



Workshop Manual Audi A6 2005 ➤

TDI injection and glow plug system (4-cyl. 2.0 ltr. 4-valve common rail)

Engine ID	CAG B	CAH A	CAH B						
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Edition 08.2019

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List of Workshop Manual Repair Groups

Repair Group

23 - Mixture preparation - injection

28 - Glow plug system



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

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23 – Mixture preparation - injection

1 Safety precautions and rules for cleanliness

(ARL006575; Edition 08.2019)

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

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

Risk of injury if test equipment is not secured

If an accident occurs and the front passenger's airbag is triggered, test equipment which is not secured adequately may be catapulted through the vehicle with potentially serious consequences.

- Secure test equipment on the rear seat with a strap.

Or:

- Have a second mechanic operate test equipment on the rear seat.

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1.2 Safety precautions when working on the fuel supply system

When working on the fuel system note the following warnings:

Risk of injury - fuel system operates under high pressure

The fuel system is pressurised. There is a risk of injury as fuel may spray out.

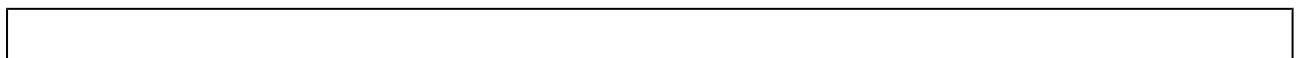
Before opening the fuel system:

- Put on safety goggles.
- Put on protective gloves.
- Release pressure (wrap a clean cloth around connection and open connection carefully).

Risk of fire due to escaping fuel

If the battery is connected, the door contact switch activates the fuel pump when the driver's door is opened. Escaping fuel may ignite, causing a fire.

- Before opening the fuel system, disconnect power supply to fuel pump.





Risk of injury - fuel system operates under high pressure

The fuel system is pressurised. There is a risk of injury as fuel may spray out.

Before opening the fuel system:

- Put on safety goggles.
- Put on protective gloves.
- Release pressure (wrap a clean cloth around connection and open connection carefully).

If components of the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the fuel system must be bled ⇒ ["5 Filling and bleeding fuel system", page 23](#) .

Risk of irreparable damage to fuel pump

After working on the fuel system, the fuel pump may be irreparably damaged if it is allowed to run while empty.

- Never allow fuel pump to run while it is empty.
- Fill/bleed fuel pump.

Risk of irreparable damage to electronic components

When disconnecting the battery there is a risk of irreparable damage to electronic components.

- Always switch off the ignition before disconnecting the battery.

1.3 To avoid any risk of injuries to persons and/or damage to the injection and glow plug system, always observe the following safety precautions:

- ◆ 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.
- ◆ During some of the tests the control unit may detect a fault and store it in the memory. The event memory should therefore be interrogated and, if necessary, erased after completing all tests and repair work.



1.4 Safety precautions when working on the exhaust system

Do not dismantle exhaust gas temperature sender - risk of injury.

Risk of injury when disconnecting the exhaust system

There is a risk of eye irritation caused by soot particles in the air.

- Put on safety goggles.

Danger from toxic exhaust gases

The auxiliary/supplementary heater produces toxic exhaust gases during operation. There is a risk of poisoning and of damage to the respiratory tract.

- In enclosed spaces, only switch on the auxiliary/supplementary heater if there is an exhaust extraction system.
- In enclosed spaces without an exhaust extraction system, switch off the auxiliary/supplementary heater.

Risk of damage to flexible joint

The flexible joint can be damaged or develop leaks if it is handled incorrectly.

- Do not bend flexible joint more than 10°.
- Install flexible joint so that it is not under tension.

1.5 Rules for cleanliness

Even small quantities of dirt can lead to defects. For this reason, please observe the following rules when working on the fuel supply system, injection system and turbocharger:

- ◆ Clean connections and surrounding area thoroughly with engine cleaner or brake cleaner and dry cleaned area before loosening.
- ◆ Immediately seal open lines and connections with clean plugs, for example from engine bung set - VAS 6122- .
- ◆ Do not remove sealing caps from components until immediately prior to installation. Keep components that are to be re-used in new, sealable plastic bags.
- ◆ After removal, place parts on a clean surface and cover them. **Only use lint-free cloths.**
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have not been stored in the proper packaging (e.g. in tool boxes etc.).



- ◆ Do not work with compressed air when the system is open. If possible, do not move vehicle.
- ◆ Make sure that no fuel runs onto the fuel hoses. Should this occur, the fuel hoses must be cleaned again immediately.
- ◆ 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.
- ◆ Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

1.6 General notes

- ◆ The engine control unit has a self-diagnosis capability. Before carrying out repairs and fault finding, the event memory must be interrogated. The vacuum hoses and connections must also be checked (unmetered air).
- ◆ A voltage of at least 11.5 V is required for proper operation of the electrical components.
- ◆ Do not use sealants containing silicone. Particles of silicone drawn into the engine will not be burnt in the engine and will damage the Lambda probe.
- ◆ The vehicles are fitted with a crash/fuel shut-off system. This system is designed to reduce the risk of a vehicle fire after a crash by deactivating the fuel pump via the fuel pump relay.
- ◆ At the same time, this system also improves the engine's starting performance. When the driver's door is opened, the fuel pump is activated for two seconds in order to build up pressure in the fuel system.

1.7 General repair instructions

If components of the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the fuel system must be bled ⇒ ["5 Filling and bleeding fuel system", page 23](#) .

Risk of irreparable damage to fuel pump

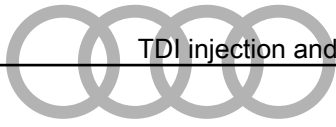
After working on the fuel system, the fuel pump may be irreparably damaged if it is allowed to run while empty.

- Never allow fuel pump to run while it is empty.

- Fill/bleed fuel pump.

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- ◆ Clean tools and workbench etc. before working on the injection system.
- ◆ Before installing, check the injectors and their surroundings visually; they must be undamaged and clean. 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 the high-pressure fuel lines are to be re-used, you must mark them before removal. High-pressure pipes must always be re-installed on the same cylinder.
- ◆ Take care not to damage the injectors when removing the old copper seals.
- ◆ Check all new O-rings for damage before installing. Lubricate O-rings with engine oil or assembly oil before installing.



- ◆ Position high-pressure pipes so they are free of stress. 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 fuel return hoses 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 fuel return hoses are seated securely and sealed properly by pulling them by hand from above.
- ◆ Do not dismantle individual common rail components. If there is a fault, the complete components must be renewed.
- ◆ When the engine is running, do not perform any repairs to the common rail system.
- ◆ Do not bleed the common rail system by unfastening high-pressure components after the engine has been started.
- ◆ All cable ties which are released or cut open when removing must be refitted in the same position when installing.
- ◆ Fuel hoses in engine compartment must only be secured with spring-type clips. O-type clips or screw-type clips must not be used.

1.8 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 fitted.

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 .

Please note:

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

1.9 Routing and attachment of pipes, hoses and wiring

- ◆ Mark fuel lines, hydraulic lines, vacuum lines, lines for activated charcoal filter and electrical wiring etc. before removal so they can be re-installed in the original positions and correctly connected. Make sketches or take photographs if necessary.
- ◆ Because of the limited space in the engine compartment, it is important to ensure that there is adequate clearance to any moving or hot components to avoid damage to lines and wiring.

1.10 Installing radiators and condensers

Even when the radiator, condenser and charge air cooler are correctly installed, slight impressions may be visible on the fins of these components. This does not mean that the components are

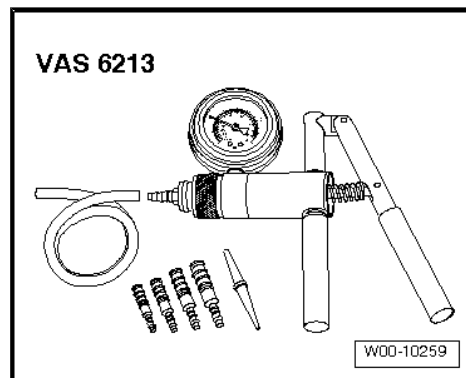


damaged. If the fins are only very slightly distorted, this does not justify renewal of the radiator, charge air cooler or condenser.

1.11 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:

- ◆ Cracks

- ◆ Traces of animal bites

- ◆ Kinked or crushed lines

- ◆ Porous or leaking lines

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

- If an entry is stored in the event memory, check the vacuum lines leading to the corresponding component and also check the other vacuum lines leading to other components.

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



2 Overview of fitting locations - injection system

Components A to I are not shown on the exploded view.

1 - Lambda probe - G39- with Lambda probe heater - Z19-

- ☐ Fitting location
⇒ [page 15](#)
- ☐ Removing and installing
⇒ [page 65](#)

2 - Exhaust gas temperature sender 3 - G495-

- ☐ Fitting location
⇒ [page 15](#)
- ☐ Removing and installing
⇒ Rep. gr. 26

3 - Fuel filter

- ☐ Removing and installing
⇒ Rep. gr. 20

4 - Electrical connector for exhaust gas temperature sender 3 - G495-

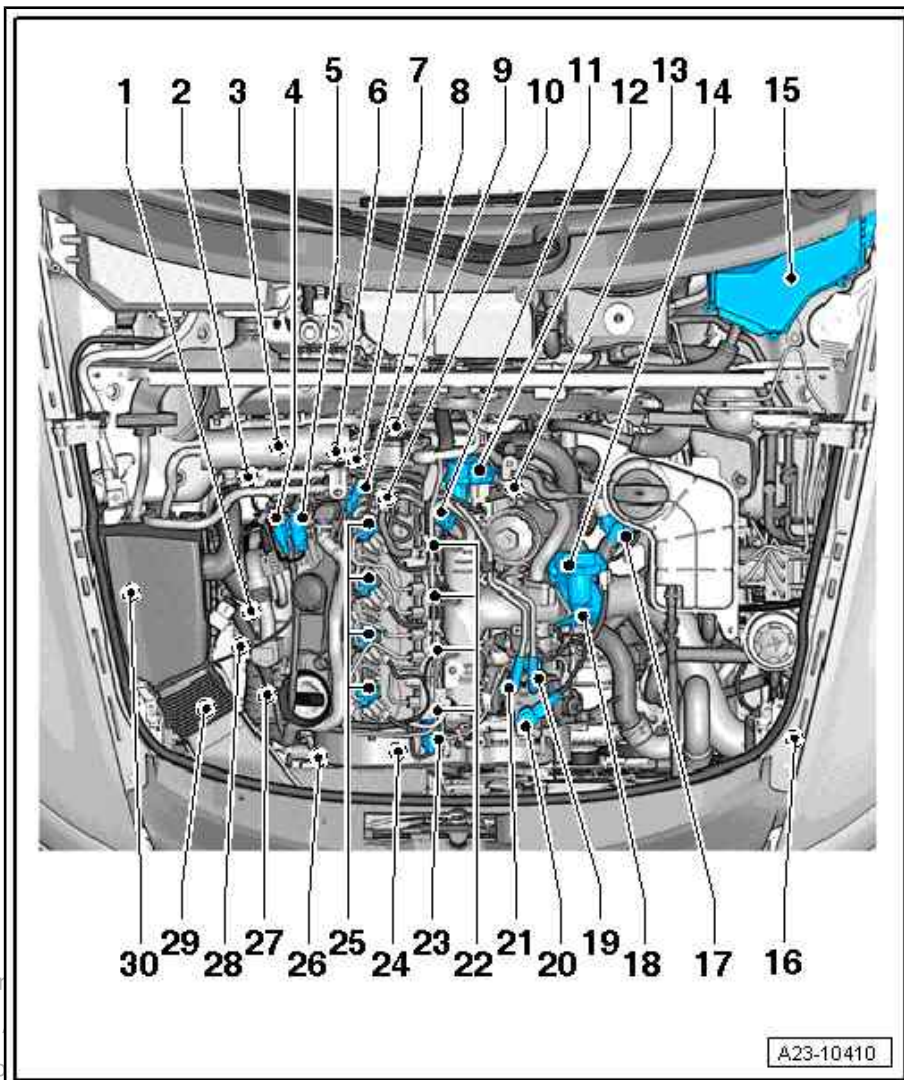
- ☐ Fitting location
⇒ [page 15](#)
- ☐ Removing and installing
⇒ Rep. gr. 26

5 - Connector for Lambda probe - G39-

- ☐ Fitting location
⇒ [page 15](#)

6 - Exhaust gas pressure sensor 1 - G450-

- ☐ Fitting location
⇒ [page 12](#)
- ☐ Adaption must be performed after renewing



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this component

- ❑ Removing and installing
⇒ ["12.3 Removing and installing exhaust gas pressure sensor 1 G450", page 66](#)

7 - Radiator outlet coolant temperature sender - G83-

- ❑ Fitting location ⇒ [page 12](#)
- ❑ Removing and installing ⇒ Rep. gr. 19

8 - Fuel temperature sender - G81-

- ❑ Fitting location ⇒ [page 15](#)

9 - Coolant temperature sender - G62-

- ❑ Fitting location ⇒ [page 12](#)
- ❑ Removing and installing ⇒ Rep. gr. 19

10 - Pressure retention valve

- ❑ Fitting location ⇒ [page 15](#)
- ❑ 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
- ❑ The pressure retention valve may only be renewed together with the fuel return lines.
- ❑ After renewing component, fuel system must be bled ⇒ ["5 Filling and bleeding fuel system", page 23](#)
- ❑ Checking pressure retention valve ⇒ [page 55](#)

11 - Fuel pressure regulating valve - N276-

- ❑ After renewing high-pressure pump and/or fuel pressure regulating valve - N276-, the learnt values must be reset. The procedure is described in [\[Guided Fault Finding\]](#) or [\[Guided Functions\]](#); use ⇒ Vehicle diagnostic tester.
- ❑ Guided Functions are not available for certain engine versions because it is not necessary to reset the learned values on these engines.
- ❑ Fitting location ⇒ [page 13](#)
- ❑ Removing and installing ⇒ [page 57](#)
- ❑ 80 Nm

12 - Intake manifold flap motor - V157-

- ❑ With intake manifold flap potentiometer - G336-
- ❑ Fitting location ⇒ [page 13](#)

13 - Engine speed sender - G28-

- ❑ Fitting location ⇒ [page 13](#)
- ❑ Removing and installing ⇒ [page 75](#)
- ❑ 4.5 Nm

14 - Throttle valve module - J338-

- ❑ With throttle valve potentiometer - G69-
- ❑ Fitting location ⇒ [page 11](#)
- ❑ Exploded view - intake manifold ⇒ [page 27](#)

15 - Engine control unit - J623-

- ❑ Fitting location ⇒ [page 10](#)
- ❑ Removing and installing ⇒ [page 63](#)

16 - Charge pressure sender - G31-

- ❑ Combined with intake air temperature sender - G42-
- ❑ Fitting location ⇒ [page 13](#)
- ❑ Removing and installing ⇒ Rep. gr. 21

17 - Pump for exhaust gas recirculation cooler - V400-

- ❑ Fitting location ⇒ [page 12](#)
- ❑ Removing and installing ⇒ Rep. gr. 19



18 - Exhaust gas recirculation valve - N18- with exhaust gas recirculation potentiometer - G212-

- ☐ Fitting location ⇒ [page 11](#)
- ☐ Exploded view - exhaust gas recirculation system ⇒ Rep. gr. 26

19 - Fuel return line connection

20 - High-pressure fuel pump with fuel metering valve - N290-

- ☐ Do not open fuel metering valve - N290-
- ☐ After renewing high-pressure pump and/or fuel pressure regulating valve - N276- , the learnt values must be reset. The procedure is described in [Guided Fault Finding](#) or [Guided Functions](#); use ⇒ Vehicle diagnostic tester.
- ☐ Guided Functions are not available for certain engine versions because it is not necessary to reset the learned values on these engines.
- ☐ Removing and installing ⇒ [page 35](#)

21 - Fuel supply line connection

22 - Glow plugs

- ☐ Glow plug 1 - Q10-
- ☐ Glow plug 2 - Q11-
- ☐ Glow plug 3 - Q12-
- ☐ Glow plug 4 - Q13-
- ☐ 17 Nm
- ☐ Fitting location ⇒ [page 14](#)
- ☐ Removing and installing ⇒ [page 73](#)

23 - Fuel pressure sender - G247-

- ☐ Fitting location ⇒ [page 11](#)
- ☐ Removing and installing ⇒ [page 59](#)
- ☐ 100 Nm

24 - Hall sender - G40- (camshaft position sensor)

- ☐ Fitting location ⇒ [page 12](#)
- ☐ Removing and installing ⇒ [page 76](#)
- ☐ 10 Nm

25 - Injectors

- ☐ Fitting location ⇒ [page 14](#)
- ☐ Removing and installing ⇒ [page 44](#)

26 - Charge pressure control solenoid valve - N75-

- ☐ Fitting location ⇒ [page 14](#)

27 - Position sender for charge pressure positioner - G581-

- ☐ Fitting location ⇒ [page 14](#)

28 - Bracket with the following electrical connectors

- ☐ Exhaust gas temperature sender 1 - G235-
- ☐ Air filter bypass flap valve - N275-
- ☐ Exhaust gas recirculation cooler changeover valve - N345-
- ☐ Fitting locations ⇒ [page 14](#)

29 - Air mass meter - G70-

- ☐ Removing and installing ⇒ [page 52](#)

30 - Air filter bypass flap valve - N275-

- ☐ These components (bypass flap with air filter bypass flap valve - N275-) are not installed on certain equipment versions or on vehicles for certain export markets
- ☐ Fitting location of electrical connector ⇒ [page 14](#)
- ☐ Exploded view - air cleaner ⇒ [page 24](#)



A - Relay and fuse holder in electronics box in plenum chamber (left-side)

- ☐ Fitting location ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

B - Low heat output relay - J359- and high heat output relay - J360-

- ☐ Fitting location ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

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

- ☐ Fitting location ⇒ [page 11](#)
- ☐ In footwell on brake pedal

D - Clutch position sender - G476-

- ☐ Fitting location ⇒ [page 11](#)
- ☐ Only fitted on vehicles with manual gearbox

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

- ☐ Fitting location ⇒ [page 11](#)
- ☐ Removing and installing ⇒ Rep. gr. 20

F - Supplementary fuel pump - V393-

- ☐ Removing and installing ⇒ Rep. gr. 20
- ☐ Fitting location ⇒ [page 13](#)

G - Exhaust gas temperature sender 1 - G235-

- ☐ Fitting location on turbocharger ⇒ [page 15](#)
- ☐ 45 Nm
- ☐ Removing and installing ⇒ Rep. gr. 26

H - Exhaust gas temperature sender 4 - G648-

- ☐ Fitting location ⇒ [page 15](#)
- ☐ 45 Nm
- ☐ Removing and installing ⇒ Rep. gr. 26

I - Particulate filter

- ☐ Fitted on underbody
- ☐ With integrated catalytic converter
- ☐ Adaption must be performed after renewing this component
- ☐ Removing and installing ⇒ Rep. gr. 26

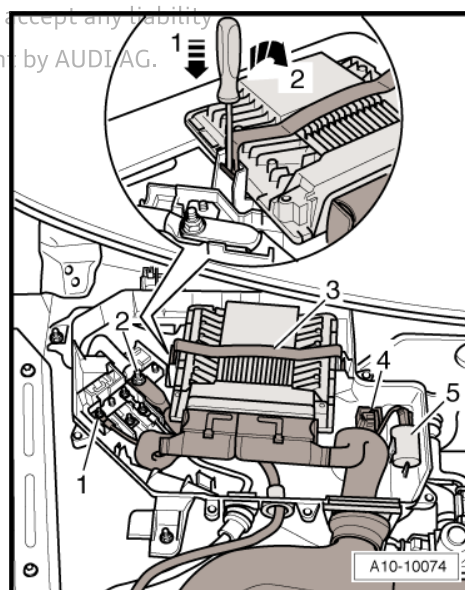
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After renewing exhaust gas pressure sensor 1 - G450- and/or particulate filter, adaption must be performed in order to reset learnt values. The adaption procedure is described in the Guided Fault Finding or Guided Functions; use a vehicle diagnostic tester.

Fitting location of engine control unit - J623-

Removing and installing

⇒ ["13 Renewing engine control unit J623", page 68](#)





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

◆ In accelerator pedal module -arrow-



Note

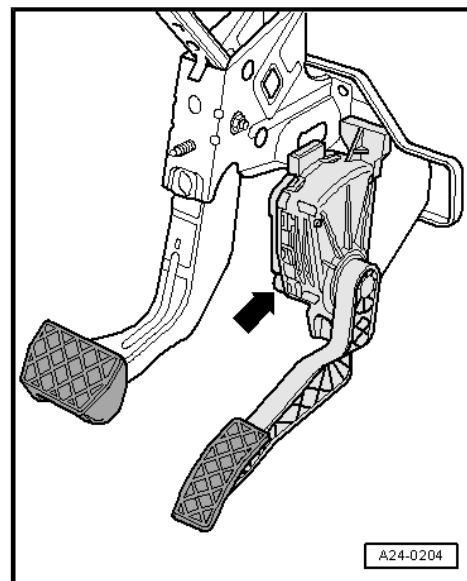
The accelerator position sender - G79- and accelerator position sender 2 - G185- are integrated in the accelerator pedal module and cannot be renewed individually.

Removing and installing ⇒ Rep. gr. 20



Note

The accelerator position sender - G79- and accelerator position sender 2 - G185- are integrated in the accelerator pedal module and cannot be renewed individually.



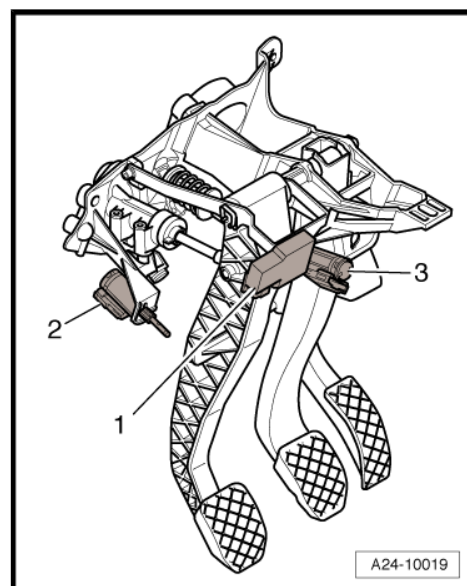
Pedal bracket

- 1 - Clutch position sender - G476-
- 2 - Clutch pedal switch for engine start - F194- and clutch pedal switch - F36- (manual gearbox only)
- 3 - Brake light switch - F- / brake pedal switch - F47-



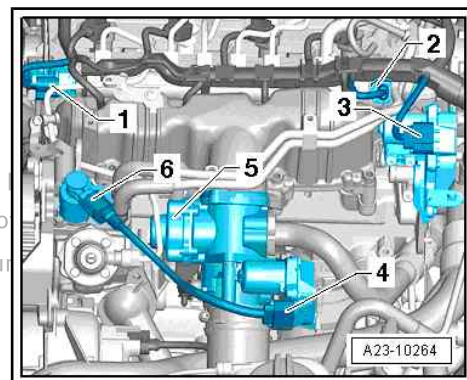
Note

Switches must not be installed more than once, otherwise they may not fit securely.



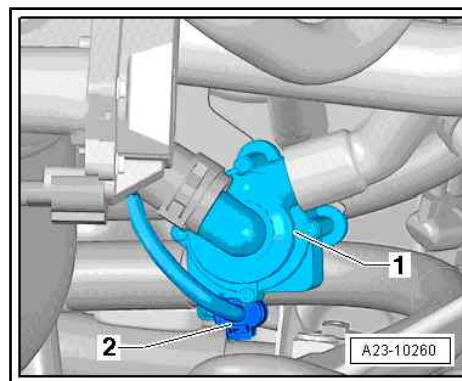
Fitting locations

- 1 - Fuel pressure sender - G247-
- 2 - Fuel pressure regulating valve - N276-
- 3 - Intake manifold flap motor - V157- with intake manifold flap potentiometer - G336-
- 4 - Throttle valve module - J338- with throttle valve potentiometer - G69-
- 5 - Exhaust gas recirculation valve - N18- with exhaust gas recirculation potentiometer - G212-
- 6 - Fuel metering valve - N290-





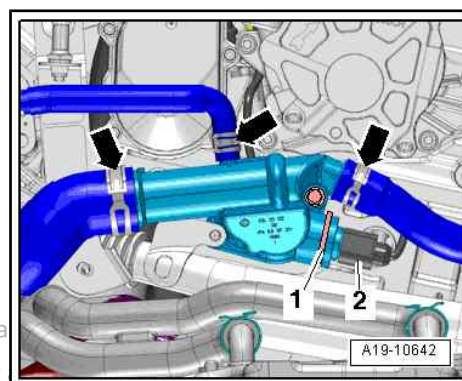
Pump for exhaust gas recirculation cooler - V400-



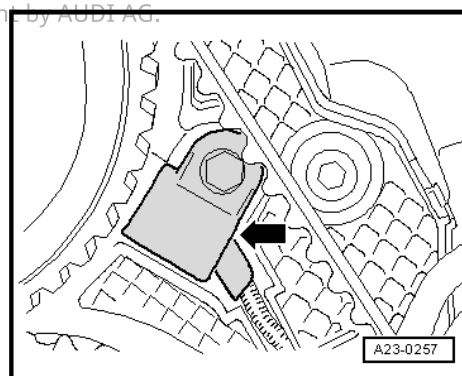
Coolant temperature sender - G62-



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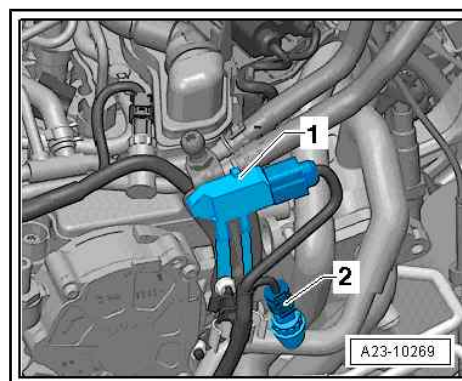
Hall sender - G40-



Components at rear of engine

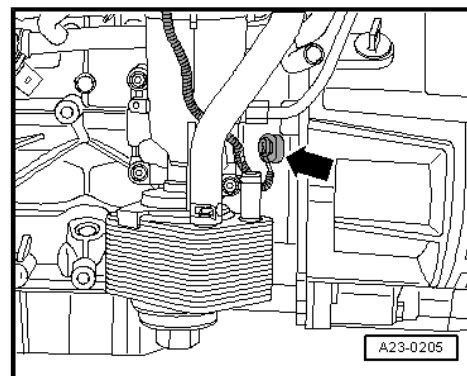
1 - Exhaust gas pressure sensor 1 - G450-

2 - Radiator outlet coolant temperature sender - G83-





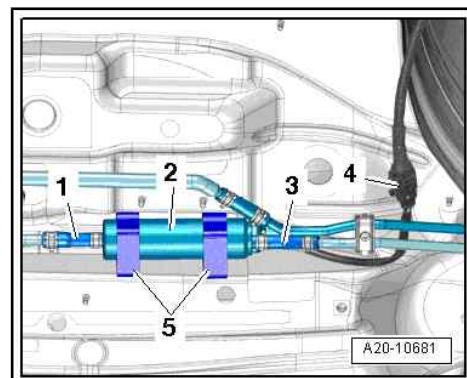
Engine speed sender - G28- -arrow-



Component on underbody

2 - Supplementary fuel pump - V393-

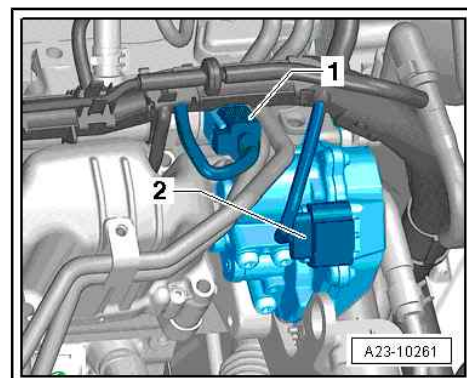
4 - Electrical connector for supplementary fuel pump - V393-



Components

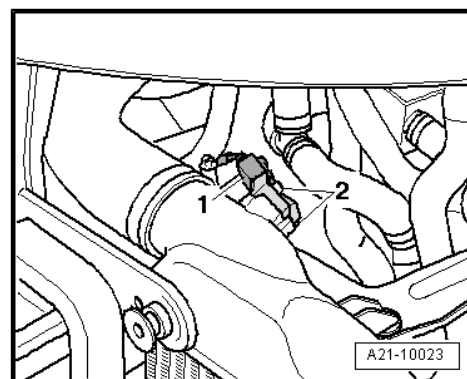
1 - Fuel pressure regulating valve - N276-

2 - Intake manifold flap motor - V157-



Charge pressure sender - G31- with intake air temperature sender - G42- -1-

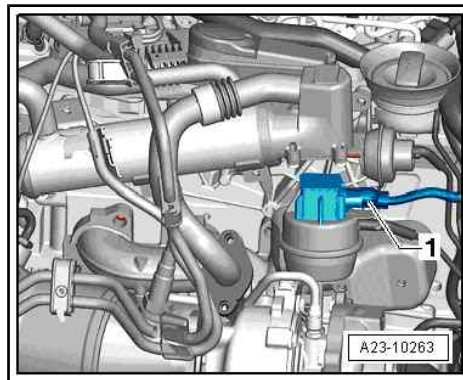
Combined in one unit



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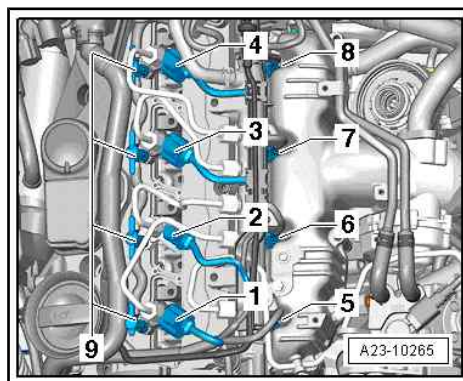


Position sender for charge pressure positioner - G581- -1-



Injectors and glow plugs

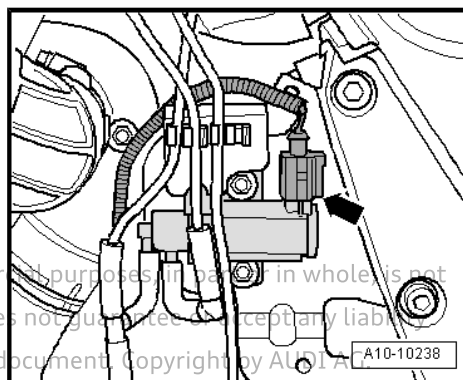
- 1 - Injector, cylinder 1 - N30-
- 2 - Injector, cylinder 2 - N31-
- 3 - Injector, cylinder 3 - N32-
- 4 - Injector, cylinder 4 - N33-
- 5 - Glow plug 1 - Q10-
- 6 - Glow plug 2 - Q11-
- 7 - Glow plug 3 - Q12-
- 8 - Glow plug 4 - Q13-
- 9 - Fuel return line connections



Charge pressure control solenoid valve - N75- -arrow-

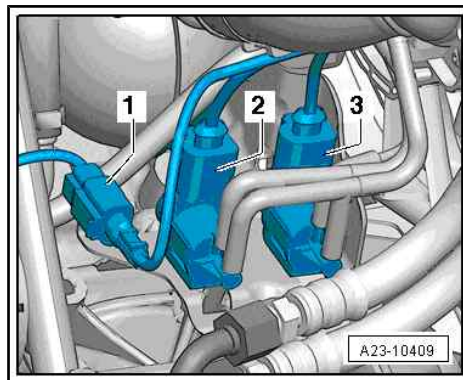


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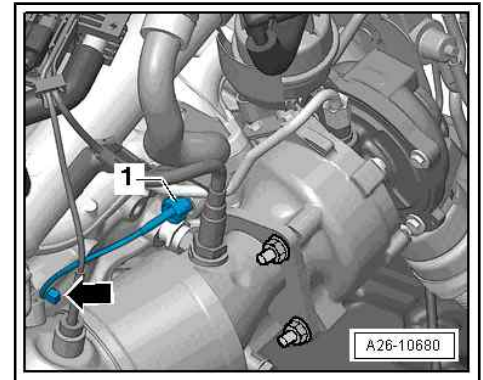
Electrical connectors

- 1 - Exhaust gas temperature sender 1 - G235-
- 2 - Air filter bypass flap valve - N275-
- 3 - Exhaust gas recirculation cooler change-over valve - N345-



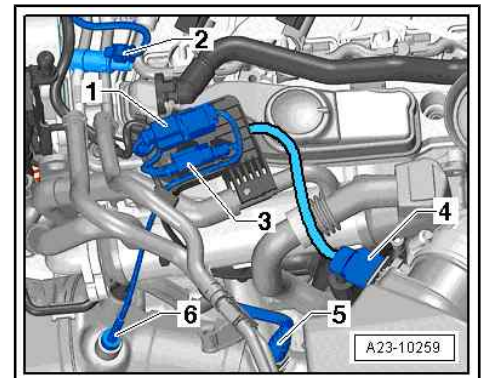


Exhaust gas temperature sender 1 - G235- -1-



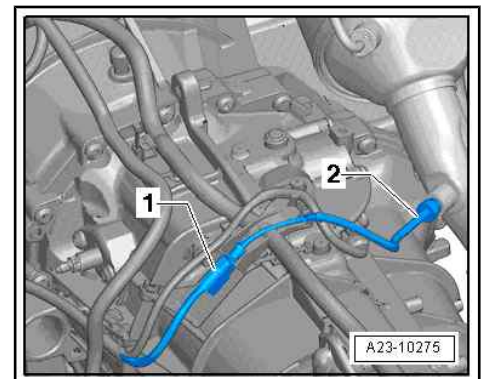
Components

- 1 - Electrical connector for Lambda probe - G39- with Lambda probe heater - Z19-
- 2 - Fuel temperature sender - G81-
- 3 - Electrical connector for exhaust gas temperature sender 3 - G495-
- 4 - Air mass meter - G70-
- 5 - Lambda probe - G39- with Lambda probe heater - Z19-
- 6 - Exhaust gas temperature sender 3 - G495-



Exhaust gas temperature sender 4 - G648- -2-

- 1 - Electrical connector for exhaust gas temperature sender 4 - G648-



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3 Overview - fuel system



Caution

The high-pressure pump has very close tolerances and must not be allowed to run without fuel. To prevent this and to enable the engine to start 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 fuel system must be bled
⇒ **"5 Filling and bleeding fuel system", page 23** .*
- ◆ *If the high-pressure pump is removed or renewed, the first fuel filling operation must be performed before the engine is started for the first time
⇒ **"5 Filling and bleeding fuel system", page 23** .*



Note

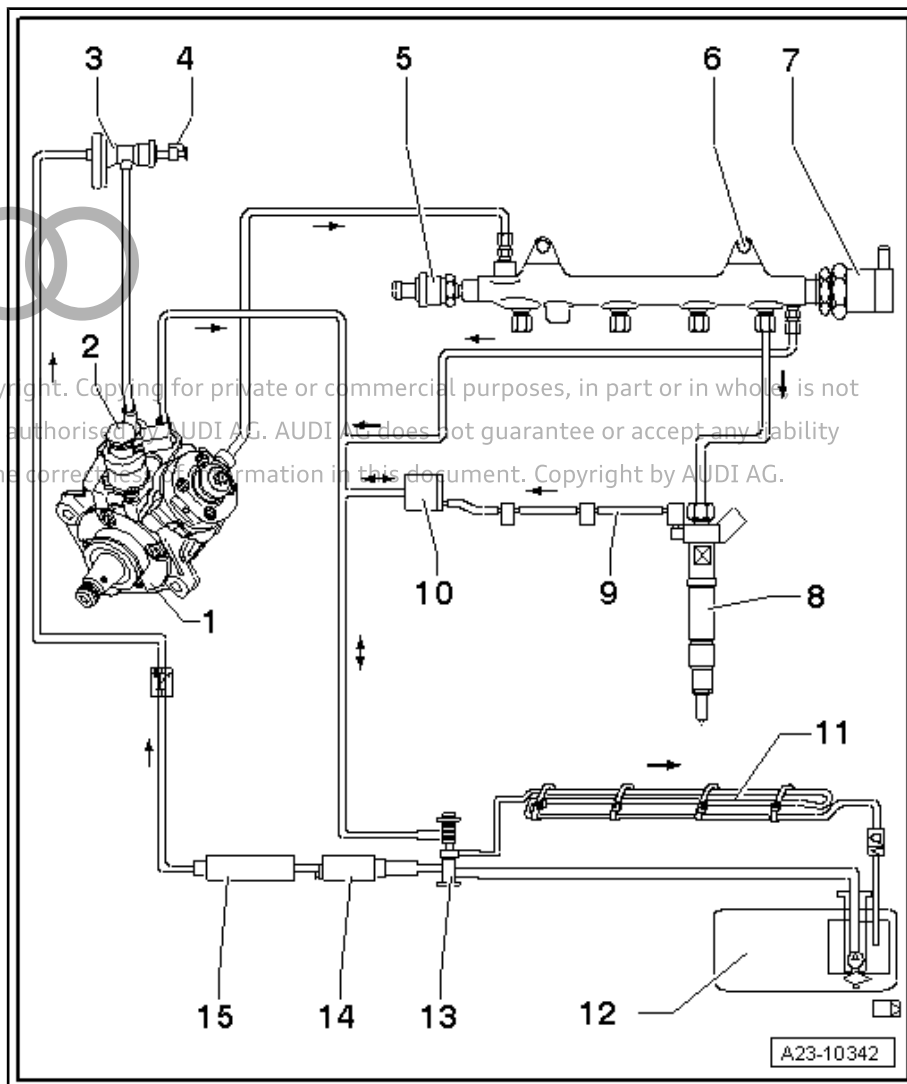
The high-pressure pump will be damaged if the first fuel filling operation is not performed.

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1 - High-pressure fuel pump

- ❑ After renewing, first fuel filling operation **MUST** be performed (it is important not to allow pump to run while it is still empty)
⇒ **"5 Filling and bleeding fuel system", page 23**
- ❑ After renewing high-pressure pump and/or fuel pressure regulating valve - N276-, the learnt values must be reset. The procedure is described in **Guided Fault Finding** or **Guided Functions**; use ⇒ Vehicle diagnostic tester.
- ❑ Guided Functions are not available for certain engine versions because it is not necessary to reset the learnt values on these engines.
- ❑ Removing and installing





⇒ [page 35](#)

2 - Fuel metering valve - N290-

- ☐ Do not unscrew

3 - Filter strainer

4 - Fuel temperature sender - G81-

5 - Fuel pressure sender - G247-

- ☐ Cannot be re-installed
- ☐ 100 Nm
- ☐ Removing and installing ⇒ [page 59](#)

6 - Fuel rail (high-pressure reservoir)

7 - Fuel pressure regulating valve - N276-

- ☐ Cannot be re-installed
- ☐ After renewing high-pressure pump and/or fuel pressure regulating valve - N276-, the learnt values must be reset. The procedure is described in [\[Guided Fault Finding\]](#) or [\[Guided Functions\]](#); use ⇒ Vehicle diagnostic tester.
- ☐ Guided Functions are not available for certain engine versions because it is not necessary to reset the learned values on these engines.
- ☐ Removing and installing ⇒ [page 57](#)
- ☐ 80 Nm

8 - Injectors

- ☐ Removing and installing ⇒ [page 44](#)

9 - Fuel return lines

- ☐ The fuel return lines must not be dismantled; if necessary they must be renewed complete 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.

10 - Pressure retention valve

- ☐ 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 injectors
- ☐ The pressure retention valve may only be renewed together with the fuel return lines.
- ☐ After renewing component, fuel system must be bled ⇒ [“5 Filling and bleeding fuel system”, page 23](#)
- ☐ Checking pressure retention valve ⇒ [page 55](#)

11 - Fuel cooler

- ☐ Fitted on underbody

12 - Fuel tank

- ☐ With fuel system pressurisation pump - G6-

13 - Preheating valve

14 - Supplementary fuel pump - V393-

15 - Fuel filter

- ☐ Exploded view - fuel filter ⇒ Rep. gr. 20
- ☐ Renewing fuel filter ⇒ Rep. gr. 20



4 Exploded view - fuel system



Caution

The high-pressure pump has very close tolerances and must not be allowed to run without fuel. To prevent this and to enable the engine to start 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 fuel system must be bled
⇒ **"5 Filling and bleeding fuel system", page 23**.*
- ◆ *If the high-pressure pump is removed or renewed, the first fuel filling operation must be performed before the engine is started for the first time
⇒ **"5 Filling and bleeding fuel system", page 23**.*



Note

The high-pressure pump will be damaged if the first fuel filling operation is not performed.

**1 - Bolt**

- 10 Nm

2 - High-pressure pipe

- 25 Nm
- Between high-pressure pump and fuel rail

3 - Fuel return lines

- To fuel tank
- Fuel return line must not be kinked, damaged or clogged
- The fuel return lines must not be dismantled; if necessary they must be renewed complete with pressure retention valve.
- 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 injectors
- Checking pressure retention valve
⇒ [page 55](#)
- After renewing component, fuel system must be bled
⇒ ["5 Filling and bleeding fuel system", page 23](#)

4 - Bolt

- 10 Nm

5 - High-pressure pipes

- 25 Nm
- Between high-pressure reservoir and injectors
- Do not interchange
- Install free of stress

6 - Fuel pressure regulating valve - N276-

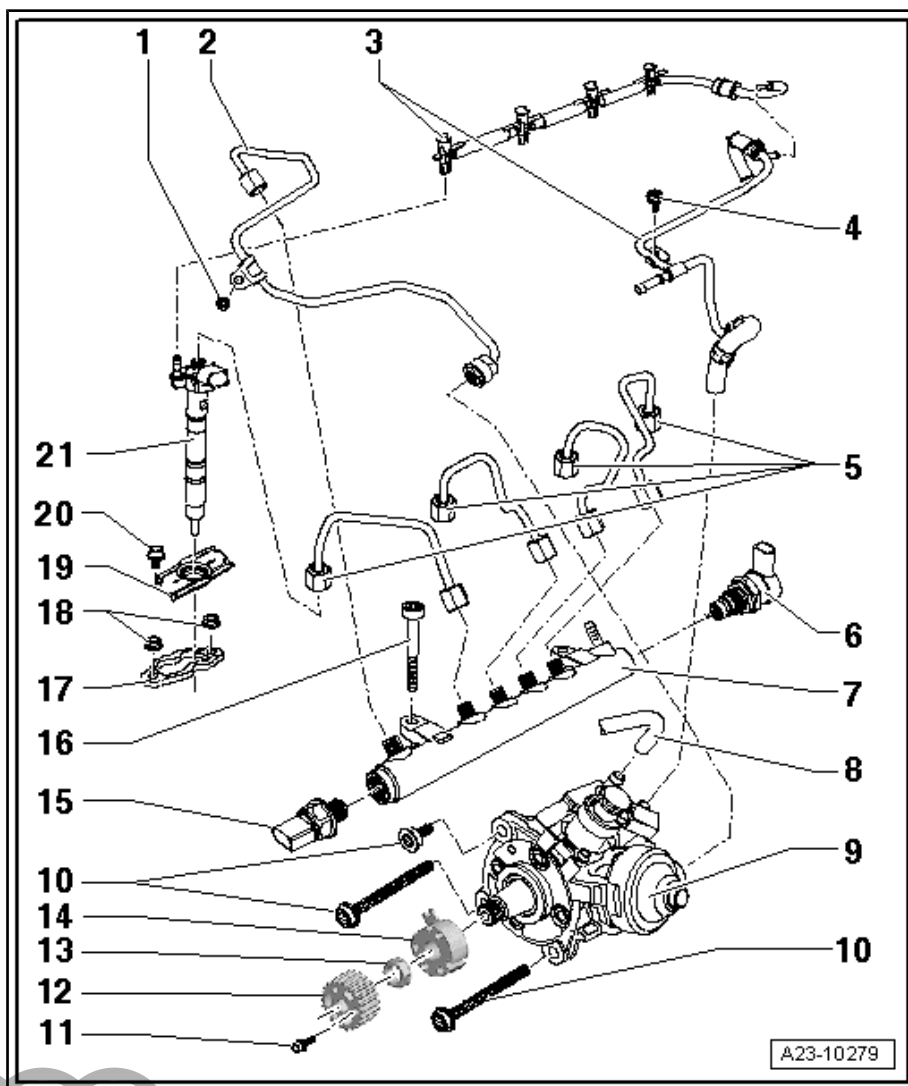
- Cannot be re-installed
- After renewing high-pressure pump and/or fuel pressure regulating valve - N276-, the learnt values must be reset. The procedure is described in [\[Guided Fault Finding\]](#) or [\[Guided Functions\]](#); use ⇒ Vehicle diagnostic tester.
- Guided Functions are not available for certain engine versions because it is not necessary to reset the learned values on these engines.
- Removing and installing ⇒ [page 57](#)
- 80 Nm

7 - Fuel rail (high-pressure reservoir)

- Removing and installing ⇒ [page 32](#)

8 - Fuel supply line**9 - High-pressure pump**

- After renewing high-pressure pump and/or fuel pressure regulating valve - N276-, the learnt values must be reset. The procedure is described in [\[Guided Fault Finding\]](#) or [\[Guided Functions\]](#); use ⇒ Vehicle diagnostic tester.





- ☐ Guided Functions are not available for certain engine versions because it is not necessary to reset the learned values on these engines.
- ☐ With fuel metering valve - N290- (do not open)
- ☐ After renewing, first fuel filling operation **MUST** be performed (it is important not to allow pump to run while it is still empty) ⇒ [“5 Filling and bleeding fuel system”, page 23](#)
- ☐ Removing and installing ⇒ [page 35](#)

10 - Bolt

- ☐ Renew
- ☐ 20 Nm
- ☐ Turn long bolts 180° further
- ☐ Turn short bolts 45° further

11 - Bolt

- ☐ 20 Nm

12 - High-pressure pump sprocket

13 - Nut

- ☐ 95 Nm

14 - Hub

- ☐ With sender wheel
- ☐ Use counterhold tool - T10051- to loosen and tighten
- ☐ To remove, use puller - T40064-

15 - Fuel pressure sender - G247-

- ☐ Always renew after removing
- ☐ 100 Nm
- ☐ Removing and installing ⇒ [page 59](#)

16 - Bolt

- ☐ 22 Nm

17 - Clamping piece

- ☐ Renew

18 - Hexagon flange nut

- ☐ For clamping piece
- ☐ 10 Nm

19 - Cover for injector

20 - Bolt

- ☐ 5 Nm

21 - Injector

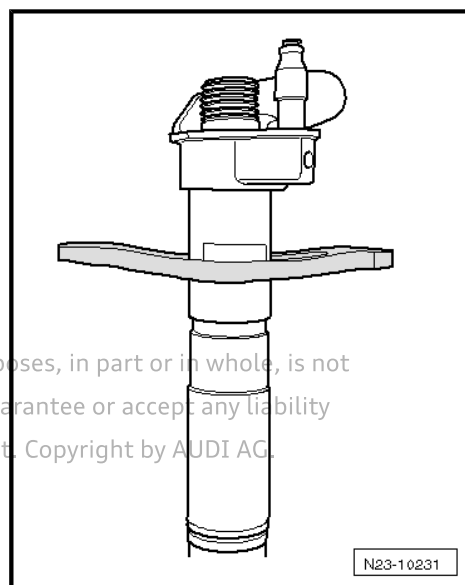
- ☐ Use a coloured pen to mark injectors and corresponding high-pressure pipes and cylinder for re-installation; pay attention to markings when installing
- ☐ Always renew copper seal when removing and installing
- ☐ To remove carbon deposits from the injector sealing surface, clean the injector bore in the cylinder head with cleaning kit - VAS 6811- (it is important to do this to avoid leaks)
- ☐ Removing and installing ⇒ [page 44](#)



Installation position of clamping piece



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5 Filling and bleeding fuel system

Special tools and workshop equipment required

- ◆ Vehicle diagnostic tester

If components of the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the fuel system must be bled.

Risk of irreparable damage to fuel pump

After working on the fuel system, the fuel pump may be irreparably damaged if it is allowed to run while empty.

- Never allow fuel pump to run while it is empty.
- Fill/bleed fuel pump.

Proceed as follows to fill high-pressure pump with fuel.

- Check fuel gauge in instrument cluster; fuel gauge needle must indicate that fuel is above reserve level.
- Connect vehicle diagnostic tester .
- Select Self diagnosis mode in ODIS.
- Select Start self diagnosis.
- Wait until the system is fully ready.
- Select the control unit 01 - Engine electronics.
- Select self-diagnosis function Basic setting.
- From the list of basic settings, select Transfer Fuel Pump (FP) test and click on  to add it to the selection list.
- Select the basic setting in the list again.
- Select Start/Stop to start or stop the basic setting process.
- The fuel pump starts running.
- The fuel pump must run for approx. 3 minutes to ensure that the fuel system is filled sufficiently with fuel.
- Start engine after filling fuel system.
- Run engine at moderate speed for several minutes and then switch off.
- Check fuel system for leaks.
- Road-test vehicle and accelerate with full throttle at least once.
- Then check high-pressure system again for leaks.
- Interrogate event memory.



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6 Air cleaner

⇒ "6.1 Exploded view - air cleaner", page 24

⇒ "6.2 Removing and installing engine cover panel", page 25

⇒ "6.3 Removing and installing air filter element", page 25

6.1 Exploded view - air cleaner

1 - Air hose

- ☐ To turbocharger

2 - Crankcase breather hose

3 - Vacuum hose

- ☐ From air filter bypass flap valve - N275- to vacuum unit for air cleaner bypass flap

4 - Air duct

- ☐ To wheel housing
- ☐ Clean out dirt and leaves, etc.

5 - Air duct

- ☐ To lock carrier
- ☐ Clean out dirt and leaves, etc.

6 - Bolt

- ☐ 1.5 Nm

7 - Air duct

- ☐ Clean out dirt and leaves, etc.

8 - Air cleaner (top section)

- ☐ Clean out salt deposits, dirt and leaves, etc.

9 - Air filter element

- ☐ Observe change intervals ⇒ Maintenance ; Booklet 405
- ☐ Removing and installing ⇒ [page 25](#)

10 - Air cleaner bypass flap

- ☐ These components (bypass flap with air filter bypass flap valve - N275-) are not installed on certain equipment versions or on vehicles for certain export markets

11 - Grommet

12 - Air cleaner (bottom section)

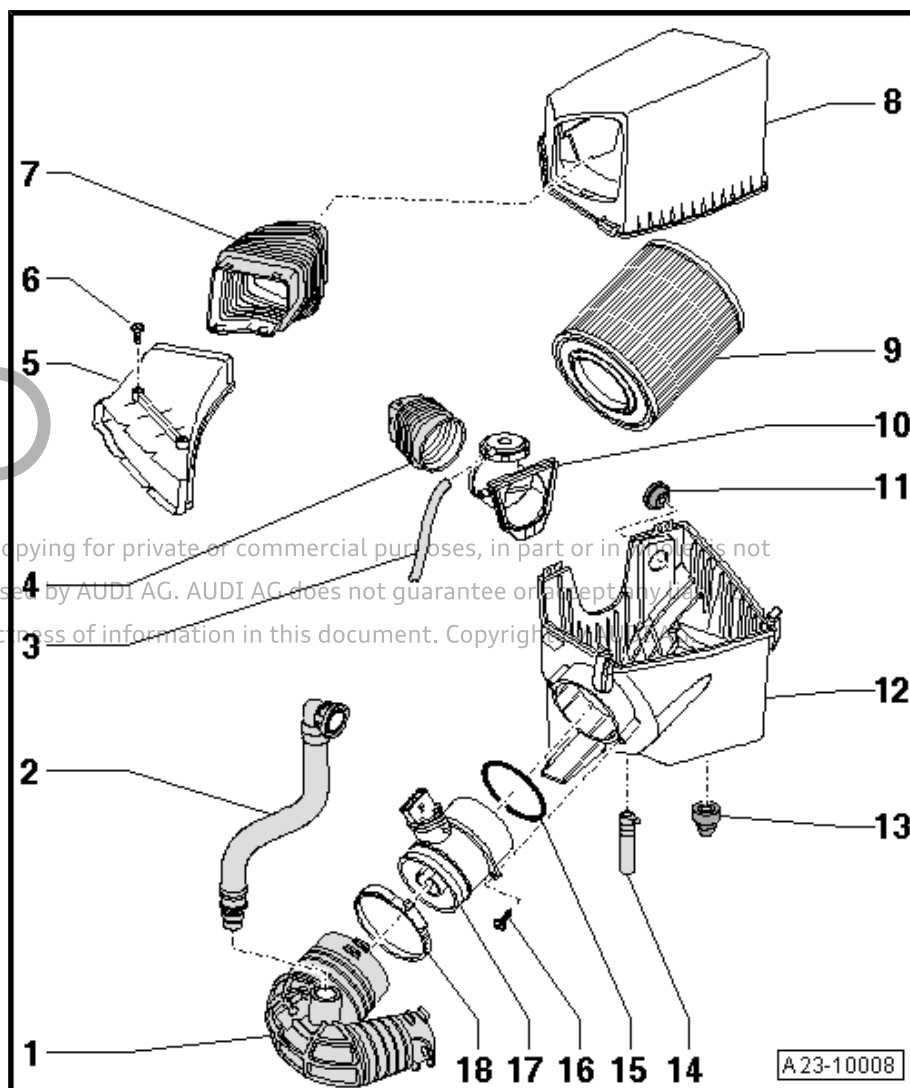
- ☐ Clean out salt deposits, dirt and leaves, etc.
- ☐ Blow out water drain (small hole in bottom section of air cleaner) with compressed air

13 - Grommet

14 - Breather hose

15 - O-ring

- ☐ Renew if damaged





16 - Bolt

- 1.5 Nm

17 - Air mass meter - G70-

- Removing and installing ⇒ [page 52](#)

18 - Hose clip

6.2 Removing and installing engine cover panel

Removing

- Carefully pull engine cover off 4 retaining pins one after another “arrows”. Do not jerk the cover panel away, and do not try to pull on one side only.

Installing

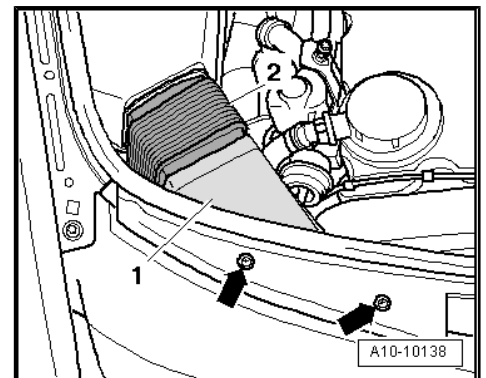
- To avoid damage, do not strike the engine cover panel with your fist or with any kind of tool.
- Position engine cover panel on engine (note locations of oil filler neck and oil dipstick).
- First press engine cover panel into rear rubber grommets and then into front rubber grommets with both hands.



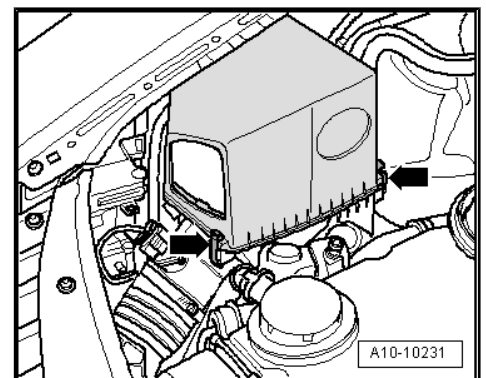
6.3 Removing and installing air filter element

Removing

- Remove bolts -arrows-.
- Remove air duct -1- and -2-.



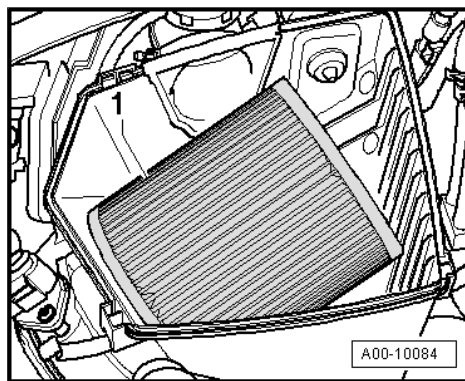
- Release clamps -arrows- and detach air cleaner (top section).



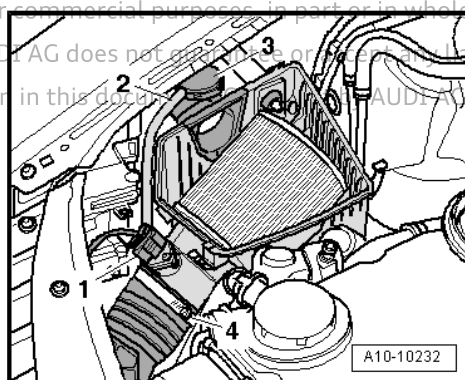


- Lift out air filter element -1-.

Removing air cleaner housing



- Unplug electrical connector -1- at air mass meter - G70- .
- Release hose clip -4- and remove air hose.
- Detach vacuum hose -2-.
- Lift off vacuum unit -3- with air flap from air cleaner housing.
- Disengage air cleaner (bottom section) from retaining pin and remove.



Installing

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 particles or water can reach the air mass meter - G70- and falsify the detected air mass values. This will cause a loss of power as the calculated injection quantities will be too low.*
- ◆ *Always use genuine air filter elements (same as original equipment).*
- ◆ *Use a silicone-free lubricant when installing the intake hose.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Check whether the water drain hose in the bottom section of the air cleaner is dirty or blocked (clean if necessary).
- Clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections); use a vacuum cleaner if necessary.
- Check air mass meter and intake hose (engine intake side) for salt residue, dirt and leaves.
- Check intake duct as far as air filter element for dirt.
- When installing air filter element, make sure it is positioned centrally on mounting in air cleaner (bottom section).
- Carefully fit air cleaner (top section) on air cleaner (bottom section) without applying any force. When fitting air cleaner (top section), make sure it is NOT positioned on air filter element at an angle. Note position of sealing lip on air filter element (to prevent air leaks).
- Then secure top section of air cleaner to bottom section.
- The remaining installation steps are carried out in the reverse sequence.



7 Intake manifold

⇒ "7.1 Exploded view - intake manifold", page 27

⇒ "7.2 Removing and installing intake manifold", page 27

⇒ "7.3 Removing and installing fuel rail", page 32

7.1 Exploded view - intake manifold

1 - Intake manifold

- ☐ With intake manifold flap motor - V157- and intake manifold flap potentiometer - G336- (combined in one component)
- ☐ With optimised intake air swirl
- ☐ Must not be dismantled

2 - Bolt

- ☐ 8 Nm

3 - Gasket

- ☐ Renew

4 - Seal

- ☐ Renew

5 - Connecting pipe

- ☐ To exhaust gas recirculation cooler

6 - Bolt

- ☐ 20 Nm

7 - Gasket

- ☐ Renew

8 - Bolt

- ☐ 10 Nm

9 - Throttle valve module - J338-

- ☐ With throttle valve potentiometer - G69-

10 - Bolt

- ☐ 10 Nm

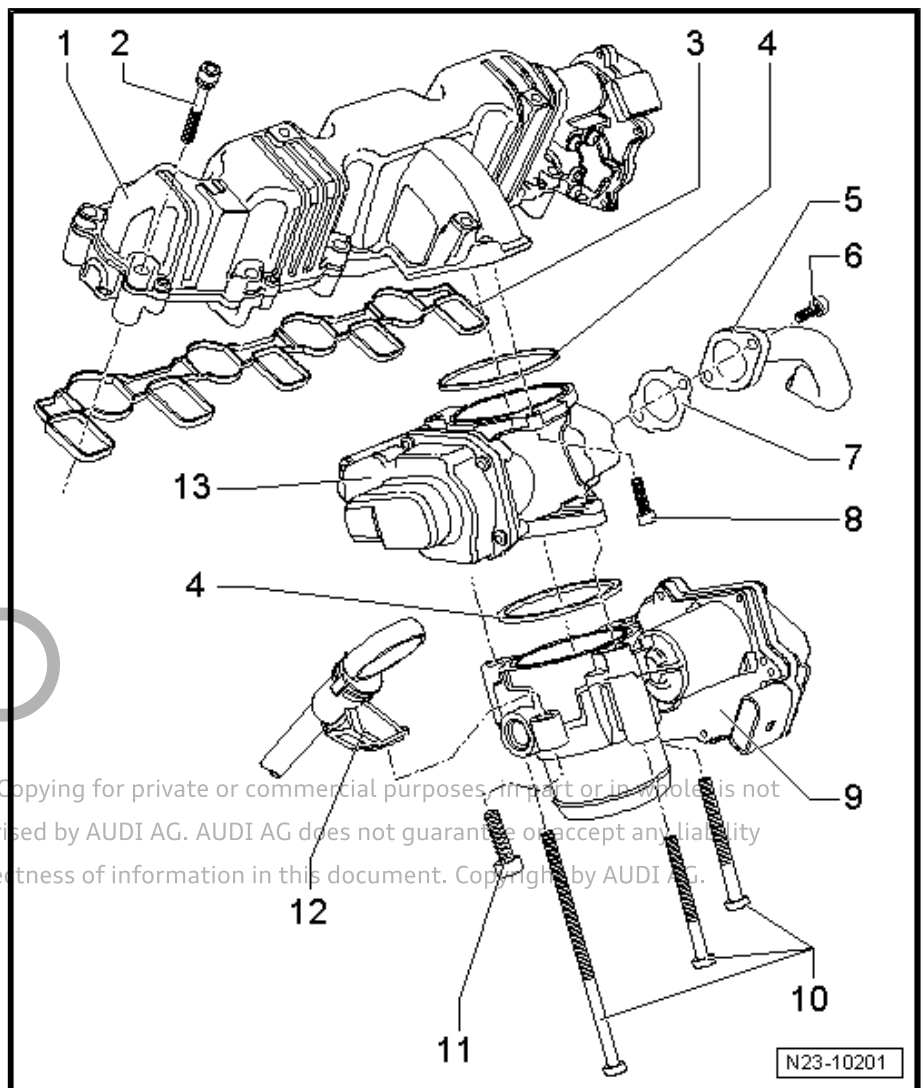
11 - Bolt

- ☐ 10 Nm

12 - Oil dipstick

13 - Exhaust gas recirculation valve - N18-

- ☐ With exhaust gas recirculation potentiometer - G212-



7.2 Removing and installing intake manifold

Special tools and workshop equipment required



◆ Torque wrench - V.A.G 1331-



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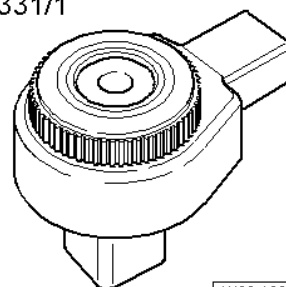
V.A.G 1331



W00-0427

◆ Ratchet - V.A.G 1331/1-

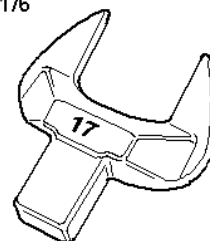
V.A.G 1331/1



W00-10045

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

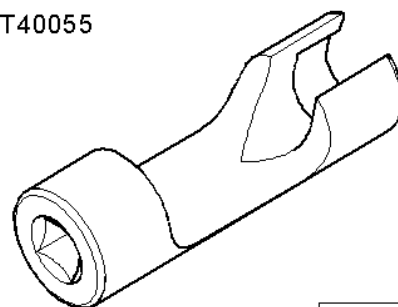
V.A.G 1331/6



W00-1126

◆ Socket - T40055-

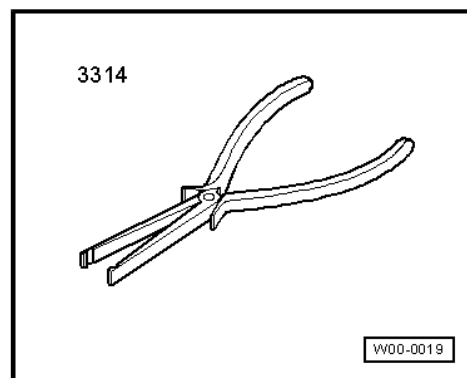
T40055



W00-10099



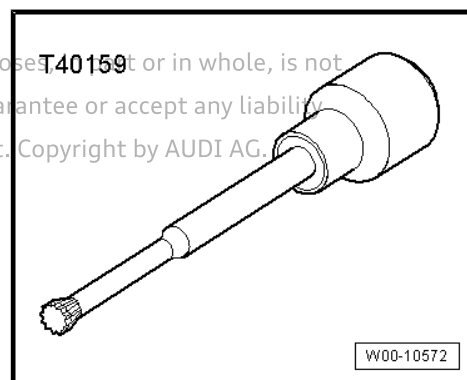
◆ Pliers - 3314-



Vehicles with aluminium intake manifold

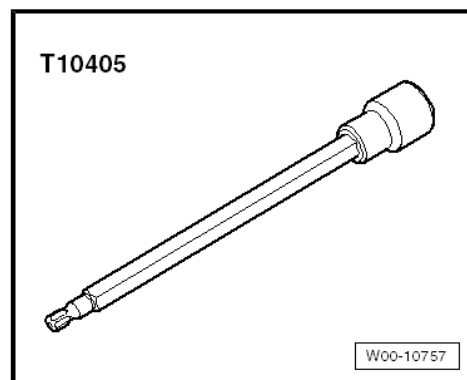
◆ Bit XZN 8 - T40159-

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Vehicles with plastic intake manifold

◆ Socket Torx T30 - T10405-



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.*

- Remove engine cover panel ⇒ [page 25](#).
- Take noise insulation off cylinder head cover.

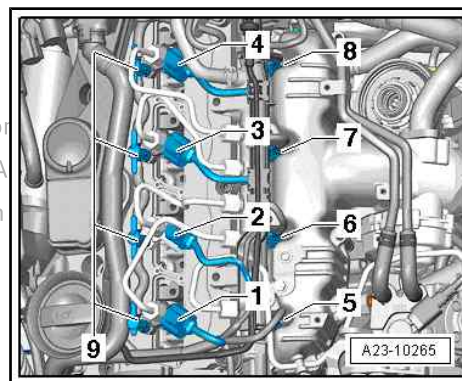


- Unplug electrical connectors -5, 6, 7 and 8- at glow plugs.

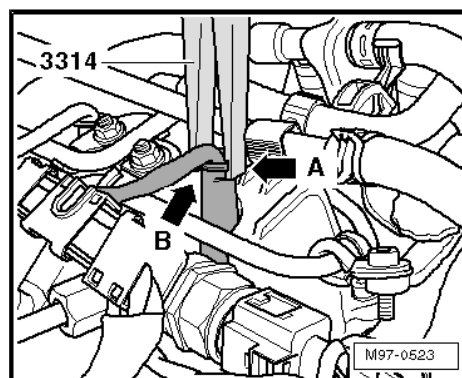


Caution

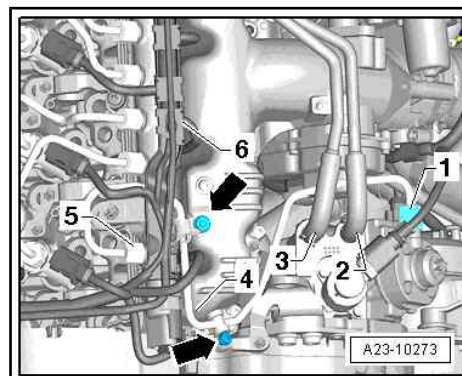
Make sure that no wire connection is damaged when unplugging the glow plug connectors; otherwise the entire wiring harness must be renewed. When unplugging the glow plug connectors, do not compress the pliers - 3314- with too much force so that the support sleeve is not damaged.



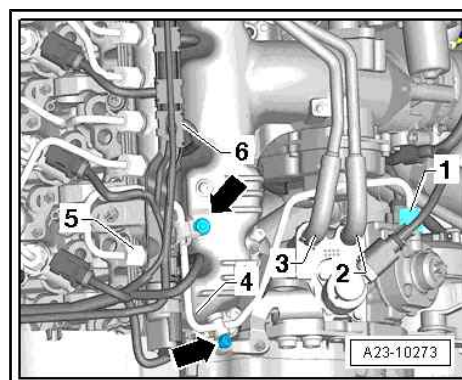
- Apply groove -arrow A- of pliers - 3314- to collar of support sleeve -arrow B- and pull connectors off glow plugs.



- Unscrew union nuts at high-pressure pump -1- and fuel rail -5- and remove high-pressure fuel pipe -4-.
- Remove bolts -arrows- for high-pressure fuel pipe.
- Move wiring harness -6- clear.



- Pull fuel pipe connections -2 and 3- off high-pressure pump.





- Remove bolts -arrows- securing the two fuel pipes.



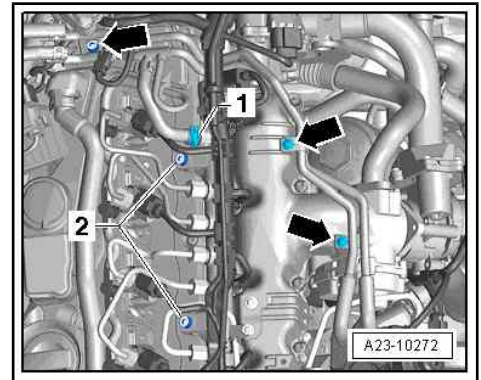
Note

Do not bend fuel lines.



Caution

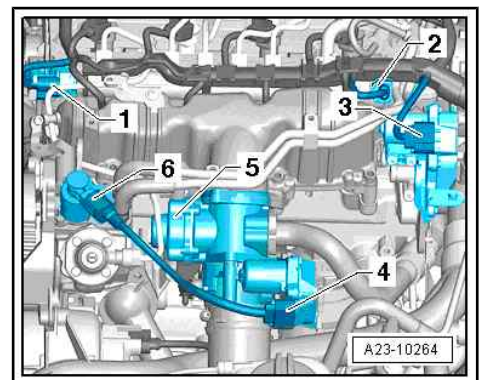
- ◆ **Observe rules for cleanliness when working on the injection system.**
- ◆ **Plug open connections with suitable sealing caps immediately.**



- Unplug following electrical connectors:
- 1 - Fuel pressure sender - G247-
- 2 - Fuel pressure regulating valve - N276-
- 3 - Intake manifold flap motor - V157-
- 4 - Throttle valve module - J338-
- 5 - Exhaust gas recirculation valve - N18-

Steps for vehicles with plastic intake manifold only

- Remove injector pipes leading to injectors.
- Remove high-pressure reservoir (rail)
⇒ ["7.3 Removing and installing fuel rail", page 32](#).



All vehicles (continued)



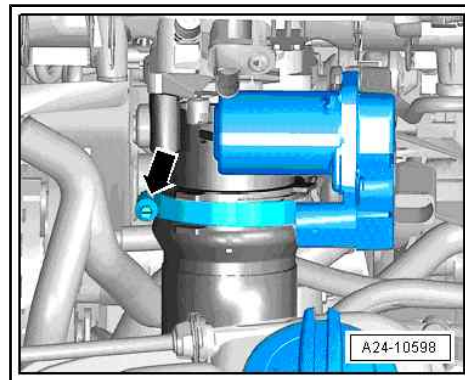
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- Release hose clip -arrow- securing air hose and disconnect hose downwards from throttle valve module - J338- .
- Remove bolt on bracket for oil dipstick.
- Detach connecting pipe for exhaust gas recirculation from exhaust gas recirculation valve - N18- .
- Remove bolts securing intake manifold in diagonal sequence starting from outside and working inwards.

To do so, use appropriate bit/socket:

- ◆ Vehicles with aluminium intake manifold: Bit XZN 8 - T40159-
- ◆ Vehicles with plastic intake manifold: Socket T30 - T10405-
- Remove intake manifold.



Installing

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

- Renew seals and/or gaskets.
- Tighten bolts securing intake manifold in diagonal sequence starting from outside and working inwards.

Vehicles with plastic intake manifold

- Install high-pressure reservoir (rail)
⇒ [“7.3 Removing and installing fuel rail”, page 32](#) .
- Install injector pipes leading to injectors.

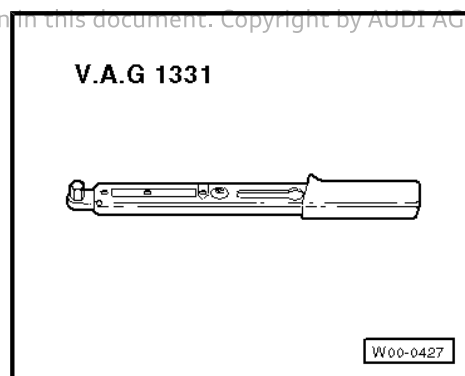
Tightening torques

- ◆ Exploded view - intake manifold ⇒ [Item 2 \(page 27\)](#)
- ◆ ⇒ [“7.1 Exploded view - intake manifold”, page 27](#)
- ◆ ⇒ [“4 Exploded view - fuel system”, page 19](#)

7.3 Removing and installing fuel rail

Special tools and workshop equipment required

- ◆ Torque wrench - V.A.G 1331-

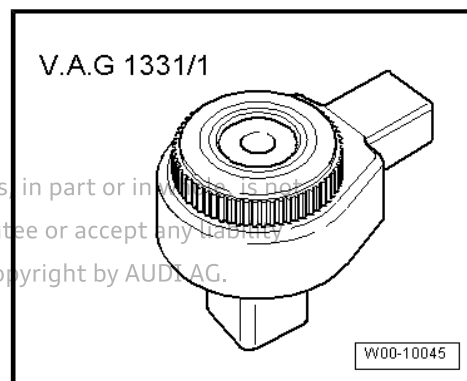




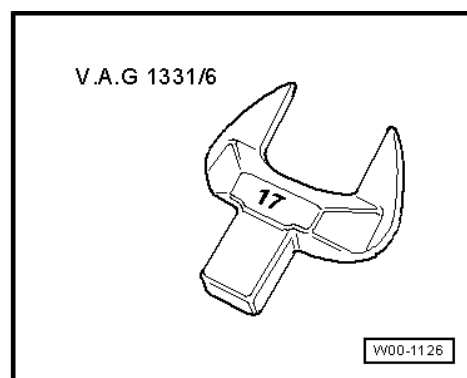
◆ Ratchet - V.A.G 1331/1-



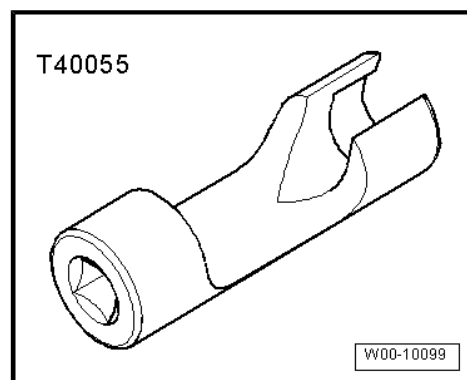
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◆ Open end spanner insert, AF 17 - V.A.G 1331/6-



◆ Socket - T40055-



Removing



WARNING

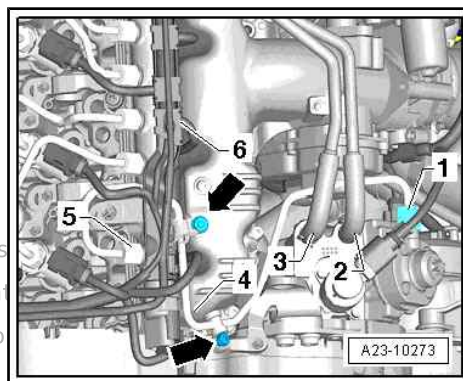
- ◆ *Always read rules for cleanliness and instructions for working on fuel system ⇒ [page 1](#).*
- ◆ *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

- Remove engine cover panel ⇒ [page 25](#).
- Take noise insulation off cylinder head cover.



- Unscrew union nuts at high-pressure pump -1- and fuel rail -5- and remove high-pressure fuel pipe -4-.
- Remove bolts -arrows- for high-pressure fuel pipe.
- Move wiring harness -6- clear.

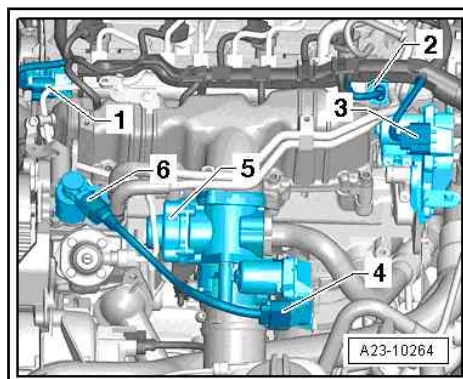
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- Unplug following electrical connectors:
- 1 - Fuel pressure sender - G247-
 - 2 - Fuel pressure regulating valve - N276-

**Caution**

- ◆ **Mark cylinder numbers on high-pressure pipes. 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.**



- Loosen union nuts for high-pressure pipes at injectors using socket - T40055- , 17 mm.
- Loosen union nuts for high-pressure pipes at fuel rail using tool insert, AF 17 - V.A.G 1331/6- .
- After removal, lay high-pressure pipes on a clean cloth.
- Unscrew bolts -2- and remove fuel rail.

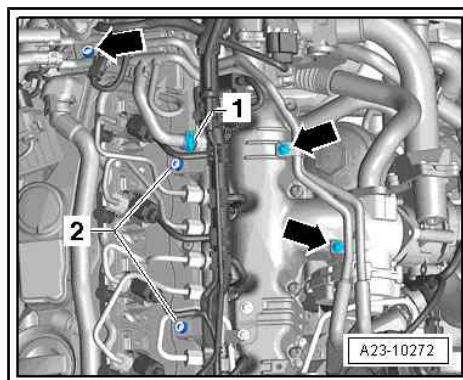
Installing

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

- Install high-pressure pipes so they are free of stress.

**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.**

**Tightening torques**

- ◆ For high-pressure pipes:
⇒ ["4 Exploded view - fuel system", page 19](#) .



8 High-pressure pump

⇒ **"8.1 Removing and installing high-pressure pump", page 35**

8.1 Removing and installing high-pressure pump

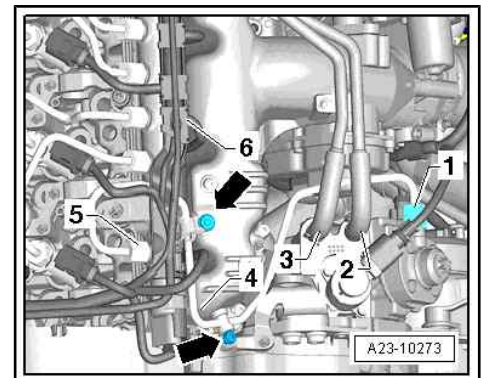


Caution

- ◆ **Always observe 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.**
- ◆ **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 ⇒ "5 Filling and bleeding fuel system", page 23.**

Removing

- Remove toothed belt from camshaft and high-pressure pump
⇒ Rep. gr. 15 .
- Unplug electrical connector at fuel metering valve - N290- .
- Unscrew union nuts at high-pressure pump -1- and fuel rail -5- and remove high-pressure fuel pipe -4-.
- Remove bolts -arrows- for high-pressure fuel pipe.
- Pull fuel pipe connections -2 and 3- off high-pressure pump.

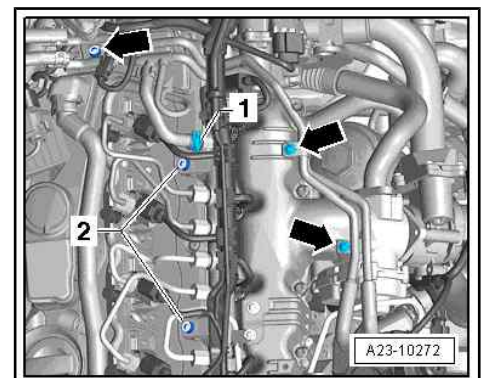


- Remove bolts -arrows- securing the two fuel pipes.



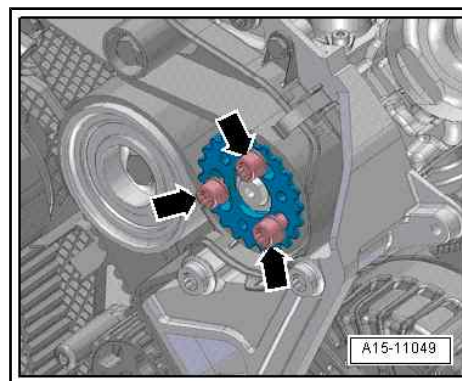
Note

Do not bend fuel lines.

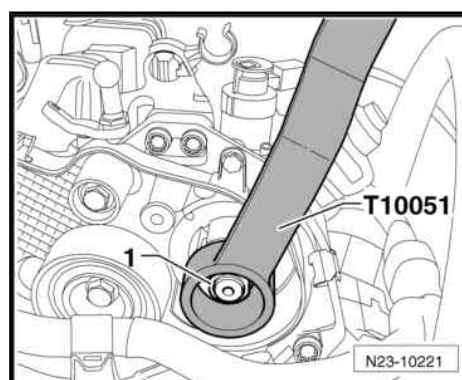




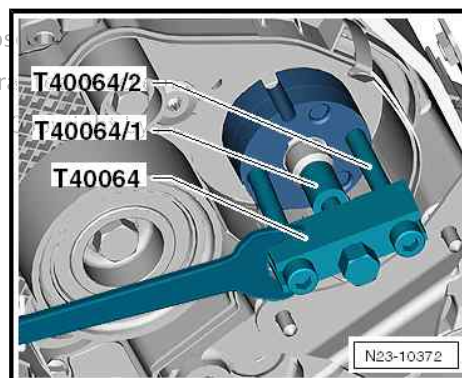
- Using an M10 bit, remove bolts -arrows- for toothed belt sprocket on high-pressure pump.



- Counterhold using counterhold tool - T10051- and remove nut -1- at hub of high-pressure pump.



- Apply puller - T40064- with thrust piece - T40064/1- and pin - T40064/2- as shown in illustration and pull hub off high-pressure pump. If necessary, counterhold using an open-end spanner (24 mm).





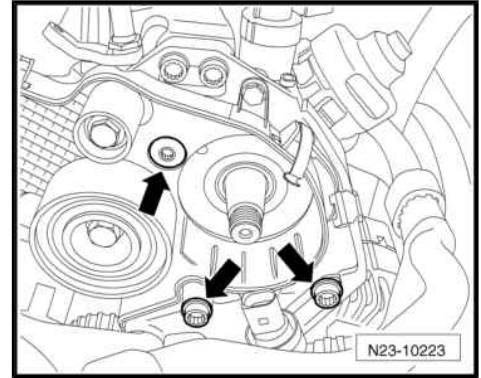
- Unscrew securing bolts -arrows- for high-pressure pump.
- Carefully take out high-pressure pump.

Installing

Installation is carried out in reverse sequence.

Tightening torques

- ◆ ⇒ ["4 Exploded view - fuel system", page 19](#)
- Install toothed belt for high-pressure pump ⇒ Rep. gr. 15 .
- Install high-pressure pipes ⇒ [page 52](#) .



Caution

- ◆ *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 ⇒ ["5 Filling and bleeding fuel system", page 23](#) .*
- ◆ *Running when dry causes irreparable damage to high-pressure pump.*



Note

Guided Functions are not available for certain engine versions because the routine is not necessary and the learned values need not be reset.

After renewing high-pressure pump and/or fuel pressure regulating valve - N276- , the learnt values must be reset
⇒ ["5 Filling and bleeding fuel system", page 23](#) .





9 Injectors

⇒ [“9.1 Checking injectors”, page 38](#)

⇒ [“9.2 Adaption of injector delivery calibration values and injector voltage calibration values”, page 38](#)

⇒ [“9.3 Checking for injectors sticking open”, page 39](#)

⇒ [“9.4 Checking return flow rate of injectors with engine running”, page 40](#)

⇒ [“9.5 Checking return flow rate of injectors at starter cranking speed”, page 43](#)

⇒ [“9.6 Removing and installing injectors”, page 44](#)

9.1 Checking injectors

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

- Checking adaption of “Injector delivery calibration values” and “Injector voltage calibration values” ⇒ [page 38](#)
- Checking for injectors sticking open ⇒ [page 39](#)
- Checking return flow rate of injectors with engine running ⇒ [page 40](#)
- Checking return flow rate of injectors at starter cranking speed ⇒ [page 43](#)

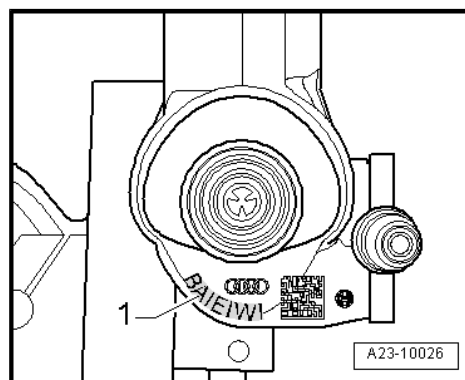
Perform the following tests first if the engine does not start at all:

- ◆ Checking for injectors sticking open ⇒ [page 39](#)
- ◆ Checking return flow rate of injectors at starter cranking speed ⇒ [page 43](#)
- ◆ Checking fuel pressure regulating valve - N276- ⇒ [page 56](#)

9.2 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).





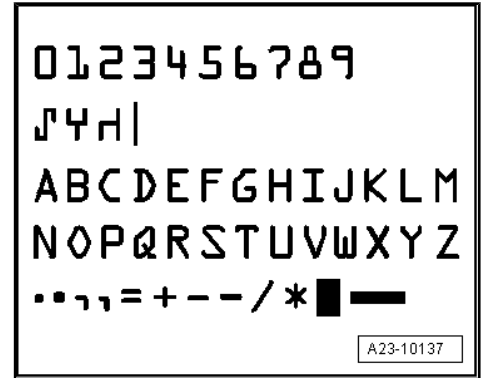
Reference table for reading out letters and/or numbers on each injector

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.

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.

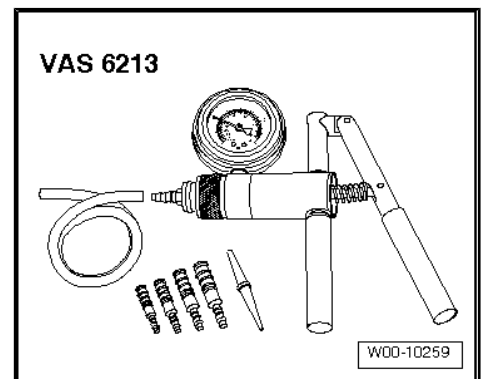
The adaption procedure is described in Guided Fault Finding. (The procedure is also described in Guided Functions.)



9.3 Checking for injectors sticking open

Special tools and workshop equipment required

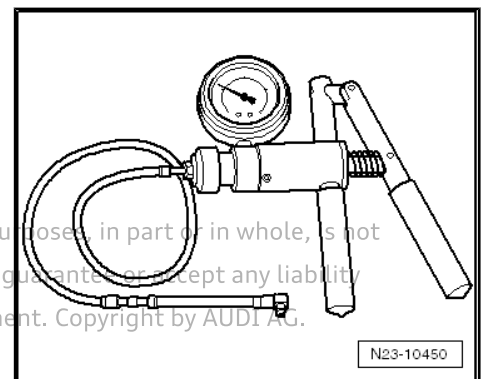
- ◆ Hand vacuum pump - VAS 6213-



- ◆ Use a return line to make an -adapter-.



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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 25](#).
- Clean all connections (with commercial cleaning solution or similar) before removing.

**Note**

- ◆ *Make sure all parts are clean; no dirt must be allowed to enter the fuel system.*
- ◆ *Check all cylinders in turn.*

- Dry all components after cleaning.

Start with cylinder No. 1.

- Pull return line connections off injectors; to do so, press tabs -1- and -2- down and at the same time pull release pin upwards -arrow-.
- Connect adapter to return line connection of injector to be tested after adapter has been cleaned and blown out.
- Generate a vacuum of -500 mbar using the hand vacuum pump - VAS 6213- .

If the vacuum reading remains the same for 30 seconds, the injector is OK.

If the injector is faulty, the vacuum reading will fall back to 0 bar within 2 to 3 seconds.

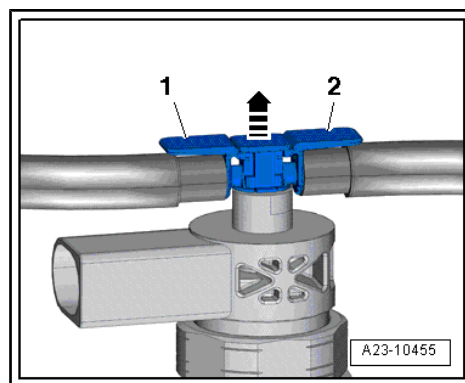
Repeat test if necessary; note drop in vacuum reading on hand vacuum pump - VAS 6213- .

- Renew faulty injectors ⇒ [page 44](#) .

Installing fuel return lines

- Check O-ring for fuel return line connection for damage and deformation.

If O-ring is damaged or deformed, renew O-ring.

**Note**

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

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

Checking fuel system 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 occurs.

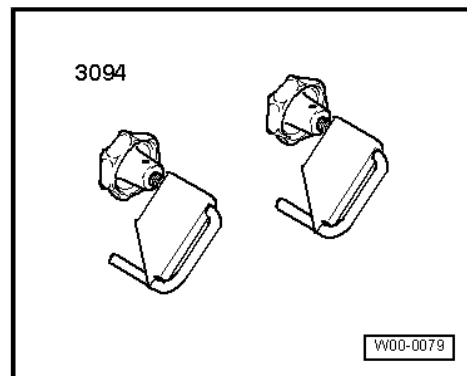
- After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

9.4 Checking return flow rate of injectors with engine running

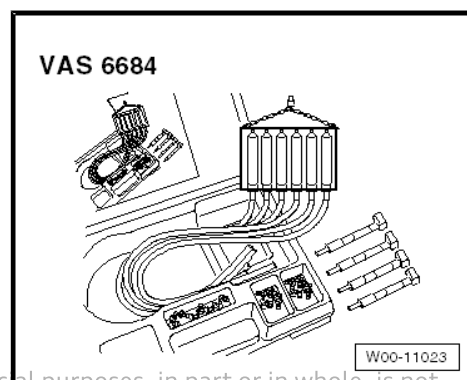
Special tools and workshop equipment required



- ◆ Hose clamps up to 25 mm - 3094-



- ◆ Return flow meter - VAS 6684-



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Checking return flow rate of all injectors



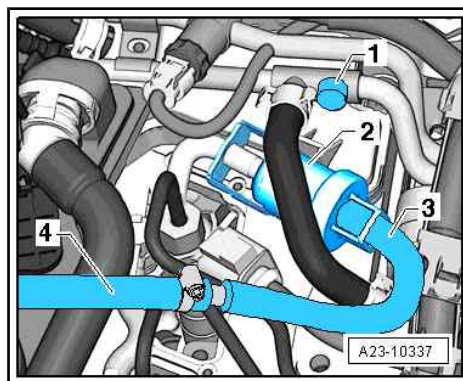
WARNING

- ◆ *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 25](#) .
- Disconnect hose connection -3- downstream of pressure retention valve -2- in fuel return line.



- Seal off open return line connection with plug -1-.
- Hold end of this hose -3- (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

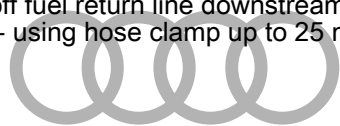
1000 ml = 1 litre

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

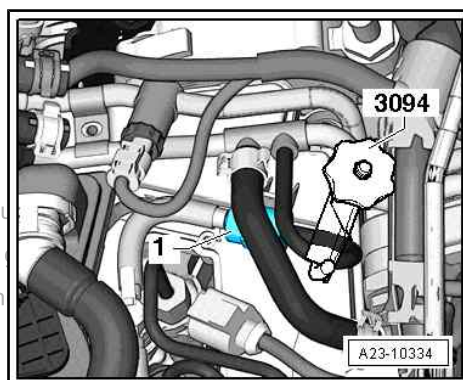
Checking return flow rate of individual injectors

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 -1- using hose clamp up to 25 mm - 3094- .



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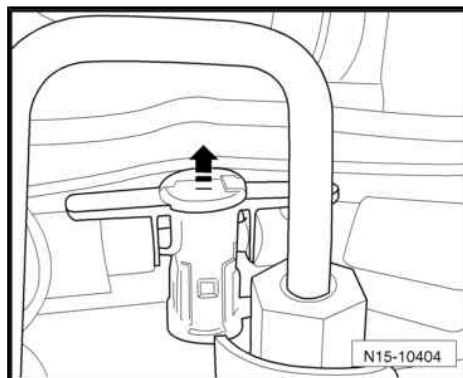
- Pull return line connections off injectors; to do so, press both tabs down and at the same time pull centre piece up to release connection -arrow-.
- Connect hoses of return flow meter - VAS 6684- to return line connections of all four injectors.



Caution

Risk of damage to injectors when return lines are disconnected.

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



- Start engine and let it idle for several minutes.



- When the engine is warm and running at idling speed, the return flow rates at each of the 4 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 44](#).

Installing fuel return lines

- Check O-ring for fuel return line connection for damage and deformation.

If O-ring is damaged or deformed, renew O-ring.



Note

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

- Push return line connections carefully over seals and onto injectors. The catch should engage audibly. Then press release pin down carefully.
- Erase entry in event memory using a diagnostic tester.

Checking fuel system 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 occurs.

- 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.

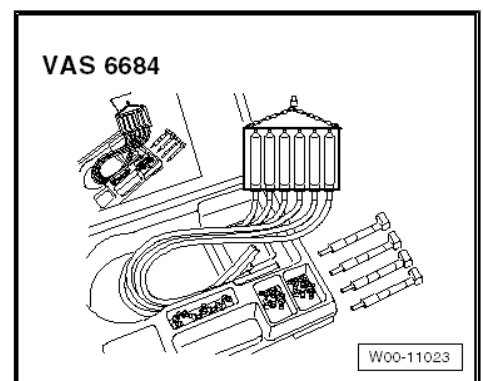
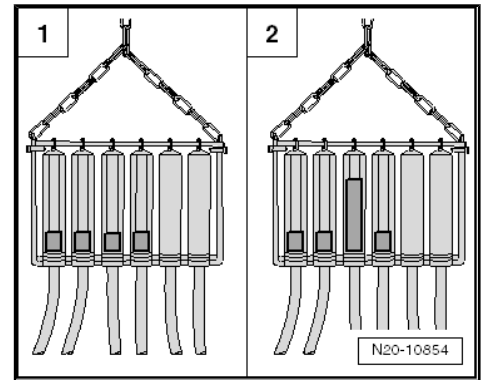
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9.5 Checking return flow rate of injectors at starter cranking speed

Only perform this test if the engine does not start at all.

Special tools and workshop equipment required

- ◆ Return flow meter - VAS 6684-



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 25](#) .
- Clean all return line connections (with commercial cleaning solution etc.) before removing.
- Dry all components after cleaning.
- Pull return line connections off injectors: to do so, press both tabs down and at the same time pull centre piece up to release connection -arrow-
- Connect hoses of return flow meter - VAS 6684- to return line connections of all four injectors.
- 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 an injector, that injector must be renewed.

Installing fuel return lines

- Check O-ring for fuel return line connection for damage and deformation.

If O-ring is damaged or deformed, renew O-ring.



Note

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

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

Checking fuel system 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.

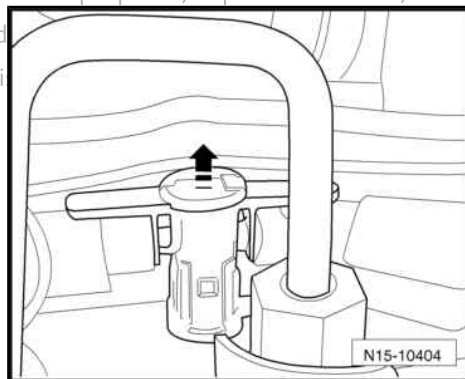
Renew the affected component if leakage occurs.

- 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.

9.6 Removing and installing injectors

Special tools and workshop equipment required

- ♦ Cleaning kit - VAS 6811-





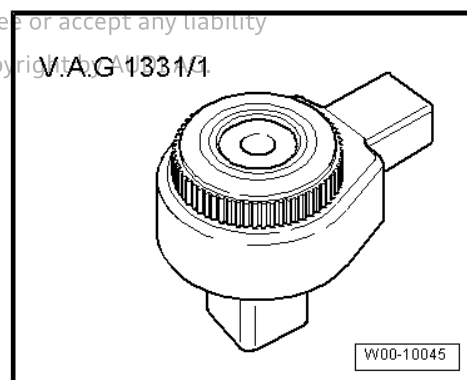
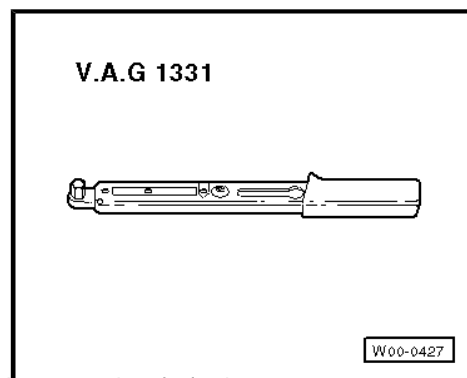
- ◆ Torque wrench - V.A.G 1331-



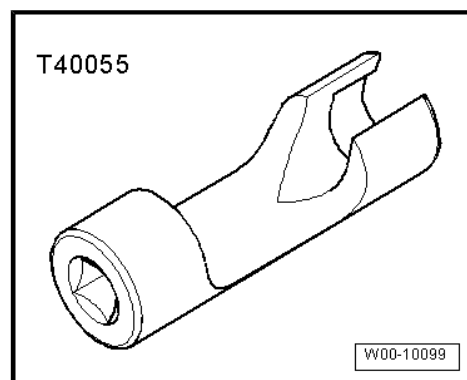
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- ◆ Ratchet - V.A.G 1331/1-

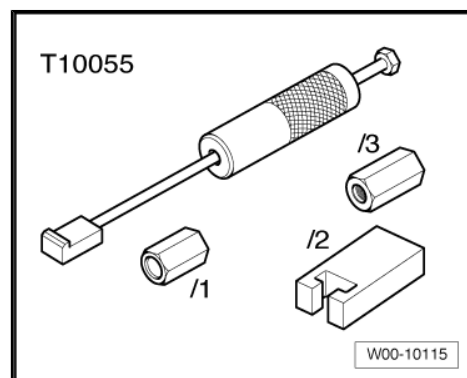
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- ◆ Socket - T40055-



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





- ◆ Assembly sleeve - T10377-



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.**

- Remove engine cover panel ⇒ [page 25](#).
- Take noise insulation off cylinder head cover.



Caution

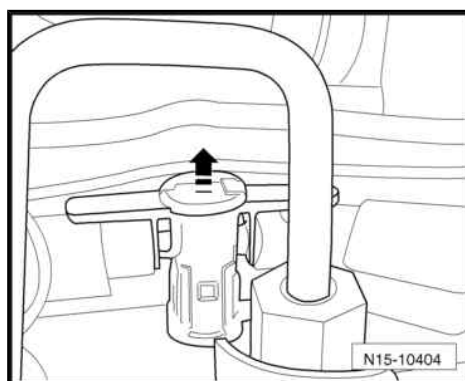
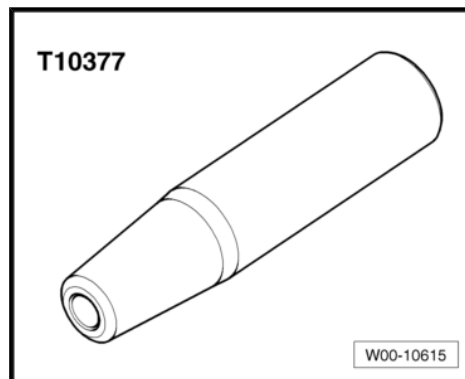
- ◆ **Mark cylinder numbers on injector units. They must always be re-installed on the same cylinders.**
- ◆ **Observe rules for cleanliness when working on the injection system.**
- ◆ **Plug open connections with suitable sealing caps immediately.**

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



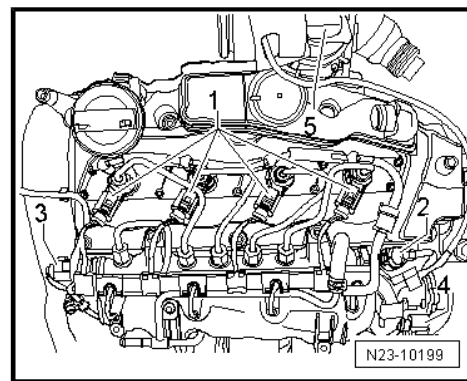
Note

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





- Unplug electrical connectors -1- at injectors which are to be removed.
- Loosen union nuts for high-pressure pipes at injectors using socket - T40055- , 17 mm.
- Loosen union nuts for high-pressure pipes at fuel rail using tool insert, AF 17 - V.A.G 1331/6- .

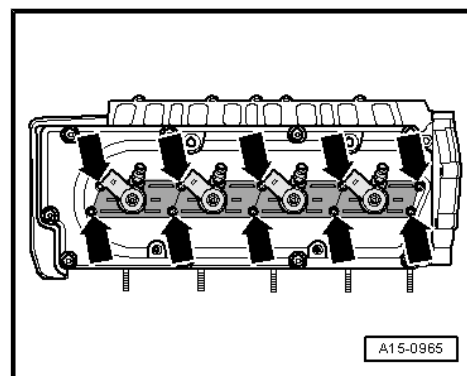


- Unbolt covers for injectors -arrows-.
- Pull covers upwards and turn them $\frac{1}{4}$ turn (90°).

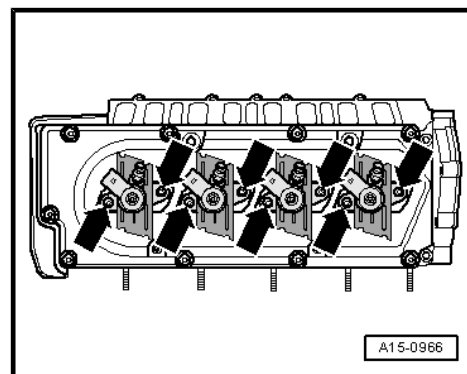


Caution

When removing securing nuts on injector there is a risk that the relevant nut will fall into the cylinder head. Proceed very carefully to prevent unnecessary dismantling or further damage.



- Unbolt clamping pieces for injectors -arrows-.



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- Apply puller - T10055- with adapter - T10055/1- as shown in illustration and pull injector out upwards by tapping gently.
- After removal, lay injectors on a clean cloth.

Important instructions for installing injectors:

When installing injectors, the following components must be renewed:

- ◆ Clamping piece
- ◆ Copper seal
- ◆ O-ring for injector bore
- ◆ O-ring for fuel return line connection



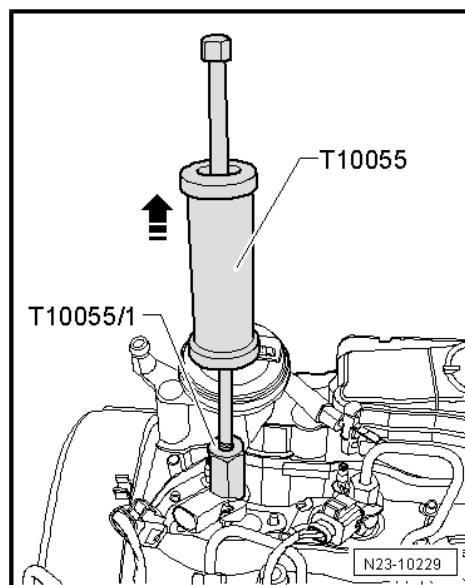
Note

- ◆ *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.
- 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.

Continued (same procedure for used and new injectors):





- Fit O-ring for injector bore using assembly sleeve - T10377- .
- To prevent damage to the new O-ring, lubricate it with oil and carefully push it onto the fuel return line connection.



Note

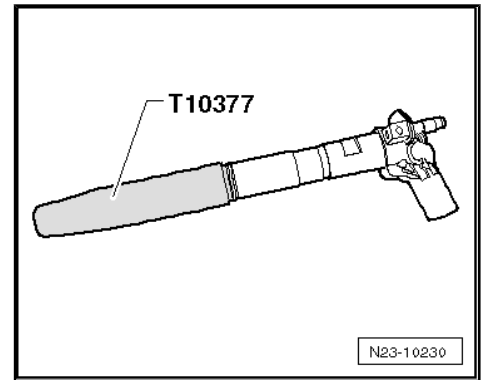
Lubricate all seals with engine oil or assembly oil before installing.



Caution

Risk of damage to injector sealing surface.

- ◆ ***To remove carbon deposits from the injector sealing surface, clean the injector bore in the cylinder head with cleaning kit - VAS 6811- .***



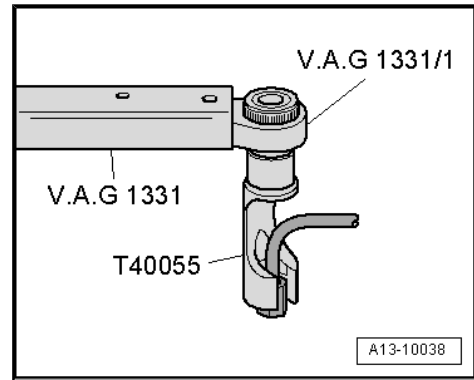
- Install injectors.
- Hand-tighten union nuts on high-pressure pipes. Make sure that connections are not under tension.



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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- .
- ♦ Tightening torque: exploded view - fuel system ➔ [page 19](#)
- ♦ Observe tightening torque: Installing high-pressure pipes ➔ [page 52](#) .
- ♦ Tightening torques: refer to exploded view of fuel system ➔ [page 19](#) .
- 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 renewing 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 38](#) .

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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.

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After renewing one or more injectors, learnt values for fuel pressure regulating valve - N276- must be reset; refer to ➔ [Vehicle diagnostic tester \("Guided Functions" Engine electronics - Reset learnt values\)](#).

Checking for leakage:



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 4 return line connections for leaks.

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



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 event memory. Then continue the road test.



10 Senders and sensors

⇒ ["10.1 Checking fuel system for leaks", page 51](#)

⇒ ["10.2 Removing and installing air mass meter G70 ", page 52](#)

⇒ ["10.3 Installing high-pressure pipes", page 52](#)

⇒ ["10.4 Checking pressure retention valve in fuel return line", page 55](#)

⇒ ["10.5 Checking fuel pressure regulating valve N276 ", page 56](#)

⇒ ["10.6 Removing and installing fuel pressure regulating valve N276 ", page 57](#)

⇒ ["10.7 Removing and installing fuel pressure sender G247 ", page 59](#)

10.1 Checking fuel system 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 event memory. Then continue the road test.



10.2 Removing and installing air mass meter - G70-

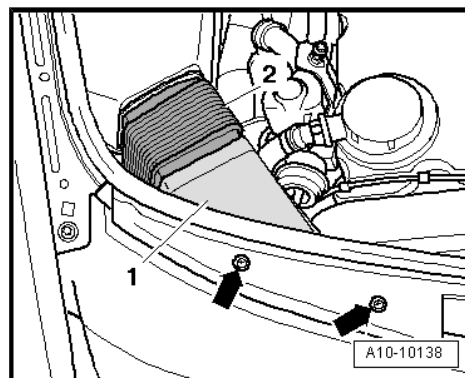
Removing

- Remove bolts -arrows-.
- Remove air duct -1- and -2-.
- Unplug electrical connector at air mass meter - G70- .
- Unscrew both bolts at air mass meter - G70- .
- Carefully pull out air mass meter - G70- .



Note

If the entire air mass meter - G70- (housing with sensor) has to be renewed, the intake air duct (between air mass meter and turbocharger) must also be disconnected from the air mass meter.



Installing

To ensure the correct function of the air mass meter it is important to observe the following notes and adhere to the procedures described below.



Note

- ◆ *If the air filter element is very dirty or wet, dirt particles or water can reach the air mass meter and falsify the detected air mass values. This will cause a loss of power as the calculated injection quantities will be too low.*
- ◆ *Always use genuine air filter elements (same as original equipment).*
- ◆ *Use silicone-free lubricant when fitting air hose.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*
- Check for salt residue, dirt and leaves in air mass meter and air hose (engine intake side).
- Check for dirt in air duct leading to air filter element. Clean salt residue, dirt and leaves out of top and bottom sections of air cleaner housing (wash out or vacuum out if necessary). Removing and installing air filter element ⇒ [page 25](#) .

The remaining installation steps are carried out in the reverse sequence.

10.3 Installing high-pressure pipes

Special tools and workshop equipment required

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◆ Torque wrench - V.A.G 1331-

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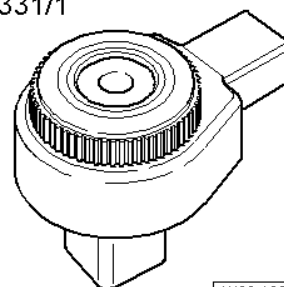
V.A.G 1331



W00-0427

◆ Ratchet - V.A.G 1331/1-

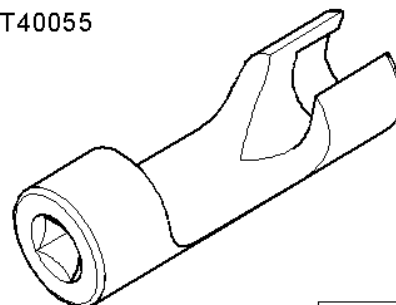
V.A.G 1331/1



VW00-10045

◆ Socket - T40055-

T40055



VW00-10099

Procedure



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.*
- Use vacuum cleaner to remove dirt from taper seat at fuel rail.
- Clean fuel pipe and end of pipe using cleaning solution and dry with compressed air.



- Lubricate threads of union nuts with fuel.
- If necessary, the fuel rail can be slackened and moved slightly so that the injector pipes are not installed under tension. Never bend the injector pipes or subject them to tension. This would ultimately cause the injector pipes to fracture.
- Take new injector pipe out of packaging, remove sealing plugs and immediately install injector pipe between fuel rail and injector.
- Initially hand-tighten union nuts of injector pipe (do not use a tool). Make sure that injector pipe is correctly seated.

Sequence for tightening injector pipes:

- 1 - First tighten union nut to specified torque at injector.
 - 2 - Tighten union nut to specified torque at fuel rail.
- Follow the same procedure to install any further injector pipes.
 - Tighten fuel rail again if it was slackened earlier.

Tightening torques

- ◆ ⇒ ["4 Exploded view - fuel system", page 19](#)
- ◆ ⇒ ["4 Exploded view - fuel system", page 19](#)
- Tighten union nuts of all installed injector pipes using torque wrench - V.A.G 1331- with ratchet - V.A.G 1331/1- and socket - T40055- .

Tightening torques

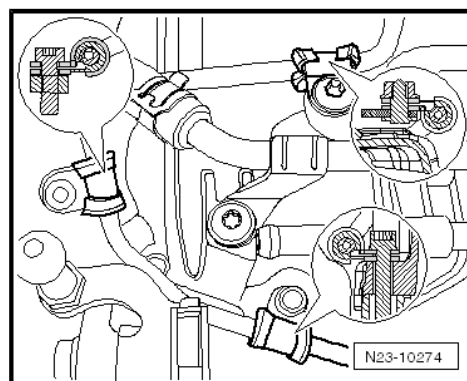
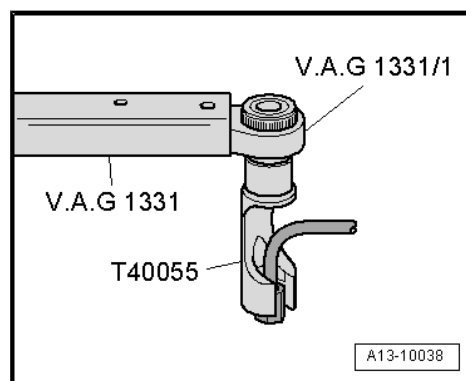
- ◆ ⇒ ["4 Exploded view - fuel system", page 19](#)

Installing fuel pipe between high-pressure pump and fuel rail

- Slacken the two bolts securing fuel rail and check that fuel rail can be moved.
- Then take new fuel pipe out of packaging, remove sealing plugs and immediately install fuel pipe between high-pressure pump and fuel rail.
- Initially hand-tighten union nuts of fuel pipe (do not use a tool). Make sure that fuel pipe is correctly seated.
- Fit all three securing clips to fuel pipe, making sure they are installed in the correct position.
- Screw in bolts on securing clips approx. 3 turns.
- Secure fuel rail again.

Tightening torques

- ◆ ⇒ ["4 Exploded view - fuel system", page 19](#)
- Tighten securing clip (top) on intake manifold to 8 Nm.





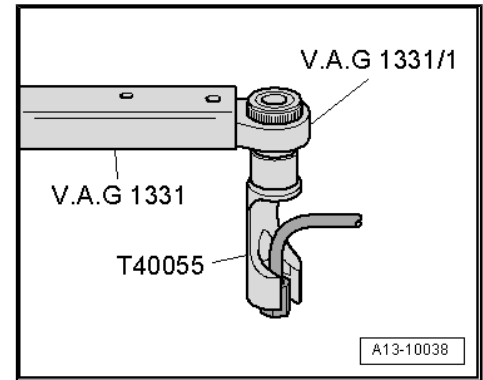
- Tighten union nuts of fuel line using torque wrench - V.A.G 1331- with ratchet - V.A.G 1331/1- and socket - T40055- .

Tightening sequence for securing fuel line:

- 1 - First tighten union nut to specified torque at high-pressure pump.
- 2 - Tighten union nut to specified torque at fuel rail.

Tightening torques

- ◆ ⇒ ["4 Exploded view - fuel system", page 19](#)
- Now tighten remaining two securing clips to 8 Nm.
- Fill fuel system
⇒ ["5 Filling and bleeding fuel system", page 23](#) .



10.4 Checking pressure retention valve in fuel return line

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

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

Special tools and workshop equipment required

- ◆ Tester for fuel return system - VAS 6330-



WARNING

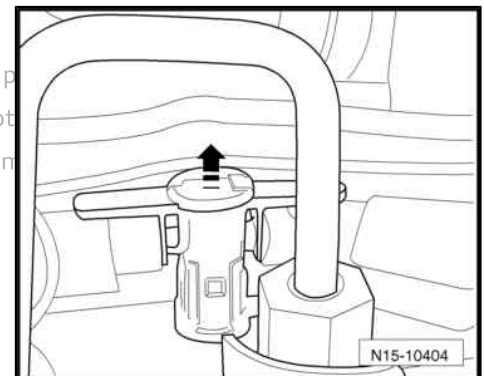
- ◆ *Always read rules for cleanliness and instructions for working on fuel system ⇒ [page 1](#) .*
- ◆ *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

- Remove engine cover panel ⇒ [page 25](#) .
- 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 cylinder 1; to do so, press both tabs down and at the same time pull centre piece up to release connection -  .



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Take care to keep all components clean. No dirt must be allowed to get into the disconnected return line or the open connection on the injector.





- Connect tester for fuel return system - VAS 6330- between return line connection on injector and 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 line

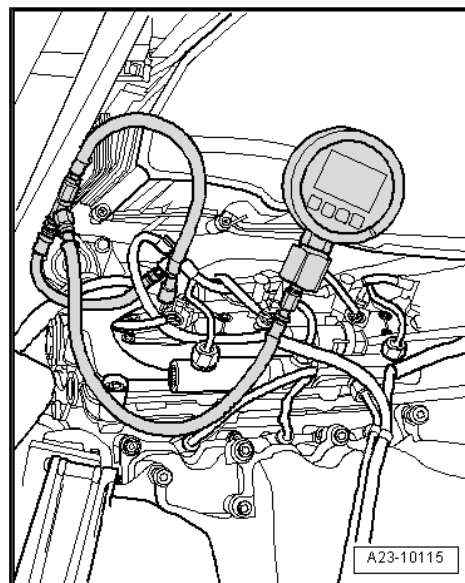
- Renew O-ring for return line connection.



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.



10.5 Checking fuel pressure regulating valve - N276-

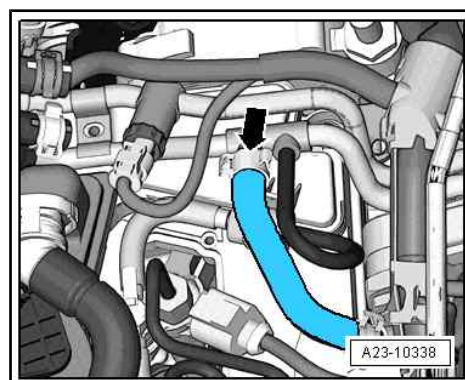
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WARNING

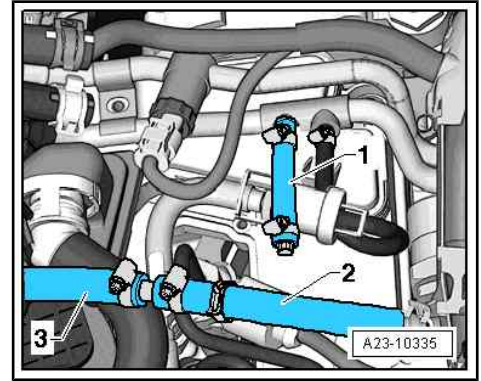
- ◆ **Always read rules for cleanliness and instructions for working on fuel system ⇒ [page 1](#).**
- ◆ **Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.**

- Remove engine cover panel ⇒ [page 25](#).
- Remove noise insulation from injectors.
- Open hose clip -arrow- and detach fuel return line.





- Seal off open return line connection with a plug -1-.
- Attach a suitable hose -3- to return line -2-.



- Hold this hose -1- in a suitable container -2- to measure the return flow rate.

1) Checking while engine is running

- Start the engine and run at idling speed.
- Specification: more than 75 ml in 30 seconds

If specification is not obtained, fuel pressure regulating valve - N276- is defective.

2) Checking while engine is running

If condition for 1) is met, start engine and increase engine speed to ≥ 2000 rpm.

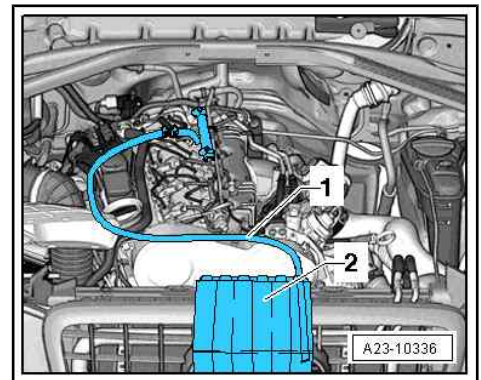
- Fuel is still discharged in the first few seconds after the engine is started
- Specification after a few seconds: return flow rate = 0 ml
- Drip leaks are permissible

If specification is not obtained, fuel pressure regulating valve - N276- is defective.

3) If engine can no longer be started

Perform check at cranking speed.

- Specification of return flow rate: 0 ml
- Drip leaks are permissible
- If specification is not obtained, fuel pressure regulating valve - N276- is defective.



10.6 Removing and installing fuel pressure regulating valve - N276-

Special tools and workshop equipment required

- ◆ Open-end spanner insert, 30 mm - T10553-
- ◆ Torque wrench



The fuel pressure regulating valve - N276- -2- is located in the fuel rail. It maintains a constant pressure in the fuel rail and the injector pipes (high-pressure fuel circuit).

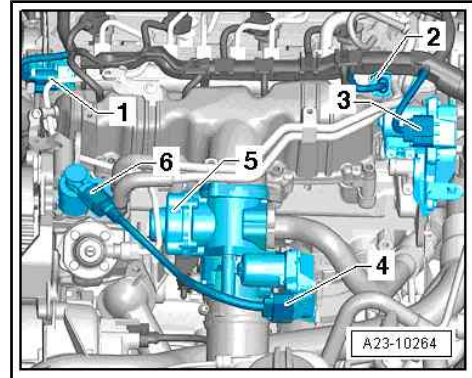
If the pressure in the high-pressure fuel circuit is too high, the regulating valve opens to allow some of the fuel to flow back from the fuel rail to the fuel tank via a return line.

If the pressure in the high-pressure fuel circuit is too low, the fuel pressure regulating valve - N276- closes and seals off the high-pressure section of the system from the low-pressure section.



Note

Fuel pressure regulating valve - N276- must always be renewed after it has been removed.



Removing



WARNING

- ◆ **Always observe 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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- Remove engine cover panel ⇒ [page 25](#) .
- Remove fuel rail ⇒ [page 32](#) .
- Before removal, clean area around thread for fuel pressure regulating valve - N276- using commercial cleaning solution etc. (no dirt must enter the bore in the high-pressure reservoir).



Note

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

- Dry off fuel pressure regulating valve - N276- .
- Loosen union nut using open-end spanner insert, 30 mm - T10553- (at the same time, counterhold at hexagon flats on housing). Then unscrew and remove by hand.
- Extract dirt from opening in fuel rail (thread and sealing surface) using a vacuum cleaner. Do not use metal tools, etc.
- Seal off open fuel rail connection with clean plug.



Installing



Note

- ◆ *The fuel pressure regulating valve - N276- has a deformable sealing lip and no separate seal; it can therefore be used only once.*
- ◆ *Check that sealing surfaces (deformable sealing lip) and threads on new fuel pressure regulating valve - N276- are not damaged.*
- ◆ *Check sealing surface at opening in fuel rail.*
- ◆ *The beginning of the thread, the deformable sealing lip and the O-ring of the fuel pressure regulating valve - N276- must be coated with diesel fuel.*
- Screw on union nut by hand.
- Align new regulating valve so that connecting wire is free of tension after connector is attached.
- Hold regulating valve in this position by holding hexagon flats on housing of regulating valve with open-end spanner or pliers (water pump pliers or similar).
- Tighten union nut using open-end spanner insert, 30 mm - T10553- (at the same time, counterhold at hexagon flats on housing).

Tightening torques

- ◆ ⇒ ["4 Exploded view - fuel system", page 19](#)
- Install fuel rail ⇒ [page 32](#) .

After renewing high-pressure pump and/or fuel pressure regulating valve - N276- , the learnt values must be reset. The procedure is described in [\[Guided Fault Finding\]](#) or [\[Guided Functions\]](#); use ⇒ Vehicle diagnostic tester.



Note

Guided Functions are not available for certain engine versions because it is not necessary to reset the learned values on these engines.

- Run engine at moderate speed for several minutes and then switch off.
- Check fuel system for leaks.
- Interrogate event memory.
- 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.
- Interrogate event memory again.

10.7 Removing and installing fuel pressure sender - G247-

Special tools and workshop equipment required

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- ◆ Bit (27 mm) - T40218- or commercially available socket (27 mm)



- ◆ Torque wrench



Note

- ◆ *The fuel pressure sender - G247- continuously measures the fuel pressure in the high-pressure system. It transmits a corresponding voltage signal to the engine control unit - J623- .*
- ◆ *Should the fuel pressure sender fail, the engine control unit will control the fuel pressure via a mapped open-loop backup function. Maximum engine speed in this mode is restricted.*
- ◆ *The fuel pressure sender - G247- has a deformable sealing lip and no separate seal; it can therefore be used only once.*

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.*

- Remove engine cover panel ⇒ [page 25](#) .
- Before removal, clean area around thread for fuel pressure sender using commercial cleaning solution etc. (no dirt must enter the opening in the fuel rail).

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Note

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

- Dry off fuel pressure sender - G247- .



- Unplug electrical connector -1- at fuel pressure sender - G247- .
- Unscrew fuel pressure sender - G247- using socket, 27 mm - T40218- .

i Note

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

- Extract dirt from opening in fuel rail (thread and sealing surface) using a vacuum cleaner. Do not use metal tools, etc.
- Seal off opening in fuel rail with a plug.

Installing

i Note

- ◆ *Fuel pressure sender - G247- must always be renewed after it has been removed.*
- ◆ *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.*
- **Screw in fuel pressure sender - G247- by hand.**
- Then tighten fuel pressure sender - G247- to specified torque.

Tightening torques

- ◆ **⇒ “4 Exploded view - fuel system”, page 19**

After installing fuel pressure sender - G247- , leave engine running at moderate speed for a few minutes when bleeding fuel system and then switch off again.

i Note

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

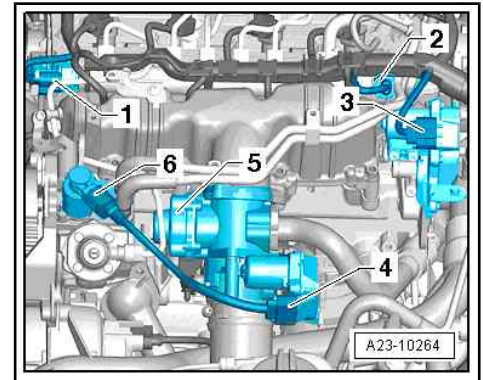
- Interrogate event memory and erase it if necessary.
- Switch off ignition.
- Carefully check the entire fuel system for leaks.

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.

i 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 event memory. Then continue the road test.





- After road test, interrogate event memory again.



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11 **Renewing engine control unit - J623-**



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12 Lambda probes

⇒ "12.1 Exploded view - Lambda probe", page 64

⇒ "12.2 Removing and installing Lambda probe G39 with Lambda probe heater Z19", page 65

⇒ "12.3 Removing and installing exhaust gas pressure sensor 1 G450", page 66

12.1 Exploded view - Lambda probe

1 - Turbocharger

- ❑ With position sender for charge pressure positioner - G581-

2 - 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 ⇒ 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 65
- ❑ 50 Nm

3 - Exhaust gas temperature sender 3 - G495-

- ❑ Removing and installing ⇒ Rep. gr. 26
- ❑ 45 Nm

4 - Exhaust gas pressure sensor 1 - G450-

- ❑ Tighten bolt to 4.5 Nm
- ❑ Removing and installing ⇒ page 66
- ❑ Pressure pipes to particulate filter: 45 Nm

5 - Exhaust gas temperature sender 4 - G648-

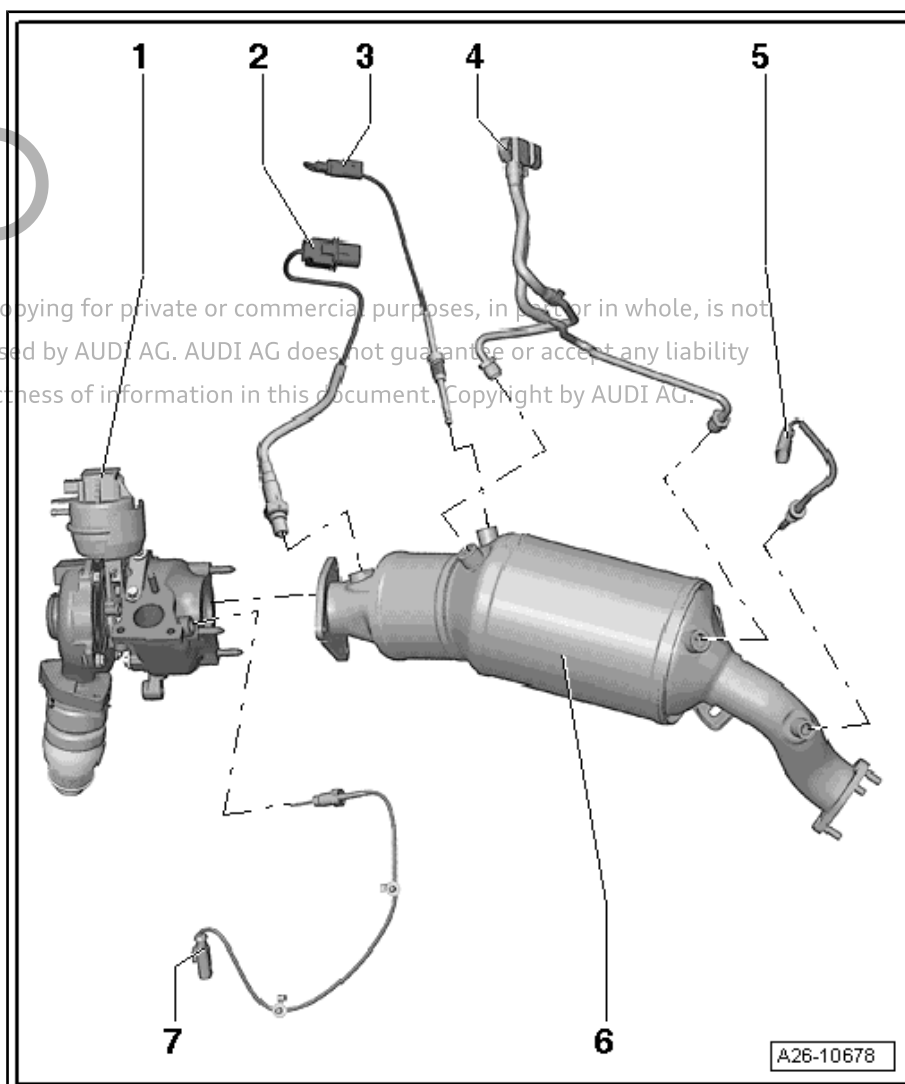
- ❑ Removing and installing ⇒ Rep. gr. 26
- ❑ 45 Nm

6 - Particulate filter

- ❑ Adaption must be performed after renewing particulate filter; see Guided Fault Finding on vehicle diagnostic, testing and information system - VAS 5051B- (the same procedure is also described under Guided Functions)

7 - Exhaust gas temperature sender 1 - G235-

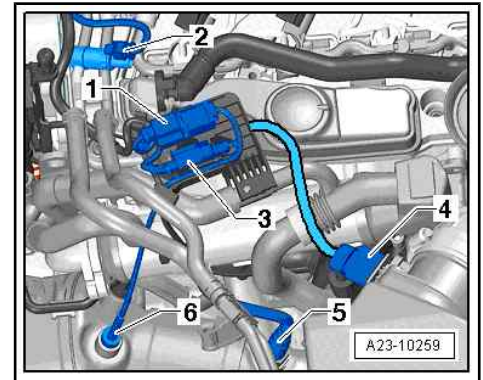
- ❑ Removing and installing ⇒ Rep. gr. 26
- ❑ 45 Nm





Components

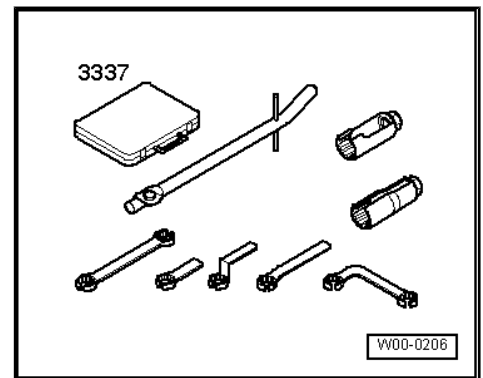
- 1 - Electrical connector for Lambda probe - G39- with Lambda probe heater - Z19-
- 2 - Fuel temperature sender - G81-
- 3 - Electrical connector for exhaust gas temperature sender 3 - G495-
- 4 - Air mass meter - G70-
- 5 - Lambda probe - G39- with Lambda probe heater - Z19-
- 6 - Exhaust gas temperature sender 3 - G495-



12.2 Removing and installing Lambda probe - G39- with Lambda probe heater - Z19-

Special tools and workshop equipment required

- ◆ Lambda probe open ring spanner set - 3337-



Removing

- Remove engine cover panel ➔ [page 25](#) .



WARNING

When working on all parts of the exhaust system:

- ◆ **Observe safety precautions when working on the exhaust system**
 ➔ **"1.4 Safety precautions when working on the exhaust system", page 3** .



- Unplug electrical connector -1- for Lambda probe - G39- .
- Unscrew Lambda probe - G39- -5- using tool from Lambda probe open ring spanner set - 3337- .

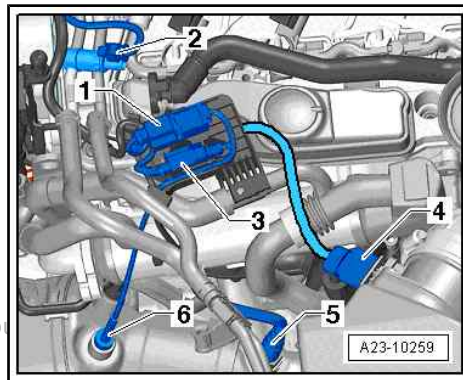
Installing

When installing, note the following:



Note

- ◆ *Threads of new Lambda probes are already coated with assembly paste; the paste must not get into the slots on the probe body.*
- ◆ *In the case of a used Lambda probe grease only the thread with high-temperature paste. The paste must not get into the slots on the Lambda probe body. For high-temperature paste refer to ⇒ [Parts catalogue](#) .*
- ◆ *When installing, the Lambda probe wiring must always be re-attached at the same locations to prevent it from coming into contact with the exhaust pipe.*



Tightening torques

- ◆ ⇒ ["12.1 Exploded view - Lambda probe", page 64](#)

12.3 Removing and installing exhaust gas pressure sensor 1 - G450-

Exhaust gas pressure sensor 1 - G450- is connected via two pipes to the take-off points upstream and downstream of the particulate filter. Exploded view - Lambda probe ⇒ [page 64](#)

Exhaust gas pressure sensor 1 - G450- detects the amount of deposits in the particulate filter.

Removing

- Remove engine cover panel ⇒ [page 25](#) .



WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ ["1.4 Safety precautions when working on the exhaust system", page 3](#) .

- Before disconnecting, spray hoses coming from exhaust gas pressure sensor 1 - G450- with suitable release agent.



- Detach electrical connector -3- from exhaust gas pressure sensor 1 - G450- .
- Carefully pull hoses off connections (take care to keep the hoses straight; the connections can easily break off exhaust gas pressure sensor 1 - G450-).
- Unscrew bolt -4- and remove exhaust gas pressure sensor 1 - G450- .

Installing

- When installing, note the following:

Tightening torques

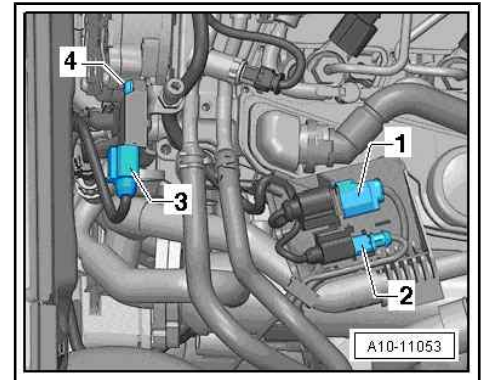
- ◆ For bolt for exhaust gas pressure sensor 1 - G450-
⇒ ["12.1 Exploded view - Lambda probe", page 64](#)



Note

- ◆ *Before installing, blow out hoses leading from exhaust gas pressure sensor 1 - G450- to particulate filter towards particulate filter with compressed air (hoses can become obstructed or may ice up due to condensation).*
- ◆ *Make sure that hoses are securely fitted and seal properly.*
- ◆ *If pressure connections are detached from particulate filter, tighten to 45 Nm.*

After renewing exhaust gas pressure sensor 1 - G450- and/or particulate filter, adaption must be performed in order to reset learnt values. The adaption procedure is described in the Guided Fault Finding or Guided Functions; use a vehicle diagnostic tester.

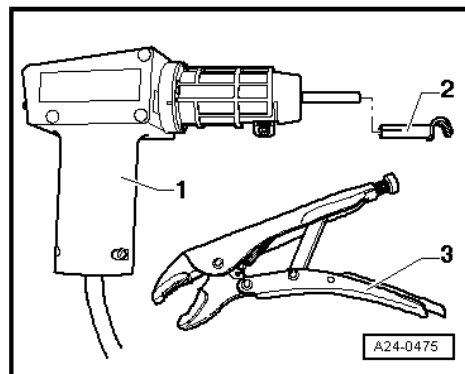




13 Renewing engine control unit - J623-

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-



Removing

- If the engine control unit - J623- is renewed, the adaption values must be read out and stored before the engine control unit - J623- is removed.

- Connect ⇒ Vehicle diagnostic tester.

- Select **Diagnosis** mode and then **Start diagnosis**.

- Choose **Select own test** tab and select following options one after the other:

- ◆ **Drive train**

- ◆ **Select engine code and engine**

- ◆ **01 - Self-diagnosis compatible systems**

- ◆ **01 - Engine electronics**

- ◆ **01 - Engine electronics, functions**

- ◆ **01 - Replace control unit**

- Switch off ignition and remove ignition key after storing electronic file containing adaption values.

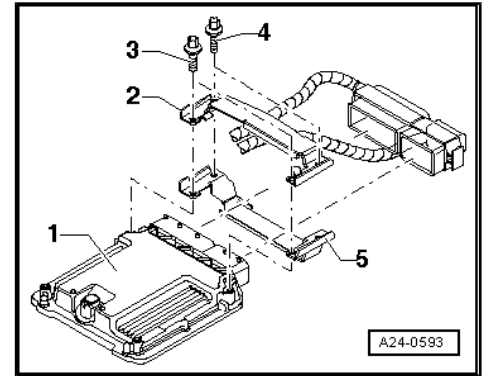
- If the adaption values of the injectors cannot be read out of the old (defective) engine control unit, the adaption values must be entered into the new engine control unit manually and the adaption procedure must be performed accordingly.

- Switch off ignition and remove ignition key.

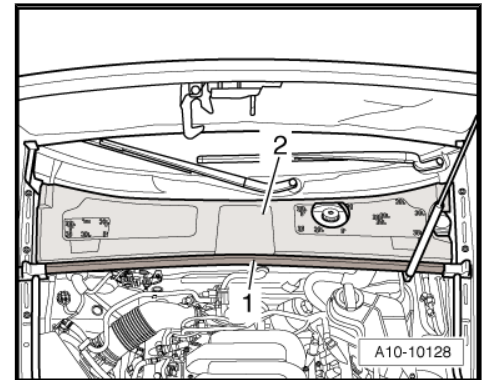


Note

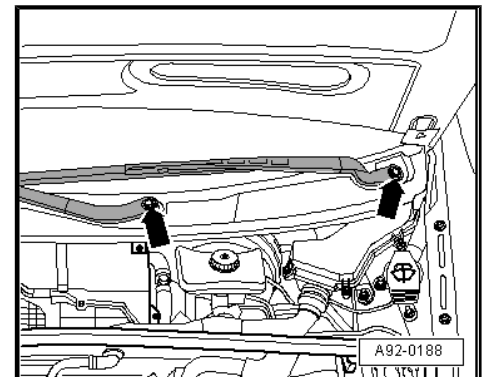
- ◆ Not every engine control unit is bolted to a protective housing. Whether a protective housing is fitted depends on the engine/gearbox combination.
- ◆ The engine control unit -1- is bolted to a protective casing -2 and 5-. To make it more difficult to unscrew the shear bolts -4- for locking plate -2-, their threads have been coated with locking fluid.
- ◆ The protective housing has to be removed before the connectors can be unplugged from the engine control unit (e.g. to connect the test box or renew the engine control unit).



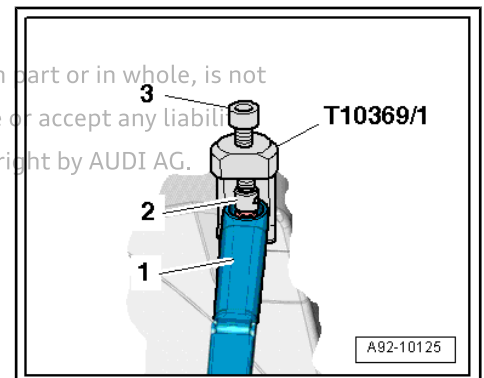
- Pull off seal -1- and remove plenum chamber cover -2-.



- Pry off caps on windscreen wiper arms with a screwdriver.
- Loosen nuts -arrows- several turns.



- Apply puller -T10369/1- to wiper arm -1- as shown in illustration.
- Apply thrust piece -2- onto wiper shaft.
- Turn bolt -3- in clockwise direction until wiper arm is pulled off wiper shaft.
- Remove nuts and detach wiper arms.

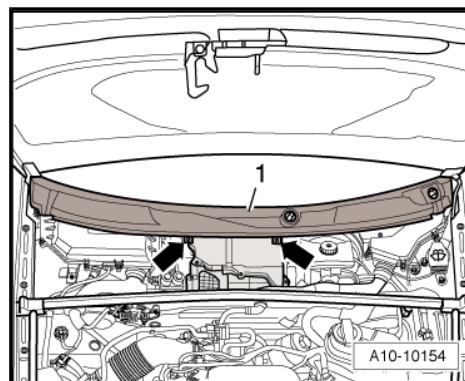




Caution

Risk of damage to cowl panel trim.

- ◆ *To avoid cracking the cowl panel trim -1- during removal, apply a small amount of soap solution to the joint between the windscreen and the cowl panel trim and pull the trim vertically up out of the windscreen surround, starting from the edge of the windscreen.*



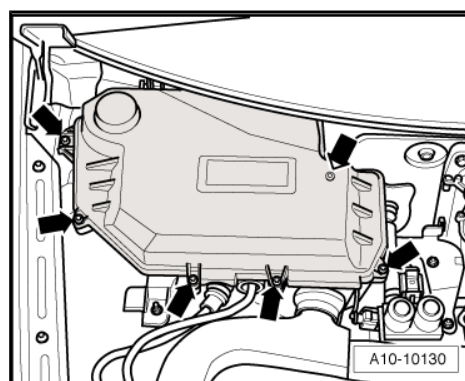
- Unscrew bolts -arrows- and pull cowl panel trim off windscreen.
- Unscrew bolts -arrows- and take off cover for electronics box in engine compartment (right-side).



WARNING

Risk of burns at the pump valve unit for the heating system (left-side in front of electronics box).

- ◆ *Wear protective gloves when working near the pump valve unit for the heating system.*

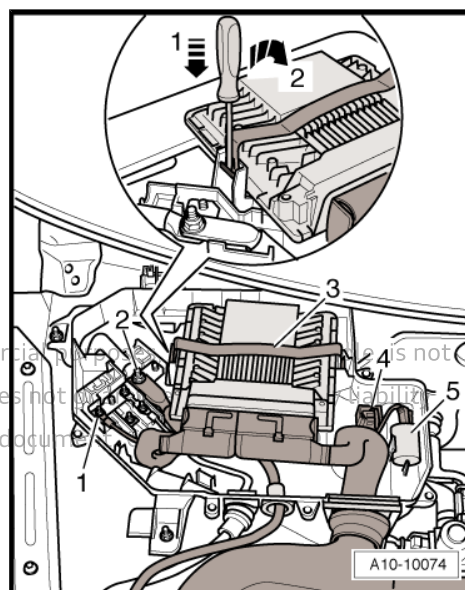


- Carefully lever out the retaining strap -2- using a screwdriver -arrows 1 and 2- and remove the engine control unit from the electronics box.

Perform the following work steps only if a protective housing is fitted:

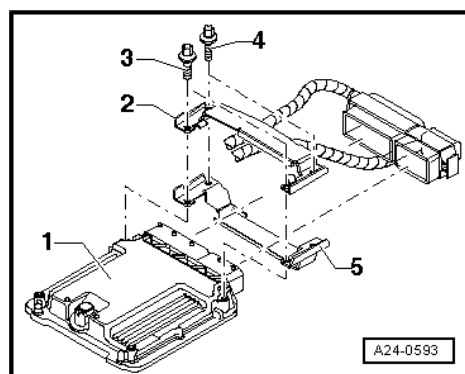


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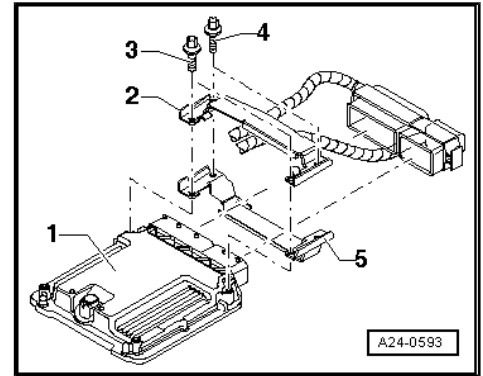
To help prevent unauthorised access to the connectors on the engine control unit, the engine control unit -1- is bolted to a protective housing -5- by means of shear bolts -3 and 4- and a locking plate -2-.

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.

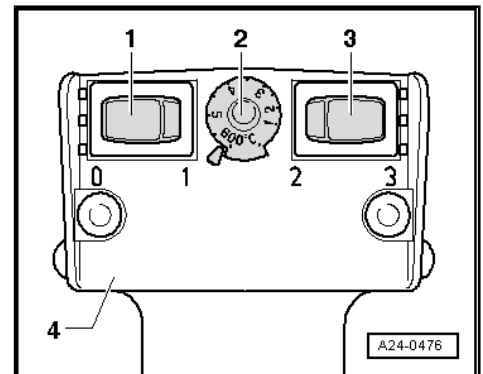


- Select settings on hot air blower as shown in illustration, i.e. set temperature potentiometer -2- to maximum heat output and two-stage air flow switch -3- to position 3.

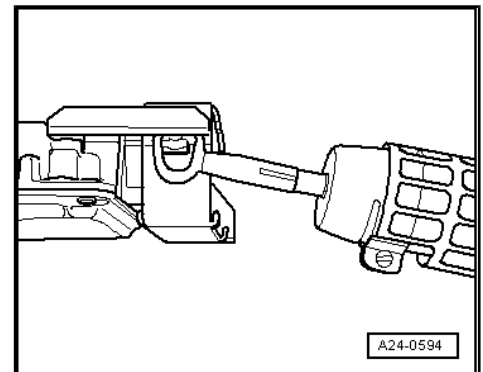


WARNING

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 should be removed without being heated.
- Detach protective housing from control unit connectors.
- Release connectors on engine control unit and unplug connectors.
- Take out old engine control unit - J623- and install new engine control unit - J623- .

Installing

Installation is performed in the reverse sequence.

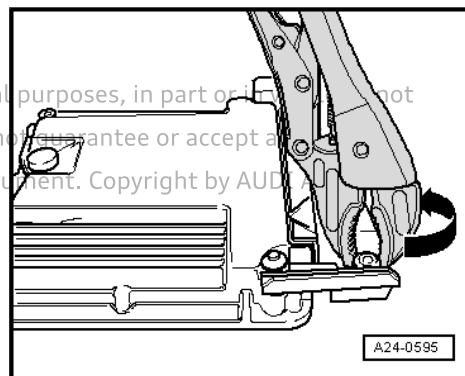
- It is important that the protective housing is re-fitted on the engine/motor control unit - J623- (if fitted previously).
- Clean threaded holes for shear bolts to remove any residue from locking fluid. This can be done using a thread tap.
- Always use new shear bolts.
- Tightening torque for bolts securing lid of electronics box: 3.5 Nm.

The procedure required after connecting the new engine control unit is described in the Guided Fault Finding or Guided Functions. Use vehicle diagnostic tester to do so.

- After the engine control unit - J623- has been renewed, the "Injector delivery calibration" and the "Injector voltage calibration" must also be re-adapted in the engine control unit (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 - J623- via an adaption procedure.

After installing a new engine control unit, the following operation must be performed:

- Activate engine control unit using ⇒ Vehicle diagnostic tester in Guided Functions mode, function 01 - Replace control unit.





28 – Glow plug system

1 Checking glow plug system

Automatic glow period control unit - J179- is located in relay carrier in electronics box in plenum chamber (right-side)

3 - Automatic glow period control unit - J179-

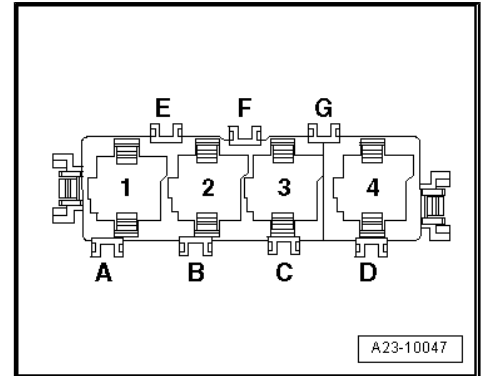
The glow plug system is activated via the automatic glow period control unit - J179- . The automatic glow period control unit - J179- is capable of self-diagnosis.

A fault is stored in the engine control unit 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.



Note

- ◆ *Wait for 60 seconds each time after performing final control diagnosis of the glow period control unit. The ignition must remain switched on.*
- ◆ *If you do not wait for 60 seconds (if ignition is switched off and immediately switched on again), the glow plugs can be damaged (due to repeated pre-heating).*
- ◆ *The activation of the glow plugs is controlled according to coolant temperature.*

1.1 Removing and installing glow plugs

Special tools and workshop equipment required

- ◆ Articulated wrench, 10 mm - 3220-



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◆ Pliers - 3314-



Removing

- Switch off ignition.
- Remove engine cover panel ⇒ [page 25](#) .
- Clean glow plug openings in cylinder head; make sure no dirt gets into cylinder.



Note

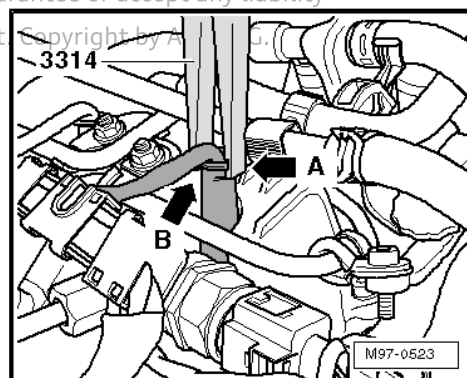
- ◆ *Cleaning procedure:*
- ◆ *Use a vacuum cleaner to remove coarse dirt.*
- ◆ *Spray brake cleaner or suitable cleaning agent into glow plug openings, let it work in briefly, and blow out with compressed air.*
- ◆ *Then clean the glow plug openings using a cloth moistened with oil.*



Caution

Make sure that no wire connections are damaged when unplugging the glow plug connectors; otherwise the entire wiring harness must be renewed. When unplugging the glow plug connectors, do not compress the pliers - 3314- with too much force so that the support sleeve is not damaged.

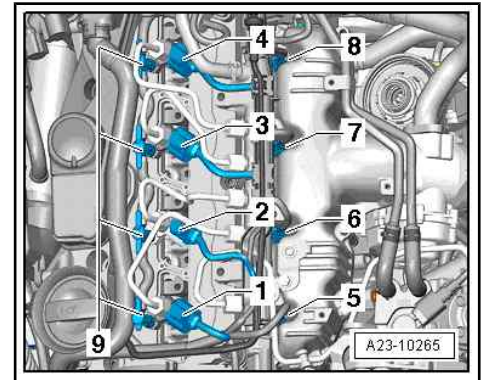
- Apply groove -arrow A- of pliers - 3314- to collar of support sleeve -arrow B- and pull glow plug connectors off glow plugs.





Note

- ◆ Glow plug 1 - Q10- -5-
- ◆ Glow plug 2 - Q11- -6-
- ◆ Glow plug 3 - Q12- -7-
- ◆ Glow plug 4 - Q13- -8-



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

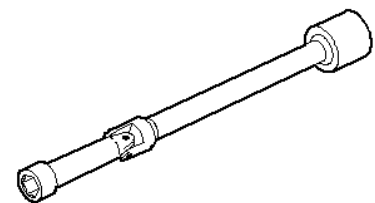
Installing

- To tighten the glow plugs use special tool U/J extension and socket, 10 mm - 3220- with a suitable torque wrench.
- Then tighten glow plugs to specified torque.

Tightening torque

- ◆ 17 Nm
- Attach glow plug connectors correctly and make sure they are securely fitted.
- Install engine cover panel [⇒ page 25](#) .

3220



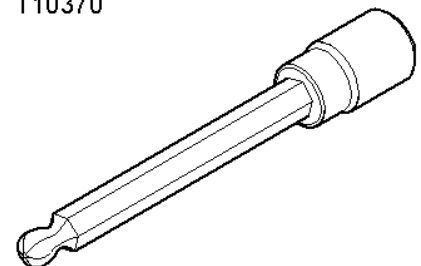
W00-0329

1.2 Removing and installing engine speed sender - G28-

Special tools and workshop equipment required

- ◆ Socket (4 mm) - T10370-

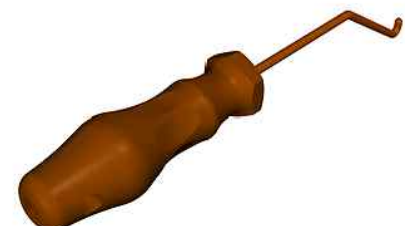
T10370



W00-10582

- ◆ Assembly tool - T10118-

T10118



W00-11303



Removing

- Remove oil filter bracket ⇒ Rep. gr. 17 .
- Unplug electrical connector at engine speed sender - G28-
-arrow- using assembly tool - T10118- .



Note

To release electrical connector without assembly tool - T10118-, press connector on engine speed sender in with a screwdriver and at the same time lift release tab with a thin wire hook.

- Move wiring clear.
- Unscrew securing bolt -2- for engine speed sender - G28-
-item 1-.

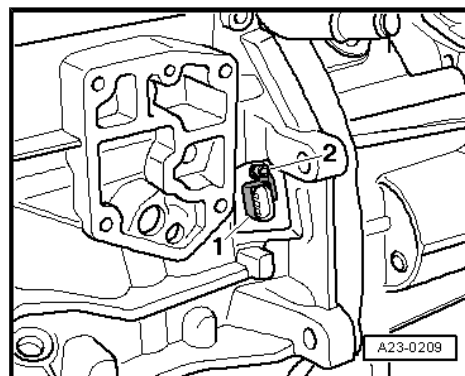
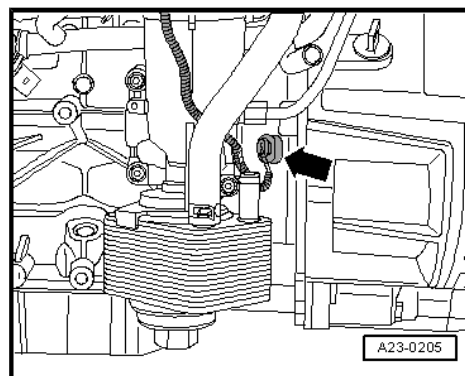
Installing

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

- Install oil filter bracket ⇒ Rep. gr. 17 .

Tightening torque

- ◆ ⇒ [“2 Overview of fitting locations - injection system”, page 7](#)

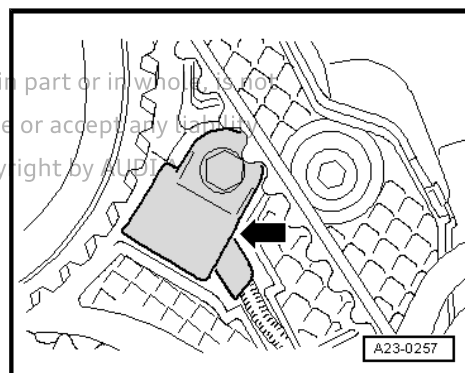
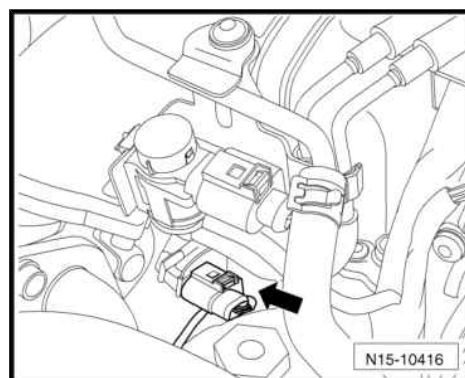


1.3 Removing and installing Hall sender - G40-

- Remove poly V-belt ⇒ Rep. gr. 13 .
- Remove toothed belt ⇒ Rep. gr. 15 .
- Remove vibration damper ⇒ Rep. gr. 13 .
- Unplug electrical connector for Hall sender - G40- -arrow-.
- Release connector from its retainer.



- Unbolt Hall sender - G40- -arrow-.



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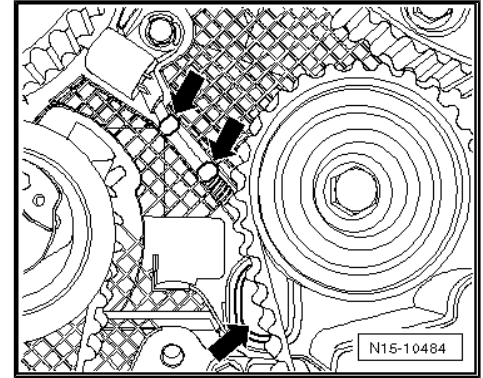
- Using a screwdriver, remove projections and take out cover for repair opening -arrows-.
- Take Hall sender - G40- off cylinder head and guide its connector through repair opening in toothed belt cover.

Installing

Installation is carried out in reverse sequence. Note the following:

Tightening torque

- ◆ ⇒ [“2 Overview of fitting locations - injection system”, page 7](#)
- ◆ Seal repair opening in toothed belt cover with rubber plug; for rubber plug refer to ⇒ ETKA (Electronic parts catalogue) .
- Fit toothed belt and adjust valve timing ⇒ Rep. gr. 15 .



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