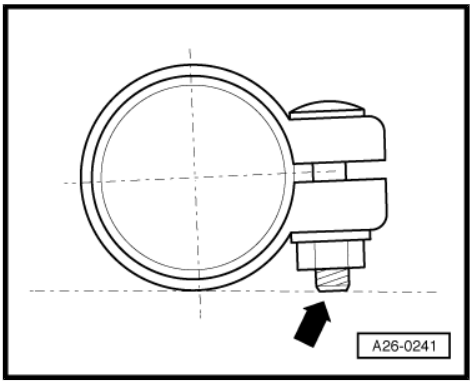
Installing

- – Install in reverse order.

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

• Threaded connection faces to rear.

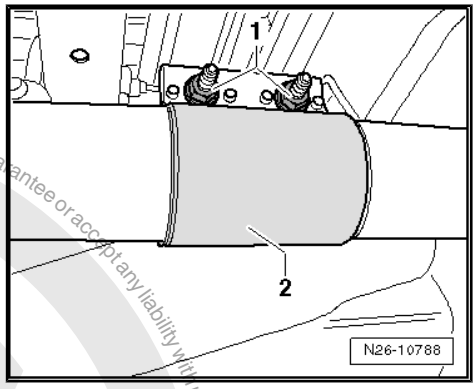
– Aligning exhaust system ⇒ page 243 .



1.4 Removing and installing rear silencer

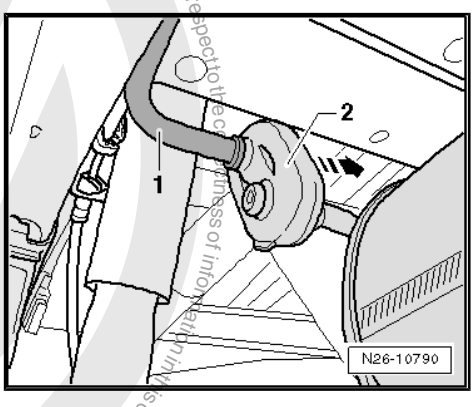
Removing

– Release double clip -2- to rear silencer; to do so, loosen securing nuts -1-.



– Detach rubber connector -2- in -direction of arrow- from bracket -1-.

– Remove rear silencer downwards.



Installing

– Install in reverse order.

• Threaded connection faces to rear.

– Aligning exhaust system ⇒ page 243 .

1.5 Checking exhaust system for leaks

– Start engine and run at idling speed.

– Plug tailpipes (e.g. with cloths or sealing plugs) and leave plugged until leak test is complete.

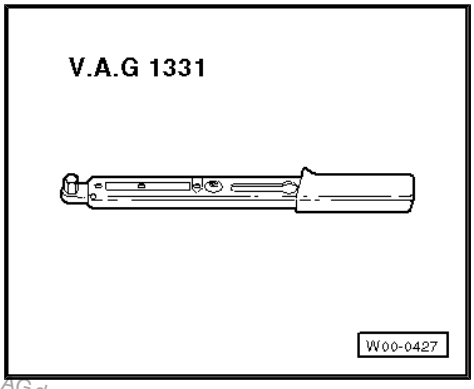
– Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc.) to locate any leaks.

– Rectify any leaks that are found.

1.6 Aligning exhaust system free of stress

Special tools and workshop equipment required

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



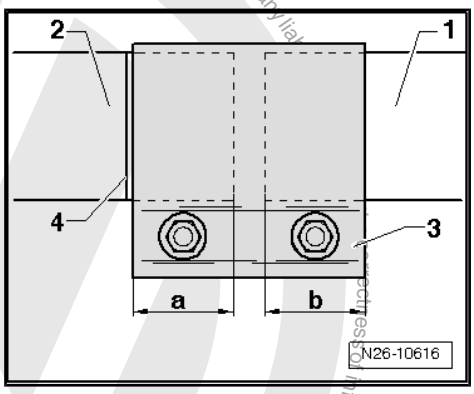
• The exhaust system must be aligned when cold.

Procedure:

– Loosen bolts of double clamp -3-.

– Tighten bolts hand tight.

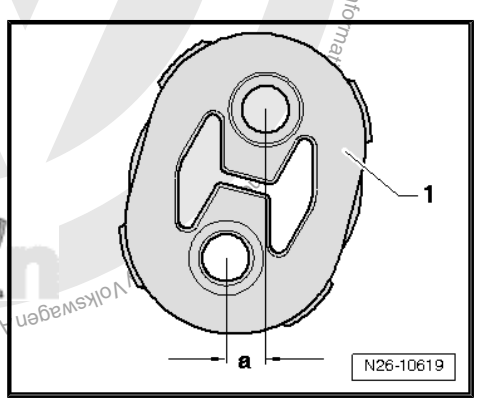
– Align exhaust system until the marking- 4- is visible.



– Align bolts of double clamp -3- horizontally.

– Align rubber mountings -1- for front silencer -2- and rear silencer -1- in such a way that dimension -a- is 8 mm.

– Tighten double clamp bolts -3- to 31 Nm.



1.7 Installation position and specified torque of the clamp

Note

Gradual introduction of clamp with continuous clip.

Specified torque and mounting dimensions of clamping sleeve.

Clamp -A- with 2 individual clips.

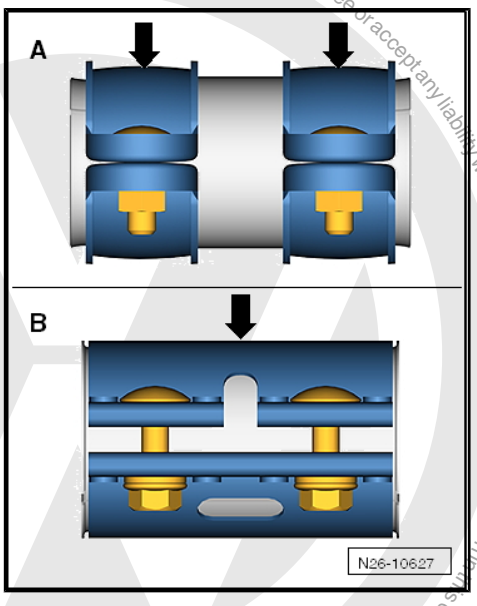
Specified torque: 25 Nm.

Installation dimensions -a- 5 mm (only for front clamp)

Clamp -B- with continuous clip.

Specified torque: 35 Nm.

Installation dimensions -a- 8.5 mm (only for front clamp)



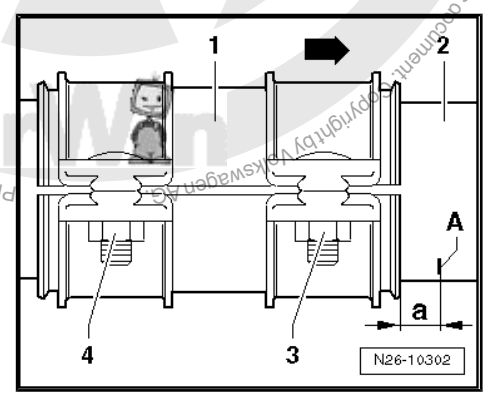
Installation dimension -a- for vehicles with marking on front exhaust pipe

1 - Clamp

2 - Front exhaust pipe

a - Installation dimension

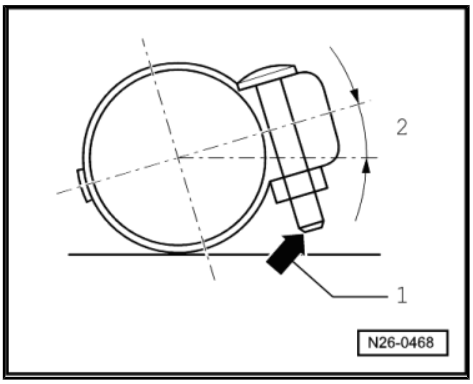
A - Marking



Installation position of front clamp

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

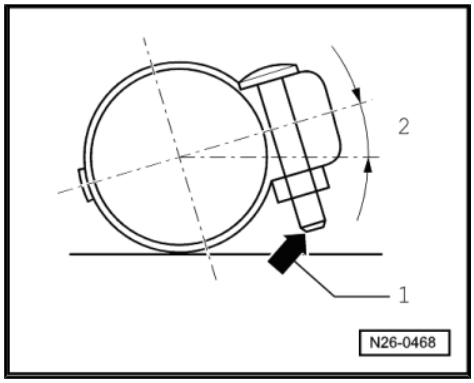
• Threaded connection faces right



Installation position of rear clamp

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

• Threaded connection faces to rear.



28 – Ignition system

1 Repairing ignition system

General notes on ignition system ⇒ page 247 .

Safety precautions ⇒ page 247 .

Assembly overview - ignition system ⇒ page 248 .

Removing and installing ignition coils with output stages ⇒ page 248 .

Spark plug test data ⇒ page 253 .

1.1 General notes on ignition system

- The battery must be disconnected only with ignition switched off. If a coded radio is installed, ascertain code before disconnecting battery.
- Observe required procedures after connecting battery ⇒ Electrical system; Rep. gr. 27 ; Disconnecting and reconnecting battery.
- For trouble-free operation of electrical components, a voltage of at least 11.5 V is necessary.
- After completing work, read fault memory of engine control unit, clear all fault entries which may have been created during checks and repairs. If the fault memory was cleared, the readiness code must be generated ⇒ 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 has to be turned over at starting speed without it starting (e.g. compression test), first unplug the connectors from the ignition coils and the injectors. Read and clear fault memory after completion of work.
- Always switch off ignition before cleaning engine.
- Disconnecting and connecting the battery must only be done with the ignition switched off, otherwise the engine control unit could be damaged.

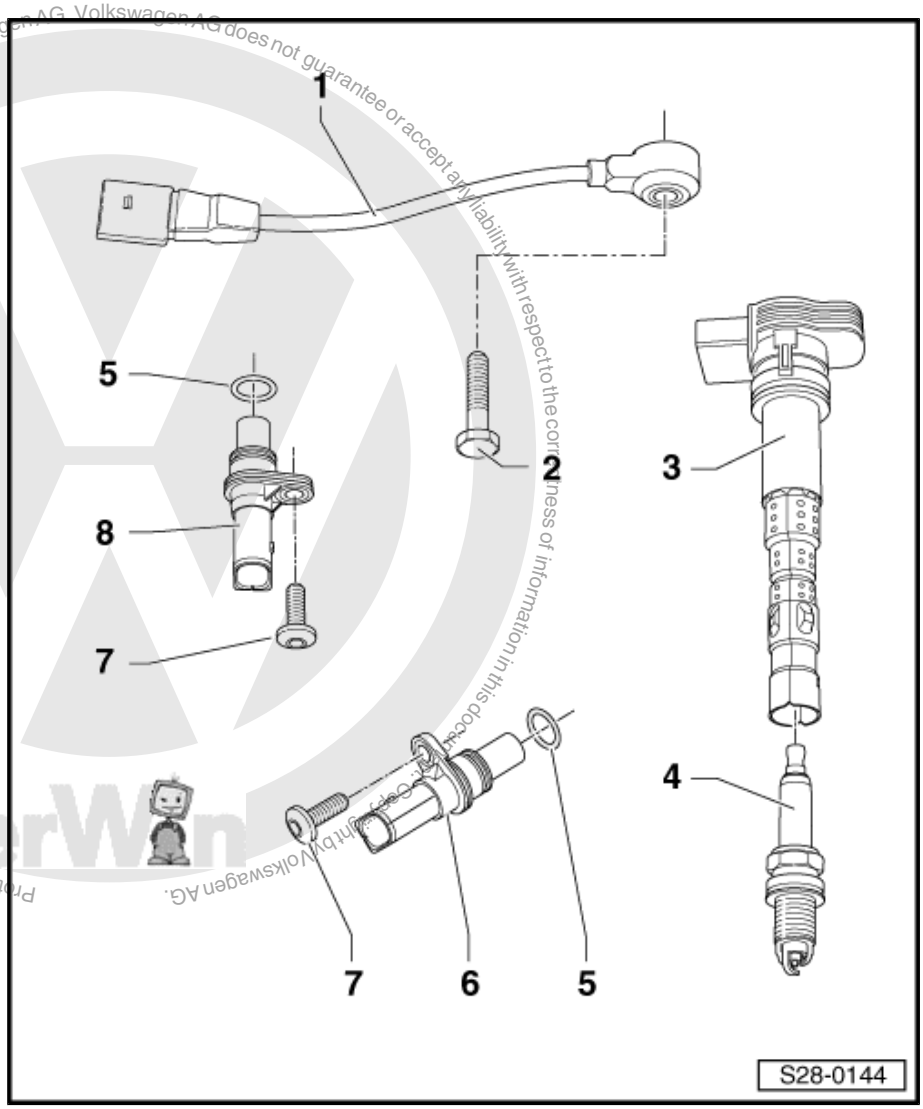
Note the following if testers and measuring instruments have to be used during a road test:

- Test and measuring instruments must always be secured to the 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 - ignition system



1 - Knock sensor 1 -G61-

- ❑ On front of cylinder head under intake manifold
- ❑ Removing and installing ⇒ page 252 .
- ❑ Gold-plated contacts.

2 - 20 Nm

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

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

- ❑ Removing and installing ⇒ page 248 .

4 - Spark plug, 25 Nm

- ❑ If a spark plug is replaced, regrease ignition coil with final output stage ⇒ page 249
- ❑ Type and electrode gap ⇒ page 253 .
- ❑ Remove and install with spark plug socket and extension -3122 B- .

5 - O-ring

- ❑ Renew.

6 - Engine speed sender -G28-

- ❑ At lower left of front cylinder block, next to coarse oil separator ⇒ page 118
- ❑ Removing and installing ⇒ page 252 .

7 - 10 Nm

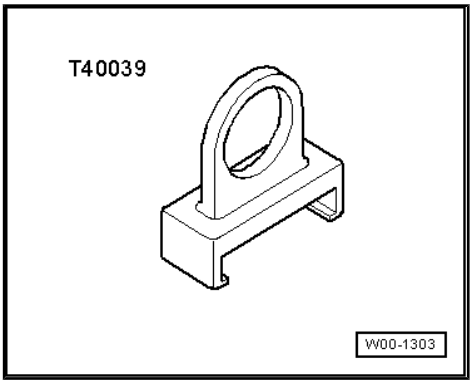
8 - Hall sender -G40-

- ❑ In cylinder head cover at front.
- ❑ Gold-plated contacts.

1.4 Removing and installing ignition coils with output stage

Special tools and workshop equipment required

♦ Puller -T40039-



♦ Lubricating paste -G 052 141 A2-

Removing

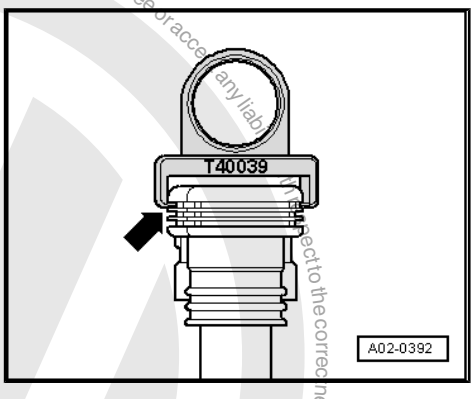
Note

♦ *Observe safety precautions ⇒ page 247 .*

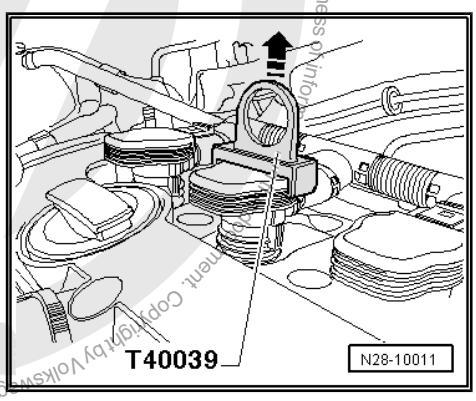
♦ *Assembly overview - ignition system ⇒ page 248 .*

♦ *To detach spark plugs, fit puller -T40039- onto uppermost, thick rib -arrow- of ignition coils with final output stages.*

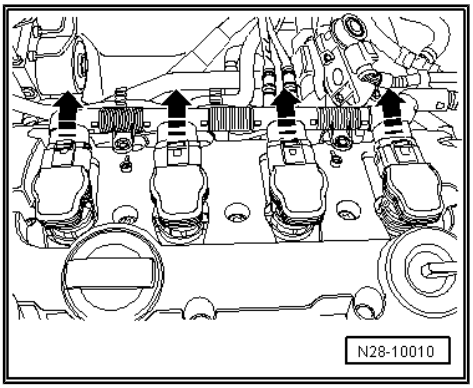
♦ *The lower ribs may be damaged if they are used.*



– Pull all ignition coils approx. 30 mm out of spark plug recess using puller -T40039- .



– Release connectors and simultaneously detach all connectors from ignition coils -arrows-.



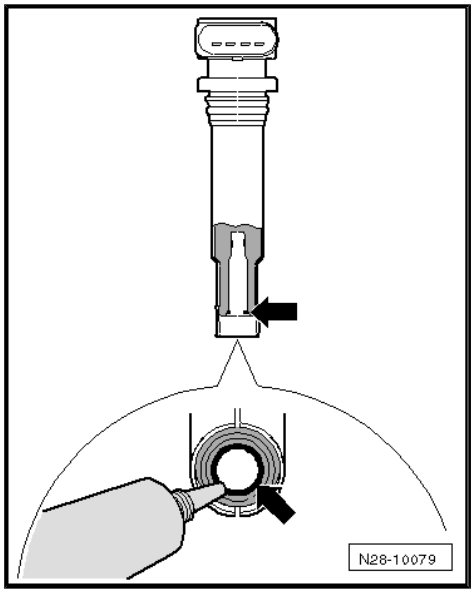
Installing

Note

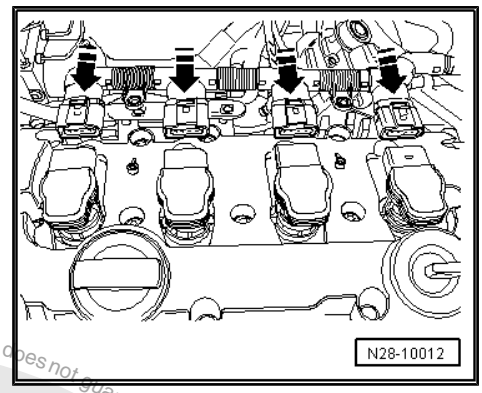
♦ *When fitting new spark plugs, the ignition coil must be re-greased using lubricating paste -G 052 141 A2- This will stop the ignition coil sealing hose from »sticking« to the spark plug. The lubricating paste must be distributed on the spark plug when inserting on the ignition coil.*

♦ *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.
– Insert all spark plugs loosely into spark plug recess.



– Align ignition coils with connectors -arrows- and push all connectors simultaneously onto ignition coils.
– Evenly push ignition coils onto spark plugs by hand.



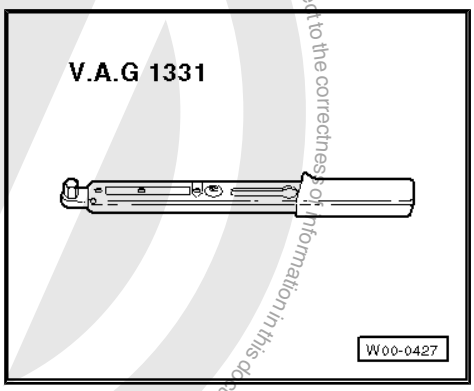
1.5 Removing and installing spark plugs

Note

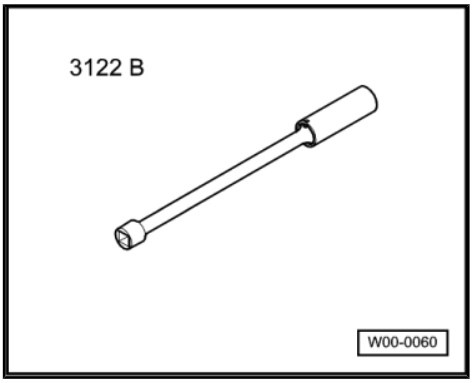
Observe disposal regulations.

Special tools and workshop equipment required

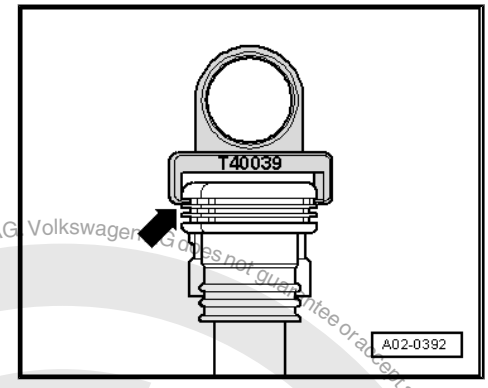
♦ Torque wrench -V.A.G 1331/-



- Spark plug socket and extension -VAS 3122B-

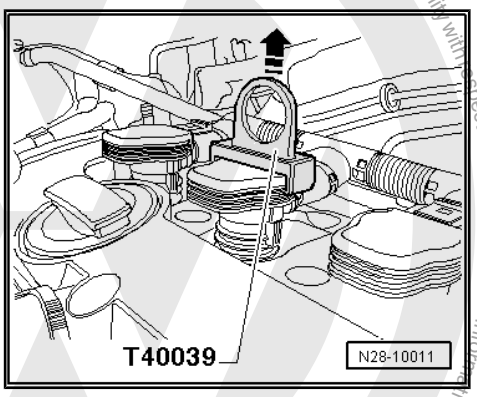


- Puller -T40039-

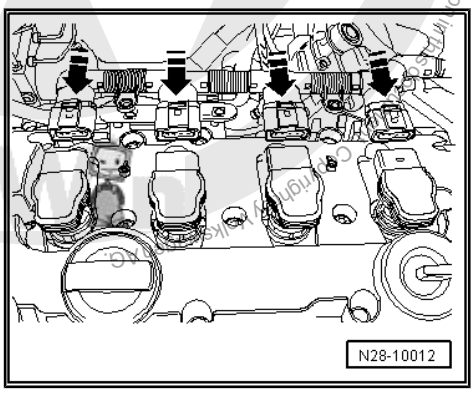


Removing

– Pull all ignition coils approx. 30 mm out of spark plug recess using puller -T40039- .



– Release connectors -arrows- and simultaneously detach all connectors from ignition coils.
– Remove ignition coil with final output stage
– Unscrew spark plugs with spark plug spanner -VAS 3122B- .



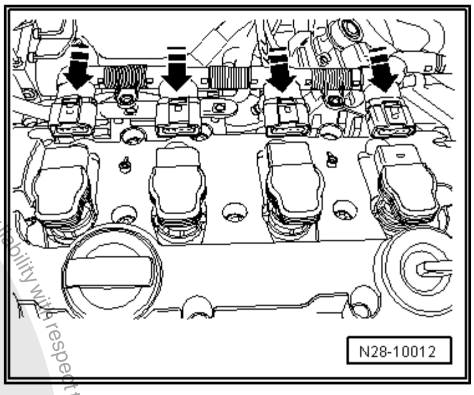
Installing

– Fit new spark plugs with spark plug spanner -VAS 3122B-

Specified torque: 30 Nm

– Insert all spark plugs with final output stage loosely into spark plug recess.

– Align ignition coil plus final output stages with connectors -arrows- and push on simultaneously.



Note

Do not strike with a hammer or similar tool.

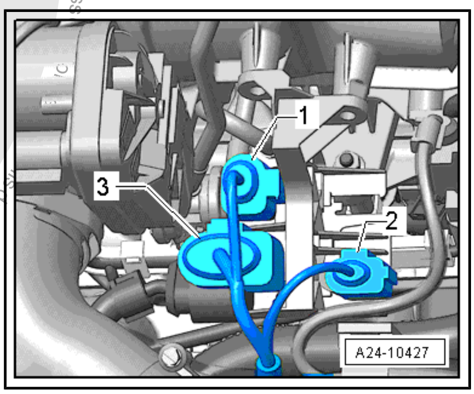
– Evenly push all ignition coils plus final output stages onto spark plugs by hand.

1.6 Removing and installing knock sensor 1 -G61-

Removing

– Detach connector -2- from knock sensor I -G61- .

– Remove coolant pump ⇒ page 149 .



Note

The knock sensor I -G61- is located under the intake manifold behind the coolant pump.

– Unscrew knock sensor I -G61- .

Installing

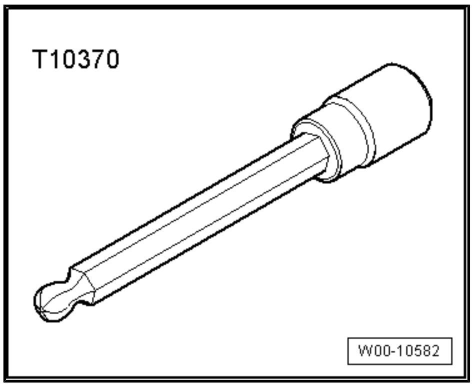
– Install in reverse order.

• Specified torque ⇒ page 248 .

1.7 Removing and installing engine speed sender -G28-

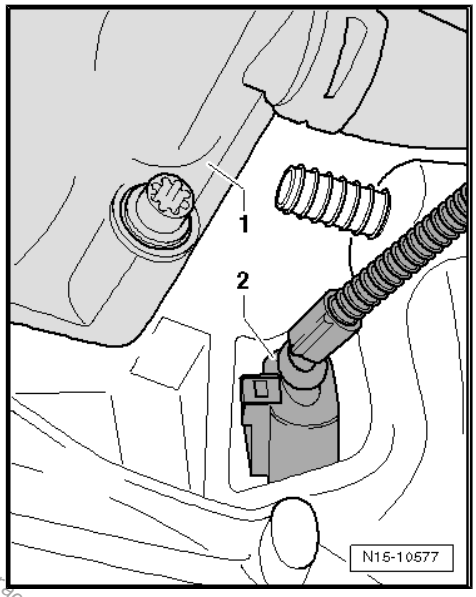
Special tools and workshop equipment required

♦ Hexagon key extension, 4 mm -T10370-



Removing

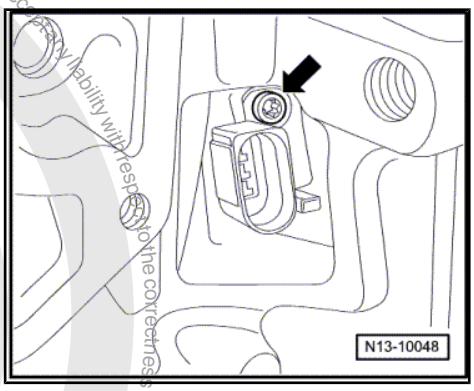
– Detach connector -2- from engine speed sender -G28- at right below coarse oil separator -1-.



Note

To release electrical connector without assembly tool -T10118- , press connector on engine speed sender -G28- in with a screwdriver and at the same time raise release tab with a thin wire hook.

– Loosen securing bolt -arrow- with socket AF 4 mm -T10370- and remove speed sender.



Installing

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

- Specified tightening torque of fastening bolt for engine speed sender -G28- 5 Nm.

1.8 Test data, spark plugs

Engine codes	CFPA
Firing order	1-3-4-2
Spark plugs	
VW/Audi	06H 905 601 A
Electrode gap	1.0…1.1 mm
Specified torque	25 Nm
Change interval	⇒ Maintenance ; Booklet ; Service tables