Workshop Manual

Audi Q7 2007 ➤

TDI injection and glow plug system (12-cyl. 6.0 ltr. 4-valve common rail)									
Engine ID	CCG A								

Edition 05.2011

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List of Workshop Manual Repair Groups

Repair Group

23 - Mixture preparation - injection

28 - Glow plug system

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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.

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Contents

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23 – Mixture preparation - injection

1 Safety precautions and rules for cleanliness

1.1 Safety precautions when using testers and measuring instruments during a road test

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Note the following if testers and measuring instruments have to be used during a road test:

WARNING

Accidents can be caused if the driver is distracted by test equipment while road-testing, or if test equipment is not properly secured.

Persons sitting in the front passenger's seat could be injured if the airbag is triggered in an accident.

- *The use of test equipment while driving causes distraction.*
- *There is an increased risk of injury if test equipment is not secured.*
- ♦ *Test equipment must always be secured on the rear seat with a strap and operated from the rear seat by a second person.*

1.2 Safety precautions when working on the fuel system

When working on the fuel system note the following warnings:

WARNING

The fuel can become extremely hot. This can cause injuries.

- ♦ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with common rail engine, even after the engine is switched off. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ♦ *Wear protective gloves.*
- ♦ *Wear safety goggles.*

Risk of injury - fuel system operates under pressure.

- ♦ *Wrap a clean cloth around the connection before opening the fuel system. Then release pressure by carefully loosening the connection.*
- ♦ *Wear protective gloves.*
- ♦ *Wear safety goggles.*

Caution

To prevent irreparable damage to the electronic components when disconnecting the battery:

- *Observe notes on procedure for disconnecting the battery.*
- *Always switch off the ignition before disconnecting the battery.*

– Disconnect battery ⇒ Rep. gr. 27 .

To prevent the high-pressure fuel 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 the fuel system between the tank and the high-pressure fuel pump are removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed to bleed the fuel system.
- If a fuel pump, fuel line or fuel filter are removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed ONCE before the engine is started for the first time.
- If the high-pressure fuel pump is removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed THREE TIMES before the engine is started for the first time.
- Performing first fuel filling after installing high-pressure pump ⇒ page 64 .

General instructions:

- Clean tools and workbench etc. before working on the injection system.
- Thoroughly clean all unions and surrounding areas before disconnecting.
- When removing components, plug all open connections immediately with suitable clean sealing caps.
- Do not remove sealing caps from components until immediately prior to installation. After removal, components should be kept in new, sealable plastic bags (use the original new part packaging if possible).
- Before installation, check the injectors and their surroundings visually; they must be undamaged and free of lint. Make sure the injector bores in the cylinder head are clean. Wipe out if necessary using a clean cloth, taking care not to cause damage. Do not use sharp objects of any kind.
- If components are not being renewed, always mark the high-pressure fuel lines on removal. High-pressure fuel lines must always be re-installed in their original positions (i.e. on the same cylinder).
- The following components and seals/O-rings must always be renewed when the injectors are removed and installed: „copper seal“, „O-ring for injector bore“, „O-ring for injector return connection“.
- The following components and seals/O-rings must always be renewed when an injector is renewed: „clamping piece“, „copper seal“, „O-ring for injector bore“, „O-ring for injector return connection“.
- Always fit new copper seals for the injectors. Check all new O-rings for damage before installing. Lubricate O-rings lightly

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with assembly oil or clean engine oil before installing. Use assembly tool for installing the „O-ring for injector return connection“.

- Take care not to damage the injectors when removing the old copper seals.
- Align the high-pressure fuel lines so they are free of tension. Tighten all unions lightly to start with before tightening to final torque.
- Never attempt to bend high-pressure fuel lines to shape.
- When working on any parts of the high-pressure fuel system, tools may only be used for loosening and tightening pipe unions. All other components must always be removed and installed by hand without using tools or other equipment.
- Press the return lines onto the injectors by hand from above so that they engage audibly on each injector (do not press in the release pins when doing this). Then press down the release pin after connecting the return line. Check that the return lines are seated securely by pulling them by hand from above. Also check that they seal properly (fuel pressure in return line as far as pressure retention valve: between 8 and 10 bar).
- All cable ties which are released or cut open when removing must be refitted in the same position when installing.
- When the fuel system is open: Do not work with compressed air if this can be avoided. Do not move the vehicle unless absolutely necessary.
- Also ensure that no diesel fuel comes into contact with the coolant hoses. Should this occur, the hoses must be cleaned immediately. Damaged hoses must be renewed.

1.3 Safety precautions when working on the ignition system

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To prevent injuries to persons and/or damage to the fuel injection and glow plug system, note the following:

- ♦ Persons wearing a pacemaker should not lean over the engine compartment while the engine is running, as the injectors use high voltage pulses.
- ♦ Do not open any fuel line connections while the engine is running.
- ♦ Always switch off the ignition before connecting or disconnecting injection and glow plug system wiring or tester cables.
- ♦ Always switch off the ignition before cleaning the engine.
- ♦ Always switch off the ignition before connecting or disconnecting the battery, otherwise the engine control unit may be damaged.
- ♦ Certain tests may lead to faults being detected and stored by the engine control units. Therefore the event memory must be interrogated after completing all tests and repair work („Interrogate event memory“).

1.4 Contact corrosion!

Contact corrosion can occur if unsuitable fasteners are used (e.g. bolts, nuts, washers, etc.).

For this reason, only fasteners with a special surface coating are used.

Additionally, all rubber and plastic parts and all adhesives are made of non-conductive materials.

Always install new parts if you are not sure whether used parts can be re-fitted ⇒ Electronic parts catalogue .

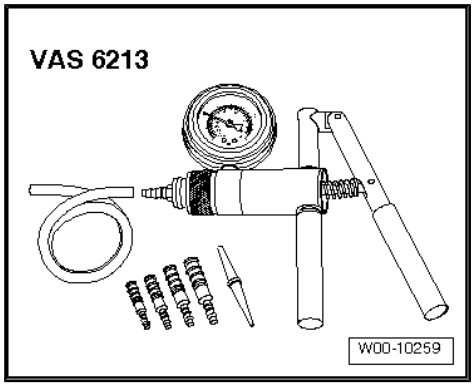
Note the following:

- We recommend using only genuine replacement parts; these have been tested and are compatible with aluminium.
- We recommend the use of Audi accessories.
- Damage caused by contact corrosion is not covered under warranty.

1.5 Checking vacuum system

Special tools and workshop equipment required

- Hand vacuum pump -VAS 6213-



Procedure

– Check all vacuum lines in the complete vacuum system for:

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- Cracks
- Traces of animal bites
- Kinked or crushed lines
- Lines porous or leaking

– Check vacuum line to solenoid valve and from solenoid valve to corresponding component.

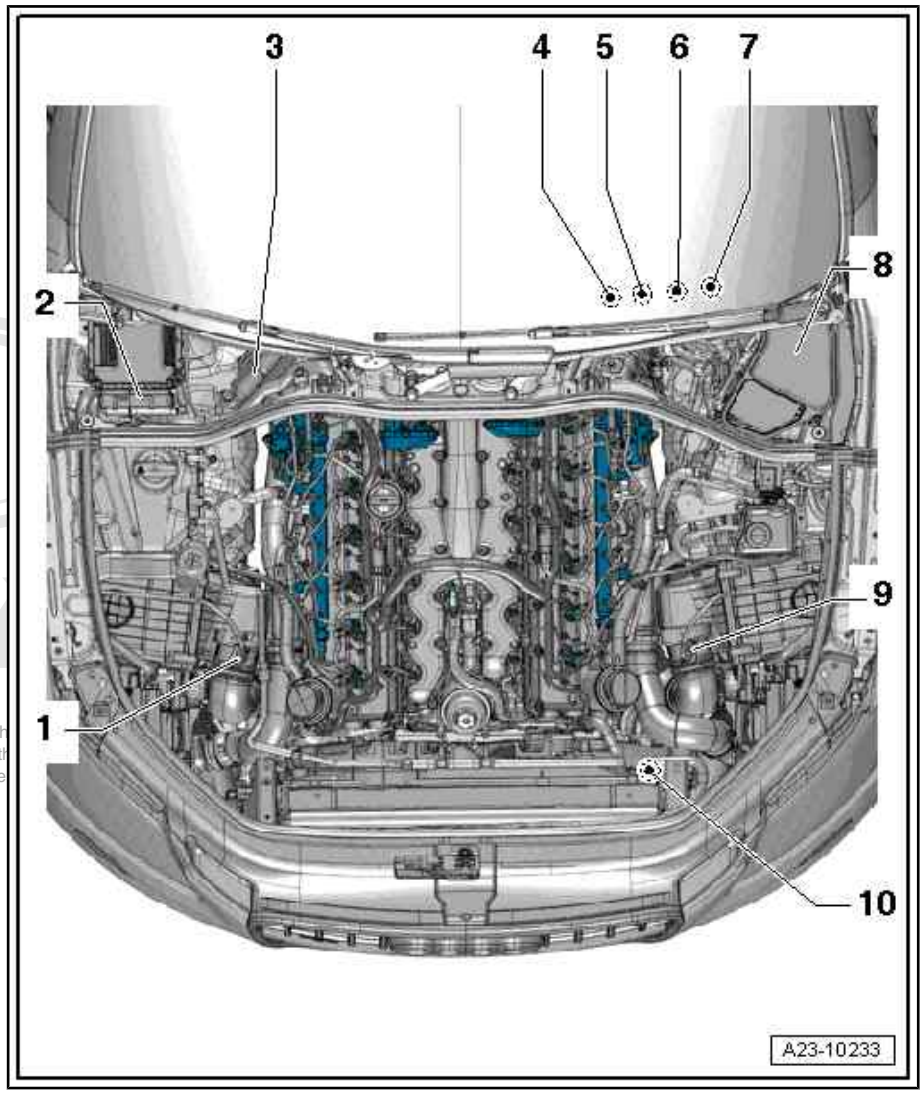
– If a fault is stored in the event memory, check the vacuum lines leading to the corresponding component, and also check the remaining vacuum lines leading to other components.

– If it is not possible to build up a vacuum with the hand vacuum pump -VAS 6213- or if the vacuum pressure drops again immediately, check the hand vacuum pump and connecting hoses for leaks.

2 Injection system

2.1 Overview of fitting locations

Engine compartment



1 - Air mass meter -G70-

- ❑ Cylinder bank 1 (right-side)
- ❑ Removing and installing ⇒ page 18

2 - Engine control unit -J623-

- ❑ Removing and installing ⇒ page 72

3 - Engine control unit 2 -J624-

- ❑ Removing and installing ⇒ page 75

4 - Accelerator position sender -G79- and accelerator position sender 2 -G185-

- ❑ Removing and installing ⇒ Rep. gr. 20

5 - Brake light switch -F- and brake pedal switch -F47-

- ❑ In footwell on brake pedal

6 - Exhaust emissions warning lamp -K83-

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- ❑ In instrument cluster

7 - Glow period warning lamp -K29-

- ❑ In instrument cluster

8 - Electronics box in engine compartment

9 - Air mass meter 2 -G246-

- ❑ Cylinder bank 2 (left-side)
- ❑ Removing and installing ⇒ page 19

10 - Continued coolant circulation pump -V51-

- ❑ Removing and installing ⇒ Rep. gr. 19

Engine (front view)

1 - Oil level and oil temperature sender -G266-

- ❑ Removing and installing ⇒ Rep. gr. 17

2 - Radiator outlet coolant temperature sender -G83-

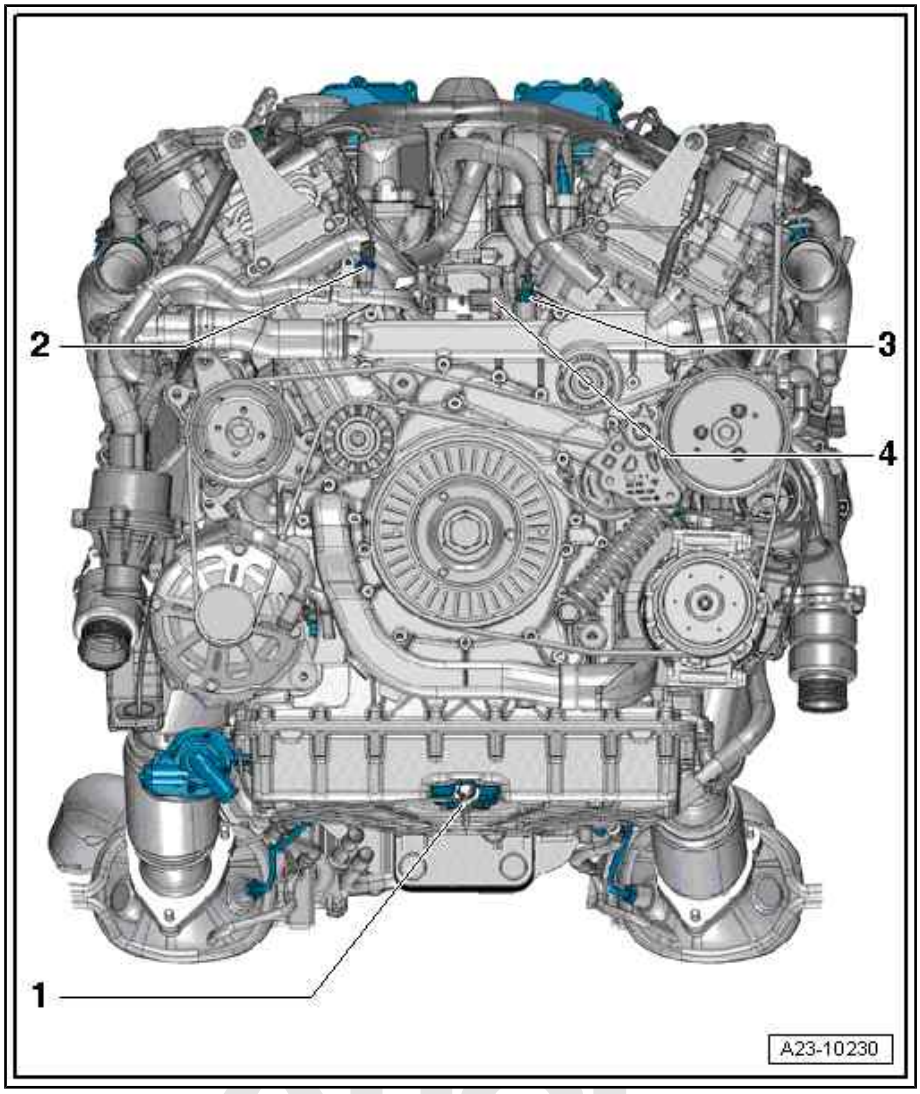
- ❑ Removing and installing ⇒ Rep. gr. 19

3 - Coolant temperature sender -G62-

- ❑ Removing and installing ⇒ Rep. gr. 19

4 - Electrical connector

- ❑ To oil pressure switch -F1-



Engine (side view, left-side)

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1 - Oil temperature sender - G8-

- ❑ Removing and installing ⇒ Rep. gr. 17

2 - Control motor 2 for exhaust gas recirculation -V339-

- ❑ Removing and installing ⇒ Rep. gr. 26

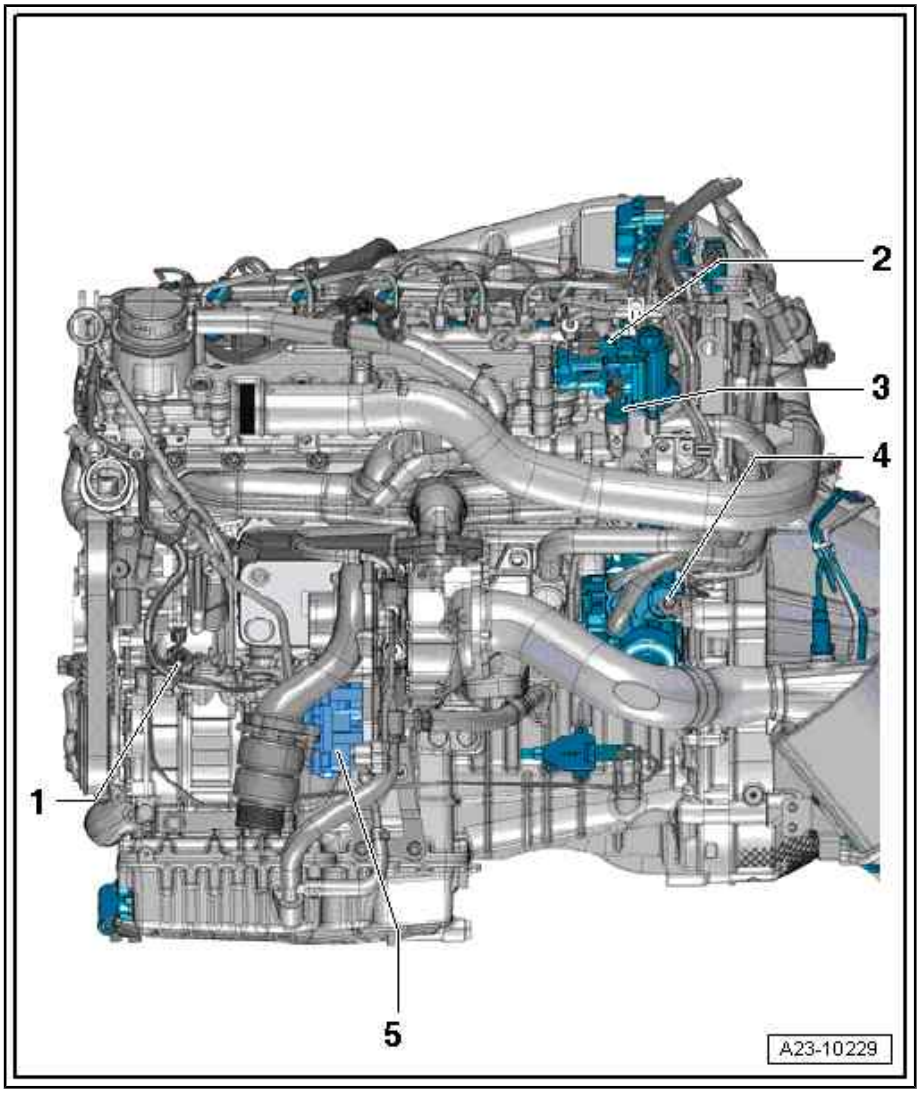
3 - Pressure sender 2 for exhaust gas recirculation -G692-

- ❑ Removing and installing ⇒ Rep. gr. 26

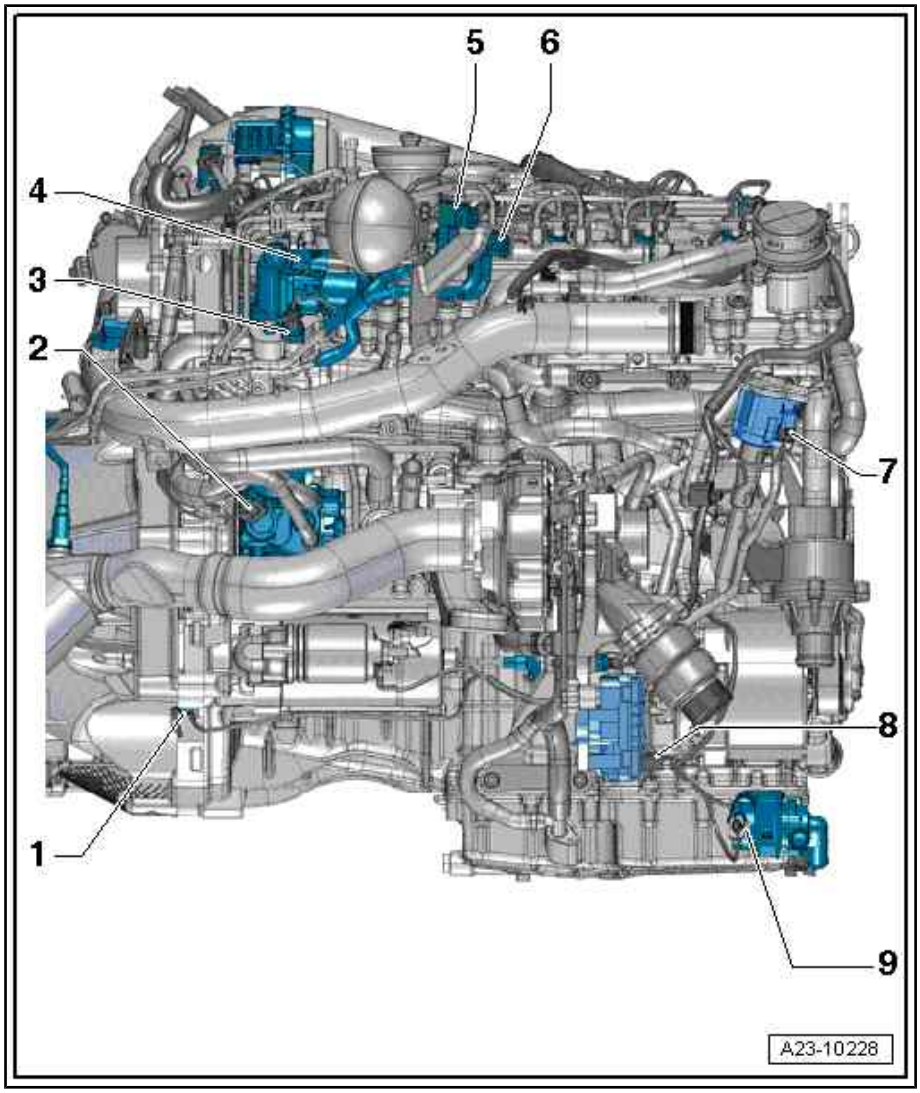
4 - Fuel metering valve 2 - N402-

- ❑ In high-pressure fuel pump
- ❑ Removing and installing ⇒ „2.25 Removing and installing high-pressure pump (left-side)“, page 50

5 - Control unit for turbocharger 2 -J725-



Engine (side view, right-side)



1 - Engine speed sender -G28-

- ❑ Removing and installing ⇒ page 83

2 - Fuel metering valve -N290-

- ❑ In high-pressure fuel pump
- ❑ Removing and installing ⇒ „2.26 Removing and installing high-pressure pump (right-side)“, page 57

3 - Pressure sender for exhaust gas recirculation -G691-

- ❑ Removing and installing ⇒ Rep. gr. 26

4 - Exhaust gas recirculation control motor -V338-

- ❑ Removing and installing ⇒ Rep. gr. 26

5 - Pressure differential sender 2 -G524-

- ❑ Removing and installing ⇒ page 70

6 - Pressure differential sender -G505-

- ❑ Removing and installing ⇒ page 70

7 - Pump for exhaust gas recirculation cooler -V400-

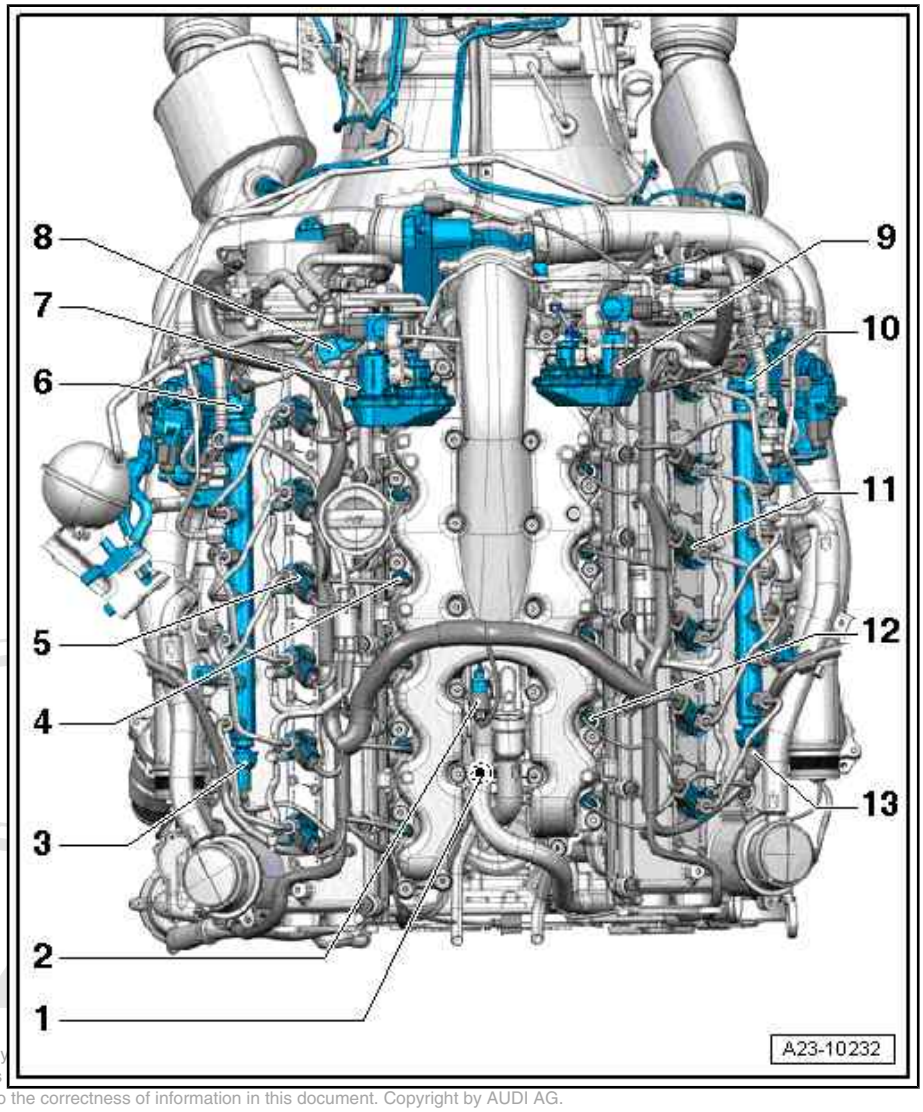
- ❑ Removing and installing ⇒ Rep. gr. 19

8 - Control unit for turbocharger 1 -J724-

9 - Fuel cooling pump -V166-

- ❑ Removing and installing ⇒ Rep. gr. 19

Engine (top view)



1 - Oil pressure switch -F1-

- ❑ Removing and installing ⇒ Rep. gr. 17

2 - Electrical connector

- ❑ For exhaust gas recirculation temperature sensor -G98-

3 - Fuel pressure sender -G247-

- ❑ Removing and installing ⇒ page 43

4 - Glow plugs

- ❑ Glow plug 1 -Q10- , glow plug 3 -Q12- , glow plug 5 -Q14- , glow plug 8 -Q17- , glow plug 10 -Q19- , glow plug 12 -Q21-
- ❑ Removing and installing ⇒ page 82

5 - Injectors

- ❑ Injector, cylinder 1 -N30- , injector, cylinder 2 -N31- , injector, cylinder 3 -N32- , injector, cylinder 4 -N33- , injector, cylinder 5 -N83- , injector, cylinder 6 -N84-

6 - Fuel pressure regulating valve -N276-

- ❑ Removing and installing ⇒ page 45

7 - Intake manifold flap motor -V157-

- ❑ Removing and installing ⇒ page 24

8 - Hall sender -G40-

- ❑ Removing and installing ⇒ page 84

9 - Intake manifold flap 2 motor -V275-

- ❑ Removing and installing ⇒ page 24

10 - Fuel pressure regulating valve 2 -N484-

- ❑ Removing and installing ⇒ page 45

11 - Injector

- ❑ Injector, cylinder 7 -N85- , injector, cylinder 8 -N86- , injector, cylinder 9 -N299- , injector, cylinder 10 -N300- , injector, cylinder 11 -N301- , injector, cylinder 12 -N302-

12 - Glow plugs

- ❑ Glow plug 2 -Q11- , glow plug 4 -Q13- , glow plug 6 -Q15- , glow plug 7 -Q16- , glow plug 9 -Q18- , glow plug 11 -Q20-
- ❑ Removing and installing ⇒ page 82

13 - Fuel pressure sender 2 -G624-

- ❑ Removing and installing ⇒ page 43

Engine (rear view)

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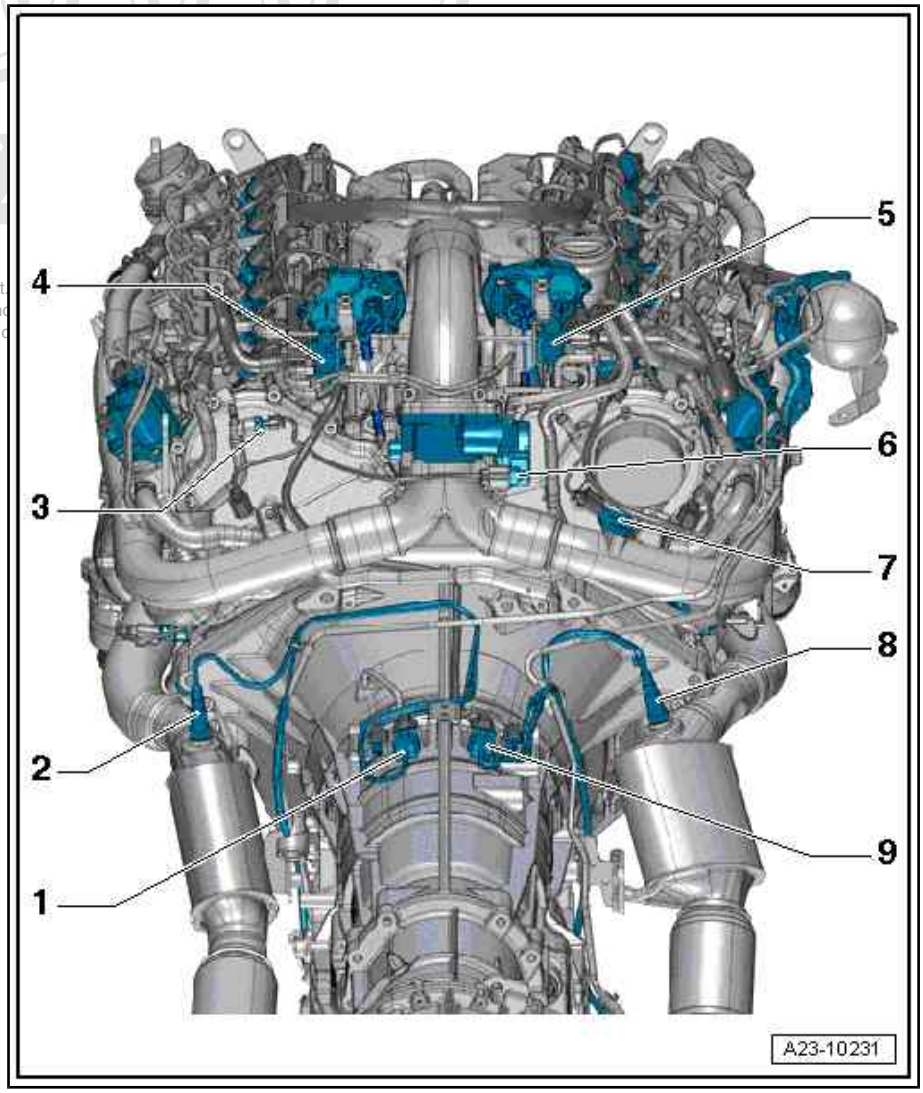


1 - Electrical connectors

- For Lambda probe 2 -G108-
- For temperature sender 2 before particulate filter -G498-

2 - Lambda probe 2 -G108-

- With Lambda probe heater 2 -Z28-
- Removing and installing ⇒ page 69

3 - Fuel temperature sender -G81-

- Removing and installing ⇒ page 67

4 - Exhaust gas recirculation cooler change-over valve -N345-

5 - Exhaust gas recirculation cooler change-over valve 2 -N381-

6 - Throttle valve module -J338-

- Removing and installing ⇒ page 25

7 - Charge pressure sender -G31- with intake air temperature sender -G42-

- Removing and installing ⇒ Rep. gr. 21

8 - Lambda probe -G39-

- With Lambda probe heater -Z19-
- Removing and installing ⇒ page 69

9 - Electrical connectors

- For Lambda probe -G39-
- For temperature sender before particulate filter -G506-

2.2 System layout

WARNING

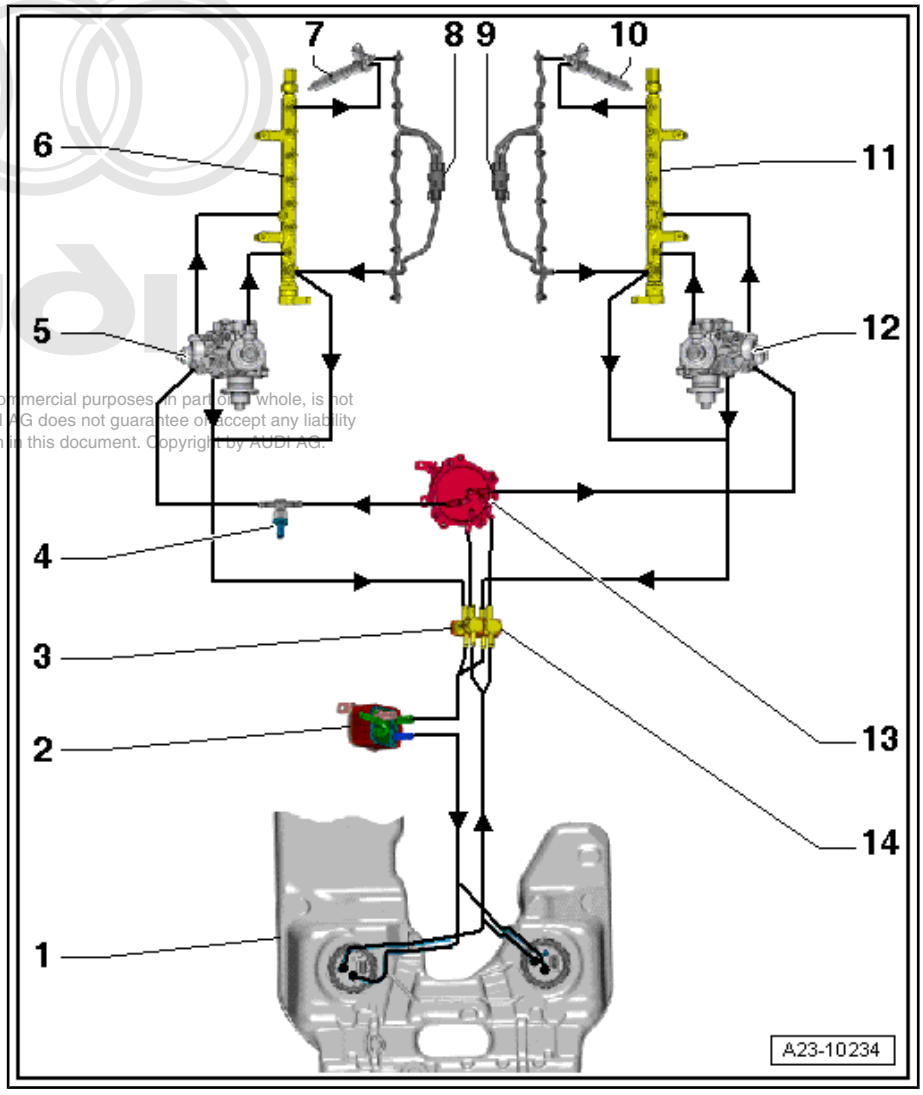
- *Always read rules for cleanliness when working on fuel system ⇒ page 1 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

Caution

To prevent the high-pressure fuel 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 the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the first fuel filling operation must be performed.*
- *If a fuel pump, fuel line (between fuel tank and high-pressure pump) or fuel filter is removed or renewed, the fuel system must be bled before the engine is started for the first time.*
- *If the high-pressure pump is removed or renewed, the fuel system must be bled before the engine is started for the first time.*

Procedure for first fuel filling ⇒ page 64



1 - Fuel tank

- ❑ With fuel system pressurisation pump -G6- and fuel pump -G23-
- ❑ Removing and installing ⇒ Rep. gr. 20

2 - Fuel cooler

- ❑ Removing and installing ⇒ Rep. gr. 20

3 - Regulating valve (left-side)

- ❑ For fuel temperature

4 - Fuel temperature sender - G81-

- ❑ Overview ⇒ page 9

5 - High-pressure pump (left-side)

- ❑ Exploded view ⇒ page 48

6 - Rail element (left-side)

- ❑ Exploded view ⇒ page 26

7 - Injector (left-side)

- ❑ Overview ⇒ page 8
- ❑ Exploded view ⇒ page 26

8 - Pressure retention valve (left-side)

- ❑ Exploded view ⇒ page 26

9 - Pressure retention valve (right-side)

- ❑ Exploded view ⇒ page 26

10 - Injector (right-side)

- ❑ Overview ⇒ page 8

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- ❑ Exploded view ⇒ page 26

11 - Rail element (right-side)

- ❑ Exploded view ⇒ page 26

12 - High-pressure pump (right-side)

- ❑ Exploded view ⇒ page 48

13 - Fuel filter

- ❑ Removing and installing ⇒ Rep. gr. 20

14 - Regulating valve (right-side)

- ❑ For fuel temperature

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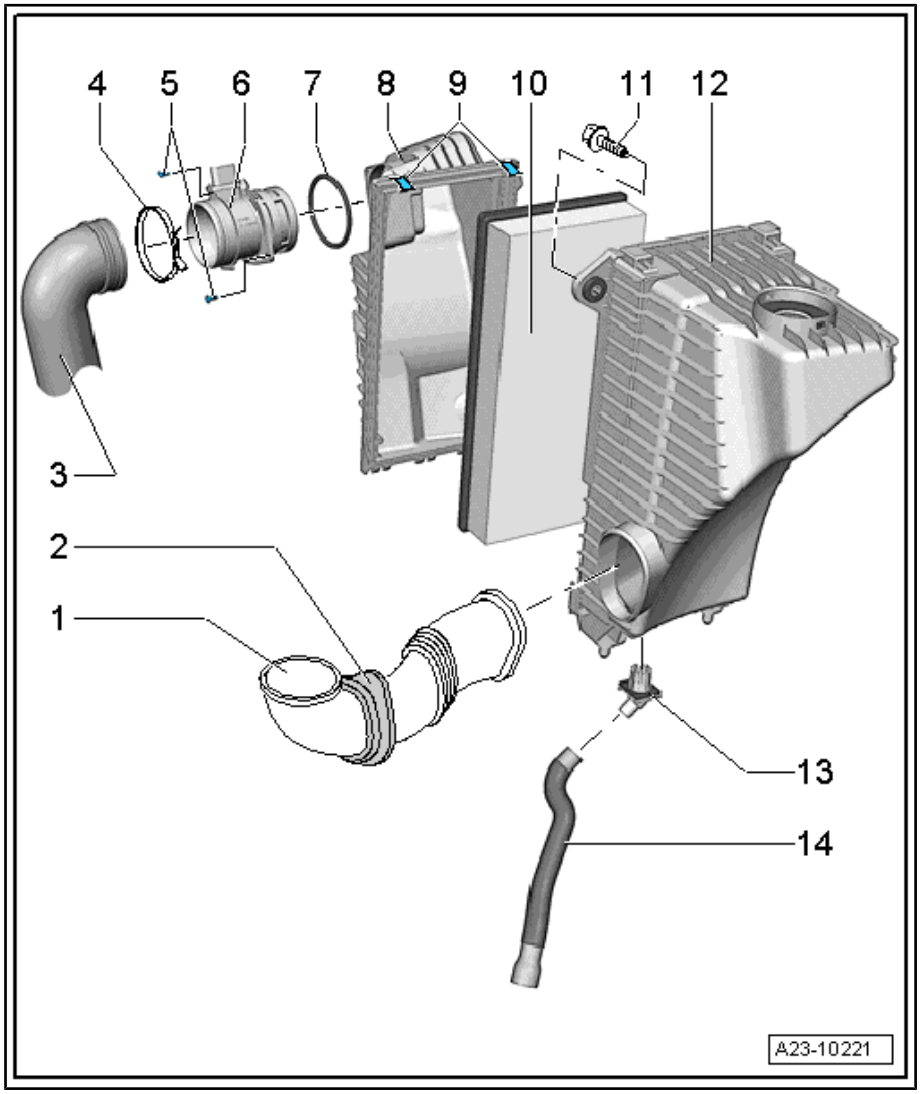
2.3 Air cleaner - exploded view



1 - Air duct

- ❑ To lock carrier
- ❑ Clean out dirt, leaves and salt deposits

2 - Rubber grommet

3 - Air hose

- ❑ To air-mass meter -G70-

4 - Hose clip

5 - Bolt

- ❑ 1.5 Nm

6 - Air mass meter

Cylinder bank 2 (left-side):

- ❑ Air mass meter 2 -G246-
- ❑ Removing and installing ⇒ page 19

Cylinder bank 1 (right-side):

- ❑ Air mass meter -G70-
- ❑ Removing and installing ⇒ page 18

7 - O-ring

- ❑ Renew

8 - Air cleaner housing (top section)

- ❑ Removing and installing: left-side ⇒ page 14 , right-side ⇒ page 15

9 - Retaining clips

- ❑ For securing to air cleaner housing (bottom section)

10 - Air filter element

- ❑ Maintenance intervals ⇒ Maintenance ; Booklet 406
- ❑ Removing and installing: left-side ⇒ page 14 , right-side ⇒ page 15

11 - Bolt

- ❑ 10 Nm

12 - Air cleaner housing (bottom section)

- ❑ Removing and installing ⇒ page 16
- ❑ Clean out dirt, leaves and salt deposits

13 - Guide

- ❑ For water drain hose

14 - Water drain hose

- ❑ Clean out dirt, leaves and salt deposits
- ❑ Must be routed straight downwards without kinks

2.4 Removing and installing engine cover panel

Removing

– Carefully pull engine cover panel off four retaining pins one after the other -arrows- (do not jerk cover panel away, and do not try to pull on one side only).

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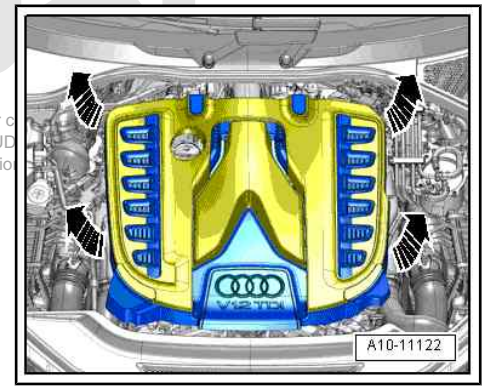
Installing

– To avoid damage, do not strike the engine cover panel with your fist or with any kind of tool.

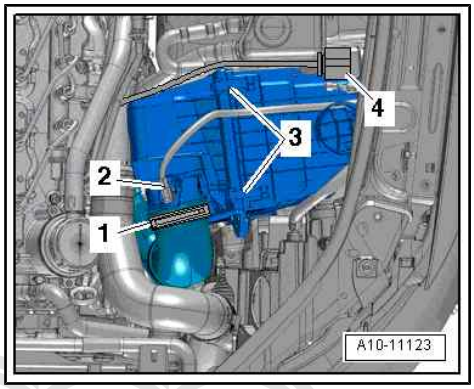
– Position engine cover panel on engine (note locations of oil filler neck and oil dipstick).

– Press engine cover panel with both hands into the rubber grommets at the rear and then into the grommets at the front.



2.5 Removing and installing air filter element (left-side)

Removing



– Remove engine cover panel ⇒ page 13 .
– Unplug electrical connector -4- and move clear.
– Release hose clip -1- and detach air pipe from air cleaner housing (top section).
– Unplug electrical connector -2- from air mass meter 2 -G246- and move wiring clear.
– Release retaining clips -3- and detach top section of air cleaner housing (left-side) from bottom section.
– Take out air filter element.

Installing

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

To ensure the proper function of the air mass meter 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 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.*
- *The air cleaner housing MUST be clean.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *To prevent malfunctions, cover critical parts of the engine air intake (air mass meter, air pipes, etc.) with a clean cloth when blowing out the air cleaner housing with compressed air.*
- *Observe environmental requirements for disposal.*

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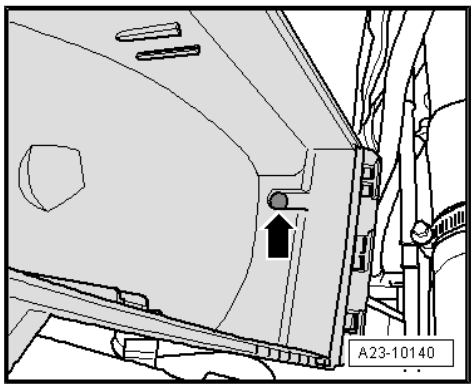
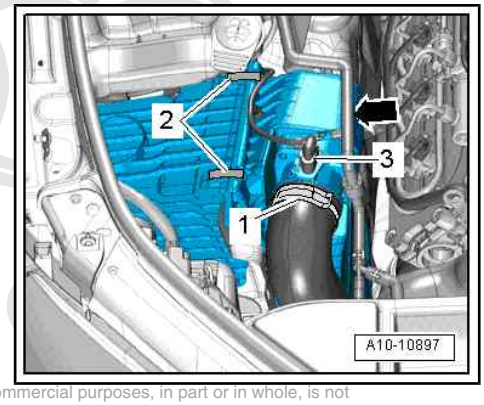


– Blow out water drain -arrow- (small hole in bottom section of air cleaner housing) with compressed air.
– Clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections) using a vacuum cleaner.
– Check for salt residue, dirt and leaves in air mass meter and air intake hose (engine intake side).
– Check for dirt and leaves in air duct going from lock carrier to air cleaner housing.
– When installing the air filter element, check that it is properly centred in the retainer in the air cleaner housing (bottom section).
– Fit the top section of the air cleaner housing carefully on the bottom section, without using force. Take care to keep the top section straight when fitting it over the air filter element and make sure the sealing lip is positioned properly.
– Ensure secure fit of intake hose at air mass meter.

2.6 Removing and installing air filter element (right-side)

Removing



– Remove engine cover panel ⇒ page 13 .

– Unplug electrical connector -3- for air mass meter -G70- and move clear.

– Release hose clip -1- and detach air pipe from air cleaner housing (top section).

– Move clear coolant hose on air cleaner housing -arrow-.

– Release retaining clips -2- and detach top section of air cleaner housing (right-side) from bottom section.

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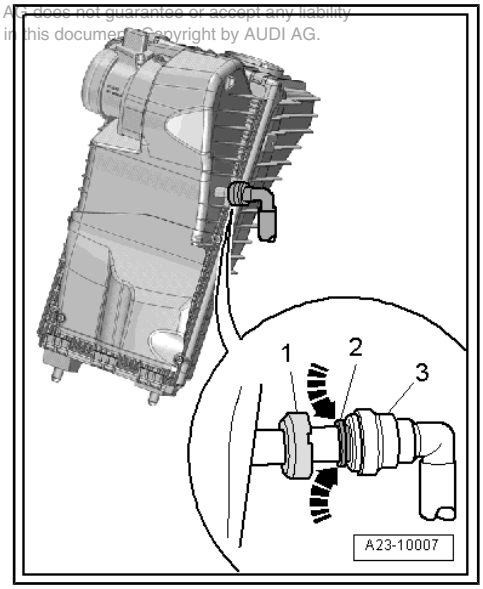


– Push retaining ring -1- forwards off hose connector , press down release ring -2- -arrows- and detach breather hose -3- from air cleaner housing (top section).

– Move clear breather hose for front differential from other breather hose.

– Take out air filter element.

Installing

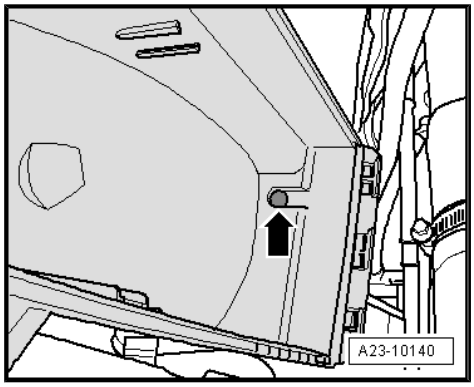
Installation is carried out in the reverse order; note the following:

To ensure the proper function of the air mass meter 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 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.*
- *The air cleaner housing MUST be clean.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *To prevent malfunctions, cover critical parts of the engine air intake (air mass meter, air pipes, etc.) with a clean cloth when blowing out the air cleaner housing with compressed air.*
- *Observe environmental requirements for disposal.*

– Blow out water drain -arrow- (small hole in bottom section of air cleaner housing) with compressed air.
– Clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections) using a vacuum cleaner.
– Check for salt residue, dirt and leaves in air mass meter and air intake hose (engine intake side).
– Check for dirt and leaves in air duct going from lock carrier to air cleaner housing.
– When installing the air filter element, check that it is properly centred in the retainer in the air cleaner housing (bottom section).
– Fit the top section of the air cleaner housing carefully on the bottom section, without using force. Take care to keep the top section straight when fitting it over the air filter element and make sure the sealing lip is positioned properly.
– Ensure secure fit of intake hose at air mass meter.



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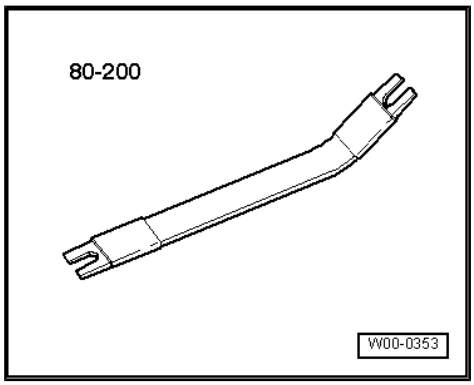
2.7 Removing and installing air cleaner housing

Special tools and workshop equipment required

♦ Removal lever -80 - 200-



♦ Silicone-free lubricant

Removing

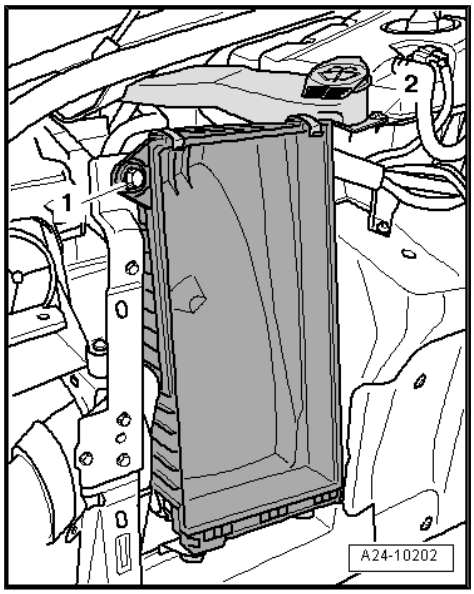
– Remove air filter element: left-side ⇒ page 14 ; right-side ⇒ page 15 .
– Remove relevant wheel housing liner ⇒ Rep. gr. 66 .

Air cleaner housing on right side:

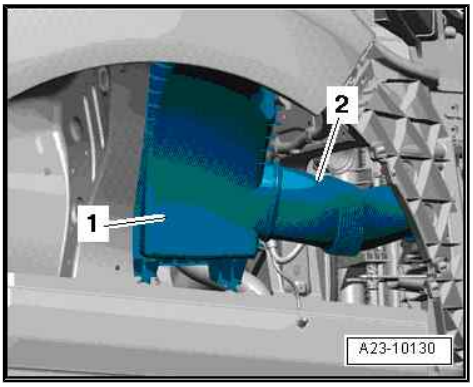
– Unbolt filler neck -2- for windscreen washer fluid reservoir.

Continuation for both sides:

– Remove bolt -1-.
– Move electrical wiring clear.



– Press air duct -2- off air cleaner housing (bottom section) from wheel housing side using removal lever -80 - 200- .



Note

Shown on air cleaner housing (right-side) in illustration.

Installing

- Tightening torque ⇒ page 12 , ⇒ Rep. gr. 92

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

– Apply silicone-free lubricant to connection and press in air duct until it engages, if necessary use removal lever -80 - 200- .

Note

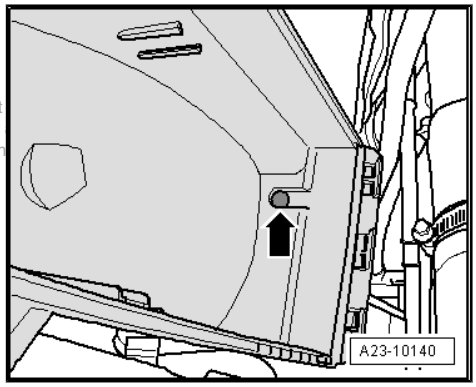
- *The air cleaner housing MUST be clean.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *To prevent malfunctions, cover all critical parts of the engine air intake tract (air mass meter, intake pipes, etc.) with a clean cloth when blowing out the air cleaner housing with compressed air.*

– Check water drain (small aperture in bottom section of air cleaner housing) -arrow- for dirt and other obstructions (clean if necessary).

– Check for dirt in air duct leading to air filter element. If necessary, clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections); wash out or use a vacuum cleaner as required.

– Check for salt residue, dirt and leaves in air mass meter -G70- / -G246- and air hose (engine intake side).

– Install air filter element: left-side ⇒ page 14 ; right-side ⇒ page 15 .



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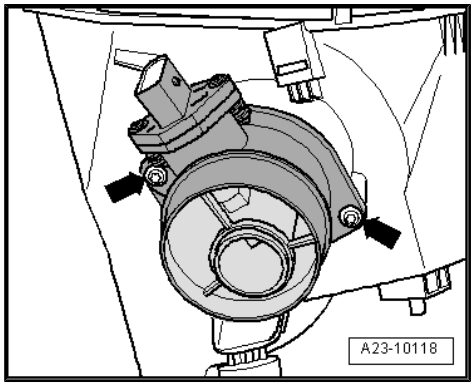
2.8 Removing and installing air mass meter -G70-



Removing

– Detach electrical connector at air mass meter -G70- .

– Release hose clip securing air hose and disconnect hose from air mass meter -G70- .

– Remove bolts -arrows-.

– Carefully pull air mass meter out of guide on air cleaner housing (top section).

Installing

• Tightening torque ⇒ page 12

To ensure the proper function of the air mass meter -G70- it is important to observe the following instructions.

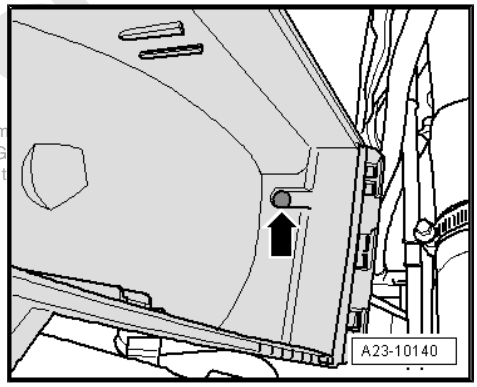
Note

- *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.*
- *Always renew seal if damaged (air leaks in intake system).*
- *Use a silicone-free lubricant when installing the air hose and seal.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Check for salt residue, dirt and leaves in air mass meter and air intake hose (engine intake side).

– Check for dirt in air duct leading to air filter element. If necessary, clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections); wash out or use a vacuum cleaner as required. Removing and installing air cleaner housing ⇒ page 16 .

– If air filter element has been removed, check water drain (small aperture) -arrow- in air cleaner housing (bottom section).



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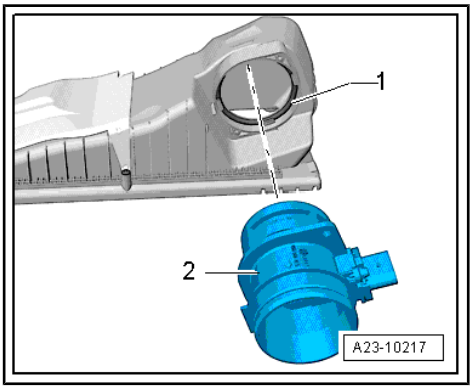
– Align O-ring -1- in groove on air cleaner housing and carefully push air mass meter -G70- -item 2- into air cleaner housing.



2.9 Removing and installing air mass meter 2 -G246-

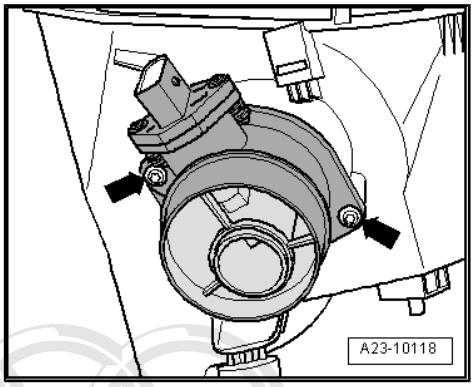
Removing

– Remove air filter element ⇒ page 14 .

– Unplug electrical connector at air mass meter 2 -G246- .

– Remove bolts -arrows-.

– Carefully pull air mass meter out of guide on air cleaner housing (top section).



Installing

• Tightening torque ⇒ page 12

To ensure the proper function of the air mass meter 2 -G246- it is important to observe the following instructions.

Note

♦ *If the air filter element is very dirty or wet, dirt or water could reach the air mass meter 2 -G246- 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.*

♦ *Always renew seal if damaged (air leaks in intake system).*

♦ *Use a silicone-free lubricant when installing the air hose and seal.*

♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Check for salt residue, dirt and leaves in air mass meter and air intake hose (engine intake side).

– Check for dirt in air duct leading to air filter element. If necessary, clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections); wash out or use a vacuum cleaner as required. Removing and installing air cleaner housing ⇒ page 16 .

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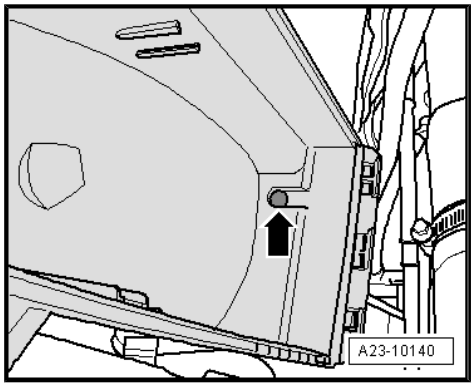
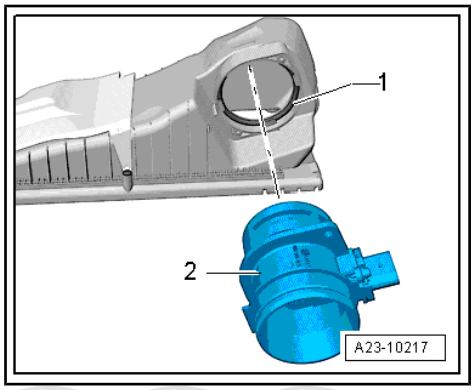
– If air filter element has been removed, check water drain (small aperture) -arrow- in air cleaner housing (bottom section).



– Align O-ring -1- in groove on air cleaner housing and carefully push air mass meter 2 -G246- -item 2- into air cleaner housing.



2.10 Intake manifold - exploded view

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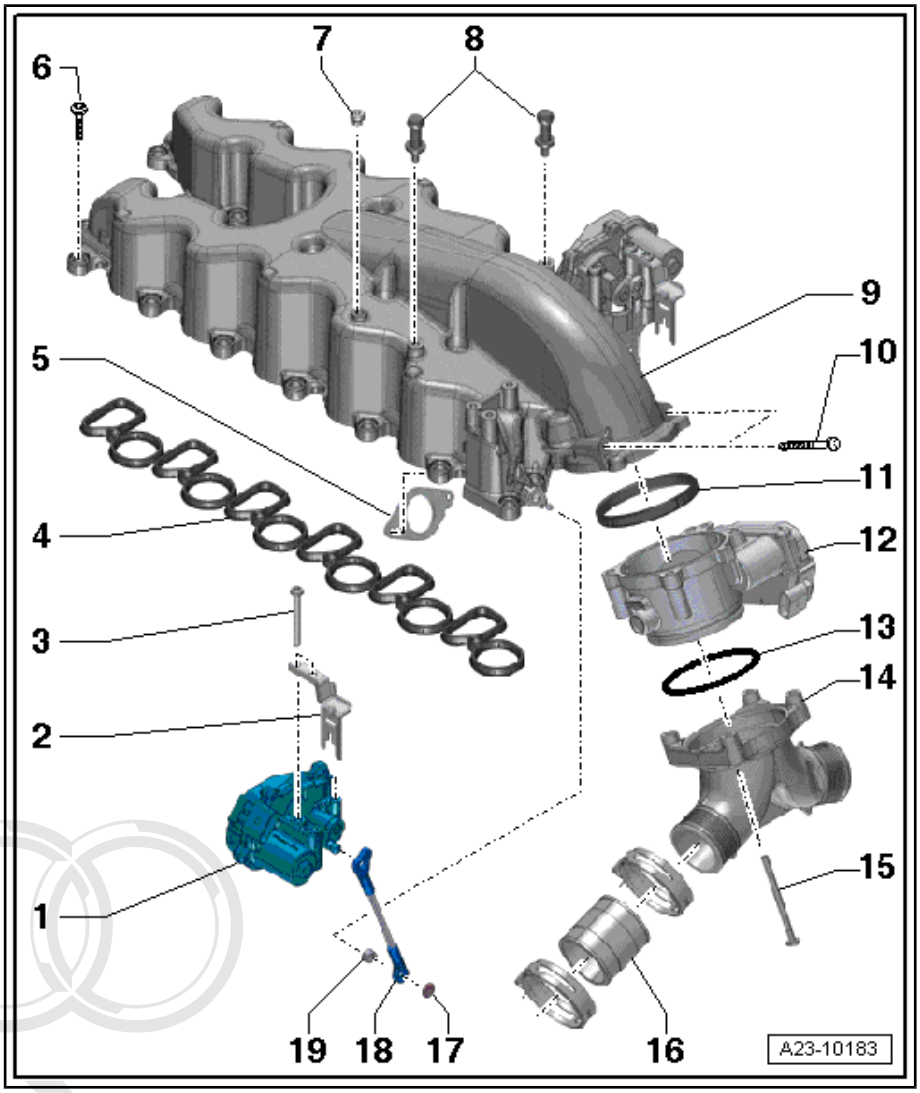

1 - Intake manifold flap motor

- ❑ Left-side: intake manifold flap 2 motor -V275-
- ❑ Right-side: intake manifold flap motor -V157-
- ❑ Removing and installing ⇒ page 24

2 - Bracket

- ❑ Left-side: for exhaust gas recirculation cooler changeover valve 2 - N381-
- ❑ Right-side: for exhaust gas recirculation cooler changeover valve - N345-

3 - Bolt

- ❑ 9 Nm

4 - Gasket

- ❑ Renew

5 - Gasket

- ❑ Renew

6 - Bolt

- ❑ With de-coupling element
- ❑ Tightening torque and sequence ⇒ page 22

7 - Screw plug

- ❑ 8 Nm

8 - Mounting pin for engine cover panel

- ❑ 5 Nm

9 - Intake manifold

- ❑ Removing and installing ⇒ page 22

10 - Bolt

- ❑ Renew
- ❑ 5 Nm + 90°

11 - Seal

- ❑ Renew

12 - Throttle valve module -J338-

- ❑ Removing and installing ⇒ page 25

13 - O-ring

- ❑ Renew

14 - Y-piece

- ❑ Removing and installing ⇒ „2.13 Removing and installing throttle valve module J338 “, page 25

15 - Bolt

- ❑ 9 Nm

16 - Air hose

- ❑ Removing and installing ⇒ Rep. gr. 21

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17 - Clip

- ❑ For ball socket -item 19-

18 - Operating rod

- ❑ For intake manifold flap motor
- ❑ Detaching from intake manifold flap motor ⇒ page 24

19 - Ball socket

- ❑ For operating rod

Intake manifold - tightening torque and sequence

– Tighten bolts for intake manifold in the sequence -1 ... 28- in stages to 10 Nm.

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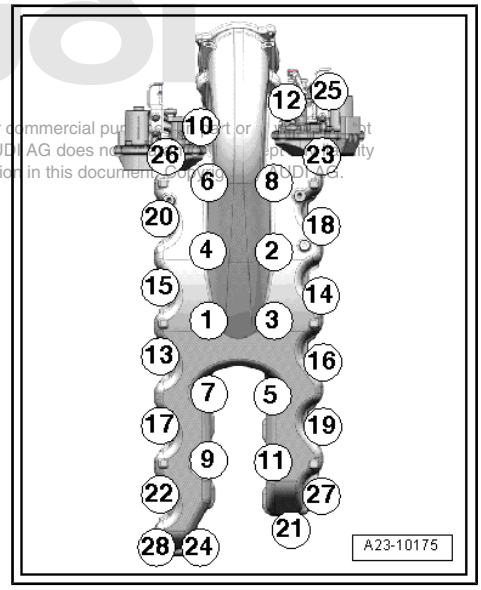


2.11 Removing and installing intake manifold

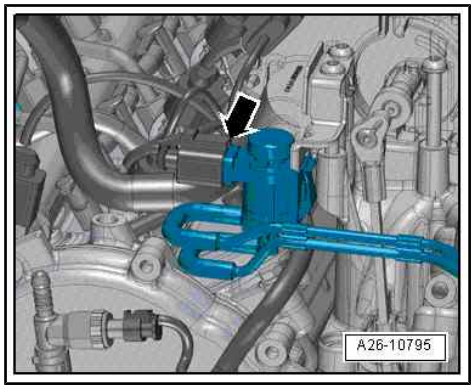
Removing

– Remove engine ⇒ Rep. gr. 10 .

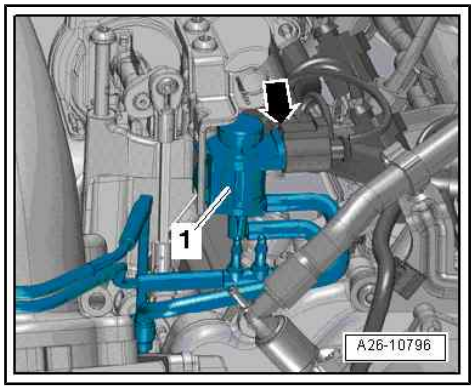
– Unplug electrical connectors on glow plugs.

– Unplug electrical connector -arrow- on exhaust gas recirculation cooler changeover valve 2 -N381- .

– Detach changeover valve from bracket and move it clear to the right.

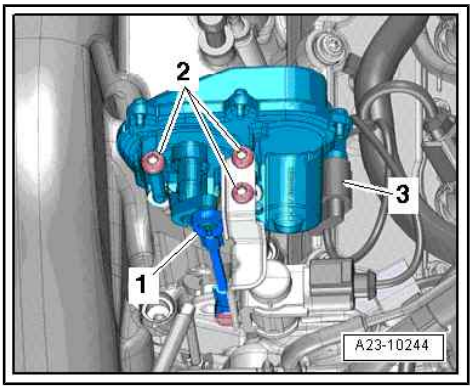


– Unplug electrical connector -arrow-, take exhaust gas recirculation cooler changeover valve -N345- out of bracket and move clear.



– Unplug electrical connector -3-.

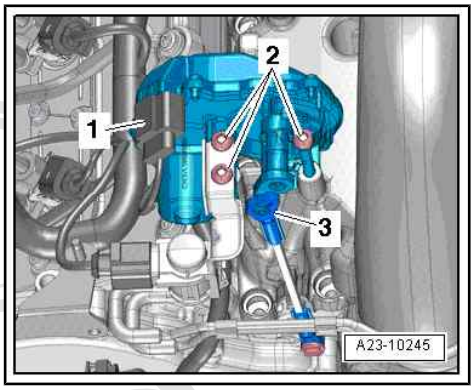
– Remove bolts -2- and press intake manifold flap motor -V157- to side.



Note

Operating rod -1- is not removed.

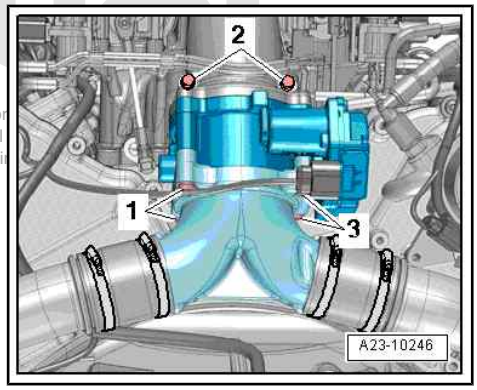
– Unplug electrical connector -1- at intake manifold flap 2 motor -V275- .



Note

Disregard -items 2, 3-.

– Remove bolts -1 ... 3-.



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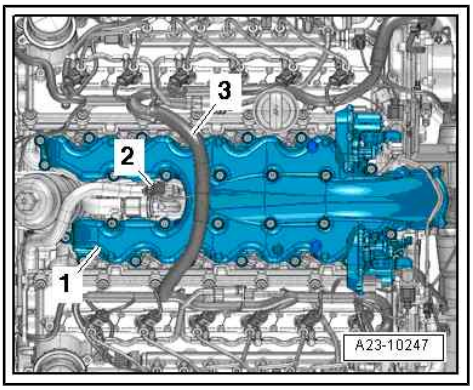
– Unplug electrical connector -2- and move wiring harness -3- at intake manifold -1- clear.

– Remove bolts and detach intake manifold -1- (secure intake manifold flap motor -V157- and throttle valve module -J338-).



Installing

- Tightening torque ⇒ page 20

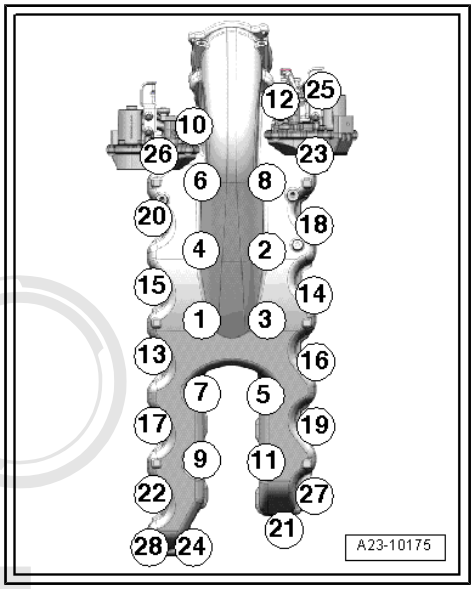
Installation is carried out in the reverse order; note the following:

Note

- ♦ *Renew seals and gaskets.*
- ♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Renew flexible joints if damaged.

– Tighten bolts for intake manifold ⇒ page 22 .
– Install engine ⇒ Rep. gr. 10 .



2.12 Removing and installing intake manifold flap motor -V157- / -V275-

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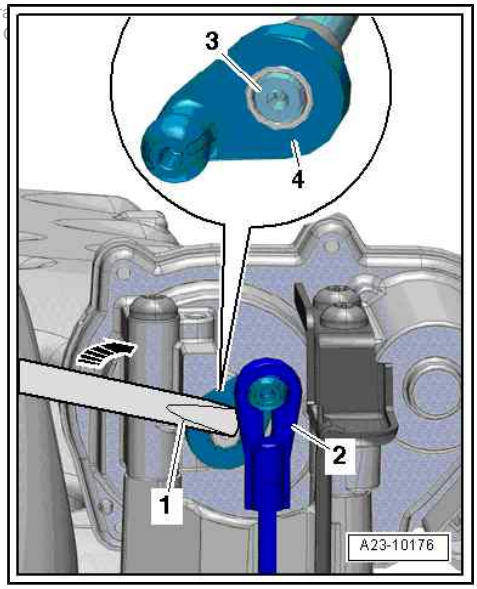
Removing

– Remove engine cover panel ⇒ page 13 .

Caution

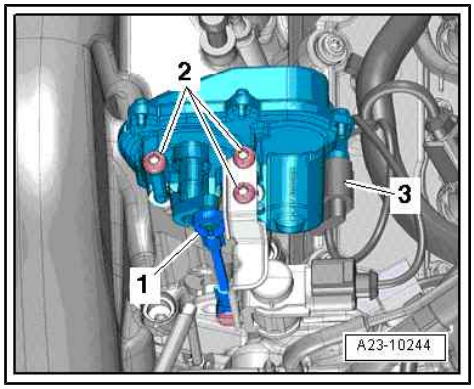
To avoid damage, operating rod must only be removed as described in the following.

– Press operating rod -2- off intake manifold flap motor in direction of -arrow-.
– To do so, position a large screwdriver between operating rod -2- and actuating lever -1- on intake manifold flap motor as shown in illustration.
• The screwdriver must be positioned at the hub -3- of the actuating lever, NOT at the outer section -4-.



Intake manifold flap motor -V157- :

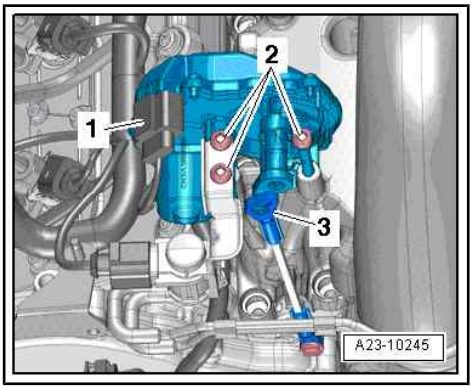
– Unplug electrical connector -3-.
– Remove bolts -2- and detach intake manifold flap motor.



Note

Disregard -item 1-.

Intake manifold flap 2 motor -V275- :



– Unplug electrical connector -1- on intake manifold flap 2 motor.
– Remove bolts -2- and detach intake manifold flap motor.

Note

Disregard -item 3-.

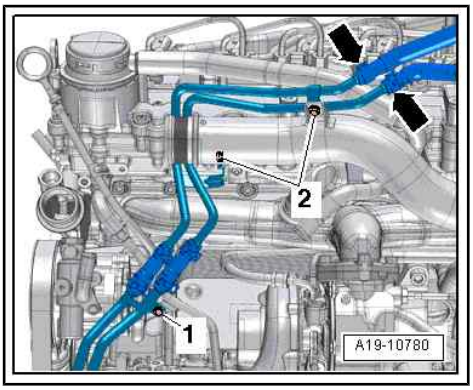
Installing

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

– Carefully press operating rod onto intake manifold flap motor.

2.13 Removing and installing throttle valve module -J338-

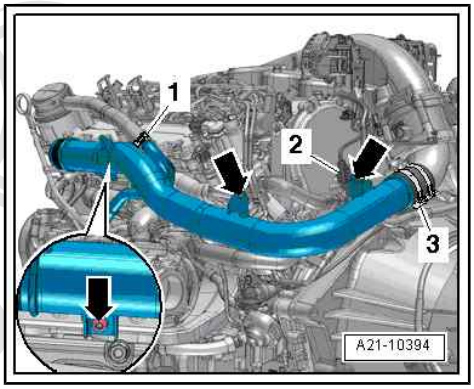
Removing



– Remove engine ⇒ Rep. gr. 10 .
– Remove bolts -2-.

Note

Ignore items marked -1- and -arrows-.



– Detach electrical connector -2- from bracket and unplug.
– Release hose clips -1- and -3-, remove bolts -arrows- and disconnect air pipe.
– Detach air pipe.

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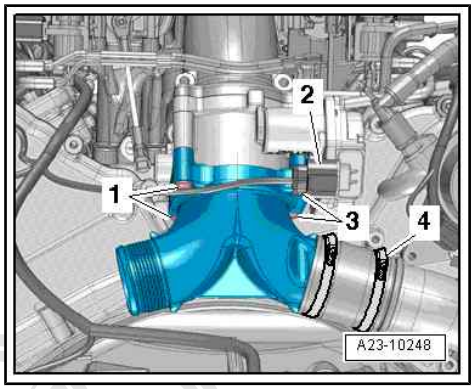
– Unplug electrical connector -2- and move clear -arrow-.
– Loosen hose clip -4-.
– Remove bolts -1- and -3- and take off throttle valve module - J338- with Y-piece.



Installing

- Tightening torque ⇒ page 20

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

Note

- *Renew seals and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install air pipe (left-side) ⇒ Rep. gr. 21 .
– Install engine ⇒ Rep. gr. 10 .

2.14 Injectors, high-pressure pipes, rail element - exploded view

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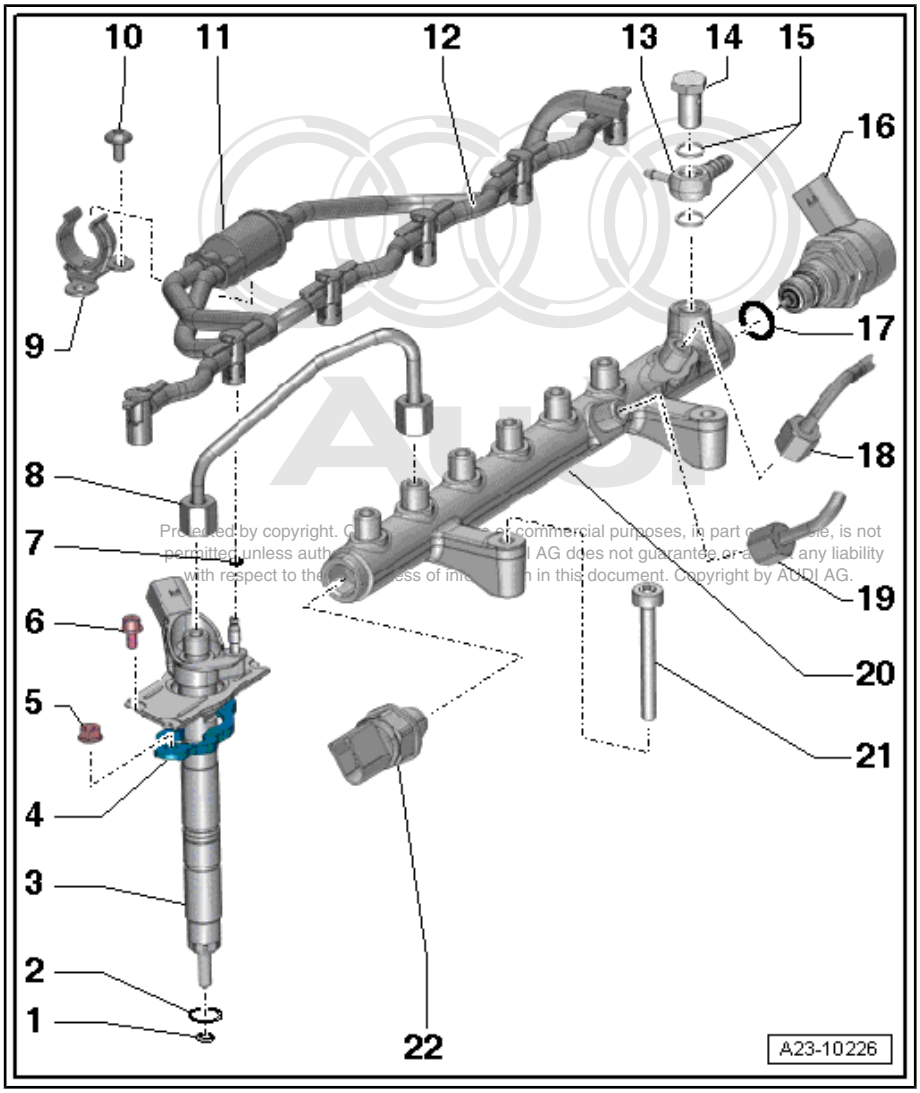
WARNING

- *Always read rules for cleanliness when working on fuel system ⇒ page 1 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

Caution

To prevent the high-pressure fuel 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 the fuel system between the tank and the high-pressure fuel pump are removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed to bleed the fuel system.*
- *If a fuel pump, fuel line or fuel filter are removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed ONCE before the engine is started for the first time.*
- *If the high-pressure fuel pump is removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed THREE TIMES before the engine is started for the first time.*
- *Performing first fuel filling after installing high-pressure pump ⇒ page 64 .*



1 - Copper seal

- ❑ Renew

2 - O-ring

- ❑ Renew

3 - Injector

- ❑ Observe rules for cleanliness ⇒ page 1
- ❑ Mark installation position for re-installation on the following components, pay attention to marking when installing:

- ♦ Injectors
- ♦ High-pressure pipes
- ♦ Clamping pieces
  - ❑ Always renew the following components after removal:
- ♦ Copper seal
- ♦ O-ring for injector bore
- ♦ O-ring for return line
  - ❑ The following components must be renewed when renewing injector:
- ♦ Clamping piece
- ♦ Copper seal
- ♦ O-ring for injector bore
- ♦ O-ring for return line
  - ❑ Removing and installing ⇒ page 37

4 - Clamping piece

- ❑ Mark installation position for re-installation; pay attention to marking when installing
- ❑ The following components must be renewed when renewing injector

5 - Nut

- ❑ 9 Nm

6 - Bolt

- ❑ 5 Nm

7 - O-ring

- ❑ Renew

8 - High-pressure pipe

- ❑ From rail element to injector
- ❑ Observe rules for cleanliness ⇒ page 1
- ❑ Do not alter shape
- ❑ Mark installation position for re-installation; pay attention to marking when installing
- ❑ When re-installing check taper seats visually for damage, scores and corrosion (always renew if damaged)
- ❑ 25 Nm
- ❑ Installing ⇒ page 29

9 - Bracket

- ❑ For pressure retention valve

10 - Bolt

- ❑ 8 Nm

11 - Pressure retention valve

- ❑ In fuel return lines from cylinder banks „1“ and „2“
- ❑ The pressure retention valve maintains a residual pressure of approx. 10 bar in the fuel return lines.
- ❑ This residual pressure is required for the control function of the injector
- ❑ May only be renewed together with fuel return lines
- ❑ After replacement, engine must be run at idling speed for approx. 2 minutes to bleed fuel system

12 - Return line

- ❑ Observe rules for cleanliness ⇒ page 1
- ❑ May only be renewed together with pressure retention valve
- ❑ After replacement, engine must be run at idling speed for approx. 2 minutes to bleed fuel system. Then check fuel return lines for leaks

13 - Connecting piece

14 - Banjo bolt

- ❑ 25 Nm

15 - Seals

- ❑ Renew

16 - Fuel pressure regulating valve

- ❑ Right-side: fuel pressure regulating valve -N276-
- ❑ Left-side: fuel pressure regulating valve 2 -N484-
- ❑ Cannot be reused after removal
- ❑ Removing and installing ⇒ page 45

17 - O-ring

- ❑ Renew

18 - High-pressure pipe

- ❑ From high-pressure pump to rail element
- ❑ Observe rules for cleanliness ⇒ page 1
- ❑ Do not alter shape
- ❑ Mark installation position for re-installation; pay attention to marking when installing
- ❑ When re-installing check taper seats visually for damage, scores and corrosion (always renew if damaged)
- ❑ 25 Nm
- ❑ Installing ⇒ page 29

19 - High-pressure pipe

- ❑ From high-pressure pump to rail element
- ❑ Observe rules for cleanliness ⇒ page 1
- ❑ Do not alter shape
- ❑ Mark installation position for re-installation; pay attention to marking when installing
- ❑ When re-installing check taper seats visually for damage, scores and corrosion (always renew if damaged)
- ❑ 25 Nm
- ❑ Installing ⇒ page 29

20 - Rail element

- ❑ Observe rules for cleanliness ⇒ page 1

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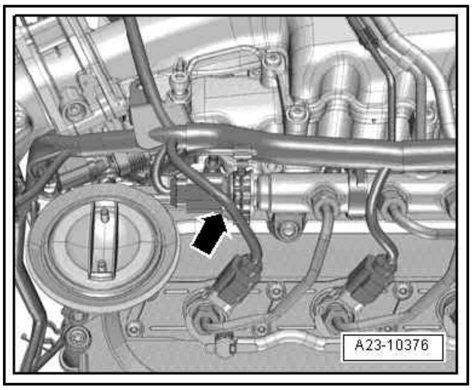
21 - Bolt
- ❑ 22 Nm

22 - Fuel pressure sender
- ❑ Right-side fuel pressure sender -G247-
- ❑ Left-side fuel pressure sender 2 -G624-
- ❑ Removing and installing ⇒ page 43
- ❑ Tightening torque ⇒ page 29



Fuel pressure sender -G247- and fuel pressure sender 2 -G624- - tightening torque

– Tighten fuel pressure sender in 4 stages as follows:

Note

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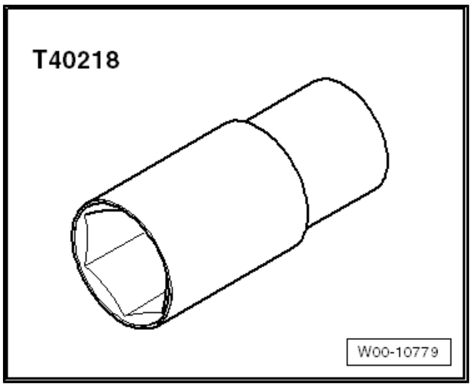
An open-end spanner must not be used for loosening or tightening.



Special tools and workshop equipment required

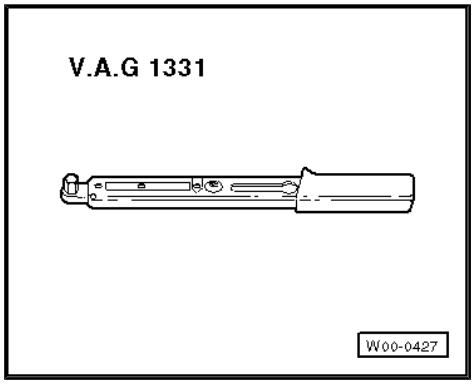
- ♦ Socket, 27 mm -T40218-
- ♦ Torque wrench

Stage	Tightening torque
1.	Screw in by hand until it makes contact
2.	60 Nm
3.	Turn back by 180°
4.	85 Nm

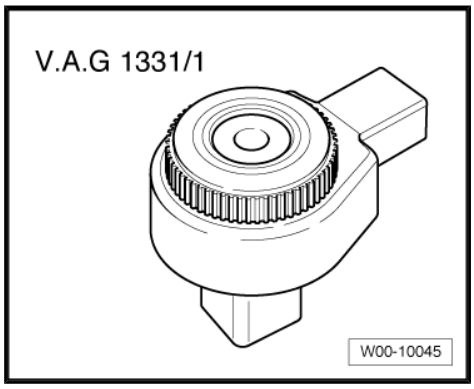
2.15 Installing high-pressure pipes

Special tools and workshop equipment required

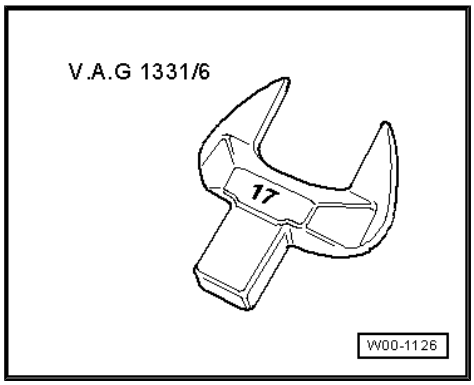
- Torque wrench -V.A.G 1331-



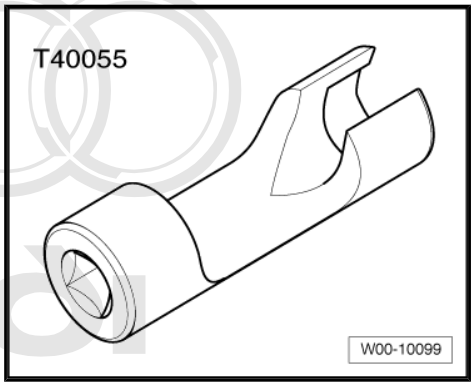
- Ratchet -V.A.G 1331/1-



- Open end spanner insert, AF 17 -V.A.G 1331/6-



- Socket -T40055-



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Procedure

- Tightening torque ⇒ page 26

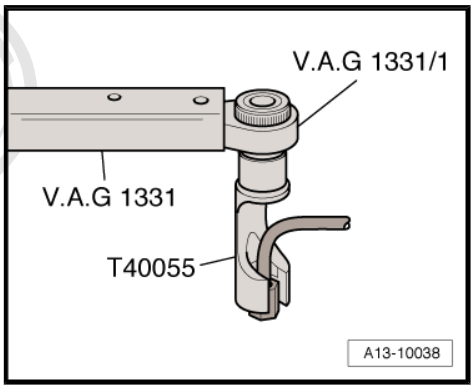
Note

- *Mark installation position for re-installation, pay attention to marking when installing.*
- *Renew high-pressure pipes if:*
- *taper seat of corresponding high-pressure pipe is deformed or has cracks.*
- *bore of pipe is distorted, restricted or damaged in any other way.*
- *high-pressure pipes are corroded.*

– Lubricate threads of union nuts with fuel.

– Hand-tighten union nuts on high-pressure pipes (ensure that pipes are not under tension).

– To secure high-pressure pipes, use torque wrench -V.A.G 1331- with tool insert, AF 17 -V.A.G 1331/6- .



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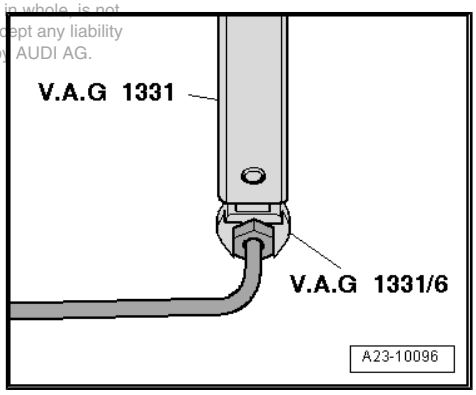
– To tighten unions of high-pressure pipes, use torque wrench -V.A.G 1331- with ratchet -V.A.G 1331/1- and socket -T40055- .

– Check fuel system for leaks ⇒ page 66 .



2.16 Checking injectors

There are three different tests for checking the operation of the injectors.

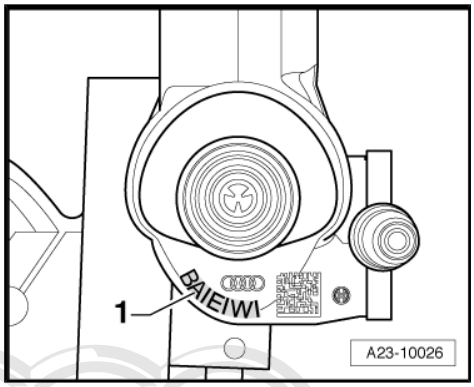
- Checking adaption of „Injector delivery calibration values“ and „Injector voltage calibration values“ ⇒ page 31 .
- Checking return flow rate of injectors with engine running ⇒ page 32
- Checking return flow rate of injectors at starter cranking speed ⇒ page 35

2.17 Adaption of injector delivery calibration values and injector voltage calibration values

The „Injector delivery calibration“ and „Injector voltage calibration“ functions serve to correct the injection rates for each cylinder of

a common rail system individually across the entire operating range.

The 7-digit adaption values -1- (details in illustration are only an example) are marked separately on each injector. They may consist of letters and/or numbers (ASCII code).



Reference table for reading out letters and/or numbers on each injector

When a new injector is installed, the adaption value for the new injector must be written into the engine control unit.

When the engine control unit is renewed, the appropriate „injector delivery calibration“ values with „injector voltage calibration“ values must be written into the new control unit.

The adaption procedure is described in the Guided Fault Finding. (The procedure is also described under Guided Functions.) Use ⇒ Vehicle diagnostic tester.

Additionally, check that the „injector delivery calibration values“ with „injector voltage calibration values“ are correctly entered for all the other injectors. Do NOT attempt to re-enter these calibration values if the correct values are already stored in the engine control unit.

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2.18 Checking return flow rate of injectors with engine running

Checking return flow rate of all injectors

Note

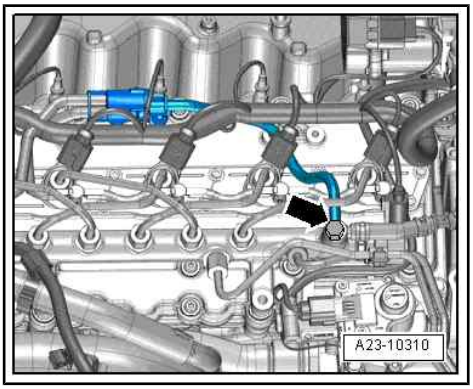
An individual test each is performed for cylinder bank 1 (right-side) and for cylinder bank 2 (left-side).

WARNING

- ***Always read rules for cleanliness and instructions for working on fuel system ⇒ page 1 .***
- ***Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.***

– Remove engine cover panel ⇒ page 13 .

– Detach hose connection from pressure retention valve -arrow- at banjo bolt connection.



– Seal off the open return connection with a plug -3-.

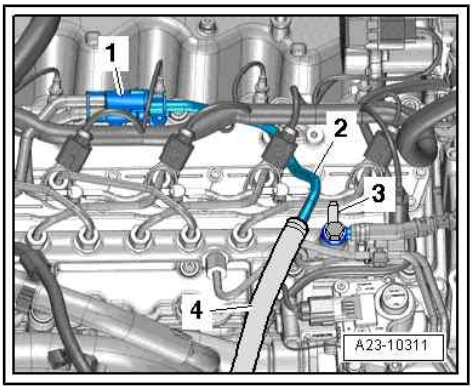
– Hold end of hose -2- detached from pressure retention valve -1- (lengthen with hose -4- if necessary) in a suitable container to measure total return flow rate.

– Start engine and let it idle for 2 minutes.

• Specification for 2 minutes: 0 ml to 50 ml

– If specification is attained, increase engine speed to 2000 ... 2500 rpm for approx. 2 minutes and then check return flow rate again.

• Specification for 2 minutes: less than 250 ml



Note

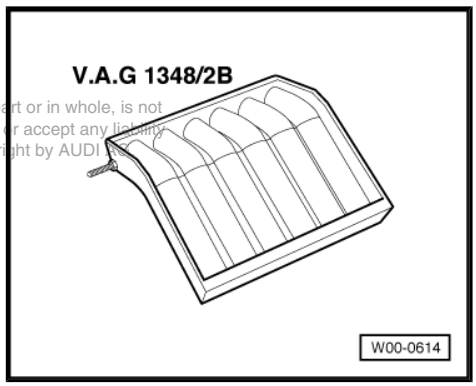
1000 ml = 1 litre

If specification is exceeded, this indicates that one or more injectors are defective. Check return flow rate from each injector individually.

Checking return flow rate of individual injectors

Special tools and workshop equipment required

♦ Injection rate comparison meter -V.A.G 1348/2B-



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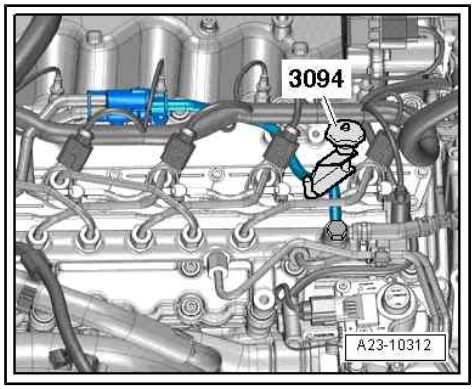
♦ 6 lengths of hose (made up in the workshop) to fit return line connections on injectors

Each injector normally has a relatively low return flow rate. If the return flow rate at one injector is relatively high compared to the other injectors, that injector is probably defective.

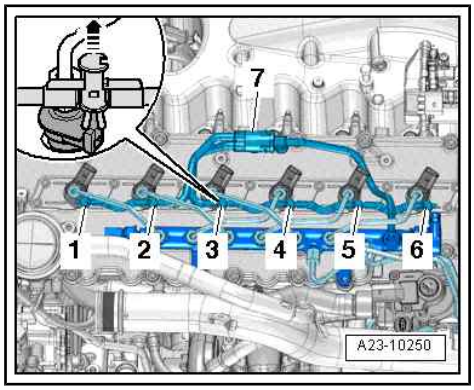
– Clean all return line connections (with commercial cleaning solution etc.) before removing.

– Dry all components after cleaning.

– Clamp off fuel return line downstream of pressure retention valve using hose clamps up to 25 mm -3094- .



– Pull return line connections off injectors -1 ... 6-; to do so, press both tabs down and at the same time pull centre piece up to release connection -arrow-.



Note

- *No dirt must be allowed to get into the disconnected return lines or the open connections on the injectors.*
- *Disregard -item 7-.*

– Connect hoses onto return line connections of all 6 injectors.

– Run the 6 hoses into injection rate comparison meter -V.A.G 1348/2B- .

– Start engine and let it idle for several minutes.

Caution

Do NOT press the accelerator during this test; the engine must only run at idling speed.

Running the engine at higher speeds with the return lines disconnected will cause damage to the injectors.

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– When the engine is warm and running at idling speed the return flow rates at each of the 6 return lines must not differ by more than a small amount.

– If one injector has a significantly higher return flow rate than the others it must be renewed ⇒ page 37 .

Installing fuel return lines

– Renew O-rings at all return line connections.

Note

Lubricate all seals with engine oil or assembly oil before installing.

Lubricate all seals with engine oil or assembly oil before installing.

– Push the return line connections carefully over the new seals and onto the injectors. The catch should engage audibly. Then press release pin down carefully.

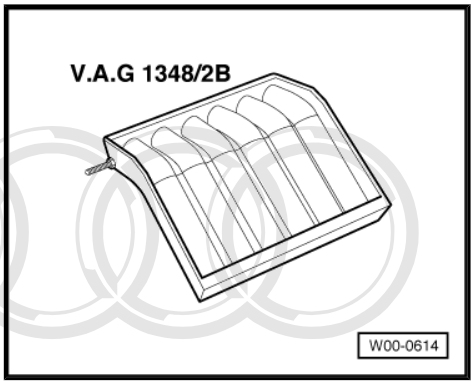
– Check fuel system for leaks ⇒ page 66 .

2.19 Checking return flow rate of injectors at starter cranking speed

If it is not possible to start engine, check return flow rate of injectors at starter cranking speed.

Special tools and workshop equipment required

- Injection rate comparison meter -V.A.G 1348/2B-



- 6 lengths of hose (made up in the workshop) to fit return line connections on injectors

Procedure

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Note

An individual test each is performed for cylinder bank 1 (right-side) and for cylinder bank 2 (left-side).

WARNING

- ***Always read rules for cleanliness and instructions for working on fuel system ⇒ page 1 .***
- ***Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.***

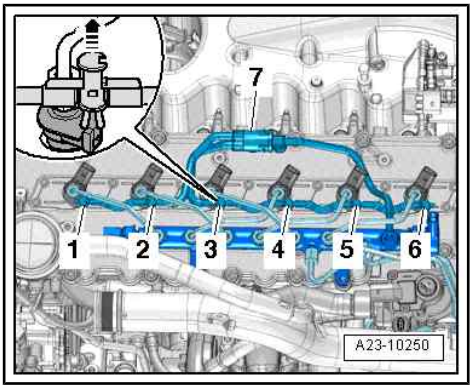
Each injector normally has a relatively low return flow rate. If the return flow rate at one injector is relatively high compared to the other injectors, that injector is probably defective.

– Remove engine cover panel ⇒ page 13 .

– Clean all return line connections (with commercial cleaning solution etc.) before removing.

– Dry all components after cleaning.

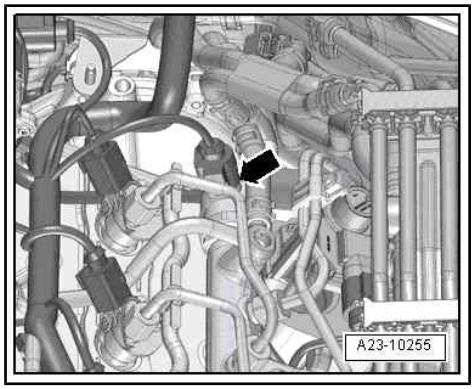
– Pull return line connections off injectors -1 ... 6-; to do so, press both tabs down and at the same time pull centre piece up to release connection -arrow-.



Note

- *No dirt must be allowed to get into the disconnected return lines or the open connections on the injectors.*
- *Disregard -item 7-.*

– Unplug electrical connector -arrow- on fuel pressure regulating valve -N276- (cylinder bank 1) and on fuel pressure regulating valve 2 -N484- (cylinder bank 2).



Note

This prevents fuel from being injected when operating starter.

– Connect 6 hoses onto return line connections of all 6 injectors.
– Run the 6 hoses into injection rate comparison meter -V.A.G 1348/2B- .
– Operate starter three times. (Wait approx. 20 seconds each time after operating starter to prevent it from overheating.)
• Specification of return flow rate: 0 ml
– If fuel comes out of one injector, that injector must be renewed.
– Re-attach electrical connector on fuel pressure regulating valve -N276- .

Installing fuel return lines

– Renew O-rings at all return line connections.

Note

Lubricate all seals with engine oil or assembly oil before installing.

– Push the return line connections carefully over the new seals and onto the injectors. The catch should engage audibly. Then press release pin down carefully.
– Erase entry in event memory using a diagnostic tester.
– Check fuel system for leaks ⇒ page 66 .

2.20 Checking pressure retention valve in fuel return line

The pressure retention valve maintains a residual pressure of approx. 10 bar in the return lines.

This residual pressure is required for the control function of the piezo injectors.

Special tools and workshop equipment required

♦ Tester for fuel return system -VAS 6330-

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Procedure

Note

An individual test each is performed for cylinder bank 1 (right-side) and for cylinder bank 2 (left-side).

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 1 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

– Remove engine cover panel ⇒ page 13 .

– Clean return line connection on cylinder 1 (with commercial cleaning solution etc.) before removing.

– Dry return line connection on cylinder 1.

– Cover return line connection on cylinder 1 with a cloth.

– Pull return line connection off 1st cylinder; to do so, press both tabs down and at the same time pull centre piece up to release connection.

– Pull return line connection off injector -1- of first cylinder; to do so, press both tabs down and at the same time pull centre piece up to release connection -arrow-.

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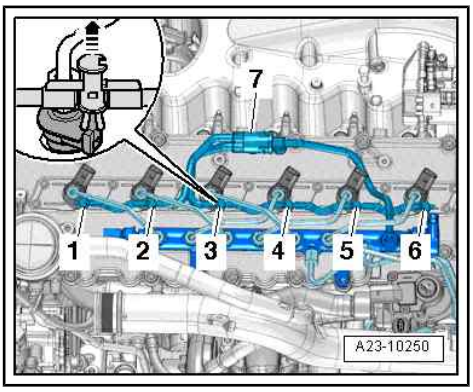


Note

- *No dirt must be allowed to get into the disconnected return lines or the open connections on the injectors.*
- *Disregard items marked -2 ... 7-.*

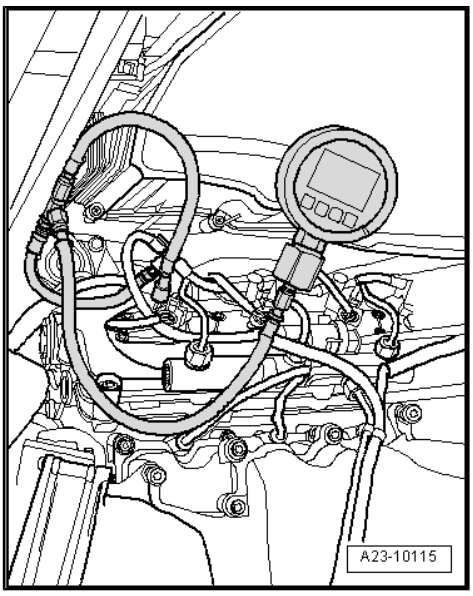
– Connect tester for fuel return system -VAS 6330- to return line connection of injector and to return line.

– Start engine.

– Check pressure indicated on tester.

• Specification: approx. 10 bar

If the value does not match the specification, fit a new pressure retention valve.



Installing fuel return lines

– Renew O-ring at return line connection.

Note

Lubricate all seals with engine oil or assembly oil before installing.

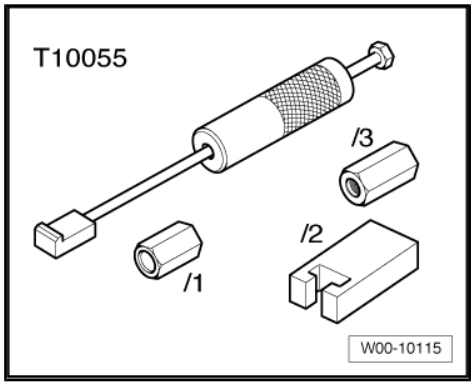
– Push the return line connection carefully over the new seal and onto the injector. The catch should engage audibly. Then press release pin down carefully.

– Erase entry in event memory using a diagnostic tester.

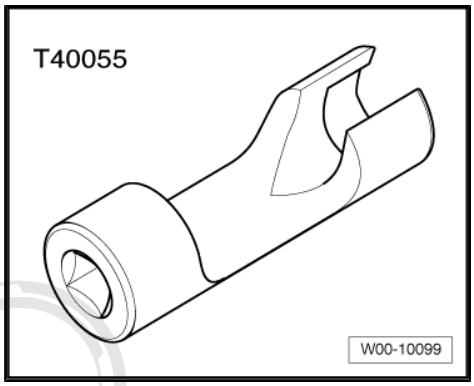
2.21 Removing and installing injectors

Special tools and workshop equipment required

- Puller -T10055- with adapter -T10055/1-



- Socket, 17 mm -T40055-



Removing

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 1 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

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Note

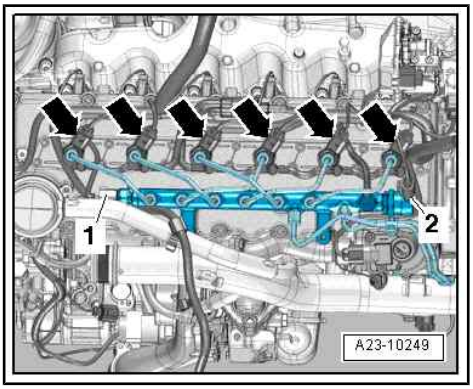
- *Fit all cable ties in the original positions when installing.*
- *The following description is for installing on cylinder head (left-side).*

– Remove engine cover panel ⇒ page 13 .

Caution

- *Mark cylinder numbers on injector units. They must always be re-installed on the same cylinders.*
- *Observe rules for cleanliness when working on the injection system.*
- *Plug open connections with suitable sealing caps immediately.*

– Unplug electrical connectors at rail element -1- and -2- and at injectors -arrows-.
– Move electrical wiring harness on cylinder head cover clear.

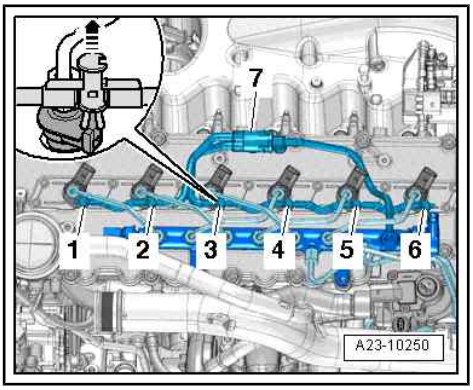


– Pull release pin upwards -arrow- and pull return line connections -1 … 6- off injectors.

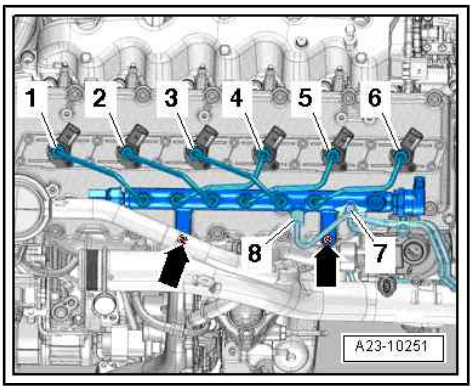
Note

No dirt must be allowed to get into the disconnected return lines or the open connections on the injectors.

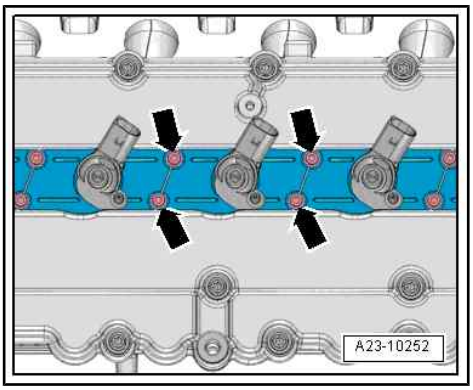
– Detach non-return valve -7- from bracket and move clear to side.



– Slacken union nuts for high-pressure pipes -1 ... 6- using socket, 17 mm -T40055- .
– Slacken union nut for high-pressure pipes -7- and -8- on rail element.
– Remove bolts -arrows-.
– Detach rail element and move clear to side.



– Remove bolts -arrows- for cover plates for injectors.
– Pull cover plates upwards and turn through 90°.



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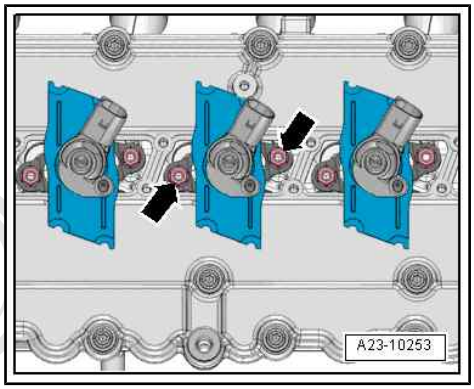
– Remove nuts -arrows- for injectors.



Caution

Used injectors must always be re-installed on the same cylinder.

- *Identify cylinder numbers on corresponding injectors.*

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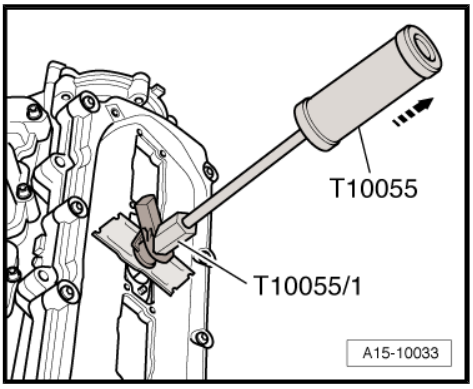
– Pull out injectors using puller -T10055- with adapter -T10055/1- .



Installing

- Tightening torques ⇒ page 26

Note

Renew seals and O-rings.

Important instructions for installing injectors:

- When removing and installing, always renew the following components and seals/O-rings: „copper seal“, „O-ring for injector bore“, „O-ring for injector return connection“.
- The following components and seals/O-rings must always be renewed when an injector is renewed: „clamping piece“, „copper seal“, „O-ring for injector bore“, „O-ring for injector return connection“
- Lubricate all O-rings with engine oil or assembly oil before installing.

Note

- *Note identification marks for cylinder allocation when re-installing high-pressure pipes.*
- *The high-pressure pipes can be re-used after performing the following checks:*
- *Check taper seats of high-pressure pipes for deformation and cracks.*
- *The bore of the pipe must not be distorted, restricted or otherwise damaged.*
- *Corroded pipes must not be used again.*

If a used injector is being re-installed:

– Spray tip of injector nozzle with rust-releasing spray. Wait approx. 5 minutes and wipe off soot particles and oil with a cloth.

– If an injector is very dirty, the tip of the nozzle should also be cleaned with a soft brass wire brush to make it easier to remove the copper seal. Do not apply the wire brush to the bores in the nozzle.

– To remove the old copper seal from the injector, clamp the seal carefully in a vice so that it is just held between the jaws without turning. Then carefully pull and twist the injector out of the copper seal by hand.

– Clean off deposits under the copper seal using a suitable scraper.

– Use a plastic bush to fit the new copper seal.

– Renew O-rings at all return line connections.

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Note

Lubricate all seals with engine oil or assembly oil before installing.

Caution

To remove carbon deposits from the injector sealing surface, clean the injector seat in the cylinder head with a cloth soaked in engine oil or rust solvent. Take care not to damage the sealing surface.

– Install injectors.
– Install high-pressure pipes ⇒ page 29 .
– Press return line connections carefully over the seals and onto the injector units (check seal for damage before connecting return line). The catch should engage audibly. Then press release pin down carefully.

After replacement of one or more injectors, the „injector delivery calibration values“ and „injector voltage calibration values“ for the new injectors must be written into the engine control unit ⇒ page 31 .

Additionally, check that the „injector delivery calibration values“ and „injector voltage calibration values“ are correctly entered for all the other injectors. Do NOT attempt to re-enter these calibration values if the correct values are already stored in the engine control unit.

Bleeding fuel system and checking for leaks

Note

The fuel system is self-bleeding; do not open the high-pressure connections.

– Run engine at idling speed for several minutes and then switch off.
– Switch off ignition.
– Check the complete fuel system including all 6 return line connections for leaks.

Renew the affected component if leakage still occurs after tightening to the correct torque.

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Note

The return lines can only be renewed together with the pressure retention valve as one unit.

– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

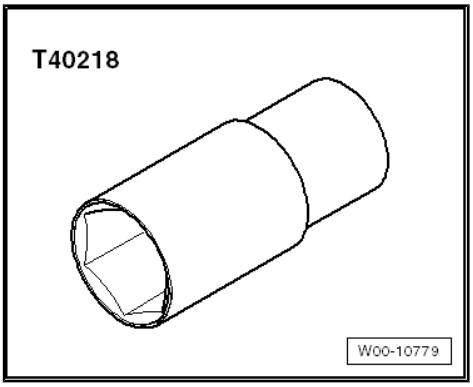
Note

If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and erase the content of the event memory. Then continue the road test.

2.22 Removing and installing fuel pressure sender -G247- / -G624-

Special tools and workshop equipment required

- Socket, 27 mm -T40218-



- Torque wrench

The fuel pressure sender -G247- is located in the right rail element (cylinder bank 1) and the fuel pressure sender 2 -G624- is located in the left rail element (cylinder bank 2).

The fuel pressure sender continuously measures the fuel pressure in the high-pressure system. It transmits a voltage signal to the corresponding engine control unit.

Should the sender fail, the engine control unit will control the fuel pressure via a mapped open-loop backup function, allowing a maximum of approx. 3000 rpm.

Caution

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 1 .*
- *Follow these instructions before starting work and while working on the fuel system.*

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Removing

– Remove engine cover panel ⇒ page 13 .

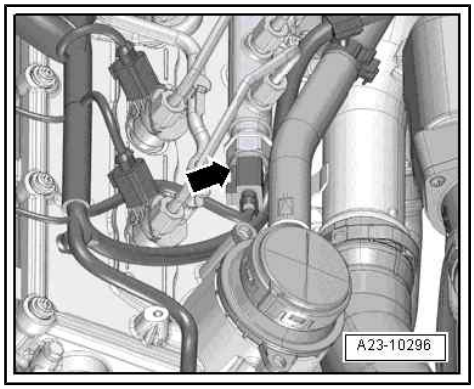
– Before removal, clean area around thread for fuel pressure sender using commercial cleaning solution etc. (no dirt must enter the opening in the rail element).

Note

Clean carefully; cleaning solution must not enter the electrical connector.

– The fuel pressure sender must be dry.

– Unplug electrical connector at fuel pressure sender.
– Unscrew fuel pressure sender -G247- using socket, 27 mm - T40218- .



Note

An open-end spanner must not be used for loosening or tightening.

– Extract dirt from opening in rail (threads and sealing surface). Do not use metal tools, etc.
– Seal off open fuel rail connection with clean plug.

Installing

Note

- *Check that sealing surfaces (deformable sealing lip) and threads on fuel pressure sender -G247- are not damaged. If inspection of fuel pressure sender -G247- shows that it is OK, it can be used again.*
- *Check that the deformable sealing lip and the thread on the new fuel pressure sender -G247- are not damaged.*
- *Check sealing surface at opening in fuel rail.*
- *The beginning of the thread and the deformable sealing lip of the fuel pressure sender -G247- must be coated with diesel fuel.*

– Secure fuel pressure sender in 4 stages as follows:

Note

An open-end spanner must not be used for loosening or tightening.

– Secure fuel pressure sender -G247- using socket, 27 mm - T40218- .

1. Hand-tighten
2. Tighten to 60 Nm.
3. Turn back by 180°
4. Final torque: 85 Nm

– Bleed fuel system ⇒ page 64 .
– Check for leaks in fuel system ⇒ page 66 .
– After installation, run engine at moderate speed for several minutes and then switch off.

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Note

The fuel system is self-bleeding; do NOT open the high-pressure connections.

– Faults are stored in engine control unit because electrical connectors were unplugged: „Interrogate event memory“ in „Vehicle self-diagnosis“ ⇒ Vehicle diagnostic tester.

– Carefully check the entire fuel system for leaks.
– If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

Note

If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and erase the content of the event memory. Then continue the road test.

– After road test interrogate event memory once again.

2.23 Removing and installing fuel pressure regulating valve -N276- / -N484-

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The fuel pressure regulating valve -N276- is located in the right rail element (cylinder bank 1) and the fuel pressure regulating valve 2 -N484- is located in the left rail element (cylinder bank 2).

The fuel pressure regulating valve maintains a constant pressure in the rail element and the high-pressure pipes (high-pressure fuel circuit).

It is not possible to start the engine if the fuel pressure regulating valve is defective.

If the pressure in the high-pressure fuel circuit is too high, the regulating valve opens to allow some of the fuel to flow back from the rail element to the fuel tank via a return line.

If the pressure in the high-pressure fuel circuit is too low, the valve closes and seals off the high-pressure section of the system from the low-pressure section.

Do not renew the fuel pressure regulating valve without checking the operation of valve.

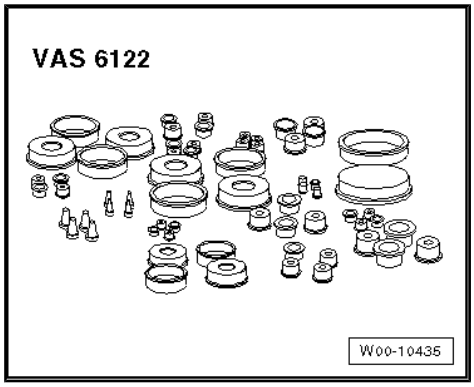
Caution

Always read rules for cleanliness when working on fuel system ***⇒ page 1*** ***.***

Follow these instructions before starting work and while working on the fuel system.

Special tools and workshop equipment required

♦ Engine bung set -VAS 6122-



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Removing

– Remove engine cover panel ⇒ page 13 .

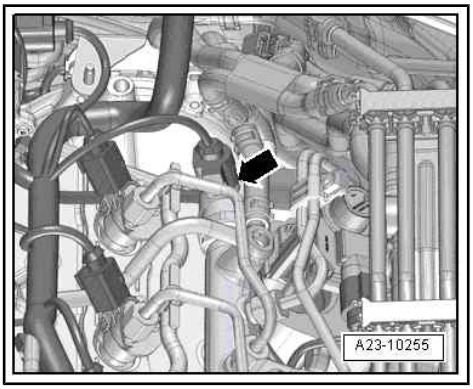
– Before removal, clean area around thread for fuel pressure regulating valve using commercial cleaning solution etc. (no dirt must enter the opening in the rail element).

Note

Clean carefully; cleaning solution must not enter the electrical connector.

– Unscrew banjo bolt for fuel return lines.

– Dry off fuel pressure regulating valve.



– Unplug electrical connector -arrow- at fuel pressure regulating valve.
– Slacken union nut (counterhold at hexagon flats on housing). Then remove by hand.
– Extract dirt from opening in rail (threads and sealing surface). Do not use metal tools, etc.
– Seal off opening in rail element immediately with a clean plug from engine bung set -VAS 6122- to prevent dirt from entering.

Installing

Note

- *The fuel pressure regulating valve has a deformable sealing lip instead of a separate seal; it can therefore be used only once.*
- *Check that sealing surfaces (deformable sealing lip) and thread on new fuel pressure regulating valve are not damaged.*
- *Check sealing surface at opening in rail.*
- *Apply Molykote grease to thread on fuel pressure regulating valve ⇒ Electronic parts catalogue .*

– Screw on union nut by hand.
– Align regulating valve so that connecting wire is free of tension after connector is attached.
– Tighten union nut on regulating valve in 3 stages as follows:

1. Tighten to 60 Nm (counterhold at hexagon flats on housing).
2. Then loosen union nut 90° ($^1/_4$ turn; counterhold at hexagon flats on housing).
3. Tighten to 80 Nm (counterhold at hexagon flats on housing).

– Tighten banjo bolt with new seals.
– Check for leaks in fuel system ⇒ page 66 .
– After installation, run engine at moderate speed for several minutes and then switch off.

Note

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The fuel system is self-bleeding; do NOT open the high-pressure connections.

– Carefully check the entire fuel system for leaks.
– If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

Note

If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and erase the content of the event memory. Then continue the road test.

– After road test interrogate event memory once again.

2.24 High-pressure pump - exploded view

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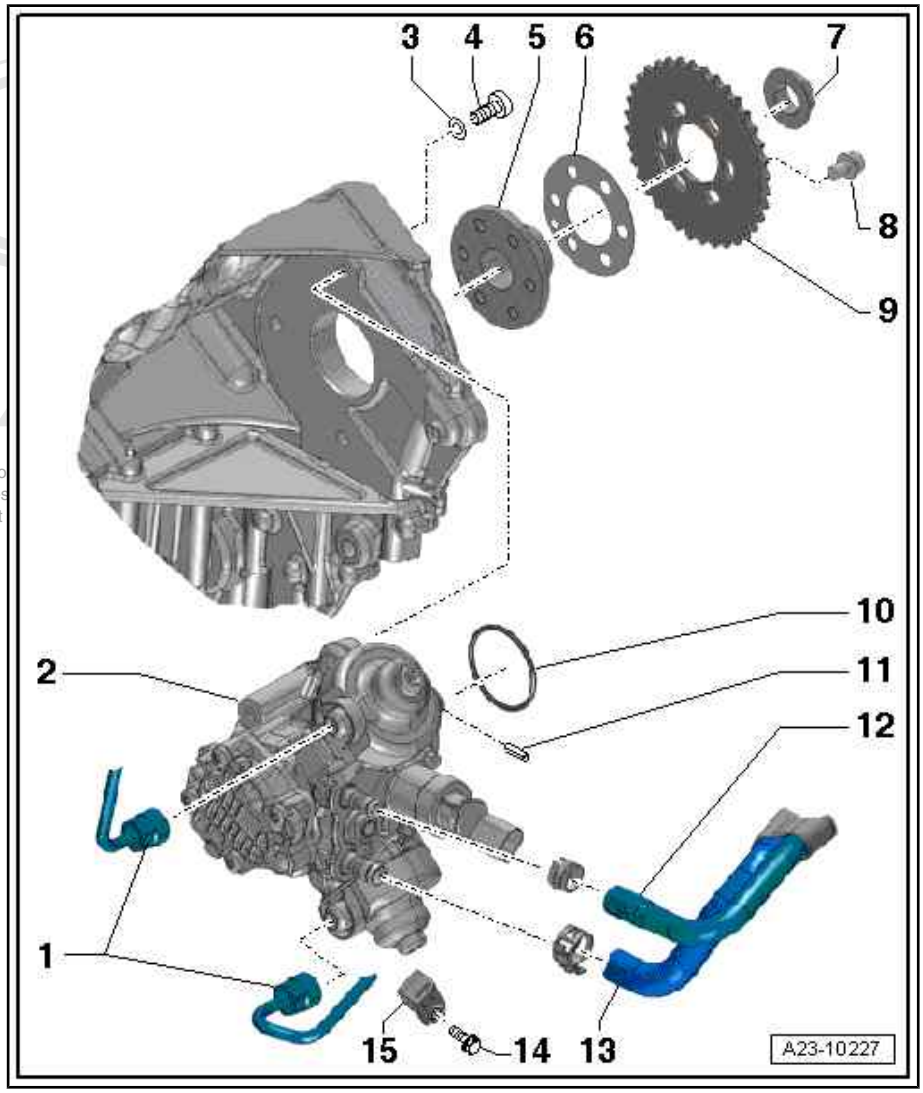
Caution

To prevent the high-pressure fuel 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 the fuel system between the tank and the high-pressure fuel pump are removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed to bleed the fuel system.***
- ***If a fuel pump, fuel line or fuel filter are removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed ONCE before the engine is started for the first time.***
- ***If the high-pressure fuel pump is removed or renewed, the basic setting „Checking fuel system pressurisation pump“ must be performed THREE TIMES before the engine is started for the first time.***
- ***Performing first fuel filling after installing high-pressure pump*** ⇒ page 64 .



1 - High-pressure pipe

- ❑ Observe rules for cleanliness ⇒ page 1
- ❑ Do not alter shape
- ❑ Mark installation position for re-installation; pay attention to marking when installing
- ❑ When re-installing check taper seats visually for damage, scores and corrosion (always renew if damaged)
- ❑ Installing ⇒ page 29

2 - High-pressure pump

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Caution

Observe rules for cleanliness when working on the injection system ⇒ page 1 .

The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty.

- ❑ Removing and installing: left-side ⇒ page 50 , right-side ⇒ page 57
- ❑ Fuel system must be bled after installing high-pressure pump ⇒ page 64 .

3 - Seal

- ❑ Renew

4 - Bolt

- ❑ 22 Nm

5 - High-pressure pump hub

- ❑ Removing ⇒ „2.25 Removing and installing high-pressure pump (left-side)“, page 50 , ⇒ „2.26 Removing and installing high-pressure pump (right-side)“, page 57

6 - Spacer

- ❑ For alignment of chain sprockets for high-pressure pump: left-side ⇒ page 50 , right-side ⇒ page 57

7 - Nut

- ❑ 60 Nm

8 - Bolt

- ❑ 24 Nm

9 - Chain sprocket

- ❑ For high-pressure pump
- ❑ Alignment: left-side ⇒ page 50 ; right-side ⇒ page 57

- ❑ Removing and installing ⇒ „2.25 Removing and installing high-pressure pump (left-side)“, page 50 , ⇒ „2.26 Removing and installing high-pressure pump (right-side)“, page 57

10 - O-ring

- ❑ Renew

11 - Dowel sleeve

- ❑ For hub
- ❑ 2x

12 - Fuel return hose

13 - Fuel supply hose

- ❑ With fuel temperature sender -G81-
- ❑ Removing and installing fuel temperature sender -G81- ⇒ page 67
- ❑ Tightening torque for fuel temperature sender -G81- ⇒ page 50

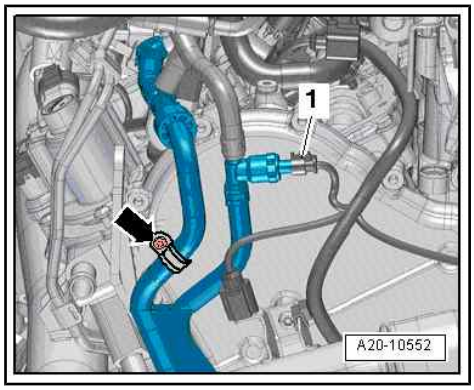
14 - Bolt

- ❑ 9 Nm

15 - High-pressure pump bracket

Tightening torque for fuel temperature sender -G81-

– Tighten connection for fuel temperature sender -G81- to 2 Nm.



2.25 Removing and installing high-pressure pump (left-side)

Caution

- *Observe safety precautions when working on fuel system ⇒ page 1 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*
- *The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling ⇒ page 64 .*

Special tools and workshop equipment required

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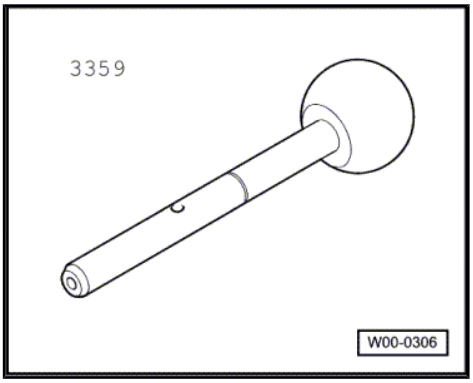
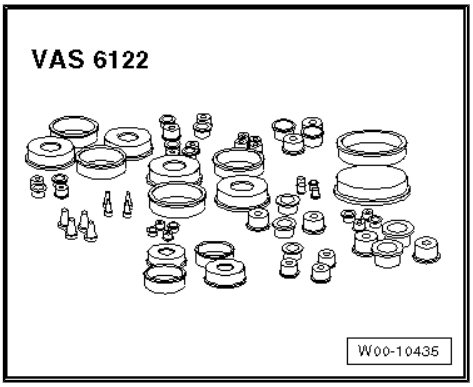
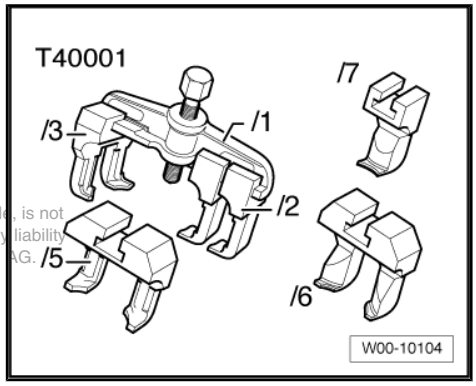
- Diesel injection pump locking pin -3359-



- Engine bung set -VAS 6122-



- Two-arm puller -T40001-



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- Drill bit, ∅ 3.3 mm
- Straight edge

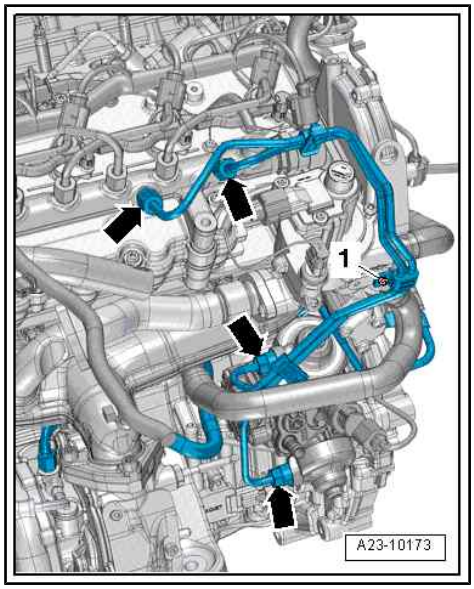
Removing

– Remove engine and separate from gearbox ⇒ Rep. gr. 10 .

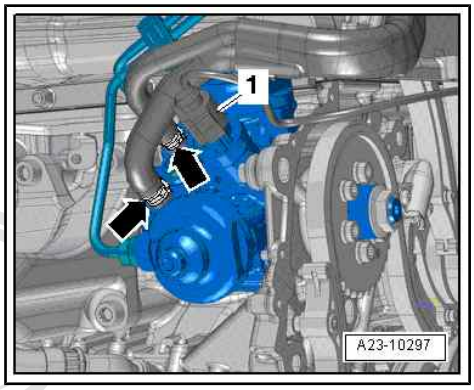
– Remove timing chain cover (bottom) ⇒ Rep. gr. 15 .

– Slacken union nuts -arrows-.

– Unscrew bolt -1- and remove high-pressure pipe.



– Unplug electrical connector -1-.



Caution

Observe rules for cleanliness when working on the injection system ⇒ page 1 .

Note

Place a cloth underneath to catch escaping fuel.

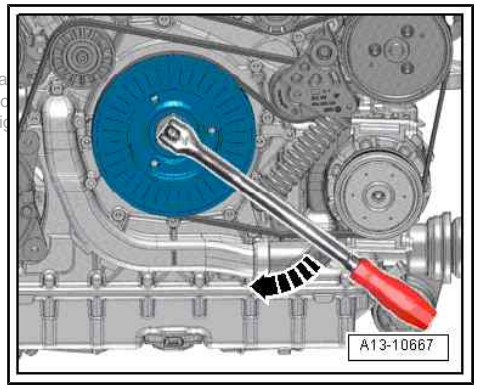
– Detach fuel hoses -arrows- on high-pressure pump.

– Seal off open pipes/lines and connections with clean plugs from engine bung set -VAS 6122- .

Caution

Irreparable damage can be caused if the camshaft timing chains slip.

- *When turning the crankshaft, turn it only in direction of engine rotation -arrow-.*



– Use a lever with 1/2” drive and a 30 mm socket to turn crankshaft to „TDC“.

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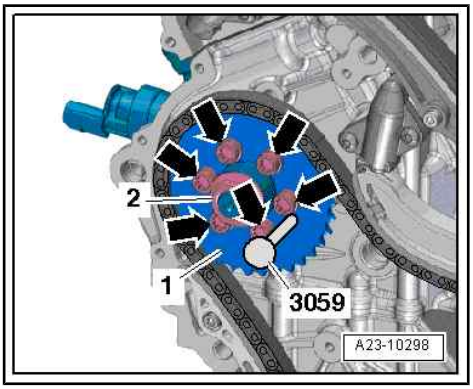
– Lock chain sprocket -1- for high-pressure pump with diesel injection pump locking pin -3359- .



Caution

If a used drive chain for high-pressure pump rotates in the opposite direction when it is refitted, this can cause irreparable damage.

- ***Mark running direction of drive chain for high-pressure pump with coloured arrows for re-installation.***

– Remove bolts -arrows- securing chain sprocket for high-pressure pump and slacken nut -2- securing hub 2 turns.

– Remove diesel injection pump locking pin -3359- .

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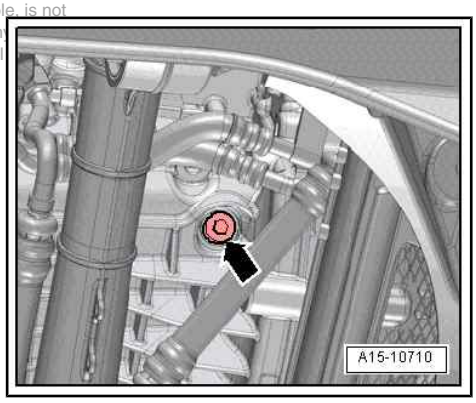
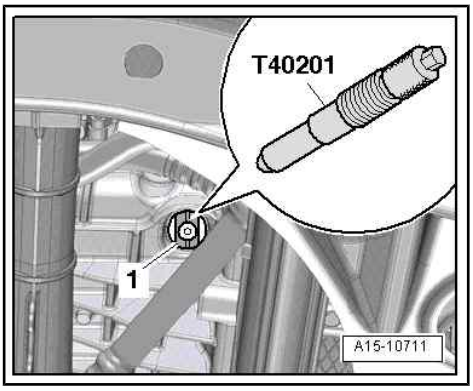
Note

Place a cloth beneath the sump (top section) to catch escaping oil.

– Unscrew plug -arrow- from sump (top section).

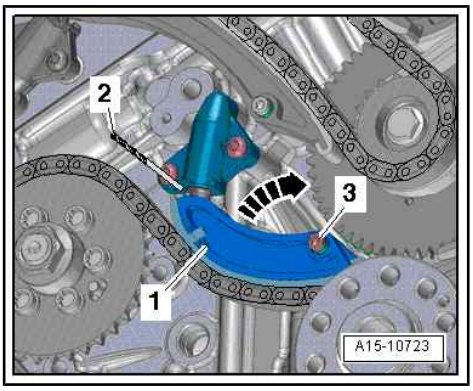


– Screw locking pin -T40201- into hole (20 Nm); if necessary, turn crankshaft -1- backwards and forwards slightly to fully centralise locking pin.



– Wrap insulating tape around tip and shaft of 3.3 mm ∅ drill bit to avoid cuts.

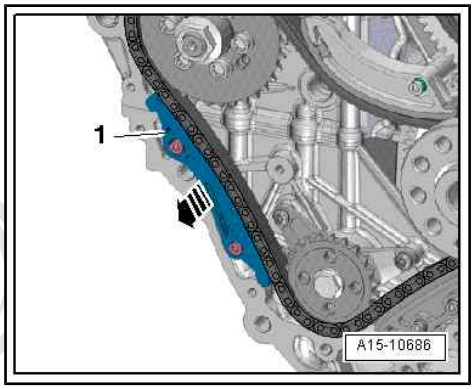
– Press tensioning rail -1- of chain tensioner for high-pressure pump (left-side) in direction of -arrow- and lock chain tensioner by inserting 3.3 mm drill bit -item 2-.



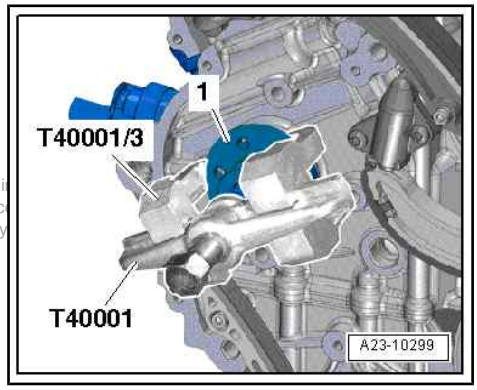
Note

Disregard -item 3-.

– Detach guide rail -1- towards rear -arrow-.
– Detach chain sprocket for high-pressure pump (left-side).



– Detach hub -1- for high-pressure pump (left-side) with two-arm puller -T40001- and claws -T40001/3- .
– Unscrew nut and remove hub.



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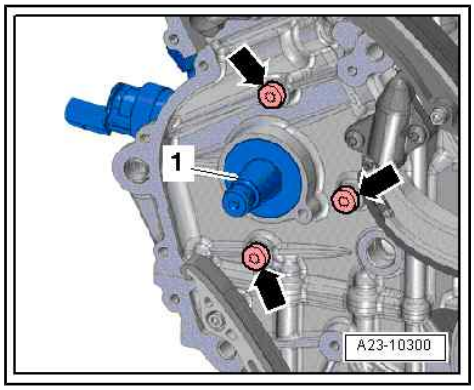
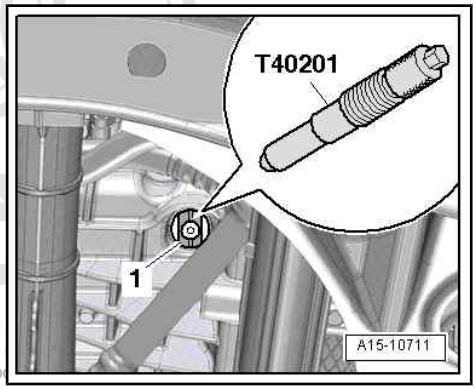
– Unscrew bolts -arrows- and remove high-pressure pump -1- (left-side) to front.



Installing

- Tightening torques ⇒ page 48
- Crankshaft -1- locked in „TDC“ position with locking pin - T40201- .



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

Caution

Running when dry causes irreparable damage to high-pressure pump.

- ***The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling*** ***⇒ page 64***

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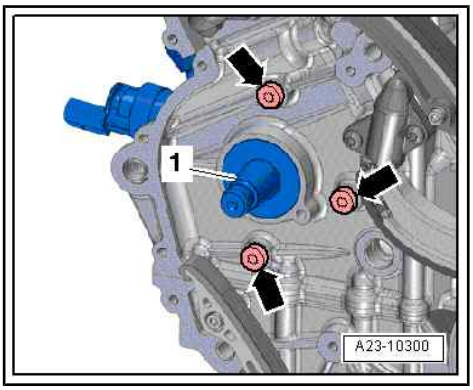
Note

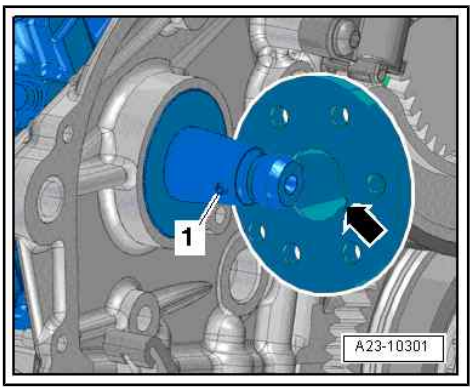
- *Renew seals and O-rings.*
- *Fuel return line must not be kinked, damaged or clogged*

– Fit high-pressure pump -1- with new O-ring and secure with bolts -arrows- and new seals.

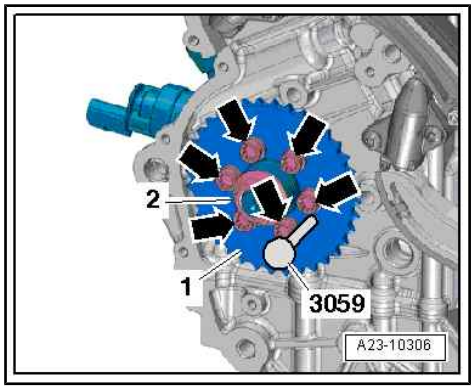


– Fit hub onto input shaft for high-pressure pump.

- Dowel sleeve -1- must engage in groove -arrow-.



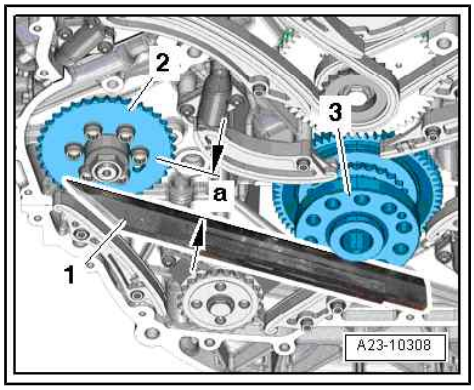
– Fit chain sprocket -1- without spacer(s) and lock high-pressure pump (left-side) with diesel injection pump locking pin -3359- .
– Tighten nut -2-.
– Tighten bolts -arrows- and determine correct spacer for chain sprocket.



Determining spacer for chain sprocket for high-pressure pump:

Note

- *Make sure alignment is performed and correct spacer(s) is/are determined before installing chain sprocket for high-pressure pump.*
- *During measurement the locking pin -T40201- must be removed.*



– Knock crankshaft flange with a hammer once to eliminate axial clearance of crankshaft.
– Press chain sprocket for high-pressure pump forwards firmly with your hands to eliminate axial clearance of high-pressure pump.
– Position straight edge -1- on flange -3- of crankshaft and determine dimension -a- (actual value) to chain sprocket -2- for high-pressure pump.

Example for determining thickness of spacer:	
Dimension -a- (actual value)	21.55 mm
Specification	– 20.40 mm
Required thickness of spacer	= 1.15 mm

– Determine spacer(s) according to table. Part numbers ⇒ Electronic parts catalogue .

Required thickness of spacer mm	Combination of spacers	
	0.3 mm	0.7 mm
0.00 … 0.15	–	–
0.15 … 0.45	1	–
0.45 … 0.65	2	–
0.65 … 0.85	–	1
0.85 … 1.20	1	1
1.20	–	2

- If a spacer thickness of 1.15 mm is required, a spacer with a thickness of 0.3 mm and a spacer with a thickness of 0.7 mm must be fitted.

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Continued:

– Remove diesel injection pump locking pin -3359- .

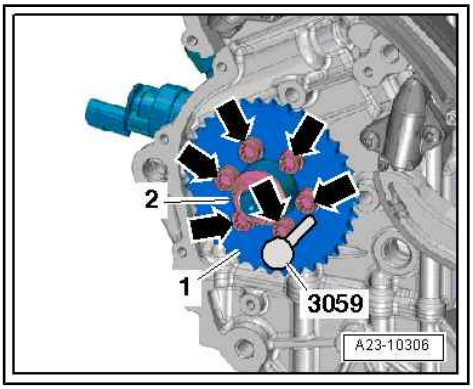
– Remove bolts -arrows- and detach chain sprocket.

– Place required spacer(s) onto high-pressure pump hub.

• If spacers of different thicknesses are required, first fit a spacer with a thickness of 0.7 mm, then a spacer with a thickness of 0.3 mm.

– Fit chain sprocket -1- and lock high-pressure pump (left-side) with diesel injection pump locking pin -3359- .

– Tighten bolts -arrows-.



Note

Disregard -item 2-.

– Install drive chain for high-pressure pump ⇒ Rep. gr. 15 .

– Install timing chain cover (bottom) ⇒ Rep. gr. 15 .

– Remove locking pin -T40201- .

– Tighten plug for „TDC“ drilling in sump (top section) ⇒ Rep. gr. 17 .

– Install high-pressure pipe ⇒ page 29 .

– Install engine ⇒ Rep. gr. 10 .

Caution

Running when dry causes irreparable damage to high-pressure pump.

- ***The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling ⇒ page 64***

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– Bleed fuel system ⇒ page 64 .

– Check for leaks in fuel system ⇒ page 66 .

2.26 Removing and installing high-pressure pump (right-side)

Caution

- ***Observe rules for cleanliness when working on the injection system ⇒ page 1 .***
- ***Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.***
- ***The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling ⇒ page 64 .***

Special tools and workshop equipment required

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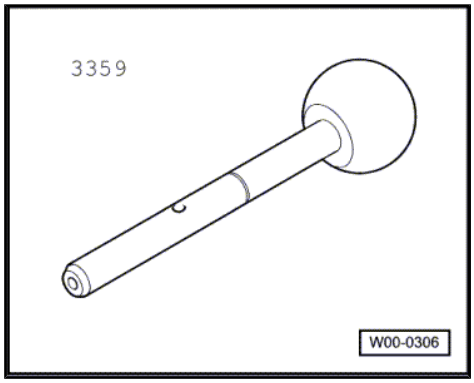
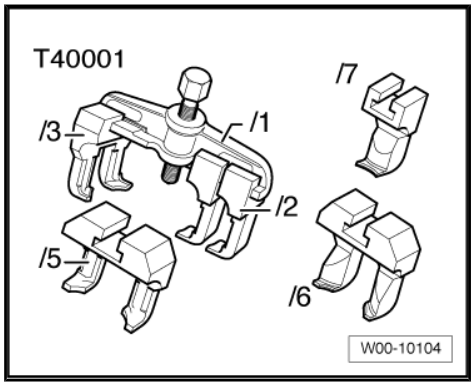
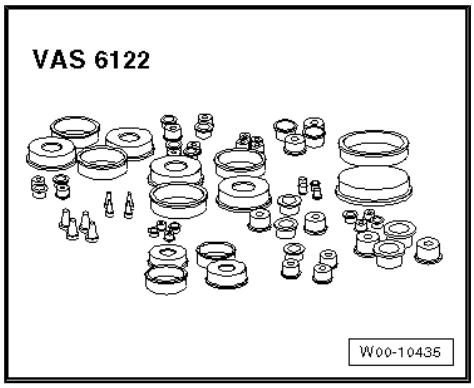
- Diesel injection pump locking pin -3359-



- Two-arm puller -T40001-



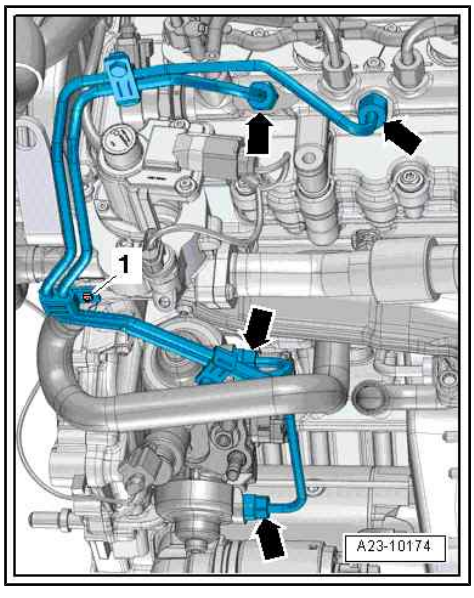
- Engine bung set -VAS 6122-



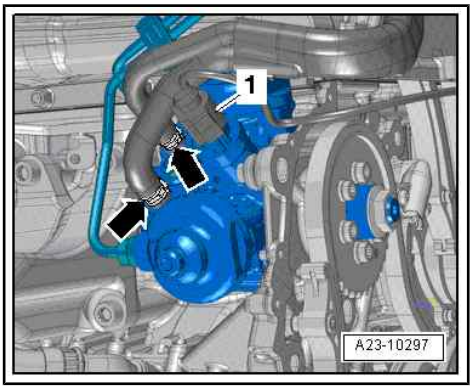
- Drill bit, ∅ 3.3 mm

Removing

– Remove engine and separate from gearbox ⇒ Rep. gr. 10 .
– Remove timing chain cover (bottom) ⇒ Rep. gr. 15 .
– Slacken union nuts -arrows-.
– Unscrew bolt -1- and remove high-pressure pipe.



– Unplug electrical connector -1-.



Caution

Observe rules for cleanliness when working on fuel system ***⇒ page 1*** ***.***

Note

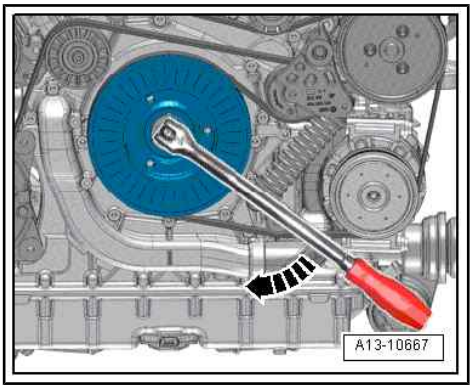
Place a cloth underneath to catch escaping fuel.

– Detach fuel hoses -arrows- on high-pressure pump.
– Seal off open pipes/lines and connections with clean plugs from engine bung set -VAS 6122- .

Caution

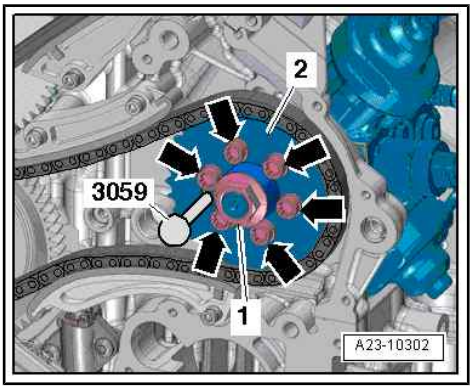
Irreparable damage can be caused if the camshaft timing chains slip.

- ***When turning the crankshaft, turn it only in direction of engine rotation -arrow-.***



– Use a lever with $^{1}/_{2}$" drive and a 30 mm socket to turn crankshaft to „TDC".

– Lock chain sprocket -2- for high-pressure pump with diesel injection pump locking pin -3359- .



Caution

If a used drive chain for high-pressure pump rotates in the opposite direction when it is refitted, this can cause irreparable damage.

- ***Mark running direction of drive chain for high-pressure pump with coloured arrows for re-installation.***

– Remove bolts -arrows- securing chain sprocket for high-pressure pump and slacken nut -1- securing hub 2 turns.
– Remove diesel injection pump locking pin -3359- .

Note

Place a cloth beneath the sump (top section) to catch escaping oil.

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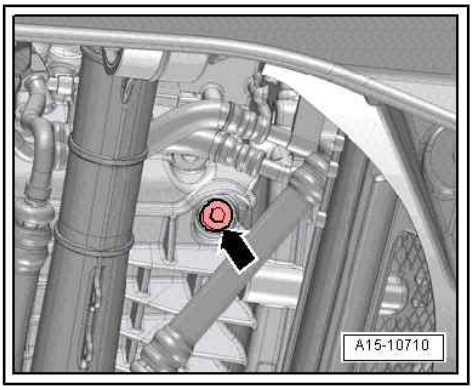
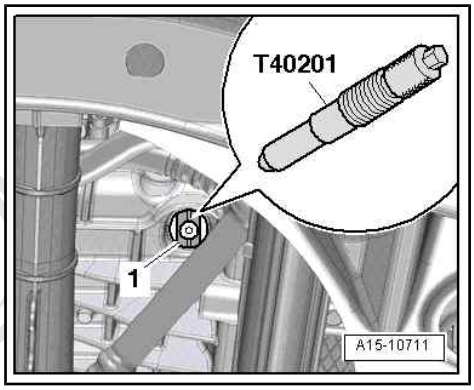
Unscrew plug -arrow- from sump (top section).



– Screw locking pin -T40201- into hole (20 Nm); if necessary, turn crankshaft -1- backwards and forwards slightly to fully centralise locking pin.



– Wrap insulating tape around tip and shaft of 3.3 mm ∅ drill bit to avoid cuts.

– Press tensioning rail -2- of chain tensioner for high-pressure pump (right-side) in direction of -arrow- and lock chain tensioner by inserting 3.3 mm drill bit -item 1-.

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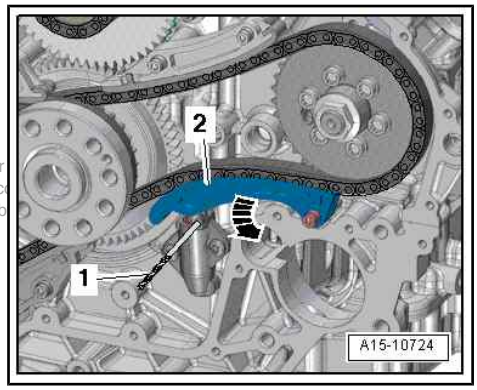
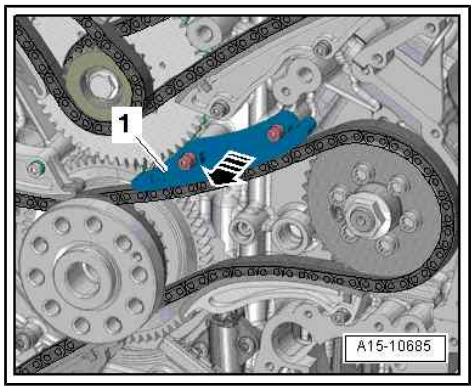


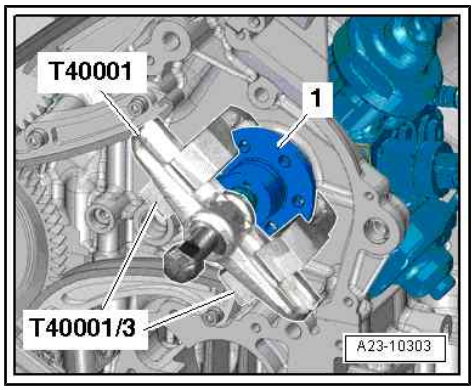
– Detach guide rail -1- towards rear -arrow-.

– Detach chain sprocket for high-pressure pump (right-side).

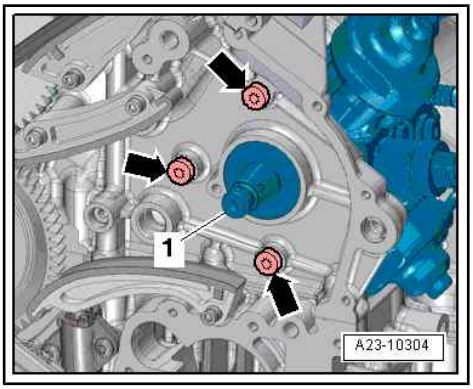


– Detach hub -1- for high-pressure pump (right-side) with two-arm puller -T40001- and claws -T40001/3- .

– Unscrew nut and remove hub.



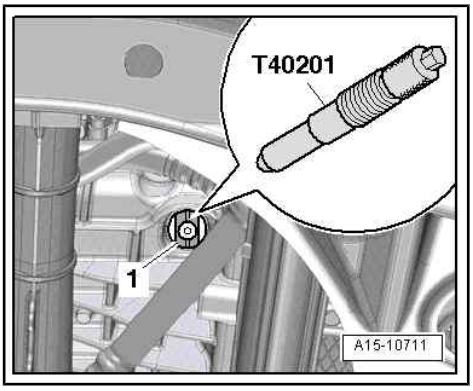
– Unscrew bolts -arrows- and remove high-pressure pump -1- (right-side) towards front.



Installing

- Tightening torques ⇒ page 48
- Crankshaft -1- locked in „TDC“ position with locking pin -T40201- .

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



Caution

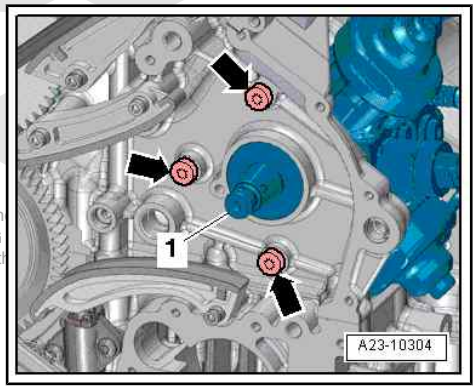
Running when dry causes irreparable damage to high-pressure pump.

- ***The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling ⇒ page 64***

Note

- *Renew seals and O-rings.*
- *Fuel return line must not be kinked, damaged or clogged*

– Fit high-pressure pump -1- with new O-ring and secure with bolts -arrows- and new seals.



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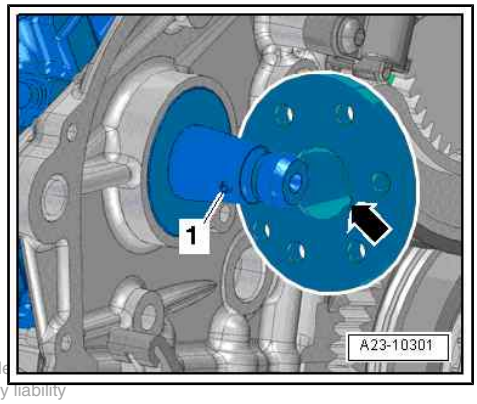
– Fit hub onto input shaft for high-pressure pump.

• Dowel sleeve -1- must engage in groove -arrow-.



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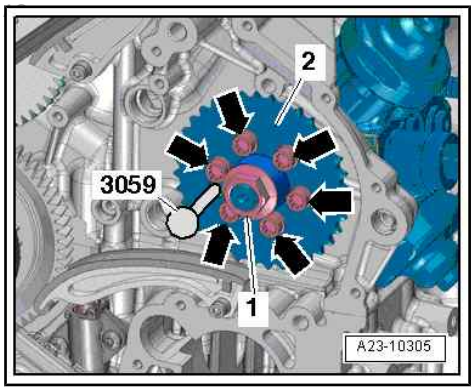
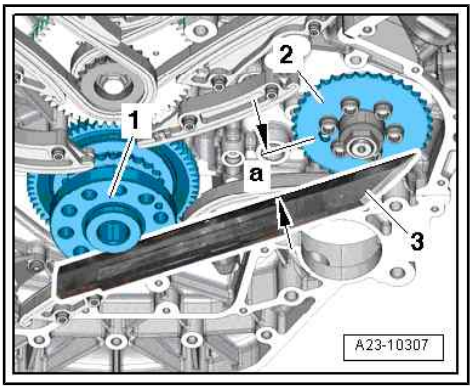
– Fit chain sprocket -1- without spacer(s) and lock high-pressure pump (right-side) with diesel injection pump locking pin -3359- .

– Tighten nut -2-.

– Tighten bolts -arrows- and determine correct spacer for chain sprocket.



Determining spacer for chain sprocket for high-pressure pump:



Note

- *Make sure alignment is performed and correct spacer(s) is/are determined before installing chain sprocket for high-pressure pump.*
- *During measurement the locking pin -T40201- must be removed.*

– Knock crankshaft flange with a hammer once to eliminate axial clearance of crankshaft.

– Press chain sprocket for high-pressure pump forwards firmly with your hands to eliminate axial clearance of high-pressure pump.

– Position straight edge -3- on flange -1- of crankshaft and determine dimension -a- (actual value) to chain sprocket -2- for high-pressure pump.

Example for determining thickness of spacer:	
Dimension -a- (actual value)	37.15 mm
Specification	– 36.00 mm
Required thickness of spacer	= 1.15 mm

– Determine spacer(s) according to table. Part numbers ⇒ Electronic parts catalogue .

Required thickness of spacer mm	Combination of spacers	
	0.3 mm	**0.7 mm**
0.00 … 0.15	–	–
0.15 … 0.45	1	–
0.45 … 0.65	2	–
0.65 … 0.85	–	1
0.85 … 1.20	1	1
1.20	–	2

- If a spacer thickness of 1.15 mm is required, a spacer with a thickness of 0.3 mm and a spacer with a thickness of 0.7 mm must be fitted.

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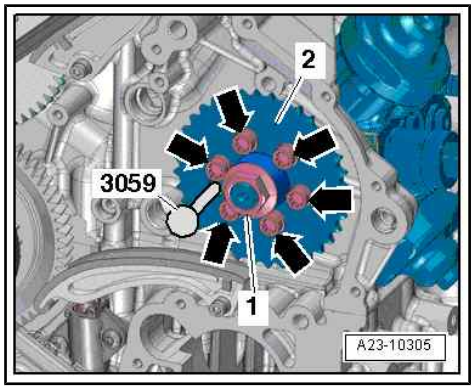
Continued:



– Remove diesel injection pump locking pin -3359- .
– Remove bolts -arrows- and detach chain sprocket.
– Place required spacer(s) onto high-pressure pump hub.
• If spacers of different thicknesses are required, first fit a spacer with a thickness of 0.7 mm, then a spacer with a thickness of 0.3 mm.
– Fit chain sprocket -1- and lock high-pressure pump (left-side) with diesel injection pump locking pin -3359- .
– Tighten bolts -arrows-.

Note

Disregard -item 2-.

– Install chain for high-pressure pump ⇒ Rep. gr. 15 .
– Install timing chain cover (bottom) ⇒ Rep. gr. 15 .
– Remove locking pin -T40201- .
– Tighten plug for „TDC“ drilling in sump (top section) ⇒ Rep. gr. 17 .
– Install high-pressure pipe ⇒ page 29 .
– Install engine ⇒ Rep. gr. 10 .

Caution

Running when dry causes irreparable damage to high-pressure pump.

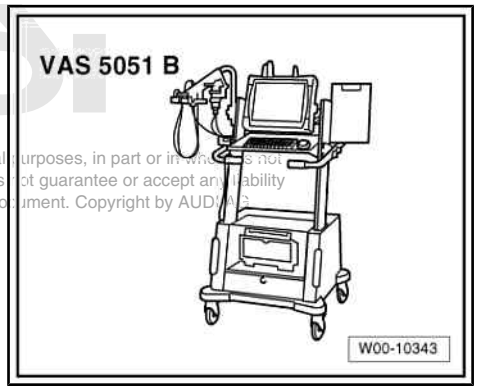
- ***The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling ⇒ page 64***

– Bleed fuel system ⇒ page 64 .
– Check for leaks in fuel system ⇒ page 66 .

2.27 Performing first fuel filling after installing high-pressure pump

Special tools and workshop equipment required

- Vehicle diagnostic, testing and information system -VAS 5051B-



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Caution

Running when dry causes irreparable damage to high-pressure pump.

- *The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty.*

Note

- *When installing the high-pressure fuel pump, it is essential to ensure that no dirt enters the fuel system.*
- *Only remove sealing plugs immediately prior to installation of fuel pipes.*
- *There must be sufficient fuel in the tank.*

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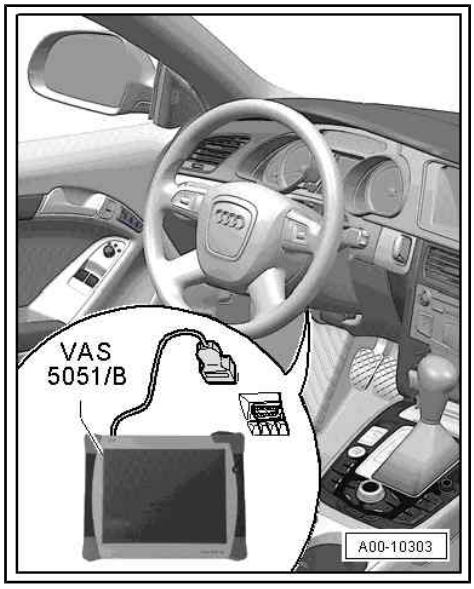
Proceed as follows to fill high-pressure pumps with fuel:



- Connect up the vehicle diagnostic, testing and information system -VAS 5051B- .
- Switch on ignition.
- Select „Engine electronics“ in vehicle self-diagnosis.
- Then select „Basic setting“.
- Select channel 35; „Pump off“ appears in display zone 2.
- Press „activate“ button.
- Fuel pumps will run for approx. 60 seconds.
- Fuel pumps will run for approx. 60 seconds; „Pump on“ appears in display zone 2.
- Repeat this procedure THREE TIMES to ensure that high-pressure pump is sufficiently filled with fuel.

Note

To repeat basic setting, switch ignition off and on once. Then start basic setting again.

- Start engine after filling fuel system.
- Run engine at moderate speed for several minutes and then switch off.
- Check fuel system for leaks.
- Erase content of event memory.
- After completing the repair, road-test the vehicle over a distance of at least 20 km. Accelerate with full throttle at least once. Then inspect the high-pressure section of the fuel system again for leaks.

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Note

If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and erase the content of the event memory. Then continue the road test.

- Interrogate event memory.

2.28 Bleeding fuel system and checking for leaks

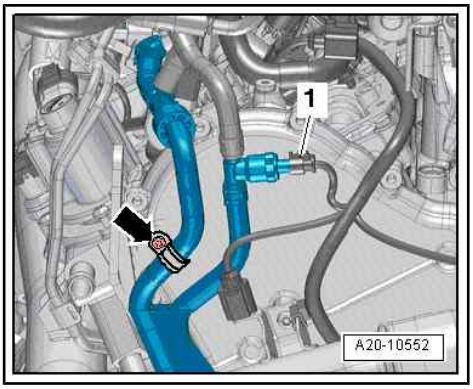
- Run engine at idling speed for several minutes (do not press accelerator) and then switch off. Fuel system will bleed itself automatically.
- Check the entire fuel system for leaks.
- Renew the affected component if leakage still occurs after tightening to the correct torque.
- After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

Note

If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and erase the content of the event memory. Then continue the road test.

2.29 Removing and installing fuel temperature sender -G81-

Removing



– Remove engine cover panel ⇒ page 13 .

– Unplug electrical connector -1-.

– Remove fuel temperature sender -G81- from fuel supply hose.

Note

- *Disregard -arrow-.*
- *The illustration shows the installation position with the engine removed.*

Installing

- Tightening torque ⇒ page 50

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

Note

Renew O-ring.

2.30 Lambda probe, exhaust gas temperature senders and pressure senders - exploded view

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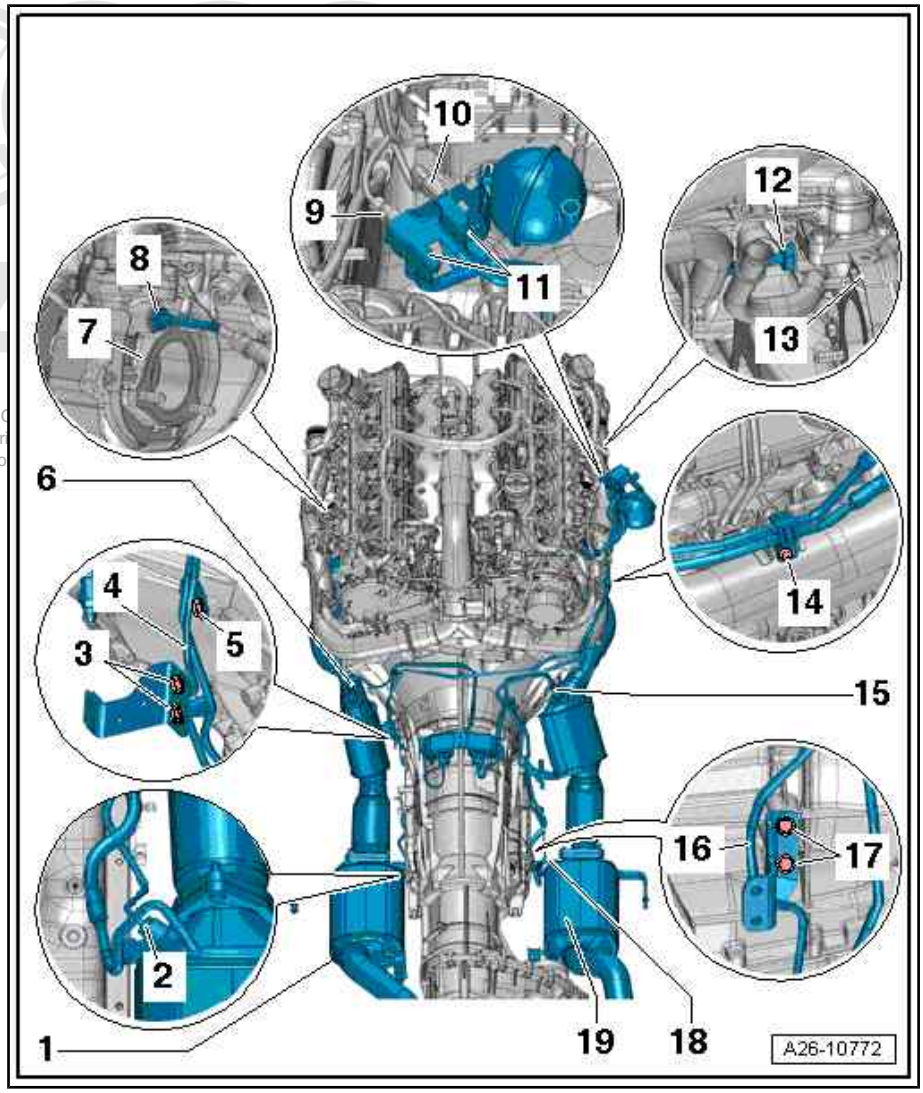

1 - Particulate filter

- ❑ For cylinder bank 2 (left-side)

2 - Temperature sender 2 before particulate filter -G498-

- ❑ Removing and installing ⇒ Rep. gr. 26

3 - Bolt

- ❑ 23 Nm

4 - Pressure pipe for pressure differential sender 2 -G524-

5 - Bolt

- ❑ 9 Nm

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6 - Lambda probe 2 -G108- with Lambda probe heater 2 -Z28-

- ❑ New Lambda probes are coated with an assembly paste
- ❑ In the case of a used Lambda probe, coat only thread with high-temperature paste; refer to ⇒ Electronic parts catalogue for high-temperature paste.
- ❑ The assembly paste / high-temperature paste must not make contact with the slots on the Lambda probe body
- ❑ Removing and installing ⇒ page 69
- ❑ 55 Nm

7 - Turbocharger

- ❑ For cylinder bank 1 (right-side)

8 - Exhaust gas temperature sender 1 for cylinder bank 2 -G236-

- ❑ Removing and installing ⇒ Rep. gr. 26

9 - Pressure differential sender 2 -G524-

- ❑ Removing and installing ⇒ page 70

10 - Pressure differential sender -G505-

- ❑ Removing and installing ⇒ page 70

11 - Nuts

- ❑ 9 Nm

12 - Exhaust gas temperature sender 1 -G235-

- ❑ Removing and installing ⇒ Rep. gr. 26

13 - Turbocharger

- ❑ For cylinder bank 2 (left-side)

14 - Bolt

- ❑ 9 Nm

15 - Lambda probe -G39- with Lambda probe heater -Z19-

- ❑ New Lambda probes are coated with an assembly paste

- ❑ In the case of a used Lambda probe, coat only thread with high-temperature paste; refer to ⇒ Electronic parts catalogue for high-temperature paste.
- ❑ The assembly paste / high-temperature paste must not make contact with the slots on the Lambda probe body
- ❑ Removing and installing ⇒ page 69
- ❑ 55 Nm

16 - Pressure pipe for pressure differential sender -G505-

17 - Bolts

- ❑ 23 Nm

18 - Temperature sender before particulate filter -G506-

- ❑ Removing and installing ⇒ Rep. gr. 26

19 - Particulate filter

- ❑ For cylinder bank 1 (right-side)

2.31 Removing and installing Lambda probe -G39- / -G108-

Special tools and workshop equipment required

♦ Lambda probe open ring spanner set -3337-

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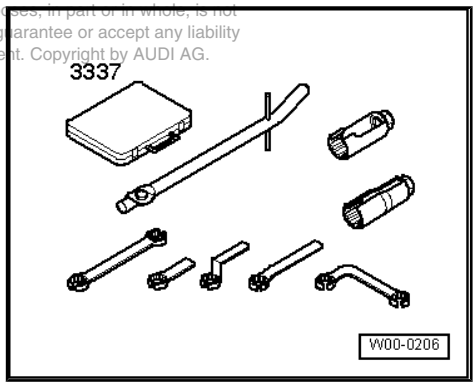
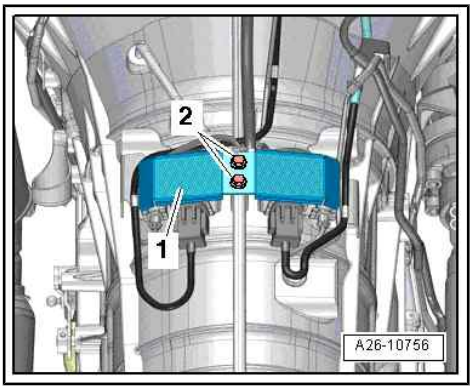


Removing

• Engine/gearbox assembly removed and in position on scissor-type assembly platform -VAS 6131 A- ⇒ Rep. gr. 10 .

– Unscrew bolts -2- and remove cover -1-.



– Detach electrical connectors from bracket and unplug.

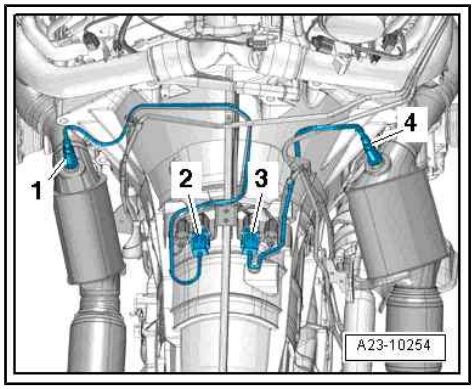
2 - For Lambda probe 2 -G108-

3 - For Lambda probe -G39-

– Move electrical wiring clear.

– Unscrew Lambda probe 2 -G108- -item 1- with -3337/1- .

– Unscrew Lambda probe -G39- -item 4- with -3337/7- .



Installing

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

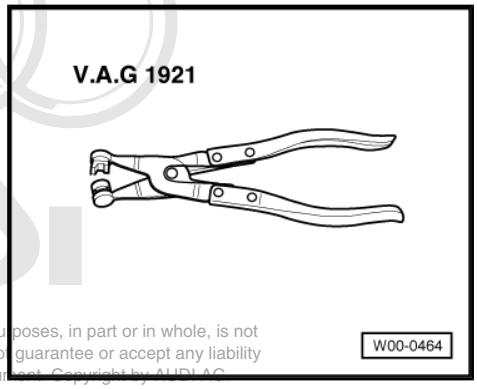
Note

- *New Lambda probes are coated with an assembly paste.*
- *In the case of a used Lambda probe, coat only the thread with high-temperature paste; refer to ⇒ Electronic parts catalogue for high-temperature paste.*
- *The assembly paste / high-temperature paste must not make contact with the slots on the Lambda probe body.*
- *When installing, the Lambda probe wire must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*
- *Reinstall all cable ties in the same locations when installing.*

2.32 Removing and installing pressure differential sender -G505- / -G524-

Special tools and workshop equipment required

- Hose clip pliers -V.A.G 1921-



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Removing

– Remove engine cover panel ⇒ page 13 .

Pressure differential sender 2 -G524- (left-side):

– Unplug electrical connector -1- and remove nut -4-.

– Detach hoses -arrows- from pipes and detach pressure differential sender 2 -G524- .

Pressure differential sender -G505- (right-side):

– Unplug electrical connector -2- and remove nut -3-.

– Detach hoses -arrows- from pipes and detach pressure differential sender -G505- .

Continuation for both sides:

– If hoses are to be removed from pressure differential sender, release hose clips (if fitted) and spray both hoses with silicone-free lubricant.

– Carefully disconnect hoses from their connections (take care to keep hoses straight: connections can break off easily).

Installing

• Tightening torque ⇒ page 67

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

Note

♦ *Blow through hoses of pressure differential senders (towards particulate filter) with compressed air to remove dirt or ice (frozen condensation).*

♦ *Make sure that hoses are securely fitted and that there are no leaks.*

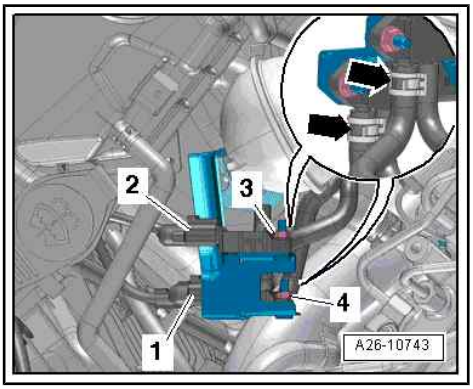
♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

Perform adaption after renewing pressure differential sender or particulate filter.

– Connect vehicle diagnostic, testing and information system - VAS 5051B- .

– Start „Guided Functions“ mode.

– Adapt particulate filter learned values ⇒ Vehicle diagnostic tester.



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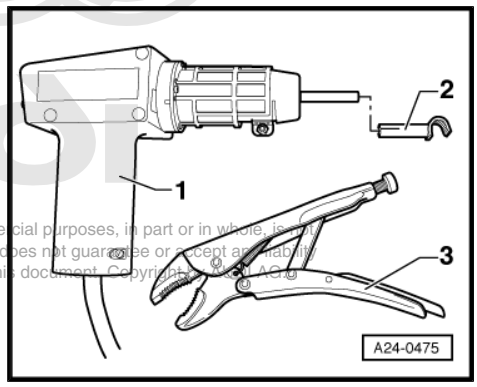
3 Engine control units

3.1 Renewing engine control unit -J623- (master control unit)

Special tools and workshop equipment required

- Hot air blower -VAS 1978/14A- -item 1- with nozzle attachment -2- from wiring harness repair set -VAS 1978 B-
- Small, commercially available mole grips -3-



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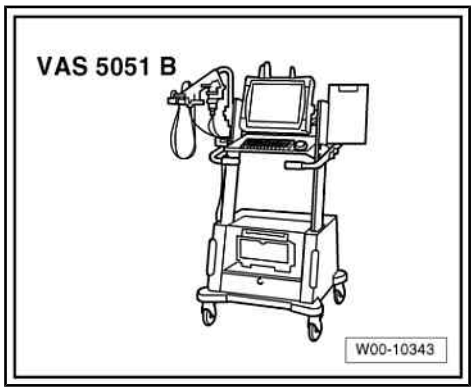
- Vehicle diagnostic, testing and information system -VAS 5051B-



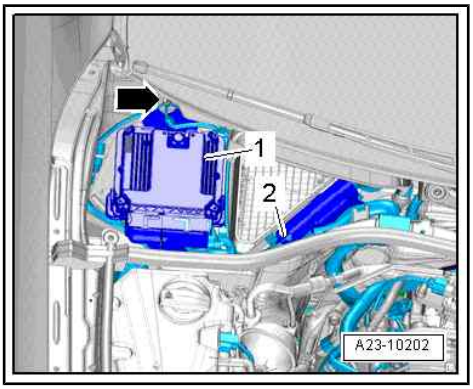
Removing

Two engine control units are responsible for engine management; these control units communicate with one another via a separate CAN bus.

- Engine control unit -J623- (master control unit) informs engine control unit 2 -J624- (slave control unit) which functions it has to perform.

The adaption values of the injectors must be stored before removing engine control unit -J623- .

The two engine control units are identical from the outside. If both control units are removed at the same time, they must be marked before removal so they are not interchanged on re-installation.



- Mark engine control unit -J623- (master control unit) -1- with e.g. an „M“.
- Mark engine control unit -J624- (slave control unit) -2- with e.g .an „S“.

Reading out adaption values of injectors of defective engine control unit

Read out adaption values for injectors using vehicle diagnostic, testing and information system -VAS 5051B- in „Guided Fault Finding“ or „Guided Functions“ and store as electronic file in the tester.

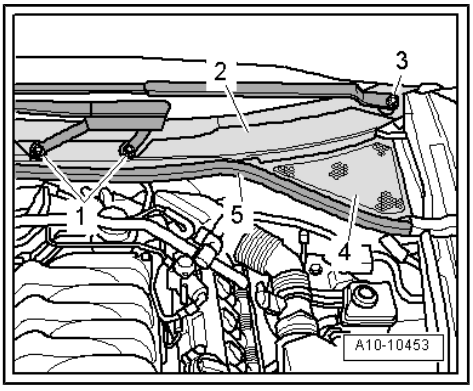
- Enter correct vehicle identification in Guided Fault Finding.
- Press „Function/component selection“.
- Select „Drive train“.
- „01 Self-diagnosis compatible systems“.
- „01/11 Engine electronics I and II J623/J624“.
- Select „01/11 - Functions“.
- Select „01/11 Injector delivery calibration (quantity adjustment) with injector voltage calibration (ISA/IVA)“.
- Press „Go to“ button.

Note

If the adaption values of the injectors of the old (defective) engine control unit cannot be read out, the adaption values must be entered into the new engine control unit manually and the adaption procedure must be performed accordingly.

– Switch off ignition after storing file containing adaption values.

Removing



– Remove wiper arms -1- and -3- ⇒ Rep. gr. 92 .
– Pull off rubber seal -5- and remove plenum chamber cover -4-.

Caution

Risk of damage to plenum chamber cover.

- ***To avoid cracking the plenum chamber cover -2- during removal, apply a small amount of soap solution to the joint between the windscreen and the plenum chamber cover and pull the plenum chamber cover vertically up out of the fastening strip, starting from the edge of the windscreen.***

– Carefully pull plenum chamber cover -2- off retainer at windscreen.

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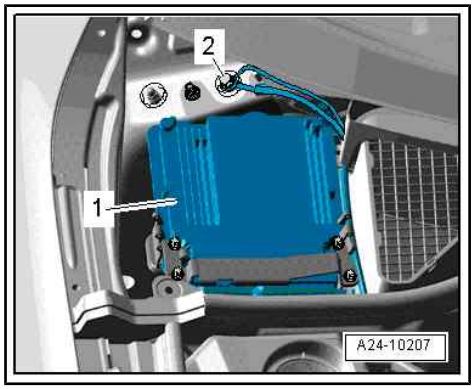
– Unclip engine control unit -1- from bracket.



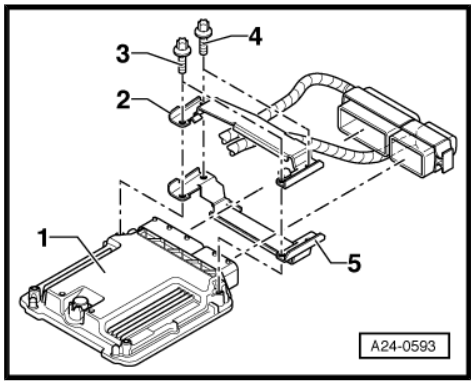
Note

- *The engine control unit remains connected to the wiring harness.*
- *Disregard -item 2-.*

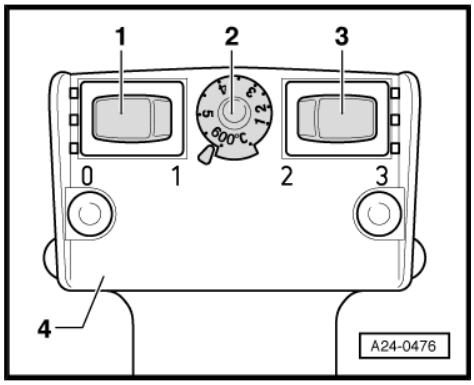
To help prevent unauthorised access to the connectors on the engine control units, the control unit -1- is bolted to a metal casing -5- by means of shear bolts -3- and -4- and a locking plate -2-.

The threads of the two shear bolts -4- which are not screwed into the engine control unit are secured with locking fluid. To unscrew these two bolts, the threads must therefore be heated with the hot air blower.

The threads of the two shear bolts -3- which are screwed into the engine control unit are not secured with locking fluid. Do not apply heat to the threads in the control unit housing; this is not necessary and would cause overheating of the control unit.



– Select settings on hot air blower as shown in illustration, i.e. set temperature potentiometer -2- to maximum heat output and two-stage air flow switch -3- to position 3.

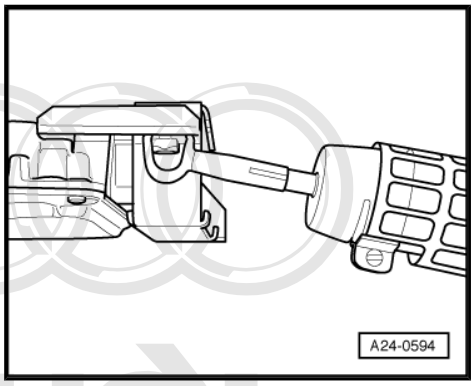


WARNING

Heating the thread of the locking plate also heats up the shear bolts and parts of the metal housing. Take care to avoid burns. It is also important to ensure that only the thread is heated and none of the surrounding components if at all possible. These should be covered if necessary.

– Apply heat to the threads of the shear bolts on the connector side for approx. 25 to 30 seconds.

– Unscrew shear bolts using mole grips (see arrow in illustration).



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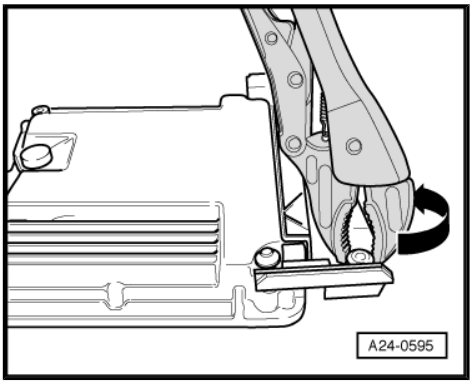

– The two shear bolts screwed into the engine control unit do not need to be heated. They can be removed without heating.
– Detach metal locking plate from control unit connectors.
– Release connectors on engine control unit and unplug connectors.
– Remove old engine control unit -J623- .

Installing

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

– Fit new engine control unit -J623- .
– Make sure you fit metal casing back on engine control unit.
– Always use new shear bolts.
– Clean threaded holes for new shear bolts to remove any residue from locking fluid. This can be done using a thread tap.
– After renewing the engine control unit on a common rail engine, the injector delivery calibration and injector voltage calibration data must be loaded into the engine control unit, in addition to the other adaption values, after the control unit has been renewed (these functions influence engine power and exhaust emissions).
– On vehicles with particulate filter the current mileage (km) reading must be stored in the engine control unit via an adaption procedure.

Entering adaption values for the new engine control unit and injectors

Read out adaption values for new engine control unit using vehicle diagnostic, testing and information system -VAS 5051B- in „Guided Fault Finding“ or „Guided Functions“.

Note

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Read out stored values for injectors from file in tester and enter into new engine control unit.

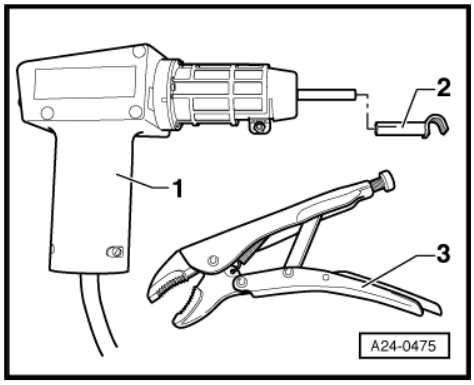
- Enter correct vehicle identification in Guided Fault Finding.
- Press „Function/component selection“.
- Select „Drive train“.
- „01 Self-diagnosis compatible systems“.
- „01/11 Engine electronics“.
- Select „Functions“.
- Select „Replace, further steps“.

3.2 Renewing engine control unit 2 -J624- (slave control unit)

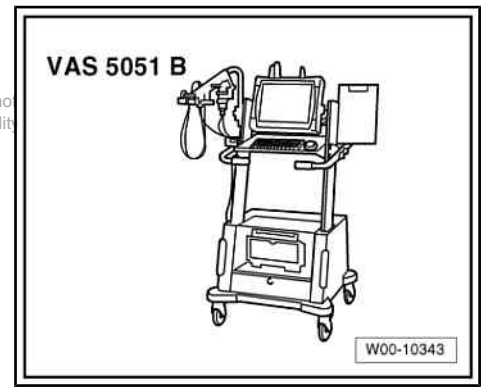
Special tools and workshop equipment required

♦ Hot air blower -VAS 1978/14A- -item 1- with nozzle attachment -2- from wiring harness repair set -VAS 1978 B-

- Small, commercially available mole grips -3-



- Vehicle diagnostic, testing and information system -VAS 5051B-



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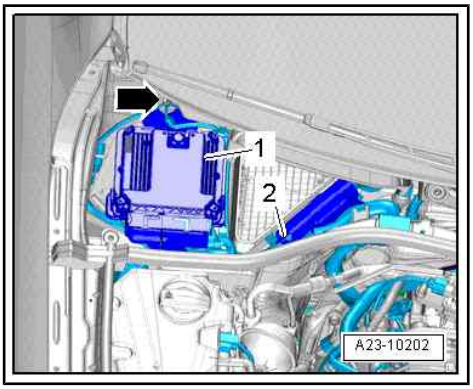
Two engine control units are responsible for engine management; these control units communicate with one another via a separate CAN bus.

- Engine control unit -J623- (master control unit) informs engine control unit 2 -J624- (slave control unit) which functions it has to perform.

Store adaption values of injectors before removing engine control unit 2 -J624- .

The two engine control units are identical from the outside. If both control units are removed at the same time, they must be marked before removal so they are not interchanged on re-installation.



- Mark engine control unit -J623- (master control unit) -1- with e.g. an „M“.
- Mark engine control unit -J624- (slave control unit) -2- with e.g .an „S“.

Reading out adaption values of injectors of defective engine control unit

Read out adaption values for injectors using vehicle diagnostic, testing and information system -VAS 5051B- in „Guided Fault Finding“ or „Guided Functions“ and store as electronic file in the tester.

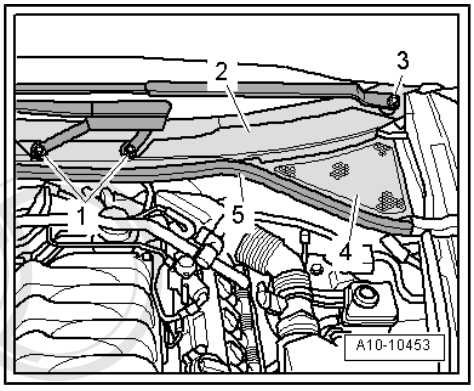
- Enter correct vehicle identification in Guided Fault Finding.
- Press „Function/component selection“.
- Select „Drive train“.
- „01 Self-diagnosis compatible systems“.
- „01/11 Engine electronics I and II J623/J624“.
- Select „01/11 - Functions“.
- Select „01/11 Injector delivery calibration (quantity adjustment) with injector voltage calibration (ISA/IVA)“.
- Press „Go to“ button.

Note

If the adaption values of the injectors of the old (defective) engine control unit cannot be read out, the adaption values must be entered into the new engine control unit manually and the adaption procedure must be performed accordingly.

– Switch off ignition after storing file containing adaption values.

Removing



– Remove wiper arms -1- and -3- ⇒ Rep. gr. 92 .
– Pull off rubber seal -5- and remove plenum chamber cover -4-.

Caution

Risk of damage to plenum chamber cover.

- ***To avoid cracking the plenum chamber cover -2- during removal, apply a small amount of soap solution to the joint between the windscreen and the plenum chamber cover and pull the plenum chamber cover vertically up out of the fastening strip, starting from the edge of the windscreen.***

– Carefully pull plenum chamber cover -2- off retainer at windscreen.

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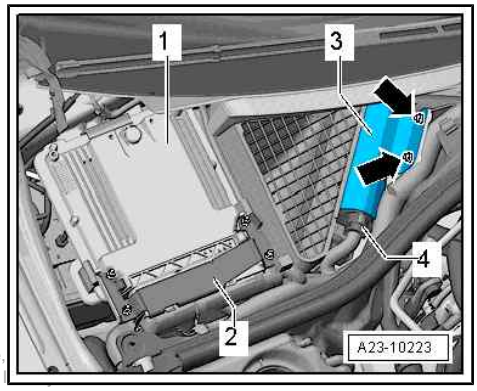
To help prevent unauthorised access to the connectors -4- on the engine control unit, the engine control unit is bolted to a metal casing by means of shear bolts -arrows- and a locking plate -3-.



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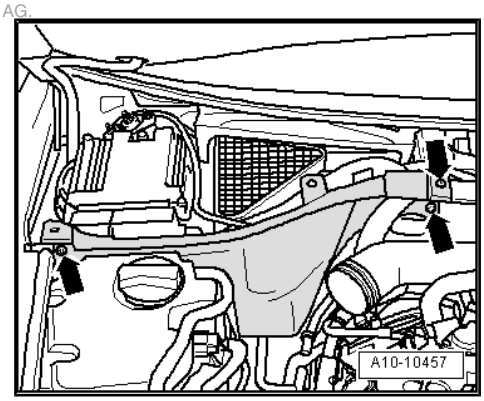
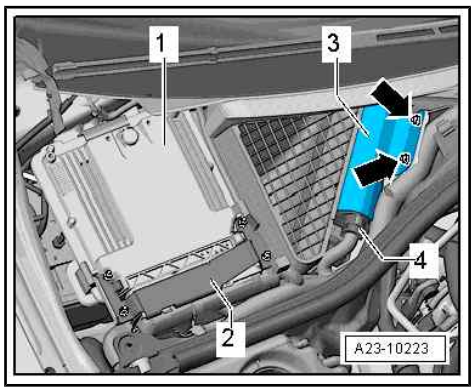
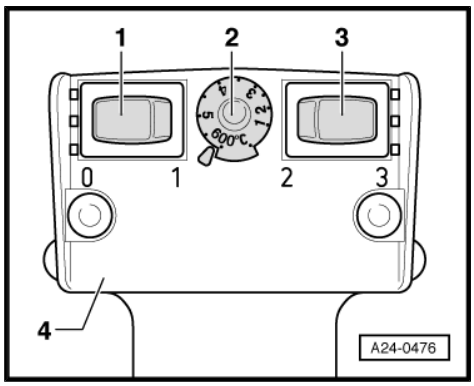
– Remove bolts -arrows-.
– Pull bulkhead plate with engine control unit as far upwards as possible.



The threads of the two shear bolts -arrows- which are not screwed into the engine control unit are coated with locking fluid. To unscrew these two bolts, the threads must therefore be heated with the hot air blower.



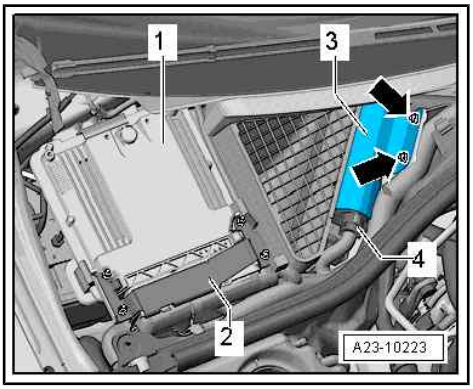
– Select settings on hot air blower as shown in illustration, i.e. set temperature potentiometer -2- to maximum heat output and two-stage air flow switch -3- to position 3.



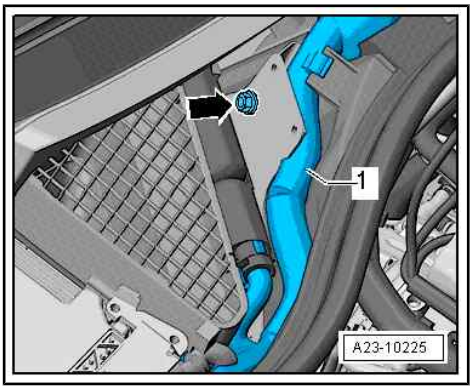
WARNING

Heating the thread of the locking plate also heats up the shear bolts and parts of the metal housing. Take care to avoid burns. It is also important to ensure that only the thread is heated and none of the surrounding components if at all possible. These should be covered if necessary.

– Apply heat to each of the shear bolts on the connector side -arrows- for approximately 25 to 30 seconds.
– Unscrew shear bolts using vice-grip pliers.
– Detach metal locking plate from control unit connectors.



– Remove bolt -arrow- securing bracket for engine control unit.
– Move wiring harness clear.
– Release connectors on engine control unit and unplug connectors.
– Take out engine control unit with bracket.



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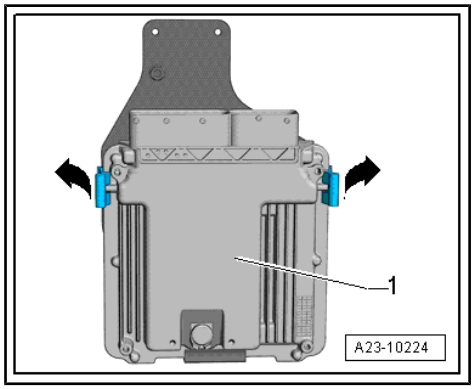
– Push retaining clips to the side -arrows- and take old engine control unit 2 -J624- -item 1- out of guide.



Installing

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

– Insert new engine control unit 2 -J624- into guide. The retaining clips must engage audibly.

– Make sure you fit metal casing back on engine control unit.

– Always use new shear bolts.

– Clean threaded holes for new shear bolts to remove any residue from locking fluid. This can be done using a thread tap.

– After renewing the engine control unit on a common rail engine, the injector delivery calibration and injector voltage calibration data must be loaded into the engine control unit, in addition to the other adaption values, after the control unit has been renewed (these functions influence engine power and exhaust emissions).

– On vehicles with particulate filter the current mileage (km) reading must be stored in the engine control unit via an adaption procedure.

Entering adaption values for the new engine control unit and injectors

Read out adaption values for new engine control unit using vehicle diagnostic, testing and information system -VAS 5051B- in „Guided Fault Finding“ or „Guided Functions“.

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Note

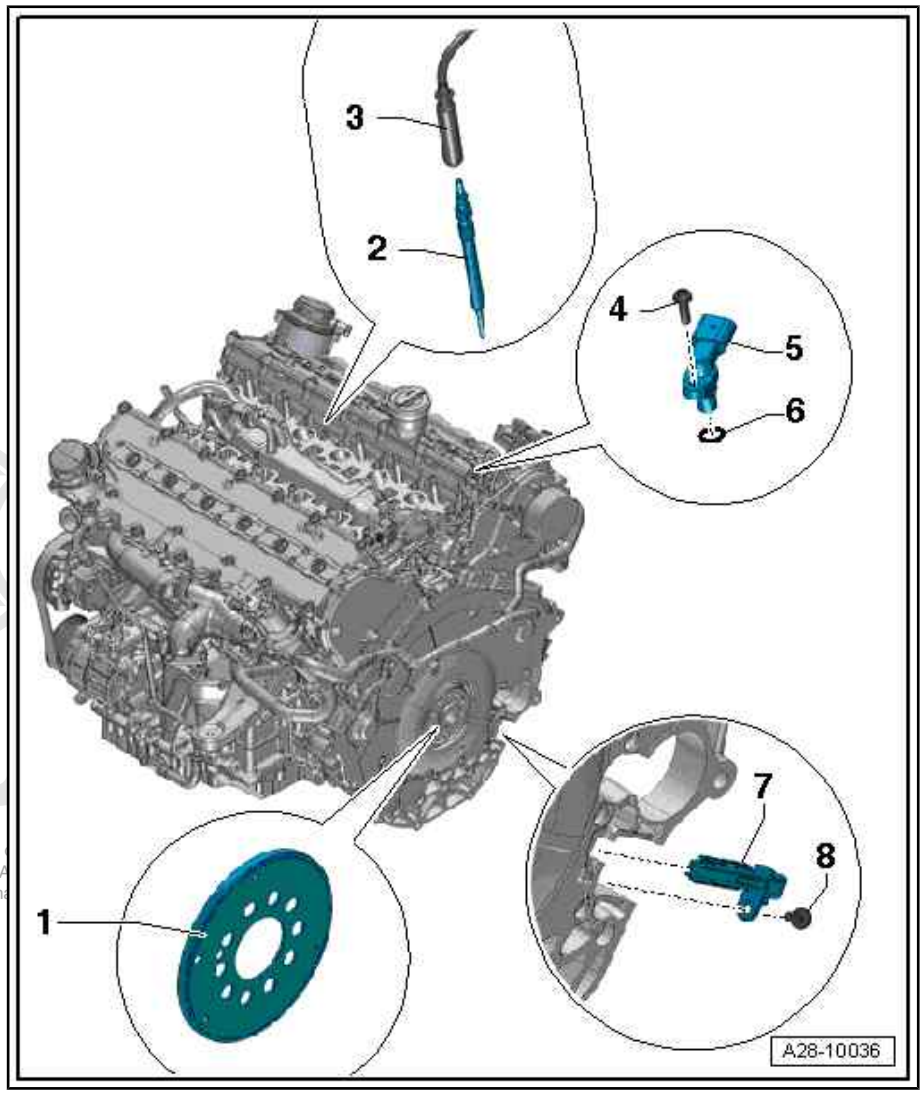
Read out stored values for injectors from file in tester and enter into new engine control unit.

- Enter correct vehicle identification in Guided Fault Finding.
- Press „Function/component selection“.
- Select „Drive train“.
- „01 Self-diagnosis compatible systems“.
- „01/11 Engine electronics“.
- Select „Functions“.
- Select „Replace, further steps“.

28 – Glow plug system

1 Glow plug system

1.1 Glow plugs, Hall sender, engine speed sender - exploded view



1 - Sender wheel

- ❑ For engine speed sender -G28-
- ❑ Removing and installing ⇒ Rep. gr. 13

2 - Glow plug

Cylinder bank 1 (right-side):

- ❑ Glow plug 1 -Q10- , glow plug 3 -Q12- , glow plug 5 -Q14- , glow plug 8 -Q17- , glow plug 10 -Q19- , glow plug 12 -Q21-

Cylinder bank 2 (left-side):

- ❑ Glow plug 2 -Q11- , glow plug 4 -Q13- , glow plug 6 -Q15- , glow plug 7 -Q16- , glow plug 9 -Q18- , glow plug 11 -Q20-
- ❑ Removing and installing ⇒ page 82
- ❑ 12 Nm

3 - Electrical connector

4 - Bolt

- ❑ 9 Nm

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5 - Hall sender -G40-

- ❑ Removing and installing ⇒ page 84

6 - O-ring

- ❑ Renew

7 - Engine speed sender -G28-

- ❑ Removing and installing ⇒ page 83

8 - Bolt

- ❑ 9 Nm

1.2 Checking glow plug system

The glow plug system is activated via the automatic glow period control unit -J179- and the glow period control unit 2 -J703- . The control units are capable of self-diagnosis.

Automatic glow period control units are located in relay and fuse holder (in electronics box in plenum chamber, left-side) ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

A fault is stored in the event memory of the engine control unit - J623- / -J624- if a fault occurs in the glow plug system.

The procedure for checking the glow plug system is described in the „Guided Fault Finding“.

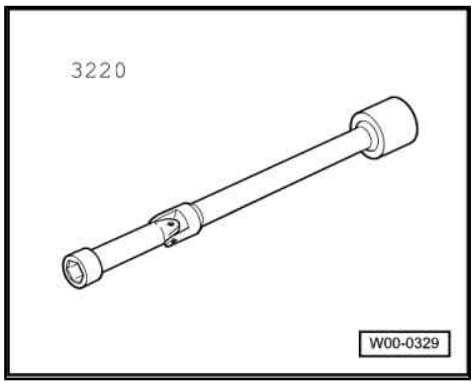
For faster starting, the vehicle is equipped with electronically controlled glow plugs and a separate glow period control unit.

Each glow plug is activated and diagnosed separately.

1.3 Removing and installing glow plugs

Special tools and workshop equipment required

- U/J extension and socket, 10 mm -3220-



Removing

– Switch off ignition.

– Remove engine cover panel ⇒ page 13 .

Note

For cylinders 6 and 12 the respective intake manifold flap motor must be unbolted. Do not detach the connecting rod.

– Detach glow plug connectors from glow plugs.

– Clean glow plug opening; make sure no dirt gets into cylinders.

– Cleaning glow plug opening:

- Use a vacuum cleaner to remove coarse dirt.
- Spray with brake cleaner and wait for it to take effect, then blow out with compressed air - wear safety goggles.
- Clean glow plug opening with an oily cloth.

– To slacken the glow plugs use special tool U/J extension and socket, 10 mm -3220-

Installing

• Tightening torque: exploded view ⇒ page 81 .

– Tighten glow plugs with torque wrench and U/J extension and socket, 10 mm -3220- .

– Fit glow plug connectors back onto corresponding glow plugs.

• Ensure that electrical connectors are securely seated.

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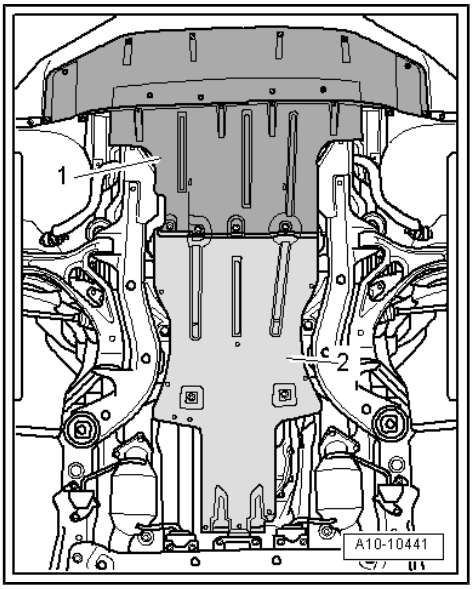
1.4 Removing and installing engine speed sender -G28-

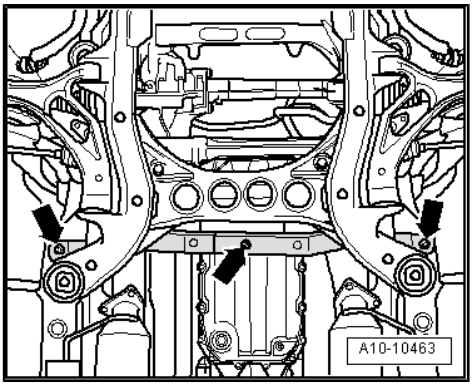
Removing

– Activate jacking mode ⇒ Rep. gr. 43 .

– Remove noise insulation panels -1- and -2- ⇒ Rep. gr. 66 .



– Unscrew bolts -arrows- and remove bracket for noise insulation.



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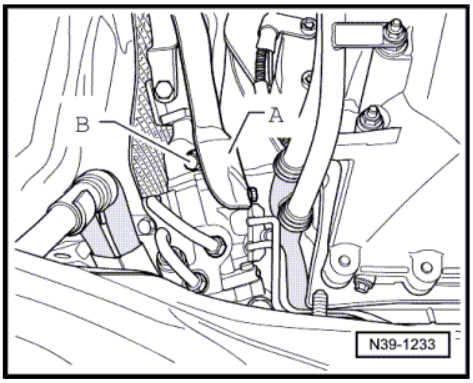
– Unscrew 2 bolts and remove heat shield -A- from steering box.

Caution

Coil connector for airbag MUST NOT be turned.

- *Make sure that front wheels are in straight-ahead position before removing universal joint from steering box.*
- *Fix steering wheel with adhesive tape to prevent steering wheel and steering box from being moved out of position.*



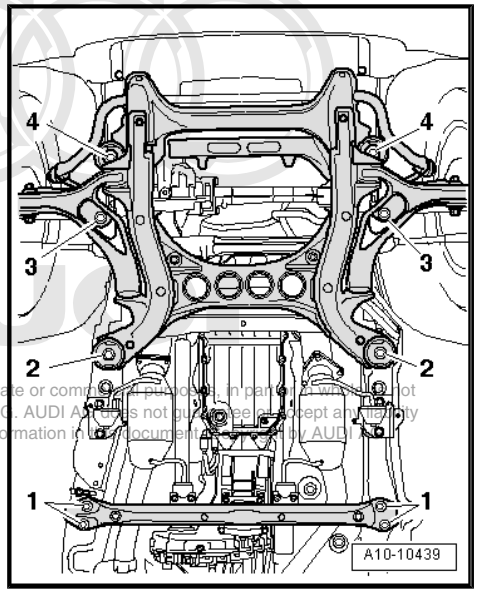
– Remove bolt -B- for universal joint ⇒ Rep. gr. 48 .

– Press off universal joint from steering box.

WARNING

Accident risk if subframe mountings are detached.

- *Do not loosen bolts -1, 3, 4- for subframe.*



– Remove bolts -2- prior to lowering subframe at the rear.

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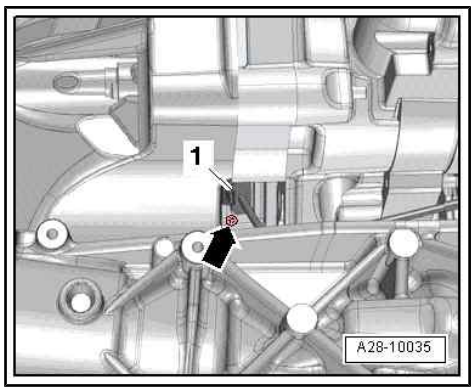
– Unplug electrical connector -1-.

– Remove bolt -arrow- and detach engine speed sender -G28- .



Installing

- Tightening torque ⇒ page 81

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

– Install subframe ⇒ Rep. gr. 40 .

– Fit universal joint to steering box ⇒ Rep. gr. 48 .

– Install bracket for noise insulation and noise insulation panels ⇒ Rep. gr. 66 .

– Deactivate jacking mode ⇒ Rep. gr. 43 .

1.5 Removing and installing Hall sender - G40-

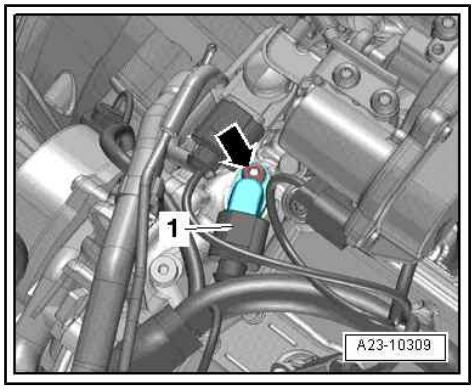
Removing

– Remove engine cover panel ⇒ page 13 .

– Remove intake manifold flap motor -V157- ⇒ page 24 .

– Unplug electrical connector -1-.

– Unscrew bolt -arrow- and remove Hall sender -G40- .



Installing

Install in reverse order.

- Tightening torque ⇒ page 81

– Install intake manifold flap motor -V157- ⇒ page 24 .