



Workshop Manual Audi A1 2011 ➤ Audi A1 Sportback 2012 ➤

4-cylinder TDI engine, 1.6 ltr. 4-valve common rail (EA 288 Gen. I)

Engine ID	CXM A								
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Edition 10.2019



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List of Workshop Manual Repair Groups



Repair Group

00 - Technical data

10 - Removing and installing engine

13 - Crankshaft group

15 - Cylinder head, valve gear

17 - Lubrication

19 - Cooling

21 - Turbocharging/supercharging

23 - Mixture preparation - injection

26 - Exhaust system

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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Contents

00 - Technical data	1
1 Identification	1
1.1 Engine number/engine data	1
2 Safety precautions	2
2.1 Safety precautions when working on the fuel system	2
2.2 Safety precautions when using testers and measuring instruments during a road test	3
2.3 Safety precautions when working on the cooling system	3
2.4 Safety precautions when working on vehicles with start/stop system	3
2.5 Safety precautions when working on the exhaust system	3
3 Repair instructions	5
3.1 Rules for cleanliness	5
3.2 General notes	5
3.3 General repair instructions	6
3.4 Performing adaptations after renewing a component	7
3.5 Nuts, bolts	7
3.6 Identification plates	7
3.7 Use of impact wrenches	8
3.8 Foreign particles in engine	8
3.9 Contact corrosion	8
3.10 Routing and attachment of pipes, hoses and wiring	9
3.11 Installing radiators and condensers	9
10 - Removing and installing engine	10
1 Removing and installing engine	10
1.1 Removing engine	10
1.2 Separating engine and gearbox	22
1.3 Securing engine to engine and gearbox support	25
1.4 Installing engine	27
2 Assembly mountings	31
2.1 Exploded view - assembly mountings	31
2.2 Supporting engine in installation position	32
2.3 Removing and installing engine mountings	34
2.4 Removing and installing gearbox mounting	36
2.5 Removing and installing pendulum support	38
3 Engine cover panel	39
3.1 Removing and installing engine cover panel	39
13 - Crankshaft group	40
1 Cylinder block (pulley end)	40
1.1 Exploded view - cylinder block (pulley end)	40
1.2 Exploded view - sealing flange (pulley end)	42
1.3 Removing and installing poly V-belt	42
1.4 Removing and installing tensioner for poly V-belt	44
1.5 Removing and installing vibration damper	44
1.6 Removing and installing bracket for ancillaries	45
1.7 Removing and installing engine support	46
1.8 Removing and installing sealing flange (pulley end)	47
2 Cylinder block (gearbox end)	50
2.1 Exploded view - cylinder block (gearbox end)	50
2.2 Removing and installing flywheel	51
2.3 Removing and installing sealing flange (gearbox end)	52
3 Crankshaft	60



3.1	Exploded view - crankshaft	60
3.2	Crankshaft dimensions	61
3.3	Measuring axial clearance of crankshaft	61
3.4	Renewing needle bearing in crankshaft	62
4	Pistons and conrods	65
4.1	Exploded view - pistons and conrods	65
4.2	Removing and installing pistons	67
4.3	Measuring piston projection at TDC	69
4.4	Checking pistons and cylinder bores	70
4.5	Checking radial clearance of conrod bearings	71
15	Cylinder head, valve gear	73
1	Toothed belt drive	73
1.1	Exploded view - toothed belt cover	73
1.2	Exploded view - toothed belt	74
1.3	Removing and installing toothed belt cover	75
1.4	Removing and installing toothed belt	77
2	Cylinder head	88
2.1	Exploded view - cylinder head cover	88
2.2	Exploded view - cylinder head	90
2.3	Removing and installing cylinder head cover	92
2.4	Removing and installing seals for injectors	93
2.5	Removing and installing camshaft housing	94
2.6	Removing and installing cylinder head	100
2.7	Checking compression	106
3	Valve gear	108
3.1	Exploded view - valve gear	108
3.2	Removing and installing camshaft oil seal	110
3.3	Removing and installing valve stem oil seals	112
4	Inlet and exhaust valves	120
4.1	Checking valve guides	120
4.2	Checking valves	121
4.3	Valve dimensions	121
17	Lubrication	122
1	Sump/oil pump	122
1.1	Exploded view - sump/oil pump	122
1.2	Engine oil	124
1.3	Removing and installing sump	124
1.4	Removing and installing oil pump	129
1.5	Removing and installing oil level and oil temperature sender G266	129
2	Engine oil cooler	131
3	Oil filter/oil pressure switches	132
3.1	Exploded view - oil filter housing/oil pressure switch	132
3.2	Removing and installing oil filter housing	133
3.3	Removing and installing oil pressure switch F22	136
3.4	Removing and installing oil pressure switch for reduced oil pressure F378	137
3.5	Removing and installing valve for oil pressure control N428	138
3.6	Checking oil pressure	139
19	Cooling	141
1	Cooling system/coolant	141
1.1	Connection diagram - coolant hoses	141
1.2	Checking cooling system for leaks	142
1.3	Draining and filling cooling system without electric vacuum pump VAS 6096/2	145



1.4	Filling cooling system with electric vacuum pump VAS 6096/2	153
1.5	Checking filling quality of cooling system	159
1.6	Checking electric vacuum pump VAS 6096/2	161
1.7	Flushing cooling system	161
1.8	Flushing cooling system - quick reference guide	182
2	Coolant pump/thermostat assembly	184
2.1	Exploded view - coolant pump/thermostat	184
2.2	Exploded view - electric coolant pump	186
2.3	Exploded view - coolant temperature senders	187
2.4	Removing and installing electric coolant pump	187
2.5	Removing and installing coolant pump	191
2.6	Removing and installing thermostat	192
2.7	Removing and installing coolant valve for cylinder head N489	194
2.8	Checking thermostat	194
2.9	Removing and installing coolant temperature sender G62	194
3	Coolant pipes	196
3.1	Exploded view - coolant pipes	196
3.2	Removing and installing coolant pipes	197
4	Radiators/radiator fan	207
4.1	Exploded view - radiators/radiator fan	207
4.2	Removing and installing radiator	209
4.3	Removing and installing radiator cowl	211
4.4	Removing and installing radiator fans	213
21	Turbocharging/supercharging	214
1	Turbocharger	214
1.1	Exploded view - turbocharger	214
1.2	Removing and installing turbocharger	216
1.3	Renewing vacuum unit for turbocharger	221
2	Charge air system	225
2.1	Exploded view - charge air system	225
2.2	Exploded view - hose connections for charge air system	227
2.3	Removing and installing charge pressure sender G31	228
2.4	Removing and installing charge air temperature sender	228
2.5	Checking charge air system for leaks	229
23	Mixture preparation - injection	234
1	Injection system	234
1.1	Overview of fitting locations - injection system	234
1.2	Overview - fuel system	240
1.3	Filling and bleeding fuel system	241
1.4	Checking fuel system for leaks	242
2	Vacuum system	243
2.1	Connection diagram - vacuum system	243
2.2	Checking vacuum system	243
3	Air cleaner	245
3.1	Exploded view - air cleaner housing	245
3.2	Removing and installing air cleaner housing	246
4	Intake manifold	247
4.1	Exploded view - intake manifold	247
4.2	Removing and installing throttle valve module J338	249
4.3	Removing and installing intake manifold	251
5	Injectors/high-pressure reservoir (rail)	255
5.1	Exploded view - injectors	255



5.2	Exploded view - high-pressure reservoir (rail)	257
5.3	Checking injectors	258
5.4	Performing adaption of correction values for injectors	258
5.5	Checking for injectors sticking open	258
5.6	Checking return flow rate of injectors with engine running	260
5.7	Checking return flow rate of injectors at starter cranking speed	263
5.8	Removing and installing injectors	264
5.9	Removing and installing high-pressure pipes	268
5.10	Removing and installing high-pressure reservoir (rail)	271
6	High-pressure pump	273
6.1	Exploded view - high-pressure pump	273
6.2	Removing and installing high-pressure pump	274
7	Senders and sensors	277
7.1	Removing and installing fuel temperature sender G81	277
7.2	Removing and installing air mass meter G70	277
7.3	Checking fuel pressure regulating valve N276	278
7.4	Removing and installing fuel pressure regulating valve N276	279
7.5	Removing and installing fuel pressure sender G247	282
7.6	Removing and installing pressure differential sender G505	284
7.7	Removing and installing exhaust gas pressure sensor 1 G450	285
8	Lambda probe	286
8.1	Exploded view - Lambda probe	286
8.2	Removing and installing Lambda probe	287
9	Engine control unit	291
9.1	Removing and installing engine/motor control unit J623	291
26	Exhaust system	294
1	Exhaust pipes/silencer	294
1.1	Exploded view - silencer	294
1.2	Removing and installing front exhaust pipe	296
1.3	Separating exhaust pipes/silencers	297
1.4	Removing and installing silencer	298
1.5	Stress-free alignment of exhaust system	299
1.6	Checking exhaust system for leaks	300
2	Emission control system	301
2.1	Exploded view - emission control system	301
2.2	Removing and installing emission control module	303
2.3	Removing and installing exhaust flap control unit J883	311
3	Exhaust gas temperature control	313
3.1	Exploded view - exhaust gas temperature control	313
3.2	Removing and installing exhaust gas temperature sender	315
4	Exhaust gas recirculation	321
4.1	Exploded view - exhaust gas recirculation system	321
4.2	Removing and installing exhaust gas recirculation control motor V338	323
4.3	Removing and installing exhaust gas recirculation control motor 2 V339	324
4.4	Removing and installing exhaust gas recirculation cooler	326
28	Glow plug system	331
1	Glow plug system	331
1.1	Exploded view - glow plug system	331
1.2	Removing and installing glow plug	332
1.3	Removing and installing automatic glow period control unit J179	335
1.4	Removing and installing Hall sender G40	335
1.5	Removing and installing engine speed sender G28	335



00 – Technical data

1 Identification

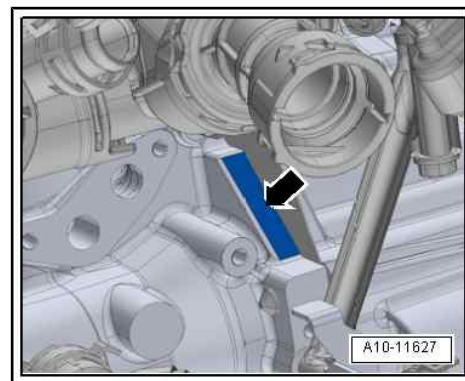
(ARL006640; Edition 10.2019)

⇒ [“1.1 Engine number/engine data”, page 1](#)

1.1 Engine number/engine data

Engine number

- ◆ The engine number (“engine code” and “serial number”) is located on the front of the joint between the engine and the gearbox -arrow-.
- ◆ Additionally there is a sticker on the toothed belt cover (top) with engine code and serial number.
- ◆ Engine codes starting with the letter “C” have four letters (previously three letters).
- ◆ The first 3 characters of the engine code stand for the engine capacity and the mechanical construction and design. They are stamped onto the cylinder block together with the serial number.
- ◆ The 4th character indicates the power output and torque of the engine and is determined by the engine control unit.



Note

- ◆ *The four-letter engine code is found on the type plate (certain countries only), vehicle data sticker and engine control unit.*
- ◆ *Fitting locations of the type plate (certain countries only) and the vehicle data sticker ⇒ Maintenance ; Booklet 819 .*

For engine data refer to ⇒ **Technical data for engines; Rep. gr. 00 ; Overview of engines .**





2 Safety precautions

⇒ [“2.1 Safety precautions when working on the fuel system”, page 2](#)

⇒ [“2.2 Safety precautions when using testers and measuring instruments during a road test”, page 3](#)

⇒ [“2.3 Safety precautions when working on the cooling system”, page 3](#)

⇒ [“2.4 Safety precautions when working on vehicles with start/stop system”, page 3](#)

⇒ [“2.5 Safety precautions when working on the exhaust system”, page 3](#)

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2.1 Safety precautions when working on the fuel system

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:

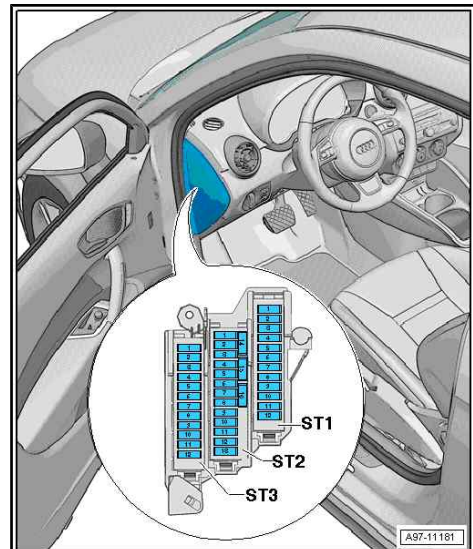
- Put on safety goggles.
- Put on protective gloves.
- Release pressure (wrap a clean cloth around connection and open connection carefully).

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.

Remove fuse for fuel pump control unit - J538- in fuse holder C - SC- under dash panel cover (driver's side); for identification of fuses refer to ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.





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

Observe the following precautions if test equipment has to be used when road-testing the vehicle:

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.

2.3 Safety precautions when working on the cooling system

When working on the cooling system note the following warnings:

Risk of scalding as hot coolant can escape

The cooling system is under pressure when the power unit is hot. Risk of scalding due to hot steam and hot coolant.

- Put on protective gloves.
- Put on safety goggles.
- Cover filler cap on expansion tank with a cloth and open carefully to release pressure.

2.4 Safety precautions when working on vehicles with start/stop system

Risk of injury - engine may start unexpectedly

The engine can start unexpectedly if the vehicle's start/stop system is activated. A message in the instrument cluster indicates whether the start/stop system is activated.

- To deactivate the start/stop system, switch off the ignition.

2.5 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.

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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.



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3 Repair instructions

⇒ [“3.1 Rules for cleanliness”, page 5](#)

⇒ [“3.2 General notes”, page 5](#)

⇒ [“3.3 General repair instructions”, page 6](#)

⇒ [“3.4 Performing adaptations after renewing a component”, page 7](#)

⇒ [“3.5 Nuts, bolts”, page 7](#)

⇒ [“3.6 Identification plates”, page 7](#)

⇒ [“3.7 Use of impact wrenches”, page 8](#)

⇒ [“3.8 Foreign particles in engine”, page 8](#)

⇒ [“3.9 Contact corrosion”, page 8](#)

⇒ [“3.10 Routing and attachment of pipes, hoses and wiring”, page 9](#)

⇒ [“3.11 Installing radiators and condensers”, page 9](#)

3.1 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 reused 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.

3.2 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 2 seconds in order to build up pressure in the fuel system ⇒ [page 2](#) .

3.3 General repair instructions



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 filled and bled before the engine is started for the first time ⇒ [page 241](#) .***
- ◆ 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.

3.4 Performing adaptations after renewing a component

The learnt values must be adapted if components of the engine or reducing agent system have been renewed or if a reducing agent line has been opened:

After renewing engine, pistons, cylinder head or turbocharger (running-in function with increased oil pressure is activated):

After a component has been renewed, the following program must be performed using the ⇒ Vehicle diagnostic tester.

- 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 J623**
 - ◆ **01 - Engine electronics, functions**
 - ◆ **01 - Work steps after component replacement**

3.5 Nuts, bolts

- ◆ Loosen bolts in reverse sequence to specified tightening sequence.
- ◆ Bolts and nuts used to secure covers and housings must be tightened in steps according to the specified tightening sequence and method.
- ◆ Bolts and nuts which secure covers and housings should be loosened and tightened in diagonal sequence and in stages if no tightening sequence is specified.
- ◆ Always renew self-locking bolts and nuts.
- ◆ Unless otherwise specified, use a wire brush to clean the threads of bolts which are secured with locking fluid. Then install bolts with locking fluid; for locking fluid refer to ⇒ Electronic parts catalogue .
- ◆ Threaded holes which take self-locking bolts or bolts coated with locking fluid must be cleaned using a thread tap or similar. Otherwise there is a danger of the bolts shearing off the next time they are removed.
- ◆ The tightening torques stated apply to non-oiled nuts and bolts.

3.6 Identification plates

When renewing vehicle components, the identification plates on the old parts that have a replacement part number (see ⇒ Elec-



tronic parts catalogue) must be attached to the new parts due to approval regulations.

3.7 Use of impact wrenches

In general, it is permitted to use an impact wrench to unscrew bolts and nuts. An exception to this is when work is performed inside an open high-voltage battery. For this work, it is not permitted to use an impact wrench.

An impact wrench may be used to screw in bolts and nuts when performing repair work if the following requirements are observed. In general, electric and compressed-air impact wrenches should be used.

Requirements:

- Only screw in bolts with locking fluid or self-locking nuts at low speed.
- Use a suitable impact wrench with variable speed and adjustable torque range.
- Use suitable bits when working in the vicinity of sensitive surfaces, e.g. plastic-coated bits for aluminium rims.
- When working in the vicinity of natural gas systems, observe the information in the Workshop Manual "Natural gas engines - General information".

Use:

- Fit bolts/nuts by hand.
- Only use an impact wrench to screw in bolts/nuts until the head of the bolt/nut makes contact and then continue tightening with a torque wrench.
- Clean threaded pins before unscrewing the bolt/nut.

3.8 Foreign particles in engine

When performing assembly work on the engine, all open passages in the intake and exhaust systems must be sealed with suitable plugs (e.g. from engine bung set -VAS 6122-) to prevent foreign particles from entering the engine.



Note

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If the turbocharger has suffered mechanical damage

⇒ [page 216](#)

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3.9 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.

3.10 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.

3.11 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.



10 – Removing and installing engine

1 Removing and installing engine

⇒ [“1.1 Removing engine”, page 10](#)

⇒ [“1.2 Separating engine and gearbox”, page 22](#)

⇒ [“1.3 Securing engine to engine and gearbox support”, page 25](#)

⇒ [“1.4 Installing engine”, page 27](#)

1.1 Removing engine

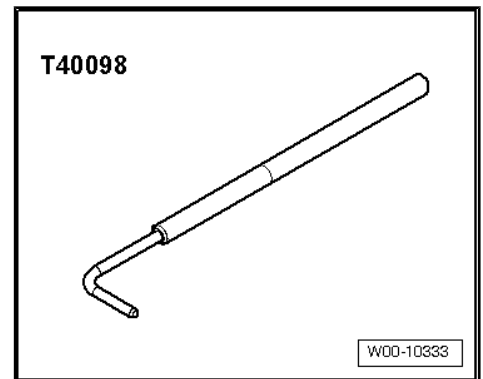
Special tools and workshop equipment required



- ◆ Removal lever - 80-200-
- ◆ Stepladder (commercially available) or -VAS 5085-
- ◆ Engine bung set - VAS 6122-
- ◆ Coolant collecting system - VAS 5014- or drip tray for workshop hoist - VAS 6208-
- ◆ Hose clip pliers - VAS 6362-



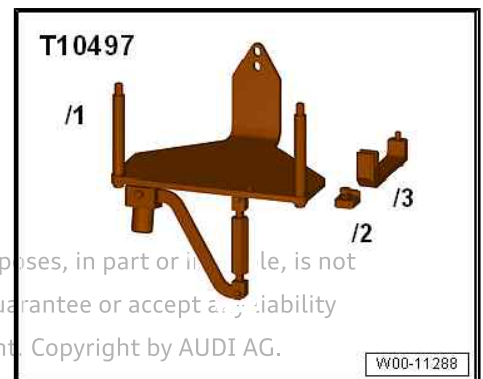
- ◆ Engine and gearbox jack - VAS 6931-
- ◆ Locking tool - T40098-



- ◆ Engine bracket - T10497- with pin -T10497/1-



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- ◆ Safety goggles
- ◆ Protective gloves

Procedure

Note

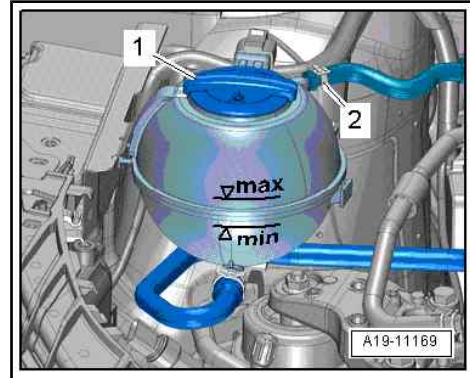
- ◆ *The engine is removed from underneath together with the gearbox.*
- ◆ *Re-fit all cable ties and heat insulation sleeves in the same locations when installing.*



WARNING

Risk of scalding due to hot steam and hot coolant.

- ◆ *The cooling system is under pressure when the power unit is hot.*
- ◆ *Wear protective gloves and safety goggles.*
- ◆ *To allow pressure to dissipate, cover filler cap on coolant expansion tank with cloth and open carefully.*



- Open filler cap -1- on coolant expansion tank.

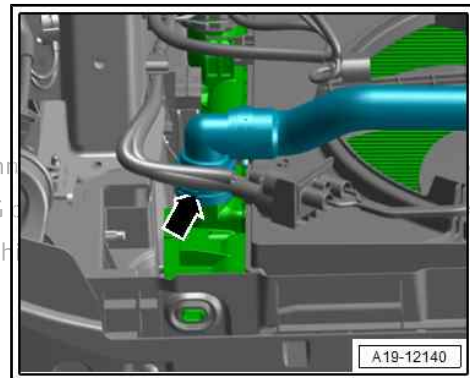


Note

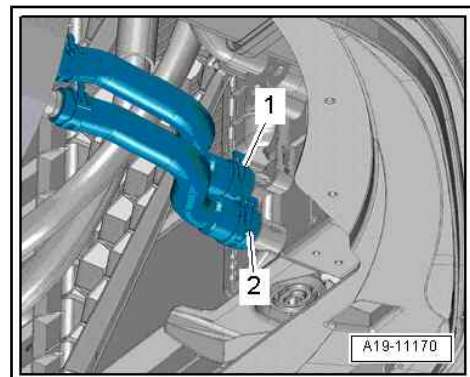
Disregard -item 2-.

- Disconnect battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .
- Remove subframe with steering rack ⇒ Rep. gr. 40 ; Sub-frame; Removing and installing subframe with steering rack .
- Remove wheel housing liners (front left and front right) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .
- Place collector tank from coolant collecting system -VAS 5014- or drip tray for workshop hoist - VAS 6208- underneath.
- Lift retaining clip -arrow-, disconnect coolant hose from radiator (bottom left) and drain off coolant.

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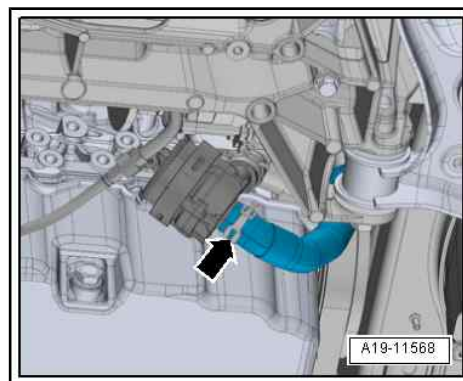


- Release hose clips -1, 2-, disconnect coolant hoses from water radiator (bottom right) for charge air cooling circuit and drain off coolant.

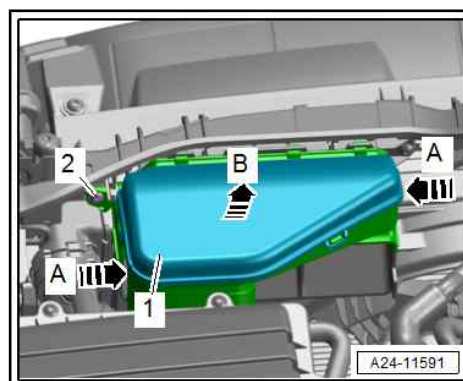




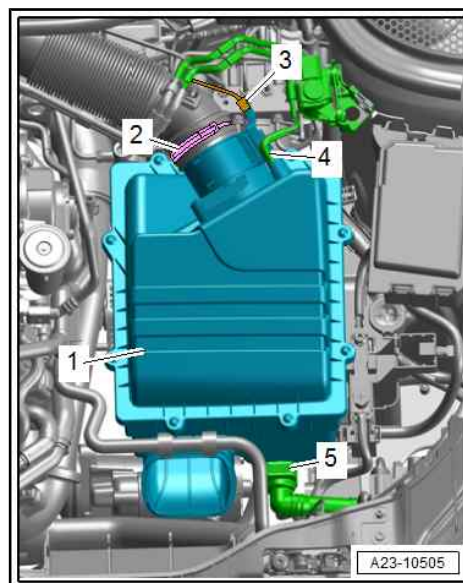
- Release hose clip -arrow-, disconnect coolant hose (bottom) from auxiliary pump for heating - V488- and drain off coolant.
- Remove engine cover panel ⇒ [page 39](#) .



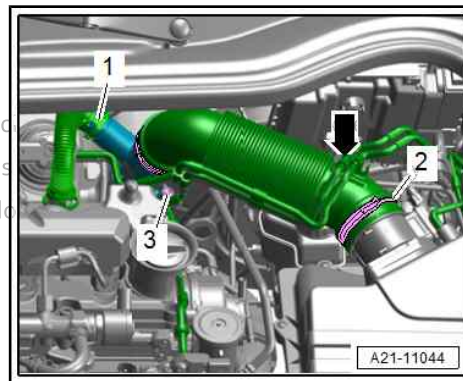
- Unscrew bolt -2- and release fasteners -arrows A-.
- Detach cover -1- from air duct -arrow B- and remove it.



- Unplug electrical connector -3-.
- Disconnect vacuum hose -4-.
- Press release tab -5- and disconnect water drain hose.
- Release hose clip -2- and detach air pipe.
- Lift off air cleaner housing -1-.



- Press release tabs on both sides of crankcase breather hose -1- and disconnect hose from connection.
- Move clear vacuum hoses -arrow- at air pipe.
- Unscrew bolt -3-, turn air pipe with connection clockwise and detach it from turbocharger.



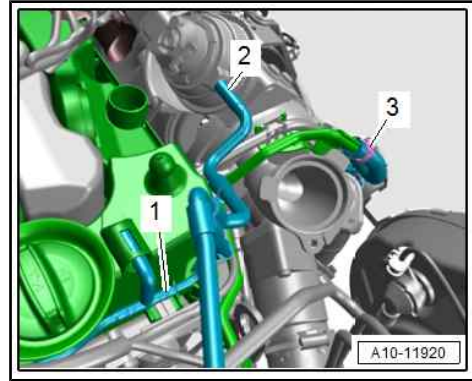
i Note

Disregard -item 2-.

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- Detach vacuum hose -2- from vacuum unit of turbocharger.
- Disconnect vacuum hose -1- from T-piece.
- Release hose clip -3- and disconnect coolant hose.

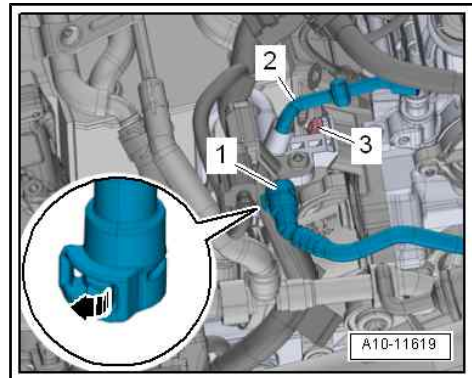


- Release catch -arrow-, disconnect vacuum hose -1- and place it to left side.

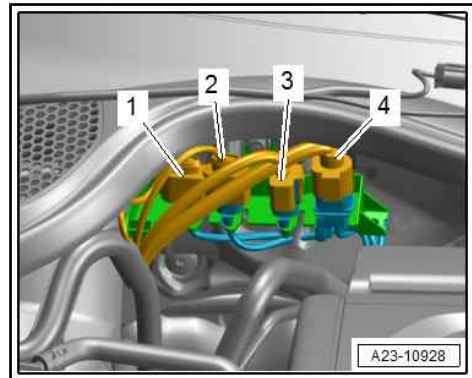


Note

Disregard items -2 and 3-.



- If fitted, open heat shield sleeve.
 - Detach electrical connectors from bracket, unplug connectors and move electrical wiring clear:
- 1 - For exhaust gas temperature sender 4 - G648-
 - 2 - For exhaust gas temperature sender 3 - G495-
 - 3 - For exhaust gas temperature sender 2 - G448-
 - 4 - For Lambda probe - G39-

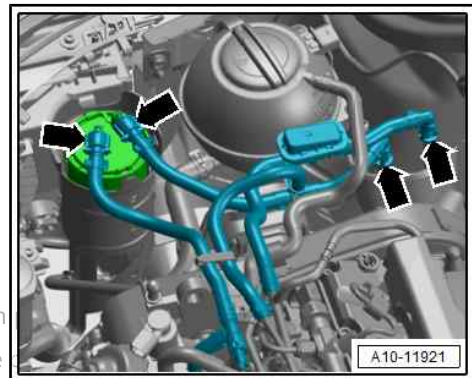


Caution

Risk of damage caused by particles of dirt.

- ◆ **Observe rules for cleanliness when working on the fuel supply system ⇒ page 5.**

- Disconnect fuel hoses -arrows- ⇒ Fuel supply system; Rep. gr. 20: Plug-in connectors; Disconnecting plug-in connectors
- Move fuel hoses clear at coolant expansion tank



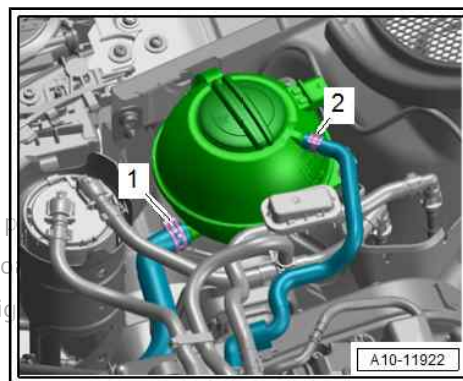
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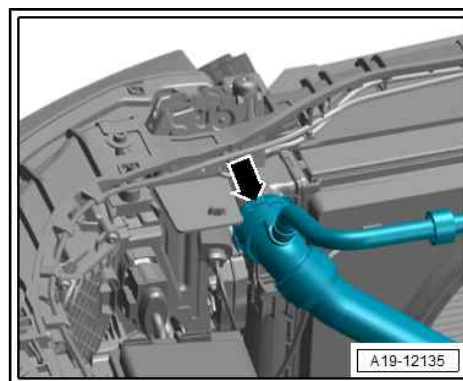
- Release hose clips -1, 2- and disconnect coolant hoses.



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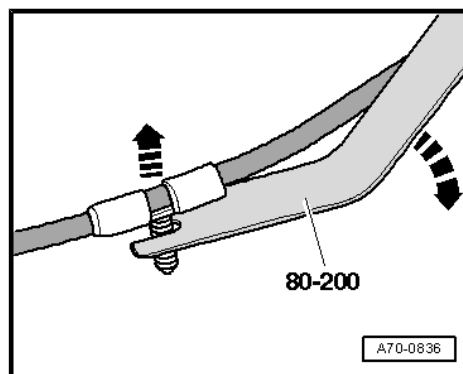


- Lift retaining clip -arrow- and disconnect coolant hose (top left) from radiator.

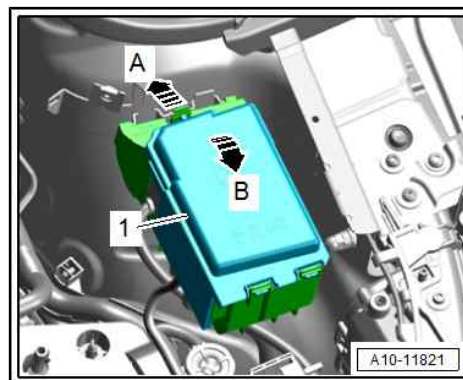


i Note

Use removal lever - 80-200- to lever out the wiring clips when performing the next work steps.

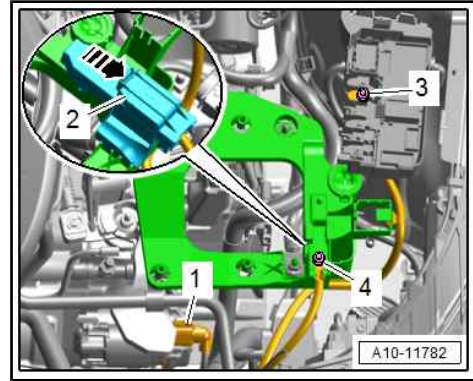


- Release catch -arrow A-, open cover -1- for electronics box in engine compartment -arrow B- and detach.

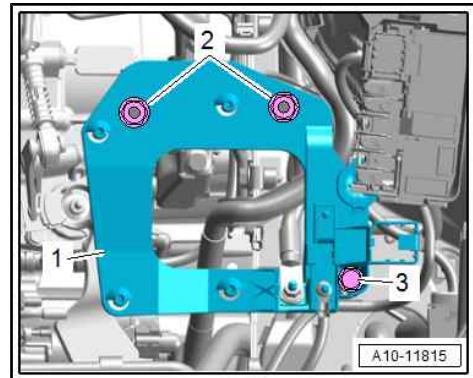




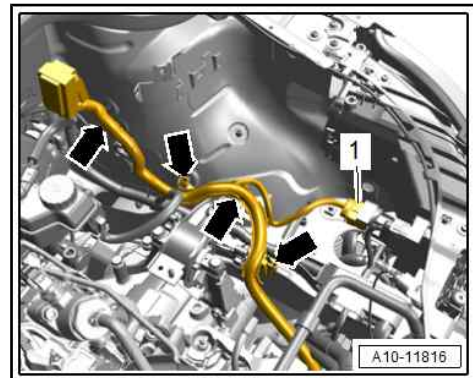
- Unplug electrical connector -1- at starter.
- Release catch -arrow- and open cover -2-.
- Remove B+ stud -4- and move electrical wiring clear.
- Remove nut -3-, detach electrical wiring and move clear.



- Remove nuts -2- and bolt -3-.
- Push mounting -1- for jump start terminal and air cleaner housing slightly to one side.



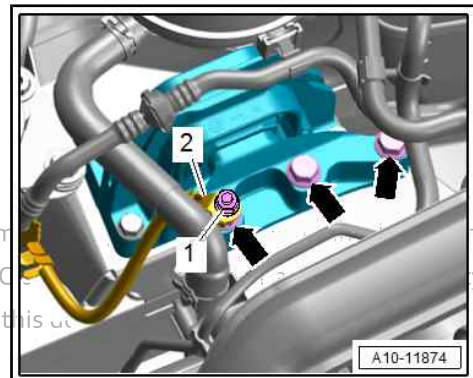
- Remove engine control unit - J623- => [page 291](#) .
- Take electrical connector -1- out of bracket, unplug it and move electrical wiring clear.
- Move engine wiring harness clear -arrows- and lay on top of engine.



- Remove nut -1- and move earth wire -2- clear.
- Loosen bolts -arrows- for support arm of engine mounting approx. 2 turns.



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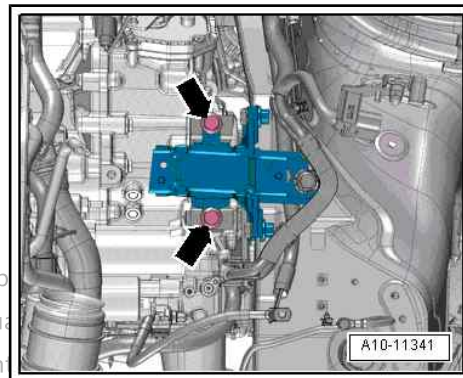




- Loosen bolts -arrows- for gearbox mounting approx. 2 turns.

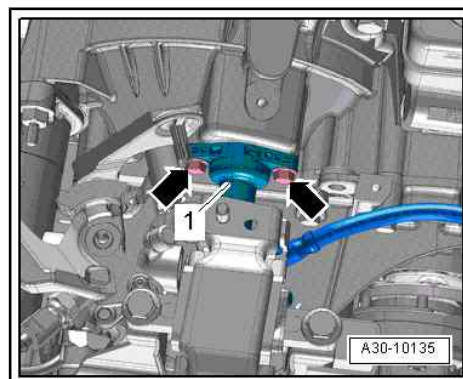


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Vehicles with manual gearbox:

- Detach gear selector cable and gate selector cable from gearbox, remove cable support bracket and place to one side with selector cables attached ⇒ Rep. gr. 34 ; Selector mechanism; Removing and installing selector mechanism .
- Remove bolts -arrows-, detach clutch slave cylinder -1- and place to one side; do not open pipes.



Caution

Risk of irreparable damage to clutch slave cylinder.

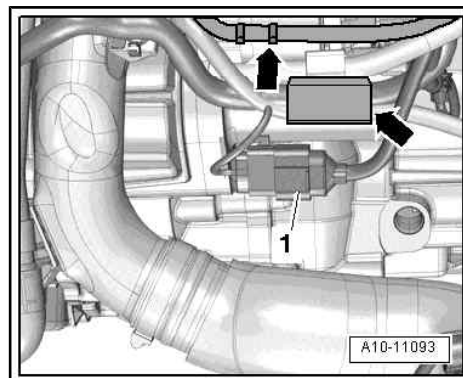
- ◆ **Do not operate clutch pedal with slave cylinder removed.**

- Unplug electrical connector -1-.

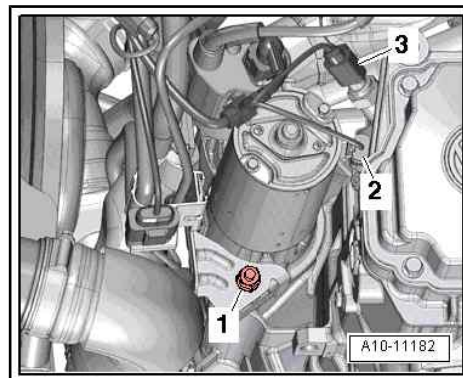


Note

Disregard -arrows-.



- Unplug electrical connectors:
 - 2 - For reversing light switch - F4-
 - 3 - For gearbox neutral position sender - G701-
- Unscrew nut -1- and detach bracket for electrical wiring.





Vehicles with dual clutch gearbox:

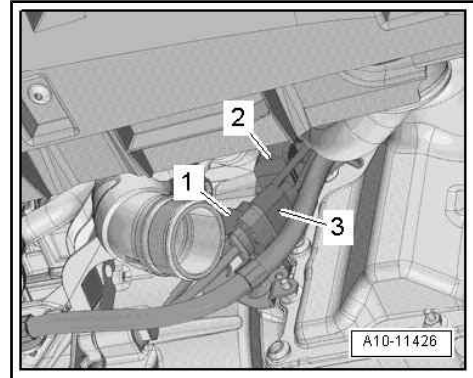
- Detach selector lever cable from selector lever and place to one side ⇒ Rep. gr. 34 ; Selector mechanism; Removing and installing selector mechanism .
- Detach electrical connectors -1, 3- from bracket and unplug.



Caution

Risk of serious damage to gearbox components.

- ◆ **Do NOT touch connector contacts in gearbox connector with your hands. Doing so could cause static discharge to damage the control unit and the mechatronic unit irreparably.**



- Touch vehicle earth with bare hands to eliminate any static charge.
- Unplug electrical connector -2- for mechatronic unit for dual clutch gearbox - J743- .

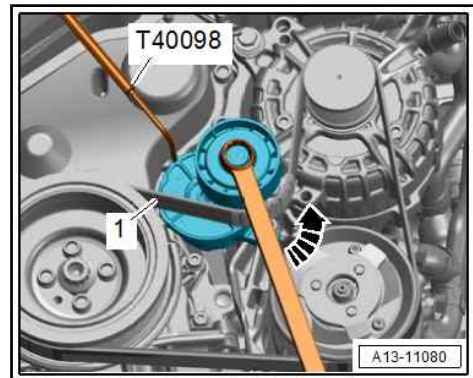
All vehicles (continued):



Caution

Running a used poly V-belt in the opposite direction could cause irreparable damage.

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



- To slacken poly V-belt turn tensioner in anti-clockwise direction -arrow-.
- Take off poly V-belt -1-.
- Lock tensioner with locking tool - T40098-.

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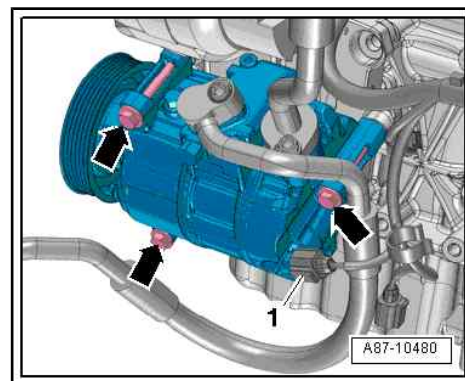


- Unplug electrical connector -1- on air conditioner compressor regulating valve - N280- .

⚠ Caution

Risk of damage to air conditioner compressor and refrigerant pipes/hoses.

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



- Remove bolts -arrows-.

⚠ WARNING

Risk of injury caused by refrigerant.

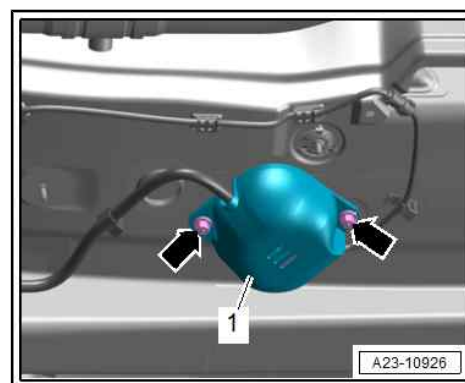
◆ **The air conditioner refrigerant circuit must not be opened.**

- Detach air conditioner compressor from bracket (refrigerant hoses remain connected) and tie up to right side.
- Unbolt drive shaft (left and right) from gearbox and tie up to rear ⇒ Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .

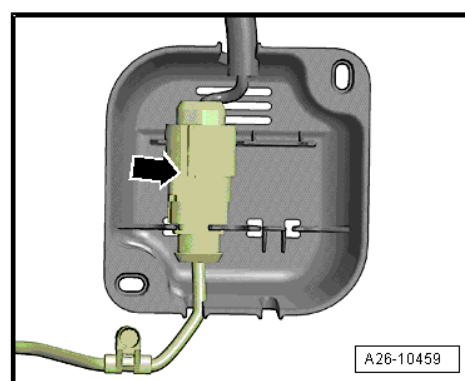
i Note

Take care not to damage the surface coating of the drive shaft.

- Unfasten underbody trim (inside centre right) and press downwards ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Exploded view - underbody trim .
- Unscrew nuts -arrows- and detach cover -1-.

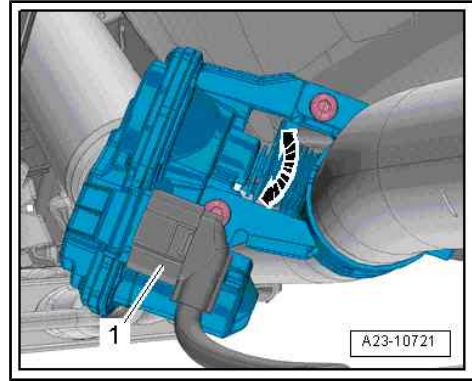


- Unplug electrical connector -arrow- for Lambda probe after catalytic converter - G130- .

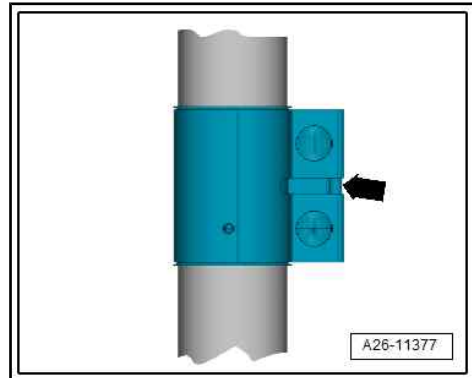




- Unplug electrical connector -1- from exhaust flap control unit - J883- .



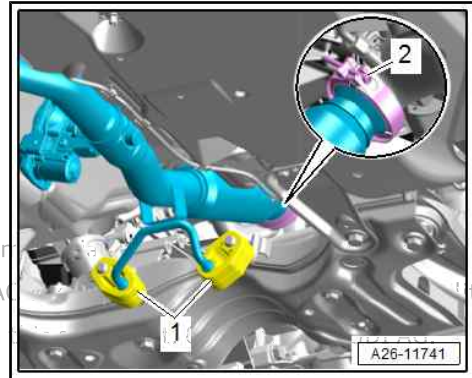
- Loosen clamp -arrow- and push towards rear.



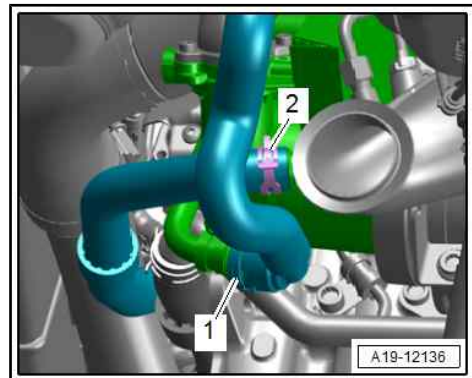
- Slacken bolt -2- and remove clip.
- Detach mountings -1- for front exhaust pipe from subframe and detach front exhaust pipe.



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- Place collector tank from coolant collecting system -VAS 5014- or drip tray for workshop hoist - VAS 6208- underneath.
- Lift retaining clips -1, 2- and disconnect coolant hoses.

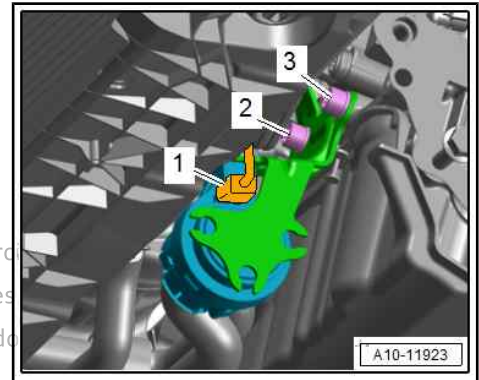




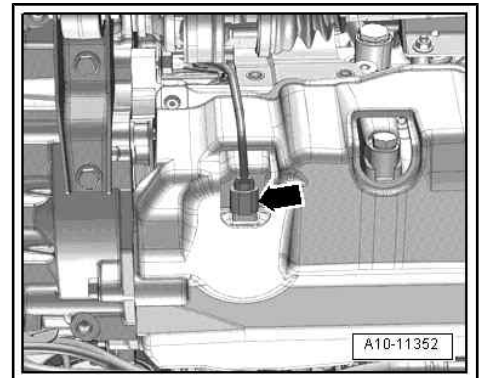
- Unplug electrical connector -1-.
- Remove bolts -2, 3- and press charge air cooling pump - V188- to side.



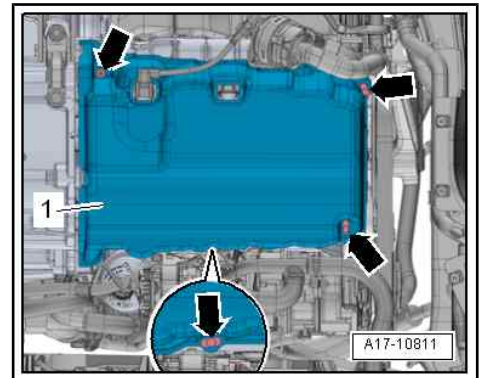
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- Unplug electrical connector -arrow- for oil level and oil temperature sender - G266- .



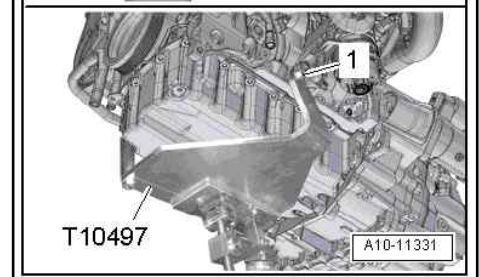
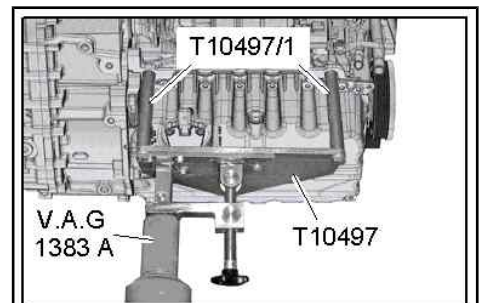
- Release fasteners -arrows- and detach noise insulation -1- for sump.



- Attach engine bracket - T10497- with pin -T10497/1- to cylinder block with bolt -1-; tighten to approx. 20 Nm and use top elongated hole "A".
- Insert engine and gearbox jack in engine bracket - T10497- and raise engine/gearbox assembly slightly.

i Note

Use a stepladder when unscrewing bolts for assembly mounting.



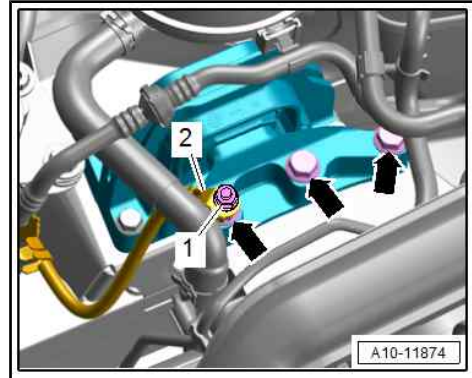


- Remove bolts -arrows- for support arm of engine mounting.



Note

Disregard items -1 and 2-.



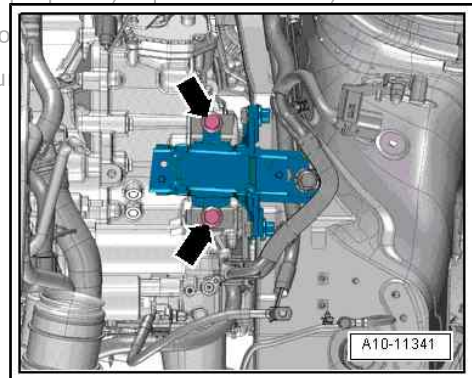
- Remove bolts -arrows- securing gearbox mounting.



Caution

Danger of damage to vacuum lines or electrical wiring and to engine compartment.

- ◆ Check that all vacuum lines and electrical wiring between engine, gearbox and body have been detached.
- ◆ Carefully guide engine/gearbox assembly out of engine compartment when lowering.



- First lower engine/gearbox assembly only slightly.
- Then swing gearbox end of engine/gearbox assembly forwards and only then lower further.

1.2 Separating engine and gearbox

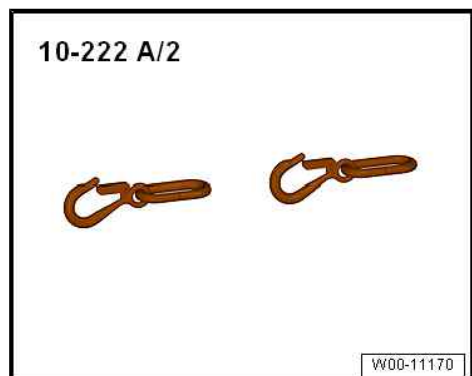
⇒ ["1.2.1 Separating engine and gearbox - vehicles with manual gearbox", page 22](#)

⇒ ["1.2.2 Separating engine and gearbox - vehicles with dual clutch gearbox", page 24](#)

1.2.1 Separating engine and gearbox - vehicles with manual gearbox

Special tools and workshop equipment required

- ◆ Hooks - 10-222A/2-





- ◆ Workshop hoist - VAS 6100-



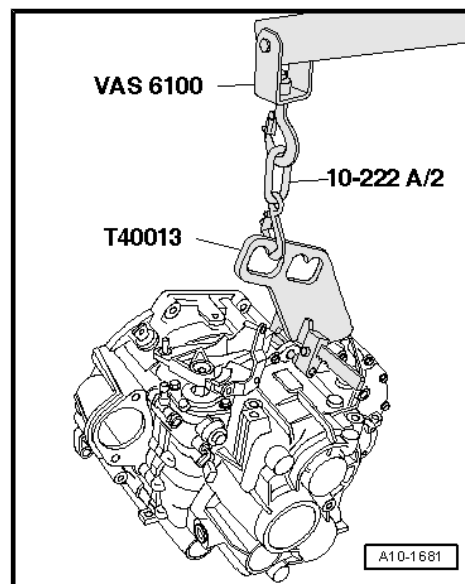
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- ◆ Lifting tackle - T40013-



Procedure

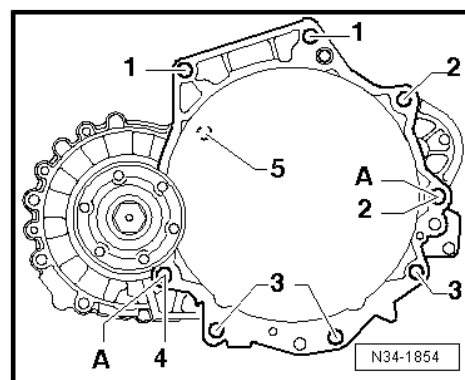
- Engine/gearbox assembly removed and attached to engine support - T10497- .
- Attach lifting tackle - T40013- to gearbox and close lock.
- Attach workshop hoist - VAS 6100- with hooks - 10-222A/2- to the lifting tackle.
- Remove starter ⇒ Electrical system; Rep. gr. 27 ; Starter; Removing and installing starter .



- Remove bolts -1, 3, 4- securing gearbox to engine.
- Detach gearbox from engine.

Note

Disregard -items 2, 5, A-.





1.2.2 Separating engine and gearbox - vehicles with dual clutch gearbox

Special tools and workshop equipment required

- ◆ Shackle - 10-222A/12-

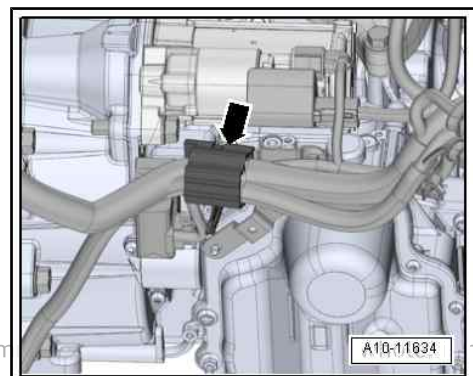


- ◆ Workshop hoist - VAS 6100-



Procedure

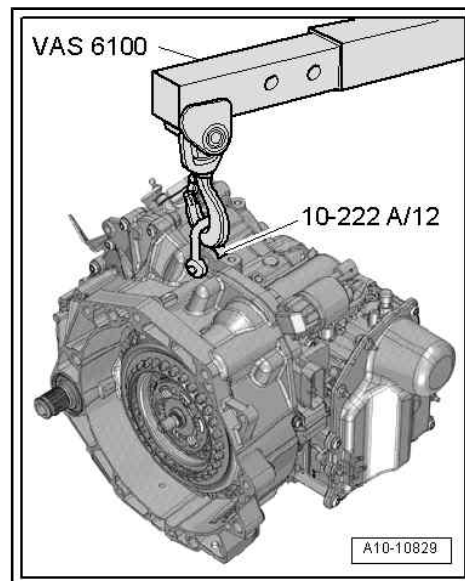
- Engine/gearbox assembly removed and attached to engine bracket - T10497- .
- Remove starter ⇒ Electrical system; Rep. gr. 27 ; Starter; Removing and installing starter .
- Move electrical wiring clear at retainer -arrow-.



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- Secure gearbox to workshop hoist - 10-222A/12- using shackle - VAS 6100- .



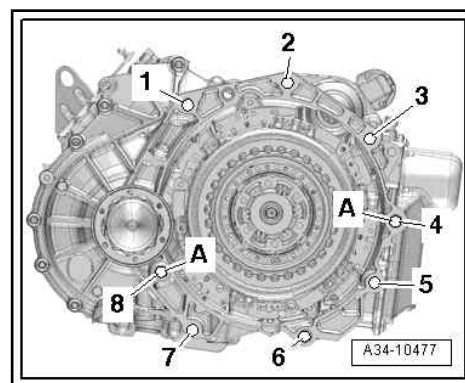
- Remove bolts -1, 3, 4, 5, 6, 7, 8- securing gearbox to engine.



Note

- ◆ Bolt -3- is fitted in the installation opening of the starter.
- ◆ Disregard -items 2, A-.

- Detach gearbox from engine.



1.3 Securing engine to engine and gearbox support

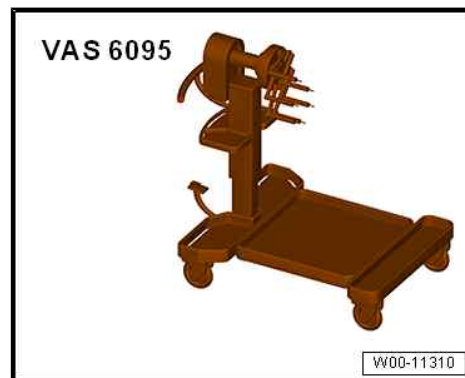
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permitted. When carrying out repairs, secure engine to engine and gearbox support - VAS 6095- using universal support - VAS 6095/1- .

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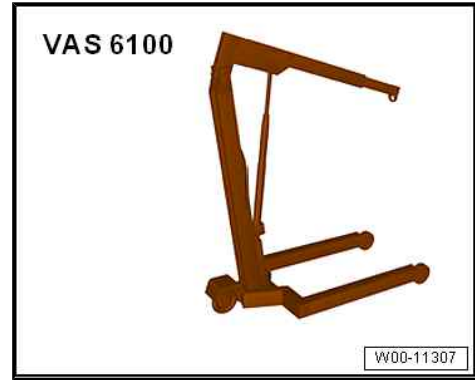
Special tools and workshop equipment required

- ◆ Engine and gearbox support - VAS 6095-





◆ Workshop hoist - VAS 6100-

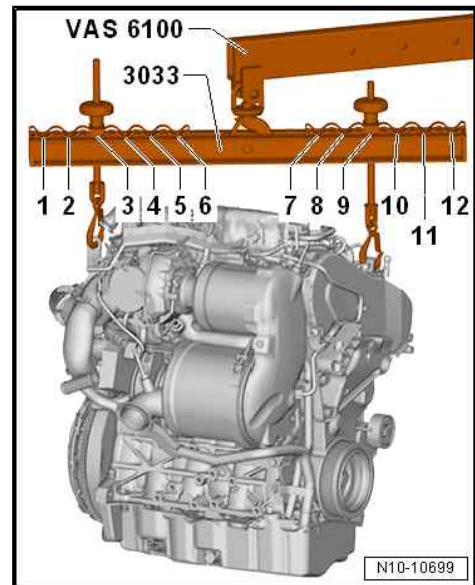


◆ Lifting tackle - 3033-



Procedure

- Gearbox detached from engine
 ⇒ ["1.2 Separating engine and gearbox", page 22](#) .
- Attach lifting tackle - 3033- to engine and workshop hoist - VAS 6100- as shown in illustration.
- ◆ Gearbox end: position 3.
- ◆ Pulley end: position 9.
- Lift engine off engine bracket - T10497A- using workshop hoist - VAS 6100- .

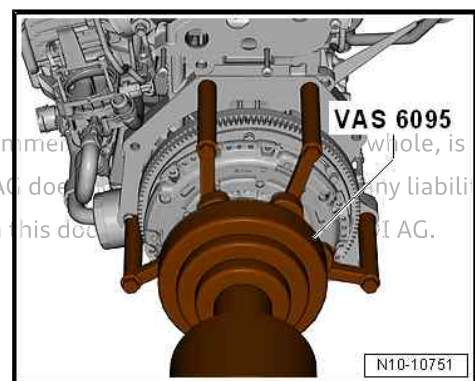


- Secure engine to engine and gearbox support - VAS 6095- using universal support - VAS 6095/1-



Tightening torque

Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65





1.4 Installing engine

When installing a new base engine, you must check whether there is a sticker on the cylinder head cover.

If a sticker is attached which states Spannpratzen auf vorgeschriebenes Drehmoment angezogen (clamping pieces tightened to specified torque), the clamping pieces have already been tightened to the specified final torque at the factory.

If no sticker is attached, it is essential that the clamping pieces for the injectors are tightened to the specified torque ⇒ [page 255](#) after installing the high-pressure pipes. If these instructions are not observed, the engine could be damaged.

Procedure

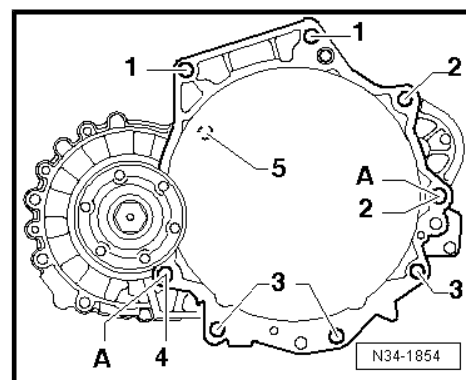


Note

- ◆ Vehicles with dual clutch gearbox: The needle bearing in the crankshaft must always be renewed if the engine has been separated from the gearbox
 ⇒ ["3.4 Renewing needle bearing in crankshaft", page 62](#) .
 - ◆ After removing, renew bolts tightened with specified tightening angle.
 - ◆ Renew self-locking nuts and bolts as well as seals, gaskets and O-rings after removal.
 - ◆ Secure all hose connections with correct type of hose clips (as original equipment) ⇒ *Electronic parts catalogue* .
 - ◆ Re-fit all cable ties and heat insulation sleeves in the same locations when installing.
- Install intermediate plate ⇒ [page 51](#) .

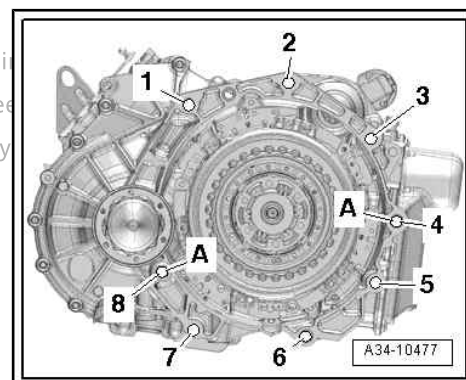
Vehicles with manual gearbox:

- If not already fitted, install dowel sleeves -A- for centring engine and gearbox in cylinder block.
- Remove needle bearing in crankshaft if fitted ⇒ [page 62](#) .
- Renew clutch release bearing if worn ⇒ Rep. gr. 30 ; Clutch mechanism; Exploded view - clutch release mechanism .
- Lubricate splines of gearbox input shaft lightly with grease for clutch plate splines ⇒ *Electronic parts catalogue* .
- Make sure that clutch plate is properly centred.



Vehicles with dual clutch gearbox:

- If not already fitted, install dowel sleeves -A- for centring engine and gearbox in cylinder block.
- Install needle bearing if not fitted in crankshaft ⇒ [page 62](#)
- Secure gearbox to engine.
- Take up engine/gearbox assembly with engine bracket - T10497- .





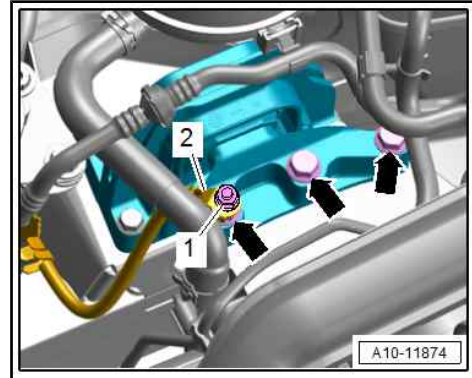
All vehicles (continued):

- Guide engine/gearbox assembly into body.
- Initially hand-tighten bolts -arrows- for support arm of engine mounting until they make contact.



Note

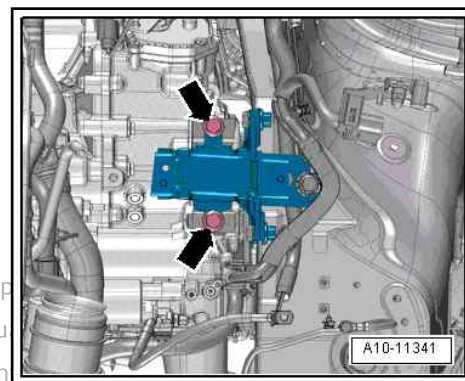
Disregard items -1 and 2-.



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- Initially screw in bolts -arrows- for gearbox mounting by hand until they make contact.
- Remove engine bracket - T10497- from engine.
- Install engine mountings ⇒ [page 34](#) .
- Connect fuel hoses ⇒ Fuel supply system; Rep. gr. 20 ; Plug-in connectors; Disconnecting plug-in connectors .
- Install starter ⇒ Electrical system; Rep. gr. 27 ; Starter; Exploded view starter
- Install charge air cooling pump ⇒ [page 187](#) .
- Install air pipe ⇒ [page 214](#) .
- Install front exhaust pipe ⇒ [page 296](#) .
- Install underbody trim ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Exploded view - underbody trim .
- Install drive shafts ⇒ Rep. gr. 40 ; Drive shaft; Exploded view - drive shaft .
- Install air conditioner compressor ⇒ Heating, air conditioning; Rep. gr. 87 ; Air conditioner compressor; Exploded view - air conditioner compressor drive unit .
- Install poly V-belt ⇒ [page 42](#) .
- Install cables with cable support bracket or selector lever cable ⇒ Rep. gr. 34 ; Selector mechanism; Exploded view - selector cables .
- Install engine control unit - J623- ⇒ [page 291](#) .
- Install mounting for jump start terminal and air cleaner housing ⇒ Electrical system; Rep. gr. 27 ; Jump start terminal; Removing and installing jump start terminal .
- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Connect vacuum hoses ⇒ [page 243](#) .
- Install air cleaner housing ⇒ [page 245](#) .
- Check oil level ⇒ Maintenance ; Booklet 819 .



Caution

Risk of irreparable damage to control units because of excessive voltage.

- ◆ *Never use battery charging equipment for boost starting.*

- Connect coolant hoses with plug-in connector ⇒ [page 208](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *Only fill and bleed fuel system using ⇒ Vehicle diagnostic tester.*



Note

Do not reuse coolant.

- Fill up with coolant ⇒ [page 148](#) .
- Install subframe with steering rack ⇒ Rep. gr. 40 ; Subframe; Removing and installing subframe with steering rack .
- Install front wheel housing liners ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .
- If engine has been renewed, perform adaptations required after renewing component
 ⇒ ["3.4 Performing adaptations after renewing a component", page 7](#) .
- Check fuel system for leaks ⇒ [page 242](#) .
- Install engine cover panel ⇒ [page 39](#) .

Tightening torques



Note

- ◆ *Tightening torques apply only to lightly greased, oiled, phosphated or black-finished nuts and bolts.*
- ◆ *Additional lubricants such as engine or gear oil may be used, but do not use lubricants containing graphite.*
- ◆ *Do not use degreased parts.*
- ◆ *Tolerance for tightening torques: ± 15 %*

Component		Nm
Bolts/nuts	M6	10
	M7	15
	M8	20
	M10	40
	M12	65

- ◆ ⇒ ["2.1 Exploded view - assembly mountings", page 31](#)
- ◆ Securing engine to gearbox ⇒ Rep. gr. 34 ; Removing and installing gearbox; Tightening torques for gearbox



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2 Assembly mountings

⇒ [“2.1 Exploded view - assembly mountings”, page 31](#)

⇒ [“2.2 Supporting engine in installation position”, page 32](#)

⇒ [“2.3 Removing and installing engine mountings”, page 34](#)

⇒ [“2.4 Removing and installing gearbox mounting”, page 36](#)

⇒ [“2.5 Removing and installing pendulum support”, page 38](#)

2.1 Exploded view - assembly mountings

1 - Engine support

- ❑ Removing and installing
⇒ [page 46](#)

2 - Bolt

- ❑ Renew after removing
- ❑ Tightening torque and sequence ⇒ [page 32](#)

3 - Engine mounting

- ❑ With support arm
- ❑ Removing and installing
⇒ [page 34](#)

4 - Bolt

- ❑ Renew after removing
- ❑ 20 Nm +90°

5 - Bolt

- ❑ Renew after removing
- ❑ 30 Nm +90°

6 - Bolt

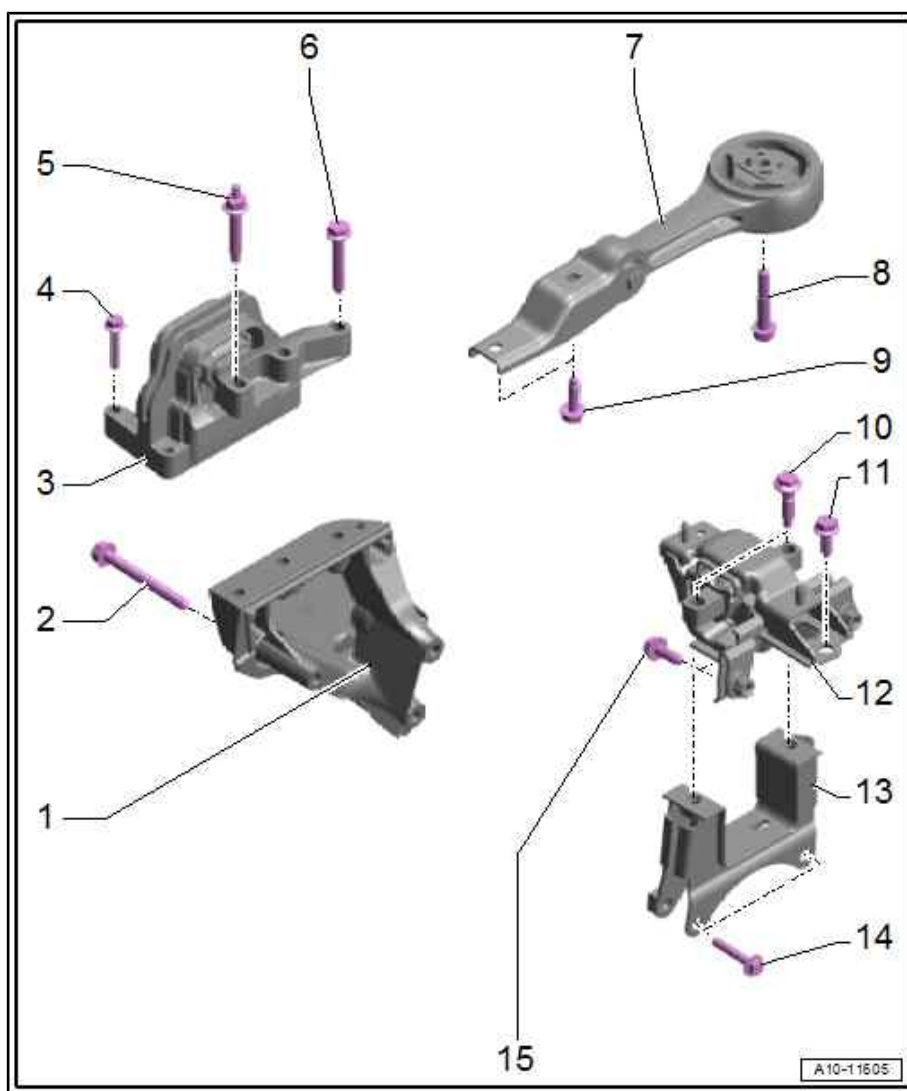
- ❑ Renew after removing
- ❑ 30 Nm +90°

7 - Pendulum support

- ❑ Removing and installing
⇒ [page 38](#)

8 - Bolt

- ❑ Renew after removing
- ❑ Tightening torque and





sequence ⇒ [page 32](#)

9 - Bolt

- Renew after removing
- Tightening torque and sequence ⇒ [page 32](#)

10, 11 - Bolts

- Tightening torque ⇒ Rep. gr. 34 ; Assembly mountings; Exploded view - assembly mountings

12 - Gearbox mounting

- With support arm
- Removing and installing ⇒ [page 36](#)

13 - Gearbox support

- For vehicles with manual gearbox

14, 15 - Bolts

- Tightening torque ⇒ Rep. gr. 34 ; Assembly mountings; Exploded view - assembly mountings

Engine support - tightening torque and sequence

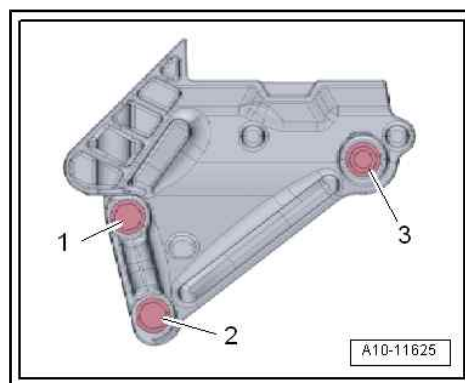


Note

After removing, renew bolts tightened with specified tightening angle.

– Tighten bolts in stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 ... 3-	7 Nm
2.	-1 ... 3-	50 Nm
3.	-1 ... 3-	Turn 90° further



Installing pendulum support

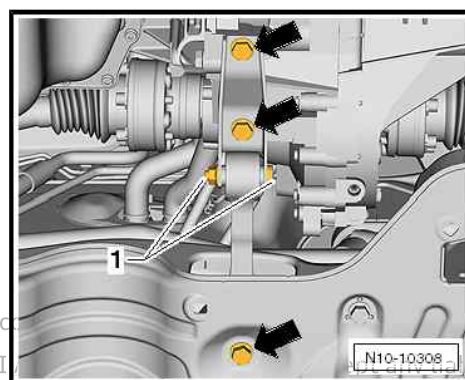


Note

After removing, renew bolts tightened with specified tightening angle.

– Tighten bolts in stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-Top arrows-	30 Nm
2.	-Bottom arrow-	40 Nm
3.	-Arrows-	Turn 90° further

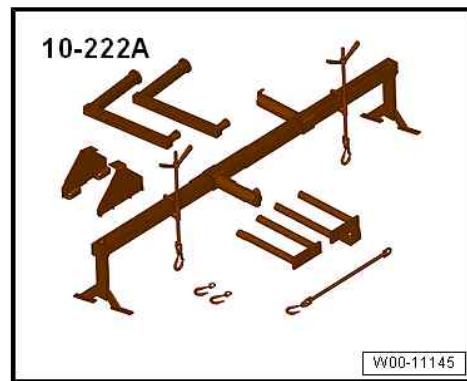


2.2 Supporting engine in installation position

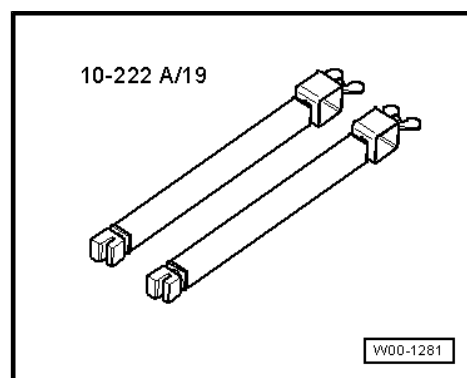
Special tools and workshop equipment required



- ◆ Support bracket - 10-222A-



- ◆ Adapter - 10-222A/19-

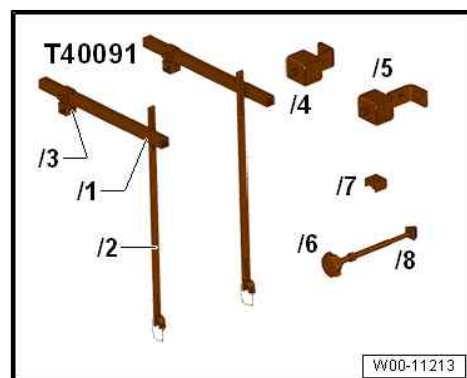


- ◆ Hose clip pliers - VAS 6362-

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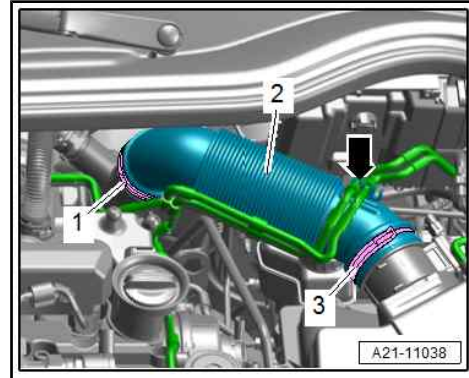
- ◆ Engine support (basic set) - T40091-



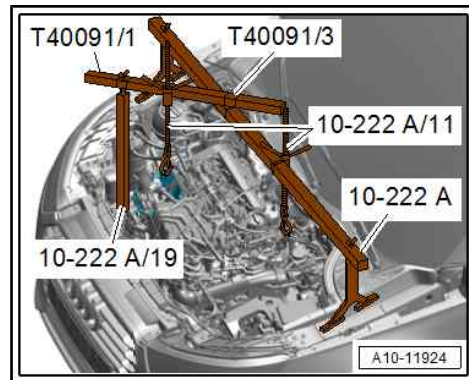


Procedure

- Remove engine cover panel ⇒ [page 39](#) .
- Move clear vacuum hoses -arrow- at air pipe.
- Loosen hose clips -1, 3- and remove air pipe -2-.
- Remove filler neck for washer fluid reservoir ⇒ Electrical system; Rep. gr. 92 ; Windscreen washer system; Removing and installing washer fluid reservoir .



- Set up support bracket - 10-222A- on top edges of body flanges (left and right) and longitudinal member (right-side), as shown in illustration.
- Attach hooks of spindles -10-222A/11- to engine lifting eyes.
- Take up weight of engine/gearbox assembly evenly with both spindles; do not lift.



Attaching

Assembly is performed in reverse sequence; note the following:



Note

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

- Install filler neck for washer fluid reservoir ⇒ Electrical system; Rep. gr. 92 ; Windscreen washer system; Removing and installing washer fluid reservoir .
- Install engine cover panel ⇒ [page 39](#) .

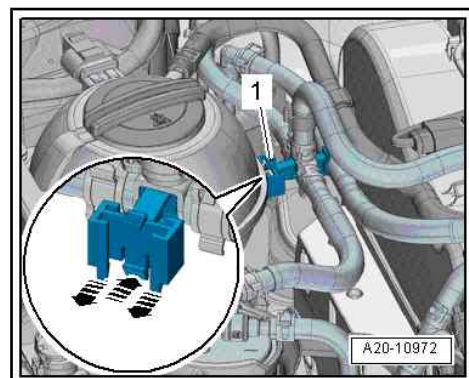
Tightening torques

- ◆ ⇒ ["2.2 Exploded view - hose connections for charge air system", page 227](#)

2.3 Removing and installing engine mountings

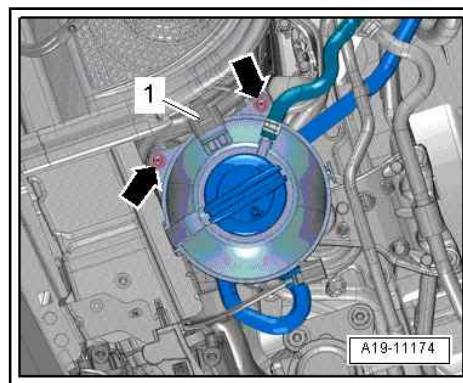
Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Remove filler neck for washer fluid reservoir ⇒ Electrical system; Rep. gr. 92 ; Windscreen washer system; Removing and installing washer fluid reservoir .
- Release catches -arrows- and pull bracket -1- with fuel hoses out of guide on coolant expansion tank.

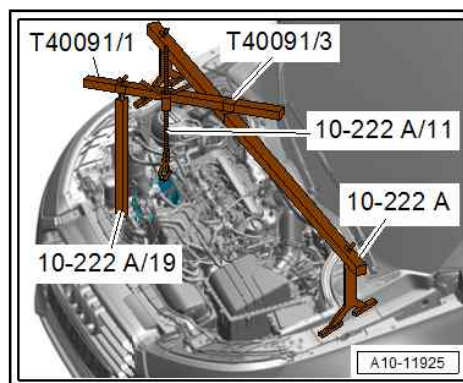




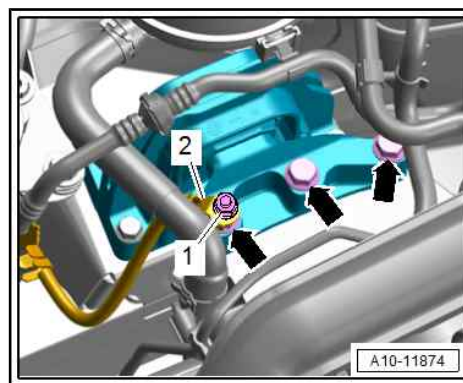
- Remove bolts -arrows-.
- Detach electrical connector -1- for coolant shortage indicator switch - F66- and move coolant expansion tank to side.



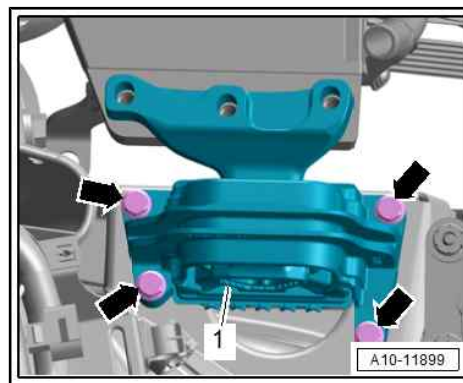
- Set up support bracket - 10-222A- on top edges of body flanges (left and right) and longitudinal member (right-side), as shown in illustration.
- Attach hook of spindle - 10-222A/11- to engine lifting eye (right-side).
- Tighten spindle to take up weight of engine/gearbox assembly; do not lift.



- Remove nut -1- and move earth wire -2- clear.
- Remove bolts -arrows- for support arm of engine mounting.



- Remove bolts -arrows- and detach engine mounting -1-.



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Installing



Note

After removing, renew bolts tightened with specified tightening angle.

- Fit engine mounting -1- on longitudinal member.
- Initially screw in bolts -arrows- by hand until they make contact.



- Initially hand-tighten bolts -arrows- for support arm of engine mounting until they make contact.

- The support arm must not turn when you tighten the bolts.
- Tighten bolts.

Remaining installation steps are carried out in reverse sequence; note the following:

- Detach support bracket - 10-222A- .
- Install filler neck for washer fluid reservoir ⇒ Electrical system; Rep. gr. 92 ; Windscreen washer system; Removing and installing washer fluid reservoir .
- Install engine cover panel ⇒ [page 39](#) .

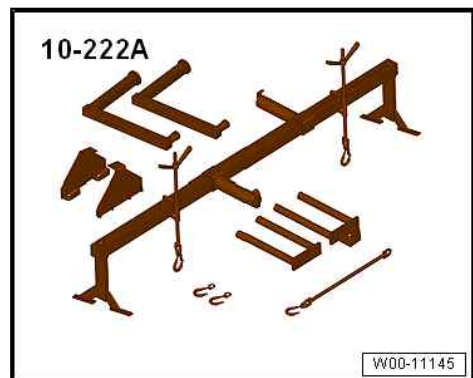
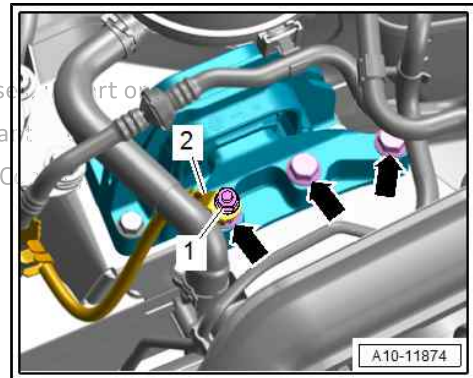
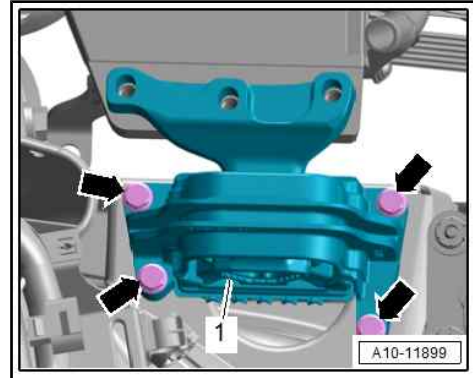
Tightening torques

- ◆ ⇒ [“2.1 Exploded view - assembly mountings”, page 31](#)
- ◆ ⇒ [“2.2 Exploded view - hose connections for charge air system”, page 227](#)
- ◆ Nut -1- for earth wire -2- ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

2.4 Removing and installing gearbox mounting

Special tools and workshop equipment required

- ◆ Support bracket - 10-222A-





- ◆ Hose clip pliers - VAS 6362-



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Removing

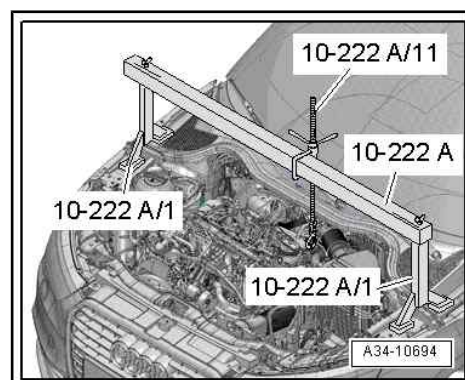
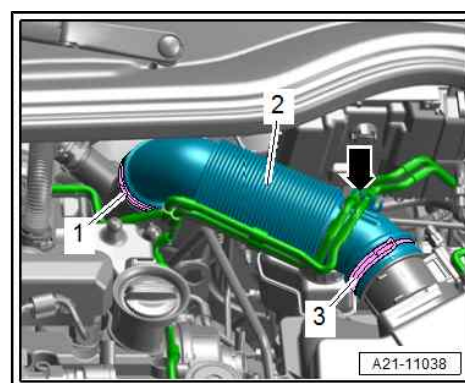
- Remove engine cover panel ⇒ [page 39](#) .
- Remove air cleaner housing ⇒ [page 246](#) .
- Move clear vacuum hoses -arrow- at air pipe.
- Release hose clip -1- and detach air pipe -2-.



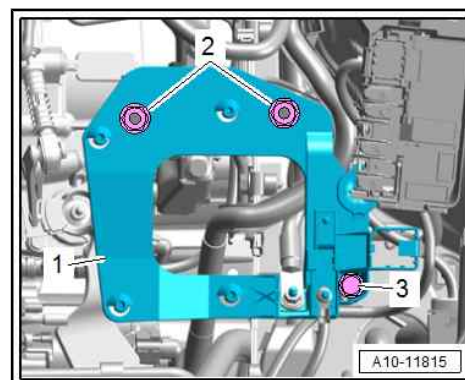
Note

Disregard -item 3-.

- Position support bracket - 10-222A- on top edges of body flanges as shown in illustration.
- Attach hook of spindle - 10-222A/11- to engine lifting eye (rear left).

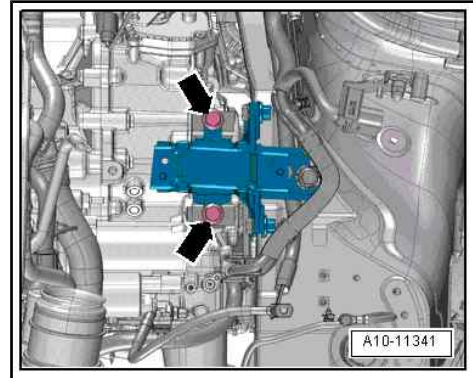


- Remove nuts -2- and bolt -3-.
- Push mounting -1- for jump start terminal and air cleaner housing slightly to one side.





- Remove bolts -arrows- securing gearbox mounting.



- Remove bolts -arrows A, B, C- and detach gearbox mounting.

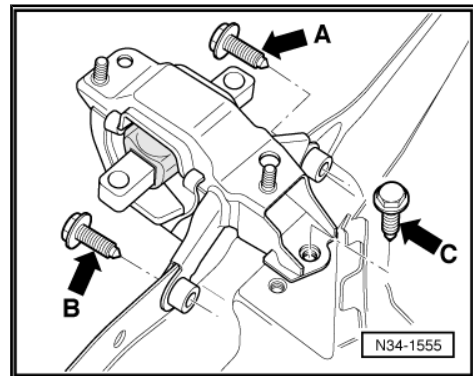
Installing

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



Note

- ◆ After removing, renew bolts tightened with specified tightening angle.
- ◆ Secure all hose connections with correct type of hose clips (as original equipment) ⇒ *Electronic parts catalogue* .



- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ Rep. gr. 34 ; Assembly mountings; Exploded view - assembly mountings
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)
- ◆ ⇒ [“2.2 Exploded view - hose connections for charge air system”, page 227](#) ⇒ Electrical system; Rep. gr. 27 ; Jump start terminal; Exploded view - jump start terminal

2.5 Removing and installing pendulum support

Removing

- Remove noise insulation ⇒ *General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation* .



Note

Do NOT loosen bolted connection -2-.

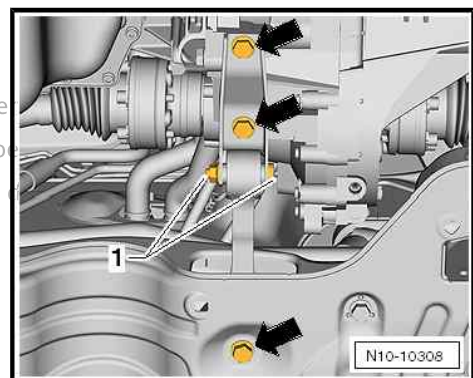
- Remove bolts -arrows- and detach pendulum support.

Installing

Installation is carried out in reverse sequence.

Tightening torques

- ◆ ⇒ [Fig. “Installing pendulum support”, page 32](#)
- ◆ ⇒ *General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation*





3 Engine cover panel

⇒ **“3.1 Removing and installing engine cover panel”, page 39**

3.1 Removing and installing engine cover panel

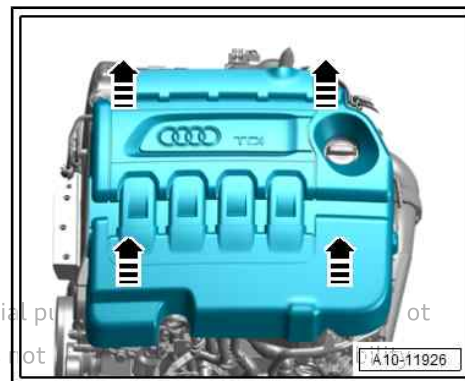
Removing



Caution

When removing and installing the engine cover panel, ensure that it does not collide with or get caught on the fuel return line. This can result in the connections to the injectors breaking, which in turn causes leaks in the fuel system.

- Carefully pull engine cover panel off retaining pins one after the other -arrows- and lift engine cover panel off, keeping it straight.



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 all retaining pins, paying attention to oil filler neck and dipstick.
- Press engine cover panel onto retaining pins, starting at oil filler neck and working clockwise.



13 – Crankshaft group

1 Cylinder block (pulley end)

⇒ [“1.1 Exploded view - cylinder block \(pulley end\)”, page 40](#)

⇒ [“1.2 Exploded view - sealing flange \(pulley end\)”, page 42](#)

⇒ [“1.3 Removing and installing poly V-belt”, page 42](#)

⇒ [“1.4 Removing and installing tensioner for poly V-belt”, page 44](#)

⇒ [“1.5 Removing and installing vibration damper”, page 44](#)

⇒ [“1.6 Removing and installing bracket for ancillaries”, page 45](#)

⇒ [“1.7 Removing and installing engine support”, page 46](#)

⇒ [“1.8 Removing and installing sealing flange \(pulley end\)”, page 47](#)

1.1 Exploded view - cylinder block (pulley end)

1 - Poly V-belt

- Check for wear
- Before removing, mark direction of rotation with chalk or felt-tip pen
- Do not kink
- Routing of poly V-belt
⇒ [page 44](#)
- Removing and installing
⇒ [page 42](#)
- When installing, make sure it is properly seated on pulleys.

2 - Bolt

- Renew after removing
- Use only genuine bolts
⇒ Electronic parts catalogue
- 10 Nm +90°

3 - Vibration damper

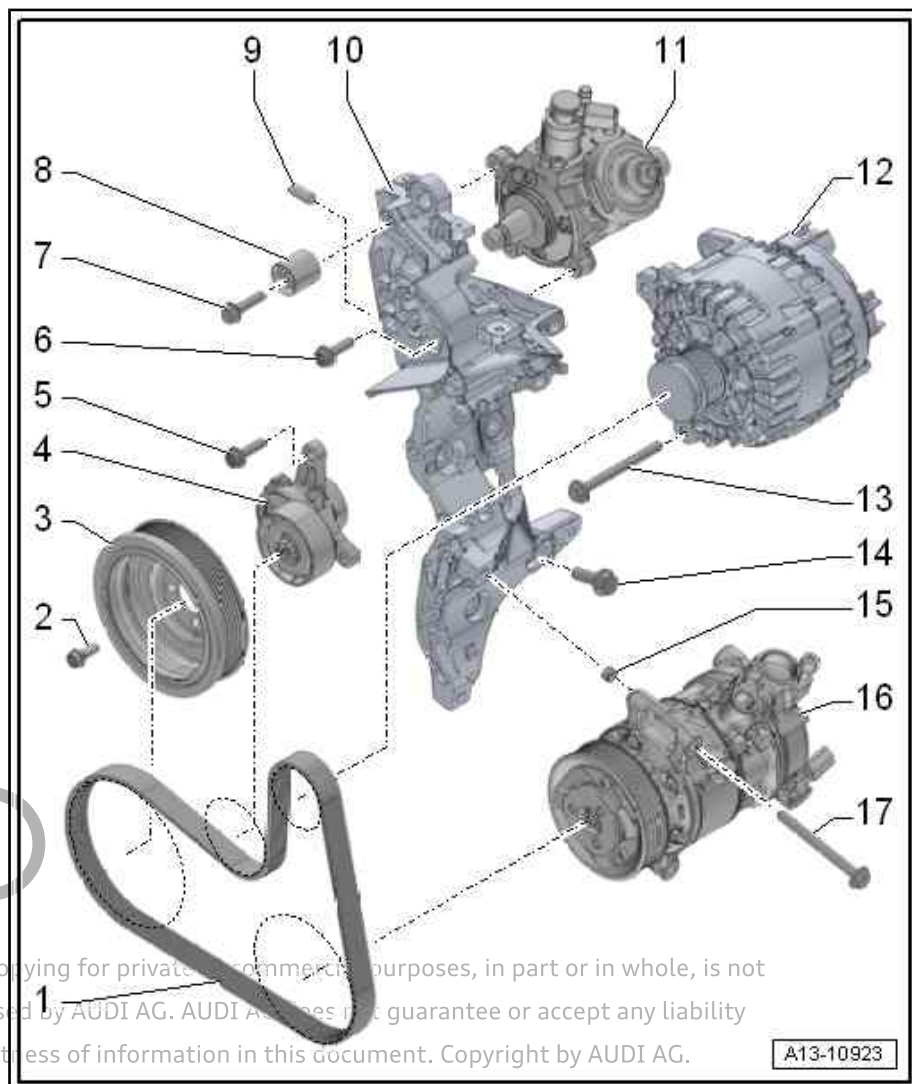
- With poly V-belt pulley
- Installation position:
hole in vibration damper must be positioned over raised section of crankshaft sprocket
- Removing and installing
⇒ [page 44](#)

4 - Tensioner for poly V-belt

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

5 - Bolt

- Renew after removing
- 20 Nm +90°



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A13-10923



6 - Bolt

- Tightening torque ⇒ [Item 2 \(page 273\)](#)

7 - Bolt

- Tightening torque ⇒ [Item 14 \(page 75\)](#)

8 - Damper wheel

9 - Dowel sleeve

- Ensure correct seating in bracket for ancillaries

10 - Bracket for ancillaries

- Removing and installing ⇒ [page 45](#)

11 - High-pressure pump

- Exploded view ⇒ [page 273](#)

12 - Alternator

- Removing and installing ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator

13 - Bolt

- Tightening torque ⇒ Electrical system; Rep. gr. 27 ; Alternator; Exploded view - alternator

14 - Bolt

- Renew after removing
- Different lengths ⇒ [page 41](#)
- Tightening torque and sequence ⇒ [page 41](#)

15 - Dowel sleeve

- Ensure correct seating in air conditioner compressor

16 - Air conditioner compressor

- Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Air conditioner compressor; Exploded view - air conditioner compressor drive unit

17 - Bolt

- Tightening torque ⇒ Heating, air conditioning; Rep. gr. 87 ; Air conditioner compressor; Exploded view - air conditioner compressor drive unit

Bracket for ancillaries - tightening torque and tightening sequence



Note

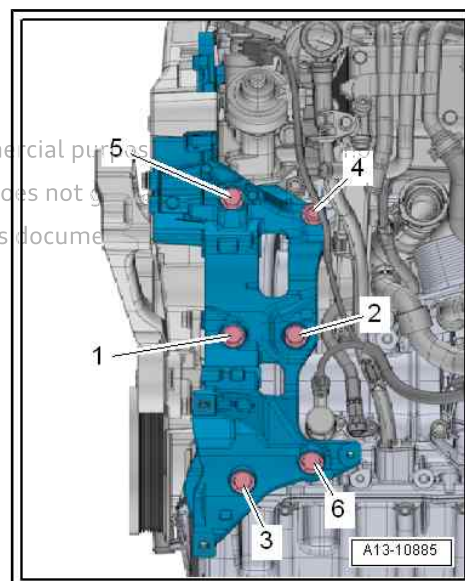
After removing, renew bolts tightened with specified tightening angle.

– Fit bolts in the following sequence:

- ◆ Bolts -1, 2, 3, 6- M10x35
- ◆ Bolt -4- M10x115
- ◆ Bolt -5- M10x175

– Tighten bolts in stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 ... 6-	Screw in by hand until contact is made
2.	-1 ... 6-	40 Nm
3.	-4- and -5-	Turn 180° further
4.	-1, 2, 3, 6-	Turn 45° further





1.2 Exploded view - sealing flange (pulley end)

1 - Sealing flange (pulley end)

- With crankshaft oil seal
- Renew after removing
- Removing and installing
 ⇒ [page 47](#)

2 - Bolt

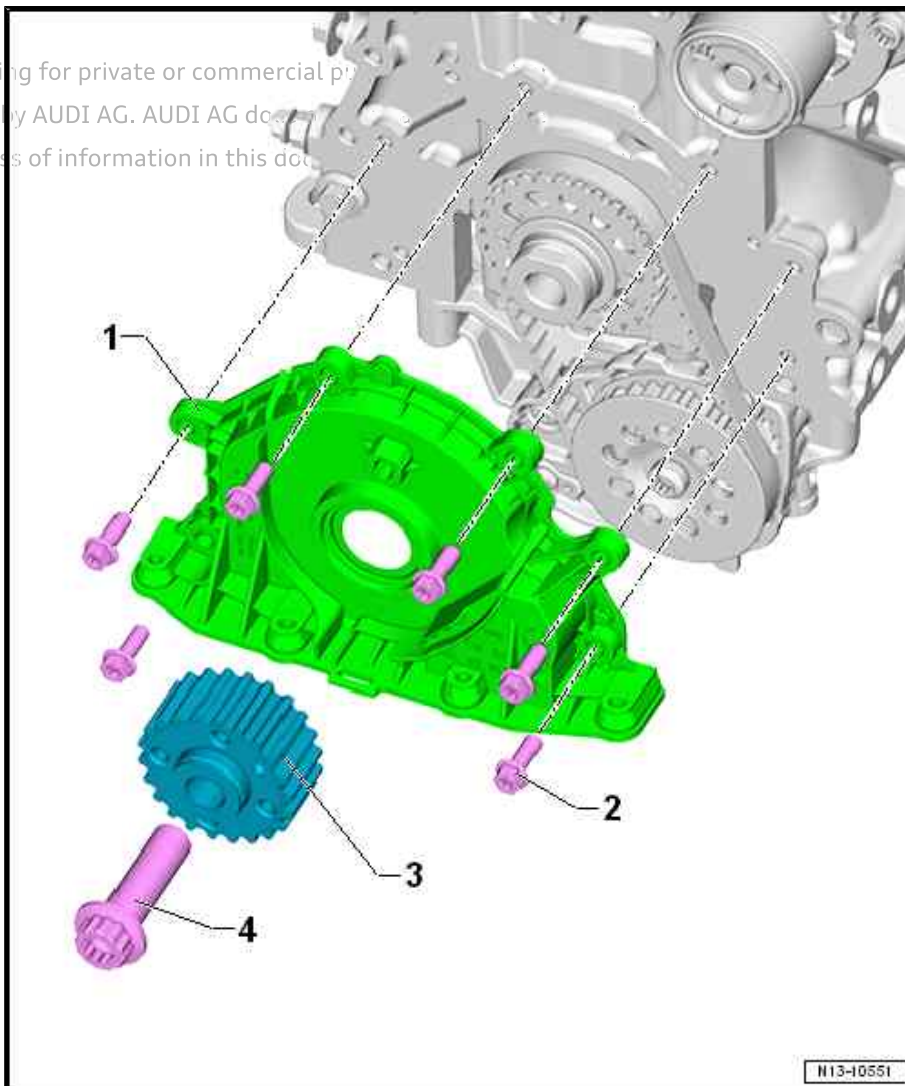
- Tightening torque and sequence ⇒ [page 42](#)

3 - Crankshaft sprocket

- Contact surface between sprocket and crankshaft must be free of oil
- Can only be installed in one position

4 - Bolt

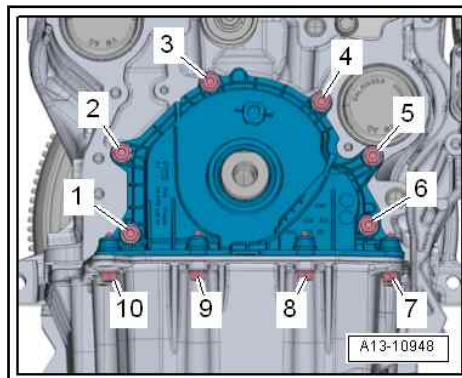
- Tightening torque
 ⇒ [Item 1 \(page 74\)](#)



Sealing flange (pulley end) - tightening torque and sequence

– Tighten bolts in stages in the sequence shown:

Stage	Bolts	Tightening torque
1.	-1 ... 10-	Screw in by hand until contact is made
2.	-1 ... 6-	Tighten in stages and in diagonal sequence; final torque 13 Nm
3.	-7 ... 10-	13 Nm

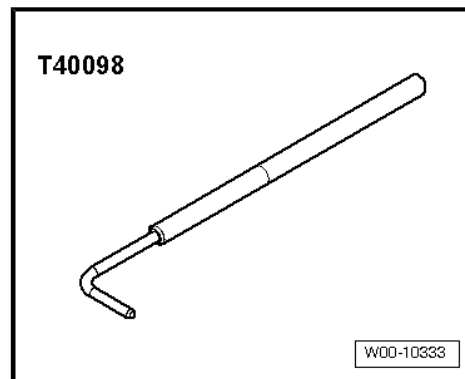


1.3 Removing and installing poly V-belt

Special tools and workshop equipment required



- ◆ Locking tool - T40098-



Removing

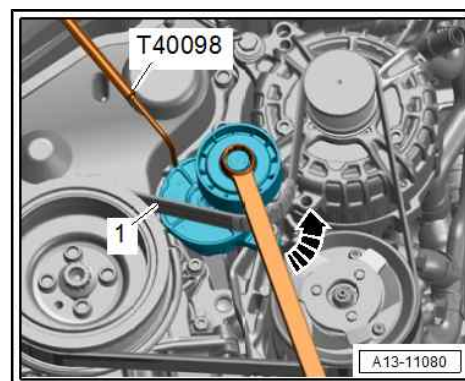
- Remove noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



Caution

Running a used poly V-belt in the opposite direction could cause irreparable damage.

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

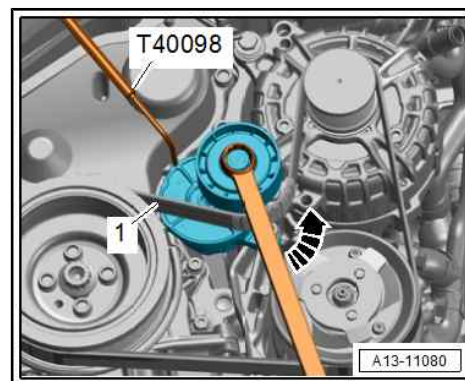


- To slacken poly V-belt turn tensioner in anti-clockwise direction -arrow- using ring spanner.
- Take off poly V-belt -1-.
- Lock tensioner with locking tool - T40098- .

Installing

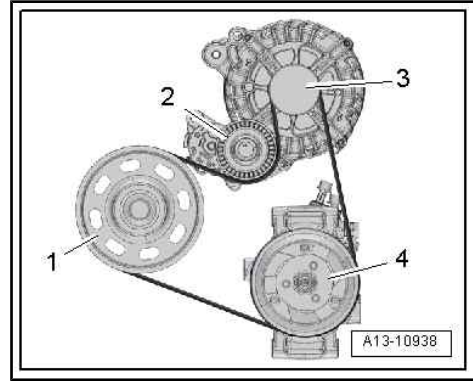
Installation is carried out in reverse order; note the following:

- Counterhold tensioner with ring spanner -arrow- and pull out locking tool - T40098- .





- Fit poly V-belt on poly V-belt pulleys:
- 1 - Vibration damper
- 2 - Tensioning roller
- 3 - Alternator
- 4 - Air conditioner compressor
- Release tensioner.
- Check that poly V-belt is in correct position.
- Start engine and check that poly V-belt(s) run properly.



Tightening torques

- ◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

1.4 Removing and installing tensioner for poly V-belt

Removing

- Remove poly V-belt ⇒ [page 42](#)
- Remove bolts - arrows and take off poly V-belt tensioner.



Note

Ignore -T10060A- .

Installing

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



Note

After removing, renew bolts tightened with specified tightening angle.

- Install poly V-belt ⇒ [page 42](#) .

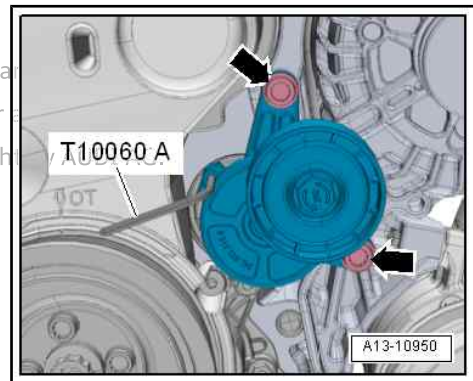
Tightening torques

- ◆ ⇒ "1.1 Exploded view - cylinder block (pulley end)", [page 40](#)

1.5 Removing and installing vibration damper

Removing

- Remove wheel housing liner (front right) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .
- Remove poly V-belt ⇒ [page 42](#) .

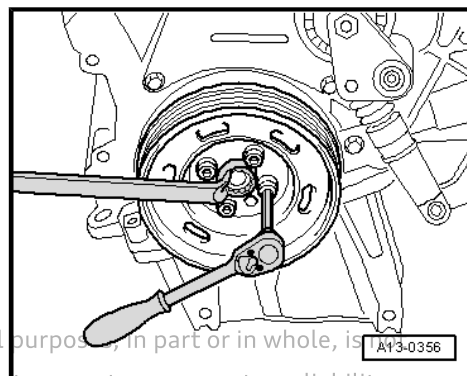




- Counterhold by applying ring spanner to bolt for crankshaft sprocket and slacken bolts for vibration damper.
- Remove bolts and take off vibration damper.



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Installing

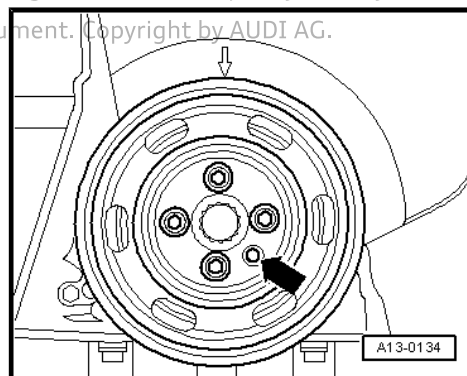
Installation is carried out in reverse order; note the following:



Note

After removing, renew bolts tightened with specified tightening angle.

- Installation position: hole -arrow- in vibration damper must be positioned over raised section of crankshaft sprocket.
- Install poly V-belt ⇒ [page 42](#) .



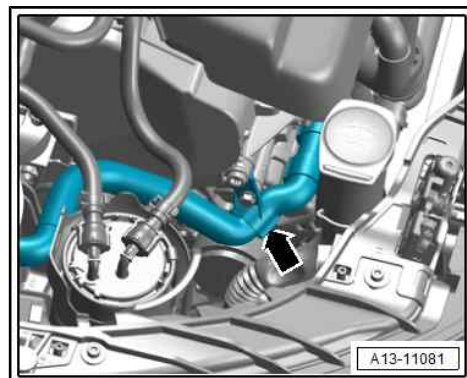
Tightening torques

- ◆ ⇒ "1.1 Exploded view - cylinder block (pulley end)", [page 40](#)
- ◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front)

1.6 Removing and installing bracket for ancillaries

Removing

- Remove alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator .
- Remove high-pressure pump ⇒ [page 274](#) .
- Move coolant hose clear -arrow-.
- Bring engine support and engine mounting into installation position and tighten bolts to 20 Nm.
- Disengage spindle - 10-222A/11- from bracket for ancillaries.





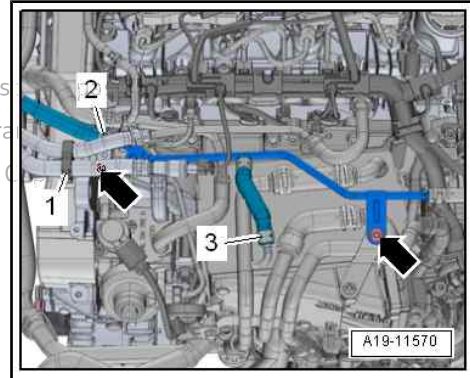
- Unclip bracket -1- with fuel hoses.
- Remove bolts -arrows-.

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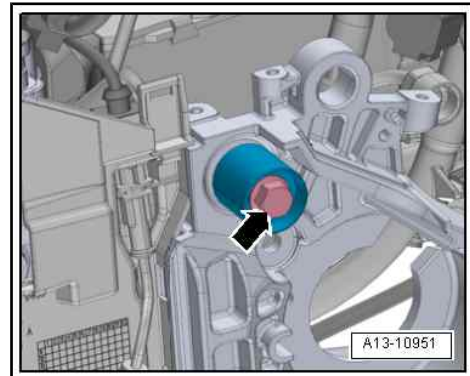


Note

Disregard items -2 and 3-.



- Remove bolt -arrow- and detach damper wheel.



- Loosen bolts in the sequence -6 ... 1-.
- Remove bolts and detach bracket for ancillaries.

Installing

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



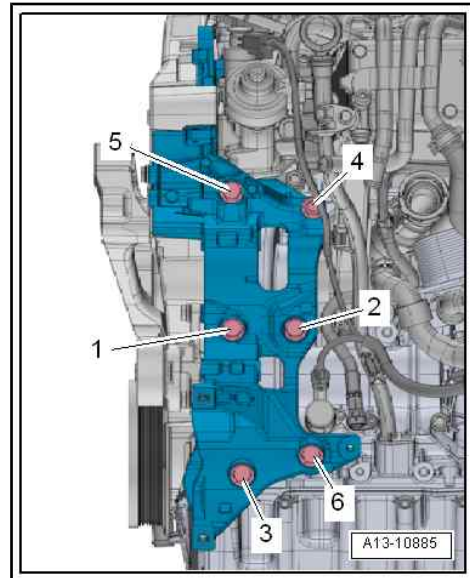
Note

After removing, renew bolts tightened with specified tightening angle.

- Check that a dowel sleeve is fitted between bracket for ancillaries and cylinder block.
- Install high-pressure pump ⇒ [page 274](#) .

Tightening torques

- ◆ ⇒ [Fig. "Bracket for ancillaries - tightening torque and tightening sequence"](#) , [page 41](#)
- ◆ ⇒ ["1.2 Exploded view - toothed belt"](#) , [page 74](#)
- ◆ ⇒ Electrical system; Rep. gr. 27 ; Alternator; Exploded view - alternator



1.7 Removing and installing engine support

Removing

- Remove toothed belt cover (bottom) ⇒ [page 77](#) .
- Remove toothed belt cover (top) ⇒ [page 75](#) .
- Remove engine mounting ⇒ [page 34](#) .
- Use spindle - 10-222A/11- to raise/lower engine until appropriate bolt of engine support is accessible.



i Note

Bolt -2- can only be removed after engine support has been detached.

- Unscrew bolts -1, 2 and 3- and detach engine support upwards.

Installing

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

- Insert bolt -2- in hole in engine support before fitting engine support.
- Fit engine support and initially hand-tighten bolts -1, 2, 3-, then tighten to specified torque in specified sequence.
- Install engine mountings ⇒ [page 34](#) .
- Install toothed belt cover (top) ⇒ [page 75](#) .
- Install toothed belt cover (bottom) ⇒ [page 77](#) .

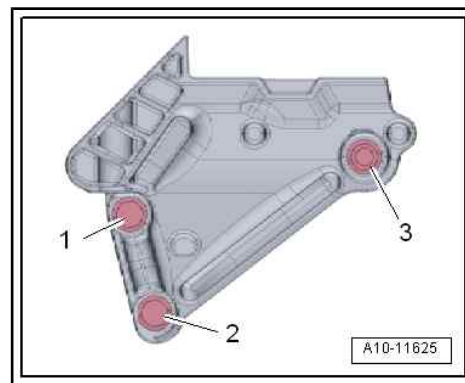
Tightening torques

- ◆ ⇒ [Fig. ““Engine support - tightening torque and sequence””, page 32](#)

1.8 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required

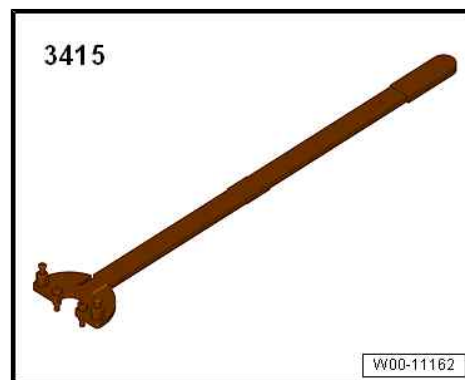
- ◆ Counterhold tool - 3415-



- ◆ Assembly tool - T10053-



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- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ [Electronic parts catalogue](#)



Removing

- Remove toothed belt ⇒ [page 77](#) .
- Loosen bolt for crankshaft sprocket using counterhold tool - 3415- .
- Remove bolt and detach crankshaft sprocket.
- Remove sump
⇒ [“1.3 Removing and installing sump”, page 124](#) .
- Remove remaining bolts and carefully release sealing flange from bonded joint.

Installing

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

- Remove sealant residue from sump -1- using rotating plastic brush or similar.



WARNING

Risk of eye injury.

- ◆ *Put on safety goggles.*

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

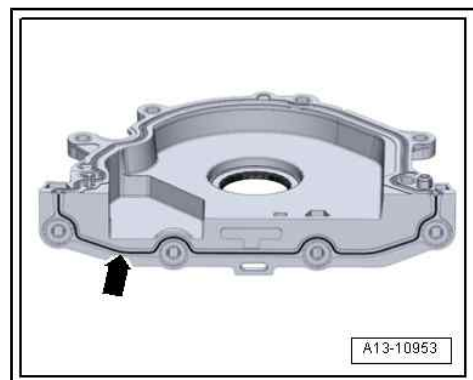
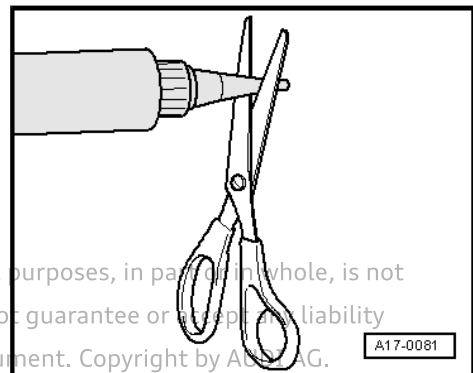
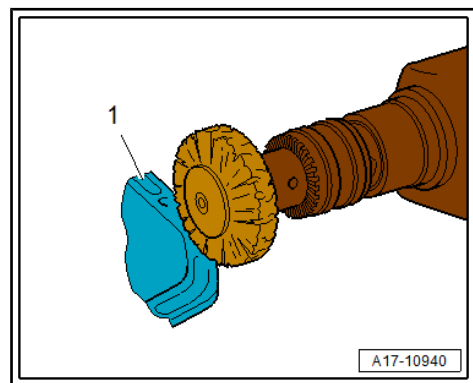
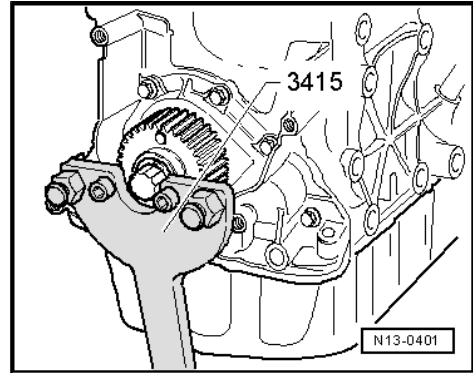
Note

Note expiry date of sealant.

- Cut off nozzle of tube at front marking (nozzle Ø approx. 2 mm).

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- Apply sealant bead -arrow- onto clean sealing surface of sealing flange as shown in illustration.
- Thickness of sealant bead: 2 ... 3 mm
- The sealant bead must not be thicker than specified.
- The sealing flange must be installed within 5 minutes after applying sealant.

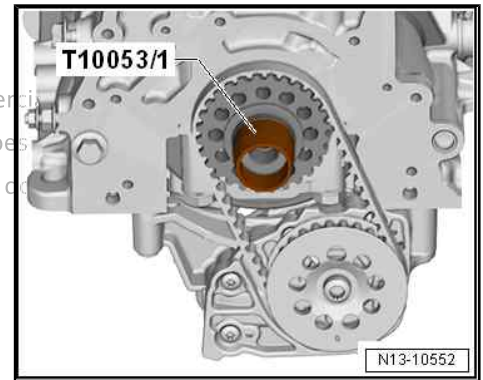




- Position assembly sleeve - T10053/1- on crankshaft journal.
- Slide sealing flange over assembly sleeve - T10053/1- .
- Dowel pins should then engage in bores on cylinder block.
- Detach assembly tool - T10053/1- .
- Tighten sealing flange bolts ⇒ [page 42](#) .
- Install sump
⇒ ["1.3 Removing and installing sump", page 124](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 81](#) .

Tightening torques

- ◆ ⇒ [Fig. "Sealing flange \(pulley end\) - tightening torque and sequence"](#) , [page 42](#)
- ◆ Crankshaft sprocket ⇒ [Item 1 \(page 74\)](#)





2 Cylinder block (gearbox end)

⇒ "2.1 Exploded view - cylinder block (gearbox end)", page 50

⇒ "2.2 Removing and installing flywheel", page 51

⇒ "2.3 Removing and installing sealing flange (gearbox end)", page 52

2.1 Exploded view - cylinder block (gearbox end)

1 - Bolt

- Renew after removing
- 60 Nm +90°

2 - Flywheel

- Removing and installing ⇒ page 51
- Can only be installed in one position

3 - Sender wheel

- For engine speed sender - G28-
- Do not rotate out of position or remove from sealing flange
- Only renew together with sealing flange -item 8-
- Removing and installing ⇒ page 52

4 - Engine speed sender - G28-

- Exploded view ⇒ page 331

5 - Bolt

- Tightening torque ⇒ Item 9 (page 332)

6 - Dowel pin

- 2x

7 - Intermediate plate

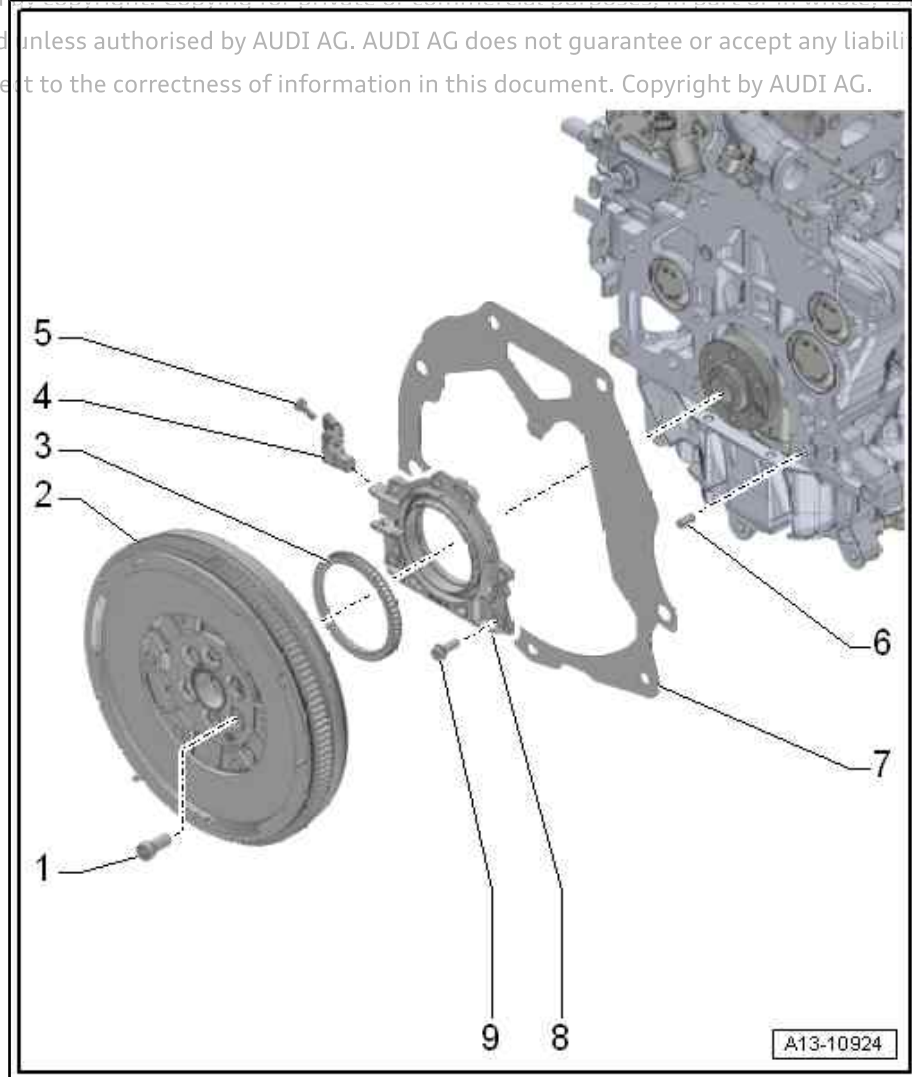
- Do not damage or bend when assembling
- Installing ⇒ page 51

8 - Sealing flange (gearbox end)

- Only renew together with seal and sender wheel -item 3-
- Do not take sender wheel out of sealing flange or rotate it out of position
- Renewing ⇒ page 52

9 - Bolt

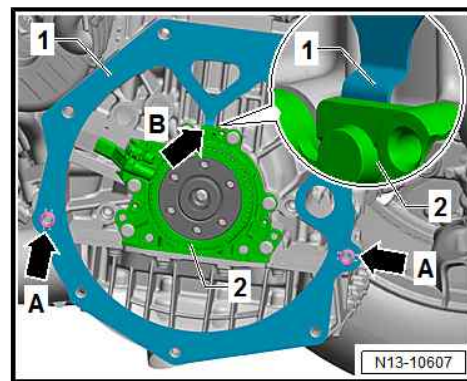
- Tightening torque and sequence ⇒ page 51





Installing intermediate plate

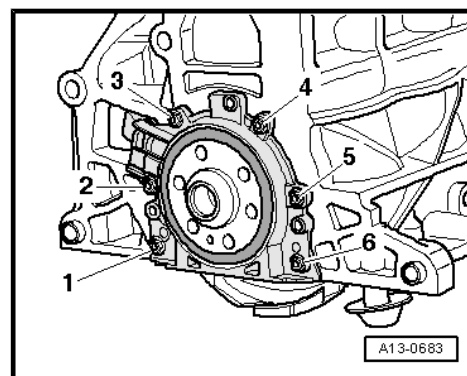
- Engage intermediate plate -1- on sealing flange -2- -arrow B- and push onto dowel sleeves -arrows A-.



Sealing flange (gearbox end) - tightening torque and sequence

- Tighten bolts in stages in the sequence shown:

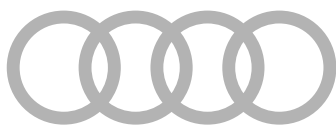
Stage	Bolts	Tightening torque
1.	-1 ... 6-	Screw in by hand until contact is made
2.	-1 ... 6-	Tighten in stages and in diagonal sequence; final torque 13 Nm



2.2 Removing and installing flywheel

Special tools and workshop equipment required

- ◆ Counterhold tool - 3067-



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Removing

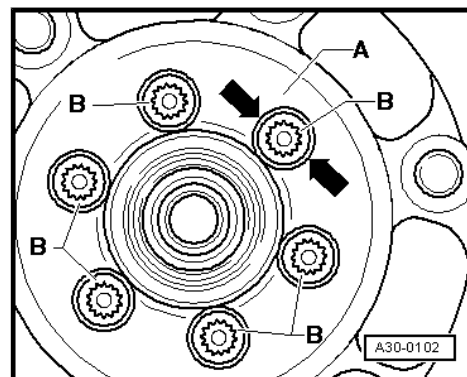
- Gearbox removed



Caution

Risk of serious damage to flywheel.

- ◆ Remove bolts -B- using normal hand tools (do not use pneumatic wrench or impact driver, etc.).
- ◆ When removing the bolts, make sure that the bolt heads do not come into contact with the flywheel.
- ◆ Rotate the flywheel -A- so that the bolts -B- align centrally with the holes -arrows-.





- Insert counterhold tool - 3067- in hole on cylinder block -item B-, slacken bolts for flywheel.
- Remove bolts and take off flywheel.

Installing

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



Note

After removing, renew bolts tightened with specified tightening angle.

- Insert counterhold - 3067- in hole on cylinder block -item A-.

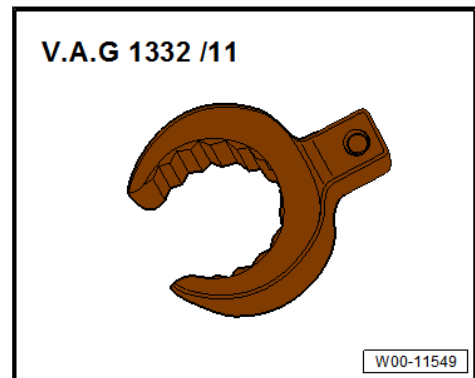
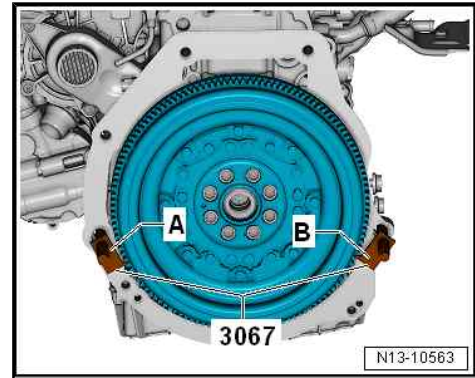
Tightening torques

- ◆ => ["2.1 Exploded view - cylinder block \(gearbox end\)", page 50](#)

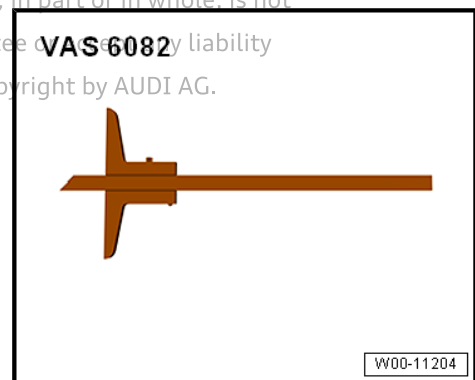
2.3 Removing and installing sealing flange (gearbox end)

Special tools and workshop equipment required

- ◆ Open end spanner insert, AF 24 - V.A.G 1332/11-

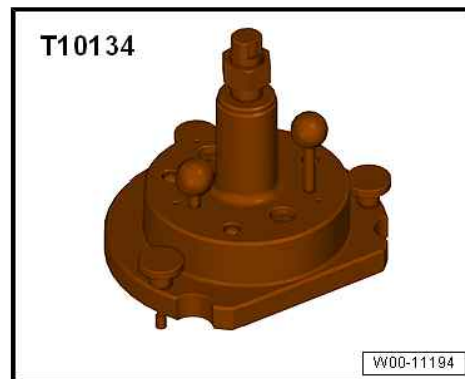


- ◆ **Depth gauge - VAS 6082-**
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- ◆ Assembly tool - T10134-



- ◆ Bolt, M6x35 (3x)
- ◆ Bolt, M7x35 (2x)

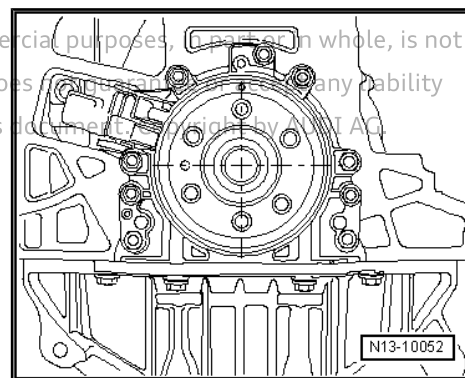
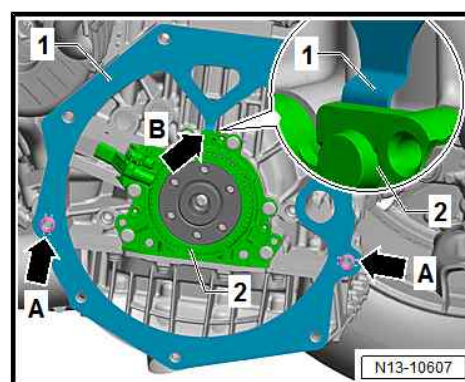
Pressing out sealing flange with sender wheel

- Gearbox removed
- Remove flywheel ⇒ [page 51](#) .

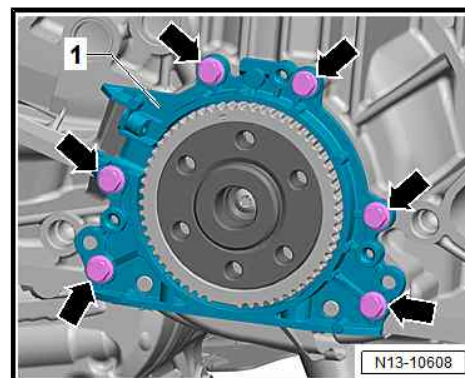
i Note

For illustration purposes, the following procedure is shown with the engine removed.

- Detach intermediate plate -1- from dowel sleeves -arrows A-.
- Guide intermediate plate upwards; at the same time, pull retaining tab -arrow B- out of opening behind sealing flange -2-.
- Rotate crankshaft by turning bolt for toothed belt sprocket until crankshaft is positioned at "TDC", as shown in illustration.
- Remove sump ⇒ [page 124](#) .
- Remove engine speed sender - G28- ⇒ [page 335](#) .



- Remove bolts -arrows- for sealing flange -1-.

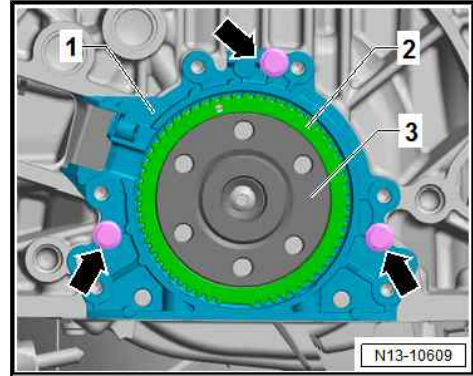




Note

The sealing flange -1- is pressed off the crankshaft -3- together with the sender wheel -2-.

- To press off, screw 3 bolts M6x35 -arrows- alternately into sealing flange not more than 1/2 turn at a time.
- Detach sealing flange together with sender wheel.

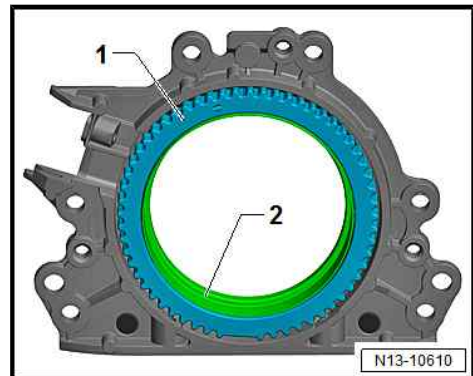


Pressing in sealing flange with sender wheel



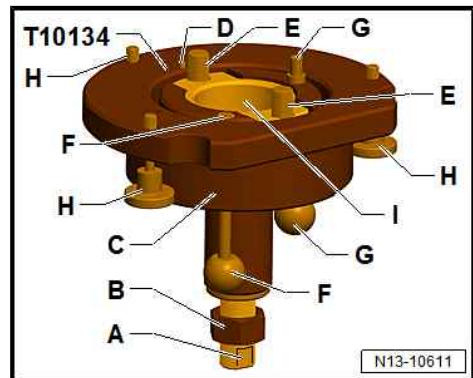
Note

- ◆ The sealing flange with PTFE oil seal is fitted with a sealing lip support ring -2-. This support ring acts as an assembly sleeve and must not be removed before installation.
- ◆ Sealing flange and sender wheel -1- must not be separated or rotated out of position after removal from packaging.
- ◆ The sender wheel is held in its installation position by a locating pin on the assembly tool - T10134- .
- ◆ The sealing flange and oil seal are one unit and can only be replaced together with the sender wheel.
- ◆ The assembly tool - T10134- is held in the correct position relative to the crankshaft by a guide pin which is inserted into a hole in the crankshaft.



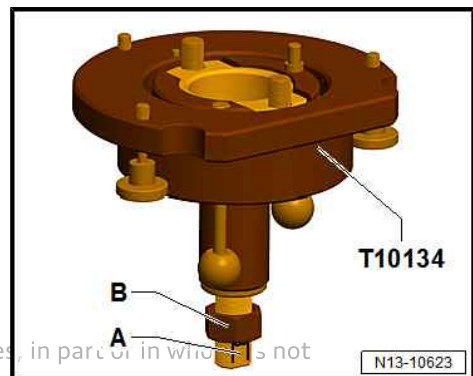
Construction of assembly tool - T10134- :

- A - Tensioning flats
- B - Nut
- C - Assembly housing
- D - Locating pin
- E - Hexagon socket head bolts (2x)
- F - Guide pin for diesel engines (black handle)
- G - Guide pin for petrol engines (red handle)
- H - Knurled screws (3x)
- I - Inner section



Fitting sealing flange with sender wheel onto assembly tool - T10134- :

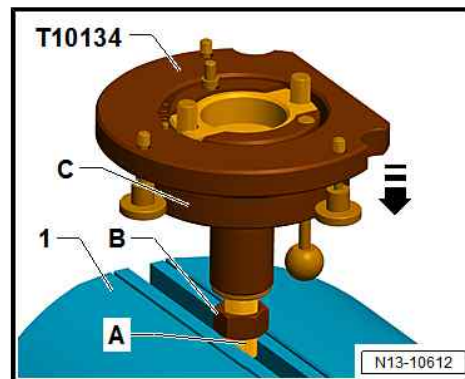
- Unscrew nut -B- until it is just in front of tightening flats -A- on threaded spindle.



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- Clamp assembly tool - T10134- in a vice -1- on tightening flats -A- of threaded spindle.
- Press assembly housing -C- downwards -arrow- so that it rests on nut -B-.
- Inner part of assembly device and assembly housing must align (be level) with each other.



- If fitted, remove securing clip -arrow- from new sealing flange -1-.

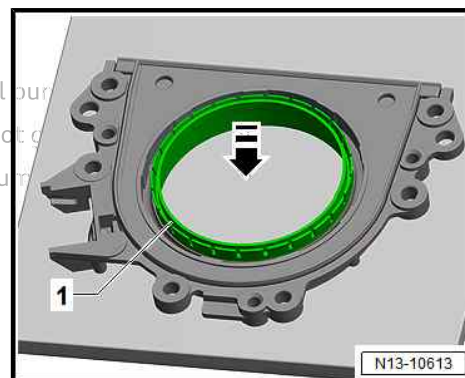
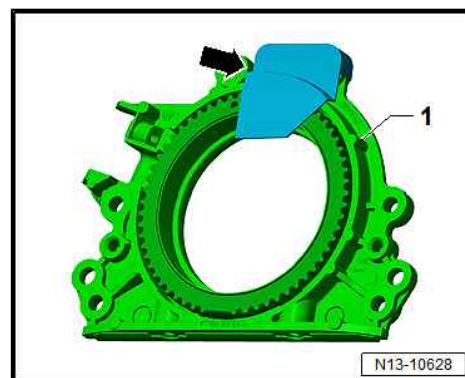


Note

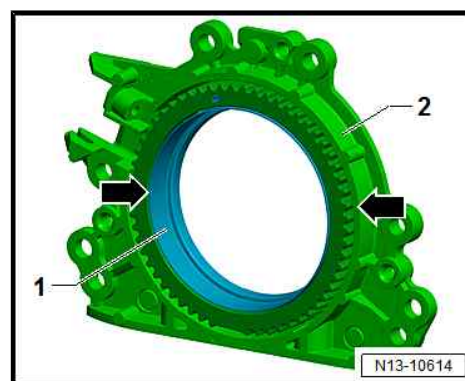
Do not take the sender wheel out of the sealing flange or rotate it out of position.



- Place sealing flange (with front side downwards) on a clean flat surface.
- Press sealing lip support ring -1- downwards in direction of -arrow- until it touches flat surface.

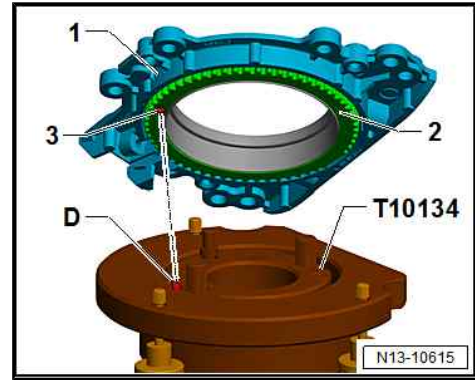


- Upper edge of sealing lip support ring -1- must be flush -arrows- with front edge of sealing flange -2-.

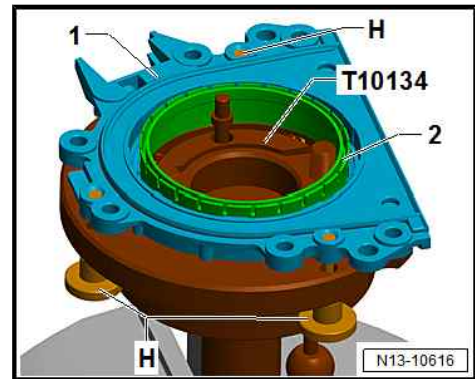




- Place front side of sealing flange -1- on assembly tool - T10134- so that locating pin -D- is seated in hole -3- in sender wheel -2-.
- Ensure that sealing flange lies flat on assembly tool.

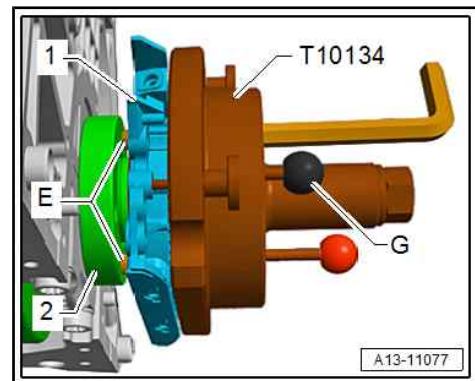
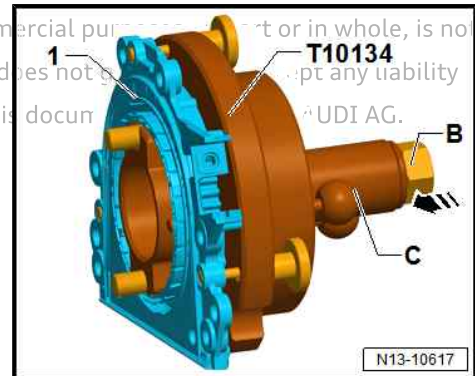


- Screw knurled screws -H- onto sealing flange -1-.
- When tightening, press sealing flange and sealing lip support ring -2- against surface of assembly tool - T10134- .
- This prevents locating pin from sliding out of hole in sender wheel.
- Ensure that sender wheel remains fixed on assembly tool when installing sealing flange.



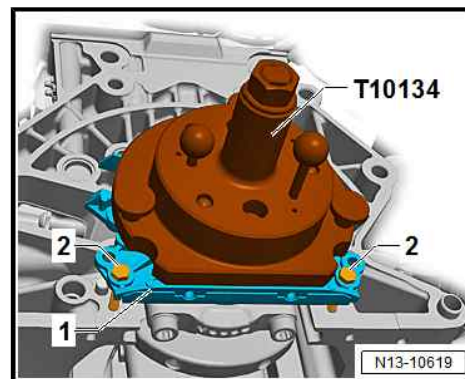
Securing assembly tool - T10134- with sealing flange -1- on crankshaft flange:

- Crankshaft flange must be free of oil and grease.
- Engine is at "TDC" position.
- Screw nut -B- to end of threaded spindle.
- Press threaded spindle of assembly tool - T10134- in direction of -arrow- until nut -B- makes contact with assembly housing -C-.
- Position flat edge of assembly housing towards sealing surface for sump on cylinder block.
- Secure assembly tool - T10134- with sealing flange -1- to crankshaft flange -2-.
- To do so, screw hexagon socket head bolts -E- approx. 5 turns into crankshaft flange with hexagon key.
- Insert guide pin for diesel engines (black handle) -G- into crankshaft flange.





- Screw 2 bolts M6x35 -item 2- into cylinder block to guide sealing flange -1-.



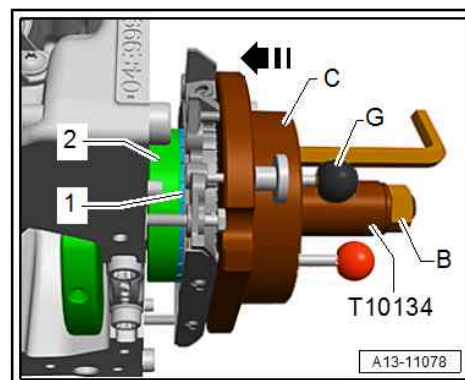
Securing assembly tool - T10134- on crankshaft flange:

- Press assembly housing -C- by hand in direction of -arrow- until sealing lip support ring -1- touches surface of crankshaft flange -2-.
- Check that guide pin for diesel engines (black handle) -G- is fitted correctly in hole in crankshaft. This ensures that sender wheel reaches its final installation position.



Note

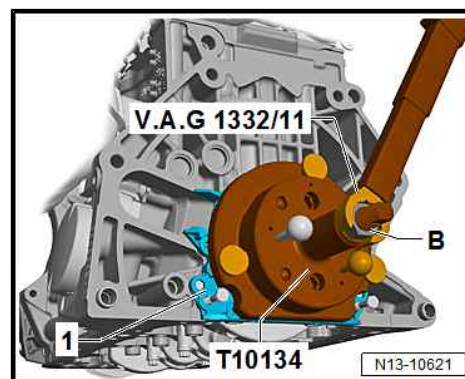
The guide pin for PETROL engines (red handle) MUST NOT be inserted into the threaded hole in the crankshaft.



- Tighten the two hexagon socket head bolts on assembly tool hand-tight.
- Screw nut -B- onto threaded spindle by hand until it touches assembly housing -C-.

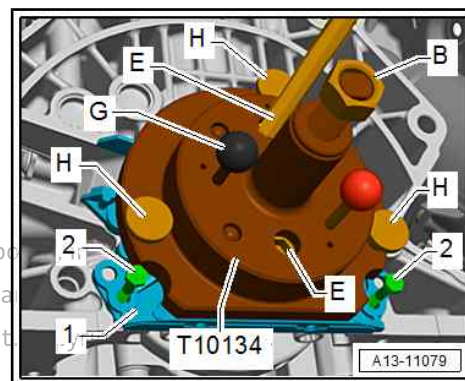
Pressing sender wheel onto crankshaft flange with assembly tool - T10134- :

- Tighten nut -B- on assembly tool - T10134- to 35 Nm.
- There must be a small gap between cylinder block and sealing flange -1- after nut has been tightened to 35 Nm.



Checking installation position of sender wheel on crankshaft:

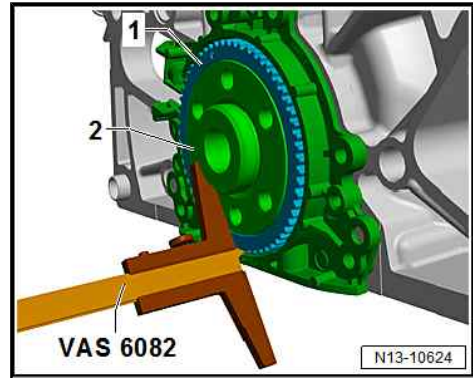
- Screw nut -B- to end of threaded spindle.
- Remove both bolts -2- from cylinder block.
- Unscrew knurled screws -H- from sealing flange -1-.
- Unbolt assembly tool - T10134- from crankshaft flange (remove hexagon socket head bolts -E- from crankshaft flange).
- Detach sealing lip support ring.



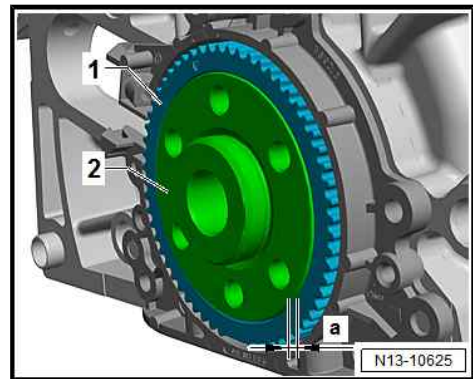
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- Apply depth gauge - VAS 6082- to crankshaft flange -2-.

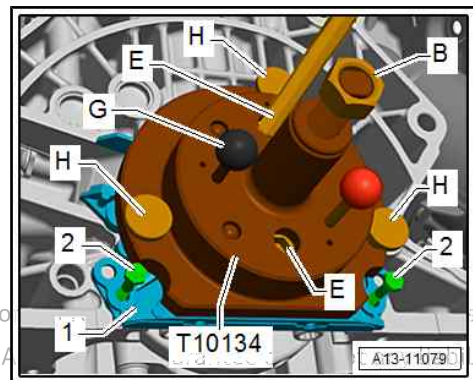


- Measure distance -a- between crankshaft flange -2- and sender wheel -1-.
- Specification: Distance -a- = 0.5 mm.
- Press sender wheel in further if measurement is too small => [page 58](#) .
- If reading matches specification, continue with assembly => [page 59](#) .



Pressing sender wheel in further:

- Secure assembly tool - T10134- to crankshaft flange.
- Ensure that locating pin of assembly tool - T10134- is fitted in hole in sender wheel.
- Hand-tighten hexagon socket head bolts -E-.
- Slide assembly tool - T10134- onto sealing flange -1- by hand.
- Screw nut -B- onto threaded spindle by hand until it touches assembly tool - T10134-.
- Insert guide pin for diesel engines (black handle) -G- into crankshaft flange.
- Screw 2 bolts M6x35 -item 2- into cylinder block to guide sealing flange -1-.





- Tighten nut -B- on assembly tool - T10134- to 40 Nm.
- Check installation position of sender wheel on crankshaft again ⇒ [page 57](#) .
- Tighten nut on assembly tool - T10134- to 45 Nm if measurement is too small.
- Check installation position of sender wheel on crankshaft again ⇒ [page 57](#) .

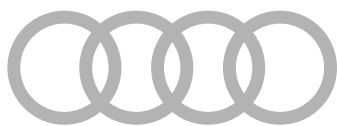
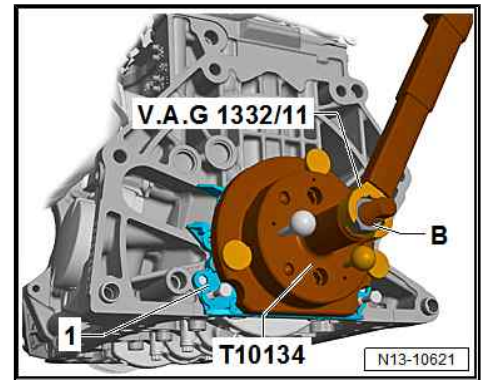
Assembling:

Assembly is performed in reverse sequence; note the following:

- Install engine speed sender - G28- ⇒ [page 335](#) .
- Install sump ⇒ [page 124](#) .
- Install intermediate plate ⇒ [page 51](#) .
- Install flywheel ⇒ [page 51](#) .

Tightening torques

- ◆ ⇒ [Fig. "Sealing flange \(gearbox end\) - tightening torque and sequence"](#) , [page 51](#)



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3 Crankshaft

⇒ ["3.1 Exploded view - crankshaft", page 60](#)

⇒ ["3.2 Crankshaft dimensions", page 61](#)

⇒ ["3.3 Measuring axial clearance of crankshaft", page 61](#)

⇒ ["3.4 Renewing needle bearing in crankshaft", page 62](#)

3.1 Exploded view - crankshaft

1 - Cylinder block

2 - Bearing shell

- For cylinder block (with oil groove)
- Renew used bearing shells

3 - Toothed belt sprocket

- For oil pump drive
- Not available as separate replacement part

4 - Bearing shell

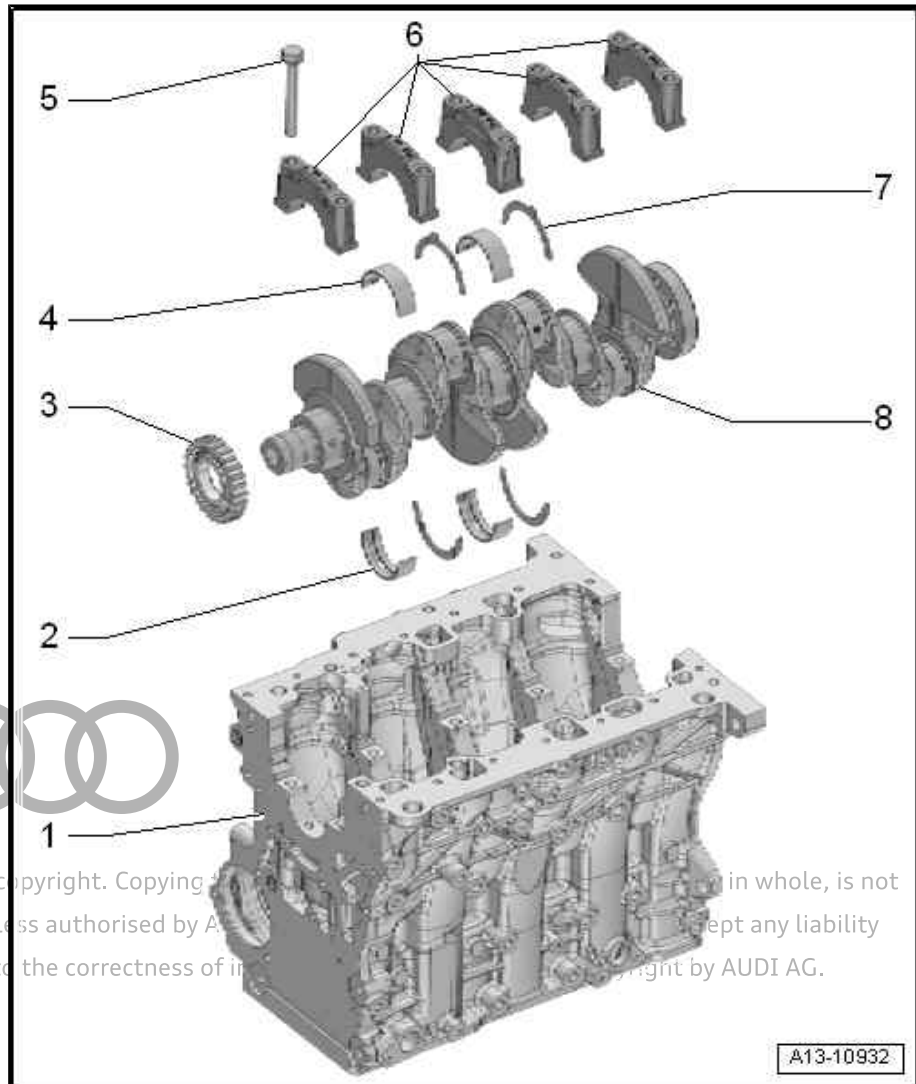
- For bearing cap (without oil groove)
- Renew used bearing shells

5 - Bolt

- Renew after removing
- Use old bolts when measuring radial clearance
- 65 Nm +90°

6 - Bearing caps

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



7 - Thrust washer

- For bearing No. 3
- Different types for cylinder block and bearing cap
- Note location

8 - Crankshaft

- There should be no needle bearing fitted in the crankshaft on vehicles with manual gearbox; remove needle bearing if necessary ⇒ [page 62](#)
- A needle bearing must be fitted in the crankshaft on vehicles with dual-clutch gearbox; install needle bearing if not yet fitted ⇒ [page 62](#) .
- Measuring axial clearance ⇒ [page 61](#)
- Crankshaft dimensions ⇒ [page 61](#)



3.2 Crankshaft dimensions

Honing dimension	Main bearing journal Ø mm	Conrod journal Ø mm
Basic dimension	54.00 -0.022 -0.042	47.80 -0.022 -0.042

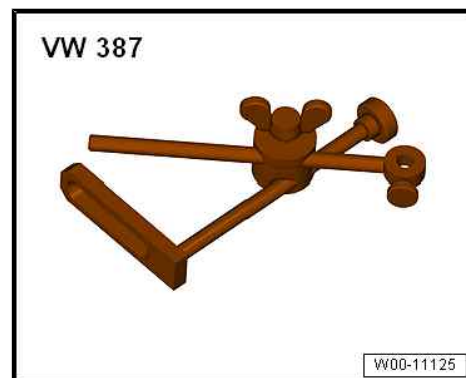
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3.3 Measuring axial clearance of crankshaft

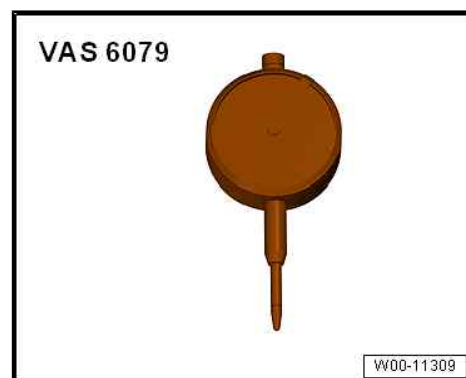
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Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-



- ◆ Dial gauge - VAS 6079-

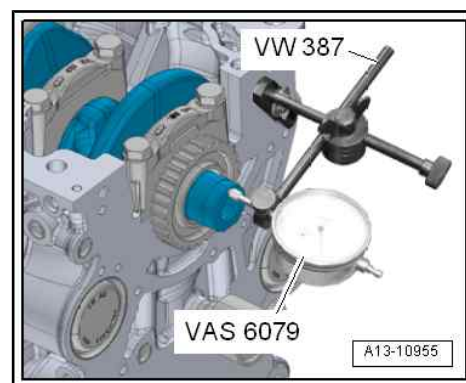


Procedure

- Bolt dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- onto cylinder block (as shown in illustration) and set it against crankshaft.
- Press crankshaft against dial gauge by hand.
- Set dial gauge to "0".
- Push crankshaft away from dial gauge and read off value.

Axial clearance:

- New: 0.07 ... 0.17 mm
- Wear limit: 0.37 mm





3.4 Renewing needle bearing in crankshaft

Only fitted on vehicles with dual clutch gearbox



Note

- ◆ A needle bearing must be fitted in the crankshaft on vehicles with dual clutch gearbox ⇒ *Electronic parts catalogue* .
- ◆ The needle bearing must always be renewed if the engine is separated from the gearbox.

Special tools and workshop equipment required

- ◆ Pin - VW 207 C-



- ◆ Internal puller - VAS 251 605- (previously Kukko 21/2)

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- ◆ Counter-support - VAS 251 621- (previously Kukko 22/1)





Procedure

Air conditioner/heater setting

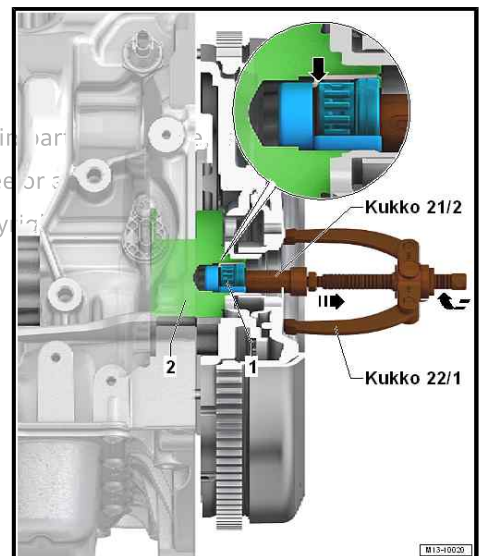
- Gearbox removed ⇒ Rep. gr. 34 ; Removing and installing gearbox; Removing gearbox
- The front edges of the internal puller must not be chipped.

Removing

- Pull needle bearing -1- out of crankshaft -2- using commercially available internal puller (e.g. Kukko - 21/2-) and counter-support (e.g. Kukko - 22/1-).
- Internal puller must be positioned behind needle roller -top arrow-.

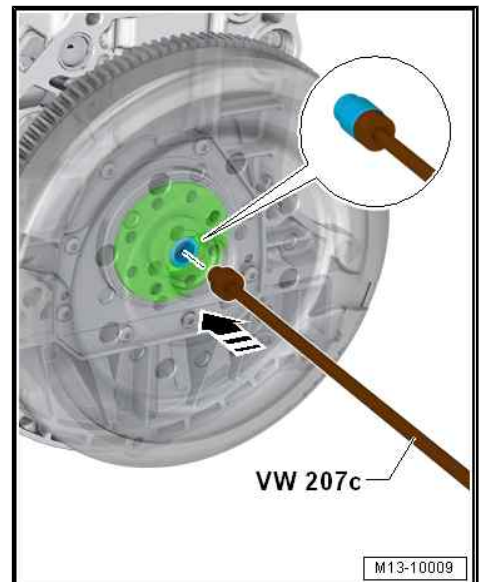


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Installing

- Clean bearing seat in crankshaft and grease lightly.
- Drive needle bearing into crankshaft with drift - VW 207 C- until it reaches installation depth -arrow-.





- Installation depth: dimension -a- = 2.0 mm



Note

Renew needle bearing if you drive it in too far (needle bearing is damaged when it is pulled out again).



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4 Pistons and conrods

⇒ [“4.1 Exploded view - pistons and conrods”, page 65](#)

⇒ [“4.2 Removing and installing pistons”, page 67](#)

⇒ [“4.3 Measuring piston projection at TDC”, page 69](#)

⇒ [“4.4 Checking pistons and cylinder bores”, page 70](#)

⇒ [“4.5 Checking radial clearance of conrod bearings”, page 71](#)

4.1 Exploded view - pistons and conrods



Note

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Oil spray jet and pressure relief valve ⇒ [page 67](#)

1 - Bolts

- Renew after removing
- Lubricate threads and contact surface
- 30 Nm +90°
- When measuring radial clearance, tighten used bolts to 30 Nm and turn 90° further

2 - Conrod bearing cap

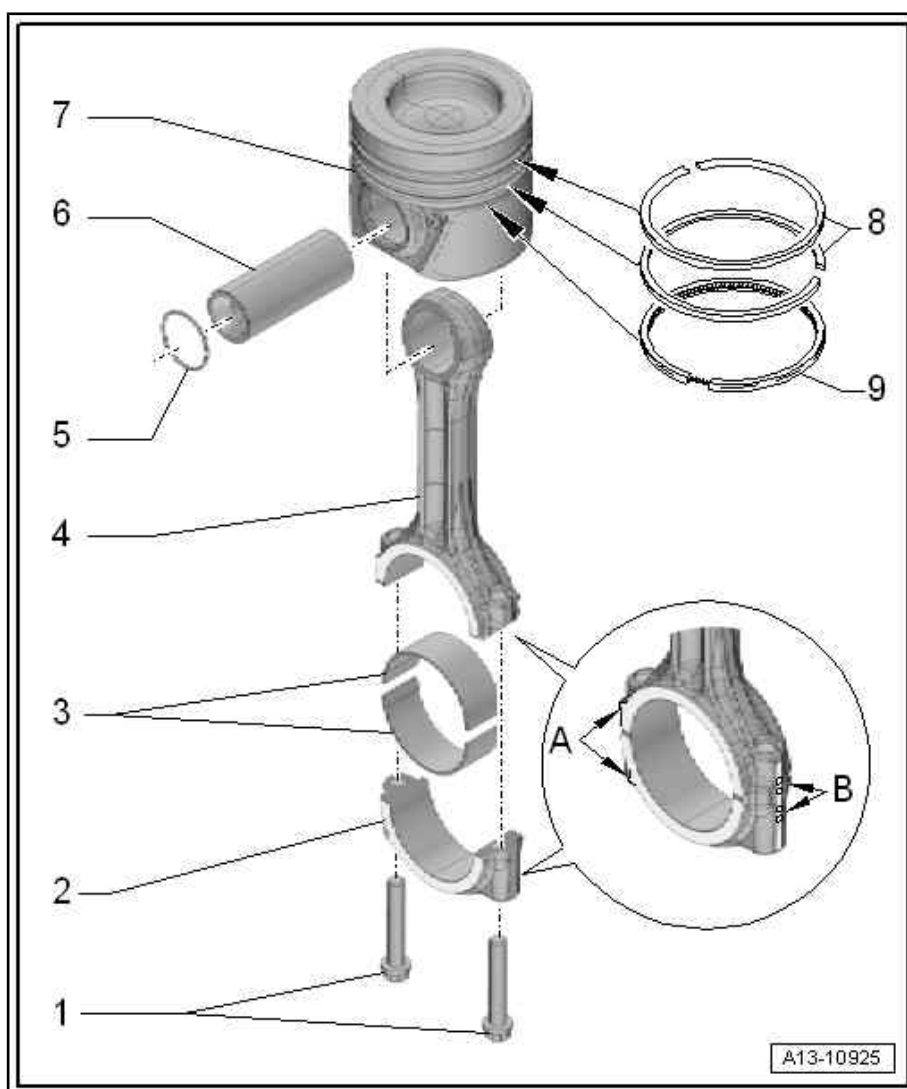
- Note installation position
- Due to the cracking method used to separate the bearing cap from the conrod in manufacture, the caps only fit in one position and only on the appropriate conrod
- Mark conrod and cylinder allocation with paint -B-
- Installation position: Markings -A- face towards pulley end

3 - Bearing shells

- Installation position ⇒ [page 67](#)
- Renew used bearing shells
- Note version: Upper bearing shell (closest to piston) is constructed from a more wear-resistant material; refer to ⇒ Electronic parts catalogue
- Check that it is securely seated

4 - Conrod

- With industrially cracked conrod bearing cap
- Only renew as a complete set





- Mark conrod bearing cap and cylinder allocation with paint -B-
- Axial clearance: wear limit: 0.37 mm
- Measuring radial clearance ⇒ [page 71](#)
- Separating parts of new conrod ⇒ [page 67](#)
- Installation position: Markings -A- face towards pulley end

5 - Circlip

- 2x
- Renew after removing

6 - Piston pin

- Removing and installing ⇒ [“4.2 Removing and installing pistons”, page 67](#)

7 - Piston

- With combustion chamber
- Renew piston if cracking is visible on piston crown or piston skirt
- Mark installation position and cylinder number ⇒ [page 66](#)
- Removing and installing ⇒ [page 67](#)
- Checking pistons and cylinder bores ⇒ [page 70](#)
- Measuring piston projection at “TDC” ⇒ [page 69](#)



8 - Compression rings

- Measuring ring gap ⇒ [page 71](#)
- Measuring ring-to-groove clearance ⇒ [page 71](#)
- Use piston ring pliers (commercially available) to remove and install
- Installation position: marking “TOP” or side with lettering faces towards piston crown
- Offset gaps by 120°

9 - Oil scraper ring

- Measuring ring gap ⇒ [page 71](#)
- Measuring ring-to-groove clearance ⇒ [page 71](#)
- Use piston ring pliers to remove and install
- Installation position: marking “TOP” or side with lettering faces towards piston crown
- Offset gap 120° from bottom compression ring

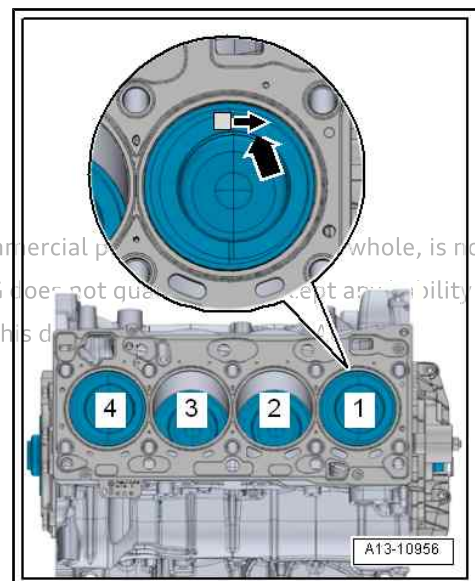
Installation position of pistons and allocation of piston/cylinder

 **Caution** 

Risk of damage to piston crown.

◆ *If you intend to re-install used pistons, mark the cylinder number on the piston crown using paint. Do not attempt to mark the piston crown with a centre punch or by making a scratch, notch or similar.*

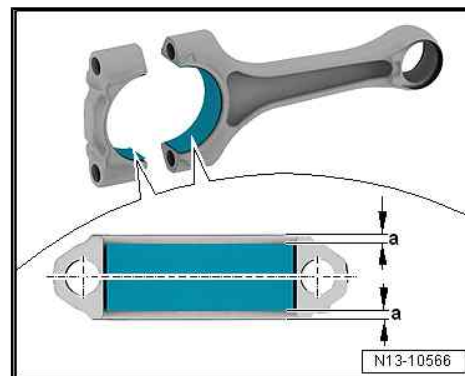
- Arrow on piston crown points to pulley end -arrow-.





Installation position of bearing shells in conrods

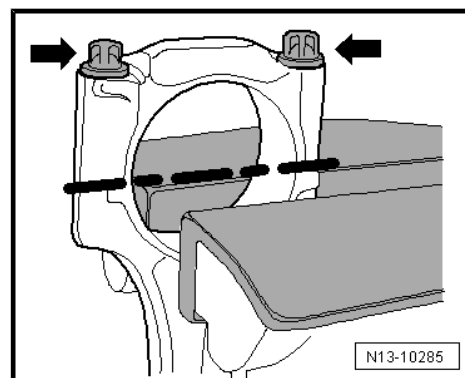
- Insert bearing shells centrally in conrod and conrod bearing cap.
- Dimension -a- = 2.5 mm



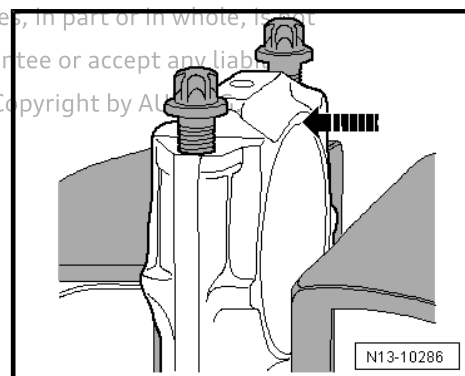
Separating parts of new conrod

On new conrods, the rod and the bearing cap may be very firmly attached to one another. If it is not possible to take off the conrod bearing cap by hand, proceed as follows:

- To avoid any risk of damage, the conrod should only be clamped lightly in a vice using jaw covers as shown in illustration.
- The conrod is clamped in position below the dotted line.
- Unscrew bolts -arrows- approx. 5 turns.

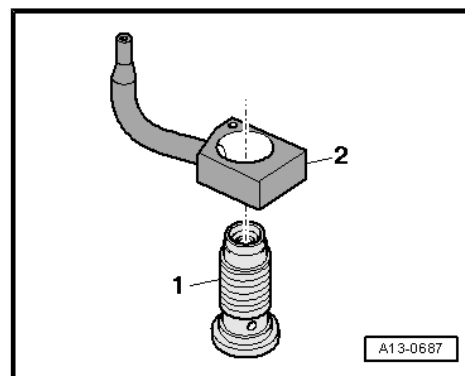


- Using a plastic hammer, carefully knock conrod bearing cap loose -arrow-



Oil spray jet and pressure relief valve

- 1 - Bolt with pressure relief valve, 24 Nm
 - 2 - Oil spray jet (for cooling of pistons)
- Installation position: align locating edge of oil spray jet with machined surface of cylinder block.



Caution

Risk of damage to oil spray jets.

- ◆ Do not bend oil spray jets.
- ◆ Check that oil spray jets have adequate clearance after re-installing pistons.
- ◆ Always renew bent oil spray jets.

4.2 Removing and installing pistons

Special tools and workshop equipment required



◆ Pin - VW 222 A-



◆ Piston ring clamp, commercially available

Removing

- Engine secured to engine and gearbox support ⇒ [page 25](#) .
- Remove cylinder head ⇒ [page 100](#) .
- Remove oil pump ⇒ [page 129](#) .
- Mark installation position and matching of conrod bearing caps to cylinder and to conrods for re-installation ⇒ [Item 2 \(page 65\)](#) .
- Unbolt conrod bearing caps.
- Pull out pistons upwards with conrods.



Note

If piston pin is difficult to remove, heat piston to approx. 60 °C.

- Take circlip out of piston pin boss.
- Use drift - VW 222 A- to drive out piston pin.

Installing

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



Note

After removing, renew bolts tightened with specified tightening

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- Oil running surfaces of bearing shells.
- Install pistons using piston ring clamp.

Installation position:

- Pistons ⇒ [page 66](#)
- Bearing shells in conrods ⇒ [page 67](#)
- Install conrod bearing caps according to markings.
- Install oil pump ⇒ [page 129](#) .
- Install cylinder head ⇒ [page 100](#) .

Tightening torques

- ◆ ⇒ [“4.1 Exploded view - pistons and conrods”, page 65](#)



4.3 Measuring piston projection at TDC

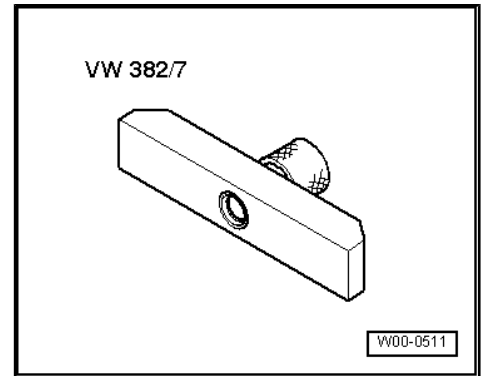


Note

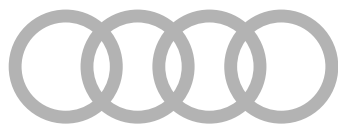
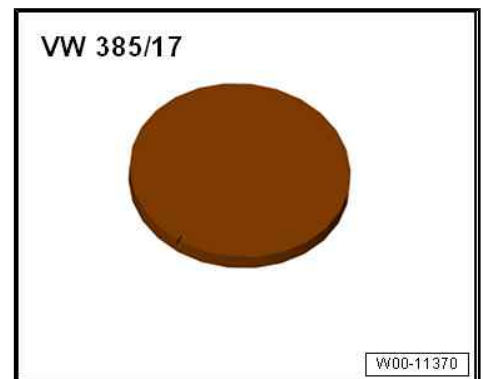
Piston projection at "TDC" must be measured when installing new pistons or a short engine.

Special tools and workshop equipment required

- ◆ Measuring bridge - VW 382/7-



- ◆ Measuring plate -VW 385/17- from universal measuring tool - VW 385-



- ◆ Dial gauge - VAS 6079-



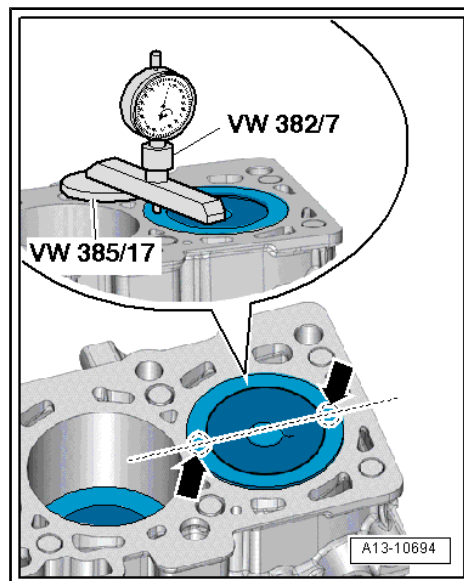
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Procedure

- Secure dial gauge - VAS 6079- with measuring bridge - VW 382/7- and measuring plate -VW 385/17- to cylinder block as shown in illustration.
- Measure projection at each piston at both locations marked with -arrows- (seen in longitudinal direction of engine: at front and rear of piston).
- Depending on piston projection, install corresponding cylinder head gasket according to following table:

Piston projection above top surface of cylinder block mm	Identification (no. of holes)
0.91 ... 1.00	1
1.01 ... 1.10	2
1.11 ... 1.20	3



Identification of cylinder head gasket

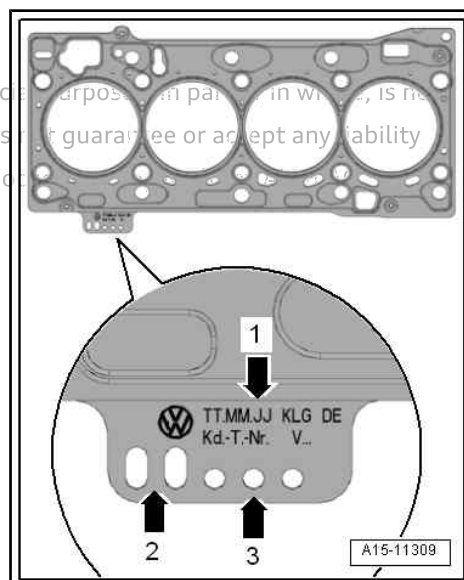
- 1 - Part number
- 2 - Ignore
- 3 - Holes

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Note

If the measured values for piston projection are not the same for all pistons, use the highest value to determine the correct cylinder head gasket size.



4.4 Checking pistons and cylinder bores

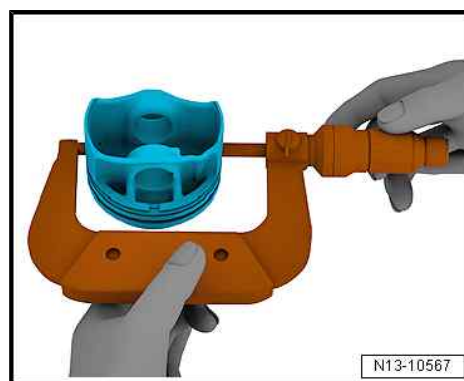
Checking piston

- Using a micrometer (75 ... 100 mm), measure approx. 15 mm from the lower edge, perpendicular to the piston pin axis.
- Maximum deviation from nominal dimension: 0.04 mm.



Note

- ◆ Check for wear on piston skirt coating and for any carbon deposits.
- ◆ Renew piston if cracking is visible on piston skirt.



Piston Ø mm	
Nominal dimension	79.455 ¹⁾
• ¹⁾ Dimensions including coating (thickness 0.02 mm). The coating will wear down in service.	



Measuring cylinder bore

- Use a cylinder gauge - VAS 6078- to take measurements at 3 points in transverse direction -A- and in longitudinal direction -B-.
- Maximum deviation from nominal dimension: 0.10 mm.

Checking cylinder bore

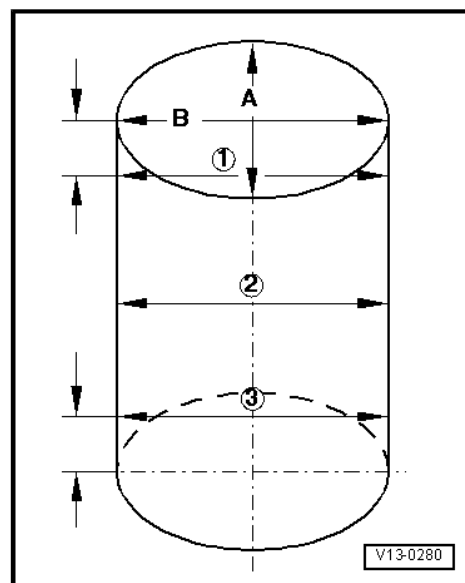
- Check cylinder bore for wear, scoring and other abnormalities.

Cylinder bore Ø mm	
Nominal dimension	79.5



Note

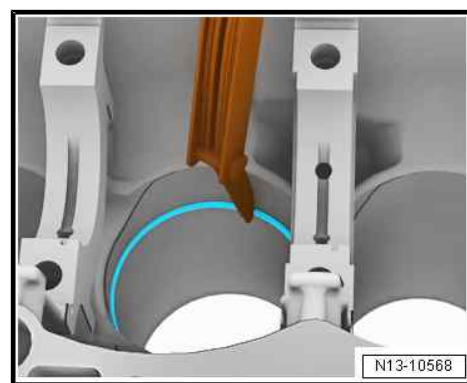
Measuring the cylinder bores must not be done when the cylinder block is mounted to the engine and gearbox support - VAS 6095-, as incorrect measurements may result.



Measuring piston ring gap

- Insert ring at right angle to cylinder wall from above and push down into lower cylinder opening approx. 15 mm from bottom of cylinder.
- To do so, use a piston without rings.

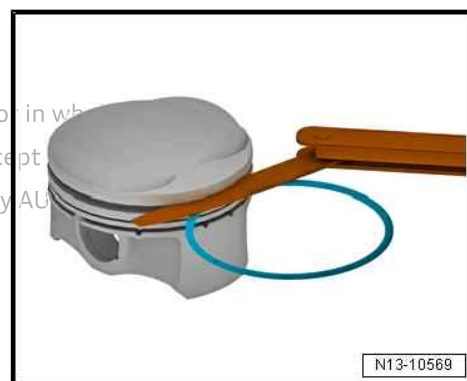
Piston ring	new mm	Wear limit mm
1st compression ring	0.30 ... 0.40	0.55
2nd compression ring	0.20 ... 0.45	0.95
Oil scraper ring	0.25 ... 0.50	0.75



Measuring ring-to-groove clearance

- Clean groove in piston before checking clearance.

Piston ring	Wear limit mm
1st compression ring	0.08
2nd compression ring	0.08
Oil scraper ring	0.08



4.5 Checking radial clearance of conrod bearings

Special tools and workshop equipment required

- ◆ Plastigauge

Procedure

- Remove conrod bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigauge corresponding to the width of the bearing on the bearing journal or in the bearing shell.
- Fit conrod bearing cap and secure with old bolts
 ⇒ [Item 1 \(page 65\)](#) without rotating crankshaft.



- Remove conrod bearing cap again.
- Compare width of Plastigauge with measurement scale.

Radial clearance:

- Wear limit: 0.08 mm.
- Renew bolts for conrods after removal.



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15 – Cylinder head, valve gear

1 Toothed belt drive

⇒ [“1.1 Exploded view - toothed belt cover”, page 73](#)

⇒ [“1.2 Exploded view - toothed belt”, page 74](#)

⇒ [“1.3 Removing and installing toothed belt cover”, page 75](#)

⇒ [“1.4 Removing and installing toothed belt”, page 77](#)

1.1 Exploded view - toothed belt cover

1 - Toothed belt cover (bottom)

- Removing and installing
⇒ [page 77](#)

2 - Bolt

- With collar
- Captive in toothed belt cover (bottom)
- 12 Nm

3 - Bolt

- Depending on version
- 5 Nm

4 - Measuring tube

- To pressure differential sender - G505-

5 - Toothed belt cover (top)

- Removing and installing
⇒ [page 75](#)

6 - Bolt

- With collar
- Captive in toothed belt cover (bottom)
- 12 Nm

7 - Toothed belt cover (rear)

8 - Retainer

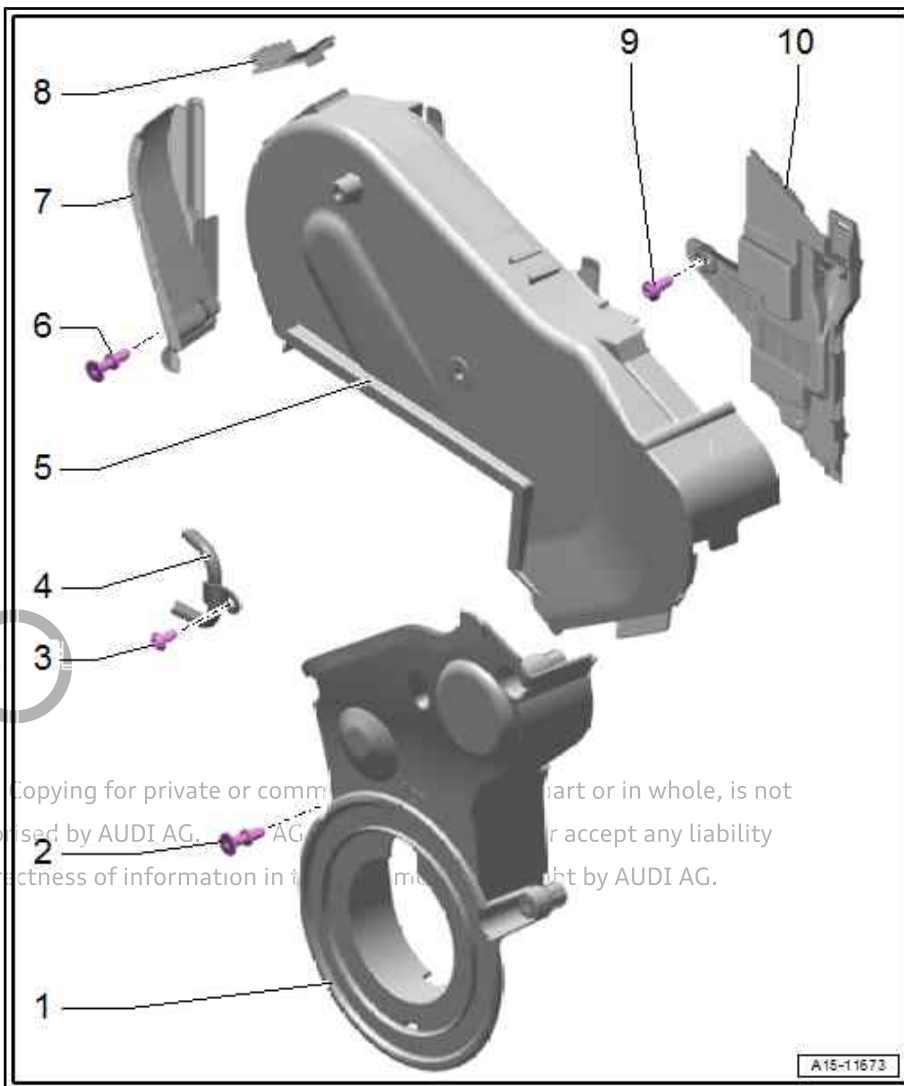
- For measuring tube

9 - Bolt

- Apply locking fluid when installing; refer to ⇒
Electronic parts catalogue
- 12 Nm

10 - Toothed belt cover (rear)

- To remove, take out coolant pump ⇒ [page 191](#)





1.2 Exploded view - toothed belt

1 - Bolt

- Renew after removing
- Slacken and tighten with counterhold tool - 3415-
- Do not additionally oil threads and shoulder

Tighten in three stages as follows:

- ◆ 1st stage: 180 Nm
- ◆ 2nd stage: Use rigid wrench to turn 90° further
- ◆ 3rd stage: Use rigid wrench to turn 45° further

2 - Crankshaft sprocket

- Contact surface between sprocket and crankshaft must be free of oil
- Can only be installed in one position

3 - Nut

- Make sure that stud is fitted securely
- 20 Nm

4 - Damper wheel

5 - Stud

- 15 Nm

6 - Nut

- Renew
- Make sure that stud is fitted securely
- 20 Nm +45°

7 - Tensioning roller

8 - Stud

- 15 Nm

9 - Toothed belt

- Before removing, mark direction of rotation with chalk or felt-tip pen
- Check for wear
- Removing ⇒ [page 77](#)
- Installing (adjusting valve timing) ⇒ [page 81](#)

10 - Bolt

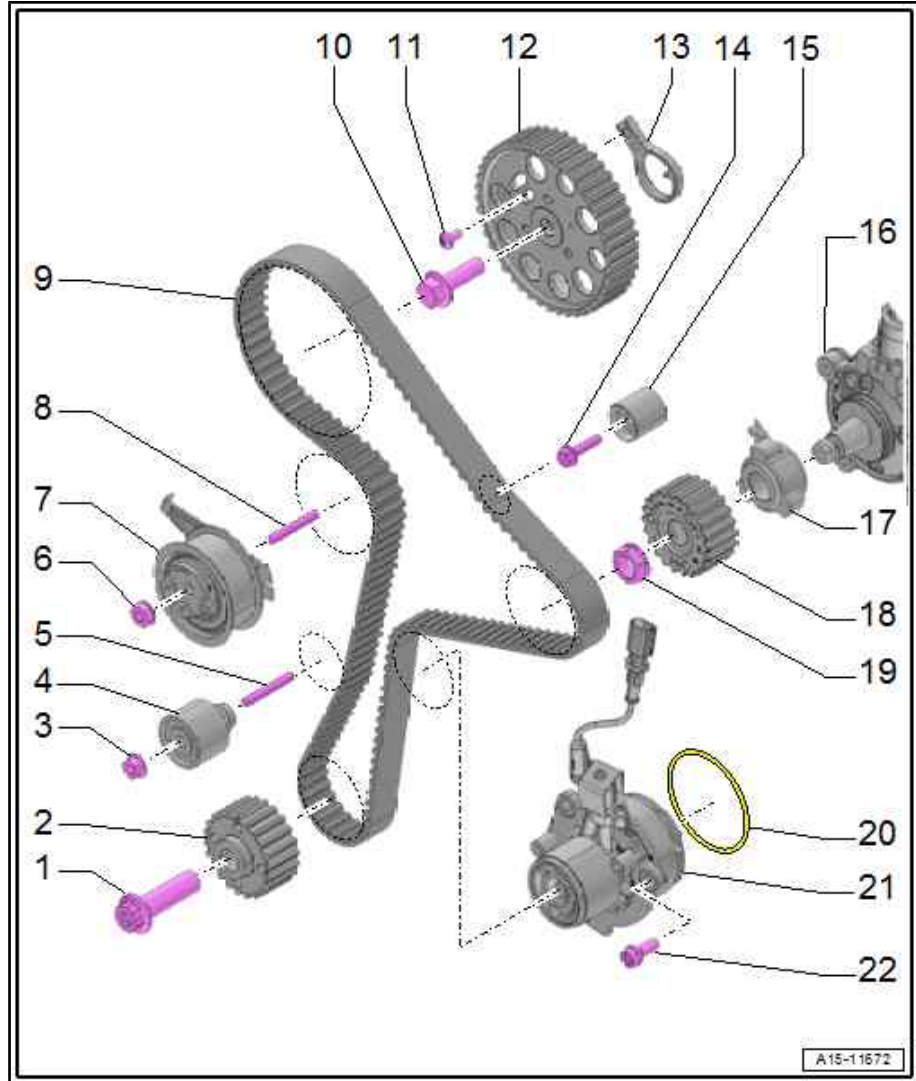
- Use counterhold tool - T10172A- with adapters -T10172/11- to loosen and tighten
- Do not additionally oil threads and shoulder
- 100 Nm

11 - Locking bolt

- 9 Nm

12 - Camshaft sprocket

- Contact surface between sprocket and camshaft must be free of oil



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13 - Locating arm for camshaft

- Removing and installing ⇒ [“2.5 Removing and installing camshaft housing”, page 94](#)

14 - Bolt

- 20 Nm

15 - Damper wheel

16 - High-pressure pump

- Exploded view ⇒ [page 273](#)

17 - High-pressure pump hub

- Exploded view ⇒ [page 273](#)
- Contact surface between hub and toothed belt sprocket must be free of oil

18 - High-pressure pump sprocket

- Exploded view ⇒ [page 273](#)
- Contact surface between hub and toothed belt sprocket must be free of oil

19 - Nut

- Do not additionally oil threads and shoulder
- Use counterhold tool - T10051- when loosening and tightening
- 95 Nm

20 - O-ring

- Renew after removing
- Lubricate with coolant

21 - Coolant pump

- Removing and installing ⇒ [page 191](#)

22 - Bolt

- Tightening torque ⇒ [Item 11 \(page 184\)](#)

1.3 Removing and installing toothed belt cover

⇒ [“1.3.1 Removing and installing toothed belt cover \(top\)”, page 75](#)

⇒ [“1.3.2 Removing and installing toothed belt cover \(bottom\)”, page 77](#)

1.3.1 Removing and installing toothed belt cover (top)

Removing

- Remove engine cover panel ⇒ [page 39](#) .



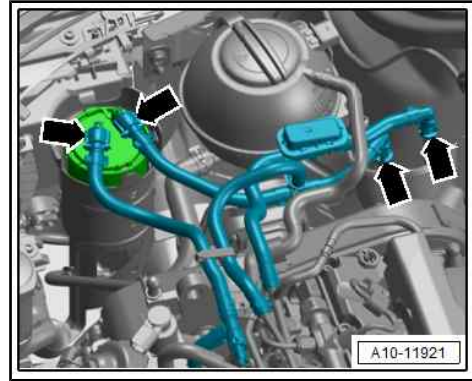
Caution

Risk of damage caused by particles of dirt.

- ◆ *Observe rules for cleanliness when working on the fuel supply system ⇒ [page 5](#) .*



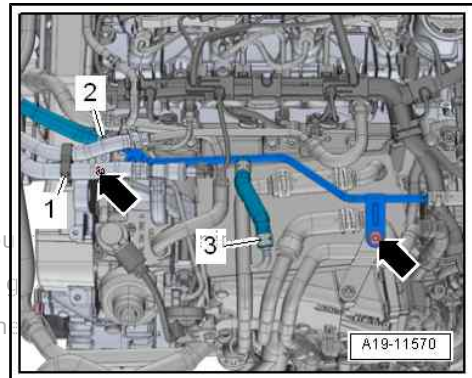
- Disconnect fuel hoses -arrows- ⇒ Fuel supply system; Rep. gr. 20 ; Plug-in connectors; Disconnecting plug-in connectors .
- Move fuel hoses clear at coolant expansion tank.



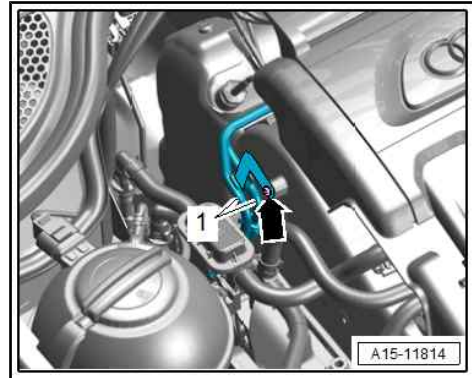
- Remove bolt -left arrow-.



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- If fitted, unscrew bolt -arrow-.
- Move measuring tube -1- clear and push to right side.

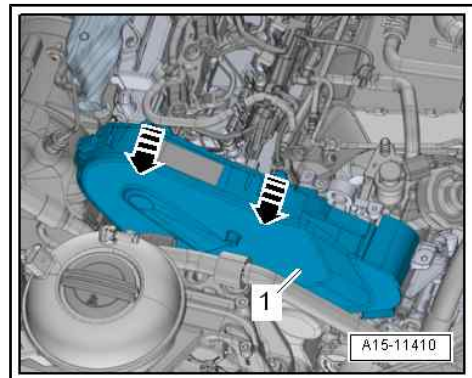


- Release catches -arrows-, disengage toothed belt cover (top) -1- and detach.

Installing

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

- Connect fuel hoses ⇒ Fuel supply system; Rep. gr. 20 ; Plug-in connectors; Disconnecting plug-in connectors .
- Bleed fuel system
⇒ ["1.3 Filling and bleeding fuel system", page 241](#) .
- Check fuel system for leaks
⇒ ["1.4 Checking fuel system for leaks", page 242](#) .
- Install engine cover panel ⇒ [page 39](#) .



Tightening torques

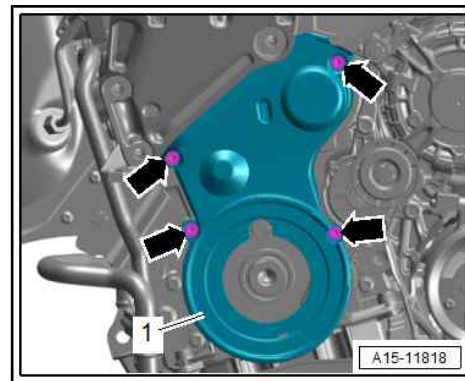
- Control pipe for pressure differential sender
⇒ ["1.1 Exploded view - toothed belt cover", page 73](#)



1.3.2 Removing and installing toothed belt cover (bottom)

Removing

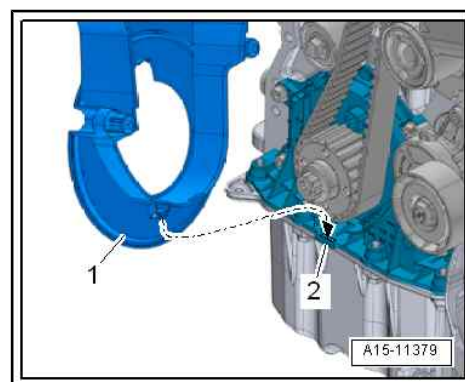
- Remove vibration damper ⇒ [page 44](#) .
- Remove bolts -arrows-.
- Disengage toothed belt cover (bottom section) -1- upwards from sealing flange (front) and detach.



Installing

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

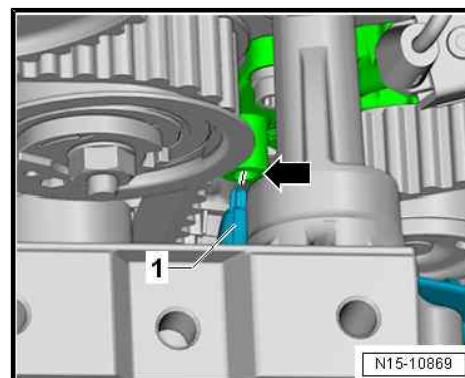
- Insert toothed belt cover (bottom) -1- into sealing flange (front) -2- -arrow-.



- Fit toothed belt cover -1- (note position of dowel pin -arrow-).
- Install vibration damper ⇒ [page 44](#) .

Tightening torques

- ◆ ⇒ [“1.1 Exploded view - toothed belt cover”, page 73](#)



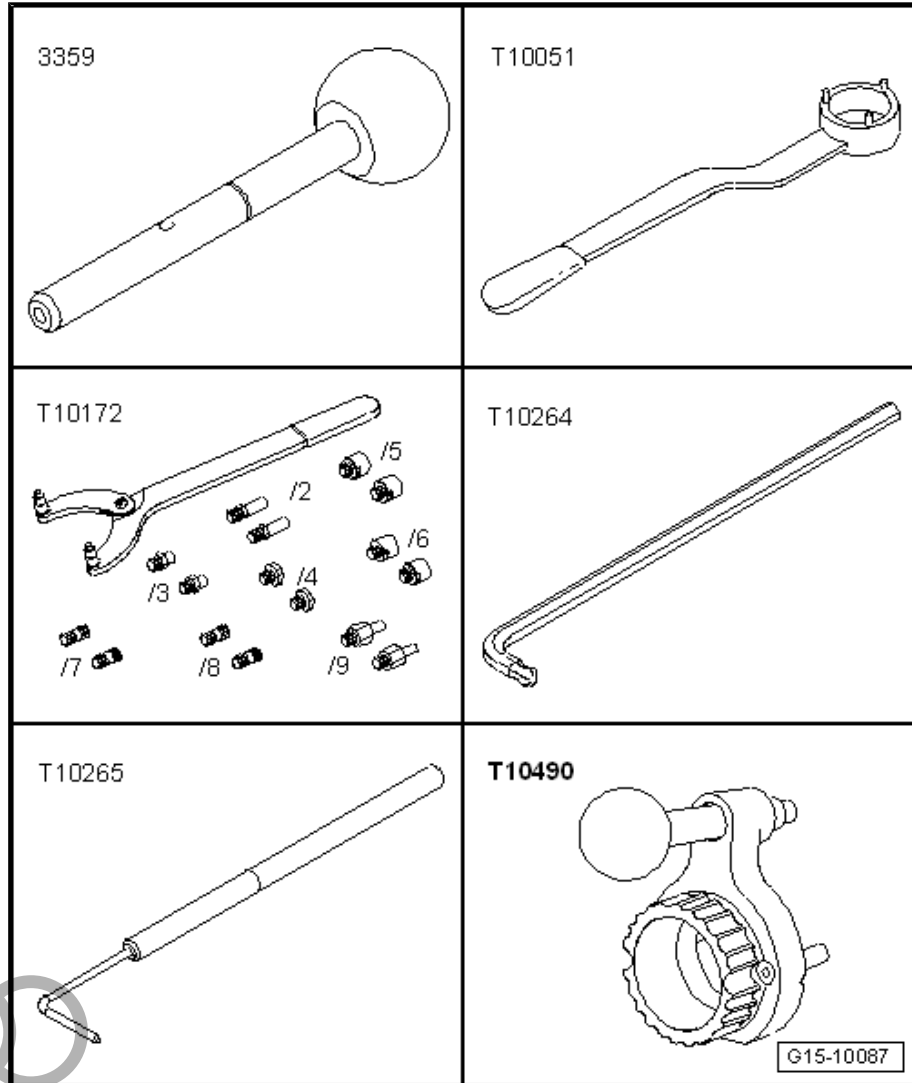
1.4 Removing and installing toothed belt



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Special tools and workshop equipment required



- ◆ Diesel injection pump locking pin - 3359-
- ◆ Counterhold tool - T10051-
- ◆ Counterhold tool - T10172A- with adapters - T10172/11-
- ◆ Offset screwdriver - T10264-
- ◆ Locking tool - T10265-
- ◆ Crankshaft stop - T10490-
- ◆ Locking pin - T10492-





Removing

- Remove engine support ⇒ [page 46](#) .

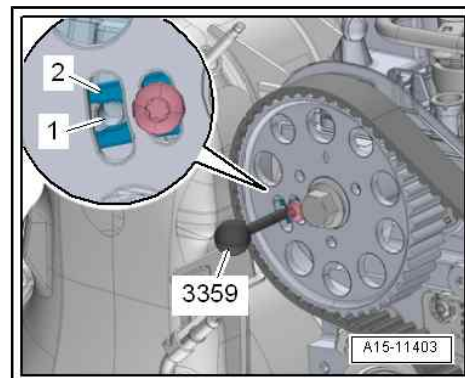


Caution

Irreparable damage can be caused if the toothed belt slips.

- ◆ **Only turn crankshaft in direction of engine rotation.**

- Rotate crankshaft by turning bolt on crankshaft sprocket until camshaft sprocket is positioned at "TDC".
- Lock camshaft hub with diesel injection pump locking pin - 3359- ; to do so, insert locking pin into fork on locating arm -2- and into hole -1- behind it in cylinder head.

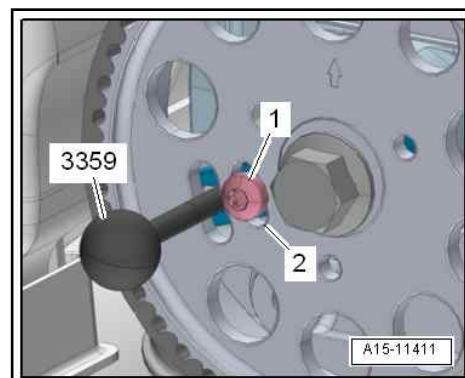


- Loosen locking bolt -1- in camshaft sprocket one half turn, but do not remove.

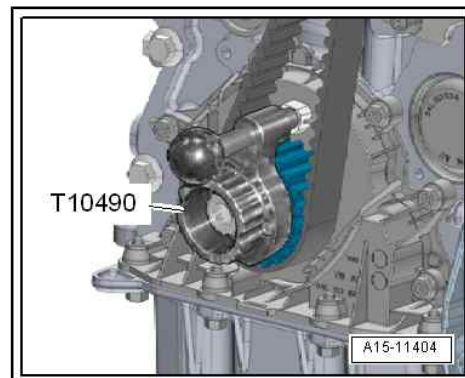


Note

Disregard -item 2-.



- Lock crankshaft sprocket in position with crankshaft stop - T10490- .
- Pins of crankshaft stop - T10490- must engage in threaded holes of sprocket.
- Locking pin of crankshaft stop - T10490- must engage in hole on sealing flange.

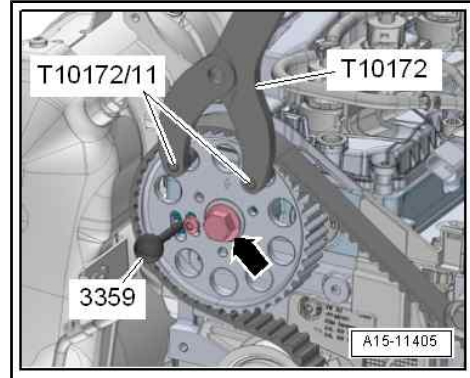




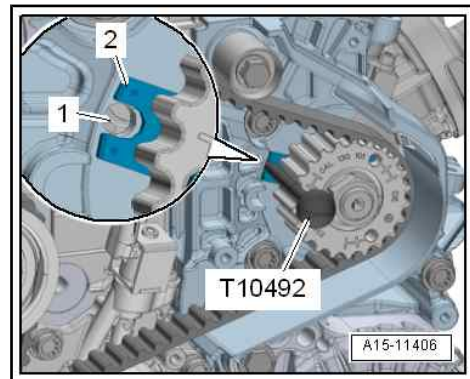
Caution

Risk of damage to engine.

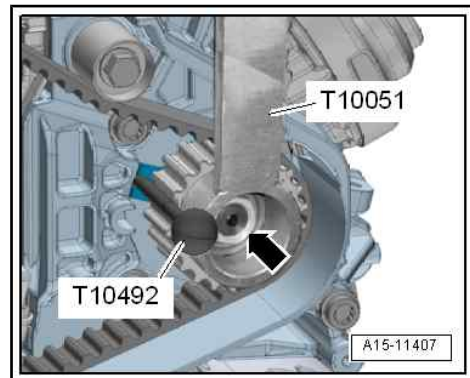
- ◆ **The torque applied to loosen or tighten the central bolts on the camshaft and high-pressure pump MUST NOT be transferred to the respective locking pin. This can cause damage to the locating arms, even if counterhold tools are used. This damage may not be visible in some cases, but can cause damage to the engine. When loosening or tightening the central bolt, pull out the locking pin and re-insert it later if necessary.**



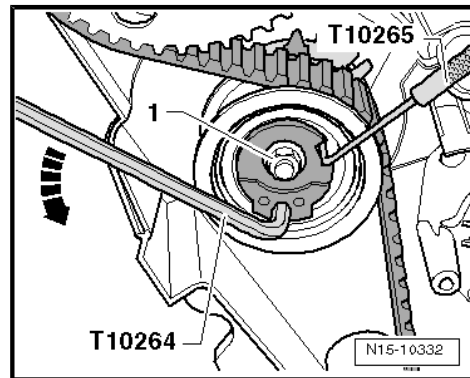
- Pull out locking pin and slacken bolt for camshaft slightly, but insert pin again before fully slackening bolt.
- Slacken bolt -arrow- for camshaft sprocket using counterhold tool - T10172A- with adapters -T10172/11- .
- Lock hub of high-pressure pump in position with locking pin - T10492- ; to do so, insert locking pin into fork -2- on hub and into hole -1- behind it in bracket for ancillaries.
- Pull out locking pin and slacken nut for high-pressure pump sprocket slightly, but insert pin again before fully slackening nut.



- Slacken nut -arrow- for toothed belt sprocket of high-pressure pump approx. 90° using counterhold tool - T10051- .



- Slacken nut -1- for tensioning roller.
- Turn eccentric adjuster of tensioning roller with offset screwdriver - T10264- anti-clockwise -arrow- until tensioning roller can be secured with locking tool - T10265- .





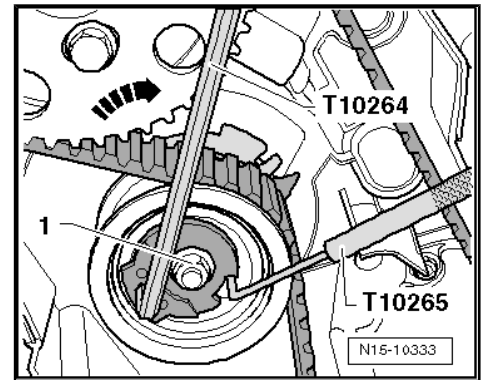
- Then use offset screwdriver - T10264- to turn eccentric adjuster of tensioning roller clockwise -arrow- as far as stop and tighten nut -1- by hand.



Caution

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

- ◆ *Before removing, mark direction of rotation of toothed belt with chalk or felt-tip pen for re-installation.*



- Take off toothed belt first from coolant pump and then from remaining sprockets.

Installing (adjusting valve timing)



Note

Perform adjustments on toothed belt only when engine is cold.



Caution

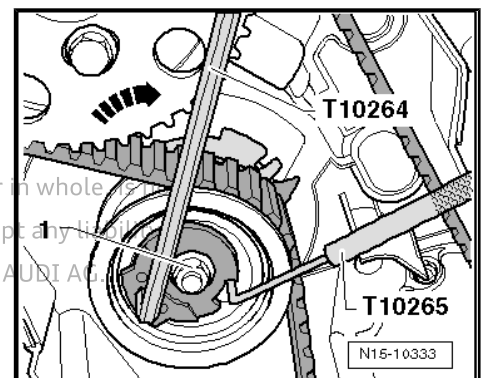
Risk of damage to valves and piston crowns.

- ◆ *The crankshaft must not be at "TDC" at any cylinder when the camshaft is turned.*

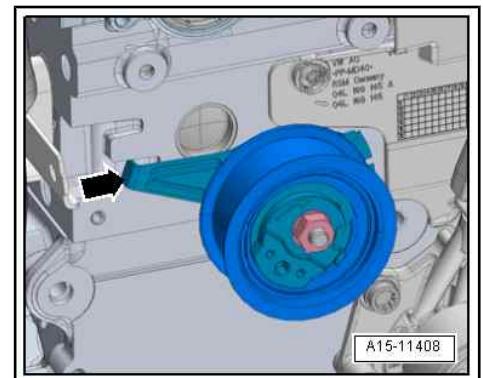
Requirements:

- Tensioning roller is locked with locking tool - T10265- and secured at right stop with nut -1-.

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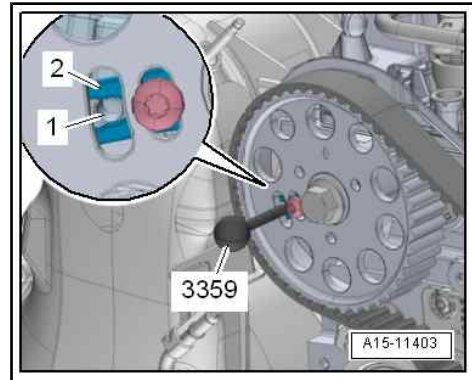


- Metal lug -arrow- of tensioning roller must engage in cast recess on cylinder head.

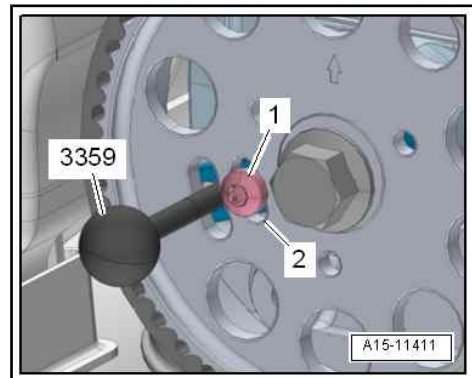




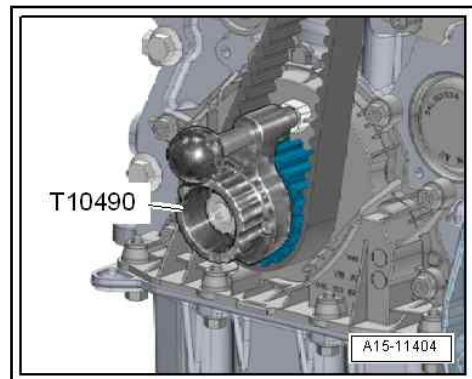
- Camshaft hub locked with diesel injection pump locking pin - 3359- .
- Bolt fitted but not tightened.
- It should just be possible to turn the sprocket on the camshaft easily without axial movement.



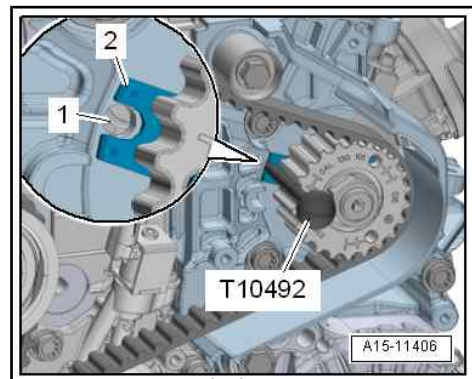
- Locking bolt -1- in locating arm loosened one half turn, positioned in centre of elongated hole -2-.



- Crankshaft is locked in position with crankshaft stop - T10490- .



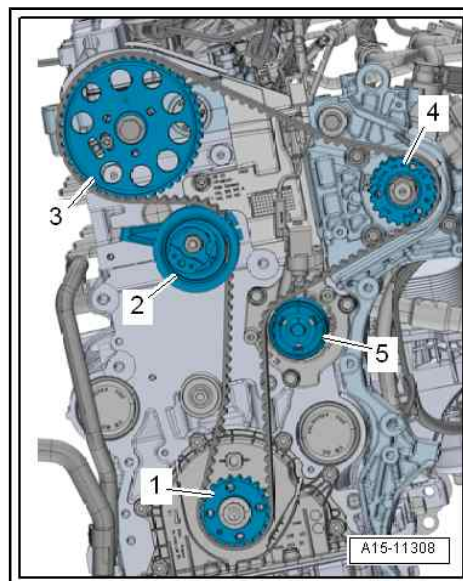
- High-pressure pump hub is locked with locking pin - T10492- .
- Nut fitted but not tightened.
- It should just be possible to easily turn the high-pressure pump sprocket, but there must be no axial movement.



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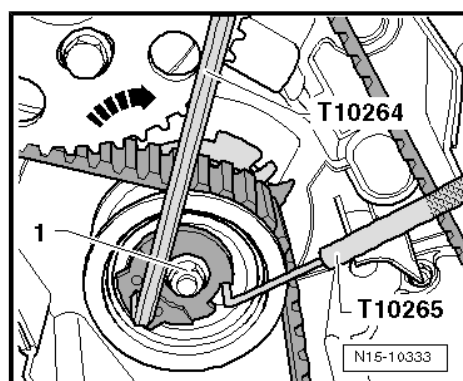
- Turn the camshaft sprocket and high-pressure pump sprocket in their elongated holes clockwise as far as the stop.
- Install toothed belt in the specified sequence:
 - 1 - Crankshaft sprocket
 - 2 - Tensioning roller
 - 3 - Camshaft sprocket
 - 4 - High-pressure pump sprocket
 - 5 - Coolant pump sprocket



- Loosen nut -1- for tensioning roller and detach locking tool - T10265- .

i Note

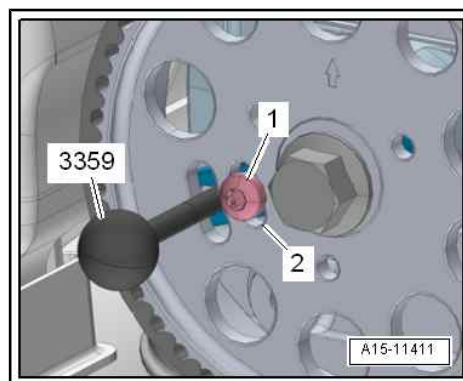
- ◆ Metal lug of tensioning roller must remain engaged in cast recess on cylinder head.
- ◆ Disregard -arrow-.



! Caution

Locking bolt -1- must not come into contact with upper end of elongated hole after toothed belt has been tensioned.

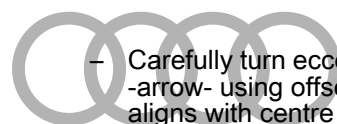
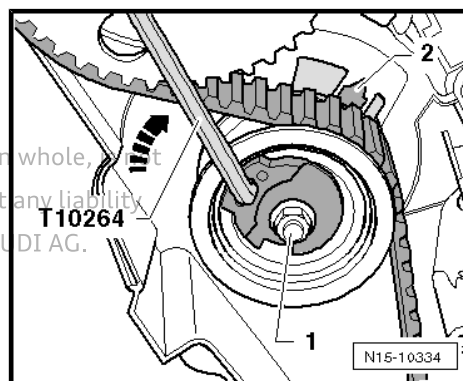
- Check that locking bolt -1- is located between centre and lower end -2- of elongated hole. If necessary, adjust position of camshaft sprocket by moving it one tooth clockwise then fit toothed belt again.



- Carefully turn eccentric adjuster of tensioning roller clockwise -arrow- using offset screwdriver - T10264- until pointer -2- aligns with centre of slot on base plate.

- Nut -1- must not turn.

- Hold tensioning roller in this position and tighten nut.



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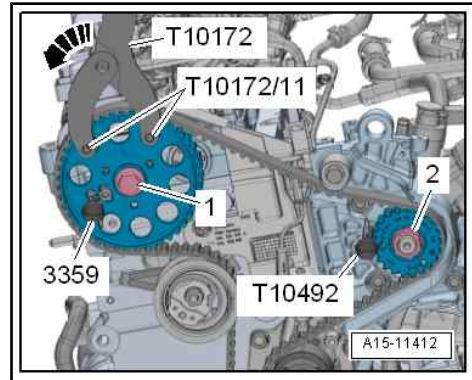


- Position counterhold tool - T10172A- with adapters - T10172/11- on camshaft sprocket as shown in illustration.
- Apply force to counterhold tool in anti-clockwise direction -arrow- and maintain tension.
- Tighten bolt -1- for camshaft sprocket and nut -2- for high-pressure pump sprocket to 20 Nm.



Note

High-pressure pump sprocket can only be turned to a limited extent. It is therefore very important to check that the sprocket is not at the end of the area within which it can turn.



- Check that marking on high-pressure pump sprocket is not aligned with locking pin. If necessary, adjust position of high-pressure pump sprocket by one tooth in clockwise direction and fit toothed belt again.

- Remove locking pins -3359- , -T10492- and crankshaft stop - T10490- and check valve timing => [page 84](#).

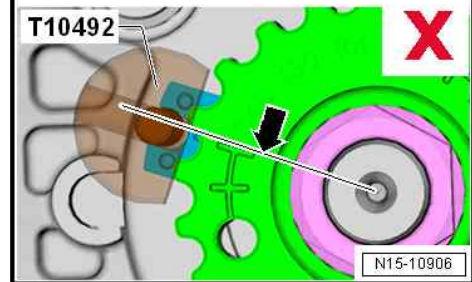
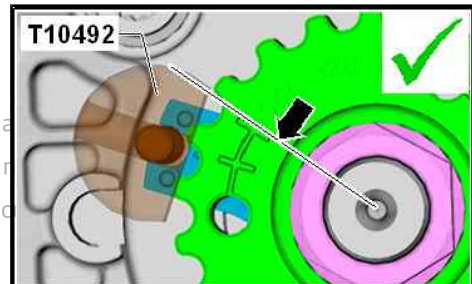
Checking valve timing:



Caution

Irreparable engine damage can be caused if the toothed belt slips.

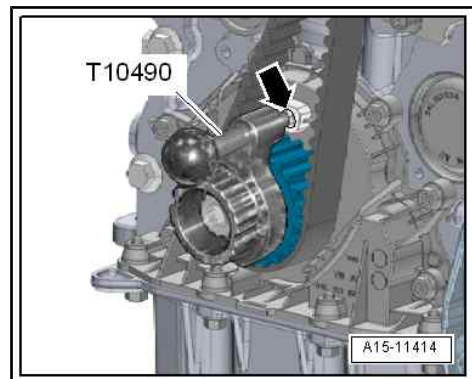
- ◆ *Only turn crankshaft in direction of engine rotation.*



- Turn crankshaft two rotations in direction of engine rotation by turning bolt for crankshaft sprocket until crankshaft is just before "TDC".

- Fit crankshaft stop - T10490- to crankshaft sprocket again.

- Turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop engages in sealing flange as crankshaft rotates.



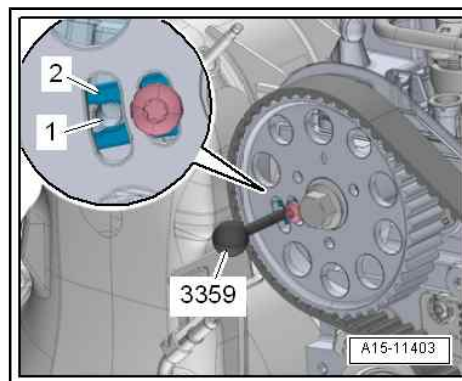
Caution

The crankshaft must be exactly in "TDC" position to ensure accurate valve timing adjustment.

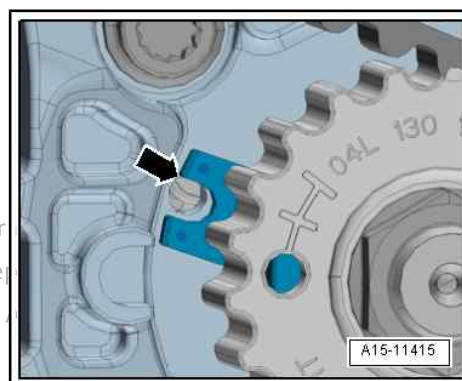
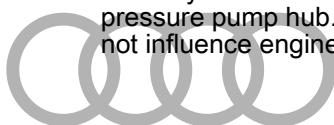
- ◆ *If crankshaft has been turned past "TDC" position, turn crankshaft two further rotations until it is again positioned just before "TDC". Then turn further in the same direction and lock crankshaft with crankshaft stop - T10490- .*



- It should now be possible to lock camshaft hub with diesel injection pump locking pin - 3359- .



- It is very difficult to reproduce the locking position of the high-pressure pump hub. However, a slight deviation -arrow- does not influence engine operation.



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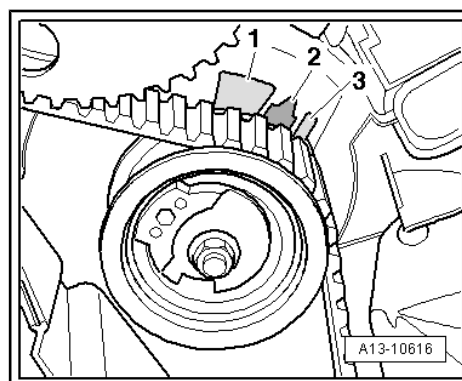
- Pointer -2- on tensioner roller must be centred between tabs -1- and -3- on base plate.

i Note

The maximum permissible sideways deviation from the specified position is 5 mm.

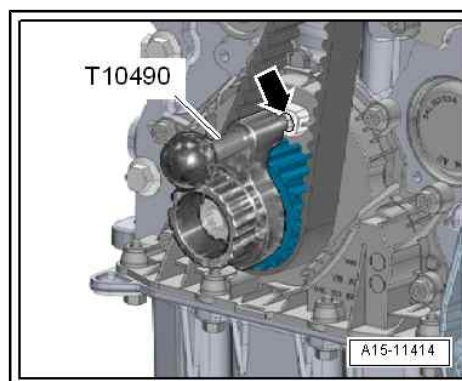
If requirements are met, continue with procedure after adjusting valve timing correctly as described below ⇒ [page 86](#) .

Re-adjust valve timing if requirements are not met ⇒ [page 85](#) .



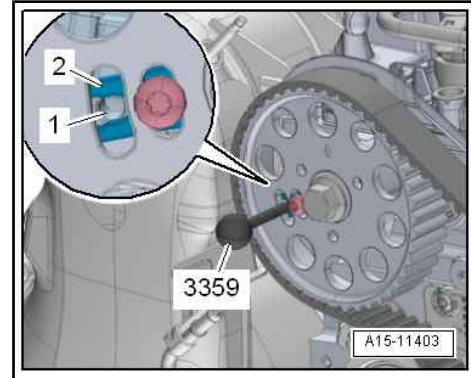
Re-adjusting valve timing:

- If camshaft hub cannot be locked, withdraw crankshaft stop - T10490- until pin is clear of bore.
- Turn crankshaft in opposite direction of engine rotation slightly past “TDC”.



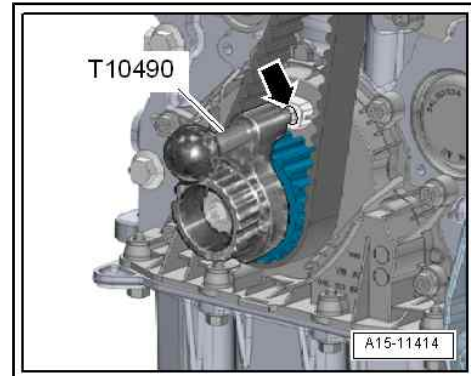


- Now turn crankshaft slowly in direction of engine rotation until it is possible to lock camshaft hub with locking pin -3359- .
- Loosen bolt for camshaft sprocket after locking.



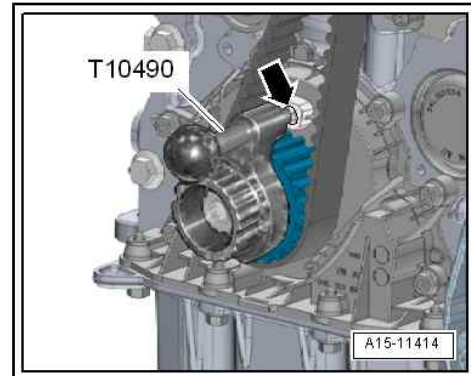
Procedure if crankshaft stop - T10490- is now on left side of bore:

- Turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop engages in sealing flange as crankshaft rotates.
- Tighten camshaft sprocket bolts to 20 Nm.



Procedure if crankshaft stop - T10490- is now on right side of bore:

- Turn crankshaft slightly in opposite direction to engine rotation.
- Turn crankshaft in direction of engine rotation again until pin of crankshaft stop engages in sealing flange as crankshaft rotates.
- Tighten camshaft sprocket bolt to 20 Nm.



Procedure after adjusting valve timing correctly:

- Remove diesel injection pump locking pin - 3359- and crankshaft stop - T10490- .
- Turn crankshaft two rotations in direction of engine rotation by turning bolt for crankshaft sprocket until crankshaft is just before "TDC".
- Check valve timing once again ⇒ [page 84](#) .

⚠ Caution

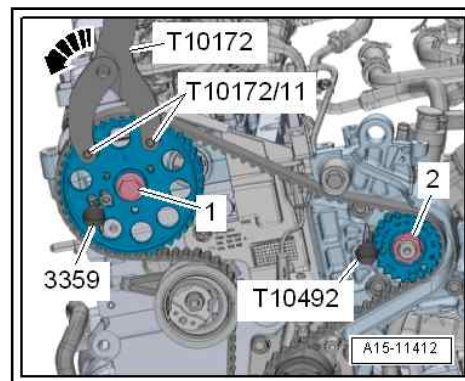
Risk of damage to engine.

◆ *The torque applied to loosen or tighten the central bolts on the camshaft and high-pressure pump **MUST NOT** be transferred to the respective locking pin. This can cause damage to the locating arms, even if counterhold tools are used. This damage may not be visible in some cases, but can cause damage to the engine. When loosening or tightening the central bolt, pull out the locking pin and reinsert it later if necessary.*

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- If camshaft hub can now be locked, tighten camshaft sprocket bolt -1- to final torque using counterhold tool - T10172A- with adapters -T10172/11- .
- Tighten nut -2- for high-pressure pump sprocket to final torque ⇒ [page 273](#) .



- Use counterhold tool - T10051- to do so.
- Check valve timing again ⇒ [page 84](#) .

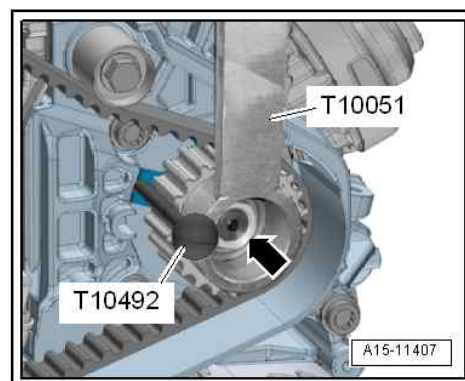
Attaching

Further installation is carried out in the reverse order; note the following:



Note

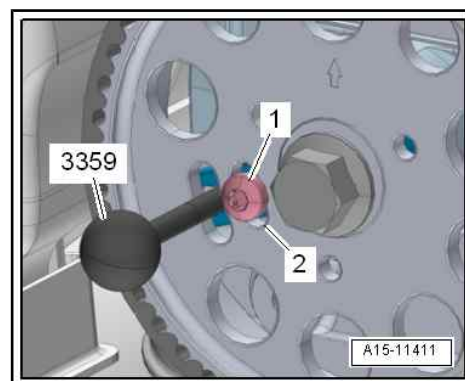
- ◆ *Renew seals/gaskets after removing.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ [Electronic parts catalogue](#) .*



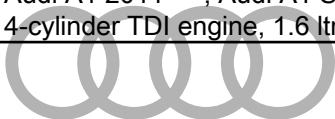
- Tighten locking pin -1-.
- Install engine support ⇒ [page 46](#) .

Tightening torques

- ◆ ⇒ ["1.2 Exploded view - toothed belt", page 74](#)



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2 Cylinder head

- ⇒ ["2.1 Exploded view - cylinder head cover", page 88](#)
 ⇒ ["2.2 Exploded view - cylinder head", page 90](#)
 ⇒ ["2.3 Removing and installing cylinder head cover", page 92](#)
 ⇒ ["2.4 Removing and installing seals for injectors", page 93](#)
 ⇒ ["2.5 Removing and installing camshaft housing", page 94](#)
 ⇒ ["2.6 Removing and installing cylinder head", page 100](#)
 ⇒ ["2.7 Checking compression", page 106](#)

2.1 Exploded view - cylinder head cover



Caution

When installing a new base engine, it is essential that the clamping pieces for the injectors are tightened to the specified torque ⇒ [page 255](#) after installing the high-pressure pipes. The clamping pieces are only secured hand-tight at the factory so the injectors can be aligned during installation. If these instructions are not observed, the engine could be damaged.

1 - Gasket

- Renew if damaged or leaking

2 - Cylinder head cover

- With vacuum reservoir
- Removing and installing ⇒ [page 92](#)

3 - O-ring

- Renew after removing

4 - Sealing plug

5 - Bracket

- For electrical wiring

6 - Bolt

- 8 Nm

7 - Grommet

- In cylinder head cover

8 - Clamping piece

9 - Bolt

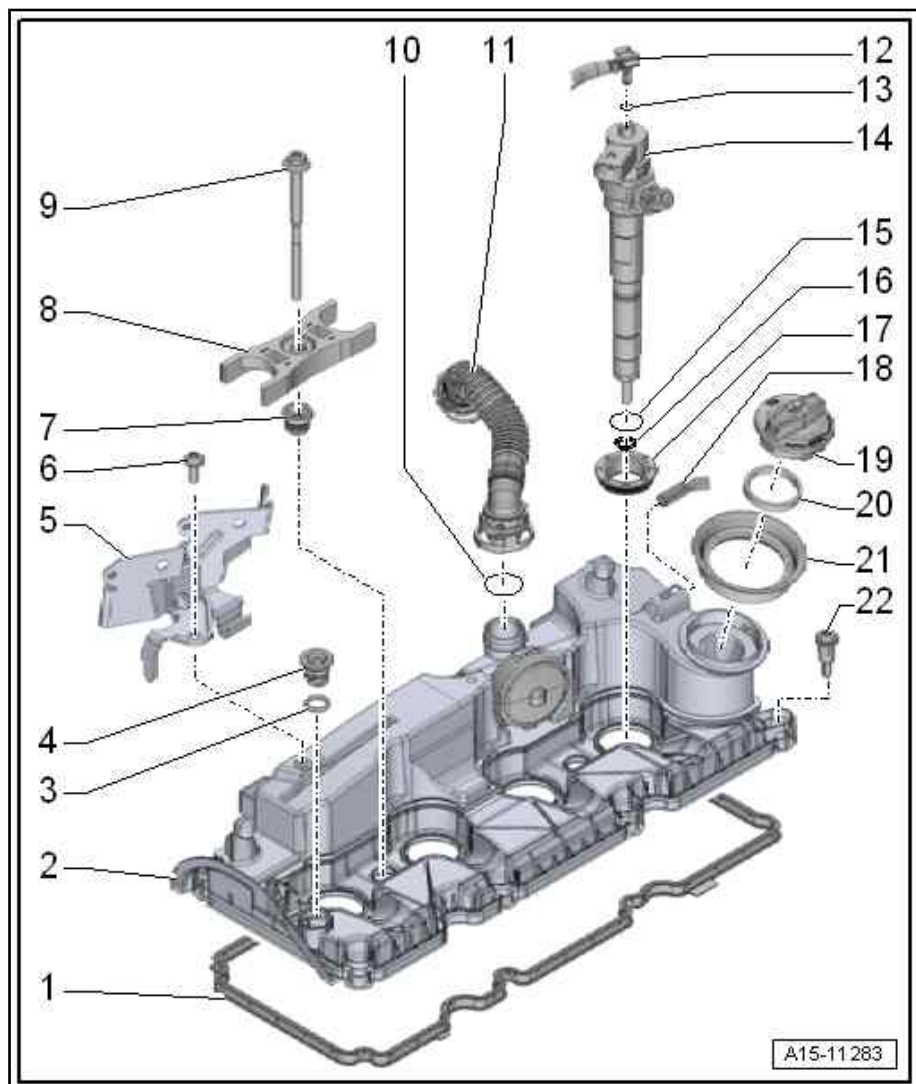
- Tightening torque ⇒ [Item 8 \(page 256\)](#)

10 - O-ring

- Renew after removing

11 - Hose

- For crankcase breather
- Press release tabs to detach





12 - Fuel return line

13 - O-ring

- Renew after removing

14 - Injector

- Observe rules for cleanliness ⇒ [page 5](#)
- Exploded view ⇒ [page 255](#)

15 - O-ring

- Renew after removing

16 - Insulating seal

- Renew after removing

17 - Seal

- For injector
- Renewing ⇒ [page 93](#)

18 - Vacuum hose

19 - Filler cap

20 - Seal

- For filler cap

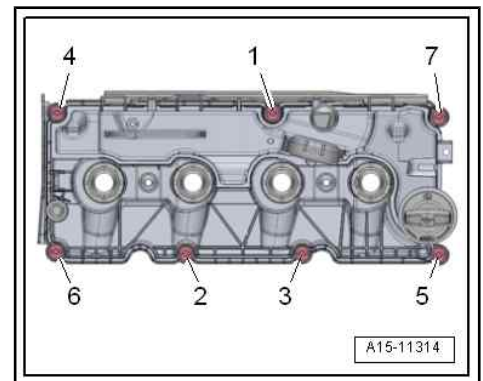
21 - Grommet

22 - Bolt

- Renew if seal is damaged
- Tightening torque and sequence ⇒ [page 89](#)

Cylinder head cover - tightening torque and sequence

- Tighten bolts for cylinder head cover in the sequence -1 ... 7- to 9 Nm.





2.2 Exploded view - cylinder head

1 - Cylinder block

2 - Cylinder head gasket

- Renewing
⇒ [“2.6 Removing and installing cylinder head”](#),
[page 100](#)
- Identification of cylinder head gasket
⇒ [page 91](#)
- If renewed, change coolant and engine oil

3 - Cylinder head

- Removing and installing
⇒ [page 100](#)
- To prevent damage to glow plugs, always place cylinder head on a soft foam surface after removal.
- Checking for distortion
⇒ [page 91](#)
- Must not be machined
- Before installing, check that the two dowel sleeves for centring cylinder head are fitted on cylinder block
- If renewed, change coolant and engine oil

4 - Dowel pin

- For camshaft housing

5 - Bolt

- Renew after removing
- Correct sequence when slackening ⇒ [page 103](#)
- Tightening torque and sequence ⇒ [page 92](#)

6 - Bolt

- 20 Nm

7 - Engine lifting eye

8 - Spacer ring

- Renew if damaged

9 - O-ring

- Renew after removing
- Lubricate with coolant

10 - Coolant temperature sender - G62-

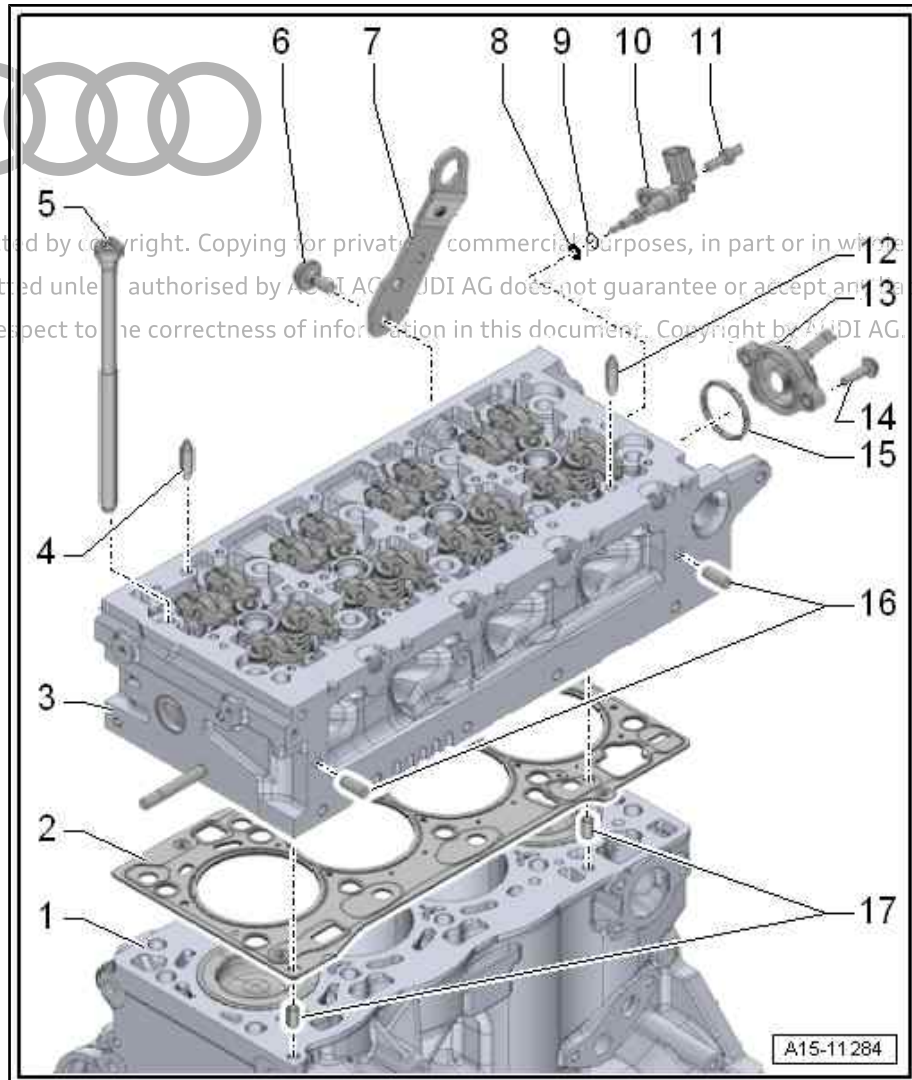
- Removing and installing ⇒ [page 194](#)

11 - Centre hex stud

- Tightening torque ⇒ [Item 4 \(page 187\)](#)

12 - Dowel pin

- For camshaft housing





13 - Connection

- For coolant hoses

14 - Bolt

- 10 Nm

15 - Seal

- Renew after removing

16 - Dowel pin

- For intake manifold with charge air cooler

17 - Dowel sleeves

Checking cylinder head for distortion

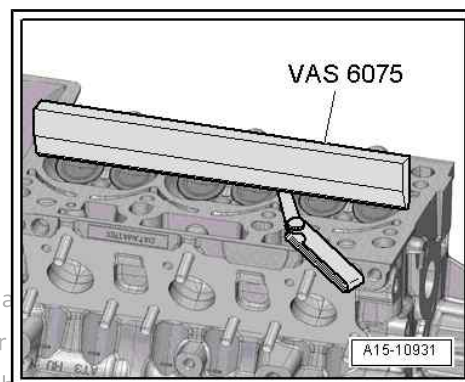
- Use straight edge 500 mm - VAS 6075- and feeler gauge to measure cylinder head for distortion at several points.
- Max. permissible distortion: 0.1 mm.



Note

Cylinder heads must not be reworked on TDI engines.

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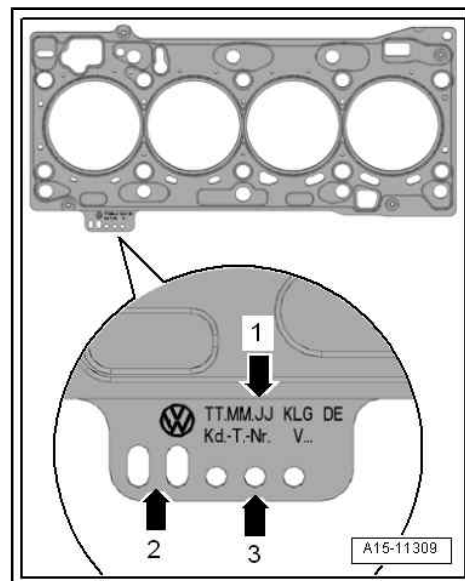
Identification of cylinder head gasket

- 1 - Part number
- 2 - Ignore
- 3 - Holes



Note

Cylinder head gaskets of different thicknesses are fitted depending on the amount of piston projection ⇒ [page 69](#). When renewing only the cylinder head gasket, the new gasket should have the same identification as the old one.





Cylinder head - tightening torque and sequence

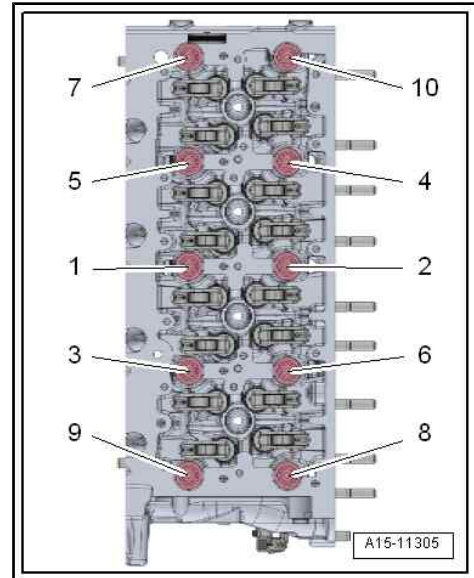


Note

After removing, renew bolts tightened with specified tightening angle.

- Tighten bolts in stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 ... 10-	30 Nm
2.	-1 ... 10-	70 Nm
3.	-1 ... 10-	Turn 90° further
4.	-1 ... 10-	Turn 90° further
5.	-1 ... 10-	Turn 90° further



2.3 Removing and installing cylinder head cover

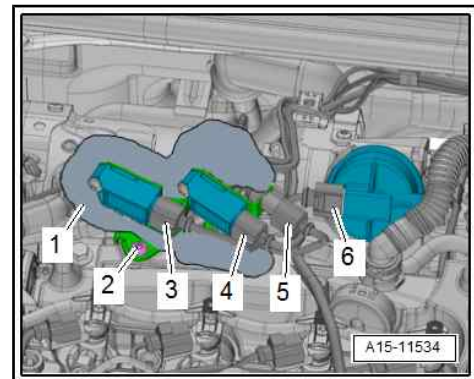
Removing



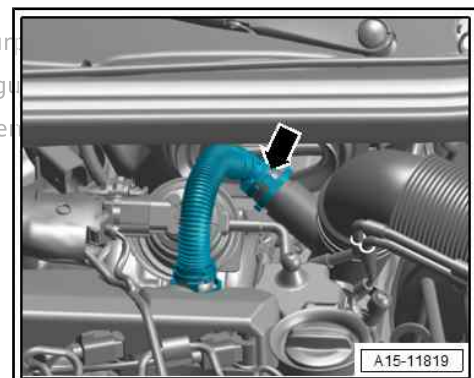
Note

Re-install all heat insulation sleeves in the same locations when installing.

- Remove toothed belt cover (top) ⇒ [page 75](#) .
- Remove injectors ⇒ [page 264](#) .
- Open heat insulation sleeve -1-.
- Unplug electrical connectors -3, 4, 6- and move electrical wiring clear.
- Detach electrical connector -5- for exhaust gas temperature sender 1 - G235- from bracket, unplug connector and move electrical wiring clear.
- Remove bolt -2- and press bracket with differential pressure sensors towards rear.



- Press release tabs on crankcase breather hose -arrow- and disconnect hose from connection.

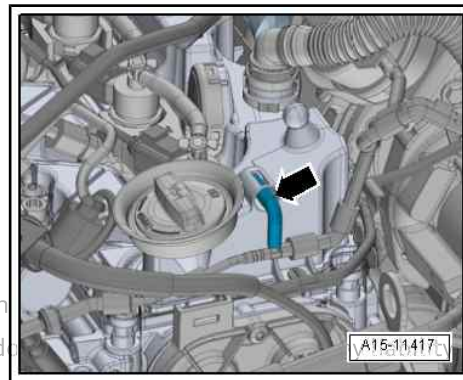




- Disconnect vacuum hose -arrow-.



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- Move electrical wiring harness clear.
- Slacken cylinder head cover bolts in the sequence -7 ... 1- and remove.
- Detach cylinder head cover.

Installing

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



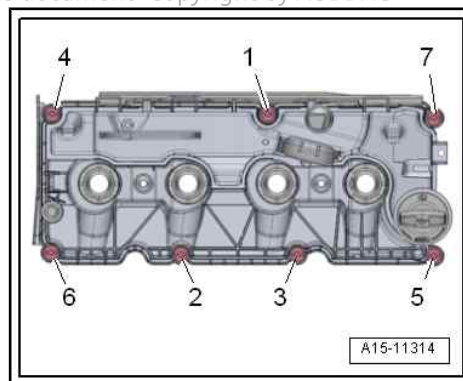
Note

- ◆ Renew O-ring after removal.
- ◆ Renew gasket and bolts for cylinder head cover if damaged or leaking.

- Connect vacuum hose ⇒ [page 243](#) .
- Install injectors ⇒ [page 264](#) .
- Install toothed belt cover (top) ⇒ [page 75](#) .

Tightening torques

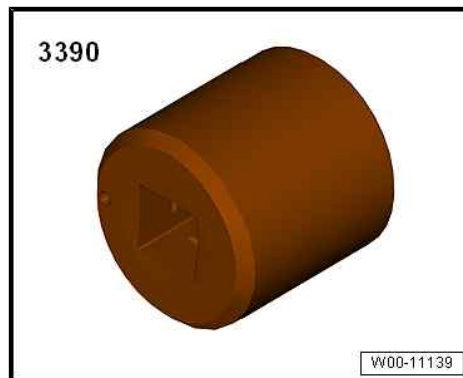
- ◆ ⇒ [Fig. “Cylinder head cover - tightening torque and sequence”](#), [page 89](#)
- ◆ ⇒ [“8.1 Exploded view - Lambda probe”](#), [page 286](#)



2.4 Removing and installing seals for injectors

Special tools and workshop equipment required

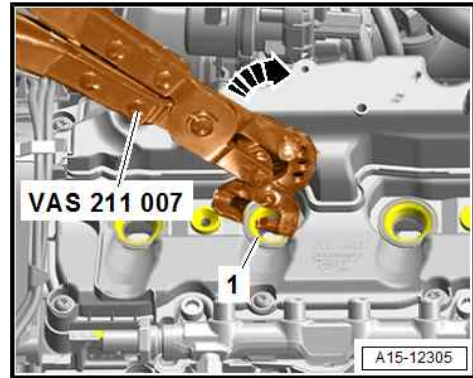
- ◆ Pliers -VAS 211 007- (not illustrated)
- ◆ Carrier - 3390-



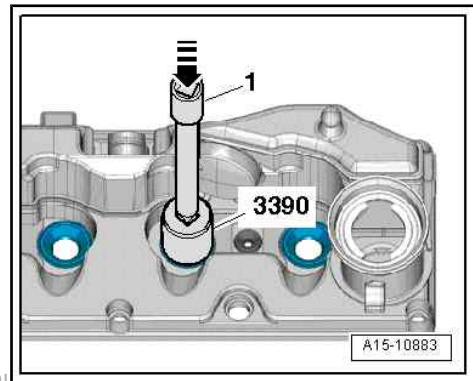


Procedure

- Remove corresponding injector ⇒ [page 264](#) .
- Pull off seal -1- using pliers -VAS 211 007- -arrow-.



- Use suitable thrust piece (e.g. carrier - 3390-) and short extension -1- to press new injector seal in from above -arrow- as far as stop.



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2.5 Removing and installing camshaft housing

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Special tools and workshop equipment required

- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Electronic parts catalogue

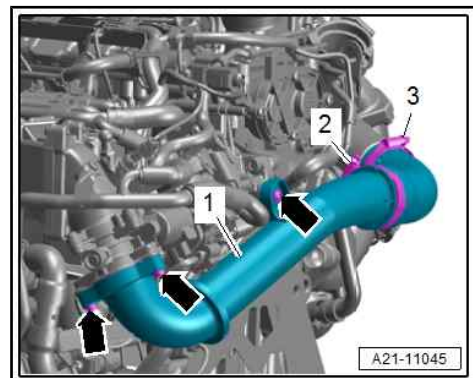
Removing

- Cylinder head installed.
- Remove toothed belt ⇒ [page 77](#) .
- Remove cylinder head cover ⇒ [page 92](#) .
- Remove high-pressure reservoir (rail) ⇒ [page 271](#) .
- Remove Lambda probe after catalytic converter - G130- ⇒ [page 288](#) .
- Remove air cleaner housing ⇒ [page 246](#) .
- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.



Note

Disregard -item 3-.

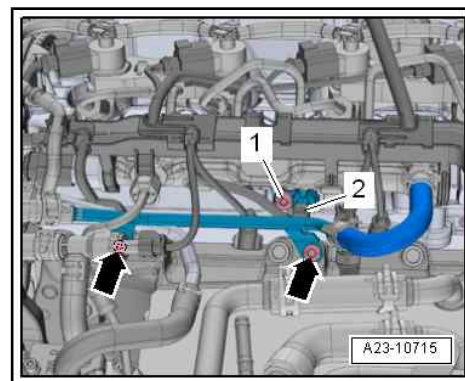




- Remove bolts -arrows- and push fuel lines slightly towards front.
- Unplug electrical connector -2- for Hall sender - G40- .

i Note

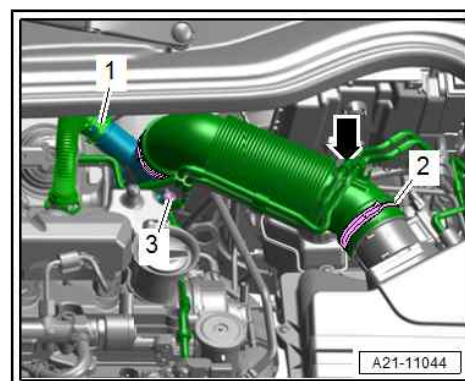
Disregard -item 1-.



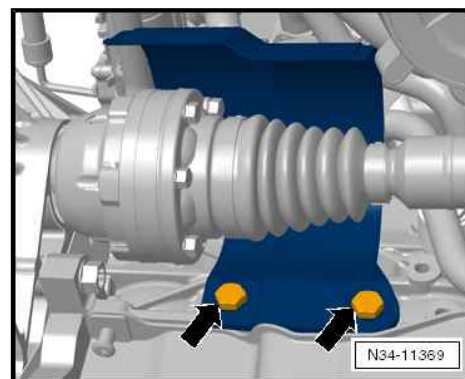
- Move clear vacuum hoses at air pipe -arrows-.
- Unscrew bolt -3-, turn air pipe with connection clockwise and detach it from turbocharger.

i Note

Disregard items -1 and 2-.



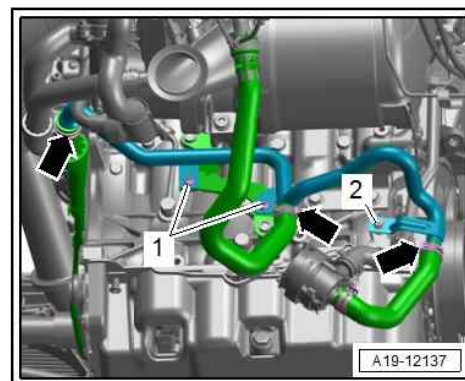
- Remove bolts -arrows- and detach heat shield for drive shaft (right-side).



- Remove bolts -1- and nut -2- and push rear coolant pipe downwards. If necessary, secure coolant pipe to drive shaft with a cable tie.

i Note

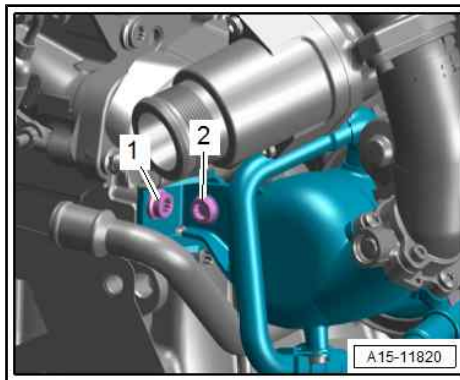
Disregard -arrows-.



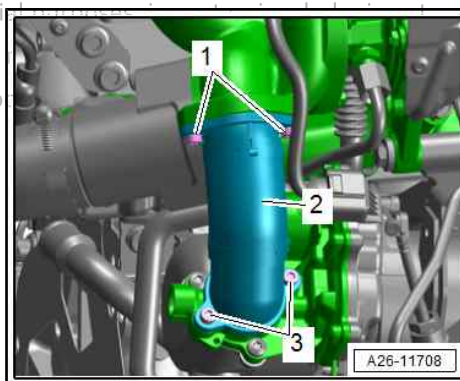
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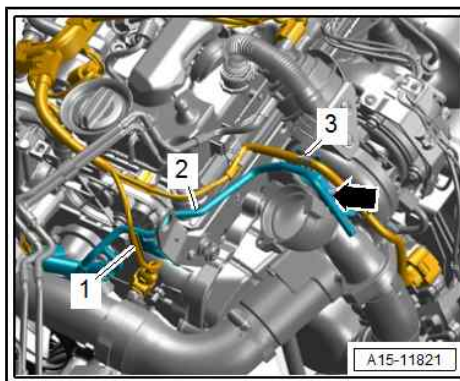
- Remove bolt -1- and loosen bolt -2-.



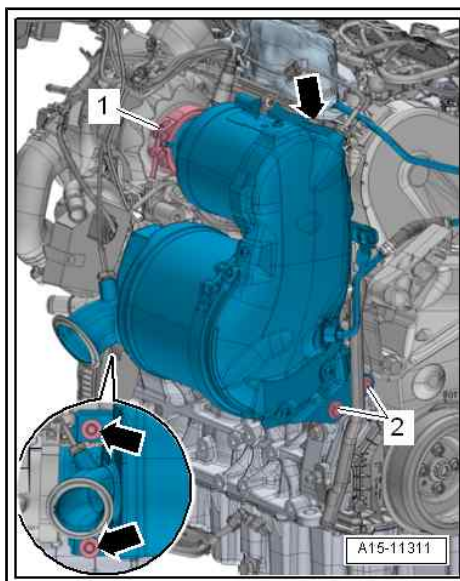
- Unscrew bolts -1, 3- and detach connection -2-.



- Move electrical wiring -1, 3- clear.
- Remove bolts -arrows- and press coolant line -2- to left side.



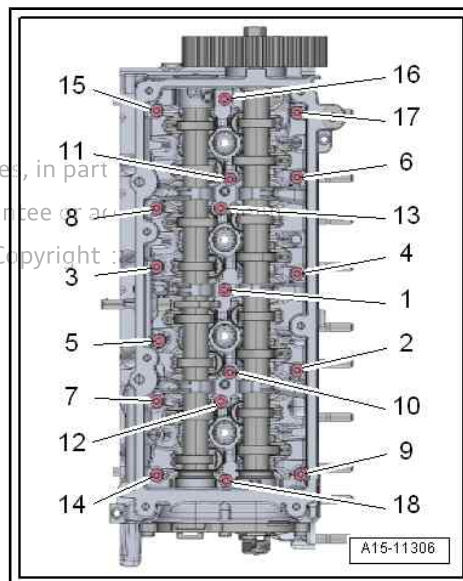
- Open screw-type clip -1- and place it on intake funnel of emission control module.
- Remove bolts -2- and -arrows-.
- Press emission control module slightly towards rear and secure it.





- Slacken camshaft housing bolts in the sequence -18 ... 1-
- Remove bolts and carefully release and detach camshaft housing from bonded joint.

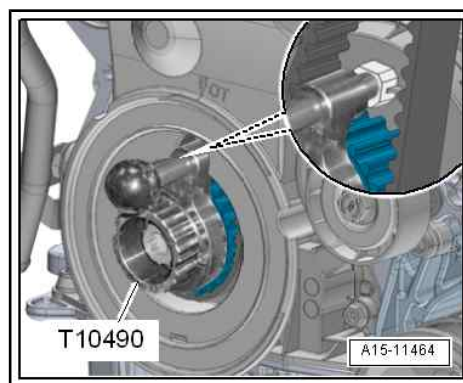
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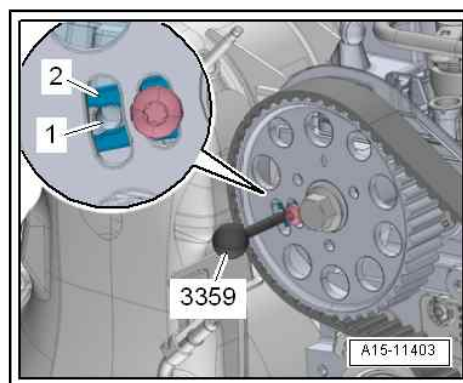
Installing


Requirements:

- Crankshaft is locked in position with crankshaft stop - T10490- .



- Camshaft hub locked with diesel injection pump locking pin - 3359- .
- Bolt fitted but not tightened.






Caution

Protect lubrication system and bearings against contamination.

◆ *Cover exposed parts of the engine.*

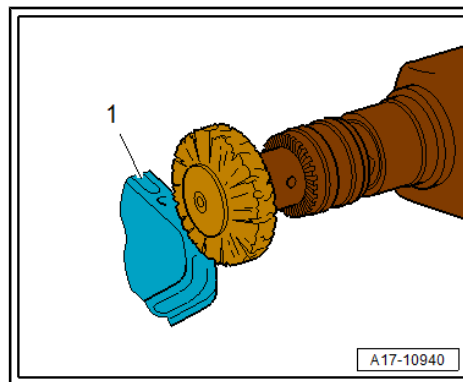


WARNING

Risk of eye injury.

◆ *Put on safety goggles.*

- Remove remaining sealant from cylinder head and camshaft housing -1- using rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.

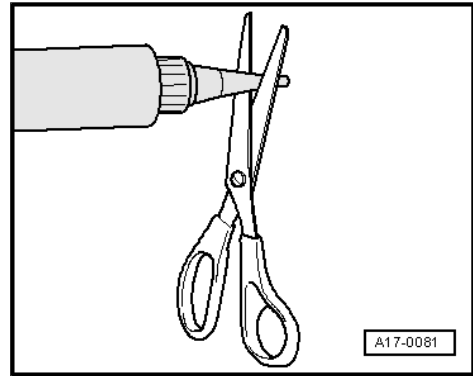




Note

Note expiry date of sealant.

- Cut off nozzle of tube at front marking (nozzle \varnothing approx. 1.5 mm).



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Caution

Make sure excess sealant does not contaminate camshaft bearings.

- ◆ **The sealant beads must not be thicker than specified.**

- Apply sealant bead -arrow- onto clean sealing surfaces of camshaft housing as shown in illustration.
- Width of sealant beads: 2 mm.

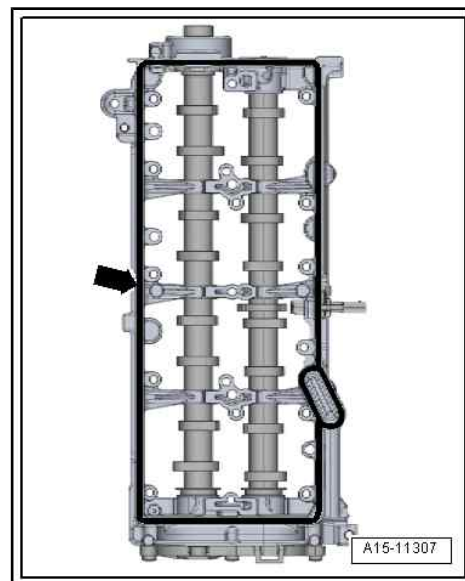


Note

- ◆ *The camshaft housing must be installed within 5 minutes after applying the sealant.*
- ◆ *After installing the camshaft housing, wait about 30 minutes for the sealant to dry.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ Electronic parts catalogue .*
- Carefully fit camshaft housing on cylinder head, paying attention to dowel pins.
- Tighten camshaft housing bolts ⇒ [page 110](#) .

Remaining installation steps are carried out in reverse sequence; note the following:

- Install emission control module ⇒ [page 303](#) .
- Install camshaft oil seal ⇒ [page 110](#) .
- Install heat shield for drive shaft ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing heat shield for drive shaft .
- Install Lambda probe after catalytic converter - G130- ⇒ [page 288](#) .
- Install high-pressure reservoir (rail) ⇒ [page 271](#) .
- Install cylinder head cover ⇒ [page 92](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 81](#) .



Caution

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

- ◆ **The hydraulic tappets have to settle; wait for approx. 30 minutes after installing camshafts before starting engine.**
- ◆ **Turn the crankshaft carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.**

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Tightening torques ss authorised by AUDI AG. AUDI AG does not guarantee or accept any liability

- ◆ ⇒ [Fig. "Camshaft housing - tightening torque and sequence"](#), [page 110](#)
- ◆ ⇒ ["3.1 Exploded view - coolant pipes"](#), [page 196](#)
- ◆ ⇒ ["1.1 Exploded view - turbocharger"](#), [page 214](#)

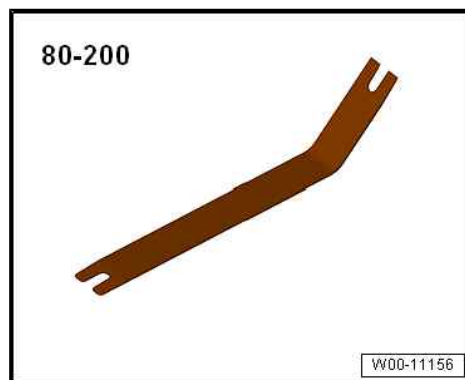


- ◆ ⇒ [“2.1 Exploded view - charge air system”, page 225](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)
- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation system”, page 321](#)

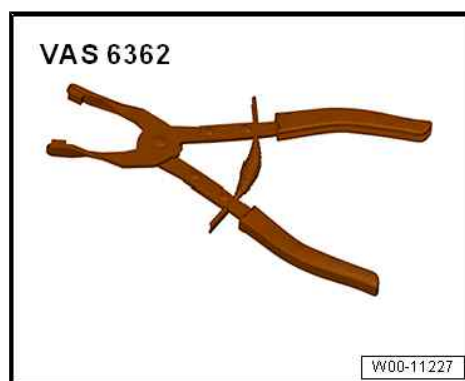
2.6 Removing and installing cylinder head

Special tools and workshop equipment required

- ◆ Removal lever - 80 - 200-



- ◆ Hose clip pliers - VAS 6362-



- ◆ Bit XZN 10 - T10501-



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- ◆ Blade scraper; blade width at least 40 mm (commercially available)

Removing



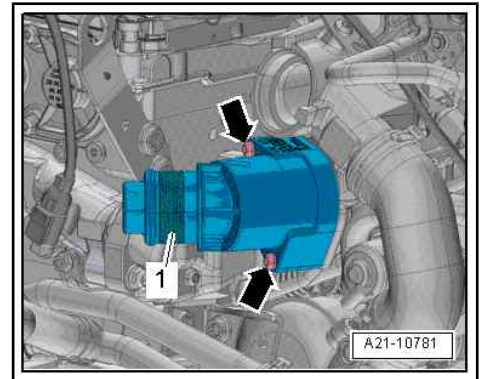
Note

Re-install all heat insulation sleeves in the same locations when installing.

- Remove engine cover panel ⇒ [page 39](#) .



- Remove coolant pipes (top) ⇒ [page 197](#) .
- Remove emission control module ⇒ [page 303](#) .
- Remove camshaft housing ⇒ [page 94](#) .
- Remove bolts -arrows- and detach resonator -1-.

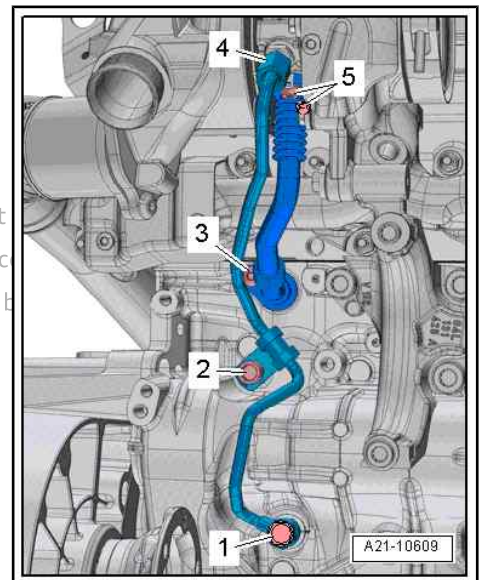


- Unscrew bolt -2- and union nut -4-.
- Remove bolts -3, 5- and detach oil return pipe.

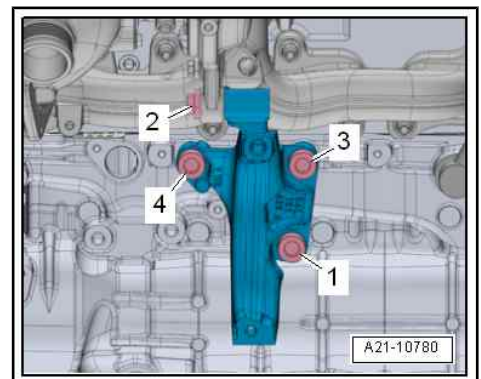


Note

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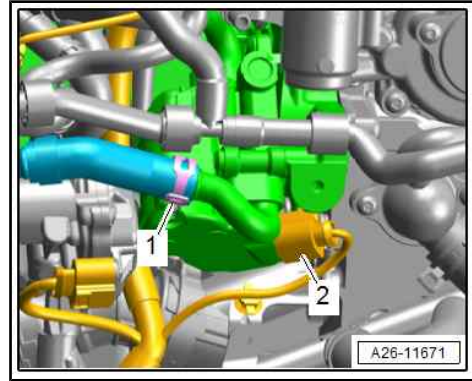


- Remove bolt -2- and loosen bolts -1, 3, 4-.



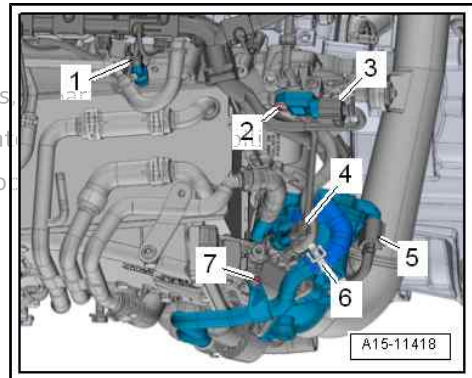


- Unplug electrical connector -2-.
- Release hose clip -1- and disconnect coolant hose.

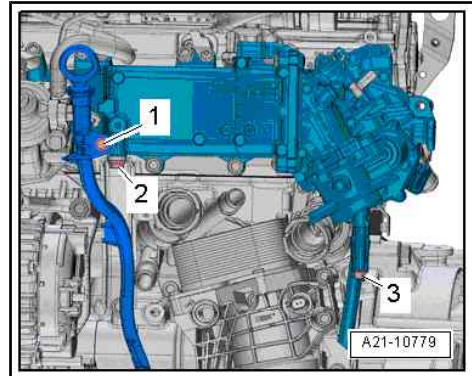


- Unplug electrical connectors and move clear:

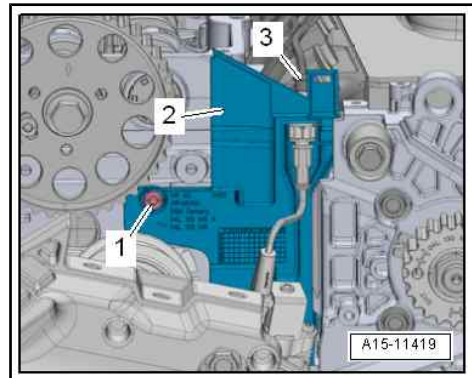
- 1 - For charge air temperature sender after charge air cooler - G811
- 3 - For charge pressure sender - G31
- 4 - For charge air temperature sender before charge air cooler - G810-



- 5 - For throttle valve module - J338-
- Remove bolts -2, 7- and detach coolant hose -6-.
- Place coolant pipe (front left) to side.
- Remove bolt -1- for dipstick guide tube.
- Remove bolts -2, 3- for bracket for intake manifold.

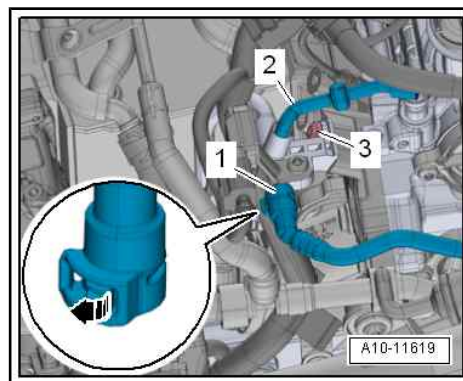
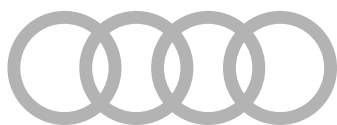


- Unplug electrical connector -3-.
- Remove bolt -1- but leave cover -2- in installation position.

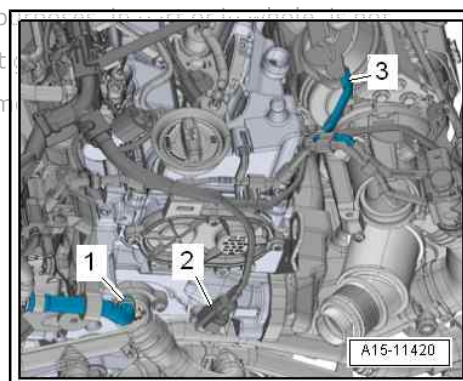




- Release catch -arrow- and disconnect vacuum hose -1-.
- Disconnect vacuum hose -2-.
- Remove bolt -3-.



- Unplug electrical connector -1- for coolant temperature sender - G62- .
- Release hose clip -1- and disconnect coolant hose.
- Disconnect vacuum hose -3-.
- Detach electrical connectors at glow plugs ⇒ [page 332](#) .
- Move electrical wiring harness to one side.



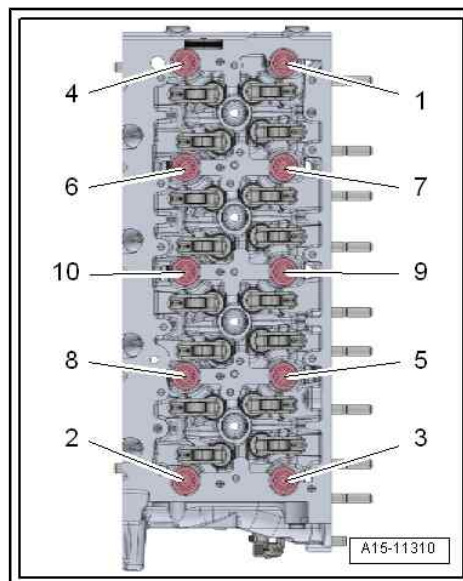
- Slacken cylinder head bolts in the sequence -1 ... 10-.



Note

A second mechanic is required for removal of the cylinder head.

- Swivel cylinder head to left and out of rear toothed belt cover and detach tensioning roller at the same time.
- Take care not to damage oil return line for turbocharger.
- Take care to place cylinder head down without bending oil return line. If necessary, place a block of wood below exhaust manifold.



Caution

Risk of damage to glow plugs when putting down cylinder head.

- ◆ ***After removal, the cylinder head must not be put down on the sealing surface with the glow plugs still installed because the glow plugs project slightly beyond the sealing surface.***

Installing



Note

- ◆ Do NOT use abrasive materials (sandpaper, sanding discs, sanding pads, abrasive web, wire wool, etc.).
- ◆ Sealing surface (see photo) must not be raised.
- ◆ Dark discolouration (see photo) does not have to be removed.
- ◆ When removing sealant residue, make sure none of the residue enters the open channels of the engine.
- ◆ Ensure that nearby workspaces are kept clean and that the abrasive materials listed above are not being used there.
- ◆ Use of non-approved abrasive materials can lead to subsequent damage to the turbocharger, conrod bearings, etc.



- Remove sealant residue from the cylinder head and cylinder block using a commercially available blade scraper.
- Sealing surfaces must NOT be damaged.
- No oil or coolant must be allowed to remain in the blind holes for the bolts.
- Do not remove new cylinder head gasket from packaging until it is ready to be fitted.
- If a new cylinder head is installed, the contact surfaces between the roller rocker fingers and the running surface of the cam must be lubricated.
- Handle the cylinder head gasket very carefully to prevent damage to the silicone coating or the indented area of the gasket.
- Turn the crankshaft carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.
- After fitting a new cylinder head or cylinder head gasket, change the engine oil and the coolant in the entire cooling system.
- Remove loose residue with a lint-free cloth.
- Before fitting cylinder head, remove crankshaft stop - T10490- and turn crankshaft against normal direction of rotation until all pistons are positioned approximately equally below "TDC".
- If not already fitted, install dowel sleeves for centring cylinder block and cylinder head in cylinder block.



– Note cylinder head gasket identification:

- 1 - Part number
- 2 - Ignore
- 3 - Holes

i Note

- ◆ If the cylinder head gasket or cylinder head have been replaced, select the new cylinder head gasket according to the number of holes on the old gasket.
- ◆ If parts of the crankshaft drive have been renewed, the new cylinder head gasket must be selected by measuring the piston projection at "TDC" => [page 69](#) .



– Fit cylinder head gasket onto dowel sleeves -arrows- in cylinder block.

Installation position of cylinder head gasket: the word "oben" (top) or the part number should face towards the cylinder head.

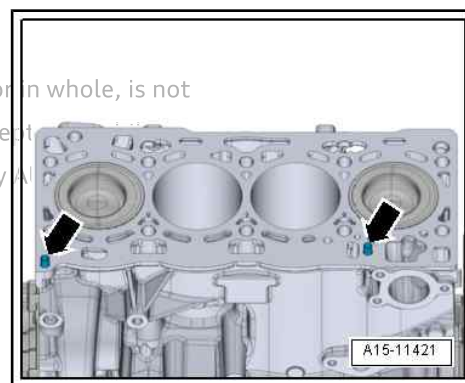
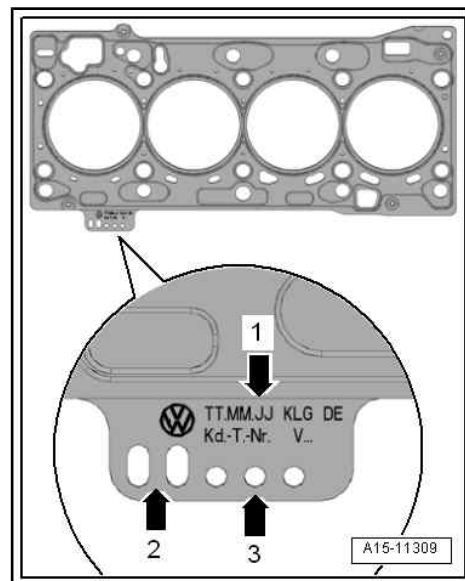
i Note

A second mechanic is required for fitting cylinder head.

- Fit cylinder head.
- Renew and tighten cylinder head bolts => [page 92](#) .

i Note

Cylinder head bolts do not have to be torqued down again later after repair work.



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- Then turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop - T10490- engages in sealing flange as crankshaft rotates.
- Install toothed belt (adjust valve timing) ⇒ [page 81](#) .

Remaining installation steps are carried out in reverse sequence; note the following:

- Install camshaft housing
⇒ [“2.5 Removing and installing camshaft housing”, page 94](#) .
- Install emission control module
⇒ [“2.2 Removing and installing emission control module”, page 303](#) .
- Install coolant pipes (top)
⇒ [“3.2.1 Removing and installing coolant pipes \(top\)”, page 197](#) .
- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install engine cover panel ⇒ [page 39](#) .
- Change engine oil ⇒ Maintenance ; Booklet 819 .
- Fill cooling system with fresh coolant
⇒ [“1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2”, page 145](#) .

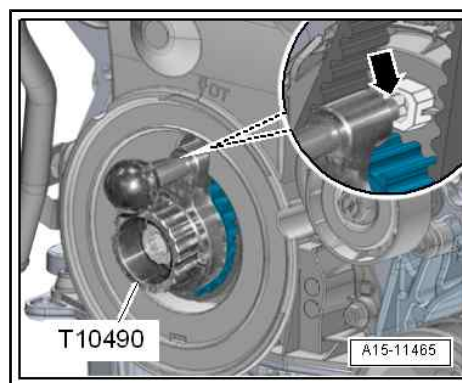
Tightening torques

- ◆ ⇒ [“2.2 Exploded view - cylinder head”, page 90](#)
- ◆ ⇒ [“1.1 Exploded view - toothed belt cover”, page 73](#)
- ◆ ⇒ [“1.1 Exploded view - turbocharger”, page 214](#)
- ◆ ⇒ [“4.1 Exploded view - intake manifold”, page 247](#)
- ◆ ⇒ [Fig. ““Bracket for emission control module - tightening torque and tightening sequence””, page 216](#)
- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation system”, page 321](#)

2.7 Checking compression

Special tools and workshop equipment required

- ◆ Compression tester - V.A.G 1763- with adapter - V.A.G 1763/8-



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Procedure

- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V
- Remove engine cover panel ⇒ [page 39](#) .
- Unplug electrical connector on fuel pressure regulating valve - N276- -item 2-.

Note

Disregard -item 1-.

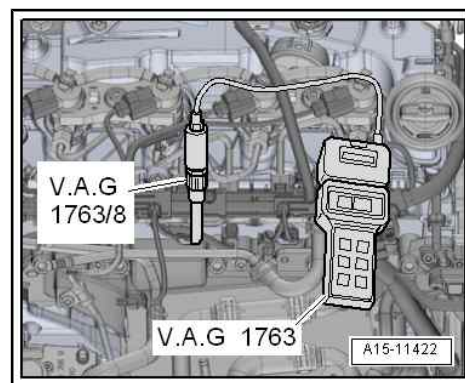
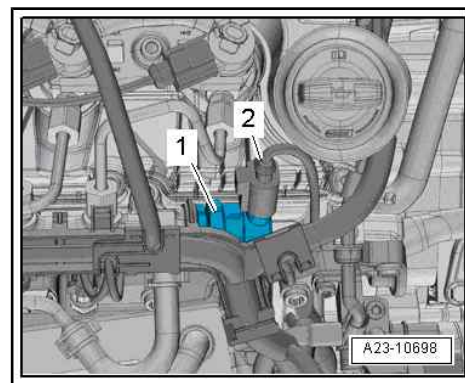
- Briefly start engine to relieve fuel pressure in high-pressure reservoir.
- Remove all glow plugs ⇒ [page 332](#) .
- Screw in adapter - V.A.G 1763/8- in place of corresponding glow plug and connect compression tester - V.A.G 1763- .

Note

Using the compression tester ⇒ Operating instructions .

- Have a second mechanic operate starter until tester shows no further pressure increase.
- Repeat procedure on each cylinder.

Compression pressure	bar
When new	25.0 ... 31.0
Wear limit	19.0
Maximum difference between cylinders	5.0



Attaching

Assembly is performed in reverse sequence; note the following:

- Install engine cover panel ⇒ [page 39](#) .
- Erase any entries in event memory resulting from testing ⇒ Vehicle diagnostic tester, Guided Functions, then 01 - Interrogate/erase event memory.

Tightening torques

- ◆ ⇒ [“1.1 Exploded view - glow plug system”, page 331](#)




3 Valve gear

⇒ "3.1 Exploded view - valve gear", page 108

⇒ "3.2 Removing and installing camshaft oil seal", page 110

⇒ "3.3 Removing and installing valve stem oil seals", page 112

3.1 Exploded view - valve gear

 **Caution**

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

- ◆ *The hydraulic tappets have to settle; wait for approx. 30 minutes after installing camshafts before starting engine.*
- ◆ *Turn the crankshaft carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

1 - Valve

- Must not be machined; only grinding-in is permissible
- Mark installation position for re-installation
- Checking ⇒ [page 121](#)
- Valve dimensions ⇒ [page 121](#)
- Checking valve guides ⇒ [page 120](#)

2 - Cylinder head

- Valve seats may not be machined due to the very small tolerances

3 - Dowel pin

- For camshaft housing

4 - Valve stem oil seal

- Renewing ⇒ [page 112](#)

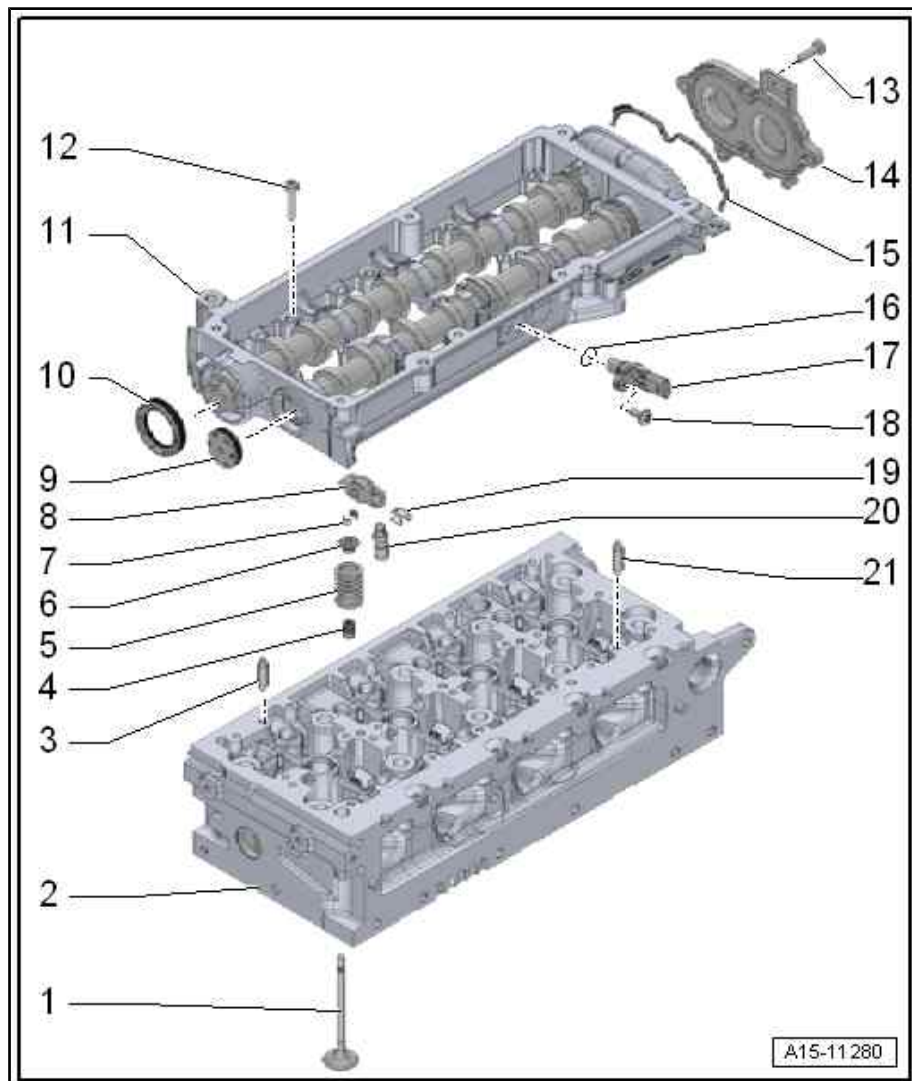
5 - Valve spring

6 - Valve spring plate

7 - Valve cotters

8 - Roller rocker finger

- Removing and installing ⇒ "2.5 Removing and installing camshaft housing", page 94
- Mark installation position for re-installation
- Check roller bearings for ease of movement
- Lubricate contact surfaces before installing



A15-11 280



9 - Sealing cap

- Renew after removing
- Removing: With camshaft housing installed, pierce one side of sealing cap with an awl and pry out
- Installing: Drive in without sealant until flush using suitable thrust piece, e.g. carrier - 3390-

10 - Camshaft oil seal

- Renewing ⇒ [page 110](#)

11 - Camshaft housing

- With integrated camshafts
- Removing and installing ⇒ [page 94](#)

12 - Bolt

- Renew after removing
- Correct sequence when slackening ⇒ [page 110](#)
- Tightening torque and sequence ⇒ [page 110](#)

13 - Bolt

- 8 Nm

14 - Cover

15 - Gasket

- Renew after removing

16 - O-ring

- Renew after removing

17 - Hall sender - G40-

- Exploded view ⇒ [page 331](#)

18 - Bolt

- Tightening torque ⇒ [Item 2 \(page 331\)](#)

19 - Securing clip

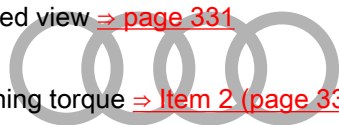
- For hydraulic compensation element

20 - Hydraulic compensation element

- Mark installation position for re-installation
- Lubricate contact surfaces before installing

21 - Dowel pin

- For camshaft housing



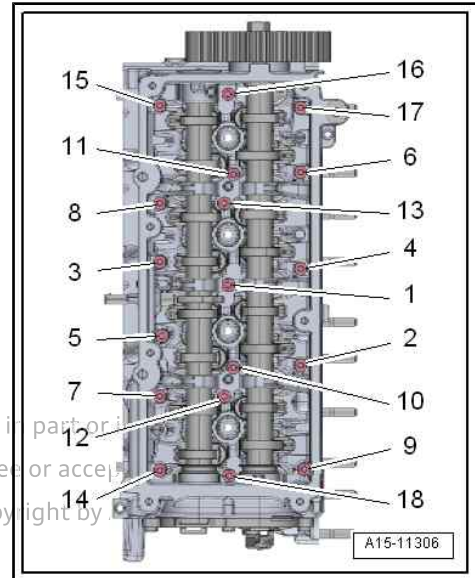
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Slacken camshaft housing bolts in the sequence -18 ... 1-



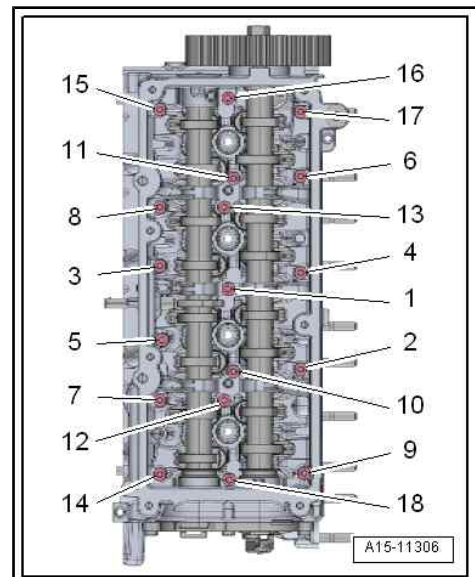
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Camshaft housing - tightening torque and sequence

– Tighten bolts in stages in the sequence shown:

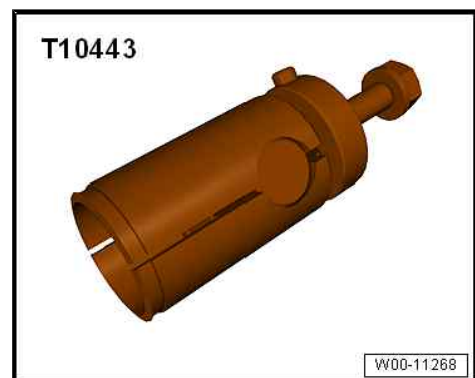
Stage	Bolts	Tightening torque
1.	-1 ... 18-	Screw in by hand until contact is made <ul style="list-style-type: none"> The camshaft housing should make contact with the cylinder head over the full surface.
2.	-1 ... 18-	10 Nm



3.2 Removing and installing camshaft oil seal

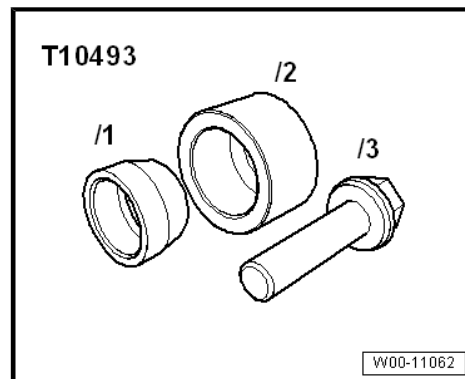
Special tools and workshop equipment required

- ◆ Puller - T10443-





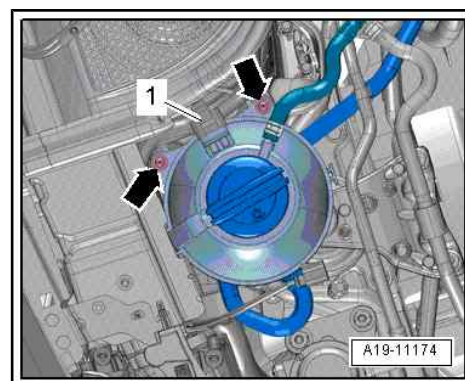
◆ Assembly tool - T10493-



Procedure

- Disconnect refrigerant lines from expansion valve, move clear and press to right side => Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Detaching and attaching refrigerant lines at service connections .
- Remove toothed belt => [page 77](#) .

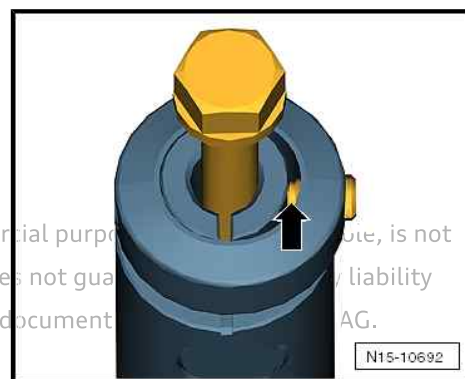
Note:



If the grub screw is unscrewed too far, the thrust plate inside the puller - T10443- will come loose from the thrust bolt. If this happens, the thrust plate must be pushed back onto the thrust bolt.

- Carefully unscrew grub screw -arrow- of puller -T10443- until slight resistance is felt.

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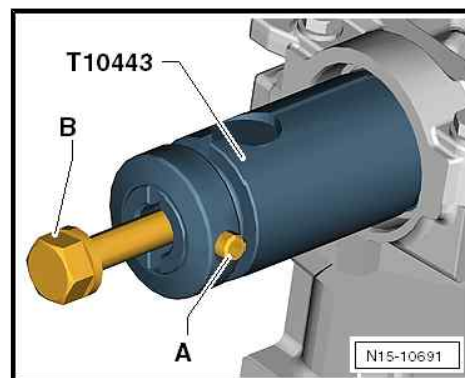


- Apply puller - T10443- in a straight line, as shown in illustration, and lock by screwing in grub screw.-A-.
- Screw in thrust bolt -B- until oil seal is pulled out.
- Completely remove any oil residue on running and sealing surfaces using degreasing agent.
- Clean entire outer circumference of sealing lip of new oil seal using degreasing agent (remove wax layer).

Note:

Use silicone adhesive sealant D 176 501 A1 to seal off oil seal.

- Press silicone adhesive sealant evenly onto sealing lip of oil seal.
- Sealant bead must be applied to entire circumference; ends of bead must meet and seal off completely.



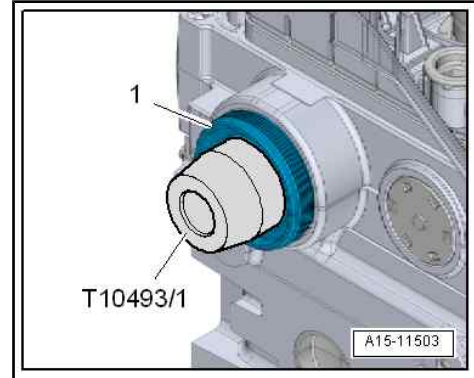


- Apply guide sleeve -T10493/1- to camshaft as shown in illustration.
- Carefully push oil seal -1- over guide sleeve and onto camshaft.

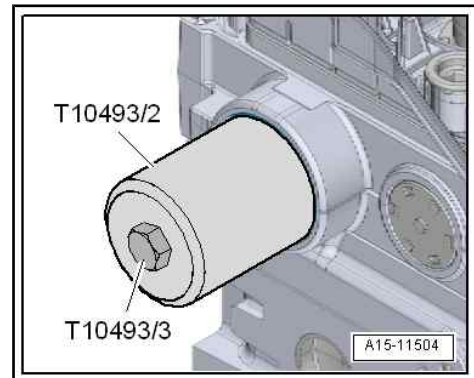


Note

When pressing in oil seal, guide sleeve remains on camshaft as a stop.



- Press oil seal in onto stop using press tool -T10493/2- and bolt -T10493/3- .
- Install toothed belt (adjust valve timing) ⇒ [page 81](#) .
- Install refrigerant lines ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Detaching and attaching refrigerant lines at service connections .



3.3 Removing and installing valve stem oil seals

⇒ [“3.3.1 Removing and installing valve stem oil seals \(cylinder head installed\)”, page 112](#)

⇒ [“3.3.2 Removing and installing valve stem oil seals \(cylinder head removed\)”, page 116](#)

3.3.1 Removing and installing valve stem oil seals (cylinder head installed)

Special tools and workshop equipment required

- ◆ Valve stem seal puller - 3364-

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- ◆ Valve stem oil seal fitting tool - 3365-



- ◆ Removal and installation device for valve cotters - VAS 5161 A-



- ◆ Sealing pin -VAS 5161/29-1-
- ◆ Guide plate -VAS 5161 A/31-
- ◆ Sleeve -VAS 5161 A/31-1-
- ◆ Assembly sleeve ⇒ Electronic parts catalogue

Procedure

- Remove all glow plugs ⇒ [page 332](#) .
- Remove camshaft housing ⇒ [page 94](#) .
- Mark original positions of roller rocker fingers and hydraulic compensation elements for re-installation.
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Set piston of appropriate cylinder to “bottom dead centre”.

Cylinders 1, 3, 4:

- Fit guide plate -VAS 5161 A/31- onto cylinder head.
- The lettering -A- faces towards turbocharger side
- The lettering -E- faces towards intake manifold side
- Secure guide plate with knurled screws -VAS 5161/12- by hand.
- Position of knurled screws, as shown in illustration

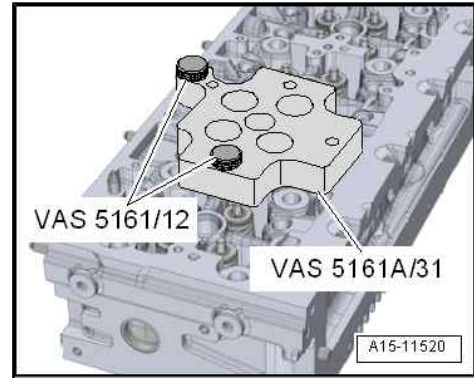


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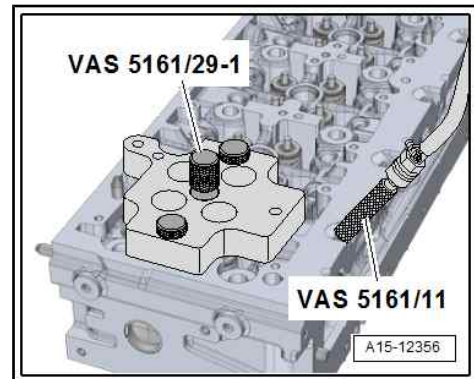
Cylinder 2:

- Fit guide plate -VAS 5161 A/31- onto cylinder head.
- The lettering -A- faces towards turbocharger side
- The lettering -E- faces towards intake manifold side
- Secure guide plate with knurled screws -VAS 5161/12- by hand.
- Position of knurled screws, as shown in illustration

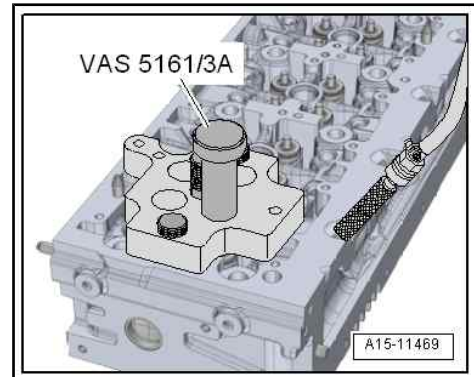


Continued for all cylinders:

- Screw sealing pin -VAS 5161/29-1- into guide plate.
- Screw adapter -VAS 5161/11- hand-tight into corresponding glow plug thread.



- Insert drift -VAS 5161/3A- into guide plate and use plastic-headed hammer to release sticking valve cotters.



- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.

- Insert assembly cartridge -VAS 5161/8A- (slide on sleeve -VAS 5161 A/31-1-) in guide plate.

- Connect adapter to compressed air line using a commercially available connection piece and apply constant air pressure

- Minimum pressure: 6 bar

- Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.

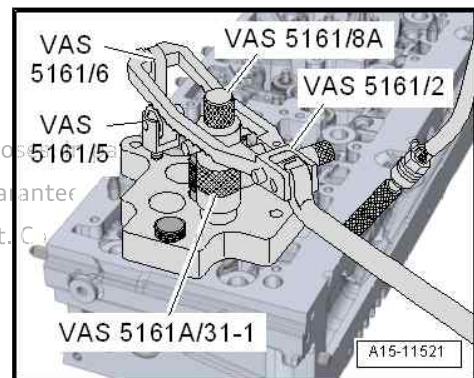
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.

- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.

- Release pressure fork.

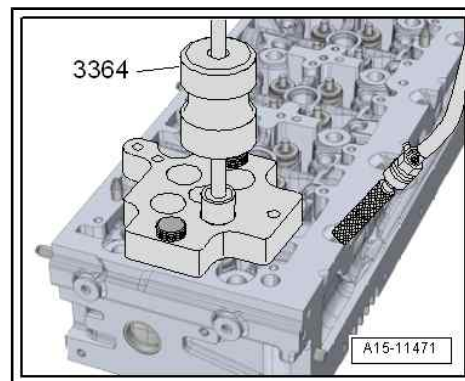
- Take off assembly cartridge with sleeve.


- Detach valve spring with valve spring plate.



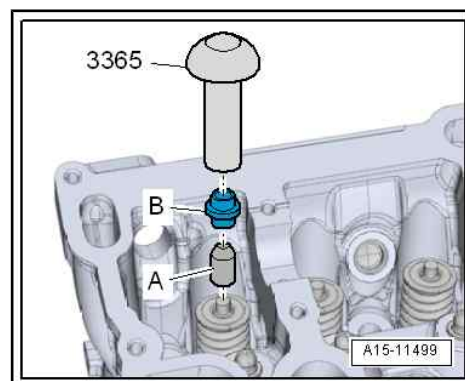


- Pull off valve stem oil seal with valve stem seal puller - 3364- .



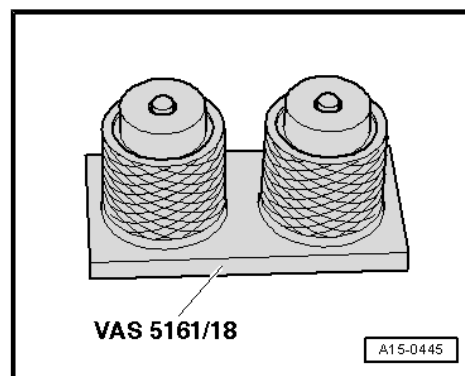
 **Caution**
Make sure valve stem oil seals are not damaged when installing.
◆ *New valve stem oil seals -B- are supplied with plastic sleeve; fit plastic sleeve -A- onto valve stem.*

- Lightly oil sealing lip of valve stem oil seal.
- Slide valve stem oil seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
- Take off plastic sleeve.



If valve cotters have been removed from assembly cartridge, they must first be inserted in insertion device -VAS 5161/18- .

- Larger diameter of valve cotters faces upwards.
- Insert valve spring and valve spring plate.
- Press assembly cartridge onto insertion device from above and take up valve cotters.



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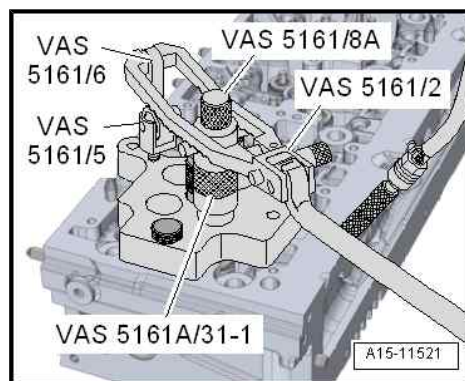


- Insert assembly cartridge in guide plate -VAS 5161 A/31- again.
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Attaching

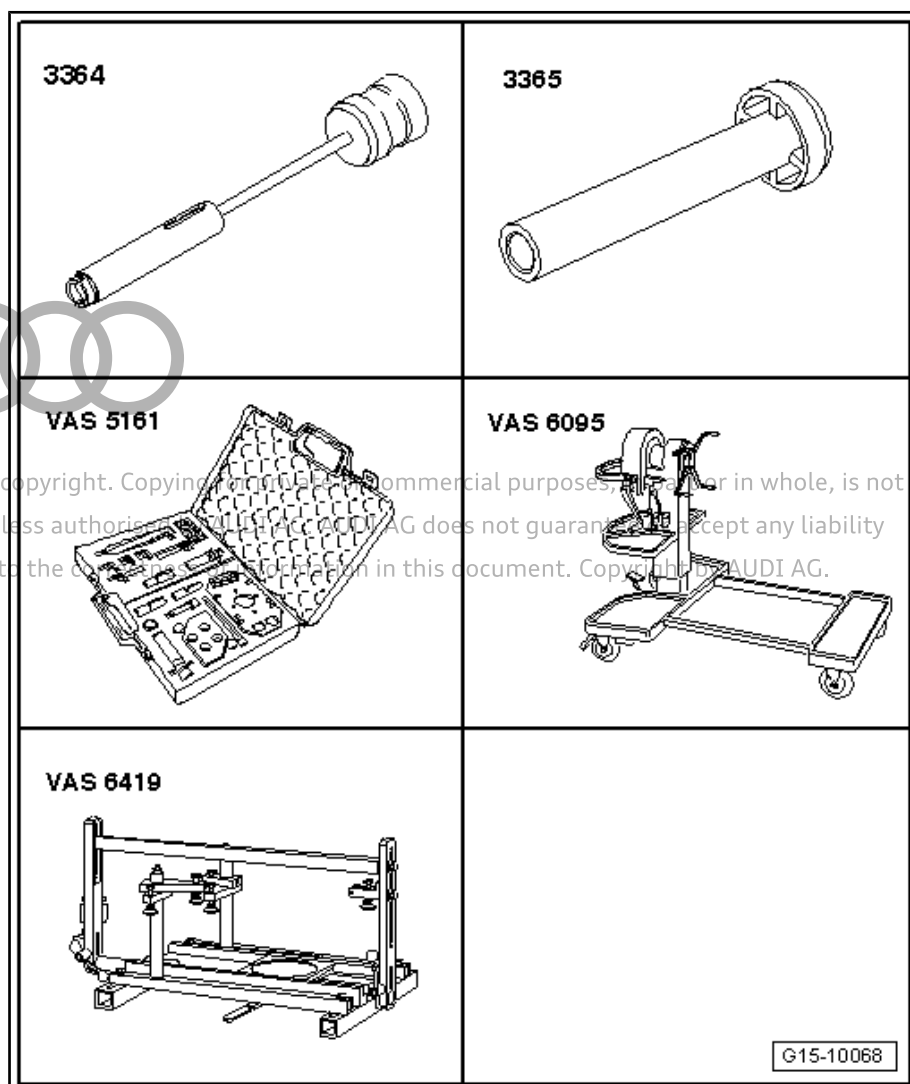
Assembly is performed in reverse sequence; note the following:

- Ensure that all roller rocker fingers make contact with the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
- Install camshaft housing ⇒ [page 94](#) .
- Install glow plugs ⇒ [page 331](#) .



3.3.2 Removing and installing valve stem oil seals (cylinder head removed)

Special tools and workshop equipment required



- ◆ Valve stem seal puller - 3364-



- ◆ Valve stem oil seal fitting tool - 3365-
- ◆ Removal and installation device for valve cotters - VAS 5161 A- with guide plate -VAS 5161 A/31- and sleeve -VAS 5161 A/31-1- .
- ◆ Engine and gearbox support - VAS 6095-
- ◆ Cylinder head tensoning device - VAS 6419-

Procedure

Important:

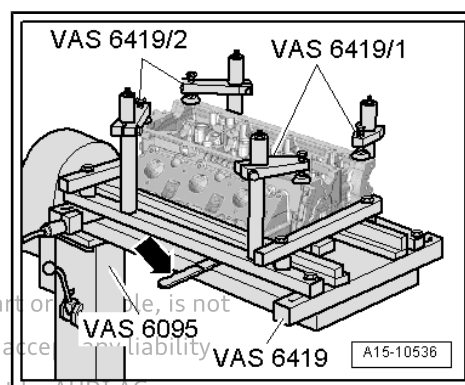
- Intake manifold removed ⇒ [page 247](#)
- Exhaust manifold/turbocharger removed ⇒ [page 214](#)
- Remove camshaft housing ⇒ [page 94](#) .
- Mark original positions of roller rocker fingers and hydraulic compensation elements for re-installation.
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Remove cylinder head ⇒ [page 100](#) .



Note

Intake manifold and exhaust manifold/turbocharger must be detached from cylinder head after it has been removed
 ⇒ [“4.1 Exploded view - intake manifold”, page 247](#) , and
 ⇒ [“1.1 Exploded view - turbocharger”, page 214](#) .

- Insert cylinder head tensoning device - VAS 6419- into engine and gearbox support - VAS 6095- .
- Secure cylinder head in cylinder head tensoning device, as shown in illustration.
- Connect cylinder head tensoning device to compressed air supply.
- Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.
- Apply just enough compressed air to bring air pad into contact with valve heads.



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Cylinders 1, 3, 4:

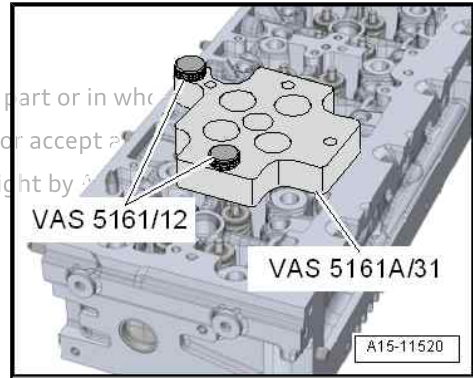
- Fit guide plate -VAS 5161 A/31- onto cylinder head.
- The lettering -A- faces towards exhaust side
- The lettering -E- faces towards intake side
- Secure guide plate with knurled screws -VAS 5161/12- by hand.
- Position of knurled screws, as shown in illustration





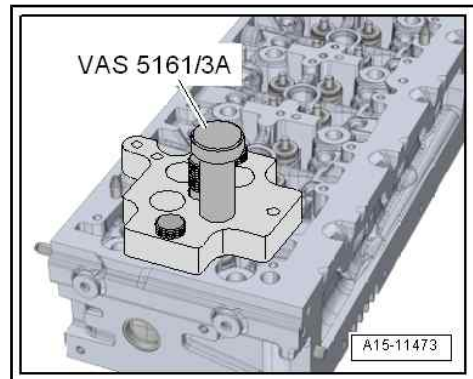
Cylinder 2:

- Fit guide plate -VAS 5161 A/31- onto cylinder head.
- The lettering -A- faces towards exhaust side
- The lettering -E- faces towards intake side
- Secure guide plate with knurled screws -VAS 5161/12- by hand.
- Position of knurled screws, as shown in illustration

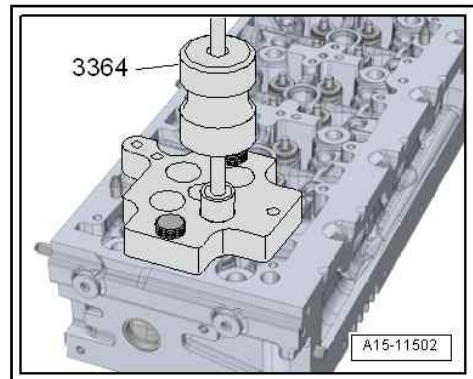
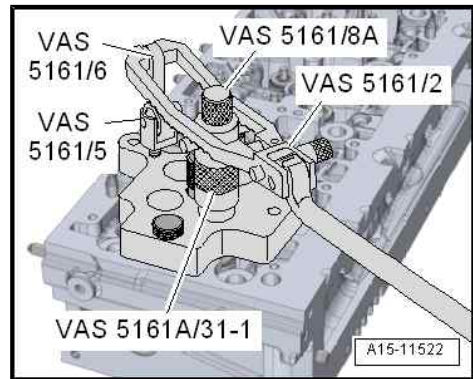


Continued for all cylinders:

- Insert drift -VAS 5161/3A- into guide plate and use plastic-headed hammer to release sticking valve cotters.



- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
- Insert assembly cartridge -VAS 5161/8A- (slide on sleeve -VAS 5161 A/31-1-) in guide plate.
- Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
- Release pressure fork.
- Take off assembly cartridge with sleeve.
- Detach valve spring with valve spring plate.
- Pull off valve stem oil seal with valve stem seal puller - 3364- .





Caution

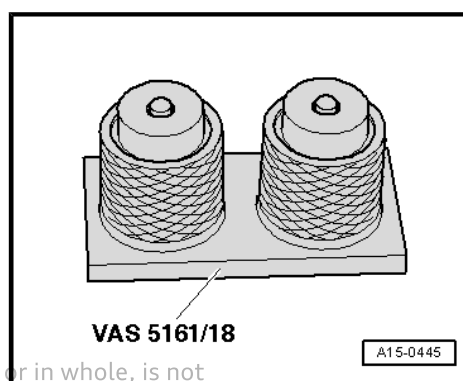
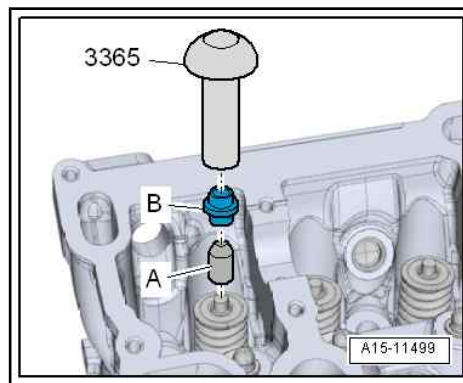
Make sure valve stem oil seals are not damaged when installing.

◆ *New valve stem oil seals -B- are supplied with plastic sleeve; fit plastic sleeve -A- onto valve stem.*

- Lightly oil sealing lip of valve stem oil seal.
- Slide valve stem oil seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
- Take off plastic sleeve.

If valve cotters have been removed from assembly cartridge, they must first be inserted in insertion device -VAS 5161/18- .

- Larger diameter of valve cotters faces upwards.
- Press assembly cartridge onto insertion device from above and take up valve cotters.
- Insert valve spring and valve spring plate.



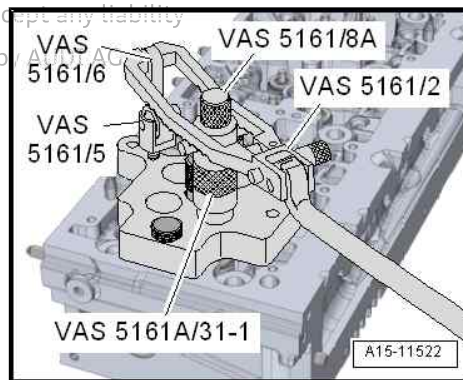
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- Insert assembly cartridge in guide plate -VAS 5161A/31- again.
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Attaching

Assembly is performed in reverse sequence; note the following:

- Ensure that all roller rocker fingers make contact with the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
- Install camshaft housing ⇒ [page 94](#) .





4 Inlet and exhaust valves

⇒ [“4.1 Checking valve guides”, page 120](#)

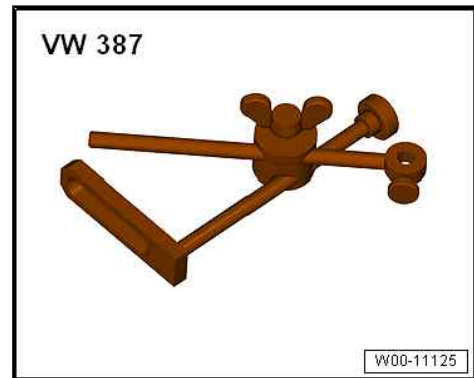
⇒ [“4.2 Checking valves”, page 121](#)

⇒ [“4.3 Valve dimensions”, page 121](#)

4.1 Checking valve guides

Special tools and workshop equipment required

◆ Universal dial gauge bracket - VW 387-



◆ Dial gauge - VAS 6079-



Procedure

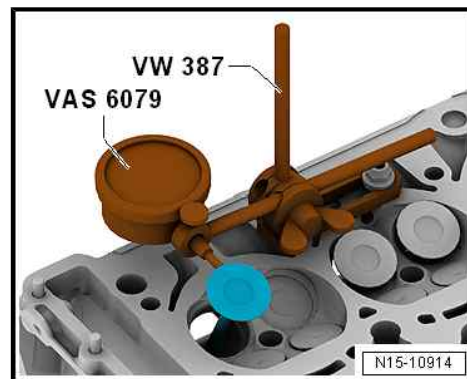


Note

- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*
- ◆ *Only insert inlet valve into inlet valve guide and exhaust valve into exhaust valve guide, as the stem diameters are different.*



- Attach dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to cylinder head.
- Insert valve into guide.
- End of valve stem must be flush with guide.
- Measure the amount of sideways play.
- Wear limit: 1.0 mm.
- If the wear limit is exceeded, repeat the measurement with new valves.
- Renew cylinder head if wear limit is still exceeded.



i Note

Valve guides cannot be renewed.

4.2 Checking valves

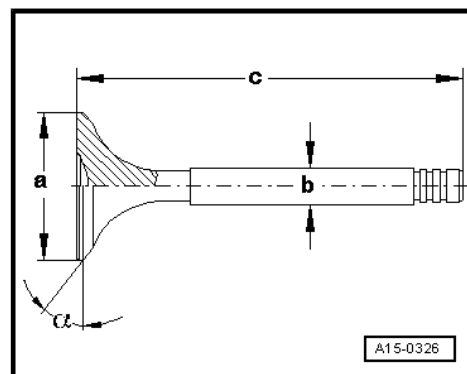
- Visually inspect for scoring on valve stems and valve seat surfaces.
- Renew valve if scoring is clearly visible.

4.3 Valve dimensions

i Note

Inlet and exhaust valves must not be machined. Only grinding-in is permitted.

Dimension		Inlet valve	Exhaust valve
∅ a	mm	28.10	26.00
∅ b	mm	5.975	5.965
c	mm	99.30	99.10
α	∠°	45	45



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17 – Lubrication

1 Sump/oil pump

⇒ [“1.1 Exploded view - sump/oil pump”, page 122](#)

⇒ [“1.2 Engine oil”, page 124](#)

⇒ [“1.3 Removing and installing sump”, page 124](#)

⇒ [“1.4 Removing and installing oil pump”, page 129](#)

⇒ [“1.5 Removing and installing oil level and oil temperature sender G266”, page 129](#)

1.1 Exploded view - sump/oil pump



Note

- ◆ *If large quantities of metal shavings or abrasion are found when performing engine repairs, this may be an indication of damage to the crankshaft or conrod bearings. To prevent further damage, the following steps are required after completion of repair work: clean the oil passages carefully and renew the oil spray jets, oil filter housing with engine oil cooler and oil filter.*
- ◆ *Oil spray jet and pressure relief valve ⇒ [page 67](#)*



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1 - Bolt

- Self-locking
- Renew after removing
- 8 Nm

2 - Oil level and oil temperature sender - G266-

- Removing and installing ⇒ [page 129](#)

3 - Seal

- Renew after removing

4 - Oil drain plug

- 30 Nm

5 - Seal

- Renew after removing

6 - Bolt

- Tightening torque and sequence ⇒ [page 124](#)

7 - Sump

- Removing and installing ⇒ [page 124](#)

8 - O-ring

- Renew after removing

9 - Bolt

- Renew after removing
- 12 Nm +180°

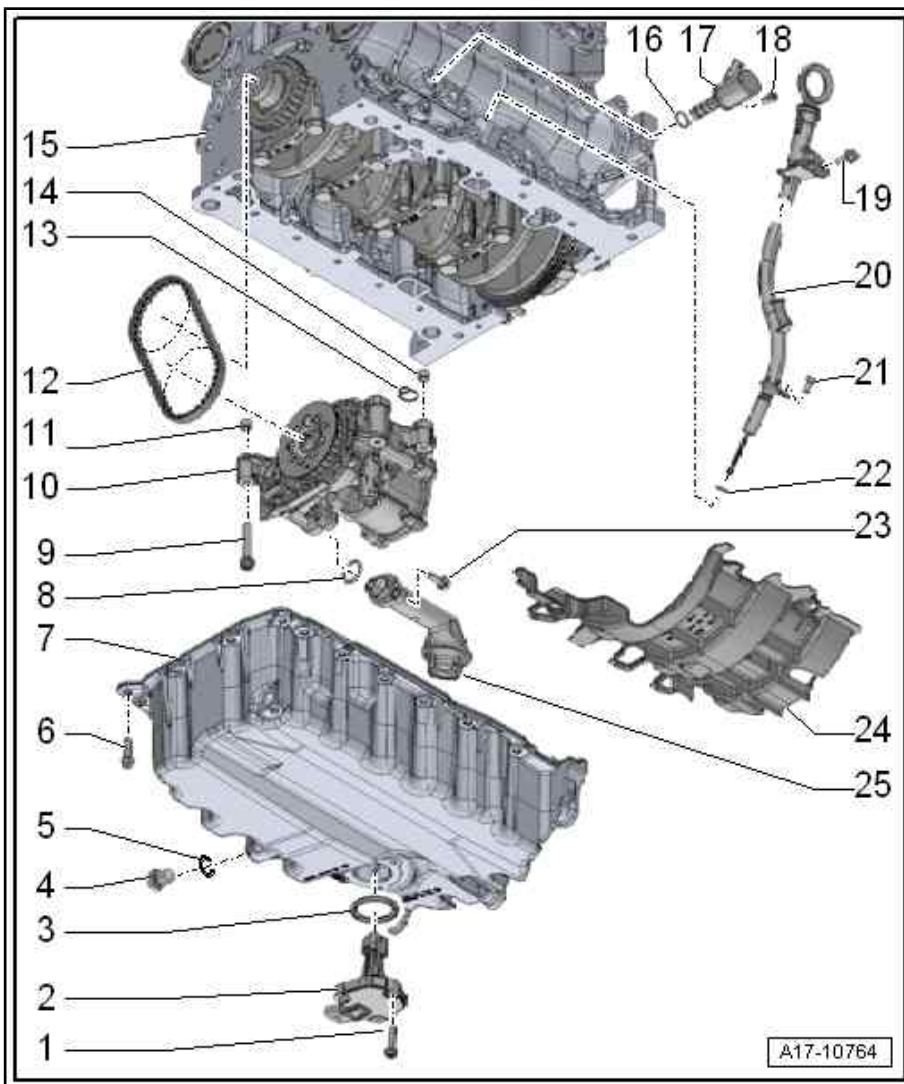
10 - Oil pump

- With vacuum pump
- Removing and installing ⇒ [page 129](#)

11 - Dowel sleeve

12 - Toothed belt

- Removing:
 - Remove oil pump ⇒ [page 129](#) .
 - Remove sealing flange (pulley end) ⇒ [page 47](#) .



Caution
 Do not kink or twist toothed belt, or allow it to be damaged on sharp edges.

13 - Gasket

- Renew after removing

14 - Dowel sleeve

15 - Cylinder block

16 - O-ring

- Renew after removing

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17 - Valve for oil pressure control - N428-

- ❑ Removing and installing ⇒ [page 138](#)

18 - Bolt

- ❑ 8 Nm

19 - Bolt

- ❑ 8 Nm

20 - Dipstick guide tube



21 - Bolt

- ❑ 8 Nm

22 - O-ring

- ❑ Renew after removing

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23 - Bolt

- ❑ 8 Nm +90°

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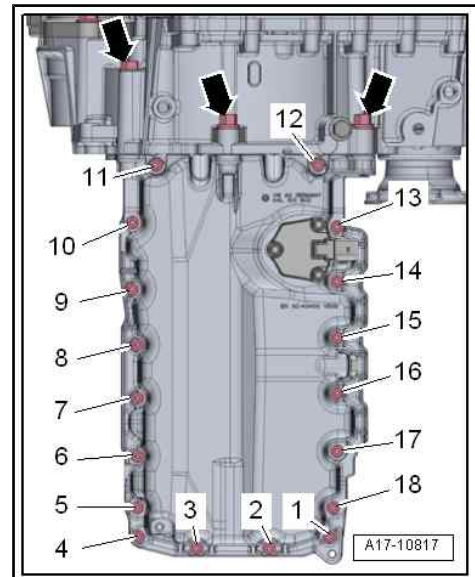
24 - Baffle plate

25 - Oil intake pipe

Sump - tightening torque and sequence

– Tighten bolts in stages as follows:

Stage	Bolts	Tightening torque
1.	-1 ... 18-	5 Nm in diagonal sequence
2.	-Arrows-	40 Nm
3.	-1 ... 18-	Tighten in stages and in diagonal sequence; final torque 13 Nm



1.2 Engine oil

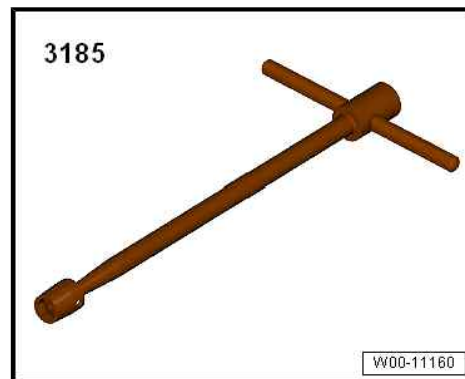
Oil capacities, oil specifications and viscosity grades ⇒ Maintenance tables .

1.3 Removing and installing sump

Special tools and workshop equipment required



- ◆ Articulated wrench, 10 mm - 3185-



- ◆ Socket - T10058-



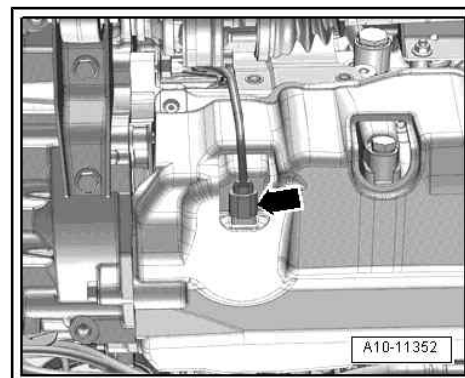
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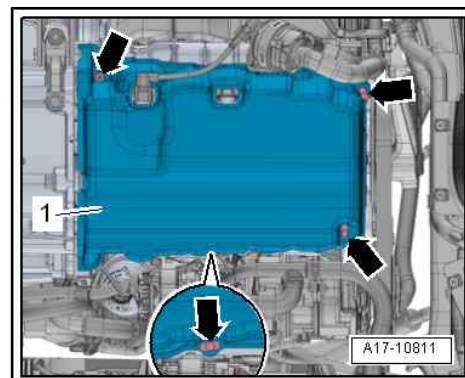
- ◆ Electric drill with plastic brush
- ◆ Sealant ⇒ Electronic parts catalogue
- ◆ Safety goggles

Removing

- Engine oil drained ⇒ Maintenance ; Booklet 819
- Unplug electrical connector -arrow- at oil level and oil temperature sender - G266- .




- Release clips -arrows- and detach noise insulation -1- for sump.





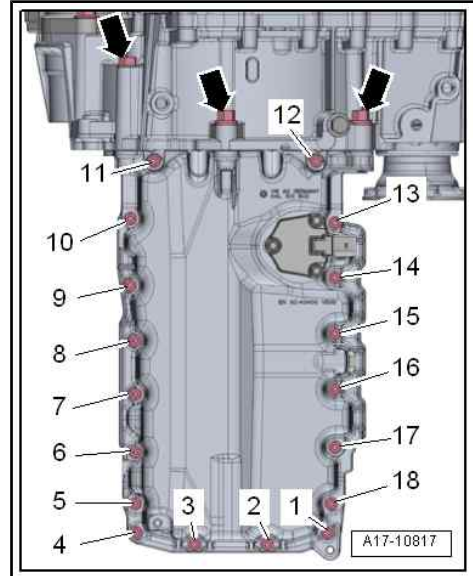
- Remove bolts securing sump to gearbox -arrows-.
- Slacken bolts -1 ... 18- in diagonal sequence and remove.
- Carefully release sump from bonded joint.


Installing

 **Caution**

Protect lubrication system and bearings against contamination.

◆ *Cover exposed parts of the engine.*

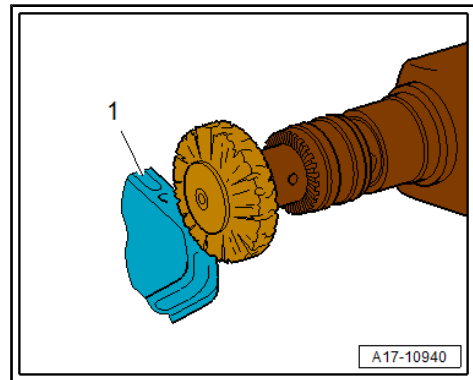



 **WARNING**

Risk of eye injury.

◆ *Put on safety goggles.*

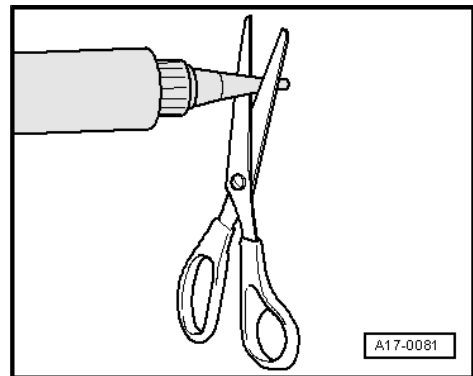
- Remove sealant residue from sump -1- and cylinder block using rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.



 **Note**

Note expiry date of sealant.

- Cut off nozzle of tube at front marking (nozzle Ø approx. 1.5 mm).



 **Caution**

Make sure lubrication system is not clogged by excess sealant.

◆ *The sealant bead must not be thicker than specified.*

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If the sealing flange (pulley end) was NOT renewed:

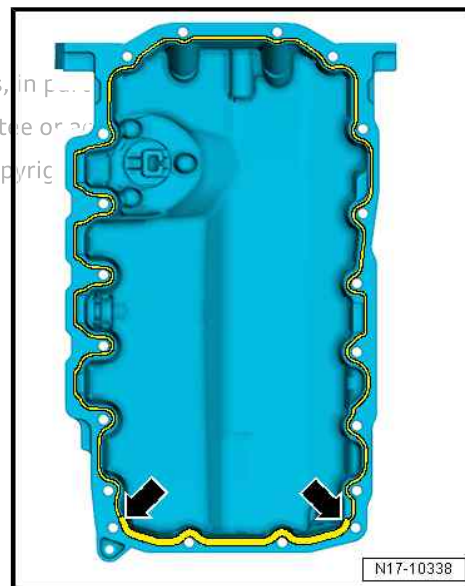


Note

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The lower surface of the sealing flange (pulley end) deviates from the lower surface of the cylinder block by approx. 1 mm after removal of the old silicone seal. This must be compensated for by applying an appropriate amount of sealant to the corresponding section of the sealing surface of the sump.

- Apply sealant bead onto clean sealing surface of sump as illustrated.
- In area of sealing surface for sealing flange (pulley end) -arrows-: 3 ... 4 mm.
- In area of sealing surfaces for cylinder block and sealing flange (gearbox end): 2 ... 3 mm.
- The sealant bead must be able to replace the silicone seal (no longer present) in the area of the sealing flange (pulley end) in both height and width.



Note

The sump must be installed within 5 minutes after applying the sealant.



If the sealing flange (pulley end) was renewed:

- Apply sealant bead onto clean sealing surface of sump as illustrated.
- Thickness of sealant bead: 2 ... 3 mm



Note

Take particular care when applying sealant bead in area of sealing flanges.

Continued for both procedures:

- Insert baffle plate.
- Fit sump and tighten bolts ⇒ [page 124](#) .
- The sump must make flush contact with intermediate plate/gearbox flange.

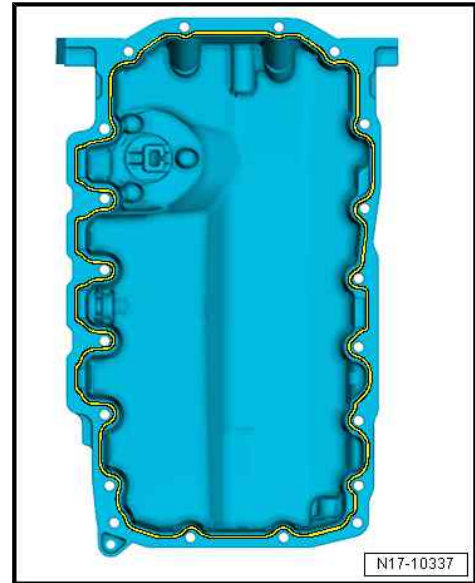


Note

- ◆ *When installing sump with engine removed from vehicle, ensure that sump is positioned flush with cylinder block at fly-wheel end.*
- ◆ *After fitting sump, sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.*
- Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 819 .

Tightening torques

- ◆ ⇒ [Fig. "“Sump - tightening torque and sequence”", page 124](#)
- ◆ ⇒ Rep. gr. 34 ; Removing and installing gearbox; Tightening torques for gearbox



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1.4 Removing and installing oil pump

Removing

- Remove sump ⇒ [page 124](#) .



Caution

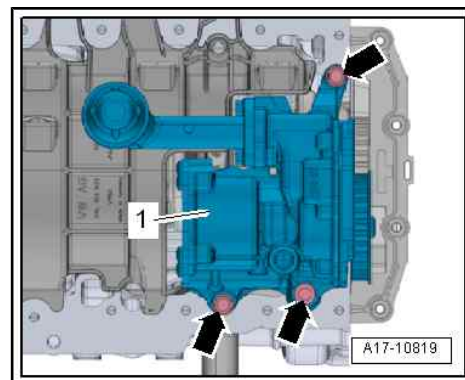
Do not kink or twist toothed belt, or allow it to be damaged on sharp edges.

- Remove bolts -arrows- and detach oil pump -1-.



Caution

The bolt on the pump impeller must NOT be loosened.



Installing

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



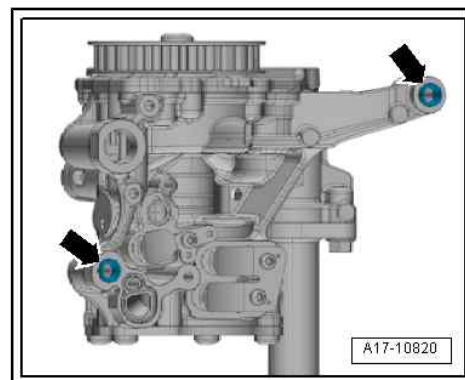
Note

◆ *Renew seal after removing.*
◆ *After removing, renew bolts tightened with specified tightening angle.*

- Insert dowel sleeves -arrows- in oil pump, if not fitted.
- Install sump ⇒ [page 124](#) .

Tightening torques

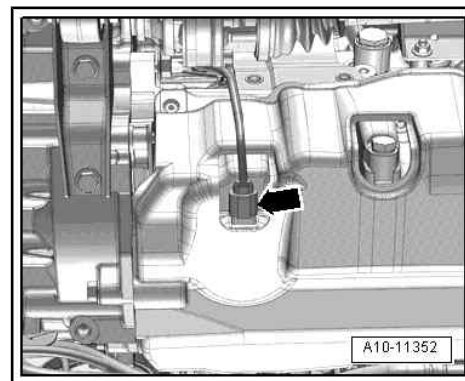
- ◆ ⇒ ["1.1 Exploded view - sump/oil pump", page 122](#)



1.5 Removing and installing oil level and oil temperature sender - G266-

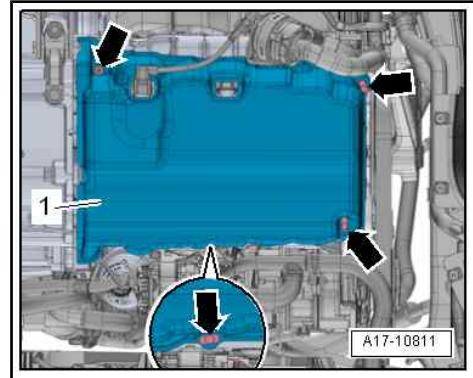
Removing

- Engine oil drained ⇒ Maintenance ; Booklet 819
- Unplug electrical connector -arrow- at oil level and oil temperature sender - G266- .





- Release fasteners -arrows- and detach noise insulation -1- for sump.



- Remove bolts -1- and detach oil level and oil temperature sender - G266- -item 3-.



Note

Disregard -item 2-.

Installing

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



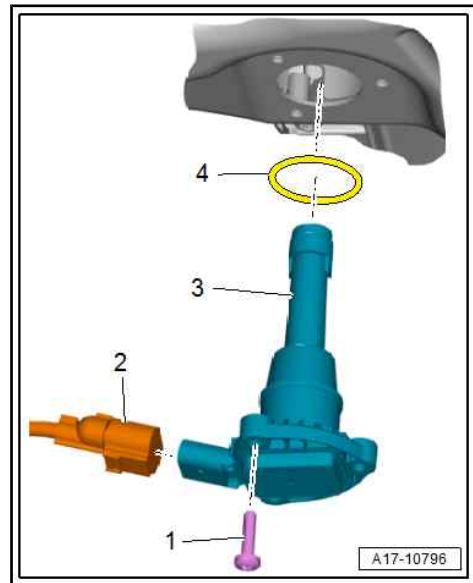
Note

Renew seal -4- and self-locking bolts -1- after removal.

- Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 819 .

Tightening torques

- ♦ ⇒ ["1.1 Exploded view - sump/oil pump", page 122](#)



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2 Engine oil cooler



Note

Engine oil cooler must not be separated from oil filter housing. If defective, engine oil cooler must be renewed together with oil filter housing ⇒ [page 133](#).



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3 Oil filter/oil pressure switches

⇒ ["3.1 Exploded view - oil filter housing/oil pressure switch", page 132](#)

⇒ ["3.2 Removing and installing oil filter housing", page 133](#)

⇒ ["3.3 Removing and installing oil pressure switch F22", page 136](#)

⇒ ["3.4 Removing and installing oil pressure switch for reduced oil pressure F378", page 137](#)

⇒ ["3.5 Removing and installing valve for oil pressure control N428", page 138](#)

3.1 Exploded view - oil filter housing/oil pressure switch

1 - Oil drain plug

- 5 Nm

2 - O-ring

- Renew after removing

3 - Sealing cap

- 25 Nm

4 - O-ring

- Renew after removing
- Lubricate lightly with engine oil

5 - Oil filter element

- See note ⇒ [page 122](#)
- Removing and installing ⇒ Maintenance ; Booklet 819

6 - Seal

- Renew (cut seal open to do so)
- If seal is not available separately, refer to ⇒ Electronic parts catalogue ; renew oil pressure switch after removal

7 - Oil pressure switch - F22-

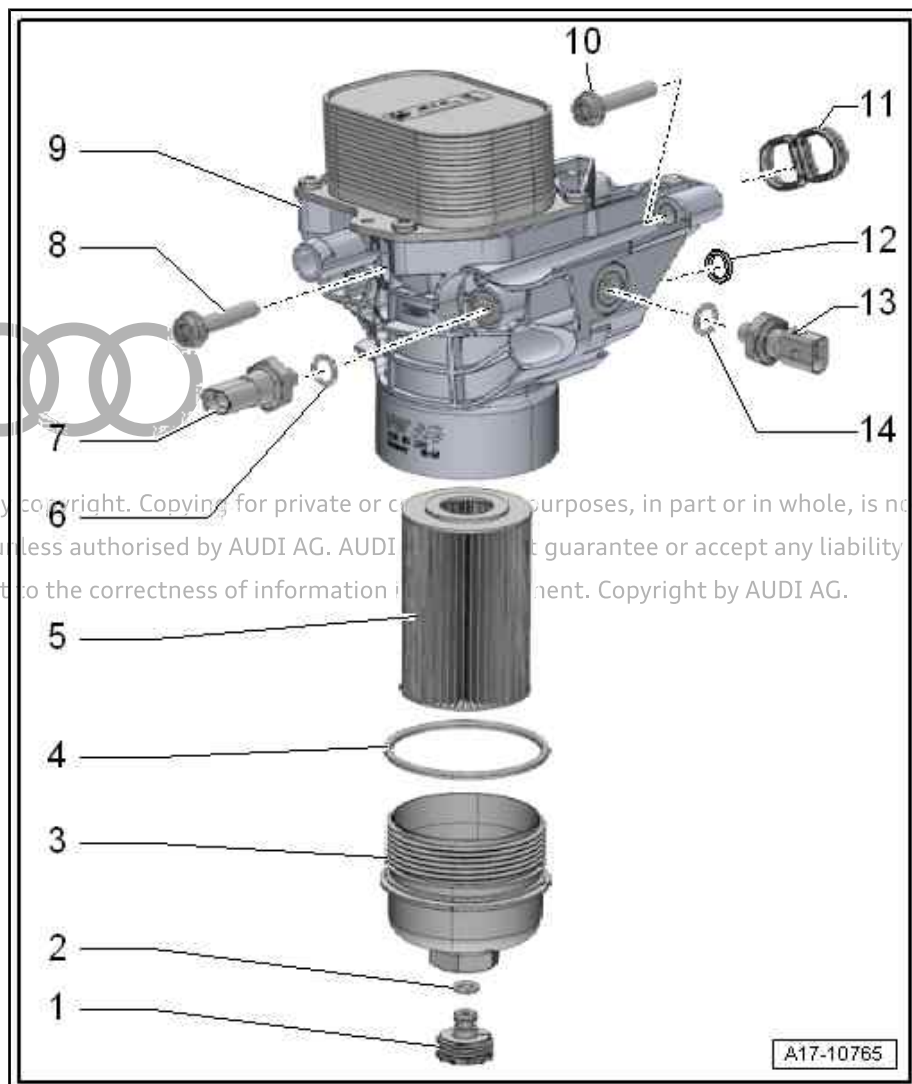
- Opening/closing pressure 2.5 ... 3.2 bar
- Brown insulation
- Removing and installing ⇒ [page 136](#)
- 20 Nm

8 - Bolt

- Renew after removing
- Tightening torque and sequence ⇒ [page 133](#)

9 - Oil filter housing with engine oil cooler

- Do not separate oil filter housing and engine oil cooler
- Removing and installing ⇒ [page 133](#)



A17-10765



10 - Bolt

- Renew after removing
- Tightening torque and sequence ⇒ [page 133](#)

11 - Gasket

- Renew after removing

12 - O-ring

- Renew after removing

13 - Oil pressure switch for reduced oil pressure - F378-

- Opening/closing pressure 0.3 ... 0.6 bar
- Green insulation
- Check in [Guided Fault Finding](#) ⇒ Vehicle diagnostic tester
- Removing and installing ⇒ [page 137](#)
- 20 Nm

14 - Seal

- Renew (cut seal open to do so)
- If seal is not available separately, refer to ⇒ Electronic parts catalogue ; renew oil pressure switch after removal

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Oil filter housing - tightening torque and sequence

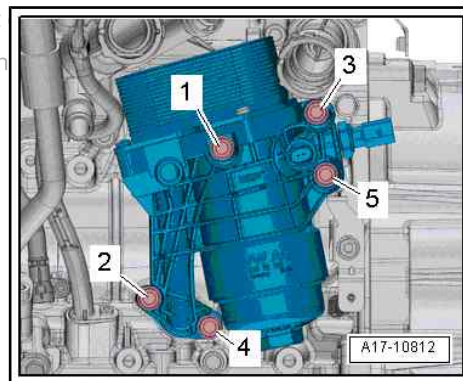


Note

After removing, renew bolts tightened with specified tightening angle.

- Fit bolts at top left and bottom right first.
- Tighten bolts in stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 ... 5-	20 Nm
2.	-1 ... 5-	Turn 90° further



3.2 Removing and installing oil filter housing

Special tools and workshop equipment required

- ◆ Hose clip pliers - VAS 6362-





◆ Assembly tool - T10118-



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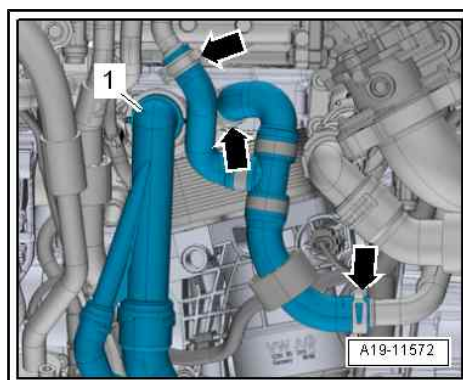
Removing

- Remove air cleaner housing ⇒ [page 246](#) .
- Remove coolant pipe (front left) ⇒ [page 200](#) .
- Loosen hose clips -arrows- and remove air hoses.



Note

Disregard -item 1-.

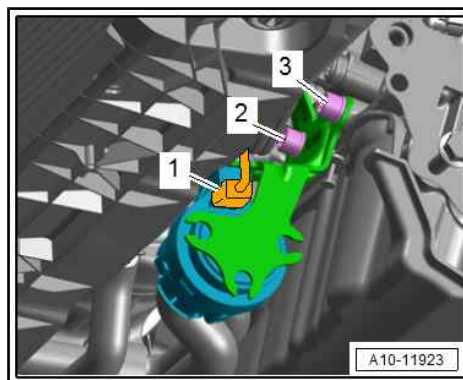


- Unplug electrical connector -1-.
- Remove bolt -3- and press charge air cooling pump - V188- to side.



Note

Disregard -item 2-.

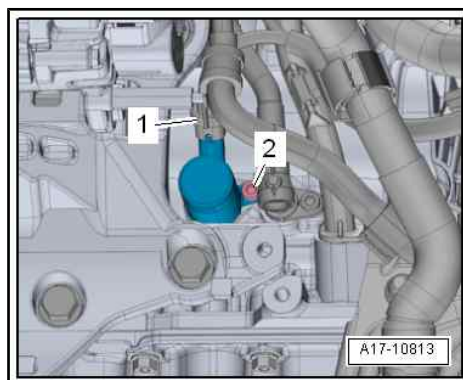


- Unplug electrical connector -1- at valve for oil pressure control - N428- and move clear.



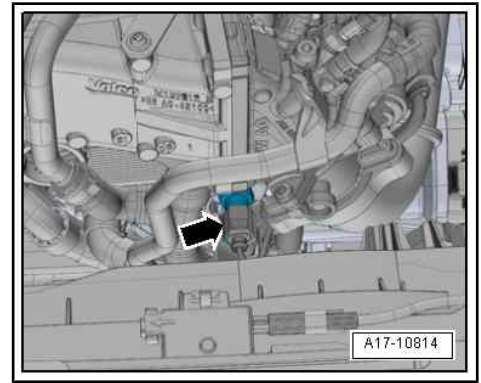
Note

Disregard -item 2-.

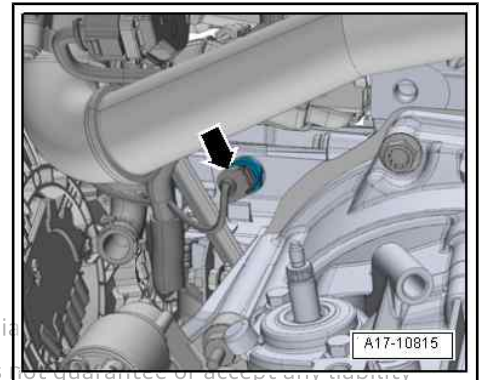




- Unplug electrical connector -arrow- on oil pressure switch - F22- .



- Unplug electrical connector -arrow- at oil pressure switch for reduced oil pressure - F378- .



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Note

Place a cloth underneath to catch escaping engine oil.

- Unscrew bolts in the sequence -5 ... 1- and detach oil filter housing together with engine oil cooler.

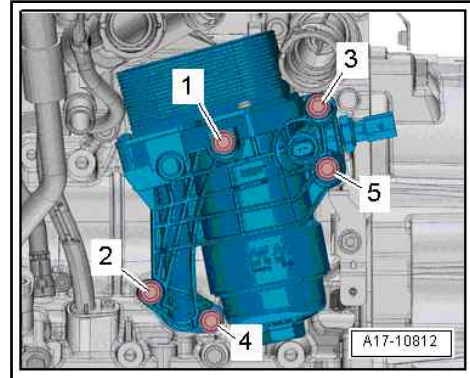
Installing

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



Note

- ◆ Renew seal and O-ring after removal.
- ◆ Secure all hose connections with correct type of hose clips (as original equipment) ⇒ *Electronic parts catalogue* .
- Install coolant pipe (front left) ⇒ [page 200](#) .
- Connect coolant hose with plug-in connector ⇒ [page 208](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ After it is filled, the cooling system must be bled with the ⇒ *Vehicle diagnostic tester*.

- Fill up with coolant ⇒ [page 148](#) .

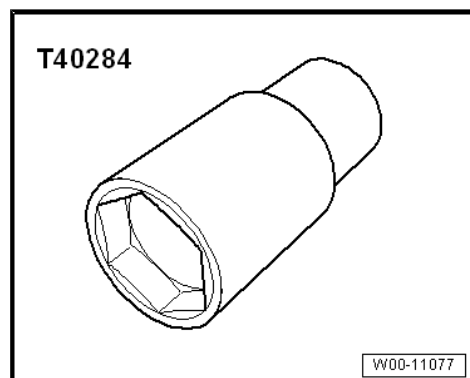
Tightening torques

- ◆ ⇒ [“3.1 Exploded view - oil filter housing/oil pressure switch”, page 132](#)
- ◆ ⇒ [“2.2 Exploded view - electric coolant pump”, page 186](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)

3.3 Removing and installing oil pressure switch - F22-

Special tools and workshop equipment required

- ◆ Socket AF 24 mm - T40284-



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- ◆ Articulated wrench, 24 mm - T40175-

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- ◆ Torque wrench with ratchet - V.A.G 1331/1-

Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Unplug electrical connector -arrow-



Note

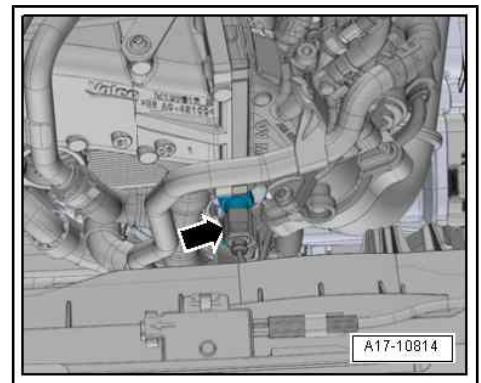
Place a cloth underneath to catch escaping engine oil.

- Unscrew oil pressure switch - F22- .

Installing

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

- Renew seal for oil pressure switch - F22- after removal.
- Cut seal open to renew.
- Check oil level ⇒ Maintenance ; Booklet 819 .
- Install engine cover panel ⇒ [page 39](#) .



Tightening torques

- ◆ ⇒ [“3.1 Exploded view - oil filter housing/oil pressure switch”, page 132](#)

3.4 Removing and installing oil pressure switch for reduced oil pressure - F378-

Special tools and workshop equipment required

- ◆ Articulated wrench, 24 mm - T40175-

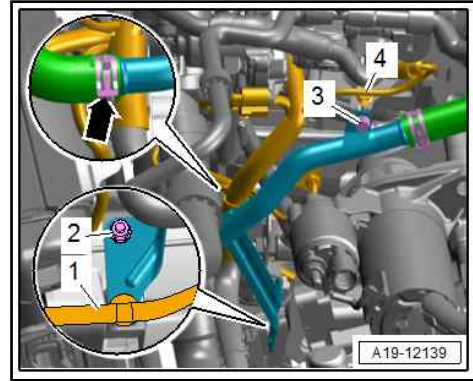


Removing

- Remove air cleaner housing ⇒ [page 246](#) .



- Remove nut -2- and bolt -3-.



- Unplug electrical connector -arrow-.



Note

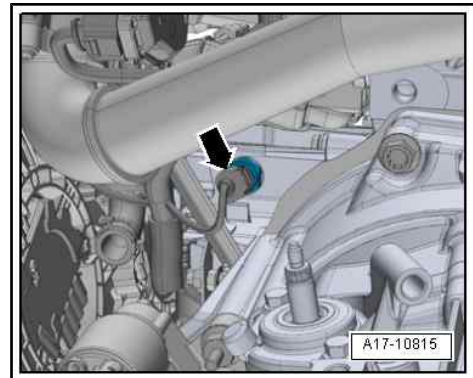
Place a cloth underneath to catch escaping engine oil.

- Use articulated wrench, 24 mm - T40175- to remove oil pressure switch for reduced oil pressure - F378- .

Installing

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

- Renew seal for oil pressure switch for reduced oil pressure - F378- after removal.
- Cut seal open to renew.
- Check oil level ⇒ Maintenance ; Booklet 819 .



Tightening torques

- ◆ ⇒ [“3.1 Exploded view - oil filter housing/oil pressure switch”, page 132](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)

3.5 Removing and installing valve for oil pressure control - N428-

Removing

- Remove poly V-belt ⇒ [page 42](#) .
- Detach air conditioner compressor from bracket (refrigerant hoses remain connected) ⇒ Rep. gr. 87 ; Air conditioner compressor; Detaching and attaching air conditioner compressor at bracket , and tie up to right side.



- Unplug electrical connector -1-.



Note

Place a cloth underneath to catch escaping engine oil.

- Unscrew bolt -2- and remove valve for oil pressure control - N428- .

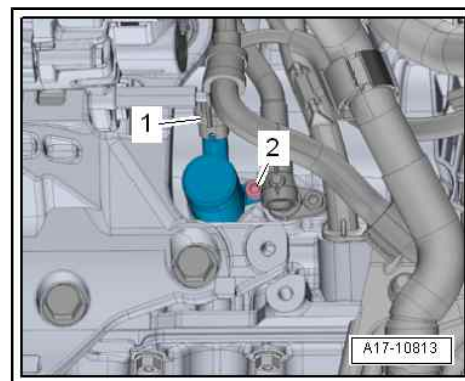
Installing

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



Note

Renew seal after removing.



- Install poly V-belt ⇒ [page 42](#)
- Check oil level ⇒ [Maintenance ; Booklet 819](#)

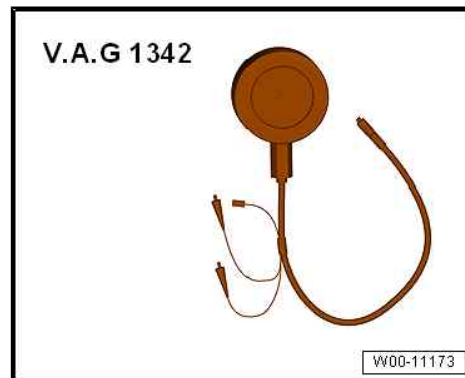
Tightening torques The correctness of information in this document. Copyright by AUDI AG.

- ◆ ⇒ [“1.1 Exploded view - sump/oil pump”, page 122](#)
- ◆ ⇒ Rep. gr. 87 ; Air conditioner compressor; Exploded view - air conditioner compressor drive unit

3.6 Checking oil pressure

Special tools and workshop equipment required

- ◆ Oil pressure tester - V.A.G 1342-



Procedure

- Oil level OK
- Remove oil pressure switch - F22- ⇒ [page 136](#) .
- Connect oil pressure tester - V.A.G 1342- to threaded hole for oil pressure switch - F22- .
- Screw a used oil pressure switch into threaded hole on oil pressure tester - V.A.G 1342- to seal hole.
- Start engine.
- Oil pressure when starting and then at idling speed: at least 1.4 bar.




If specification is not obtained, switch off engine immediately and check oil pump drive; renew oil pump if necessary
⇒ [“1.4 Removing and installing oil pump”, page 129](#) .



If specification is obtained, higher oil pressure must be checked using ⇒ Vehicle diagnostic tester.

- Let engine warm up.

It is not possible to test all levels of the oil pressure control system while the vehicle is stationary. The higher oil pressure must therefore be checked using the ⇒ Vehicle diagnostic tester:

- Connect ⇒ Vehicle diagnostic tester.
- Switch on ignition.
- Select Engine electronics in vehicle self-diagnosis.
- Then select Basic setting.
- Select Checking oil pressure valve change-over on the Basic setting page and then click on  (not >!).
- No settings are required on the parameter settings page. Now click on  (not >!).
- Select Operating instructions and Oil pressure actual value on the measured values page and then click on  (not >!).
- Start the basic setting routine and follow the operating instructions.
- Do not press the pedals until requested; otherwise the routine (checking the oil pressure valve changeover) will be cancelled for safety reasons.
- Oil pressure must rise to at least 3.5 bar.



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19 – Cooling

1 Cooling system/coolant

- ⇒ [“1.1 Connection diagram - coolant hoses”, page 141](#)
- ⇒ [“1.2 Checking cooling system for leaks”, page 142](#)
- ⇒ [“1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2”, page 145](#)
- ⇒ [“1.4 Filling cooling system with electric vacuum pump VAS 6096/2”, page 153](#)
- ⇒ [“1.5 Checking filling quality of cooling system”, page 159](#)
- ⇒ [“1.6 Checking electric vacuum pump VAS 6096/2”, page 161](#)
- ⇒ [“1.7 Flushing cooling system”, page 161](#)
- ⇒ [“1.8 Flushing cooling system - quick reference guide”, page 182](#)

1.1 Connection diagram - coolant hoses



Note

- ◆ *Blue = Large coolant circuit*
- ◆ *Red = Small coolant circuit*
- ◆ *Violet = Coolant circuit for charge air cooler.*
- ◆ *Brown = Heating circuit*
- ◆ *Arrows show direction of coolant flow.*

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1 - Water radiator for charge air cooling circuit

2 - Charge air cooler

3 - Restrictor

4 - Non-return valve

5 - Coolant pump

6 - Cylinder head/cylinder block

7 - Coolant expansion tank

8 - Filler cap

- For coolant expansion tank
- Checking pressure relief valve ⇒ [page 145](#)

9 - Auxiliary pump for heating - V488-

- Depending on version

10 - Non-return valve

11 - Heat exchanger for heater

12 - Exhaust gas recirculation cooler

13 - Non-return valve

14 - Non-return valve

15 - Coolant temperature sender - G62-

16 - Restrictor

17 - Non-return valve

18 - Coolant connection

19 - Thermostat

20 - Engine oil cooler

21 - Restrictor

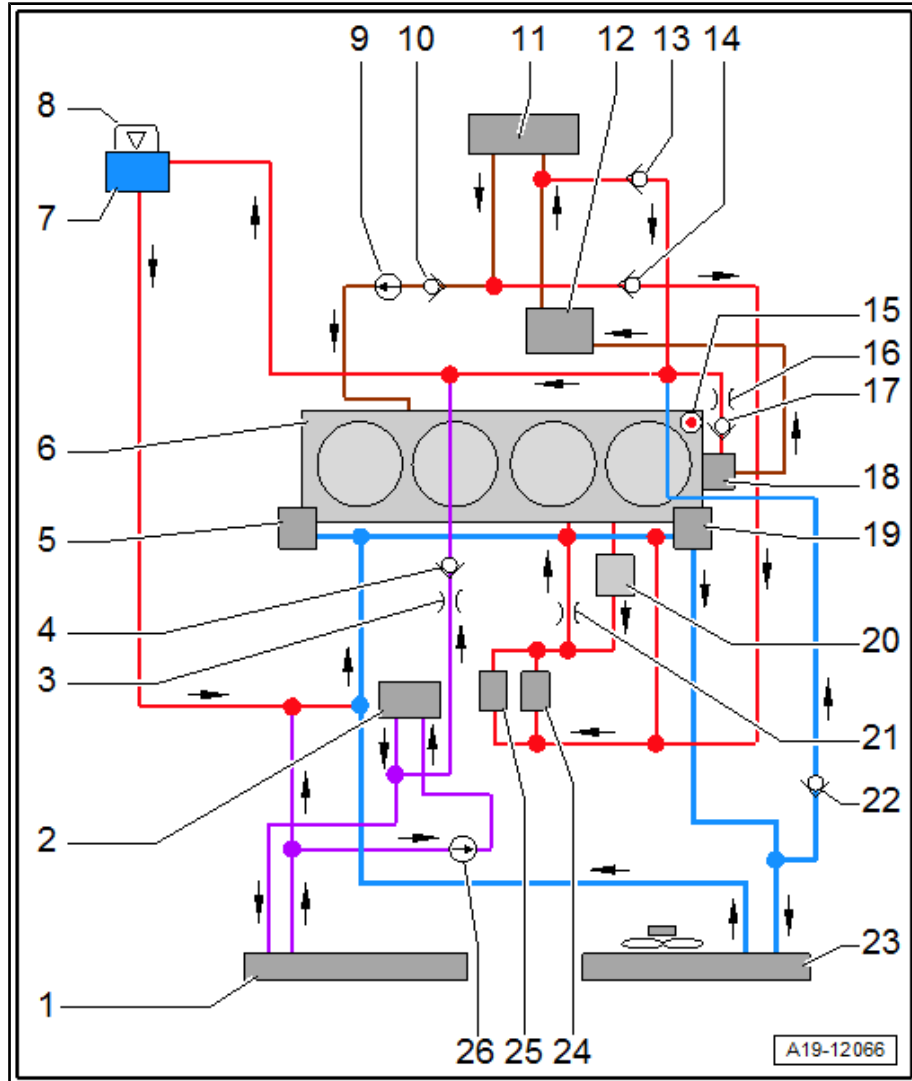
22 - Non-return valve

23 - Radiator

24 - Throttle valve module - J338-

25 - Exhaust gas recirculation control motor - V338-

26 - Charge air cooling pump - V188-



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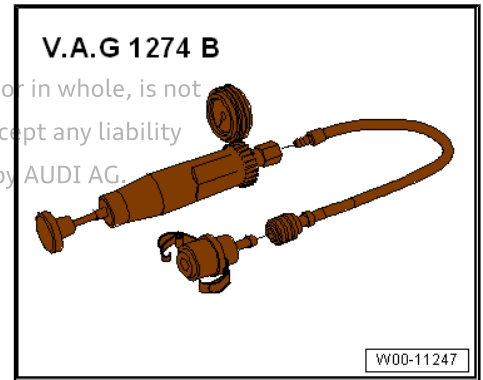
1.2 Checking cooling system for leaks

Special tools and workshop equipment required



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

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



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



- To ensure that the leak test is carried out correctly, a self-test must first be performed on the cooling system tester - V.A.G 1274 B- .



Checking cooling system tester - V.A.G 1274 B- (self-test)

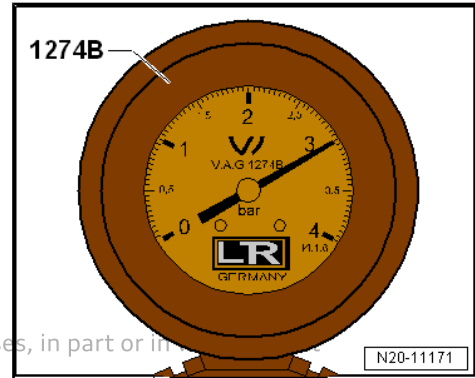
- Operate cooling system tester - V.A.G 1274 B- several times.
- Build up a pressure of 3.0 bar on cooling system tester.
- Monitor pressure on pressure gauge of cooling system tester - V.A.G 1274 B- for 30 seconds.

If pressure does not build up, or if pressure dissipates again:

- Cooling system tester - V.A.G 1274 B- is leaking and must not be used.

Checking cooling system for leaks

- Engine must be warm.
- Ignition switched off.



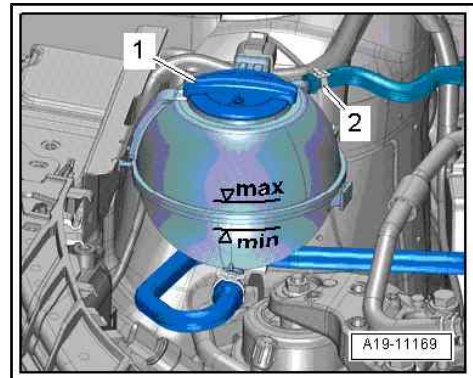
WARNING

The cooling system is under pressure when the power unit is hot. Risk of scalding due to hot steam and hot coolant.

Danger of scalding skin and other parts of the body.

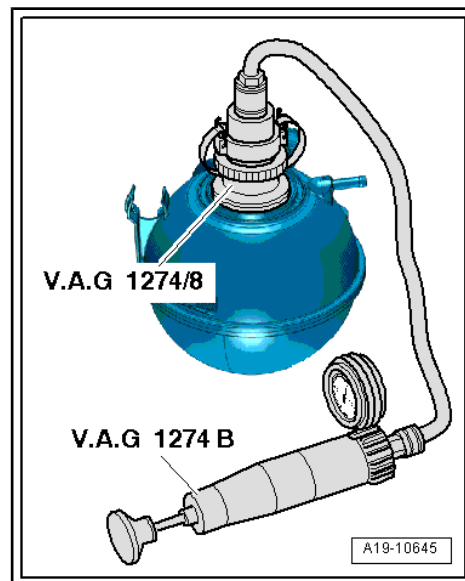
- ◆ Put on protective gloves.
- ◆ Put on safety goggles.
- ◆ Cover filler cap on expansion tank with a cloth and open carefully to release pressure.

- Open filler cap -1- on coolant expansion tank.





- Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/8- onto coolant expansion tank.
- Using hand pump on cooling system tester, build up a pressure of approx. 1.5 bar.
- The pressure should not drop more than 0.2 bar within 10 minutes.
- The drop in pressure of 0.2 bar within 10 minutes is caused by the decrease in coolant temperature. The colder the engine is, the less the pressure will fall. If necessary, check again when the engine is cold.
- If the pressure drops by more than 0.2 bar:
- Examine engine and radiator to find and eliminate the leak.
- If no leaks can be found, check for leaks in water-cooled charge air cooler and exhaust gas recirculation cooler.



Checking pressure relief valve in filler cap

- Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/9- onto filler cap.
- Build up pressure with hand pump on cooling system tester.

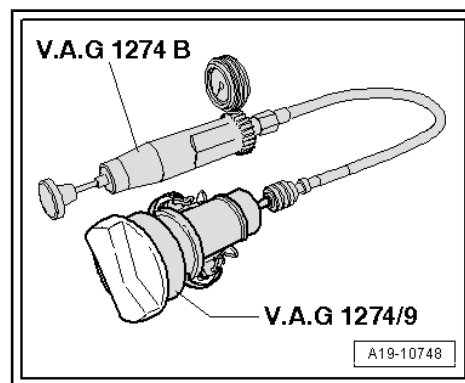
Blue filler cap

- ◆ The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.

Black filler cap

- ◆ The pressure relief valve should open at a pressure of 1.6 ... 1.8 bar.

- Renew filler cap if pressure relief valve does not open as described.



1.3 Draining and filling cooling system without electric vacuum pump - VAS 6096/2-

Drain coolant ⇒ [page 147](#) .

Fill and bleed coolant circuit ⇒ [page 148](#) .

Bleed cooling system ⇒ [page 152](#) .

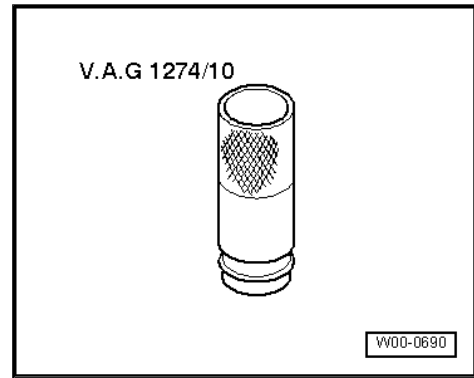
Special tools and workshop equipment required

- ◆ Vehicle diagnostic tester
- ◆ Adapter for cooling system tester - V.A.G 1274/8-

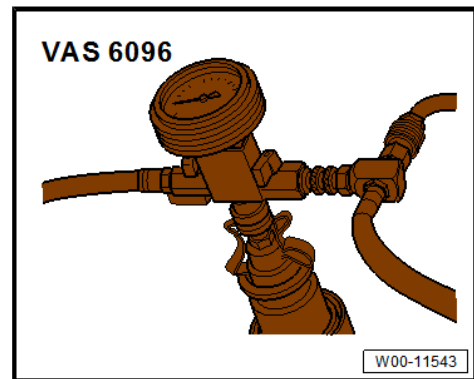




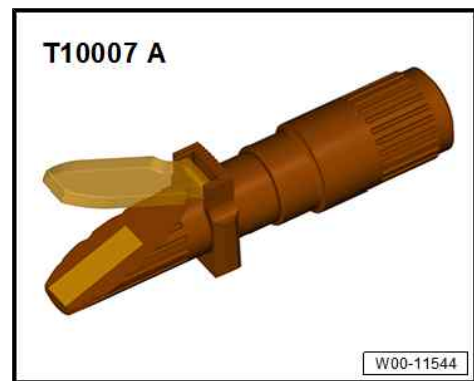
- ◆ Pipe for cooling system tester - V.A.G 1274/10-



- ◆ Cooling system charge unit - VAS 6096-



- ◆ Refractometer - T10007A-



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- ◆ Coolant collecting system - VAS 5014- or drip tray for workshop hoist - VAS 6208-





- ◆ Hose clip pliers - VAS 6362-




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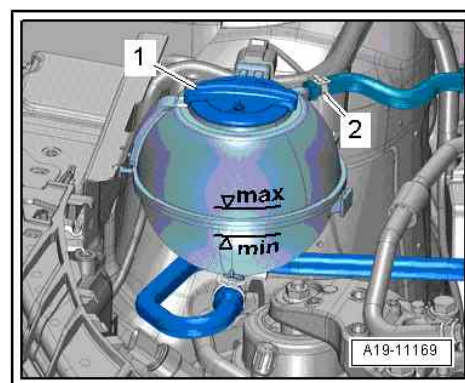
- ◆ Safety goggles
- ◆ Protective gloves

Draining

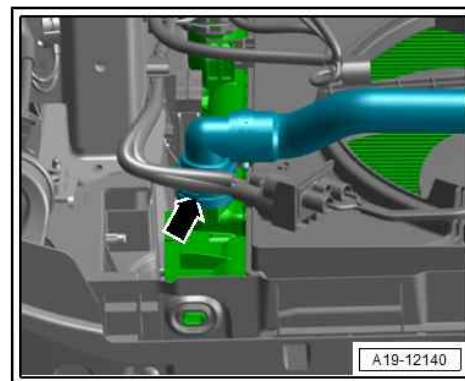
 **WARNING**

Risk of scalding due to hot steam and hot coolant.

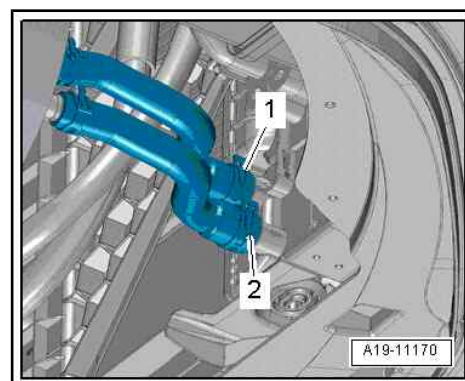
- ◆ *The cooling system is under pressure when the power unit is hot.*
- ◆ *To allow pressure to dissipate, cover filler cap on coolant expansion tank with cloth and open carefully.*



- Open filler cap -1- on coolant expansion tank.
- Remove noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
- Place collector tank from coolant collecting system -VAS 5014- or drip tray for workshop hoist - VAS 6208- underneath.
- Lift retaining clip -arrow-, disconnect coolant hose from radiator (bottom left) and drain off coolant.



- Release hose clips -1, 2-, disconnect coolant hoses from water radiator (bottom right) for charge air cooling circuit and drain off coolant.





- Release hose clip -arrow-, disconnect coolant hose (bottom) from auxiliary pump for heating - V488- and drain off coolant.

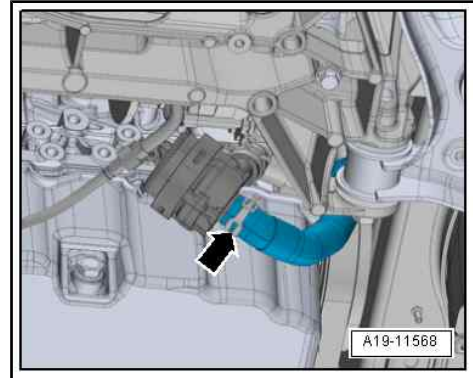
Filling and bleeding coolant circuit:



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.*

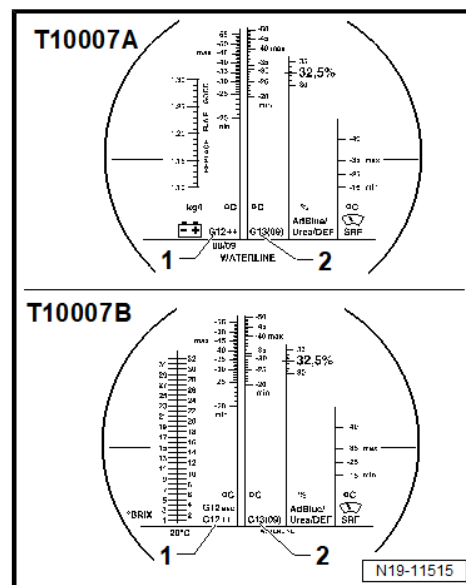


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i Note

- ◆ *The effectiveness of the coolant is greatly influenced by the quality of the water with which it is mixed. Because water may contain different substances depending on the country or even the region, the water quality to be used for cooling systems has been specified. Distilled water meets all the requirements and is therefore recommended for use when topping up or filling up with coolant.*
- ◆ *Use only coolant additives listed in the ⇒ Electronic parts catalogue (ETKA) . If you use other coolant additives, this can significantly impair in particular the corrosion protection effect. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- ◆ *Coolant with the recommended mixture ratio prevents frost and corrosion damage and stops scaling. At the same time it raises the boiling point of the fluid in the system. For this reason the cooling system must be filled all year round with the correct coolant additive.*
- ◆ *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- ◆ *Refractometer - T10007A- or refractometer - T10007B- MUST be used to determine the current level of frost protection.*
- ◆ *Scale -1- on the refractometer applies to coolant additives G12 ++ and G12evo.*
- ◆ *Scale -2- on the refractometer applies to coolant additive G13.*
- ◆ *If more than one type of coolant additive has been used: Always use the scale for G13 to determine the anti-freeze protection.*
- ◆ *The mixture must guarantee frost protection down to at least -25 °C (in countries with arctic climate: down to -36 °C). The amount of antifreeze should only be increased if greater frost protection is required in very cold climates. This must only be down to -48 °C, however, as otherwise the cooling efficiency of the coolant is impaired.*
- ◆ *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. Frost protection must be provided to at least -25 °C.*
- ◆ *The temperature indicated on the refractometer corresponds to the temperature at which the first ice crystals can form in the coolant.*
- ◆ *Do not reuse coolant.*
- ◆ *Only use water/coolant additive as a lubricant for coolant hoses.*



Recommended mixture ratio for coolant

- Coolant (40 %) and distilled water (60 %) for frost protection to -25 °C
- Coolant (50 %) and distilled water (50 %) for frost protection to -36 °C
- Coolant ⇒ Electronic parts catalogue (ETKA)

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Only if coolant has been drained off:



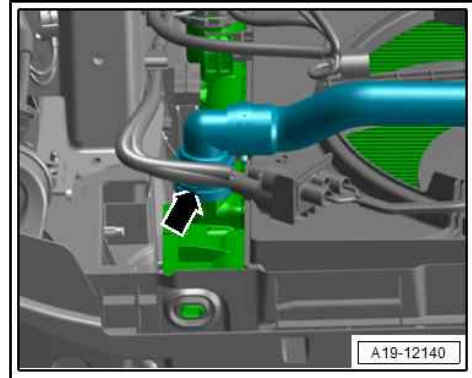
Note

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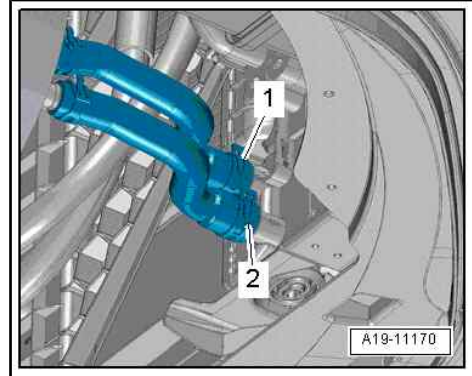
Secure all hose connections with correct type of hose clips (as original equipment) => *Electronic parts catalogue*.

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- Connect coolant hose with plug-in connector -arrow- to radiator (bottom left) => [page 208](#) .

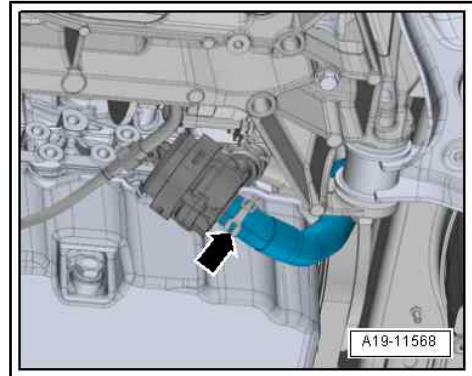


- Connect coolant hoses with hose clips -1, 2- to water radiator for charge air cooling circuit.



- Connect coolant hose to auxiliary pump for heating - V488- (bottom) with hose clip -arrow-.

To fill up with coolant:





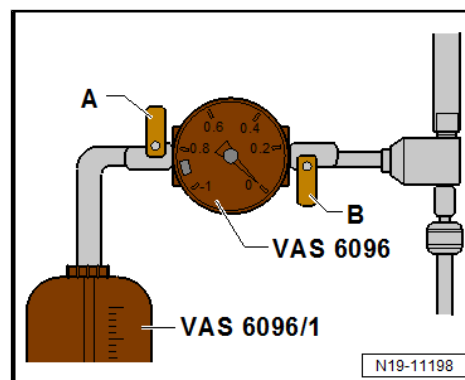
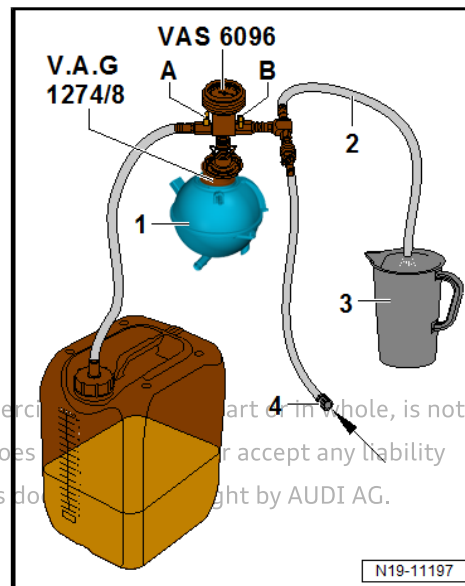
- Fill reservoir of -VAS 6096- with at least 8 litres of premixed coolant (according to recommended ratio):
- Fit adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit - VAS 6096- to adapter - V.A.G 1274/8- .
- Run vent hose -2- into a small container -3-.

i Note



The vented air draws along a small amount of coolant, which should be collected.

- Close both valves -A- and -B- (turn lever at right angles to direction of flow).
- Connect hose -4- to compressed air supply.
- Pressure: 7 ... 10 bar.
- Open valve -B- by setting lever in direction of flow.
- The suction jet pump generates a partial vacuum in the cooling system; the needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir of -VAS 6096- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump continues to generate a partial vacuum in the cooling system; the needle on the gauge should remain in the green zone.
- Close valve -B-.
- The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

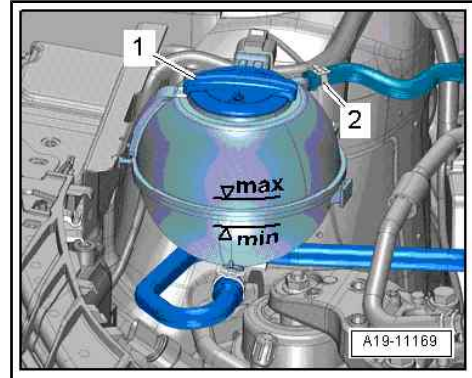


i Note

- ◆ *If the needle does not reach the green zone, repeat the process.*
- ◆ *Check cooling system for leaks if the vacuum is not maintained.*
- Detach compressed air hose.
- Open valve -A-.
- The vacuum in the cooling system causes the coolant to be drawn out of the reservoir of the cooling system charge unit - VAS 6096- ; the cooling system is then filled.
- Detach cooling system charge unit - VAS 6096- from coolant expansion tank.

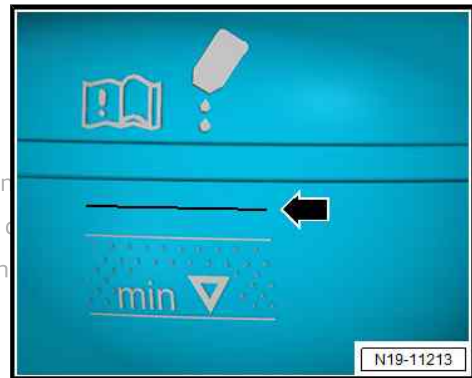


- Top up coolant to "max" mark.
- Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation .



Bleeding cooling system:

- Coolant must be topped up to "max" mark.
- Start engine.
- Set temperature to "HI".
- Switch off air conditioner compressor (press **AC** button).
- LED in button should not light up.
- Set fresh air blower to lowest setting.
- 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 - Coolant circuit charge**
- Follow instructions shown on ⇒ Vehicle diagnostic tester.
- Switch off engine.
- Check filling quality after completion of bleeding
⇒ ["1.5 Checking filling quality of cooling system", page 159](#) .



Check coolant level.



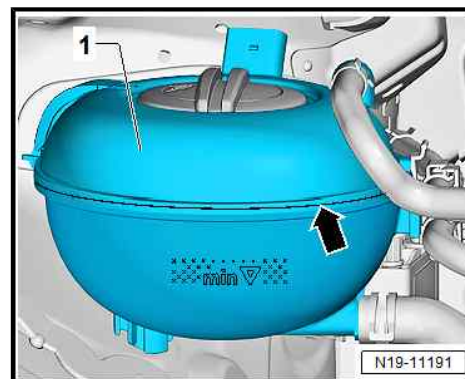
WARNING

Risk of scalding due to hot steam and hot coolant.

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



- The coolant level must not be above the -seam- -arrow- when the engine is warm.

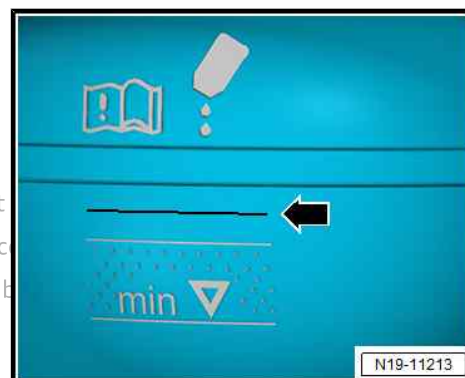


- The coolant level should be about 5 mm above the MAX mark -arrow- when the engine is cold.

Note

The increased coolant level is necessary as the coolant level can drop during the bleeding process.

- Top up with coolant again if necessary.
- Erase event memory ⇒ Vehicle diagnostic tester.
- Install engine cover panel ⇒ [page 39](#).

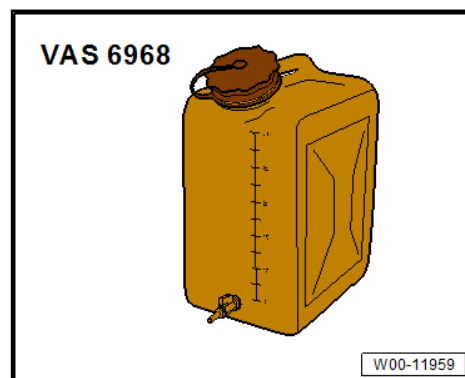


1.4 Filling cooling system with electric vacuum pump - VAS 6096/2-

Using the electric vacuum pump - VAS 6096/2- creates a higher vacuum in the cooling system. Due to the higher vacuum there is less air in the cooling system after filling.

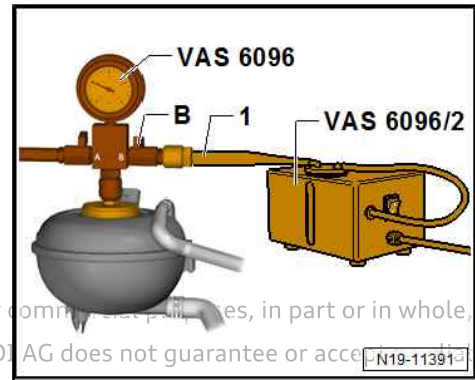
Special tools and workshop equipment required

- ◆ Vehicle diagnostic tester
- ◆ Test instrument adapter - VAS 691 005/5-
- ◆ Coolant filling device - VAS 6968-



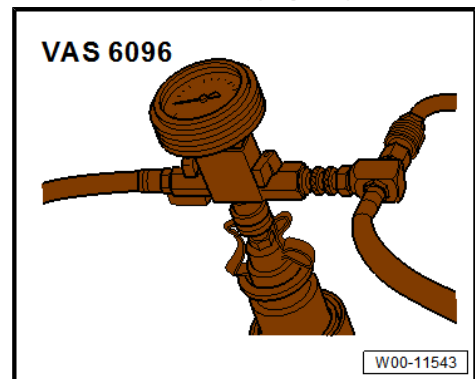


◆ Electric vacuum pump - VAS 6096/2-



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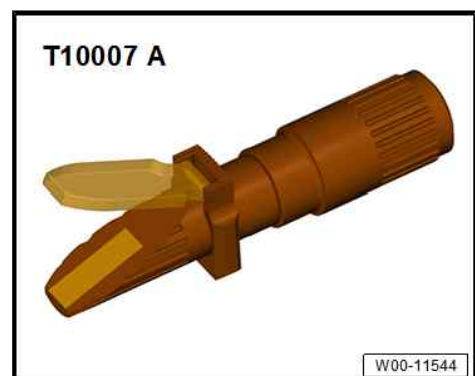
◆ Cooling system charge unit - VAS 6096-



◆ Drip tray for workshop hoist - VAS 6208-

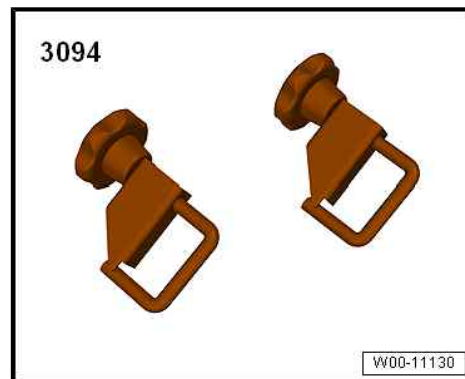


◆ Refractometer - T10007 A-



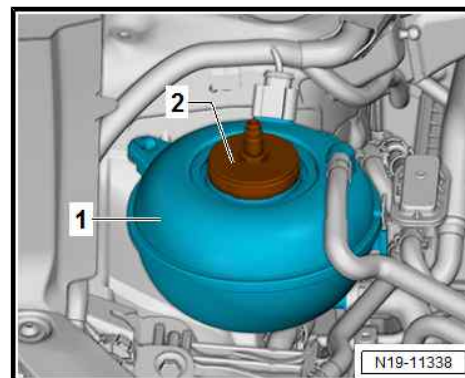


- ◆ Hose clamps up to 25 mm - 3094-

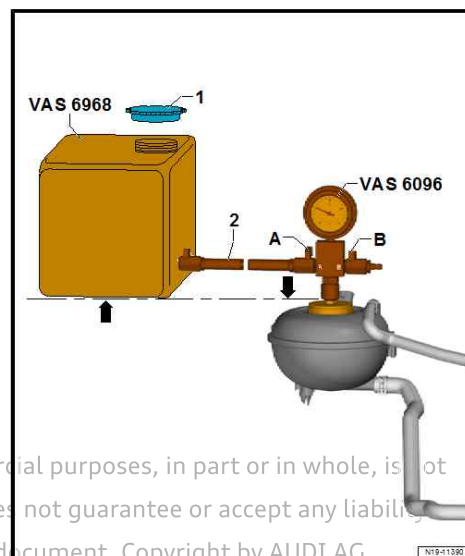


Important:

- Coolant has been drained as described in ⇒ [page 147](#) .
- Reconnect all coolant hoses that have been disconnected ⇒ [page 150](#) .
- Screw test adapter - VAS 691 005/5- -2- onto coolant expansion tank -1-.
- Check the electric vacuum pump - VAS 6096/2- ⇒ [“1.6 Checking electric vacuum pump VAS 6096/2”](#), [page 161](#) .



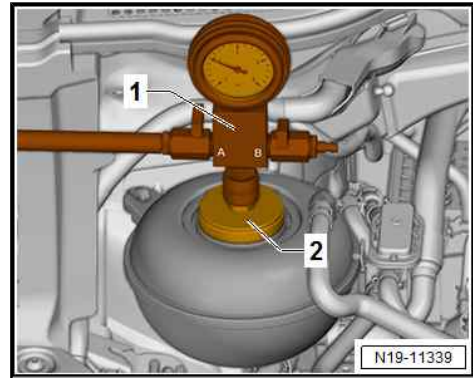
- Place coolant filling device -VAS 6968- on a surface that is higher than the coolant expansion tank -arrows- and fill coolant filling device with at least 10 litres of premixed coolant (according to recommended ratio). Observe notes on coolant ⇒ [page 148](#) .
- Connect cooling system charge unit - VAS 6096- to coolant filling device - VAS 6968- as shown.
- Do not plug cooling system charge unit - VAS 6096- into test adapter - VAS 691 005/5- yet. The filler hose must be bled first.
- Bleed hose -2-; to do so, briefly open valve on coolant filling device and valves -A- and -B- until hose -2- is filled with coolant.
- Close both valves -A- and -B- (turn lever at right angles to direction of flow).
- Open filler cap -1-.



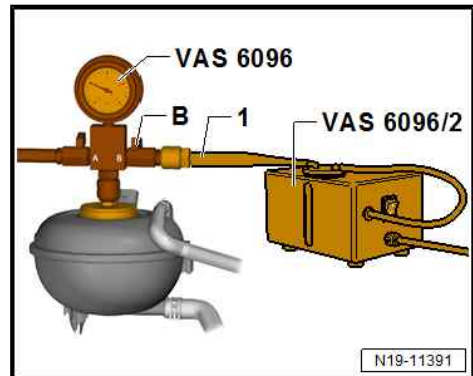
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- Plug cooling system charge unit -1- into test adapter -2-.



- Connect hose -1- of electric vacuum pump - VAS 6096/2- to cooling system charge unit at plug-in connector -B-.
- Connect electric vacuum pump - VAS 6096/2- to vehicle battery and switch pump on. Open valve -B-.

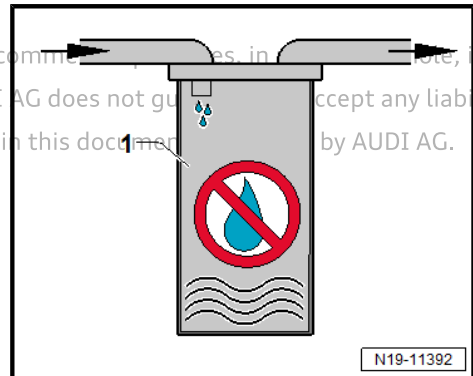


- When generating vacuum, make sure that water separator -1- in vacuum pump does not fill with coolant.

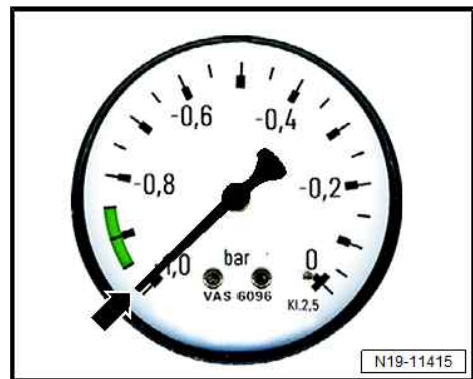
Caution

Risk of damage to electric vacuum pump due to coolant being drawn into pump.

Make sure that electric vacuum pump does not draw in any coolant. If necessary, stop procedure and discharge coolant expansion tank => [page 157](#).



- Using electric vacuum pump , generate vacuum until pointer on pressure gauge -arrow- is significantly below green area.
- Close cut-off valve -B- and switch electric vacuum pump - VAS 6096/2- off.
- Observe pressure gauge. The pointer on the pressure gauge must not move.
- If the requirements are fulfilled, the cooling system can be filled => [page 157](#) .





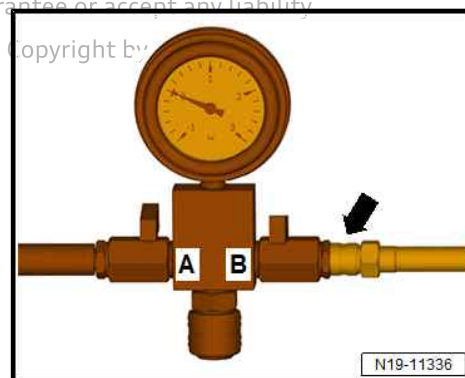
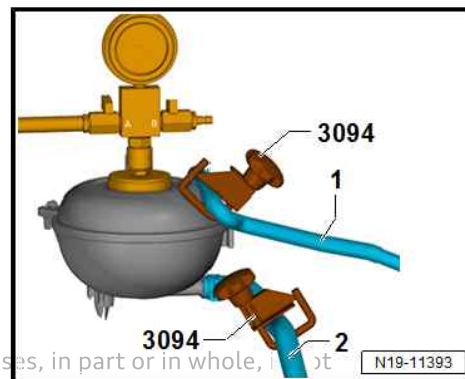
If the water separator in the electric vacuum pump fills with coolant, the coolant expansion tank must be discharged:

- Close cut-off valve -B- and switch electric vacuum pump off.
- Clamp off supply hose -2- and return hose -1- of coolant expansion tank with hose clamps up to 25 mm - 3094- .



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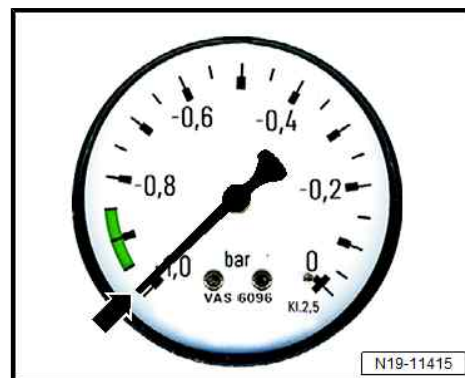
- Unplug plug-in connector -arrow- and open cut-off valve -B- to vent coolant expansion tank.
- Disconnect cooling system charge unit - VAS 6096- from test adapter - VAS 691 005/5- .
- Extract coolant from coolant expansion tank.
- Plug cooling system charge unit back into test adapter and remove hose clamps.
- Switch electric vacuum pump back on and continue generating vacuum.



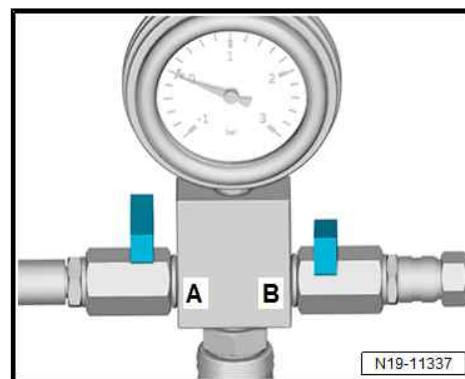
Filling cooling system:

Important:

- The pointer on the pressure gauge -arrow- must be significantly below the green area.



- Open cut-off valve -A- slowly to prevent foam build-up in coolant.
- The vacuum in the cooling system causes the coolant to be drawn out of the coolant filling device -VAS 6968-; the cooling system is then filled.
- After filling, close cut-off valve -A-.
- Disconnect electric vacuum pump - VAS 6096/2- , cooling system charge unit - VAS 6096- and test adapter - VAS 691 005/5- from coolant expansion tank.





- Coolant must be topped up to MAX mark.
- Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation .
- Start engine.
- Set temperature to "HI".
- Switch off air conditioner compressor (press **AC**).
- LED in button should not light up.
- Set fresh air blower to lowest setting.
- 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 - Coolant circuit charge**
- Follow instructions shown on ⇒ Vehicle diagnostic tester.
- Switch off engine.
- Check filling quality after completion of bleeding
⇒ ["1.5 Checking filling quality of cooling system", page 159](#) .



Checking coolant level after repair work



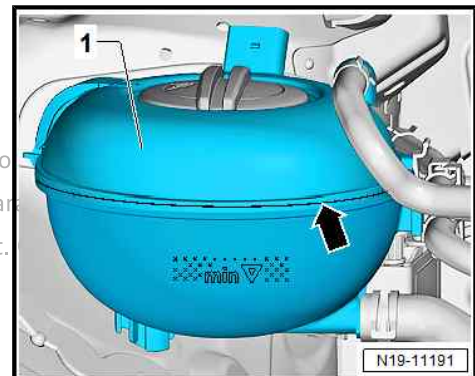
WARNING

Risk of scalding due to hot steam and hot coolant.

- ◆ *The cooling system is under pressure when the power unit is hot.*
- ◆ *To allow pressure to dissipate, cover filler cap on coolant expansion tank with cloth and open carefully.*

- The coolant level must not be above the -seam- -arrow- when the engine is warm.

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- The coolant level should be about 5 mm above the MAX mark -arrow- when the engine is cold.

Note:

The increased coolant level is necessary as the coolant level can drop during the bleeding process.

- Top up with coolant again if necessary.
- Install engine cover panel
⇒ "3 Engine cover panel", page 39 .
- Erase event memory ⇒ Vehicle diagnostic tester.



1.5 Checking filling quality of cooling system



Note

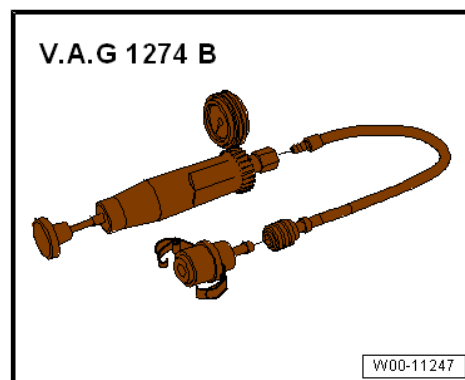
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It is necessary to check the filling quality in order to determine whether there is air in the cooling system. If there is air in the cooling system, the coolant level may gradually drop below the minimum level. The engine may also overheat.

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Special tools and workshop equipment required

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

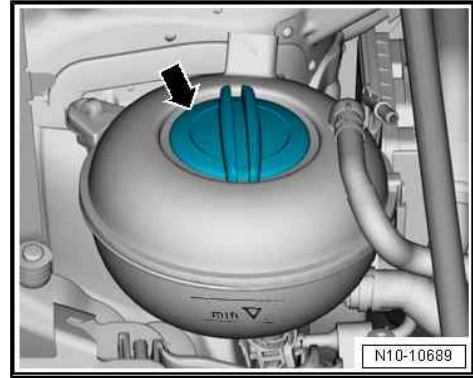


Air conditioner/heater setting

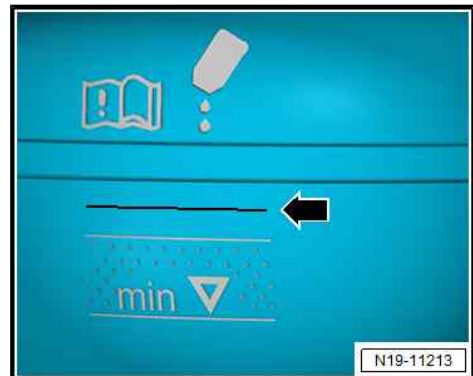
- Ignition switched off
- Coolant temperature between 40 °C and 60 °C



- Open sealing cap -arrow-.



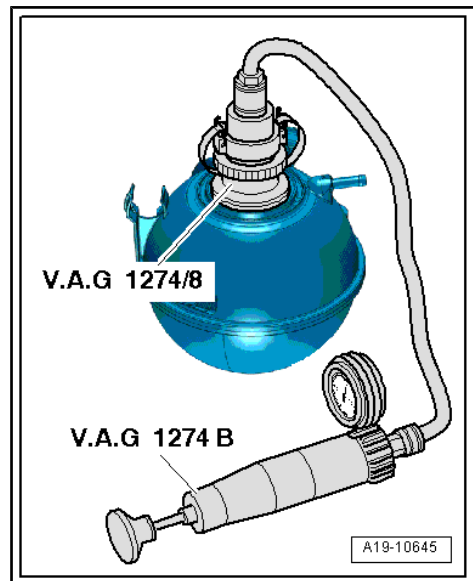
- Check coolant level; it should be approx. 5 mm -arrow- above max. marking. Top up coolant if necessary.



- Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/8- onto coolant expansion tank.
- Using hand pump on cooling system tester, build up a pressure of 1.5 bar.
- Observe coolant level in expansion tank.

If coolant level in expansion tank drops by more than 30 mm, this indicates that there is an air bubble in the cooling system. The bleeding procedure must be performed using the vehicle diagnostic tester.

If coolant level in expansion tank drops by less than 30 mm, the cooling system is filled correctly.



- After the system has been bled, fill in coolant up to approx. 5 mm -arrow- above max. marking.



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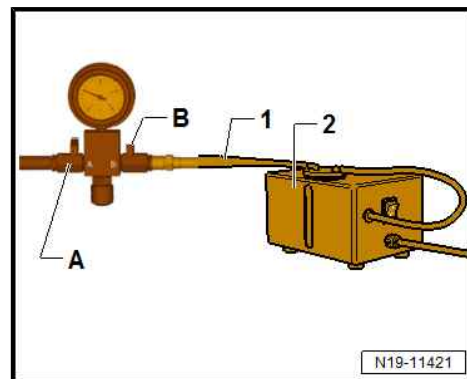
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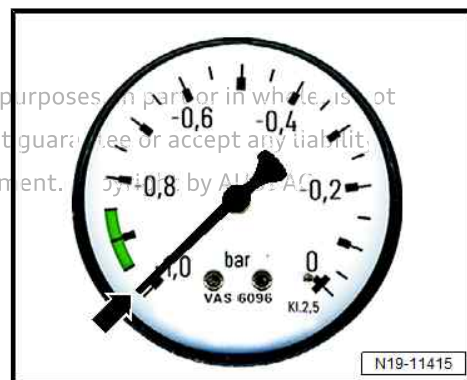
1.6 Checking electric vacuum pump - VAS 6096/2-

Note:

- ◆ To ensure that the cooling system is filled correctly, the cooling system charge unit - VAS 6096- and electric vacuum pump - VAS 6096/2- must be checked before use.
- Connect hose -1- of electric vacuum pump - VAS 6096/2- to cooling system charge unit - VAS 6096- at plug-in connector -B-.
- Connect electric vacuum pump - VAS 6096/2- to vehicle battery and switch pump on.
- Close valve -A- and open valve -B-.



- The pointer on the pressure gauge -arrow- must move to significantly below the green area.
- Close valve -B- and switch electric vacuum pump - VAS 6096/2- off.
- Observe vacuum on pressure gauge for 10 seconds. The pointer must not move.



If sufficient vacuum does not build up, or if pressure rises again:

Cooling system charge unit - VAS 6096- , pressure gauge or electric vacuum pump - VAS 6096/2- has a leak or is defective and must not be used.

1.7 Flushing cooling system

During flushing, old coolant is replaced by new coolant.

- ◆ Coolant is strongly discoloured
- ◆ Coolant has an unnatural or unusual smell
- ◆ Particles are visible in coolant
- ◆ Deposits have formed in coolant expansion tank

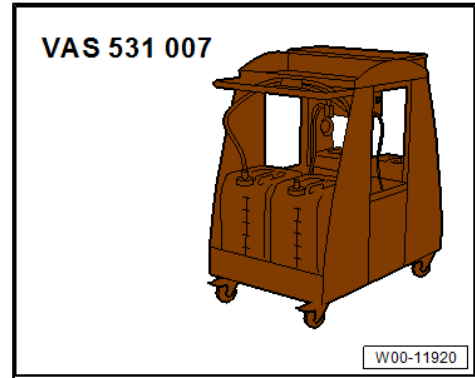
Note:

- ◆ Coolant is drained before flushing. The cooling system is then filled with distilled water.
- ◆ The cooling system is then flushed with approx. 12 litres of distilled water. The distilled water is then replaced by coolant (ratio 50:50).
- ◆ The cooling system is bled with the ⇒ Vehicle diagnostic tester after changing the coolant.
- ◆ Do not reuse coolant.
- ◆ A quick reference guide can be found under ⇒ ["1.8 Flushing cooling system - quick reference guide", page 182](#) . The quick reference guide lists the main steps in the procedure. The quick reference guide can be printed out and the steps checked off during the procedure.

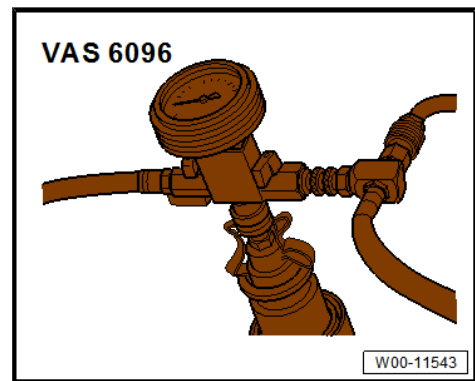
Special tools and workshop equipment required



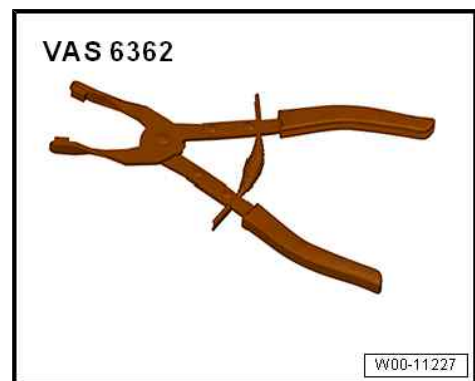
- ◆ Test instrument adapter - VAS 691 005/5-
- ◆ Flushing and filling unit for cooling system - VAS 531 007-



- ◆ Cooling system charge unit - VAS 6096-



- ◆ Hose clip pliers - VAS 6362-



- ◆ Refractometer T10007 A. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.





- ◆ 2x hose clamps, up to 25 mm - 3094-



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- ◆ Compressed air connection, 7 ... 10 bar

Overview – flushing and filling unit for cooling system - VAS 531 007- :

1 - Container with distilled water

- ❑ Fill with at least 20 litres of distilled water
- ❑ 12 litres of this is required for flushing
- ❑ 8 litres are used as a safety reserve and remain in canister

2 - Container with coolant

- ❑ Fill with at least 20 litres of coolant
- ❑ 12 litres of this is required for flushing
- ❑ 8 litres are used as a safety reserve and remain in canister
- ❑ Coolant additive: up to approx. -36 °C (ratio 50:50)

3 - Empty container

- ❑ For used coolant

4 - Empty container

- ❑ For used coolant

5 - Suction hose

- ❑ From connection 2 on sight glass

6 - Sight glass

- ❑ If discoloured, sight glass must be cleaned with a nylon brush

7 - Pump

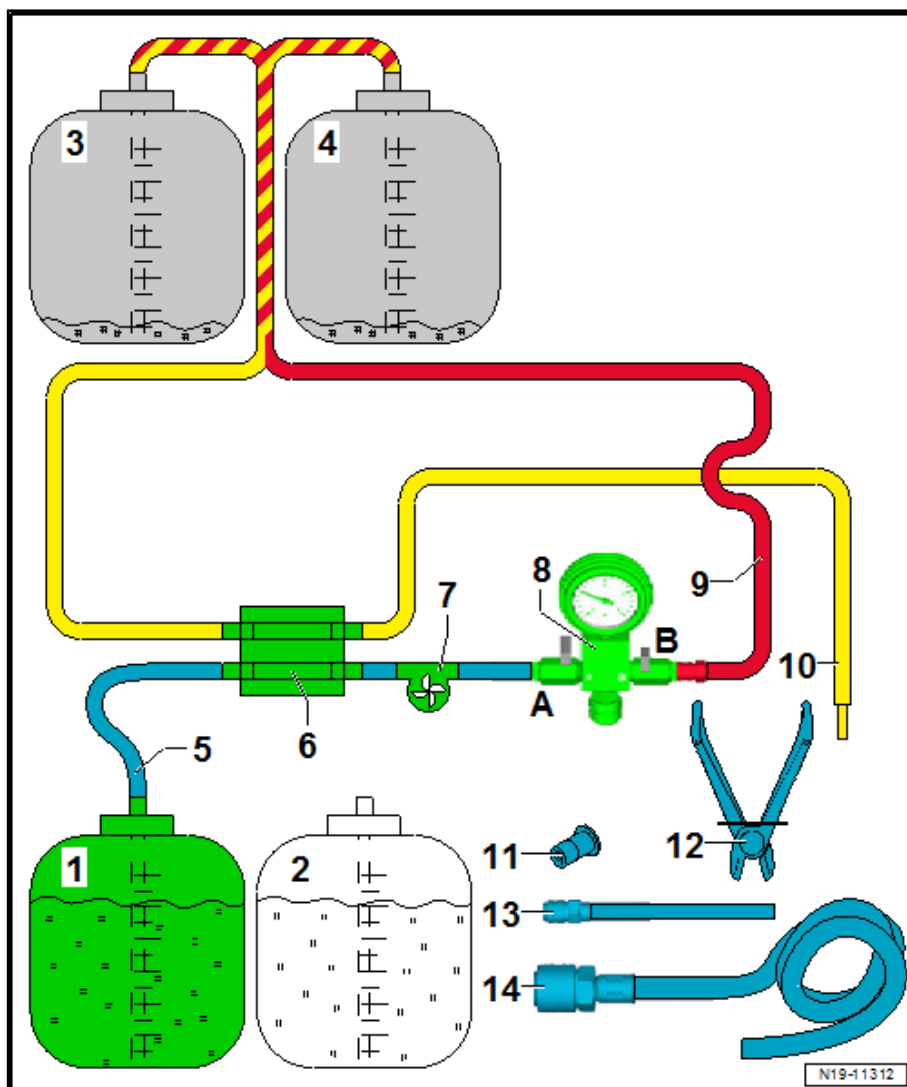
- ❑ Shut-off pressure: approx. 1.5 bar

8 - Valve block

- ❑ With pressure gauge and cut-off valves

9 - Drain hose

- ❑ For reducing pressure; connected to valve block





10 - Flushing hose

- For flushing; connected to breather hose of coolant expansion tank
- From connection 1 on sight glass
- If not being used: seal off with sealing plugs

11 - Sealing plug

12 - Hose clamps

- 4x

13 - Cleaning adapter

- Approx. 15 cm in length
- For cleaning flushing and filling unit for cooling system - VAS 531 007- after flushing
- Connected between valve block and flushing hose ⇒ [Item 10 \(page 164\)](#)

14 - Extraction adapter

- Approx. 100 cm in length
- For extracting coolant; connected to suction hose ⇒ [Item 5 \(page 163\)](#)

Preparing flushing and filling unit for cooling system - VAS 531 007- :

- Fill container 1 with at least 20 litres of distilled water.
- Fill container 2 with at least 20 litres of coolant (ratio 50:50; approx. -36 °C).
- Drain containers 3 and 4.
- Connect battery charger.
- Disconnect valve block from plug-in connector on equipment trolley.
- Connect flushing and filling unit for cooling system - VAS 531 007- to battery.

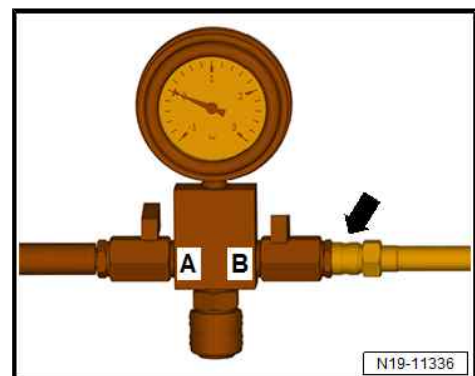
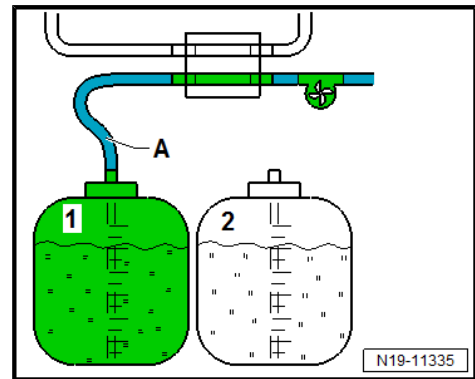
Bleeding flushing and filling unit for cooling system - VAS 531 007- :

- Connect suction hose -A- to container »1« with distilled water.

- Insert drain hose -arrow- into plug-in connector -B- on valve block.



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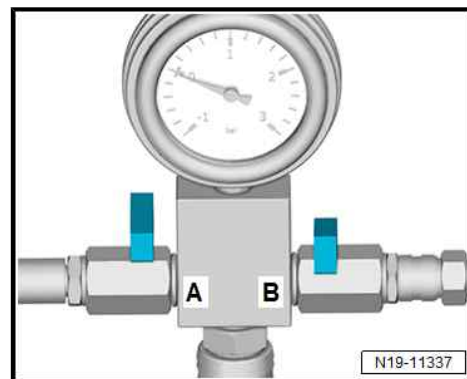




- Close cut-off valves -A- and -B-.

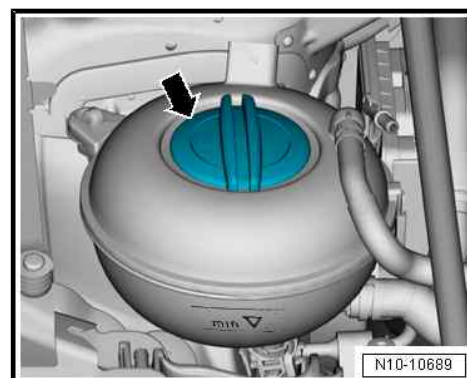
Note:

- ◆ Do not plug valve block into adapter for cooling system tester - V.A.G 1274/8- . The filler hose must be bled first.
- Switch pump for flushing and filling unit for cooling system - VAS 531 007- on.
- Open cut-off valve -A-.
- Briefly open cut-off valve -B- to bleed filler hose.
- Close cut-off valves -A- and -B- again.

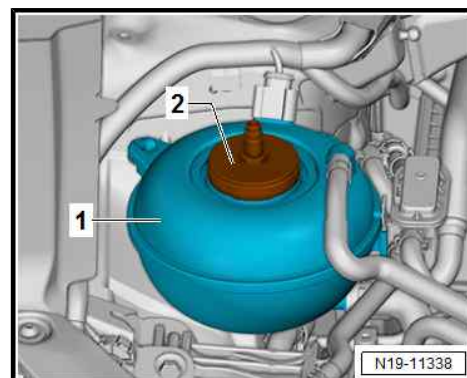


Connecting flushing and filling unit for cooling system - VAS 531 007- :

- Open filler cap -arrow- on coolant expansion tank.



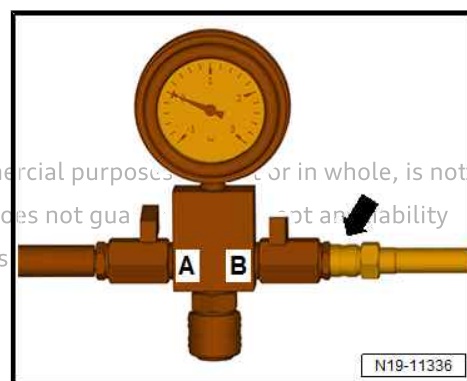
- Screw test adapter - VAS 691 005/5- -2- onto coolant expansion tank -1-.



- Disconnect drain hose -arrow- from plug-in connector -B- on valve block.

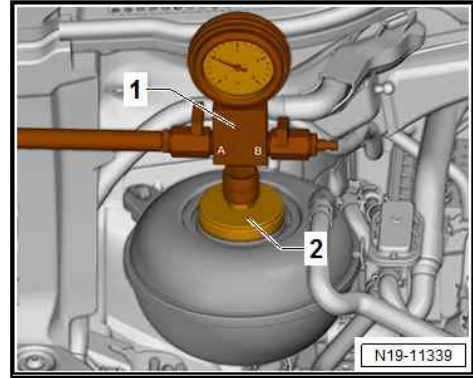


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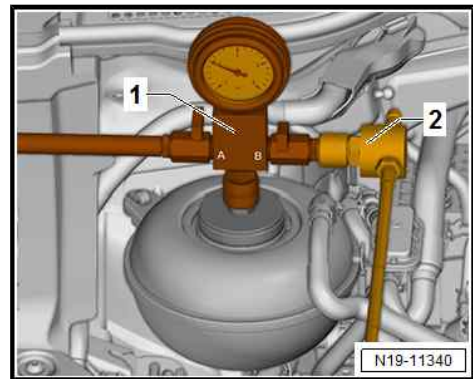
- Plug valve block -1- into test adapter -2-.



- Connect suction-jet pump -2- from cooling system charge unit - VAS 6096- to plug-in connector -B- on valve block -1-.

Note:

- ◆ The electric vacuum pump - VAS 6096/2- can be used instead of the suction-jet pump to generate a vacuum. Connect electric vacuum pump and generate vacuum.



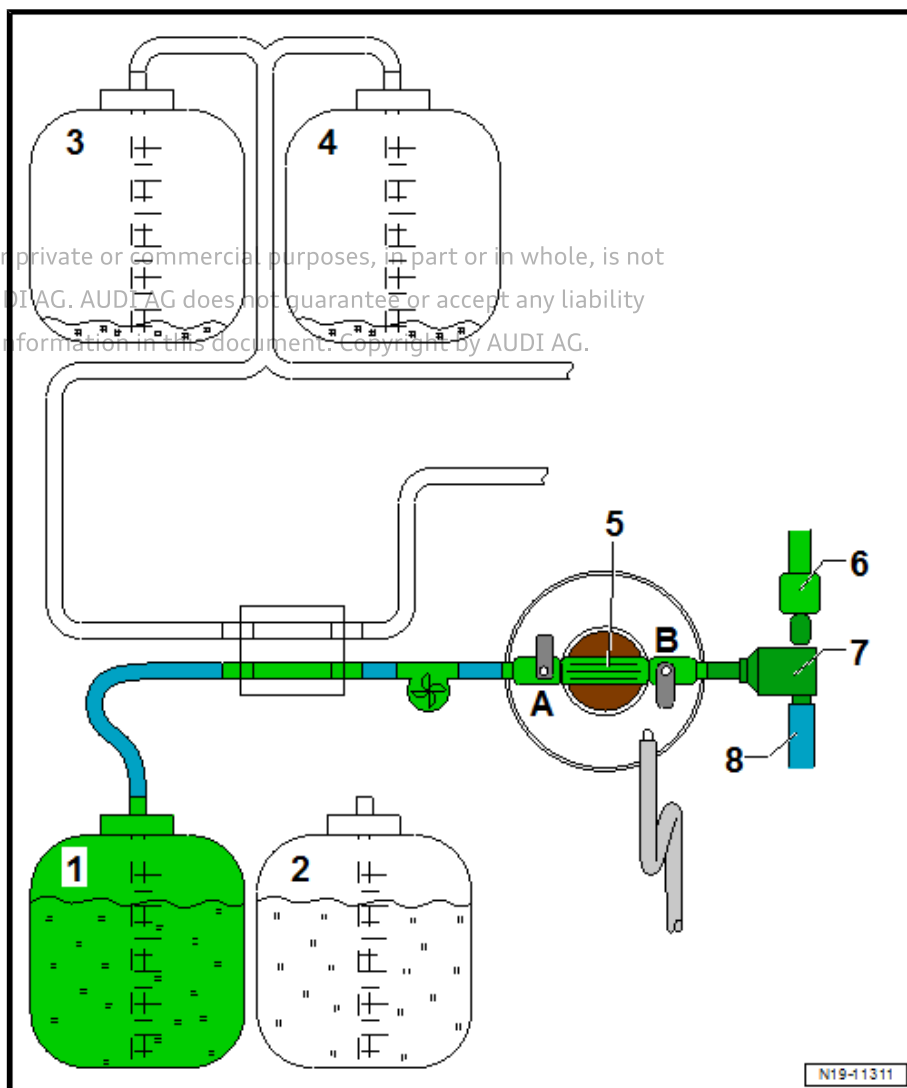
Filling cooling system with distilled water:



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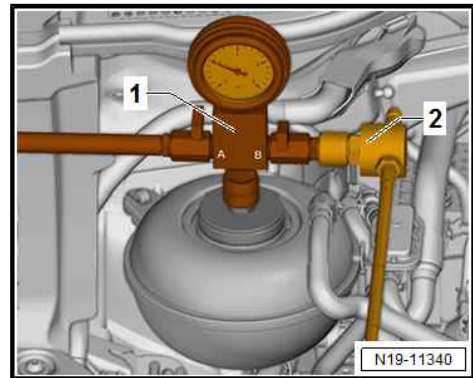
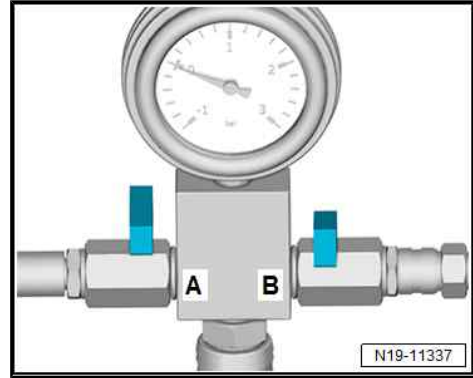
- Run vent hose -8- of suction-jet pump into a container.
- Connect compressed air hose -6- to suction-jet pump -7-.
- Open cut-off valve -B- on valve block -5-.
- The suction jet pump generates a vacuum in the cooling system. The pointer on the pressure gauge must drop to - 0.85 bar or lower.
- Close shut-off valve -B-.
- Detach compressed air hose -6-.
- Observe pressure gauge. The pointer on the pressure gauge must remain stationary at - 0.85 bar. The vacuum level in the cooling system is then sufficient for subsequent filling.

Note:

- ◆ Check cooling system for leaks if the vacuum is not maintained.
- ◆ The vacuum generated depends on the pressure in the compressed air system.



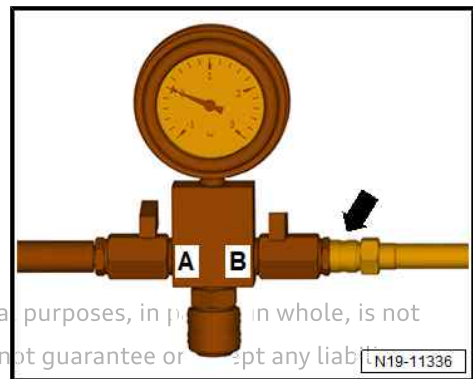
- Pump of flushing and filling unit for cooling system - VAS 531 007- must be switched on.
- Open cut-off valve -A- slowly.
- The vacuum in the cooling system causes distilled water to be drawn out; the cooling system is then filled. Additionally, the pump of the flushing and filling unit for cooling system - VAS 531 007- pumps distilled water into the coolant expansion tank.
- After filling, the vacuum in the coolant expansion tank must be released as follows:
 - After filling, close cut-off valve -A-.
 - Disconnect suction-jet pump -2- from valve block -1-.



- Plug drain hose -arrow- into plug-in connector. Open cut-off valve -B- and leave open to release pressure in cooling system.

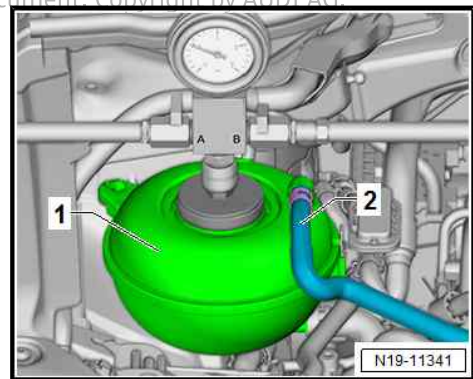


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Flushing cooling system with distilled water:

- Disconnect breather hose -2- from coolant expansion tank -1-.





- Connect breather hose -2- of coolant expansion tank to flushing hose -1-.
- Seal connection on coolant expansion tank with plug -3-. Secure plug with a hose clip.
- Close shut-off valve -B-.
- Remove engine cover panel.

Vehicles with variable valve timing:

- Remove air cleaner housing ⇒ [page 246](#) .

All vehicles (continued):

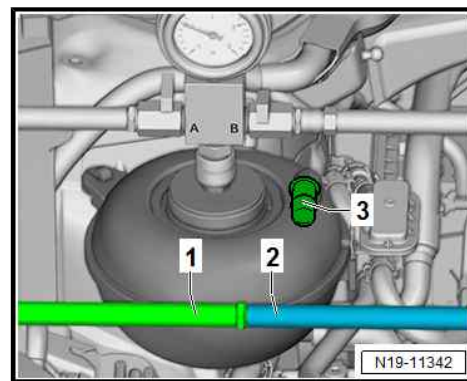
The cooling system consists of the following coolant circuits:

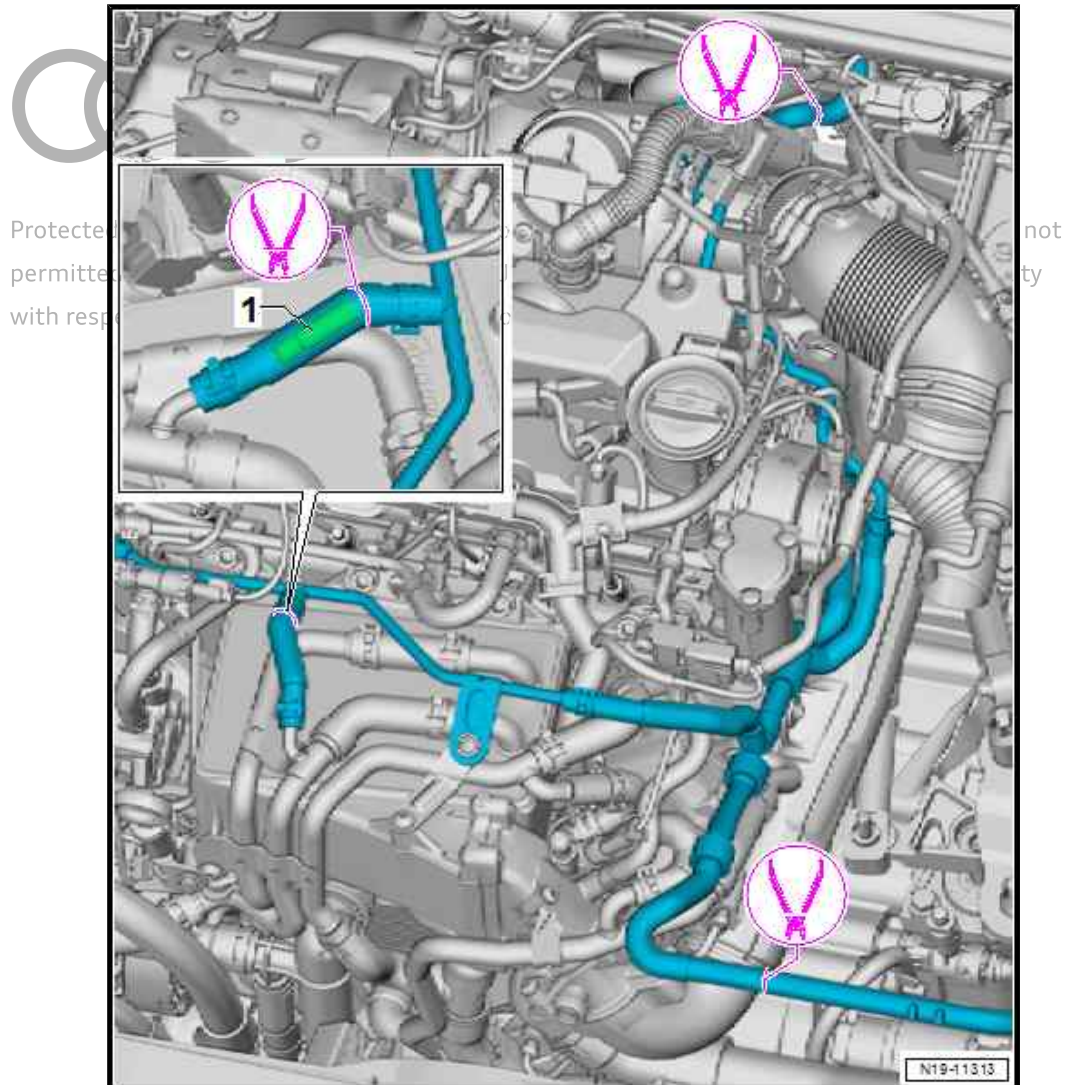
- ◆ Cylinder block and cylinder head
- ◆ Heat exchanger for heater
- ◆ Radiator
- ◆ Charge air cooler and water radiator for charge air cooling circuit

Note:

- ◆ In the following procedure, the 4 coolant circuits are flushed by clamping the breather hoses shut alternately.
- ◆ This procedure must be carried out twice with distilled water and then twice with coolant.
- ◆ The values given in litres are mean values and may differ depending on the vehicle equipment. The amount can be read off the scale on the container.
- ◆ The change in colour at connection 1 in the sight glass is used to determine the flush volume. The colour at connections 1 and 2 does not become the same until after the second flushing cycle.
- ◆ Once the change in colour is visible in the sight glass the next coolant circuit is flushed.

1. Flushing cylinder block and cylinder head with distilled water:

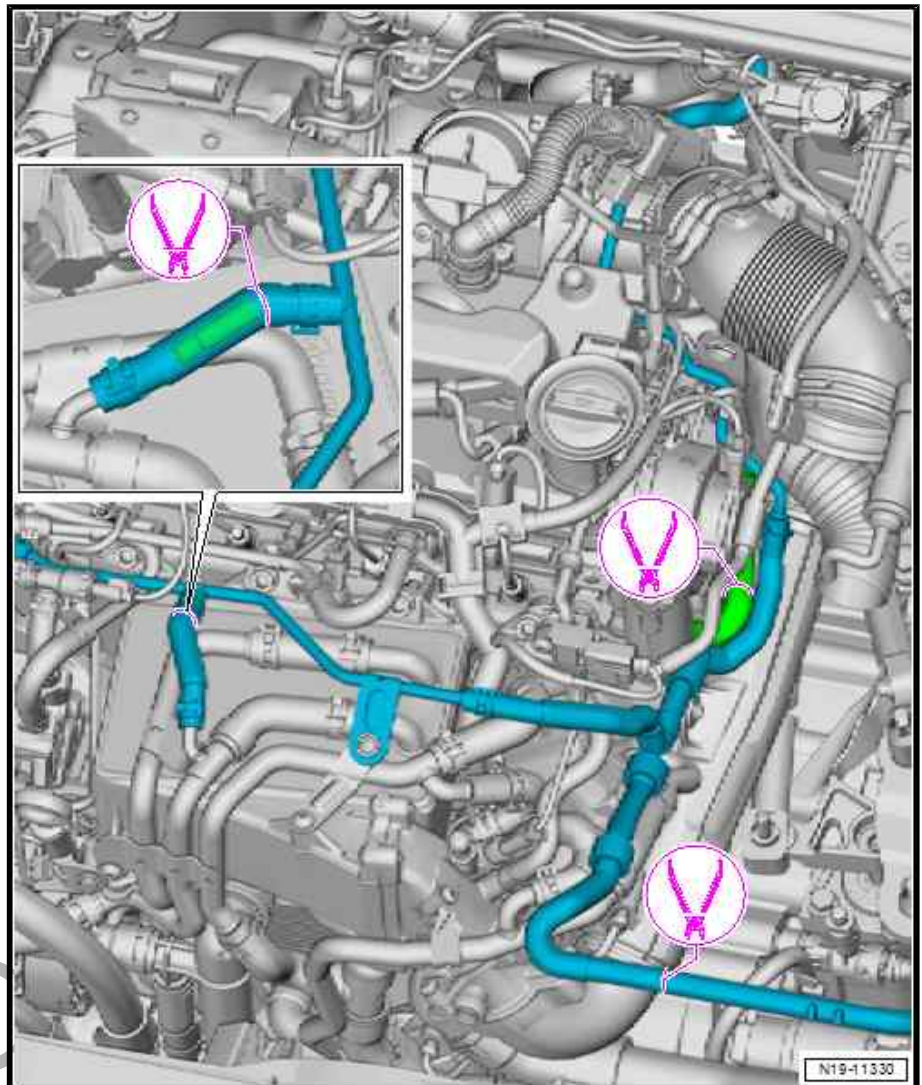




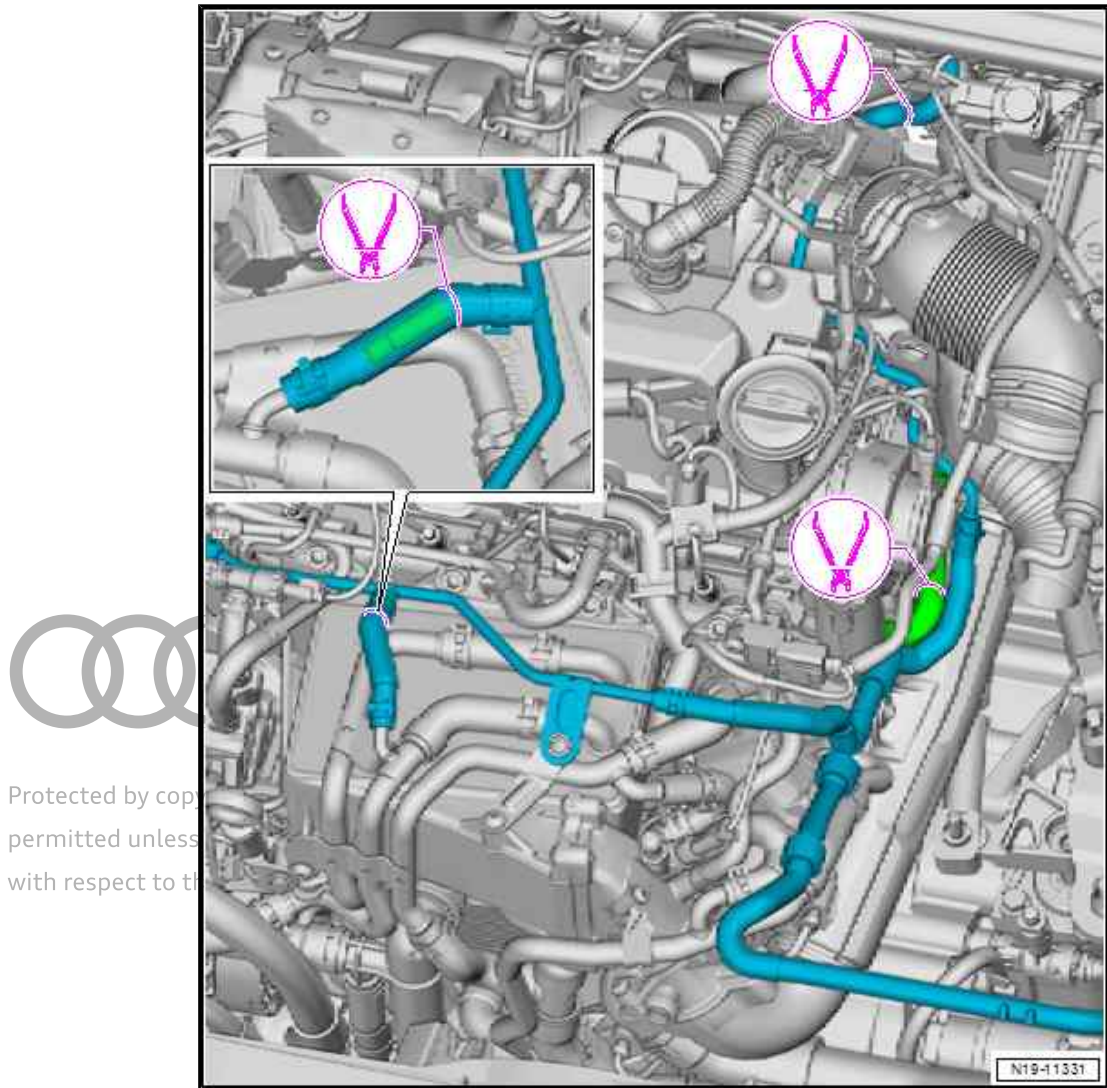
A non-return valve -1- is fitted in the breather hose of the charge air cooler. The hose must therefore be clamped shut at the positions shown.

- Clamp breather hoses shut at positions shown.
- Open cut-off valve -A- on valve block. Distilled water is now pumped through the engine.
- Observe sight glass: once coolant begins to discolour, close cut-off valve -A-.
- Required amount of distilled water: approx. 2 to 3 litres

2. Flushing heat exchanger for heater with distilled water:



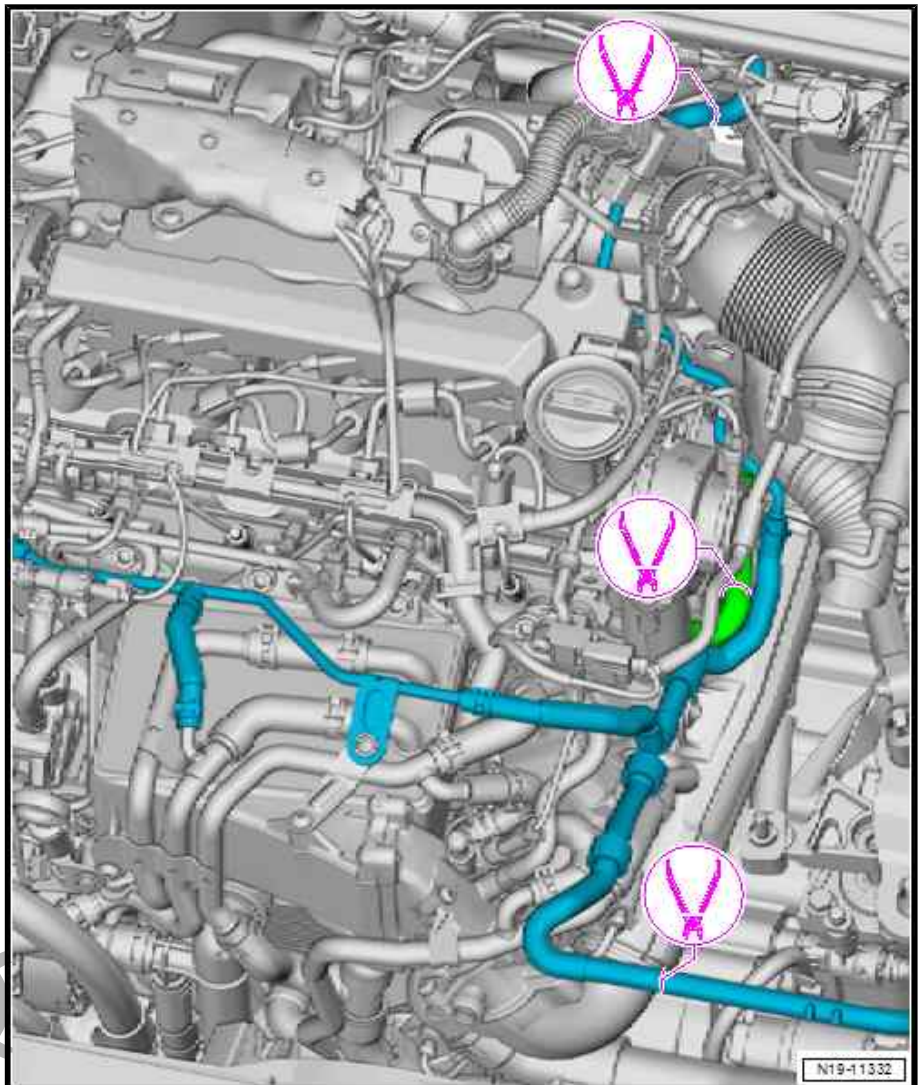
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- Clamp breather hoses shut at positions shown.
 - Open cut-off valve -A- on valve block. Distilled water is now pumped through the engine.
 - Observe sight glass: once coolant begins to discolour, close cut-off valve -A-.
 - Required amount of distilled water: approx. 2 litres
- 3. Flushing radiator with distilled water:**



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- Clamp breather hoses shut at positions shown.
- Open cut-off valve -A- on valve block. Distilled water is now pumped through the engine.
- Observe sight glass: once coolant begins to discolour, close cut-off valve -A-.
- Required amount of distilled water: approx. 2 litres

4. Flushing charge air cooler and water radiator for charge air cooling circuit with distilled water:

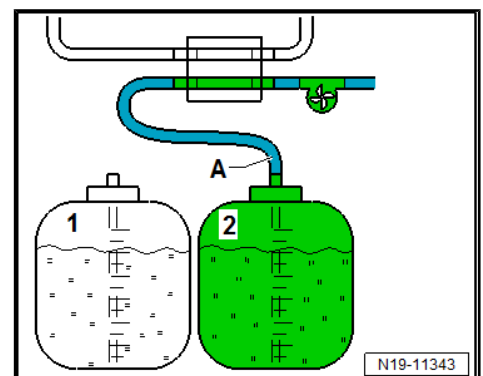


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- Clamp breather hoses shut at positions shown.
 - Open cut-off valve -A- on valve block. Distilled water is now pumped through the engine.
 - Observe sight glass: once coolant begins to discolour, close cut-off valve -A-.
 - Required amount of distilled water: approx. 2 litres

Repeat flushing cycles 1 to 4 but pump only approx. 1 litre of distilled water through ⇒ [page 169](#) . Then flush cooling system with coolant.

Flushing cooling system with coolant

- Connect suction hose -A- to container -2- for coolant.

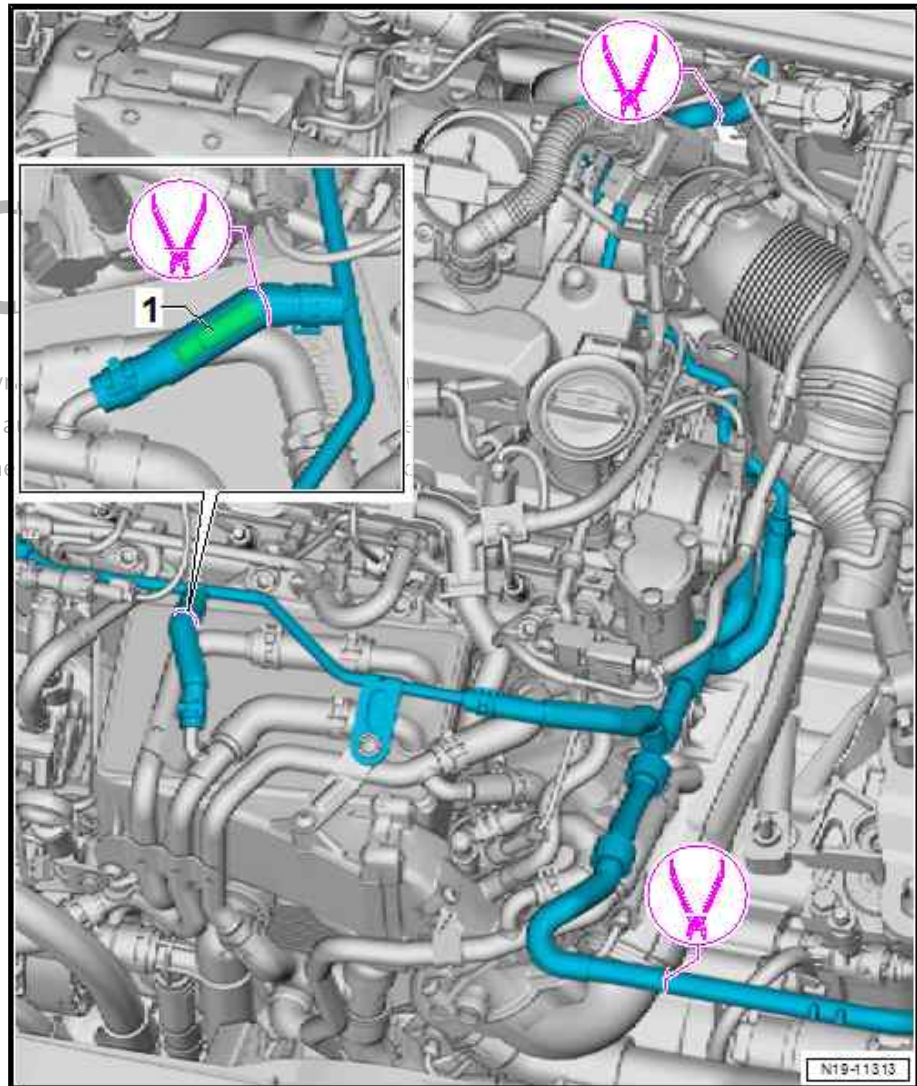




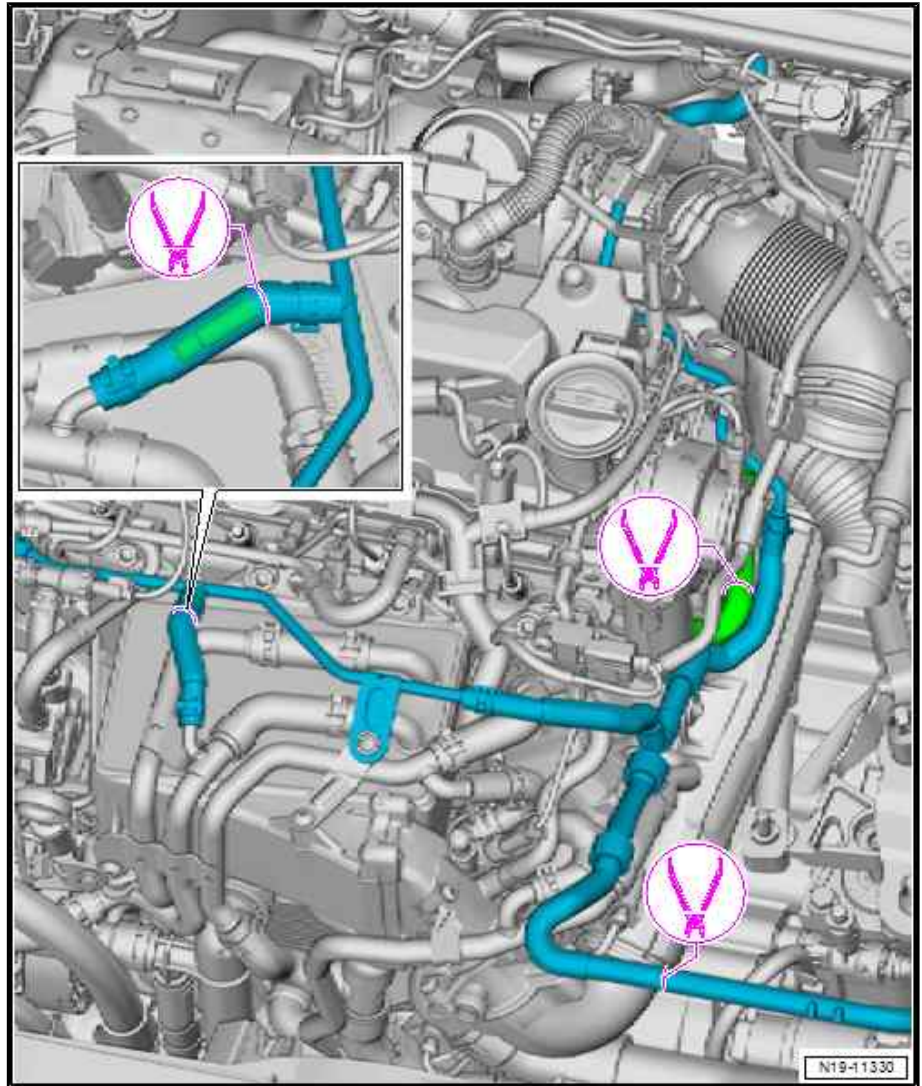
1. Flushing cylinder block and cylinder head with coolant:



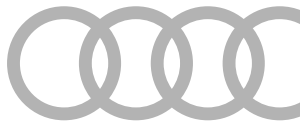
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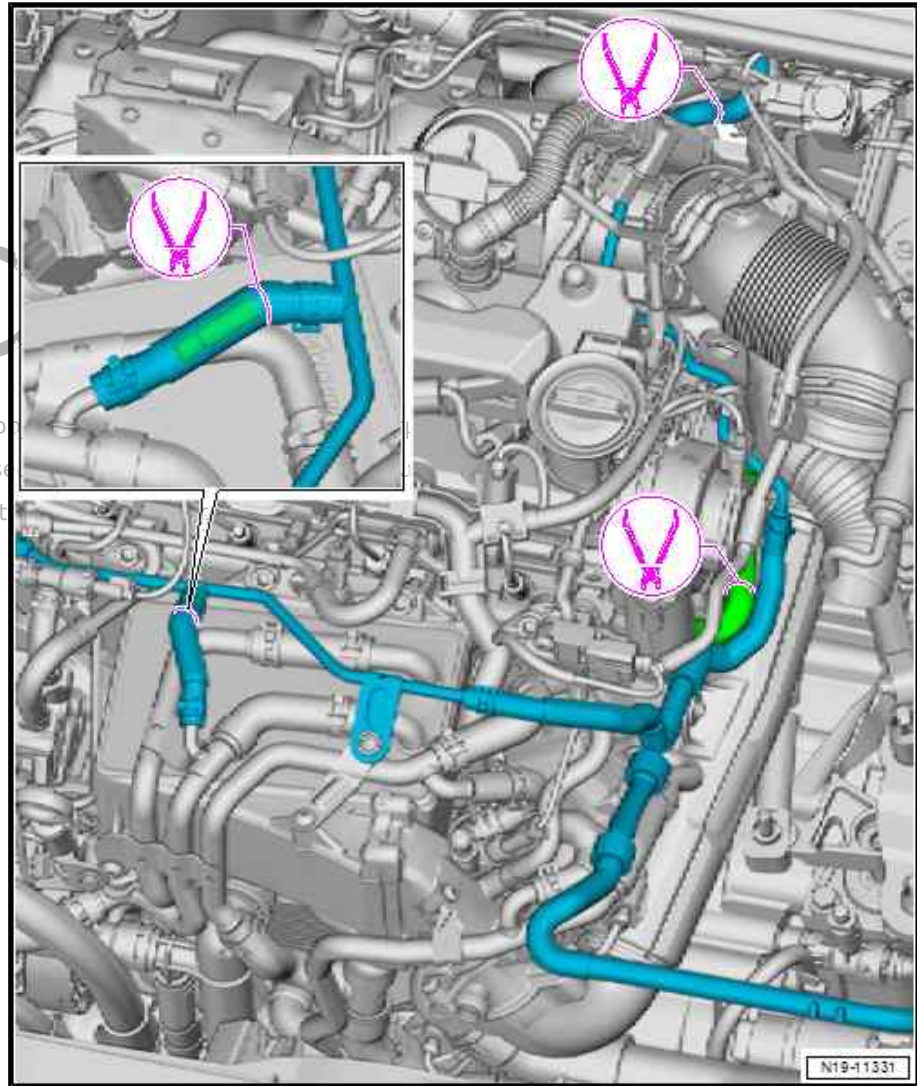
- Clamp breather hoses shut at positions shown.
 - Open cut-off valve -A- on valve block. Coolant is now pumped through the engine.
 - Observe sight glass: once emerging coolant becomes visible in sight glass, close cut-off valve -A-.
 - Required amount of coolant: approx. 2 to 3 litres
- ## 2. Flushing heat exchanger for heater with coolant:



- Clamp breather hoses shut at positions shown.
 - Open cut-off valve -A- on valve block. Coolant is now pumped through the engine.
 - Observe sight glass: once emerging coolant becomes visible in sight glass, close cut-off valve -A-.
 - Required amount of coolant: approx. 2 litres
3. Flushing radiator with coolant:

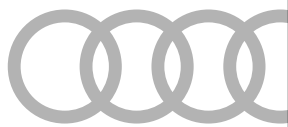


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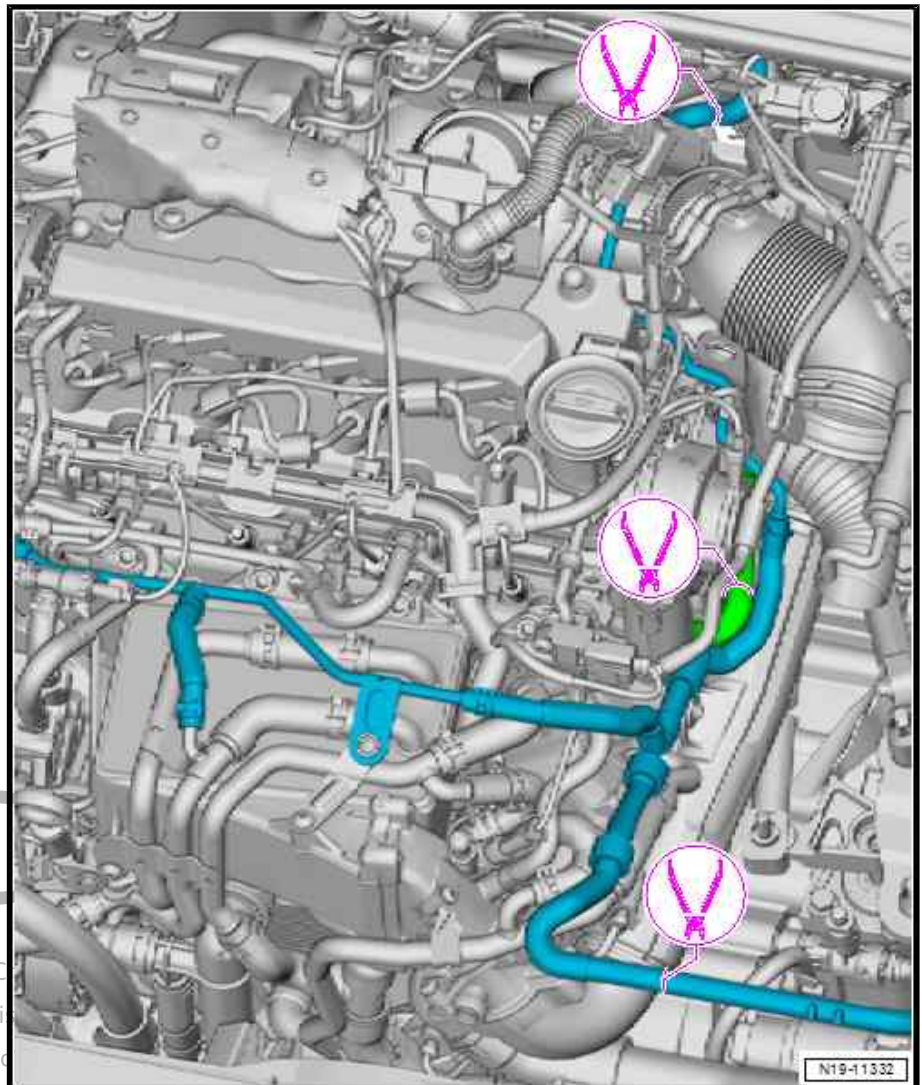


- Clamp breather hoses shut at positions shown.
- Open cut-off valve -A- on valve block. Coolant is now pumped through the engine.
- Observe sight glass: once emerging coolant becomes visible in sight glass, close cut-off valve -A-.
- Required amount of coolant: approx. 2 litres

4. Flushing charge air cooler and water radiator for charge air cooling circuit with coolant:



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- Clamp breather hoses shut at positions shown.
- Open cut-off valve -A- on valve block. Coolant is now pumped through the engine.
- Observe sight glass: once emerging coolant becomes visible in sight glass, close cut-off valve -A-.
- Required amount of coolant: approx. 2 litres

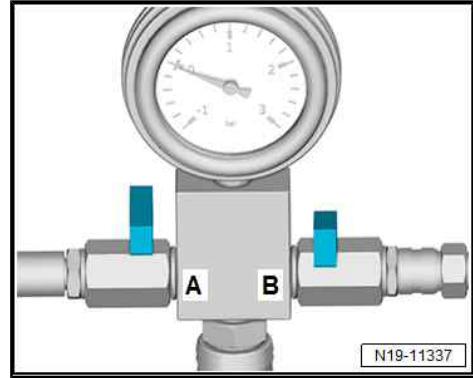
Repeat flushing cycles 1 to 4 but pump only approx. 1 litre of coolant through ⇒ [page 174](#) . The flushing procedure is then complete.

- Switch pump off after flushing procedure.
- Remove all hose clamps.

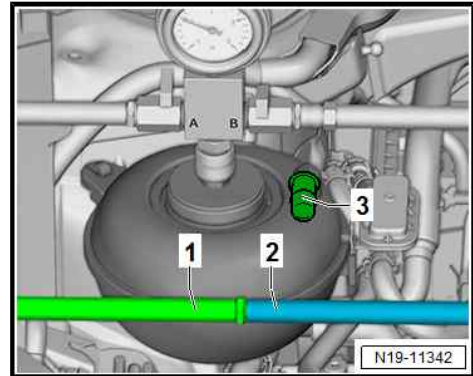


Disconnecting flushing and filling unit for cooling system - VAS 531 007- :

- Open cut-off valve -B- and leave open to release pressure in cooling system.



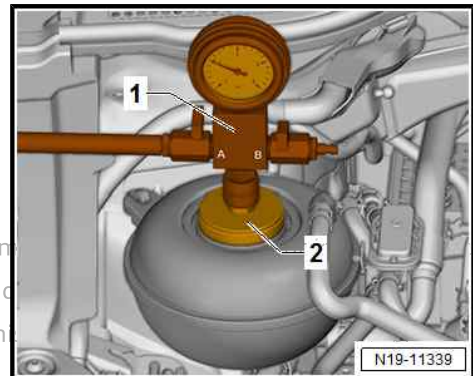
- Remove plug -3- from coolant expansion tank and reconnect breather hose -2-.
- Seal flushing hose -1- with plug.



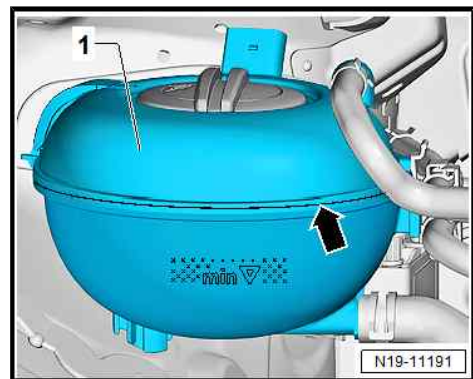
- Remove valve block -1- and test adapter - VAS 691 005/5-2-.



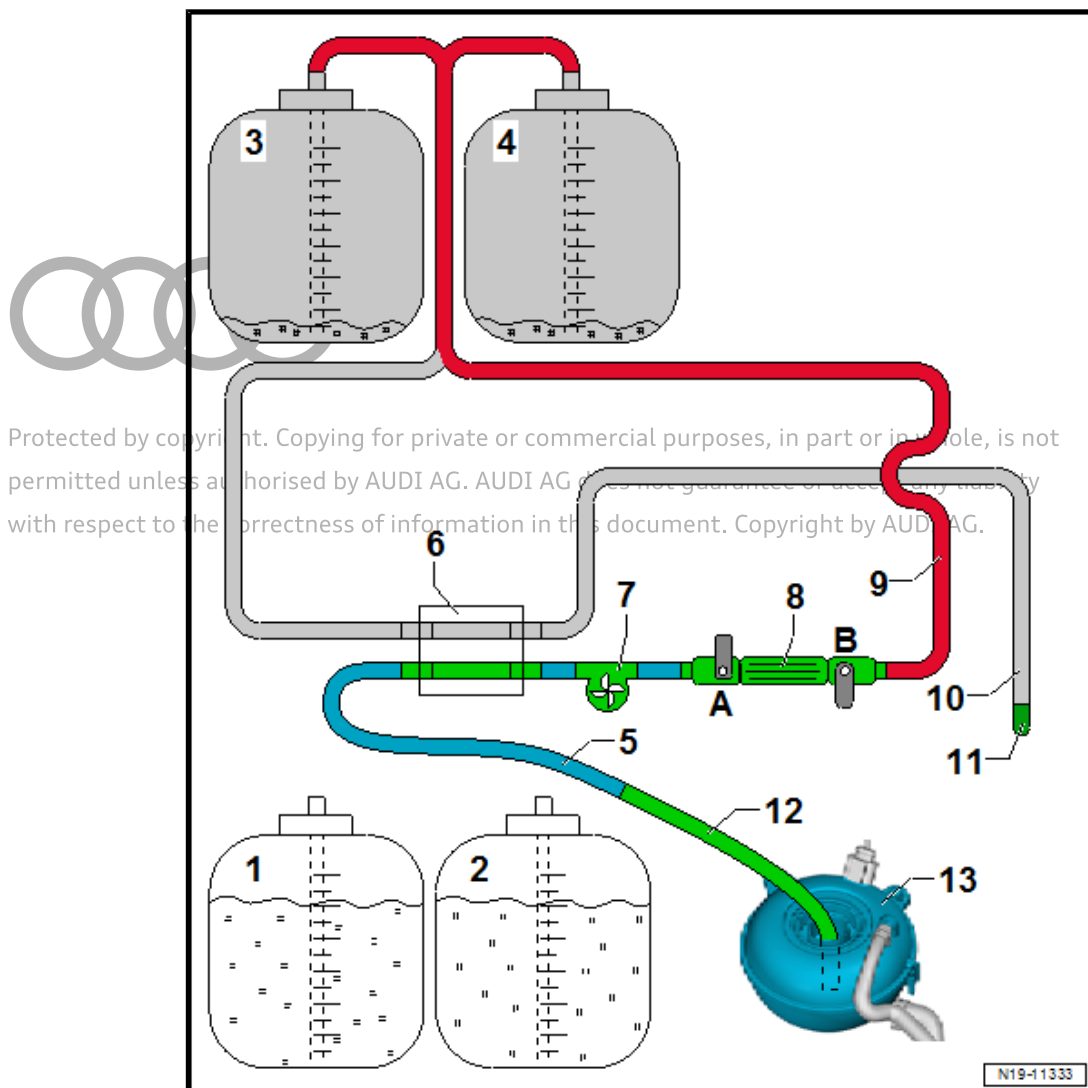
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- The coolant level should approximately reach the »seam« -arrow-.
- Extract or top up coolant if necessary.



Extracting coolant:



Note:

- ◆ Extraction adapter ⇒ [Item 14 \(page 164\)](#) is used to extract coolant.
- Detach suction hose -5- from container -2-.
- Plug extraction adapter -12- into plug-in connector of suction hose -5-.
- Switch pump -7- on and open cut-off valves -A- and -B- on valve block -8-.
- Extract excess coolant with extraction adapter -12-.
- Close cut-off valves on valve block and switch pump off.

Bleeding cooling system:

- Set temperature to “HI”.
- Switch off air conditioner compressor (press button).
- LED in button should not light up.
- Connect ⇒ Vehicle diagnostic tester.
- Select mode and then .



– 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 - Coolant circuit charge**

– Follow instructions shown on ⇒ Vehicle diagnostic tester.

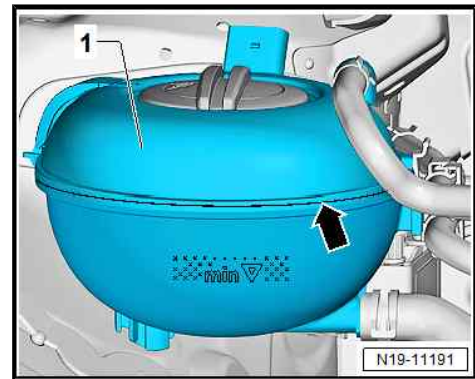
– Allow engine to cool down.

– Check coolant level and frost protection.

– If frost protection is not sufficient, extract coolant from coolant expansion tank. Top up coolant additive until correct frost protection is achieved.

– After topping up coolant additive, always allow the engine to run at increased speed for approx. 2 minutes then check frost protection again.

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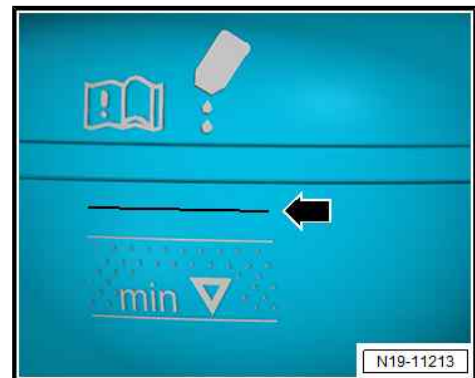
• The mixture must guarantee frost protection down to at least -25 °C (in countries with arctic climate: down to -36 °C). The amount of antifreeze should only be increased if greater frost protection is required in very cold climates. This must only be down to -48 °C, however, as otherwise the cooling efficiency of the coolant is impaired.

• The coolant level should reach the seam -arrow- when the engine is warm.

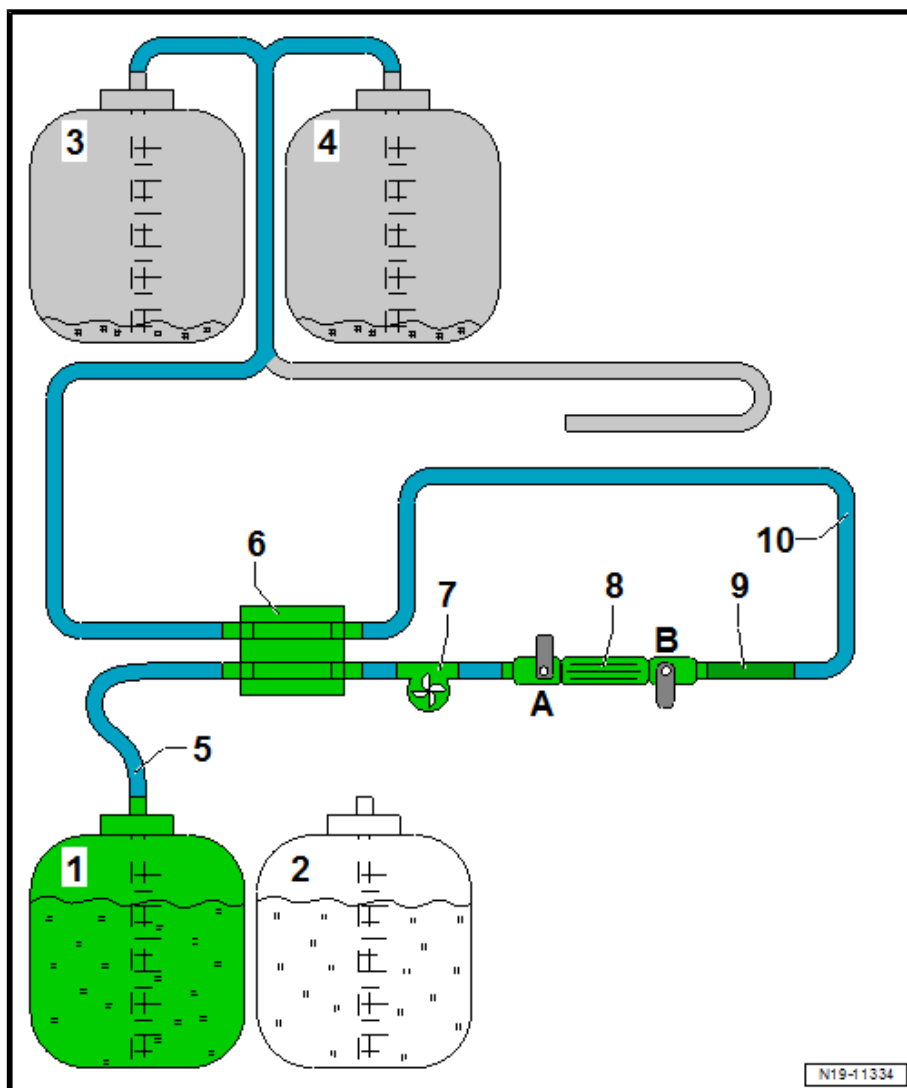
• The coolant level should be about 5 mm above the MAX mark -arrow- when the engine is cold.

Note:

◆ The increased coolant level is necessary as the coolant level can drop during the bleeding process.



Cleaning flushing and filling unit for cooling system - VAS 531 007- :



Note:

- ◆ Discolouration may occur if coolant is allowed to remain in the sight glass for long periods. The sight glass must therefore be flushed with distilled water after the flushing procedure.
- ◆ If the sight glass is discoloured it must be cleaned with a nylon brush.
- ◆ Use cleaning adapter ⇒ [Item 13 \(page 164\)](#) to flush.
- Connect suction hose -5- to container -1- for distilled water.
- Fit flushing hose -10- onto cleaning adapter -9-. Fit cleaning adapter -9- onto plug-in connector -B- on valve block -8-.
- Open cut-off valves -A- and -B- on valve block -8-.
- Switch pump -7- on and pump distilled water through hoses until coolant in sight glass -6- has been flushed out.
- Switch pump off and close cut-off valves.
- Remove cleaning adapter and seal flushing hose with plug again.



1.8 Flushing cooling system - quick reference guide

Note:

- ◆ The quick reference guide lists the main steps in the procedure. It can be printed out and the steps checked off during the procedure. A detailed description of the procedure can be found in ⇒ ["1.7 Flushing cooling system", page 161](#) .

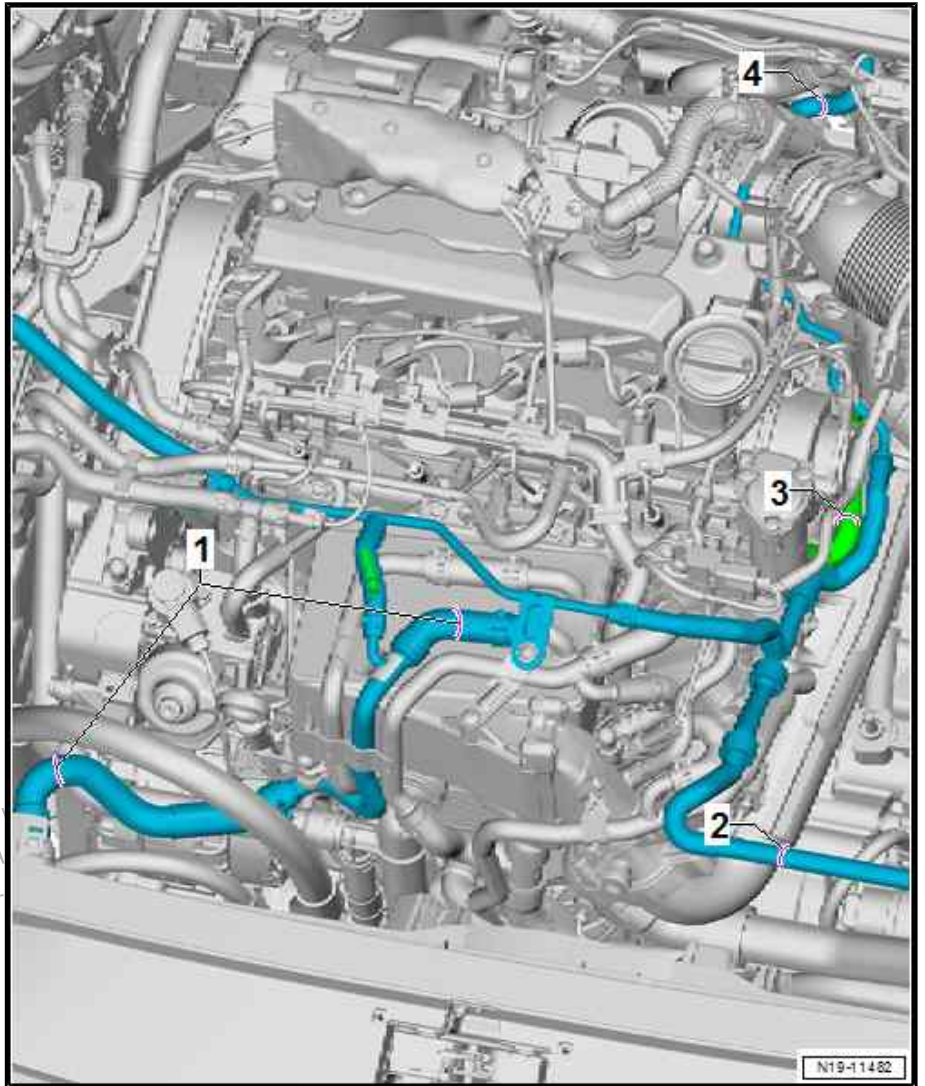
Step	Operation	Flush volume
1	Draining coolant	---
2	Fill cooling system with distilled water.	---
3	Connect breather hose of coolant expansion tank to flushing and filling unit for cooling system .	---
4	Clamp off hoses for charge air cooler -1-, breather hose for radiator -2- and breather hose for heat exchanger for heater -4-, and flush cooling system.	3 litres of distilled water
5	Clamp off hoses for charge air cooler -1-, breather hose for radiator -2- and breather hose for cylinder head -3-, and flush cooling system.	2 litres of distilled water
6	Clamp off hoses for charge air cooler -1-, breather hose for cylinder head -3- and breather hose for heat exchanger for heater -4-, and flush cooling system.	2 litres of distilled water
7	Clamp off breather hose for radiator -2-, breather hose for cylinder head -3- and breather hose for heat exchanger for heater -4-, and flush cooling system.	2 litres of distilled water
	Repeat steps 4, 5, 6 and 7 but only pump through 1 litre of distilled water each time.	1 litre of distilled water each time
8	Clamp off hoses for charge air cooler -1-, breather hose for radiator -2- and breather hose for heat exchanger for heater -4-, and flush cooling system.	3 litres of coolant
9	Clamp off hoses for charge air cooler -1-, breather hose for radiator -2- and breather hose for cylinder head -3-, and flush cooling system.	2 litres of coolant
10	Clamp off hoses for charge air cooler -1-, breather hose for cylinder head -3- and breather hose for heat exchanger for heater -4-, and flush cooling system.	2 litres of coolant
11	Clamp off breather hose for radiator -2-, breather hose for cylinder head -3- and breather hose for heat exchanger for heater -4-, and flush cooling system.	2 litres of coolant
	Repeat steps 8, 9, 10 and 11 but only pump through 1 litre of coolant each time.	1 litre of coolant each time
12	Remove all hose clamps.	---
16	Disconnect flushing and filling unit for cooling system and close coolant expansion tank.	---
17	Bleed cooling system using vehicle diagnostic tester.	---
18	Check frost protection and coolant level.	---

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Clamp positions



- 1 - Hoses for charge air cooler
- 2 - Breather hose for radiator
- 3 - Breather hose for cylinder head
- 4 - Breather hose for heat exchanger for heater



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2 Coolant pump/thermostat assembly

⇒ [“2.1 Exploded view - coolant pump/thermostat”, page 184](#)

⇒ [“2.2 Exploded view - electric coolant pump”, page 186](#)

⇒ [“2.3 Exploded view - coolant temperature senders”, page 187](#)

⇒ [“2.5 Removing and installing coolant pump”, page 191](#)

⇒ [“2.6 Removing and installing thermostat”, page 192](#)

⇒ [“2.7 Removing and installing coolant valve for cylinder head N489”, page 194](#)

⇒ [“2.8 Checking thermostat”, page 194](#)

⇒ [“2.9 Removing and installing coolant temperature sender G62”, page 194](#)

⇒ [“2.4 Removing and installing electric coolant pump”, page 187](#)

2.1 Exploded view - coolant pump/thermostat

1 - O-rings

- Renew after removing
- Lubricate with coolant

2 - Connection

3 - O-ring

- Renew after removing
- Lubricate with coolant

4 - Coolant pipe (bottom front)

- Removing and installing
⇒ [page 199](#)

5 - Seal

- Renew after removing

6 - O-ring

- Renew after removing
- Lubricate with coolant

7 - Coolant pump

- Removing and installing
⇒ [page 191](#)

8 - O-rings

- Renew after removing
- Lubricate with coolant

9 - Bolt

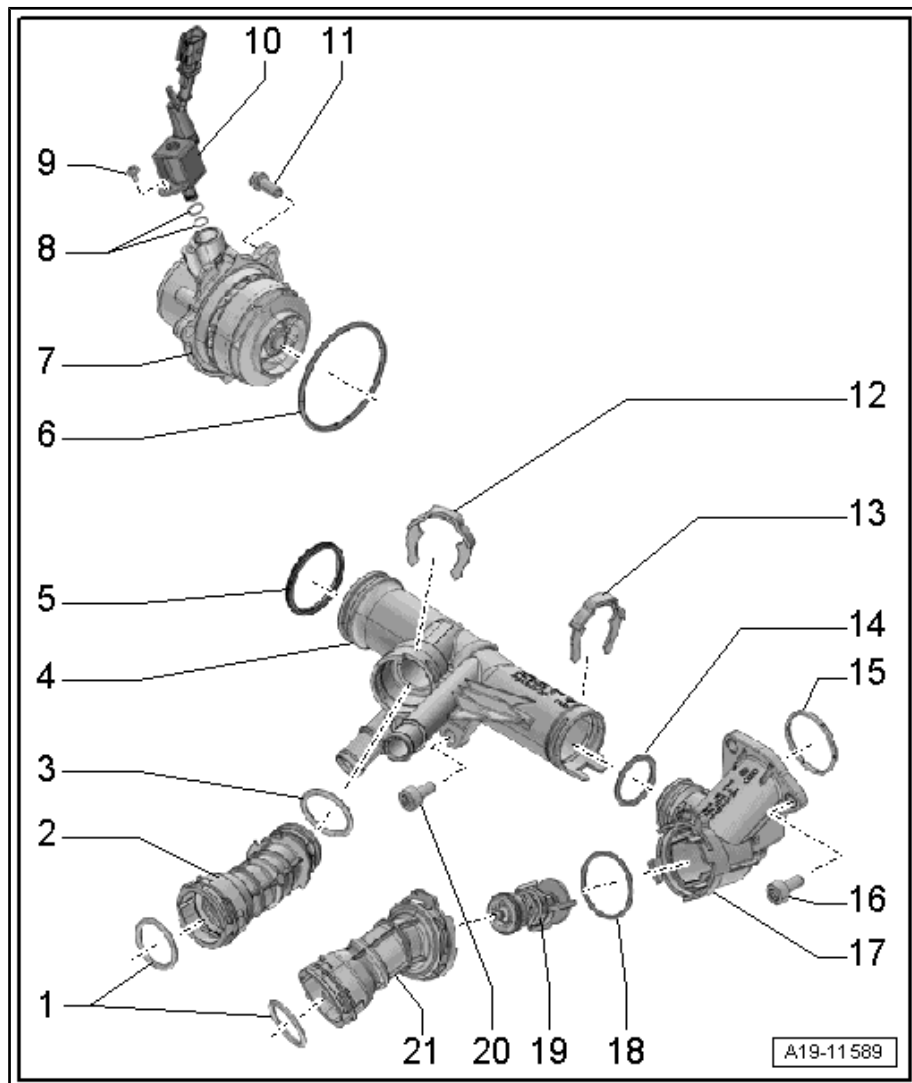
- 8 Nm

10 - Coolant valve for cylinder head - N489-

- Removing and installing
⇒ [page 194](#)

11 - Bolt

- Renew after removing
- 20 Nm +45°





12 - Retaining clip

- Check that it is securely seated

13 - Retaining clip

- Check that it is securely seated

14 - O-ring

- Renew after removing
- Lubricate with coolant

15 - Seal

- Renew after removing

16 - Bolt

- 20 Nm

17 - Thermostat housing

18 - O-ring

- Renew after removing
- Lubricate with coolant

19 - Thermostat

- Removing and installing ⇒ [page 192](#)

20 - Bolt

- 20 Nm

21 - Connection

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2.2 Exploded view - electric coolant pump

1 - Charge air cooling pump - V188-

- Removing and installing
⇒ [page 187](#)

2 - Coolant hose

3 - Coolant hose

4 - Bolt

- 40 Nm

5 - Bolt

- 40 Nm

6 - Auxiliary pump for heating - V488-

- Removing and installing
⇒ [page 189](#)

7 - Coolant hose

8 - Coolant hose

9 - Bracket

- For auxiliary pump for heating - V488-

10 - Clips

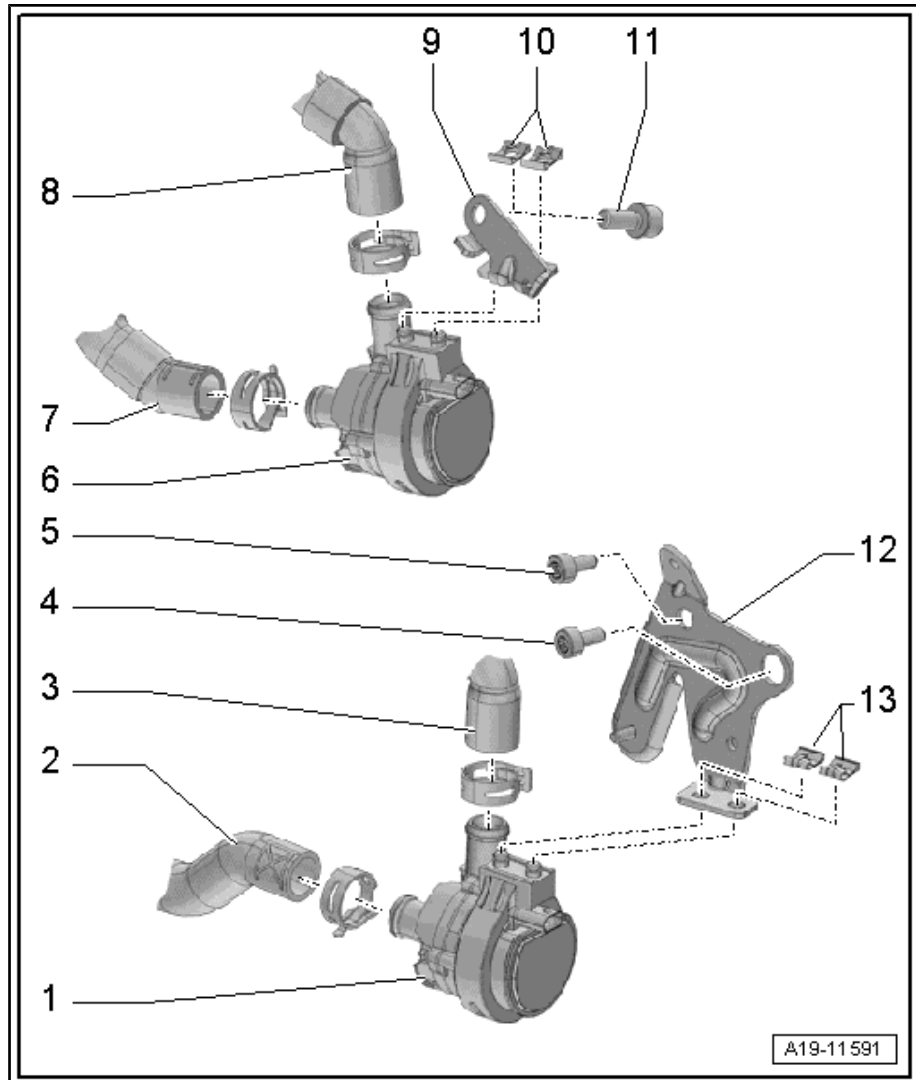
11 - Bolt

- 40 Nm

12 - Bracket

- For charge air cooling pump - V188-

13 - Clips



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2.3 Exploded view - coolant temperature senders

1 - Coolant temperature sender - G62-

- Removing and installing
⇒ [page 194](#)

2 - Spacer ring

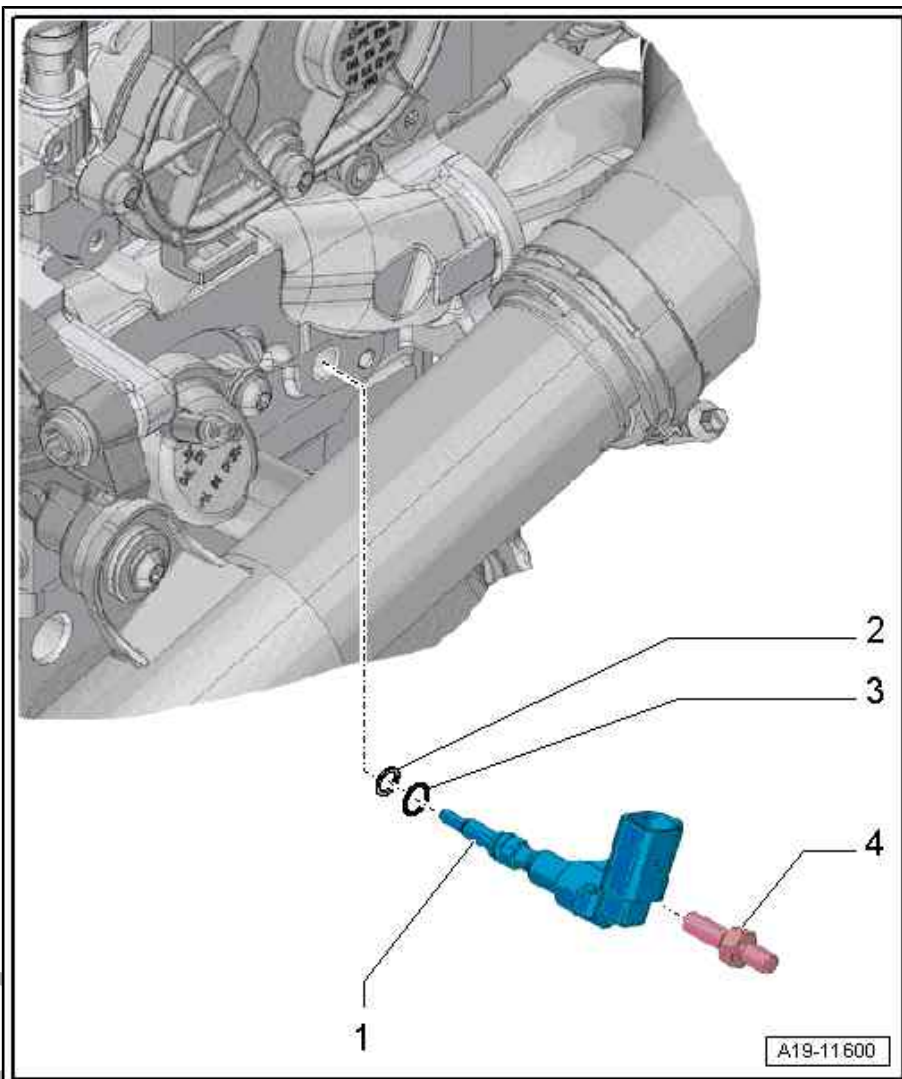
- Renew if damaged

3 - O-ring

- Renew after removing
- Lubricate with coolant

4 - Centre hex stud

- 8 Nm



2.4 Removing and installing electric coolant pump

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⇒ ["2.4.1 Removing and installing charge air cooling pump V188"](#), [page 187](#)

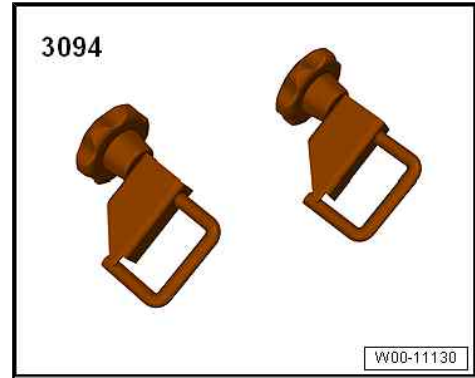
⇒ ["2.4.2 Removing and installing auxiliary pump for heating V488"](#), [page 189](#)

2.4.1 Removing and installing charge air cooling pump - V188-

Special tools and workshop equipment required



- ◆ Hose clamps up to 25 mm - 3094-

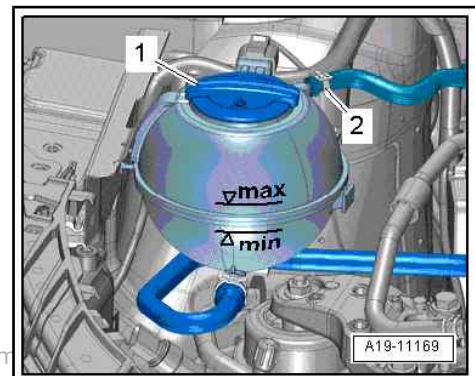


- ◆ Hose clip pliers - VAS 6362-



Removing

- Remove noise insulation => General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
- To relieve residual pressure in cooling system: Cover filler cap -1- on coolant expansion tank with a cloth and carefully open briefly and close again.



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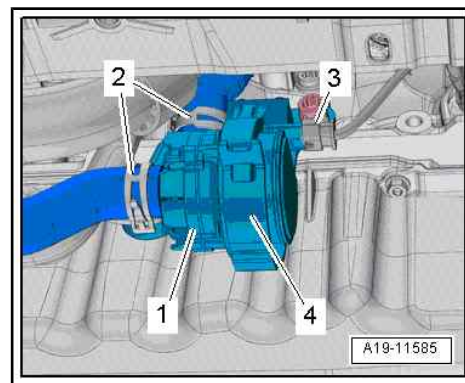


- Unplug electrical connector -3-.

i Note

Place a cloth underneath to catch escaping coolant.

- Clamp off coolant hoses with hose clamps up to 25 mm - 3094- .
- Release hose clips -2- and disconnect coolant hoses.
- Detach charge air cooling pump - V188- -item 1- from mounting -4-.



Installing

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

i Note

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



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.**

i Note

Do not reuse coolant.

- Bleed cooling system ⇒ [page 152](#) .

Tightening torques

- ◆ ⇒ ["2.2 Exploded view - electric coolant pump", page 186](#)
- ◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

2.4.2 Removing and installing auxiliary pump for heating - V488-

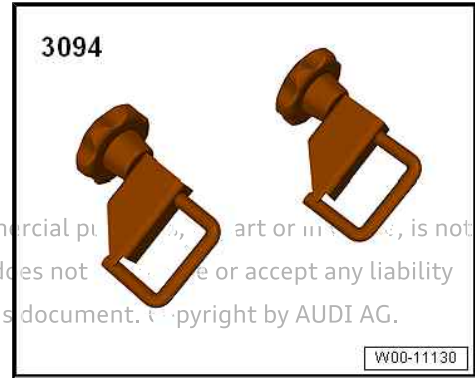
Special tools and workshop equipment required



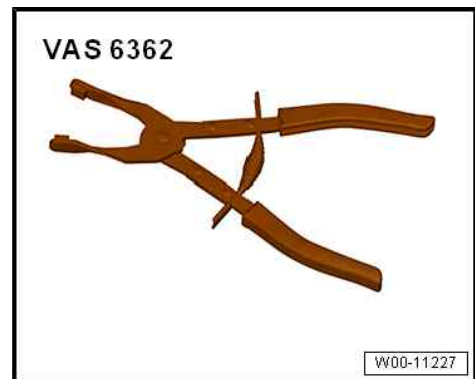
◆ Hose clamps up to 25 mm - 3094-



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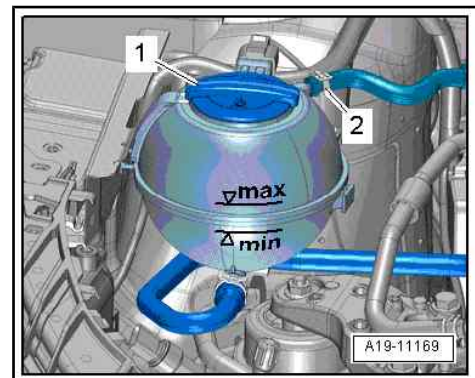


◆ Hose clip pliers - VAS 6362-



Removing

- Engine cold.
- To relieve residual pressure in cooling system: Cover filler cap -1- on coolant expansion tank with a cloth and carefully open briefly and close again.
- Remove noise insulation => General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



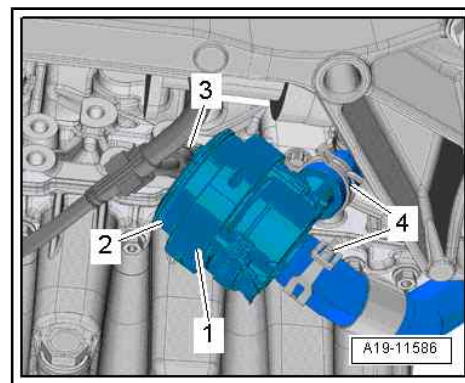


- Unplug electrical connector -3-.

i Note

Place a cloth underneath to catch escaping coolant.

- Clamp off coolant hoses with hose clamps up to 25 mm - 3094- .
- Release hose clips -4- and disconnect coolant hoses.
- Detach auxiliary pump for heating - V488- -item 2- from mounting -1-.



Installing

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

i Note

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



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.*

i Note

Do not reuse coolant.

- Bleed cooling system ⇒ [page 152](#) .

Tightening torques

- ◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

2.5 Removing and installing coolant pump

Removing

- Drain coolant
⇒ ["1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2"](#), [page 145](#) .
- Remove toothed belt ⇒ [page 77](#) .

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- Unplug electrical connector -2- and move wiring clear.
- Remove bolts -arrows- and detach coolant pump -1-.

Installing

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

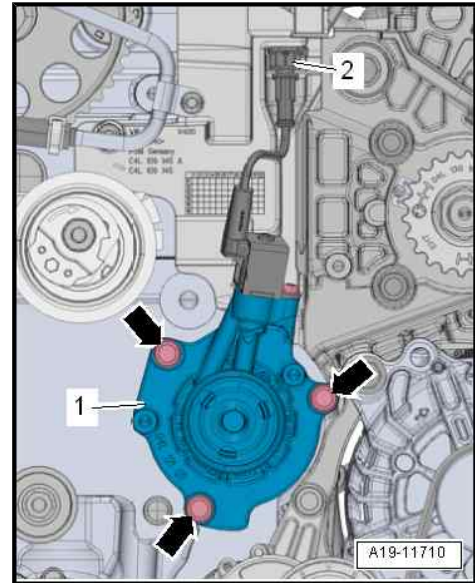


Caution

Do NOT pull the modulating mechanism of the coolant pump with your hand to check its function.

This can cause damage within the coolant pump, resulting in an insufficient coolant supply to the engine.

- Do not hold or carry the coolant pump by the connector or modulating mechanism.
- Do not operate the modulating mechanism.
- Renew O-rings.
- Clean and smoothen sealing surfaces for O-rings.
- Lubricate O-rings with coolant.
- Install toothed belt (adjust valve timing) ⇒ [page 81](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.**

- Fill and bleed coolant circuit ⇒ [page 148](#) .

Tightening torques

- ◆ ⇒ [“2.1 Exploded view - coolant pump/thermostat”, page 184](#)

2.6 Removing and installing thermostat

Special tools and workshop equipment required

- ◆ Hook - 3438-

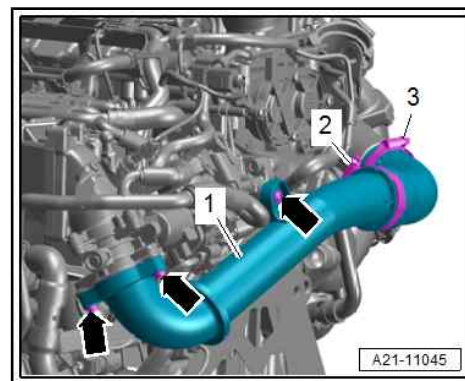


Removing

- Drain coolant ⇒ [page 147](#) .
 - Remove air cleaner housing ⇒ [page 246](#)
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- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.
- Remove throttle valve module - J338- ⇒ [page 249](#) .



- Release catch from left side using hook - 3438- -arrow B-.
- Turn connection -1- in direction of -arrow A- and disconnect.
- Detach thermostat.

Installing

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

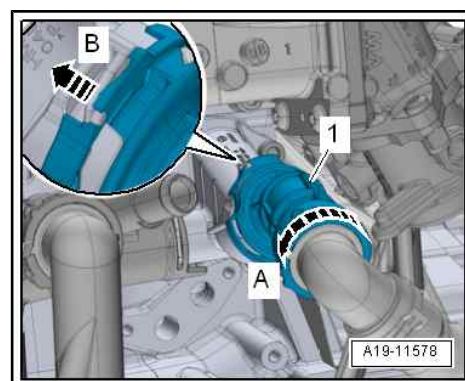


Note

Renew O-ring after removal.

- Clean and smoothen sealing surface for O-ring.
- Lubricate O-ring with coolant.

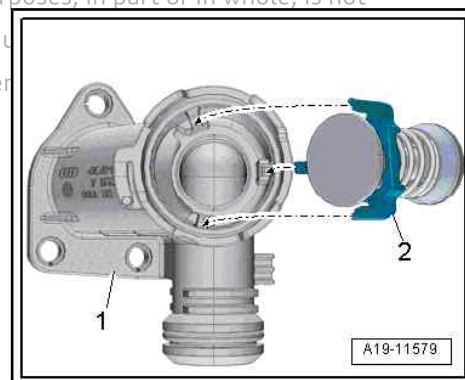
- Fit thermostat -2- in thermostat housing -1-.
- Retaining lugs must engage in guides -arrows-.
- Install throttle valve module - J338- ⇒ [page 249](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.**



Note

Do not reuse coolant.

- Fill and bleed coolant circuit ⇒ [page 148](#) .

Tightening torques

- ◆ ⇒ [“2.1 Exploded view - coolant pump/thermostat”, page 184](#)
- ◆ ⇒ [“2.1 Exploded view - charge air system”, page 225](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)

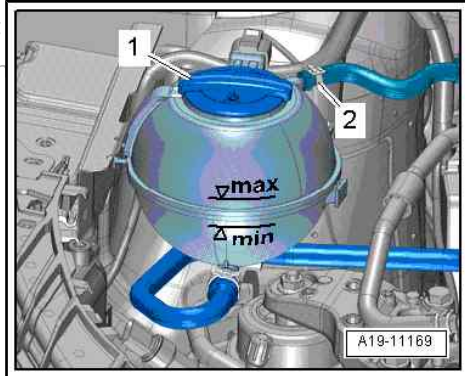


2.7 Removing and installing coolant valve for cylinder head - N489-

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Removing

- Engine cold.
- To relieve residual pressure in cooling system: Cover filler cap -1- on coolant expansion tank with a cloth and carefully open briefly and close again.
- Remove toothed belt cover (top) ⇒ [page 75](#) .



- Unplug electrical connector -2- and move wiring clear.
- Remove bolt -3- and detach coolant valve for cylinder head - N489- -item 1-.

Installing

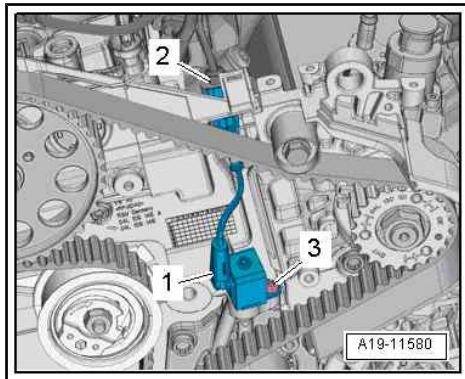
Installation is carried out in reverse order; note the following:



Note

Renew O-rings after removing.

- Install toothed belt cover (top) ⇒ [page 75](#) .
- Bleed cooling system ⇒ [page 152](#) .



Tightening torques

- ♦ ⇒ ["2.1 Exploded view - coolant pump/thermostat", page 184](#)

2.8 Checking thermostat

- Remove thermostat and heat it in a water bath.

Starts to open	Fully open	Opening travel
87 ± 2 °C	approx. 102 °C ¹⁾	at least 9 mm
• ¹⁾ Cannot be tested.		

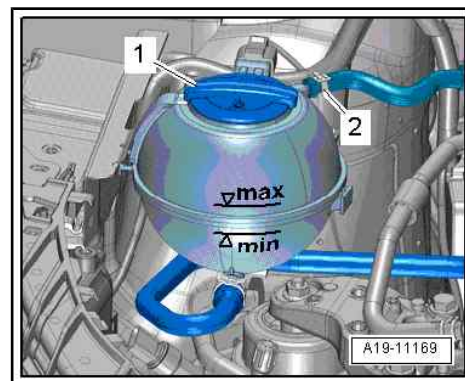
2.9 Removing and installing coolant temperature sender - G62-

Removing

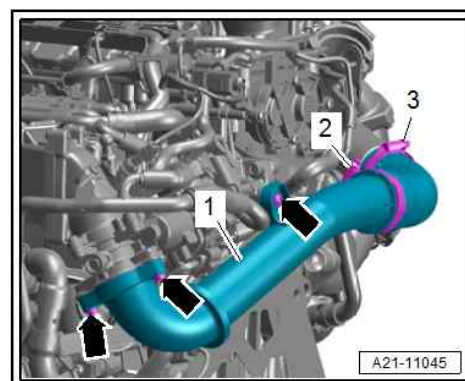
- Engine cold.



- To relieve residual pressure in cooling system: Cover filler cap -1- on coolant expansion tank with a cloth and carefully open briefly and close again.
- Remove air cleaner housing ⇒ [page 246](#) .



- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.



- Unplug electrical connector -1-.
- Unscrew centre hex stud -2- and pull off coolant temperature sender - G62- .



Note

If an O-ring or spacer ring remains lodged in cylinder head, lift it out with a piece of wire.

Installing

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

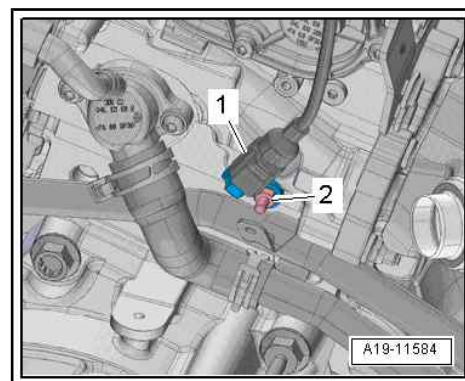


Note

- ◆ *Renew O-rings after removing.*
- ◆ *Renew spacer ring if damaged.*
- Bleed cooling system ⇒ [page 152](#) .

Tightening torques

- ◆ ⇒ [“2.3 Exploded view - coolant temperature senders”, page 187](#)
- ◆ ⇒ [“2.1 Exploded view - charge air system”, page 225](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)



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3 Coolant pipes

⇒ "3.1 Exploded view - coolant pipes", page 196

⇒ "3.2 Removing and installing coolant pipes", page 197

3.1 Exploded view - coolant pipes



Note

The arrow markings on coolant pipes and on ends of hoses must align.

1 - Coolant pipe (front left)

- Removing and installing ⇒ [page 200](#)

2 - Bolt

- 10 Nm

3 - Coolant pipes (top)

- Removing and installing ⇒ [page 197](#)

4 - Bolt

- 10 Nm

5 - Centre hex stud

- 23 Nm

6 - Coolant pipe (rear right)

- Removing and installing ⇒ [page 205](#)

7 - O-ring

- Renew after removing
- Lubricate with coolant

8 - Bolt

- 10 Nm

9 - Coolant pipe (rear)

- Removing and installing ⇒ [page 203](#)

10 - Nut

- 10 Nm

11 - Bolt

- 8 Nm

12 - Bolt

- 8 Nm

13 - Bolt

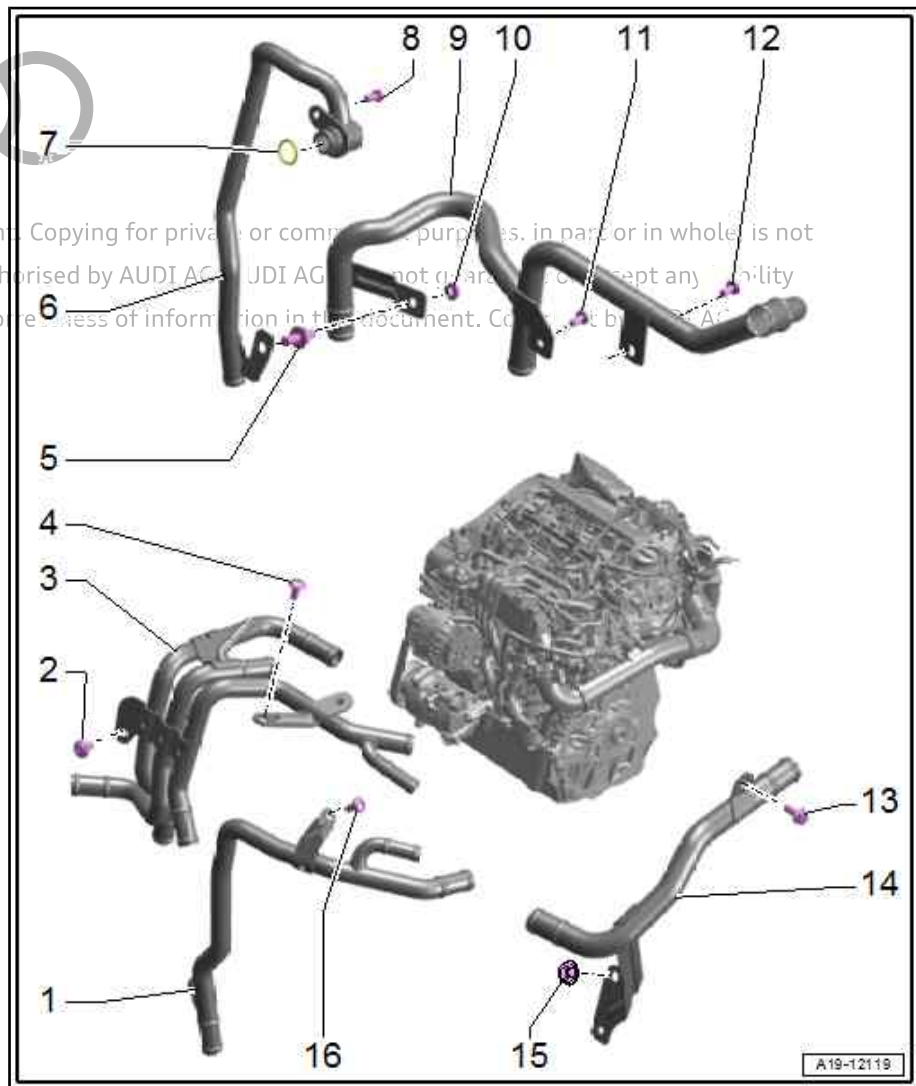
- 8 Nm

14 - Coolant pipe (left-side)

- Removing and installing ⇒ [page 201](#)

15 - Nut

- 8 Nm





16 - Bolt

- 10 Nm

3.2 Removing and installing coolant pipes

⇒ [“3.2.1 Removing and installing coolant pipes \(top\)”, page 197](#)

⇒ [“3.2.2 Removing and installing coolant pipe \(bottom front\)”, page 199](#)

⇒ [“3.2.3 Removing and installing coolant pipe \(front left\)”, page 200](#)

⇒ [“3.2.4 Removing and installing coolant pipe \(left-side\)”, page 201](#)

⇒ [“3.2.5 Removing and installing coolant pipe \(rear\)”, page 203](#)

⇒ [“3.2.6 Removing and installing coolant pipe \(rear right\)”, page 205](#)

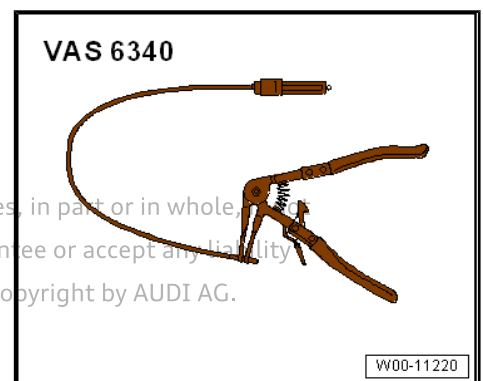
3.2.1 Removing and installing coolant pipes (top)

Special tools and workshop equipment required

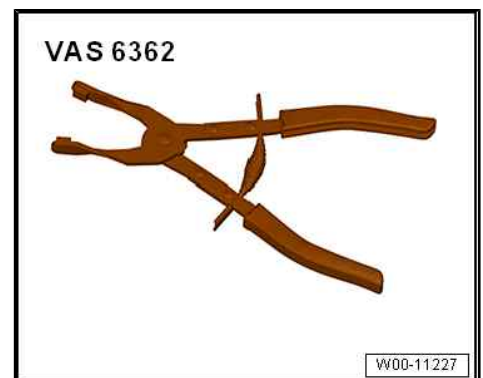
- ◆ Hose clip pliers - VAS 6340-



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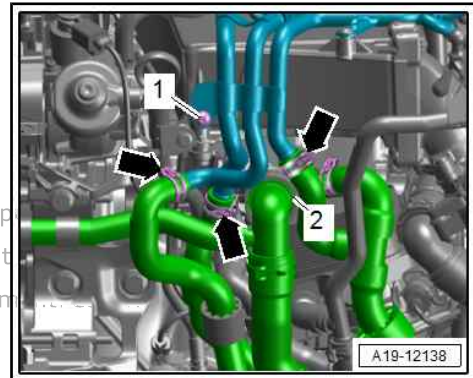
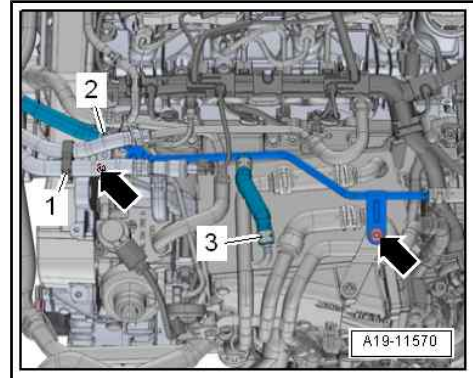
- ◆ Hose clip pliers - VAS 6362-





Removing

- Remove engine cover panel ⇒ [page 39](#) .
 - Drain coolant
⇒ ["1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2"](#) , [page 145](#) .
 - Release hose clips -2, 3- and disconnect coolant hoses.
 - Unclip bracket -1- with fuel hoses.
 - Remove bolts -arrows-.
-
- Lift retaining clip -2- and press coolant connection to side.
 - Release hose clips -arrows- and disconnect coolant hoses.
 - Remove bolt -1-.



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- Remove bolt -1-.
- Release hose clips -arrows- and disconnect coolant hoses.
- Detach coolant pipes (top).

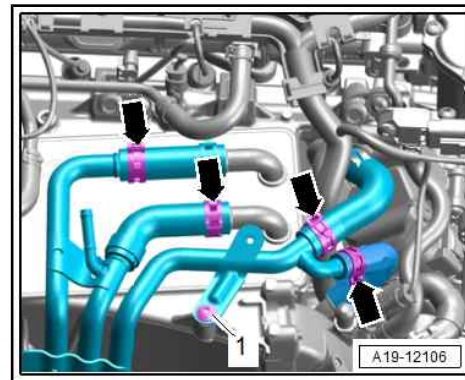
Installing

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



Note

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



- Connect coolant connection with plug-in connector
⇒ [page 208](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **After it is filled, the cooling system must be bled with the
⇒ *Vehicle diagnostic tester*.**



Note

Do not reuse coolant.

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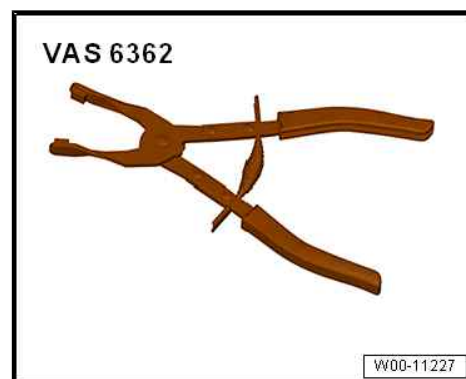
Tightening torques

- ◆ ⇒ ["3.1 Exploded view - coolant pipes"](#), [page 196](#)

3.2.2 Removing and installing coolant pipe (bottom front)

Special tools and workshop equipment required

- ◆ Hose clip pliers - VAS 6362-

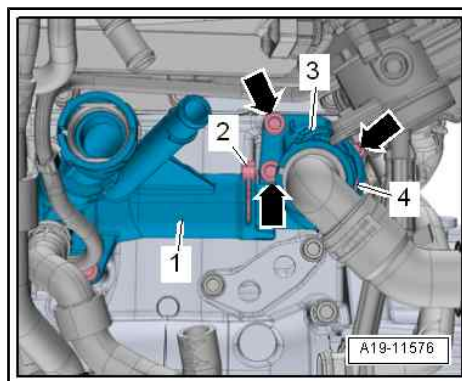


Removing

- Remove oil filter housing ⇒ [page 133](#) .
- Remove throttle valve module - J338- ⇒ [page 249](#) .



- Lift retaining clip -4- and disconnect coolant hose.
- Remove bolts -arrows-.
- Pull off securing clip -2-, disconnect thermostat housing -3- from coolant pipe (bottom front) -1- and detach.



- Release hose clip -1- and disconnect coolant hose.
- Remove bolt -4-.
- Detach and remove coolant pipe (bottom front) -3-, taking care not to damage vacuum line -2-.

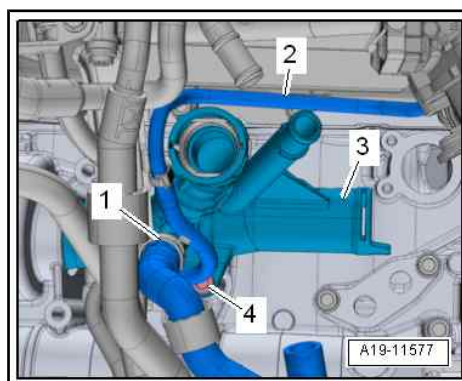
Installing

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



Note

- ◆ *Renew gaskets and O-rings after removal.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ [Electronic parts catalogue](#) .*
- Clean and smoothen sealing surfaces for seals and O-rings.
- Lubricate seals and O-rings with coolant.
- Install throttle valve module - J338- ⇒ [page 249](#) .
- Install oil filter housing ⇒ [page 133](#) .
- Connect coolant hose with plug-in connector ⇒ [page 208](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *After it is filled, the cooling system must be bled with the ⇒ [Vehicle diagnostic tester](#).*

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Note

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Do not reuse coolant.

- Fill and bleed coolant circuit ⇒ [page 148](#) .

Tightening torques

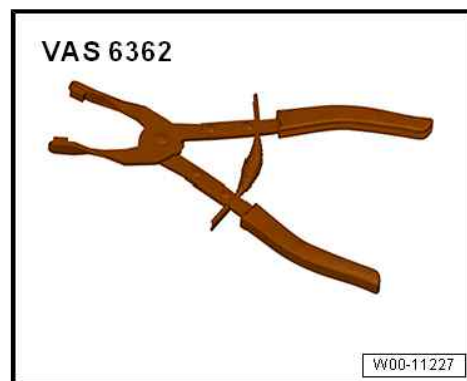
- ◆ ⇒ [“2.1 Exploded view - coolant pump/thermostat”, page 184](#)

3.2.3 Removing and installing coolant pipe (front left)

Special tools and workshop equipment required



- ◆ Hose clip pliers - VAS 6362-



Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Remove radiator cowl ⇒ [page 211](#) .
- Lift retaining clip -1- and detach connection for coolant.
- Remove bolt -2-.
- Release hose clips -arrows- and disconnect coolant hoses.
- Detach coolant pipe (front left).

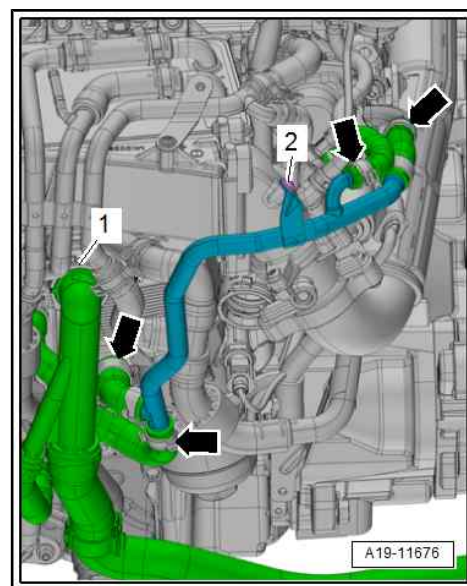
Installing

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



Note

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



- Install radiator cowl ⇒ [page 211](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.*



Note

Do not reuse coolant.

- Fill and bleed coolant circuit ⇒ [page 148](#) .
- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

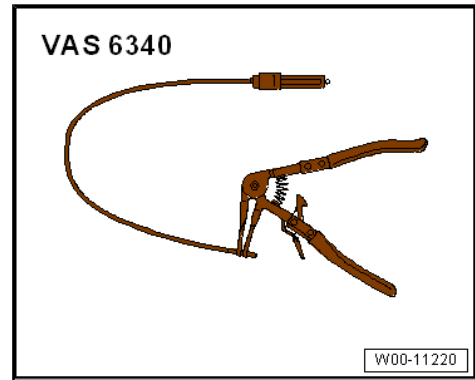
- ◆ ⇒ [“3.1 Exploded view - coolant pipes”, page 196](#)

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Special tools and workshop equipment required



- ◆ Hose clip pliers - VAS 6340-



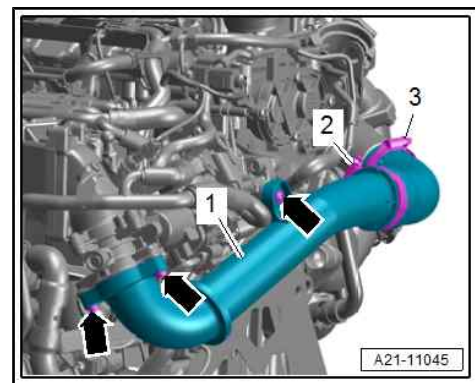
Removing

- Remove air cleaner housing ⇒ [page 246](#) .
- Drain coolant
⇒ ["1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2"](#) , [page 145](#) .
- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.



Note

Disregard -item 3-.



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- Move electrical wiring harness -1- clear.
- Remove nut -2- and bolt -3-.
- Detach coolant hoses from coolant pipe (left-side) and remove coolant pipe.

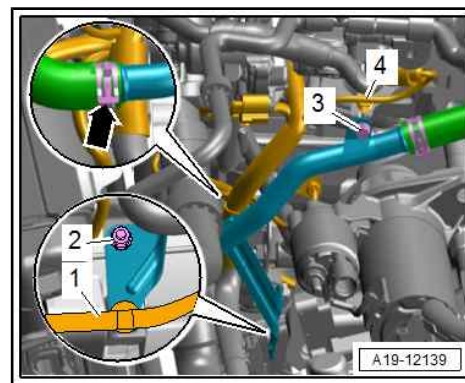
Installing

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



Note

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



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.*



Note

Do not reuse coolant.

- Fill and bleed coolant circuit ⇒ [page 148](#) .

Tightening torques

- ◆ ⇒ [“3.1 Exploded view - coolant pipes”, page 196](#)
- ◆ ⇒ [“2.1 Exploded view - charge air system”, page 225](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)

3.2.5 Removing and installing coolant pipe (rear)

Special tools and workshop equipment required

- ◆ Coolant collecting system - VAS 5014- or drip tray for workshop hoist - VAS 6208-



VAS 6208

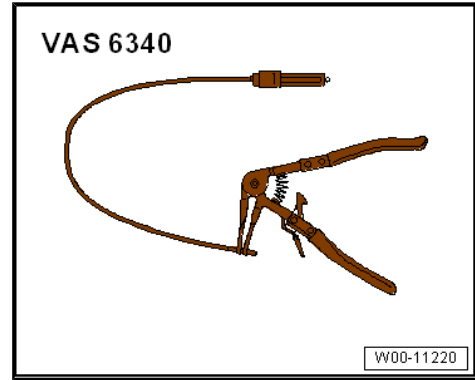


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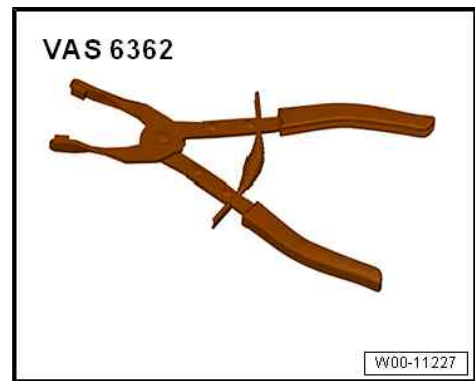
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- ◆ Hose clip pliers - VAS 6340-



- ◆ Hose clip pliers - VAS 6362-



Removing

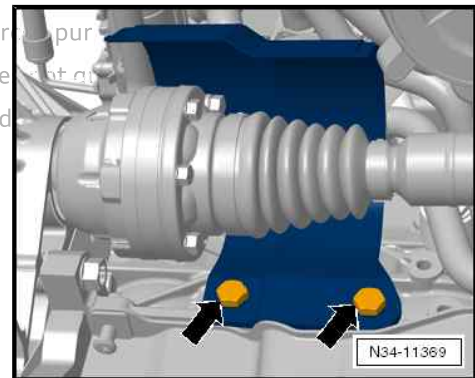
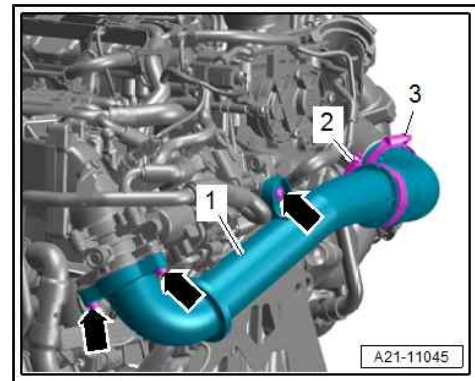
- Drain coolant
 ⇒ ["1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2", page 145](#) .
- Remove air cleaner housing ⇒ [page 246](#) .
- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.



Note

Disregard -item 3-.

- Remove wheel housing liner (front right) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .
- Remove bolts -arrows- and detach heat shield for drive shaft (right-side).





- Release hose clips -arrows- and disconnect coolant hoses.
- Remove bolts -1- and nut -2- and take off rear coolant pipe.

Installing

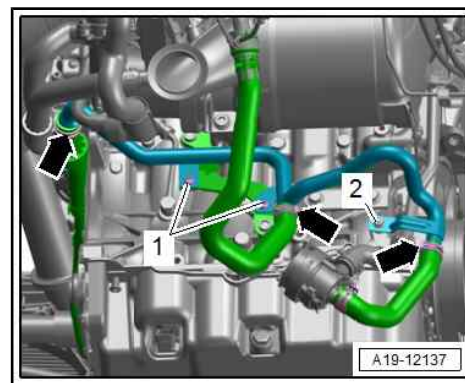
Installation is carried out in reverse order; note the following:



Note

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

- Install heat shield for drive shaft ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing heat shield for drive shaft .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.**



Note

Do not reuse coolant.

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- **Fill and bleed coolant circuit ⇒ page 148** .

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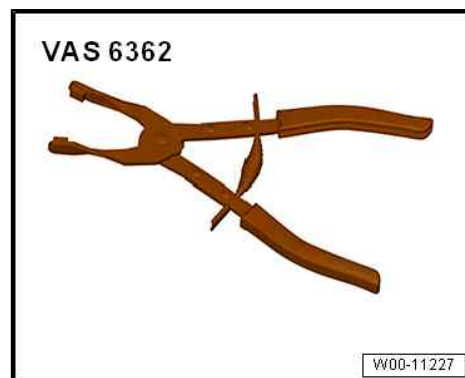
Tightening torques

- ◆ ⇒ **“3.1 Exploded view - coolant pipes”, page 196**
- ◆ ⇒ **“2.1 Exploded view - charge air system”, page 225**
- ◆ ⇒ **“3.1 Exploded view - air cleaner housing”, page 245**
- ◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front)

3.2.6 Removing and installing coolant pipe (rear right)

Special tools and workshop equipment required

- ◆ Hose clip pliers - VAS 6362-





Removing



Note

Reinstall heat insulation sleeves in the same locations when installing.

- Remove emission control module ⇒ [page 303](#) .
- Release hose clip -1- and disconnect coolant hose.
- Remove centre hex stud -2- and bolt -3- and take off coolant pipe (rear right).

Installing

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



Note

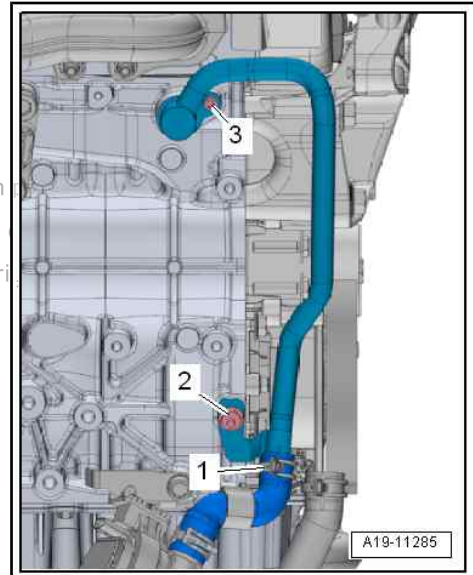
- ◆ Renew O-ring after removal.
- ◆ Secure all hose connections with correct type of hose clips (as original equipment) ⇒ *Electronic parts catalogue* .
- Install emission control module ⇒ [page 303](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ After it is filled, the cooling system must be bled with the ⇒ *Vehicle diagnostic tester*.



Note

Do not reuse coolant.

- Fill and bleed coolant circuit ⇒ [page 148](#) .

Tightening torques

- ◆ ⇒ [“3.1 Exploded view - coolant pipes”, page 196](#)



4 Radiators/radiator fan

⇒ [“4.1 Exploded view - radiators/radiator fan”, page 207](#)

⇒ [“4.2 Removing and installing radiator”, page 209](#)

⇒ [“4.3 Removing and installing radiator cowl”, page 211](#)

⇒ [“4.4 Removing and installing radiator fans”, page 213](#)

4.1 Exploded view - radiators/radiator fan

Radiator

1 - Coolant hoses

- For coolant circuit for charge air cooler

2 - Air duct

3 - Water radiator for charge air cooling circuit

- Radiator and water radiator for charge air cooling circuit are removed together
- Removing and installing ⇒ [“4.2 Removing and installing radiator”, page 209](#)

4 - Coolant hose (bottom)

5 - O-ring

- Renew if damaged
- Lubricate with coolant

6 - Coolant hose (top)

7 - Coolant hose

- To coolant expansion tank

8 - O-ring

- Renew if damaged
- Lubricate with coolant

9 - Radiator

- Removing and installing ⇒ [page 209](#)

10 - Air duct

11 - Air duct

12 - Bolt

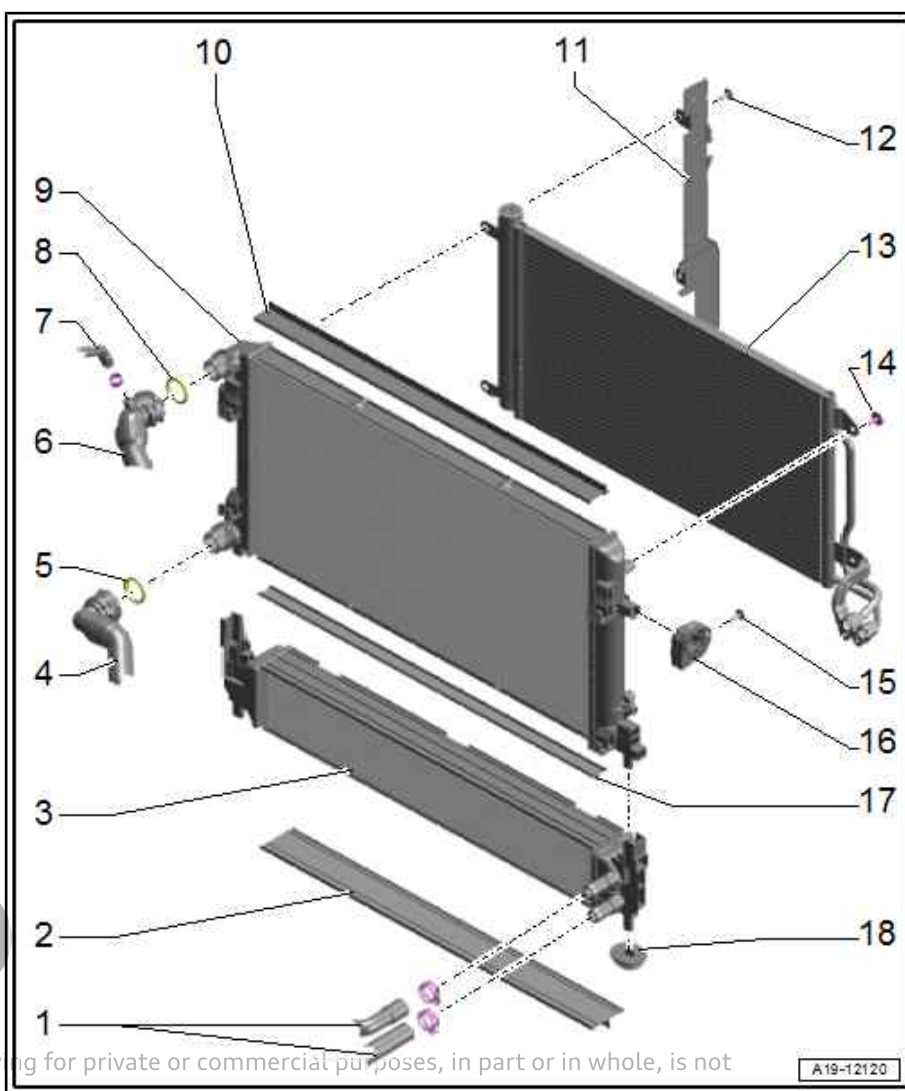
- Tightening torque ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Exploded view - condenser

13 - Condenser

- Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Removing and installing condenser

14 - Bolt

- Tightening torque ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Exploded view - condenser



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15 - Bolt

- 5 Nm

16 - Rubber mounting

- For radiator

17 - Air duct

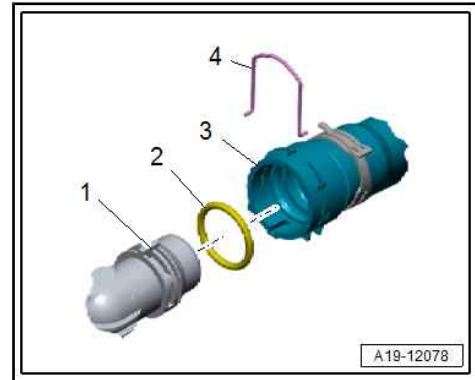
18 - Rubber bush

- For water radiator for charge air cooling circuit

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Connecting coolant hose with plug-in connector

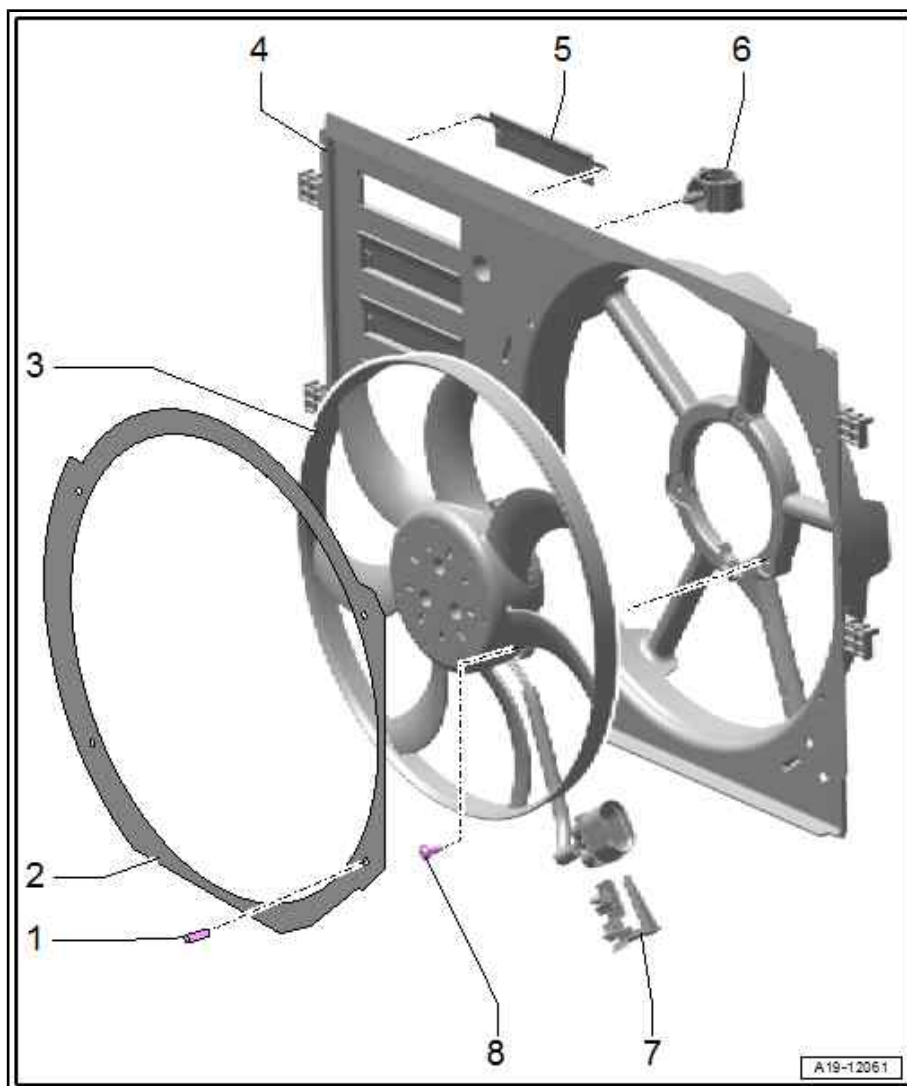
- If damaged, renew retaining clip -4-.
- If damaged, renew O-ring. To do so, remove O-ring -2- from plug-in connector -3- using a suitable tool (do not use a sharp tool). Take care not to damage the plug-in connector or the surface on which the O-ring is seated.
- Lightly lubricate new O-ring with coolant and fit O-ring in coolant hose.
- Press coolant hose onto connection -1- until it engages audibly.
- Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.



Radiator cowl and radiator fan



- 1 - Pin
 - For spreader clip
- 2 - Air flow ring
 - Depending on version
- 3 - Radiator fan - V7-
 - With radiator fan control unit - J293-
 - Removing and installing ⇒ [page 213](#)
- 4 - Radiator cowl
 - Removing and installing ⇒ [page 211](#)
- 5 - Air flow flap
- 6 - Clip
 - For coolant hose
- 7 - Bracket
 - For electrical connector
- 8 - Bolt
 - 1.5 Nm



4.2 Removing and installing radiator



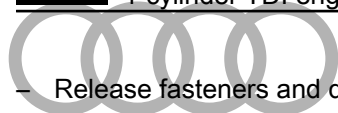
Note

Radiator and water radiator for charge air cooling circuit must be removed and installed together.

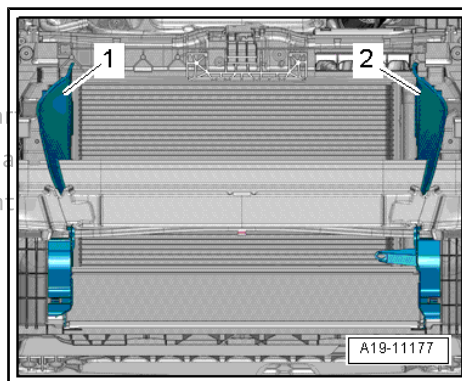
Removing

- Drain coolant
⇒ ["1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2", page 145](#).
- Remove radiator cowl ⇒ [page 211](#).
- Remove bumper cover ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing bumper cover.

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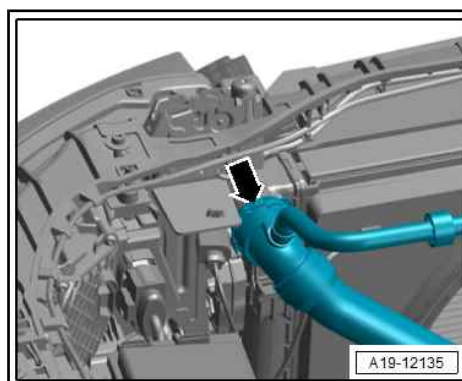


- Release fasteners and detach air ducts -1 and 2-.

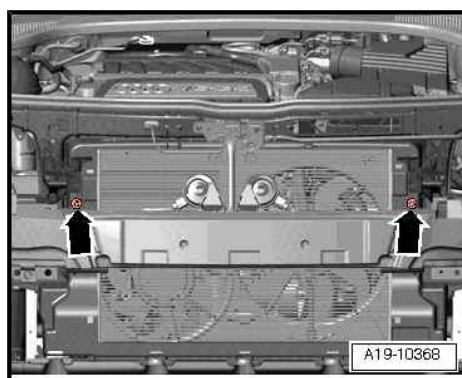


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- Lift retaining clip -arrow- and disconnect coolant hose (top left) from radiator.



- Remove bolts -arrows-.
- Swivel top edge of radiator slightly to rear.
- Lift radiator, disengage it from bottom mounting points and press it to the rear.



Vehicles with air conditioner:




WARNING

Risk of injury caused by refrigerant.

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

- Remove bolts -arrows-.

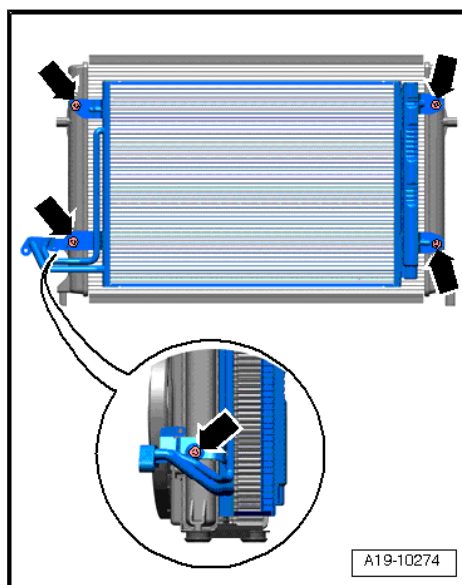


Caution

Risk of damage to refrigerant lines and hoses

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

- Move condenser to front and place in lock carrier, then secure with cable ties to prevent from dropping.





All vehicles (continued):

- Release fasteners at water radiator for charge air cooling circuit -1- -arrows A-.
- Pull water radiator for charge air cooling circuit off radiator -2- -arrow B- and disengage -arrow C-.
- Remove both radiators.

Installing

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



Note

If there are slight impressions on the fins, refer to [⇒ page 9](#).

- Vehicles with air conditioning: Install condenser ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Removing and installing condenser .

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- Install radiator cowl ⇒ [page 211](#)
- Connect coolant hose with plug-in connector ⇒ [page 208](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.**



Note

Do not reuse coolant.

- Fill and bleed coolant circuit ⇒ [page 148](#) .

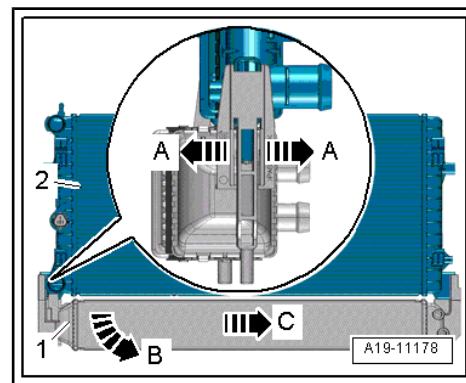
Tightening torques

- ◆ ⇒ [“4.1 Exploded view - radiators/radiator fan”, page 207](#)

4.3 Removing and installing radiator cowl

Special tools and workshop equipment required

- ◆ Coolant collecting system - VAS 5014- or drip tray for workshop hoist - VAS 6208-

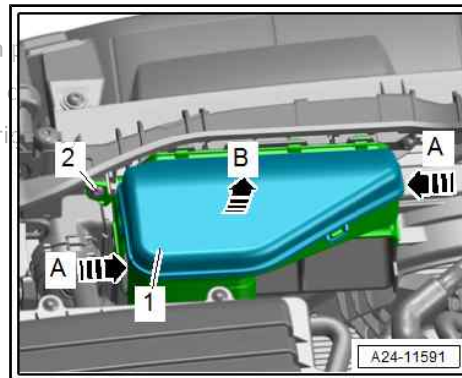




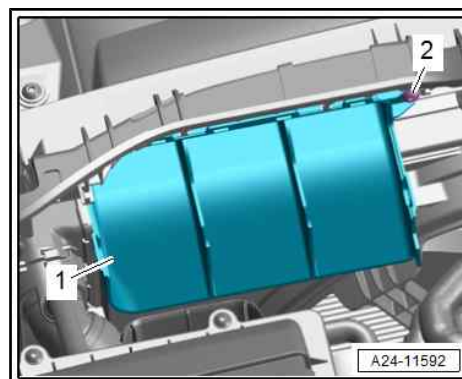
Removing

- Remove noise insulation => General body repairs, exterior;
Rep. gr. 66; Noise insulation; Removing and installing noise insulation.

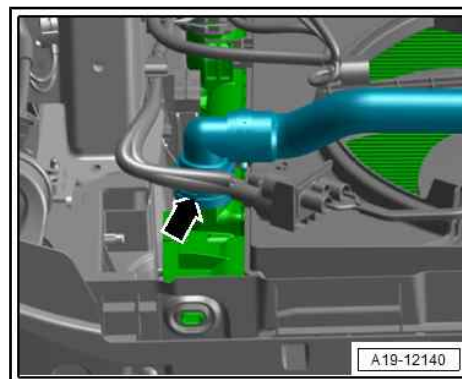
- Unscrew bolt -2- and release fasteners -arrows A-.
- Detach cover -1- from air duct -arrow B- and remove it.

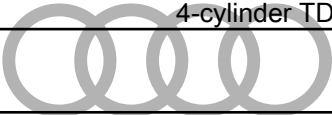


- Remove bolt -2- and detach air duct -1-.



- Place collector tank from coolant collecting system -VAS 5014- or drip tray for workshop hoist - VAS 6208- underneath.
- Lift retaining clip -arrow-, disconnect coolant hose from radiator (bottom left) and drain off coolant.





⚠ WARNING
 Risk of injury as the radiator fans may start up automatically.
 ♦ **Unplug electrical connectors before performing work on radiator cowl.**

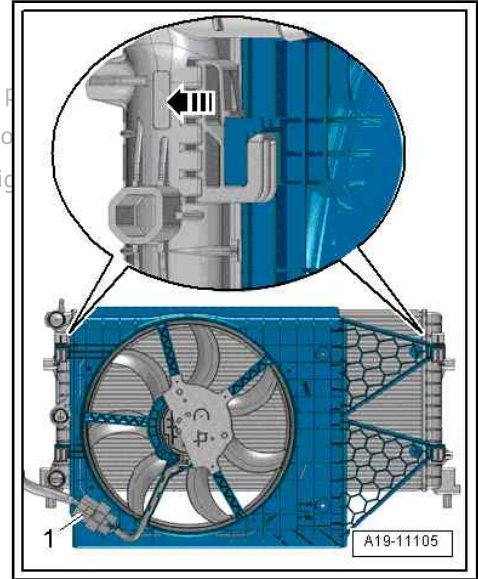
- Unplug electrical connector -1- for radiator fan at bottom of radiator cowl.
- Press locking tabs on left and right sides of radiator cowl together -arrow- and lift radiator cowl off radiator.

Installing

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

- Connect coolant hose with plug-in connector ⇒ [page 208](#) .

⚠ Caution
 Risk of damage to engine if cooling system is insufficiently filled/bled.
 ♦ **After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.**



i Note

Do not reuse coolant.

- Fill up with coolant ⇒ [page 148](#) .

Tightening torques

- ♦ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)
- ♦ ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

4.4 Removing and installing radiator fans

Removing

- Remove radiator cowl ⇒ [page 211](#) .
- Take electrical wiring -1- out of cable guide.
- Unscrew nuts -arrows- and detach radiator fan - V7- .

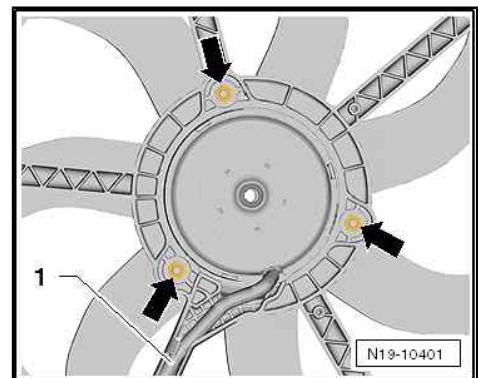
Installing

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

- Install radiator cowl ⇒ [page 211](#) .

Tightening torques

- ♦ ⇒ [“4.1 Exploded view - radiators/radiator fan”, page 207](#)





21 – Turbocharging/supercharging

1 Turbocharger

⇒ [“1.1 Exploded view - turbocharger”, page 214](#)

⇒ [“1.2 Removing and installing turbocharger”, page 216](#)

⇒ [“1.3 Renewing vacuum unit for turbocharger”, page 221](#)

1.1 Exploded view - turbocharger

1 - Banjo bolt

- 30 Nm
- Tighten banjo bolt using a commercially available open-end spanner insert and a suitable torque wrench

2 - Seals

- Renew

3 - Oil supply line

- Check for obstructions
- Before installing, fill turbocharger with engine oil at connection for oil supply line

4 - Bolt

- 12 Nm

5 - Exhaust gas temperature sender 1 - G235-

- Exploded view
⇒ [page 313](#)

6 - Bolt

- 20 Nm

7 - Bolt

- 15 Nm

8 - Heat shield

9 - Bolt

- 8 Nm

10 - Connection

11 - O-ring

- Renew after removing

12 - Bolt

- 8 Nm

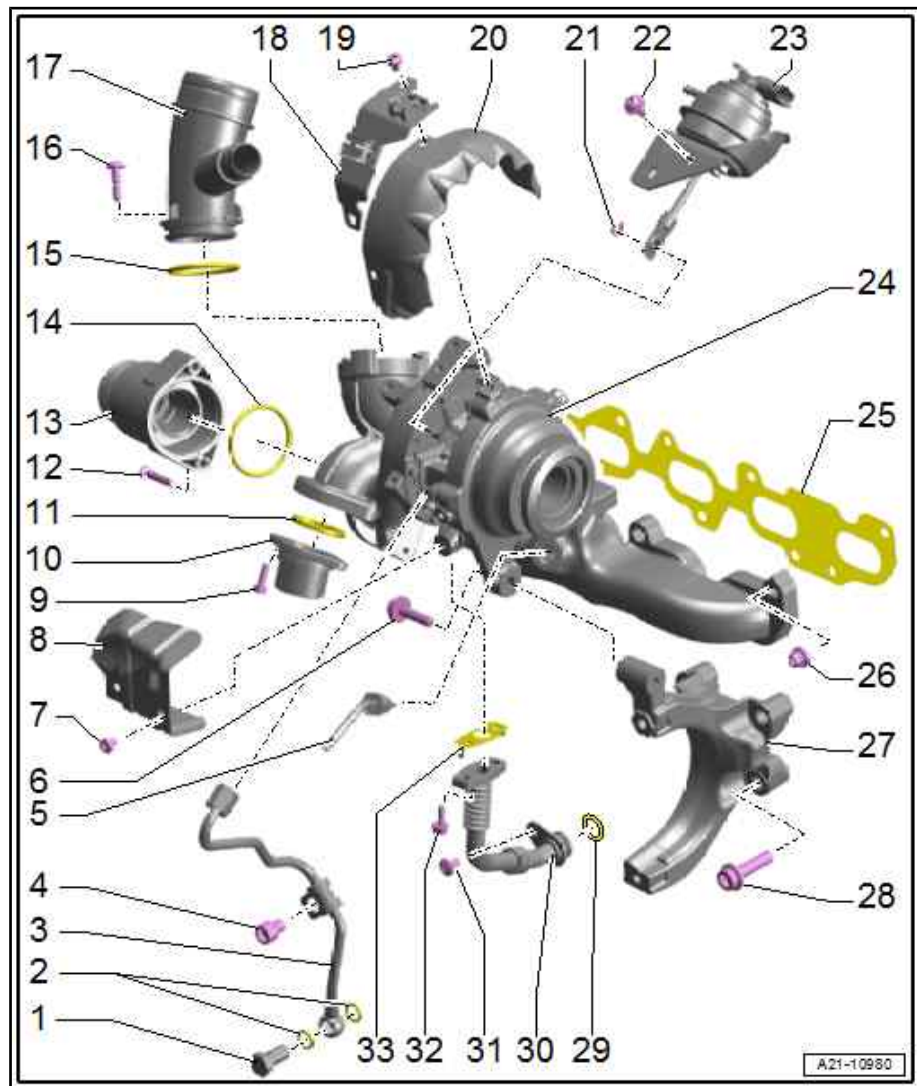
13 - Pulsation damper

14 - O-ring

- Renew after removing

15 - O-ring

- Renew after removing





16 - Bolt

- 8 Nm

17 - Connection

18 - Bracket

- For electrical wiring

19 - Bolt

- 15 Nm

20 - Heat shield

21 - Circlip

- Renew after removing

22 - Bolt

- 10 Nm

23 - Vacuum unit

- For turbocharger
- Renewing ⇒ [page 221](#)

24 - Turbocharger

- Adaption must be performed after renewing this component
- Select [01 - Engine electronics, functions](#) and perform Guided Function [01 - Adaption after replacing positioner](#)
- Removing and installing ⇒ [page 216](#)

25 - Gasket

- Renew after removing

26 - Nut

- Renew after removing
- Tightening torque and sequence ⇒ [page 216](#)

27 - Bracket

- For emission control module

28 - Bolt

- Tightening torque and sequence ⇒ [page 216](#)

29 - O-ring

- Renew after removing
- Lubricate lightly with engine oil

30 - Oil return line

31 - Bolt

- 10 Nm

32 - Ribbed bolt

- 14 Nm

33 - Gasket

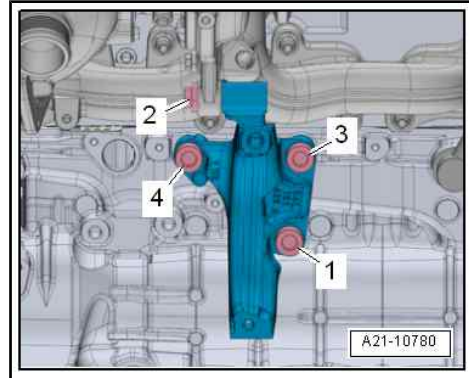
- Renew after removing



Bracket for emission control module - tightening torque and tightening sequence

- Fit bracket in correct installation position.
- Tighten bolts in stages in the sequence described:

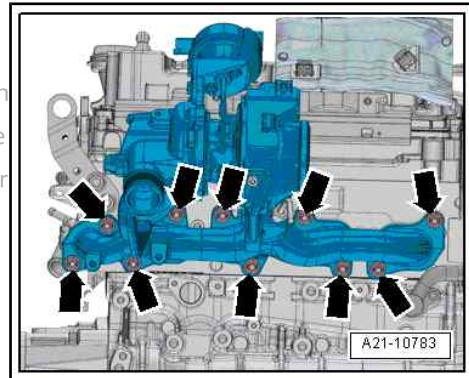
Stage	Bolts	Tightening torque
1.	-1, 2, 3, 4-	Screw in by hand until contact is made
2.	-2-	20 Nm
3.	-1-	40 Nm
4.	-3, 4-	40 Nm



Turbocharger - tightening torque and sequence

- Tighten bolts in stages in the sequence described:

Stage	Bolts	Tightening torque
1.	-Arrows-	Tighten to 11 Nm in diagonal sequence, working from centre outwards
2.	-Arrows-	Tighten to 22 Nm in diagonal sequence, working from centre outwards
3.	-Arrows-	Tighten to 22 Nm in diagonal sequence, working from centre outwards <ul style="list-style-type: none"> • This procedure has been specified in order to compensate for the settling of the components.



1.2 Removing and installing turbocharger



Caution

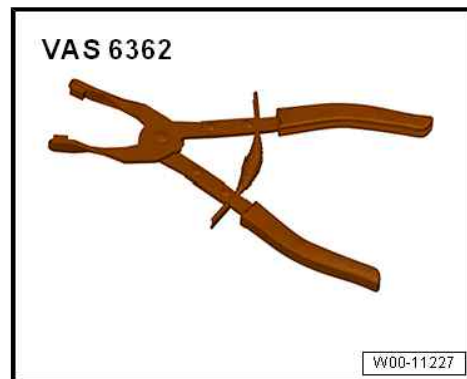
If the turbocharger has suffered mechanical damage (e.g. damaged compressor wheel), it is not sufficient merely to fit a new turbocharger. The following work must be performed in order to avoid further damage:

- ◆ *Check air cleaner housing, air filter element and air hoses for dirt and foreign particles.*
- ◆ *Check the entire charge air system (including the charge air cooler) for foreign matter.*
- ◆ *If foreign matter is found in the charge air system, clean all relevant ducts and hoses and renew charge air cooler if necessary.*

Special tools and workshop equipment required



- ◆ Hose clip pliers - VAS 6362-



Removing



Note

Re-install all heat insulation sleeves in the same locations when installing.



Caution

Risk of malfunctions caused by dirt.

- ◆ Observe ⇒ **"3.1 Rules for cleanliness", page 5** .

- Remove engine cover panel ⇒ [page 39](#) .
- Remove emission control module ⇒ [page 303](#) .
- Remove air cleaner housing ⇒ [page 246](#) .
- Press release tabs on both sides of crankcase breather hose -1- and disconnect hose from connection.
- Move clear vacuum hoses -arrow- at air pipe.
- Unscrew bolt -3-, turn air pipe with connection clockwise and detach it from turbocharger.



Note

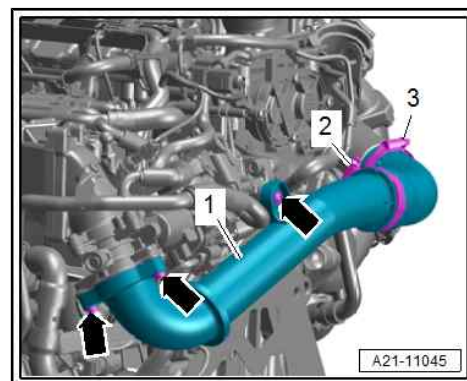
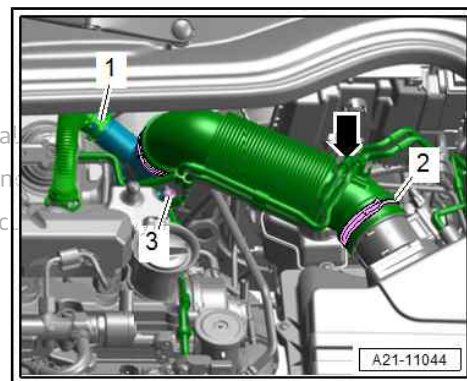
Disregard -item 2-.

- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.



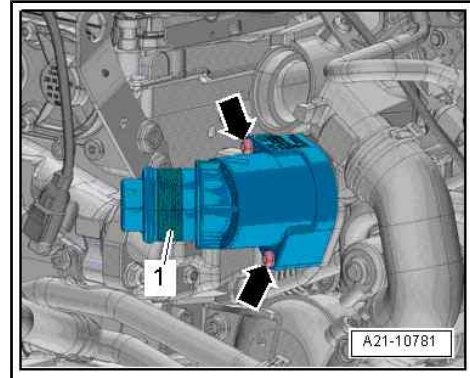
Note

Disregard -item 3-.





- Remove bolts -arrows- and detach resonator -1-.

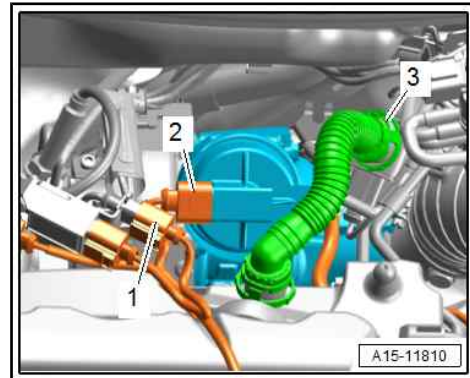


- Unplug electrical connectors and move electrical wiring harness clear.
- 1 - For exhaust gas temperature sender 1 - G235-
 - 2 - For position sender for charge pressure positioner - G581-

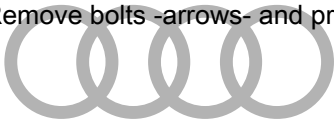


Note

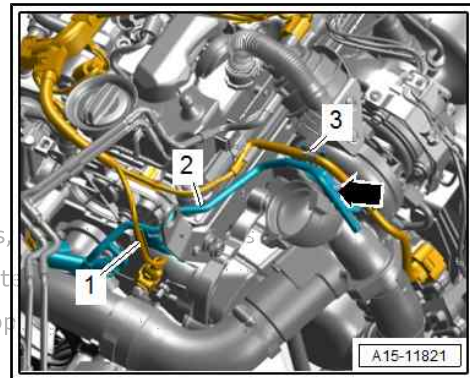
Disregard -item 3-.



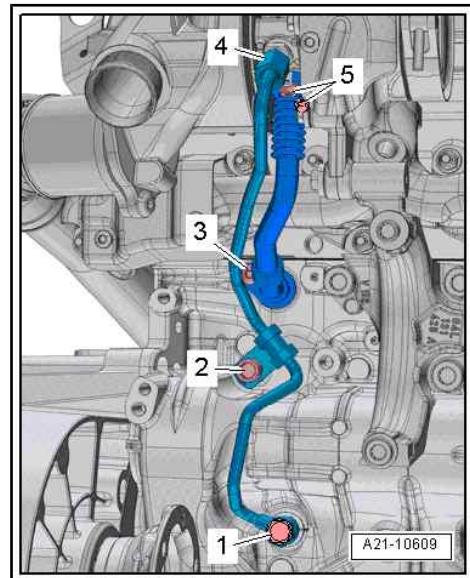
- Move electrical wiring -1, 3- clear.
- Remove bolts -arrows- and press coolant line -2- to left side.



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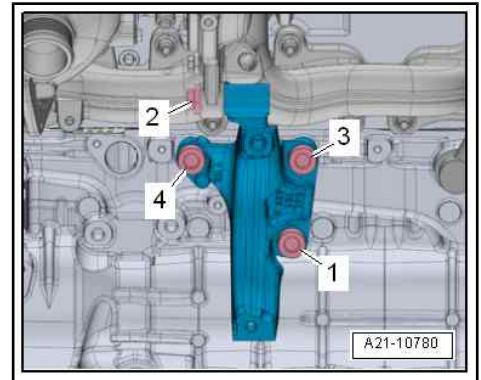


- Unscrew banjo bolt -1-, bolt -2- and union nut -4-.
- Unscrew bolts -3 and 5- and detach oil return line.





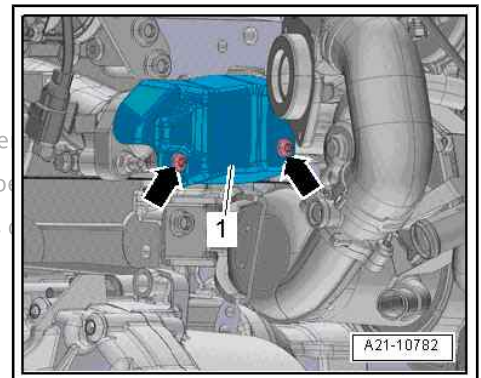
- Remove bolts -1 ... 4- and detach bracket for emission control module.



- Remove bolts -arrows- and detach heat shield -1-.



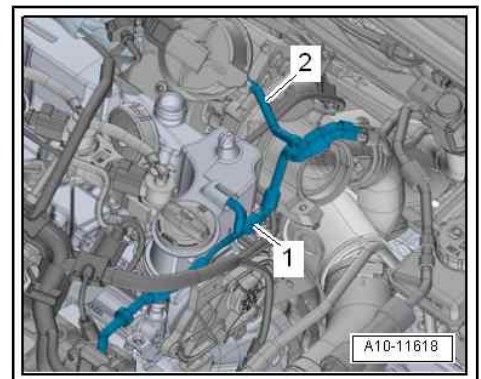
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- Detach vacuum hose -2- from vacuum unit of turbocharger.

i Note

Disregard -item 1-.





- Remove nuts -arrows- and detach turbocharger with exhaust manifold from cylinder head.

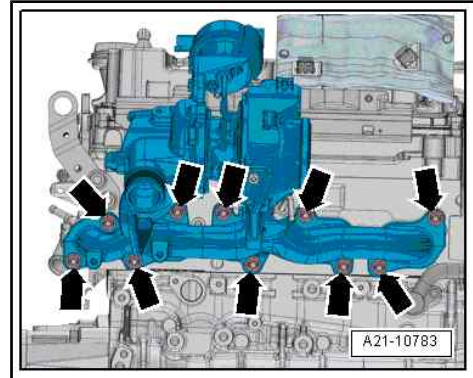
Installing

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



Note

- ◆ *Renew gaskets, seals, O-rings and self-locking nuts after removal.*
 - ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
 - ◆ *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
 - ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ Electronic parts catalogue .*
 - ◆ *After installing the turbocharger, allow the engine to idle for approx. 1 minute without pressing the accelerator to ensure that the turbocharger is supplied with oil.*
- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
 - Install emission control module ⇒ [page 303](#) .
 - Connect vacuum hose ⇒ [page 243](#) .
 - Install engine cover panel ⇒ [page 39](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **Only fill and bleed fuel system using ⇒ Vehicle diagnostic tester.**



Note

Do not reuse coolant.

- Fill up with coolant ⇒ [page 152](#) .

Adaption must be performed after renewing this component:

- 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 - Adaption after replacing positioner]

Tightening torques

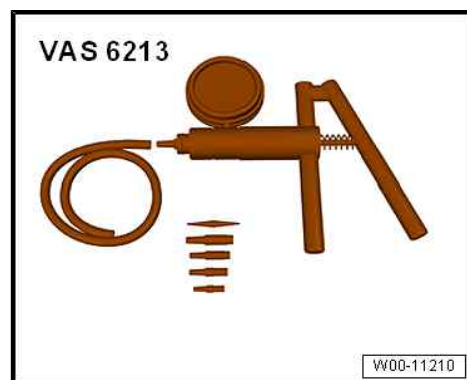
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- ◆ ⇒ "1.1 Exploded view - turbocharger", page 214
- ◆ ⇒ "2.1 Exploded view - charge air system", page 225
- ◆ ⇒ "3.1 Exploded view - air cleaner housing", page 245

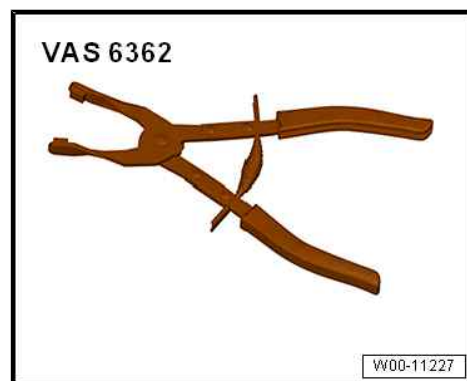
1.3 Renewing vacuum unit for turbocharger

Special tools and workshop equipment required

- ◆ Hand vacuum pump - VAS 6213-



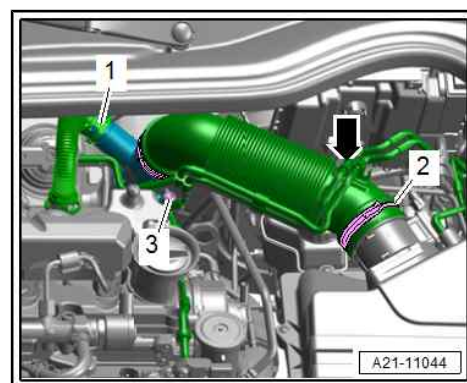
- ◆ Hose clip pliers - VAS 6362-



- ◆ Vehicle diagnostic tester

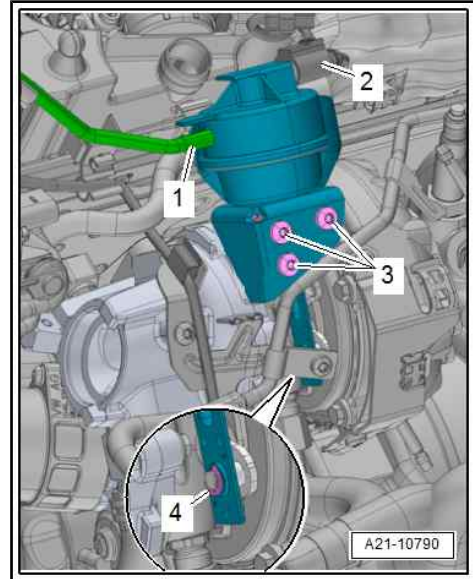
Removing

- Remove engine cover panel ⇒ page 39 .
- Press release tabs on both sides of crankcase breather hose -1- and disconnect hose from connection.
- Move clear vacuum hoses -arrow- at air pipe.
- Loosen hose clip -2- and detach air pipe.
- Unscrew bolt -3-, turn air pipe with connection clockwise and detach it from turbocharger.
- Remove plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - plenum chamber partition panel .





- Unplug electrical connector -2- for position sender for charge pressure positioner - G581- .
- Detach vacuum hose -1- from vacuum unit of turbocharger.
- Remove circlip -4-.
- Remove bolts -3- for vacuum unit.
- Disengage control rod at adjusting lever and detach vacuum unit with position sender for charge pressure positioner - G581- .



Installing



Note

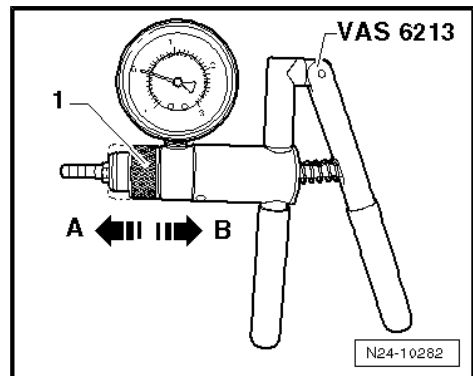
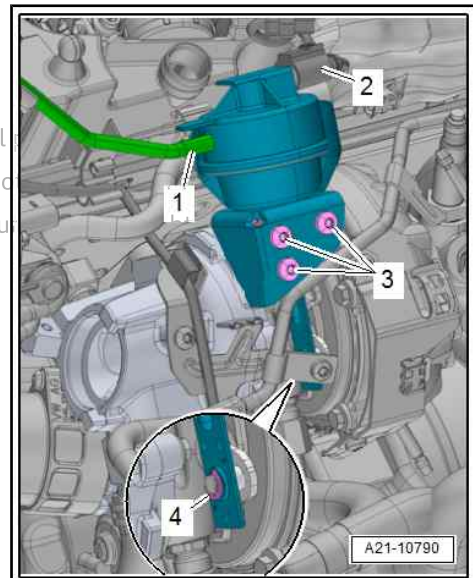
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Use new bolts and a new circlip from the repair kit.

- Attach control rod at adjusting lever, position vacuum unit and screw in bolts -3- by hand until they make contact.
- Install circlip -4-.
- Plug in electrical connector -2- at position sender for charge pressure positioner - G581- .

Checking adjustment of vacuum unit

- Use ⇒ Vehicle diagnostic tester.
- From the list in Self-diagnosis under Measured values, select Turbine actuator 1 bank 1, position feedback, raw voltage.
- Move adjuster ring -1- on hand vacuum pump - VAS 6213- to position -A- to select "vacuum".





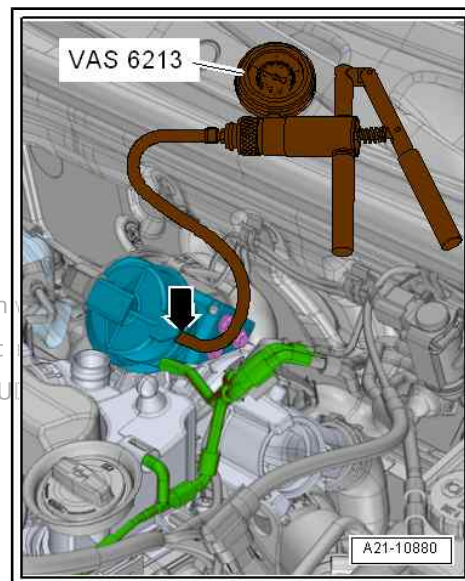
- Connect hand vacuum pump - VAS 6213- to vacuum unit -arrow-.

Caution

Risk of damage to vacuum unit on account of excessive vacuum.

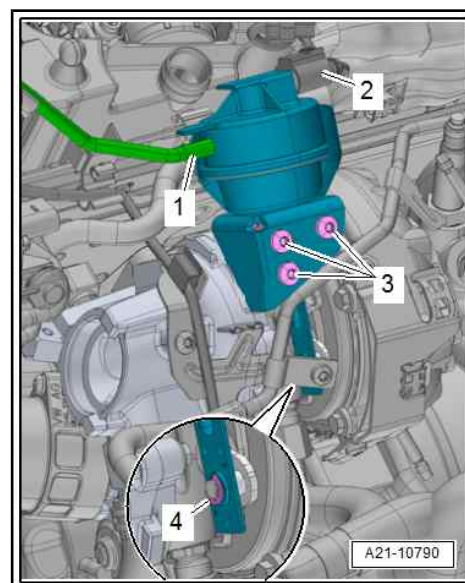
◆ *Vacuum must NOT exceed -800 mbar.*

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Adjusting voltage value

- Operate hand vacuum pump - VAS 6213- until a vacuum between -650 ... -700 mbar is displayed on pressure gauge.
- Slide vacuum unit -arrow- until specification in Measured values display zone is attained.
- ◆ Specification: 0.75 ± 0.05 V
- Tighten bolts -3- to 10 Nm.



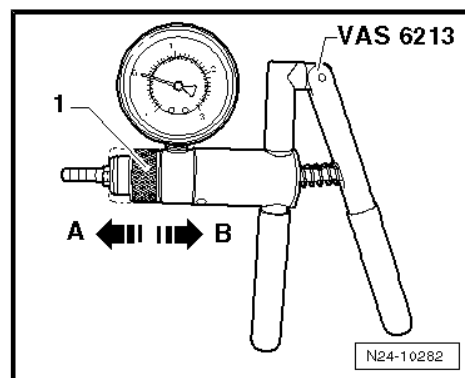
- Move adjuster ring -1- on hand vacuum pump - VAS 6213- to position -B- to vent vacuum in vacuum unit to ambient pressure.

Performing adaption

- Switch to Guided Functions and select 01 - Adaption after replacing positioner.
- Perform adaption for turbocharger.

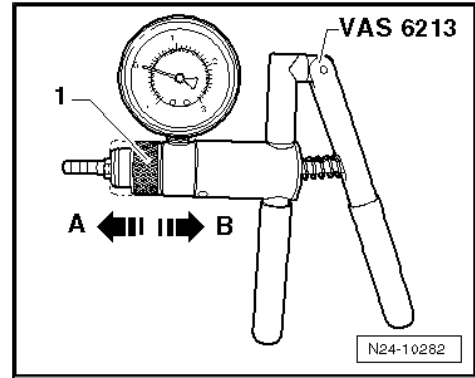
Check voltage value again after adaption.

- Switch to Self-diagnosis and in the list under Measured values, select Turbine actuator 1 bank 1, position feedback, raw voltage.





- Move adjuster ring -1- on hand vacuum pump - VAS 6213- to position -A- to select "vacuum".
- Operate hand vacuum pump - VAS 6213- until a vacuum between -650 ... -700 mbar is displayed on pressure gauge.
- A voltage of 0.75 ± 0.05 V should now be shown in the Measured values display zone.



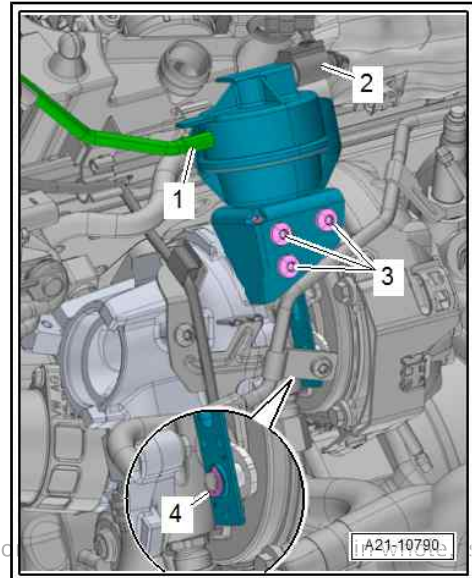
Voltage value not OK

- Loosen bolts -3-.
- Adjust voltage value again ⇒ [page 223](#) .

Voltage value OK

Assembly is performed in reverse sequence; note the following:

- Seal bolts with sealing paint from repair kit.
- Connect vacuum hose ⇒ [page 243](#) .
- Install engine cover panel ⇒ [page 39](#) .
- Erase all event memories ⇒ Vehicle diagnostic tester.



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2 Charge air system

⇒ ["2.1 Exploded view - charge air system", page 225](#)

⇒ ["2.2 Exploded view - hose connections for charge air system", page 227](#)

⇒ ["2.3 Removing and installing charge pressure sender G31", page 228](#)

⇒ ["2.4 Removing and installing charge air temperature sender", page 228](#)

⇒ ["2.5 Checking charge air system for leaks", page 229](#)

2.1 Exploded view - charge air system

1 - Seal

- Renew after removing

2 - Dowel pin

3 - Bolt

- Tightening torque
⇒ [Item 3 \(page 247\)](#)

4 - Gasket

- Renew after removing

5 - Bolt

- Tightening torque
⇒ [Item 5 \(page 247\)](#)

6 - Bracket

- For intake manifold

7 - Bolt

- Tightening torque
⇒ [Item 7 \(page 247\)](#)

8 - Bolt

- Tightening torque and sequence ⇒ [page 248](#)

9 - Dowel pin

10 - Bolt

- Tightening torque
⇒ [Item 10 \(page 247\)](#)

11 - Intake manifold with charge air cooler

- Intake manifold and charge air cooler are combined as one unit
- Removing and installing ⇒ [page 251](#)

12 - Bolt

- Tightening torque and sequence ⇒ [page 248](#)

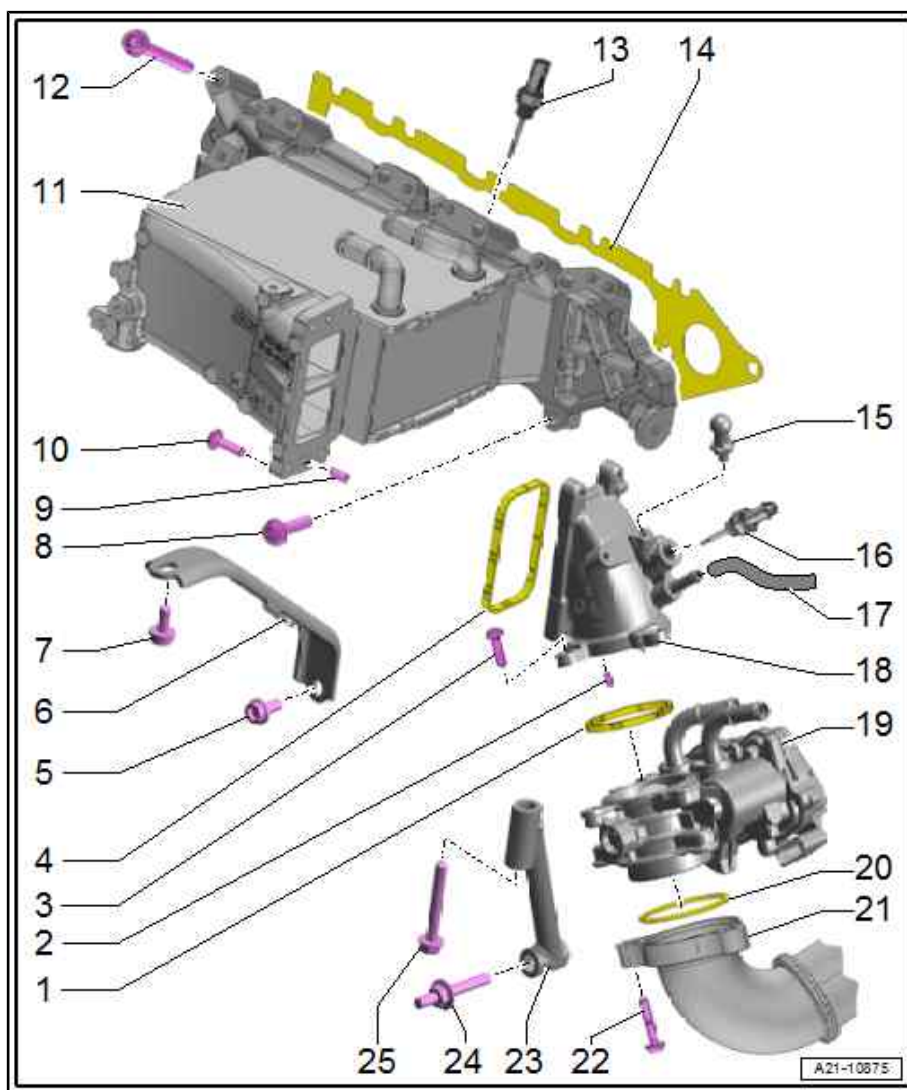
13 - Charge air temperature sender after charge air cooler - G811-

- Removing and installing ⇒ [page 228](#)

22 Nm

14 - Gasket

- Renew after removing



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15 - Ball stud

- For engine cover panel
- Tightening torque ⇒ [Item 15 \(page 247\)](#)

16 - Charge air temperature sender before charge air cooler - G810-

- Removing and installing ⇒ [page 228](#)
- 22 Nm

17 - Hose

- To charge pressure sender - G31-

18 - Connection

- For throttle valve module - J338-

19 - Throttle valve module - J338-

- With throttle valve potentiometer - G69-
- Removing and installing ⇒ [page 249](#)

20 - O-ring

- Renew after removing

21 - Air pipe

22 - Bolt

- 8 Nm

23 - Bracket

- For throttle valve module - J338-

24 - Centre hex stud

- Tightening torque and sequence ⇒ [page 249](#)

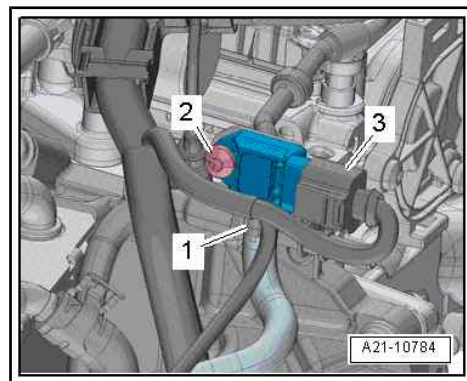
25 - Bolt

- Tightening torque and sequence ⇒ [page 249](#)

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Charge pressure sender - G31- - tightening torque

- Tighten bolt -2- to 9 Nm.





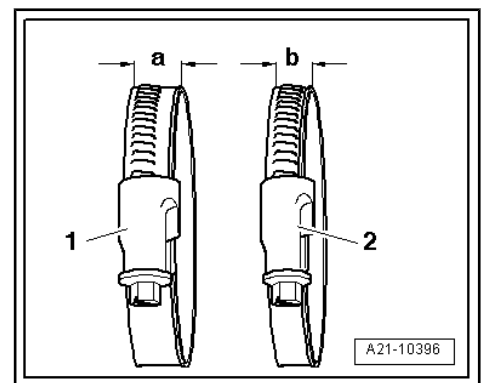
2.2 Exploded view - hose connections for charge air system

Note

- ◆ *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*

Tightening torque for

- 1 - Hose clip with width -a- = 13 mm: 5.5 Nm
- 2 - Hose clip with width -b- = 9 mm: 3.4 Nm



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2.3 Removing and installing charge pressure sender - G31-

Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Unplug electrical connector -3-
- Spray hose -1- on charge pressure sender - G31- with suitable release agent before disconnecting.

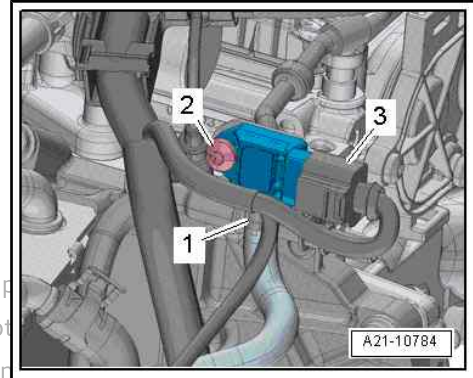


Caution

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Irreparable damage to charge pressure sender can be caused if the connection breaks off.

- ◆ **Carefully disconnect hose from connection, taking care to keep hose straight.**



- Unscrew bolts -2- and remove charge pressure sender - G31- .



Note

Components may be fitted in different locations depending on version.

Installing

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

- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [Fig. "Charge pressure sender -G31- - tightening torque"](#), [page 226](#)

2.4 Removing and installing charge air temperature sender

Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Unplug relevant electrical connector -1 or 2-:
- 1- Charge air temperature sender after charge air cooler - G811-
- 2- Charge air temperature sender before charge air cooler - G810-
- Unscrew relevant charge air temperature sender.

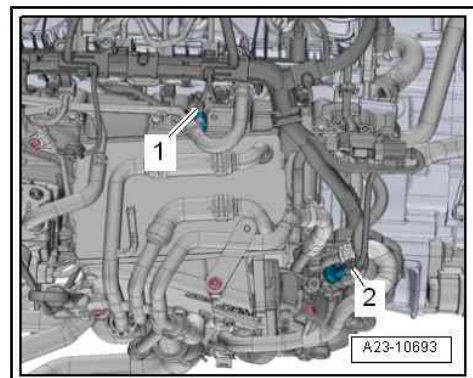
Installing

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

- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ ["2.1 Exploded view - charge air system"](#), [page 225](#)



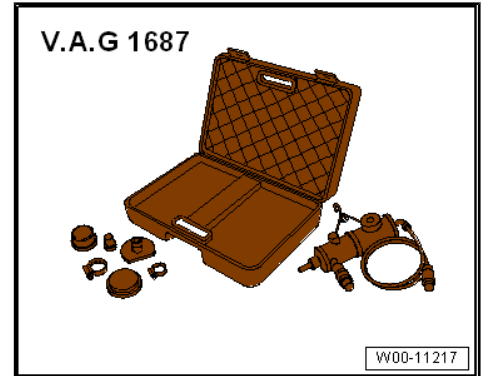


2.5 Checking charge air system for leaks

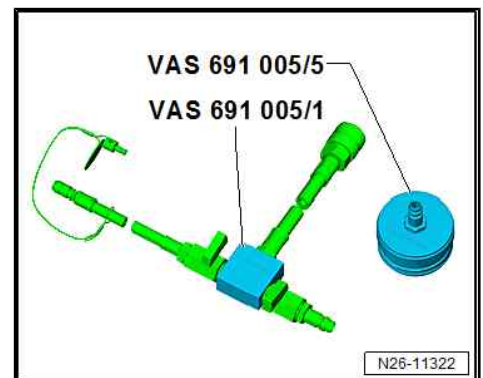
Water-cooled charge air cooler is integrated in intake manifold (combined as one part).

Special tools and workshop equipment required

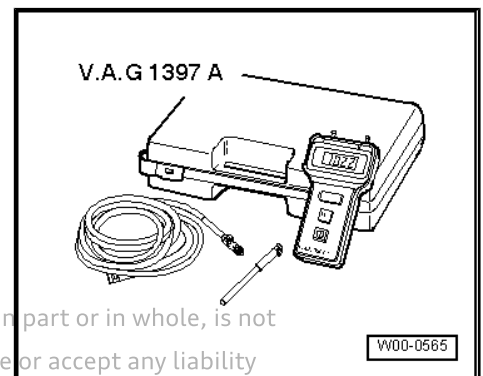
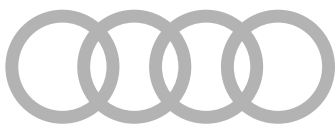
- ◆ Charge air system tester - V.A.G 1687-



- ◆ Adapter - V.A.G 1687/11-
- ◆ Adapter - V.A.G 1687/15-
- ◆ Y-connector - VAS 691 005/1-



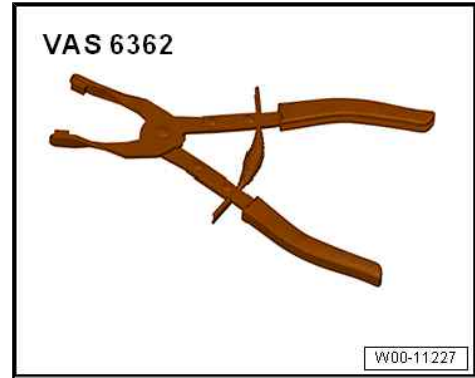
- ◆ Test instrument adapter - VAS 691 005/5-
- ◆ Turbocharger tester - V.A.G 1397A-



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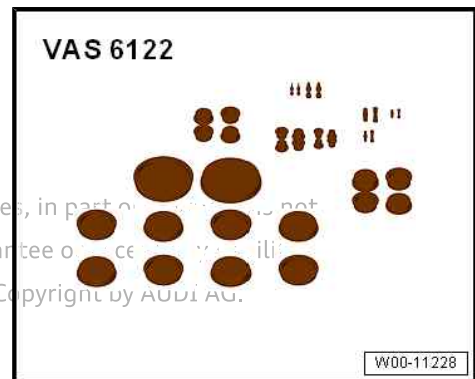
◆ Hose clip pliers - VAS 6362-



◆ Engine bung set - VAS 6122-



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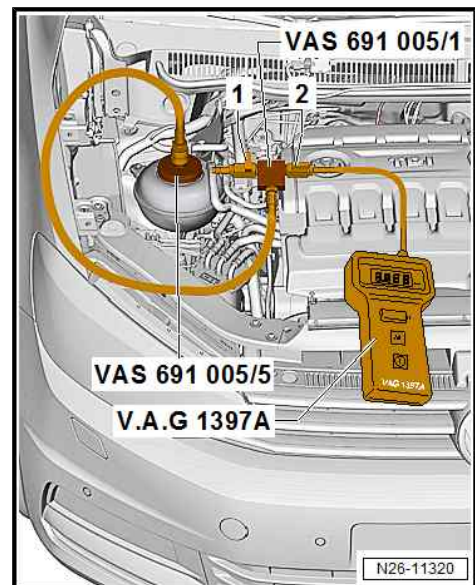
Preparing adapter - V.A.G 1687/15- :

- Shorten adapter - V.A.G 1687/15- to 70 mm.
- Order new adapter - V.A.G 1687/15- to be kept in stock as replacement parts when required.

Procedure

Connecting turbocharger tester - V.A.G 1397A- :

- Remove engine cover panel ⇒ [page 39](#) .
- Fit test adapter - VAS 691 005/5- onto coolant expansion tank.
- Fit Y-connector - VAS 691 005/1- onto test adapter - VAS 691 005/5- .
- Close valve -1- for connection »C« and open valve -2- for connection »A«.
- Attach hose from connection »A« on Y-connector to connection »II« on turbocharger tester - V.A.G 1397A- .
- Set turbocharger tester - V.A.G 1397A- to switch position »II« (relative pressure measurement) and switch it on. The »II« must be visible.





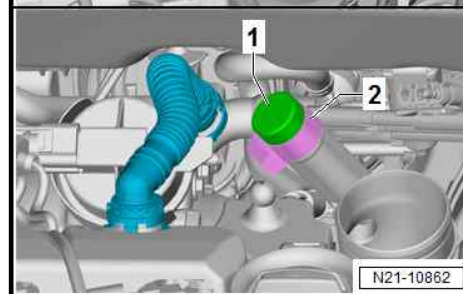
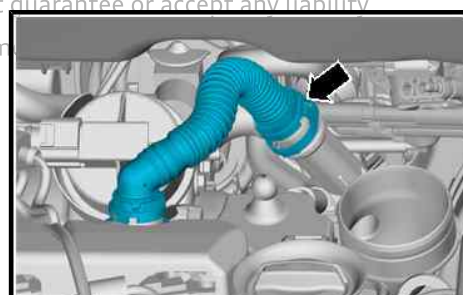
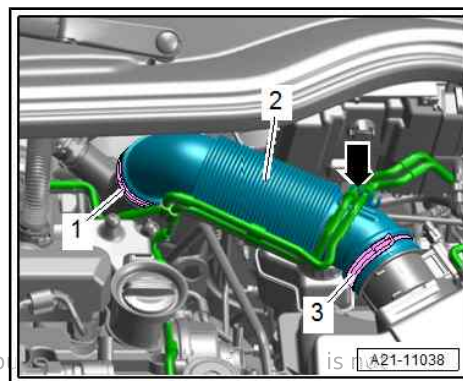
Connecting tester - V.A.G 1687- :

- Move clear vacuum hoses -arrow- at air pipe.
- Loosen hose clips -1, 3- and remove air pipe -2-.

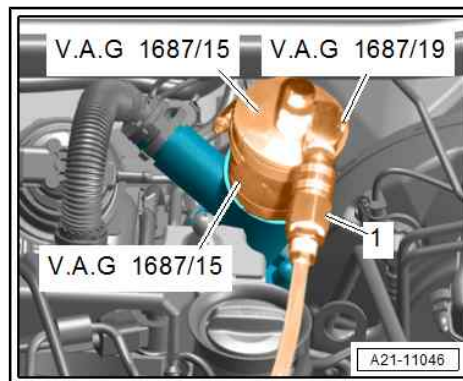


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- Detach breather pipe for crankcase breather system -arrow-.
- Seal off connecting piece with a plug -1- from engine bung set -VAS 6122- . Secure plug with a hose clip -2-.



- Connect adapter - V.A.G 1687/11- with -V.A.G 1687/15- and -V.A.G 1687/19- to turbocharger.
- Connect pressure hose -1- of charge air system tester - V.A.G 1687- to adapter.





Prepare charge air system tester - V.A.G 1687- as follows:

- Pull pressure control valve -2- upwards, then unscrew completely and close valves -3- and -4-.
- Using a commercially available connection piece, connect charge air system tester - V.A.G 1687- to compressed air -1-.
- If there is water in sight glass, remove drain plug -6- and drain water.
- Open valve -3-.



Caution

Risk of damage if pressure is set too high.

- ◆ *The pressure must not exceed 0.5 bar.*

- Adjust pressure to 0.5 bar via pressure control valve -2-.
- Open valve -4- and wait until test system is pressurised. If necessary, adjust pressure to 0.5 bar again.
- Check charge air system for audible leaks or leaks that can be felt with the hand; apply commercially available leak detection spray or use ultrasonic tester - V.A.G 1842- .



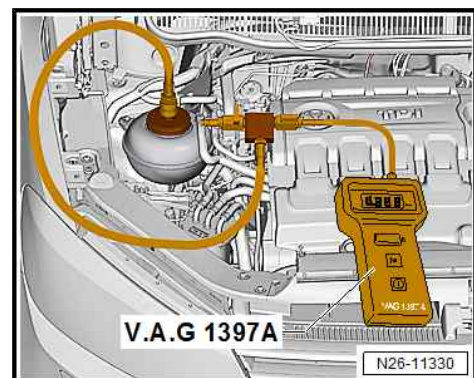
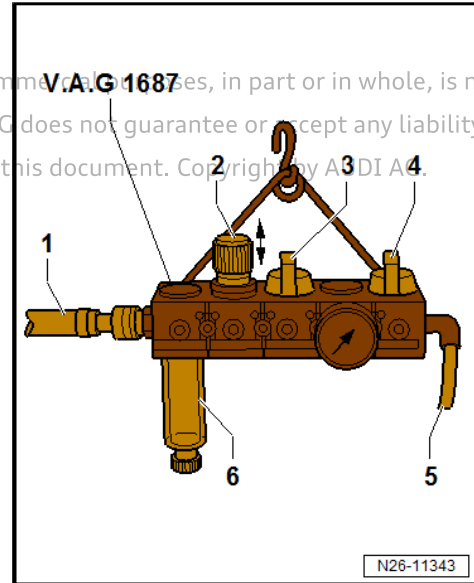
Note

- ◆ *A small amount of air escapes through the valves and enters the engine and the exhaust gas recirculation cooler. Therefore it is not possible to perform a pressure retention test.*
- ◆ *For operation of ultrasonic tester -V.A.G 1842- , refer to ⇒ Operating instructions .*
- Check entire charge air system for leaks:
 - ◆ By listening
 - ◆ By feeling
 - ◆ Using a commercially available leak detection spray
 - ◆ Using ultrasonic tester - V.A.G 1842-

If no leak is found in the charge air system, check water-cooled charge air cooler for leaks.

Reading off values from turbocharger tester - V.A.G 1397A- :

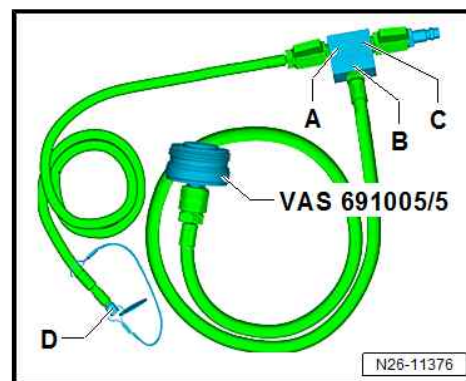
- Pressure must remain set to 0.5 bar.
- Observe turbocharger tester for approx. 5 minutes.
- The pressure displayed on the turbocharger tester must not rise.
- If pressure displayed on turbocharger tester rises, this means that compressed air is escaping into the cooling system.
- Charge air cooler has a leak, renew intake manifold with charge air cooler.
- If there are no leaks in the charge air cooler, a vacuum may form when the coolant cools down. A minus sign on the turbocharger tester indicates that a vacuum has formed.





Cleaning Y-connector - VAS 691 005/1- :

- After the leak test has been completed, the Y-connector - VAS 691 005/1- must be cleaned to remove any water which may have entered.
- Insert cleaning nozzle -D- in hose from connection -A- on Y connector .
- Fit test adapter - VAS 691 005/5- onto hose from connection -B-.
- Fit compressed air hose on connection -C-.
- Open cut-off valves and blow through hose for approx. 15 seconds.
- Release pressure in test circuit by detaching hose coupling from adapter before removing adapter.



Attaching

Assembly is performed in reverse sequence; note the following:



Note

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

- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [“2.1 Exploded view - charge air system”, page 225](#)



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23 – Mixture preparation - injection

1 Injection system

⇒ [“1.1 Overview of fitting locations - injection system”, page 234](#)

⇒ [“1.2 Overview - fuel system”, page 240](#)

⇒ [“1.3 Filling and bleeding fuel system”, page 241](#)

⇒ [“1.4 Checking fuel system for leaks”, page 242](#)

1.1 Overview of fitting locations - injection system

Overview of fitting locations - engine compartment

1 - Exhaust flap control unit - J883-

- Fitting location
⇒ [page 236](#)

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

- Fitting location
⇒ [page 235](#)

3 - Brake light switch - F-

- Fitting location
⇒ [page 235](#)

4 - Engine control unit - J623-

- Removing and installing
⇒ [page 291](#)

5 - Clutch position sender - G476-

- For vehicles with manual gearbox
- Fitting location
⇒ [page 235](#)

6 - Charge pressure control solenoid valve - N75-

7 - Air mass meter - G70-

- Exploded view
⇒ [page 245](#)

8 - Automatic glow period control unit - J179-

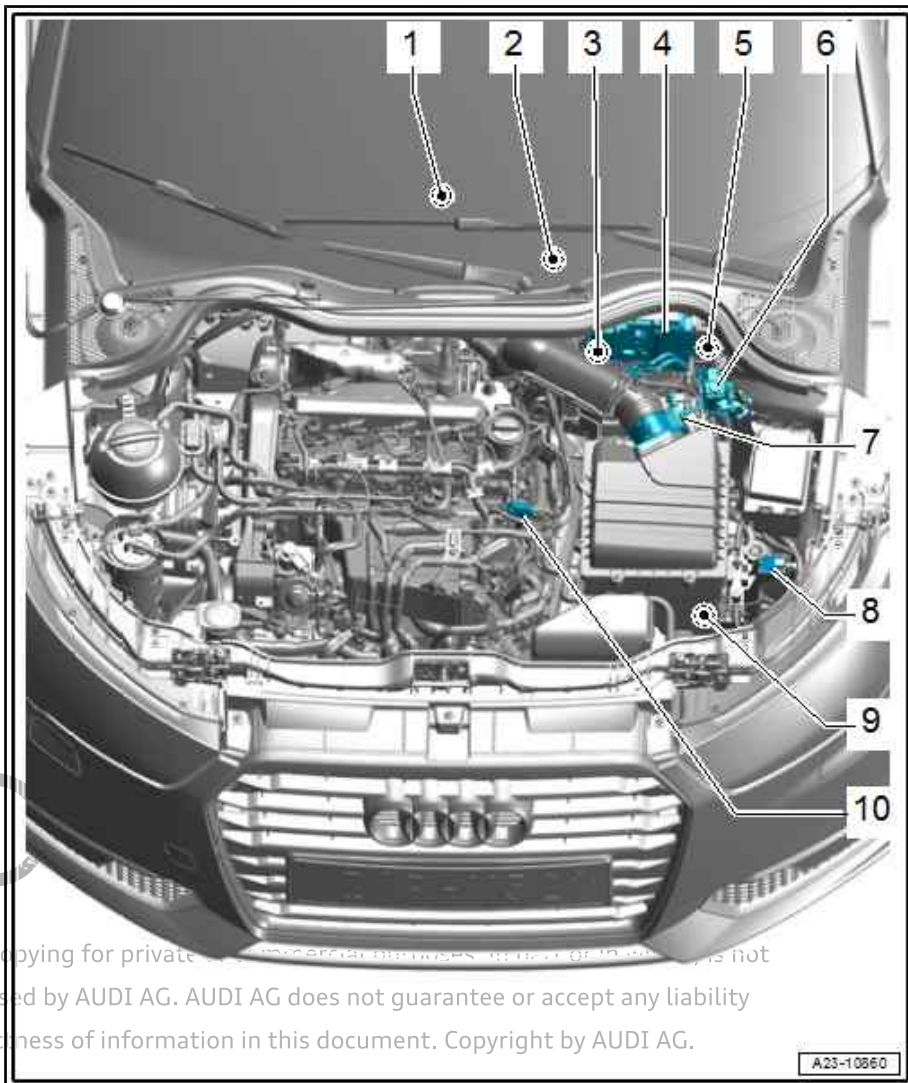
- Fitting location
⇒ [page 236](#)

9 - Gearbox neutral position sender - G701- / reversing light switch - F4-

- For vehicles with manual gearbox
- Fitting location ⇒ [page 235](#)

10 - Brake servo pressure sensor - G294-

- Sends signals to ABS control unit - J104-





Fitting location of accelerator position sender - G79- / accelerator position sender 2 - G185-

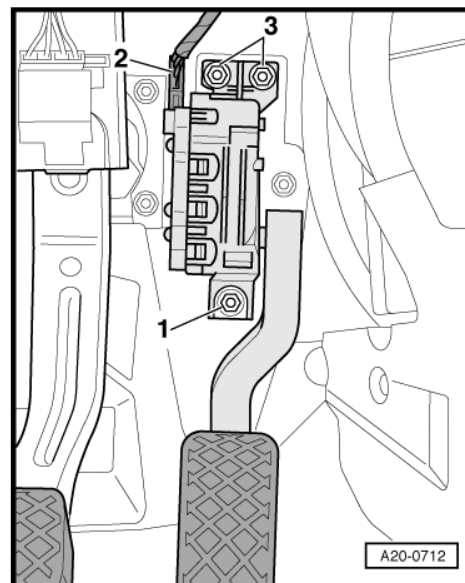
- ◆ In accelerator pedal module



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 ⇒ Fuel supply system; Rep. gr. 20 ; Accelerator mechanism; Removing and installing accelerator pedal module with accelerator position sender -G79- / -G185-

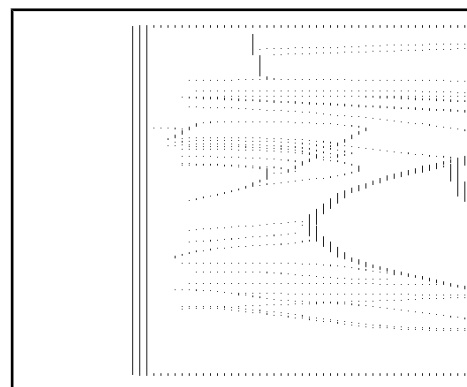


Fitting location of brake light switch - F-

- ◆ On brake master cylinder

C - Brake light switch - F-

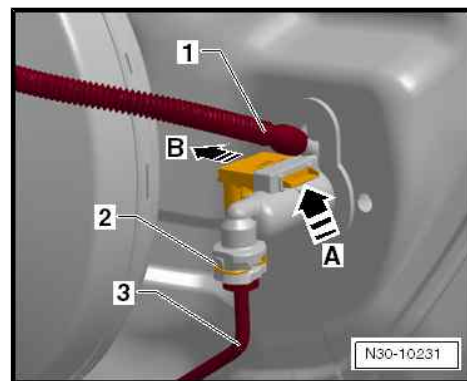
Removing and installing ⇒ Brake system; Rep. gr. 47 ; Brake servo/brake master cylinder; Removing and installing brake light switch



Fitting location of clutch position sender - G476-

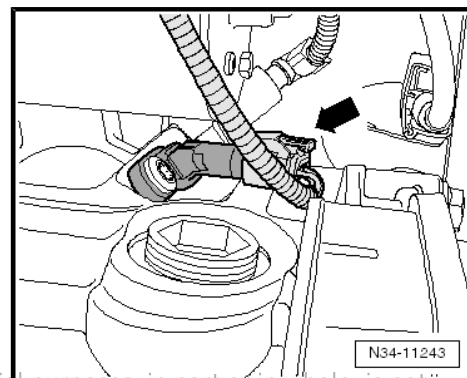
- ◆ On clutch master cylinder, next to brake servo

Removing and installing ⇒ Rep. gr. 30 ; Clutch mechanism; Removing and installing clutch position sender - G476-



Fitting location of gearbox neutral position sender - G701-

- ◆ At front of manual gearbox -arrow-



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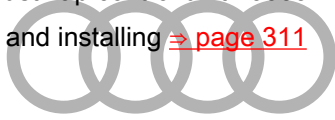
Fitting location of exhaust flap control unit - J883-

- In front exhaust pipe

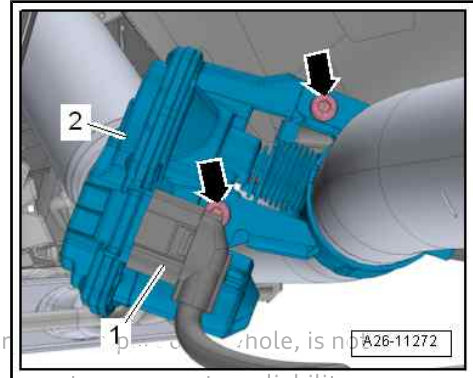
1 - Electrical connector

2 - Exhaust flap control unit - J883-

Removing and installing => [page 311](#)

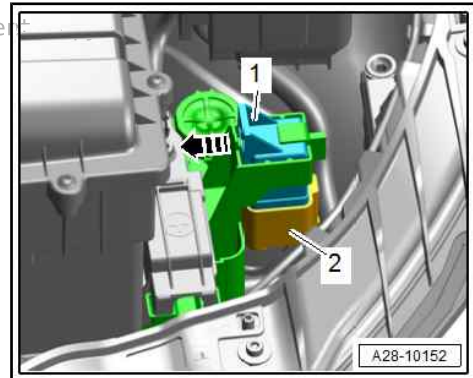


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Fitting location of automatic glow period control unit - J179-

- ◆ -Item 1- in mounting for fuse holder B - SB- in engine compartment (front left) => Current flow diagrams, Electrical fault finding and Fitting locations.



Overview of fitting locations - engine (view from above)



1 - Fuel metering valve - N290-

- Integrated in high-pressure pump
- Exploded view
⇒ [page 273](#)

2 - Glow plug 1 - Q10-

- Exploded view
⇒ [page 331](#)

3 - Coolant valve for cylinder head - N489-

- Exploded view
⇒ [page 184](#)

4 - Fuel pressure sender - G247-

- Exploded view
⇒ [page 257](#)

5 - Injector, cylinder 1 - N30-

- Exploded view
⇒ [page 255](#)

6 - Injector, cylinder 2 - N31-

- Exploded view
⇒ [page 255](#)

7 - Pressure differential sender - G505-

- Exploded view
⇒ [page 286](#)

8 - Exhaust gas pressure sensor 1 - G450-

- Exploded view
⇒ [page 286](#)

9 - Injector, cylinder 3 - N32-

- Exploded view
⇒ [page 255](#)

10 - Position sender for charge pressure positioner - G581-

11 - Injector, cylinder 4 - N33-

- Exploded view ⇒ [page 255](#)

12 - Fuel pressure regulating valve - N276-

- Exploded view ⇒ [page 257](#)

13 - Glow plug 4 - Q13-

- Exploded view ⇒ [page 331](#)

14 - Charge pressure sender - G31-

- Exploded view ⇒ [page 225](#)

15 - Charge air temperature sender before charge air cooler - G810-

- Exploded view ⇒ [page 247](#)

16 - Glow plug 3 - Q12-

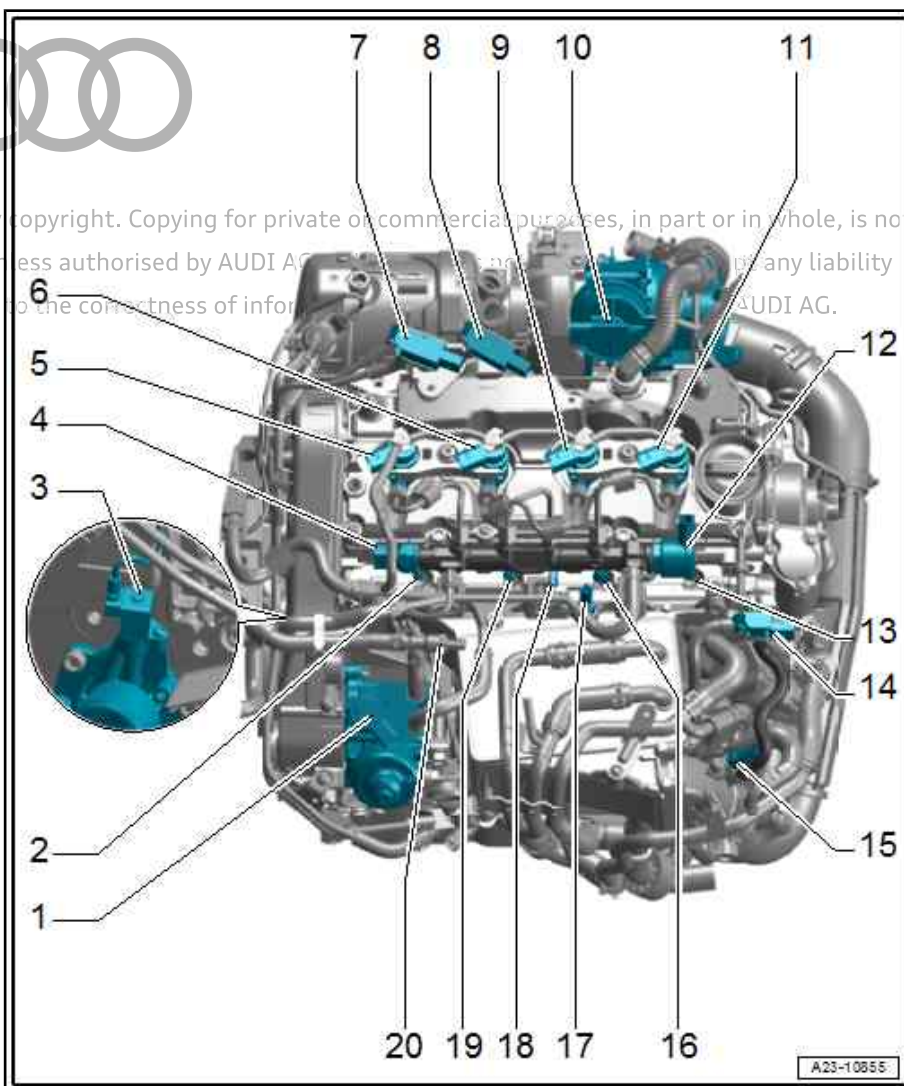
- Exploded view ⇒ [page 331](#)

17 - Charge air temperature sender after charge air cooler - G811-

- Exploded view ⇒ [page 247](#)

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

- Exploded view ⇒ [page 331](#)





19 - Glow plug 2 - Q11-

- Exploded view ⇒ [page 331](#)

20 - Fuel temperature sender - G81-

- In fuel supply line
- Removing and installing ⇒ [page 277](#)

Overview of fitting locations - engine (inlet side)

1 - Charge air cooling pump - V188-

- Exploded view
⇒ [page 186](#)

2 - Valve for oil pressure control - N428-

- Exploded view
⇒ [page 122](#)

3 - Throttle valve module - J338-

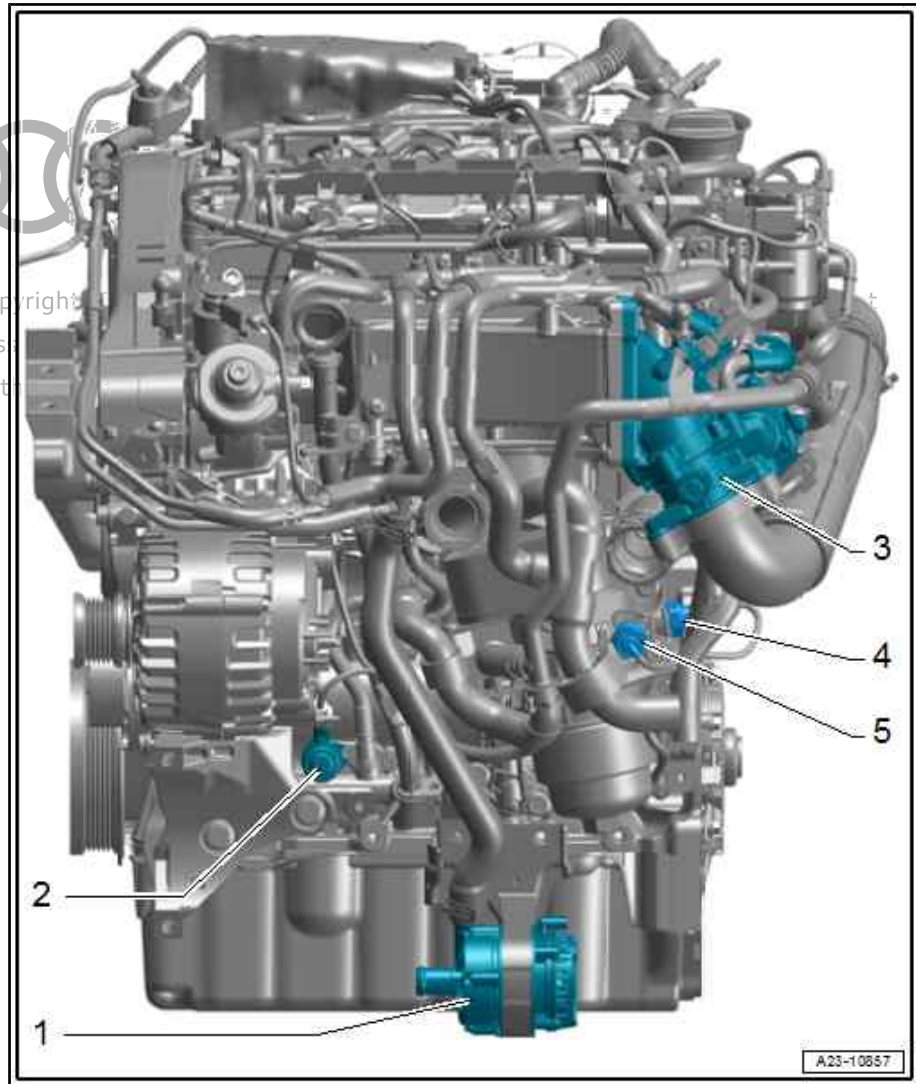
- With throttle valve potentiometer - G69-
- Exploded view
⇒ [page 247](#)

4 - Oil pressure switch for reduced oil pressure - F378-

- Exploded view
⇒ [page 132](#)

5 - Oil pressure switch - F22-

- Exploded view
⇒ [page 132](#)



Overview of fitting locations - engine (exhaust side)



1 - Oil level and oil temperature sender - G266-

- Exploded view
⇒ [page 122](#)

2 - Exhaust gas recirculation control motor 2 - V339-

- Exploded view
⇒ [page 321](#)

3 - Exhaust gas temperature sender 1 - G235-

- Exploded view
⇒ [page 286](#)

4 - Exhaust gas temperature sender 2 - G448-

- Exploded view
⇒ [page 286](#)

5 - Lambda probe - G39- with Lambda probe heater - Z19-

- Exploded view
⇒ [page 286](#)

6 - Exhaust gas temperature sender 3 - G495-

- May be fitted depending on emission standard
- Exploded view
⇒ [page 286](#)

7 - Exhaust gas temperature sender 4 - G648-

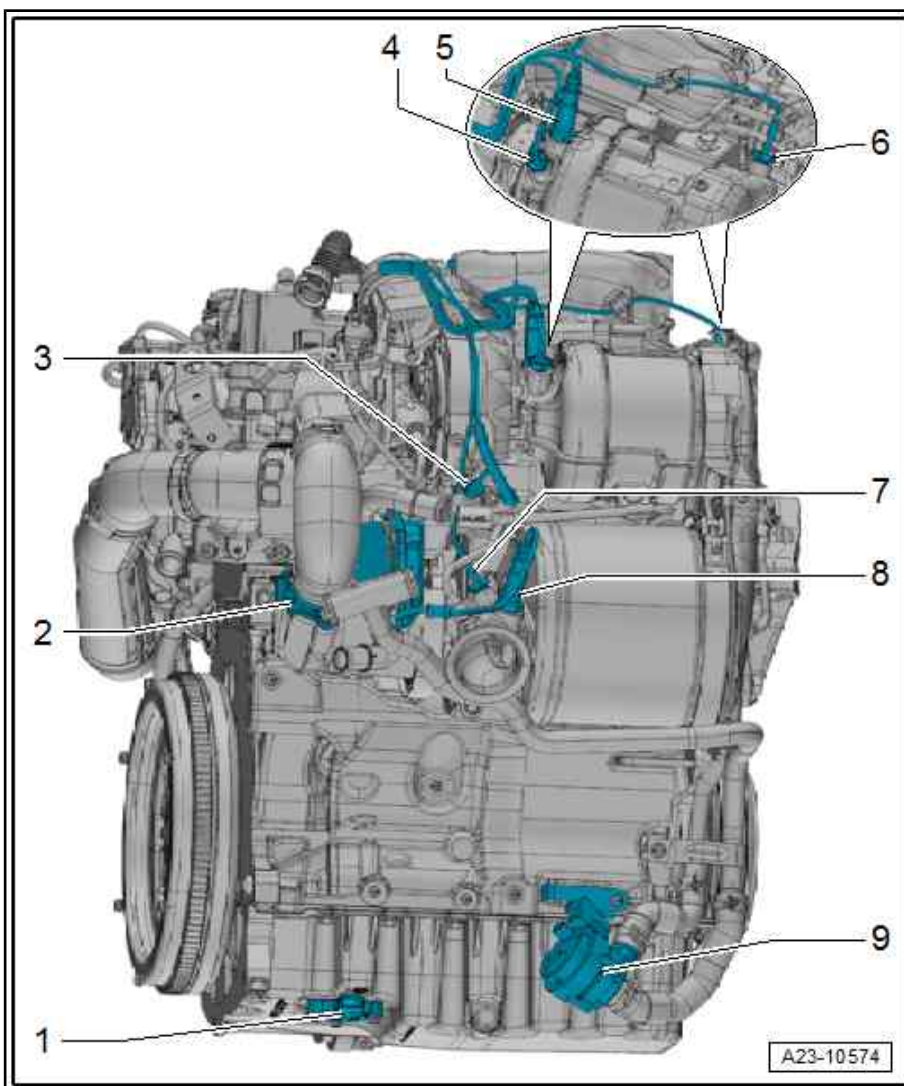
- Exploded view
⇒ [page 286](#)

8 - Lambda probe after catalytic converter - G130- with Lambda probe 1 heater after catalytic converter - Z29-

- Exploded view ⇒ [page 286](#)

9 - Auxiliary pump for heating - V488-

- Exploded view ⇒ [page 186](#)



Overview of fitting locations - engine (gearbox end)



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1 - Engine speed sender - G28-

- ❑ Exploded view
⇒ [page 331](#)

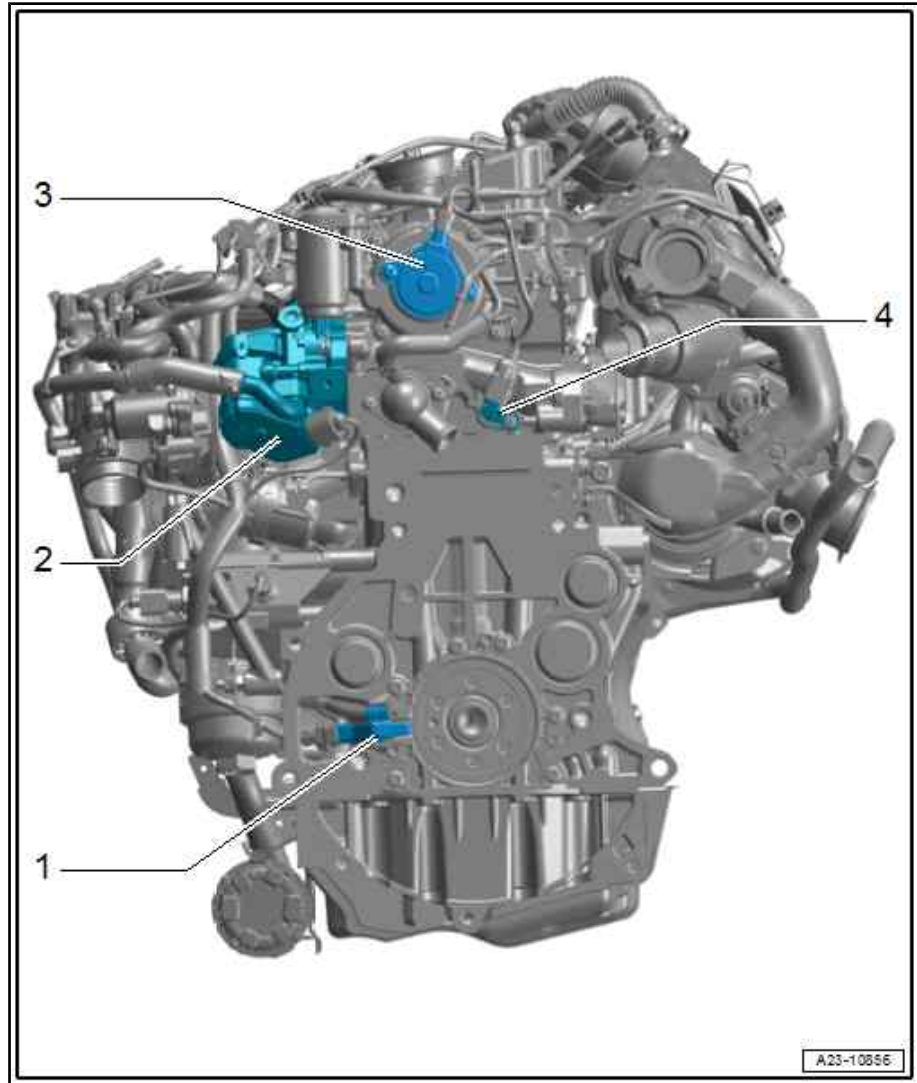
2 - Exhaust gas recirculation control motor - V338- with exhaust gas recirculation potentiometer - G212-

- ❑ Exploded view
⇒ [page 321](#)

3 - Not fitted

4 - Coolant temperature sender - G62-

- ❑ Exploded view
⇒ [page 187](#)



1.2 Overview - fuel system



Note

- ◆ *Red = Fuel supply lines*
- ◆ *Blue = Fuel return lines*
- ◆ *Arrows show direction of fuel flow.*



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1 - Fuel filter

- ❑ Exploded view ⇒ Fuel supply system; Rep. gr. 20 ; Fuel filter; Exploded view - fuel filter

2 - High-pressure pump

- ❑ Exploded view ⇒ Fuel supply system; Rep. gr. 20 ; High-pressure pump; Exploded view - high-pressure pump ⇒ [page 273](#)

3 - Fuel metering valve - N290-

4 - Fuel temperature sender - G81-

- ❑ 2 Nm

5 - Fuel pressure sender - G247-

- ❑ Exploded view ⇒ Fuel supply system; Rep. gr. 20 ; Fuel pressure sender - G247- ⇒ [page 257](#)

6 - Fuel rail

- ❑ Exploded view ⇒ Fuel supply system; Rep. gr. 20 ; Fuel rail; Exploded view - fuel rail ⇒ [page 257](#)

7 - Fuel pressure regulating valve - N276-

- ❑ Exploded view ⇒ Fuel supply system; Rep. gr. 20 ; Fuel pressure regulating valve - N276- ⇒ [page 257](#)

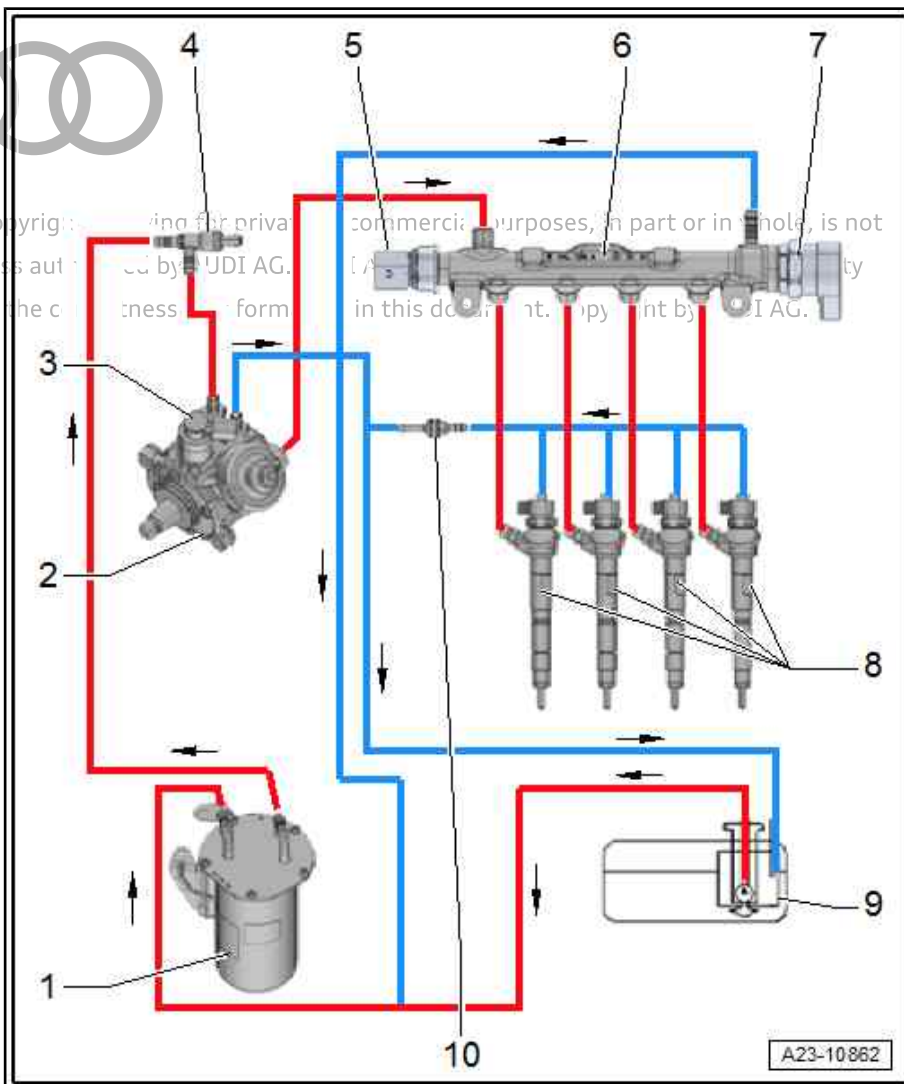
8 - Injectors

- ❑ Exploded view ⇒ Fuel supply system; Rep. gr. 20 ; Injectors; Exploded view - injectors ⇒ [page 255](#)

9 - Fuel tank

- ❑ With fuel system pressurisation pump - G6-
- ❑ Exploded view ⇒ Fuel supply system; Rep. gr. 20 ; Fuel tank; Exploded view - fuel tank

10 - Restrictor



1.3 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 **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**
 - ◆ **Activate fuel pump**
 - ◆ Press **Carry out check**
 - ◆ Select 120 seconds.
- The fuel pump must run for 120 seconds 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 inspect high-pressure section again for leaks.

1.4 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 complete fuel system for leaks.
- If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
- Road-test vehicle and accelerate with full throttle at least once.
- Then inspect high-pressure section again for leaks.

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2 Vacuum system

⇒ "2.1 Connection diagram - vacuum system", page 243

⇒ "2.2 Checking vacuum system", page 243

2.1 Connection diagram - vacuum system

1 - Vacuum line

2 - Non-return valve

- Note installation position

3 - Cylinder head cover

- With vacuum reservoir

4 - Vacuum unit for charge pressure control

- With position sender for charge pressure positioner - G581-
- On turbocharger

5 - Control pipe for vacuum

- From charge pressure control solenoid valve - N75- to vacuum unit on turbocharger

6 - Charge pressure control solenoid valve - N75-

7 - Vent line

8 - Air cleaner housing

9 - Brake servo pressure sensor - G294-

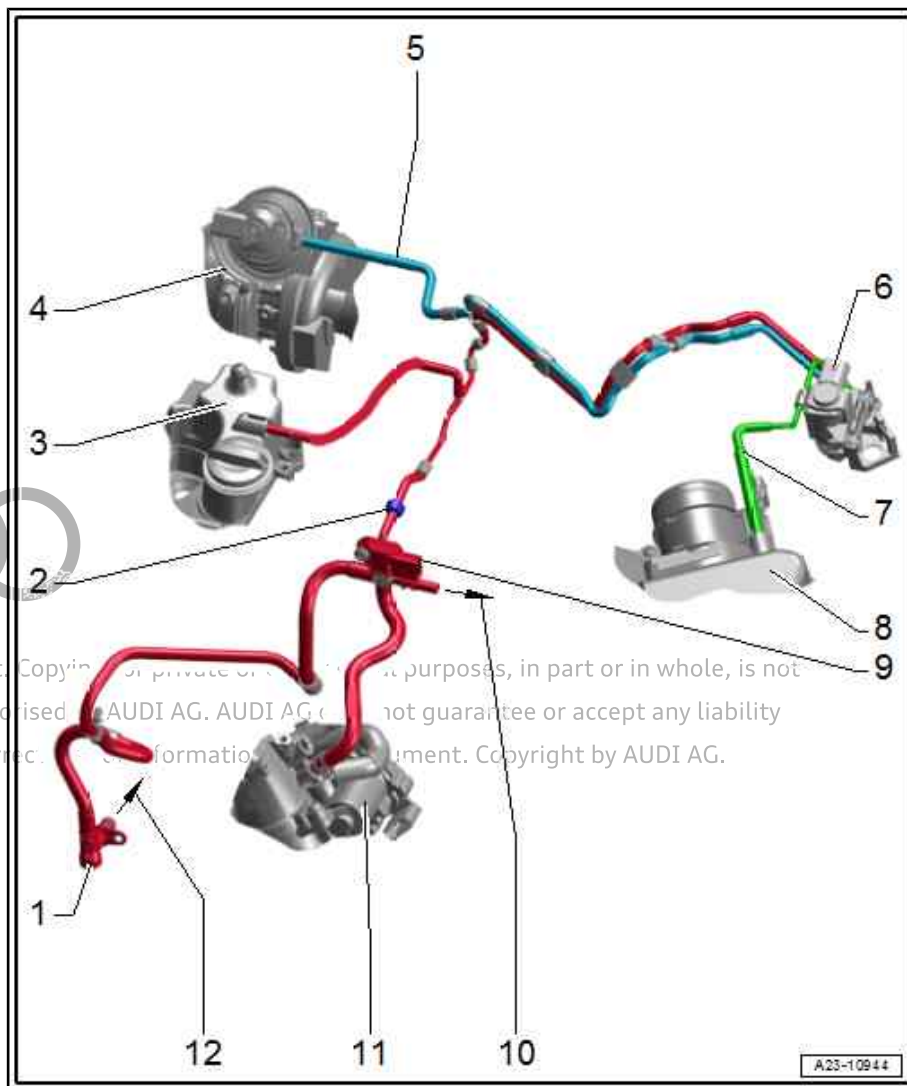
10 - To brake servo

11 - Connection

- For throttle valve module - J338-

12 - To vacuum pump

- In oil pump ⇒ [page 122](#)



2.2 Checking vacuum system

Special tools and workshop equipment required



◆ Hand vacuum pump - VAS 6213-



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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 all vacuum lines leading to the corresponding component and also check the remaining vacuum lines leading to other components.
- If it is not possible to build up a vacuum with the hand vacuum pump - VAS 6213- or if the vacuum pressure drops again immediately, check the hand vacuum pump and connecting hoses for leaks.



3 Air cleaner

⇒ "3.1 Exploded view - air cleaner housing", page 245

⇒ "3.2 Removing and installing air cleaner housing", page 246

3.1 Exploded view - air cleaner housing

1 - Water drain hose

- With valve
- Clean

2 - Bolt

- 5 Nm

3 - Air duct (bottom section)

- On lock carrier

4 - Bolt

- 5 Nm

5 - Air duct (top section)

- On lock carrier

6 - O-ring

- Renew if damaged

7 - Air mass meter - G70-

- Removing and installing ⇒ [page 277](#)

8 - Bolt

- 1.5 Nm

9 - Air hose

10 - Cover

- For air duct

11 - Breather hose

- For charge pressure control solenoid valve - N75-

12 - Bolt

- 1.5 Nm

13 - Air cleaner (top section)

- Check for dirt

14 - Air filter element

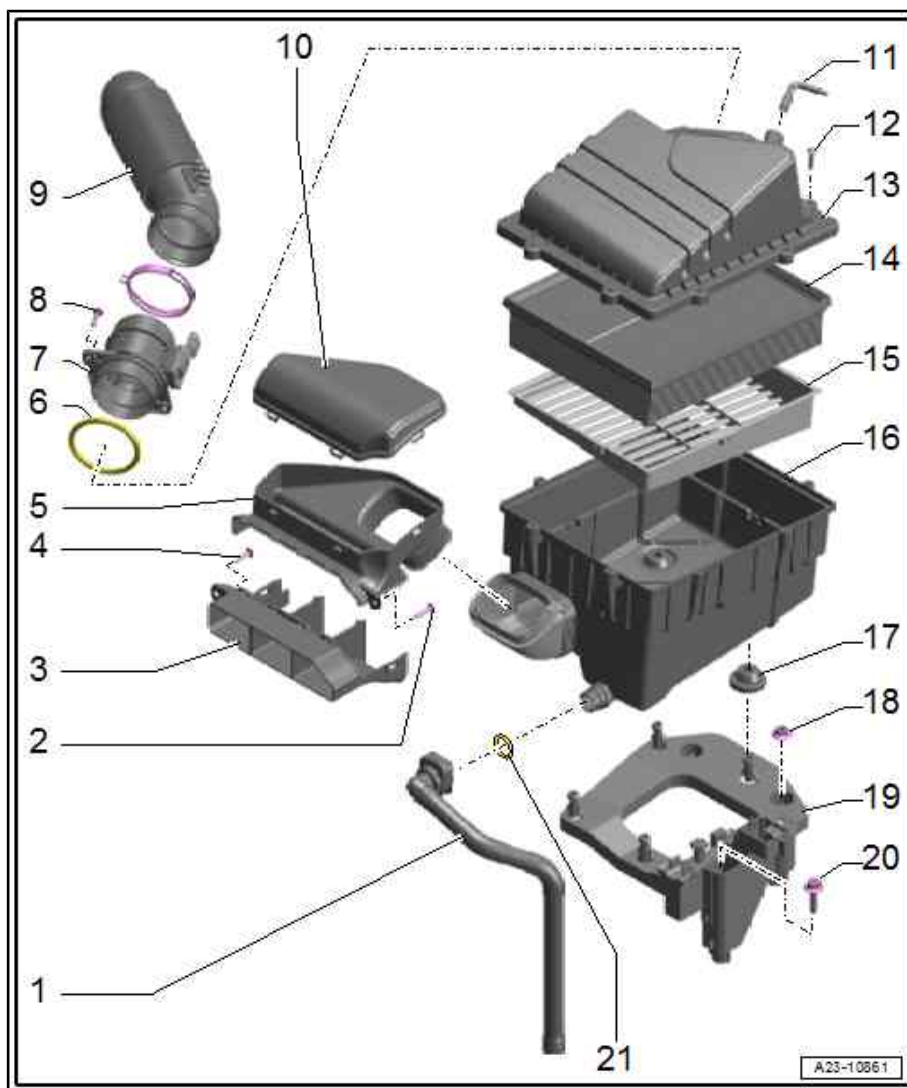
- Use genuine air filter element ⇒ Electronic parts catalogue
- Change intervals ⇒ Maintenance tables
- Removing and installing ⇒ Maintenance ; Booklet 819

15 - Insert

- For air cleaner (bottom section)

16 - Air cleaner (bottom section)

- Remove any salt residue, dirt and leaves
- Removing and installing ⇒ [page 246](#)





17 - Rubber buffer

18 - Nut

- ❑ Tightening torque ⇒ Electrical system; Rep. gr. 27 ; Jump start terminal; Exploded view - jump start terminal

19 - Mounting bracket

- ❑ For jump-start terminal and air cleaner housing
- ❑ Removing and installing ⇒ Electrical system; Rep. gr. 27 ; Jump start terminal; Removing and installing jump start terminal

20 - Bolt

- ❑ Tightening torque ⇒ Electrical system; Rep. gr. 27 ; Jump start terminal; Exploded view - jump start terminal

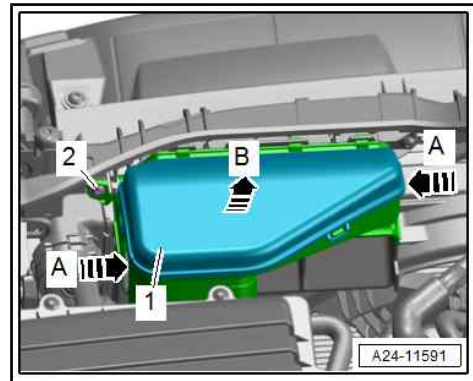
21 - O-ring

- ❑ Renew if damaged

3.2 Removing and installing air cleaner housing

Removing

- Unscrew bolt -2- and release fasteners -arrows A-.
- Detach cover -1- from air duct -arrow B- and remove it.



- Unplug electrical connector -3-.
- Disconnect vacuum hose -4-.
- Press release tab -5- and disconnect water drain hose.
- Release hose clip -2- and detach air pipe.
- Lift off air cleaner housing -1-.

Installing

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



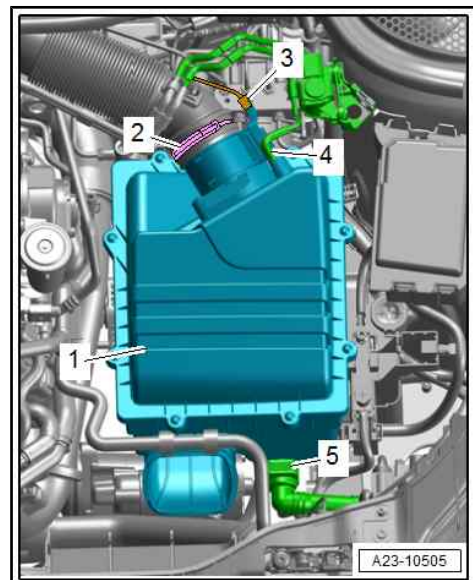
Note

- ◆ *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- ◆ *Use silicone-free lubricant when installing air hose.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ Electronic parts catalogue .*

- Clean dirt and leaves, etc. out of water drain hose.

Tightening torques

- ◆ ⇒ ["3.1 Exploded view - air cleaner housing", page 245](#)





4 Intake manifold

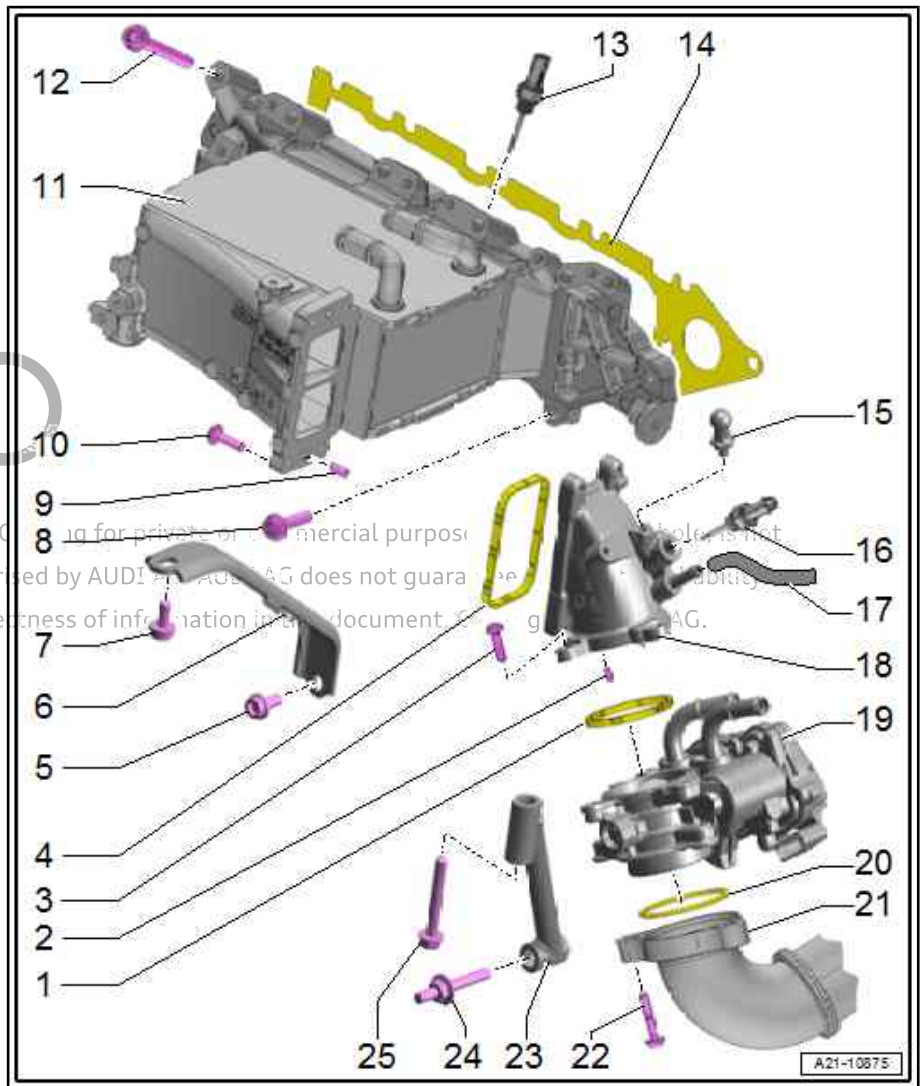
⇒ "4.1 Exploded view - intake manifold", page 247

⇒ "4.2 Removing and installing throttle valve module J338 ", page 249

⇒ "4.3 Removing and installing intake manifold", page 251

4.1 Exploded view - intake manifold

- 1 - Seal
 - Renew after removing
- 2 - Dowel pin
- 3 - Bolt
 - 8 Nm
- 4 - Gasket
 - Renew after removing
- 5 - Bolt
 - Tightening torque and sequence ⇒ [page 249](#)
- 6 - Bracket
 - For intake manifold
- 7 - Bolt
 - Tightening torque and sequence ⇒ [page 249](#)
- 8 - Bolt
 - Renew after removing
 - Tightening torque and sequence ⇒ [page 248](#)
- 9 - Dowel pin
- 10 - Bolt
 - 8 Nm
- 11 - Intake manifold with charge air cooler
 - Intake manifold and charge air cooler are combined as one unit
 - Removing and installing ⇒ [page 251](#)
- 12 - Bolt
 - Renew after removing
 - Tightening torque and sequence ⇒ [page 248](#)
- 13 - Charge air temperature sender after charge air cooler - G811-
 - Removing and installing ⇒ [page 228](#)
 - Tightening torque ⇒ [Item 13 \(page 225\)](#)
- 14 - Gasket
 - Renew after removing
- 15 - Ball stud
 - For engine cover panel
 - 9 Nm





16 - Charge air temperature sender before charge air cooler - G810-

- Removing and installing ⇒ [page 228](#)
- Tightening torque ⇒ [Item 16 \(page 226\)](#)

17 - Hose

- To charge pressure sender - G31-

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18 - Connection

- For throttle valve module - J338-

19 - Throttle valve module - J338-

- With throttle valve potentiometer - G69-
- Removing and installing ⇒ [page 249](#)

20 - O-ring

- Renew after removing

21 - Air pipe

22 - Bolt

- Tightening torque ⇒ [Item 22 \(page 226\)](#)

23 - Bracket

- For throttle valve module - J338-

24 - Centre hex stud

- 8 Nm

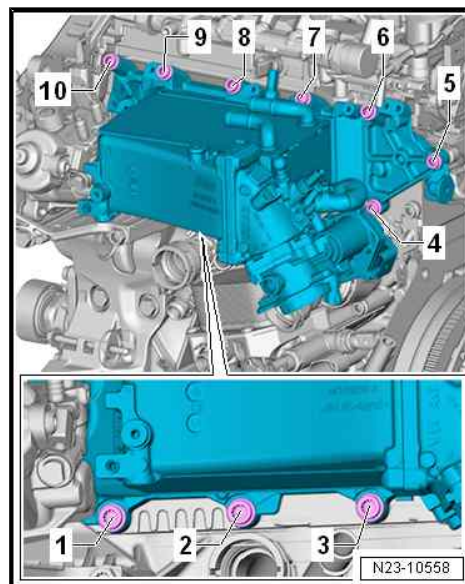
25 - Bolt

- Tightening torque and sequence ⇒ [page 249](#)

Intake manifold with charge air cooler - tightening torque and sequence

- Tighten bolts in stages:


Stage	Bolts	Tightening torque
1.	-1 ... 10-	Screw in by hand until contact is made
2.	-1 ... 10-	Tighten to 20 Nm
3.	-1 ... 10-	Turn 90° further





Bracket for intake manifold and bracket for throttle valve module - tightening torque and sequence

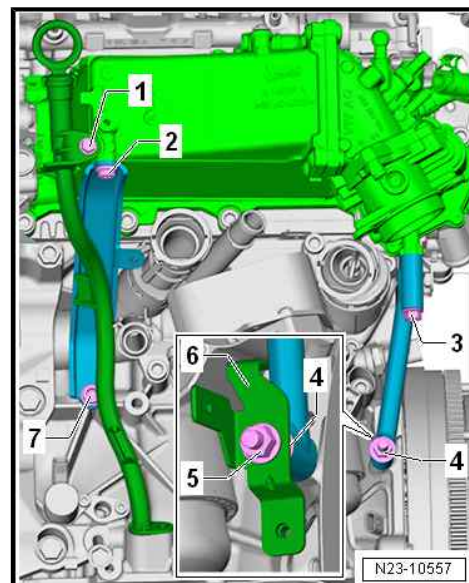
- Tighten bolts in stages:



Caution

When installing bracket -6- for intake manifold/bracket for throttle valve module, it is very important to ensure that the bracket is not bolted on while under tension.

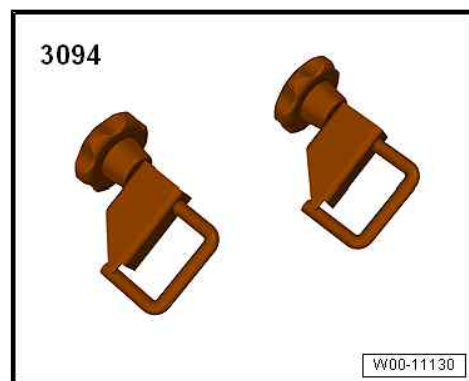
Stage	Bolts/nuts	Tightening torque
1.	-2, 3, 4, 7-	Screw in hand-tight as far as stop
2.	-2, 3, 4, 7-	Tighten to 20 Nm
3.	-5-	Tighten to 10 Nm
4.	-1-	Tighten to 10 Nm



4.2 Removing and installing throttle valve module - J338-

Special tools and workshop equipment required

- ◆ Hose clamps up to 25 mm - 3094-



- ◆ Hose clip pliers - VAS 6362-



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Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Remove air cleaner housing ⇒ [page 246](#) .

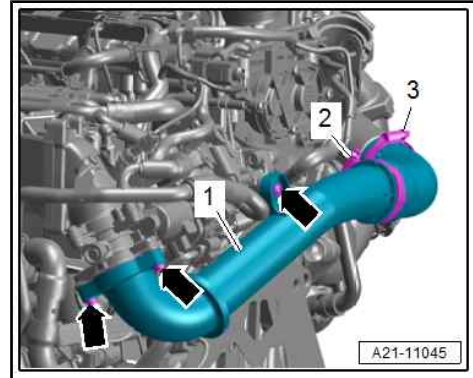


- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.



Note

Disregard -item 3-.



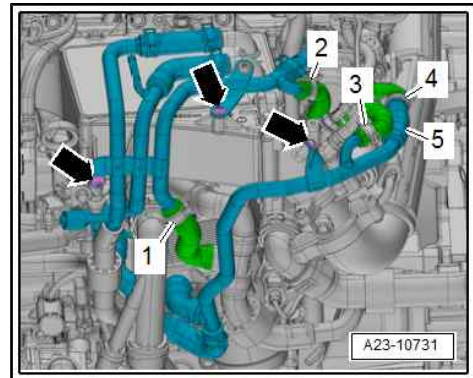
- Remove bolts -arrows-.
- Clamp off coolant hoses -1- and -5- using hose clamps for hoses up to 25 mm - 3094- .



Note

Place a cloth underneath to catch escaping coolant.

- Release hose clips -2, 3, 4- and disconnect coolant hoses.

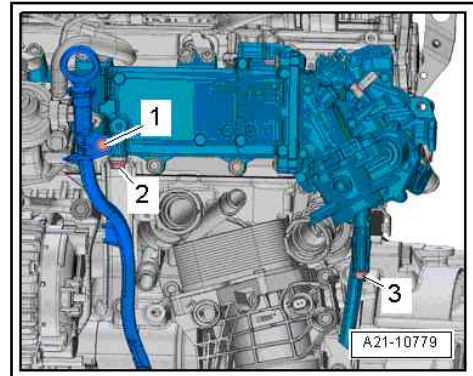


- Remove bolt -3-.



Note

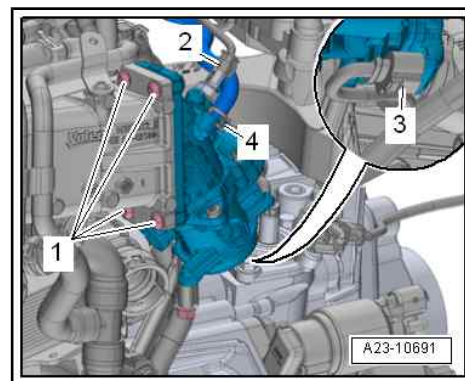
Disregard items -1 and 2-.



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- Unplug electrical connectors:
- 2 - For charge air temperature sender before charge air cooler - G810-
- 3 - For throttle valve module - J338-
- Release hose clip -4- and detach air hose.
- Remove bolts -1- and detach connection with throttle valve module - J338- .



Installing

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



Note

Renew seals and O-ring after removal.

- When fitting intake connecting pipe with throttle valve module - J338- , pay attention to dowel pins.



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ **Only fill and bleed fuel system using ⇒ Vehicle diagnostic tester.**



Note

Do not reuse coolant.

- Fill up with coolant ⇒ [page 148](#) .
- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [“4.1 Exploded view - intake manifold”, page 247](#)
- ◆ ⇒ [“3.1 Exploded view - coolant pipes”, page 196](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)
- ◆ ⇒ [“2.1 Exploded view - charge air system”, page 225](#)

4.3 Removing and installing intake manifold



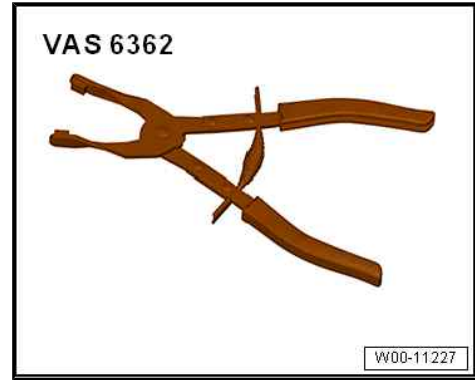
Note

Intake manifold and charge air cooler are combined as one unit.

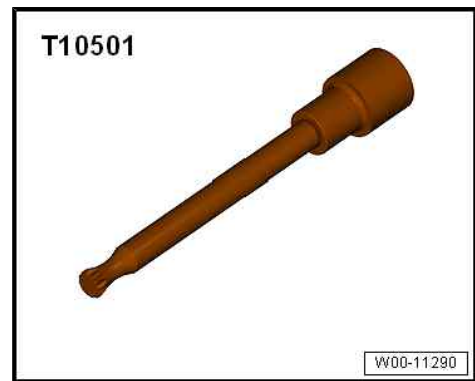
Special tools and workshop equipment required



- ◆ Hose clip pliers - VAS 6362-



- ◆ Bit XZN 10 - T10501-

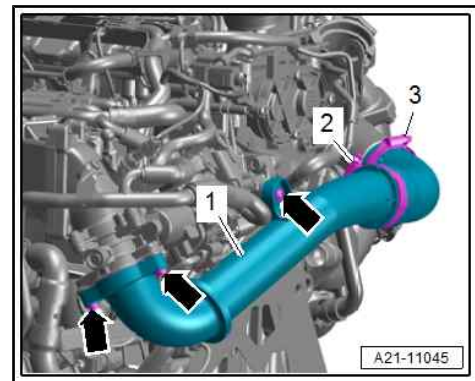


Removing

- Remove coolant pipes (top) ⇒ [page 197](#) .
- Remove high-pressure pipe ⇒ [page 268](#) .
- Remove air cleaner housing ⇒ [page 246](#) .
- Remove bolts -arrows-.
- Release screw-type clip -2- and detach air pipe -1-.

Note

Disregard -item 3-.

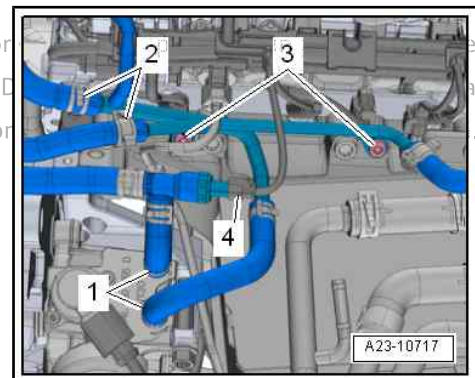


- Unplug electrical connector -4-.

 **Caution**

Risk of malfunctions caused by dirt.

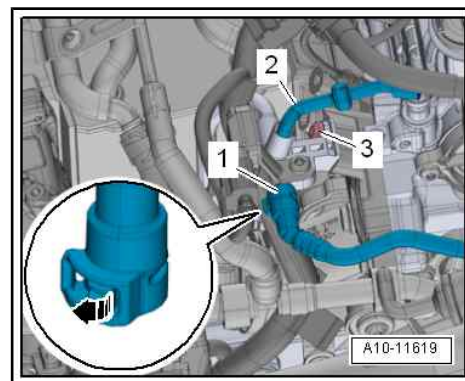
◆ Observe ⇒ ***"3.1 Rules for cleanliness", page 5*** .



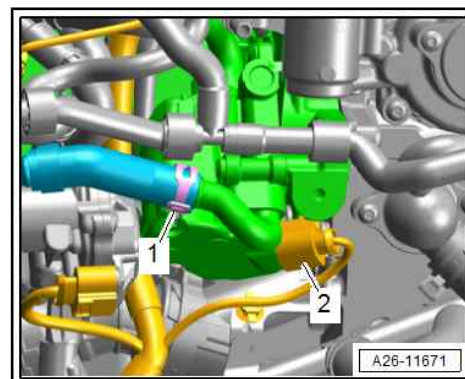
- Release hose clips -1 and 2- and detach fuel hoses.
- Remove bolts -3- and move fuel lines to rear.



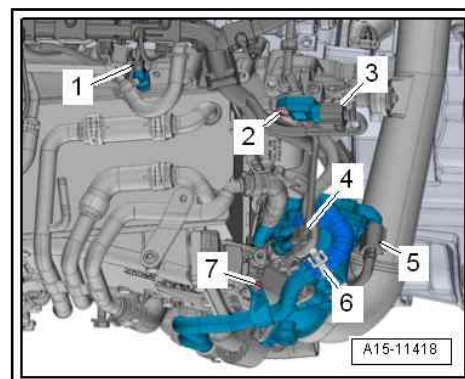
- Release catch -arrow- and disconnect vacuum hose -1-.
- Remove bolt -3- and disconnect vacuum hose -2-.



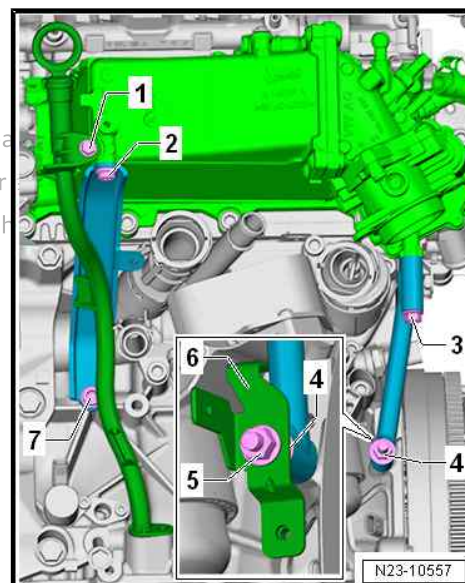
- Unplug electrical connector -2-.
- Release hose clip -1- and disconnect coolant hose.



- Unplug electrical connectors and move clear:
 - 1 - For charge air temperature sender after charge air cooler - G811-
 - 3 - For charge pressure sender - G31-
 - 4 - For charge air temperature sender before charge air cooler - G810-
 - 5 - For throttle valve module - J338-
- Remove bolts -2, 7- and detach coolant hose -6-.
- Remove connection together with throttle valve module - J338- → [page 249](#).



- Remove bolt -1- for dipstick guide tube.
- Remove nut -5- and detach bracket -6- from centre hex stud -4-.



Loosen bolts -4 and 7- several turns for commercial purposes, in part
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Disregard -item 3-.



- Remove bolts -10 ... 1- with bit XZN 10 - T10501- and detach intake manifold with charge air cooler.

Installing



Note

- ◆ *Renew gasket after removing.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ Electronic parts catalogue .*

- Fit new gasket onto dowel pins in cylinder block.



Caution

Make sure that sealing surface of intake manifold does not come into contact with dowel pins - this may cause damage.

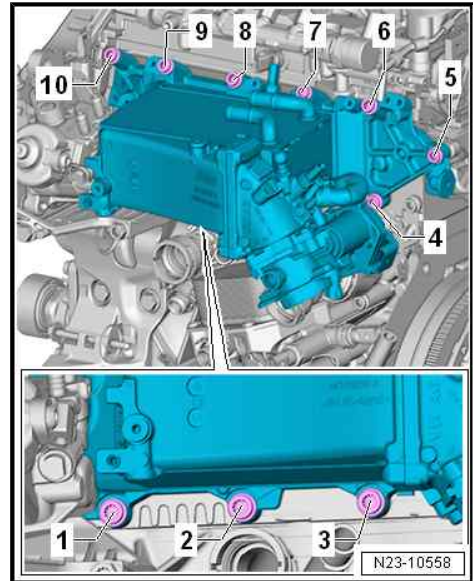
- Fit intake manifold onto dowel pins in cylinder block.
- Tighten bolts for intake manifold ⇒ [page 248](#) .

Remaining installation steps are carried out in reverse sequence; note the following:

- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install high-pressure pipe ⇒ [page 268](#) .
- Install coolant pipes (top) ⇒ [page 197](#) .

Tightening torques

- ◆ ⇒ [“4.1 Exploded view - intake manifold”, page 247](#)
- ◆ ⇒ [Fig. “Intake manifold with charge air cooler - tightening torque and sequence” , page 248](#)
- ◆ ⇒ [“2.1 Exploded view - charge air system”, page 225](#)
- ◆ ⇒ [“2.2 Exploded view - hose connections for charge air system”, page 227](#)
- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)
- ◆ ⇒ [“3.1 Exploded view - coolant pipes”, page 196](#)
- ◆ ⇒ [“1.1 Exploded view - sump/oil pump”, page 122](#)





5 Injectors/high-pressure reservoir (rail)

⇒ [“5.1 Exploded view - injectors”, page 255](#)

⇒ [“5.2 Exploded view - high-pressure reservoir \(rail\)”, page 257](#)

⇒ [“5.3 Checking injectors”, page 258](#)

⇒ [“5.4 Performing adaption of correction values for injectors”, page 258](#)

⇒ [“5.5 Checking for injectors sticking open”, page 258](#)

⇒ [“5.6 Checking return flow rate of injectors with engine running”, page 260](#)

⇒ [“5.7 Checking return flow rate of injectors at starter cranking speed”, page 263](#)

⇒ [“5.8 Removing and installing injectors”, page 264](#)

⇒ [“5.9 Removing and installing high-pressure pipes”, page 268](#)

⇒ [“5.10 Removing and installing high-pressure reservoir \(rail\)”, page 271](#)

5.1 Exploded view - injectors

1 - Seal

- In cylinder head cover
- Renew if leaking
⇒ [page 93](#)

2 - Copper seal

- Always renew copper seal when removing and installing

3 - O-ring

- Renew after removing

4 - Injector

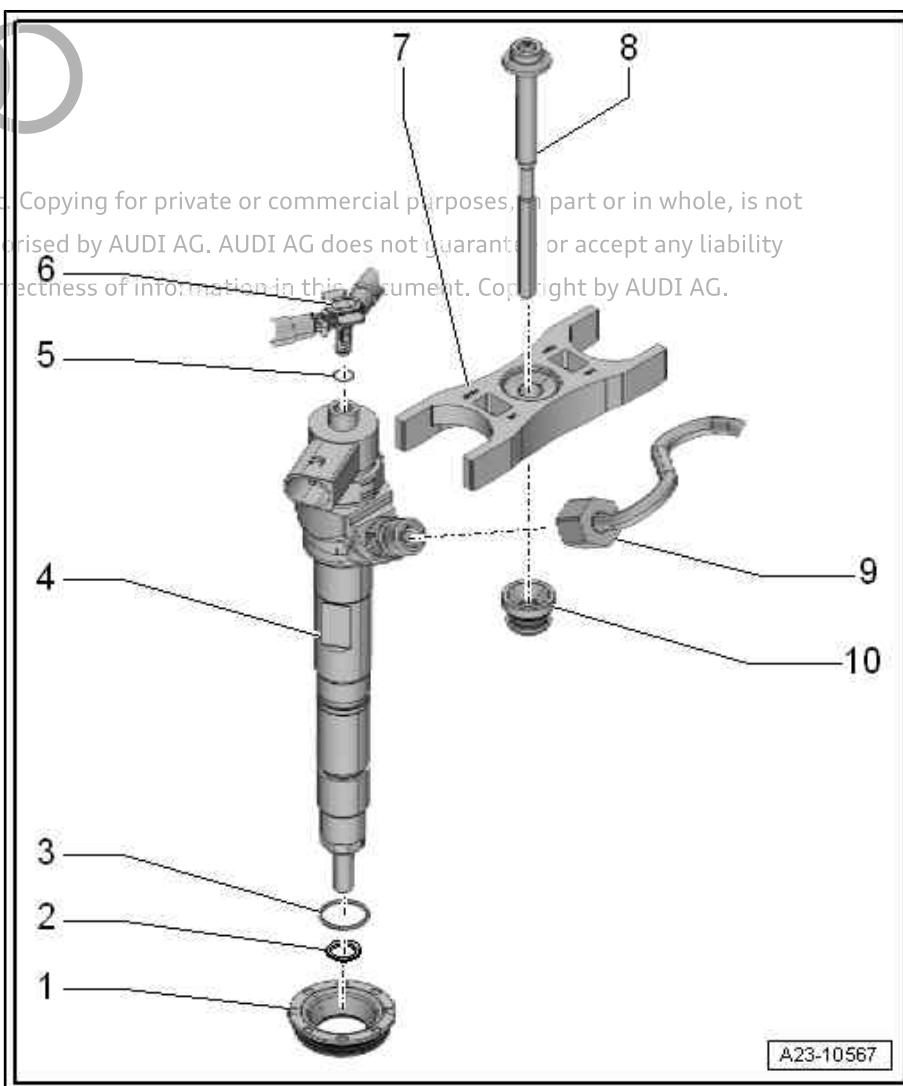
- If they are to be re-installed, the injectors and high-pressure pipes must always be re-fitted on the same cylinder
- Always renew copper seal when removing and installing
- To remove carbon deposits from the injector sealing surface, clean the injector bore in the cylinder head with cleaning kit - VAS 6811- (it is important to do this to avoid leaks)
- Removing and installing
⇒ [page 264](#)

5 - O-ring

- Renew after removing

6 - Fuel return line

- To fuel tank





- Must not be kinked, damaged or clogged
- Do not dismantle
- Fill and bleed fuel system after renewing ⇒ [page 241](#)

7 - Clamping piece

- Use a coloured pen to mark injectors and corresponding clamping piece and cylinder for re-installation; pay attention to markings when installing
- The clamping pieces can be re-used when installing new injectors
- Installation position ⇒ [page 256](#)

8 - Bolt

- Renew after removing
- Tighten initially to 2 Nm, then screw on union nuts for high-pressure pipes hand-tight and align injectors
- 8 Nm + 270° (3x 90° further)
- Note warning instructions for clamping piece ⇒ [Item 7 \(page 256\)](#)

9 - High-pressure pipe

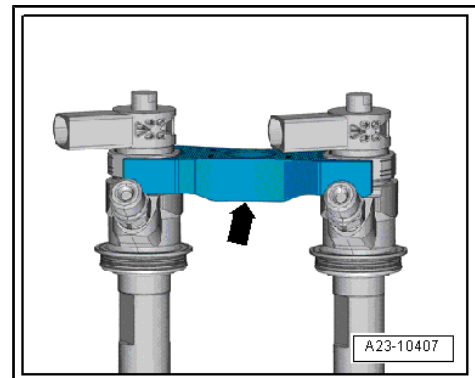
- Between high-pressure reservoir and injectors
- Observe all instructions for installing high-pressure pipes ⇒ [page 269](#)
- Install free of stress
- Fit damper weights ⇒ [page 256](#)
- 28 Nm

10 - Grommet

- In cylinder head cover
- Renew if damaged or leaking

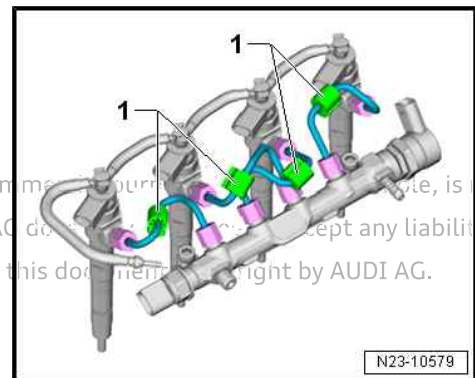
Installation position of clamping piece

- Each clamping piece secures two injectors.
- The bulge -arrow- of the clamping piece should point downwards.



Fitting damper weights to high-pressure pipes

- Fit damper weights -1- to high-pressure pipes.



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5.2 Exploded view - high-pressure reservoir (rail)

1 - Fuel pressure sender - G247-

- If deformable sealing lip and thread of fuel pressure sender - G247- are not damaged, sender can be re-used once.
- 100 Nm
- Removing and installing ⇒ [page 282](#)

2 - High-pressure pipe

- Between high-pressure reservoir and injectors
- Observe all instructions for installing high-pressure pipes ⇒ [page 269](#)

- Fit damper weights ⇒ [page 256](#)
- 28 Nm

3 - High-pressure reservoir (rail)

- Removing and installing ⇒ [page 271](#)

4 - Bolt

- 20 Nm

5 - O-ring

- Renew after removing

6 - Fuel pressure regulating valve - N276-

- When re-installing fuel pressure regulating valve - N276- , check for damage on deformable sealing lip and thread. Renew fuel pressure regulating valve - N276- if damaged

- Renew O-ring after removal

- Removing and installing ⇒ [page 279](#)

- Performing adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester) ⇒ ["3.4 Performing adaptations after renewing a component", page 7](#)

- 80 Nm

7 - Fuel return hose

8 - Fuel return line

9 - Bolt

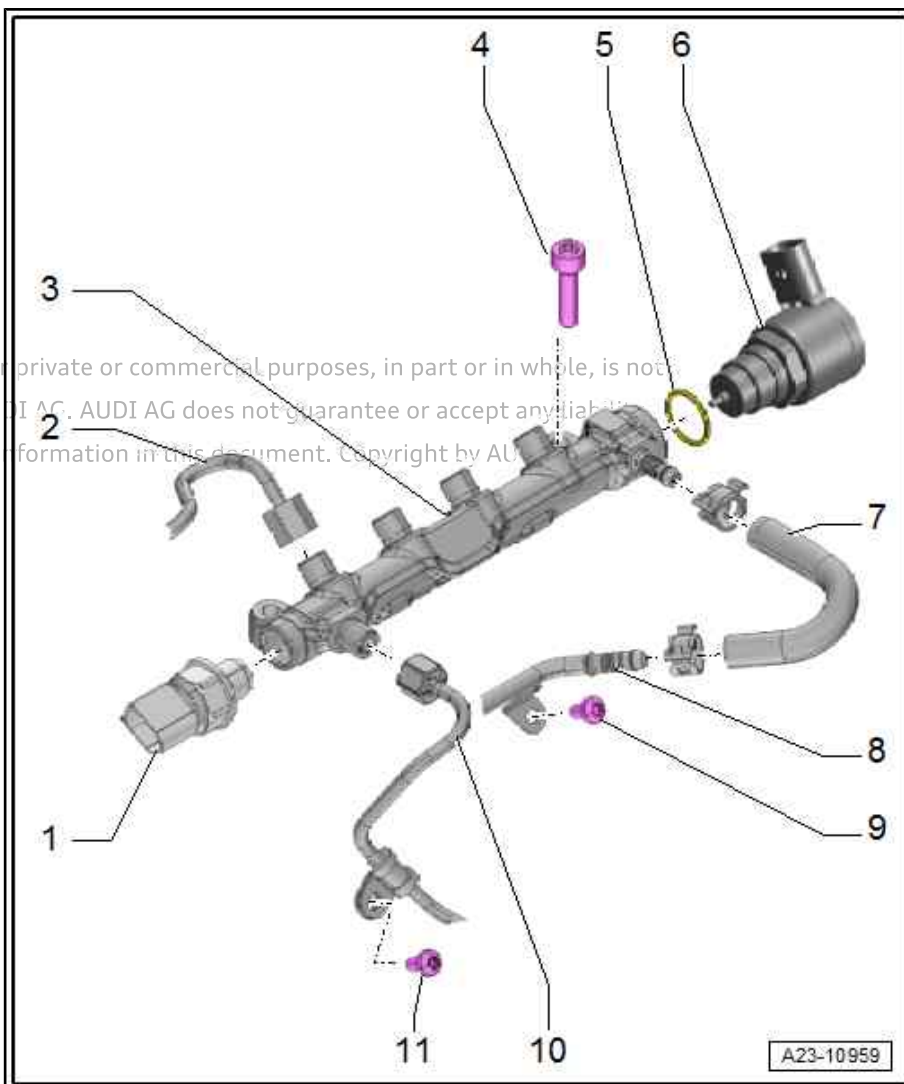
- 8 Nm

10 - High-pressure pipe

- Between high-pressure pump and high-pressure reservoir (rail)
- Observe all instructions for installing high-pressure pipes ⇒ [page 269](#)
- 28 Nm

11 - Bolt

- 8 Nm





5.3 Checking injectors

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

- ◆ ⇒ [“5.4 Performing adaption of correction values for injectors”, page 258](#)
- ◆ ⇒ [“5.5 Checking for injectors sticking open”, page 258](#)
- ◆ ⇒ [“5.6 Checking return flow rate of injectors with engine running”, page 260](#)
- ◆ ⇒ [“5.7 Checking return flow rate of injectors at starter cranking speed”, page 263](#)

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

- ◆ ⇒ [“5.5 Checking for injectors sticking open”, page 258](#)
- ◆ ⇒ [“5.7 Checking return flow rate of injectors at starter cranking speed”, page 263](#)
- ◆ ⇒ [“7.3 Checking fuel pressure regulating valve N276”, page 278](#)

5.4 Performing adaption of correction values for injectors

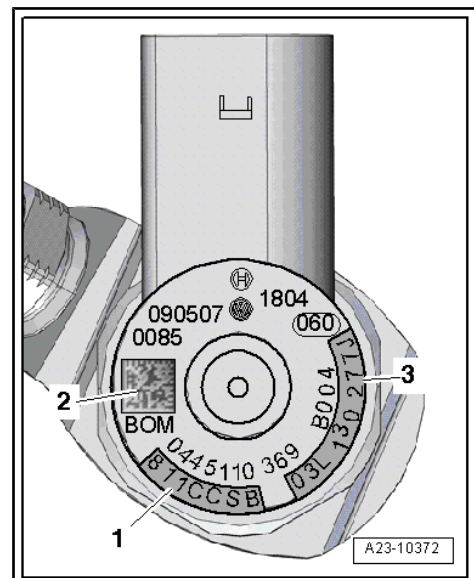
- ◆ The “Injector delivery calibration values” function serves to correct the injection rates for each cylinder of a common rail system individually across the entire operating range.
- ◆ The 7-digit adaption values are marked on each injector. The values may consist of letters and/or numbers.

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Injector (view from above)

- 1 - Adaption value (checksum; details in illustration are only an example)
 - 2 - Data matrix code
 - 3 - Part number
- ◆ When a new injector is installed, the adaption value must be written into the engine control unit.
 - ◆ When a new engine control unit is installed, the “Adaption values for injectors” must be written into the new control unit.
 - ◆ Additionally, check that the “injector delivery calibration values” are correctly entered for all the other injectors. Do NOT attempt to re-enter these values if the correct values are already stored in the engine control unit.
 - ◆ The adaption procedure is described in [Guided Functions](#) mode of ⇒ Vehicle diagnostic tester.



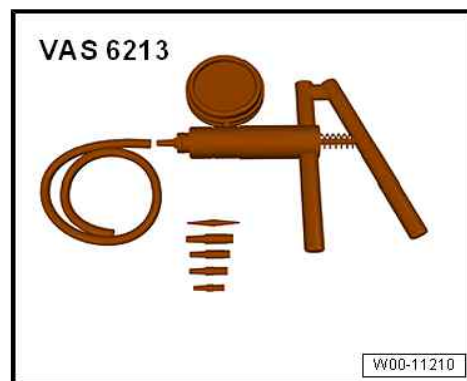
5.5 Checking for injectors sticking open

Special tools and workshop equipment required

- ◆ Vehicle diagnostic tester




- ◆ Hand vacuum pump - VAS 6213-



- ◆ Adapter C6 of return flow meter - VAS 6684-

Procedure

- Remove engine cover panel ⇒ [page 39](#) .

 **Caution**

Risk of malfunctions caused by dirt.

◆ *Observe ⇒ ["3.1 Rules for cleanliness", page 5](#) .*

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

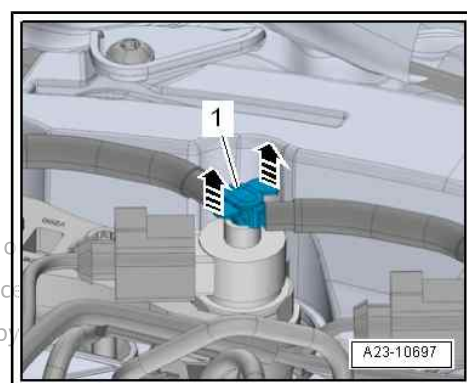
Note

- ◆ *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.

- Detach noise insulation.
- Pull release tabs upwards -arrows- and pull return line connections -1- off injectors.



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- Connect adapter C6 of return flow meter - VAS 6684- to return line connection of injector to be tested -arrow- 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 264](#) .

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 onto injectors. The catch should engage audibly. Then press release pin down carefully.
- Erase any entries in event memory resulting from testing ⇒ Vehicle diagnostic tester, [Guided Functions], then [01 - Interrogate/erase event memory].

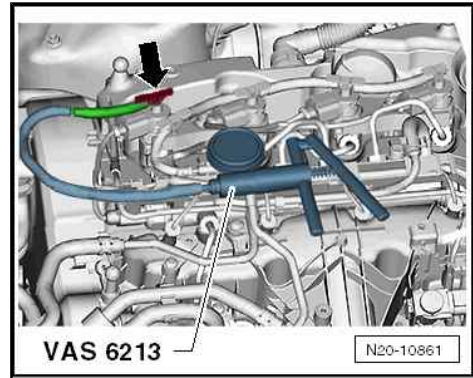
Bleeding fuel system and checking for leaks

- Run engine at idling speed for several minutes (do not press accelerator) and then switch off. Fuel system will bleed itself automatically.
- Check the entire fuel system for leaks.
- Renew the affected component if leakage 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.
- Install engine cover panel ⇒ [page 39](#) .

5.6 Checking return flow rate of injectors with engine running

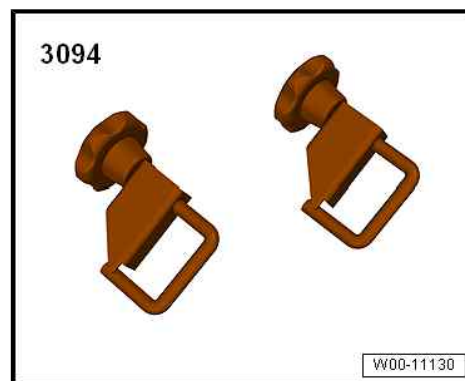
Checking return flow rate of individual injectors

Special tools and workshop equipment required

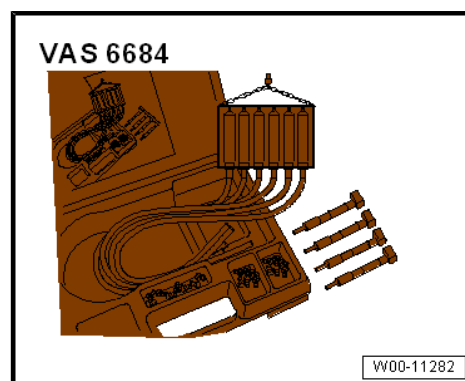




- ◆ Hose clamps up to 25 mm - 3094-



- ◆ Return flow meter - VAS 6684-



- ◆ Fuel-resistant measuring container

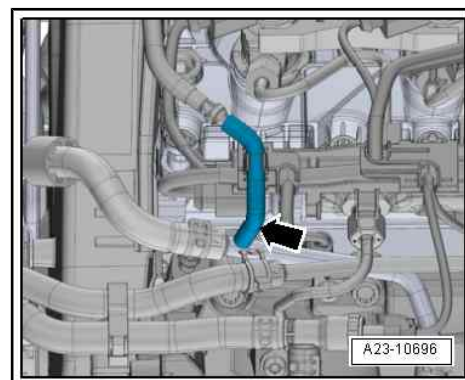
Procedure

Each injector normally has a relatively low fuel 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 39](#) .

No dirt must be allowed to enter the fuel system; note ⇒ [“3.1 Rules for cleanliness”, page 5](#) .

- Clean all return line connections (e.g. with commercial cleaning solution etc.) before removing.
- Dry all components after cleaning.
- Clamp off fuel return hose -arrow- using hose clamp up to 25 mm -3094- .
- Detach noise insulation.





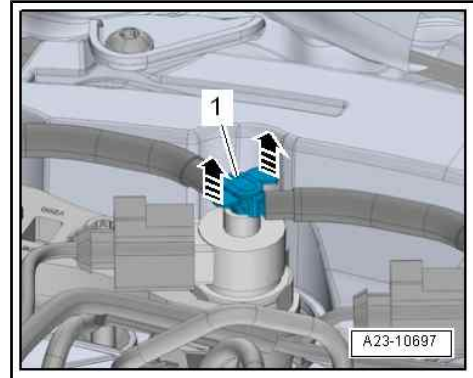
- Pull release tabs upwards -arrows- and pull return line connections -1- off injectors.
- Connect adapters of return flow meter - VAS 6684- to return line connections of all 4 injectors.



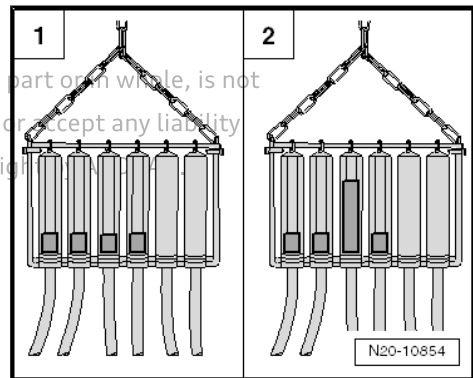
Caution

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 (example -1-).
- 1 - Injectors OK. Return flow rate approx. identical on all injectors.
 - 2 - Injector for cylinder 3 not OK. Return flow rate greater than three times the volume of smallest measured return flow rate.
- If one injector has a significantly higher return flow rate than the others (example -2-), it must be renewed ⇒ [page 264](#) .



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 onto injectors. The catch should engage audibly. Then press release pin down carefully.
- Erase any entries in event memory resulting from testing ⇒ Vehicle diagnostic tester, [Guided Functions](#), then [01 - Interrogate/erase event memory](#).

Bleeding fuel system and checking for leaks

- Run engine at idling speed for several minutes (do not press accelerator) and then switch off. Fuel system will bleed itself automatically.
- Check the entire fuel system for leaks.
- Renew the affected component if leakage 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.
- Install engine cover panel ⇒ [page 39](#) .

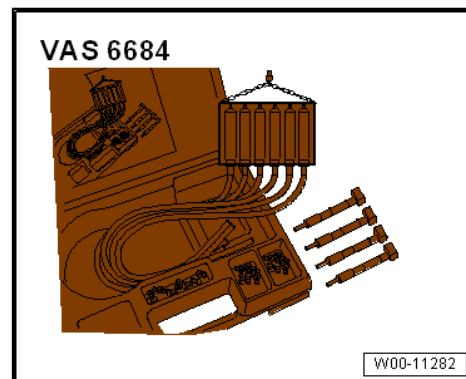


5.7 Checking return flow rate of injectors at starter cranking speed

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

Special tools and workshop equipment required

- ◆ Return flow meter - VAS 6684-



Caution

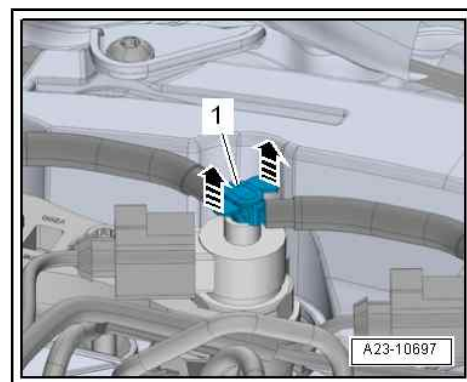
Risk of malfunctions caused by dirt.

- ◆ *Observe ⇒ "3.1 Rules for cleanliness", page 5 .*

Procedure

Each injector normally has a relatively low fuel 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 39](#) .
- Clean all return line connections (e.g. with commercial cleaning solution etc.) before removing.
- Dry all components after cleaning.
- Pull release tabs upwards -arrows- and pull return line connections -1- off injectors.



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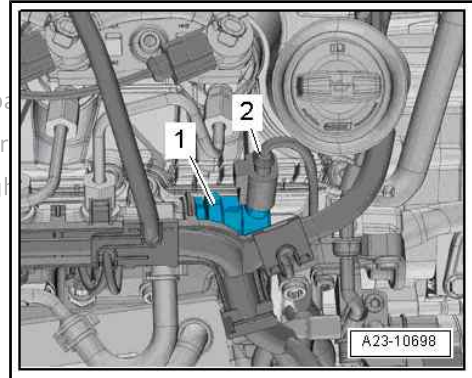


- Unplug electrical connector -2- on fuel pressure regulating valve - N276- -item 1-.

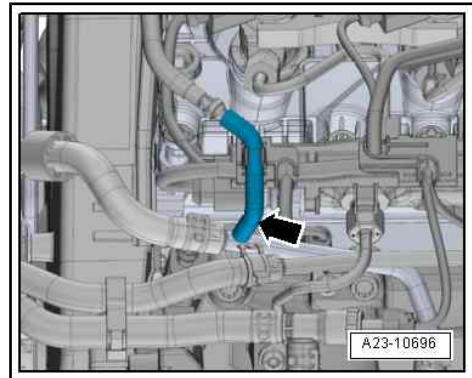


Note

ected by copyright. Copying for private or commercial purposes, in part or in full, is prohibited unless authorised by AUDI AG. AUDI AG does not guarantee or warrant the accuracy of this information. This prevents fuel from being injected when starter is operated.



- Clamp off fuel return hose -arrow- using hose clamp up to 25 mm - 3094- .
- 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
- Drip leaks are permissible
- If fuel comes out of an injector, that injector must be renewed.
- Re-attach electrical connector on fuel pressure regulating valve - N276- .



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 onto injectors. The catch should engage audibly. Then press release pin down carefully.
- Erase any entries in event memory resulting from testing => Vehicle diagnostic tester, Guided Functions, then 01 - Interrogate/erase event memory.

Bleeding fuel system and checking for leaks

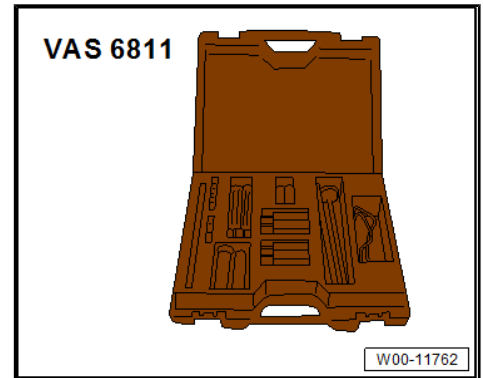
- Run engine at idling speed for several minutes (do not press accelerator) and then switch off. Fuel system will bleed itself automatically.
- Check the entire fuel system for leaks.
- Renew the affected component if leakage occurs.
- After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.
- Install engine cover panel => [page 39](#) .

5.8 Removing and installing injectors

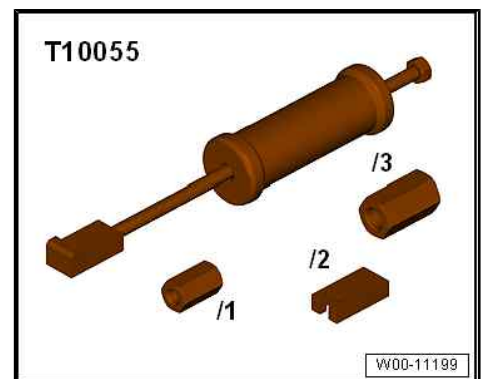
Special tools and workshop equipment required



- ◆ Cleaning kit - VAS 6811-



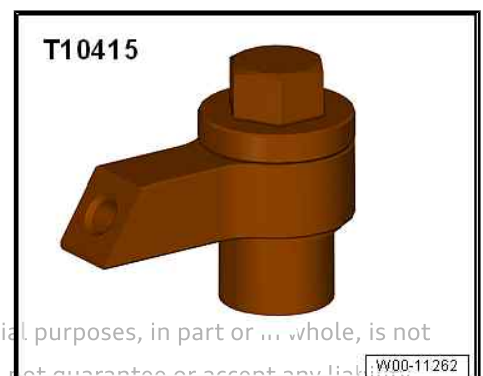
- ◆ Puller - T10055-



- ◆ Assembly sleeve - T10377-



- ◆ Puller - T10415-



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Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Detach noise insulation.

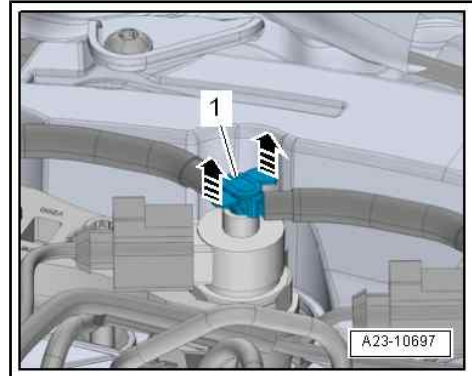


Caution

Risk of malfunctions caused by dirt.

◆ **Observe** ⇒ ***"3.1 Rules for cleanliness", page 5.***

- Pull release tabs upwards -arrows- and pull return line connections -1- off injectors.



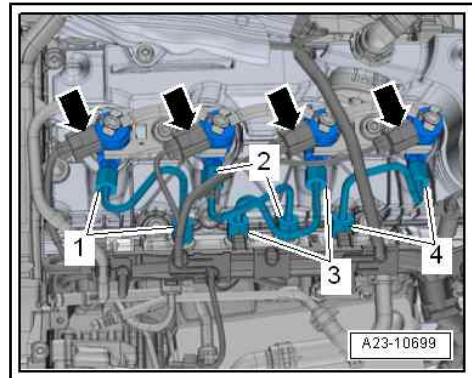
- Unplug electrical connectors -arrows- at injectors.



Note

Each clamping piece always secures two injectors and can only be taken out if both injectors are removed.

- Unscrew union nut on corresponding high-pressure pipe (-1 to 4-) and detach corresponding high-pressure pipe.
- Seal off open lines and connections with clean plugs.



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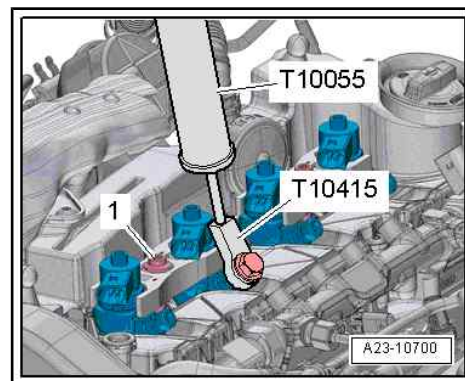


- Remove bolt -1-.
- Sequence for removing injectors: First remove injector for cylinder 2, then for cylinder 1/cylinder 4, and then for cylinder 3.
- Apply puller - T10055- with puller - T10415- as shown in illustration, and pull out injectors upwards.
- Detach clamping piece before taking injector out.



Note

To avoid damaging the sealing lip, rotate the injector while pulling it out.



- Place removed injectors on a clean cloth.

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- .***

Installing new injectors

When installing new injectors, the following components must also be renewed:

- ◆ Bolt for clamping piece
- ◆ O-ring for fuel return line connection
- Observe all instructions for installing high-pressure pipes
⇒ [page 269](#) .

Installing used injectors

When re-installing used injectors, the following components must be renewed:

- ◆ Bolt for clamping piece
- ◆ Copper seal
- ◆ O-ring for injector bore
- ◆ O-ring for fuel return line connection
- 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.



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- Renew seal for injector using assembly sleeve - T10377- .

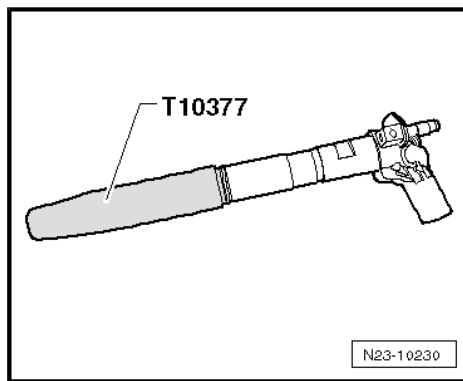
Continued (same procedure for used and new injectors):



Note

Lubricate all O-rings with assembly oil, engine oil or diesel fuel before installing.

- Install injectors.
- Press return line connections onto injectors until they engage audibly.
- Then press down catches on both sides.
- Tighten union nuts on high-pressure pipes hand-tight initially. Make sure that connections are not under tension.
- When one or more injectors have been renewed, the adaption of the correction values for the new injectors must be written into the engine control unit ⇒ [page 258](#) .
- Reset learnt value for fuel pressure regulating valve - N276- ⇒ Vehicle diagnostic tester ⇒ [page 258](#) .
- Install engine cover panel ⇒ [page 39](#) .



Tightening torques

- ◆ ⇒ ["5.1 Exploded view - injectors", page 255](#)

5.9 Removing and installing high-pressure pipes

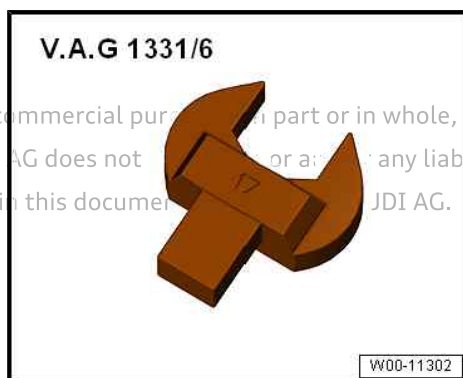
⇒ ["5.9.1 Removing high-pressure pipe between high-pressure reservoir \(rail\) and high-pressure pump", page 268](#)

⇒ ["5.9.2 Installing high-pressure pipe", page 269](#)

5.9.1 Removing high-pressure pipe between high-pressure reservoir (rail) and high-pressure pump

Special tools and workshop equipment required

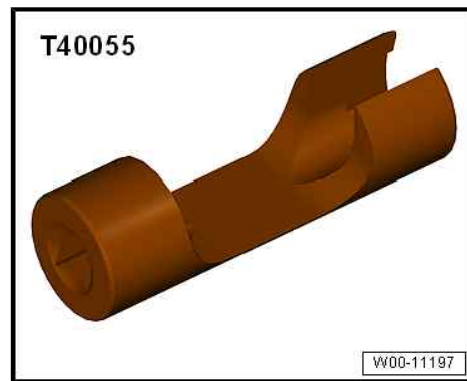
- ◆ Open end spanner insert, AF 17 - V.A.G 1331/6-



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- ◆ Socket - T40055-



Removing

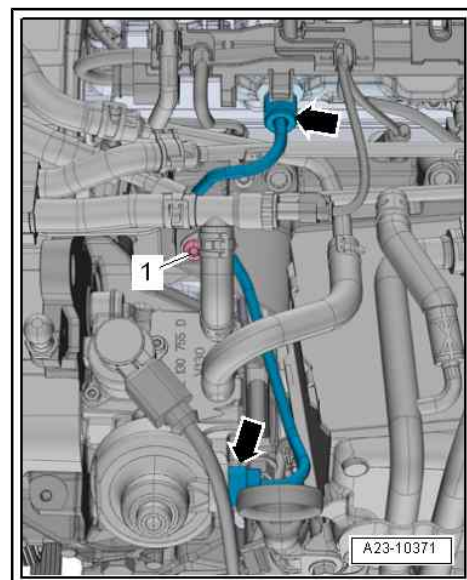
- Remove engine cover panel ⇒ [page 39](#) .
- Use vacuum cleaner to remove dirt from taper seat at high-pressure reservoir.
- Clean fuel pipe and end of pipe using cleaning solution and dry with compressed air.
- Remove bolt -1-.
- Unscrew union nuts -arrows- and detach high-pressure pipe.



Caution

Risk of malfunctions caused by dirt.

- ◆ Observe ⇒ ["3.1 Rules for cleanliness", page 5](#) .



Install high-pressure pipe ⇒ [page 269](#) .

5.9.2 Installing high-pressure pipe

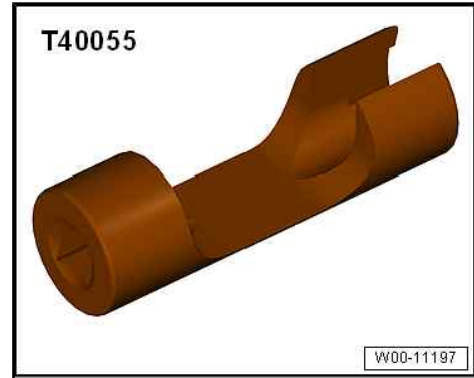
Special tools and workshop equipment required

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





◆ Socket - T40055-



Installing



i Note

◆ *Before removing, clean fuel pipe and end of pipe using cleaning solution and dry with compressed air.*

◆ *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.*



Caution

Risk of malfunctions caused by dirt.

- ◆ ***Observe ⇒ ["3.1 Rules for cleanliness", page 5](#).***

Risk of high-pressure pipe breaking if it is under tension.

- ◆ ***If necessary, the high-pressure reservoir can be slackened and moved slightly so that the injector pipes are not installed under tension. Never bend the pipes or subject them to tension.***

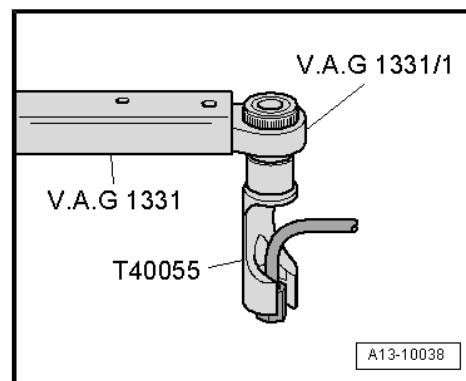
- Use vacuum cleaner to remove dirt from taper seat at high-pressure reservoir.
- Lubricate threads of union nuts with clean engine oil.
- Hand-tighten union nuts on high-pressure pipes (ensure that pipes are not under tension).



- To tighten unions of high-pressure pipes at high-pressure reservoir and injectors, use torque wrench - V.A.G 1331- with open-end spanner insert SW 17 - V.A.G 1331/6- or socket - T40055- .
- Fit damper weights to high-pressure pipes ⇒ [page 256](#) .
- Check fuel system for leaks ⇒ [page 242](#) .
- Install engine cover panel ⇒ [page 39](#) .


Tightening torques

- ◆ ⇒ [“5.1 Exploded view - injectors”, page 255](#)
- ◆ ⇒ [“5.2 Exploded view - high-pressure reservoir \(rail\)”, page 257](#)
- ◆ ⇒ [“6.1 Exploded view - high-pressure pump”, page 273](#)



5.10 Removing and installing high-pressure reservoir (rail)

Removing

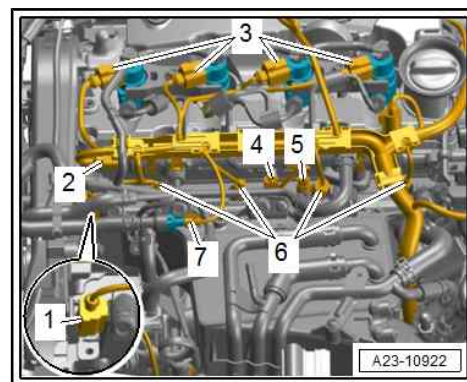


Caution

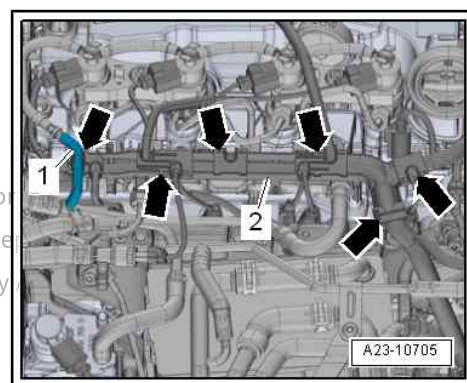
Risk of malfunctions caused by dirt.

◆ **Observe** ⇒ [“3.1 Rules for cleanliness”, page 5](#) .

- Remove high-pressure pipe between high-pressure reservoir (rail) and high-pressure pump ⇒ [page 268](#) .
- Detach noise insulation.
- Unplug electrical connectors:
 - 1 - For coolant valve for cylinder head - N489-
 - 2 - For fuel pressure sender - G247-
 - 3 - For injectors
 - 4 - For Hall sender - G40-
 - 5 - For intake air temperature sender - G42-
 - 6 - For glow plugs
 - 7 - For fuel temperature sender - G81-



- Move clear fuel return hose -1-.
- Open retaining clips -arrows-, and unclip and detach wiring duct -2-.



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- Unplug electrical connectors:
- 1 - For fuel pressure sender - G247-
- 3 - For fuel pressure regulating valve - N276-
- Release hose clip -4- and detach fuel return hose.
- Remove union nuts -2- for high-pressure pipes.
- Detach high-pressure pipe and set it down on a clean cloth.
- Remove bolts -arrows- and detach high-pressure reservoir.

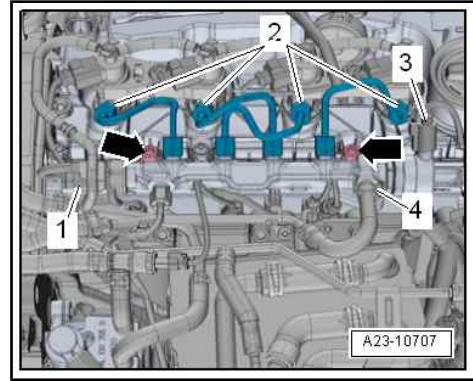
Installing

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

- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe all instructions for installing high-pressure pipes ⇒ [page 269](#) .

Tightening torques

- ◆ ⇒ [“5.1 Exploded view - injectors”](#), [page 255](#)
- ◆ ⇒ [“5.2 Exploded view - high-pressure reservoir \(rail\)”](#), [page 257](#)



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6 High-pressure pump

⇒ [“6.1 Exploded view - high-pressure pump”, page 273](#)

⇒ [“6.2 Removing and installing high-pressure pump”, page 274](#)

6.1 Exploded view - high-pressure pump

1 - Bracket for ancillaries

- ❑ Removing and installing
 ⇒ [page 45](#)

2 - Bolt

- ❑ 3x
- ❑ Renew after removing
- ❑ Different lengths
- ❑ Different tightening torques:

◆ Short bolt, 20 Nm + 45°

◆ Long bolt, 20 Nm + 180°

3 - High-pressure pump sprocket

4 - Nut

- ❑ Use counterhold tool - T10051- when loosening and tightening
- ❑ 95 Nm

5 - Hub

- ❑ To remove, use puller - T10489-

6 - High-pressure pump

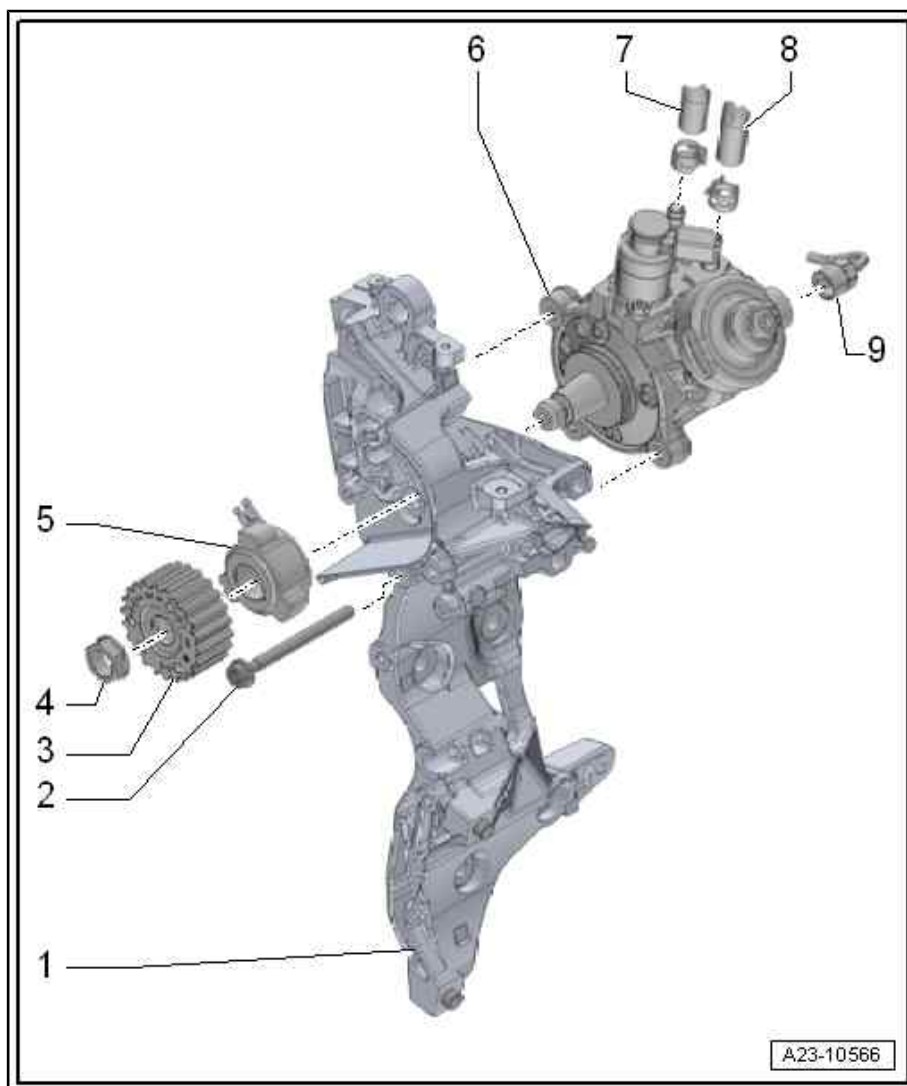
- ❑ If the high-pressure pump is removed or renewed, it is important to fill and bleed the fuel system before the engine is started for the first time ⇒ [page 241](#).
- ❑ Performing adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester) ⇒ [“3.4 Performing adaptations after renewing a component”, page 7](#)
- ❑ With fuel metering valve - N290- (do not open)
- ❑ Removing and installing ⇒ [page 274](#)

7 - Fuel supply hose

8 - Fuel return hose

9 - High-pressure pipe

- ❑ Between high-pressure reservoir (rail) and high-pressure pump
- ❑ Removing ⇒ [page 268](#)
- ❑ Observe all instructions for installing high-pressure pipes ⇒ [page 269](#)
- ❑ 28 Nm



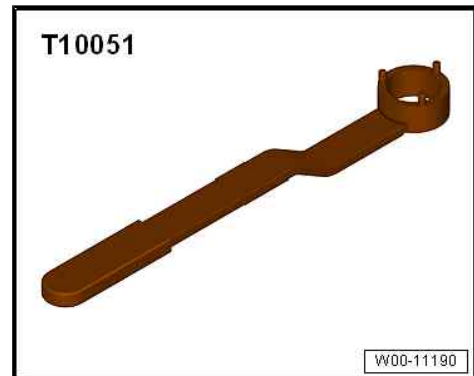
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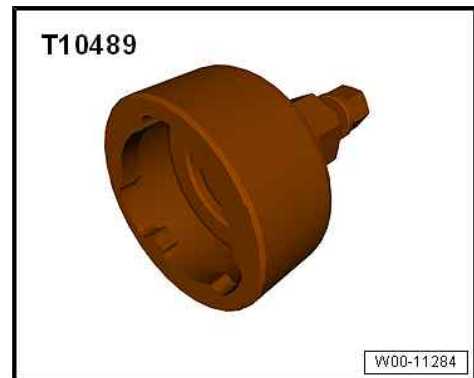
6.2 Removing and installing high-pressure pump

Special tools and workshop equipment required

- ◆ Counterhold tool - T10051-



- ◆ Puller - T10489-



- ◆ Locking pin - T10492-



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Removing



Caution

Risk of malfunctions caused by dirt.

- ◆ *Observe ⇒ "3.1 Rules for cleanliness", page 5 .*

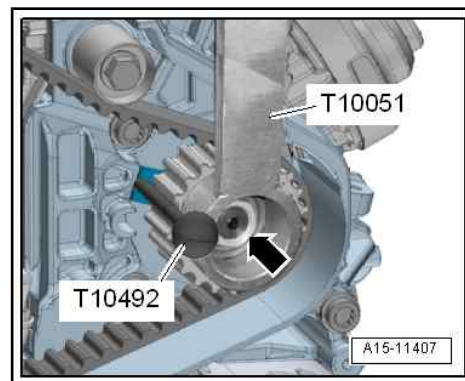
Running when dry causes irreparable damage to high-pressure pump.

- ◆ *If the high-pressure pump has been removed or renewed, it is important to fill and bleed the fuel system before the engine is started for the first time ⇒ page 241 .*

- Remove toothed belt ⇒ [page 77](#) .



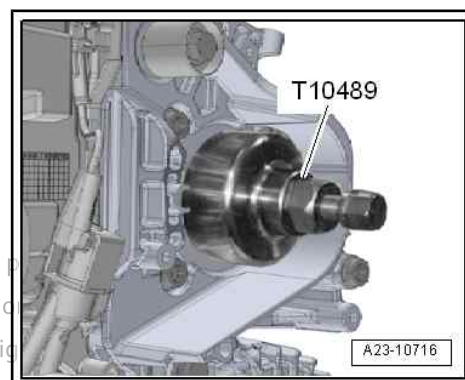
- Remove high-pressure pipe between high-pressure reservoir (rail) and high-pressure pump ⇒ [page 268](#) .
- Apply counterhold tool - T10051- to high-pressure pump sprocket.
- Hand-tighten nut -arrow-.
- Detach locking pin - T10492- and slowly turn high-pressure pump shaft to a position in which it is not under tension.
- Remove nut -arrow- and detach counterhold tool - T10051- .
- Detach high-pressure pump sprocket.



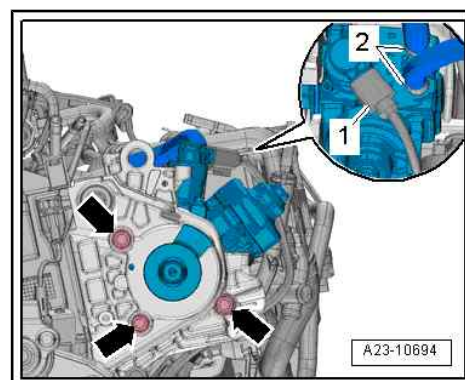
- Engage puller - T10489- at hub of high-pressure pump by turning it clockwise.
- Detach hub of high-pressure pump.



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- Detach fuel return hoses -2-.
- Unplug electrical connector -1-.
- Remove bolts -arrows-.
- Carefully take out high-pressure pump.



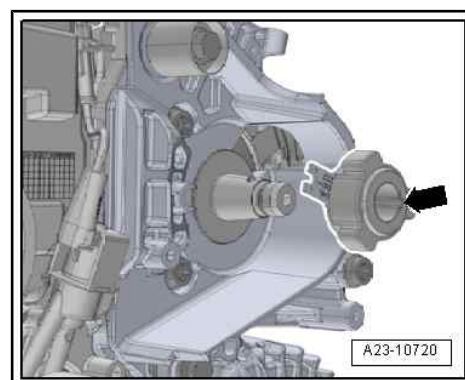
Installing

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

Note

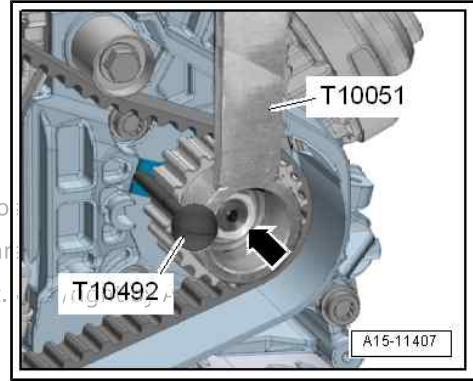
After removing, renew bolts tightened with specified tightening angle.

- Apply hub -arrow- to high-pressure pump shaft.
- The parallel key on the high-pressure pump shaft must engage in the groove in the hub.
- Place high-pressure pump sprocket on hub.
- Contact surface between counterhold tool and toothed belt sprocket must be free of oil.





- Screw nut -arrow- onto thread of high-pressure pump shaft.
- Apply counterhold tool to toothed belt sprocket and hand-tighten nut -arrow-.
- Turn high-pressure pump sprocket with counterhold tool - T10051- until it can be locked in position with locking pin - T10492- .
- To do so, insert locking pin - T10492- into fork -2- on hub and into hole -1- behind it in bracket for ancillaries.
- Loosen nut -arrow- again.
- The high-pressure pump sprocket should still just turn, but there must be no axial movement.
- Install toothed belt (adjust valve timing) ⇒ [page 81](#) .
- Install high-pressure pipe ⇒ [page 268](#) .



Caution

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

- ◆ ***If the high-pressure pump has been removed or renewed, it is important to fill and bleed the fuel system before the engine is started for the first time ⇒ [page 241](#) .***

Perform adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester)

⇒ [“3.4 Performing adaptations after renewing a component”, page 7](#) .

Tightening torques

- ◆ ⇒ [“6.1 Exploded view - high-pressure pump”, page 273](#)



7 Senders and sensors

⇒ [“7.1 Removing and installing fuel temperature sender G81 ”, page 277](#)

⇒ [“7.2 Removing and installing air mass meter G70 ”, page 277](#)

⇒ [“7.3 Checking fuel pressure regulating valve N276 ”, page 278](#)

⇒ [“7.4 Removing and installing fuel pressure regulating valve N276 ”, page 279](#)

⇒ [“7.5 Removing and installing fuel pressure sender G247 ”, page 282](#)

⇒ [“7.6 Removing and installing pressure differential sender G505 ”, page 284](#)

⇒ [“7.7 Removing and installing exhaust gas pressure sensor 1 G450 ”, page 285](#)

7.1 Removing and installing fuel temperature sender - G81-

Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Unplug electrical connector -1-.
- Remove fuel temperature sender - G81- .



Note

Disregard -item 2-.

Installing

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

- Check fuel system for leaks ⇒ [page 242](#) .
- Install engine cover panel ⇒ [page 39](#) .

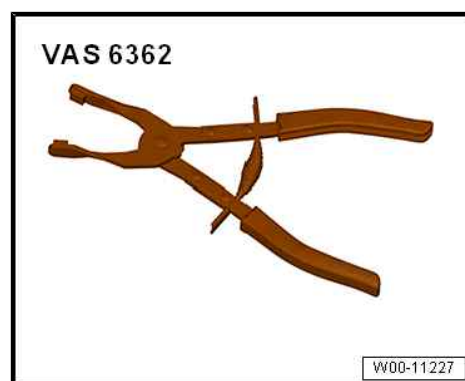
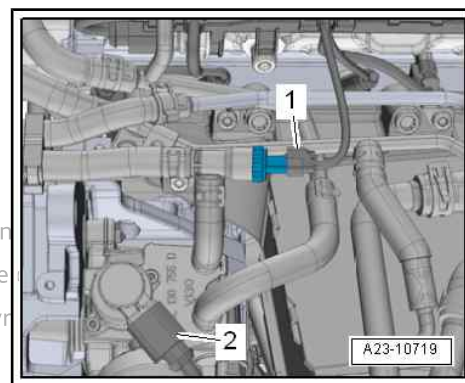
Tightening torques

- ◆ ⇒ [“1.2 Overview - fuel system”, page 240](#)

7.2 Removing and installing air mass meter - G70-

Special tools and workshop equipment required

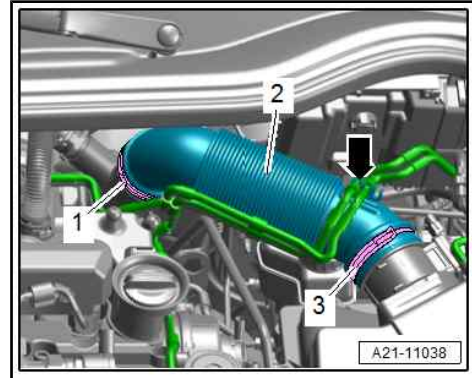
- ◆ Hose clip pliers - VAS 6362-





Removing

- Move clear vacuum hoses -arrow- at air pipe.
- Loosen hose clips -1, 3- and remove air pipe -2-.



- Remove bolts -arrows-.
- Detach air mass meter - G70- -item 2- from air cleaner housing -1-.

Installing

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

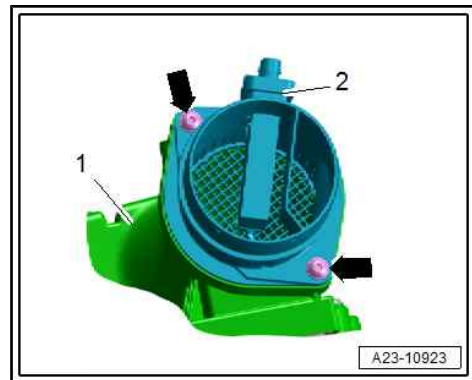


Note

- ◆ *If the air filter element is very dirty or wet, dirt particles or water can reach the air mass meter 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).*
- ◆ *Always renew seal if damaged (air leaks in intake system).*
- ◆ *Use a silicone-free lubricant when installing the air hose and seal.*
- ◆ *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ **Electronic parts catalogue** .*

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- Check air mass meter and air hose (engine intake side) for salt residue, dirt and leaves.
- Check intake duct as far as air filter element for dirt. If necessary, clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections); wash out or use a vacuum cleaner as required.



Tightening torques

- ◆ ⇒ [“3.1 Exploded view - air cleaner housing”, page 245](#)

7.3 Checking fuel pressure regulating valve - N276-

Special tools and workshop equipment required

- ◆ Fuel-resistant measuring container



Procedure

- Remove engine cover panel ⇒ [page 39](#) .
- Release hose clip -arrow- and detach fuel return hose from high-pressure reservoir.
- Seal off open return line connection with a plug.

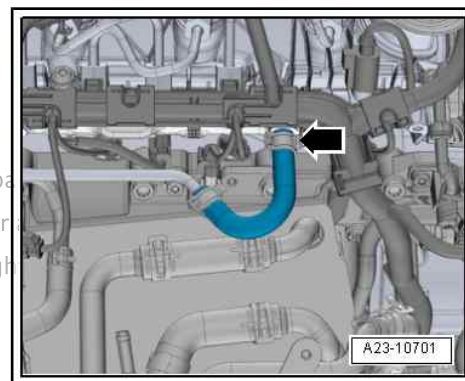
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Caution

Risk of malfunctions caused by dirt.

- ◆ **Observe ⇒ "3.1 Rules for cleanliness", page 5 .**



- Connect test hose -3- to return line connection of high-pressure reservoir -2-.



Note

Disregard -item 1-.

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

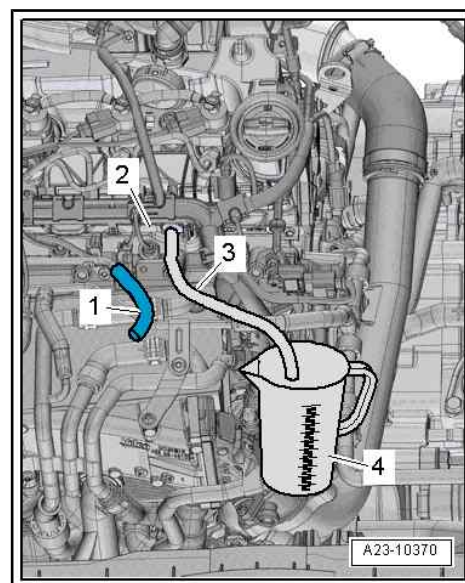
If specification is not obtained, fuel pressure regulating valve - N276- is defective.

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 - N 276- is defective.

- Install engine cover panel ⇒ [page 39](#) .



7.4 Removing and installing fuel pressure regulating valve - N276-

Special tools and workshop equipment required



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



- ◆ Torque wrench - V.A.G 1332-



Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Remove high-pressure reservoir (rail) ⇒ [page 271](#) .
- Before removal, clean area around thread for fuel pressure regulating valve - N276- using e.g. commercial cleaning solution.
- Make sure no dirt gets into opening in high-pressure reservoir.
- Clean carefully; cleaning solution must not enter the electrical connector.
- Dry off fuel pressure regulating valve - N276- .



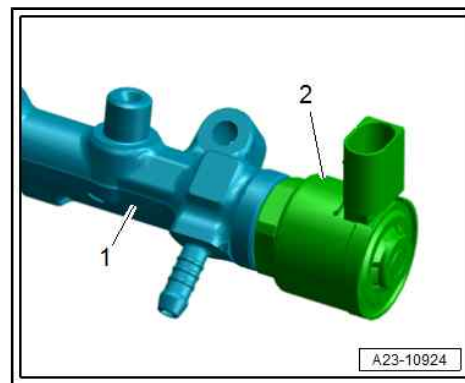
Note

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The high-pressure reservoir can be clamped in a vice in order to remove the pressure regulating valve; however, it is essential that protective jaw covers are used. Do NOT take up the weight of the high-pressure reservoir by the threaded connections for the high-pressure pipes or the retaining tabs for the cylinder head.



- Mark installation position of connector of fuel pressure regulating valve - N276- relative to high-pressure reservoir.
- Unscrew fuel pressure regulating valve - N276- -item 2- from high-pressure reservoir -1- using insert tool (30 mm) - T10553- .
- Extract dirt from opening in high-pressure reservoir (thread and sealing surface) using a vacuum cleaner. Do not use metal tools, etc.
- Seal off open connection in high-pressure reservoir with clean plug.

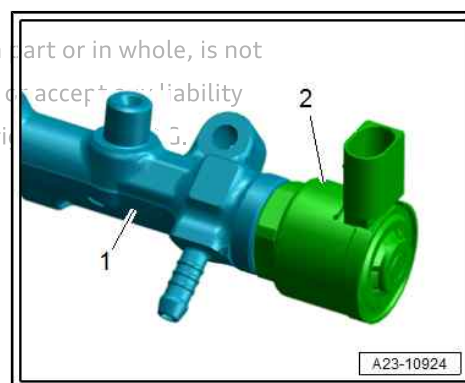


Installing

- Check that deformable sealing lip and thread on fuel pressure regulating valve - N276- are not damaged. Renew fuel pressure regulating valve - N276- if damaged.
- Check sealing surface at opening in high-pressure reservoir.
- If old fuel pressure regulating valve - N276- is reinstalled, O-Ring must be renewed.
- Coat beginning of thread, deformable sealing lip and O-ring of regulating valve lightly with diesel fuel.

- Tighten fuel pressure regulating valve - N276- -item 2- using insert tool (30 mm) - T10553- .

- Turn valve body to align connector of fuel pressure regulating valve - N276- with high-pressure reservoir according to mark made previously.



- Install high-pressure reservoir (rail) ⇒ [page 271](#) .
- If necessary, turn valve body to align regulating valve so that connecting wire is free of tension after connector is attached.

Perform adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester)
 ⇒ [“3.4 Performing adaptations after renewing a component”](#), [page 7](#) .

After installing fuel pressure regulating valve - N276- , leave engine running at moderate speed for a few minutes to bleed fuel system and then switch off again.

Note

- ◆ The fuel system is “self-bleeding”; do NOT open the high-pressure connections.
- Interrogate event memory.
- Switch off ignition.
- Carefully check the entire fuel system for leaks.

Renew affected component if leakage still occurs after tightening to 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.
- After road test, interrogate event memory again.
- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [“5.2 Exploded view - high-pressure reservoir \(rail\)”](#), [page 257](#)



7.5 Removing and installing fuel pressure sender - G247-

Special tools and workshop equipment required

- ◆ Socket, 27 mm - T40218-



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.*

Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Before removal, clean area around thread for fuel pressure sender - G247- using e.g. commercial cleaning solution.
- Make sure no dirt gets into opening in high-pressure reservoir.
- Clean carefully; cleaning solution must not enter the electrical connector.
- Dry off fuel pressure sender - G247- .



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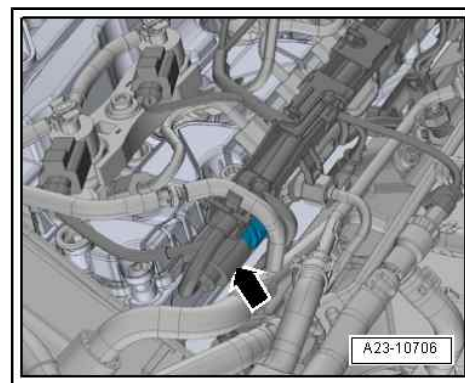


- Unplug electrical connector -arrow-.
- Unscrew fuel pressure sender - G247- using socket, 27 mm - T40218- .

i Note

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

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



Installing

- If the deformable sealing lip and the thread of the fuel pressure sender - G247- are not damaged, the sender can be re-used once.
- Check sealing surface at opening in high-pressure reservoir.
- The beginning of the thread and the deformable sealing lip of the fuel pressure sender must be coated with diesel fuel.
- Screw in fuel pressure sender - G247- by hand.
- Then tighten fuel pressure sender - G247- to specified torque.
- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [“5.2 Exploded view - high-pressure reservoir \(rail\)”, page 257](#)

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 affected component if leakage still occurs after tightening to 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.



7.6 Removing and installing pressure differential sender - G505-



Note

- ◆ *The pressure differential sender - G505- detects the amount of deposits in the emission control module.*
- ◆ *Re-install all heat insulation sleeves in the same locations when installing.*

Removing

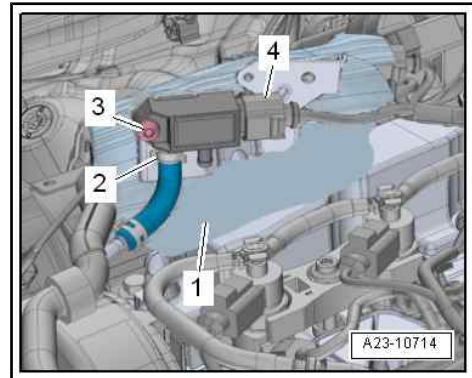
- Remove engine cover panel ⇒ [page 39](#) .
- Open heat insulation sleeve -1-.
- Unplug electrical connector -4-.
- Remove bolt -3- and detach pressure differential sender - G505- from bracket.
- Before disconnecting hose from pressure differential sender - G505- , spray hose with suitable release agent.
- Release hose clip -2-.



Caution

Irreparable damage to pressure differential sender can be caused if the connection breaks off.

- ◆ *Carefully disconnect hose from connection, taking care to keep hose straight.*



Installing

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



Note

- ◆ *Before installing, blow out control lines from pressure differential sender - G505- to emission control module towards emission control module with compressed air (pipes can become obstructed or may ice up due to condensation).*
- ◆ *Make sure that hose is securely fitted and that there are no leaks.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ [Electronic parts catalogue](#) .*

- Install engine cover panel ⇒ [page 39](#) .

Perform adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester)
⇒ [“3.4 Performing adaptations after renewing a component”](#), [page 7](#) .

Tightening torques

- ◆ ⇒ [“8.1 Exploded view - Lambda probe”](#), [page 286](#)



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

Removing

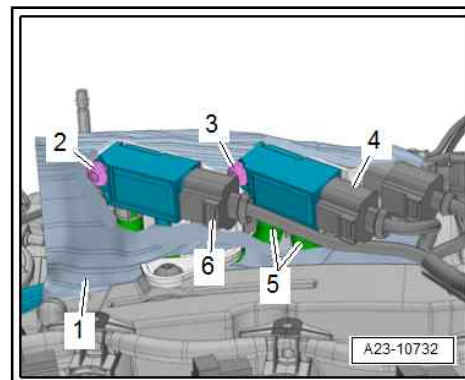
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Re-install all heat insulation sleeves in the same locations when installing.

- Remove engine cover panel ⇒ [page 39](#) .
- Open heat insulation sleeve -1-.
- Unplug electrical connector -6-.
- Remove bolt -2- and press exhaust gas pressure sensor 1 - G450- slightly to side.
- Unplug electrical connector -4-.
- Remove bolt -3- from exhaust gas pressure sensor 1 - G450- .
- Before disconnecting hoses from exhaust gas pressure sender 1 - G450- , spray hoses with suitable release agent.
- Release hose clips -5- and detach hoses.



Caution

Irreparable damage to pressure differential sender can be caused if the connection breaks off.

- ◆ *Carefully disconnect hose from connection, taking care to keep hose straight.*

Installing

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



Note

- ◆ *Before installing, blow out control lines from exhaust gas pressure sensor 1 - G450- to emission control module towards emission control module with compressed air (pipes can become obstructed or may ice up due to condensation).*
- ◆ *Make sure that hose is securely fitted and that there are no leaks.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ *Electronic parts catalogue* .*

- Install engine cover panel ⇒ [page 39](#) .

Perform adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester)

⇒ [“3.4 Performing adaptations after renewing a component”, page 7](#) .

Tightening torques

- ◆ ⇒ [“8.1 Exploded view - Lambda probe”, page 286](#)



8 Lambda probe

⇒ "8.1 Exploded view - Lambda probe", page 286

⇒ "8.2 Removing and installing Lambda probe", page 287

8.1 Exploded view - Lambda probe



WARNING

When working on all parts of the exhaust system:

- ◆ Observe safety precautions when working on the exhaust system
⇒ "2.5 Safety precautions when working on the exhaust system", page 3 .

1 - Lambda probe after catalytic converter - G130- with Lambda probe 1 heater after catalytic converter - Z29-

- Removing and installing ⇒ page 288
- Observe fitting instructions ⇒ page 290
- 52 Nm

2 - Exhaust gas temperature sender 4 - G648-

- Removing and installing ⇒ page 318

3 - Exhaust gas temperature sender 1 - G235-

- Removing and installing ⇒ page 315

4 - Exhaust gas temperature sender 2 - G448-

- Removing and installing ⇒ page 316

5 - Bolt

- 8 Nm

6 - Pressure differential sender - G505-

- Removing and installing ⇒ page 284

7 - Bracket

- For pressure differential sender

8 - Exhaust gas pressure sensor 1 - G450-

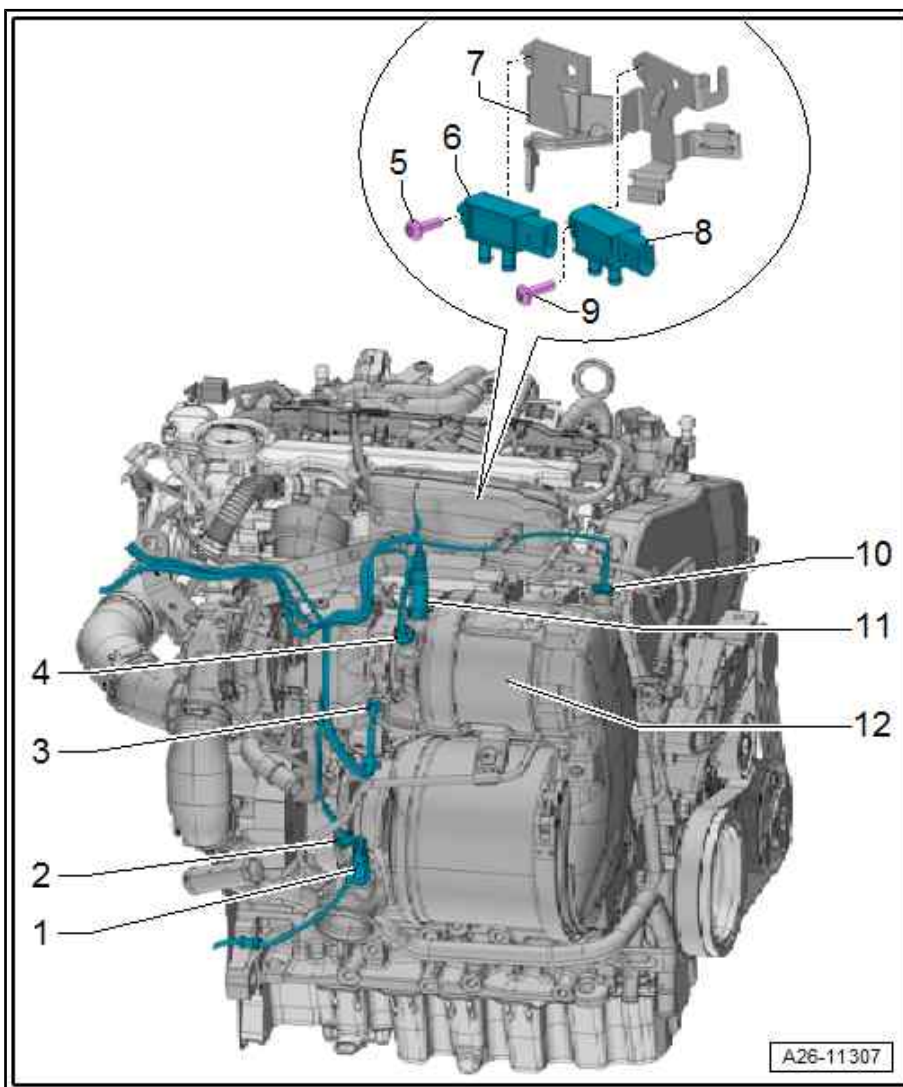
- Removing and installing ⇒ page 285

9 - Bolt

- 8 Nm

10 - Exhaust gas temperature sender 3 - G495-

- Removing and installing ⇒ page 318



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11 - Lambda probe - G39- with Lambda probe heater - Z19-

- Removing and installing ⇒ [page 287](#)
- Observe fitting instructions ⇒ [page 288](#)
- 52 Nm

12 - Emission control module

8.2 Removing and installing Lambda probe

⇒ ["8.2.1 Removing and installing Lambda probe G39"](#),
[page 287](#)

⇒ ["8.2.2 Removing and installing Lambda probe after catalytic
converter G130"](#), [page 288](#)

8.2.1 Removing and installing Lambda probe - G39-

Special tools and workshop equipment required

- ◆ Socket, 22 mm - T10491-



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Removing

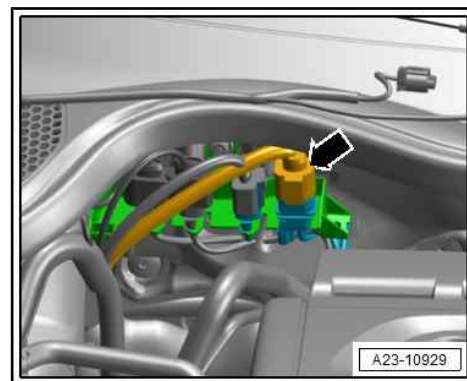


WARNING

When working on all parts of the exhaust system:

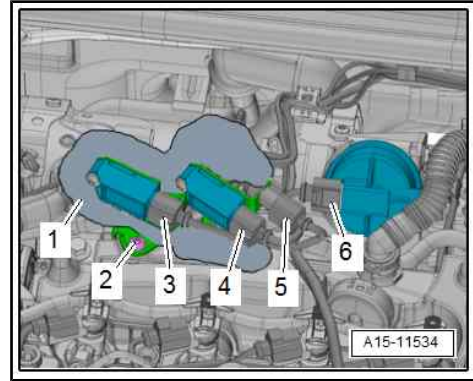
- ◆ *Observe safety precautions when working on the exhaust system*
⇒ ["2.5 Safety precautions when working on the exhaust system"](#), [page 3](#).

- Remove engine cover panel ⇒ [page 39](#).
- If fitted: Open heat shield sleeve.
- Remove electrical connector -arrow- for Lambda probe - G39- from bracket and unplug connector.





- Open heat insulation sleeve -1-.
- Unplug electrical connectors -3, 4, 6- and move electrical wiring clear.
- Detach electrical connector -5- for exhaust gas temperature sender 1 - G235- from bracket, unplug connector and move electrical wiring clear.
- Remove bolt -2- and press bracket with pressure differential senders towards front.



- Unscrew Lambda probe - G39- -arrow- using socket, AF 22 mm - T10491- .

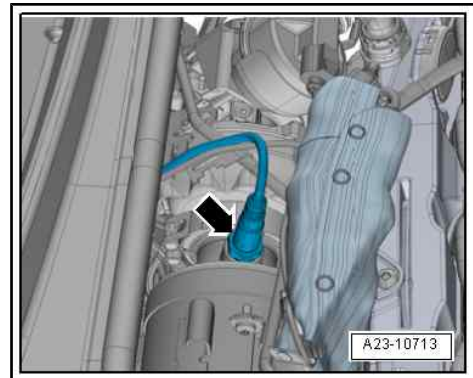
Installing

Installation is carried out in reverse order; 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 ⇒ *Electronic 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.*



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- Install engine cover panel ⇒ [page 39](#). AUDI AG. AUDI AG does not guarantee or accept any liability

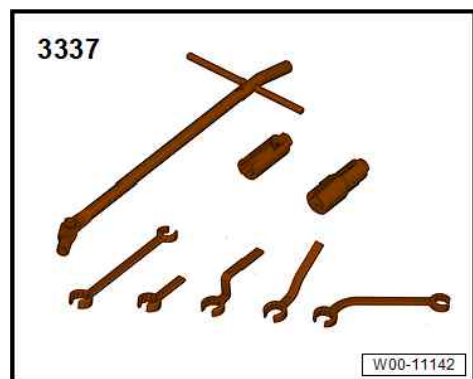
Tightening torques respect to the correctness of information in this document. Copyright by AUDI AG.

- ◆ ⇒ ["8.1 Exploded view - Lambda probe", page 286](#)
- ◆ ⇒ ["2.1 Exploded view - cylinder head cover", page 88](#)

8.2.2 Removing and installing Lambda probe after catalytic converter - G130-

Special tools and workshop equipment required

- ◆ Lambda probe open ring spanner set - 3337-





Removing

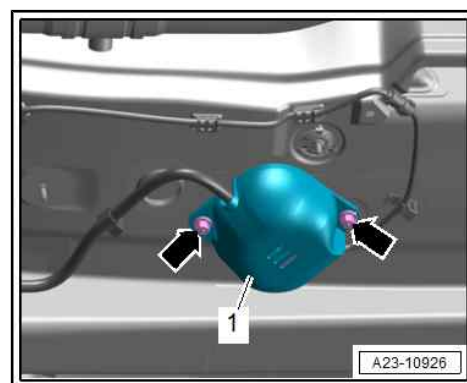


WARNING

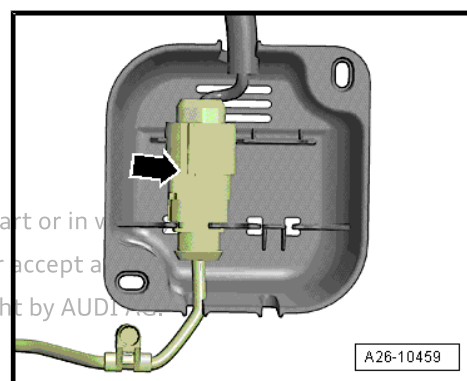
When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ ***“2.5 Safety precautions when working on the exhaust system”, page 3 .***

- Unfasten underbody trim (inside centre right) and press downwards ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Exploded view - underbody trim .
- Remove front exhaust pipe ⇒ [page 296](#) .
- Unscrew nuts -arrows- and detach cover -1-.



- Unplug electrical connector -arrow- for Lambda probe after catalytic converter - G130- .



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- Unscrew Lambda probe after catalytic converter - G130-
-arrow- using a tool from Lambda probe open ring spanner set
- 3337- .

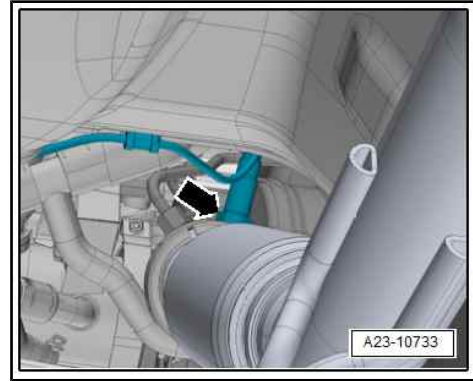
Installing

Installation is carried out in reverse order; 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 ⇒ *Electronic 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.*



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Tightening torques

- ◆ ⇒ [“8.1 Exploded view - Lambda probe”, page 286](#)
- ◆ ⇒ [“1.1 Exploded view - silencer”, page 294](#)
- ◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Exploded view - underbody trim



9 Engine control unit

⇒ ["9.1 Removing and installing engine/motor control unit J623"](#),
[page 291](#)

9.1 Removing and installing engine/motor control unit - J623-

- ◆ Not every engine control unit is bolted to a protective housing. Whether a protective housing is fitted depends on the vehicle equipment.

Special tools and workshop equipment required

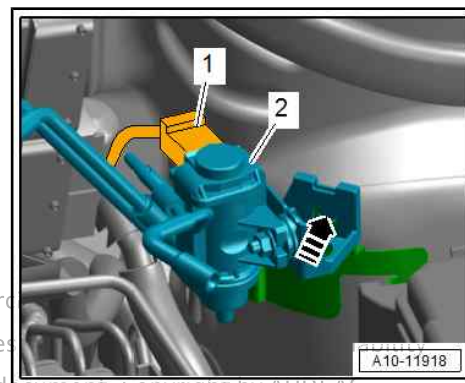
- ◆ Small mole grips -3- (commercially available)
- ◆ Vehicle diagnostic tester

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.
- Remove air cleaner housing
⇒ ["3.2 Removing and installing air cleaner housing"](#),
[page 246](#) .
- Unplug electrical connector -1- at turbocharger air recirculation valve - N249- -item 2-.
- Release retainer -arrow-, detach bracket with recirculation valve upwards and place to one side.



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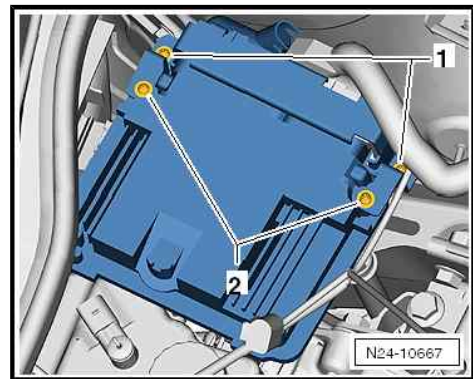
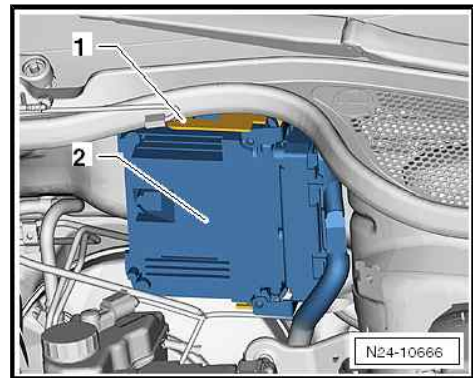
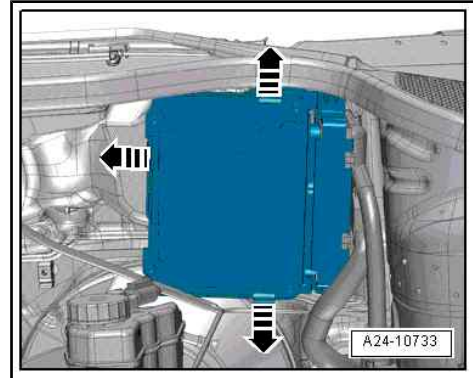
Engine control unit without protective housing

- Release fasteners -arrows- and detach engine control unit - J623- from bracket.

Engine control unit with protective housing

- Lift fastener -1- and detach engine control unit -2-.

- Remove shear bolts -1- using pliers.



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All versions

- Lever locking bar -1- of top wiring harness in direction of -arrow- using a screwdriver.
- Lever locking bar -2- of bottom wiring harness in direction of -arrow- using a screwdriver.
- Unplug connectors from engine control unit.
- Remove engine control unit.

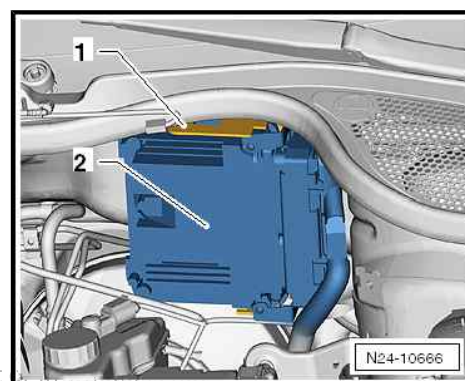
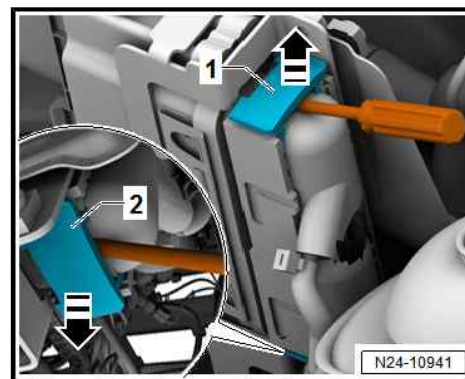


Note

If the engine control unit is to be renewed, the shear bolts -2- must also be removed.

Installing

- Plug electrical connectors back into engine control unit.
- If previously fitted, re-install protective housing on engine control unit.
- Install bracket for protective housing with new shear bolts.
- Tighten shear bolts evenly until bolt heads shear off.
- Insert engine control unit -2- into retainer on plenum chamber partition panel until fastener -1- engages audibly.
- If engine control unit - J623- has been renewed, connect ⇒ Vehicle diagnostic tester, switch on ignition and select Replace engine control unit in Guided Functions mode.



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26 – Exhaust system

1 Exhaust pipes/silencer

- ⇒ "1.1 Exploded view - silencer", page 294
- ⇒ "1.2 Removing and installing front exhaust pipe", page 296
- ⇒ "1.3 Separating exhaust pipes/silencers", page 297
- ⇒ "1.5 Stress-free alignment of exhaust system", page 299
- ⇒ "1.6 Checking exhaust system for leaks", page 300

1.1 Exploded view - silencer



WARNING

When working on all parts of the exhaust system:

- ◆ Observe safety precautions when working on the exhaust system
⇒ "2.5 Safety precautions when working on the exhaust system", page 3 .

1 - Rear silencer

- Combined with exhaust pipe
- With cutting point for easier removal
⇒ page 297
- Align exhaust system so it is free of stress
⇒ page 299

2 - Bolt

- 23 Nm

3 - Mounting

- Renew if damaged

4 - Exhaust pipe

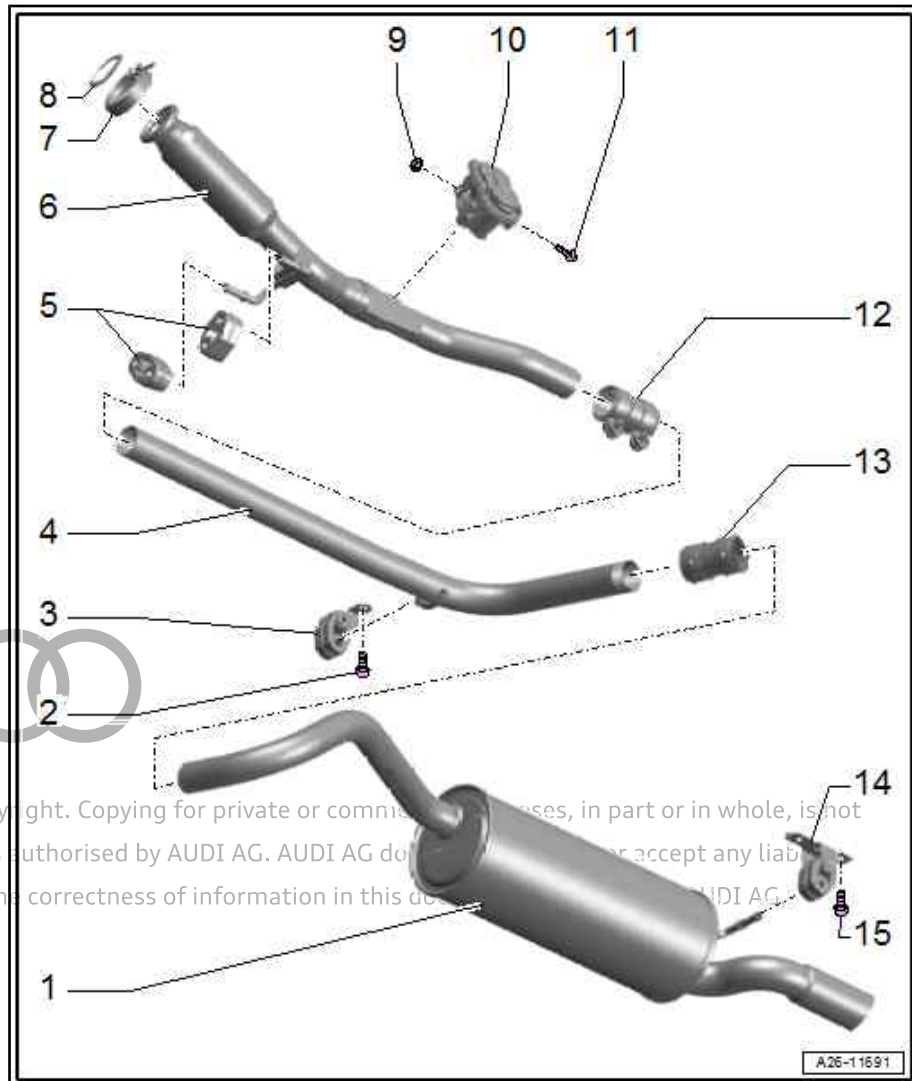
- Combined with rear silencer
- With cutting point for easier removal
⇒ page 297
- Align exhaust system so it is free of stress
⇒ page 299

5 - Rubber mounting

- Renew if damaged

6 - Front exhaust pipe

- With cutting point for easier removal of exhaust system
- Removing and installing
⇒ page 296
- Align exhaust system so it is free of stress





⇒ [page 299](#)

7 - Screw-type clip

- Renew after removing
- Installation position ⇒ [page 295](#)
- 7 Nm

8 - Gasket

- Renew after removing

9 - Nut

- 10 Nm

10 - Exhaust flap control unit - J883-

- Removing and installing ⇒ [page 311](#)

11 - Bolt

12 - Clamp (front)

- Before tightening, align exhaust system so it is free of stress ⇒ [page 299](#)
- Installation position ⇒ [page 296](#)
- Versions and tightening torques ⇒ [page 296](#)
- Tighten bolted connections evenly

13 - Clamp (rear)

- Before tightening, align exhaust system so it is free of stress ⇒ [page 299](#)
- Installation position ⇒ [page 296](#)
- Versions and tightening torques ⇒ [page 296](#)
- Tighten bolted connections evenly

14 - Mounting

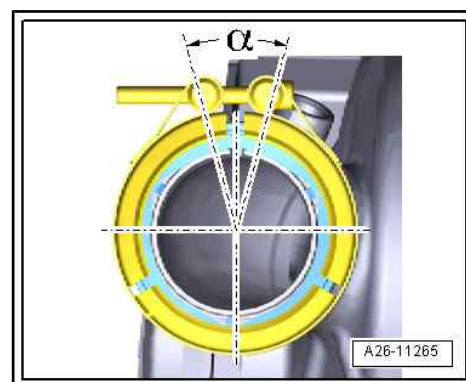
- Renew if damaged

15 - Bolt

- 23 Nm

Installation position of screw-type clip for front exhaust pipe

- Angle $-\alpha = 0 \pm 30^\circ$



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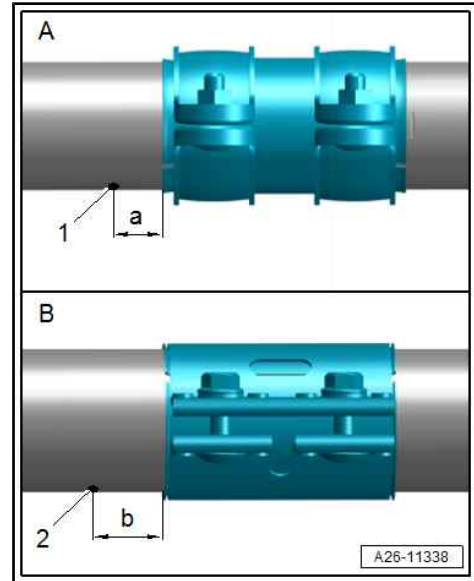
Clamp - versions and tightening torques

Clamp -A- (comprising two separate clamps):

- a - Installation position for front clamp = 5 mm from marking -1-
- Tighten bolted connections to 25 Nm.

Clamp -B- (comprising one continuous clamp):

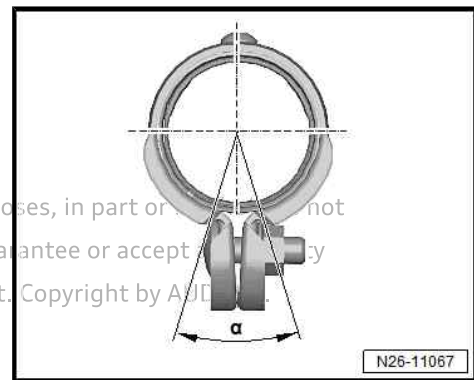
- b - Installation position for front clamp = 8.5 mm from marking -2-
- Tighten bolted connections to 35 Nm.



Installation position of clamps (front and rear)

- Fit clamp in position shown:
- Angle α = 15°
- Bolt connections face downwards.

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1.2 Removing and installing front exhaust pipe

Removing

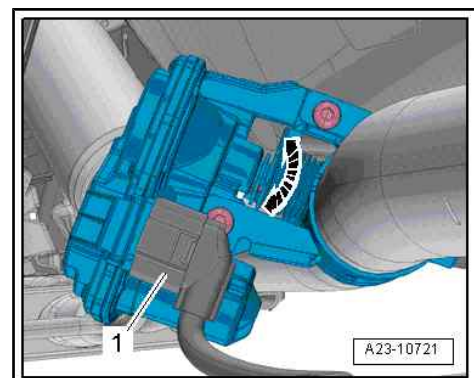


WARNING

When working on all parts of the exhaust system:

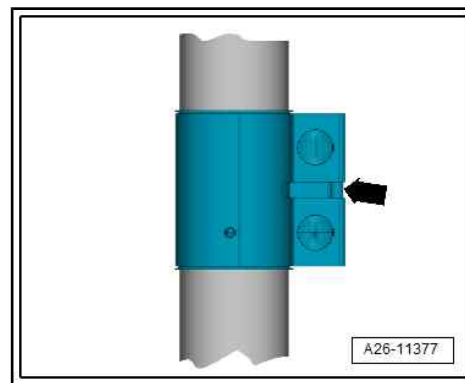
- ◆ *Observe safety precautions when working on the exhaust system*
⇒ ***"2.5 Safety precautions when working on the exhaust system", page 3.***

- Unplug electrical connector -1- from exhaust flap control unit - J883- .





- Loosen clamp -arrow- and push towards rear.



- Slacken bolt -2- and remove clip.
- Detach mountings -1- for front exhaust pipe from subframe and detach front exhaust pipe.

Installing

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



Note

Renew gasket after removing.

- Align the exhaust system so it is free of stress ⇒ [page 299](#) .

Tightening torques

- ◆ ⇒ ["1.1 Exploded view - silencer", page 294](#)

1.3 Separating exhaust pipes/silencers

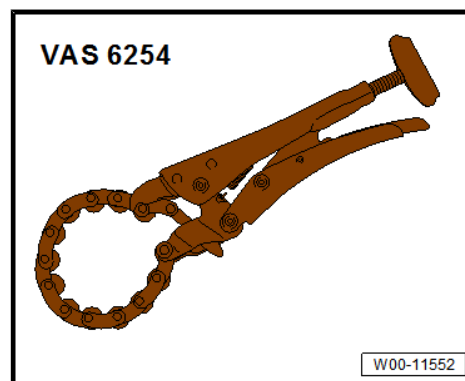
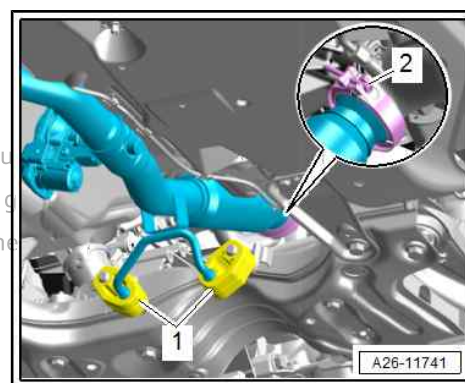


Note

- ◆ *On vehicles with torsion beam axle, a cutting point is provided on the exhaust pipe for easier removal of the exhaust system.*
- ◆ *The cutting point is marked by an indentation on the circumference of the exhaust pipe.*

Special tools and workshop equipment required

- ◆ Chain pipe cutter - VAS 6254-





Procedure

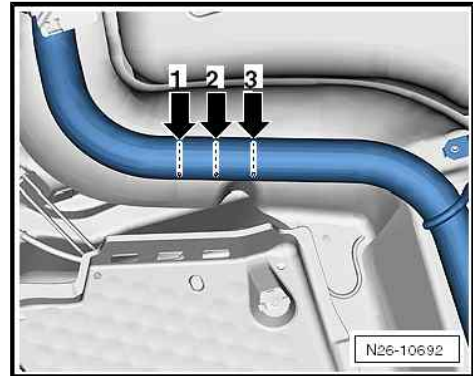


WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ *"2.5 Safety precautions when working on the exhaust system", page 3.*

- Cut through exhaust pipe at right angles at the position marked -arrow 2- using chain pipe cutter - VAS 6254- .
- Position clamp centrally at side marks -arrows 1, 3- when installing.
- Fit rear clamp ⇒ [page 296](#) .
- Align the exhaust system so it is free of stress ⇒ [page 299](#) .



1.4 Removing and installing silencer

Removing



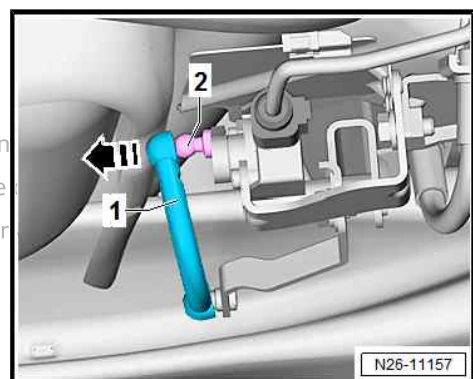
WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ *"2.5 Safety precautions when working on the exhaust system", page 3.*

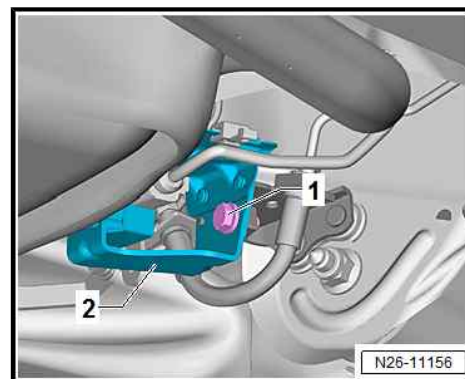
- Press coupling rod of rear left vehicle level sender -G76- off ball stud -2- -arrow-.

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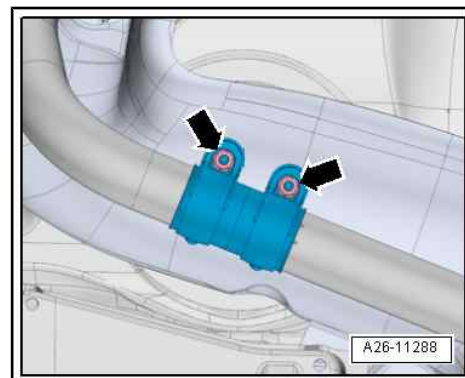




- Remove bolt -1- and press bracket -2- with rear left vehicle level sender - G76- to one side.
- Vehicles without connection point: separate exhaust pipe/silencer => [page 297](#) .



- Vehicles with connection point: release clamp -arrows- and push to right side.



- Unscrew bolts -1- and detach rear silencer -2-.

Installing

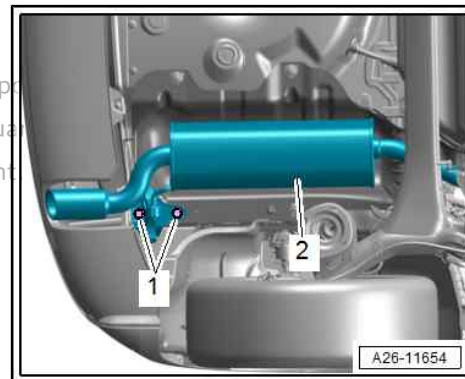
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Installation is carried out in reverse order; note the following:

- Align the exhaust system so it is free of stress => [page 299](#) .

Tightening torques

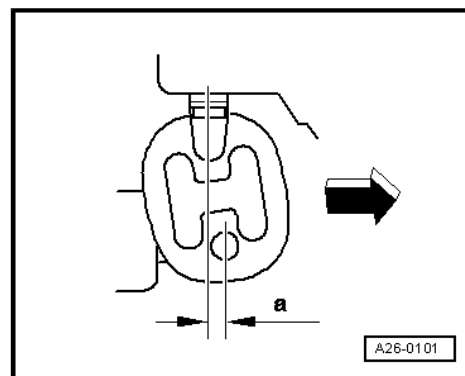
- ◆ => "1.1 Exploded view - silencer", page 294
- ◆ => Running gear, axles, steering; Rep. gr. 43 ; Vehicle level sender; Exploded view - rear vehicle level sender



1.5 Stress-free alignment of exhaust system

Procedure

- The exhaust system must be aligned when it is cool.
- Loosen bolt connections for clamp.
- Push exhaust system towards front of vehicle -arrow- so that mounting for rear silencer is preloaded by -a- = 15 ... 17 mm.
- Fit clamp => [page 296](#) .
- Bolted connection facing towards right
- Tighten bolt connections on clamp evenly.



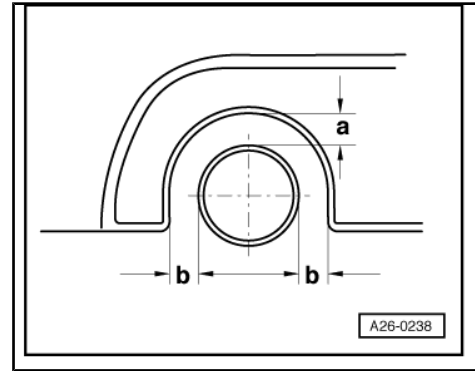


Aligning tailpipe

- Align rear silencer so that there is an equal distance -a- and -b- between bumper cut-out and tailpipe.

Tightening torques

- ◆ ⇒ ["1.1 Exploded view - silencer", page 294](#)



1.6 Checking exhaust system for leaks

- Start the engine and run at idling speed.
- Plug tailpipes during leak test (e.g. with cloth or plug).
- Listen for noise at the connection points of cylinder head/exhaust manifold, turbocharger/front exhaust pipe etc. to locate any leaks.
- Rectify any leaks that are found.



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2 Emission control system

⇒ ["2.1 Exploded view - emission control system", page 301](#)

⇒ ["2.2 Removing and installing emission control module", page 303](#)

⇒ ["2.3 Removing and installing exhaust flap control unit J883", page 311](#)

2.1 Exploded view - emission control system



WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ ["2.5 Safety precautions when working on the exhaust system", page 3](#).

1 - Front exhaust pipe

- ❑ Removing and installing
⇒ [page 296](#)
- ❑ Align exhaust system so it is free of stress
⇒ [page 299](#)

2 - Screw-type clip

- ❑ Renew after removing
- ❑ Installation position
⇒ [page 295](#)
- ❑ Tightening torque
⇒ [Item 7 \(page 295\)](#)

3 - Seal

- ❑ Renew after removing

4 - Bolt

- ❑ Tightening torque and sequence ⇒ [page 310](#)

5 - Seal

- ❑ Renew after removing

6 - Screw-type clip

- ❑ Renew after removing
- ❑ Installation position
⇒ [page 322](#)
- ❑ Tightening torque and sequence ⇒ [page 322](#)

7 - Exhaust gas recirculation cooler

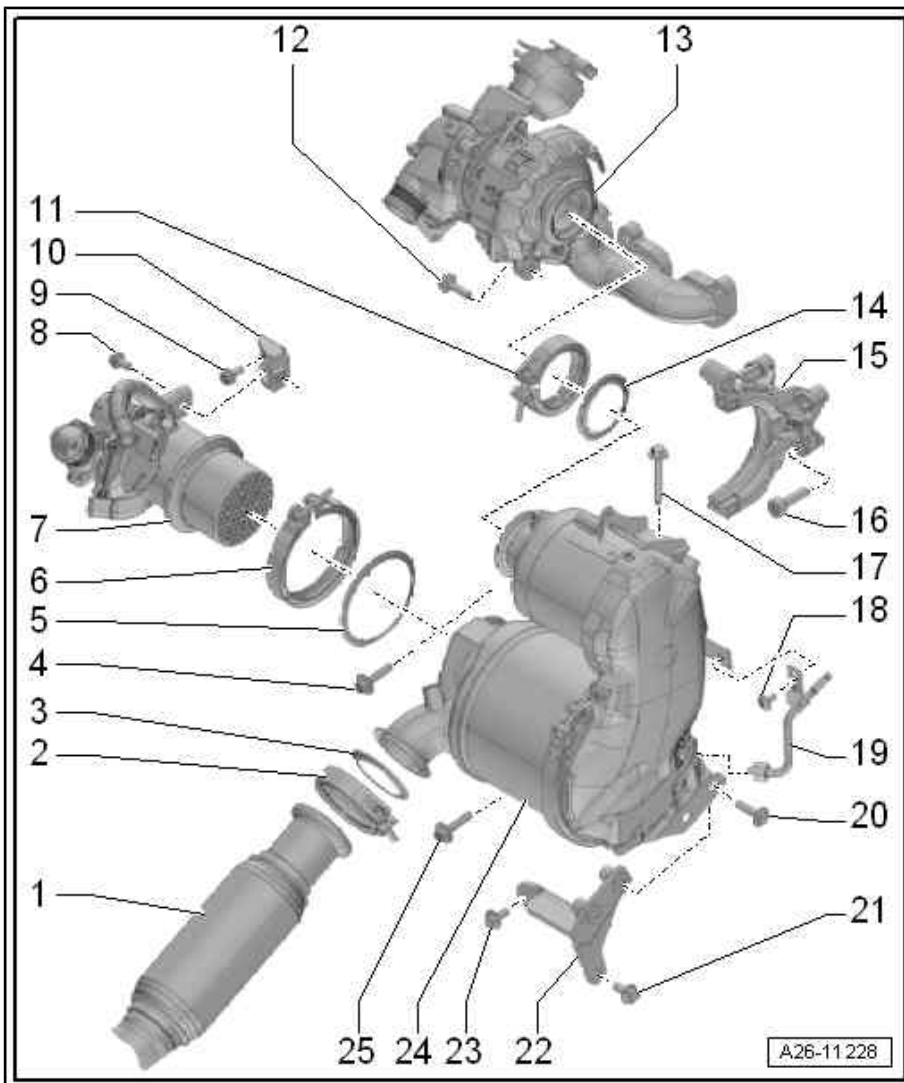
- ❑ Removing and installing
⇒ [page 326](#)

8 - Bolt

- ❑ Tightening torque and sequence ⇒ [page 310](#)

9 - Bolt

- ❑ Tightening torque and sequence ⇒ [page 310](#)





10 - Bracket

- For exhaust gas recirculation cooler

11 - Screw-type clip

- Renew after removing
- Installation position ⇒ [page 303](#)

12 - Bolt

- Renew after removing
- Tightening torque and sequence ⇒ [page 216](#)

13 - Turbocharger

- Removing and installing ⇒ [page 216](#)

14 - Seal

- Renew after removing
- Fit on catalytic converter

15 - Bracket

- For emission control module
- With compensation element
- Preparing compensation element for fitting ⇒ [page 308](#)

16 - Bolt

- Renew after removing

Tightening torque and sequence ⇒ [page 216](#)

17 - Bolt

- Renew after removing
- Tightening torque and sequence ⇒ [page 310](#)

18 - Bolt

- 9 Nm

19 - Measuring tube

- To pressure differential sender - G505-
- Additional measuring tube to exhaust gas pressure sensor 1 - G450-
- Tightening torque for union nut: 45 Nm

20 - Bolt

- Tightening torque and sequence ⇒ [page 310](#)

21 - Bolt

- Renew after removing
- Tightening torque and sequence ⇒ [page 310](#)

22 - Bracket

- For emission control module
- With compensation elements
- Preparing compensation elements for fitting ⇒ [page 308](#)

23 - Bolt

- Renew after removing
- Tightening torque and sequence ⇒ [page 310](#)

24 - Emission control module

- Particulate filter with catalytic converter
- Removing and installing ⇒ [page 303](#)

25 - Bolt

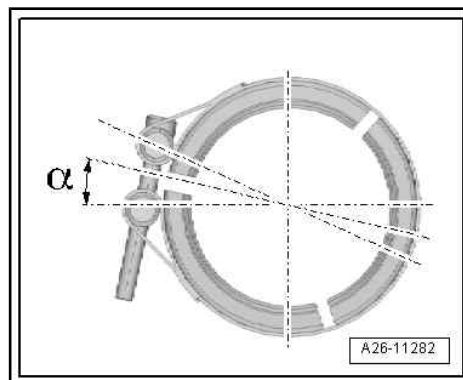
- Renew after removing



□ Tightening torque and sequence ⇒ [page 310](#)

Installation position of screw-type clip for emission control module

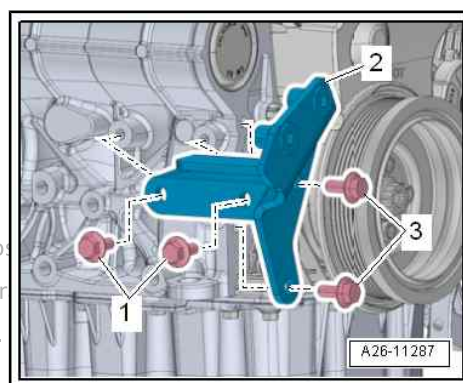
- Angle $\alpha = 30^\circ$



Bracket -2- for emission control module - tightening torque and tightening sequence

– Tighten bolts in stages in the sequence described:

Stage	Bolts	Tightening torque
1.	-3-	Screw in by hand until contact is made
2.	-1-	20 Nm
3.	-3-	20 Nm

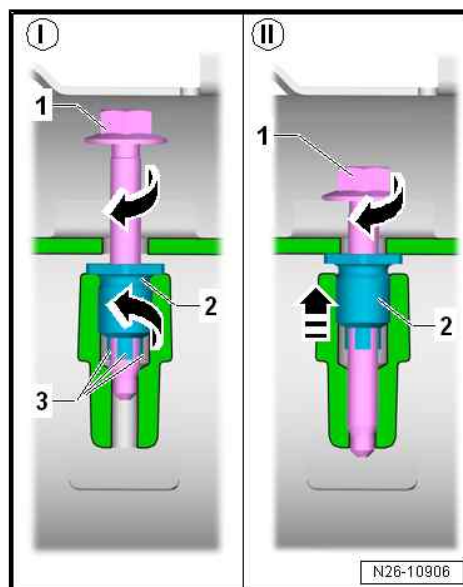


2.2 Removing and installing emission control module



Note

The emission control module is secured to the engine in part by four compensation elements. These compensation elements have a left-hand thread on the outside. When the bolt -1- is screwed in, the friction against the retaining tabs -3- initially causes the compensation element -2- to turn as well. Even though the bolt is turned clockwise, the left-hand thread causes the compensation element to move towards the bolt head, which compensates for the play between the components. The compensation element must rotate freely on the left-hand thread, otherwise the retaining tabs will not produce enough friction on the bolt to turn the compensation element. To avoid impairing the required friction, ensure that the retaining tabs do not come in contact with any lubricant.



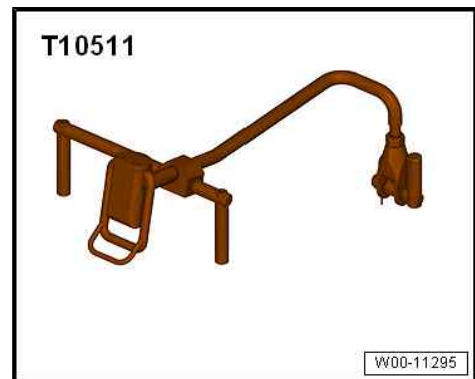
Special tools and workshop equipment required



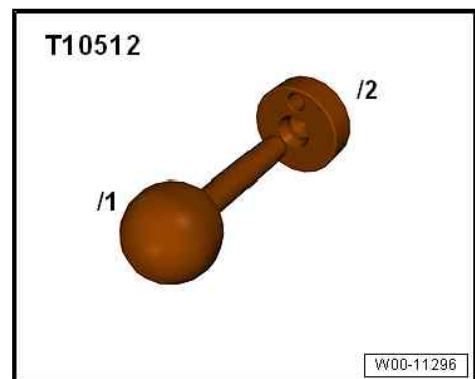
- ◆ Socket (8 mm) - 3247-



- ◆ Assembly aid - T10511-



- ◆ Calibration tool - T10512-



- ◆ Engine support - T10533-

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Removing

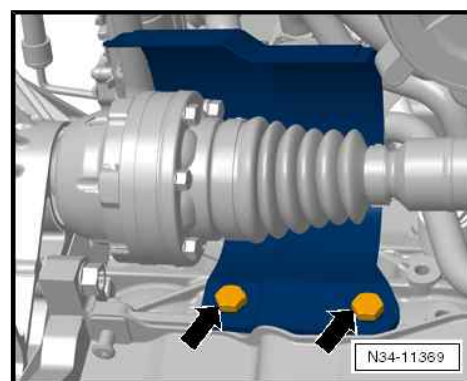


WARNING

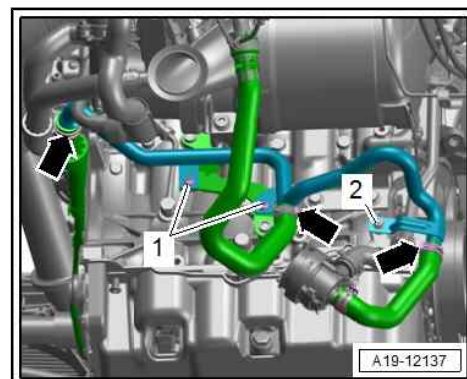
When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
 ⇒ ***"2.5 Safety precautions when working on the exhaust system", page 3*** .

- Remove engine cover panel ⇒ [page 39](#) .
- Remove subframe with steering rack ⇒ Rep. gr. 40 ; Sub-frame; Removing and installing subframe with steering rack .
- Remove bolts -arrows- and detach heat shield for drive shaft (right-side).

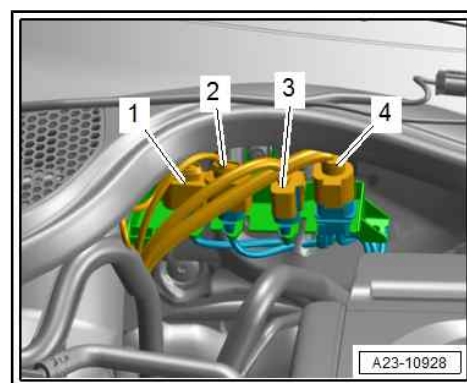


- Release hose clips -arrows- and disconnect coolant hoses.
- Remove bolts -1- and nut -2- and take off rear coolant pipe.
- Remove Lambda probe after catalytic converter - G130- ⇒ [page 288](#) .
- Remove exhaust gas recirculation cooler ⇒ [page 326](#) .



- If fitted: Open heat shield sleeve.
- Detach electrical connectors from bracket, unplug connectors and move electrical wiring clear:

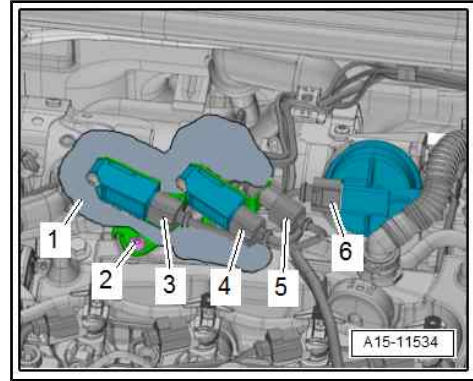
- 1 - For exhaust gas temperature sender 4 - G648-
- 2 - For exhaust gas temperature sender 3 - G495-
- 3 - For exhaust gas temperature sender 2 - G448-
- 4 - For Lambda probe - G39-



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- Open heat insulation sleeve -1-.
- Take electrical connector -5- out of bracket, unplug it and move electrical wiring clear.
- Unplug electrical connectors -3, 4- and move electrical wiring harness clear.
- Take electrical connector -4- for Lambda probe - G39- out of bracket, unplug and move wiring clear.
- Remove bolt -2- and move bracket clear at cylinder head cover.

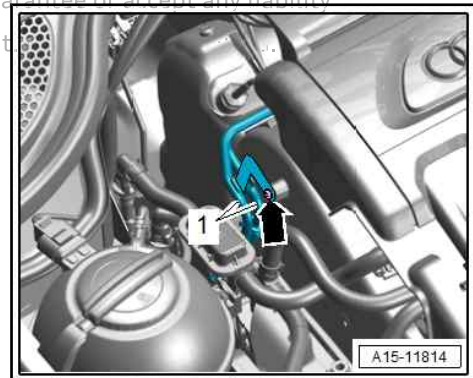


Note

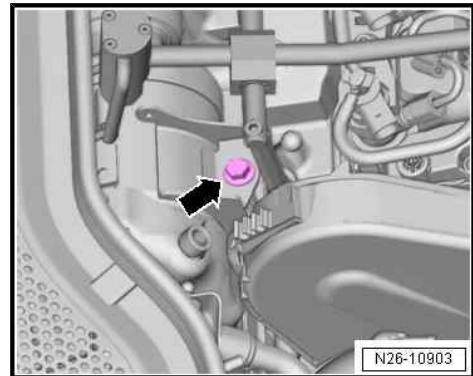
Disregard -item 6-

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- If fitted, unscrew bolt -arrow- and move measuring tube -1- clear.



- Remove bolt -arrow-.

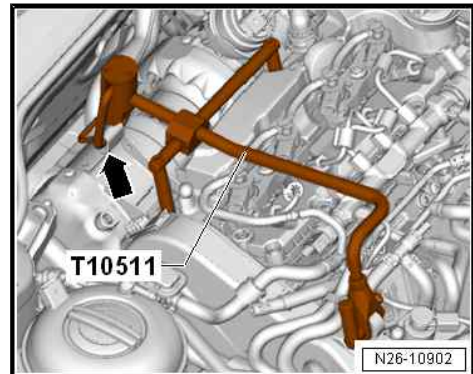


- Detach noise insulation from injectors.
- Set up assembly aid - T10511- as shown and engage retainer -arrow- in bracket of emission control module.



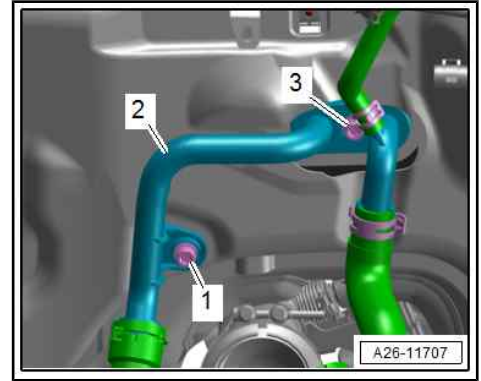
Note

The legs of the assembly aid - T10511- are positioned on the heads of the bolts for the cylinder head cover.






- Unscrew nut -1- and bolt -3-, detach adapter -2- for coolant hoses from heat exchanger for heater and place to one side.
- Unbolt drive shaft (right-side) from gearbox and tie up to rear
⇒ Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .

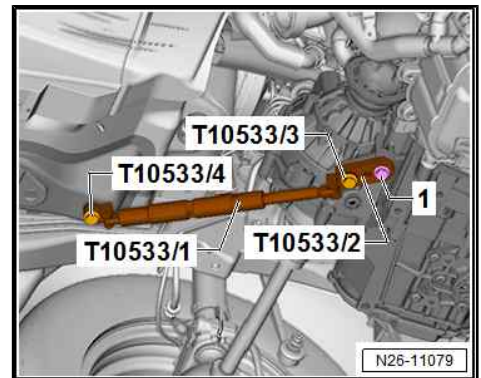


- Attach engine support - T10533- as shown and hand-tighten bolts for engine support.
- In addition, hand-tighten bolt -1- for pendulum support.

 **Caution**

Risk of damage to components.

◆ ***When pushing the engine/gearbox assembly forwards, it is important that no components press against the radiator cowl.***



- Push engine/gearbox assembly forwards as far as possible by tightening spindle on engine support - T10533- .



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- Open screw-type clip -1- and place it on intake funnel of emission control module.
- Remove remaining bolts in the sequence -4, 3, 2-.
- Pivot lower part of emission control module away from engine and push upwards.
- Pull retainer out of bracket of emission control module and remove emission control module downwards.

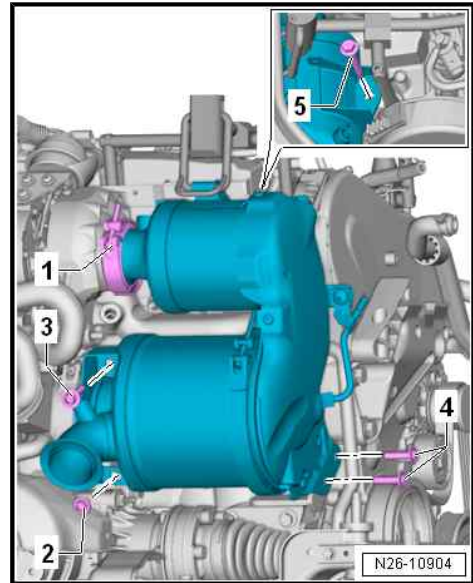
Installing

- Assembly aid - T10511- set up on engine



Note

- ◆ *Ensure that the retainer of the assembly tool - T10511- is pivoted in the direction of the plenum chamber partition panel.*
- ◆ *Renew bolts tightened with specified tightening angle.*
- ◆ *Renew seals, self-locking nuts and screw-type clips for emission control module after removal.*
- ◆ *Re-fit all cable ties and heat insulation sleeves in the same locations when installing.*



Caution

Emission control module must be installed free of tension to avoid risk of stress fractures and engine damage.

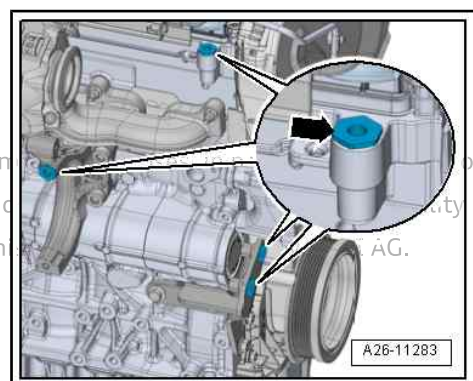
- ◆ *Prior to installation, ensure that the compensation elements move easily and do not stick.*
- ◆ *Compensation element must turn easily on its threads.*
- ◆ *Only apply lubricant to thread; retainer tabs must remain clean.*
- ◆ *The retainer tabs for the bolt must be bent together so that when the bolt is screwed in, the compensation element turns as well.*

- Check to ensure freedom of movement of compensation elements -arrow-.
- Unscrew compensation elements completely in clockwise direction (left-hand thread).
- Clean any threads that do not turn easily and lubricate lightly with rust remover if necessary.



Caution

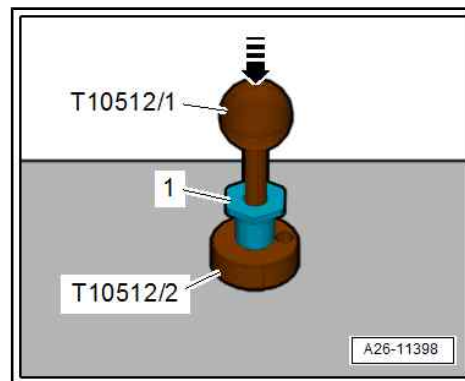
Do not use any kind of lubricant on the retaining tabs of the compensation elements, as this will reduce the build-up of friction and compromise the function of the compensation elements.



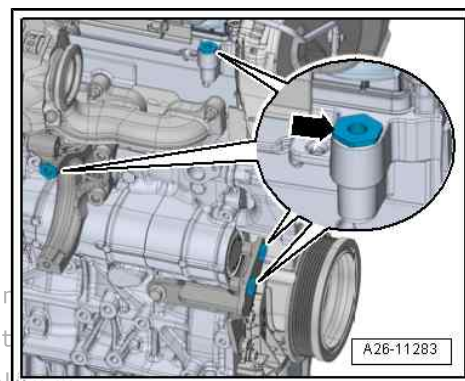
- Adjust retainer tabs to functional dimension using calibration tool - T10512- as follows:



- Slide compensation element -1- onto pin -T10512/1-, insert into centring sleeve -T10512/2- and bend back retainer tabs by gently striking -arrow- ball head with heel of your hand.



- Screw in compensation elements -arrow- by hand as far as they will go, then loosen again by 45°.

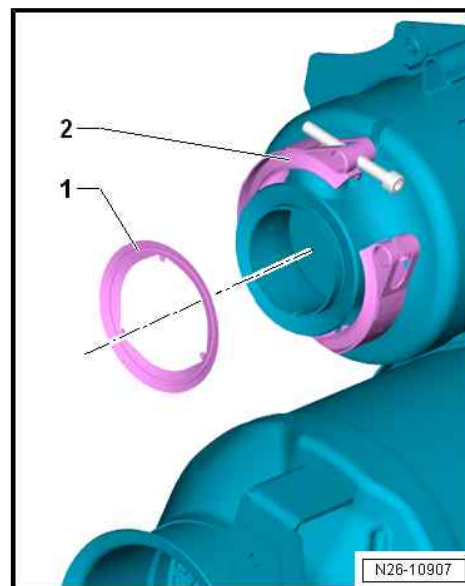


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i Note

Renew seal -1- and screw-type clip -2- after removal.

- Fit seal -1- onto emission control module.
- Disengage screw on clip -2- and move clip all the way onto intake funnel of emission control module. Do not bend clip open.
- Guide emission control module into installation position from below, push upwards and hook retainer into bracket of emission control module.
- Emission control module is now suspended approximately in installation position with its weight supported.



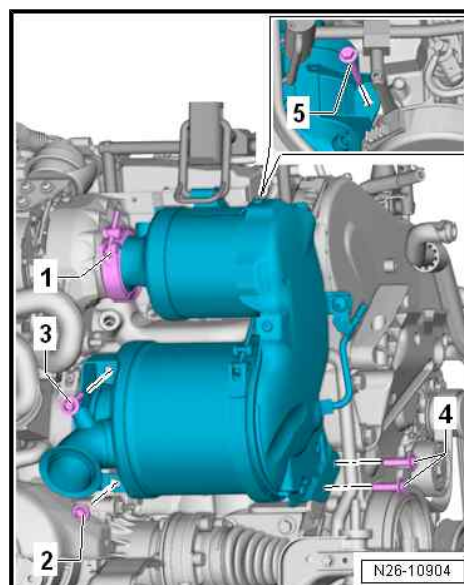
i Note

Renew all securing bolts for emission control module after removal.

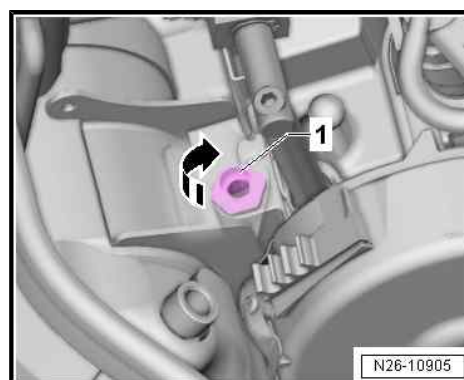


Tightening sequence for emission control module

Stage	Bolt	Measure
1.	Screw-type clip -1-	Fit over sealing flange and engage screw
2.	Bolt -2-	Tighten by hand and loosen immediately by 90°
3.	Screw-type clip -1-	Tighten to 8 Nm
4.	Bolt -2-	Tighten to 20 Nm
5.	Bolt -3-	Insert and press until it engages. Do not tighten or turn bolt
6.	Bolts -4-	Insert and press until it engages. Tighten bolts to 20 Nm.
7.	Bolt -3-	Tighten to 20 Nm



- Using socket, 8 mm - 3247- , unscrew compensation element (left-hand thread) -1- on cylinder head in direction of -arrow- until it makes contact, then turn 90° further.



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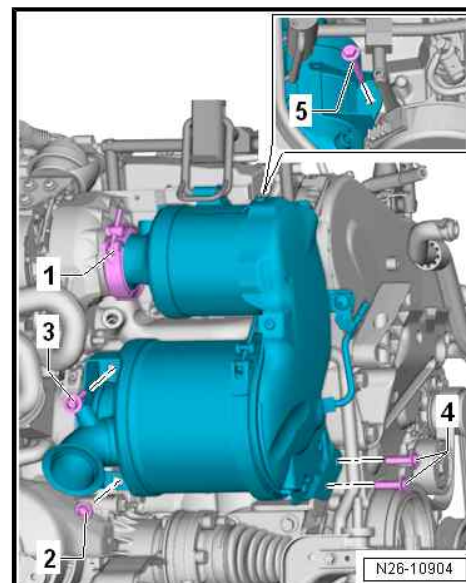
Tightening sequence continued

Stage	Bolt	Measure
8.	Bolt -5-	Insert and press until it engages
9.	Bolt -5-	Tighten to 20 Nm
10.	Bolt -5-	Turn 90° further
11.	Bolt -5-	Turn another 45° further.

- Detach assembly aid - T10511- .

Further installation is carried out in the reverse order; note the following:

- Install exhaust gas recirculation cooler ⇒ [page 326](#) .
- Install Lambda probe after catalytic converter - G130- ⇒ [page 288](#) .
- Install coolant pipe (rear) ⇒ [page 203](#) .
- Install heat shield for drive shaft ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing heat shield for drive shaft .
- Install subframe ⇒ Rep. gr. 40 ; Subframe; Removing and installing subframe with steering rack .
- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install engine cover panel ⇒ [page 39](#) .
- After renewing emission control module, adaption must be performed using ⇒ Vehicle diagnostic tester, Guided Functions, 01 - Replacing engine CU / particulate filter.



Tightening torques

- ◆ ⇒ [“1.1 Exploded view - toothed belt cover”, page 73](#)
- ◆ ⇒ Heating, air conditioning; Rep. gr. 87 ; Heater and air conditioning unit (front); Exploded view - attachments for heater and air conditioning unit and air intake box
- ◆ ⇒ Rep. gr. 40 ; Drive shaft; Exploded view - drive shaft

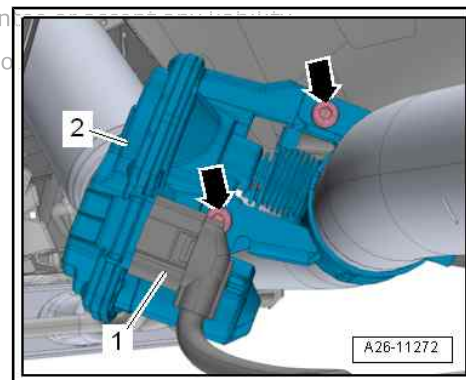
2.3 Removing and installing exhaust flap control unit - J883-

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Removing

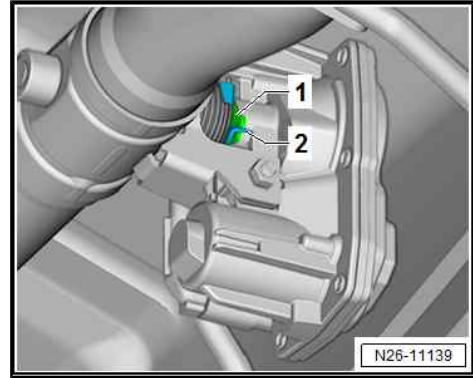
- Unplug electrical connector (1).
- Remove bolts (arrows) and detach exhaust flap control unit - J883- (item 2).

Installing





- Fit new exhaust flap control unit. When doing so, ensure that coupling of control unit -1- engages in tab on exhaust flap -2-.
- Fit new securing bolts and nuts.

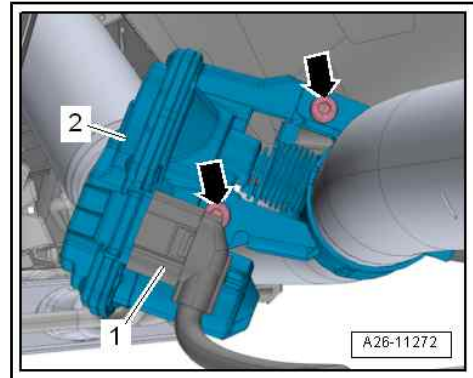


- Tighten upper bolt first, then tighten lower bolt.
- Remove protective cap for electrical connector and plug connector -1- in. Secure heat insulation sleeve if necessary.

Perform adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester)
⇒ [“3.4 Performing adaptations after renewing a component”, page 7](#) .

Tightening torques

- ◆ ⇒ [Item 9 \(page 295\)](#)
- ◆ ⇒ [“1.1 Exploded view - silencer”, page 294](#)



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3 Exhaust gas temperature control

⇒ **“3.1 Exploded view - exhaust gas temperature control”,
page 313**

⇒ **“3.2 Removing and installing exhaust gas temperature sender”,
page 315**

3.1 Exploded view - exhaust gas temperature control



WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*

⇒ **“2.5 Safety precautions when working on the exhaust system”, page 3 .**



Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- ◆ *The threads of the exhaust gas temperature senders - G495- and -G648- are coated. It is important that you do NOT coat them additionally with high-temperature paste and that you tighten them to the specified torque.*



1 - Lambda probe after catalytic converter - G130- with Lambda probe 1 heater after catalytic converter - Z29-

- ❑ Removing and installing ⇒ [page 288](#)

2 - Exhaust gas temperature sender 4 - G648-

- ❑ Removing and installing ⇒ [page 318](#)
- ❑ The thread of the exhaust gas temperature sender is coated; it must not additionally be greased with high-temperature paste
- ❑ 45 Nm

3 - Exhaust gas temperature sender 1 - G235-

- ❑ Removing and installing ⇒ [page 315](#)
- ❑ Coat with high-temperature paste when installing; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ❑ 45 Nm

4 - Exhaust gas temperature sender 2 - G448-

- ❑ The thread of the exhaust gas temperature sender is coated; it must not additionally be greased with high-temperature paste

- ❑ Removing and installing ⇒ [page 316](#)
- ❑ 60 Nm

5 - Bolt

- ❑ Tightening torque ⇒ [Item 5 \(page 286\)](#)

6 - Pressure differential sender - G505-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ [page 284](#)

7 - Bracket

- ❑ For pressure differential sender

8 - Exhaust gas pressure sensor 1 - G450-

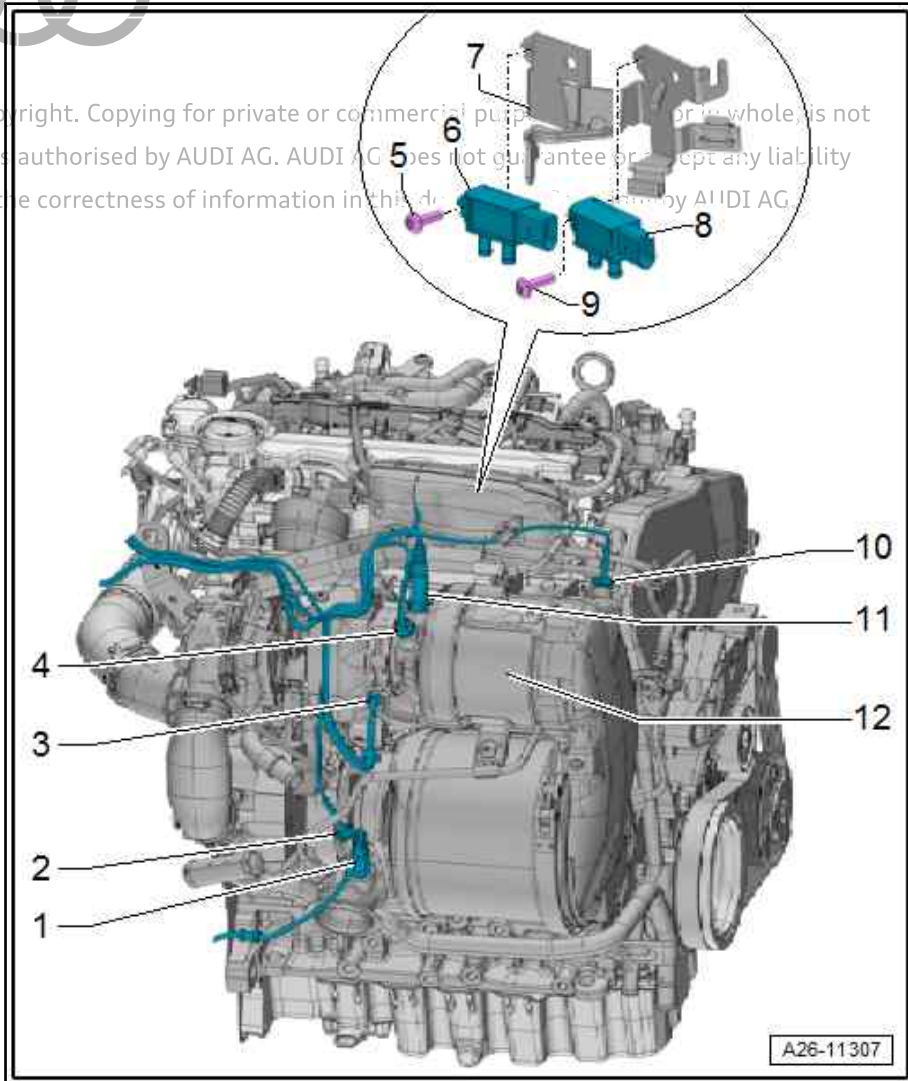
- ❑ Removing and installing ⇒ [page 285](#)

9 - Bolt

- ❑ Tightening torque ⇒ [Item 9 \(page 286\)](#)

10 - Exhaust gas temperature sender 3 - G495-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ [page 318](#)
- ❑ The thread of the exhaust gas temperature sender is coated; it must not additionally be greased with high-temperature paste
- ❑ 45 Nm



A26-11307



11 - Lambda probe - G39- with Lambda probe heater - Z19-

- Removing and installing ⇒ [page 287](#)

12 - Emission control module

3.2 Removing and installing exhaust gas temperature sender

⇒ [“3.2.1 Removing and installing exhaust gas temperature sender 1 G235”, page 315](#)

⇒ [“3.2.3 Removing and installing exhaust gas temperature sender 3 G495 / exhaust gas temperature sender 4 G648”, page 318](#)

⇒ [“3.2.2 Removing and installing exhaust gas temperature sender 2 G448”, page 316](#)

3.2.1 Removing and installing exhaust gas temperature sender 1 - G235-

Special tools and workshop equipment required

- ◆ Tool set - T10395A-



- ◆ Suitable tool insert AF 19
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WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ [“2.5 Safety precautions when working on the exhaust system”, page 3](#).



Note

- ◆ *Re-fit all cable ties and heat insulation sleeves in the same locations when installing.*
- ◆ *When removing, the electrical wiring must not be cut, otherwise a fault diagnosis would no longer be possible.*
- Remove engine cover panel ⇒ [page 39](#) .
- Remove front exhaust pipe ⇒ [page 296](#) .
- Remove subframe with steering rack ⇒ Rep. gr. 40 ; Subframe; Removing and installing subframe with steering rack .



- Open heat insulation sleeve.
- Take electrical connector -1- out of bracket, unplug connector and move wiring harness clear.
- Unscrew exhaust gas temperature sender 1 - G235- -item 2- using a tool from tool set - T10395 A- .

Installing

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



Note

- ◆ *Take care to protect exhaust gas temperature sender from knocks and impact; if dropped, the exhaust gas temperature sender can no longer be used.*
- ◆ *Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ [Electronic parts catalogue](#) .*

Installation position of exhaust gas temperature sender 1 - G235- :

- Angled part of line -1- must point vertically downwards.
- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install subframe with steering rack ⇒ Rep. gr. 40 ; Subframe; Removing and installing subframe with steering rack .
- Install engine cover panel ⇒ [page 39](#) .

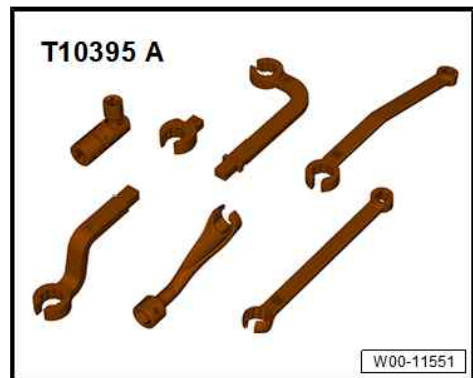
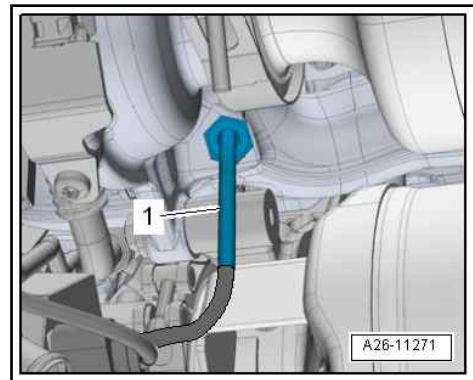
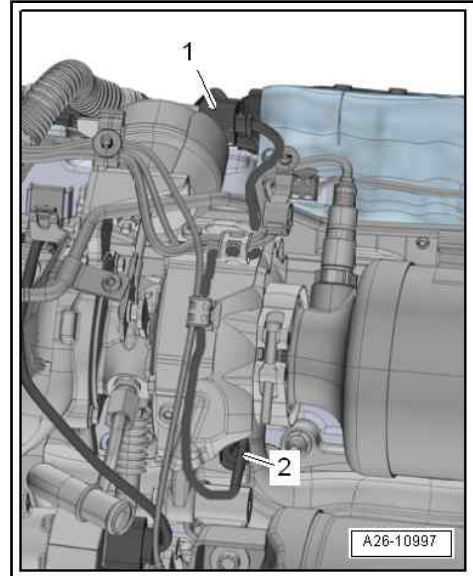
Tightening torques

- ◆ ⇒ ["3.1 Exploded view - exhaust gas temperature control", page 313](#)
- ◆ ⇒ ["1.1 Exploded view - silencer", page 294](#)

3.2.2 Removing and installing exhaust gas temperature sender 2 - G448-

Special tools and workshop equipment required


- ◆ Tool set - T10395 A-



- ◆ Suitable tool insert, AF 19



Removing

 **WARNING**

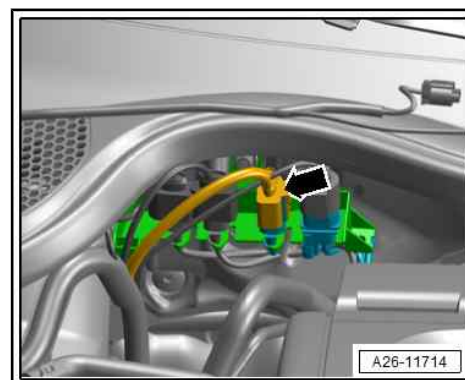
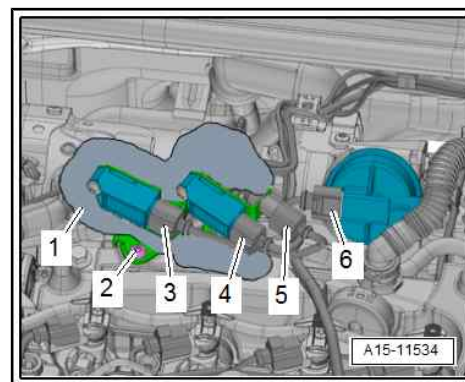
When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ ***"2.5 Safety precautions when working on the exhaust system", page 3***



Note

- ◆ *Re-fit all cable ties and heat insulation sleeves in the same locations when installing.*
 - ◆ *When removing, the electrical wiring must not be cut, otherwise a fault diagnosis would no longer be possible.*
- Remove engine cover panel ⇒ [page 39](#) .
 - Open heat insulation sleeve -1-.
 - Unplug electrical connectors -3, 4, 6- and move electrical wiring clear.
 - Detach electrical connector -5- for exhaust gas temperature sender 1 - G235- from bracket, unplug connector and move electrical wiring clear.
 - Remove bolt -2- and press bracket with pressure differential senders towards front.
-
- If fitted, open heat shield sleeve.
 - Detach electrical connector -arrow- for exhaust gas temperature sender 2 - G448- from bracket, unplug connector and move electrical wiring clear.





- Unscrew exhaust gas temperature sender 2 - G448- -arrow- using a tool from tool set - T10395 A- .

Installing

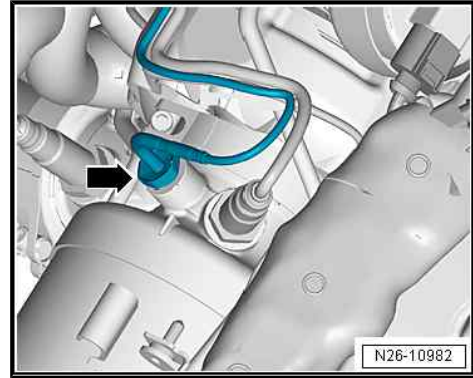
Installation is carried out in reverse order; note the following:



Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- ◆ *The exhaust gas temperature sender 2 - G448- has a coated thread. It is important that you do NOT coat it additionally with high-temperature paste and that you tighten it to the specified torque.*



Note

Take care to protect exhaust gas temperature sender from knocks and impact; if dropped, the exhaust gas temperature sender can no longer be used.

Installation position of exhaust gas temperature sender 2 - G448- :

- Angled part of line must point vertically downwards.
- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ ["3.1 Exploded view - exhaust gas temperature control", page 313](#)
- ◆ ⇒ ["2.1 Exploded view - cylinder head cover", page 88](#)

3.2.3 Removing and installing exhaust gas temperature sender 3 - G495- / exhaust gas temperature sender 4 - G648-

Special tools and workshop equipment required

- ◆ Tool set - T10395 A-



- ◆ Suitable tool insert, AF 19



Removing



WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ "2.5 Safety precautions when working on the exhaust system", page 3 .



Note

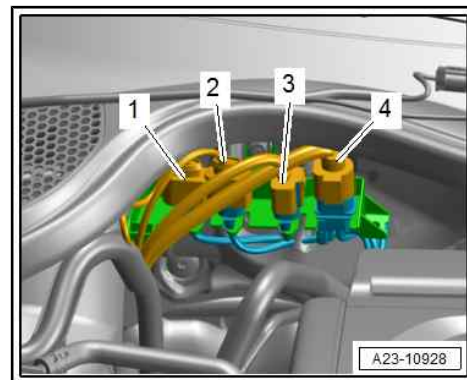
- ◆ *Re-fit all cable ties and heat insulation sleeves in the same locations when installing.*
 - ◆ *When removing, the electrical wiring must not be cut, otherwise a fault diagnosis would no longer be possible.*
- Remove engine cover panel ⇒ [page 39](#) .
 - If fitted, open heat shield sleeve.
 - Detach electrical connectors from bracket, unplug connectors and move electrical wiring clear:
- 1 - For exhaust gas temperature sender 3 - G495-
 - 2 - For exhaust gas temperature sender 4 - G648-



Note

Disregard items -3 and 4-.

- To remove exhaust gas temperature sender 4 -G648- , first remove front exhaust pipe ⇒ [page 296](#) .



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– Unscrew relevant exhaust gas temperature sender using a tool from tool set - T10395 A- .

1 - Exhaust gas temperature sender 4 - G648-

2 - Exhaust gas temperature sender 3 - G495-

Installing

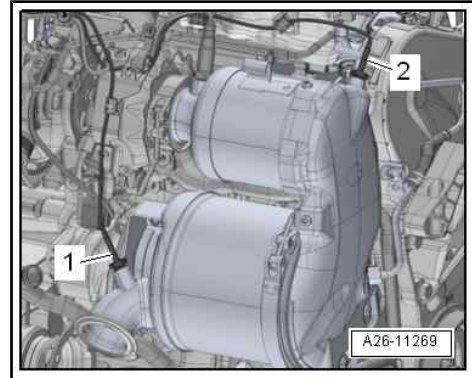
Installation is carried out in reverse order; note the following:



Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- ◆ ***The threads of the exhaust gas temperature senders - G495- and -G648- are coated. It is important that you do NOT coat them additionally with high-temperature paste and that you tighten them to the specified torque.***



Note

Take care to protect exhaust gas temperature sender from knocks and impact; if dropped, the exhaust gas temperature sender can no longer be used.

- Electrical connections and routing ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [“3.1 Exploded view - exhaust gas temperature control”, page 313](#)
 - ◆ ⇒ [“1.1 Exploded view - silencer”, page 294](#)
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4 Exhaust gas recirculation

⇒ [“4.1 Exploded view - exhaust gas recirculation system”, page 321](#)

⇒ [“4.2 Removing and installing exhaust gas recirculation control motor V338”, page 323](#)

⇒ [“4.3 Removing and installing exhaust gas recirculation control motor 2 V339”, page 324](#)

⇒ [“4.4 Removing and installing exhaust gas recirculation cooler”, page 326](#)

4.1 Exploded view - exhaust gas recirculation system

1 - Gasket

- Renew after removing

2 - Exhaust gas recirculation control motor 2 - V339-

- With exhaust gas recirculation potentiometer 2 - G466-
- Removing and installing ⇒ [page 324](#)
- Performing adaptations required after renewing a component (using → Vehicle diagnostic tester)
 ⇒ [“3.4 Performing adaptations after renewing a component”, page 7](#)



Caution

The control motor for exhaust gas recirculation is protected from heat damage by an insulation mat. If the insulation mat is damaged, it must be renewed. The control motor must then be checked for heat damage and renewed if necessary.

3 - Exhaust gas recirculation cooler

- Removing and installing ⇒ [page 326](#)

4 - Bolt

- Tightening torque and sequence ⇒ [page 322](#) if only exhaust gas recirculation cooler was removed

5 - Bracket

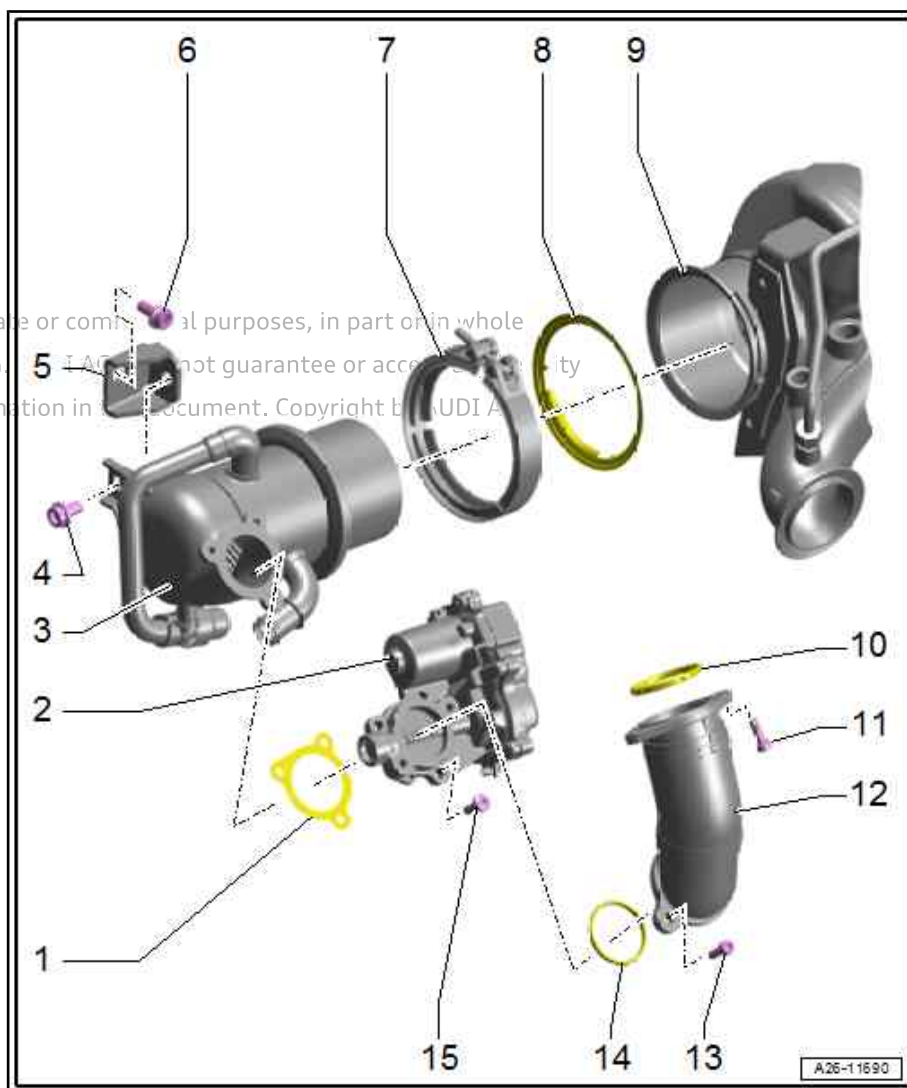
- For exhaust gas recirculation cooler

6 - Bolt

- Tightening torque and sequence ⇒ [page 322](#) if only exhaust gas recirculation cooler was removed

7 - Screw-type clip

- Renew after removing





- Installation position ⇒ [page 322](#)
- Tightening torque and sequence ⇒ [page 322](#)

8 - Seal

- Renew after removing

9 - Emission control module

- Removing and installing ⇒ [page 303](#)

10 - O-ring

- Renew after removing

11 - Bolt

- 9 Nm

12 - Connection

13 - Bolt

- 9 Nm

14 - O-ring

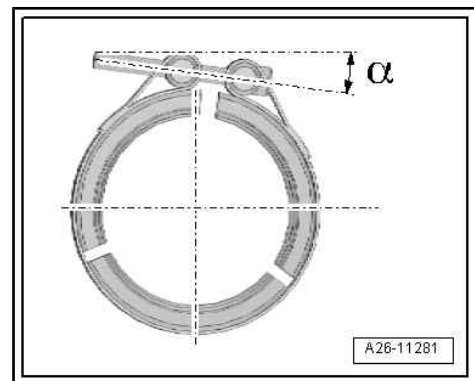
- Renew after removing

15 - Bolt

- 9 Nm

Installation position of screw-type clip for exhaust gas recirculation cooler

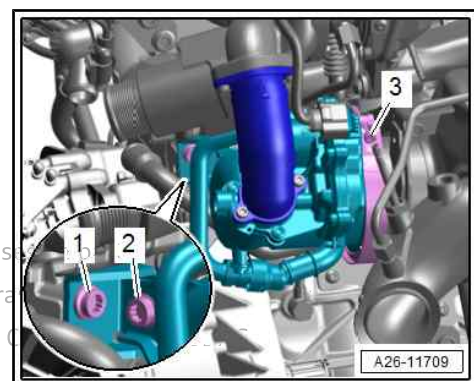
- Angle $-\alpha$ = 10 ... 15°



Exhaust gas recirculation cooler - tightening torque and sequence

– Tighten bolts in stages in the sequence shown:

Stage	Bolts	Tightening torque
1.	Screw-type clip -3-	7 Nm
2.	-1, 2-	Screw in by hand until contact is made
3.	-1, 2-	20 Nm





4.1.1 Exploded view - exhaust gas recirculation system, exhaust gas recirculation control motor - V338-

1 - Bolt

- 9 Nm

2 - Coolant hoses

3 - Exhaust gas recirculation control motor - V338-

- With exhaust gas recirculation potentiometer - G212-
- Removing and installing
⇒ [page 323](#)
- Performing adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester)
⇒ ["3.4 Performing adaptations after renewing a component", page 7](#)

4 - Bolt

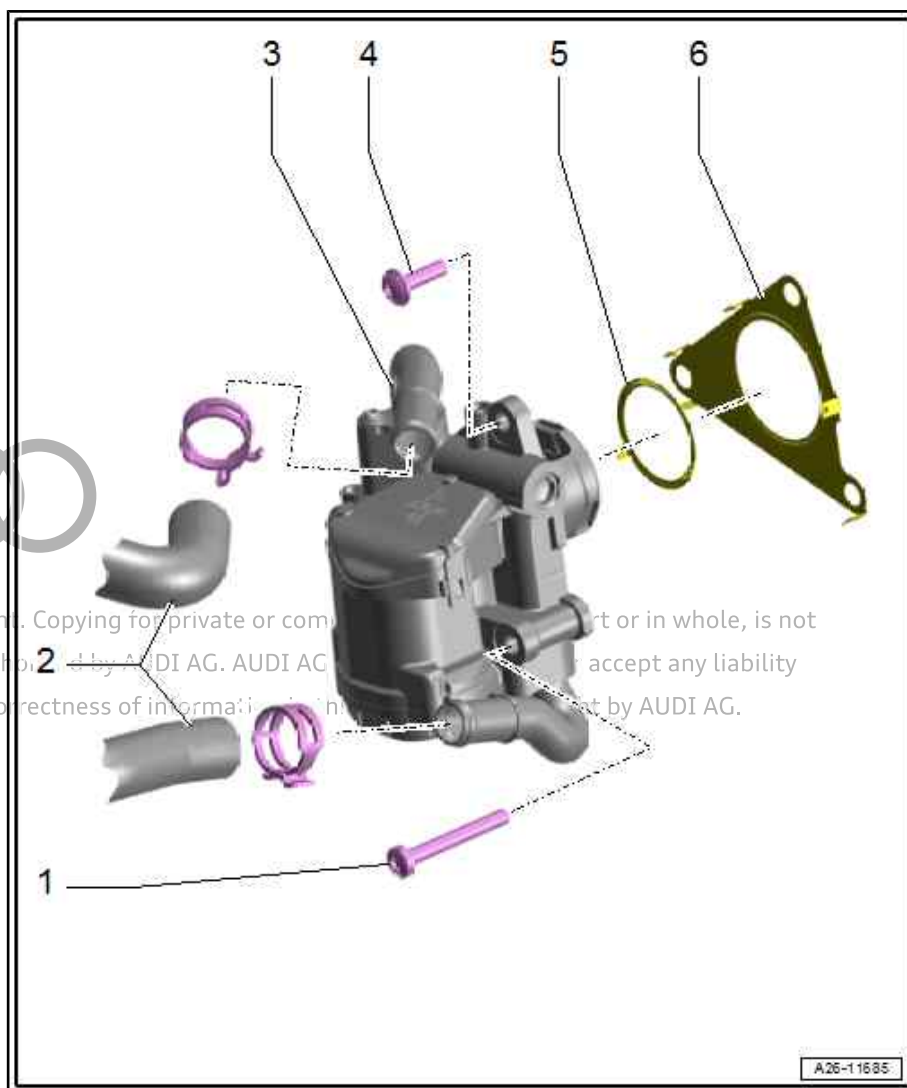
- 9 Nm

5 - Seal

- Renew after removing

6 - Gasket

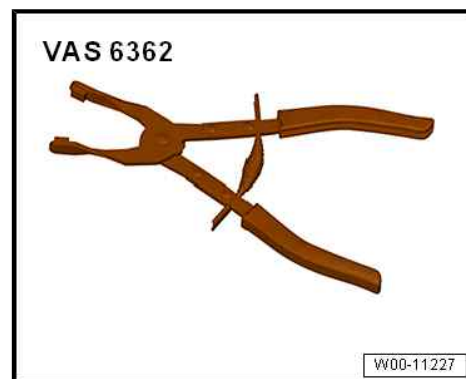
- Renew after removing



4.2 Removing and installing exhaust gas recirculation control motor - V338-

Special tools and workshop equipment required

- ◆ Hose clip pliers - VAS 6362-





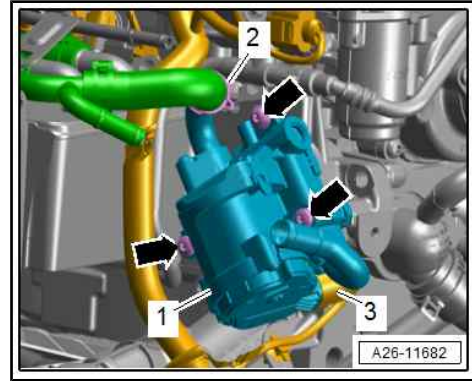
Removing



Note

Observe rules for cleanliness.

- Remove throttle valve module - J338- ⇒ [page 249](#) .
- Unplug electrical connector -3-.
- Release hose clip -2- and disconnect coolant hose.
- Unscrew bolts -arrows- and detach exhaust gas recirculation control motor - V338--1-.



Installing

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

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Note

- ◆ *Renew seals after removing.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ [Electronic parts catalogue](#) .*
- Install throttle valve module - J338- ⇒ [page 249](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *Only fill and bleed fuel system using ⇒ [Vehicle diagnostic tester](#) ⇒ [page 148](#) .*



Note

Do not reuse coolant.

- Fill up with coolant ⇒ [page 148](#) .

Perform adaptations required after renewing a component (using ⇒ [Vehicle diagnostic tester](#))
⇒ [“3.4 Performing adaptations after renewing a component”](#),
[page 7](#) .

Tightening torques

- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation system”](#),
[page 321](#)

4.3 Removing and installing exhaust gas recirculation control motor 2 - V339-

Special tools and workshop equipment required




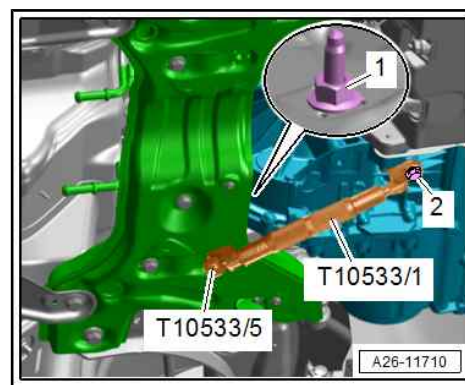
◆ Engine support - T10533-



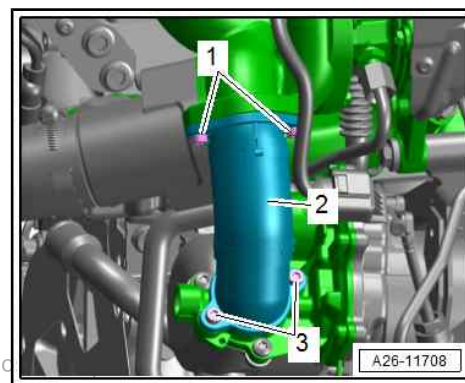
Removing

- Remove front exhaust pipe ⇒ [page 296](#) .
- Remove pendulum support ⇒ [page 38](#) .
- Attach engine support - T10533- and secure with a nut -1- and bolt -2-, as shown in illustration.

 **Caution**
Risk of damage to components.
◆ *When pushing the engine/gearbox assembly forwards, it is important that no components press against the radiator cowl.*



- Push engine/gearbox assembly forwards as far as possible by tightening spindle on engine support - T10533- .
- Unscrew bolts -1, 3- and detach connection -2-.



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- Push heat insulation sleeve to one side and unplug electrical connector -2-.
- Unscrew bolts -arrows- and detach exhaust gas recirculation control motor 2 - V339- -item 1-.

Installing

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



Note

Renew seal and O-rings after removal.

- Install pendulum support ⇒ [page 32](#) .

Perform adaptations required after renewing a component (using ⇒ Vehicle diagnostic tester)
⇒ [“3.4 Performing adaptations after renewing a component”, page 7](#) .

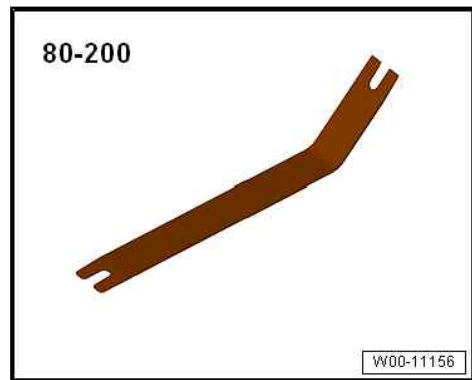
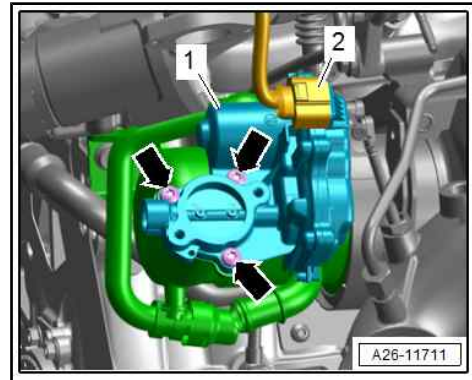
Tightening torques

- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation system”, page 321](#)
- ◆ ⇒ [“1.1 Exploded view - turbocharger”, page 214](#)
- ◆ ⇒ [“1.1 Exploded view - silencer”, page 294](#)

4.4 Removing and installing exhaust gas recirculation cooler

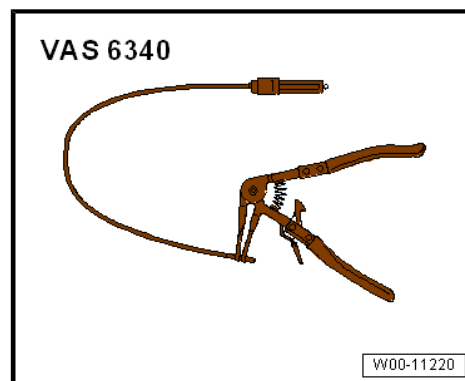
Special tools and workshop equipment required

- ◆ Removal lever - 80-200-
- ◆ Coolant collecting system - VAS 5014- or drip tray for workshop hoist - VAS 6208-





- ◆ Hose clip pliers - VAS 6340-



- ◆ Bit XZN 10 - T10501-



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- ◆ Engine support - T10533-

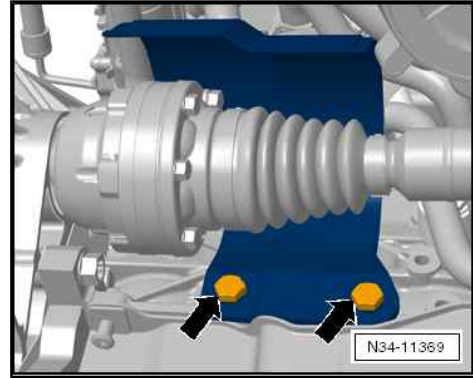


Removing

- Remove air cleaner housing
⇒ ["3.2 Removing and installing air cleaner housing", page 246](#) .
- Remove front exhaust pipe
⇒ ["1.2 Removing and installing front exhaust pipe", page 296](#) .
- Remove pendulum support
⇒ ["2.5 Removing and installing pendulum support", page 38](#) .
- Drain coolant
⇒ ["1.3 Draining and filling cooling system without electric vacuum pump VAS 6096/2", page 145](#) .



- Remove bolts -arrows- and detach heat shield for drive shaft (right-side).

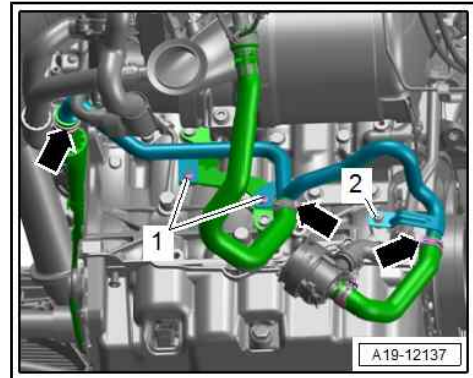


- Remove bolts -1- and nut -2- and push rear coolant pipe downwards. If necessary, secure coolant pipe to drive shaft with a cable tie.



Note

Disregard -arrows-.



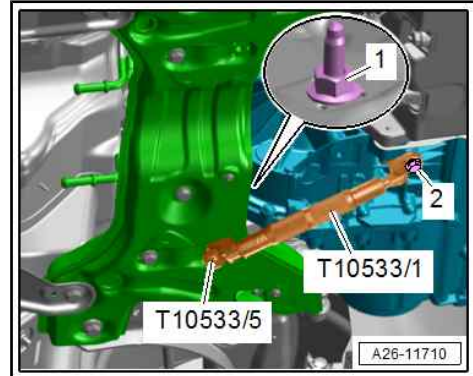
- Attach engine support - T10533- and secure with a nut -1- and bolt -2-, as shown in illustration.



Caution

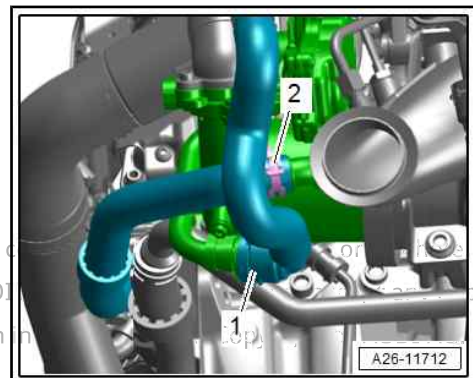
Risk of damage to components.

◆ *When pushing the engine/gearbox assembly forwards, it is important that no components press against the radiator cowl.*



- Push engine/gearbox assembly forwards as far as possible by tightening spindle on engine support - T10533- .
- Place collector tank from coolant collecting system -VAS 5014- or drip tray for workshop hoist - VAS 6208- underneath.
- Lift retaining clip -1-, release hose clip -2- and detach coolant hoses.

Step only required on vehicles with dual clutch gearbox:



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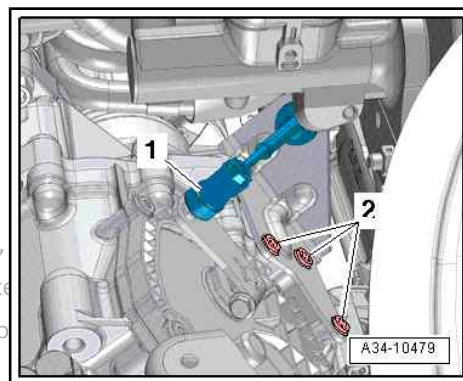
- Use removal lever - 80-200- to prise selector lever cable -1- off gearbox selector lever.
- Remove bolts -2- and push selector lever cable with cable support bracket to left side.



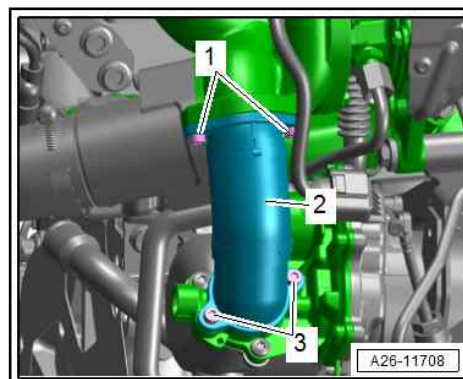
Note

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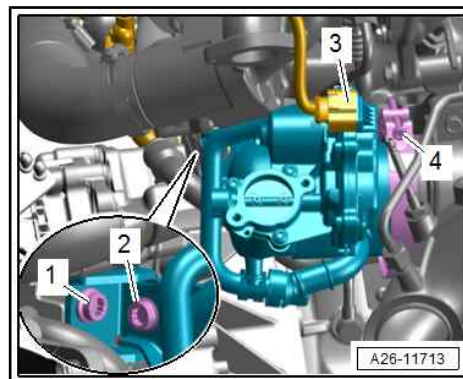
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- Unscrew bolts -1, 3- and detach connection -2-.



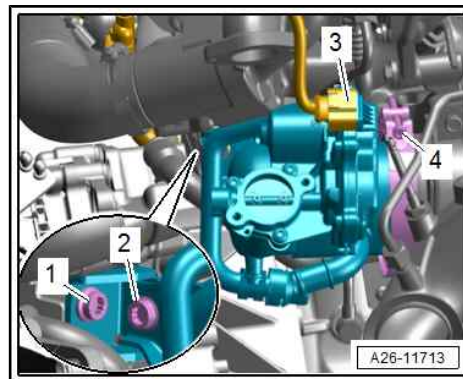
- Push heat insulation sleeve to one side and unplug electrical connector -3-.
- Loosen screw-type clip -4- and push towards emission control module.
- Remove bolt -1- and loosen bolt -2-.
- Detach exhaust gas recirculation cooler.



Note

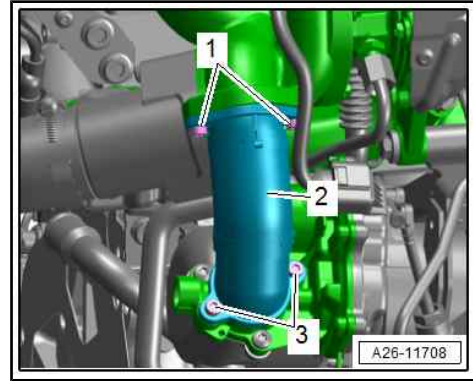
- ◆ *Renew seal, O-rings, hose clips and screw-type clip after removal.*
- ◆ *Secure all hose connections with correct type of hose clips (as original equipment) ⇒ Electronic parts catalogue .*

- Fit exhaust gas recirculation cooler with seal and screw-type clip -4- on emission control module.
- Hand-tighten bolts -1, 2-.





- Place connection -1- in installation position and tighten bolts -1, 3-.
- Fit screw-type clip -3- in correct installation position ⇒ [page 322](#) .
- Tighten connections ⇒ [page 322](#) .
- Install and adjust selector lever cable ⇒ Rep. gr. 34 ; Selector mechanism .
- Install pendulum support ⇒ [page 32](#) .
- Install heat shield for drive shaft ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing heat shield for drive shaft .
- Connect coolant hose with plug-in connector ⇒ [page 208](#) .



Caution

Risk of damage to engine if cooling system is insufficiently filled/bled.

- ◆ *After it is filled, the cooling system must be bled with the ⇒ Vehicle diagnostic tester.*



Note

Do not reuse coolant.

- Install air cleaner housing ⇒ [“3.2 Removing and installing air cleaner housing”, page 246](#) .
- Fill up with coolant ⇒ [page 148](#) .

Tightening torques

- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation system”, page 321](#)
- ◆ ⇒ [Fig. “Exhaust gas recirculation cooler - tightening torque and sequence””, page 322](#)
- ◆ ⇒ [“1.1 Exploded view - turbocharger”, page 214](#)
- ◆ ⇒ [“1.1 Exploded view - silencer”, page 294](#)
- ◆ ⇒ [“3.1 Exploded view - coolant pipes” page 196](#)
- ◆ ⇒ [Rep. gr. 34 ; Selector mechanism; Exploded view - selector cables](#)

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28 – Glow plug system

1 Glow plug system

⇒ [“1.1 Exploded view - glow plug system”, page 331](#)

⇒ [“1.2 Removing and installing glow plug”, page 332](#)

⇒ [“1.3 Removing and installing automatic glow period control unit J179”, page 335](#)

⇒ [“1.4 Removing and installing Hall sender G40”, page 335](#)

⇒ [“1.5 Removing and installing engine speed sender G28”, page 335](#)

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1.1 Exploded view - glow plug system

1 - Hall sender - G40-

- Removing and installing
⇒ [page 335](#)

2 - Bolt

- 9 Nm

3 - O-ring

- If damaged, renew Hall sender - G40-

4 - Glow plug

- ◆ Glow plug 1 - Q10-
- ◆ Glow plug 2 - Q11-
- ◆ Glow plug 3 - Q12- with cylinder 3 combustion chamber pressure sender - G679-

◆ Glow plug 4 - Q13-

- Glow plug versions
⇒ [page 332](#)
- Removing and installing
⇒ [page 332](#)
- Tightening torques
⇒ [page 332](#)

5 - Electrical connector

6 - Sealing flange (gearbox end)

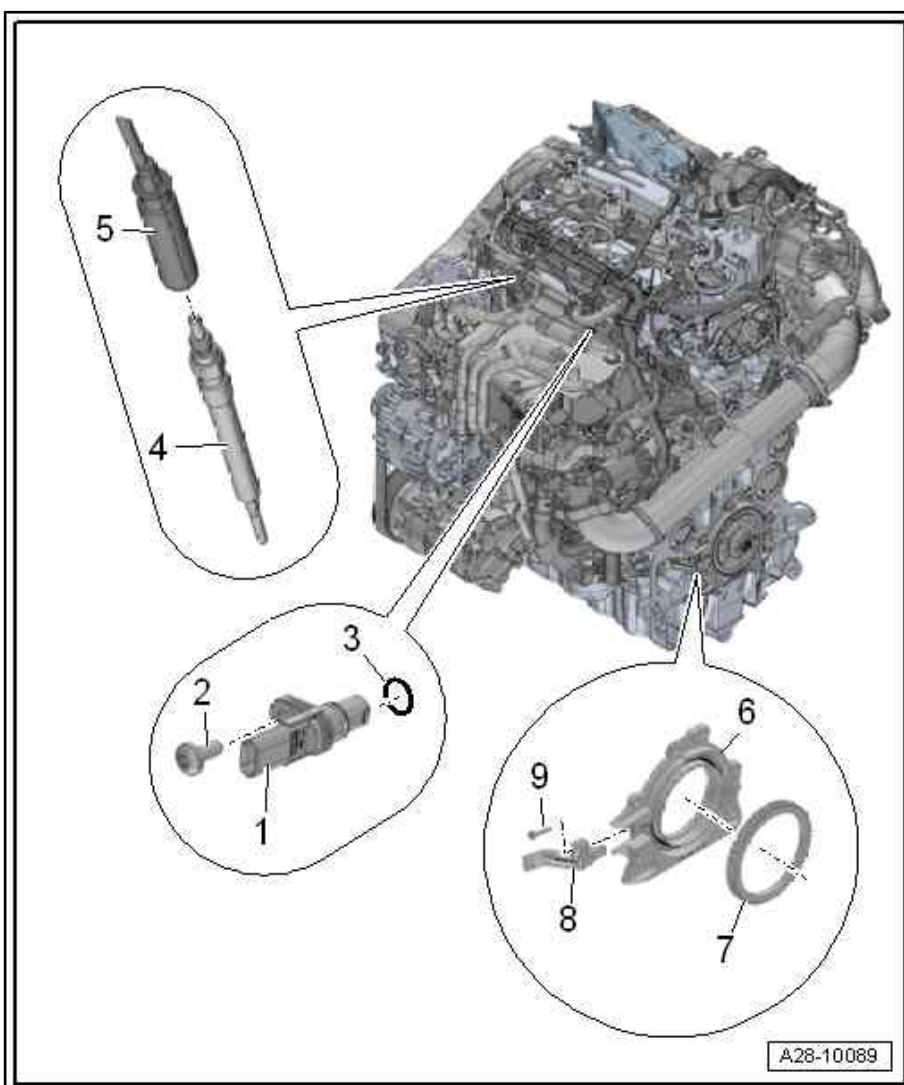
- Removing and installing
⇒ [page 52](#)

7 - Sender wheel

- For engine speed sender - G28-
- Must not be separated from sealing flange
- Removing and installing ⇒ [“2.3 Removing and installing sealing flange \(gearbox end\)”, page 52](#)

8 - Engine speed sender - G28-

- Removing and installing ⇒ [page 335](#)



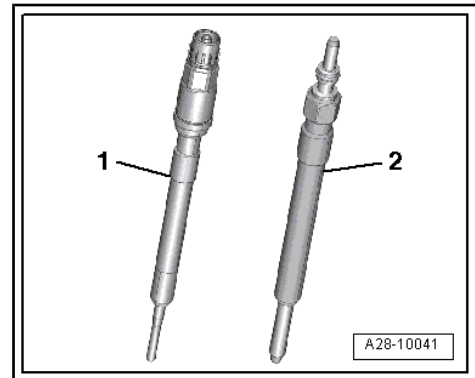


9 - Bolt

- 4.5 Nm

Glow plug versions and tightening torques

- 1 - Glow plug with internal cylinder pressure sender
 - ◆ Cylinder 3 only
 - ◆ 12 Nm
- 2 - Glow plug without combustion chamber pressure sender
 - ◆ 17 Nm



1.2 Removing and installing glow plug

Special tools and workshop equipment required

- ◆ Articulated wrench, 10 mm - 3220-
- ◆ Socket insert AF 12 for glow plugs 4-cyl. TDI CR diesel - VAS 6454-
- ◆ Pliers - 3314-



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- ◆ Assembly tool - T40428-

Removing

- Switch off ignition.
- Remove engine cover panel ⇒ [page 39](#) .



Caution

Risk of damage to support sleeves.

- ◆ **Use pliers - 3314- to remove glow plug connectors, squeezing just enough to grasp the collar of the support sleeve securely without damaging it.**

- Release retaining clips at wiring harness and detach electrical connectors from glow plugs as follows.
- Apply groove -arrow A- of pliers - 3314- to collar of support sleeve -arrow B- as shown in illustration.
- Carefully detach glow plug connectors from glow plugs.
- 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.**



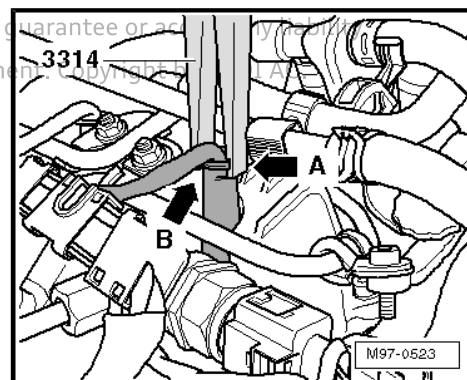
WARNING

Risk of eye injury.

- ◆ **Put on safety goggles.**

With T-bar and socket, 10 mm - 3220-

- Cylinders 1, 2, 4





With socket insert AF 12 for glow plugs 4-cyl. TDI CR diesel - VAS 6454-

- Cylinder 3 only

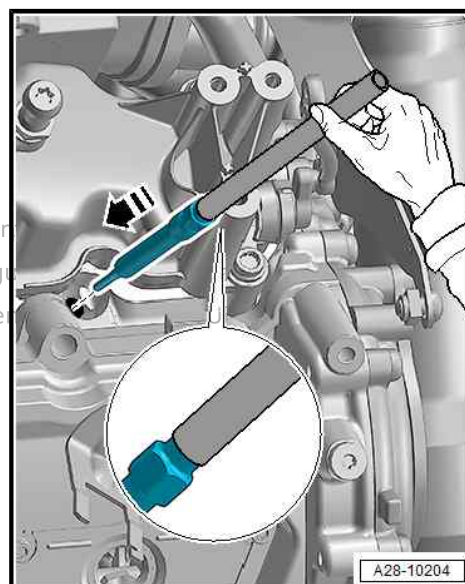
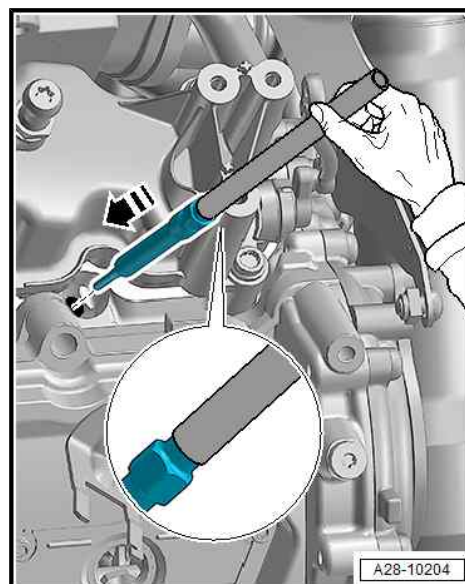


Note

- ◆ *The glow plugs can only be released up to an angle of approx. 90°. After this, the turning movement is hindered in part by a tendency to seize.*
 - ◆ *This tendency to seize is caused by particles of dirt (e.g. sand) entering the first glow plug threads as heat causes the glow plugs (steel) and the cylinder head (aluminium) to expand.*
- Unscrew glow plug until it begins to stick, then screw it in again. After this, unscrew it again until it begins to stick.
 - Keep turning the glow plug back and forth up to the point where it begins to stick. Repeat this procedure until the glow plug can be removed.
 - Pull out glow plugs carefully by hand or using assembly tool - T40428- , as shown in illustration. Keep glow plugs straight while unscrewing.

Installing

- Screw in glow plugs carefully by hand or using assembly tool - T40428- , keeping them straight, as shown in illustration, and then tighten them to specified torque.



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

- Fit glow plug connectors -1- back onto glow plugs -arrow-.



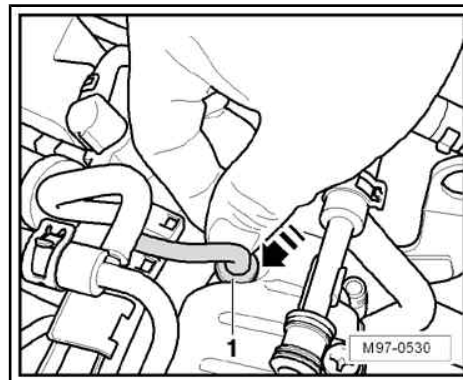
Note

Check that glow plug connectors are securely seated.

- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [Fig. ““Glow plug versions and tightening torques””, page 332](#)



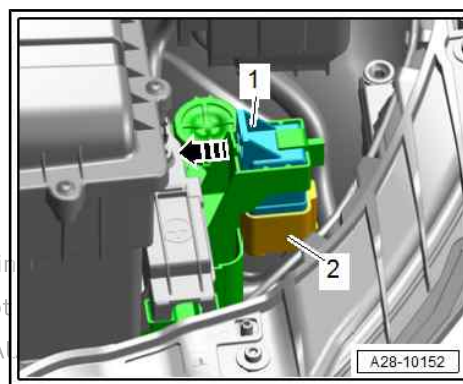
1.3 Removing and installing automatic glow period control unit - J179-

Removing

- Release catch -arrow-, detach automatic glow period control unit - J179- -item 1- downwards and unplug electrical connector -2-.

Installing

Installation is carried out in reverse sequence.



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1.4 Removing and installing Hall sender - G40-

Removing

- Remove engine cover panel ⇒ [page 39](#) .
- Remove bolts -arrows- and push fuel lines slightly towards front.
- Unplug electrical connector -2-.
- Unscrew bolt -1- and detach Hall sender - G40- .

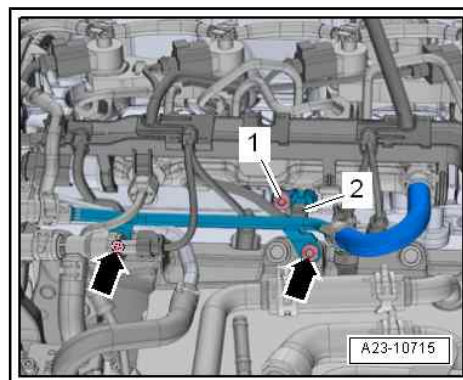
Installing

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

- Install engine cover panel ⇒ [page 39](#) .

Tightening torques

- ◆ ⇒ [“1.1 Exploded view - glow plug system”, page 331](#)

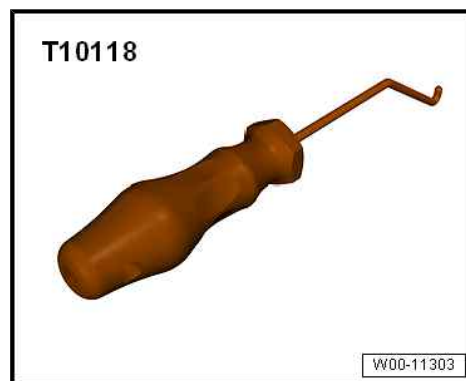


1.5 Removing and installing engine speed sender - G28-

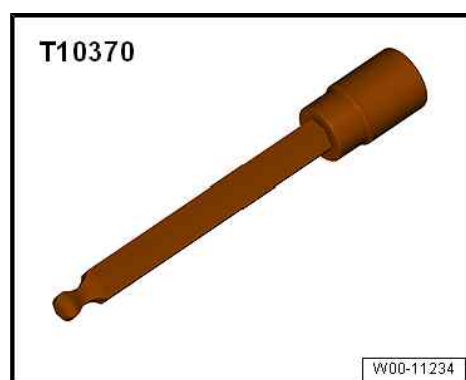
Special tools and workshop equipment required



◆ Assembly tool - T10118-



◆ Socket, 4 mm - T10370-

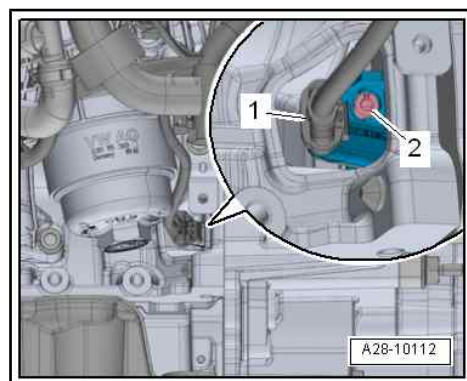


Removing

- Remove noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation .
- Move electrical wiring harness clear and press to one side.
- Use assembly tool - T10118- to unplug electrical connector -1-.

 **Note**

- ◆ *To release electrical connector without assembly tool - T10118- , use a screwdriver.*
- ◆ *Press in connector on engine speed sender.*
- ◆ *At the same time, lift release tab with a thin wire hook.*



- Unscrew bolt -2- and detach engine speed sender - G28-

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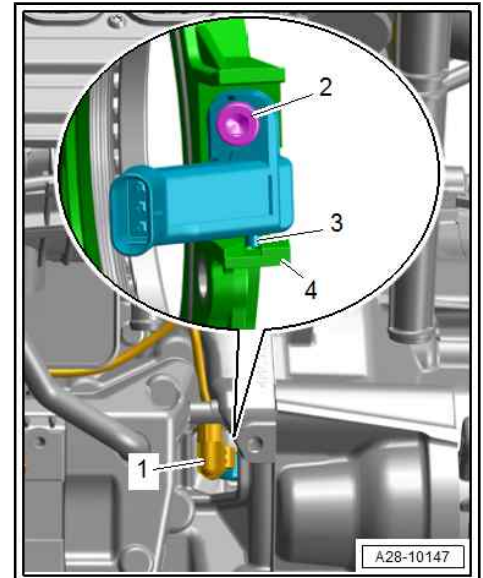
Installing

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

- Move engine speed sender - G28- into installation position, ensuring that tab -3- slides into guide slot on sealing flange -4-, as shown in illustration.
- Tighten bolt -2- and plug in electrical connector -1-.

Tightening torques

- ◆ ⇒ [“1.1 Exploded view - glow plug system”, page 331](#)
- ◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation



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